

Dysphoria and facial emotion recognition: Examining the role of rumination

by

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A thesis

presented to the University of Waterloo

in fulfillment of the

thesis requirement for the degree of

Doctor of Philosophy

in

Psychology

Waterloo, Ontario, Canada, 2012

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Author's Declaration

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Abstract

Rumination has been shown to be an influential part of the depressive experience, impacting on various cognitive processes including memory and attention. However, there is a dearth of studies examining the relationship between rumination and emotion recognition, deficits or biases in which have been closely linked to a depressive mood state. In Study 1, participants ($N = 89$) received either a rumination or distraction induction prior to completing three variants of an emotion recognition task assessing decoding accuracy or biases. Results demonstrated that greater levels of dysphoria were associated with poorer facial emotion recognition accuracy, but only when participants were induced to ruminate (as opposed to being induced to distract). The aim of Study 2 ($N = 172$) was to examine a possible mechanism, namely cognitive load, by which rumination affects emotion recognition. Results from this study indicated that participants endorsing greater levels of dysphoria were less accurate on an emotion recognition task when they received either a rumination induction or a cognitive load task compared to their counterparts who received a distraction induction. Importantly, the performance of those in the cognitive load and rumination conditions did not differ from each other. In summary, these findings suggest that the confluence of dysphoria and rumination can influence individuals' accuracy in identifying emotional content portrayed in facial expressions. Furthermore, rumination, by definition an effortful process, might negatively impact emotion recognition via the strain it places on cognitive resources.

Acknowledgements

I would like to thank the many people involved in this project because, without them, this research would not have been possible. First and foremost, I would like to thank my supervisor, Dr. Uzma Rehman, for her help and guidance throughout this entire process. Her wisdom and enthusiasm for research were invaluable assets. Second, I would like to acknowledge the contributions of my committee members, Dr. Christine Purdon and Dr. Elizabeth Nilsen. Their advice and feedback helped to shape and strengthen this project. Third, I would like to thank my fellow graduate students, Gelareh Karimiha, Erin Fallis, and Jenna Dawson, for providing support and assistance as well as creating a friendly, collegial atmosphere in which to toil away. Of course, special thanks go to Rebecca Wells who's many contributions I cannot even begin to list here. Fourth, I am deeply grateful and indebted to the many research assistants whose time and efforts made this project a reality. Finally, I would like to thank my wife, Jen, for her support and patience and my son, Isaac, for providing me with the motivation to finish writing the dissertation. Judging by his enthusiasm for my laptop, I believe that Isaac also wanted to offer his assistance with typing but, alas, his fine motor skills have yet to be fully developed. It's the sentiment that counts.

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Dysphoria and facial emotion recognition: Examining the role of rumination

Nolen-Hoeksema's (1987) responses style theory of depression has been very influential in explaining the etiology and course of depression. This theory posits that the manner with which we respond to dysphoric mood can impact the development and duration of a depressive episode. The theory focuses specifically on the response style, rumination, which is conceptualized as a mood regulation process which involves an inward focus on the possible causes and implications of one's current mood state and is viewed as maladaptive. Studies that examine the various effects of rumination typically compare it to an alternative response style, distraction. In contrast to rumination, distraction involves an outward focus on pleasant or neutral thoughts or actions. A recent review of the rumination literature (Thomsen, 2006) concluded that rumination does, indeed, have a negative effect on depressed mood and that greater levels of rumination are associated with greater declines in affect (Morrow & Nolen-Hoeksema, 1990). Furthermore, people differ with respect to their tendency to ruminate in response to their depressed mood (Nolen-Hoeksema, Morrow, & Fredrickson, 1993). Those who exhibit a ruminative response style have a greater risk of becoming depressed, and their depressive episodes tend to last longer and be more severe compared to those who have a tendency to use distraction in response to their low mood (e.g., Nolen-Hoeksema & Morrow, 1991; Nolen-Hoeksema et al., 1993; Nolen-Hoeksema, Parker, & Larson, 1994).

As many studies have established a link between rumination and depression, researchers have begun to investigate the effects of rumination on depression-related cognitive biases. The overarching aim of the current set of studies is to examine the possible role of rumination in the relationship between depressed mood and facial emotion recognition. First, I will review studies that have linked rumination with various cognitive processes. Second, I will discuss a specific cognitive process, emotion recognition. Specifically, I will review the discrepant findings from studies that have investigated the

relationship between depression and emotion recognition. Finally, I will examine the existing evidence which suggests that rumination can have an impact on emotion recognition.

Both of the research studies I conducted as part of this program of research were based on samples of non-patient, dysphoric individuals (i.e., those who report mild-to-moderate levels of depressive symptomatology). Interestingly, the bulk of the emotion recognition literature has focused mainly on clinically depressed individuals whereas the rumination literature was built on studies employing dysphoric samples. Of course, emotion recognition studies using a dysphoric sample (e.g., Frewen & Dozois, 2005; Persad & Polivy, 1993) and rumination studies using a depressed sample (e.g., Donaldson & Lam, 2004; Joorman, Dkane, & Gotlib, 2006; Raes, Hermans, & Williams, 2006) have been conducted but they are in the relative minority. Although some theorists argue otherwise (e.g., Coyne & Downey, 1991), the generally accepted conceptualization is that depression is dimensional in nature rather than categorical (e.g., Fergusson et al., 2005; Flett, Vredenburg, & Krames, 1997; Halberstadt et al., 2008; Lahey et al., 2008; Okumura, Sakamoto, Tomoda, & Kijima, 2009; Vredenburg, Flett, & Krames, 1993). Analogue studies which focus on dysphoric participants are informative of phenomena in individuals with greater symptom severity and vice versa. Thus, I will review both studies that employ dysphoric samples as well as those that use clinical samples. Furthermore, individuals with subclinically elevated depressive symptoms are at increased risk for later development of Major Depressive Disorder (Fergusson et al., 2005) and other negative outcomes such as substance abuse (Lewinsohn, Solomon, Seely, & Zeiss, 2000). Thus, gaining a greater understanding of individuals with subthreshold depression symptoms would serve to inform the development of intervention and prevention protocols.

Rumination and Cognitive Processes

On the surface, rumination seems as if it should be an effective strategy to lift one's spirits. There is an intuitive appeal to sitting down and analyzing one's current situation to pinpoint the reasons contributing to one's negative mood state. Although this strategy is employed in an attempt to alleviate

low mood, rumination typically results in a paradoxical exacerbation of one's negative mood. This unintended consequence is thought to occur via rumination's effect on various other cognitive processes (e.g., Hertel, 1998; Lyubomirsky & Nolen-Hoeksema, 1995; Sutherland & Bryant, 2007; Watkins & Baracaia, 2002). For example, dysphoric ruminators (i.e., individuals who tend to employ rumination in response to a negative mood) are more pessimistic about the probability of future positive events (Lyubomirsky & Nolen-Hoeksema, 1995), the severity of their own problems, and the efficacy of their proposed solutions to their problems (Lyubomirsky, Tucker, Caldwell, & Berg, 1999). Dysphoric participants who are randomly assigned to a rumination condition are also more likely to spontaneously discuss their current difficulties (Lyubomirsky et al., 1999), and, in general, display a more negative cognitive style, such as holding maladaptive attitudes towards evaluation, performance standards, and expectations for control (Spasojevic & Alloy, 2001).

In addition to pessimistic predictions and general negativity, rumination also appears to affect other cognitive processes. For example, dysphoric participants who are induced to ruminate are more likely to recall negative autobiographical memories (Lyubomirsky, Caldwell, & Nolen-Hoeksema, 1998) and the details of their autobiographical memories tend to be more vague and lacking in detail (Sutherland & Bryant, 2007). Furthermore, dysphoric ruminators exhibit an attentional bias to sad faces (Joorman et al., 2006) and a negative bias in their interpretation of schematic facial emotions (Raes et al., 2006) and hypothetical events (Lyubomirsky & Nolen-Hoeksema, 1995; Lyubomirsky et al., 1999). Thus, for dysphoric individuals, rumination appears to have a pervasive effect on cognition, affecting a variety of cognitive processes.

As mentioned previously, distraction is typically employed as a foil to rumination. In the aforementioned studies that used an experimental induction methodology, distraction as well as rumination was induced in participants. Whereas rumination serves to maintain dysphoric mood, distraction serves to reduce depressive symptoms (e.g., Morrow & Nolen-Hoeksema, 1990; Trask &

Sigmon, 1999). Distraction is proposed to redirect attention away from the ruminative process and, thus, frees up cognitive resources to pursue more enjoyable and/or productive activities (Tse & Bond, 2004). Indeed, dysphoric participants who receive a distraction induction typically perform similarly to control participants (i.e., non-dysphoric or non-depressed) who receive either a distraction or rumination induction (e.g., Hertel & El-Messidi, 2006; Lyubomirsky et al., 1998; Lyubomirsky, Kasri, & Zehm, 2003; Lyubomirsky & Nolen-Hoeksema, 1995).

While impairments or biases in cognitive processes have long been linked to depression, the aforementioned studies suggest that rumination might be the mechanism underlying these relationships (see Figure 1 for a schematic representation). Rumination appears to have a negative effect on these processes but it is important to note that theorists are divided with respect to whose processing should be affected by rumination. Some researchers believe that this effect should occur only for dysphoric individuals. Indeed, some studies that employ a response style induction (i.e., rumination vs. distraction) have found that control participants' performance is comparable across both inductions and dysphoric or depressed participants who receive a distraction induction perform similarly to the control group (e.g., Lyubomirsky et al., 1998; Lyubomirsky et al., 2003; Lyubomirsky & Nolen-Hoeksema, 1995). This pattern of results could be interpreted to mean either that the rumination induction has a negative effect on dysphoric participants or that the distraction induction has a positive effect. A study which included a non-induction condition (i.e., participants were instructed to think about anything they wanted during the induction phase) found evidence in favour of the latter interpretation (Hertel, 1998). In this study, dysphoric participants who received either a rumination or no induction, but not those who received a distraction induction, performed significantly worse on a fragment completion task compared to control participants. These results suggest that distraction may be the active ingredient in these studies and that it serves to disrupt dysphoric individuals' typical ruminative state. However, the conclusions from this study are somewhat tempered due to the uncertainty surrounding the non-

induction procedure. While participants were instructed to think about any topic of their choosing, given the experimental context, the thoughts induced may not be representative of their typical thinking patterns.

Results from the aforementioned studies suggest that dysphoric participants are prone to the effects of rumination (Lyubomirsky et al., 1998; Lyubomirsky et al., 2003; Lyubomirsky & Nolen-Hoeksema, 1995). A related point is that the rumination induction should not affect nondysphoric individuals in the same manner as dysphoric individuals. That is, the rumination induction should initiate the ruminative process only in depressed and dysphoric individuals. Indeed, results from these studies are consistent with this claim and suggest that the rumination induction does not seem to ‘stick’ with nondysphoric participants. In other words, the ruminative process does not seem to have any impact on their performance on experimental tasks.

Whereas these studies suggest that rumination differentially affects dysphoric versus nondysphoric individuals, an opposing viewpoint gives greater prominence to the effects of rumination. According to this perspective, rumination’s influence on cognitive processing is not limited to those who are dysphoric. Results from studies employing a non-selected sample (i.e., participants were not selected or categorized according to their mood) support this hypothesis. Specifically, these studies have also found rumination effects using an induction methodology (e.g., Morrow & Nolen-Hoeksema, 1990; Trask & Sigmon, 1999) or self-report measures assessing general tendencies to use rumination as a coping mechanism (Spasojevic & Alloy, 2001; Weinstock & Whisman, 2007). In considering both sets of studies, one interpretation is that rumination has the potential to affect the cognitive processing of both dysphoric and nondysphoric individuals. However, dysphoric individuals may be more susceptible to the effects of rumination, whereas nondysphoric individuals may be particularly adept at stopping the ruminative process, or rumination may be more difficult to induce in nondysphoric individuals.

Depression/Dysphoria and Emotion Recognition

Although many studies have examined the effects of rumination on certain cognitive processes (e.g., autobiographical memory, attention), little attention has been paid to the relationship between rumination and emotion recognition. The dearth of studies examining this link is notable as emotion recognition is an ability that is fundamental to shaping our perceptions during interpersonal interactions. Due to the highly subjective nature of social interactions, various factors, including mood, can affect our judgments of emotional stimuli. Historically, the belief has been that depressed individuals view the world with a negative bias (e.g., Beck, 1967; DeMonbreun & Craighead, 1977). Their bias can lead them to disregard certain cues indicating warmth from others, while making them more attuned to negative cues that serve to reinforce their skewed outlook. Difficulties with reading the myriad subtle cues informing us of another person's thoughts, feelings, and intentions place us at greater risk of developing a psychological disorder (Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979). More specifically, maladaptive biases that disrupt the ability to read social cues have been proposed to contribute to the development of depression (Coyne, 1976; Lewinsohn, 1974).

In examining the relationship between mood and emotion recognition, many researchers have employed emotional facial expressions (or, at least, schematic representations of emotional facial expressions) as stimuli. The human face is a powerful and particularly salient stimulus, with basic facial emotions being recognizable across many cultures (Ekman, 1992, 1994). Although a number of studies have been conducted with the aim of elucidating the relationship between depressed mood and facial emotion recognition, a consensus on the nature of this relationship has yet to be reached.

Several studies have found evidence suggesting that depressed individuals exhibit a pattern of performance on facial emotion recognition tasks that differ from their nondepressed counterparts. In particular, some studies have found that depressed participants displayed a mood-congruent bias, meaning that they had a greater tendency to rate all facial expressions as more negative than control

participants (Bouhuys, Geerts, & Gordijn, 1999; Bouhuys, Geerts, & Mersch, 1997; Gur et al., 1992; Hale, 1998). On the other hand, other studies have demonstrated that depressed participants were poorer at decoding various emotions, not just negative ones. In tasks that required participants to either determine if the emotion displayed on two faces were similar (Asthana, Mandal, Khurana, & Haque-Nizamie, 1998), or match a target face to a series of other faces that portrayed various emotions (Rubinow & Post, 1992), depressed participants exhibited poorer accuracy across all emotional valences compared to nondepressed control participants. These findings run counter to the idea of a negative bias and, instead, are suggestive of a general impairment in emotion recognition. Of note, there are also a few studies which do find evidence to support some sort of group difference, either an impairment or bias, but their pattern of results are not entirely consistent with existing theories of depression. For example, depressed participants have been found to have lower accuracy rates but only for identifying the emotions surprise (Kan, Mimura, Kamijima, & Kawamura, 2006) or anger (Mendlewicz, Linkowski, Bazelmans, & Philippot, 2005). Finally, not all studies have found evidence in support of depression-related group differences. Studies that have used a recognition paradigm in which participants chose a response from a list of emotion words that they believed matched the target face have found no group differences (Frewen & Dozois, 2005; Gaebel & Wolwer, 1992; Gessler, Cutting, Frith, & Weinman, 1989).

Harkness, Sabbagh, Jacobson, Chowdrey, and Chen (2005) proposed that the lack of consensus on the relationship between depression and emotion recognition may be at least partly attributable to methodological shortcomings or differences. For example, some studies (e.g., Mandal & Bhattacharya, 1985) required participants to generate their own emotion labels for the stimuli, thus involving the use of recall memory which has been shown to be influenced by depression (Dalgleish & Watts, 1990), and studies that used a recognition paradigm (e.g., Gaebel & Wolwer, 1992) often employed tasks that had high accuracy rates and may not have been sensitive enough to detect subtle group differences. An additional criticism is that several studies (e.g., Bouhuys, Geerts, Mersch, & Jenner, 1996) used

schematic drawings of faces rather than pictures of actual faces. This practice erases many of the complexities and nuances of the human face and, therefore, may be lacking in ecological validity.

Using Baron-Cohen, Wheelwright, Hill, Raste, and Plumb's (2001) theory-of-mind task, Reading the Mind in the Eyes, both Harkness and colleagues (2005) and Lee, Harkness, Sabbagh, and Jacobson (2005) examined facial emotion recognition in dysphoric and depressed samples, respectively. The Reading the Mind in the Eyes task is comprised of cropped photographs of the eye region of people's faces and employs a forced choice recognition methodology. While Lee and colleagues found that depressed participants were less accurate than non-depressed participants, Harkness and colleagues found that dysphoric participants were actually *more* accurate than their non-dysphoric counterparts. Furthermore, neither study found any evidence of a mood-related bias. The findings from these studies dovetail with those from the social cognition literature which propose that dysphoric individuals experience greater uncertainty about their environment and, thus, are consequently more motivated to accurately process social information in order to resolve their uncertainty (Weary & Edwards, 1994; Yost & Weary, 1996). Taken together, these results raise the possibility that there is a curvilinear relationship in which dysphoric mood is associated with enhanced emotion recognition whereas clinically depressed mood is associated with deficits in this same process.

Although the results from these studies are intriguing, it is unclear if they provide greater clarity to the relationship between depression/dysphoria and emotion recognition. The Reading the Mind in the Eyes task was designed to assess theory of mind (Baron-Cohen et al., 2001). As mentioned previously, this task merely presents participants with the eye region of the face. However, Ekman and Friesen (1978) posited that facial expressions are comprised of myriad combinations of facial action units. That is, a particular emotion can be broken down into a specific arrangement of facial muscle movements. Admittedly, the eyes are disproportionately influential in determining the affective tone of a face, but they do not tell the whole story. Of course, by not providing all of the visual affective cues,

participants are invited to *infer* the affective state, rather than simply recognizing it which was the intent of the task. Although emotion recognition and theory of mind may appear to be similar constructs, several theorists have proposed that they are distinct components of a broader concept, social cognition (Blair & Cipolotti, 2000; Joseph & Tager-Flusberg, 2004). Indeed, scores on a test of emotion recognition were only modestly correlated with scores on various tests of theory of mind (Dyck, Piek, Hay, Smith, & Hallmayer, 2006). Also, the Reading the Mind in the Eyes task successfully discriminated between healthy control participants and those with either Asperger's Syndrome or high functioning autism whereas all three groups did not differ on a test of emotion recognition (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997). Furthermore, emotion recognition and theory of mind also do not appear to involve the same neural substrate (Shaw, Lawrence, Bramham, Brierley, Radbourne, & David, 2007). Thus, questions of the nature of the relationship between depression/dysphoria and emotion recognition remain unresolved.

Overall, the body of research suggests that that depression does have an influence on emotion decoding abilities (Tse & Bond, 2004) and that these findings also extend to dysphoria (Persad & Polivy, 1993). With a few exceptions (e.g., Frewen & Dozois, 2005; Gaebel & Wolwer, 1992; Gessler et al., 1989), on tasks assessing facial emotion recognition, depressed/dysphoric individuals typically performed in a manner that differed from control participants. However, what is less clear is the exact nature of dysphoria's influence on this socially relevant skill. In other words, do dysphoric individuals display a general negative bias or perhaps a specific emotion (e.g., sadness) bias in their perceptions of facial expressions? Or do dysphoric individuals exhibit a generalized deficit in emotion recognition? These questions remain to be addressed and the methodological issues described above describe a path to providing greater clarity.

The Proposed Role of Rumination in Emotion Recognition

As discussed previously, rumination has been shown to be influential in the phenomenology of depression and dysphoria. In fact, rumination has been shown to mediate many effects previously attributed to dysphoria or depression. For example, a longitudinal study found that rumination mediated the relationship between various risk factors (negative cognitive style, self-criticism, neediness) and the eventual development of depressive episodes (Spasojevic & Alloy, 2001). Furthermore, although previous studies have found that negative biases in ratings of facial expressions were associated with depressive symptomatology and severity (e.g., Bouhuys et al., 1996, Bouhuys et al., 1999; Hale, 1998), findings from a recent study suggest that rumination, not depressed mood, might be the key mechanism (Raes et al., 2006). The evidence is beginning to mount in favour of implicating a ruminative response style as an important proximal risk factor for the development or recurrence of depressive episodes.

To date, only one study has implicated rumination as the underlying factor in the association between depression/dysphoria and emotion recognition (Raes et al., 2006). For depressed participants, they demonstrated that greater endorsement of ruminative practices was associated with greater perceptions of negativity in schematic facial expressions. However, due to the correlational nature of their study, their results cannot speak towards the directionality of the relationship between rumination and biased emotion judgments. The results of their study were further limited by the lack of a control group. That is, while rumination is associated with biased processing in depressed participants, it is unclear whether this relationship would also be present in nondepressed participants. Indeed, as discussed previously, some researchers have demonstrated rumination effects in non-selected samples.

In summary, rumination has been shown to be closely linked with depression and dysphoria. Indeed, rumination is associated with various depression-related cognitive biases and impairments and one study has demonstrated a relationship between rumination and emotion recognition, the cognitive

process of interest in the proposed study. However, the exact nature of the relationship between depression/dysphoria and emotion recognition is unclear. Thus, the goals of Study 1 were to clarify this relationship by using several indices of emotion recognition and also to provide a stronger test of the causal association between rumination and emotion recognition using an experimental methodology. The aim of Study 2 was to extend this line of research by examining the mechanism by which rumination exerts its influence on cognitive processing.

Study 1

The two primary goals of Study 1 are to: (a) clarify the nature of the relationship between dysphoria and emotion recognition, and (b) examine whether rumination is the causal mechanism by which dysphoric individuals exhibit emotion recognition impairments and/or biases. The bulk of the research suggests that depressed and dysphoric individuals do differ in some manner with respect to emotion recognition. Although some studies failed to find any evidence of a depressive impairment or bias, these studies are in the relative minority. Thus, the existing evidence is in favour of some sort of group difference, but there is decidedly less agreement with respect to the nature of this difference. In other words, is this group difference best represented in terms of an impairment (i.e., discrepancies in accuracy rates) or a bias? In an effort to clarify this issue, tasks were employed that examine both accuracy and bias. For the present study, accuracy is defined as the correct identification of the depicted emotion. While accuracy is relatively self-explanatory, bias is a concept that has been defined in two different ways. One method of defining bias is to do so in terms of accuracy. That is, a bias could refer to unequal performance across categories of test items. An intuitive hypothesis might be that depressed or dysphoric participants would be less accurate on positive items or more accurate on negative items compared to control participants but the existing evidence largely does not support this hypothesis. A similar hypothesis that has found greater traction is that depressed or dysphoric participants are more likely to mislabel neutral facial expressions in a negative manner. Indeed, studies have demonstrated that depressed participants are more likely to identify neutral faces as sad (Leppanen et al., 2004) or another negative emotion, fear (Kan et al., 2004).

A second method of defining bias is to do so in terms of stimulus intensity. Researchers who use this definition of bias have examined participants' perceptions of emotional intensity and/or manipulated the emotional intensity level of the stimuli. Bouhuys and colleagues presented participants with schematic facial expressions and asked them to judge the relative intensity or strength of a

particular emotion (i.e., fear, happiness, anger, sadness, disgust, and surprise) that they perceived in these faces. Using this task, they demonstrated that depressed participants perceived more negativity and less positivity in the schematic faces compared to control participants (Hale, Jansen, Bouhuys, & van den Hoofdakker, 1998), and for depressed participants, greater endorsement of negative emotions was associated with higher rates of relapse (Bouhuys et al., 1999), and greater symptom severity and persistence (Hale, 1998). However, as mentioned previously, the schematic facial expressions are quite simplistic and lack the many nuances of a human face.

Yoon, Joorman, and Gotlib (2009) examined perceived stimulus intensity in another manner. Using photographs of mildly emotional (i.e., 40% intensity) facial expressions from a standardized series (Young, Perrett, Calder, Sprengelmeyer, & Ekman, 2002), they examined biases in the processing of subtle facial expressions of emotions. Specifically, participants were presented with pairs of faces, either a neutral face with a positive one (i.e., happy) or a negative face (i.e., sad, angry, fearful) with a positive one, and were asked to choose the more emotionally intense photograph. For both neutral-positive and negative-positive pairs, depressed participants were less likely to judge the positive face as more intense compared to nondepressed participants. Thus, their results are consistent with the notion of a depression-related negative bias or lack of a positive bias.

While the aforementioned line of research examined participants' perceived intensity of the emotional stimuli, several studies varied the actual emotional intensity level of the facial expressions. Surguladze and colleagues (2004) used a standardized set of happy, sad, and neutral facial expressions (Young et al., 2002) and digitally morphed a neutral facial expression into an emotional one (i.e., faces expressing happiness or sadness) in order to create two intensity levels (50% and 100%) for facial expressions of happiness and sadness. Overall, depressed participants were less accurate in their labelling of the happy and sad faces compared to nondepressed participants. Moreover, depressed participants were also less likely to label mildly happy faces (50% intensity) as happy. Joorman and

Gotlib (2006) also morphed happy and sad facial expressions from the same standardized set of stimuli but they also included angry facial expressions. Their task differed in that neutral facial expressions were gradually morphed into an emotional facial expression in small increments (10% intervals) and participants were asked to indicate when they could detect and identify an emotional expression. They found that depressed participants required higher intensity levels in order to detect happy facial expressions compared to control participants. Gilboa-Schechtman, Foa, Vaknin, Marom, and Hermesh (2008) used a similar morphing procedure to generate happy, sad, and angry faces of varying intensity levels (0-60%). Participants were presented with these mildly emotive photographs (as well as neutral ones) in a random order and were asked to label them as positive, negative, or neutral. They found that depressed participants were more likely to judge mildly sad and mildly angry faces as negative compared to control participants. Moreover, depressive symptom severity was positively associated with greater sensitivity to changes in intensity levels of sadness. Together, the results of these studies suggest that depressed individuals are less sensitive to facial cues associated with happiness and more sensitive to those associated with negative emotions.

Two studies examined both perceived and actual emotional intensity of the stimuli. Gur and colleagues (1992) used photographs of professional actors and actresses portraying happy and sad facial expressions at varying intensities as well as neutral facial expressions. Participants were asked to rate these photographs on a 7-point scale ranging from *very happy* to *neutral* to *very sad*. As predicted, depressed participants perceived more sadness in the photographs compared to nondepressed participants. However, it should be noted that neither the emotions portrayed (happiness and sadness) nor the intensity levels of the emotions were collected in a standardized, systematic manner.

Conversely, Mendlewicz and colleagues (2005) employed a standardized series of photographs depicting emotional facial expressions (happiness, anger, sadness, disgust, and fear; Matsumoto & Ekman, 1998) which were morphed to create four intensity levels (0%, 30%, 70%, and 100%). Participants were asked

to rate these photographs using an intensity scale similar to one employed by Bouhuys et al. (1996). Specifically, participants judged each photograph based on eight emotion scales (happiness, sadness, fear, anger, disgust, surprise, shame, and contempt). A judgment was considered accurate if the emotion scale that received the highest rating corresponded with the actual emotion portrayed in the photograph. Interestingly, depressed participants were less accurate than control participants at decoding angry faces but only when these faces were presented at an intensity level of 70%. No significant differences were found when they examined perceived intensity ratings. However, perhaps because the researchers were mainly interested in investigating emotion decoding in anorexic participants and only included depressed participants as a clinical control group, the depression group was comprised of a small number of participants ($n = 21$). Thus, their study may not have had sufficient statistical power to detect subtle group differences. Indeed, although depressed participants were less accurate than control and anorexic participants on all of the emotion categories, only one effect (i.e., anger) reached significance.

In order to elucidate the nature of the relationship between dysphoria and emotion recognition, I examined participants' judgments of perceived emotional intensity and varied the actual emotional intensity of the stimuli as well. Including both aspects allows for the examination of participants' perception of emotional stimuli as well as whether their ratings vary as a factor of objective differences in intensity. In addition, I aimed to further clarify this relationship by employing ambiguous stimuli (chimeric faces). Cognitive theories of depression suggest that when the stimuli or situation is not clear-cut or straightforward, schema-related biases are more readily activated and employed (e.g., Beck, 1976). Furthermore, a negative interpretive bias for ambiguous stimuli may represent a cognitive vulnerability for the development of depression (Dearing & Gotlib, 2009).

Previous studies have demonstrated a negative interpretative bias for ambiguous stories (e.g., Butler & Mathews, 1983; Eley et al., 2008; Halberstadt et al., 2008) and orally presented words (e.g.,

Eley et al., 2008; Hertel & El-Messidi, 2006; Lawson, MacLeod, & Hammond, 2002; Mogg, Bradbury, & Bradley, 2006) in depressed and dysphoric participants. Beyond verbal content, several researchers have also examined depressed individuals' perceptions of ambiguous facial stimuli. For example, some studies have used chimeric faces in which the left half of the face displays a different emotion than the right half of the face. However, these studies specifically investigated hemifacial biases (i.e., perceiving greater emotionality on one side of the face instead of the other when the emotion displayed on either side is equivalent), which have been proposed as a biological marker for distinguishing subtypes of depression, rather than valence-specific biases (e.g., Bruder, Stewart, McGrath, Ma, Wexler, & Quitkin, 2002; Kucharska-Pietura & David, 2003). As mentioned previously, Bouhuys and colleagues employed schematic faces in their investigations of biased facial expression processing. Of note, their stimuli also included three ambiguous faces. In this case, the term ambiguous was defined as possessing equal amounts of positivity and negativity, using a top-bottom dichotomy rather than a left-right one. In other words, the eyes and the mouth of these ambiguous faces were of opposing valences. This line of research demonstrated that greater perception of negativity was associated with more severe and persistent depressive episodes (Hale, 1998) and greater risk of relapse (Bouhuys et al., 1999), but their results were either strongest for or only applicable to ratings of the ambiguous faces.

Although the results of Bouhuys and colleagues' line of research are intriguing and consistent with cognitive theories of depression, the ambiguity of their ambiguous faces might be debatable. For example, one such ambiguous face was composed of "angry" eyes (eyebrows pointing down towards the middle of the face forming a 'V') and a smile. The end result appears decidedly negative and may not be ambiguous in terms of valence. This result is not surprising given that the eye region of the face is disproportionately influential in conveying emotionality (see Ekman, Friesen, & Ellsworth, 1972). Nonetheless, while its valence may not be ambiguous, the exact emotion conveyed may be more so (perhaps *schadenfreude* or *malicious glee* would be an adequate descriptor). Indeed, the resulting face

does not represent a basic emotion but a more complex one which leaves greater room for interpretation. Again, it bears repeating that a limitation of the schematic faces is their dearth of ecological validity. A facial expression is comprised of complex interactions between many small facial muscle movements (Ekman & Friesen, 1978). Therefore, a basic line drawing of a face will not capture the many nuances of an actual emotional facial expression, especially a more complex one.

This study extended the work of Bouhuys and colleagues by employing more ecologically valid stimuli. The ambiguous photographs used in the present study were top-bottom chimeric faces. That is, the top and bottom halves of a chimeric face displayed one of four basic emotions (anger, fear, happiness, or sadness) or neutral with the caveat that the two halves displayed a different emotion. The original photographs (i.e., displaying only one emotion) were developed in accordance with FACS (Ekman & Friesen, 1978) and, thus, capture the many subtleties of an emotional facial expression. In doing so, the chimeric faces are more suited to conveying multiple emotional cues compared to schematic faces and this methodology has been shown to produce valid facial expressions (LaPlante & Ambady, 2000). Because of their emotional complexity, the chimeric faces allow for the examination of participants' interpretations of ambiguous facial expressions.

The second goal of the present study was to examine the causal role of rumination in dysphoric individuals' facial emotion processing by employing an induction methodology. Rumination has been proposed as the key mechanism that underlies the relationship between depression/dysphoria and various cognitive impairments and/or biases. Especially relevant to the present study, Raes and colleagues (2006) found that greater self-reported rumination was associated with greater perception of negativity in schematic facial expressions. The current study extends their work in several important ways. First, Raes and colleagues only focused on bias whereas in the current study, I examined both bias and accuracy. Second, the current study employed the use of both straightforward and chimeric emotional stimuli in order to assess for the hypothesized exacerbating effect of ambiguity. Third, both

types of stimuli possess greater ecological validity than schematic line drawings. That is, the stimuli were developed in accordance with specifications outlined in FACS (Ekman & Friesen, 1978). Fourth, a control group of participants reporting few or minimal depressive symptoms was included to determine the generality of rumination's effect on emotion recognition. Finally, Raes and colleagues used a correlational design which limits their conclusions regarding directionality of the effect. On the other hand, an experimental induction methodology allows for a stronger determination of causality. Thus, one of the major contributions of this study was to examine the causal role of rumination in depressive processing using a rigorous experimental design.

In summary, the data suggests that depressed or dysphoric individuals exhibit biased processing of emotional facial expressions. Specifically, depressed mood seems to be associated with a negative bias which manifests as perceiving greater negativity in negative or neutral stimuli or perceiving less positivity in positive stimuli. The majority of studies also suggest that dysphoric participants may be less accurate compared to nondysphoric participants at decoding facial expressions. There is also evidence to suggest that depressive biases may become more evident when the stimuli are ambiguous. Based on the existing evidence, I predicted that dysphoric participants will be less accurate on the facial emotion recognition task. However, whether group differences in accuracy will be emotion-specific or not is unclear. Furthermore, I predicted that dysphoric participants will perceive more negativity and less positivity in their ratings of emotional intensity and this difference will be exacerbated when the facial expression is more complex and ambiguous. These predictions are qualified by the type of induction that participants receive. That is, dysphoric participants are predicted to be less accurate and more negatively biased in their facial emotion judgments but only when they are induced to ruminate, not when they are induced to distract. When given a distraction induction, dysphoric participants should perform similarly to nondysphoric participants.

Method

Participants

Participants were 102 undergraduate students recruited from introductory psychology courses at the University of Waterloo. They received partial course credit for their participation in the study. In accordance with recommendations from Clark, Crewdson, and Purdon (1998), six participants were excluded from the analyses because they scored 0 or 1 on the BDI-II. An additional seven participants were not included in the final sample, four of whom failed to complete all of the questionnaires and three of whom experienced technical difficulties and, thus, could not complete all of the tasks. The final sample included 89 participants (28 men, 57 women, 4 declined to provide their gender) with 45 in the rumination condition (14 men, 29 women, 2 declined to answer) and 44 in the distraction condition (14 men, 29 women, 2 declined to answer).

Materials

Rumination Induction (Nolen-Hoeksema & Morrow, 1993). Participants randomly assigned to the rumination condition received a modified version of Nolen-Hoeksema and Morrow's rumination induction procedure. In the original procedure, participants are presented with 45 statements designed to focus their attention on themselves (e.g., "Think about why your body feels this way"). Participants are given 8 minutes to work their way through these statements. In the modified version, rather than being a self-paced task, participants were given 15s to read and focus on each statement. Like the original procedure, the induction task lasted 8 minutes. Given the 8-minute length of the task (designed to be consistent with past research), participants saw most but not all of the rumination items. Therefore, the order of presentation of these statements was randomized across participants. This modification was aimed at eliminating possible group differences in the amount of time spent focusing on a particular item.

Distraction Induction (Nolen-Hoeksema & Morrow, 1993). Participants randomly assigned to the distraction condition received a modified version of Nolen-Hoeksema and Morrow's distraction induction procedure. This induction procedure is similar to the rumination induction procedure described above. However, rather than being presented with self-focus statements, participants were asked to focus their attention outward (e.g., "Think about clouds forming in the sky"). The distraction induction lasted 8 minutes with each statement presented for 15s and the order of presentation of the items was randomized.

Accuracy Task. This task assesses participants' emotion recognition abilities. The accuracy task consisted of black-and-white photographs of people's faces that are standardized to the same size (280 pixels X 480 pixels). The stimuli included photographs of four target individuals (two males, two females) mimicking facial expressions of five different emotions (anger, fear, happiness, sadness, and neutral). A trained research assistant instructed the target participants to express each emotion according to detailed specifications outlined by Marshall (2005) which were based on Ekman and Friesen's (1978) Facial Action Coding System. The photographs used in this study were also independently verified by two FACS-trained coders. Furthermore, each person was asked to express each emotion at three intensity levels (low, medium, high; see Figure 2). Of course, varying intensity levels could not be obtained for the neutral facial expression. Nonetheless, three different photographs of the target with a neutral facial expression was included in the stimulus set in order to avoid having participants view the exact same neutral face more times than they would view other emotion faces. Thus, in total, the stimulus set consists of 72 photographs. Finally, the photographs were converted into gray scale using image editing software in order to minimize any confounding effects of colour in the photographs. The stimuli were presented on a notebook computer using E-Prime software.

Each trial began with a fixation cross presented for 1000ms, the purpose of which was to orient participants' attention to the impending stimulus. Next, a photograph was presented in the middle of

the screen for 60ms. This presentation time was chosen because previous studies recommend using shorter durations to detect subtle, depression-related cognitive impairments (e.g., Surguladze et al., 2004). Furthermore, this brief presentation time also served to reduce the possibility of obtaining ceiling effects. Finally, participants were presented with four response options (i.e., the correct response and three distracters) and were asked to indicate their response, as quickly and accurately as possible, by pressing one of four keys on the keyboard. Each photograph was presented a total of four times with each presentation accompanied by a different set of response options (to ensure that all photographs were presented with all possible response option combinations). The order of presentation of the photographs as well as the position of the response options (i.e., top left vs. top right vs. bottom left vs. bottom right) was randomized. In addition to participants' responses, their reaction time was also recorded. Once participants have indicated their response, the next trial was initiated.

Bias Task. This task utilized the same stimulus set as the accuracy task. However, rather than identifying the emotion displayed in the faces, participants rated the amount of emotionality that they perceived in each photograph. Specifically, each photograph was shown four times, each time asking participants to rate how strongly that particular photograph depicted a certain emotion (i.e., anger, fear, sadness, happiness). Consistent with previous studies that have employed this task (e.g., Bouhuys et al., 1996; Hale, 1998; Raes et al., 2006), participants indicated their response using a five-point scale (1 = *not at all* to 5 = *very strongly*).

All items were randomly presented to participants in one block. Also similar to the accuracy task, participants were first presented with a fixation cross for 1000ms followed by a photograph for 60ms. Finally, participants were presented with the aforementioned response scale. To indicate their response, participants pressed a key on the keyboard that corresponded to their desired answer. Participants' reaction time was also recorded.

Chimera Task. The stimuli for this task differed from the photographs used for the other two tasks. Although the same photographs as the ones used for the Accuracy and Bias tasks were used in the development of this stimulus set, each photograph was altered to create new photographs depicting mixed emotions. Using an image editing software, each photograph was separated into two halves (upper and lower) which were approximately equal in size. The halfway point down the bridge of the nose was used as a guideline for the editing process. Thus, for each photograph, this process resulted in two pictures, the upper and lower halves of the target's face. Next, the new photographs were carefully pieced together to form the chimeric faces. Only facial halves from the same target person were combined (e.g., the upper half of Target A's face was not put together with the lower half of Target B's face). Furthermore, facial halves representing the same emotion but at different levels of intensity were not combined. Only the low and high intensity photographs were included in this process in order to keep the stimulus set at a reasonable number. With these guidelines in place, all possible combinations of photographs were created resulting in 320 new photographs depicting mixed emotions (e.g., fear in the upper half of the face and happiness in the lower half; see Figure 3).

Due to the large number of photographs, participants were only presented with half of the photographs. That is, for each combination of emotions (e.g., low intensity anger and high intensity happiness), there are two possible chimeric faces (anger in the upper half of the face with happiness in the lower half and vice versa). Thus, participants only saw one of the two possible chimeric faces for each combination of emotions. The face that was presented was randomly determined for each participant.

The procedure of this task was the same as that of the Bias task. Participants were presented with a fixation cross for 1000ms followed by a randomly selected photograph presented for 60ms. Participants then rated how strongly that photograph depicted an emotion (i.e., anger, fear, sadness, happiness) using a five-point scale (1 = *not at all* to 5 = *very strongly*). To indicate their response,

participants pressed the key on the keyboard that corresponded to their desired answer. As well, participants' reaction time was recorded.

Beck Depression Inventory-II (BDI-II; Beck, 1996). The BDI-II is a 21-item self-report questionnaire which assesses the presence and severity of depressive symptoms. Scores for each item on the BDI-II ranges from 0-3 and all items are summed to create a total score with higher scores indicating more severe depressive symptomatology. This questionnaire is widely used in depression research and many studies have established its concurrent and discriminant validity as well as its high internal consistency (e.g., Beck, Steer, & Garbin, 1988). In addition, this measure's test-retest reliability has ranged from .67 to .90 (Lightfoot & Oliver, 1985; Oliver & Burkham, 1979; Oliver & Simmons, 1984).

Mood and Anxiety Symptom Questionnaire (MASQ; Watson & Clark, 1991). The MASQ is a 90-item self-report measure of both depressive and anxious symptoms. This questionnaire employs a 5-point response scale (1 = *not at all* to 5 = *extremely*) and yields five indexes. Two of the indexes, Anhedonic Depression (AD) and Anxious Arousal (AA), assess symptoms that differentiate depression and anxiety, respectively. The other three indexes load onto General Distress (GD; i.e., symptoms common to both depression and anxiety). This scale has considerable psychometric evidence for its convergent and discriminant validity (Watson, Weber, Assenheimer, Clark, Strauss, & McCormick, 1995). More important for the purposes of this study, the MASQ was designed to assess symptoms that are unique to depression and anxiety. Because depression and anxiety tend to co-occur, the AA index was used as a covariate to account for the contributions of purely anxious symptoms to task performance.

Procedure

Once participants have been informed about the study and given their written informed consent, they were randomly assigned to receive a rumination or distraction induction. Prior to receiving the assigned induction, participants completed the questionnaire packet which was comprised of the BDI-II and MASQ. Next, participants completed the three experimental tasks (Accuracy, Bias, and

Chimera). The order of the three tasks was counterbalanced across participants. In order to familiarize participants with the demands of each task, they completed several practice items at the beginning of each task. These practice items required participants to make the same type of judgments as the task in question, but the stimuli were photographs that were not used for the final stimulus sets (i.e., the targets are not the same people). Upon completion of the study, participants were debriefed and received their course credit as compensation.

Results

Condition Randomization

To ensure that participants were, indeed, properly randomized, their scores on the BDI-II and AA were examined across the two conditions. First, an independent samples t-test was conducted with Condition (rumination induction vs. distraction induction) as the between-subjects factor and BDI-II scores as the dependent factor. Participants' level of dysphoria did not differ between the two conditions (Rumination: $M = 13.16$, $SD = 8.82$; Distraction: $M = 13.86$, $SD = 8.64$), $t(87) = -0.38$, $p = .70$. A second independent samples t-test was conducted with Condition as the between-subjects factor and AA scores as the dependent factor. Participants' level of anxiety also did not differ between the two conditions (Rumination: $M = 31.16$, $SD = 12.63$; Distraction: $M = 33.00$, $SD = 12.50$), $t(87) = -0.69$, $p = .49$. Therefore, neither dysphoria nor anxiety was confounded with the induction manipulation.

General Analytic Model

The majority of the analyses discussed below are based on one main analytic model which is described in this section for simplicity's sake. This model was used for the main analyses comparing the rumination and distraction inductions across the three experimental tasks. For this model, an effects-coded variable was created to compare participants in the rumination and distraction conditions (Induction: rumination = +1, distraction = -1). The Induction variable, centered BDI-II scores, and the two-way Induction X BDI-II interaction were the between-subjects predictors. Emotion (anger vs.

sadness vs. happiness vs. fear vs. neutral) was the within-subjects factor. Centered AA scores were included as a covariate¹. The predictor variables and covariates were held constant for the analyses described below, but the models differed in terms of the dependent variable.

Accuracy Task Analyses

Correlations. First, correlations between participants' BDI-II scores and their overall accuracy on the accuracy task (expressed as a percent) as well as specific accuracy for the five emotions were conducted (see Table 1 for correlations between questionnaire scores and indices of accuracy). For the rumination condition, the correlation between BDI-II scores and overall accuracy was significant, $r(43) = -.50, p < .001$, such that higher BDI-II scores were associated with lower levels of overall accuracy. Participants' BDI-II scores were also significantly correlated with the accuracy for anger, $r(43) = -.40, p = .007$, fear, $r(43) = -.50, p < .001$, happiness, $r(43) = -.32, p = .03$, and sadness, $r(43) = -.41, p = .005$, such that higher BDI-II scores were associated with lower levels of accuracy for anger, fear, happiness, and sadness. There was no significant association between BDI-II scores and accuracy for the neutral condition, $r(43) = -.22, p = .15$. As for the distraction condition, none of the correlations between BDI-II scores and overall or specific emotion accuracy were significant ($ps > .37$). Thus, greater endorsement of depressive symptoms was generally associated with poorer facial emotion decoding accuracy when participants were given a rumination induction but not when they were given a distraction induction.

General Linear Model (GLM) Analysis. A mixed-design GLM analysis was conducted to examine performance on the accuracy task. As described above, the main analytic model was employed with percent accuracy on the task as the dependent measure. In general, participants' accuracy across the five emotions differed, $F(4, 84) = 28.55, p < .001$ (see Table 2 for results of the follow-up paired-samples

¹ Miller and Chapman (2001) highlighted concerns about including an anxiety covariate in analyses involving depressive symptoms as a predictor. To address this issue, all of the main analyses (including those in Study 2) were re-computed without the inclusion of the AA covariate. Results of the re-analyses indicated that the exclusion of the AA covariate did not significantly alter the findings and, in fact, the effects were slightly stronger when this covariate was removed.

t-test). None of the other main effects or interaction were significant ($ps > .29$) except for the Induction X BDI-II interaction, $F(1, 84) = 5.15, p = .026$.

Simple slopes analyses were conducted to interpret the significant Induction X BDI-II interaction. That is, the simple Induction main effect was examined separately at two levels of BDI-II. Prior to conducting the simple slopes analyses, two new continuous variables were created. As suggested by Cohen and Cohen (1983) and Cohen, Cohen, West, and Aiken (2003), I selected a value of one *SD* to create these new variables because there were no a priori reasons for selecting other specific high and low values. The first variable, High BDI-II, corresponded to one standard deviation above the centered BDI mean, and was created by subtracting one standard deviation from each participant's centered BDI-II score. The other variable, Low BDI-II, corresponded to one standard deviation below the centered BDI-II mean, and was created by adding one standard deviation from each participant's centered BDI-II score (Aiken & West, 1991; Cohen & Cohen, 1983; Cohen et al., 2003; West, Aiken, & Krull, 1996).

In regression, the effects of one variable are interpreted when all other variables equal zero. Because I centered my continuous predictors, the results from the primary analyses were interpreted with respect to the mean value of the other variables (because for centered scores, the mean value is zero). Therefore, when utilizing the new High BDI-II and Low BDI-II variables, zero is no longer the BDI-II mean, but one standard deviation above and below the BDI mean, respectively.

To test the simple Induction effect at high and low levels of BDI-II, two separate regression analyses were conducted. As participants' accuracy across the five emotions did not differ between the two induction conditions, percent accuracy was collapsed across the different emotions. Percent accuracy on this task was regressed onto: 1) an effects-coded Induction variable (rumination = +1, distraction = -1), High BDI-II scores, the two-way Induction X High BDI-II interaction, and the centered AA covariate; and 2) an effects-coded Induction variable (rumination = +1, distraction = -1), Low BDI-II scores, the two-way Induction X Low BDI-II interaction, and the centered AA covariate. The simple slopes

analyses are represented in Figure 4. Participants who endorsed more depressive symptoms performed less accurately on this task when given a rumination induction than when given a distraction induction, $B = -.10$, $t(85) = -4.34$, $p < .001$. However, no induction group differences were observed at lower BDI-II levels, $B = -.03$, $t(85) = -1.22$, $p = .22$.

Reaction Time Analyses. To examine the possibility that performance differences were attributable to a speed/accuracy tradeoff strategy, a mixed-design GLM analysis was conducted. Again, the main analytic model was used with mean reaction time on the task as the dependent measure. In general, participants' reaction times across the five emotions differed, $F(4, 84) = 36.61$, $p < .001$ (see Table 3 for results of the follow-up paired-samples t-test). The BDI-II main effect was marginally significant, $F(1, 84) = 3.74$, $p = .06$, such that higher BDI-II scores was associated with slower reaction times. None of the other main effects or interactions was significant ($ps > .15$). Although participants who reported more depressive symptoms were generally slower to respond to the items, this effect did not differ as a function of the induction that they received.

Bias Task Analyses

Correlations. First, correlations between participants' BDI-II scores and their overall intensity ratings on the bias task as well as specific ratings for the four emotions were conducted (see Table 4 for correlations between questionnaire scores and indices of perceived intensity). For the rumination condition, the correlation between BDI-II scores and overall intensity rating was marginally significant, $r(43) = .26$, $p = .09$. With respect to specific emotion ratings, there was a significant correlation between BDI-II scores and anger intensity ratings, $r(43) = .32$, $p = .03$, and a marginally significant correlation between BDI-II scores and fear intensity ratings, $r(43) = .27$, $p = .08$. None of the other correlations were significant. As for the distraction condition, none of the correlations between BDI-II scores and overall or specific emotion intensity ratings were significant ($ps > .33$). Thus, greater endorsement of depressive symptoms was generally associated with greater perceived emotional intensity (particularly for anger

and fear) when participants were given a rumination induction but not when they were given a distraction induction.

General Linear Model (GLM) Analysis. A mixed-design GLM analysis was conducted to examine performance on the bias task. The main analytic model was used with participants' emotional intensity ratings as the dependent measure. In general, participants' emotional intensity ratings across the four emotions differed, $F(3, 82) = 21.76, p < .001$ (see Table 5 for results of the follow-up paired-samples t-test). None of the other main effects or interaction were significant ($ps > .36$) except for the main effect of the AA covariate which was marginally significant, $B = .35, t(84) = 1.81, p = .07$, which indicated that greater endorsement of anxiety symptoms was associated with greater perceived emotional intensity regardless of the type of induction participants received.

Reaction Time Analyses. Reaction time differences were also examined using a mixed-design GLM analysis. The main analytic model was utilized with mean reaction time on the task as the dependent measure. In general, participants' reaction times across the four emotions differed, $F(3, 82) = 16.90, p < .001$ (see Table 6 for results of the follow-up paired-samples t-test). None of the other main effects or interactions were significant ($ps > .19$).

Chimera Task Analyses

Correlations. First, correlations between participants' BDI-II scores and their overall intensity ratings on the chimera task as well as specific ratings for the four emotions were conducted (see Table 7 for correlations between questionnaire scores and indices of perceived intensity). For the rumination condition, the correlation between BDI-II scores and overall intensity rating was significant, $r(43) = .41, p = .005$. With respect to specific emotion ratings, there was a significant correlation between BDI-II scores and anger intensity ratings, $r(43) = .42, p = .004$, fear intensity ratings, $r(43) = .38, p = .009$, and happiness intensity ratings, $r(43) = .36, p = .016$, but not sadness intensity ratings ($p = .32$). As for the distraction condition, none of the correlations between BDI-II scores and overall or specific emotion

intensity ratings were significant ($ps > .44$). Thus, greater endorsement of depressive symptoms was generally associated with greater perceived emotional intensity (particularly for anger, fear, and happiness) when participants were given a rumination induction but not when they were given a distraction induction.

General Linear Model (GLM) Analysis. A mixed-design GLM analysis was conducted to examine performance on the chimera task. The main analytic model was used with participants' emotional intensity ratings as the dependent measure. In general, participants' emotional intensity ratings across the four emotions differed, $F(3, 82) = 41.52, p < .001$ (see Table 8 for results of the follow-up paired-samples t-test). The main effect of the AA covariate was significant, $B = .57, t(84) = 2.24, p = .03$, such that greater endorsement of anxiety symptoms was associated with greater perceived emotional intensity regardless of the type of induction participants received. In addition, the Induction X BDI-II interaction was marginally significant, $B = .91, t(84) = 1.69, p = .09$. No other effects were significant ($ps > .46$).

Simple slopes analyses (see Figure 5) were conducted to test the simple Induction effect at high and low levels of BDI-II. As participants' emotional intensity ratings across the four emotions did not differ between the two induction conditions, their ratings were collapsed across the different emotions. Results indicated that no induction group differences were observed at either lower BDI-II levels, $B = -6.79, t(84) = -1.03, p = .31$, or higher BDI-II levels, $B = 9.07, t(84) = 1.69, p = .18$.

Reaction Time Analyses. Reaction time differences were examined using a mixed-design GLM analysis. The main analytic model was employed with mean reaction time on the task as the dependent measure. In general, participants' reaction times across the four emotions differed, $F(3, 82) = 30.58, p < .001$ (see Table 9 for results of the follow-up paired-samples t-test). In addition, the BDI-II main effect was marginally significant, $B = 18.59, t(84) = 1.85, p = .07$, and the main effect of the AA covariate was significant, $B = -14.61, t(84) = -2.72, p = .008$. These results suggest that greater levels of depressed

mood and lower levels of anxiety are associated with longer reaction times. None of the other main effects or interactions were significant ($ps > .18$).

Discussion

The main goals of Study 1 were to elucidate the relationship between dysphoria and facial emotion recognition and to determine whether rumination is an underlying mechanism in this association. I hypothesized that for participants who were asked to ruminate, greater endorsement of depressive symptoms would be associated with lower facial emotion recognition accuracy rates. This relationship was not expected to be present for participants who are asked to distract. Correlational analyses demonstrated that greater levels of dysphoric mood were associated with poorer identification of four out of five emotional faces (anger, sadness, happiness, and fear, but not neutral) but only when participants received a rumination induction. Given that these correlations were of the same direction and of similar magnitude, it was not surprising that participants' level of dysphoria was not associated with differential performance across the five types of facial expressions. Using a single index of accuracy (as opposed to examining accuracy for each emotion), analyses revealed that participants who endorsed more depressive symptoms were less accurate at identifying the emotion portrayed when they received a rumination induction compared to their counterparts who received a distraction induction. However, for participants who endorsed fewer depressive symptoms, no group differences emerged between those who received a rumination or a distraction induction. Taken together, these results suggest that the confluence of dysphoria and rumination can better account for poor facial emotion identification than either factor in isolation.

I also hypothesized that participants who endorsed greater depressive symptoms would perceive greater negativity in the facial stimuli. For the bias task, this hypothesis was partially supported by correlational analyses which indicated that higher levels of dysphoric mood were associated with higher ratings of perceived anger and fear but only for those in the rumination condition. However,

results from subsequent analyses suggest that these correlational differences between groups were not statistically significant. Of course, each picture for the bias task depicted only one emotion and, thus, may have been too straightforward to elicit biased responding. A related hypothesis was that differences in perceived emotional intensity would be exacerbated when the stimuli are more complex and ambiguous. Similar to the results from the bias task, correlational analyses for the chimera task indicated that greater endorsement of depressive symptoms was associated with greater perceived intensity of anger and fear but only for those in the rumination condition. Interestingly, the positive relationship between dysphoria and intensity rating was also applicable to happiness. Using a single index of perceived emotional intensity, subsequent analyses demonstrated a significant interaction between dysphoria and induction condition. While Figure 5 suggests that participants who endorsed greater depressive symptoms perceived more emotional intensity when they received a rumination induction compared to those who received a distraction induction and vice versa for those who endorsed fewer depressive symptoms, it must be stressed that neither slope was significant.

For all three tasks, participants' accuracy for or rating of specific emotions did not differ as a function of their level of dysphoria. Interestingly, happiness was typically perceived differently than the other emotions. Specifically, participants were most accurate at identifying happiness and rated happy faces as the least intense. That happiness stood apart from the other emotions is not surprising given that it was the only emotion represented that was of a positive valence. While differences were demonstrated between negatively-valenced emotions (sadness, fear, anger), they were not as consistent or as prominent.

In summary, rumination appeared to negatively impact dysphoric participants' ability to accurately identify emotional facial expressions. Furthermore, correlational analyses suggested that dysphoric participants who were induced to ruminate perceived certain emotions, particularly fear and anger, as more emotionally intense both when the stimuli were straightforward and when they more

complex and ambiguous. Thus, the evidence indicated that the ruminative process uniquely affects individuals who endorse higher levels of dysphoria. However, the question of how rumination impacts facial emotional information processing remains. One possibility is that dysphoric ruminators overthink their answers and, thus, take more time to respond. Indeed, studies have demonstrated that a more deliberate and reasoned approach can hinder the accuracy of certain types of judgments (e.g., Ambady & Gray, 2002). However, results from the present study do not favour this hypothesis. Another possibility is that the cognitive load placed on dysphoric individuals due to their ruminative tendencies hinders performance accuracy. Study 2 aimed to investigate this hypothesis in addition to replicating the results from Study 1.

Study 2

The goal of Study 1 was not only to clarify the relationship between dysphoria and several indices of emotion recognition, but also to examine the role of rumination in this relationship. Overall, there was evidence to suggest that the combined influence of dysphoria and induced rumination negatively impacts accuracy of facial emotion recognition and, to a lesser extent, perceived intensity of emotional facial expressions. The aim of Study 2 was to further elucidate the manner by which rumination influences dysphoric processing (see Figure 6). While many studies have documented rumination's effects on various cognitive processes, there is a relative dearth of studies examining *how* rumination affects these processes.

The proposed mechanism that was examined in the present study involves rumination's effect on the availability of cognitive resources (see Figure 7 for a schematic representation of the rumination-as-cognitive-load hypothesis). Rumination is defined as an analytical, effortful form of thinking involving a constant cycling of unpleasant thoughts. Indeed, dysphoric participants who were induced to ruminate reported greater difficulty concentrating on various academic tasks, were slower to complete these tasks, and exhibited overall poorer performance in contrast to dysphoric participants who were given a distraction induction (Lyubomirsky et al., 2003). Similarly, in a rumination analogue study, Krames and MacDonald (1985) demonstrated dual-task performance deficits in depressed participants (compared to control participants) when the tasks were moderately but not highly taxing. The researchers attributed this deficit to the additional load caused by ruminative thoughts and posited that a highly taxing task would, in essence, act as a distraction from depressed participants' ruminating. Although rumination may be considered relatively effortful, it should not negatively impact emotion recognition if this latter process is an entirely automatic one. Of course, cognitive processes are not simply dichotomized as either automatic or effortful but rather automaticity is generally conceptualized as a continuum (Hasher & Zacks, 1979; Kahneman & Chajczyk, 1983; Logan, 1985; MacLeod & Dunbar, 1988; Schneider &

Shiffrin, 1977; Shiffrin, 1988). If a cognitive process is considered to be wholly automatic (or at least very nearly so), it should be immune to disruption from another cognitive process (see Hartlage, Alloy, Vazquez, & Dykman, 1993, for an in-depth discussion of automatic and effortful processes). Therefore, if facial emotion recognition is a completely automatic process, then the heavy strain that rumination places on cognitive resources should not have an effect on emotion recognition performance. There is some existing evidence to suggest that emotion recognition may be at least somewhat automatic. For example, subliminally presented emotional facial expressions have been shown to influence participants' subsequent behaviours and judgments in a manner consistent with the stimuli (Dimberg & Thunberg, 1998; Dimberg, Thunberg, & Elmehed, 2000; Niedenthal, 1990; Winkielman, Berridge, & Willbarger, 2005). However, a recent study suggests that facial emotion recognition may not be entirely automatic. Tracy and Robins (2008) found that participants, overall, were fairly accurate at identifying facial expressions when asked to do so quickly (i.e., within 1000 ms) or under cognitive load (i.e., rehearsing a 7-digit number). However, participants' accuracy rates improved when they were given more time to respond. Therefore, facial emotion recognition appears to not be wholly automatic, but rather it is at least somewhat effortful as performance improved when cognitive resources were not stressed.

Although Study 1 did not yield strong evidence to support the presence of biasing effects of dysphoria and rumination, both the Bias and Chimera tasks were included in Study 2. Their inclusion allows for a more thorough examination of possible similarities (and differences) between the effects of induced rumination and cognitive load. Specifically, whereas results from Study 1 suggest that rumination seems to impact accuracy of emotion identification but not perception of emotional intensity, a cognitive load may influence both accuracy and perceived intensity. Researchers have shown that when participants' cognitive systems are sufficiently taxed, they increasingly rely on less effortful forms of processing such as stereotypes (e.g., Gilbert & Hixon, 1991). Depressive schemas, often invoked

in cognitive theories of depression, are another form of efficient processing. For example, Reich and Weary (1998) found that when sufficient cognitive resources were available, participants in dysphoric and nondysphoric groups did not differ in the valence of their dispositional and situational inferences. However, when participants were cognitively busy, dysphoric participants made more negative dispositional and situational inferences than did those in the nondysphoric group. Similar negative biases have also been demonstrated in at-risk participants (i.e., previously depressed but currently asymptomatic) when they were cognitively taxed (e.g., Wenzlaff & Bates, 1998). With respect to the present study, when a cognitive load (which is effortful) is introduced, negative processing biases (which are more efficient) may become more apparent in dysphoric individuals.

The present study examined the viability of the rumination-as-cognitive-load hypothesis. In other words, is rumination's effect on facial emotion recognition due to the cognitive load it places on dysphoric individuals? To address this question, the present study features a cognitive load condition in addition to the rumination and distraction conditions. Specifically, rather than receiving an induction, participants assigned to this condition were presented with a nine-digit number prior to each emotion recognition task and were asked to rehearse this number during the task. Previous studies have successfully used the digit-memorization task to tax participants' cognitive resources (e.g., Andersen & Limpert, 2001; Gilbert & Hixon; 1991; Reich & Weary, 1998; Swann, Hixon, Stein-Seroussi, & Gilbert, 1990; Wenzlaff & Bates, 1998). Based on previous studies that have examined the influence of cognitive loads on depressive processing, I predicted that dysphoric participants in the cognitive load condition will perform similarly to dysphoric participants in the rumination but not distraction condition on the Accuracy task. That is, dysphoric participants in the cognitive load and rumination conditions will be less accurate. In contrast, dysphoric participants in the distraction condition should perform more similarly to nondysphoric participants in the rumination and distraction conditions. Following the results from Study 1, I predicted that neither rumination nor dysphoria will significantly influence performance on

the Bias and Chimera tasks. I also predicted that nondysphoric participants who are given a cognitive load will be less accurate at identifying facial expressions compared to nondysphoric participants in the other two conditions. The burdens of an additional, simultaneous task should sufficiently reduce their cognitive resources, thus reducing their accuracy. However, as nondysphoric participants should not be influenced by negative schemas, they should not exhibit a negative bias in their emotion recognition performance.

In addition to the main hypotheses, I also investigated an additional methodological issue which involves the negative tone and valence that is characteristic of the standard rumination induction methodology that has been used in past studies. Specifically, the concern is that the standard rumination induction (Nolen-Hoeksema & Morrow, 1993) that is typically used in past studies may lead to both an inward focus as well as induce negative affect, thus confounding these two processes. Indeed, researchers have commented on the overlap between measures of ruminative tendencies and depressive symptoms (Conway, Csank, Holm, & Blake, 2000; Cox, Enns, & Taylor, 2001; Roberts, Gilboa, & Gotlib, 1998; Segerstrom, Tsao, Alden, & Craske, 2000; Treynor, Gonzalez, & Nolen-Hoeksema, 2003). Similarly, Purdon and Nilsen (personal communication, November 2009) observed that certain items employed in the rumination induction developed by Nolen-Hoeksema and Morrow (1993) exhibited a negative tone or valence. Therefore, an additional condition was included which involved a rumination induction denuded of its negative content (see below for more detailed information regarding the development of this induction). As the inclusion of this condition was for exploratory purposes, specific hypotheses were not given. Instead, this neutral rumination condition was used primarily to assess possible differences with the original rumination procedure.

Method

Participants

Participants were 184 undergraduate students recruited from introductory psychology courses at the University of Waterloo. They received partial course credit for their participation in the study. Five participants were not included in the analyses because they scored 0 or 1 on the BDI-II (based on recommendations by Clark et al., 1998). Another seven participants were excluded from the analyses because they failed to complete all experimental tasks and questionnaires due to technical difficulties. Therefore, the final sample included 172 participants (43 men, 115 women, 14 chose not to disclose) with 45 in the rumination condition (12 men, 30 women, 3 chose not to disclose), 43 in the distraction condition (11 men, 29 women, 3 chose not to disclose), 42 in the cognitive load condition (9 men, 28 women, 5 chose not to disclose), and 42 in the neutral rumination condition (11 men, 28 women, 3 chose not to disclose).

Materials

Participants were randomly assigned to one of four conditions: rumination induction, distraction induction, neutral rumination induction, and cognitive load. These conditions are described in greater detail below.

Induction Conditions. Approximately three-quarters of the participants were randomly assigned to receive a rumination, distraction, or neutral rumination induction. The rumination and distraction induction tasks were previously described for Study 1.

The neutral rumination induction was a slight modification on the rumination induction. That is, the structure and procedure of the induction remained the same, but the content was slightly altered. As discussed above, certain phrases used in the rumination induction could be construed as somewhat negative in tone. Specifically, phrases that contained words with negative connotations (e.g., consequences, tension) or ones that may be perceived as accusatory (e.g., “why” or “should”

statements) were re-worded in a manner that made them more neutral in tone but maintained the original meaning. In all, 10 of the 45 induction phrases were altered for the neutral rumination induction.

Cognitive Load Condition. The final one-quarter of the participants randomly assigned to the cognitive load condition were presented with a different, randomly generated nine-digit number prior to each experimental task. They were given 30s to memorize this number and were instructed that they will be asked to report this number upon completion of each task.

Experimental Tasks. As in Study 1, participants completed, in a counterbalanced order, the Accuracy, Bias, and Chimera tasks.

Questionnaires. Again, participants completed the BDI-II and MASQ.

Procedure

Once participants have been informed about the study and given their written informed consent, they were randomly assigned to the rumination, distraction, cognitive load, or neutral rumination condition. Prior to receiving the assigned induction or cognitive load, participants completed the questionnaire packet which was comprised of the BDI-II and MASQ. Next, participants completed the three experimental tasks (Accuracy, Bias, and Chimera). Participants completed several practice items at the beginning of each task. Upon completion of the study, participants were debriefed and received their course credit as compensation.

Results

Condition Randomization

Participants' scores on the BDI-II and the AA subscale of the MASQ were examined across the four conditions to verify that the randomization procedure was successful. First, a one-way analysis of variance (ANOVA) was conducted with Condition (rumination vs. distraction vs. cognitive load vs. neutral rumination) as the between-subjects factor and BDI-II scores as the dependent factor. Participants' level

of dysphoria did not differ between the four conditions, $F(3, 168) = .14, p = .93$. Another ANOVA was conducted with Condition as the between-subjects factor and AA scores as the dependent factor. Participants' level of anxiety also did not differ between the four conditions, $F(3, 168) = .50, p = .68$. Therefore, the results indicated that neither dysphoria nor anxiety was unequally distributed across groups (see Table 10 for descriptive statistics of each questionnaire across the four conditions).

Cognitive Load Manipulation Check

For the accuracy task, of the 42 participants in the cognitive load condition, 13 participants (30.95%) correctly recalled the nine-digit number at the end of the task. An additional eight participants (19.05%) made one recall error (e.g., one incorrect digit or a pair of transposed numbers), six (14.28%) made two recall errors, five (11.90%) made three recall errors, and 10 (23.81%) made four or more recall errors. For the bias task, 14 participants (33.33%) correctly recalled the nine-digit number upon completion of the task, five (11.90%) made one recall error, four (9.52%) made two recall errors, seven (16.67%) made three recall errors, and 12 (28.57%) made four or more recall errors. Finally, for the chimera task, 11 participants (26.19%) correctly recalled the nine-digit number, eight (19.05%) made one recall error, six (14.28%) made two recall errors, two (4.76%) made three recall errors, and 15 (35.71%) made four or more recall errors.

For all three experimental tasks, a t -test with load task accuracy (correct vs. incorrect) as the independent variable and participants' BDI-II scores as the dependent variables was conducted to assess for possible dysphoria-related effects. Results revealed that recall for the nine-digit number did not vary as a function of participants' endorsement of depressive symptoms for any of the experimental tasks ($p > .42$). Taken together with the above findings, participants appeared to be sufficiently engaged in the cognitive load task and their engagement in the task was not influenced by their level of dysphoria.

General Analytic Model

The majority of the analyses discussed below are based on two analytic models and, thus, are described in this section for simplicity's sake. Model 1 was employed for the main analyses comparing the rumination, distraction, and cognitive load conditions across the three experimental tasks. The predictor variables and covariates were held constant for these analyses and they differed chiefly in the dependent variable of interest. For Model 1, two contrast-coded variables were created, one comparing participants in the rumination and cognitive load conditions with those in the distraction condition (Contrast 1; rumination = +.33, distraction = -.67, cognitive load = +.33), and the other examining whether performance differs between the rumination and cognitive load conditions (Contrast 2: rumination = +.50, distraction = 0, cognitive load = -.50). These contrast-coded variables, Contrast 1 and Contrast 2, centered BDI-II scores, the two-way Contrast 1 X BDI-II interaction, and the two-way Contrast 2 X BDI-II interaction were the between-subjects predictors. Emotion (fear vs. anger vs. sadness vs. happiness vs. neutral) was the within-subjects factor. Centered AA scores were included as a covariate.

Model 2 was employed for the exploratory analyses comparing the rumination condition with the neutral rumination condition. Specifically, an effects-coded Condition variable (rumination = +1, neutral rumination = -1), centered BDI-II scores, and the two-way Condition X BDI-II interaction were the between-subjects predictors. Emotion (fear vs. anger vs. sadness vs. happiness vs. neutral) was the within-subjects factor and centered AA scores were included as a covariate.

Accuracy Task Analyses

Correlations. For each condition, correlations were conducted between participants' BDI-II scores and their overall accuracy rate (expressed as a percent) on the accuracy task as well as specific accuracy for each of the five emotions (see Table 11 for correlations between questionnaire scores and indices of accuracy). In general, greater endorsement of depressive symptoms was associated with poorer facial emotion decoding accuracy when participants received either a rumination induction or a

cognitive load but not when they were given a distraction or neutral rumination induction. Interestingly, for participants in the neutral rumination condition, higher levels of depressive symptomatology were associated with *greater* accuracy for angry and sad faces.

Do participants who receive a cognitive load perform similarly to those who receive a rumination induction? To address this question, a mixed-design GLM analysis was conducted examining performance on the accuracy task for the rumination, distraction, and cognitive load conditions. As noted above, Model 1 was utilized for this analysis with percent accuracy on the task as the dependent variable. Results indicated that participants' accuracy differed across the five emotions, $F(4, 123) = 58.13, p < .001$ (see Table 12 for results of the follow-up paired samples t-test). The Contrast 2 main effect was also significant, $F(1, 123) = 7.38, p = .008$, such that participants in the rumination condition were more accurate than those in the cognitive load condition. The main effect of the AA covariate was also significant, $F(1, 123) = 4.19, p = .04$, such that greater anxiety was associated with poorer accuracy. The BDI-II main effect, $F(1, 123) = 4.08, p = .05$, and the Contrast 1 main effect, $F(1, 123) = 8.07, p = .005$, were both significant. However, they were qualified by the two-way BDI-II X Contrast 1 interaction, $F(1, 123) = 7.95, p = .006$. None of the other main effects or interactions were significant ($ps > .10$).

Simple slopes analyses were conducted to interpret the significant BDI-II X Contrast 1 interaction. Specifically, two separate regression analyses were conducted to examine the simple Contrast 1 effect at high and low levels of BDI-II (represented in Figure 8). As participants' accuracy across the five emotions did not differ between the three conditions as a function of level of dysphoria, percent accuracy was collapsed across the different emotions. Participants who endorsed more depressive symptoms were less accurate on this task when given either a rumination induction or a cognition load than when given a distraction induction, $B = -.12, t(126) = -4.31, p < .001$. The Contrast 1 effect was not significant at lower BDI-II levels, $B = -.01, t(126) = -.24, p = .81$.

Participants' reaction times on this task were also examined using a mixed-design GLM. Again, Model 1 was employed for this analysis with participants' mean reaction time as the dependent measure. In general, participants' reaction times across the five emotions differed, $F(4, 123) = 66.88, p < .001$ (see Table 13 for results of the follow-up paired-samples t-test). The BDI-II X Contrast 1 interaction was marginally significant, $F(1, 123) = 3.04, p = .08$. None of the other main effects or interactions was significant ($ps > .16$).

Simple slopes analyses were conducted to examine the BDI-II X Contrast 1 interaction (represented in Figure 9). As with the previous simple slopes analysis, response times across the five emotions were collapsed. Participants who endorsed fewer depressive symptoms exhibited slower response times when they received either a rumination induction or cognitive load than when given a distraction induction, $B = 269.87, t(126) = 2.10, p = .04$. However, the Contrast 1 effect was not significant for those who endorsed greater depressive symptoms, $B = -.71.11, t(126) = -.54, p = .59$.

Do the rumination and neutral rumination inductions have differing effects on participants?

To address this question, a mixed-design GLM analysis was conducted examining performance on the accuracy task for the rumination and neutral rumination conditions. Model 2 was employed for this analysis with percent accuracy as the dependent measure. Again, participants' results across the five emotions differed, $F(4, 82) = 42.36, p < .001$ (see Table 14 for results of the follow-up paired-samples t-test). The main effect of the AA covariate was significant, $F(4, 82) = 5.88, p = .02$, such that greater anxiety was associated with poorer accuracy. The two-way BDI-II X Condition interaction was also significant, $F(4, 82) = 14.82, p < .001$. None of the other main effects or interactions were significant ($ps > .10$).

Simple slopes analyses were conducted to interpret the significant BDI-II X Condition interaction (represented in Figure 10). Again, as participants' accuracy across the five emotions did not differ between the two conditions, percent accuracy was collapsed. Participants who endorsed more

depressive symptoms were less accurate on this task when given a rumination induction than when given a neutral rumination induction, $B = -.04$, $t(82) = -3.03$, $p = .003$. For those who endorsed fewer depressive symptoms, they were *more* accurate when given a rumination induction than when given a neutral rumination induction, $B = .03$, $t(82) = 2.36$, $p = .02$.

Participants' reaction times on this task were also examined using a mixed-design GLM. Again, Model 2 was employed with mean reaction time as the dependent measure. The main effect of Emotion was significant, $F(4, 82) = 35.11$, $p < .001$ (see Table 15 for the results of the follow-up paired-samples t-test). None of the other main effects or interactions were significant ($ps > .14$).

Bias Task Analyses

Correlations. For each condition, correlations were conducted between participants' BDI-II scores and their overall intensity ratings on the bias task as well as specific ratings for the four emotions (see Table 16 for correlations between questionnaire scores and indices of perceived intensity. For the cognitive load condition, greater endorsement of depressive symptoms was marginally associated with greater accuracy for happy faces, $r(40) = .30$, $p = .06$. None of the other correlations were significant ($ps > .21$).

Do participants who receive a cognitive load perform similarly to those who receive a rumination induction? A mixed-design GLM analysis was conducted examining performance on the bias task for the rumination, distraction, and cognitive load conditions. Model 1 was employed for this analysis with participants' emotional intensity ratings as the dependent measure. Results indicated that participants' emotional intensity ratings differed across the four emotions, $F(3, 123) = 55.19$, $p < .001$ (see Table 17 for results of the follow-up paired samples t-test). The Contrast 1 main effect was also significant, $F(1, 123) = 6.22$, $p = .01$, such that participants in the rumination and load conditions exhibited greater emotional intensity ratings than those in the distraction condition. The main effect of the AA covariate

was also significant, $F(1, 123) = 4.63, p = .03$, such that greater anxiety was associated with higher emotional intensity ratings. None of the other main effects or interactions were significant ($ps > .27$).

Participants' response times on this task were also examined using a mixed-design GLM. Again, Model 1 was employed with mean reaction time as the dependent measure. The main effect of Emotion was significant, $F(3, 123) = 20.76, p < .001$ (see Table 18 for the results of the follow-up paired-samples t-test). None of the other main effects or interactions were significant ($ps > .12$) except for the BDI-II X Contrast 1 interaction, $F(1, 123) = 5.68, p = .02$.

The Contrast 1 X BDI-II interaction was examined using simple slopes analyses (represented in Figure 11). As participants' response times across the four emotions did not differ between the three conditions, response times were collapsed across the different emotions. For those endorsing greater depressive symptoms, participants in the rumination or cognitive load condition were quicker to respond than those in the distraction condition, $B = -273.70, t(123) = -2.04, p = .04$. No group differences were observed for those endorsing fewer depressive symptoms, $B = 186.70, t(123) = 1.42, p = .16$.

Do the rumination and neutral rumination inductions have differing effects on participants?

A mixed-design GLM analysis was conducted examining performance on the bias task for the rumination and neutral rumination conditions. Model 2 was used for this analysis with emotional intensity ratings as the dependent measure. Again, participants' emotional intensity ratings differed across the four emotions, $F(3, 82) = 45.38, p < .001$ (see Table 19 for results of the follow-up paired-samples t-test). None of the other main effects or interactions were significant ($ps > .10$).

Participants' reaction times on this task were also examined using a mixed-design GLM. Again, Model 2 was employed with mean reaction time as the dependent measure. The main effect of Emotion was significant, $F(4, 82) = 35.11, p < .001$ (see Table 20 for the results of the follow-up paired-samples t-test). None of the other main effects or interactions were significant ($ps > .14$).

Chimera Task Analyses

Correlations. For each condition, correlations were conducted between participants' BDI-II scores and their overall intensity ratings on the chimera task as well as specific ratings for the four emotions (see Table 21 for correlations between questionnaire scores and indices of perceived intensity). Results indicated that BDI-II scores were not correlated with emotional intensity ratings for the chimera task ($ps > .15$).

Do participants who receive a cognitive load perform similarly to those who receive a rumination induction? A mixed-design GLM analysis was conducted examining performance on the chimera task for the rumination, distraction, and cognitive load conditions. Model 1 was utilized for this analysis with participants' emotional intensity ratings as the dependent measure. Again, participants' intensity ratings varied across the four emotions, $F(3, 123) = 100.24, p < .001$ (see Table 22 for results of the follow-up paired samples t-test). The Contrast 1 main effect was also significant, $F(1, 123) = 5.57, p = .02$, such that participants in the rumination and load conditions tended to rate the stimuli as more emotionally intense than those in the distraction condition. The main effect of the AA covariate was marginally significant, $F(1, 123) = 3.83, p = .05$, such that higher levels of anxiety were associated with greater emotional intensity ratings. None of the other main effects or interactions were significant ($ps > .32$).

Participants' response times on this task were also examined using a mixed-design GLM. Model 1 was employed with mean reaction time as the dependent measure. The main effect of Emotion was significant, $F(3, 123) = 37.43, p < .001$ (see Table 23 for the results of the follow-up paired-samples t-test). None of the other main effects or interactions were significant ($ps > .15$) except for the BDI-II X Contrast 1 interaction, $F(1, 123) = 6.68, p = .01$.

Simple slopes analyses were used to examine the Contrast 1 X BDI-II interaction (represented in Figure 12). As participants' response times across the four emotions did not differ between the three conditions, response times were collapsed across the different emotions. For those endorsing greater

depressive symptoms, participants in the rumination or cognitive load condition were quicker to respond than those in the distraction condition, $B = -326.98$, $t(123) = 6.85$, $p = .01$. No group differences were observed for those endorsing fewer depressive symptoms, $B = 143.41$, $t(123) = 1.17$, $p = .24$.

Do the rumination and neutral rumination inductions have differing effects on participants?

To address this question, a mixed-design GLM analysis was conducted examining performance on the chimera task for the rumination and neutral rumination conditions. Model 2 was employed with participants' emotional intensity ratings as the dependent measure. Once again, participants' emotional intensity ratings differed across the four emotions, $F(3, 82) = 77.03$, $p < .001$ (see Table 24 for results of the follow-up paired-samples t-test). None of the other main effects or interactions were significant ($ps > .19$).

Participants' reaction times on this task were examined using a mixed-design GLM. Again, Model 2 was used for this analysis with mean reaction time as the dependent measure. The main effect of Emotion was significant, $F(3, 82) = 53.44$, $p < .001$ (see Table 25 for the results of the follow-up paired-samples t-test). The Condition main effect was marginally significant, $F(1, 82) = 3.70$, $p = .06$, such that participants in the rumination condition were quicker to respond than those in the load condition. The main effect of the anxiety covariate was also marginally significant, $F(1, 82) = 2.98$, $p = .09$, such that higher levels of anxiety were associated with faster response times. None of the other main effects or interactions were significant ($ps > .14$).

Discussion

The main goals of this study were to replicate findings from Study 1 and to examine a possible mechanism by which rumination affects facial emotion recognition. Briefly, results from Study 1 indicated that participants endorsing greater levels of dysphoria were less accurate on a facial expression identification task when they received a rumination induction but not when they received a distraction induction. Accuracy of participants who reported fewer depressive symptoms was not

affected by the type of induction given. Findings from Study 2 were consistent with these results. Specifically, both correlation and regression analyses provided evidence in support of the aforementioned relationship between dysphoria, rumination, and emotion recognition accuracy. As with Study 1, poorer accuracy by dysphoric participants who received a rumination induction was not attributable to a faster pace of responding (which, presumably, would be associated with a more reckless style of responding).

To a lesser degree, results from Study 1 provided some evidence to support the hypothesis that the combined influence of dysphoria and induced rumination would translate into greater perceived negativity of emotional facial expressions. However, the positive correlation between endorsement of depressive symptoms and perceived intensity of anger and fear for participants who received a rumination induction was not replicated in Study 2. Similarly, the interaction between dysphoria and induction received for the chimera task, which suggested that dysphoric participants perceived more emotional intensity when asked to ruminate while non-dysphoric participants tended to perceive less emotional intensity when asked to ruminate, was not found in Study 2. Taken together, greater confidence can be placed in results regarding accuracy of emotion recognition than in those for biased emotional perception.

Rumination appears to negatively impact accuracy of facial emotion recognition in dysphoric individuals, but how does the ruminative process exert its pernicious influence? I hypothesized that the mechanism underlying this relationship is the load that rumination places on cognitive resources. To test this hypothesis, Study 2 included a condition which employed the use of a cognitive load (i.e., rehearsing a 9-digit number over the course of the task). Correlational analyses revealed a negative relationship between level of dysphoria and emotion recognition accuracy for both the rumination and cognitive load conditions but not the distraction condition. Furthermore, subsequent analyses indicated that participants reporting greater depressive symptoms were less accurate when they received a rumination

induction or cognitive load in contrast to those who received a distraction induction. Accuracy of participants reporting fewer depressive symptoms was not affected by the type of induction (or cognitive load) that they received. This interaction is coupled with the finding that the performance of participants in the rumination and cognitive load conditions did not differ significantly from each other. These results are consistent with the rumination-as-cognitive-load hypothesis. Interestingly, response time analyses indicate that non-dysphoric participants took longer to respond in the rumination and cognitive load conditions compared to the distraction condition. No difference in response times across conditions was observed for the dysphoric participants. One interpretation of this finding is that non-dysphoric participants may be compensating for the increased demand on cognitive resources whereas dysphoric participants are not using extra time to process the information before making a judgment. However, it is important to note that this finding was not demonstrated in Study 1 (which found that dysphoric participants were slower to respond regardless of the condition) and, therefore, should be interpreted with some caution.

Although the results support the claim that the ruminative process has a deleterious effect on mental resources of dysphoric individuals, it is important to consider the alternative possibility that the effects of rumination on cognitive processing are due to the associated negative mood. Indeed, rumination can serve to exacerbate and prolong a negative mood state (see Thomsen, 2006). In effect, rumination can act similarly to a negative mood induction in that it merely results in negative content being more salient for dysphoric individuals (Tse & Bond, 2004). By definition, dysphoric rumination is a process of inward focus on one's mood and the causes and consequences of it. This process should prime individuals to be more attentive to additional negative content. Indeed, widely used negative mood induction procedures employ negative thoughts to achieve the desired effect or at least enhance it. For example, participants may be asked to repeat negative self-referent statements (e.g., "I feel listless"; Velten, 1968) or recall an upsetting memory while listening to slow, sad music (e.g., Fresco,

Heimberg, Abramowitz, & Bertram, 2006; Segal, Gemar, & Williams, 1999). In effect, these procedures, especially the Velten mood induction procedure (VMIP), are similar to the ruminative process and previous studies have demonstrated that depressed participants' cognitive processes are more negatively biased after receiving a negative VMIP (e.g., Teasdale & Fogarty, 1979). The idea that one's negative thoughts can result in a cascade of additional negative thoughts is central to cognitive theories of depression (e.g., Beck, 1967; Ingram, 1984; Teasdale, 1983).

Of relevance to this question, an important feature of the cognitive load task employed in this study was its emotional neutrality. Specifically, the digit-memorization task kept participants cognitively busy without employing negative content. Thus, this cognitive load task mimics the ruminative process while removing the potential priming influence of cycling through negative thoughts. It bears repeating that since the emotion recognition accuracy of dysphoric participants who received a rumination induction was similar to those who received a cognitive load, the results of this study support the hypothesis that cognitive load serves as an underlying mechanism of rumination. On the other hand, comparisons between the original rumination induction and the neutral rumination induction may suggest that cognitive load might not be the only mechanism. Briefly, the statements employed in the original rumination induction were revised so as to minimize any negative connotations to form the neutral rumination induction. Results from Study 2 indicated that participants did not perform comparably in the two conditions. Specifically, dysphoric participants were less accurate when they received the rumination induction which raises the possibility that negative affect also plays a role in the relationship between dysphoria and poorer emotion recognition accuracy. Perhaps by de-emphasizing negative aspects of self-focused thinking, the neutral rumination induction may have induced a more adaptive form of self-reflection. Indeed, researchers have found that focusing on positive self-content (e.g., Mor & Winquist, 2002) or employing a more concrete, experiential form of rumination (Watkins, 2008) are strategies associated with positive outcomes. In the present study, for the neutral rumination

condition, greater endorsement of depressive symptoms was associated with *greater* accuracy for certain emotions (i.e., anger & sadness). While this hypothesis remains a viable and interesting one, it is important to not overstate these findings. The original rumination induction has been employed extensively whereas further work needs to be done to validate the neutral rumination induction. As noted previously, analyses involving the neutral rumination condition were exploratory in nature.

As in Study 1, participants' performance across the emotions did not differ as a function of their level of dysphoria in Study 2. However, more general differences in emotion perception were observed. Again, the most consistent finding was that happiness was typically perceived differently than the other emotions (fear, anger, sadness), even neutral. Happiness was identified more accurately and perceived as less intense. Participants also responded to happy items more quickly. Again, these findings are likely attributable to the fact that happiness was the only positive-valence emotion. Differences were observed between the other emotions, but they were not as consistent or prominent.

In summary, results from both studies suggest that induced rumination is associated with decreased emotion recognition accuracy, but only for participants reporting greater depressive symptoms. Furthermore, the current study provided evidence to support the claim that cognitive load is an important mechanism that may underlie the effects of rumination on dysphoric individuals. Dysphoric participants' poorer accuracy when under the influence of rumination or cognitive load does not appear to be attributable to their pace of responding. Furthermore, dysphoric and/or ruminative effects on perceived intensity of facial emotions were less robust than findings for accuracy. Finally, exploratory analyses suggested a possible role for negative affect in addition to cognitive load, but further studies are required to strengthen this hypothesis.

General Discussion

According to Nolen-Hoeksema's (1987) responses styles theory, rumination is conceptualized as an emotion regulation strategy which involves a repetitive analysis aimed at gaining a better understanding of one's depressed mood. On the surface, such a strategy would appear to be consonant with cognitive therapies and, therefore, be associated with positive outcomes. On the contrary, rumination appears to have an unintended, paradoxical effect. For example, individuals who respond to their dysphoria by dwelling on and trying to understand their low mood state have been shown to be more pessimistic or negative in their outlook compared to their counterparts who respond with distraction (e.g., Lyubomirsky & Nolen-Hoeksema, 1995; Lyubomirsky et al., 1999; Spasojevic & Alloy, 2001). Joorman and colleagues (2006), using a dot probe task, found that depressed participants who reported a greater tendency to brood (i.e., ruminate) exhibited an attentional bias for sad faces. Rumination has also been shown to be associated with greater recall of negative autobiographical memories in dysphoric participants (Lyubomirsky et al., 1998). Rather than being a beneficial strategy to regulate one's mood, rumination appears to play an important role in the development and course of depressive symptoms in part through its influence on cognitive processes.

The present investigation focused on one particular cognitive process that has been closely linked with a depressed mood state, namely, emotion recognition. Briefly, for the most part, previous studies have found evidence to support either a general impairment (e.g., Asthana et al., 1998; Rubinow & Post, 1992) or negative bias (e.g., Bouhuys et al., 1999; Bouhuys et al., 1997; Gur et al., 1992; Hale, 1998) in depressed participants. While there is disagreement about the exact nature of the relationship between emotion recognition and depression, the bulk of the literature supports the conclusion that this cognitive process is influenced by a depressive state. What is less clear, however, is how depression/dysphoria exerts its influence on emotion recognition. The possibility of rumination as a process underlying this association was examined in the current set of studies. Indeed, researchers have

demonstrated rumination's role as a mediator between certain risk factors and the eventual development of depressive symptoms (Spasojevic & Alloy, 2001).

Although there has been considerable research on both emotion recognition and rumination and their link to depressive symptoms, the relationship between these two variables has not been extensively studied. In fact, to the best of my knowledge, only one study has examined the links between depression, rumination, and emotion recognition. Briefly, in a sample of depressed patients, the researchers found that greater levels of rumination were associated with more pronounced negative biases in judgments of facial expression (Raes et al., 2006). Their findings suggest that rumination may, indeed, be the mechanism by which depression impacts this particular cognitive process. However, certain design elements of their study serve to limit their results. First, by relying on participants' self-reported ruminative tendencies, their findings do not address the question of causality or directionality. Second, the stimuli used in their study were simplistic line drawings which inherently lack realism and do not capture the subtle nuances of human faces. Third, Raes and colleagues did not include a control group in their study.

One of the main goals of the present investigation was to build on the results of Raes and colleagues' study by addressing the aforementioned limitations. Specifically, the present set of studies (1) employed an induction methodology to empirically test the effects of rumination versus distraction (as opposed to relying on self-reported tendencies to ruminate); (2) used stimuli that are more ecologically valid and developed according to a rigorous and well-established protocol; and (3) included participants reporting a range of depressive symptoms (including those who endorse few symptoms). These study design elements allowed for a stronger test of the relationships between depressed mood, rumination, and facial emotion recognition. In Study 1, I found that greater endorsement of depressive symptoms was associated with poorer accuracy in identifying the emotion portrayed in facial expressions, but only when participants received a rumination induction. No such relationship was

exhibited for either dysphoric participants who received a distraction induction or participants with fewer depressive symptoms (regardless of the induction). This finding was replicated in Study 2 and provides evidence to support the specificity of the relationship between dysphoria, emotion recognition, and rumination. That is, previous studies examining the effect of rumination on various cognitive processes have resulted in mixed findings. Some researchers have found that rumination influences performance in an unselected (i.e., participants were not specifically targeted based on their level of dysphoria) sample (e.g., Morrow & Nolen-Hoeksema, 1990; Trask & Sigmon, 1999) which would suggest that rumination, rather than dysphoria, is the key factor. However, others have found that the ruminative process only impacted the performance of dysphoric participants (e.g., Lyubomirsky et al., 1998; Lyubomirsky et al., 2003; Lyubomirsky & Nolen-Hoeksema, 1995) which would suggest that the presence of both variables are required to elicit the effect in question. The results of the present study are consistent with the latter camp.

While the results of these aforementioned studies may appear to be incongruent, a closer look at their aims and results reveal a more nuanced picture. That is, studies involving unselected samples typically involved one of two approaches. One of the approaches was investigating the effects of rumination on changes in mood (e.g., Morrow & Nolen-Hoeksema, 1990; Trask & Sigmon, 1999). Broadly, these researchers demonstrated that rumination can maintain a negative mood state whereas distraction can improve it (although a review by Thomsen, 2006, concluded that rumination may also exacerbate a negative mood state). The other approach involved examining ruminative tendencies as a mediator between risk factors and depressive symptoms. For example, Weinstock and Whisman (2007) found that rumination mediated the relationship between reassurance-seeking and depressive symptoms. Similarly, Spasojevic and Alloy (2001) found that rumination mediated links between various vulnerability factors (e.g., negative cognitive style, self-criticism, and neediness) and eventual development of a depressive episode. Although these findings certainly highlight the importance of

ruminative effects, they do not speak towards possible reciprocal (i.e., the effects of dysphoria on ruminative tendencies) or synergistic effects. They also do not examine rumination's effect on specific cognitive processes.

Studies investigating rumination in selected samples (either sub-threshold dysphoric or clinically depressed participants) are typically interested in examining the effects of rumination on factors other than mood. Specifically, researchers have demonstrated that rumination is associated with cognitive (e.g., autobiographical memory; Sutherland & Bryant, 2007) and behavioural (e.g., support-seeking; Nolen-Hoeksema & Davis, 1999) effects in those experiencing depressed mood. Taken together with results from non-selected samples, a clearer picture begins to emerge in which rumination maintains or exacerbates depressed mood (either experimentally induced or naturally occurring) and, when both factors are present, additional processes which have been shown to exacerbate the depressive state or increase vulnerability for a relapse are set into motion.

In Study 2, using a cognitive load manipulation, I investigated the hypothesis that rumination impacts emotion recognition by taxing cognitive resources. Previous studies have provided evidence to suggest that rumination is an effortful process which slows down processing of other tasks (e.g., Lyubomirsky et al., 2003). Furthermore, while emotion recognition appears to be a relatively automatic process, Tracy and Robins (2008) demonstrated that it is not wholly automatic and, therefore, is vulnerable to disruption. Results from this study suggested that, in terms of emotion recognition accuracy, participants' performance in the rumination and cognitive load conditions closely mirrored one another. That is, analyses revealed that accuracy of dysphoric participants did not differ between the rumination and cognitive load conditions and, collectively, they were less accurate than their counterparts in the distraction condition. These findings are consistent with the rumination-as-cognitive-load hypothesis.

As discussed previously, an alternative explanation would be that rumination, which involves an inward focus on negative content, acts as a sad mood induction and, instead, this mood induction is the key mechanism underlying ruminative effects. On the one hand, the aforementioned results are not supportive of this hypothesis as the cognitive load employed in Study 2 was neutral in valence. On the other hand, findings from an exploratory condition hint at a possible role of induced negative affect. Specifically, a new type of rumination induction (neutral rumination) was developed for this study in which the induction statements were denuded of negative connotations and allusions. Analyses comparing performance in the neutral rumination condition to the original rumination condition indicated that dysphoric participants in the former were more accurate than those in the latter. While this result is suggestive of a role for induced negative affect, it is important to note that the neutral rumination induction needs to be further studied before firmer conclusions can be drawn.

The possible role of induced negative affect is also intriguing because it could help explain why rumination impacts dysphoric but not euthymic individuals. By definition, rumination involves an inward focus. Therefore, dysphoric individuals would focus on content associated with their low mood whereas euthymic individuals would, presumably, focus on material of a less negative nature. As a result, only those focusing on negative content would be induced to feel sad or depressed. A corollary question, one more relevant to the present study, is how the rumination-as-cognitive-load hypothesis addresses this issue. Again, returning to the definition of rumination is informative. Rumination is defined as an inward focus on the possible causes and consequences of one's negative mood state. Therefore, euthymic individuals, presumably, have relatively less material with which to ruminate compared to those experiencing dysphoria. Employing a broader definition of rumination to capture an inward focus on one's current mood state, regardless of valence, can also be informative. Existing research suggests that content is more easily recalled when it is emotional rather than neutral (see review by Buchanan & Adolphs, 2002). Furthermore, although results have been somewhat mixed, some studies suggest that

negative material is more memorable than positive material (e.g., Charles, Mather, & Carstensen, 2003; Ortony, Turner, & Antos, 1983). Also, negative memories tend to be remembered as more vivid than positive ones (e.g., Dewhurst & Parry, 2000; Ochsner, 2000). As such, an individual who has more salient and readily accessible negative content to process would be more at risk of falling into a ruminative cycle than one who has more neutral and positive thoughts on their mind. This effect would be further exacerbated by the fact that depressed individuals are even more likely to display a negative recall bias (Matt, Vazquez, & Campbell, 1992). Dysphoric individuals' greater susceptibility to engaging in rumination is coupled with greater reliance on depressive schematic processing when cognitive resources are strained by their self-focused attention (Flory, Raikkonen, Matthews, & Owens, 2000). For euthymic individuals, it follows that having fewer salient and accessible negative thoughts would translate to a lesser strain on cognitive resources.

The main finding that the specific combination of dysphoria and induced rumination was associated with poorer accuracy in identifying facial expressions (in comparison to dysphoria and induced distraction or non-dysphoria and either induction) also has implications for the emotion recognition literature. As noted previously, results from existing studies which examined the relationship between depression/dysphoria and emotion recognition have been mixed. The results of the current study are more in line with those that have found a general (i.e., not emotion-specific or mood-congruent) impairment of facial emotion recognition in depressed or dysphoric participants (e.g., Asthana et al., 1998; Rubinow & Post, 1992) rather than those that support a negative bias (e.g., Bouhuys et al., 1999; Bouhuys et al., 1997; Gur et al., 1992; Hale, 1998). Of course, in the present study, dysphoria in isolation was not sufficient to elicit poorer accuracy. Instead, it was at the intersection of higher levels of depressive symptoms and induced rumination that poorer emotion recognition accuracy was observed. This finding is consistent with past studies which have found that rumination mediated the relationship between depressive symptoms and interpersonal risk factors (e.g., Spasojevic & Alloy,

2001; Weinstock & Whisman, 2007) and cognitive impairments (e.g., Lyubomirsky et al., 1998; Lyubomirsky et al., 2003; Sutherland & Bryant, 2007). Furthermore, Raes and colleagues (2006) did not find a direct relationship between depressive symptoms and negatively biased ratings of facial expressions in their sample of depressed patients, but, instead, demonstrated a positive association between trait rumination and negative ratings. Moving forward, future studies which examine synergistic influences of depressive symptoms and rumination, rather than individual effects, on cognitive functioning may help to clarify past disparate findings.

Although the present study demonstrated a link between dysphoria and impaired identification of emotional facial expressions, a similar relationship for biased emotion recognition was not firmly established. Certain findings from the bias and chimera tasks from Study 1 supported the hypothesis that dysphoric ruminators would perceive emotional facial expressions more negatively, but these results were not replicated in Study 2. Furthermore, as discussed previously, negative bias can be defined not only as perceiving greater negativity, but also as greater accuracy for negative stimuli. Employing this definition, results from the Accuracy task also did not support a negative bias. Therefore, the present study was not able to provide strong evidence of a negative emotion recognition bias in dysphoric individuals. This result differs from past studies that have demonstrated such a negative bias. Briefly, these studies found that a negative bias in depressed patients was associated with greater severity and poorer outcomes especially if the stimuli were made to look less straightforward (e.g., Bouhuys et al., 1999; Hale, 1998; Hale et al., 1998). Of course, as discussed previously, problems with respect to the realism of the stimuli serve to limit conclusions drawn from these results. Some past studies have also found evidence for emotion-specific biases (e.g., Gur et al., 1992; Joorman & Gotlib, 2006; Kan et al., 2004; Mendlewicz et al., 2005), but they have largely been inconsistent. Therefore, the existing evidence does not strongly favour the idea of negatively biased emotion identification (as opposed to generally impaired emotion identification).

Limitations of the Present Study

Tennen, Hall, and Affleck (1995) noted that the terms *depression*, *syndromal depression*, *dysphoria*, and *major depression* are often used interchangeably or without key distinctions made between them. In the present investigation, the term “dysphoria” was used to denote individuals experiencing subclinical levels of depression, not people who are clinically depressed. The appropriate term was also employed when reviewing past studies. Still, these results do not directly speak toward emotion recognition abilities and ruminative effects for clinically depressed individuals. However, as mentioned previously, a great number of dysphoric individuals go on to develop full-blown depression (Fergusson et al., 2005), and thus, investigations using this population are of practical, as well as theoretical, value.

The current set of studies involved stimuli that were not employed in previous research. Instead, the photographs that were used were developed specifically for this investigation. Of course, when novel stimuli are utilized, the question of validity is rightfully raised. For example, are the results simply attributable to artifacts or quirks of the photographs? Do the photographs portray the emotion that was intended? To address questions of validity, certain steps were taken. First, the stimuli were developed according to the gold standard criteria developed by Ekman and Friesen (1978). Second, two trained coders reviewed the stimuli in order to ensure their fidelity to the criteria. Therefore, greater confidence can be placed in the veracity of the stimuli.

Directions for Future Research

In the present investigation, one of the main findings was that dysphoric participants who were presented with a cognitive load performed similarly to their counterparts who were induced to ruminate which suggest that depletion of mental resources is likely a key factor in explaining how rumination influences emotion recognition. While the finding that rumination only affects the performance of dysphoric participants is consistent with previous studies, it is interesting that cognitive load appeared

to hinder the accuracy of dysphoric but not control participants. Response time analyses suggest that this result may be due to non-dysphoric participants compensating for the increased strain on resources by taking greater time to respond. The possibility that dysphoric individuals are less adept at adapting to the demands of the environment is an intriguing one and deserves further investigation. For example, future studies could examine whether explicitly instructing dysphoric participants under cognitive load to take more time to respond would improve their accuracy rates.

Another interesting direction for future research would be to examine alternative coping strategies to distraction. Theoretically, distraction disrupts the ruminative cycle which, in turn, reduces the amount of cognitive load. From a therapeutic standpoint, this strategy is beneficial in the short-term as it allows for a potential boost to one's mood as well as the opportunity to return to problem with greater cognitive resources and, perhaps, a fresh perspective. Recently, researchers have begun to turn their attention to exploring alternative methods to disrupting rumination such as mindfulness-based approaches (e.g., Broderick, 2005; Jain et al., 2007; Watkins & Teasdale, 2001) and distanced-recall of painful memories (e.g., Kross, Ayduk, & Mischel, 2005). These approaches may seem paradoxical as the former encourages greater awareness of one's cognitions and the latter specifically involves recalling details of negative memories. Similarly, the most prevalent form of therapy at present, cognitive behavioural therapy, also involves fostering greater attention to and awareness of negative cognitions. However, Nolen-Hoeksema, Wisco, and Lyubomirsky (2008) noted that these interventions may be effective counters to rumination because they provide an explanation as to why one is feeling down and depressed and strategies to challenge or reduce the emotional intensity of negative memories and cognitions. Therefore, the current line of research can be expanded by examining whether these alternative counters to rumination would also have the desired effect of improving emotion recognition accuracy.

Future studies can also further dissect the process of rumination. The present study examined a mechanism, cognitive load, by which rumination influences other cognitive processes. While cognitive load certainly appears to play an important role in the relationship between dysphoria and emotion recognition, other factors may be present as well. For example, as discussed at greater length above, follow-up studies can investigate the possible contributory role of induced negative affect. A similar, complementary direction would be to examine cognitive processes that underlie the process of rumination. A defining characteristic of rumination is its persistence. As such, deficits in executive functioning may be associated with tendencies toward rumination. For example, studies have demonstrated impairments in inhibitory control in both depressed participants (Langenecker, Bieliauskas, Rappport, Zubieta, Wilde, & Berent, 2005) and trait ruminators (Davis & Nolen-Hoeksema, 2000).

Finally, additional research should also focus addressing issues of generalizability. Indeed, a follow-up study can examine whether the results of the present study are applicable to a clinically depressed sample. Additional studies can also investigate the effects of dysphoria and rumination on other types of emotional stimuli. The present study employed pictures of real people displaying various emotional facial expressions. While the stimuli used in this study represented an upgrade in terms of ecological validity over the schematic line drawings used in some past studies in this line of research, they are, nonetheless, static in nature. Therefore, future studies can investigate dysphoric ruminators' performance on a task that employs dynamic stimuli that more closely resembles real-life social interactions.

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Appendix A

Rumination Induction

Instructions

For the next few minutes, try your best to focus your attention on each of the ideas on the following pages. Read each item slowly and silently to yourself. As you read the items, use your imagination and concentration to focus your mind on each of the ideas. Spend a few moments visualizing and concentrating on each item. Please continue until the experimenter returns.

Think about the physical sensations you feel in your body

Think about your character and who you strive to be

Think about the degree of clarity in your thinking right now

Think about why you react the way you do

Think about the way you feel inside

Think about the possible consequences of your current mental state

Think about how similar/different you are relative to other people

Think about what it would be like if your present feelings lasted

Think about why things turn out the way they do

Think about trying to understand your feelings

Think about how awake/tired you feel now

Think about the amount of tension in your muscles

Think about whether you are fulfilled

Think about your physical appearance

Think about whether you feel stressed right now

Think about the long-term goals you have set

Think about the amount of certainty you feel

Think about your present feelings of fatigue/energy

Think about possible explanations for your physical sensations

Think about how hopeful/hopeless you are feeling

Think about the level of motivation you feel right now

Think about the degree of helplessness you feel

Think about the degree of calmness/restlessness you feel

Think about the possible consequences of the way you feel

Think about what your feelings might mean

Think about how sad/happy you are feeling

Think about the expectations your family has for you

Think about why your body feels this way

Think about why you get this way sometimes

Think about how passive/active you feel

Think about what people notice about your personality

Think about the kind of student you are and wish you were

Think about how weak/strong your body feels now

Think about the degree of relaxation/agitation you feel

Think about the kind of person you think you should be

Think about the degree of control you feel right now

Think about what would happen if your current physical state lasted

Think about sitting down and analyzing your personality

Think about why you turned out this way

Think about the things that are most important in your life

Think about how quick/slow your thinking is right now

Think about the degree of decisiveness you feel

Think about trying to understand who you are

Think about how you feel about your friendships

Think about whether you have accomplished a lot so far

Appendix B

Distraction Induction

Instructions

For the next few minutes, try your best to focus your attention on each of the ideas on the following pages. Read each item slowly and silently to yourself. As you read the items, use your imagination and concentration to focus your mind on each of the ideas. Spend a few moments visualizing and concentrating on each item. Please continue until the experimenter returns.

Think about and imagine a boat slowly crossing the Atlantic

Think about the layout of a typical classroom

Think about the shape of a large black umbrella

Think about the movement of an electric fan on a warm day

Think about raindrops sliding down a windowpane

Think about a double-decker bus driving down a street

Think about and picture a full moon on a clear night

Think about clouds forming in the sky

Think about the layout of the local shopping center

Think about and imagine a plane flying overhead

Think about fire darting around a log in a fire-place

Think about and concentrate on the expression on the face of the Mona Lisa

Think about a clown putting on his or her make-up

Think about two birds sitting on a tree branch

Think about the shadow of a stop sign

Think about the layout of the local post office

Think about the structure of a high-rise office building

Think about and picture the Eiffel Tower

Think about and imagine a truckload of watermelons

Think about the pattern on an Oriental rug

Think about the "man in the moon"

Think about the shape of the continent of Africa

Think about a band playing outside

Think about a group of polar bears fishing in a stream

Think about the shape of the torch on the Statue of Liberty

Think about the shape of the state of Michigan

Think about the way the ocean looks at sunset

Think about the layout of the Diag

Think about a train stopped at a station

Think about a lone cactus in the desert

Think about the shape of the country of Italy

Think about a row of shampoo bottles on display

Think about a gas station on the side of a highway

Think about the fuzz on the shell of a coconut

Think about the Presidents' faces on Mount Rushmore

Think about and picture Mickey Mouse's face

Think about a band playing "The Star Spangled Banner"

Think about the shape of a cello

Think about the layout of a computer keyboard

Think about the shape of the United States

Think about the baggage claim area at the airport

Think about the shape of a tuba

Think about the shape of a baseball glove

Think about a freshly painted door

Think about the shiny surface of a trumpet

Appendix C

Neutral Rumination Induction – Revised Statements

Original Phrase	Revised Phrase
Why your body feels this way	The way your body feels
The amount of tension in your muscles	The way your muscles feel
Whether you feel stressed right now	Whether you feel stressed or at ease right now
The possible consequences of the way you feel	The possible outcomes of the way you feel
The possible consequences of your current mental state	The possible outcomes of your current mental state
The kind of person you think you should be	The kind of person you want to be
Why you react the way you do	The way you tend to react
Why things turn out the way they do	The way things tend to turn out
Why you turned out this way	Where you are in your life and how you got there
Why you get this way sometimes	The things that contribute to the way you're feeling now

Table 1

Study 1: Correlations between questionnaire (BDI-II, AA) scores and indices of accuracy for rumination and distraction conditions.

	Rumination		Distraction	
	BDI-II	AA	BDI-II	AA
Anger	-.40**	-.38**	-.01	-.03
Fear	-.50**	-.44**	.03	.05
Sadness	-.41**	-.41**	.03	.00
Happiness	-.32*	-.23	.14	-.04
Neutral	-.22	-.25	-.12	.00
Overall	-.50**	-.48**	.00	.00

* $p < .05$, ** $p < .01$

Table 2

Study 1: Means and standard deviations of accuracy across emotions for accuracy task stimuli.

Anger		Fear		Sadness		Happiness		Neutral	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
.78 _a	.12	.87 _b	.11	.88 _b	.10	.93 _c	.07	.78 _a	.15

Note. Means that do not share subscripts are significant at $p < .05$.

Table 3

Study 1: Means and standard deviations of reaction times (ms) across emotions for accuracy task stimuli.

Anger		Fear		Sadness		Happiness		Neutral	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1704.50 _a	369.54	1613.05 _b	434.94	1561.97 _b	416.30	1246.29 _c	271.07	1664.39 _{ab}	410.54

Note. Means that do not share subscripts are significant at $p < .05$.

Table 4

Study 1: Correlations between questionnaire (BDI-II, AA) scores and indices of perceived intensity (Bias Task) for rumination and distraction conditions.

	Rumination		Distraction	
	BDI-II	AA	BDI-II	AA
Anger	.32*	.25	.12	.24
Fear	.27	.28	.15	.32*
Sadness	.10	.08	.08	.21
Happiness	.15	.28	.04	.14
Overall	.26	.26	.12	.27

* $p < .05$, ** $p < .01$

Table 5

Study 1: Means and standard deviations of emotional intensity ratings across emotions for bias task stimuli.

Anger		Fear		Sadness		Happiness	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
121.45 _a	22.25	123.36 _{ab}	21.93	125.98 _b	20.51	105.24 _c	13.73

Note. Means that do not share subscripts are significant at $p < .05$.

Table 6

Study 1: Means and standard deviations of reaction times (ms) across emotions for bias task stimuli.

Anger		Fear		Sadness		Happiness	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1459.13 _a	505.48	1554.82 _b	562.01	1514.53 _b	485.77	1315.77 _c	432.66

Note. Means that do not share subscripts are significant at $p < .05$.

Table 7

Study 1: Correlations between questionnaire (BDI-II, AA) scores and indices of perceived intensity (Chimera Task) for rumination and distraction conditions.

	Rumination		Distraction	
	BDI-II	AA	BDI-II	AA
Anger	.42**	.38*	.08	.22
Fear	.38**	.34*	.12	.28
Sadness	.15	.08	.04	.20
Happiness	.36*	.38*	.09	.30*
Overall	.41**	.36*	.10	.29

* $p < .05$, ** $p < .01$

Table 8

Study 1: Means and standard deviations of emotional intensity ratings across emotions for chimera task stimuli.

Anger		Fear		Sadness		Happiness	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
161.91 _a	29.31	156.07 _b	31.94	169.11 _c	27.41	126.61 _d	22.41

Note. Means that do not share subscripts are significant at $p < .05$.

Table 9

Study 1: Means and standard deviations of reaction times (ms) across emotions for chimera task stimuli.

Anger		Fear		Sadness		Happiness	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1525.86 _a	525.19	1533.19 _a	490.94	1533.86 _a	505.68	1325.12 _b	431.86

Note. Means that do not share subscripts are significant at $p < .05$.

Table 10

Study 2: Means and standard deviations of participants' responses on the BDI-II and AA across the four conditions.

	BDI-II		AA	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Rumination	12.98	7.27	30.44	10.43
Distraction	12.56	7.20	25.70	7.43
Cognitive Load	13.55	7.82	30.24	10.63
Neutral Rumination	12.69	7.71	31.43	10.32

Table 11

Study 2: Correlations between questionnaire (BDI-II, AA) scores and indices of accuracy for each condition.

	Rumination		Distraction		Cognitive Load		Neutral Rumination	
	BDI-II	AA	BDI-II	AA	BDI-II	AA	BDI-II	AA
Anger	-.23	-.23	.15	.03	-.44**	-.40**	.41**	-.05
Fear	-.38**	-.28	.28	.16	-.27	-.27	.12	-.27
Sadness	-.16	-.26	.02	-.13	-.29	-.27	.37*	-.08
Happiness	-.50**	-.24	.07	-.15	-.32*	-.33*	.19	-.13
Neutral	-.44**	-.24	-.05	-.27	-.16	-.03	.05	-.13
Overall	-.52**	-.37*	.12	-.10	-.35*	-.31*	.28	-.16

* $p < .05$, ** $p < .01$

Table 12

Study 2: Means and standard deviations of accuracy across emotions for accuracy task stimuli.

Anger		Fear		Sadness		Happiness		Neutral	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
.75 _a	.15	.84 _b	.13	.85 _b	.14	.92 _c	.11	.76 _a	.17

Note. Means that do not share subscripts are significant at $p < .05$.

Table 13

Study 2: Means and standard deviations of reaction times (ms) across emotions for accuracy task stimuli.

Anger		Fear		Sadness		Happiness		Neutral	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1781.51 _a	523.84	1676.41 _b	510.32	1569.52 _c	405.96	1301.75 _d	674.49	1730.86 _{ab}	570.58

Note. Means that do not share subscripts are significant at $p < .05$.

Table 14

Study 2: Means and standard deviations of accuracy across emotions for accuracy task stimuli.

Anger		Fear		Sadness		Happiness		Neutral	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
.78 _a	.14	.85 _b	.12	.87 _c	.11	.93 _d	.08	.76 _a	.16

Note. Means that do not share subscripts are significant at $p < .05$.

Table 15

Study 2: Means and standard deviations of reaction times (ms) across emotions for accuracy task stimuli.

Anger		Fear		Sadness		Happiness		Neutral	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1817.13 _a	560.75	1728.53 _b	592.30	1640.59 _c	448.12	1355.74 _d	788.99	1820.78 _a	668.95

Note. Means that do not share subscripts are significant at $p < .05$.

Table 16

Study 2: Correlations between questionnaire (BDI-II, AA) scores and indices of perceived intensity (Bias Task) for each condition.

	Rumination		Distraction		Cognitive Load		Neutral Rumination	
	BDI-II	AA	BDI-II	AA	BDI-II	AA	BDI-II	AA
Anger	-.06	.05	-.13	.01	.05	.20	.04	.11
Fear	.00	.15	-.20	-.08	.02	.28	.04	.22
Sadness	-.04	.03	-.14	.01	.07	.26	.09	.14
Happiness	.15	.33*	-.16	-.21	.30	.39*	.18	.32*
Overall	.00	.15	-.19	-.07	.11	.32*	.09	.22

* $p < .05$, ** $p < .01$

Table 17

Study 2: Means and standard deviations of emotional intensity ratings across emotions for bias task stimuli.

Anger		Fear		Sadness		Happiness	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
119.82 _a	22.27	120.03 _a	21.37	123.22 _b	22.09	104.46 _c	15.18

Note. Means that do not share subscripts are significant at $p < .05$.

Table 18

Study 2: Means and standard deviations of reaction times (ms) across emotions for bias task stimuli.

Anger		Fear		Sadness		Happiness	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1492.92 _a	559.94	1550.14 _b	561.07	1516.50 _{ab}	518.53	1354.62 _c	513.15

Note. Means that do not share subscripts are significant at $p < .05$.

Table 19

Study 2: Means and standard deviations of emotional intensity ratings across emotions for bias task stimuli.

Anger		Fear		Sadness		Happiness	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
122.20 _a	20.57	123.62 _{ab}	22.48	125.61 _b	20.99	105.63 _c	13.89

Note. Means that do not share subscripts are significant at $p < .05$.

Table 20

Study 2: Means and standard deviations of reaction times (ms) across emotions for bias task stimuli.

Anger		Fear		Sadness		Happiness	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1488.01 _a	491.58	1581.14 _b	555.39	1553.62 _b	501.43	1366.54 _c	440.66

Note. Means that do not share subscripts are significant at $p < .05$.

Table 21

Study 2: Correlations between questionnaire (BDI-II, AA) scores and indices of perceived intensity (Chimera Task) for each condition.

	Rumination		Distraction		Cognitive Load		Neutral Rumination	
	BDI-II	AA	BDI-II	AA	BDI-II	AA	BDI-II	AA
Anger	.12	.11	.00	.11	-.08	.28	.17	.15
Fear	.02	.06	.00	-.02	-.08	.25	.08	.32*
Sadness	.08	.02	.00	-.02	.05	.28	.02	-.05
Happiness	.18	.19	-.21	-.17	.20	.42**	.22	.35*
Overall	.12	.12	-.04	.00	.01	.34*	.13	.21

* $p < .05$, ** $p < .01$

Table 22

Study 2: Means and standard deviations of emotional intensity ratings across emotions for chimera task stimuli.

Anger		Fear		Sadness		Happiness	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
154.43 _a	35.14	149.86 _b	33.26	163.73 _c	31.40	121.41 _d	22.05

Note. Means that do not share subscripts are significant at $p < .05$.

Table 23

Study 2: Means and standard deviations of reaction times (ms) across emotions for chimera task stimuli.

Anger		Fear		Sadness		Happiness	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1430.93 _a	521.69	1479.13 _b	484.24	1482.03 _b	567.81	1272.06 _c	389.32

Note. Means that do not share subscripts are significant at $p < .05$.

Table 24

Study 2: Means and standard deviations of emotional intensity ratings across emotions for chimera task stimuli.

Anger		Fear		Sadness		Happiness	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
161.78 _a	30.09	154.26 _b	31.84	170.93 _c	30.48	125.47 _d	21.94

Note. Means that do not share subscripts are significant at $p < .05$.

Table 25

Study 2: Means and standard deviations of reaction times (ms) across emotions for bias task stimuli.

Anger		Fear		Sadness		Happiness	
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1545.03 _a	588.30	1579.35 _a	538.53	1613.57 _b	566.60	1368.20 _c	493.13

Note. Means that do not share subscripts are significant at $p < .05$.

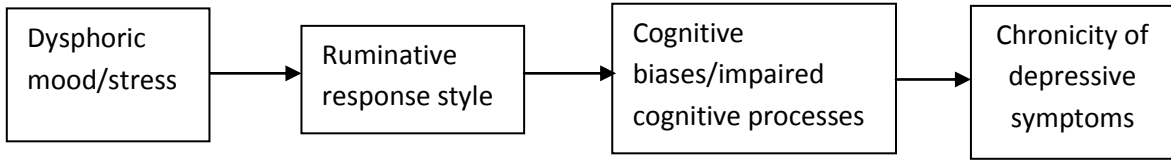


Figure 1. Schematic representation of the mediating role of rumination in the development and maintenance of depressive symptoms.



Figure 2. Sample stimuli depicting a female target expressing an emotion (i.e., happiness) at three intensity levels.



Figure 3. Sample stimuli for the Chimera task depicting a female target expressing fear in the upper half of her face and happiness in the lower half.

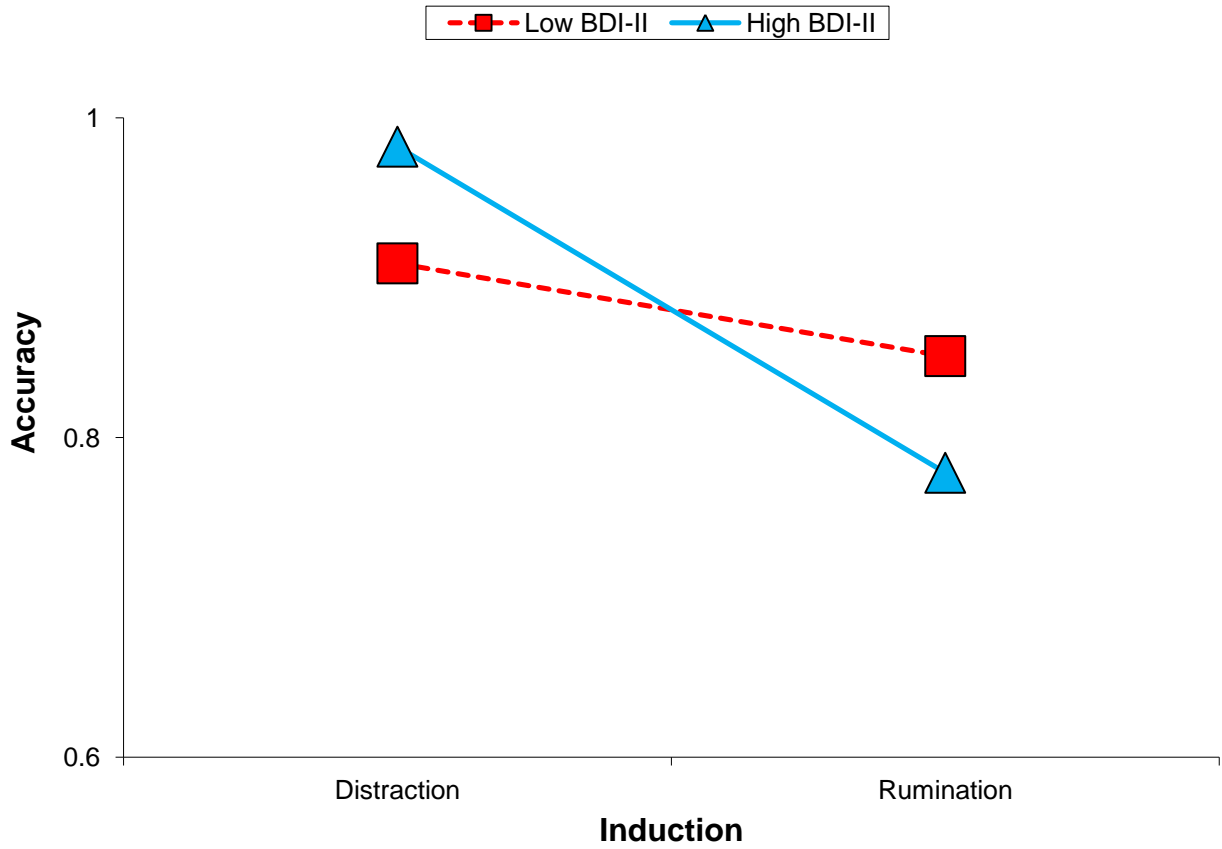


Figure 4. Study 1: Simple slope lines for the relationship between the type of induction received and accuracy on the accuracy task as a function of high and low BDI-II levels.

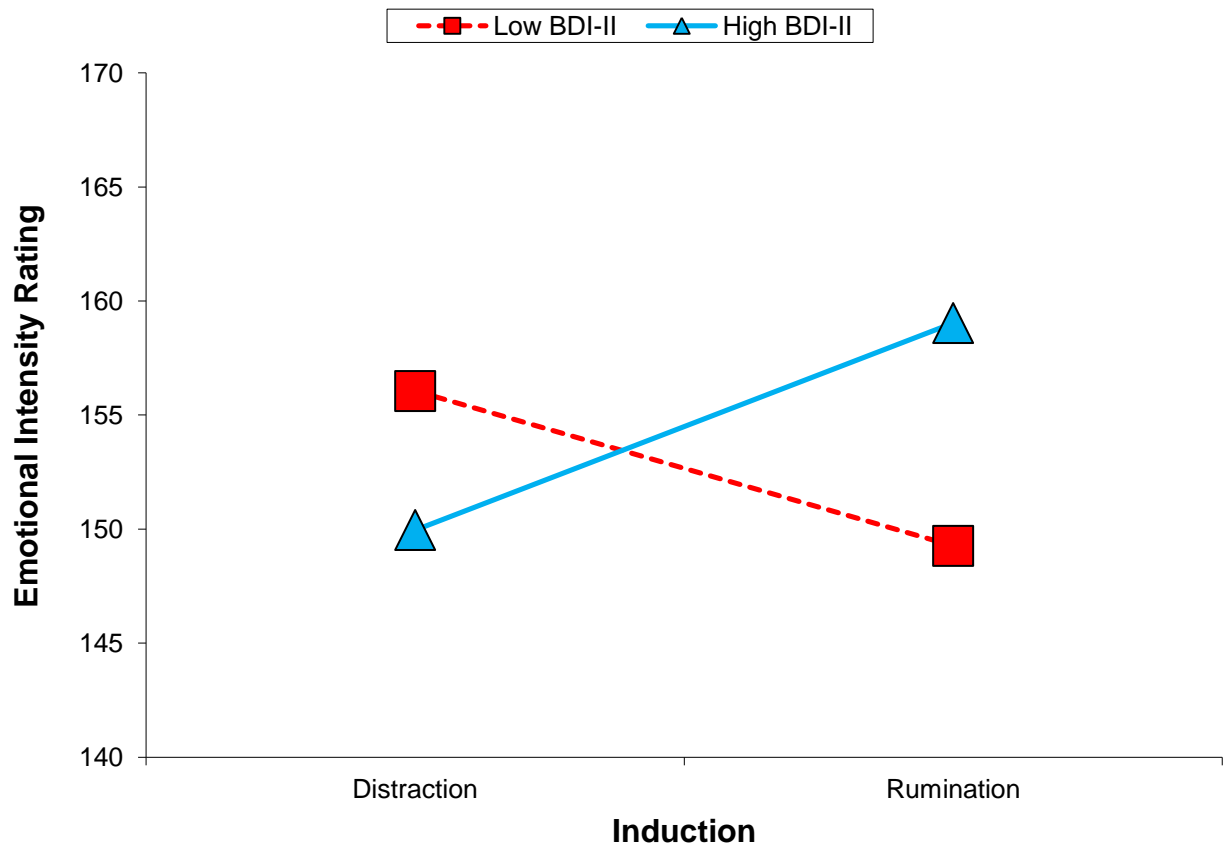


Figure 5. Study 1: Simple slope lines for the relationship between the type of induction received and emotional intensity ratings on the chimera task as a function of high and low BDI-II levels.

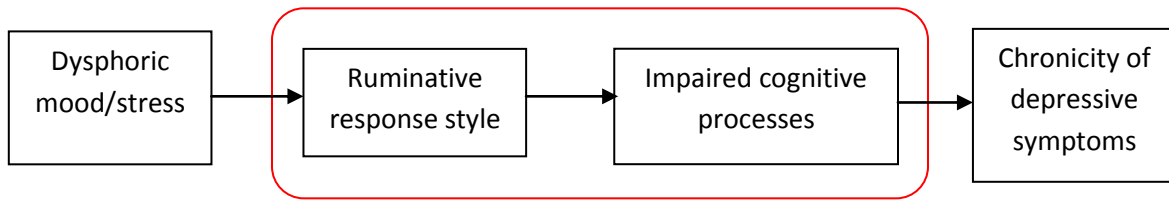


Figure 6. Schematic representation of the mediating role of rumination in the development and maintenance of depressive symptoms. The enclosed section represents the relationship of interest in Study 2.

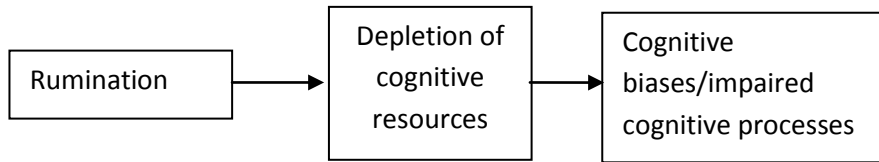


Figure 7. Schematic representation of the rumination-as-cognitive-load hypothesis.

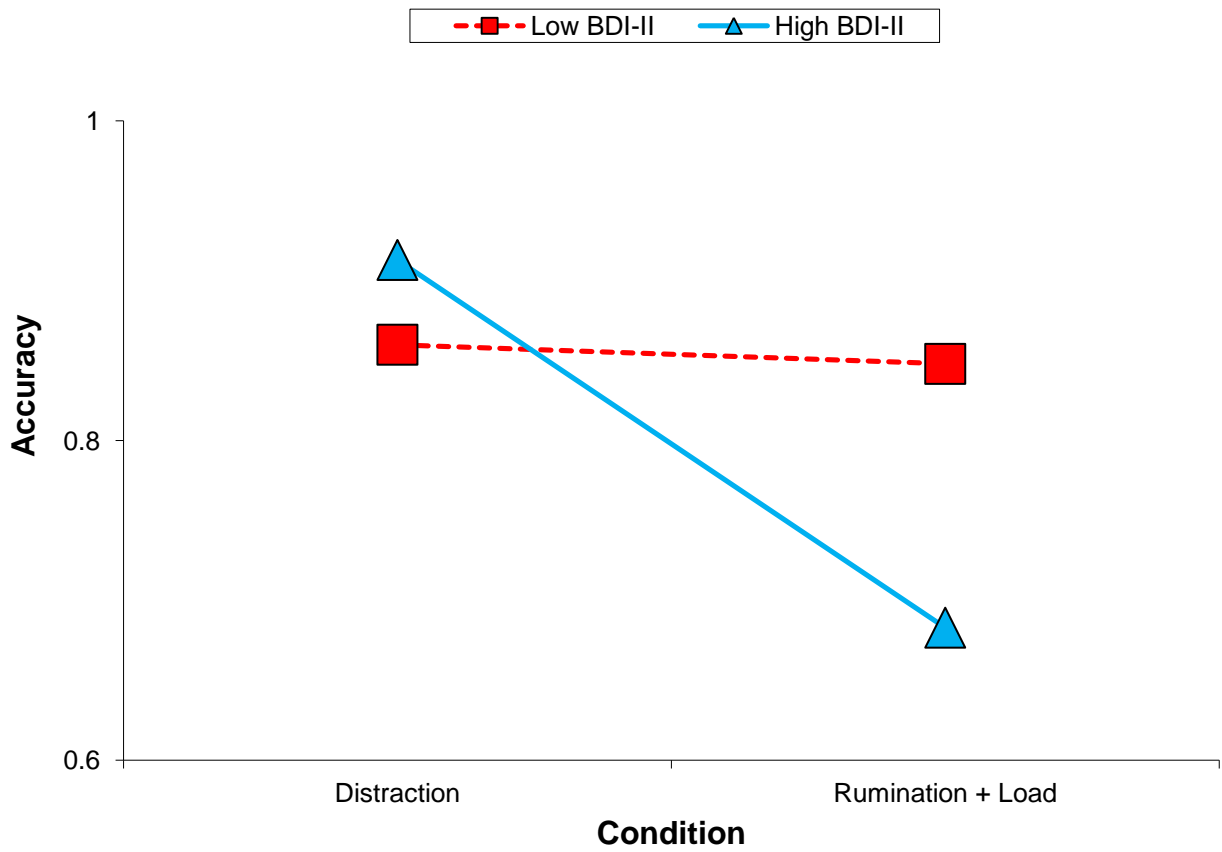


Figure 8. Study 2: Simple slope lines for the relationship between the type of induction (or cognitive load) received and accuracy on the accuracy task as a function of high and low BDI-II levels.

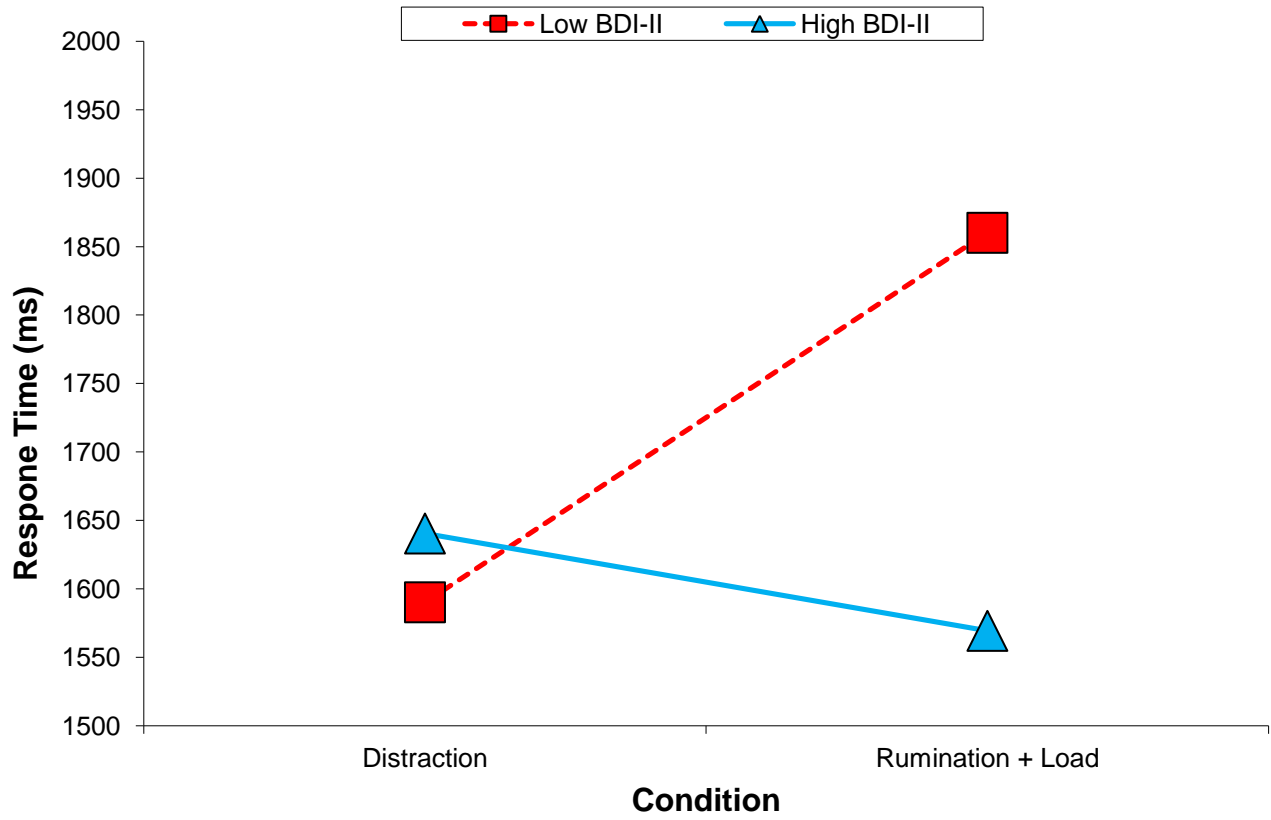


Figure 9. Study 2: Simple slope lines for the relationship between the type of induction (or cognitive load) received and reaction time on the accuracy task as a function of high and low BDI-II levels.

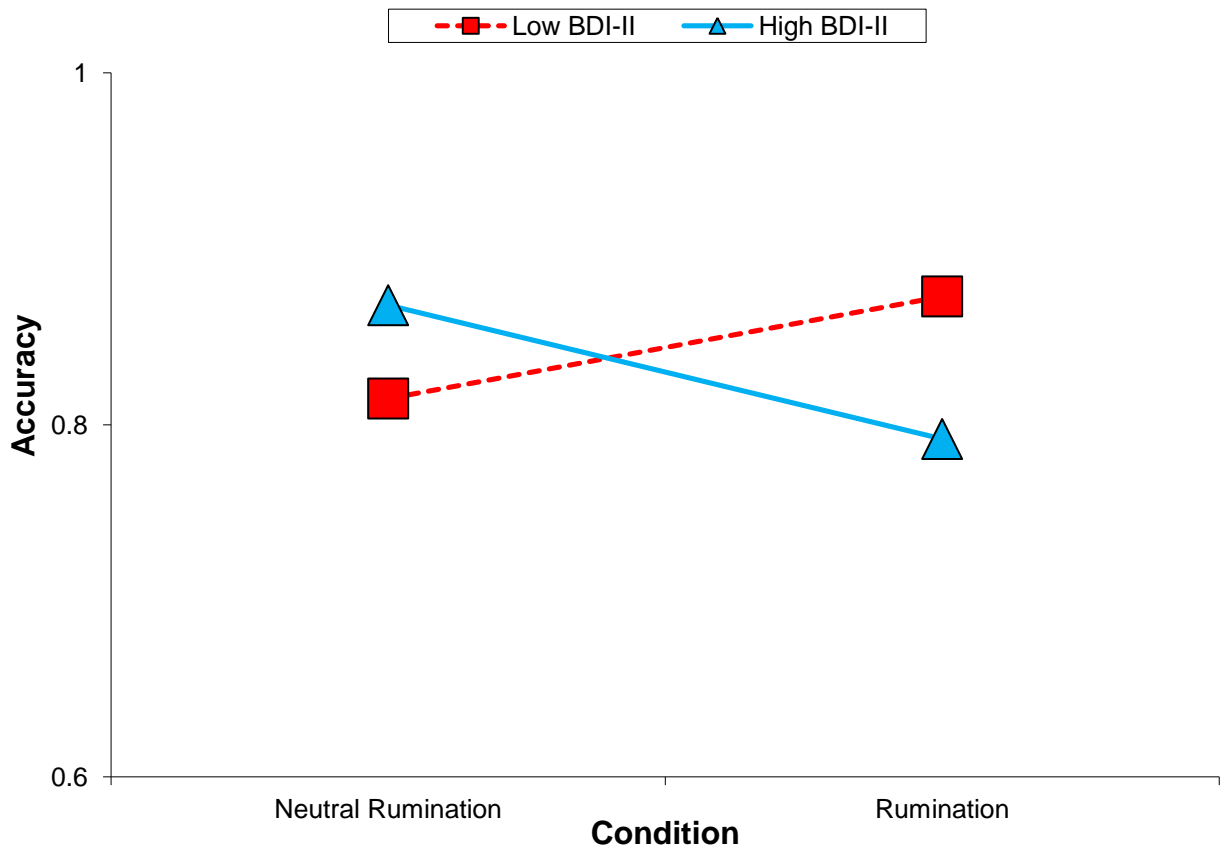


Figure 10. Study 2: Simple slope lines for the relationship between the type of induction received and percent accuracy on the accuracy task as a function of high and low BDI-II levels.

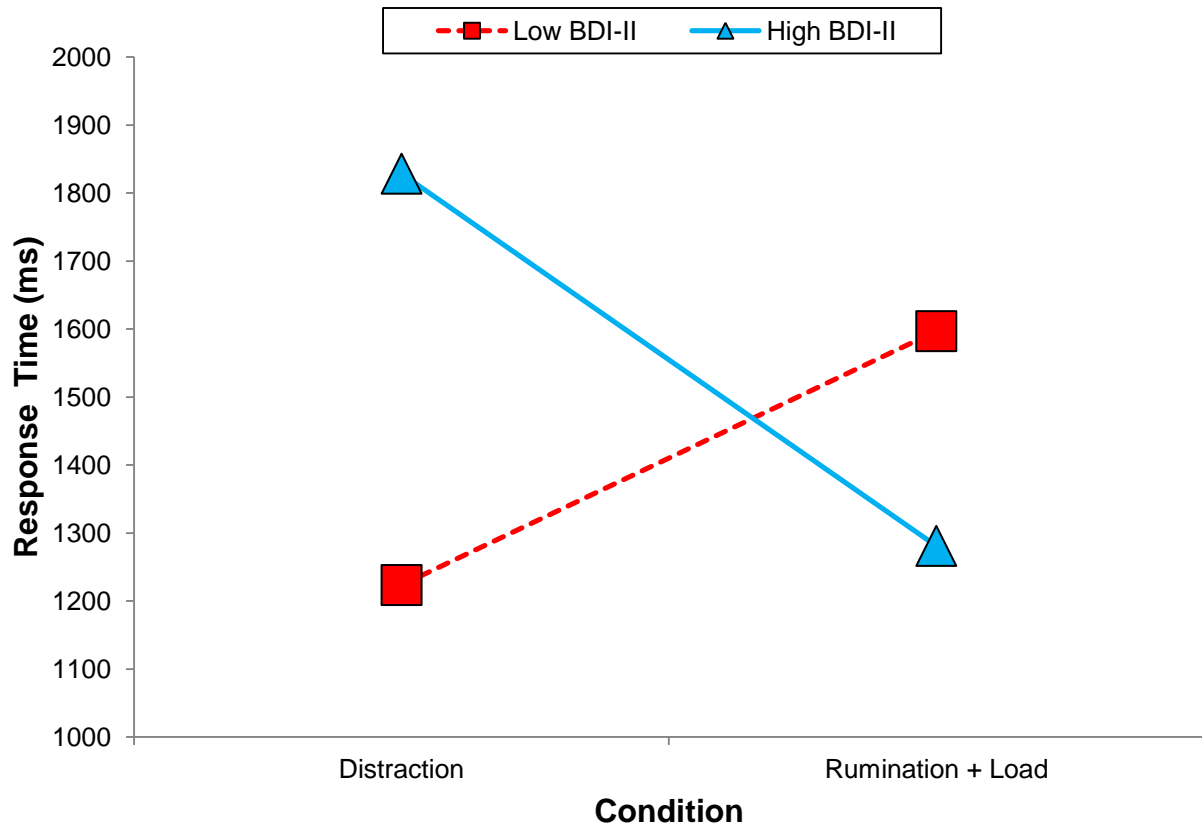


Figure 11. Study 2: Simple slope lines for the relationship between the type of induction (or cognitive load) received and reaction time on the bias task as a function of high and low BDI-II levels.

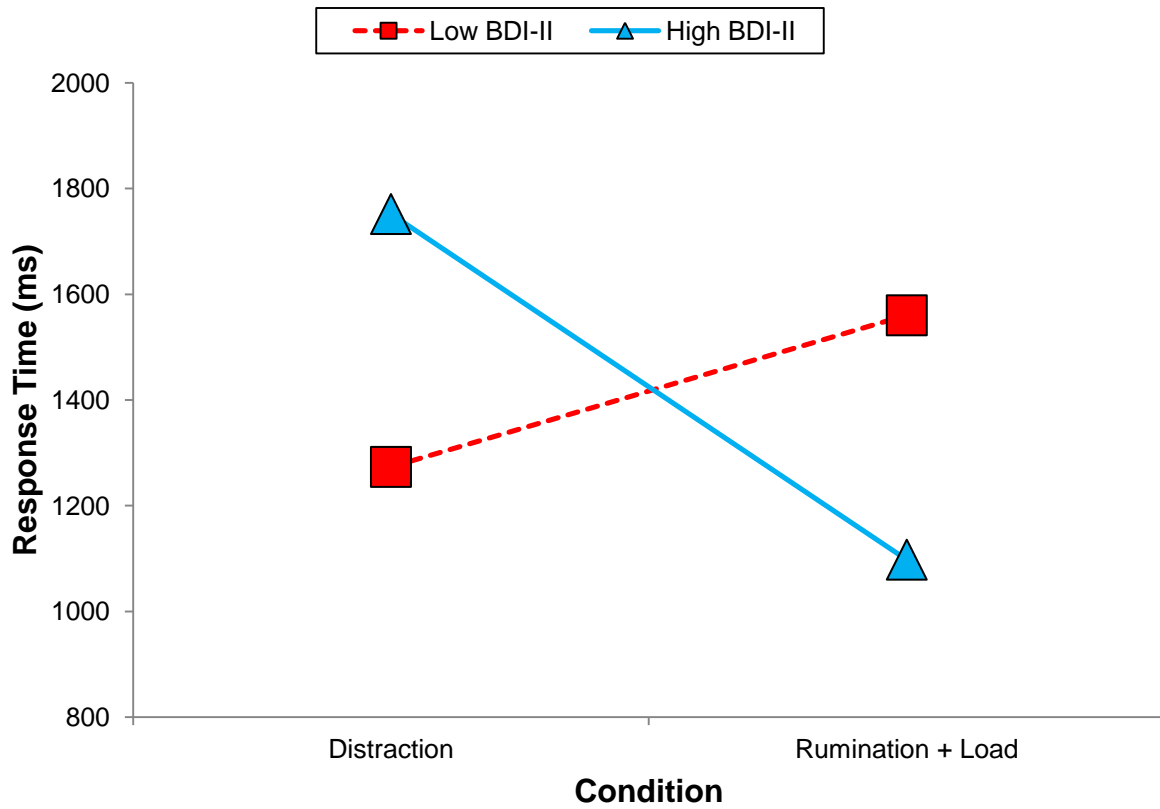


Figure 12. Study 2: Simple slope lines for the relationship between the type of induction (or cognitive load) received and reaction time on the chimera task as a function of high and low BDI-II levels.