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Cognitive Inhibition and Its Relation to Emotion Regulation in Dysphoria

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Cognitive Inhibition and Its Relation to Emotion Regulation in Dysphoria

by

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Abstract

In Phase 1: Trait Emotion Regulation, participants (N = 1625) completed self-report measures of perceived attentional control, habitual use of emotion regulation strategies, and depressive symptoms. Use of rumination, suppression, and reappraisal each significantly partially mediated the relationship between attentional control and depression. In Phase 2: Spontaneous and Instructed Emotion Regulation, dysphoric (n = 66) and non-dysphoric (n = 86) participants completed a measure of cognitive inhibition and watched a sadness-inducing film clip. Participants were randomly assigned to use reappraisal while watching the clip, or were not given specific viewing instructions. No significant associations were observed between cognitive inhibition, emotion regulation, and depression, contrary to hypotheses. However, dysphoric individuals reported greater spontaneous use of rumination and suppression than non-dysphoric individuals, and these strategies were associated with greater negative emotion. Both groups were able to effectively use reappraisal when instructed to do so. Clinical implications and future research directions are discussed.

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Chapter 1: Introduction

1.1 Background

Depression is among the most prevalent and burdensome psychiatric disorders. Epidemiological research estimates the point prevalence of major depressive disorder (MDD) to be 2 – 4% in adults (WHO International Consortium in Psychiatric Epidemiology, 2000). Prevalence rates from studies that assess depressive symptoms are considerably higher, and estimate that 20% of adults score high on symptom scales of depression, or exhibit what researchers have termed "dysphoria" (Kessler & Wang, 2009). To facilitate terminological clarity, Kendall, Hollon, Beck, Hammen, and Ingram (1987) proposed that the term "dysphoric" be used to describe individuals who report high levels of depressive symptoms but have not been assessed for MDD using a structured clinical interview. Although some dysphoric individuals may indeed meet the diagnostic criteria for MDD, the terms "depression", "clinical depression", and "MDD" are reserved for cases in which a diagnosis of MDD has been confirmed by a structured clinical interview. Depression is ranked as one of the most burdensome diseases worldwide by the World Health Organization (WHO) Global Burden of Disease Study in terms of total years lived with disability (Üstün, Ayuso-Mateos, Chatterji, Mathers, & Murray, 2004), and is associated with a cost of $14.4 billion annually in treatment, lost productivity, and premature death in Canada (Health Canada, 2001). Given the pervasiveness and encumbrance of depression and dysphoria, it is imperative that research investigate factors that may cause and sustain depressive conditions. Persistent negative affect and lack of positive affect are the central features of depression, and these affective features have led some researchers to hypothesize that impaired emotion regulation and consequently, an inability to recover from negative mood, may

contribute to the development and recurrence of depression (Nolen-Hoeksema, 1991; Gross, 2002; Joormann & Gotlib, 2010).

A large body of research has investigated the effectiveness and consequences of various emotion regulation strategies. Gross (2002) posited a process model of emotion regulation that describes how regulation can occur at each of the stages in the emotion generative process, and in this model, he drew a broad distinction between antecedent- and response-focused emotion regulation strategies. Antecedent-focused strategies occur relatively early in the emotion generative process, and attempt to modify one's experience of a stressor or prevent or minimize the emotional impact of a stressor before a full emotional response to the stressor has been generated. Reappraisal is an example of an antecedent-focused strategy, and it involves changing one's interpretation of a potentially emotional experience in order to neutralize its emotional impact. Response-focused strategies occur relatively late in the emotion generative process, and attempt to modify one's emotional expression after a full emotional response to a stressor has been generated. Expressive suppression is an example of a response-focused strategy, and it involves preventing or thwarting any outward expression of emotion.

Gross (1998) found that participants who were instructed to reappraise a disgusting film experienced less subjective emotion relative to control participants who did not receive any instructions. Participants who were instructed to suppress their emotional expression to the film did not report any reduction in subjective emotional experience, and showed increased sympathetic nervous system activation relative to the control participants (Gross, 1998). Thus, this study suggests that whereas reappraisal reduces the subjective experience of negative emotion, emotion suppression does not reduce the subjective experience of negative emotion and is associated with a physiological cost in terms of amplified sympathetic nervous system

activation (Gross, 1998). In addition, Gross & John (2003) found that habitual use of reappraisal compared to expressive suppression is related to more positive well-being and interpersonal functioning. More recently, Gross' (2002) process model of emotion regulation has been examined in the context of depression. Joormann & Gotlib (2010) found that depressed participants reported less habitual use of reappraisal than control participants. Other studies have shown that depressed and recovered-depressed participants suppress their emotional expression to a distressing film to a greater extent than nonclinical controls (Campbell-Sills, Barlow, Brown, & Hofmann, 2006; Ehring, Tuschen-Caffier, Schnülle, Fischer, & Gross, 2010).

Rumination has also been a primary focus for research on emotion regulation in depression. Nolen-Hoeksema (1991) described rumination as a response style to negative affect characterized by repetitive thinking about one's mood as well as the causes and implications of the negative mood. Across an extensive program of research, Nolen-Hoeksema and her colleagues have demonstrated that rumination exacerbates and prolongs negative mood, is associated with higher levels of depressive symptoms, and predicts the onset of future depressive episodes (see Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008 for a review). Taken together, the research on emotion regulation and its relation to depression suggest that more frequent use of certain emotion regulation strategies, such as expressive suppression and rumination, and less frequent use of other strategies, such as reappraisal, are associated with higher levels of depressive symptoms and negative mood. Thus, individual differences in the habitual use of particular emotion regulation strategies may confer vulnerability to the sustained negative affect that characterizes depression. From this standpoint, it is important to identify factors that influence a person's use of adaptive versus maladaptive emotion regulation strategies.

Impaired cognitive inhibition has been hypothesized to contribute to the use of maladaptive emotion regulation strategies and depression (Joormann, 2004; Joormann & D'Avanzato, 2010). Cognitive inhibition is described as a set of processes that prevent irrelevant information from entering working memory and update working memory by deleting information that is no longer pertinent to the current goal (Hasher & Zacks, 1988). Joormann (2004) first used a modified version of negative priming (Tipper, 1985) called the negative affective priming (NAP) task to assess the association between inhibition of emotional material and depressive symptoms. Each complete trial of the NAP task consists of a prime trial followed by a probe trial, although participants are not aware of the distinction between prime and probe trials. Both the prime and probe trials involve the simultaneous presentation of a target stimulus (e.g., a word presented in blue colour) and a distracter stimulus (e.g., a word presented in red colour). Participants are instructed to respond to the target by classifying it as negative or positive with a key press while ignoring the distracter. In experimental trials, the valence of the distracter in the prime trial is congruent with the valence of the target in the subsequent probe trial. In control trials, the valences of the distracter in the prime trial and the target in the probe trial are incongruent. Response times to the target in the probe trial are typically slower if the valence of the target matches the valence of the previous prime distracter (Wentura, 1999). This relative reduction in response time between experimental and control trials is called the NAP effect and is considered to be an index of the degree to which the emotional representation of the prime distracter is inhibited (Wentura, 1999).

Joormann (2004) found that dysphoric participants showed a reduced NAP effect for negative targets, but not positive targets, consistent with her hypothesis that such participants would be impaired in their ability to inhibit processing of negative task-irrelevant information.

Frings, Wentura, and Holtz (2007) replicated this finding, using a slightly modified NAP index that corrected for the confounding possibility that non-dysphoric participants demonstrated nonspecific response slowing following exposure to a negative prime distracter. Reduced inhibition of negative material as assessed by the NAP task has also been demonstrated in clinically depressed participants relative to control participants using both face stimuli (Goeleven, De Raedt, Baert, & Koster, 2006) and word stimuli (Joormann & Gotlib, 2010). Again, reduced inhibition was specific to negative stimuli; depressed participants exhibited intact negative priming for positive stimuli (Goeleven et al., 2006; Joormann & Gotlib, 2010).

Emerging research suggests that inhibitory processes may play a central role in the use of specific emotion regulation strategies. Joormann & Gotlib (2010) found that reduced inhibition of negative material was associated with greater self-reported habitual rumination in a group of depressed participants. In addition, reduced inhibition of negative material was related to less frequent use of reappraisal and more frequent use of expressive suppression across the entire sample of depressed, formerly depressed, and never-depressed participants (Joormann & Gotlib, 2010). Joormann (2006) and Joormann and Gotlib (2008) also reported a correlation between self-reported rumination and deficits in cognitive inhibition of negative material. In the first study to examine the associations among cognitive inhibition, rumination, and depression in a prospective design, Zetsche and Joormann (2011) found that reduced inhibition of negative words at baseline predicted depressive symptoms at a 6-month follow-up and reduced inhibition of sad faces at baseline predicted self-reported rumination at follow-up. These results support the notion that impaired inhibitory processes may reduce cognitive flexibility and make it difficult to employ more adaptive emotion regulation strategies such as reappraisal. Instead, impaired inhibition may lead to habitual use of maladaptive emotion regulation strategies such as

expressive suppression and rumination, which may in turn sustain negative affect and prevent recovery from negative mood.

While the empirical literature discussed above holds exciting implications for current theories and treatment of depression, it is important to note that the extant studies that have examined the relation between inhibition, emotion regulation strategies, and depression have assessed self-reported habitual use of strategies. To date, no study has investigated whether deficits in inhibition are related to actual use of or impairment in the ability to use adaptive emotion regulation strategies such as reappraisal to recover from negative mood states.

1.2 The Present Study

The purpose of the present study was to assess both cognitive inhibition and emotion regulation in dysphoric and non-dysphoric individuals, and examine whether individual differences in inhibition are related to the spontaneous use of specific emotion regulation strategies and the ability to employ an adaptive strategy, namely reappraisal, to regulate induced negative mood. This study extended past research through the examination of both self-reported and actual observation of mood regulation strategies. Cognitive inhibition ability was assessed using both positive and negative stimuli to determine whether relationships between impaired cognitive inhibition, emotion regulation, and depression hold for inhibition of all emotional information, or negative information specifically.

The study consisted of two phases. In *Phase 1: Self-Reported Emotion Regulation,* participants completed an online survey of questionnaires that assessed trait levels of depressive symptoms, habitual use of emotion regulation strategies, and perceived control over attention. Perceived control over attention was used as a proxy for self-reported cognitive control and inhibition ability. Based on previous empirical research and theoretical models of the

relationship between cognitive/attentional control, emotion regulation, and depression (Joormann & D'Avanzato, 2010), it was hypothesized that: 1) Depressive symptoms would be significantly associated with more self-reported use of rumination and suppression and less self-reported use of reappraisal emotion regulation strategies; 2) Depressive symptoms would be significantly associated with lower self-reported attentional control, and; 3) The relationship between attentional control and depressive symptoms would be partially mediated by self-reported use of emotion regulation strategies.

Participants were recruited to participate in *Phase 2: Spontaneous and Instructed Emotion Regulation* based on their level of depressive symptoms as assessed in Phase 1 of the study. Participants with high levels of depressive symptoms (i.e., "dysphoric" participants) and participants with low levels of depressive symptoms (i.e., "non-dysphoric" participants) completed the NAP task to assess their ability to inhibit positive and negative material from working memory. Participants were then randomly assigned to receive neutral film-viewing instructions (i.e., "the spontaneous emotion regulation condition") or reappraisal film-viewing instructions (i.e., "the instructed emotion regulation condition") adapted from Gross (1998), and subsequently watched a sadness-inducing film. Thus, the spontaneous emotion regulation condition allowed for the assessment of the degree to which participants spontaneously engage in various strategies to regulate induced sad mood, whereas the instructed emotion regulation condition tested participants' ability to employ reappraisal to regulate induced sadness.

The hypotheses for Phase 2 of the study were: 1) Dysphoric participants would show reduced inhibition of negative material relative to non-dysphoric participants; 2) Dysphoric participants would report more spontaneous use of maladaptive emotion regulation strategies (i.e., rumination, suppression) and less spontaneous use of adaptive emotion regulation strategies

(i.e., reappraisal) while watching the film than non-dysphoric participants; 3) Reduced inhibition of negative material would be related to more spontaneous use of rumination and suppression and less spontaneous use of reappraisal while watching the film; 4) Dysphoric participants would show an impaired ability to use reappraisal to regulate mood while watching the film relative to non-dysphoric participants; and 5) Reduced inhibition of negative material would be associated with an impaired ability to use reappraisal to regulate mood while watching the film.

Emotional reactivity to the sadness-inducing film clip was measured through the comparison of pre-film and post-film levels of positive and negative mood. Mood was also measured after a 2-minute recovery period following the film. Previous research has found that emotion regulation can affect the speed of recovery from negative mood, in addition to initial emotional reactivity to an affect-provoking event (Campbell-Sills et al., 2006; Ehring et al., 2010). Speed of recovery from the film clip was operationalized as remaining levels of negative mood after the recovery period (Ehring et al., 2010). It was hypothesized that previous findings (Gross, 2002) would be replicated, in that greater spontaneous use of reappraisal and less spontaneous use of rumination and suppression while watching the film would predict lower levels of negative emotion and greater recovery from negative mood across groups.

Chapter 2: Method

2.1 Participants

Participants were undergraduate students at the University of Calgary who participated for course credit. A total of 1625 participants participated in Phase 1 of the study, which consisted of an online survey. For Phase 2 of the study, a two-step procedure was used for participant selection. Participants were first selected from the 1625 respondents from Phase 1 of the study on the basis of their scores on the Beck Depression Inventory-II (BDI-II; Beck, Steer,

& Brown, 1996), which was one of the self-report questionnaires included in the online survey. Recruitment was restricted to those who scored high (≥ 20) or low (≤ 6) on the BDI-II. A total of 796 participants met the eligibility criteria and consented to be contacted for Phase 2 of the study. Of these eligible participants, 211 participants signed up and took part in Phase 2.

Phase 2 was an in-lab study. As part of the study protocol, participants completed a re-administration of the BDI-II. The same cut-off scores on the BDI-II as used for recruitment were used to form participant groups; participants who scored ≥ 20 on the in-lab BDI-II formed the dysphoric group and participants who scored ≤ 6 on the in-lab BDI-II formed the non-dysphoric group. Participants who scored between 7 and 19 on the in-lab BDI-II were excluded from analyses (n = 52). An additional seven participants were excluded because of missing data due to technical difficulties, most often the loss of wireless internet connection. Thus, the final sample consisted of 152 participants; 66 participants formed the dysphoric group and 86 participants formed the non-dysphoric group. Participants were randomly assigned to either the spontaneous (n = 68) or the instructed (n = 84) emotion regulation condition. Thus, the final breakdown of participants was 28 dysphoric and 40 non-dysphoric participants in the spontaneous emotion regulation condition and 38 dysphoric and 46 non-dysphoric participants in the instructed emotion regulation condition.

Demographic information for the dysphoric and non-dysphoric participant groups is presented in Table 1. As is evident in Table 1, participants were predominantly female, single, and Caucasian. Analyses of variance (ANOVAs) or chi-square tests, as appropriate, were conducted to test for group differences on each of the demographic variables. There were no significant differences between the dysphoric and non-dysphoric groups with regard to age, gender, or marital status. However, there was a significant difference between participant groups

on ethnicity, $x^2(2) = 6.81$, $p = .033$. Participants in the dysphoric group were less likely to be Caucasian and more likely to be Asian than participants in the non-dysphoric group. Ethnicity, however, did not have a significant effect on any of the outcome variables and was therefore not included as a factor in subsequent analyses.

2.2 Measures

Depressive symptoms. Participants completed the BDI-II (Beck et al., 1996), which is a 21-item questionnaire that assesses the severity of depressive symptoms over the past 2 weeks. Items are rated on a 4-point scale, where higher scores indicate greater depressive symptomatology. The BDI-II demonstrates excellent reliability in undergraduate populations, with coefficient alpha estimates ranging from .91 to .93 (Dozois, Dobson, & Ahnberg, 1998; Beck et al., 1996).

Rumination. The Ruminative Responses Scale (RRS; Nolen-Hoeksema & Morrow, 1991) was used to assess the degree to which participants tend to ruminate in response to a negative mood. The RRS consists of 22 items that assess rumination focused on the self, on symptoms, and on possible consequences and causes of symptoms. Items are rated on a 4-point scale (1 = *almost never* and 4 = *almost always*), with higher scores indicating greater ruminative response style. The RRS demonstrates good internal consistency, test-retest reliability, and construct validity (Nolen-Hoeksema & Morrow, 1991; Nolen-Hoeksema, Parker, & Larson, 1994; Treynor, Gonzalez, & Nolen-Hoeksema, 2003).

Reappraisal and suppression. The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) was used to assess participants' tendency to use cognitive reappraisal and expressive suppression to control mood. The ERQ consists of a 6-item reappraisal subscale and a 4-item

Table 1

Demographic information across participant groups and full sample.

Variable	Dysphoric Group (n = 66)	Non-Dysphoric Group (n = 86)	Full Sample (N = 152)	Omnibus F-Test / Chi-Square
Age, *M (SD)*	20.73 (5.61)	20.51 (3.49)	20.60 (4.49)	0.09
Gender, % female	86%	79%	82%	1.06
Marital Status, % single	90%	95%	93%	1.40
Ethnicity, %				
Caucasian	42%	58%	51%	6.81*
Asian	26%	11%	17%	
Other	32%	31%	32%	

Note. * $p < .05$.

suppression subscale. Items are rated on a 7-point scale, with higher scores indicating greater use of reappraisal or suppression, respectively. The internal consistency of the reappraisal subscale is higher than that of the suppression subscale, although both subscales demonstrate adequate internal consistency (Gross & John, 2003).

Attentional control. The Attentional Control Scale (ACS; Derryberry & Reed, 2002) was used to assess the perceived ability of participants to control their attention during everyday experiences. The ACS consists of 20 items that assess the frequency of problems in focussing and shifting attention. Items are rated on a 4-point scale (1 = *almost never* and 4 = *always*) and coded such that high scores indicate greater ability to control attention. The ACS has demonstrated good internal consistency (α = .88; Derryberry & Reed, 2002).

Mood. Participants rated their mood at several points throughout the experiment using the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS consists of 10 positive descriptors that form the positive affect subscale and 10 negative descriptors that form the negative affect subscale. Participants rate the extent to which they currently feel the emotion listed in each descriptor on a 5-point scale (1 = *very slightly or not at all* and 5 = *extremely*), with higher scores indicating greater positive or negative affect, respectively. The PANAS demonstrates good internal consistency (α = .89 for the positive subscale and α = .85 for the negative subscale), and strong convergent validity with other measures of mood and general distress (Watson et al., 1988).

Participants also rated their mood throughout the study on a single-item mood scale. The mood scale consisted of an11-point scale (-5 = *very negative* and 5 = *very positive*) with 0 as the mid-point. Participants were asked to select the number on the scale that corresponded to their present mood.

State emotion regulation. The Strategies Questionnaire (SQ) was used to assess the degree to which participants used various emotion regulation strategies while watching the sadness-inducing film (see Egloff, Schmukle, Burns, & Schwerdtfeger, 2006 and Ehring et al., 2010 for similar operationalizations). The SQ was developed for the purpose of this study, and consists of three items assessing each of four emotion regulation strategies: emotion suppression, rumination, distraction, and reappraisal. Thus, the full scale has a total of 12 items. Items were adapted from trait measures of emotion regulation, including the ERQ and RRS, to reflect state emotion regulation. Participants rate each item on a 7-point scale (1 = *strongly disagree* and 7 = *strongly agree*). The ratings for the three items for each emotion regulation strategy were summed to create a suppression score, a rumination score, a distraction score, and a reappraisal score, where higher scores indicate greater use of the respective emotion regulation strategy. The distraction subscale was not relevant to any of the hypotheses of the present study and thus was not included in the analyses.

All unpublished self-report measures used in this study can be found in Appendix A.

2.3 Negative Affective Priming (NAP) Task

Stimuli. Positive, neutral, and negative words from the Affective Norms of English Words (ANEW; Bradley & Lang, 1999) database were used as stimuli. The ANEW database provides normative valence and arousal ratings, as well as frequency ratings taken from Kucera and Francis (1967) norms, for over 1000 English adjectives, verbs, and nouns. Adjectives with a rating of 4 or less were considered for inclusion in the negative valence category, adjectives with a rating between 4 and 6 were considered for inclusion in the neutral category, and adjectives with a rating over 7 were considered for inclusion in the positive valence category. A total of 44 negative adjectives, 44 positive adjectives, and 44 neutral adjectives were selected. Average

valence ratings were 2.50 (*SD* = .54) for the negative words, 5.86 (*SD* = .88) for the neutral words, and 7.57 (*SD* = .40) for the positive words. Negative, neutral, and positive words did not differ in average arousal rating, average word length, or average word frequency, all *p*s > .10. A complete list of the word stimuli that were in this study along with valence, arousal, word length, and word frequency ratings from the ANEW manual (Bradley & Lang, 1999) can be found in Appendix B.

Design. The NAP task consisted of 256 prime and probe trials completed in 4 blocks of 64 trials each. As previously described, each complete trial consisted of a prime trial and a probe trial. Half of the NAP trials formed the experimental condition, in which the valence of the distracter in the prime trial was congruent with the valence of the target in the probe trial. The prime trials in the experimental condition each consisted of one positive adjective and one negative adjective, and either the positive or negative word was the target. The other half of the trials consisted of control trials, in which the distracters in the prime trial were neutral words, and thus incongruent with the target in the probe trial. For both the experimental and control conditions, the distracter in the probe trial was always a neutral word (see Table 2). The valences of the words in the prime and probe trials in the experimental and control conditions followed standard NAP designs (Wentura, 1999).

Participants were told that two words would be displayed simultaneously on the upper and lower half of the computer screen, and that one word would be presented in blue and the other in red. They were instructed to attend only to the blue word and ignore the red word. Participants were asked to indicate whether the attended blue word was positive or negative by pressing the appropriate key on the computer keyboard and were told that this decision should be made as quickly and accurately as possible. In each trial, a fixation cross first appeared on the

computer screen for 500 ms. After the fixation cross disappeared, a prime trial consisting of a blue target word and a red distracter word appeared simultaneously on the computer screen. Once the participant responded to the trial by pressing a computer key, the trial ended and the words disappeared from the screen. Another fixation cross was then be presented for 500 ms, followed by the probe trial. Again, a blue target word and a red distracter word were presented until the participant responded by indicating the valence of the target by key press.

The letters of the target and distracter words were 1 cm in size. In each trial, one of the words was positioned 0.5 cm above the centre of the screen and the other word was positioned 0.5 cm below the centre of the screen. The location of the target and distracter words in either the top or bottom half of the screen was randomly assigned on each trial. The blue and red colours in which the target and distracter words were displayed, respectively, were matched for brightness. Participants' reaction times and responses to the prime and probe trials were recorded.

2.4 Sadness Induction

Participants watched a sadness-inducing film clip (4 min 14 s) from the film *Dead Poets Society* (Weir, 1989) that depicts the suicide of an adolescent boy. This particular film clip has been shown to effectively induce sadness in undergraduate students (Schaefer, Nils, Sanchez, & Philippot, 2010). Prior to watching the film, participants received viewing instructions adapted from Gross (1998). Participants in the spontaneous emotion regulation condition were told: "We will now be showing you a short film clip. It is important to us that you watch the film clip carefully until the end. However, if you find the film too distressing, please inform the investigator and the investigator will pause the film if needed". Participants in the instructed emotion regulation condition were told: "We will now be showing you a short film clip. It is

Table 2

Experimental and control conditions for the Negative Affective Priming (NAP) task.

Condition	Prime trial		Probe trial	
	Distracter	Target	Distracter	Target
NP-Pos	+	-	*	+
Control-Pos	*	-	*	+
NP-Neg	-	+	*	-
Control-Neg	*	+	*	-

Note. NP-Pos = experimental condition for positive words, Control-Pos = control condition for positive words, NP-Neg = experimental condition for negative words, Control-Neg = control condition for negative words, +, positive words, -, negative words, *, neutral words.

important to us that you watch the film clip carefully until the end. However, if you find the film too distressing, please inform the investigator and the investigator will pause the film if needed. Please try to adopt a detached and unemotional attitude as you watch the film. In other words, as you watch the film, think about what you are seeing objectively, in terms of the technical aspects of the events you observe. Watch the film carefully, but please try to think about what you are seeing in such a way that you don't feel anything at all."

2.5 Procedure

Phase 1: Trait emotion regulation. Participants were able to sign up for the study through the Research Participation System (RPS) at the University of Calgary. Upon sign-up, participants were directed to the online survey site and provided informed consent. Participants then completed the BDI-II, RRS, ERQ, and ACS, as well as other questionnaires not relevant to the present study, in a randomized order.

Phase 2: Spontaneous and instructed emotion regulation. Participants were able to sign up for the study through the RPS at the University of Calgary. All participants were tested individually in one session. Upon arrival to the laboratory, participants provided written informed consent. Participants then completed the mood scale, PANAS, and BDI-II. Next, participants completed the NAP task and another computer task not relevant to the present study. The order of the two computer tasks was randomized across participants. Participants first completed 8 practice trials prior to completing the 256 trials of the NAP task. Following the computer tasks, participants rated their mood on the mood scale and PANAS. Participants were then randomly assigned to the spontaneous or the instructed emotion regulation condition. In the spontaneous emotion regulation condition, participants received the neutral film-watching instructions and then watched the sadness-inducing film clip. In the instructed emotion

regulation condition, participants received the reappraisal film-watching instructions and then watched the sadness-inducing film clip. After watching the film, participants again rated their mood on the mood scale and PANAS and also completed the SQ to assess the degree to which participants used various emotion regulation strategies while watching the film. This was followed by a 2-minute recovery period during which participants were instructed to sit and rest while the experimenter left the room. Participants rated their mood once again on the mood scale after the recovery period. Finally, participants watched a short humorous film clip to elevate their mood prior to leaving the laboratory.

Chapter 3: Results

3.1 Data Preparation

The data were inspected for accuracy and missing values. In no case did a variable have more than 3% missing data. Given the low rate of missing data, listwise deletion was used for cases with variables with missing values for all analyses.

3.2 Phase 1: Trait Emotion Regulation

Association between depressive symptoms and emotion regulation. Pearson correlations (two-tailed) between scores on the BDI-II and scores on the RRS and the ERQ were calculated to test the hypothesized positive correlations between trait depressive symptoms and habitual use of rumination and emotion suppression, and the hypothesized inverse correlation between trait depressive symptoms and habitual use of reappraisal. Scores on the BDI-II were positively correlated with scores on the RRS, $r = .56$, $p < .001$, and with scores on the emotion suppression subscale of the ERQ, $r = .19$, $p < .001$. Scores on the BDI-II were negatively correlated with scores on the reappraisal subscale of the ERQ, $r = -.25$, $p < .001$.

Association between depressive symptoms and attentional control. A Pearson correlation (two-tailed) between scores on the BDI-II and the ACS was calculated to test the hypothesized inverse correlation between depressive symptoms and perceived attentional control. As hypothesized, scores on the BDI-II were negatively correlated with scores on the ACS, $r = -.40$, $p < .001$.

Mediation of relationship between depressive symptoms and attentional control by emotion regulation. Structural equation modelling was used to test whether emotion regulation mediated the relationship between attentional control, as measured by the ACS, and depressive symptoms, as measured by the BDI-II. Three separate path analyses were conducted. The first analysis tested whether rumination, as assessed by the RRS, mediated the relationship between attentional control and depressive symptoms. The second analysis tested whether suppression, as assessed by the ERQ, mediated the relationship between attentional control and depressive symptoms. The third analysis tested whether reappraisal, as assessed by the ERQ, mediated the relationship between attentional control and depressive symptoms. The hypothesized models and standardized estimates of the effects for each model are displayed in Appendix C.

The significance of the hypothesized mediators was evaluated using the Sobel test for mediation (Sobel, 1982). Rumination significantly mediated the relationship between attentional control and depressive symptoms, $z = -11.34$, $p < .05$. Decreased attentional control predicted greater use of rumination which predicted greater depressive symptoms. Suppression also significantly mediated the relationship between attentional control and depressive symptoms, $z = -2.57$, $p < .05$. Decreased attentional control predicted greater use of suppression which predicted greater depressive symptoms. Finally, reappraisal significantly mediated the relationship

between attentional control and depressive symptoms, $z = -4.82$, $p < .05$. Decreased attentional control predicted less use of reappraisal which predicted greater depressive symptoms.

Pearson correlations (two-tailed) among the self-report measures administered in Phase 1: Trait Emotion Regulation are shown in Appendix D.

3.2 Manipulation Check

Sadness-inducing film clip. Mean mood ratings across the study as a function of emotion regulation condition (spontaneous and instructed emotion regulation conditions) and participant group (dysphoric and non-dysphoric groups) are displayed in Table 3. Three separate 2 (Group; dysphoric vs. non-dysphoric) × 2 (Time; pre-film vs. post-film) mixed analyses of variance (ANOVAs) were conducted on the PANAS-N ratings, the PANAS-P ratings, and the mood scale ratings to test whether the sadness-inducing film was effective at inducing negative mood. For the PANAS-N ratings, analyses revealed a significant main effect of group, $F(1, 150) = 88.14$, $p < .001$, $\eta_p^2 = .37$, a significant main effect of time, $F(1, 150) = 66.26$, $p < .001$, $\eta_p^2 = .31$, and a significant Group × Time interaction, $F(1, 150) = 4.16$, $p = .043$, $\eta_p^2 = .03$. To follow-up the significant interaction, separate paired-samples *t*-tests were conducted on the PANAS-N ratings at pre-film and post-film for the dysphoric and non-dysphoric groups. For the dysphoric group, PANAS-N ratings were significantly higher at post-film ($M = 21.09$, $SD = 7.80$) than pre-film ($M = 17.56$, $SD = 6.67$), $t(65) = -5.31$, $p < .001$. For the non-dysphoric group, PANAS-N ratings were also significantly higher at post-film ($M = 13.10$, $SD = 3.42$) than pre-film ($SD = 10.99$, $SD = 1.66$), $t(85) = -6.40$, $p < .001$.

For the PANAS-P ratings, analyses revealed a significant main effect of group, $F(1, 150) = 26.76$, $p < .001$, $\eta_p^2 = .15$, and a significant main effect of time, $F(1, 150) = 13.65$, $p < .001$, $\eta_p^2 = .08$. PANAS-P ratings were higher overall for non-dysphoric participants ($M = 26.52$, $SD =$

Table 3

Mean mood ratings across experimental time points as a function of emotion regulation condition and participant group.

	Pre-film	Post-film	Post-recovery
Spontaneous emotion regulation condition			
Dysphoric group			
PANAS-N	18.46 (6.91)	22.57 (9.23)	---
PANAS-P	20.39 (7.49)	19.29 (5.70)	---
Mood scale	0.00 (2.07)	-1.57 (1.77)	-0.71 (1.90)
Non-dysphoric group			
PANAS-N	11.20 (2.05)	13.05 (3.10)	---
PANAS-P	25.68 (9.25)	24.60 (9.00)	---
Mood scale	2.42 (1.58)	1.40 (2.17)	2.47 (1.63)
Instructed emotion regulation condition			
Dysphoric group			
PANAS-N	16.89 (6.50)	20.00 (6.48)	---
PANAS-P	20.92 (8.08)	19.89 (6.16)	---
Mood scale	0.18 (2.19)	-1.39 (1.81)	0.39 (1.90)
Non-dysphoric group			
PANAS-N	10.80 (1.22)	13.15 (3.71)	---
PANAS-P	29.24 (7.55)	26.22 (8.67)	---
Mood scale	2.80 (1.60)	1.09 (2.25)	2.37 (1.98)

Note. Standard deviations are shown in parentheses.

9.99) than dysphoric participants (M = 20.17, SD = 11.34), and were lower after watching the sadness-inducing film clip (M = 22.93, SD = 8.20) than prior to watching the clip (M = 24.59, SD = 8.87). The Group × Time interaction was non-significant, $p > .10$.

For the mood scale ratings, there was a significant main effect of group $F(1, 150) = 89.21$, $p < .001$, $\eta_p^2 = .37$, and a significant main effect of time, $F(1, 150) = 90.45$, $p < .001$, $\eta_p^2 = .38$. Mood scale ratings were lower overall for dysphoric participants (M = -.68, SD = 2.59) than non-dysphoric participants (M = 1.93, SD = 2.22), and were lower after watching the sadness-inducing film clip (M = .06, SD = 2.43) than prior to watching the clip (M = 1.53, SD = 2.23). The Group × Time interaction was non-significant, $p > .10$.

Based on these analyses, it was concluded that the sadness-inducing film clip had its intended effect on participants' mood. Participants reported greater negative mood on the PANAS-N, less positive mood on the PANAS-P, and lower mood on the mood scale after watching the film clip than they did prior to watching the clip. Thus, the film clip was an appropriate experimental manipulation to assess regulation of negative affect.

Reappraisal instructions. A 2 (Group; dysphoric vs. non-dysphoric) by 2 (Condition; spontaneous vs. instructed) mixed ANOVA was conducted on reappraisal use as assessed by the SQ to determine whether the experimental induction of reappraisal in the instructed emotion regulation condition was successful. There was a significant main effect of condition, $F(1, 148) = 39.87$, $p < .001$, $\eta_p^2 = .21$, such that participants reported engaging in significantly higher levels of reappraisal in the instructed emotion regulation condition (M = 15.60, SD = 5.51) than the spontaneous emotion regulation condition (M = 11.37, SD = 6.12). There were no other significant effects in the model, all ps > .10. These results indicate that reappraisal was

successfully manipulated in the instructed emotion regulation condition, and that the effectiveness of this manipulation did not differ across dysphoric and non-dysphoric groups.

3.3 Group Differences in Negative Priming

Mean response times and standard deviations for the NAP conditions as a function of group are displayed in Table 4.To examine group differences in negative priming for positive and negative words, a 2 (Group; dysphoric vs. non-dysphoric) × 2 (Condition; experimental vs. control) × 2 (Valence; positive vs. negative) mixed ANOVA was conducted on the mean response times to probe targets. Trials in which participants made incorrect responses (3.8% of all trials) and trials with extreme response times (below 300 and above 2000 ms; 2.2% of all trials) were eliminated from the analyses following standard NAP procedures. There was a main effect of Condition, $F(1, 146) = 22.82$, $p < .001$, $\eta_p^2 = .14$, such that mean response times were greater in the experimental (M = 897.76 ms, SD = 111.68 ms) than the control condition (M = 883.08 ms, SD = 108.03 ms). There was also a main effect of Valence, $F(1, 146) = 118.16$, $p < .001$, $\eta_p^2 = .45$, such that mean response times were greater for negative (M = 911.71 ms, SD = 109.61 ms) than positive probe targets (M = 869.13 ms, SD = 112.04 ms). There were no other significant effects, including the hypothesized Group × Condition × Valence interaction.

To test the relationship between cognitive inhibition and severity of depressive symptoms, individual negative priming index scores were calculated by subtracting the mean response time to control trials from the mean response time to experimental trials of the same valence, such that higher scores indicated greater inhibition. Negative priming index scores were calculated separately for positive and negative words. Pearson correlations (two-tailed) were then conducted between the scores on the BDI-II and negative priming index scores for positive and

Table 4

Mean response times (in ms) for the NAP conditions and negative priming indices as a function of participant group.

	Dysphoric group			Non-dysphoric group		
	Experimental	Control	Negative priming index	Experimental	Control	Negative priming index
Negative words	915.72 (112.63)	897.40 (111.99)	18.32 (44.89)	924.76 (115.62)	908.56 (106.15)	15.80 (51.94)
Positive words	874.62 (116.11)	862.79 (118.70)	11.83 (56.76)	875.95 (115.58)	863.17 (108.67)	12.78 (52.88)

Note. Standard deviations are shown in parentheses.

negative words. Results showed that neither cognitive inhibition for negative nor positive words was significantly related to BDI-II depressive symptom scores, all *p*s > .10.

3.4 Phase 2: Spontaneous Emotion Regulation Condition

The following set of analyses were conducted with the participants in the spontaneous emotion regulation condition (*n* = 68).

Group differences in spontaneous emotion regulation. Three independent samples t-tests were conducted to test whether dysphoric and non-dysphoric participants differed in their spontaneous use of different emotion regulation strategies while watching the sadness-inducing film. The first t-test was conducted with rumination as measured by the SQ as the dependent variable and Group (dysphoric vs. non-dysphoric) as the grouping variable. Dysphoric participants were significantly more likely to spontaneously use rumination (*M* = 14.68, *SD* = 2.51) than non-dysphoric participants (*M* = 11.30, *SD* = 3.62), *t*(66.00) = -4.54, *p* < .001. In the second *t*-test, suppression as measured by the SQ was the dependent variable. Dysphoric participants were significantly more likely to spontaneously use suppression (*M* = 15.29, *SD* = 3.26) than non-dysphoric participants (*M* = 11.55, *SD* = 4.92), *t*(65.85) = -3.76, *p* < .001. The third *t*-test used reappraisal as measured by the SQ as the dependent variable. There was no significant difference between dysphoric and non-dysphoric participants in their spontaneous use of reappraisal, *t*(66) = -.18, *p* = .861.

Association between negative priming and emotion regulation. Pearson correlations (two-tailed) were conducted between individual negative priming index scores for positive and negative words and spontaneous use of rumination, suppression, and reappraisal as measured by the SQ. These correlations were first conducted across the full sample, and then within the dysphoric and non-dysphoric groups separately. Contrary to hypotheses, there were no

significant associations between negative priming index scores for positive or negative words and spontaneous use of rumination, suppression, and reappraisal, both across the full sample and within the participant groups separately. A table displaying the correlations between the negative priming index scores for the positive and negative words and spontaneous use of rumination, suppression, and reappraisal can be found in Appendix E.

Secondary analysis: Association between emotion regulation and mood. Change scores were computed for the PANAS-N subscale and the mood scale to assess mood change while watching the sadness-inducing film and during the post-film recovery period. Pre-film to post-film change scores were computed by subtracting pre-film mood ratings from post-film mood ratings for both the PANAS-N subscale and the mood scale to reflect emotional reactivity to the film. A post-film to post-recovery change score to assess speed of recovery from negative mood was computed by subtracting post-film mood ratings from post-recovery mood ratings for the mood scale only, as the PANAS was not administered after the post-film recovery period.

A set of regression analyses was carried out to test the effect of spontaneous emotion regulation and its interaction with dysphoria status on emotional reactivity to the film and speed of recovery from negative mood. Using the pre-film to post-film change scores on the PANAS-N as the dependent variable, three different regression analyses were conducted with the following independent variables: 1) Group (scored as a dummy variable), reported spontaneous use of suppression on the SQ, and the interaction term (Group × Suppression); 2) Group, reported spontaneous use of reappraisal, and the interaction term (Group × Reappraisal; and 3) Group, reported spontaneous use of rumination, and the interaction term (Group × Rumination). This set of regression analyses was then carried out on the pre-film to post-film change scores on the

mood scale as the dependent variable and then the post-film to post-recovery change scores on the mood scale as the dependent variable.

In the analyses with pre-film to post-film change scores on the PANAS-N as the dependent variable, there was a significant interaction between group and reappraisal, $t(64) = -2.98$, $p = .004$, $\beta = -.41$. Follow-up tests showed that high levels of reappraisal were related to less negative shift in mood while watching the film only for the dysphoric participants, $t(26) = -2.62$, $p = .015$, $\beta = -.46$, but not for the non-dysphoric participants, $t(38) = .22$, $p = .825$, $\beta = .04$. There was also a significant interaction between group and rumination, $t(64) = 2.92$, $p = .005$, $\beta = .44$. Follow-up tests showed that high levels of rumination were related to greater negative shift in mood while watching the film only for dysphoric participants, $t(26) = 2.43$, $p = .022$, $\beta = .43$, but not for non-dysphoric participants, $t(38) = .05$, $p = .958$, $\beta = .01$. No other significant effects involving spontaneous use of emotion regulation or its interaction with dysphoria were found.

In the analyses with pre-film to post-film change scores on the mood scale as the dependent variable, there was a significant main effect of suppression such that high levels of suppression were related to greater negative shift in mood while watching the film, $t(64) = -2.63$, $p = .011$, $\beta = -.38$. No other significant effects involving spontaneous use of emotion regulation or its interaction with dysphoria were found.

In the analyses with post-film to post-recovery change scores on the mood scale as the dependent variable, no significant effects involving spontaneous use of emotion regulation or its interaction with dysphoria were found.

3.5 Phase 2: Instructed Emotion Regulation Condition

The following set of analyses were conducted with the participants in the spontaneous emotion regulation condition ($n = 84$).

Group differences in ability to use reappraisal. Impaired ability to use cognitive reappraisal was operationalized as less self-reported use of reappraisal while watching the film and higher self-reported negative mood after watching the sadness-inducing film clip and after the recovery period. To determine whether the dysphoric and non-dysphoric groups differed in their use of reappraisal while watching the film, an independent samples *t*-test was conducted with reappraisal as measured by the SQ as the dependent variable and Group as the grouping variable. Contrary to hypothesis, there was no significant difference between the dysphoric and non-dysphoric groups in their reported use of reappraisal, $t(82) = .75$, $p = .455$.

Independent samples *t*-tests were also conducted with suppression and rumination as measured by the SQ as the dependent variables and Group as the grouping variable to determine whether dysphoric and non-dysphoric groups differed in their use of these strategies while watching the film. There was no significant difference between the dysphoric and non-dysphoric groups in their reported use of suppression, $t(82) = -1.54$, $p = .127$. However, dysphoric participants ($M = 12.08$, $SD = 5.05$) reported significantly greater use of rumination than non-dysphoric participants ($M = 9.50$, $SD = 3.20$), $t(60.09) = -2.73$, $p = .008$.

To assess whether dysphoric participants benefited less from instructed reappraisal than non-dysphoric participants (i.e., experienced more negative mood during the film and after the post-film recovery period), a 2 (Group; dysphoric vs. non-dysphoric) × 3 (Time; pre-film vs. post-film vs. post-recovery) mixed ANOVA was conducted with the mood scale as the dependent variable. There was a significant main effect of Time, $F(2, 81) = 36.64$, $p < .001$, $\eta_p^2 = .48$, and a significant main effect of Group, $F(1, 82) = 42.13$, $p < .001$, $\eta_p^2 = .34$, such that dysphoric participants had lower mood than non-dysphoric participants across time points. The predicted Group × Time interaction did not reach statistical significance, $F(2, 81) = 2.02$, $p =$

.139, η_p^2 = .05. No other effects were statistically significant, all *p*s > .10. Similar results were obtained using the negative subscale of the PANAS as the dependent variable in the analysis.

Association between negative priming and ability to use reappraisal. Pearson correlations (two-tailed) were conducted between the negative priming index scores for positive and negative words and use of reappraisal as measured by the SQ. There was a significant correlation between negative priming index scores and reappraisal, $r = .22$, $p = .046$, such that participants who were better able to inhibit negative words reported greater use of reappraisal when instructed to use reappraisal while watching the sadness-inducing film.

To determine whether inhibition for negative material influenced ability to obtain benefit from instructed reappraisal, regression analyses were conducted entering pre-film mood in step 1, BDI-II scores in step 2, and negative priming index scores for negative words in step 3 to predict post-film negative mood as measured by the mood scale. The full model was significant, $F(3, 79) = 18.65$, $p < .001$. Pre-film mood significantly predicted post-film mood, $t(79) = 4.39$, $p < .001$, and BDI-II scores significantly predicted post-film mood, $t(79) = -2.48$, $p = .015$. However, negative priming index scores for negative words did not significantly predict less negative mood, $t(79) = -.42$, $p = .674$. Similar results were obtained using the negative subscale of the PANAS as the dependent variable in the analysis.

Chapter 4: Discussion

The aim of the current study was to examine the relationships among individual differences in cognitive inhibition, emotion regulation, and depressive symptoms. Phase 1 of the study examined associations among trait levels of perceived attentional control, emotion regulation, and depressive symptoms, and tested whether habitual use of particular emotion regulation strategies mediates the relationship between perceived attentional control and

depressive symptoms. Phase 2 of the study investigated the relationship between cognitive inhibition and both spontaneous use of emotion regulation strategies in response to a sad mood induction and ability to use an adaptive strategy, namely reappraisal, to repair induced sad mood.

The hypothesized relationships between trait levels of perceived attentional control, emotion regulation, and depressive symptoms were supported in Phase 1 of the study. As predicted, greater rumination and suppression were associated with higher levels of depressive symptoms, whereas greater reappraisal was associated with lower levels of depressive symptoms. These results replicate those of previous work on emotion regulation and depression (Gross & John, 2003; Nolen-Hoeksema et al., 2008), and are in line with the proposal that dysphoric and depressed individuals demonstrate differences in their habitual use of emotion regulation strategies relative to non-depressed individuals (Campbell-Sills et al., 2006; Garnefski & Kraaij, 2006, 2007). A novel aspect of the present study was the test of emotion regulation strategies as mediators of the relationship between perceived attentional control and depressive symptoms. Results confirmed that trait rumination, suppression, and reappraisal each significantly partially mediated the association between attentional control and depressive symptoms. Rumination was the strongest mediator, followed by reappraisal, and then suppression. Although the present test of these relationships is weakened by the use of a self-report measure of attentional control rather than a behavioural measure, these results converge with those of a study that found that rumination mediated the relationship between impaired cognitive control, as assessed by a behavioural measure, and later depressive symptoms in a sample of remitted depressed individuals (Demeyer, De Lissnyder, Koster, & De Raedt, 2012).

Results from Phase 2 of the study revealed that both dysphoric and non-dysphoric participants were able to successfully inhibit emotional stimuli, as reflected in greater reaction

times in the NAP task to experimental versus control trials, which is the standard negative affective priming effect (Wentura, 1999). There was also an overall effect of valence, such that participants were slower to respond to negative target stimuli than positive target stimuli. However, contrary to predictions and the findings of previous studies, no significant differences in cognitive inhibition of negative or positive stimuli were found between the dysphoric and non-dysphoric participant groups.

The lack of a group difference in cognitive inhibition of negative stimuli is inconsistent with the results of several studies that have demonstrated that dysphoric and depressed individuals show impairments in cognitively controlling and inhibiting negative information (Frings et al., 2007; Goeleven et al., 2006; Joormann, 2004; Joormann & Gotlib, 2010). It is important to emphasize that this study found the standard negative affective priming effect such that both dysphoric and non-dysphoric participants were slower to respond to experimental than control trials. Thus, there was not a failure of the employed experimental task, the NAP task, to assess cognitive inhibition via negative priming. One explanation for the lack of significant difference between dysphoric and non-dysphoric individuals in cognitive inhibition of negative words is that the present study used an analog sample of dysphoric participants and it may be that deficits in cognitive inhibition are more pronounced and thus more readily observed in clinically depressed individuals. This explanation is somewhat unconvincing, however, as other studies have demonstrated reduced cognitive inhibition in dysphoric individuals (e.g., Frings et al., 2007; Joormann, 2004). Furthermore, the present study used more stringent cut-offs for levels of depressive symptoms to form dysphoric and non-dysphoric participant groups than previous studies. Whereas both Frings et al. (2007) and Joormann (2004) used a median split on depressive symptom measures to form their dysphoric and non-dysphoric groups for analyses,

extreme groups (cut-off scores of ≤ 6 on the BDI-II for the non-dysphoric group and ≥ 20 on the BDI-II for the dysphoric group) were used in this study. The present study also had a considerably larger sample size (n = 66 for the dysphoric group and n = 86 for the non-dysphoric group) than both Frings et al. (2007; n = 21 for the dysphoric group and n = 21 for the non-dysphoric group) and Joormann (2004; n = 37 for the dysphoric group and n = 37 for the non-dysphoric group). Thus, the current study was adequately if not over-powered to detect the effect. However, the possibility remains that cognitive inhibition deficits for negative information may be more consistently observed in clinically depressed individuals, and this study should be replicated with a clinical sample to test this possibility.

An alternative explanation for these null results concerns the stimuli used in the NAP task. There were two differences between this study and the bulk of other studies that have used the NAP task with regard to the word stimuli used. First, the probe distracters in the task in this study were neutral words, whereas several other studies have used emotional words incongruent in valence to the probe target (e.g., Joormann, 2004; Joormann, 2006; Goeleven et al., 2008). In his seminal paper in which he introduced the NAP task, Wentura (1999) recommended the use of neutral probe distracters, as the use of emotional words which require participants to inhibit an emotional distracter in the probe trial could interfere with the assessment of inhibition of the previous prime distracter. A recent study that used the NAP task followed Wentura's (1999) original recommendation and observed significant relationships among inhibition, rumination, and depressive symptoms (Zetsche & Joormann, 2011). Still, this stimuli difference prevents direct comparison of results from the current study and several previous studies that have employed the NAP task.

Second, the negative, neutral, and positive word stimuli were matched on arousal in the current study, whereas previous studies have used neutral words that have significantly lower arousal ratings than the negative and positive words (e.g., Joormann & Gotlib, 2010; Zetsche & Joormann, 2011), thus confounding valence and arousal. This is problematic because depression is highly comorbid with anxiety (Kessler, Chiu, Delmer, & Walters, 2005), and anxiety is characterized by information processing biases that favour the processing of anxiety-relevant (i.e., negative and highly arousing) information (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007). Thus, the results of previous studies that have used the NAP task to examine inhibition and its relation to depression may be confounded by the possibility that observed deficits in inhibition may be due to the arousal level of the negative words rather than their negative valence alone, and these deficits may be influenced by participants' anxiety levels, rather than, or in addition to, their depression. It is clear that more research is needed to determine how the valence and arousal levels of the distracter stimuli affect the ability of the NAP task to detect depression-related inhibition deficits.

Given the lack of an association between cognitive inhibition of negative or positive stimuli as assessed by the NAP task and depressive symptoms, it is perhaps unsurprising that no significant associations were found between cognitive inhibition and spontaneous engagement in various emotion regulation strategies in the spontaneous emotion regulation condition. Greater ability to inhibit negative stimuli was significantly associated with self-reported use of reappraisal in the instructed emotion regulation condition. However, cognitive inhibition did not significantly predict emotional reactivity to the sadness-inducing film. Thus, the hypotheses regarding the relationship between cognitive inhibition and both spontaneous and instructed emotion regulation were largely unsupported here. It is possible that these null results reflect a

problem with the measurement of cognitive inhibition using the NAP task in this study, rather than a true lack of association between cognitive inhibition and emotion regulation. Other recent studies have provided preliminary evidence that impaired cognitive control is indeed related to use of maladaptive emotion regulation strategies and depressive symptoms, and as discussed, further research is needed to reconcile these findings.

The most noteworthy findings of the present study pertain to group differences in emotion regulation. Consistent with hypotheses, dysphoric participants were more likely to spontaneously engage in rumination and suppression in response to the sadness-inducing film than non-dysphoric participants. Furthermore, for dysphoric participants only, spontaneous use of reappraisal was associated with less negative shift in mood while watching the sadness-inducing film and spontaneous use of rumination was associated with greater negative shift in mood while watching the film. Spontaneous use of suppression was related to greater negative shift in mood while watching the film for both dysphoric and non-dysphoric participants. It is possible that the relative lack of significant effects of spontaneous emotion regulation on emotional reactivity for the non-dysphoric participants reflects the relatively small variance in emotional reactivity of this group. No significant relationships were observed between spontaneous use of emotion regulation strategies and speed of recovery from negative mood in this study. Taken together, these results corroborate the idea that depression and depression vulnerability are related to maladaptive emotion regulation. Engaging in rumination and suppression appears to increase emotional reactivity whereas engaging in reappraisal lessens the emotional impact of a potentially emotional event.

The hypothesis that dysphoric individuals would be less able to use reappraisal and derive less benefit from its use than non-dysphoric individuals was not supported. Rather, the

results of this study suggest that dysphoric individuals are able to use reappraisal when instructed to do so, and derive similar benefit from its use to non-dysphoric individuals. Combining the results of the spontaneous and instructed emotion regulation conditions, it appears that dysphoria is related to a problematic choice of emotion regulation strategies, rather than deficits in ability to use adaptive strategies. If this is the case, interventions that promote and train functional emotion regulation may be effective in preventing and treating depression.

Alternatively, dysphoria and depression may be linked to impairments in only specific forms of emotion regulation (Ehrings et al., 2010). While dysphoric individuals may not display deficits in their use of reappraisal when instructed to use this strategy, they may show deficits in using other forms of instructed emotion regulation not tested in the present study, such as allocation of attention and situation selection (Ehring et al., 2010). Moreover, although dysphoric and non-dysphoric individuals did not differ in their use of reappraisal or its effectiveness in the instructed emotion regulation condition, dysphoric individuals continued to engage in higher levels of rumination than non-dysphoric individuals. Thus, instructing dysphoric individuals to use an adaptive emotion regulation strategy appears to increase their use of that strategy, but not simultaneously decrease their use of maladaptive emotion regulation strategies. Consequently, interventions and prevention programs for depression should emphasize reducing use of maladaptive emotion regulation strategies in addition to promoting and training use of adaptive ones. If deficits in cognitive control contribute to increased use of rumination as recently hypothesized (e.g., Joormann & D'Avanzato, 2010), cognitive control training may help ameliorate problematic use of rumination.

This study had several theoretical and methodological strengths that render it a valuable contribution to the empirical literature in this area. This study was the first to test whether

deficits in inhibition are related to both spontaneous and instructed emotion regulation in response to a negative mood induction, which represents a critical step in research on the associations among cognitive inhibition, emotion regulation, and depression. Furthermore, this study allowed for a comprehensive examination of the influence of dysphoria on trait emotion regulation, spontaneous emotion regulation, and instructed emotion regulation across several emotion regulation strategies including suppression, reappraisal, and rumination.

One of the methodological strengths of the present study was the large sample size. The very large sample size in Phase 1 of the study (N = 1625) permitted the use of structural equation modelling to test the hypothesized mediation of the relationship between perceived attentional control and depressive symptoms by habitual use of emotion regulation strategies. Phase 2 of the study also had a fairly large sample size (N = 152), which allowed for a powerful test of the study hypotheses. Another strength of this study was its rigorous recruitment method. Participants were first screened on the BDI-II in Phase 1 and only those who scored in the extremes on this measure (i.e., low or high) were permitted to sign up for Phase 2. The BDI-II was re-administered in-lab in Phase 2, and participants who no longer scored in the extremes were removed from analyses, thus maintaining a sample of participants whose status as dysphoric or non-dysphoric was relatively stable. In addition, this study employed the NAP task, which is one of the most commonly used measures of cognitive inhibition in this area of research, permitting comparison with other studies that have used the NAP task. Finally, this study used a method of mood induction that has strong empirical validation. The presentation of film clips is one of the most effective means of inducing negative mood (Westermann, Spies, Stahl, & Hesse, 1996), and the particular film clip used from *Dead Poets Society* was in the top

five ranked film clips for inducing sadness in a recent study assessing the effectiveness of a database of emotion-eliciting film clips (Schaefer et al., 2010).

There are a number of limitations to the present study that warrant discussion. First, the use of an analog sample of dysphoric individuals limits the conclusions that can be drawn from this study about clinical depression. Previous work has shown that young people with elevated depressive symptoms are at a greater risk of developing clinical depression in the future (Fergusson, Horwood, Ridder, & Beautrais, 2005). Thus, the results of this study provide information about cognitive and affective processes in individuals who are potentially vulnerable to developing clinical depression. It would be valuable, however, to replicate this study with a clinically depressed sample. Second, the current sample was a relatively homogenous undergraduate student sample, consisting predominantly of Caucasian, single females. Replication in more diverse samples is necessary to generalize findings to other populations.

Third, the present study used a single paradigm, the NAP task, to assess cognitive inhibition. Cognitive inhibition is a multifunctional set of processes that limit the access of information to working memory and update the contents of working memory by removing information that is no longer relevant (Hasher & Zacks, 1988). The NAP task assesses only one of the functions of cognitive inhibition: the ability to control and limit the access of irrelevant information to working memory. A study by Joormann and Gotlib (2008) used a modified Sternberg task that required participants to ignore a previously memorized list of words, and thus assessed the updating function of working memory. This study showed that depressed participants had more difficulty removing irrelevant information from working memory when this information was negative, and this difficulty was also associated with rumination.

Furthermore, cognitive inhibition is subsumed under the broader construct of cognitive control. Cognitive control is thought to involve the separate but interrelated functions of monitoring and updating working memory representations, inhibition, and mental set shifting (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). Numerous behavioural tasks have been developed to assess various aspects of cognitive and attentional control. The majority of these tasks measure cognitive control ability for externally presented stimuli. However, one recently developed task, the Internal Switch Task (IST), was designed to measure cognitive control for internal mental representations held in working memory. Using the IST to examine the relationship between cognitive control, emotion regulation, and depression, is appealing on a theoretical level given that depressive rumination and other forms of depressive thinking typically focus on internal negative content. Recent studies employing the IST have found support for hypothesized relationships between cognitive control deficits, rumination, and depression (De Lissnyder et al., 2012; Demeyer et al., 2012). In sum, there are alternative paradigms to the NAP task and future studies should investigate which are most valid and reliable for assessing different aspects of cognitive control. Moreover, future work employing these alternative paradigms should examine whether the associations between cognitive control, emotion regulation, and depression hold for cognitive control globally or only specific functions.

Lastly, this study is limited by its reliance on cross-sectional and correlational data. Studies that use cross-sectional data can only examine the magnitude of relationships between variables and are unable to test the directionality of these relationships. Prospective longitudinal studies are needed to test the critical hypothesis that impaired cognitive control leads to poor emotion regulation and depression in the future. Likewise, studies that use correlational data cannot test causality of the relationships between variables. Studies that involve the experimental

manipulation of cognitive control are required to determine whether cognitive control is a casual factor in the development of maladaptive emotion regulation and depression, rather than simply a factor associated with these outcomes. Establishing a causal link between cognitive control deficits and depression would have significant clinical implications for the prevention and treatment of depression. Emerging work suggests that cognitive control can be enhanced through training and cognitive control training can reduce rumination and depressive symptoms (Siegle, Ghinassi, & Thase, 2007). Additional research is needed, but these preliminary results are exciting in that they suggest that prevention and treatment programs for depression may be benefitted by the addition of cognitive training components.

Despite these limitations, the results of this study hold important implications for our understanding of depression and its treatment, as well as future research in this area. This study provides support for the notion that use of maladaptive emotion regulation strategies mediates the relationship between impaired attentional control and depressive symptoms. Furthermore, this study demonstrates that dysphoric individuals are more likely to spontaneously engage in maladaptive emotion regulation strategies such as suppression and rumination than non-dysphoric individuals in response to induced negative mood. In turn, spontaneous use of suppression and rumination predict greater negative emotionality whereas spontaneous use of reappraisal predicts less negative emotionality. Thus, dysphoric individuals appear to engage in regulation strategies that lead to greater negative emotion, which may contribute to sustained negative mood and depression. However, when instructed to use an adaptive emotion regulation strategy, dysphoric individuals are able to successfully employ that strategy. The promotion of functional emotion regulation and reduction of dysfunctional strategies should thus be a focus of prevention and treatment programs for depression. Further, to the extent that improving cognitive

control ability enhances functional emotion regulation, the addition of cognitive training to interventions for depression may improve their effectiveness. It remains for future research to further elucidate the relationships between cognitive control, emotion regulation, and depression, and use this knowledge to translate research findings to clinical practice.

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Appendices

Appendix A: Unpublished Self-Report Measures

Attentional Control Scale (ACS)

Instructions: Please rate each item using the following scale:

1	2	3	4
Almost never	Sometimes	Often	Always

---

1. It is very hard for me to concentrate on a difficult task when there are noises around.
2. When I need to concentrate and solve a problem, I have trouble focusing my attention.
3. When I am working hard on something, I still get distracted by events around me.
4. My concentration is good even if there is music in the room around me.
5. When concentrating, I can focus my attention so that I become unaware of what's going on in the room around me.
6. When I am reading or studying, I am easily distracted if there are people talking in the same room.
7. When trying to focus my attention on something, I have difficulty blocking out distracting thoughts.
8. I have a hard time concentrating when I'm excited about something.
9. When concentrating I ignore feelings of hunger or thirst.
10. I can quickly switch from one task to another.
11. It takes me a while to get really involved in a new task.
12. It is difficult for me to coordinate my attention between the listening and writing required when taking notes during lectures.
13. I can become interested in a new topic very quickly when I need to.
14. It is easy for me to read or write while I'm also talking on the phone.
15. I have trouble carrying on two conversations at once.
16. I have a hard time coming up with new ideas quickly.
17. After being interrupted or distracted, I can easily shift my attention back to what I was doing before.
18. When a distracting thought comes to mind, it is easy for me to shift my attention away from it.
19. It is easy for me to alternate between two different tasks.
20. It is hard for me to break from one way of thinking about something and look at it from another point of view.

Positive and Negative Affect Schedule (PANAS)

Directions: This scale consists of a number of words that describe different feelings and emotions. Read each item and then circle the appropriate answer next to that word. Indicate to what extent you feel this way right now.

Use the scale to the right of each item to record your answers.

	Very slightly or not at all	**A little**	**Moderately**	**Quite a bit**	**Extremely**
1. Interested	1	2	3	4	5
2. Distressed	1	2	3	4	5
3. Excited	1	2	3	4	5
4. Upset	1	2	3	4	5
5. Strong	1	2	3	4	5
6. Guilty	1	2	3	4	5
7. Scared	1	2	3	4	5
8. Hostile	1	2	3	4	5
9. Enthusiastic	1	2	3	4	5
10. Proud	1	2	3	4	5
11. Irritable	1	2	3	4	5
12. Alert	1	2	3	4	5
13. Ashamed	1	2	3	4	5
14. Inspired	1	2	3	4	5
15. Nervous	1	2	3	4	5
16. Determined	1	2	3	4	5
17. Attentive	1	2	3	4	5
18. Jittery	1	2	3	4	5
19. Active	1	2	3	4	5
20. Afraid	1	2	3	4	5

Strategies Questionnaire (SQ)

Instructions: We are interested in how you experience and manage emotions. Below is a list of things that people might think or do when they watch an emotional film. Using the rating scale below, please indicate the extent to which you agree with the following statements about your experience while watching the film. Please write the number that corresponds to your response in the blank area to the left of each statement.

1----------2----------3----------4----------5----------6----------7
strongly disagree **neutral** **strongly agree**

1. _____I tried not to let my feelings show.
2. _____I thought about how the film made me feel.
3. _____I tried to suppress my emotions.
4. _____I tried to distract myself from the content and/or emotions of the film.
5. _____I thought about the film in a way that helps me to experience less emotion.
6. _____I thought about something unrelated to the film
7. _____I tried to adopt an unemotional attitude toward the film.
8. _____I thought about how the content and/or emotions in the film are relevant to me.
9. _____I tried to keep my emotions to myself.
10. _____I thought about the film in a way that made me feel neutral.
11. _____I tried not to think about how the film made me feel.
12. _____I focused on the emotions depicted in the film.

Appendix B: Word Stimuli Used in Negative Affective Priming (NAP) Task

Category	Word	Valence mean	Arousal mean	Word length	Word frequency
Negative	Addicted	2.51	4.81	8	3
Negative	Alone	2.41	4.83	5	195
Negative	Anguished	2.12	5.33	9	2
Negative	Bloody	2.9	6.41	6	8
Negative	Bored	2.95	2.83	5	14
Negative	Broken	3.05	5.43	6	63
Negative	Burdened	2.5	5.63	8	4
Negative	Confused	3.21	6.03	8	44
Negative	Cruel	1.97	5.68	5	15
Negative	Crushed	2.21	5.52	7	10
Negative	Dead	1.94	5.73	4	174
Negative	Defeated	2.32	5.09	8	15
Negative	Depressed	1.83	4.72	9	11
Negative	Dirty	3.08	4.88	5	36
Negative	Disgusted	2.45	5.42	9	6
Negative	Dreadful	2.26	5.84	8	10
Negative	Evil	3.23	6.39	4	72
Negative	Fatigued	3.28	2.64	8	3
Negative	Fearful	2.25	6.33	7	13
Negative	Frustrated	2.48	5.61	10	10
Negative	Guilty	2.63	6.04	6	29
Negative	Helpless	2.2	5.34	8	21
Negative	Hurt	1.9	5.85	4	37
Negative	Immoral	3.5	4.98	7	5
Negative	Inferior	3.07	3.83	8	7
Negative	Insecure	2.36	5.56	8	3
Negative	Lonely	2.17	4.51	6	25
Negative	Lost	2.82	5.82	4	173
Negative	Meek	3.87	3.8	4	10
Negative	Regretful	2.28	5.74	9	1
Negative	Rejected	1.5	6.37	8	33
Negative	Scornful	3.02	5.04	8	5
Negative	Selfish	2.42	5.5	7	8
Negative	Shamed	2.5	4.88	6	1
Negative	Sick	1.9	4.29	4	51
Negative	Sinful	2.93	6.29	6	3
Negative	Stupid	2.31	4.72	6	24

Negative	Tense	3.56	6.53	5	15
Negative	Terrible	1.93	6.27	8	45
Negative	Troubled	2.17	5.94	8	31
Negative	Ugly	2.43	5.38	4	21
Negative	Unhappy	1.57	4.18	7	26
Negative	Upset	2	5.86	5	14
Negative	Useless	2.13	4.87	7	17
Neutral	Aggressive	5.1	5.83	10	17
Neutral	Aloof	4.9	4.28	5	5
Neutral	Astonished	6.56	6.58	10	6
Neutral	Awed	6.7	5.74	4	5
Neutral	Blond	6.43	5.07	5	11
Neutral	Bold	6.8	5.6	4	21
Neutral	Consoled	5.78	4.43	8	2
Neutral	Curious	6.08	5.82	7	46
Neutral	Dark	4.71	4.28	4	185
Neutral	Defiant	4.26	6.1	7	3
Neutral	Famous	6.98	5.73	6	89
Neutral	Hard	5.22	5.12	4	202
Neutral	Humble	5.86	3.74	6	18
Neutral	Innocent	6.51	4.21	8	37
Neutral	Lavish	6.21	4.93	6	3
Neutral	Limber	5.68	4.57	6	2
Neutral	Mighty	6.54	5.61	6	29
Neutral	Modest	5.76	3.98	6	29
Neutral	Muscular	6.82	5.47	8	16
Neutral	Mystic	6	4.84	6	3
Neutral	Natural	6.59	4.09	7	156
Neutral	Nice	6.55	4.38	4	75
Neutral	Noisy	5.02	6.38	5	6
Neutral	Nonchalant	4.74	3.12	10	1
Neutral	Patient	5.29	4.21	7	86
Neutral	Powerful	6.84	5.83	8	63
Neutral	Quick	6.64	6.57	5	68
Neutral	Quiet	5.58	2.82	5	76
Neutral	Radiant	6.73	5.39	7	8
Neutral	Rough	4.74	5.33	5	41
Neutral	Serious	5.08	4	7	116
Neutral	Sheltered	5.75	4.28	9	4
Neutral	Skeptical	4.52	4.91	9	7
Neutral	Smooth	6.58	4.91	6	42

Neutral	Solemn	4.32	3.56	6	12
Neutral	Startled	4.5	6.93	8	21
Neutral	Stiff	4.68	4.02	5	21
Neutral	Subdued	4.67	2.9	7	8
Neutral	Swift	6.46	5.39	5	32
Neutral	Tender	6.93	4.88	6	11
Neutral	Thankful	6.89	4.34	8	6
Neutral	Tidy	6.3	3.98	4	1
Neutral	Vigorous	6.79	5.9	8	29
Neutral	Young	6.89	5.64	5	385
Positive	Admired	7.74	6.11	7	17
Positive	Adorable	7.81	5.12	8	3
Positive	Alive	7.25	5.5	5	57
Positive	Beautiful	7.6	6.17	9	127
Positive	Brave	7.15	6.15	5	24
Positive	Bright	7.5	5.4	6	87
Positive	Capable	7.16	5.08	7	66
Positive	Carefree	7.54	4.17	8	9
Positive	Confident	7.98	6.22	9	16
Positive	Cozy	7.39	3.32	4	1
Positive	Cute	7.62	5.53	4	5
Positive	Devoted	7.41	5.23	7	51
Positive	Dignified	7.1	4.12	9	7
Positive	Easygoing	7.2	4.3	9	1
Positive	Elated	7.45	6.21	6	3
Positive	Elegant	7.43	4.53	7	14
Positive	Free	8.26	5.15	4	260
Positive	Friendly	8.43	5.11	8	61
Positive	Gentle	7.31	3.21	6	27
Positive	Grateful	7.37	4.58	8	25
Positive	Happy	8.21	6.49	5	98
Positive	Honest	7.7	5.32	6	47
Positive	Hopeful	7.1	5.78	7	12
Positive	Inspired	7.15	6.02	8	25
Positive	Joyful	8.22	5.98	6	1
Positive	Kind	7.59	4.46	4	313
Positive	Lively	7.2	5.53	6	26
Positive	Loved	8.64	6.38	5	56
Positive	Loyal	7.55	5.16	5	18
Positive	Masterful	7.09	5.2	9	2
Positive	Merry	7.9	5.9	5	8

Positive	Pretty	7.75	6.03	6	107
Positive	Protected	7.29	4.09	9	31
Positive	Proud	8.03	5.56	5	50
Positive	Respectful	7.22	4.6	10	4
Positive	Safe	7.07	3.86	4	58
Positive	Satisfied	7.94	4.94	9	36
Positive	Secure	7.57	3.14	6	30
Positive	Strong	7.11	5.92	6	202
Positive	Terrific	8.16	6.23	8	5
Positive	Thoughtful	7.65	5.72	10	11
Positive	Useful	7.14	4.26	6	58
Positive	Wealthy	7.7	5.8	7	12
Positive	Wise	7.52	3.91	4	36

Appendix C: Structural Equation Modelling Mediation Models

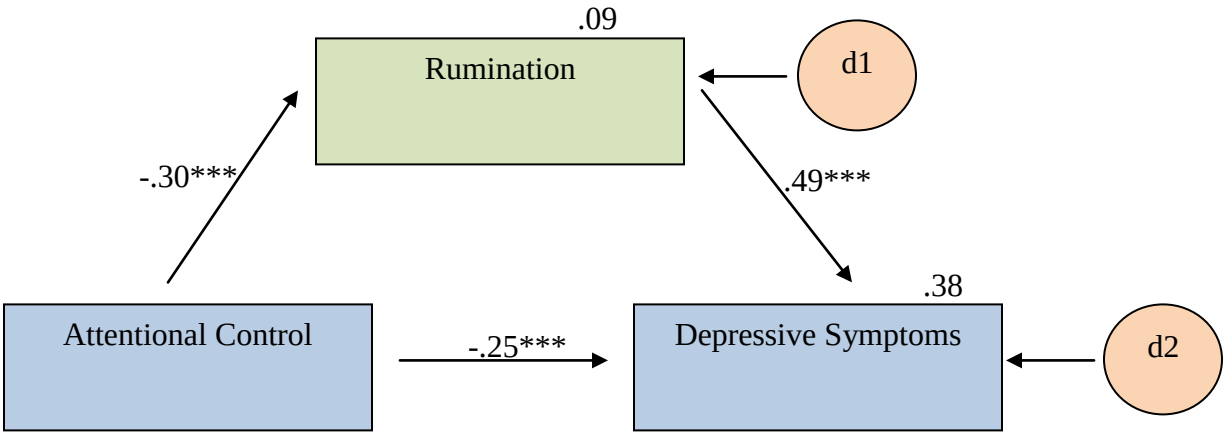

Figure 1. Mediation model with rumination mediating the relationship between attentional control and depressive symptoms. Values along paths are standardized regression weights. Values above endogenous variables are squared multiple correlations. *** $p < .001$.

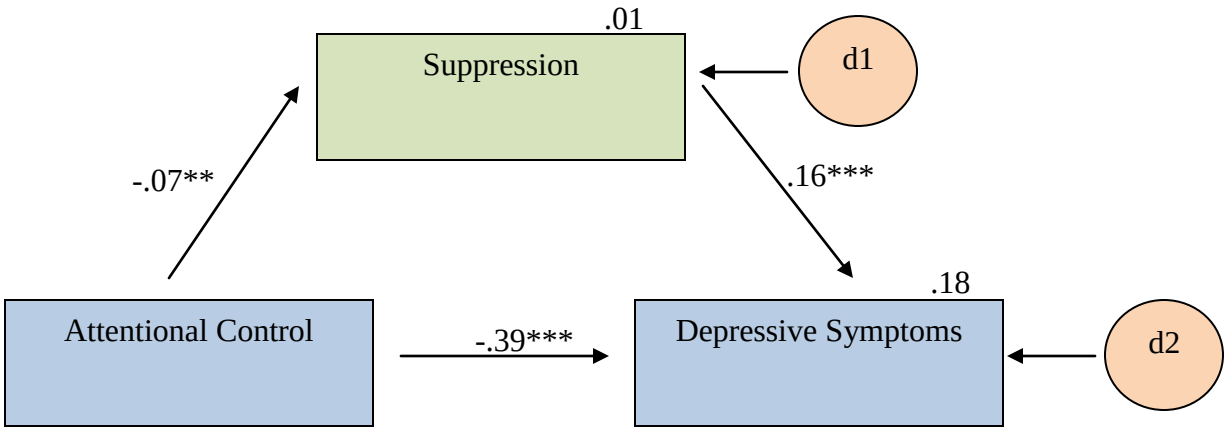

Figure 2. Mediation model with suppression mediating the relationship between attentional control and depressive symptoms. Values along paths are standardized regression weights. Values above endogenous variables are squared multiple correlations. ***p* <.01 **** p* < .001.

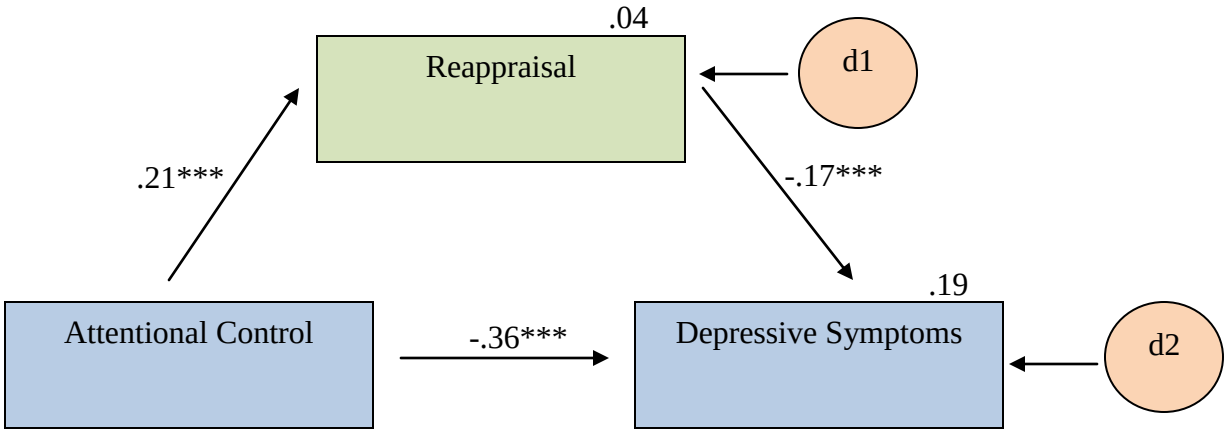

Figure 3. Mediation model with reappraisal mediating the relationship between attentional control and depressive symptoms. Values along paths are standardized regression weights. Values above endogenous variables are squared multiple correlations. *** $p < .001$.

Appendix D: Correlations among self-report measures administered in Phase 1: Trait Emotion Regulation.

Self-report measure	2	3	4	5
1. BDI-II	-.40**	.56**	.19**	-.25**
2. ACS	---	-.30**	-.07**	.21**
3. RRS		---	.14**	-.10**
4. ERQ-Suppression			---	-.03
5. ERQ-Reappraisal				---

Note. ** Correlation is significant at the $p < .01$ level. BDI-II = Beck Depression Inventory-II; ACS = Attentional Control Scale; RRS = Ruminative Responses Scale; ERQ-Suppression = Suppression subscale of the Emotion Regulation Questionnaire; ERQ-Reappraisal = Reappraisal subscale of the Emotion Regulation Questionnaire.

Appendix E: Correlations between negative priming index scores and spontaneous use of emotion regulation strategies as measured by the Strategies Questionnaire.

	Rumination	Suppression	Reappraisal
Full sample			
NP-N	.01	-.01	.15
NP-P	-.05	.12	-.09
Dysphoric group			
NP-N	-.10	.16	.20
NP-P	.09	.03	.11
Non-dysphoric group			
NP-N	.12	-.06	.12
NP-P	-.23	.15	-.28

Note. All correlations non-significant at the $p < 0.05$ level. NP-N = negative priming index scores for negative words; NP-P = negative priming index scores for positive words.