DEPRESSIVE THINKING

EXAMINING DEPRESSIVE THINKING FROM A FUNCTIONAL PERSPECTIVE:

ITS LINKS WITH STRESSORS, SADNESS, AND SYMPTOMS

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Lay Abstract

Depression is a mental health condition in part characterized by sadness and changes in thinking. One evolutionary perspective argues that depression is a response to complicated, personal problems, and that symptoms of depression, like sadness, help individuals think through their problems. According to this perspective, depressive thinking is analytical, and it involves causal thinking to identify why the problems happened and problem-solving to find potential solutions. In my dissertation, I examine whether individuals engage in causal thinking and problem-solving when they are sad or depressed. My experiments assess whether writing about personal problems promotes sadness and causal thinking, and they examine the impact of analytical thinking on changes in sadness during writing. Because the evolutionary perspective is one of several theories on depressive thinking, I also use a psychometric method to integrate these theories and to examine how causal thinking and problem-solving are linked with sadness and other depressive symptoms.

Abstract

Depression is a condition characterized by sadness and other symptoms, which are implicated in a persistent style of thinking referred to as depressive rumination. The *analytical rumination hypothesis* argues that depression is an adaptive response to complicated, personal problems, and that rumination involves an analysis of these problems. This analytical rumination has two stages: first, depressive symptoms promote causal analysis (i.e., considering why the problems happened). Causal analysis then leads to problem-solving analysis (i.e., finding ways to deal with problems), which in turn reduces depression. The empirical studies in this dissertation collectively test whether the nature of depressive thinking is consistent with the *analytical rumination hypothesis*. In Chapter 2, I investigated the temporal order of sadness and the stages of analytical rumination by asking participants to write about their personal problems. This writing paradigm promoted sadness and causal analysis, but not problem-solving analysis, suggesting that depressive symptoms coincide with causal thinking. In Chapter 3, I explored whether emotions during writing were related to analytical thinking by modifying the paradigm to isolate the impact of other factors (i.e., personal experience with the problem and its valence). These factors could not fully account for emotional changes during writing, suggesting that analytical thinking played a role. Analytical rumination is one of several theories of depressive thinking, so in Chapter 4, I conducted a joint factor analysis of four rumination questionnaires and compared the prevalence of the emerging factors. Factors reflecting causal thoughts and problem-solving were most frequently endorsed, even when they were measured in the presence of sadness induced by the writing paradigm in Chapter 5. Furthermore, associations between these factors and depressive symptoms were consistent with the stages of analytical rumination. Overall, my findings suggest that depressive thinking focuses on understanding and solving problems, and it may have functional implications for depression.

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I thank Anna and Sarah for making the Evo-Health Lab a cheerier place to work, and all the members of the lab who have helped me in countless ways over the years. Much of the work in this dissertation is the result of many hours spent collecting and processing data by various students and volunteers, and it is improved by the thoughts, ideas, and suggestions of other researchers and collaborators.

I also thank my parents for their love, support, and patience. I am lucky to have been only a phone call or bike ride away from two incredibly caring people, and their presence has made all the difference. Lastly, I thank Graham and my friends for providing much-needed distractions, and for tolerating my tendency to turn every space I'm in into an office.

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Declaration of Academic Achievement

This dissertation includes an introduction (Chapter 1), four empirical investigations that are to be submitted for publication in scientific journals (Studies 1 and 2 in Chapter 2, Studies 1 and 2 in Chapter 3, one study in Chapter 4, and one study in Chapter 5), and a general discussion of the empirical work (Chapter 6). As the author of this dissertation, I will be the first author on the manuscripts in Chapters 2–5, and my supervisor, Dr. Paul Andrews (McMaster University), will be the last author. All studies in Chapters 2–5 were carried out in collaboration with Dr. Andrews and with input from my supervisory committee, Dr. Steven Brown (McMaster University) and Dr. David Shore (McMaster University). For all the studies in this dissertation, Dr. Andrews assisted with the conceptualization of the research design, statistical analyses, and interpretation of the results. He also provided edits and feedback on all drafts of the manuscripts. The contributions of other individuals to these studies is outlined below.

Chapter 2 consists of two studies using an expressive writing paradigm to study emotions and thoughts in response to a personal problem. I developed the design of the experiments, assisted with data collection, carried out data analyses, and wrote the manuscript. One study was included in the Honours Thesis of an undergraduate student, Alan Rheaume, who assisted with collecting and analyzing data for this study, and he is a second author on this manuscript. Dr. Louis Schmidt (McMaster University), who is the third author, assisted with the interpretation of the results for both studies and provided his feedback and edits in the manuscript.

Chapter 3 consists of two experiments attempting to dismantle aspects of expressive writing that affect emotion. I developed the design of the experiments, assisted with data collection, carried out statistical analyses, and wrote the manuscript. Each experiment was included in the Honours Theses of two undergraduate students, Liesbeth Frontjes and Niki Srikanth. Niki and Liesbeth provided their input regarding the design of the experiments, they assisted with data collection and statistical analyses, and they helped to interpret the study results. They also provided edits to the manuscript, and they are second and third authors on the submitted manuscript respectively.

Chapter 4 is a joint factor analysis of four measures of rumination, and a prospective, longitudinal study of the associations between the emerging rumination factors and depression. I developed the design of this study, collected the data, analyzed the results, and wrote the manuscript. Dr. Benoit Mulsant (The Center for Addiction and Mental Health) assisted with the interpretation of the study results and provided edits to the manuscript.

The study in Chapter 5 assesses the relative prevalence of the rumination factors during expressive writing, and it examines their links with emotions induced by writing. I developed the study's design, assisted with data collection, analyzed the data, and wrote the manuscript. Vamika Mann, an undergraduate research assistant, collected substantial portions of the data and assisted with statistical analyses, and she is the second author on the manuscript.

CHAPTER 1

Introduction

  Depression is a common mental health condition, often precipitated by a negative or stressful experience (Keller, Neale & Kendler, 2007). It is characterized by emotional, cognitive, somatic, and behavioural symptoms, such as persistent sadness, difficulties concentrating, a loss of interest in pleasurable activities, and changes in sleeping and eating habits (American Psychiatric Association, 2013). Although many symptoms can be markers of depression, emotional changes (i.e., sustained sadness or a loss of pleasure) are necessary for a diagnosis (Gotlib & Joorman, 2010). Cognitive changes are not central to diagnosis, but there is a large literature on how people think when they are depressed, sparking theoretical and empirical interest about the implications of these thoughts for emotional changes and other symptoms observed in depression.

  In this dissertation, I use two methods, a writing paradigm and joint factor analysis, to examine the content of depressive thinking and its link with depressive symptoms. My dissertation incorporates a variety of perspectives on depressive thinking, but it is primarily informed by an evolutionary approach referred to as the *analytical rumination hypothesis*, which argues that depressive thinking involves analyzing a problem or stressor that triggered the depression (Andrews & Thomson, 2009). This dissertation includes four chapters describing my empirical research. Collectively, these chapters address two related questions: does sadness in response to a problem or stressor engage analytical thinking? Is the content of depressive thinking best characterized as analytical rumination?

  Chapter 2 includes two experiments that assess whether sadness and the analysis of a problem can be induced with an experimental writing paradigm. In Chapter 3, I conduct two experiments examining why the writing paradigm promotes emotional change. Chapter 4 brings in other theoretical perspectives on depressive thinking, and it attempts to integrate them in a joint factor analysis. In Chapter 5, I re-visit the writing paradigm to examine depressive thinking in response to sadness over a stressor, extending findings from the joint factor analysis.

Background

Depression as a Reaction to Life Stressors

Virtually all cognitive theories of depression acknowledge the impact of negative life events in the etiology of depression to varying degrees (Abramson, Alloy & Metalsky, 1989; Beck, 1976). In the 1960's, depression in adulthood was conceptualized as a reaction to early maternal death or separation (Beck, Sethi & Tuthill, 1963; Bowlby, 1969; Redlich & Freedman, 1966), but this notion was not supported empirically (Crook & Eliot, 1980; Green, McLaughlin & Berglund, 2010). Instead, life stressors tend to precede or coincide with depressive episodes. The nature of these stressors is diverse, and they include the death of a loved one, interpersonal conflict, romantic relationship difficulties or divorce, health problems, dissatisfaction with oneself, or personal failure (Freud, 1917; Keller et al., 2007; Kendler et al., 1995; Lewinsohn, Rosenbaum, & Hoberson, 1988; Zisook & Schuchter, 1991).

Given that many different types of experiences have been linked with depression, researchers have tried to identify characteristics that are common to these experiences, rather than specifying their nature or type. For instance, Weary, Marsh, Gleicher and Edwards (1993) emphasize the uncontrollability of the stressor, suggesting that, to the degree the cause of the stressor is unknown, it will trigger depression. Andrews and Thomson (2009) argue that the complexity of a stressor is important, with dilemma-type situations without clear solutions or involving costly trade-offs being particularly depressogenic. Kendler and colleagues (2003) show that experiences involving loss or humiliation (or a combination of both) are more likely to trigger depression than other mental health conditions like anxiety. Furthermore, different symptom profiles might accompany different triggering events for functional reasons (Keller & Nesse, 2006). For instance, crying is prominent following a death or romantic loss, which might serve to elicit social support and sympathy from others, whereas pessimism and fatigue are commonly triggered by failure and stress, perhaps to decrease initiative and conserve resources (Keller & Nesse, 2005, 2006). Despite different views on the common characteristics of these precipitating experiences, most researchers seem to agree that to trigger depression, an experience or event must be subjectively important to the individual (Abramson et al., 1989; Haaga, Ersnt & Dyck,

1991; Metalsky, Halberstadt, & Abramson, 1987).

The emotional component of depression (e.g., sadness) is similarly recognized as a reaction to environmental triggers, with functional implications. Situations that decrease fitness, such as illness, social rejection, and loss of status and resources, have been hypothesized to elicit sadness (Levenson, 1999), with an emphasis in the clinical literature on loss, disappointment, or defeat (Beck & Freeman, 1990). Sadness might cue discrepancies between actual and desired states (e.g., in identity, between who one is and who one strives to be), or it may reflect the inability to achieve a goal or intended outcome (Carver, 2015; Luyten & Blatt, 2012). Other proposed triggers for sadness involve navigating the complexities of social relationships, such as managing reciprocity (Nesse, 1993) or balancing self-interests with those of others without breaking crucial, cooperative bonds (Andrews & Thomson, 2009).

Cognitive Hypotheses

Most cognitive hypotheses suggest that a negative experience or stressor is not sufficient to trigger depression, and that individuals' thoughts and attitudes following the experience modulate their risk for becoming depressed. Beck (1976) grouped these thoughts into three categories: negative thoughts about the self (i.e., as being deficient, inadequate, and unworthy), negative thoughts about the world (i.e., as being defeatist, disparaging, and hostile), and pessimistic expectations of the future. Psychometric studies have since suggested that these three categories are better conceptualized as a single tendency to engage in negative and self-relevant thinking (Haaga, Dyck & Ernst, 1991; McIntosh & Fischer, 2000).

Over time, pessimistic expectations of the future are thought to lead to an attitude of hopelessness (Abramson et al., 1989). These expectations are characterized by beliefs that positive outcomes will not occur, but negative ones will. When a negative event occurs, individuals with a hopeless attitude are also thought to form attributions about the event: it is uncontrollable, its consequences are global (or widespread) and enduring, and it has an internal cause (or reflects poorly on one's self-worth, abilities, or desirability) (Abramson et al., 1989). This attitude might affect depression to the degree that the individual is uncertain about the accuracy of these attributions, with some evidence suggesting that depressed individuals are motivated to assess the accuracy of these attributions, for example, by being

more sensitive to information useful for understanding or predicting the behaviour of others (Weary et al., 1993). Nevertheless, a hopeless attitude is thought to form part of a cognitive profile that predisposes individuals to becoming depressed (Abramson et al., 1989).

Depressive Rumination

When depression is severe, negative and self-relevant cognitions become intense and persistent, and this style of thinking is referred to as depressive rumination (Beck, 1976). In the context of depression, most ruminative thinking is thought to be dysfunctional (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008), based on several studies suggesting that individuals who are predisposed to ruminate when feeling sad or experiencing distress tend to become depressed (Morrow & Nolen-Hoeksema, 1990; Nolen-Hoeksema & Morrow, 1993; Nolen-Hoeksema, Morrow & Frederickson, 1993). Although researchers agree that rumination is characterized by thoughts that are negative and persistent, there are a variety of theories about the precise content of this thinking (for a review, see Smith & Alloy, 2009; these theories are also described in Chapters 4 and 5). The *ruminative responses style theory* suggests that rumination involves two types of thoughts (Treynor, Gonzalez, & Nolen-Hoeksema, 2003): brooding, which reflects a tendency to engage in self-criticism or counterfactual thinking (i.e., thoughts about how a situation might have gone better), and reflective pondering, or a purposeful introspection and self-contemplation to overcome difficulties. Other researchers argue that, rather than involving self-criticism or instrumental thinking, rumination strictly focuses on feelings (i.e., *rumination on sadness*; Conway, Csank, Holm, & Blake, 2000). According to this approach, rumination involves thinking about the nature, meaning, and cause of sadness, as well as thinking about the intensity and repetitive nature of these thoughts. Rumination has also been described as a response to a negative event or stressor. This *stress-reactive rumination* is characterized by a persistent focus on negative attributions about the event, including thoughts about its uncontrollability, magnitude, and the degree to which it is caused by internal factors (Robinson & Alloy, 2003). Few attempts have been made to compare across these existing theories, so the question of how the content of depressive rumination is best characterized requires further investigation.

A Stress–Diathesis Model

Depressive thinking and rumination are typically understood as forming part of a stress–diathesis framework, which acknowledges the combined influence of stressful events (i.e., stress) and an individual's cognitive vulnerability or predisposition (i.e., the diathesis) in the development of depression (Beck, 2005). This framework posits that depressive rumination precedes depression. According to this stress–diathesis model, the pairing of a stressful event with an attitude characterized by hopelessness and negative attributions will produce negative, self-relevant thinking or rumination, which triggers depression. Some support for the stress–diathesis model has been found in cross-sectional and longitudinal studies, often following student samples throughout academic milestones, such as exams or acceptance into academic programs. In these studies, negative attitudes interact with poor grades or unsuccessful applications to predict depression, with negative, self-relevant thinking often mediating this association (Abela & D'Alessando, 2002; Abela, Stolow, Mineka, Yao, Zhu et al., 2011; Hankin, Wetter, Cheely & Oppenheimer, 2008; Kwon & Oei, 1992; Joiner, Metalsky, Lew & Klocek 1999; Metalsky et al., 1987). Depressive rumination can also mediate the link between stressful or negative events and depression (Ruscio et al., 2015), particularly in the presence of a negative or hopeless attitude (Alloy et al., 2000; Lyubomirsky & Nolen-Hoeksema, 1995; Robinson & Alloy, 2003). However, other studies have not supported this model, either by suggesting that negative or hopeless attitudes are not connected to negative or stressful events (Yeoh & Wilkinson, 2014) or that these attitudes do not predict depression (Barnett & Gotlib, 1990; Conway, Slavich & Hammen, 2015; Persons & Rao, 1985).

The Symptom Model

Other researchers argue that depressive rumination is a consequence of depressive symptoms following a stressful event, which is referred to as the symptom model (Lewinsohn, Steinmetz, Larson, & Franklin, 1981). Like the stress–diathesis model, the symptom model has gathered empirical support (Hamilton & Abramson, 1983; Silverman, Silverman, & Eardley, 1984; Simons, Garfield, & Murphy, 1984). Studies attempting to distinguish between the two models have produced inconsistent findings, with some studies supporting both the stress–diathesis and symptom models (Kwon & Oei, 1992; Stewart

et al., 2004), the stress–diathesis model alone (Oei, Goh, & Kwon, 1996; Oei & Kwon, 2007; Metalsky, Lew, & Klocek, 1999), or the symptom model alone (Oei, Hibberd, & O'Brien, 2005). Still others have proposed that the association is multi-directional (Possel & Black, 2014). When it comes to associations between depressive symptoms and thoughts, it is not clear that the current cognitive models have accurately captured their nature and temporal order.

It is widely accepted that important life stressors and the thoughts that follow these stressors are implicated in depression and the expression of its symptoms. However, there are inconsistencies in the literature about the temporal order of these constructs, which may have emerged, in part, because current cognitive models consider depressive thinking to be harmful or maladaptive. Negative, self-relevant thoughts (about the self, the world, and the future) are considered dysfunctional to the degree that they do not reflect reality or an accurate perception of events (Beck, 1971). Similarly, a negative event's attribution as uncontrollable, global, or internal is thought to be useful if it is accurate (Abramson et al., 1989). Because depressive thoughts and attitudes were assumed to distort an individual's perception of reality, they were conceptualized as harmful precursors to, or consequences of, depressive episodes (Beck 1976; Clark & Beck, 1999). However, studies of depressive realism have challenged the notion that depressive thinking is based on an inaccurate representation of reality (Alloy & Abramson, 1979). These studies show that depressed individuals judge their ability to predict the likelihood of outcomes on laboratory tasks more accurately than non-depressed individuals, who seem to display an optimistic bias (for reviews, see Alloy & Abramson, 1988; Dobson & Franche, 1989), and this effect has also been extended to ecologically-valid domains (Dunning & Story, 1991). Furthermore, even if thoughts reflect pessimistic views of the self, the world, or the future, or if they are persistent, they may still be useful or serve a function. The studies in my dissertation test a model conceptualizing rumination as a consequence of depression (i.e., a symptom model), but from the perspective that there may be functional associations between rumination and depression.

An Evolutionary Approach

One evolutionary approach to depression argues that depressive thinking forms part of a normal,

adaptive process. This *analytical rumination hypothesis* (Andrews & Thomson, 2009) posits that negative life events or stressors trigger depression when they present complicated problems that cannot be easily solved or ones that involve costly trade-offs or competing goals. Because dealing with these issues requires analysis, the various symptoms of depression (e.g., sadness, anhedonia, fatigue) coordinate to promote a state of sustained and effortful thinking about the situation (i.e., analytical rumination). Analytical rumination focuses on resolving the problem, and progress at its resolution alleviates depressive symptoms. Over time, the process of analytical rumination functions to address the triggering problem and alleviate the depressive episode (Andrews & Thomson, 2009).

The *analytical rumination hypothesis* was developed based on clinical, neurobiological, and evolutionary research (reviewed in Andrews & Thomson, 2009), but one of its most compelling lines of evidence concerns the utility of negative emotion for promoting appropriate behaviours (Levenson, 1999; Watson & Andrews, 2002), focusing on how sadness and happiness (i.e., the emotional components of depression) affect cognition. Because sadness signals the presence of a threat or problem in the environment, it is thought to promote an analytical, effortful, and systematic style of thinking (outlined in Chapter 3). In contrast, happiness signals that the environment is favourable or benign, cuing a superficial processing style that relies on heuristics (Forgas, 2013). These effects have been supported by a variety of correlational and experimental studies (for a review, see Lerner et al., 2015). Given that depression, and particularly its emotional symptoms, are best conceptualized on a continuum (Beach & Amir, 2003; Krueger & Markon, 2006), analytical rumination could be a prolonged state of analytical thinking characterizing extreme or persistent sadness.

Analytical rumination involves two stages of thinking about a problem (Bartoskova et al., 2018; also outlined in Chapter 2). The first stage is causal analysis, or identifying why the problem happened, which includes features of other theoretical perspectives on depressive thinking, such as negative views of the self and counterfactuals (Beck, 1976; Treynor et al., 2003). Instead of viewing self-critical thoughts or counterfactuals as dysfunctional however, the *analytical rumination hypothesis* argues that this type of thinking helps to clarify one's role in the situation and to identify what could have been done to avoid it

(Andrews & Thomson, 2009). The second stage is problem-solving analysis, or finding ways to alleviate or cope with the cause of the problem. Because problems that trigger depression may involve difficult trade-offs or competing goals (Andrews & Thomson, 2009), problem-solving analysis involves considering how to take appropriate action while maintaining one's goals and learning from past mistakes or failures (Bartoskova et al., 2018).

Unlike other cognitive theories, the *analytical rumination hypothesis* proposes that the associations between the stages of analytical rumination and depressive symptoms are circular. According to this hypothesis, depressive symptoms promote causal analysis, which then leads to problem-solving analysis. In turn, problem-solving analysis reduces symptoms in a negative feedback loop. These associations have emerged in cross-sectional data (Bartoskova et al., 2018), suggesting that problem-solving analysis reduces symptoms in the short-term. The mechanism by which this happens is unclear; perhaps insight into which actions can best address the problem or prevent future problems reduces symptoms because it reflects progress at solving the problem (Bartoskova et al., 2018) or because it reduces uncertainty about the situation (Weary et al., 1993). Alternatively, the actions or behaviours following problem-solving analysis may directly improve the situation, which might reduce symptoms. Nevertheless, the implication is that over time, this circular process works to resolve the triggering problem, eventually alleviating the depressive episode. At the same time, depressive symptoms may be necessary to promote causal thinking about the problem, which is analytical and effortful, but useful for coping with the situation (Andrews & Thomson, 2009). In other words, to find effective ways for dealing a complicated problem, it may be necessary to address its cause, which requires a good understanding of why the problem happened or how it could have been avoided (Barbic, Durisko & Andrews, 2014). The studies in my dissertation examine whether this functional process might characterize depressive thinking, focusing on the short-term, circular associations between depressive symptoms, causal thinking, and problem-solving.

Research Rationale

Research into the cognitive characteristics of depression has moved away from examining the

content of depressive thinking (i.e., the specific types of thoughts characterizing depressive states) to cataloguing differences in cognitive processes between clinically depressed and non-depressed individuals. In other words, researchers are focusing on how depression affects the way individuals attend to, process, and remember information (Gotlib & Joorman, 2010). In various studies, depression has been associated with deficits in cognitive domains such as attention, working memory, and different forms of learning, as assessed by neuropsychological tests (Lee, Hermens, Porter, Redoblado-Hodge, 2011). These deficits have been interpreted as evidence to suggest that depressed individuals have difficulties engaging in productive thinking or problem-solving (Lyubomirsky & Nolen-Hoeksema, 1995). However, these deficits might emerge because depressed individuals are already engaging in productive thinking or problem-solving about personally-relevant problems or stressors, which interferes with their performance on laboratory tests (Andrews & Thomson, 2009). Accordingly, studies that do not provide depressed individuals the opportunity to ruminate (e.g., by ensuring attention is well-controlled by the demands of the laboratory task) do not find these depressive deficits (Gotlib & Joorman, 2010). Examining what depressed individuals think about can therefore help us understand why depression is associated with these processing deficits.

At the same time, changes in cognitive processing associated with depression can affect the content of thinking. Another widely-researched cognitive characteristic of depression is a potential negative bias in early stages of processing, with studies suggesting that depressed individuals are quicker to orient to or identify negative stimuli (for a review, see Mathews & MacLeod, 2005). However, these findings are inconsistent, and more robust effects seem to occur once negative information captures attention, with depression increasing a tendency to elaborate on this information and to have difficulties disengaging from it (Gotlib & Joorman, 2010). Thus, depressed individuals are not necessarily more likely to inaccurately perceive their environments as being more negative than they are. If the environment is negative, however, they tend to elaborate on its negative features more persistently, perhaps due to a slow, detail-oriented, and effortful style of processing. This effect of depression on processing can help explain why depressed individuals tend to engage in negative, self-relevant thinking

(i.e., rumination) after a negative experience. In sum, examining what depressed individuals think about can inform our understanding of the literature on other cognitive characteristics of depression (e.g., deficits and biases), suggesting that there is reason to re-visit the issue of the content of depressive thinking.

Furthermore, it may be useful to study the content of depressive thinking from a functional perspective. Some of the inconsistencies in the literature on the cognitive characteristics of depression (e.g., regarding the ordering of depressive symptoms and thoughts) might be resolved by considering their adaptive value. Specifically, the *analytical rumination hypothesis* proposes a circular association between depressive symptoms and thoughts: symptoms function to promote a causal understanding of the triggering problem or stressor, which may be necessary for effective problem-solving. To the extent that problem-solving produces meaningful insights or addresses the cause of the problem or stressor, it will reduce symptoms. The circular model has been empirically supported, but studies show that it can only be detected using psychometric measures of depressive thinking that reflects its functional purpose (Bartoskova et al., 2018). In other words, adopting an evolutionary perspective might generate new insights into our understanding of depressive thinking and its links with depressive symptoms. In my dissertation, I examine whether sadness in response to a stressor promotes analytical rumination, and whether the process of analytical rumination might characterize depressive thinking when comparing across the existing theoretical frameworks.

Research Methods

Expressive Writing

To examine depressive thinking, I use expressive writing (EW). This paradigm is described in Chapters 2, 3, and 5. Briefly, EW involves writing one's deepest thoughts and feelings about a negative event or problem for at least 15 minutes (Pennebaker & Beall, 1986). When used as a therapeutic intervention, EW is completed over multiple sessions (Pennebaker, 1997), and it has been associated with various physical and psychological health benefits (Fratarolli, 2006). EW also appears to reduce symptoms of depression (Gortner, Rude, & Pennebaker, 2006; Koopman et al., 2005; Krpan et al., 2013;

Sloan, Marx, Epstein, & Dobbs, 2008).

Rather than being interested in EW for its therapeutic purposes, however, the EW studies in my dissertation involve examining emotions and thoughts during a single session of writing. Despite observing beneficial long-term outcomes, studies have often demonstrated that participants experience transient increases in negative emotion immediately after EW (Pennebaker, 2004). These short-term increases in negative emotion are thought to index emotional and cognitive processing (Pascual-Leone, Yeryomenko, Morrison, Arnold & Kramer, 2016). It is possible that considering important, negative events or problems during EW induces the process of analytical rumination; sadness during writing may be related to analytical thinking, including causal analysis. Over time, causal analysis during EW might lead to considerations about how best to address the problem, which might help explain EW's role in reducing depressive symptoms. In my research, I use EW as a paradigm to induce emotions related to an ecologically valid stressor, and measure participants' thoughts with questionnaires, as well as with the use of linguistic data from the EW tasks.

Joint Factor Analysis

In addition to EW, I use a psychometric method to integrate various perspectives on the content of depressive thinking. Analytical rumination is only one such perspective, and, as discussed above, many other perspectives have been offered (for a review, see Smith & Alloy, 2009). Accordingly, a variety of questionnaires have been developed to measure depressive rumination (outlined in Chapter 4, Table 1). However, there have been few attempts to integrate these existing perspectives, and it is unclear what perspective (and corresponding questionnaire) best characterizes depressive thinking. Factor analysis is a useful two-step method to derive a parsimonious conceptual understanding of a set of measured variables. The first step, exploratory factor analysis, determines the number and nature of common factors needed to account for the pattern of correlations among the variables, and a subsequent confirmatory factor analysis provides a test of this factor structure (Fabrigar, Wegener, MacCallum, & Strahan, 1999). Researchers have completed factor analyses (or used data reduction methods) of individual rumination questionnaires to examine whether there are different types of depressive rumination. These analyses have yielded

different kinds of thoughts, such as thoughts about the presence and consequences of depressive symptoms, self-blame or criticism, and broad attempts at introspection or self-reflection (Lam, Smith, Checkley, Rijsdijk & Sham, 2003; Roberts, Gilboa & Gotlib, 1998; Treynor et al., 2003). Other factors involving problem-solving have emerged (Bartoskova et al., 2018), as well as thoughts about causation, such as analyzing oneself or recent events to understand the source of depression (Lam et al., 2003), thoughts about the causes of problems (Bartoskova et al., 2018), and thoughts about the causes and meaning of both feelings and problems (Raes, Hermans, Williams, Bijttebier & Eelen, 2008).

Given that there are many (competing and overlapping) possibilities for what characterizes depressive thinking, I conduct a joint factor analysis of four existing measures of depressive rumination. Joint factor analysis typically involves two or more measures representing various related constructs. It has been useful in elucidating the structure of worry, with rumination emerging as a distinct factor (Muris, Roelofs, Meesters & Boomsma, 2004), as well as in converging two existing theoretical approaches of depressive rumination (i.e., *ruminative response styles theory* and *rumination on sadness*) (Roelofs, Muris, Huibers, Peeters, & Arntz, 2006). Conducting a joint factor analysis of four existing depressive rumination questionnaires allows me to compare across the theoretical perspectives on depressive thinking, to begin to understand how it is best characterized and its associations with depressive symptoms.

Dissertation Outline

The next four chapters in my dissertation are empirical studies collectively testing whether the nature of depressive thinking is consistent with the analytical rumination hypothesis.

In Chapter 2, I investigate the temporal order of sadness and the stages of analytical rumination by inducing emotions related a personal problem with EW. I assess participants' thoughts during writing with questionnaires and by conducting a linguistic analysis of their writing tasks. My findings show that EW reliably induces sadness and causal analysis, but not problem-solving analysis, suggesting that depressive symptoms coincide with causal thinking. In Chapter 3, I examine why EW about a problem increases sadness, hypothesizing that sadness may be related to analytical or effortful thinking about the

problem or stressor (Andrews & Thomson, 2009; Forgas, 2013). In a set of experiments, I modify the writing paradigm in Chapter 2 to assess how personal experience with the writing topic and its valence affects emotions. My findings suggest that although personal experience and valence plays a role, some of the negative emotions felt during EW might be related to effortful or analytical processing. Collectively, studies from Chapters 2 and 3 provide evidence that sadness in response to a problem is related to causal and analytical thinking, which is consistent with the first stage of analytical rumination.

In Chapter 4, I conduct a joint factor analysis of four rumination questionnaires, and I examine associations between the emerging factors and depression in a prospective, longitudinal design. My findings suggest that questionnaire items related to problem-solving and causal analysis are most commonly endorsed, and that the factors representing these items are related to depression in a circular fashion. In Chapter 5, I demonstrate that these items are still commonly endorsed in response to sadness over a stressor, by assessing the prevalence of items from the four rumination questionnaires during EW. Findings from Chapters 4 and 5 suggest that comparing across the four theoretical perspectives, depressive thinking might be most aptly characterized by process of analytical rumination.

References

Abela, J. R., & D'Alessandro, D. U. (2002). Beck's cognitive theory of depression: A test of the diathesis-stress and causal mediation components. *British Journal of Clinical Psychology*, *41*(2), 111–128.

Abela, J. R., Stolow, D., Mineka, S., Yao, S., Zhu, X. Z., & Hankin, B. L. (2011). Cognitive vulnerability to depressive symptoms in adolescents in urban and rural Hunan, China: A multiwave longitudinal study. *Journal of Abnormal Psychology*, *120*(4), 765–778.

Abramson, L. Y., Metalsky, G. I., & Alloy, L. B. (1989). Hopelessness depression: A theory-based subtype of depression. *Psychological Review*, *96*(2), 358-372.

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders (DSM-5®)*. American Psychiatric Pub.

Andrews, P. W., & Thomson Jr, J. A. (2009). The bright side of being blue: depression as an adaptation for analyzing complex problems. *Psychological Review*, *116*(3), 620–654.

Alloy, L. B., & Abramson, L. Y. (1979). Judgment of contingency in depressed and nondepressed students: Sadder but wiser? *Journal of Experimental Psychology: General*, *108*(4), 441–485.

Alloy, L. B., & Abramson, L. Y. (1988). Depressive realism: Four theoretical perspectives. In L. B. Alloy (Ed.), *Cognitive processes in depression* (pp. 223–265). New York, NY, US: Guilford Press.

Alloy, L. B., Abramson, L. Y., Hogan, M. E., Whitehouse, W. G., Rose, D. T., Robinson, M. S., ... & Lapkin, J. B. (2000). The Temple-Wisconsin Cognitive Vulnerability to Depression Project: Lifetime history of Axis I psychopathology in individuals at high and low cognitive risk for depression. *Journal of Abnormal Psychology*, *109*(3), 403–418.

Beach, S. R., & Amir, N. (2003). Is depression taxonic, dimensional, or both? *Journal of Abnormal Psychology*,*112*(2), 228–236.

Bagby, R. M., & Parker, J. D. (2001). Relation of rumination and distraction with neuroticism and extraversion in a sample of patients with major depression. *Cognitive Therapy and Research*, *25*(1), 91–102.

Barbic, S. P., Durisko, Z., & Andrews, P. W. (2014). Measuring the bright side of being blue: A new tool for assessing analytical rumination in depression. *PloS One*, *9*(11), e112077.

Barnett, P. A., & Gotlib, I. H. (1990). Cognitive vulnerability to depressive symptoms among men and women. *Cognitive Therapy and Research*, *14*(1), 47–61.

Bartoskova, M., Sevcikova, M., Durisko, Z., Maslej, M. M., Barbic, S. P., Preiss, M., & Andrews, P. W. (2018). The form and function of depressive rumination. *Evolution and Human Behavior*, *39*(3), 277–289.

Beck, A. T. (1976). *Cognitive therapy and the emotional disorders. New* York: International Universities Press.

Beck, A. T. (2005). The current state of cognitive therapy: a 40-year retrospective. *Archives of General Psychiatry*, *62*(9), 953–959.

Beck, A. T., & Freeman, A. (1990). *Cognitive therapy of personality disorders.* New York: Guilford.

Beck, A. T., Sethi, B. B., & Tuthill, R. W. (1963). Childhood bereavement and adult depression. *Archives of General Psychiatry, 9*, 295–302.

Bowlby, J. (1969). *Attachment.* New York: Basic Books.

Clark, D. A., & Beck, A. T. (1999). *Scientific foundations of cognitive theory and therapy of depression*. New Jersey: John Wiley & Sons.

Conway, M., Csank, P. A., Holm, S. L., & Blake, C. K. (2000). On assessing individual differences in rumination on sadness. *Journal of Personality Assessment*, *75*(3), 404–425.

Conway, C. C., Slavich, G. M., & Hammen, C. (2015). Dysfunctional attitudes and affective responses to daily stressors: Separating cognitive, genetic, and clinical influences on stress reactivity. *Cognitive Therapy and Research*, *39*(3), 366–377.

Crook, T., & Eliot, J. (1980). Parental death during childhood and adult depression: A critical review of the literature. *Psychological Bulletin*, *87*(2), 252–259.

Dobson, K., & Franche, R. L. (1989). A conceptual and empirical review of the depressive realism hypothesis. *Canadian Journal of Behavioural Science*, *21*(4), 419–433.

Dunning, D., & Story, A. L. (1991). Depression, realism, and the overconfidence effect: Are the sadder wiser when predicting future actions and events? *Journal of Personality and Social Psychology*, *61*(4), 521–532.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods*, *4*(3), 272–299.

Forgas, J. P. (2013). Don't worry, be sad! On the cognitive, motivational, and interpersonal benefits of negative mood. *Current Directions in Psychological Science*, *22*(3), 225–232.

Frattaroli, J. (2006). Experimental disclosure and its moderators: a meta-analysis. *Psychological Bulletin*, *132*(6), 823–865.

Freud, S. (1917). Mourning and melancholia. *Collected Papers, IV,* 152-170.

Gortner, E. M., Rude, S. S., & Pennebaker, J. W. (2006). Benefits of expressive writing in lowering rumination and depressive symptoms. *Behavior Therapy*, *37*(3), 292–303.

Gotlib, I. H., & Joormann, J. (2010). Cognition and depression: Current status and future directions. *Annual Review of Clinical Psychology*, *6*, 285–312.

Green, J. G., McLaughlin, K. A., Berglund, P. A., Gruber, M. J., Sampson, N. A., Zaslavsky, A. M., & Kessler, R. C. (2010). Childhood adversities and adult psychiatric disorders in the national comorbidity survey replication I: associations with first onset of DSM-IV disorders. *Archives of General Psychiatry*, *67*(2), 113–123.

Haaga, D. A., & Beck, A. T. (1995). Perspectives on depressive realism: Implications for cognitive theory of depression. *Behaviour Research and Therapy*, *33*(1), 41–48.

Haaga, D. A., Dyck, M. J., & Ernst, D. (1991). Empirical status of cognitive theory of depression. *Psychological Bulletin*, *110*(2), 215–236.

Hamilton, E. W., & Abramson, L. Y. (1983). Cognitive patterns and major depressive disorder: A longitudinal study in a hospital setting. *Journal of Abnormal Psychology*, *92*(2), 173–184.

Joiner, T. E., Metalsky, G. I., Lew, A., & Klocek, J. (1999). Testing the causal mediation component of Beck's theory of depression: Evidence for specific mediation. *Cognitive Therapy and*

Research, *23*(4), 401–412.

Keller, M. C., Neale, M. C., & Kendler, K. S. (2007). Association of different adverse life events with distinct patterns of depressive symptoms. *American Journal of Psychiatry*, *164*(10), 1521–1529.

Keller, M. C., & Nesse, R. M. (2006). The evolutionary significance of depressive symptoms: different adverse situations lead to different depressive symptom patterns. *Journal of Personality and Social Psychology*, *91*(2), 316–330.

Keller, M. C., & Nesse, R. M. (2005). Is low mood an adaptation? Evidence for subtypes with symptoms that match precipitants. *Journal of Affective Disorders*, *86*(1), 27–35.

Kendler, K. S., Hettema, J. M., Butera, F., Gardner, C. O., & Prescott, C. A. (2003). Life event dimensions of loss, humiliation, entrapment, and danger in the prediction of onsets of major depression and generalized anxiety. *Archives of General Psychiatry*, *60*(8), 789–796.

Kendler, K. S., Walters, E. E., Neale, M. C., Kessler, R. C., Heath, A. C., & Eaves, L. J. (1995). The structure of the genetic and environmental risk factors for six major psychiatric disorders in women: Phobia, generalized anxiety disorder, panic disorder, bulimia, major depression, and alcoholism. *Archives of General Psychiatry*, *52*(5), 374–383.

Koopman, C., Ismailji, T., Holmes, D., Classen, C. C., Palesh, O., & Wales, T. (2005). The effects of expressive writing on pain, depression and posttraumatic stress disorder symptoms in survivors of intimate partner violence. *Journal of Health Psychology*, *10*(2), 211–221.

Krpan, K. M., Kross, E., Berman, M. G., Deldin, P. J., Askren, M. K., & Jonides, J. (2013). An everyday activity as a treatment for depression: the benefits of expressive writing for people diagnosed with major depressive disorder. *Journal of Affective Disorders*, *150*(3), 1148–1151.

Krueger, R. F., & Markon, K. E. (2006). Reinterpreting comorbidity: A model-based approach to understanding and classifying psychopathology. *Annual Review of Clinical Psychology, 2,* 111–133.

Kwon, S. M., & Oei, T. P. (1992). Differential causal roles of dysfunctional attitudes and automatic thoughts in depression. *Cognitive Therapy and Research*, *16*(3), 309–328.

Lam, D., Smith, N., Checkley, S., Rijsdijk, F., & Sham, P. (2003). Effect of neuroticism, response style and information processing on depression severity in a clinically depressed sample. *Psychological Medicine*, *33*(3), 469–479.

Lee, R. S., Hermens, D. F., Porter, M. A., & Redoblado-Hodge, M. A. (2012). A meta-analysis of cognitive deficits in first-episode major depressive disorder. *Journal of Affective Disorders, 140*(2), 113–124.

Lerner, J. S., Li, Y., Valdesolo, P., & Kassam, K. S. (2015). Emotion and decision-making. *Annual Review of Psychology*, *66*, 799–823.

Levenson, R. W. (1999). The intrapersonal functions of emotion. *Cognition & Emotion*, *13*(5), 481–504.

Lewinsohn, P. M., Hoberman, H. M., & Rosenbaum, M. (1988). A prospective study of risk factors for unipolar depression. *Journal of Abnormal Psychology*, *97*(3), 251–264.

Lewinsohn, P. M., Steinmetz, J. L., Larson, D. W., & Franklin, J. (1981). Depression-related cognitions: antecedent or consequence? *Journal of Abnormal Psychology*, *90*, 213–219.

Luyten, P., & Blatt, S. J. (2012). Psychodynamic treatment of depression. *Psychiatric Clinics, 35*(1), 111–129.

Lyubomirsky, S., & Nolen-Hoeksema, S. (1995). Effects of self-focused rumination on negative thinking and interpersonal problem solving. *Journal of Personality and Social Psychology*, *69*(1), 176–190.

Mathews, A., & MacLeod, C. (2005). Cognitive vulnerability to emotional disorders. *Annual Reviews of Clinical Psychology*, *1*, 167–195.

McIntosh, C. N., & Fischer, D. G. (2000). Beck's cognitive triad: One versus three factors. *Canadian Journal of Behavioural Science, 32*(3), 153–157.

Metalsky, G. I., Halberstadt, L. J., & Abramson, L. Y. (1987). Vulnerability to depressive mood reactions: Toward a more powerful test of the diathesis–stress and causal mediation components of the reformulated theory of depression. *Journal of Personality and Social Psychology*, *52*(2), 386–393.

Morrow, J., & Nolen-Hoeksema, S. (1990). Effects of responses to depression on the remediation of depressive affect. *Journal of Personality and Social Psychology*, *58*(3), 519–527.

Muris, P., Roelofs, J., Meesters, C., & Boomsma, P. (2004). Rumination and worry in nonclinical adolescents. *Cognitive Therapy and Research*, *28*(4), 539–554.

Nesse, R. M. (1993). Evolutionary explanations of emotions. *Human Nature, 1*(3), 261–289.

Nolen-Hoeksema, S., & Morrow, J. (1993). Effects of rumination and distraction on naturally occurring depressed mood. *Cognition & Emotion*, *7*(6), 561–570.

Nolen-Hoeksema, S., Morrow, J., & Fredrickson, B. L. (1993). Response styles and the duration of episodes of depressed mood. *Journal of Abnormal Psychology*, *102*(1), 20–28.

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science*, *3*(5), 400–424.

Oei, T. P. S., Goh, Y. W., & Kwon, S. M. (1996). A cross-cultural study of the integrated cognitive model of depression. *Cahiers de Psychologie Cognitive, 15*(3), 265–281.

Oei, T. P., Hibberd, E., & O'brien, A. J. (2005). Study of the integrated cognitive model of depression among Latin-Americans. *Australian and New Zealand Journal of Psychiatry*, *39*(10), 932–939.

Oei, T. P., & Kwon, S. M. (2007). Evaluation of the integrated cognitive model of depression and its specificity in a migrant population. *Depression and Anxiety*, *24*(2), 112–123.

Pascual-Leone, A., Yeryomenko, N., Morrison, O. P., Arnold, R., & Kramer, U. (2016). Does feeling bad, lead to feeling good? Arousal patterns during expressive writing. *Review of General Psychology*, *20*(3), 336–347.

Pennebaker, J. W. (1997). Writing about emotional experiences as a therapeutic process. *Psychological Science*, *8*(3), 162–166.

Pennebaker, J. W. (2004). Theories, therapies, and taxpayers: On the complexities of the expressive writing paradigm. *Clinical Psychology: Science and Practice*, *11*(2), 138–142.

Pennebaker, J.W., & Beall, S. K. (1986). Confronting a traumatic event: Toward an understanding of inhibition and disease. *Journal of Abnormal Psychology, 95*, 274–281.

Persons, J. B., & Rao, P. A. (1985). Longitudinal study of cognitions, life events, and depression in psychiatric inpatients. *Journal of Abnormal Psychology*, *94*(1), 51–63.

Pössel, P., & Black, S. W. (2014). Testing three different sequential mediational interpretations of Beck's cognitive model of the development of depression. *Journal of Clinical Psychology*, *70*(1), 72–94.

Raes, F., Hermans, D., Williams, J. M. G., Bijttebier, P., & Eelen, P. (2008). A "Triple W"-model of rumination on sadness: Why am I feeling sad, what's the meaning of my sadness, and wish I could stop thinking about my sadness (but I can't!). *Cognitive Therapy and Research*, *32*(4), 526–541.

Redlich, F. C., & Freedman, D. X. (1966). *The theory and practice of psychiatry.* New York: Basic Books.

Roberts, J. E., Gilboa, E., & Gotlib, I. H. (1998). Ruminative response style and vulnerability to episodes of dysphoria: Gender, neuroticism, and episode duration. *Cognitive Therapy and Research*, *22*(4), 401–423.

Robinson, M. S., & Alloy, L. B. (2003). Negative cognitive styles and stress-reactive rumination interact to predict depression: A prospective study. *Cognitive Therapy and Research*, *27*(3), 275–291.

Roelofs, J., Huibers, M., Peeters, F., Arntz, A., & van Os, J. (2008). Rumination and worrying as possible mediators in the relation between neuroticism and symptoms of depression and anxiety in clinically depressed individuals. *Behaviour Research and Therapy*, *46*(12), 1283–1289.

Ruscio, A. M., Gentes, E. L., Jones, J. D., Hallion, L. S., Coleman, E. S., & Swendsen, J. (2015). Rumination predicts heightened responding to stressful life events in major depressive disorder and generalized anxiety disorder. *Journal of Abnormal Psychology*, *124*(1), 17–26.

Silverman, J. S., Silverman, J. A., & Eardley, D. A. (1984). Do maladaptive attitudes cause depression? *Archives of General Psychiatry*, *41*(1), 28–30.

Sloan, D. M., Marx, B. P., Epstein, E. M., & Dobbs, J. L. (2008). Expressive writing buffers against maladaptive rumination. *Emotion*, *8*(2), 302–306.

Smith, J. M., & Alloy, L. B. (2009). A roadmap to rumination: A review of the definition, assessment,

and conceptualization of this multifaceted construct. *Clinical Psychology Review*, *29*(2), 116–128.

Stewart, S. M., Kennard, B. D., Lee, P. W. H., Hughes, C. W., Mayes, T. L., Emslie, G. J., & Lewinsohn, P. M. (2004). A cross-cultural investigation of cognitions and depressive symptoms in adolescents. *Journal of Abnormal Psychology, 113*, 248–257.

Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research*, *27*(3), 247–259.

Watson, P. J., & Andrews, P. W. (2002). Toward a revised evolutionary adaptationist analysis of depression: The social navigation hypothesis. *Journal of Affective Disorders*, *72*(1), 1–14.

Weary, G., Marsh, K. L., Gleicher, F., & Edwards, J. A. (1993). Depression, control motivation, and the processing of information about others. In K. L. Marsh, F. Gleicher, & G. Weary (Eds.) *Control motivation and social cognition* (pp. 255–287). Springer, New York, NY.

Yeoh, S. Y., & Wilkinson, P. (2014). Acute psychosocial stress does not increase dysfunctional attitudes. *Psychiatria Danubina*, *26*(1), 240–245.

Zisook, S., & Shuchter, S. R. (1991). Depression through the first year after the death of a spouse. *The American Journal of Psychiatry*, *148*(10), 1346–1352.

CHAPTER 2

Changes in emotion and causal analysis during expressive writing about a personal problem

Abstract

The *analytical rumination hypothesis* proposes that depression is an evolved response to complicated life stressors or problems. As part of this response, depressive symptoms promote a prolonged and distraction-resistant style of thinking referred to as analytical rumination. Analytical rumination involves thinking about why the problem happened (i.e., causal analysis), and how it can be addressed or alleviated (i.e., problem-solving analysis). Analyses of cross-sectional data suggest that causal analysis is directly related to symptoms and precedes problem-solving analysis, but this finding should be supported with experimental methods. In two studies, we used an expressive writing (EW) paradigm to investigate the temporal order of emotion, causal analysis, and problem-solving analysis. Compared to control writing, EW reliably increased sadness and reports of causal analysis, but it did not affect problem-solving analysis. In linguistic analyses of the writing tasks, we found evidence of both causal analysis and problem-solving. Collectively, our findings suggest that sadness co-occurs with causal thinking about a problem. We discuss the limitations of our studies, as well as EW's potential utility to studying the *analytical rumination hypothesis* of depression.

Introduction

Evolutionary approaches can contribute valuable insights to our understanding of mental health and specifically, the etiology of depression (Durisko, Mulsant, & Andrews, 2015; Durisko, Mulsant, McKenzie, & Andrews, 2016). Depression is a common condition that in most cases, emerges after highly stressful events or experiences (Angst, 2016; Keller, Neale, & Kendler, 2007). Its symptoms include anhedonia (an inability to feel pleasure), difficulties concentrating, changes in sleeping and eating habits, and most notably, persistent sadness (American Psychiatric Association, 2013). Some epidemiological characteristics of depression (i.e., high prevalence in the reproductive years, being triggered by a precipitating event) suggest that it may not be a disorder. Moreover, the non-random nature of its symptoms, which seem to be directed toward promoting a function, point to the possibility that depression could be adaptive (Durisko, Mulsant & Andrews, 2015).

The authors of the *analytical rumination hypothesis* argue that the function of depression is to promote a prolonged, distraction-resistant style of thinking referred to as analytical rumination (Andrews & Thomson, 2009). According to this perspective, depression is triggered by personal problems or stressors that are analytically complex, involving costly trade-offs or competing goals. Analytical rumination functions to cope with the problem. However, it is effortful and requires prioritized access to energetic and attentional resources (Andrews, Bharwani, Lee, Fox & Thomson, 2015). Consequently, the symptoms of depression, such as sadness, adaptively shift energy and attention away from distracting pleasurable pursuits toward focused, uninterrupted processing (Andrews & Thomson, 2009). Since it has been proposed, the *analytical rumination hypothesis* has received theoretical and empirical attention (e.g., Barbic, Durisko, & Andrews, 2014; Bartoskova et al., 2018; Hagen, 2011), but the connections between depressive symptoms and analytical rumination need more rigorous investigation. The current study used an experimental writing paradigm to examine the temporal order of emotion and the components of analytical rumination.

Analytical Rumination

Analytical rumination involves various thoughts about a stressor or personal problem, including clarifying its nature, determining its cause, as well as generating and evaluating potential solutions (Andrews & Thomson, 2009). The Analytical Rumination Questionnaire (Barbic et al., 2014) was developed to test the predictions of the analytical rumination hypothesis. According to a recent latent factor analysis, analytical rumination has two components (Bartoskova et al., 2018). Causal analysis (CA) involves attempts to understand the cause of problems, identify one's role in the situation, and consider what could have been done to avoid it. It includes self-blame and upward counterfactuals, which are thoughts about how a situation could have turned out better (Andrews & Thomson, 2009; Roese, 1997). The second component, problem-solving analysis (PSA), involves thoughts about how to solve problems under difficult or constrained conditions. These conditions could require trade-offs between competing demands, so PSA involves considering how to take appropriate action while maintaining one's goals and learning from past mistakes or failures (Bartoskova et al., 2018).

In a recent cross-sectional study, connections between depressive symptoms and the two components of analytical rumination were circular, and consistent with the model depicted in Figure 1 (Bartoskova et al., 2018). Symptoms promoted CA, which promoted PSA, and in turn, PSA reduced symptoms in a negative feedback loop. This model was supported in five samples that differed in clinical status, recruitment method, and nationality. These findings begin to demonstrate how the characteristics of depression might organize to promote a function (i.e., solving the triggering problem), implying that when a problem is particularly complicated, it may be necessary to first understand why it happened, before it can be solved (Barbic et al., 2014). Due to the cross-sectional design of the study however, the researchers could not establish the temporal order of CA and PSA. Further empirical work is needed to elucidate whether depressive symptoms occur closer in time to CA or PSA, to support the conceptual rationale that clarifying a problem precedes attempts to solve.

Counterfactual Thinking and Causal Uncertainty

The directionality proposed by Bartoskova and colleagues (i.e., CA preceding PSA) is supported by research on upward counterfactual thinking (i.e., thinking about how an event could have gone better) (Epstude & Roese, 2008). Visualization tasks and false negative feedback paradigms highlight how negative events, particularly mistakes or failed goals, trigger negative emotions, which activate counterfactual thinking (Markman, Gavanski, Sherman & McMullen, 1993; Roese & Olsen, 1997; Roese, Hur, & Pennington, 1999; Sanna & Turley, 1996). Generating an upward counterfactual can exacerbate negative emotion, but it also involves making a causal inference about the event, or identifying why it happened (Roese & Olsen, 1997; Wells & Gavanski, 1989). This causal inference is useful for generating ideas about actions or behaviours that will lead to a desired outcome in the future (Boninger, Gleicher, & Strathman, 1994; Roese, 1997). In one study, for example, students recalling bad grades on recent exams randomized to generate upward counterfactuals expressed more intentions to study for future exams, as compared to those who generated downward counterfactuals (i.e., thoughts about how the situation could been worse) (Roese, 1994). In turn, the frequency of upward counterfactual thinking about bad grades predicted changes in study habits, which were associated with higher scores on subsequent tests (Nasco & Marsh, 1996). Thus, negative emotions appear to promote causal inferencing in the form of upward counterfactuals, and this causal inferencing is useful for generating ideas about how to address the situation that triggered the negative emotions (Epstude & Roese, 2008; Roese & Olson, 1997). These findings are consistent with the analytical rumination model, which posits that sadness promotes thinking about the causes of difficult, personal problems (CA), and this causal thinking subsequently leads to thoughts about how to solve them (PSA).

In the context of depression, counterfactuals and other types of causal thoughts may be reactions to a perceived loss of control (Markman & Weary, 1998). Experimental, correlational, and longitudinal research suggests that perceptions of uncontrollability predict depression, at least when paired with expectations that the outcomes of events will be negative (Jacobson, Weary & Edwards, 1999; Weary, Marsh, Gleicher & Edwards, 1993). These perceptions are hypothesized to produce causal uncertainty, or

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a feeling of uncertainty about the depressed individual's ability to understand causal relations in the social world (Markman & Weary, 1998). Causal uncertainty motivates individuals to attend to information that helps them understand, predict, and control their social environments (Gleicher & Weary, 1991; Marsh & Weary, 1989; Weary & Gannon, 1996). Furthermore, this social processing appears to be analytical in nature, with experiments suggesting that it is more elaborate, systematic, and effortful for depressed individuals, as compared to non-depressed controls (Edwards & Weary, 1993; Edwards, Weary, & Gleicher 1991; Gleicher & Weary, 1991). In turn, social processing is thought to alleviate causal uncertainty and increase a sense of control (Markman & Weary, 1998; Weary et al., 1993). Thus, the analytical processing of social information may alleviate a perceived sense of causal uncertainty, which is hypothesized to trigger depression (Weary & Gannon, 1996).

Similarly, the *analytical rumination hypothesis* posits that causal thinking about a complicated problem (i.e., CA) is part of a process that alleviates depression. Under circumstances of constraint or when a solution is not apparent, it may be necessary to generate causal inferences before PSA can occur. Successfully identifying the cause of an issue generates ideas about what to do to improve circumstances or avoid future issues, and perhaps to regain a sense of control (Epstude & Roese, 2008). Counterfactual thinking is only one way to identify a situation's cause, and it contributes to one aspect of CA. Other CA aspects are causal inferences as well (e.g., directly considering why a problem happened or what the person had done wrong). PSA differs from regular problem-solving (such as the simple, behavioural intentions that follow counterfactual thinking) because it involves finding ways to deal with problems, form goals, or learn from mistakes under complicated circumstances, such as when there are limited resources, competing demands, or perhaps a high sense of causal uncertainty. In these situations, pinpointing the true cause of an issue may be difficult, but necessary so that the cause of the issue can be addressed. In other words, when circumstances are complicated, CA may be necessary for PSA to occur. Many studies support links between depression, causal uncertainty, and efforts to process the social environment (Weary et al., 1993). The temporal order of negative affect, counterfactual thinking, and

plans for constructive action are also well-supported (for reviews, see Epstude & Roese, 2008; Olson & Roese, 1997). However, it is not clear whether these predictions hold for sadness, CA, and PSA.

Expressive Writing

Expressive writing (EW) is a potentially useful paradigm for understanding the temporal relation between emotions, CA, and PSA, which is integral to the analytical rumination model. This intervention asks individuals to write their deepest thoughts and feelings about a negative issue or troubling experience for at least 15 minutes, typically over 3–4 sessions (Pennebaker & Beall, 1986). There is a large literature examining various physical and psychological health benefits associated with EW (for a meta-analysis, see Fratarolli, 2006). In some studies, EW appears to reduce depression as well (Baikie, Geerligs & Wilhelm, 2012; Gortner, Rude & Pennebaker, 2006; Koopman et al., 2005; Krpan et al., 2013; Sloan, Marx & Epstein, 2007). Despite these long-term benefits, EW produces transient increases in negative emotions after single sessions of writing. Many studies show that participants report more negative emotions after completing EW as compared to control writing tasks (Dickerson, Kemeny, Aziz, Kim & Fahey, 2004; Donelly & Murray, 1991; Greenberg & Stone, 1992; Kloss & Lisman, 2002; Pennebaker & Beall, 1986).

Unlike emotion induction paradigms that use an irrelevant stimulus (such as music or a video), changes in emotion after EW are related to the topic of writing, making it a useful paradigm to study the components of the analytical rumination model. Changes in emotion during EW are thought to reflect emotional and cognitive processing, or that participants are confronting difficult emotions and thinking deeply about their issues (Pascual-Leone, Yeryomenko, Morrison, Arnold, & Kramer, 2016). EW can therefore be tailored to promote emotions and thoughts related to an important, personal problem, and studying these emotions and thoughts can clarify the temporal order of sadness, CA, and PSA. Finding that sadness during EW coincides with CA, but not PSA, would suggest that CA precedes PSA in time, providing experimental support for the first step of the analytical rumination model. Furthermore, EW tasks are a source of rich linguistic data, and can be used as a proxy of people's thoughts about their problems. These tasks can be analyzed for linguistic evidence of causal thinking or problem-solving.

The Present Studies

We conducted two studies to assess whether EW about an important, personal problem promotes sadness, CA, and PSA. We asked participants to either complete a single session of EW or control writing, and we examined their emotions and thoughts over the course of writing. To capture changes in emotion induced by the EW and control writing tasks, participants rated their emotions at three times: before, during, and after writing. To rate their emotions, participants used the Valence-Arousal Mood Profile, a brief scale developed to assess rapid and subtle changes in emotional state (Maslej, Rheaume, Barbic, & Andrews, unpublished). This scale assesses four emotions (i.e., sadness, happiness, anxiety, calmness), allowing us to examine the effect of EW on sadness as well as other negative and positive emotional states. To measure analytical rumination and its components, participants completed an Analytical Rumination Questionnaire immediately after writing; however, we modified its instructions by asking participants to reflect on their thoughts during writing. We also completed linguistic analyses of the writing tasks, identifying language related to CA and problem-solving.

We had tentative expectations regarding the effects of EW on emotion and the analytical rumination components. EW studies often use a combined index of negative emotion, without distinguishing between changes in various emotions (e.g., Pennebaker & Beall, 1986; Pennebaker, Kiecolt-Glaser, & Glaser, 1988). Since depressive symptoms are thought to be triggered by difficult, personal problems (Andrews & Thomson, 2009), we expected EW about a problem to primarily affect sadness and not other negative emotions, such as anxiety. Based on previous work on the temporal order of causal thinking and problem-solving (Bartoskova et al., 2018; Epstude & Roese, 2008), we expected that during EW, participants would report thoughts reflecting CA, but not PSA.

Study 1

Method

Participants

We collected data from 107 undergraduate students (91 females, 16 males) recruited through a research participant pool at a Canadian university. We aimed for a sample of approximately 50

participants per condition, since the effect of EW on mood is rather large (e.g., Pennebaker & Beall, 1986), and a preliminary power analysis showed that our study required 49 participants per condition to achieve a high level of power (0.95).

The mean age of participants was 18.70 years (*SD*=1.82) and self-identified cultural backgrounds were white (44.1%), South Asian (18%), East Asian (11.2%), West Asian (6.8%), mixed (6.2%), black (3.7%), South East Asian (3.7%), and Latin American (0.6%). *Table 1* presents participant information for each writing condition. We did not make exclusions based on mental health status or writing ability.

Materials

The Valence-Arousal Mood Profile. The Valence-Arousal Mood Profile (Maslej et al., unpublished) is a 16-item measure of current emotional state, and it assesses each participant on four emotions: sad, happy, anxious, and calm. Each emotion is represented by 3–4 adjectives, and participants rate the degree to which the adjective describes their emotional state on a 9-point Likert scale ranging from 1 (*extremely inaccurate as a self-description*) to 9 (*extremely accurate as a self-description*). Responses are summed for each emotion to generate sadness, happiness, anxiety, and calmness scores for each participant.

The Analytical Rumination Questionnaire. The Analytical Rumination Questionnaire (Barbic et al., 2014) measures the extent to which participants have thought about their personal problems over the past two weeks, and it asks whether participants have thought about the nature and cause of their problems, generated potential solutions, and considered the consequences of solutions. This questionnaire consists of 18 items scored on a 5-point Likert scale ranging from 1 *(never)* to 5 *(all the time)*. Responses from each question are summed to generate a single measure of total AR for each participant. The questionnaire has high convergent and test-retest reliability, and its items are metrically invariant across sex, culture, and diagnostic status (Barbic et al., 2014). Six of its items form latent factors for CA and PSA (Bartoskova et al., 2018), which we used to assess the analytical rumination components in our analysis.

Writing Task Analysis

We performed a linguistic analysis of the writing tasks focusing on capturing the two analytical rumination components. We created lists of relevant words and phrases for CA and problem-solving, and we determined the proportions of the writing tasks that matched the words and phrases from each word list.

CA word list. Developing the CA list, we consulted a computer-based textual analysis program, the Linguistic Inquiry and Word Count (LIWC; Pennebaker & Francis, 1999). The LIWC calculates proportions of words in a text belonging to various word categories, and these categories have demonstrated validity with respect to the psychological process they represent (Tausczik & Pennebaker, 2010). The LIWC includes a causal word category containing words indicative of causal thinking, such as *because*, *affect*, and *why*, which we used as the basis of our CA list. However, we removed 17 words that were unrelated to CA (e.g., *boss*, *comply*, and *solve*), and we added words and phrases to capture specific aspects of CA. For example, *beginning*, *previous*, or *mistake* suggested participants were thinking about the past to understand what went wrong, and *blame* or *fault* reflected attempts to assign responsibility or blame. We also included words and phrases that indicated participants were considering how they could have avoided their problems, such as *instead*, *prevent*, and *if only*. Appendix A contains all 113 words and phrases in our CA list.

Problem-solving word list. PSA involves problem-solving under constraints, and it is measured with items on the Analytical Rumination Questionnaire that reflect attempts to learn from the past and manage competing goals. This type of thinking would likely be conveyed using subtle language and contextual cues, so we could not operationalize PSA by compiling a list of words and phrases. Instead, we created a list capturing language related to problem-solving in general.

We started with a subset of 41 words from the LIWC insight word category. These were words clearly related to problem-solving, such as *solution*, *lesson*, and *resolve*, as well as words indicating that participants were changing their thoughts or perspectives (e.g., *reconsider*, *reevaluate*) or accepting circumstances that perhaps could not be changed (e.g., *accept*, *forgive*). Next, we added words and phrases to other capture aspects of PSA. For instance, *cope*, *manage*, *mitigate* and *struggle through*

reflected attempts to deal with particularly difficult situations, whereas *ameliorate*, *answer*, or *better way* suggested participants were contemplating constructive action. We attempted to capture goal setting by including words such as *prioritize*, *focus*, and *plan*, with concrete plans for action being captured by phrases such as *first I must* or *next I should*. Appendix B contains all 104 words and phrases in our PSA list.

Procedure

All participants completed the study individually, alone in a room with the door closed to maintain a sense of privacy.

Pre-writing task procedures. After providing consent, participants were randomly assigned to complete a control task (*n*=54) or an EW task (*n*=53). We prepared and randomized study materials in advance, so that experimenters were blind to condition assignment. Before the writing task, participants completed a Valence-Arousal Mood Profile as baseline measure of emotion. Next, we asked all participants to indicate whether they were experiencing any of ten listed problems, and to choose their most important problem. These questions were meant to orient participants to consider a problem, since this would be the topic of EW tasks. We wanted to capture changes in emotion and analytical rumination resulting from the writing tasks (and not from having answered these questions), so participants in the control writing condition answered these questions before writing as well.

Writing task procedures. Participants received booklets with writing task instructions that differed according to their condition. The control task asked participants to write about their schedule over the past 7 days, focusing on concrete facts and details rather than emotions or thoughts. The EW task prompted participants to write their deepest thoughts and feelings about their most important, personal problem. As per typical EW instructions, participants were asked to explore the nature of this problem as it related to their relationships with others, and their past, present, and future circumstances (Pennebaker, 1997). Each participant wrote for a total of 25 minutes and completed a second Valence-Arousal Mood Profile mid-task (i.e., after 15 minutes of writing) as a measure of emotion during writing. Participants wrote with a pen or pencil on blank lined paper.

Post-writing task procedures. After the writing task, participants completed a third Valence-Arousal Mood Profile and a modified version of the Analytical Rumination Questionnaire, designed to prompt participants to retrospectively report on their ruminative thoughts during the writing task. Participants were then debriefed and provided with a course credit for completing the study.

Statistical Analysis

Data preparation and instruction adherence. Because we summed scores for the Valence-Arousal Mood Profile and Analytical Rumination Questionnaire, we imputed missing data. Data imputation uses a regression-based procedure to generate multiple copies of the data set, each containing different estimates for the missing values (Rubin, 1987). Less than 5% of data were missing for each measure, so we generated 5 copies of the data sets. We averaged missing value estimates across the data sets to generate a final estimate for each missing score. We conducted a Chi-square test to determine whether the frequency of males and females differed in each condition. To check whether participants followed task instructions, we used the LIWC to compare the proportion of affect and cognitive processing words in the writing tasks using Wilcoxon rank-sum tests.

Data analysis. We examined what percentage of participants identified each of the ten problems they chose from as their most important problem, since this problem would be the topic of the EW task. Data from the Valence-Arousal Mood Profile and the Analytical Rumination Questionnaire were not normally distributed, so we used Generalized Estimating Equations to assess the effect of the writing conditions on emotion across the three time points. Generalized Estimating Equations are non-parametric regression models that accommodate within-subjects measurements (i.e., correlated data). We generated models for each emotion specifying time, writing condition, and the interaction between time and condition as independent variables. If there was evidence of an interaction, we assessed the effects of writing condition on emotion with Generalized Linear Models (i.e., non-parametric regression models for uncorrelated data), controlling for baseline emotion. We generated models for the emotion during and after writing, specifying writing condition and the emotion at baseline as independent variables. If there was no interaction but an effect of time was significant, we compared emotions between time points with

Wilcoxon signed-rank tests, collapsing across writing conditions. If an effect of condition was significant, we collapsed across time points, and compared emotions between conditions with Wilcoxon rank-sum tests.

We examined the effect of writing condition on analytical rumination during writing with a Generalized Linear Model. A psychometric study of the Analytical Rumination Questionnaire recommended that researchers use items contributing to CA and PSA as latent factors, and not averages or summed scores (Bartoskova et al., 2018). For this reason, we used measurement invariance testing when assessing differences in CA and PSA across writing conditions (Vanderberg & Lance, 2000). Briefly, this approach involved contrasting two models: one in which the latent factor means (for CA or PSA) were constrained to be equal across writing conditions and another in which these means were free to differ. Significant differences between the two models (as assessed by a Chi-square test) indicated that the CA or PSA factor means differed between conditions. To evaluate how the factor means differed, we examined the estimated factor means for EW participants using control writers as a baseline comparison group. All analyses involving latent factor means were completed in MPlus (Muthén & Muthén, 2007).

Linguistic analysis. For each writing task, we counted the frequency of words and phrases from the word lists. We divided this frequency by the total number of words in the text to obtain the proportion of the writing task that contained evidence of CA or problem-solving. Next, we compared proportions of CA and problem-solving between conditions using Wilcoxon rank-sum tests. Linguistic analyses were completed in R, Version 3.3.3.

Results

Instruction Adherence

The frequency of males and females did not differ across conditions (χ^2 (1, $N = 107$) = 2.52, p =.09). Compared to EW texts, control texts contained less affect words ($W = 197$, $p < .01$) and cognitive processing words ($W = 48$, $p < .01$).

Personal Problems

Most participants (46%) identified academic difficulties as being their most important problem. Of the remaining participants, 14% identified a romantic relationship difficulty as being most important, 12% reported issues with self-esteem, 5% reported financial stress, 5% reported difficulties adjusting to university, 4% reported an interpersonal conflict, 2% reported health-related problems, 2% reported loss or bereavement, and 1% reported their most important issue to be work-related. 8% of participants either did not specify their most important problem or had a problem that was not listed. The prevalence of personal problems was qualitatively similar in the subset of participants who completed EW.

Changes in Emotion

Table 1 contains the summed scores for each emotion averaged across participants in each writing condition at each measured time point (i.e., before, during, and after writing).

Sadness. We found a significant time by condition interaction for sadness (GEE: Wald χ^2 =13.22, N=107, p<.01). During writing, control writers were less sad than EW participants (β= -0.48, 95% CI: -0.67, -0.30). After writing, control writers remained less sad than EW participants (β= -0.33, 95% CI: -0.50, -0.15).

Happiness. We found only main effects of time and condition for happiness (Time: GEE: Wald χ^2 =14.36, N=107, p<.01; Condition: GEE: Wald χ^2 =7.65, N=107, p=.01). Collapsing across writing conditions, all participants became less happy during writing (Z = -5.92, p <.01), and happiness did not change in the second half of writing (Z = -1.67, p =.10), so participants were less happy after writing than they were before writing (Z = 4.43, p <.01). Collapsing across time points, control writers were happier than EW participants (W = 1859.5, p = .01).

Anxiety. There were main effects of time and condition for anxiety as well (Time: GEE: Wald χ^2 =17.53, N=107, p <.01; Condition: GEE: Wald χ^2 =4.37, N=107, p =.04). Collapsing across writing conditions, there were no changes in anxiety in the first half of writing (Z =1.80, p =.08). All participants became less anxious in the second half of writing (Z = -4.92, p <.01), so there was a decrease in anxiety from before to after writing (Z = -4.87, p <.01). Collapsing across time points, EW participants were more

anxious than control writers ($W = 1103$, $p = .04$).

Calmness. There were also main effects of time and condition for calmness (Time: GEE: Wald χ^2 =18.00, N=107, p <.01; Condition: Wald χ^2 =4.82, N=107, p =.03). Collapsing across conditions, participants became less calm during writing ($Z = -4.49$, p <.01), but they became calmer in the second half of writing ($Z = -3.38$, p <.01), resulting in no change in calmness from before to after writing (Z =1.70, p= .09). Collapsing across time points, control writers were calmer than EW participants ($W =$ 1759.5, p= .04).

Analytical Rumination, CA, and PSA

Total analytical rumination during writing did not differ according to task instructions (GLM: Wald $\chi^2 = 3.04$, $N = 107$, $p = .08$). Control participants did not ruminate less than EW participants (β= -0.11, 95% CI: -0.22, 0.01). *Table 1* contains summed analytical rumination scores averaged across participants in each writing condition. CA differed across writing conditions (χ^2 (1) = 8.93, p <.01), and EW participants reported more CA than control writers (β= 0.66, $SE = 0.25$). PSA did not differ significantly across writing conditions (χ^2 (1) = 1.00, p =.32).

Linguistic Analyses

On average, only 2% of each writing task was composed of CA words or phrases (SD=1%), and this percentage was smaller for problem-solving (M=1%, SD=1%). Table 1 contains proportions of CA and problem-solving words and phrases for each condition. As compared to control writing tasks, EW tasks contained higher proportions of CA and problem-solving content (CA: W=555.5, p<.01; problem-solving: W=546.5, p<.01).

Discussion

As compared to control writers, EW participants were sadder during writing and they reported engaging in more CA, but not more PSA. EW tasks contained more language related to CA than control writing tasks; however, they contained more language reflecting problem-solving as well. Collectively, these findings suggest that sadness in response to a personal problem coincides with CA, providing preliminary support for the first step of the analytical rumination model.

For other emotions, only main effects of time and condition were significant, but their interactions were not. All participants became less happy and calm in the first half of writing, suggesting that completing a writing task, regardless of its nature, induced a negative emotional state. However, negative emotions appeared to alleviate over time. All participants became calmer and less anxious after writing, suggesting that they became more comfortable with the writing task as it progressed or relieved that it was finished. Collapsing across the three time points, EW participants were less happy, more anxious, and less calm than control writers. These differences may have emerged due to unsuccessful randomization of these emotions at baseline, since participants in both writing conditions experienced similar patterns of change in happiness, anxiety, and calmness (See Table 1). Alternatively, emotional changes during EW about a personal problem may not be specific to sadness as we had predicted, and research suggests that it is difficult to induce sadness without inducing changes in other emotions as well (Westermann, Stahl, & Hesse, 1996).

Importantly, our findings suggest that EW promotes both sadness and CA, but not total analytical rumination or PSA. Based on participants' responses on the Analytical Rumination Questionnaire as well as the linguistic content in their writing tasks, expressive writers engaged in more causal thinking about their problems than control participants. Responses on this questionnaire additionally suggested that they did not report engaging in more PSA than control writers. These findings are largely consistent with our prediction that during EW, sadness would co-occur with causal thinking (Barbic et al., 2014; Bartoskova et al., 2018).

Findings from our linguistic analysis are somewhat inconsistent with the self-reported data; although EW participants did not report engaging in more PSA than control writers, their writings contained more evidence of problem-solving words than the control writing tasks. One possible explanation for this inconsistency is that the Analytical Rumination Questionnaire and the linguistic analysis measured different types of problem-solving. Although participants may have expressed thoughts related to problem-solving in general, which was captured by the linguistic analysis, they may not have engaged in PSA, which refers to problem-solving under constraints.

Alternatively, this inconsistency might be related to the writing task instructions. We asked EW participants to consider how their problems affect their circumstances and their relationships with others (Pennebaker, 1997). These instructions are related to aspects of CA, but not PSA, which underscores an important limitation of Study 1. The EW instructions may have prompted participants to either remember or report engaging in CA, but not PSA. In other words, EW may have promoted both analytical rumination components, but because the EW task instructions included prompts related to CA, participants only reported engaging in CA on the Analytical Rumination Questionnaire. To address this issue, we conducted a second study with three writing conditions. These conditions included the same EW and control writing tasks from Study 1. The third condition asked participants to complete EW with instructions that did not include any prompts related to CA. With this design, we aimed to determine if the effects of EW on emotion and analytical rumination would replicate (i.e, that EW would increase sadness and reports of CA, but not PSA), when there were no references to CA in the EW instructions.

Study 2

Method

Participants

A sample of 143 undergraduate students (114 females, 29 males) from the same university, who did not participate in Study 1, consented to and completed Study 2. Their mean age was 18.77 years (*SD*=2.0) and cultural backgrounds were white (47.6%), South Asian (18.9%), East Asian (14%), South East Asian (6.3%), mixed (4.9%), West Asian (2.8%), black (2.1%), Latin American (1.4%), and 2.1% participants either reported another cultural background or did not respond. See *Table 2* for demographic information separated by writing condition.

Materials and Procedure

Materials and procedures for this study were the same as those in the first study, except there was an additional EW condition with brief instructions (EW-B), which asked participants to write about their deepest thoughts and feelings about their most important problem, with no other directions or prompts.

Statistical Analysis

Statistical analyses for this study were similar to those in Study 1. First, we imputed missing data for the Valence-Arousal Mood Profile and the Analytical Rumination Questionnaire. Next, we checked for differences in the proportions of males and females in each condition, and we assessed adherence to writing task instructions using the LIWC. We conducted Generalized Estimating Equations to assess the effect of writing condition on each emotion across the time points, and we explored time by condition interactions with Wilcoxon signed-rank tests as well as Generalized Linear Models, controlling for baseline emotion. We explored main effects of time with Wilcoxon signed-rank tests, and main effects of condition with Wilcoxon rank-sum tests.

We examined the effect of condition on analytical rumination with Generalized Linear Models. To assess differences in CA and PSA, we performed invariance tests of their latent factor means across the three writing conditions. If the models differed, we tested for differences in latent factor means between each pair of conditions (i.e., control writing and EW, control writing and EW-B, EW and EW-B) and examined the estimated factor means, using control writing as a baseline comparison group.

We completed a linguistic analysis of the writing tasks using word lists developed in Study 1. Since the proportions of CA words and phrases were normally distributed, we compared CA content across conditions with t-tests. Finally, we created frequency lists of CA and problem-solving words and phrases from EW and EW-B texts in Studies 1 and 2. Based on these lists, we generated word clouds, which depict all CA and problem-solving language pulled from the writing tasks.

Results

Instruction Adherence

There were no differences in the frequency of males and females in each condition (χ^2 (2, $N =$ 143) $=2.47$, $p =.29$). Control texts contained less affect words than EW texts ($W = 198$, $p <.01$) and EW-B texts ($W = 130$, $p <.01$). Control texts also contained less cognitive processing words than EW texts ($W = 92$, $p <.01$) and EW-B texts ($W = 11$, $p <.01$).

Personal Problems

Most participants (37%) identified academic difficulties as being their most important problem, 18% of participants reported difficulties with romantic relationships as being most important, 11% reported a problem related to their self-esteem, 8% had issues adjusting to university, 6% reported an interpersonal conflict, 6% reported financial stress, 3% had a health-related issue, 2% experienced loss or bereavement, and 1% reported a legal problem. The remaining 8% of participants reported another problem or did not specify one. The prevalence of these topics was not qualitatively different in participants completing the EW or EW-B task.

Changes in Emotion

The summed scores averaged across participants in each writing condition for each emotion before, during, and after writing are presented in *Table 2*.

Sadness. We found a significant time by condition interaction for sadness (GEE: Wald χ^2 =22.85, *N*=143, *p*<.01). During writing, EW and EW-B participants were sadder than controls (EW: β= -0.29, 95% CI: -0.52, -0.06; EW-B: β= -0.37, 95% CI: -0.60, -0.14), with no differences between EW and EW-B participants (β= -0.08, 95% CI: -0.30, 0.15). After writing, EW-B participants remained sadder than controls (β= -0.36, 95% CI: -0.60, -0.13), but EW participants were not sadder than controls (β= -0.20, 95% CI: -0.43, 03) or EW-B participants (β= -0.17, 95% CI: -0.39, 0.06).

Happiness. We also found a time by condition interaction for happiness (GEE: Wald χ^2 =12.02, *N*=143, *p*=.02). Control writers were happier than EW and EW-B participants during writing (EW: β= 0.31, 95% CI: 0.15, 0.47; EW-B: β= 0.25, 95% CI: 0.09, 0.41). EW and EW-B induced similar levels of happiness (β= -0.06, 95% CI: -0.21, 0.09). After writing, controls remained happier than EW and EW-B participants (EW: β= 0.27, 95% CI: 0.10, 0.43; EW-B: β= 0.23, 95% CI: 0.06, 0.40), with no differences between EW and EW-B participants (β= 0.03, 95% CI: -0.20, 0.13).

Anxiety. We only found an effect of time for anxiety (GEE: Wald χ^2 =21.27, *N*=143, *p*<.01). All participants became less anxious in the first half of writing (*Z*= -2.57, *p*= .01), as well as in second half of writing (*Z*= -4.19, *p* <.01), resulting in an overall decrease in anxiety from before to after writing (*Z*= -

4.79, p <.01).

Calmness. We found a time by condition interaction for calmness (GEE: Wald χ^2 =16.19, N=143, p<.01). During writing, control participants were calmer than participants who wrote about their problems (EW: β= 0.25, 95% CI: 0.08, 0.42; EW-B: β= 0.23, 95% CI: 0.06, 0.39), with no differences between EW and EW-B participants (β= -0.03, 95% CI: -0.18, 0.13). After writing, controls remained calmer than EW-B participants (β= 0.21, 95% CI: 0.03, 0.38), but they were not calmer than EW participants (β= .15, 95% CI: -0.03, 0.33). EW and EW-B participants experienced similar levels of calmness after writing (β= 0.04, 95% CI: -0.12, 0.21).

Analytical Rumination, CA, and PSA

Table 2 contains the summed analytical rumination scores averaged across each writing condition. Self-reported analytical rumination differed according to task instructions (GLM: Wald χ^2 =13.22, N=143, p <.01). Control participants ruminated less than the EW groups (EW: β= -0.22, 95% CI: -0.35, -0.08; EW-B: β= -0.16, 95% CI: -0.29, -0.04). EW and EW-B participants reported a similar amount of analytical rumination (β= 0.05, 95% CI: -0.07, 0.17).

CA also differed according to task instructions (χ^2 (2) = 13.11, p <.01). Examining the estimated means using control participants as a comparison, EW participants reported more CA (β= 0.84, SE = 0.30) and this effect was statistically significant (χ^2 (1) = 8.83, p <.01). EW-B also participants reported more CA than control participants (β= 0.73, SE = 0.33) to a statistically significant degree (χ^2 (1) = 6.57, p =.01). CA did not differ between EW-B and EW participants (β= -0.28, SE = 0.27, χ^2 (1) = 0.88, p =.35). The latent factor for PSA did not differ significantly across writing conditions (χ^2 (2) = 3.15, p =.21).

Linguistic Analyses

On average, 2% of each writing task included CA content (*SD*=1%), and 1% (*SD*=1%) included problem-solving words and phrases. *Table 2* contains proportions of CA and problem-solving content, averaged across conditions. As compared to control writing tasks, EW tasks contained higher proportions of CA and problem-solving content (CA: t (93.25) = -6.17, p<.01; problem-solving: Z=694, p<.01). EW-B tasks also contained higher proportions of CA and problem-solving content than control tasks (CA: t

(84.58) = -6.97, $p<.01$; problem-solving: $Z=710.5$, $p<.01$). EW and EW-B tasks contained similar proportions of CA and problem-solving content (CA: t (91.62) = -1.31, $p=.19$; problem-solving: $Z=1230$, $p=.69$).

CA and problem-solving words or phrases extracted from writing tasks across the two studies are depicted using word clouds in Figures 2a and 2b, respectively.

Discussion

Consistent with Study 1, both EW tasks produced increases in sadness during writing that persisted after writing for EW-B participants. Additionally, EW and EW-B participants were less happy and calm during writing than control participants. Thus, both EW tasks appeared to induce a generally negative affective state, but changes in sadness and calmness persisted after writing for EW-B participants only. It is possible that fewer instructions in the EW-B task gave participants the freedom to explore their emotions about the problem more deeply, resulting in lingering negative emotions. Nevertheless, all participants became less anxious over the course of the experiment.

Participants who were only asked to describe their thoughts and feelings (EW-B) reported similar levels of analytical rumination and CA as participants who received additional prompts (EW), suggesting that responses on the Analytical Rumination Questionnaire are unaffected by EW instructions. In other words, simply asking participants to write their "deepest thoughts and feelings" about a personal problem still prompted analytical rumination, including CA, but it did not affect PSA. Consistent with Study 1, the EW and EW-B tasks contained more evidence of CA and problem-solving than control writing tasks, despite a self-reported difference in CA, but not PSA.

General Discussion

Effects of EW on Emotion

In both studies, participants became sadder when they wrote about their problems. This finding is consistent with the claim that sadness is triggered by complicated problems, since it may underlie the analytical thinking that these situations demand (Andrews & Thomson, 2009). EW and EW-B had less reliable effects on other emotional states. The degree to which participants experienced changes in other

emotions could reflect that these emotions will sometimes co-vary with sadness. Alternatively, some unique features of the situations participants wrote about may have elicited the other emotional states (e.g., decreases in happiness and calmness).

Our results are consistent with other research showing that EW induces a negative emotional state (Dickerson et al., 2004; Donelly & Murray, 1991; Greenberg & Stone, 1992; Kloss & Lisman, 2002; Pennebaker & Beall, 1986). They additionally highlight the value of examining emotion during writing, since the only consistent effects on emotion that we captured were at this time. In Study 1, participants remained sadder after EW than control writing. However, in Study 2, participants remained sadder and less happy after EW-B only, with no differences in sadness and happiness after EW and control writing. Without measuring emotion during writing, we might have concluded that EW does not impact sadness or happiness, which is consistent with several other studies that report null effects of EW on emotion (e.g. Gidron, Peri, Connolly & Shalev, 1996; Kovac & Range, 2002; Smyth, Hockemeyer & Tulloch, 2008). However, participants in these studies may have experienced transient emotional changes that were not measured.

Effect of EW on Components of Analytical Rumination

When considering total analytical rumination, our findings across the two studies were somewhat inconsistent with respect to traditional EW. In Study 1, EW participants did not ruminate more than control writers, but in Study 2, both EW and EW-B participants reported more analytical rumination during writing than control participants. The difference between EW and analytical rumination across the two studies is somewhat surprising because the samples were similar in size and type.

Nevertheless, our EW conditions had replicable effects on the two analytical rumination components, providing support for the first step of the analytical rumination model (Bartoskova et al., 2018). Across our two studies, a single session of EW or EW-B increased self-reported thoughts related to the cause of problems (i.e., CA) but not problem-solving under constraints (i.e., PSA). EW participants also used more causal language than control writers, corroborating the finding that EW promotes CA. This finding is consistent with the temporal order of depression and CA from Bartoskova and colleagues'

(2018) study, and the well-evidenced links between negative emotion and upward counterfactual thinking (Roese, 1997).

In Study 2, regardless of whether EW was presented with traditional or brief instructions, as compared to control writers, participants did not report engaging in PSA, but they used more language related to problem-solving. Because this discrepancy between the self-reported and linguistic data was unaffected by writing task instructions, it may have emerged because the Analytical Rumination Questionnaire items and our linguistic analysis captured different forms of problem-solving. Figure 2b shows that EW and EW-B participants frequently used words and phrases that reflected general problem-solving, such as "deal with", "my best", "plan", "achieve" and "focus". Although participants were instructed to write about their most important problems, not all these problems would have involved constraints or competing goals and demands. To the degree that some participants were writing about problems that had apparent solutions, they may have engaged in general problem-solving with minimal CA. On the other hand, PSA involves attempts to problem-solve in the presence of particularly difficult circumstances, which is assessed with the Analytical Rumination Questionnaire. If dealing with particularly complicated problems requires first pinpointing their cause, PSA may not emerge within a single writing session. With continued EW however, participants may have switched their focus from CA to PSA.

Limitations and Directions for Future Research

We assume that PSA follows CA based on theoretical and empirical work (e.g., Andrews & Thomson, 2009; Barbic et al., 2014; Bartoskova et al., 2018); however, because we examined emotions and thoughts in a single session of EW, our study does not exclude the possibility of an alternative model, where induced sadness reduces the ability to engage in problem-solving, resulting in a persistent focus on the cause of problems. This possibility is consistent with the cognitive model of depression, which argues that depressed people are biased in how they process information, leading them to perceive negative events as hopeless or outside of their control (Beck, 1987; Beck, 2008). According to this view, when people with this bias experience a negative event and become sad, they tend to ruminate, which prevents

them from actively coping with their issues (Lyubomirsky & Nolen-Hoeksema, 1995). In our study, induced sadness could have prompted this bias, reducing participants' abilities to engage in problem-solving and leading them to report CA, but not PSA. However, this alternative view is inconsistent with findings from our linguistic analyses. If sadness was interfering with attempts to problem-solve, then EW participants would not have used more problem-solving language than control participants.

Nevertheless, an important direction for future work will be a longitudinal study involving multiple sessions of EW about the same problem. Such a study would establish the temporal order of CA and PSA (i.e., the second step of the analytical rumination model), by determining whether participants report engaging in PSA in subsequent EW sessions. If so, evidence of the analytical rumination model during EW might help explain why this simple intervention has been associated with reductions in depressive symptoms (e.g., Krpan et al., 2013). EW may be therapeutic because it promotes emotional and cognitive processing (Fratarolli, 2006; Pascual-Leone et al., 2016). By examining the linguistic content of EW texts, researchers have demonstrated a link between cognitive processing during EW and its therapeutic effects, both in terms of general health-related outcomes (Pennebaker, 1993) and reductions in depressive symptoms (Lee et al., 2016). The analytical rumination model offers a specific prediction about the process by which this may occur. Sadness during writing may promote CA, which, over multiple sessions, leads to PSA and helps individuals address their problems (Bartoskova et al., 2018). Our study offers support for the first step of this model, but whether EW eventually promotes its other components remains an interesting direction for future work.

Our linguistic analysis has limitations, which may have produced discrepancies between the self-reported and linguistic data. Our word lists are subjectively-compiled and limited approximations of the analytical rumination components. The lists may be too broad, capturing thoughts unrelated to CA or problem-solving, they might miss instances of CA and problem-solving, or misinterpret one analytical rumination component for another. This would have likely occurred when CA or problem-solving were revealed in subtle or contextual ways. In addition to our inability to operationalize PSA, the discrepancy we observed may have resulted from our problem-solving list being too broad and identifying neutral or

CA content as problem-solving. Although these limitations are inherent in applying computational methods to textual analysis, our word lists are a starting point for capturing instances of CA and problem-solving in textual data. Researchers interested in using EW to study analytical rumination might revise these lists to make them comparable in length and readability (or how commonly its words are used on average) which would allow for comparisons between CA and problem-solving content. Future directions for this work also include validating the word lists by conducting content analyses of EW texts.

Relatedly, in our studies, we modified the Analytical Rumination Questionnaire to capture participants' thoughts during writing, and in this process, we may have changed its psychometric properties. Future research might focus on validating the modified version of the Analytical Rumination Questionnaire, so that it can be used in conjunction with the EW paradigm.

Finally, our study investigates a model that is informed by an evolutionary theory of depression, but we do not administer a formal measure of depression. We assessed emotions with the Valence-Arousal Mood Profile, because we required a measure that could detect subtle and transient changes in emotion (Maslej et al., unpublished). The latent factor for sadness derived from this measure correlates highly with the latent depression factor from the Beck Depression Inventory (i.e., $r = .69$; Bartoskova et al., 2018), so the sadness subscale on the Valence-Arousal Mood Profile can be a proxy of depressive symptoms. Given that the incidence of depression and other psychiatric conditions in young adults is high (Copeland, Shanahan & Angold, 2011), some of our participants may have been clinically depressed. It is unlikely that clinical depression confounds our findings due to our experimental design. However, we could not assess how depression severity and other pre-existing emotional dispositions impact or interact with emotion and analytical rumination during EW, which is an interesting direction for future research.

Summary and Conclusions

In our studies, we assessed the utility of the EW paradigm to study the analytical rumination model, and the temporal order of emotion, CA, and PSA. Overall, we found that EW is an effective mood induction paradigm for promoting sadness related to a difficult problem or stressor. EW also appears to increase CA and potentially other analytical rumination components. Our findings collectively suggest

that the first stage of the analytical rumination model may be observed within a single session of EW, and they offer a starting point to testing its other predictions.

There is much to be gained in applying evolutionary thinking to the study of mental health. Without the appropriate empirical tools however, it is difficult to detect functional relations between emotions, cognitions, and other psychological constructs relevant to the study of depression (Bartoskova et al., 2018). By promoting depressive emotions and cognitions, the EW paradigm can help us test the analytical rumination hypothesis of depression, and eventually, contribute insights to our understanding of the etiology of depression.

References

American Psychiatric Association (APA) (2013). *(DSM-5) Diagnostic and statistical manual of mental disorders.* Washington, DC: American Psychiatric Press, Inc.

Andrews, P. W., & Thomson Jr, J. A. (2009). The bright side of being blue: depression as an adaptation for analyzing complex problems. *Psychological Review*, *116*(3), 620–654.

Angst, J., Paksarian, D., Cui, L., Merikangas, K. R., Hengartner, M. P., Ajdacic-Gross, V., & Rössler, W. (2016). The epidemiology of common mental disorders from age 20 to 50: results from the prospective Zurich cohort Study. *Epidemiology and Psychiatric Sciences*, *25*(1), 24–32.

Baikie, K. A., Geerligs, L., & Wilhelm, K. (2012). Expressive writing and positive writing for participants with mood disorders: An online randomized controlled trial. *Journal of Affective Disorders*, *136*(3), 310–319.

Barbic, S. P., Durisko, Z., & Andrews, P. W. (2014). Measuring the bright side of being blue: A new tool for assessing analytical rumination in depression. *PloS One*, *9*(11), e112077.

Bartoskova, M., Sevcikova, M., Durisko, Z., Maslej, M., Preiss, M., & Andrews, P. W. (2018). The form and function of depressive rumination. *Evolution and Human Behavior, 39*(3), 277–289.

Boninger, D. S., Gleicher, F., & Strathman, A. (1994). Counterfactual thinking: From what might have been to what may be. *Journal of Personality and Social Psychology*, *67*(2), 297–307.

Copeland, W., Shanahan, L., Costello, E. J., & Angold, A. (2011). Cumulative prevalence of psychiatric disorders by young adulthood: A prospective cohort analysis from the Great Smoky Mountains Study. *Journal of the American Academy of Child & Adolescent Psychiatry*, *50*(3), 252–261.

Dickerson, S. S., Kemeny, M. E., Aziz, N., Kim, K. H., & Fahey, J. L. (2004). Immunological effects of induced shame and guilt. *Psychosomatic Medicine, 66,* 124–131.

Durisko, Z., Mulsant, B. H., & Andrews, P. W. (2015). An adaptationist perspective on the etiology of depression. *Journal of Affective Disorders*, *172*, 315–323.

Durisko, Z., Mulsant, B. H., McKenzie, K., & Andrews, P. W. (2016). Using evolutionary theory to guide mental health research. *Canadian Journal of Psychiatry*, *61*(3), 159–165.

Edwards, J. A., & Weary, G. (1993). Depression and the impression-formation continuum: Piecemeal processing despite the availability of category information. *Journal of Personality and Social Psychology, 64*(4), 636-645.

Edwards, J., Weary, G., & Gleicher, F. (1991). Depression and social inferences. Paper presented at the *Meeting of the Midwestern Psychological Association, Chicago*.

Epstude, K., & Roese, N. J. (2008). The functional theory of counterfactual thinking. *Personality and Social Psychology Review*, *12*(2), 168–192.

Frattaroli, J. (2006). Experimental disclosure and its moderators: a meta-analysis. *Psychological Bulletin, 132*(6), 823–865.

Gidron, Y., Peri, T., Connolly, J. F., & Shalev, A. Y. (1996). Written disclosure in Posttraumatic Stress Disorder: Is it benefical for the patient? *The Journal of Nervous and Mental Disease*, *184*(8), 505–506.

Gleicher, F., & Weary, G. (1991). Effect of depression on quantity and quality of social inferences. *Journal of Personality and Social Psychology, 61*(1), 105-114.

Gortner, E. M., Rude, S. S., & Pennebaker, J. W. (2006). Benefits of expressive writing in lowering rumination and depressive symptoms. *Behavior Therapy*, *37*(3), 292–303.

Greenberg, M. A., & Stone, A. A. (1992). Emotional disclosure about traumas and its relation to health: effects of previous disclosure and trauma severity. *Journal of Personality and Social Psychology, 63*(1), 75–84.

Hagen, E. H. (2011). Evolutionary theories of depression: A critical review. *Canadian Journal of Psychiatry, 56* (12), 716–726.

Jacobson, J. A., Weary, G., & Edwards, J. A. (1999). Certainty-related beliefs and depressive symptomatology: Concurrent and longitudinal relationships. *Social Cognition, 17*(1), 19-45.

Keller, M. C., Neale, M. C., & Kendler, K. S. (2007). Association of different adverse life events with distinct patterns of depressive symptoms. *American Journal of Psychiatry*, *164*(10), 1521–1529.

Kloss, J. D., & Lisman, S. A. (2002). An exposure-based examination of the effects of written emotional disclosure. *British Journal of Health Psychology, 7,* 31–46.

Koopman, C., Ismailji, T., Holmes, D., Classen, C. C., Palesh, O., & Wales, T. (2005). The effects of expressive writing on pain, depression and posttraumatic stress disorder symptoms in survivors of intimate partner violence. *Journal of Health Psychology*, *10*(2), 211–221.

Kovac, S. H., & Range, L. M. (2002). Does writing about suicidal thoughts and feelings reduce them? *Suicide and Life-Threatening Behavior*, *32*(4), 428–440.

Krpan, K. M., Kross, E., Berman, M. G., Deldin, P. J., Askren, M. K., & Jonides, J. (2013). An everyday activity as a treatment for depression: the benefits of expressive writing for people diagnosed with major depressive disorder. *Journal of Affective Disorders*, *150*(3), 1148–1151.

Lee, S. W., Kim, I., Yoo, J., Park, S., Jeong, B., & Cha, M. (2016). Insights from an expressive writing intervention on Facebook to help alleviate depressive symptoms. *Computers in Human Behavior*, *62*, 613–619.

Maslej, M. M., Rheaume, A. R., Barbic, S. P. & Andrews, P. W. (unpublished). *The Valence Arousal Mood Profile*.

Markman, K. D., Gavanski, I., Sherman, S. J., & McMullen, M. N. (1993). The mental simulation of better and worse possible worlds. *Journal of Experimental Social Psychology, 29*(1), 87–109.

Markman, K. D., & Weary, G. (1998). Control motivation, depression, and counterfactual thought. In Kofta M, Weary G, Sedek G (Eds.), *Personal control in action* (pp. 363-390). Boston, MA: Springer.

Marsh, K. L., & Weary, G. (1989). Depression and attributional complexity. *Personality and Social Psychology Bulletin, 15*(3), 325-336.

Muthén, L. K., & Muthén, B. O. (2007). Mplus. *Statistical analysis with latent variables. Version*, *3*.

Pascual-Leone, A., Yeryomenko, N., Morrison, O. P., Arnold, R., & Kramer, U. (2016). Does feeling

bad, lead to feeling good? Arousal patterns during expressive writing. *Review of General Psychology*, *20*(3), 336–347.

Nasco, S. A., & Marsh, K. L. (1996). The effect of upward counterfactuals on subsequent test performance. In *Midwestern Psychological Association conference, Chicago, IL*

Pennebaker, J. W. (1993). Putting stress into words: Health, linguistic, and therapeutic implications. *Behaviour Research and Therapy*, *31*(6), 539–548.

Pennebaker, J. W. (1997). Writing about emotional experiences as a therapeutic process. *Psychological Science*, *8*(3), 162–166.

Pennebaker, J. W., & Beall, S. K. (1986). Confronting a traumatic event: Toward an understanding of inhibition and disease. *Journal of Abnormal Psychology*, *95*(3), 274–281.

Pennebaker, J. W., Kiecolt-Glaser, J. K., & Glaser, R. (1988). Disclosure of traumas and immune function: health implications for psychotherapy. *Journal of Consulting and Clinical Psychology*, *56*(2), 239–245.

Roese, N. J. (1994). The functional basis of counterfactual thinking. *Journal of Personality and Social Psychology*, *66*(5), 805–818.

Roese, N. J. (1997). Counterfactual thinking. *Psychological Bulletin*, *121*(1), 133–148.

Roese, N. J., Hur, T., & Pennington, G. L. (1999). Counterfactual thinking and regulatory focus: Implications for action versus inaction and sufficiency versus necessity. *Journal of Personality and Social Psychology, 77*(6), 1109–1120.

Roese, N. J., & Olson, J. M. (1997). Counterfactual thinking: The intersection of affect and function. *Advances in Experimental Social Psychology, 29*, 1–59.

Rubin, D. B. (1987). The calculation of posterior distributions by data augmentation: Comment: A noniterative sampling/importance resampling alternative to the data augmentation algorithm for creating a few imputations when fractions of missing information are modest: The SIR algorithm. *Journal of the American Statistical Association*, *82*(398), 543–546.

Rude, S., Gortner, E. M., & Pennebaker, J. (2004). Language use of depressed and depression-vulnerable college students. *Cognition & Emotion, 18*(8), 1121–1133.

Sanna, L. J., & Turley, K. J. (1996). Antecedents to spontaneous counterfactual thinking: Effects of expectancy violation and outcome valence. *Personality and Social Psychology Bulletin, 22*(9), 906–919.

Sloan, D. M., Marx, B. P., & Epstein, E. M. (2007). Does altering the writing instructions influence outcome associated with written disclosure? *Behavior Therapy*, *38*(2), 155–168.

Smyth, J. M., Hockemeyer, J. R., & Tulloch, H. (2008). Expressive writing and post-traumatic stress disorder: Effects on trauma symptoms, mood states, and cortisol reactivity. *British Journal of Health Psychology*, *13*(1), 85–93.

Tausczik, Y. R., & Pennebaker, J. W. (2010). The psychological meaning of words: LIWC and computerized text analysis methods. *Journal of Language and Social Psychology, 29*(1), 24–54.

Vanderberg, R. J., & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods*, *3*(1), 4–70.

Weary, G. & Gannon, K. (1996). Depression, control motivation, and person perception. In P.M. Gollwitzer & J.A. Bargh (Eds.), *The psychology of action: Linking cognition and motivation to behaviour* (pp. 146-147). New York: Guilford Press.

Weary, G., Marsh, K. L., Gleicher, F., & Edwards, J. A. (1993). Depression, control motivation, and the processing of information about others. In *Control motivation and social cognition* (pp. 255-287). Springer, New York, NY.

Wells, G. L., & Gavanski, I. (1989). Mental simulation of causality. *Journal of Personality and Social Psychology, 56*(2), 161–169.

Westermann, R., Stahl, G., & Hesse, F. (1996). Relative effectiveness and validity of mood induction procedures: A meta-analysis. *European Journal of Social Psychology, 26*(4), 557–580.

Tables and Figures

Table 1

Descriptive information for each writing condition in Study 1

	EW (*n* = 53)	Control writing (*n* = 54)
Age: *M (SD)*	18.75 (2.25)	18.65 (1.29)
Gender: % female	91%	80%
Sadness: *M (SD)*		
Before writing	10.80 (7.13)	10.44 (6.83)
During writing	13.74 (8.13)	8.67 (5.35)
After writing	11.06 (7.33)	8.01 (5.31)
Happiness: *M (SD)*		
Before writing	11.37 (5.97)	13.64 (5.67)
During writing	9.28 (5.57)	12.78 (6.05)
After writing	10.24 (6.04)	13.07 (6.08)
Anxiety: *M (SD)*		
Before writing	19.09 (10.34)	17.03 (9.72)
During writing	19.38 (10.34)	14.26 (8.34)
After writing	16.87 (10.30)	13.71 (8.73)
Calmness: *M (SD)*		
Before writing	19.82 (8.02)	21.66 (6.81)
During writing	17.11 (8.14)	20.76 (6.95)
After writing	19.03 (8.62)	22.34 (7.12)
Total AR: *M (SD)*	63.08 (14.26)	56.77 (18.98)
Writing content: *M* % (SD)		
CA	2.2 (0.9)	1.5 (0.60)
Problem-solving	0.90 (0.60)	0.40 (0.40)

Note. Age in years; EW=Expressive writing; *M*=Mean; *SD*=Standard deviation; AR=Analytical rumination; CA=Causal analysis.

Table 2

Descriptive information for each writing condition in Study 2

	EW (*n* = 50)	EW-B (*n* = 47)	Control writing (*n* = 46)
Age: *M (SD)*	18.75 (2.25)	18.44 (1.22)	18.65 (1.29)
Gender: % female	91%	80%	80%
Sadness: *M (SD)*			
Before writing	11.09 (7.63)	11.01 (7.32)	12.76 (7.65)
During writing	14.29 (8.51)	13.51 (8.17)	10.71 (6.76)
After writing	11.65 (7.81)	12.11 (7.52)	9.64 (6.47)
Happiness: *M (SD)*			
Before writing	12.84 (5.60)	14.70 (5.86)	11.54 (5.61)
During writing	10.59 (6.51)	12.62 (6.26)	11.98 (5.64)
After writing	10.84 (6.72)	12.36 (6.68)	11.69 (5.93)
Anxiety: *M (SD)*			
Before writing	20.26 (9.83)	20.15 (9.75)	18.56 (9.32)
During writing	19.66 (10.15)	18.97 (10.44)	16.12 (9.59)
After writing	17.56 (10.21)	17.07 (9.15)	15.20 (9.97)
Calmness: *M (SD)*			
Before writing	21.57 (7.24)	21.74 (6.76)	19.61 (7.09)
During writing	18.68 (9.12)	20.57 (7.98)	21.66 (6.81)
After writing	20.46 (9.46)	20.95 (8.06)	21.57 (8.02)
Total AR: *M (SD)*	62.53 (14.74)	59.35 (11.32)	50.39 (18.83)
Writing content: *M* % (SD)			
CA	2.5 (0.90)	2.8 (1.1)	1.4 (0.80)
Problem-solving	1.1 (0.80)	1.0 (0.70)	0.60 (0.50)

Note. Age in years; EW=Expressive writing; EW-B=Expressive writing with brief instructions; *M*=Mean; *SD*=Standard deviation; AR=Analytical rumination; CA=Causal analysis.

Figure 1

Depressive symptoms and the two stages of analytical rumination
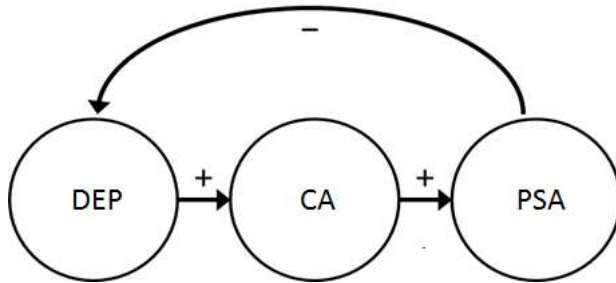
Note. DEP=Depressive symptoms; CA=Causal analysis; PSA=Problem-solving analysis.

Figure 2a

Word cloud depicting causal analysis words and phrases in expressive writing texts from Studies 1 and 2

Note. The size of words and phrases varies with their relative frequency; larger words reflect a higher frequency in expressive writing (EW or EW-B) texts.

Figure 2b

Word cloud depicting problem-solving words and phrases in expressive writing texts from Studies 1 and 2

Note. The size of words and phrases varies with their relative frequency; larger words reflect a higher frequency in expressive writing (EW or EW-B) texts.

Supplementary Sections

Appendix A

Word list capturing causal analysis (CA)

affect	generator.*	produc.*
affected	hence	provoc.*
affecting	how	provok.*
affects	hows	purpose.*
aggravat.*	how's	react.*
allow.*	ignit.*	response
attribut.*	implica.*	result.*
based	implie.*	root.*
bases	imply.*	source.*
basis	inact.*	stimul.*
because	independ.*	therefor.*
caus.*	induc.*	thus
change	infer	trigger.*
changed	inferr.*	why
changes	infers	beginning
changing	influenc.*	preced.*
compel.*	intend.*	previous.*
conclud.*	intent.*	blame.*
consequen.*	justif.*	blaming
control.*	launch.*	fault
cos	lead.*	responsibility
coz	led	responsible
create.*	made	accountability
creati.*	make	accountable
cuz	maker.*	wrong.*
deduc.*	makes	error.*
depend	making	mistake.*
depended	manipul.*	avoid.*
depending	misle.*	instead
depends	motiv.*	alternative.*
effect.*	obedien.*	substitut.*
elicit.*	obey.*	prevent.*
force.*	origin	avert.*
foundation.*	originat.*	if only
founded	origins	due to
founder.*	outcome.*	if \\w only
generate.*	permit.*	if \\w just
generating	pick	

Note. .* denotes any character appearing 0 or any number of times; \\w denotes any word.

Appendix B

Word list capturing problem-solving

accept	solving	re-assess.*
accepta.*	forgave	find ways
accepted	forgiv.*	struggle through
insight.*	unaccept.*	struggling through
accepting	fix.*	struggles through
inspir.*	mend	carry on
accepts	mends	carries on
acknowledg.*	mending	carrying on
adjust.*	mended	get by
answer.*	ameliorat.*	gets by
appreciat.*	mitigate	getting by
learn.*	accomplish.*	get through
lesson.*	achieve.*	gets through
motiv.*	succeed.*	getting through
choice.*	cope	my best
choos.*	copes	deal.* with
prefer.*	coping	find a way
conclud.*	priorit.*	rise to occasion.*
conclus.*	goal.*	first \\w could
rearrang.*	aim.*	next \\w could
confess.*	focus	first \\w must
reconcil.*	motive.*	next \\w must
reconsider.*	motivat.*	first \\w should
re-evaluat.*	plan.*	next \\w should
reevaluat.*	answer	first \\w would
decid.*	answers	next \\w would
decis.*	manage.*	what to do
reorgani.*	managing	hold \\w own
resolu.*	surviv.*	how to act
resolv.*	subsist.*	keep \\w head up
restructur.*	fend	
evaluat.*	fends	
solution.*	fending	
solve	bear.*	
explor.*	remedy	
solved	assess.*	
solves	reassess.*	

Note. .* denotes any character appearing 0 or any number of times; \\w denotes any word

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CHAPTER 3

Why does expressive writing affect emotion?

Considering the impact of valence and cognitive processing

Abstract

Expressive writing (EW) is an intervention that involves writing one's thoughts and feelings about a negative event or problem. Although EW benefits wellbeing in the long-term, it produces transient increases in negative emotion during writing. These negative emotions are thought to evidence emotional and cognitive processing and may be important for deriving EW's therapeutic effects. However, it is unclear why they occur. We explore two possibilities: writing about negative topics produces congruent emotions (valence), or EW involves deep or effortful processing, which is associated with negative emotion (cognitive processing). In Study 1, EW about a hypothetical problem induced a negative emotional state (i.e., increased sadness, decreased happiness and calmness), suggesting that emotional changes during EW do not depend on the topic's personal nature. In Study 2, participants considered a scenario involving a decision between two jobs balanced on positive and negative attributes. This job scenario was framed positively (as a promotion) or negatively (as a job loss). Participants were randomized to EW about the positive scenario (P-EW-P; $n=32$), the negative scenario (N-EW; $n=29$), or control writing (CW; $n=36$). As compared to before writing, N-EW participants became sadder, less happy, and less calm during writing, suggesting an effect of valence. However, P-EW participants did not experience a change in sadness, and they became less happy than they were before writing. Our findings may reflect a combined effect: cognitive processing influences happiness during P-EW, with the positive valence of the P-EW topic mitigating changes in sadness. We discuss our study's limitations and its implications for understanding emotional changes during EW.

Introduction

Over the past several decades, researchers have studied the physical and psychological health benefits of expressive writing (EW), an intervention that asks people to write their deepest thoughts and feelings about a negative event or stressor (Pennebaker, 1997). Studies of EW typically distinguish between its short-term and long-term effects, and they tend to show that although EW improves well-being and decreases negative emotions over time, it produces transient increases in negative emotion and arousal during writing (Pennebaker, 2004). No single theory can account for EW's therapeutic effects, but researchers have suggested that its benefits are tied to emotional and cognitive processing (Fratarolli, 2006; Pennebaker, 2004). Increases in negative emotion during writing may signal that processing is taking place (Pascual-Leone, Yeryomenko, Morrison, Arnold, & Kramer, 2016). Accordingly, studies have examined various facets of these short-term emotional changes by measuring self-reported mood, monitoring heart rate and blood pressure, assessing stress hormones, and examining EW texts for evidence of emotive language (Epstein, Sloan, & Marx, 2005; Pennebaker & Beall, 1986; Pennebaker & Francis, 1996). To extend on this work, the present set of studies investigates why EW produces short-term emotional changes by isolating aspects of EW topics that contribute to changes in emotion during writing.

Long-term Benefits of EW

Benefits of EW have been documented in a variety of physical and psychological domains, though the effects are generally small (for a meta-analysis, see Fratarolli, 2006). In studies of EW, researchers often assign participants to short sessions of writing about a negative event or a control topic (e.g., one's schedule). These writing sessions are generally completed daily for at least 15 minutes over three or four days (Pennebaker, 1997). In various studies, EW has improved aspects of physical health, such as liver and immune function, and decreased illness symptoms and the need for doctor visits (Booth, Petrie, & Pennebaker, 1997; King & Miner, 2000; Pennebaker & Beall, 1986; Pennebaker, Kiecolt-Glaser, & Glaser, 1988). EW also appears to benefit psychological health, with studies showing that it may improve working memory and reduce symptoms of anxiety and depression over time (Fratarolli,

2006; Klein & Boals, 2001; cf. Reinhold, Bürkner, & Holling, 2017). Other interesting benefits of EW have been noted, such as unemployed participants being more likely to find a job (Spera, Buhrfeind, & Pennebaker, 1994) or participants struggling with marital separation either re-uniting with an ex-partner or reporting increased emotional detachment (Lepore & Greenberg, 2002). Several studies have also observed higher grade point averages for students who write expressively about an upcoming exam or adjustment to college (Pennebaker & Francis, 1996; Scanlan, 2000).

Short-term Effects of EW on Emotion

Despite beneficial long-term outcomes, studies have consistently demonstrated that participants experience transient increases in negative emotion immediately after EW (Pennebaker, 2004). In a seminal study, Pennebaker and Beall (1986) assigned undergraduates who experienced a traumatic event to four sessions of writing about one of three topics: their emotions surrounding the event, concrete facts about the event, or both emotions and facts. Students writing about their emotions or both emotions and facts reported fewer doctor visits in the six months following the intervention than students who only wrote about facts. However, immediately after each writing session, students who wrote about emotions or both emotions and facts had higher blood pressure and reported a more negative emotional state than students who wrote about facts. Discussing subjective feelings seems important for eliciting the long-term and short-term effects of EW, and many other studies using different variations of the EW paradigm and different measures of emotion have replicated this increase in negative emotion immediately after EW (Aziz, Kim, & Fahey, 2004; Dickerson, Kemeny, Murray, Lamnin, & Carver, 1989; Donelly & Murray, 1991; Greenberg & Stone, 1992; Kloss & Lisman, 2002; Pascual-Leone et al., 2016).

Most EW studies measure short-term increases in subjective emotion using composite negative and positive scores, but one recent set of studies distinguished between changes in specific emotions during EW. In two studies, participants completed EW tasks about their most important personal problems or control writing tasks about their schedules. They also reported on four emotions (sadness, happiness, anxiety, and calmness) before, during, and after writing. During writing, EW participants consistently reported increases in sadness and decreases in calmness as compared to control writers, and

in some cases, they reported increases in anxiety and decreases in happiness as well (see Chapter 2). When emotions were examined after writing, EW participants only sometimes reported being sadder and less happy than control writers. These findings suggest that the transient emotional changes may dissipate after the writing session is completed, and they may be best detected during writing. Additionally, specific emotional changes may include sadness, at least when the topic of writing is related to an ongoing personal problem or stressor.

Importance of Emotional Changes during EW

Increases in negative emotions during EW may be important for deriving its longer-term effects. Of the potential mechanisms underlying EW's therapeutic benefits, habituation to negative emotion and cognitive processing have emerged as primary explanations (Fratarolli, 2006; Pennebaker, 2004). Increases in negative emotions during EW tend to decrease over the course of several sessions, suggesting that being exposed to these emotions makes expressive writers less affected by them over time (Martino, Freda, & Camera, 2013; Pascual-Leone et al., 2016). At the same time, writing extensively about the events eliciting these negative emotions may produce a better understanding of the events or relevant insights (Fratarolli, 2006). Eventually, these insights might help writers resolve their problems or avoid similar negative events in the future. In linguistic analyses of EW texts, increases over several sessions of EW in the use of negative emotion words (i.e., expressions of sadness and anxiety) and words that signal cognitive processing (e.g., understand, thought, because, why) predict improvements in health (Pennebaker, 1993). Processing a difficult issue during EW may therefore contribute to its health benefits or other outcomes, such as finding a job or achieving better grades. Regardless of whether EW facilitates insight or makes individuals better at handling their negative emotions, the temporary increases in negative emotions during EW seem to play an important role. These emotions could suggest that emotional and cognitive processing is taking place, or that participants are being exposed to difficult feelings or thoughts and constructing new meanings of the issues they write about (Pascual-Leone et al., 2016).

Given the potential importance of negative emotions for EW's long-term benefits, it is important

to understand why these transient increases in sadness and other negative emotions occur. In the current set of studies, we investigate what aspect of the EW topic produces short-term emotional changes. Researchers distinguish between two effects of emotion (Forgas, 2013): informational effects (i.e., when emotions influence the valence of responses) and processing effects (i.e., when emotions affect how information is processed). In our studies, we consider related aspects of the EW topic that potentially affect emotions during writing: the negative valence of the topic or the type of processing that the topic elicits.

Valence of the EW Topic

Perhaps the most obvious reason why EW promotes negative emotions is because the valence of the EW topic is usually negative. During EW, writers are typically asked to describe their deepest thoughts and feelings about negative circumstances in their lives, such as traumatic events and difficult problems. Sadness and other negative emotions are reactions to negative circumstances, which, from an evolutionary perspective, reduce fitness, such as social exclusion, romantic rejection, and loss of resources (Nesse, 1990). Since negative emotions are subjectively unpleasant, they motivate action to escape or alleviate the negative circumstances (Levenson, 1999; Tooby & Cosmides, 1990). During EW, individuals think deeply about a negative circumstance, its consequences, and its associated emotions (Pennebaker, 1997), which is likely to elicit congruent, negative emotions.

Recalling negative circumstances might elicit negative emotions due to spreading activation, or the notion that information encoded into memory is interconnected with other related memories. When a memory is recalled, other instances related to that initial memory are triggered (Mayer, Gayle, Meehan, & Haarman, 1989). Importantly, spreading activation can also apply to emotions, which are memory units that form associations with related events (Bower, 1981). Recalling a negative event activates negative memories (such as consequences of the event or other instances when this negative event occurred) as well as emotions experienced during the event. Writing expressively about receiving a poor grade, for example, might activate related memories (e.g., other poor grades, arguments with parents over academics) and related emotions (i.e., sadness, disappointment, shame), leading the expressive writer to

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feel these emotions while writing.

Empirical support for this hypothesis comes from various experiments using negatively (and positively) valenced stimuli to induce emotions. One widely-used method is the Autobiographical Emotional Memory Task, where participants are asked to recall intensely positive or negative experiences. In various studies, this technique has successfully induced emotions congruent with the valence of experience being recalled (Mills & D'Mello, 2014), suggesting that considering negative, self-referential topics during EW may be what elicits negative emotions. Furthermore, recalling positive memories after negative ones seems to alleviate negative emotions, with some evidence showing that individuals might do this on purpose to improve their emotional states (Josephson, 1996). Accordingly, when the topic of EW is positive, EW induces a positive mood. One study compared emotions after a session of control writing or EW where participants described their feelings and thoughts about an intensely positive experience. Not surprisingly, this EW intervention left participants feeling more positive emotions than control writing (Burton & King, 2003). If shifting the valence of the EW topic affects the valence of the emotions felt during writing, the short-term emotional effects of EW may be tied to the valence of the writing topic.

Cognitive Processing during EW

Alternatively, considering difficult circumstances during EW may change the way that information is processed, which can affect emotions during writing. Specifically, EW about negative circumstances may require individuals to think deeply and analytically. Sadness signals the presence of complicated problems that do not have clear solutions (Andrews & Thomson, 2009; Forgas, 2013). Dealing with these problems involves breaking them into smaller components to consider each individually, while making trade-offs between competing goals. This analytical and effortful style of thinking can help individuals find ways to best cope with the situation and eventually alleviate the negative emotion (Andrews & Thomson, 2009). In contrast, happiness is elicited in situations that are beneficial or, from an evolutionary standpoint, situations that increase fitness, such as social inclusion, romantic reciprocation, or a gain in resources (Nesse, 1990). These types of situations are less

challenging, allowing individuals to rely on heuristic or superficial thought (Forgas, 2013; Schwarz, 2000).

Thus, rather than being a response to the valence of the EW topic, changes in emotion during EW may be related to how deeply participants are processing the issues they write about. A student writing about a poor grade may try to pinpoint what went wrong, deliberate changes that must be made to do better next time, while juggling other considerations such as whether it is logical to drop the course or hire a tutor given limited financial resources. EW about a positive experience, however, is not likely to involve deep or effortful processing. In the study of positive EW, Burton and King (2004) provided an example of a participant who wrote about hiking with friends in a scenic location, describing this experience as a bonding opportunity. Favourable circumstances (e.g., social inclusions) would not benefit from cognitive processing (Forgas, 2013), which may explain why EW about positive experiences does not increase negative emotions.

Evidence for the cognitive processing hypothesis comes from a variety of experiments examining the impact of emotions like sadness and happiness on depth of processing. Associations between sadness and analytical thinking and between happiness and heuristic thinking have emerged when these emotions are induced using different paradigms involving music, videos, and visualization exercises. When recalling information in a memory test for example, sad participants are less likely than happy participants to rely on heuristics or fall prey to lures (Bless et al., 1996; Storbeck & Clore, 2005). Happy participants are more susceptible to bias, relying on stereotypes when making judgments about people (Park & Banaji, 2000). In contrast, sad participants tend to process information in a systematic and detailed way when forming judgements about statistical or interpersonal relationships (Ambady & Gray, 2002; Sinclair & Mark, 1995). Sad participants also take longer to make decisions, the outcomes of which appear to be guided by systematic thinking (Hertel, Heuhof, Theuer, & Kerr, 2000).

Although studies have not examined the degree to which EW elicits deep or effortful cognitive processing, EW may promote causal thinking about a problem or circumstance, which is thought to be analytically demanding. Negative events, particularly experiences of failure, trigger upward

counterfactuals, which are thoughts about how things could have gone differently (Roese, 1997). Because counterfactual thoughts identify what should have happened for the situation to be favourable, they identify the cause or source of negative events or problems (Roese, 1997). These causal thoughts are hypothesized to be analytical and effortful in nature (Andrews & Thomson, 2009), and recent research suggests that EW promotes causal thinking. In two studies, participants randomized to complete EW about a personal problem became sadder during writing than participants writing about a neutral topic. EW participants also reported thinking more about the causes of their problems, their roles in the situation, and how their problems could have been avoided, and their texts contained higher proportions of causal words than control writing texts (See Chapter 2). Although the link between emotion and causal thinking in these studies was not explicit, it is possible that sadness during EW is related to the cognitive processing associated with generating these causal thoughts. If so, as long as an EW topic elicits deep or effortful cognitive processing, it should result in negative emotions, regardless of whether the topic is positively or negatively-valenced (i.e., about a social inclusion or exclusion, a romantic reciprocation or rejection, or a gain or loss in resources).

There have not been attempts to dismantle the aspects of EW that lead to transient changes in emotion, but findings from one study suggest that the topic of EW does not need to be personally experienced by writers to induce negative emotions. Greenberg, Wortman, and Stone (1996) randomized students to write about a real traumatic event (an event that they personally experienced), an imaginary traumatic event (an experience that they read a brief excerpt about, but did not personally experience), or a control topic. Before writing, participants completed a measure of their emotions, and a visualization exercise, in which they deeply explored their (real or imaginary) trauma or the college campus. The significance of this step was to promote an "imagistic representation" of traumatic events, which resulted in increased access to associated feelings than just "lexical representation" (Horowitz & Reidbord, 1992). After writing, participants completed a second measure of their emotions. Participants who wrote about real and imaginary traumas reported more anger, fear, and depression after writing than control writers, and participants who wrote about real traumas were more depressed than participants who wrote about

imaginary ones. Thus, some of the depressed affect or sadness that participants feel during EW may be related to the personal relevance of the writing topic; however, writing about imaginary traumas still increased negative emotions relative to control writing (i.e., depression, anger, fear), suggesting that these emotions are also related to other aspects of the EW topic (such as valence or cognitive processing).

The Present Studies

The present set of studies examines why EW produces transient increases in negative emotions, distinguishing between two hypotheses: valence and cognitive processing. In both studies, we provided participants with hypothetical scenarios and randomized them to complete EW tasks about these scenarios or control writing tasks, which involved writing about their schedules.

In Study 1, we examined the short-term changes in emotion in response to writing about a complicated but non-personal problem (i.e., a problem not currently being experienced by participants). Participants chose a problem that they were least affected by from a list, and either wrote about this problem in an EW task or wrote about their schedule in a control writing task. Research suggests that EW about personal problems increases sadness and sometimes other negative emotions relative to writing about control topics (Chapter 2), and that writing about imaginary traumas induces similar emotional changes as writing about real traumatic events (Greenberg et al., 1996). We therefore expected participants writing about non-personal problems to be sadder than participants writing about control topics. However, the primary aim of Study 1 was to establish a baseline of emotional changes that writing about a hypothetical problem elicits, since Greenberg and colleagues' (1996) study suggests that writing about an imaginary event elicits less depressed affect than writing about a real event.

In Study 2, we examined the influence of the topic's valence on emotion during EW. We asked participants to consider a problem: a hypothetical scenario that required a decision between two jobs balanced in their positive and negative attributes. For half of our participants, this problem was framed positively as a gain in resources: participants were told that they were upgraded from their current position into one of two better job opportunities. For the other half, the problem was framed negatively as a loss in resources, with participants being fired from their current jobs and forced to decide between two

unappealing jobs. All participants were then randomized to write expressively about either problem (either the positively- or negatively-valenced scenario) or to a control writing condition. Importantly, the EW conditions only differed in the valence of the situation, and the task required participants to engage in similar amounts of analytical thinking when deliberating about the job options, which were balanced in their attributes.

If transient changes in emotion during EW were related to the valence of the writing topic, we predicted participants writing about the negative situation (job loss) would be sadder during writing, relative to control writers and participants writing about the positive situation. In contrast, participants writing about the positive situation (job gain) would be happier and less sad during writing, as compared to control writers and participants writing about the negative situation. Alternatively, if emotion during EW was related to the cognitive processing elicited by the writing topic, we predicted participants writing about both the positive and negative scenarios would be sadder during writing, as compared to control writers. We reasoned that both scenarios required participants to consider competing goals and make trade-offs between job attributes (e.g., flexible work hours and proximity) and therefore would elicit the same cognitive processing depth. Therefore, changes in emotions related to thinking deeply about the situation should occur in both EW groups. We also considered the possibility that valence and cognitive processing would combine to produce a graded effect, such that during writing, participants writing about the negative scenario would be saddest, and those writing about the positive scenario would be sadder than control writers but less sad than those writing about the negative scenario.

Additionally, we examined associations between emotions and trait indecisiveness, given its potential implications for our findings. Correlational and experimental research suggests that sadness increases indecisiveness (Pereira, 2014), perhaps because sadness promotes analytical thinking, which is slower and more effortful (Evans, 2003). Other experiments suggest that feelings of uncertainty can intensify affective reactions, making unpleasant events feel more unpleasant and pleasant events feel more pleasant (Bar-Anan, Wilson, & Gilbert, 2009). In Study 2, a tendency to be indecisive or feel uncertain could affect sadness when writing about the positively and negatively-valenced job decisions.

Alternatively, it could intensify positive or negative emotions in these two conditions. To control for these possibilities, we measured trait indecisiveness, assessed its links with emotions at baseline, and included it as a covariate in our analyses.

Study 1

Methods

Participants

We collected data from 68 undergraduate Psychology students, recruited from a research participation pool at a Canadian university. Data from 8 students were excluded either because they misunderstood the writing instructions by writing about a problem they were most affected by, they failed to complete the writing task, or they reported difficulties completing a visualization exercise intended to get participants into the prescribed mindset for EW. Our final sample consisted of 60 participants (52 females, 8 males), with a mean age of 18.51 (*SD*=1.54).

Measure

Valence–Arousal Mood Profile. To measure emotions before and during writing, we used the Valence–Arousal Mood Profile (VAMP; Maslej, Rheaume, Barbic, & Andrews, unpublished). It contains 16 adjectives used to rate how participants currently feel on a 5-point Likert scale from 1 (*not accurate as a self-description*) to 5 (*extremely accurate as a self-description*). Each of these adjectives corresponds to one of four emotions: sadness, happiness, anxiety, and calmness, and each emotion is represented by 3-5 adjectives. Ratings for each adjective are summed for each emotion, and participants receive an overall score for happiness, sadness, anxiety, and calmness.

Procedure

Pre-writing task procedures. All participants completed the entire study on a computer in a separate room, to maintain a sense of privacy and to limit the influence of experimenters (who were blind to study condition). After providing their consent to participate, participants completed the VAMP as a measure of their baseline emotions. Next, they read a list of four hypothetical problems: trouble adjusting

to school, financial difficulties, relationship troubles, and difficulties with grades. Participants rated the extent to which they were affected by each problem on a scale from 1 (*very unaffected*) to 10 (*very affected*). From this list, they chose one problem that affected them the least.

Participants subsequently read a scenario written in second-person perspective narrating a description of the problem that they rated being least affected by. Briefly, the scenario describing adjustment difficulties places participants in a situation where they are unable to form meaningful connections with anyone at university, feel uncomfortable around their roommates, and worry that they will never make friends. In the passage describing financial difficulties, the participants are no longer supported financially by their parents. Unable to find a job, they have no money and are accumulating debt. The passage describing relationship troubles puts participants in a situation where the person they are dating suddenly becomes distant, and they worry about an impending break-up. In the passage describing difficulties with grades, despite participants' best efforts to seek help, they struggle in their courses, and they worry about passing their exams and continuing in their program (See Appendix A for full descriptions of the scenarios).

After reading the passage, all participants completed an exercise in which they closed their eyes and visualized themselves experiencing the problem they read about for two minutes. Specifically, participants were instructed to let their imaginations carry them away into the situation, and experience the feelings and thoughts that a person experiencing the problem would. These instructions were adapted from Greenberg, Wortman, and Stone's (1996) study where participants mentally recreated imaginary traumatic scenarios before writing expressively about them.

Writing task procedures. After completing the visualization exercise, participants were randomized to one of two conditions. In the EW condition (*n*=32), participants wrote about the feelings and thoughts they would have if they were in the situation they envisioned. As per typical EW instructions, they were asked to "really let go and explore their very deepest emotions and thoughts" without worrying about spelling or grammar (Pennebaker, 1997). In the control condition (*n*=28), participants wrote about their schedule over the past week, focusing on concrete facts and details rather

than emotions. Each participant wrote for a total of 25 minutes, and completed a second VAMP mid-task (i.e., after 15 minutes of writing) as a measure of emotion during writing.

Post-writing task procedures. Next, participants answered two questions about the visualization task: whether they could get into the mindset of someone experiencing the problem and whether they were distracted or unable to complete the task. Participants were then debriefed and provided with a course credit for completing the study.

Statistical Analysis

Data preparation. Because we summed scores for the VAMP, we imputed missing data (Rubin, 1987). Less than 5% of data were missing for each measure, so we generated 5 copies of the data sets. We averaged missing value estimates across the data sets to generate a final estimate for each missing score.

Data analysis. To determine whether the frequency of males and females differed in each condition, we conducted a Chi-square test, and we used Wilcoxon-rank sum tests to check for differences across conditions in age. We assessed whether EW and CW exerted different effects on emotion by comparing emotions between time points with Wilcoxon signed-rank tests separately in each condition. To compare emotions between conditions during writing, we conducted generalized linear models, controlling for baseline emotions.

Results

The frequency of males and females did not differ across conditions, χ^2 (1, $N= 60$) = 0.03, $p= .86$, nor did age, $Z= -0.09$, $p= .94$. Most participants ($n=27$) reported that their least important problem involved relationship troubles, which had a mean importance score of 3.32 ($SD=2.62$) out of 10. Financial difficulty was the next least important problem ($n=22$), followed by difficulties adjusting to school ($n=8$), and problems with grades ($n=3$).

Changes in Emotion

Sadness. During CW, participants did not become sadder than they were before writing, $Z= 0.80$, $p= .43$, $r= 0.11$, but EW participants did, $Z= 2.20$, $p= .03$, $r=0.28$. Comparing between writing conditions, CW participants were non-significantly less sad than EW participants during writing, $\beta= -.17$, $SE= .12$, $p=$

.14. Figure 1 depicts sadness at each time point for CW and EW.

Happiness. Compared to before writing, CW participants became less happy during writing, $Z= -2.35$, $p= .02$, $r=0.31$, and the same was true for EW participants, $Z= -3.84$, $p<.01$, $r= 0.48$. During writing, CW participants were happier than EW participants, $\beta= .21$, $SE= .07$, $p< .01$.

Anxiety. CW and EW participants experienced no change in anxiety (CW: $Z= -0.19$, $p= .85$, $r= 0.03$; EW: $Z= 0.81$, $p= .43$, $r= 0.10$). During writing, anxiety did not differ between the two groups, $\beta= -.07$, $SE= .08$, $p= .39$.

Calmness. CW participants became non-significantly less calm during writing than they were before writing, $Z= -1.59$, $p=.11$, $r= 0.21$, and this effect was significant for EW participants, $Z= -3.42$, $p< .01$, $r= 0.43$. During writing, CW participants were calmer than EW participants, $\beta= .22$, $SE= .08$, $p= .01$.

Discussion

Writing expressively about a personally irrelevant problem or stressor impacted participants' emotions. Although EW and CW participants did not differ significantly in their sadness during writing, EW participants became sadder in the first half of writing, but CW participants did not. All participants became less happy in the first half of writing, but CW participants were happier and calmer during writing than EW participants were. In sum, participants who wrote about hypothetical problems reported increases in negative emotions (i.e., sadness, less happiness and calmness), as compared to before writing, and they were less happy and calm during writing than participants who wrote about their schedules.

Our findings allow us to generate more specific predictions for Study 2. Writing about a negative issue, which participants are not currently affected by, influences emotions in a way that is largely consistent with EW about a personal issue (e.g., Pennebaker & Beall, 1986) or EW about imaginary events (Greenberg et al., 1996). However, there is one inconsistency between our results and findings from other EW studies where the topic of writing is a personal problem. In these studies, EW consistently increased sadness relative to control writing (Chapter 2). In our study, expressive writers became sadder in the first half of writing, but this effect was not large enough for sadness to differ significantly between EW and CW. The effects were larger for changes in happiness and calmness, which differed significantly

between the two groups. Compared to writing about personal problems, writing about non-personal problems may not impact sadness as much it impacts happiness or calmness. This possibility is consistent with Greenberg and colleagues' (1996) result that writing about imaginary traumatic events left participants feeling less depressed than writing about real events, despite both groups being more depressed than control writers. In Study 2, we therefore expected that writing about a non-personal issue might influence happiness or calmness more than sadness.

Additionally, our CW task had unintended impacts on happiness. This task requires participants to describe their schedules over the past week as well as for the upcoming week. Given that our participants were undergraduate students, writing about their schedules may involve considering past assignments or tests as well as upcoming deadlines and tasks, which could make them unhappier during writing relative to before writing. In Study 2, we expected CW participants might report a small decrease in happiness in the first half of writing.

In Study 1, we observed a pattern of emotional changes emerging in response to writing about a hypothetical, negative issue. These changes must have depended on some aspect of the EW topic outside of its personal nature. In Study 2, we examine two possible aspects: the valence of the topic and the degree to which the topic elicits cognitive processing. If changes in emotion are an effect of valence, participants writing about a topic that elicits cognitive processing framed in a positive way should not experience the emotional changes we observed during EW in Study 1 (e.g., a small increase in sadness, and a decrease in happiness and calmness). Instead, this topic should produce a positive emotional state (e.g., a decrease in sadness and an increase in happiness and calmness). If changes in emotion are not due to the valence of the topic, then writing about a positive situation may produce emotional changes that are thought to underlie deep or effortful cognitive processing, even if they are incongruent with the topic's valence (e.g., an increase in sadness and a decrease in happiness).

Study 2

Methods

Participants

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We collected data from 112 undergraduate Psychology students from the same university, recruited from the research participation pool. We excluded data from 15 participants because they either did not complete the writing task or they reported difficulties completing the visualization exercise. Our final sample consisted of 97 participants (78 females, 19 males). Their mean age was 18.53 (SD=1.22).

Measures

Indecisiveness Scale. In addition to administering the VAMP, we assessed participants' trait indecisiveness using the 22-item Indecisiveness Scale (Germeijs & De Boeck, 2002). This scale contains phrases describing difficulties in making decisions, such as taking a long time to decide or not knowing how to make decisions. Participants rate their agreement with each phrase on a 7-point scale, ranging from 0 (*strongly disagree*) to 6 (*strongly agree*). Half of the items are reverse-coded, and all are summed to generate a total indecisiveness score. The scale has demonstrated reliability and validity, and it has been used to measure indecisiveness in different situations, including career indecision (Germeijs & De Boeck, 2002).

Procedure

Pre-writing task procedures. As with Study 1, all participants completed the study on a computer in a separate room and experimenters were blind to their condition. Participants completed a VAMP, and received the following instructions: "In this study, we want to know whether reflection through analysis can help people make better decisions in dilemma-type situations (i.e., situations where the correct solution to a problem is not apparent right away). Please read the dilemma below." Next, all participants read a hypothetical scenario (written in second-person perspective) where they had to choose between two jobs. Half of participants read a positively-valenced version (i.e., participants are working at their dream jobs and are offered two better positions) and the other half read a negatively-valenced version (i.e., participants are fired from their dream jobs and must decide between two unappealing job options). Next, all participants read descriptions of two job options that were balanced in their negative and positive attributes. We developed these options based on previous research identifying job attributes that applicants considered important in their decisions to accept or reject job offers (Turban, Eyring &

Campion, 1993). Since work enjoyment and advancement opportunities were most valued (Turban et al., 1993), these attributes were the same in the two job options presented in both versions of the scenario. P-EW participants were told that in both jobs, they would enjoy the work and have many opportunities to advance. In contrast, N-EW participants were told they would not enjoy the work and would have no opportunities to advance in either job. Other attributes (i.e., co-worker friendliness, boss friendliness, pay, benefits, company reputation, longevity, flexible hours and location) were balanced between the two job options in the same way in both versions (Appendix B contains full descriptions of the scenarios and the job options). After reading through the scenario and job options, participants completed a two-minute visualization exercise (as in Study 1).

Writing task procedures. Next, participants were assigned to either complete EW about the positively-valenced dilemma (P-EW, n=32), EW about the negatively-valenced dilemma (N-EW, n=29), or the same CW task used in Study 1 (n=36). The N-EW and P-EW tasks instructed participants to write their deepest thoughts and feelings about the situation they envisioned. In addition, the instructions stated: "write why you feel the way you do about each job, and list its benefits and disadvantages. Be sure to balance reasons before making a decision, and please do not make your decision before thoroughly reflecting on your thoughts and feelings." We adapted these instructions from previous studies which have successfully manipulated analytical thinking during decision-making tasks using these prompts (Hortsmann et al., 2009; Wilson & Schooler, 1991). N-EW and P-EW participants had the option to view the job options on their screens during the writing task. As in Study 1, all participants wrote for 25 minutes and completed a second VAMP after 15 minutes of writing.

Post-writing task procedures. Participants indicated which job option they would pick. They completed the Indecisiveness Scale, and answered two questions used in Study 1 about their abilities to complete the visualization exercise. Lastly, they were debriefed and given a course credit.

Statistical Analyses

Statistical analyses were similar to those in Study 1. We imputed missing data for the VAMP and the Indecisiveness Scale. To determine whether the frequency of males and females differed in each

condition, we conducted a Chi-square test. We used a Mann-Whitney U test to check for differences across conditions in age, and an ANOVA to check for differences across conditions in trait indecisiveness. We also examined correlations between indecisiveness and baseline emotions. For each condition, we compared emotions before and during writing with Wilcoxon signed-rank tests. We also compared emotions between conditions during writing with generalized linear models, controlling for baseline emotions, indecisiveness, and sex. Finally, we analyzed the content of the writing tasks using a computer-based text analysis program, the Linguistic Inquiry and Word Count (LIWC; Pennebaker & Francis, 1999). The LIWC calculates proportions of words belonging to various categories in a text. We compared word counts between the writing conditions, as well as the proportion of positive and negative affect words and cognitive processing words, using Wilcoxon rank-sum tests.

Results

The frequency of males and females differed across conditions, χ^2 (2, N= 87) = 5.85, p= .05. The N-EW condition had a larger proportion of males (34%), compared to the P-EW (13%) and CW conditions (14%). Age did not differ across conditions, W= 429, p= .94, nor did indecisiveness, F (2, 94) = 2.10, p= .35.

Negative emotions at baseline correlated positively with indecisiveness (sadness: r_s=.35, p<.01; anxiety; r_s=.43, p<.01), and positive emotions correlated negatively with indecisiveness (happiness: r_s= -.35, p<.01; calmness: r_s= -.42, p<.01). When indicating their job choice, most participants (79%) chose the first job described, and 21% chose the second job.

Changes in Emotion

Sadness. During CW, there was no change in sadness from baseline, Z= 0.22, p=.83, r=0.03. N-EW participants became sadder during writing as compared to before writing, Z=2.31, p=.02, r=0.30, but P-EW participants did not, Z=0.40, p=.70. r=0.05. During writing, control writing participants were less sad than N-EW participants, β= -.24, SE=.08, p<.01, but not P-EW participants, β= -.00, SE=.06, p=.97, and N-EW participants were sadder than P-EW participants, β=.26, SE=.08, p<.01.

Happiness. As compared to before writing, CW participants became non-significantly less happy

during writing, $Z= -1.80$, $p= .07$, $r=0.21$. This effect was statistically significant for N-EW and P-EW

participants (N-EW: $Z= -4.07$, $p<.01$, $r=0.53$; P-EW: $Z= -3.26$, $p<.01$, $r=0.41$). During writing, CW

participants were happier than N-EW participants to a marginally significantly degree, $\beta= .09$, $SE=0.04$,

$p=.05$, but not happier than P-EW participants, $\beta= .05$, $SE=.03$, $p=.10$, and P-EW participants were not

happier than N-EW participants, $\beta= .03$, $SE=.04$, $p=.50$. Figure 4 depicts happiness in each condition at

each time point.

Anxiety. Anxiety did not change during writing relative to baseline for any of the writing

conditions (CW: $Z= -1.52$, $p=.13$, $r=0.18$; N-EW: $Z= 1.11$, $p=.28$, $r=0.15$; P-EW: $Z=0.19$, $p=.86$, $r=0.02$).

However, during writing, CW participants were less anxious than N-EW participants, $\beta=.25$, $SE=.09$,

$p=.01$, and P-EW participants, $\beta=.19$, $SE=.09$, $p=.04$, with no differences between N-EW and P-EW

participants, $\beta=.05$, $SE=.10$, $p=.60$.

Calmness. As compared to before writing, CW participants became non-significantly less calm

during writing, $Z= -1.90$, $p=.06$, $r=0.22$, and this effect was statistically significant for N-EW participants,

$Z= -3.51$, $p<.01$, $r=0.46$. There was no change in calmness for P-EW participants however, $Z= -0.36$, $p=$

$.73$, $r=0.05$. During writing, control writers were calmer than N-EW participants, $\beta=0.18$, $SE=.06$, $p=.01$,

but they were not calmer than P-EW participants, $\beta=-0.03$, $SE=.06$, $p=.63$, and P-EW participants were

calmer than N-EW participants, $\beta= .20$, $SE=.07$, $p=.01$.

Linguistic Analyses

Control participants wrote more in their writing tasks than P-EW participants, $Z= 2.82$, $p<.01$, $r=$

0.34, and N-EW participants, $Z= 3.18$, $p<.01$, $r= 0.39$. N-EW and P-EW writing tasks were of a similar

length, $Z= 0.12$, $p= .91$, $r= 0.01$. Control writers used less positive affect words than P-EW participants,

$Z= -7.10$, $p<.01$, $r= 0.88$, and N-EW participants, $Z= -6.82$, $p<.01$, $r= 0.83$, but P-EW and N-EW

participants used a similar proportion of positive affect words, $Z= -0.71$, $p= .49$, $r= 0.09$. Control writers

also used less negative affect words than P-EW participants, $Z= -6.50$, $p<.01$, $r=0.79$, and N-EW

participants, $Z= -6.71$, $p<.01$, $r=0.83$. P-EW and N-EW participants did not differ in their use of negative

affect words, $Z= 0.30$, $p= .77$, $r= 0.04$. Control writers used less words reflecting cognitive processing

than P-EW participants, $Z= -6.82$, $p<.01$, $r= 0.83$, and N-EW participants, $Z= -6.51$, $p<.01$, $r=0.81$. There were no differences in the proportions of P-EW and N-EW texts containing cognitive processing words, $Z= 0.37$, $p= .72$, $r= 0.05$.

Discussion

When participants wrote expressively about a hypothetical, negative circumstance (e.g., being fired and having to choose between two unappealing jobs), they felt more negative than they did before writing. That is, they became sadder, less happy, and less calm than they were at the start of the experiment, and they were more anxious than CW participants during writing. Writing about a positive, hypothetical situation that elicited the same degree of cognitive processing did not appear to affect sadness or calmness, but it made participants less happy than they were before writing. This effect was larger for the negative topic (N-EW) than the positive topic (P-EW). Although P-EW participants were not significantly less happy than CW participants during writing, they were more anxious. Thus, writing about the positive topic did not induce negative emotions to the extent that writing about negative topics did, but it did not induce a positive or neutral emotional state either.

Implications for Hypotheses

Valence

Our results suggest that emotions during EW are related to the valence of the writing topic, in that the N-EW task elicited a congruently negative emotional state. Emotional changes during N-EW resembled those that occurred during EW in Study 1, where participants wrote about negative, hypothetical problems. In both writing conditions, sadness increased during writing (however, this increase only produced a statistically significant difference from CW in Study 2). Happiness and calmness decreased during writing as well. Overall, writing about a negative issue seems to decrease positive emotions and increase negative ones.

P-EW participants did not become happier or less sad during writing, which suggests that emotions do not necessarily match the valence of the EW topic. In fact, P-EW participants reported a decrease in happiness from baseline, and they were more anxious than CW participants during writing.

These results are inconsistent with previous research suggesting that EW about positive experiences produces positive emotions (Burton & King, 2004). However, the topic of P-EW was hypothetical and relatively mundane, which may explain why P-EW participants did not feel happier or calmer during writing. Furthermore, P-EW participants were not significantly less happy than CW participants, and they reported a smaller decrease in happiness than N-EW participants. In Study 1, control writers became less happy during writing (and this effect was not significant in Study 2), suggesting that writing about the positive job decision may have produced similar emotional changes to writing about a neutral or control topic. From this perspective, emotions during EW may be an effect of valence, with positive topics exerting less of an influence than negative ones.

N-EW may have had a larger impact on emotion than P-EW due to a negativity bias, which describes a tendency to be more responsive to a negative event than a positive event. From an evolutionary standpoint, the cost of reacting slowly to a negative situation or threat (e.g., a predator) is larger than the cost of reacting slowly to a positive or benign stimulus (e.g., a source of food) (Ekman, 1992). This negativity bias can occur in various domains (Rozin & Royzman, 2001), and in studies of emotion, our reactions to low intensity negative events are stronger than our reactions to low intensity positive events (Gilboa & Revelle, 1994). In Study 2, a hypothetical job loss or gain may be a low intensity event. Due to a negativity bias however, the negative scenario may have elicited a stronger emotional reaction than the positive scenario, which was not intense enough to increase happiness or calmness, nor decrease sadness.

Cognitive Processing

Alternatively, the decrease in happiness experienced by P-EW participants suggests that cognitive processing might contribute to emotion during EW. During writing, happiness did not differ between P-EW and N-EW participants. Unlike N-EW participants however, P-EW participants were not significantly less happy than CW participants, potentially because they reported a smaller decrease in happiness than N-EW participants. Both EW conditions instructed participants to think deeply about the job options, and we adapted these instructions from previous research that has successfully manipulated processing depth

(Hortsmann et al., 2009; Wilson & Schooler, 1991). The job options in each condition were balanced in the same way in terms of their positive and negative attributes, so all EW participants were deliberating the same trade-offs (e.g., friendly co-workers or a friendly supervisor, a company with a good reputation or one that treats employees fairly, good pay or attractive benefits, flexible work hours or a longer commute time). According to our linguistic analysis, P-EW and N-EW texts contained more positive and negative affect words than CW texts, but they did not differ in their proportions of these two categories. This suggests that EW participants were discussing their emotions, but in contrast to the spreading activation account, these emotions did not necessarily match the valence of their writing topic. P-EW and N-EW texts contained similar proportions of cognitive processing words, and they both contained a higher proportion of these words than CW texts. These linguistic parameters are only rough proxies of cognitive processing, but they suggest that N-EW and P-EW elicited similar amounts of processing, which may have been reflected in a decrease in happiness during writing.

If changes in emotion during EW were due to processing depth, it is unclear why P-EW did not affect sadness. One possibility is that the negativity bias may extend to the link between emotion and processing depth. Effortful processing elicited by a positive situation may affect emotion less than processing elicited by a negative situation, accounting for the increase in negative emotion during N-EW but not during P-EW. Furthermore, EW participants wrote about situations they were not personally affected by, and the personal irrelevance of the topics seemed to affect happiness more than sadness. This finding is consistent with other research on EW about imaginary or hypothetical events (Greenberg et al., 1996). If changes in emotion associated with processing depth are smaller when considering positive situations, we may have detected changes in happiness during P-EW (but not changes in sadness) because of a tendency for decreases in happiness to be larger in magnitude than increases in sadness when topics of EW are not personally relevant.

A Combined Effect of Valence and Cognitive Processing

The emotions we experience when considering difficult situations are likely the combined effect of a variety of factors, which may inform our results. Our hypotheses were not mutually exclusive, and it

is possible that both valence and cognitive processing influenced emotions. For instance, N-EW and P-EW may have elicited deep and effortful thinking about the job dilemma, which was linked with negative emotions during writing. N-EW participants considered an unfavourable situation (i.e., a job loss) and two unappealing job options, producing negative emotions that were consistent with the impact of thinking effortfully (i.e., an increase in sadness and a decrease in happiness). In contrast, P-EW participants considered a favourable situation (i.e., gaining a job) and deliberated between appealing job opportunities. The valence of this topic could have prevented a processing-related increase in sadness, or it could have induced positive emotions, which lessened the impact of sadness. Because changes in happiness tended to be larger than changes in sadness when participants wrote about personally irrelevant situations, P-EW participants may have only reported a net decrease in happiness.

Our findings additionally suggest that sadness and happiness are perhaps not opposite states on the same emotional spectrum, and instead, they may be distinct emotions with unique cognitive effects. Research suggests that sadness and happiness do not always co-vary (Rafaeli & Revelle, 2006). In studies that measured distinct emotions during EW, changes in sadness were not always accompanied by changes in happiness (Chapter 2). Furthermore, different emotions have unique effects on processing depth, even if they share the same valence. For instance, like happiness, anger and disgust are associated with heuristic and superficial processing (Tiedens & Linton, 2001). In Study 2, sadness and happiness could have distinct and unique associations with cognitive processing. Although P-EW participants did not become sadder during writing, their emotions might still be a reaction to the processing demands of the positive job decision. Happier individuals are more likely to rely on heuristics and peripheral cues when considering information (Park & Banaji, 2000). P-EW participants became less happy during writing, which may have decreased their reliance on heuristic or superficial thinking.

Emotion and Indecisiveness

When we examined correlations between emotions at baseline and trait indecisiveness, participants who were sadder and more anxious tended to be more indecisive, and participants who were happier and calmer tended to be less indecisive. This finding is consistent with other studies suggesting

that sadness and anxiety are associated with increased uncertainty (Pereira, 2014; Raghunathan & Pham, 1999). If sadness is linked with a slow, deliberate style of processing, participants who tend to be sad may take a longer time to make decisions (Forgas, 2013; Lerner, Li, Valdesolo, & Kassam, 2015). On the other hand, decision-making may be a quick and easy process for participants who tend to be happy, since happiness is linked with a reliance on mental shortcuts and heuristic cues (Lerner et al., 2015). The main features of indecisiveness measured in Germeijs and De Boeck's (2002) scale are the length and difficulty of the decision-making process, making it possible that processing styles associated with sadness and happiness account for the links we observed between emotions and indecisiveness. Alternatively, there may be individual differences related to emotions and indecisiveness which mediate their link. For instance, higher levels of trait neuroticism and low self-esteem have been associated with career indecisiveness, and these traits could be linked with a tendency to feel negative emotions (Bacanli, 2006; Gati et al., 2011).

Limitations and Future Directions

One important limitation of Study 2 is that we assume our EW instructions promote cognitive processing, but the decision participants considered in their EW tasks may not have been difficult enough. Researchers suggest that depressed affect is triggered by problems that are complicated and lack a simple or obvious solution (Andrews & Thomson, 2009). In Study 2, most participants (about 80%) chose the first job option, suggesting that this option was clearly favoured. In our post-hoc reading of the writing tasks, many participants mentioned that they preferred friendly co-workers (a feature of the first job option) to a competitive work environment (a feature of the second option).

Another related issue is that our study examines valence, but it does not directly test the effect of cognitive processing on emotion during writing. We assume that emotional changes common to both P-EW and N-EW (such as a decrease in happiness) are related to processing depth, but there are other variables that could be accounting for these emotional changes. For example, in both scenarios, participants are pressured to decide, since they are told that once they make a choice, they cannot change their minds (Appendix B). In both conditions, participants are uncertain of the outcomes of each option,

and happiness seems to be related to appraisals of high certainty (Tiedens & Linton, 2001). Rather than being an effect of cognitive processing, changes in happiness for P-EW and N-EW participants may reflect the urgency or uncertainty of the situation. To address this limitation, future research might modify the existing study design to manipulate processing depth, either by changing the difficulty of the decision or the EW instructions. If emotion is related to cognitive processing during EW, an easier decision (e.g., making one job option clearly preferable) or modified instructions (e.g., asking participants not to think deeply and to "go with their gut") should increase happiness, relative to conditions with difficult decisions or instructions to think analytically.

Relatedly, we interpret differences in emotions between N-EW (and EW in Study 1) and P-EW as an effect of valence, but the scenarios in these conditions differ in other, more specific ways, which could account for these differences. For instance, a hypothesized trigger for sadness is the experience of loss, either of a person, status, or goal (Carver, 2015; Raghunathan & Pham, 1999). In Study 1, the hypothetical problems participants wrote about involved a potential for loss (e.g., of a romantic relationship, social status, financial support, or good standing in an academic program). N-EW participants were considering a situation of loss as well, as they had lost a source of income (i.e., their current job) and were forced to decide between two unattractive options, which could have been interpreted as a loss of status. Depressed affect may also be related to hopelessness or a loss of control (Ragthunathan & Pham, 1999; Smith & Alloy, 2009). Each hypothetical scenario in Study 1 described an initial positive situation (i.e., having good grades or being part of a social group in high school, being in a loving relationship, having financial support) and an eventual unravelling, where the participant is left not knowing how to improve the situation (Appendix A). Implicit in these scenarios is a loss of control and a seemingly hopeless situation. Similarly, N-EW participants were told that in both job options, they would not enjoy the work and did not have any opportunities to advance, which they may have interpreted as a hopeless situation outside of their control. It is possible that any of the emotions the EW participants in Study 1 or the N-EW participants in Study 2 reported were specifically related to loss, hopelessness, or uncertainty, and not just the general valence of the situation. An important direction for future research

will be to develop scenarios that distinguish between the effects of these different features, and monitor emotional responses to EW about these scenarios.

One final limitation is that participants for both studies were primarily female. After examining whether the proportions of males and females differed across our writing conditions, we controlled for gender in Study 2, so that the larger proportion of males in the N-EW condition would not affect our results. However, the effect of decision-making on emotion might differ according to gender, so our overall findings may have been different if we were able to recruit more males.

Clearly, there are many aspects of EW that could produce transient negative emotions, and our two studies offer only a starting point. In them, we have identified the patterns of emotional changes that occur in response to EW about personally irrelevant topics, and negatively or positively-valenced situations. Although valence was influential, we also found some evidence that processing depth might play a role, perhaps as part of a combined effect. Importantly, our studies offer a useful paradigm for exploring the various aspects of EW that produce these transient emotions, which can lead to further research that delineates these aspects more specifically. Other future directions might include incorporating physiological measures of emotion or more complicated linguistic analyses of EW texts to measure processing depth. This research can help us pinpoint the reasons for the emotional changes that seem to underlie EW's therapeutic benefits. On a larger scale, it helps us understand how our emotions might shift according to different environmental circumstances, and eventually, the consequences of these emotions for producing appropriate cognitive and behavioural responses.

References

Ambady, N., & Gray, H. M. (2002). On being sad and mistaken: Mood effects on the accuracy of thin-slice judgments. *Journal of Personality and Social Psychology, 83*(4), 947–961.

Andrews, P. W., & Thomson Jr, J. A. (2009). The bright side of being blue: Depression as an adaptation for analyzing complex problems. *Psychological Review, 116*(3), 620–654.

Bacanli, F. (2006). Personality characteristics as predictors of personal indecisiveness. *Journal of Career Development, 32*(4), 320–332.

Bar-Anan, Y., Wilson, T. D., & Gilbert, D. T. (2009). The feeling of uncertainty intensifies affective reactions. *Emotion, 9*(1), 123–127.

Bless, H., Clore, G. L., Schwarz, N., Golisano, V., Rabe, C., & Wolk, M. (1996). Mood and the use of scripts: Does a happy mood really lead to mindlessness? *Journal of Personality and Social Psychology, 71*(4), 665–679.

Booth, R. J., Petrie, K. J., & Pennebaker, J. W. (1997). Changes in circulating lymphocyte numbers following emotional disclosure: evidence of buffering? *Stress Medicine, 13*(1), 23–29.

Bower, G. H. (1981). Mood and memory. *American Psychologist, 36*(2), 129–148.

Burton, C. M., & King, L. A. (2004). The health benefits of writing about intensely positive experiences. *Journal of Research in Personality, 38*(2), 150–163.

Carver, C. S. (2015). Control processes, priority management, and affective dynamics. *Emotion Review, 7*(4), 301–307.

Cousineau, D. (2005). Confidence intervals in within-subject designs: A simpler solution to Loftus and Masson's method. *Tutorials in Quantitative Methods for Psychology, 1*(1), 42–45.

Dickerson, S. S., Kemeny, M. E., Aziz, N., Kim, K. H., & Fahey, J. L. (2004). Immunological effects of induced shame and guilt. *Psychosomatic Medicine, 66,* 124–131.

Donnelly, D. A., & Murray, E. J. (1991). Cognitive and emotional changes in written essays and therapy interviews. *Journal of Social and Clinical Psychology, 10*(3), 334–350.

Ekman, P. (1992). An argument for basic emotions. *Cognition & Emotion*, *6*(3-4), 169–200.

Epstein, E. M., Sloan, D. M., & Marx, B. P. (2005). Getting to the heart of the matter: Written disclosure, gender, and heart rate. *Psychosomatic Medicine, 67*(3), 413–419.

Forgas, J. P. (2013). Don't worry, be sad! On the cognitive, motivational, and interpersonal benefits of negative mood. *Current Directions in Psychological Science, 22*(3), 225–232.

Frattaroli, J. (2006). Experimental disclosure and its moderators: a meta-analysis. *Psychological Bulletin*, *132*(6), 823–865.

Gati, I., Gadassi, R., Saka, N., Hadadi, Y., Ansenberg, N., Friedmann, R., & Asulin-Peretz, L. (2011). Emotional and personality-related aspects of career decision-making difficulties: Facets of career indecisiveness. *Journal of Career Assessment, 19*(1), 3–20.

Germeijs, V., & De Boeck, P. (2002). A measurement scale for indecisiveness and its relationship to career indecision and other types of indecision. *European Journal of Psychological Assessment*, *18*(2), 113–122.

Gidron, Y., Peri, T., Connolly, J. F., & Shalev, A. Y. (1996). Written disclosure in posttraumatic stress disorder: is it beneficial for the patient? *Journal of Nervous and Mental Disease, 184*(8), 505–507.

Greenberg, M. A., & Stone, A. A. (1992). Emotional disclosure about traumas and its relation to health: Effects of previous disclosure and trauma severity. *Journal of Personality and Social Psychology, 63*(1), 75–84.

Greenberg, M. A., Wortman, C. B., & Stone, A. A. (1996). Emotional expression and physical health: Revising traumatic memories or fostering self-regulation? *Journal of Personality and Social Psychology, 71*(3), 588–602.

Hertel, G., Neuhof, J., Theuer, T., & Kerr, N. L. (2000). Mood effects on cooperation in small groups: Does positive mood simply lead to more cooperation? *Cognition and Emotion, 14*(4), 441–472.

Horowitz, M. J., & Reidbord, S. P. (1992). Memory, emotion, and response to trauma. *The Handbook of Emotion and Memory: Research and Theory,* 343–357.

Horstmann, N., Hausmann, D., & Ryf, S. (2009). Twelve methods for inducing intuitive and deliberate

processing modes. In A. Glöckner & C. Witteman (Eds.), *Foundations for tracing intuition: Challenges and methods* (pp. 219). New York, NY: John Wiley & Sons.

Ito, T., & Cacioppo, J. (2005). Variations on a human universal: Individual differences in positivity offset and negativity bias. *Cognition & Emotion, 19*(1), 1–26.

Josephson, B. R. (1996). Mood regulation and memory: Repairing sad moods with happy memories. *Cognition & Emotion, 10*(4), 437–444.

Klein, K., & Boals, A. (2001). Expressive writing can increase working memory capacity. *Journal of Experimental Psychology: General, 130*(3), 520–533.

Kloss, J. D., & Lisman, S. A. (2002). An exposure-based examination of the effects of written emotional disclosure. *British Journal of Health Psychology, 7,* 31–46.

King, L. A., & Miner, K. N. (2000). Writing about the perceived benefits of traumatic events: Implications for physical health. *Personality and Social Psychology Bulletin, 26*(2), 220–230.

Kovac, S. H., & Range, L. M. (2002). Does writing about suicidal thoughts and feelings reduce them? *Suicide and Life-Threatening Behavior, 32*(4), 428–440.

Lepore, S. J., & Greenberg, M. A. (2002). Mending broken hearts: Effects of expressive writing on mood, cognitive processing, social adjustment and health following a relationship breakup. *Psychology and Health, 17*(5), 547–560.

Lerner, J. S., Li, Y., Valdesolo, P., & Kassam, K. S. (2015). Emotion and decision making. *Annual Review of Psychology, 66*, 799–823.

Levenson, R. W. (1999). The intrapersonal functions of emotion. *Cognition and Emotion, 13*(5), 481–504.

Martino, M. L., Freda, M. F., & Camera, F. (2013). Effects of Guided Written Disclosure Protocol on mood states and psychological symptoms among parents of off-therapy acute lymphoblastic leukemia children. *Journal of Health Psychology, 18*(6), 727–736.

Maslej, M.M., Rheaume, A., Barbic, S., & Andrews, P. (Unpublished manuscript). The Valence-Arousal Mood Profile.

Maslej, M.M., Rheaume, A.R., Schmidt, L., & Andrews, P.W. (Chapter 2). Changes in emotion and causal analysis during expressive writing about a personal problem.

Mayer, J. D., Gayle, M., Meehan, M. E., & Haarman, A. K. (1990). Toward better specification of the mood-congruency effect in recall. *Journal of Experimental Social Psychology, 26*(6), 465–480.

Mills, C., & D'Mello, S. (2014). On the validity of the autobiographical emotional memory task for emotion induction. *PloS One, 9*(4), e95837.

Murray, E. J., Lamnin, A. D., & Carver, C. S. (1989). Emotional expression in written essays and psychotherapy. *Journal of Social and Clinical Psychology, 8*(4), 414–429.

Nesse, R. M. (1990). Evolutionary explanations of emotions. *Human Nature, 1*(3), 261–289.

Pascual-Leone, A., Yeryomenko, N., Morrison, O. P., Arnold, R., & Kramer, U. (2016). Does feeling bad, lead to feeling good? Arousal patterns during expressive writing. *Review of General Psychology, 20*(3), 336–347.

Park, J., & Banaji, M. R. (2000). Mood and heuristics: The influence of happy and sad states on sensitivity and bias in stereotyping. *Journal of Personality and Social Psychology, 78*(6), 1005–1023.

Pennebaker, J. W. (1993). Putting stress into words: Health, linguistic, and therapeutic implications. *Behaviour Research and Therapy, 31*(6), 539–548.

Pennebaker, J. W. (1997). Writing about emotional experiences as a therapeutic process. *Psychological Science, 8*(3), 162–166.

Pennebaker, J. W. (2004). Theories, therapies, and taxpayers: On the complexities of the expressive writing paradigm. *Clinical Psychology: Science and Practice, 11*(2), 138–142.

Pennebaker, J.W., & Beall, S. K. (1986). Confronting a traumatic event: Toward an understanding of inhibition and disease. *Journal of Abnormal Psychology, 95*, 274–281.

Pennebaker, J. W., & Francis, M. E. (1996). Cognitive, emotional, and language processes in disclosure. *Cognition & Emotion, 10*(6), 601–626.

Pennebaker, J. W., Kiecolt-Glaser, J. K., & Glaser, R. (1988). Disclosure of traumas and immune

function: Health implications for psychotherapy. *Journal of Consulting and Clinical Psychology, 56*(2), 239–245.

Pereira, B. D. C. S. (2014). *The Ironic Interplay of Choice and Sadness.* Unpublished dissertation.

Rafaeli, E., & Revelle, W. (2006). A premature consensus: Are happiness and sadness truly opposite affects? *Motivation and Emotion*, *30*(1), 1–12.

Raghunathan, R., & Pham, M. T. (1999). All negative moods are not equal: Motivational influences of anxiety and sadness on decision making. *Organizational Behavior and Human Decision Processes, 79*(1), 56–77.

Reinhold, M., Bürkner, P. C., & Holling, H. (2018). Effects of expressive writing on depressive symptoms-A meta-analysis. *Clinical Psychology: Science and Practice, 25*(1), e12224.

Roese, N. J. (1997). Counterfactual thinking. *Psychological Bulletin*, *121*(1), 133–148.

Rozin, P., & Royzman, E. B. (2001). Negativity bias, negativity dominance, and contagion. *Personality and Social Psychology Review, 5*(4), 296–320.

Rubin, D. B. (1987). The calculation of posterior distributions by data augmentation: Comment: A noniterative sampling/importance resampling alternative to the data augmentation algorithm for creating a few imputations when fractions of missing information are modest: The SIR algorithm. *Journal of the American Statistical Association, 82*(398), 543–546.

Scanlan, C. R. (2000). *An investigation of the effect of writing about traumatic events on knowledge structures in dysphoric individuals.* Unpublished dissertation.

Schwarz, N. (2000). Emotion, cognition, and decision making. *Cognition & Emotion*, *14*(4), 433–440.

Sinclair, R. C., & Mark, M. M. (1995). The effects of mood state on judgmental accuracy: Processing strategy as a mechanism. *Cognition & Emotion*, *9*(5), 417–438.

Smith, J. M., & Alloy, L. B. (2009). A roadmap to rumination: A review of the definition, assessment, and conceptualization of this multifaceted construct. *Clinical Psychology Review, 29*(2), 116–128.

Smyth, J. M., Hockemeyer, J. R., & Tulloch, H. (2008). Expressive writing and post-traumatic stress

disorder: Effects on trauma symptoms, mood states, and cortisol reactivity. *British Journal of Health Psychology*, *13*(1), 85–93.

Spera, S. P., Buhrfeind, E. D., & Pennebaker, J. W. (1994). Expressive writing and coping with job loss. *Academy of Management Journal*, *37*(3), 722–733.

Storbeck, J., & Clore, G. L. (2005). With sadness comes accuracy; with happiness, false memory: Mood and the false memory effect. *Psychological Science, 16*(10), 785–791.

Tiedens, L. Z., & Linton, S. (2001). Judgment under emotional certainty and uncertainty: The effects of specific emotions on information processing. *Journal of Personality and Social Psychology, 81*(6), 973–988.

Tooby, J., & Cosmides, L. (1990). The past explains the present: Emotional adaptations and the structure of ancestral environments. *Ethology and Sociobiology, 11*, 375–424.

Turban, D. B., Eyring, A. R., & Campion, J. E. (1993). Job attributes: Preferences compared with reasons given for accepting and rejecting job offers. *Journal of Occupational and Organizational Psychology, 66*(1), 71–81.

Wilson, T. D., & Schooler, J. W. (1991). Thinking too much: Introspection can reduce the quality of preferences and decisions. *Journal of Personality and Social Psychology, 60*(2), 181–192.
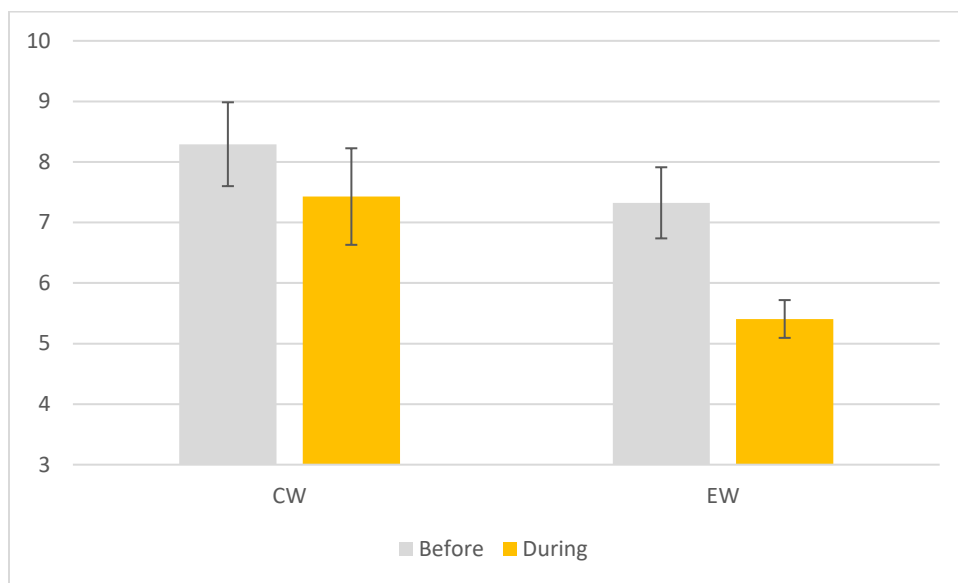
Tables and Figures

Figure 1

Sadness before and during EW and CW in Study 1
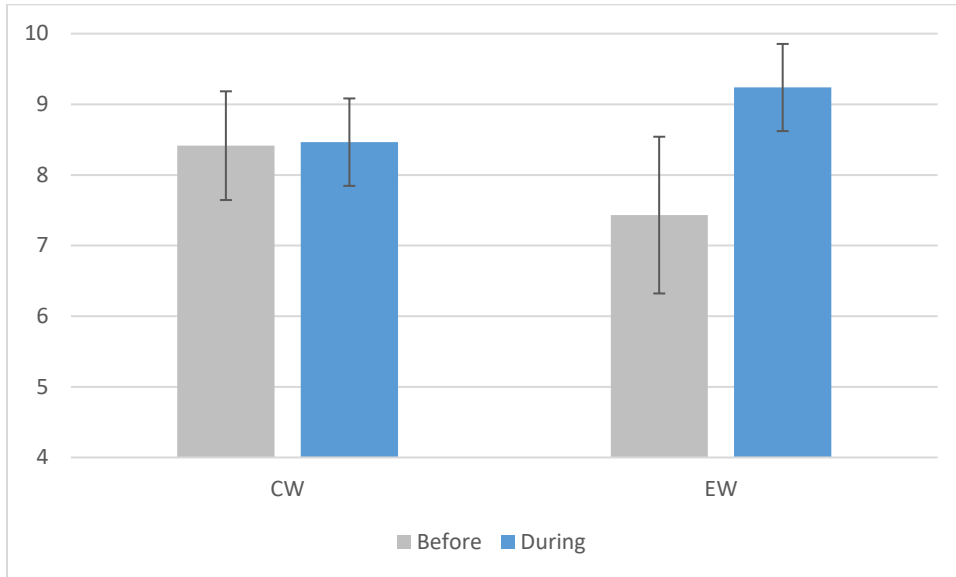
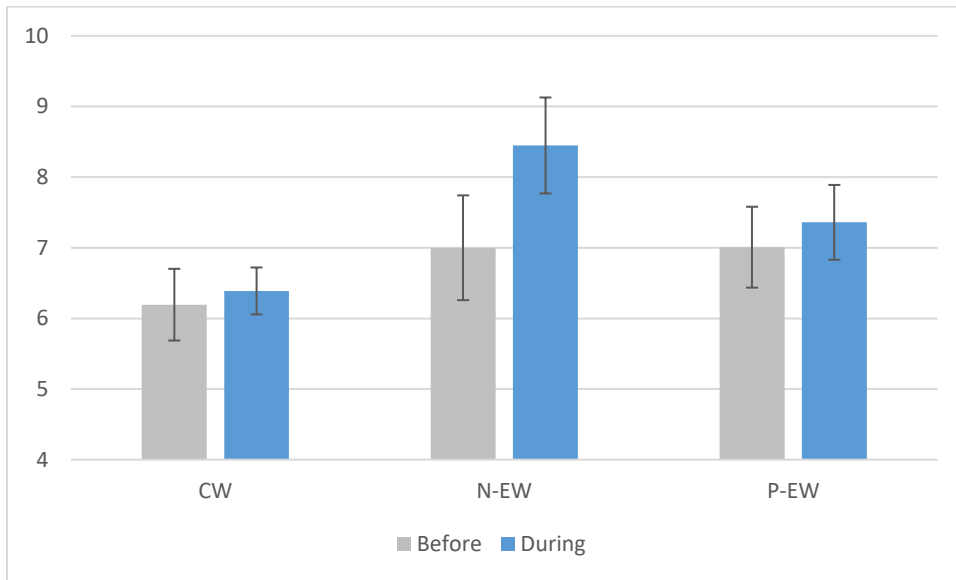*Note.* Error bars are within-subject 95% confidence intervals (Cousineau, 2005)

Figure 2

Happiness before and during EW and CW in Study 1

Note. Error bars are within-subject 95% confidence intervals (Cousineau, 2005)

Figure 3

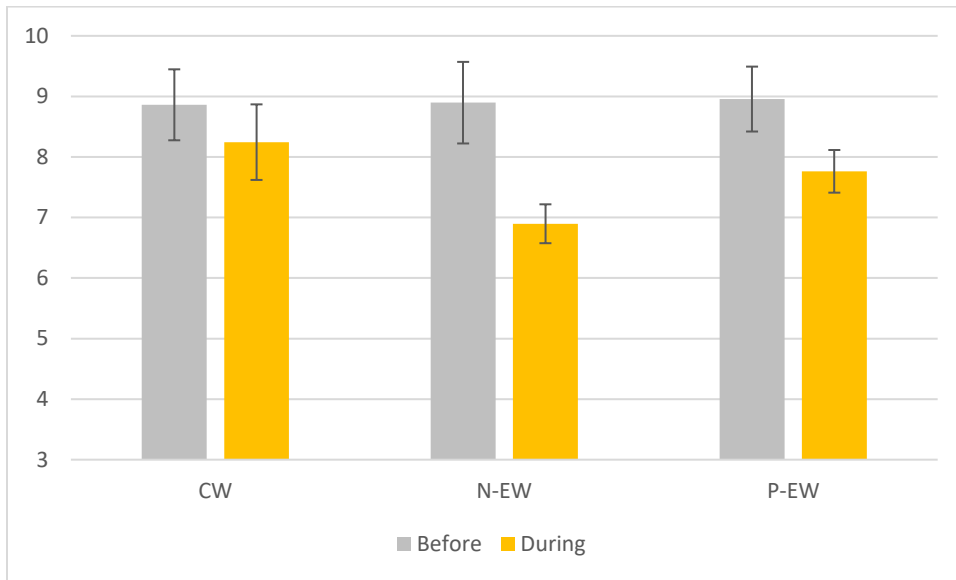*Sadness before and during CW, N-EW and P-EW in Study 2*

Note. Error bars are within-subject 95% confidence intervals (Cousineau, 2005)

Figure 4

Happiness before and during CW, N-EW and P-EW in Study 2

Note. Error bars are 95% within-subject confidence intervals (Cousineau, 2005)

Supplementary Sections

Appendix A

Hypothetical problems used in Study 1

i) *Difficulty adjusting to school*
As a high school student, you felt comfortable living at home and you had many friends. After finishing high school, you were confident that you would quickly make many new friends at McMaster and you were excited about moving away from your home town. In the first week, you did your best to get involved in activities, and attend parties and social events. But you had a hard time connecting with anyone and you felt as though everyone had already formed friend groups. Any time you tried to join a group or contact people outside of class, they seemed hesitant. On top of that, your roommates are awkward around you, they keep to themselves, and seem a bit rude. You feel really uncomfortable in your own home, and you feel like you have no friends on campus. Recently, you spoke to your old friends from high school, and although it made you happy to hear from them, they all seem to be adjusting to university very well. Now, you found out that someone from your classes is throwing a huge party this weekend, but you didn't receive an invitation, and you're really starting to worry that you won't ever make any friends at university.

ii) *Financial difficulty*
Growing up, you've always had enough money to get what you needed and your family did their best to provide you with all the opportunities that your friends received. Your caregivers owned a business that was going well, and money was never an issue. Right as you started university this year, the business fell through, and your caregivers lost their jobs. They needed to care for your younger siblings and maintain their household, so they were no longer able to help you with tuition payments, housing, and food while you're away at university. At the start of the term, you had some money saved up. But halfway into the term, you still can't find a part time job (and you don't think you even have time for one), your money ran out, and you've accumulated debt on your credit card. You keep getting invited to go out to movies or dinners that you can't afford, so you have to make excuses about why you can't hang out with your friends, because they all seem to have money and you're embarrassed that you don't. Now, you're late on rent a couple months in a row, you haven't been able to contribute to the grocery bill in a while, and your roommates are getting very annoyed. Your credit card is maxed out, your parents won't give you any more money until next term, and you're worried that you'll never pay back your debt and you'll get kicked out of your home.

iii) *Difficulty with a romantic relationship*
At the start of this term, you met a person you really liked in class. You find this person really attractive both inside and out, and you seem to have a lot in common. Most importantly, you have lots of fun when you're together. You talk and laugh a lot, and you would spend almost every day together. You were so happy, until a month ago, when this person became cold and distant. At first, this person started not responding to your messages on a regular basis, and then cancelled when you were supposed to hang out. When you did hang out, this person was easily annoyed and you both bickered and fought more than you used to. Now, you only see each other in class. You're upset that this person is not trying to work on the relationship, but also extremely sad and scared that you two will break up. Even though things are bad, you're not ready to let go because this person used to make you really happy. Now, the term is almost done, and you're worried that once this person goes away for the holidays, the relationship will be over.

iv) *Difficulty with grades*

You are completing your first year at university, and you are feeling the pressure to succeed. You have paid thousands of dollars into your tuition, your cost of living, and your family is expecting you to do well in your program. You are also putting a lot of pressure on yourself. You need good grades to continue in your program, and you generally consider yourself to be a smart and hard-working student. Unfortunately, you've been struggling with the material in all your courses despite seeking help from TAs, doing extra readings and assignments, and taking the time to study. Even though you have put your full effort into your work, you've been receiving midterm grades that are well below anything close to what you'd be happy with. On the other hand, your classmates are doing really well, and every time you study together, they seem to be picking up the material much more quickly than you. Now, final exams are coming up in a couple of weeks. You have been trying to study and prepare, but you're worried that your best is just not good enough.

Appendix B

Study dilemma descriptions

In this study, we want to know whether reflection through analysis can help people make better decisions in dilemma-type situations (i.e., situations where the correct solution to the problem is not apparent right away). Please read the dilemma below.

i) Negative dilemma (N-EW):
After completing university, you landed your dream job. You loved it because it was the exact type of work you enjoy doing, and there was plenty of opportunity for advancement. After several months, you were fired. The job market is terrible, and after a few months of looking and going to interviews with disappointing results, you've finally been offered two different positions. The problem is that both options are pretty bad. You know you won't enjoy the work at either job, and you'd be stuck with no opportunity for advancement or moving up in the company. But your bills are piling up and you need to pick one by today. Once you make your choice, there's no going back. Please read the job descriptions below to make your choice.

Job A: You would not enjoy the work here, and there are no opportunities to apply for a better position down the road. When you had gone in for an interview, the co-workers seemed friendly and welcoming, and you even heard some laughs around the office. But you had a feeling that the person interviewing you (who would be your supervisor) did not like you. This person seemed disappointed that the last employee left, and frustrated that they had to hire someone new. The pay is slightly worse than Job B, but Job A offers benefits and a better medical insurance plan. The location for both jobs is not ideal, but it will take you longer to get to this job because of traffic, so some days, you might be sitting in your car for an extra half hour just to get there.

Job B: You would not enjoy the work here, and there are no opportunities to apply for a better position down the road. The company has a slightly better reputation and pay than Job A. However, when you looked the company up online, you found many complaints from ex-employees that they were fired for no reason. When you had gone in for an interview, the co-workers seemed rude and competitive. Some of them looked very annoyed that you were being interviewed for the position. However, the person interviewing you (who would be your supervisor) seemed friendly and nice. The hours at this job are slightly more flexible than those for Job A, but an employee told you that they often have to come in to work on weekends.

ii) Positive dilemma (P-EW):
After completing university, you landed your dream job. You loved it because it was the exact type of work you enjoy doing, and there was plenty of opportunity for advancement. After several months, you

were offered two different and even better positions. The problem is that both options are excellent. You know you will enjoy the work at either job, and there are many opportunities for you to advance or move up in the company once you start. You've taken some time to decide, but your time is running out and you need to pick one by today. Once you make your choice, there's no going back. Please read the job descriptions below to make your choice.

Job A: You would enjoy the work here very much, and there are many opportunities for advancement. When you had gone in for an interview, the co-workers seemed really friendly and welcoming, and you heard them laughing and joking around in the office. Although the person interviewing you (who would be your supervisor) seemed disappointed that the last employee left, they were nice and friendly to you. The pay is slightly worse than Job B, but Job A offers benefits and a better medical insurance plan. The location for both jobs is very good, but it will take you longer to get to this job because of traffic, so some days, you might be sitting in the car or bus for an extra amount of time just to get there.

Job B: You would enjoy the work here very much, and there are many opportunities for advancement. The company has a better reputation and offers better pay than Job A. However, when you looked the company up online, you found one complaint from an ex-employee that they were fired unfairly. When you had gone in for an interview, the co-workers were very friendly but seemed a bit competitive. Some of them looked worried that you were being interviewed for the position. However, the person interviewing you (who would be your supervisor) seemed to like you a lot, and was very friendly and welcoming. The hours at this job are slightly more flexible than those for Job A, but an employee told you that they often have to come in to work on weekends.

CHAPTER 4

The nature of depressive rumination and its connection with depressive symptoms

Abstract

Researchers have proposed several theories of depressive rumination and developed different questionnaires to measure them. To compare these existing frameworks, we conducted a joint factor analysis of four main rumination measures and examined associations between the emerging factors and depressive symptoms. An online sample (n=498) completed the rumination questionnaires and the Beck Depression Inventory-II. One month later, 209 participants completed the same questionnaires. The factor analysis yielded four factors. Items from *Symptoms* (thoughts about depressive symptoms) and *Sadness* (attempts to understand its source or meaning) were least frequent. *Stressors* (primarily involving causal thoughts about negative situations) occurred more frequently, and *Solving* (considering solutions or ways to cope) were most frequent. All factors were associated with current depression. To examine these associations, we conducted a series of regressions and structural equation models. Their findings suggest that *Sadness* is not uniquely related to depression, and when preceded by *Stressors*, *Solving* negatively predicts depressive symptoms. Only *Symptoms* were unique predictors of depression one month later. We discuss our results in the context of other research and highlight their limitations.

Introduction

Clinicians have displayed a growing interest in thoughts that occur when people are sad or depressed, referred to as depressive rumination. Most researchers view rumination as a stable, individual style of responding to a negative mood, after Nolen-Hoeksema and her colleagues observed negative emotional outcomes in people who are predisposed to ruminate – i.e., to focus their attention on depressive symptoms and the consequences of these symptoms, when feeling sad or distressed (Morrow & Nolen-Hoeksema, 1990; Nolen-Hoeksema & Morrow, 1993; Nolen-Hoeksema, Morrow & Fredrickson, 1993). This ruminative response style has been implicated in the onset and maintenance of depression (for a review, see Thomsen, 2006). As a result, depressive rumination has been generally defined as a tendency to engage in recurrent, negative thinking, which the primary individual intervention for depression, cognitive-behavioral therapy, aims to reduce or suppress (e.g., Watkins et al., 2007).

Other researchers have proposed alternative theories of depressive rumination that tap into different constructs (for a review of rumination theories, see Smith & Alloy, 2009). As a result, the literature, although abundant, is not unified, and there have not been many empirical efforts to elucidate the nature of depressive rumination based on the various proposed frameworks. The current study is a starting point to address this challenge and to integrate the research on rumination. We conducted a joint factor analysis of four depressive rumination questionnaires (see Table 1) and examined how the resulting rumination factors are related to depressive symptoms.

Given the need for studies to determine how the various rumination questionnaires converge (Siegle, 2000), Roelofs and colleagues (2006) conducted joint factor analyses of the Ruminative Response Scale (RRS) and the Rumination on Sadness Scale (RSS) in undergraduate student samples. Their analyses revealed three factors: rumination about depressive symptoms, rumination on the causes of sadness, and rumination about other aspects of sadness (which were not well specified). Unlike what had been reported previously (Treynor, Gonzalez & Nolen-Hoeksema, 2003; Nolen-Hoeksema & Davis, 2004), distinct factors resembling brooding and reflective pondering did not emerge, and their items were dispersed among the three factors. All three factors were associated with current depressive symptoms;

however, only rumination on the causes of sadness predicted depressive symptoms six months later (Roefols, Muris, Huibers, Peeters & Arntz, 2006).

Roefels and colleagues' (2006) joint factor analysis is useful for understanding how the RRS and RSS represent similar aspects of rumination, but it only included two existing measures. Given the variety of proposed perspectives on depressive rumination, our first aim was to clarify the nature of ruminative thoughts based on four existing perspectives. To do so, we conducted a joint factor analysis of the RRS, the RSS, the rumination subscale of the Stress-Reactive Rumination Scale (SRRS), and the Analytical Rumination Questionnaire (ARQ). These questionnaires are based on different (and sometimes competing) theoretical conceptualizations of ruminative thoughts and reflect multiple factors, so we expected our analysis to produce several rumination factors. We predicted the emergence of a factor reflecting thoughts about the cognitive and somatic symptoms of depression and their consequences, since other factor analyses have consistently yielded this type of factor (Roberts, Gilboa & Gotlib, 1998; Lam, Smith, Checkley, Rijsdijk & Sham, 2003; Roefols et al., 2006). In addition, we expected our results to include a factor describing thoughts related to solving a problem or contemplating instrumental or remedial action, since some theoretical approaches and empirical data support that these thoughts occur in the context of depression (Treynor et al., 2003; Nolen-Hoeksema, Wisco & Lyubomirsky, 2008; Andrews & Thomson, 2009; Bartoskova et al., 2018). We also anticipated a factor reflecting an attempt to understand the causes of sadness or the causes of negative events, since these factors have emerged in previous studies (Lam et al., 2003; Raes, Hermans, Williams, Bijttebier & Eelen, 2008; Bartoskova et al., 2018). We were not certain about what other factors to expect. For instance, the factors could distinguish between a focus on external circumstances and internal feelings or mental states.

A second aim of this study was to examine the prevalence of the rumination factors. Since the existing measures use different instructions and rating scales, it is difficult to compare the frequency of these thoughts across measures. However, certain rumination items might be more commonly endorsed than others.

Third, we examined the covariance patterns between the rumination factors and depressive

symptoms, both concurrently and longitudinally. Depressive rumination has traditionally been conceptualized as thinking in response to a sad or depressed mood (Nolen-Hoeksema, 1991), and in previous research, when a rumination factor was not a reliable predictor of depression, it was not considered relevant in the study of depressive rumination (e.g., Lam et al., 2003). A ruminative responses style, rumination on sadness, stress reactive rumination, and analytical rumination have been theoretically and empirically linked with current depressive symptoms (reviewed in Table 1), so we expected that all emerging factors would be associated with current depression. However, it was not clear whether these associations were unique, or independent of associations with other factors. For instance, the link between depression and a factor reflecting attempts to problem-solve may include multiple sources of covariance (e.g., from causal thoughts) that affect the nature of this link (Bartoskova et al., 2018).

Often, researchers examine rumination as a predictor of future depression, and we wondered if different factors had different longitudinal implications. Rumination on sadness, stress reactive rumination, and brooding predict higher levels of depressive symptoms over time (see Table 1). Reflective pondering has been associated with lower levels of depression in some longitudinal samples (Treynor et al., 2003), but not others (Nolen-Hoeksema & Davis, 2004). In contrast, analytical rumination (including problem-solving analysis) is hypothesized to hasten the resolution of depressive episodes over time (Andrews & Thomson, 2009; Bartoskova et al., 2018). However, symptoms are expected to increase and decrease over the course of an episode in ways that reflect progress on the triggering problem (Bartoskova et al., 2018).

Methods

Participants

We recruited 508 participants from Amazon's Mechanical Turk (M-Turk). The M-Turk advertisement identified the study as a mental health questionnaire, which asked about participants' mental health and how they think. We offered two US dollars as compensation, and on average, the study took about 35 minutes to complete. Ten people did not complete the study, resulting in a final sample of 498 participants.

Of these initial participants, 266 agreed to be contacted for a follow up study. We notified them of the follow up study's availability via e-mails sent through M-Turk. We offered an additional two dollars for completing the follow up questionnaires and 209 participants completed the follow up study in about 23 minutes. Sample demographic information is provided in Table 2.

Measures

We administered the following three questionnaires to participants in the study and at follow up:

Beck Depression Inventory-II (BDI-II; Beck, Brown, & Steer, 1996). The BDI–II contains 21 items assessing depressive symptoms. Each item is rated on a 4-point Likert scale, with higher scores representing greater severity of depression. Scores from 0–13 are thought to reflect minimal levels of depression, 14–19 reflects mild depression, 20–28 indicates moderate depression, and 29–63 indicates severe depression (Beck et al., 1996). The BDI-II has excellent internal consistency as well as high content and construct validity (Beck et al., 1996; Richter, Werner, Heerlein, Kraus & Sauer, 1998).

Rumination questions. We administered 62 items from four existing rumination questionnaires, with neutral instructions (i.e., "Below are some statements that may or may not describe your thinking. For each statement, please select the rating that best fits your thoughts over the past two weeks"). The items were presented to each participant in a random order, with a 4-point Likert scale from 1 (*not at all*) to 4 (*the whole time*). The rumination questions included: 22 items from the depression, brooding, and reflective pondering subscales of the RRS (Nolen-Hoeksema, 1991); 13 items from the RSS (Conway et al., 2000); 9 rumination items from SRRS (Robinson & Alloy, 2003); and 18 items from the ARQ (Barbic et al., 2014), which included the six items used to assess causal analysis and problem-solving analysis (Bartoskova et al., 2018).

Minnesota Multiphasic Personality Inventory-2 (MMPI-II; Arbisi & Ben-Porath, 1995). Research suggests that M-Turk samples tend to have higher than average scores on measures of malingering (i.e., exaggerating or faking symptoms), introducing the possibility that some participants would report inflated rates of depression and rumination (Chandler & Shapiro, 2016). To identify these participants, we administered the MMPI-II, which assesses a tendency to report implausible symptoms. These symptoms

are rarely endorsed by healthy or clinical populations and tend to be endorsed by individuals attempting to fake a psychiatric disorder. In detecting exaggerated or malingered symptoms, the MMPI-II has good construct and incremental validity (Arbisi & Ben-Porath, 1995).

Procedure

The study was approved by our institutional Research Ethics Board, and all participants read and agreed to an electronic consent form, and indicated whether they agreed to be contacted for another study one month later. They completed the BDI-II, the rumination questions, the MMPI-II, and the standard demographics questionnaire. Participants who expressed an interest in the follow up study read an abridged debriefing form, which informed them that they would receive information about study aims and predictions after completing the follow up study. The remaining participants read a debriefing form which contained study aims and predictions. The procedure for the follow up study was the same as the initial study except after completing the study, all participants were fully debriefed.

Statistical Analyses

Descriptive Information

We examined the frequency of study participants in the initial and follow up study in each BDI-II symptom category (Beck et al., 1996). We also examined how frequently all 62 rumination items were endorsed.

Generation and Interpretation of Latent Rumination Factors

We performed an exploratory factor analysis on data from the rumination questions, using the WLSMV estimator and an oblique rotation method to account for potential correlations between factors. We used several strategies for factor number selection (Fabrigar et al., 1999). We conducted a Scree test by plotting the eigenvalues of the correlation matrix in descending order against the number of factors and identifying the number of factors that reflected the last substantial drop in magnitude (Cattell, 1966). Next, we used the ML method, and examined fit statistics for a range of factors, identifying the smallest number of factors that resulted in the most substantial improvement in fit (Fabrigar et al., 1999). We considered a given factor structure to fit well if it exhibited values over .95 for the Comparative Fit Index

(CFI) and the Tucker-Lewis Index (TLI) (Hu & Bentler, 1999), and values under .05 for the Root Mean Square Error of Approximation (RMSEA) (Browne & Cudeck, 1992).

After determining the number of factors, we reviewed each item, basing its inclusion on whether it was sufficiently differentiated (i.e., it loaded more than .5 on its primary factor and less than .2 on other factors). Next, we decided to include or exclude each item that just passed or missed our differentiation criteria based on its conceptual fit with the primary factor.

Once we determined the items representing each factor, we tested the factor structure in a confirmatory factor analysis (using the WLSMV estimator). We conducted tests of metric invariance across sex and self-identified white or non-white racial status to determine whether participants in these groups attributed the same meaning to each factor (Horn & McArdle, 1992; Schoot, Lugtig, & Hox, 2012). All psychometric analyses were completed in MPlus (Muthén & Muthén, 2012).

Examining and Comparing Latent Factors

We examined how frequently items corresponding to the rumination factors were endorsed in the overall sample. Then, we compared the average ratings of items from each factor with Wilcoxon-signed rank tests, and we examined correlations between the factors.

Examining Covariance Patterns with Depression

We generated correlations between the rumination factors and depressive symptoms (both current and at follow up), treating depression as a continuous variable. To examine the unique effects of each rumination factor on current and future depression, we generated multiple linear regression models. We assessed for the possibility of nonlinearities and discontinuities as symptoms become more severe with quadratic models, testing the effect of current depression on rumination and longitudinal effects of the rumination factors on depression at follow up. Finally, following Bartoskova and colleagues (2018), we tested for circular associations between depression and the rumination factors with structural equation models, using maximum likelihood with a robust standard error estimator. All regressions and structural equation models were generated using the *lavaan* package in R (Rosseel, 2012), and quadratic tests were performed in MPlus (Muthén & Muthén, 2012).

Sensitivity Analyses Eliminating Potential Malingerers

We repeated these analyses including only participants who were not suspected to be exaggerating their symptoms, based on a conservative cut-off of three standard deviations (i.e., a T-score >80) on the MMPI-II (Arbisi & Ben-Porath, 1995; Shapiro et al., 2013).

Results

Descriptive Information

Table 2 contains depressive symptom severity information for samples at both time points. Appendix A is a descriptive graph of all rumination items categorized according to their respective rumination questionnaire or subscale (i.e., the RRS, including the depression, brooding, and reflective pondering subscales, the RSS, the SRRS, and the ARQ, including the causal analysis and problem-solving analysis subscales).

Generation and Interpretation of Latent Rumination Factors

Our exploratory factor analysis yielded four eigenvalues from the correlation matrix that were greater than one. When we conducted a Scree test (depicted in Appendix B), we noticed a substantial drop in values after two factors. We also inspected fit indices for any number between one and six factor solutions (i.e., the ML method; Appendix B). There was little improvement in fit beyond four factors, although two, three, or four factor solutions would have been acceptable. We reviewed the items and determined that a four-factor solution made conceptual sense. Coupled with the suggestion that over-factoring introduces less error to factor loading estimates than under-factoring (Fava & Velicer. 1992; Wood et al., 1996), we decided on a four-factor solution. This solution fit the data well, RMSEA = 0.023 (95% CI: 0.020, 0.026), CFI = 0.99, TLI = 0.98. Each factor was represented by 23-32 significantly loading items, with some items having significant cross-loadings on multiple factors (Appendix C).

We excluded 31 items based on our a-priori differentiation criteria (and retained 31 differentiated items) (see Appendix C). After considering the conceptual fit of 14 items at the threshold of our differentiation rule, we added 12 items and discarded two (see Appendix C), resulting in 40 items comprising four distinct factors of rumination (see Appendix C and Table 3).

The first factor, labelled *Symptoms*, involves thoughts about somatic and cognitive symptoms, such as tiredness, lack of motivation, or loss of concentration. This factor contains 6 items from the RRS depression subscale, and one RSS item. The second factor, labelled *Sadness*, involves contemplating feelings of sadness or depression. It includes attempts to understand their nature, source, or underlying meaning to gain information about oneself or one's life. This factor contains 5 RSS items and four RRS items from the reflective pondering subscale. Most items from the third factor are causal thoughts about a stressor, involving attempts to understand why it occurred, upward counterfactuals (i.e., considering how a negative situation could have gone better or been avoided) and expressions of self-criticism or blame. One item involves thinking about the negative nature of a stressful event. Because all items generally include attempts to understand a stressor (involving causation or negative thoughts about the self in relation to the stressor), we labelled this factor *Stressors*. This factor includes 7 SRRS items, 5 brooding items and 1 depression item from the RRS, and two ARQ items reflecting causal analysis. The fourth factor, labelled *Solving*, involves attempts to find solutions to problems, achieve goals, or cope with circumstances, and contains 9 items from the ARQ, including three items reflecting problem-solving analysis.

A confirmatory factor analysis of the 40 items comprising these four factors indicated that the model fit well, RMSEA = 0.048 (95% CI: 0.045, 0.051), CFI = 0.97, TLI = 0.97. The items passed tests of metric invariance across sex (males and females), $X^2 (36) = 49.91$, $p = .06$, and across white or non-white status, $X^2 (36) = 40.63$, $p = .27$.

All the factors were correlated with one another. *Sadness* and *Stressors* were highly correlated (r (496) = .89, $p <.01$), as were *Symptoms* and *Stressors* (r (496) = .87, $p <.01$), and *Symptoms* and *Sadness* (r (496) = .80, $p <.01$). *Solving* was not as strongly correlated with the other three factors: *Sadness* (r (496) = .67, $p <.01$), *Stressors* (r (496) = .67, $p <.01$), and *Symptoms* (r (496) = .47, $p <.01$).

Which Rumination Factors are most Commonly Endorsed?

Figure 1 depicts the 40 items graphed according to their rumination factor. Items from the *Solving* factor were most frequently endorsed (*M*=2.27, *SD*=0.63; vs *Symptoms*: *Z*=60710, *p*<.01; *Sadness*:

W=5378, *p*<.01; *Stressors*: *W*=68866, *p*<.01). Items from the *Stressors* factor were the next most frequently endorsed (*M*=1.79, *SD*=0.67; vs. *Symptoms*: *W*=97174, *p*<.01; *Sadness*: *W*=93912, *p*<.01). Items from the other factors were endorsed less frequently (i.e., *Symptoms*: *M*=1.66, *SD*=0.74; *Sadness*: *M*=1.60, *SD*=0.64), and to a similar degree (*W*=122739, *p*=.62).

What are the Covariance Patterns between Current Depression and Rumination Factors?

Bivariate Correlations

All four rumination factors were correlated with current depression. The correlation between depressive symptoms and *Solving* was weakest (r (496) = .26, *p*<.01), followed by *Sadness* (r (496) = .48, *p*<.01), and *Stressors* (r (496) = .54, *p* <.01). Depressive symptoms most strongly correlated with *Symptoms* (r (496) = .66, *p*<.01).

Non-linear Associations

We found no evidence of non-linear effects of current depressive symptoms on *Symptoms* (β =.04, *SE*=.27, *p*=.79), *Sadness* (β =.01, *SE*= .10, *p*=.93), and *Stressors* (β =-.02, *SE*=.09, *p*=.83). However, depression was non-linearly related to *Solving* (β = -.18, *SE*=.08, *p*=.03). The plot depicting the association between depression and *Solving* (see Appendix D) suggests a monotonically increasing relation that is positive and linear when depressive symptoms are minimal. As symptoms become more severe, the association of depressive symptoms to *Solving* appears to plateau.

Which Rumination Factors Uniquely Predict Current Depression?

In a multiple linear regression, *Symptoms* and *Stressors* uniquely predicted depressive symptoms (*Symptoms*: β = .56, *SE* = .06, *p*<.01; *Stressors*: β = .18, *SE* = .03, *p* = .03). *Solving* and *Sadness* were not significant predictors (β = -.06, *SE* = .03, *p* = .06; β = -.03, *SE* = .08, *p* = .66, respectively).

Because the *Sadness* factor shares strong associations with *Stressors* and *Symptoms*, we conducted two additional regressions, excluding each of these two rumination factors, to assess whether their exclusion changes the nature of the link between *Sadness* and depression (see Appendix E). Contrary to our expectation, *Sadness* was not a unique predictor of depression in either of these models.

Structural Equations (Testing the Circular Model)

Previous work suggests there are circular associations between depression, causal analysis, and problem-solving analysis, described in Table 1 (Bartoskova et al., 2018). Importantly, problem-solving analysis had a strong negative effect on depression, but only when causal analysis was included. We expected that *Solving* might be a negative predictor of current depression, after accounting for its association with the factor most conceptually related to causal analysis, *Stressors*. When we tested this circular model (see Figure 3), depressive symptoms predicted the *Stressors* factor, which in turn, predicted *Solving*. Importantly, *Solving* negatively predicted depressive symptoms. Furthermore, the circular association was specific to depression, *Stressors* and *Solving*. Substituting in any of the other rumination factors caused one or more links in the circular model to become non-significant (full results for these analyses are presented in Appendix F).

What are the Covariance Patterns between the Baseline Rumination Factors and Depression at Follow Up?

Bivariate Correlations

From our subsample of participants re-tested one month later, we found that the four rumination factors endorsed at baseline were associated with future depressive symptoms. Again, the correlation between depression at follow up and *Solving* was weakest (r (204) = .18, p <.01), followed by *Sadness* (r (204) = .42, p <.01) and *Stressors* (r (496) = .49, p <.01). *Symptoms* shared the strongest association with depression at follow up (r (204) = .58, p <.01).

Non-linear Associations

In addition to positive, linear associations (see Appendix G), we found evidence of quadratic associations of depression at follow-up with: *Symptoms* (β = -.23, SE = .10, p = .03), *Stressors* (β = -.32, SE = .14, p = .03), and *Solving* (β = -.20, SE = .07, p = .01). However, there was no quadratic association between depression at follow up and *Sadness* (β = -.15, SE = .10, p = .16). The plots of the associations between rumination factors and depression at follow up fitted with LOESS and quadratic curves (see Appendix G) suggest that the association between depression at follow up and *Symptoms* is primarily

linear, and its association with *Solving* is primarily quadratic. Its association with *Stressors* appears to level off when *Stressors* is highly endorsed.

Which Baseline Rumination Factors Uniquely Predict Depression at Follow Up?

In a multiple linear regression, *Symptoms* was a positive predictor of depression at follow up *(β =* .53, *SE* = .15, *p* <.01). Future depressive symptoms were not uniquely related to *Sadness* (*β* = -.003, *SE* = .10, *p* = .97) or *Stressors* (*β* = .16, *SE* = .19, *p* = .38) or *Solving* (*β* = -.08, *SE* = .04, *p* = .06).

Sensitivity Analyses Eliminating Potential Malingerers

Analyses excluding the 18 participants with a T-score three standard deviations above the mean on the MMPI (see Appendix H) suggest that the primary findings do not qualitatively change when participants who may be exaggerating their symptoms are removed.

Discussion

The Nature of Depressive Rumination

In our joint factor analysis of four rumination questionnaires, we settled on a four-factor solution for quantitative and conceptual reasons. On average, items from the *Solving* factor were most commonly endorsed, suggesting that depressive rumination might include goal-oriented or instrumental thinking (Gut, 1989; Nolen-Hoeksema, 2008; Andrews & Thomson, 2009). Items from the *Stressors* factor were the next most commonly endorsed, and they involved an attempt to understand a negative or stressful situation. Most of these items reflected causal thinking about the stressor, for instance, by identifying how the situation could have gone better or considering how personal characteristics are contributing to its occurrence. Factors involving causal thinking have been derived in previous studies of depressive rumination (Lam et al., 2003; Raes et al., 2008; Bartoskova et al., 2018). Given that the most commonly endorsed thoughts involve attempts to resolve problems or understand stressful situations (mainly their causes), our findings are consistent with the conceptualization of rumination proposed by the analytical rumination hypothesis of depression (Andrews & Thomson, 2009; Barbic et al., 2014). Figure 1 (and Appendix A) shows that the most frequently endorsed rumination items belong to the ARQ, suggesting

that this scale best captures most commonly-occurring ruminative thoughts, which may be analytical in nature.

The two less commonly endorsed factors were: *Sadness*, which was devoted to understanding the meaning and cause of sadness, with many items being characterized by the persistence or repetitiveness of these thoughts, and *Symptoms*, or thoughts about symptoms, their duration, and consequences. Symptom-based factors have emerged in several other studies of depressive rumination (Roberts et al., 1998; Lam et al., 2003; Roefols et al., 2006). Although this factor is a predictor of current and longitudinal depression, our findings suggest that it is not commonly endorsed.

Connections between the Rumination Factors and Current Depressive Symptoms

Our structural equation models point to complex associations between depression, *Solving*, and other rumination factors. Consistent with previous work (Bartoskova et al., 2018), *Solving* appears to have two sources of co-variance: a positive association mediated by *Stressors*, which is also uniquely related to depression, and a negative direct association when coupled with *Stressors*. Our specificity tests show that *Solving* only negatively predicts depression when it is preceded by *Stressor*s, suggesting that when attempting to deal with a difficult situation, it may be necessary to first clarify its nature and cause. Without these causal considerations, it may not be possible to problem-solve and alleviate depressive symptoms (Andrews & Thomson, 2009; Barbic et al., 2014). These findings challenge the notion that depressive rumination contributes to depression by interfering with problem-solving and instrumental thinking (Nolen-Hoeksema, 1991).

We were surprised to find that *Sadness* was not a unique predictor of depression, which is inconsistent with previous work (Conway et al., 2000). Nevertheless, our finding suggests that depressed individuals perhaps do not spend much of their time thinking specifically about feelings of sadness. The specificity tests in our structural equation models (Appendix F) may provide insight into this result. *Sadness* was not associated with depression when we included *Symptoms* and *Stressors* into the structural equation models, suggesting that *Sadness* shares covariance with these two factors. Although there are

aspects of the two other factors that uniquely predict depressive symptoms, there may be no aspects of *Sadness* unique from the two other rumination factors that predict depression.

Connections between the Rumination Factors and Future Depressive Symptoms

All the rumination factors correlated with depression at follow up, but only *Symptoms* was a unique, positive predictor. Although the other factors were not predictors, *Stressors* and *Solving* at baseline had quadratic effects on depression one month later. The effects of these factors on depression seem to plateau or reverse when they are commonly endorsed one month earlier, making them difficult to detect in a linear regression. *Solving* had a pronounced quadratic effect on future depression, and it was the only factor that was non-linearly associated with current depression. Furthermore, our structural equation models suggest that *Solving* is only negatively related to depression when it is preceded by causal thoughts. These findings collectively suggest that *Solving* is related to depression, but in a rather complex way. The association may be non-linear, and it may depend on the presence of other types of thoughts (i.e., *Stressors*).

We should therefore be cautious about interpreting the implications of a given factor based on its ability to predict future depressive symptoms. For instance, we might suppose that the *Symptoms* factor worsens depression over time, perhaps by promoting avoidance of productive or instrumental thinking. However, changes in depression are not linear. Fluctuations in symptoms have been observed during treatment and in observational studies (Tang & DeRubeis, 1999; Kelly, Roberts, & Bottonari, 2007), and both reductions and temporary increases in depressive symptoms have been associated with better long-term outcomes (Tang & DeRubeis, 1999; Vittengl Clark, & Jarrett, 2005; Tang, DeRubeis, Hollon, Amsterdam, & Shelton, 2007). To understand how rumination is related to depression then, we may need to consider the possibility of non-linear or circular effects, and examine associations between different types of ruminative thoughts (e.g., the different factors) at multiple time points. Future research should assess the impact of different temporal combinations of ruminative thoughts, to determine, for instance, whether *Stressors* precedes *Solving* to reduce depression.

Limitations

One limitation of our study is that we use a non-clinical sample and ask them to report on their naturally-occurring thoughts from the past two weeks. In the absence of sadness or clinical depression, it is possible that we captured thoughts that do not characterize depressive rumination. However, 93 baseline participants reported moderate or severe levels of depression on the BDI, so our study samples the continuum of depressive symptoms, including extreme ends. All rumination factors were associated with current depression, which suggests that the reported frequency of these ruminative thoughts would be higher in a clinically depressed sample. At the same time, the non-linear association between current depression and the *Solving* factor suggests that *Solving* increases with depression when symptoms are minimal, but this association plateaus when depressive symptoms are more severe. In clinically depressed samples, other rumination factors sharing unique associations with depression (i.e., *Symptoms* and *Stressors*) could surpass *Solving* in frequency. Conceptually, experiencing severe cognitive and somatic symptoms could result in a larger proportion of thoughts being occupied by symptoms, relative to other things. Since most cases of depression are tied to important stressors (Keller, Neale, & Kendler, 2007), depressed individuals might also spend more time trying to understand their circumstances, in addition to solving them (Andrews & Thomson, 2009). A future direction is to examine the prevalence of the rumination factors in formally diagnosed patients.

A more difficult concern to address is that the accuracy of our factor analysis depends on the quality of items from the rumination questions (Cattell, 1978). Including scales with poor psychometric properties can distort the results of an exploratory factor analysis, resulting in spurious factors (Fabrigar et al., 1999). We intended to use the available measures of depressive rumination from the theoretical perspectives we explored in our study, but some of these questionnaires have faced criticisms. For instance, the RRS overlaps with constructs and scales that may be unrelated to depressive rumination (Conway et al., 2000; Armey et al., 2009). Items contributing to reflective pondering may not be valid with respect to the way they are typically interpreted (i.e., self-contemplation driving instrumental action) (Griffith & Raes, 2014; Bartoskova et al., 2018). Indeed, none of the reflective pondering items contributed to *Solving*, and instead, they contributed to the *Sadness* factor, suggesting that they are better

interpreted as attempts to understand the causes of feelings. Our results may have been affected by psychometric issues with the RRS or with any of the other rumination scales we included, especially if the scales have not undergone rigorous psychometric testing (as with the rumination subscale of the SRRS). Thus, any of our factors may not accurately represent depressive rumination, or there may be other forms of rumination not captured in our study.

Conclusions

Our results are consistent with a multifaceted view of depressive rumination (Smith & Alloy, 2009), and they suggest that its association with depression is complex, particularly with respect to our most common factor, *Solving*. The unique characteristics of this factor may lead to more theoretical questions about whether it falls under the category of depressive rumination, or if it might belong to a different category of cognitions, like repetitive thoughts which include processing and coping (Segerstrom, Stanton, Alden & Shortridge, 2003). In previous work, reflective or introspective factors have emerged that are not directly related to symptoms (Roberts et al., 1998; Bagby & Parker, 2001). Furthermore, the association between rumination and depression may be dynamic; rumination could be associated with negative affect in its initial stages, and have positive, instrumental effects over time (Thomsen, 2006), a notion that is consistent with recent empirical studies of analytical rumination (Bartoskova et al., 2018). It may be useful to consider depressive rumination as a process involving a variety of thoughts, with different combinations of these thoughts having different consequences for depression.

References

Alloy, L. B., Abramson, L. Y., Hogan, M. E., Whitehouse, W. G., Rose, D. T., Robinson, M. S., ... & Lapkin, J. B. (2000). The Temple-Wisconsin Cognitive Vulnerability to Depression Project: lifetime history of axis I psychopathology in individuals at high and low cognitive risk for depression. *Journal of Abnormal Psychology, 109*(3), 403–418.

Andrews, P. W., & Thomson, J. A. (2009). The bright side of being blue: Depression as an adaptation for complex problems. *Psychological Review, 116*(3), 620–654.

Arbisi, P. A., & Ben-Porath, Y. S. (1995). An MMPI-2 infrequent response scale for use with psychopathological populations: The Infrequency-Psychopathology Scale, F (p). *Psychological Assessment,* 7(4), 424–431.

Armey, M. F., Fresco, D. M., Moore, M. T., Mennin, D. S., Turk, C. L., Heimberg, R. G., ... & Alloy, L. B. (2009). Brooding and pondering: Isolating the active ingredients of depressive rumination with exploratory factor analysis and structural equation modeling. *Assessment, 16*(4), 315–327.

Bagby, R. M., & Parker, J. D. (2001). Relation of rumination and distraction with neuroticism and extraversion in a sample of patients with major depression. *Cognitive Therapy and Research, 25*(1), 91–102.

Barbic, S. P., Durisko, Z., & Andrews, P. W. (2014). Measuring the bright side of being blue: A new tool for assessing analytical rumination in depression. *PloS One, 9*(11), e112077.

Bartoskova, M., Sevcikova, M., Durisko, Z., Maslej, M. M., Barbic, S. P., Preiss, M., & Andrews, P. W. (2018). The form and function of depressive rumination. *Evolution and Human Behavior, 39*(3), 277–289.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck Depression Inventory-II.* San Antonio, TX: Psychological Corporation.

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods & Research, 21*(2), 230–258.

Cattell, R. B. (1966). The scree test for the number of factors. *Multivariate Behavioral Research, 1*(2), 245–276.

Cattell, R. B. (1978). *The scientific use of factor analysis in behavioral and life sciences*. New York, NY: Plenum Press.

Chandler, J., & Shapiro, D. (2016). Conducting clinical research using crowdsourced convenience samples. *Annual Review of Clinical Psychology, 12,* 53–81.

Connolly, S. L., & Alloy, L. B. (2017). Rumination interacts with life stress to predict depressive symptoms: An ecological momentary assessment study. *Behaviour Research and Therapy, 97,* 86–95.

Conway, M., Csank, P. A., Holm, S. L., & Blake, C. K. (2000). On assessing individual differences in rumination on sadness. *Journal of Personality Assessment, 75*(3), 404–425.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods, 4*(3), 272–299.

Fava, J. L., & Velicer, W. F. (1992). The effects of overextraction on factor and component analysis. *Multivariate Behavioral Research, 27*(3), 387–415.

Griffith, J. W., & Raes, F. (2015). Factor structure of the Ruminative Responses Scale: A community-sample study. *European Journal of Psychological Assessment, 31*(4), 247–253.

Gut, E. (1989). *Productive and unproductive depression: Success or failure of a vital process.* NY: Basic Books.

Horn, J. L., & McArdle, J. J. (1992). A practical and theoretical guide to measurement invariance in aging research. *Experimental Aging Research, 18*(3), 117–144.

Hu, L. T., & Bentler, P. M. (1999). Cut-off criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1–55.

Keller, M. C., Neale, M. C., & Kendler, K. S. (2007). Association of different adverse life events with distinct patterns of depressive symptoms. *American Journal of Psychiatry, 164*(10), 1521–1529.

Kelly, M. A., Roberts, J. E., & Bottonari, K. A. (2007). Non-treatment-related sudden gains in depression: The role of self-evaluation. *Behaviour Research and Therapy, 45*(4), 737–747.

Lam, D., Smith, N., Checkley, S., Rijsdijk, F., & Sham, P. (2003). Effect of neuroticism, response style and information processing on depression severity in a clinically depressed sample. *Psychological Medicine, 33*(3), 469–479.

Lyubomirsky, S., & Nolen-Hoeksema, S. (1995). Effects of self-focused rumination on negative thinking and interpersonal problem-solving. *Journal of Personality and Social Psychology, 69*(1), 176–190.

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological Methods, 4*(1), 84–99.

Morrow, J., & Nolen-Hoeksema, S. (1990). Effects of responses to depression on the remediation of depressive affect. *Journal of Personality and Social Psychology, 58*(3), 519–527.

Muthén, L., & Muthén, B. (2012). Mplus statistical modeling software: Release 7.0. *Los Angeles, CA: Muthén & Muthén*.

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of abnormal psychology, 100*(4), 569–582.

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science, 3*(5), 400–424.

Nolen-Hoeksema, S., & Davis, C. G. (2004). Theoretical and methodological issues in the assessment and interpretation of posttraumatic growth. *Psychological Inquiry, 15*(1), 60–64.

Nolen-Hoeksema, S., & Morrow, J. (1991). A prospective study of depression and posttraumatic stress symptoms after a natural disaster: the 1989 Loma Prieta earthquake. *Journal of Personality and Social Psychology, 61*, 115–121.

Nolen-Hoeksema, S., Morrow, J., & Fredrickson, B. L. (1993). Response styles and the duration of episodes of depressed mood. *Journal of Abnormal Psychology, 102*(1), 20–28.

Raes, F., Hermans, D., Williams, J. M. G., Bijttebier, P., & Eelen, P. (2008). A "Triple W"- model of rumination on sadness: Why am I feeling sad, what's the meaning of my sadness, and wish I could stop thinking about my sadness (but I can't!). *Cognitive Therapy and Research, 32*(4), 526–541.

Roberts, J. E., Gilboa, E., & Gotlib, I. H. (1998). Ruminative response style and vulnerability to episodes of dysphoria: Gender, neuroticism, and episode duration. *Cognitive Therapy and Research, 22*(4), 401–423.

Robinson, M. S., & Alloy, L. B. (2003). Negative cognitive styles and stress-reactive rumination interact to predict depression: A prospective study. *Cognitive Therapy and Research, 27*(3), 275–291.

Roelofs, J., Muris, P., Huibers, M., Peeters, F., & Arntz, A. (2006). On the measurement of rumination: A psychometric evaluation of the ruminative response scale and the rumination on sadness scale in undergraduates. *Journal of Behavior Therapy and Experimental Psychiatry, 37*(4), 299–313.

Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software, 48*(2), 1-36. URL http://www.jstatsoft.org/v48/i02/.

Segerstrom, S. C., Stanton, A. L., Alden, L. E., & Shortridge, B. E. (2003). A multidimensional structure for repetitive thought: what's on your mind, and how, and how much? *Journal of Personality and Social Psychology, 85*(5), 909–921.

Shapiro, D. N., Chandler, J., & Mueller, P. A. (2013). Using Mechanical Turk to study clinical populations. *Clinical Psychological Science, 1*(2), 213–220.

Siegle, G. J., Steinhauer, S. R., Carter, C. S., & Thase, M. E. (2000, November). Convergence and divergence in measures of rumination. Presented in 34th Annual Convention of the Association for Advancement of Behavior Therapy, New Orleans.

Smith, J. M., & Alloy, L. B. (2009). A roadmap to rumination: A review of the definition, assessment, and conceptualization of this multifaceted construct. *Clinical Psychology Review, 29*(2), 116–128.

Thomsen, D. (2006). The association between rumination and negative affect: A review. *Cognition and Emotion, 20*(8), 1216–1235.

Tang, T. Z., & DeRubeis, R. J. (1999). Sudden gains and critical sessions in cognitive-behavioral therapy for depression. *Journal of Consulting and Clinical Psychology, 67*(6), 894–904.

Tang, T. Z., DeRubeis, R. J., Hollon, S. D., Amsterdam, J., & Shelton, R. (2007). Sudden gains in cognitive therapy of depression and depression relapse/recurrence. *Journal of Consulting and Clinical Psychology, 75*(3), 404–408.

Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research, 27*(3), 247–259.

Van de Schoot, R., Lugtig, P., & Hox, J. (2012). A checklist for testing measurement invariance. *European Journal of Developmental Psychology, 9*(4), 486–492.

Vittengl, J. R., Clark, L. A., & Jarrett, R. B. (2005). Validity of sudden gains in acute phase treatment of depression. *Journal of Consulting and Clinical Psychology, 73*(1), 173–182.

Watkins, E., Scott, J., Wingrove, J., Rimes, K., Bathurst, N., Steiner, H., ... & Malliaris, Y. (2007). Rumination-focused Cognitive–Behaviour Therapy for residual depression: A case series. *Behaviour Research and Therapy, 45*(9), 2144–2154.

Wood, J. M., Tataryn, D. J., & Gorsuch, R. L. (1996). Effects of under-and over-extraction on principal axis factor analysis with varimax rotation. *Psychological Methods, 1*(4), 354–365.

Tables and Figures

Table 1

Depressive rumination questionnaires, proposed factor structure and associations with depression

Questionnaire	Items	Proposed factor structure	Association with depression
Ruminative Response Scale (Nolen-Hoeksema, 1991)	22 items describing what people do "when they feel down, sad, or depressed"; focus on the self, depressive symptoms and their consequences	Three factors: symptom-based rumination, introspection or self-reflection, self-blame (and in a clinical sample, analysis to understand) (Roberts et al., 1998; Lam et al., 2003); Two factors: brooding (self-criticisms and counterfactuals), reflective pondering (introspection and contemplation) (Treynor et al., 2003)	Ruminative response predicts depression over time (Thomsen, 2006); brooding and reflective pondering are associated with current depression; reflective pondering has been negatively or non-significantly related to depression over time (Treynor et al., 2003; Nolen-Hoeksema & Davis, 2004)
Rumination on Sadness Scale (RSS; Conway et al., 2000).	13 items describing attempts to understand the nature of sadness, and the intensity and persistence of ruminative thoughts	One factor (Conway et al., 2000); Three factors: causal analysis of feelings and problems, understanding oneself and sadness, and describing the uncontrollability of thoughts about sadness (Raes, Hermans, Williams, Bijttebier & Eelen, 2008).	Rumination on sadness associated with depression (after controlling for the 22-item RRS) (Conway et al., 2000).
Stress Reactive Rumination Scale (SRRS; Robinson & Alloy, 2003)	9 items adapted from the RRS reflecting a single tendency to generate negative inferences in response to a negative event or stressor	No data available	Stress reactive rumination moderates the link between hopelessness and depression, and is implicated in the onset, duration, and recurrence of depression (Alloy et al., 2000; Robinson & Alloy, 2003; Connolly & Alloy, 2017).
Analytical Rumination Questionnaire (ARQ) (Barbic et al, 2014).	18 items describing thoughts about the nature and cause of problems, and attempts to generate and evaluate potential solutions	Two factors: causal analysis (understanding the cause of problems), problem-solving analysis (attempts to solve problems under constraints) (Bartoskova et al., 2018)	Factors share circular associations with current depression: depression promotes causal analysis, which leads to problem-solving analysis, which in turn, reduces depression (Bartoskova et al., 2018)

Table 2

Participant demographics, medication use, and depression information

	Sample	
	Study (*n*=498)	Follow-up (*n*=209)
Age, *M* (*SD*)	34.56 (10.46)	35.79 (10.91)
Gender, %	45	44
Female	55	56
Male		
Cultural background, %		
White	70	74
South Asian	8	8
Black	8	7
East Asian	3	2
Mixed	2	2
South East Asian	1	2
First Nations	.06	.05
West Asian	.02	.05
Socioeconomic status, %		
Middle class	38	43
Lower middle class	36	34
Lower class	18	16
Upper middle class	7	6
Upper class	.02	0
Medication use		
Depression, %	9	8
Anxiety, %	8	11
Depression		
BDI *M* (*SD*)	9.97 (11.49)	9.79 (11.29)
BDI Range	0–51	0–55
Symptom severity, *n*		
0–13 (Minimal)	335	137
14–19 (Mild)	52	23
20–28 (Moderate)	56	17
>29 (Severe)	37	22

Note. BDI=Beck Depression Inventory.

Table 3

The four factors of rumination and sample items

|	Factor		
Symptoms	*Sadness*	*Stressors*	*Solving*
"I feel passive and unmotivated."	"I thought about my feelings."	"I thought about how terrible a stressful event was."	"I thought about my options for dealing with my problems."
"I kept thinking about my lack of motivation and wondered if it would ever return."	"I repeatedly analyzed and kept thinking about the reasons for my sadness."	"I thought about what I could have done to avoid these problems."	"I tried to figure out which of the problems I was facing were the most important and what I should do first."
"I thought about how I don't feel up to doing anything."	"I repeatedly thought about what sadness really is by concentrating on my feelings and trying to understand them."	"I thought about a recent situation and wished it had gone better."	"I tried to learn from my mistakes."

Figure 1

Forty rumination items belonging to the four factors of rumination, categorized by factor and labelled by questionnaire
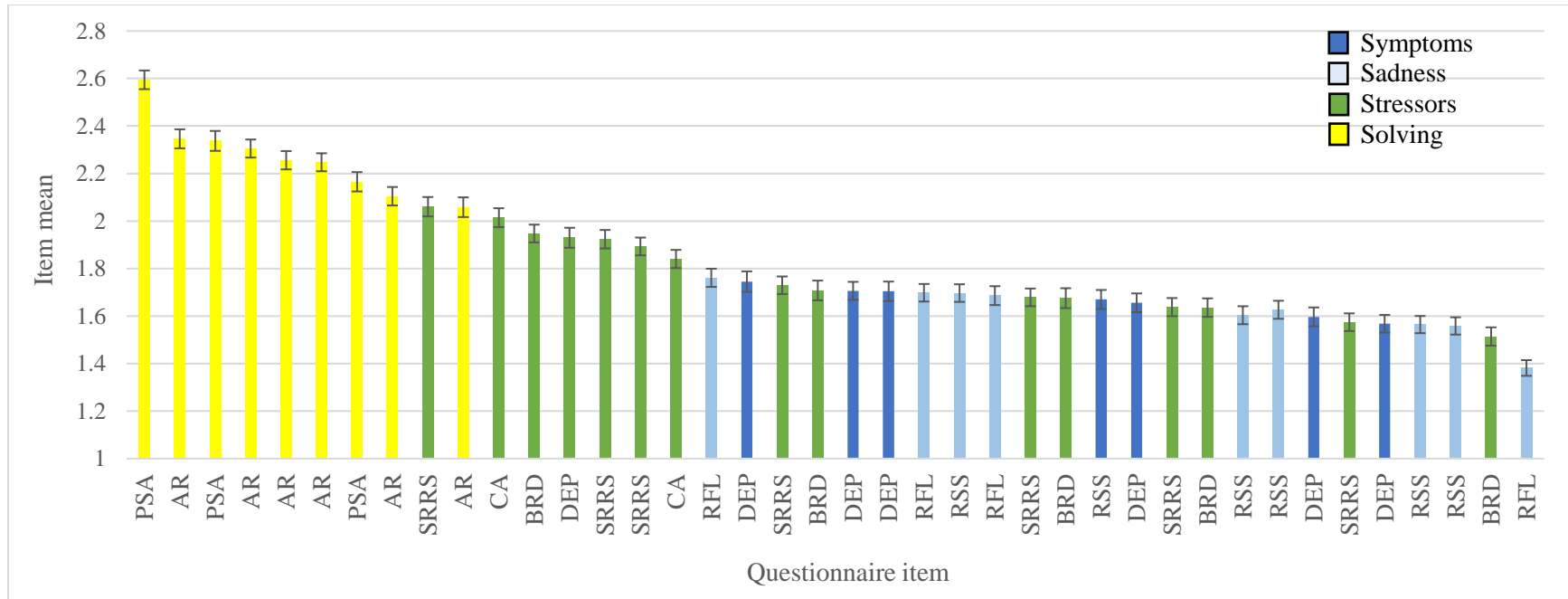
Note. Items are ordered by frequency, from most to least frequently endorsed. Error bars are standard errors. DEP = Depression subscale of the RSS; BRD = Brooding subscale of the RSS; RFL = Reflective pondering subscale of the RSS; AR = ARQ; CA = Causal analysis; PSA = Problem-solving analysis; RSS = Rumination on sadness; SRRS = Stress reactive rumination.

Figure 2

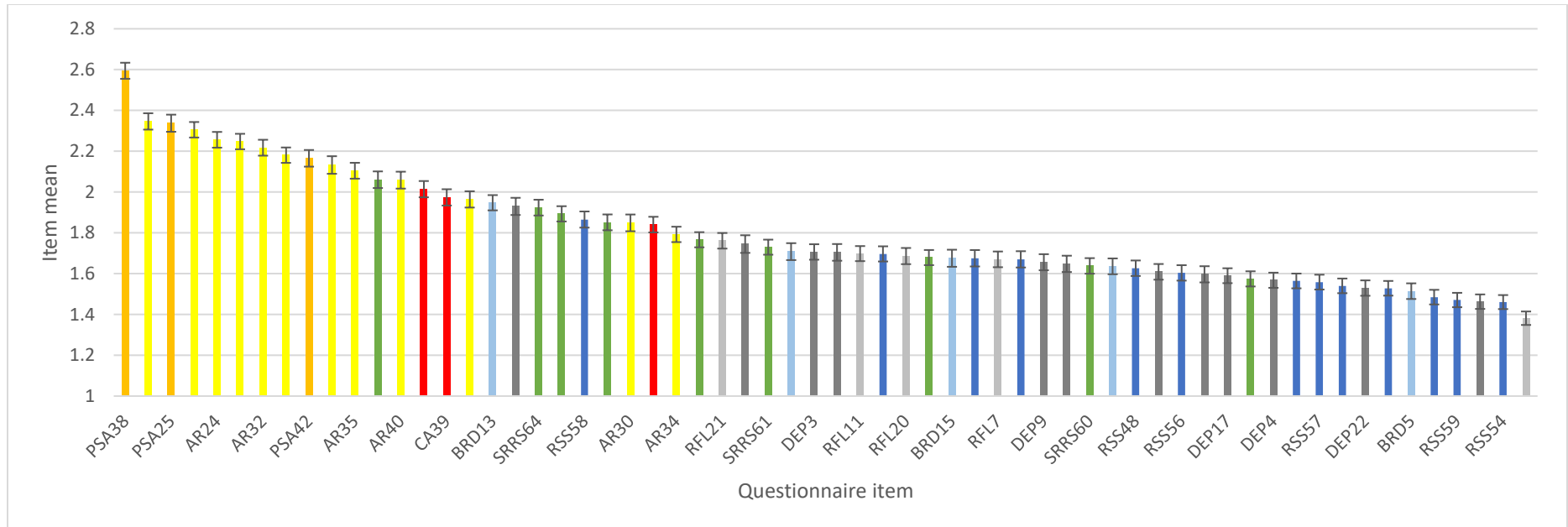*Circular model with depression and the Stressors and Solving factors*
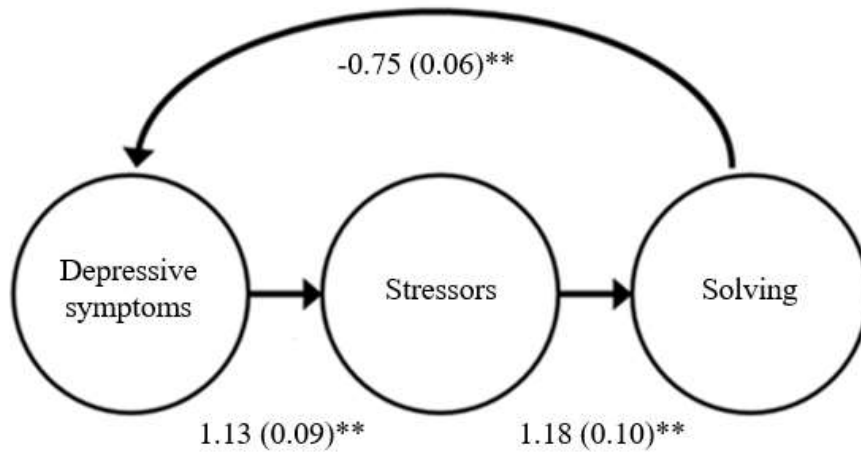
Note. Standard errors are in parantheses. **p<.01
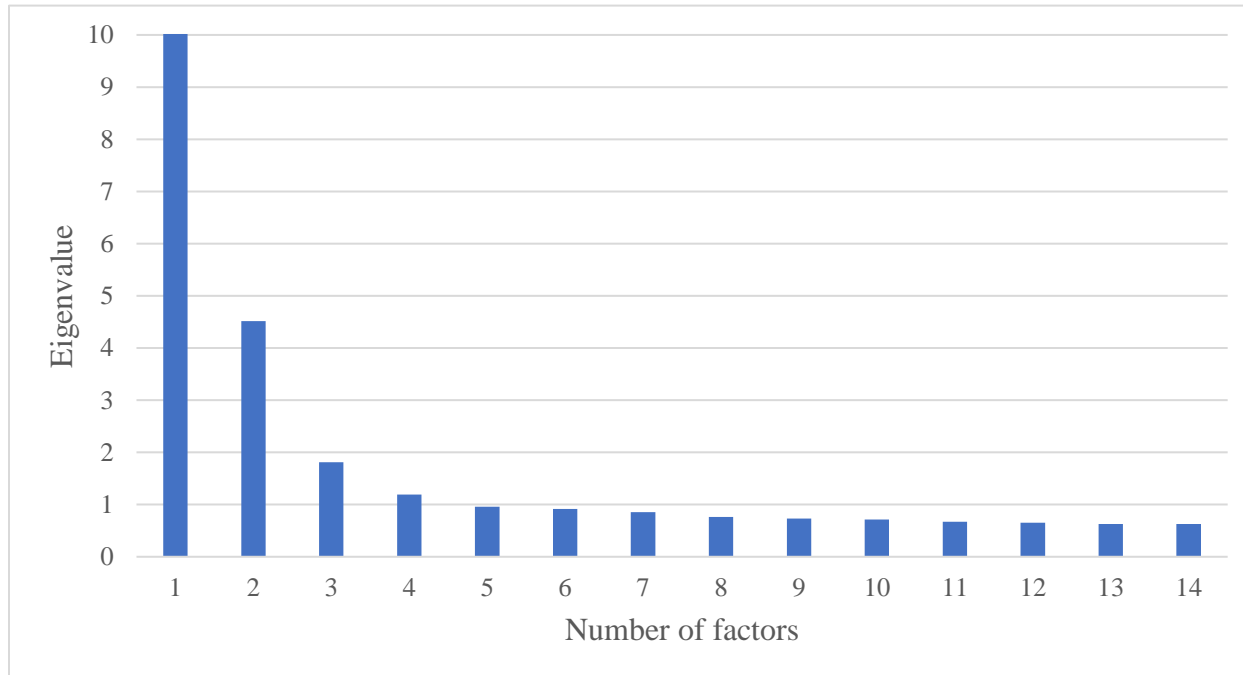
Appendix A

All 62 rumination items administered to participants, categorized by their rumination questionnaire or subscale

Note. Items are ordered by frequency, from most to least frequently endorsed. Error bars are standard errors. DEP = Depression subscale of the RSQ; BROOD = Brooding subscale of the RSQ; REFLECT = Reflective pondering subscale of the RSQ; AR = ARQ item; CA = Causal analysis; PSA = Problem-solving analysis; RSS = Rumination on sadness; SRRS = Stress reactive rumination.

Appendix B

Correlation matrix eigenvalues for 1-14 factors plotted in descending order (Scree test)

The ML method: Fit indices for 1-6 factor solutions

Number of factors	RMSEA	CFI	TLI
1	0.064	0.931	0.928
2	0.036	0.979	0.978
3	0.028	0.988	0.986
4	0.024	0.991	0.99
5	0.022	0.993	0.992
6	0.021	0.994	0.992

Appendix C

Factor loadings for a four-factor solution

Item	Factor One	Factor Two	Factor Three	Factor Four
I thought about how alone I feel.	0.393*	0.253*	0.278*	-0.079
I thought "I won't be able to do my job if I don't snap out of this."	0.673*	0.049	0.105	0.155*
I thought about my feelings of fatigue and achiness.	0.742*	0.008	0.021	0.1
I thought about how hard it is to concentrate.	0.699*	0.165*	0.033	0.03
I thought "What am I doing to deserve this?"	0.058	0.145	0.664*	-0.092
I thought about how passive and unmotivated I feel.	0.903*	0.009	0.02	-0.023
I analyzed recent events to try to understand why I am depressed.	0.206*	0.500*	0.176	0.134*
I thought about how I don't seem to feel anything anymore.	0.586*	0.305*	0.012	-0.065
I thought "Why can't I get going?"	0.813*	0.06	0.016	0.068
I thought "Why do I always react this way?"	0.039	0.286*	0.623*	-0.137
I thought about why I feel this way.	0.029	0.691*	0.027	0.143*
I wrote down what I was thinking and analyzed it.	-0.088	0.820*	-0.102	-0.006
I thought about a recent situation, wishing it had gone better.	0.003	-0.085	0.810*	0.084
I thought "I won't be able to concentrate if I keep feeling this way."	0.542*	0.232*	0.103	0.072
I thought "Why do I have problems other people don't have?"	0.07	0.136	0.738*	-0.164
I thought "Why can't I handle things better?"	0.155*	0.126	0.717*	-0.152
I thought about how sad I feel.	0.470*	0.384*	0.126	0.012
I thought about all my shortcomings, failings, faults, mistakes.	0.267*	0.07	0.557*	-0.025
I thought about how I don't feel up to doing anything.	0.895*	0.111	-0.085	-0.013
I analyzed my personality to try to understand why I am depressed.	0.183*	0.599*	0.132	0.078
I thought about my feelings.	-0.022	0.792*	-0.056	0.134*
I thought about how angry I am with myself.	0.368*	0.223*	0.391*	-0.091
I tried to find the answer to my problems.	-0.098	0.254*	0.08	0.659*
I tried to figure out the best option for dealing with my dilemma.	0.06	-0.068	0.21	0.628*
I tried to figure out how I could stick to my goals.	0.269*	0.089	-0.157	0.605*

I thought about whether some of the options I could take were likely to solve my problems or make things worse.	0.064	0.184*	0.391*	0.271*
I tried to find a goal or purpose that would be meaningful to me.	0.044	0.437*	-0.062	0.389*
I tried to figure out what was wrong in my life	0.122	0.260*	0.408*	0.17
I tried to think through my difficulties.	0.065	-0.018	0.257	0.610*
I thought about my options for dealing with my problems.	0.263*	-0.063	0.014	0.734*
I thought about the ways my life had become more difficult.	0.307*	-0.045	0.535*	0.102
I thought about all the aspects of the problems I was facing that needed to be solved.	0.121	0.108	0.141	0.560*
I tried to figure out how best to avoid future problems.	-0.115	-0.004	0.494*	0.477*
I tried to learn from my mistakes.	-0.114	0.111	-0.058	0.684*
I tried to understand why I had these problems.	-0.102	0.355*	0.444*	0.217*
I tried to figure out which of the problems I was facing were the most important and what I should do first.	0.172	0.044	0.005	0.696*
I tried to figure out what I had done wrong.	-0.067	0.143	0.631*	0.224
I tried to figure out how to make the best out of a bad situation	-0.155	0.13	0.188	0.506*
I tried to find a way to resolve an important issue.	-0.003	0.02	0.132	0.646*
I thought about what I could have done to avoid these problems.	0.018	0.024	0.662*	0.228
I had difficulty getting myself to stop thinking about how sad I am.	0.457*	0.408*	0.152	-0.066
I repeatedly analyzed and kept thinking about the reasons for my sadness.	0.184*	0.567*	0.211*	0.008
I searched my mind many times to try and figure out if there is anything about my personality that may have led me to feel this way.	0.153*	0.429*	0.259*	0.108
I got absorbed in thinking about why I am sad and found it difficult to think about other things.	0.345*	0.478*	0.145	0.002
I searched my mind repeatedly for events or experiences in my childhood that may help me understand my sad feelings.	0.054	0.632*	0.165	0.077
I kept wondering about how I was able to be happy at other points in my life.	0.230*	0.269*	0.274*	0.116
I kept thinking about my lack of motivation and wondered about whether it will ever return.	0.901*	-0.087	0.06	0.044

When people talk to me, I feel as though it interrupts an ongoing silent conversation I was having with myself about my sadness.	0.276*	0.593*	0.037	-0.059
I questioned and kept wondering about the meaning of life to find clues that may help me understand my sadness.	0.103	0.554*	0.224*	0.03
I repeatedly thought about what sadness really is by concentrating on my feelings and trying to understand them.	0.089	0.686*	0.054	0.195*
I got the feeling that if I thought long enough about my sadness, I would find that it has some deeper meaning and that I would be able to understand myself better because of it.	0.045	0.774*	-0.011	0.109*
I kept think about my problems to try and examine where things went wrong.	0.004	0.285*	0.469*	0.215*
I exhausted myself by thinking so much about myself and the reasons for my sadness.	0.333*	0.453*	0.221*	-0.045
I thought about how a stressful event was all my fault.	-0.017	0.263*	0.740*	-0.187*
I thought about what the occurrence of a stressful event means about me.	0.012	0.203*	0.572*	0.148
I thought about how things could have gone differently.	0.097	-0.233*	0.832*	0.127
I thought about how terrible a stressful event was.	-0.041	-0.031	0.902*	0.024
I thought about a stressful event and wished it had gone better.	0.051	-0.081	0.790*	0.11
I thought about how a stressful event would negatively affect my life.	0.197*	0.012	0.538*	0.197*
I thought about the causes of a stressful event.	-0.048	0.074	0.653*	0.221
I thought about how important a stressful event is for me.	0.175*	0.007	0.555*	0.175
I thought about how things like this always happen to me.	0.126	0.148	0.658*	-0.069

Appendix C

n=31 items passing the differentiation rule
(i.e., loading more than .5 on a primary factor, and less than .2 on another factor)

Item	Factor One	Factor Two	Factor Three	Factor Four
I thought "I won't be able to do my job if I don't snap out of this."	**0.673***	0.049	0.105	0.155*
I thought about my feelings of fatigue and achiness.	**0.742***	0.008	0.021	0.1
I thought about how hard it is to concentrate.	**0.699***	0.165*	0.033	0.03
I thought "What am I doing to deserve this?"	0.058	0.145	**0.664***	-0.092
I thought about how passive and unmotivated I feel.	**0.903***	0.009	0.02	-0.023
I thought "Why can't I get going?"	**0.813***	0.06	0.016	0.068
I thought about why I feel this way.	0.029	**0.691***	0.027	0.143*
I wrote down what I was thinking and analyzed it.	-0.088	**0.820***	-0.102	-0.006
I thought about a recent situation, wishing it had gone better.	0.003	-0.085	**0.810***	0.084
I thought "Why do I have problems other people don't have?"	0.07	0.136	**0.738***	-0.164
I thought "Why can't I handle things better?"	0.155*	0.126	**0.717***	-0.152
I thought about how I don't feel up to doing anything.	**0.895***	0.111	-0.085	-0.013
I analyzed my personality to try to understand why I am depressed.	0.183*	**0.599***	0.132	0.078
I thought about my feelings.	-0.022	**0.792***	-0.056	0.134*
I tried to figure out the best option for dealing with my dilemma.	0.06	-0.068	0.21	**0.628***
I thought about all the aspects of the problems I was facing that needed to be solved.	0.121	0.108	0.141	**0.560***
I tried to learn from my mistakes.	-0.114	0.111	-0.058	**0.684***
I tried to figure out which of the problems I was facing were the most important and what I should do first.	0.172	0.044	0.005	**0.696***
I tried to figure out what I had done wrong.	-0.067	0.143	**0.631***	0.224
I tried to figure out how to make the best out of a bad situation	-0.155	0.13	0.188	**0.506***
I tried to find a way to resolve an important issue.	-0.003	0.02	0.132	**0.646***
I searched my mind repeatedly for events or experiences in my childhood that may help me understand my sad feelings.	0.054	**0.632***	0.165	0.077

I kept thinking about my lack of motivation and wondered about whether it will ever return.	**0.901***	-0.087	0.06	0.044
I repeatedly thought about what sadness really is by concentrating on my feelings and trying to understand them.	0.089	**0.686***	0.054	0.195*
I got the feeling that if I thought long enough about my sadness, I would find that it has some deeper meaning and that I would be able to understand myself better because of it.	0.045	**0.774***	-0.011	0.109*
I thought about how things could have gone differently.	0.097	-0.233*	**0.832***	0.127
I thought about how terrible a stressful event was.	-0.041	-0.031	**0.902***	0.024
I thought about a stressful event and wished it had gone better.	0.051	-0.081	**0.790***	0.11
I thought about how a stressful event would negatively affect my life.	0.197*	0.012	**0.538***	0.197*
I thought about how important a stressful event is for me.	0.175*	0.007	**0.555***	0.175
I thought about how things like this always happen to me.	0.126	0.148	**0.658***	-0.069

Items included and excluded after second review

Factor 2 *Sadness*

Additional items included were:

I repeatedly analyzed and kept thinking about the reasons for my sadness.	0.184*	0.567*	0.211*	0.008
I questioned and kept wondering about the meaning of life to find clues that may help me understand my sadness.	0.103	0.554*	0.224*	0.03

This factor includes various items related to understanding sadness and the source of sadness. These two items fit well with the factor conceptually, and in both cases, they only barely did not pass the differentiation test, loading .011 and .024 over the threshold for being adequately differentiated from other items.

Factor 3 *Stressors*

Additional items included were:

I thought "Why do I always react this way?"	0.039	0.286*	0.623*	-0.137
I thought about all my shortcomings, failings, faults, mistakes.	0.267*	0.07	0.557*	-0.025

I tried to figure out what I had done wrong.	-0.067	0.143	0.631*	0.224
I thought about what I could have done to avoid these problems.	0.018	0.024	0.662*	0.228
I thought about how a stressful event was all my fault.	-0.017	0.263*	0.740*	-0.187*
I thought about what the occurrence of a stressful event means about me.	0.012	0.203*	0.572*	0.148
I thought about how things could have gone differently.	0.097	-0.233*	0.832*	0.127

This factor conceptually reflects attempts to understand stressful events (mostly their causes), involving self-critical or blaming thoughts about the potential role of the individual (either their character or their actions), and counterfactual thoughts about a situation. These items all represented these conceptual considerations about this factor, and although they did not pass the differentiation test thresholds, the differences between values loading onto primary factors and other factors were all approximately .30, which is the difference in the initial differentiation test.

Items that were removed were:

I thought about how a stressful event would negatively affect my life.	0.197*	0.012	0.538*	0.197*
I thought about how important a stressful event is for me.	0.175*	0.007	0.555*	0.175

These items did not fit conceptually into a factor that was largely composed of items attempting to understand the cause of stressors, and seemed to instead reflect the negative ramifications of the stressor. Furthermore, they only barely based the differentiation criteria (loading just under .2 and just over .5).

Factor 4 *Solving*

Additional items included were:

I tried to find the answer to my problems.	-0.098	0.254*	0.08	0.659*
I tried to figure out how I could stick to my goals.	0.269*	0.089	-0.157	0.605*
I thought about my options for dealing with my problems.	0.263*	-0.063	0.014	0.734*

This factor conceptually reflects an attempt to find the best solution to a problem or meet a goal. These items reflected this conceptual aim, while missing the differentiation rule by a small margin. The differences between values loading onto primary factors and other factors were all > .30, which is the difference in the initial differentiation test.

The final four factors and their 40 items, with factor loadings

Symptoms
I thought 'won't be able to do my job if don't snap out'. (0.673)
I thought of feelings of fatigue. (0.742)
I thought of hard to concentrate. (0.699)
I thought 'feel passive and unmotivated'. (0.903)
I thought 'why can't get going'. (0.813)
I thought about how I don't feel up to doing anything. (0.895)
I kept thinking about my lack of motivation and wondered about whether it will ever return. (0.901)

Sadness
I thought about why I feel this way. (0.691)
I wrote what I was thinking and analyzed it. (0.820)
I analyzed my personality to try to understand why I'm depressed. (0.599)
I thought about my feelings. (0.792)
I repeatedly analyzed and kept thinking about the reasons for my sadness. (0.567)
I searched my mind repeatedly for events or experiences in my childhood that may help me understand my sad feelings. (0.632)
I questioned and kept wondering about the meaning of life to find clues that may help me understand my sadness. (0.554)
I repeatedly thought about what sadness really is by concentrating on my feelings and trying to understand them. (0.686)
I got the feeling that if I thought long enough about my sadness, I would find that it has some deeper meaning and that I would be able to understand myself better because of it. (0.774)

Stressors
I thought 'what did I do to deserve this'. (0.664)
I thought 'why do I always react this way'. (0.623)
I thought about recent situation and wished it went better. (0.810)
I thought 'why do I have problems other people don't have'. (0.738)
I thought 'why can't I handle things better'. (0.717)
I thought about my failures and shortcomings. (0.557)
I tried to figure out what I had done wrong. (0.631)
I thought about what I could have done to avoid these problems. (0.662)
I thought about how a stressful event was all my fault. (0.740)
I thought about what the occurrence of a stressful event means about me. (0.572)
I thought about how things could have gone differently. (0.832)
I thought about how terrible a stressful event was. (0.902)
I thought about a stressful event and wished it had gone better. (0.790)
I thought about the causes of a stressful event. (0.653)
I thought about how things like this always happen to me. (0.658)

Solving
I tried to find the answer to my problems. (0.659)
I tried to figure out the best option for dealing with my dilemma. (0.628)
I tried to figure out how I could stick to my goals. (0.605)
I thought about my options for dealing with my problems. (0.734)

I thought about all the aspects of the problems I was facing that needed to be solved. (0.560)
I tried to learn from my mistakes. (0.684)
I tried to figure out which of the problems I was facing were the most important and what I should do first. (0.696)
I tried to figure out how to make the best out of a bad situation. (0.506)
I tried to find a way to resolve an important issue. (0.646)

Appendix D

Results of the linear terms in quadratic models testing non-linear effects of current depression on the rumination factors

We tested for the possibility that there may be non-linear associations between depressive symptoms and the rumination factors. We found no evidence of non-linear associations between current depressive symptoms and *Symptoms*, *Sadness* and *Stressors* (reported in the manuscript), but in all cases, the linear relation was significant (*Symptoms*: β =1.97, *SE*=.26, *p*<.01, *Sadness*: β = 1.05, *SE*= .13, *p*<.01, *Stressors*: β = 1.50, *SE*=.17, *p*<.01).

Plot depicting association between depression and Symptoms
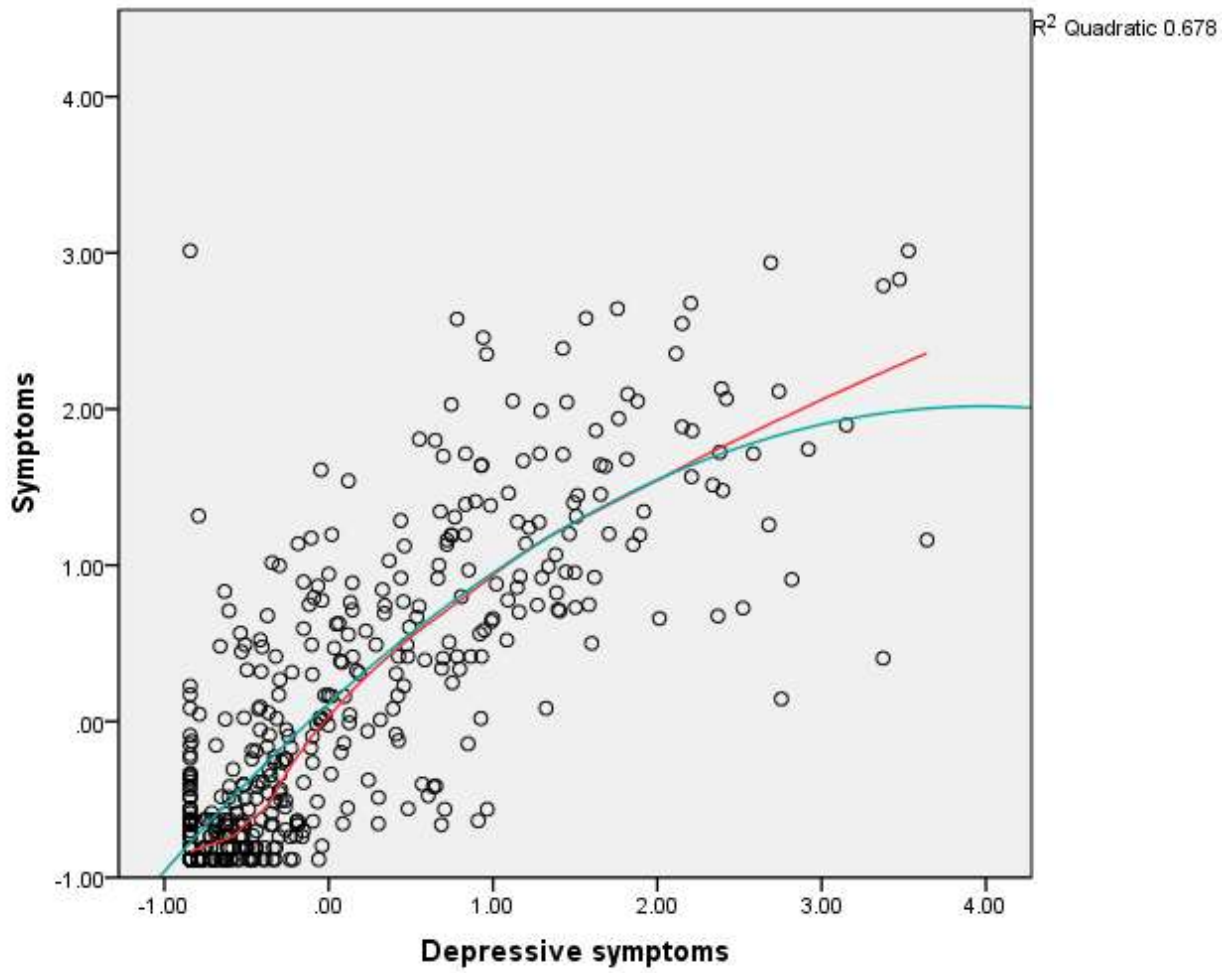
Note. Data are factor scores fitted with LOESS and quadratic curves.

Plot depicting association between depression and Sadness
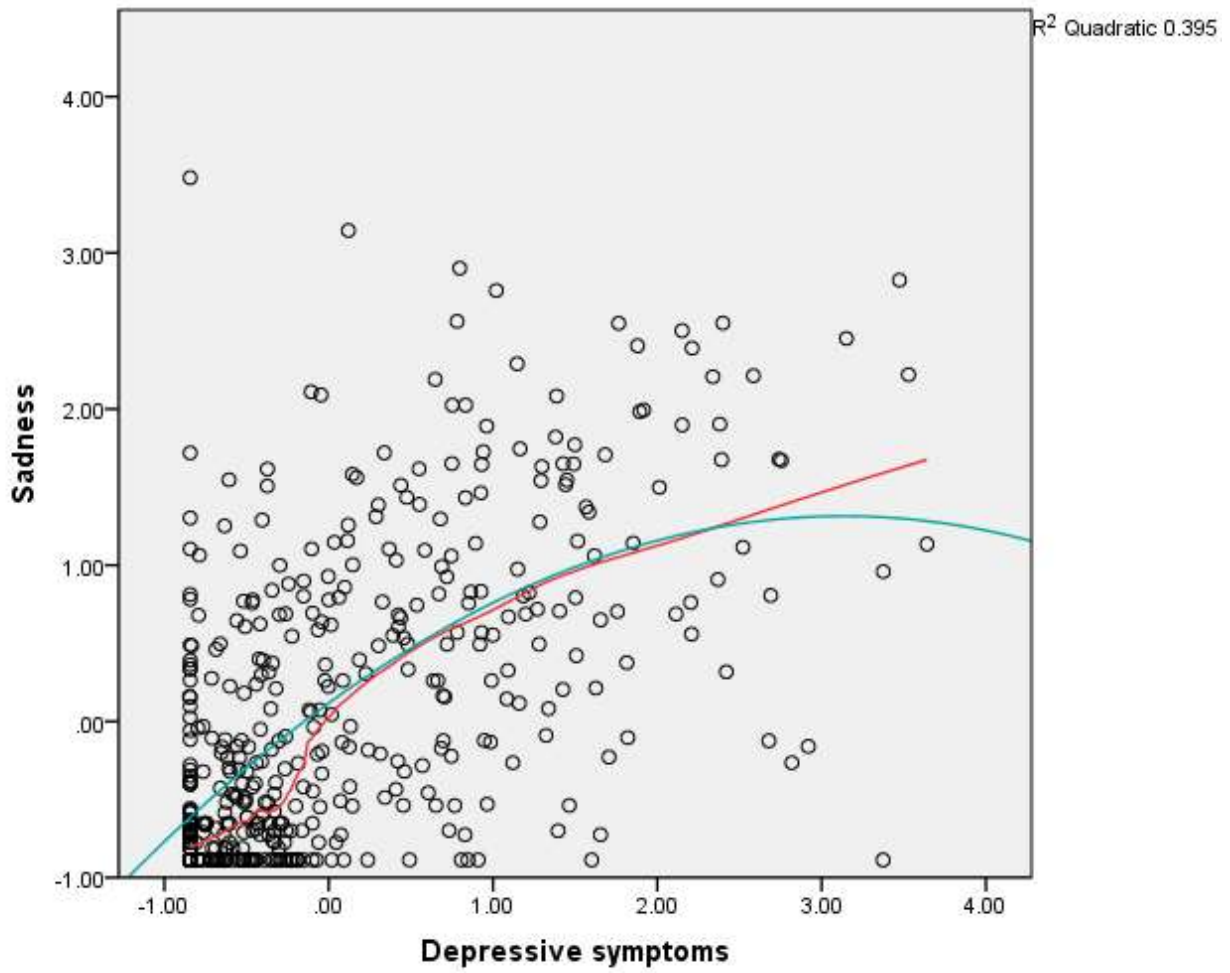
Note. Data are factor scores fitted with LOESS and quadratic curves.

Plot depicting association between depression and Stressors
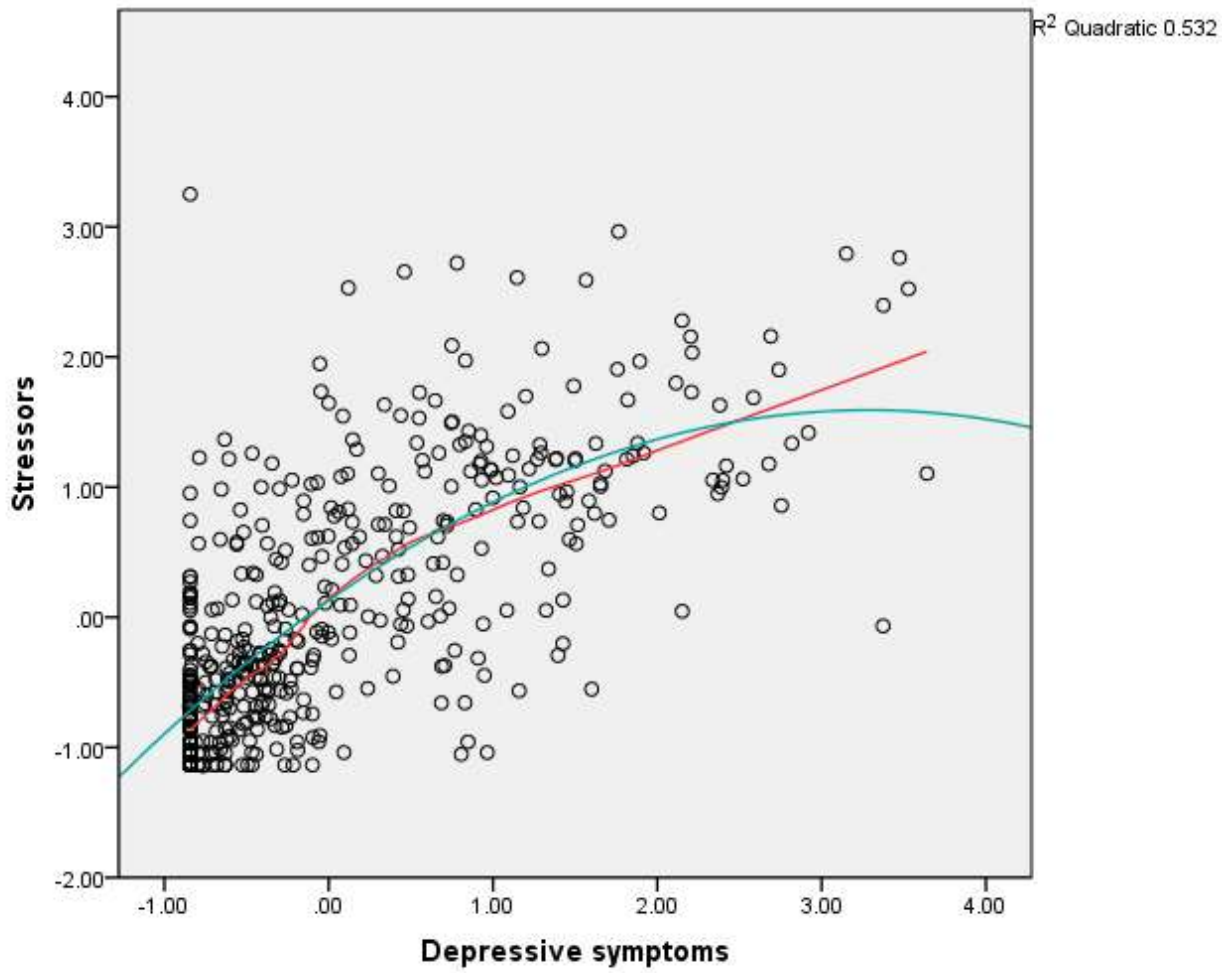
Note. Data are factor scores fitted with LOESS and quadratic curves.

Plot depicting association between depression and Solving
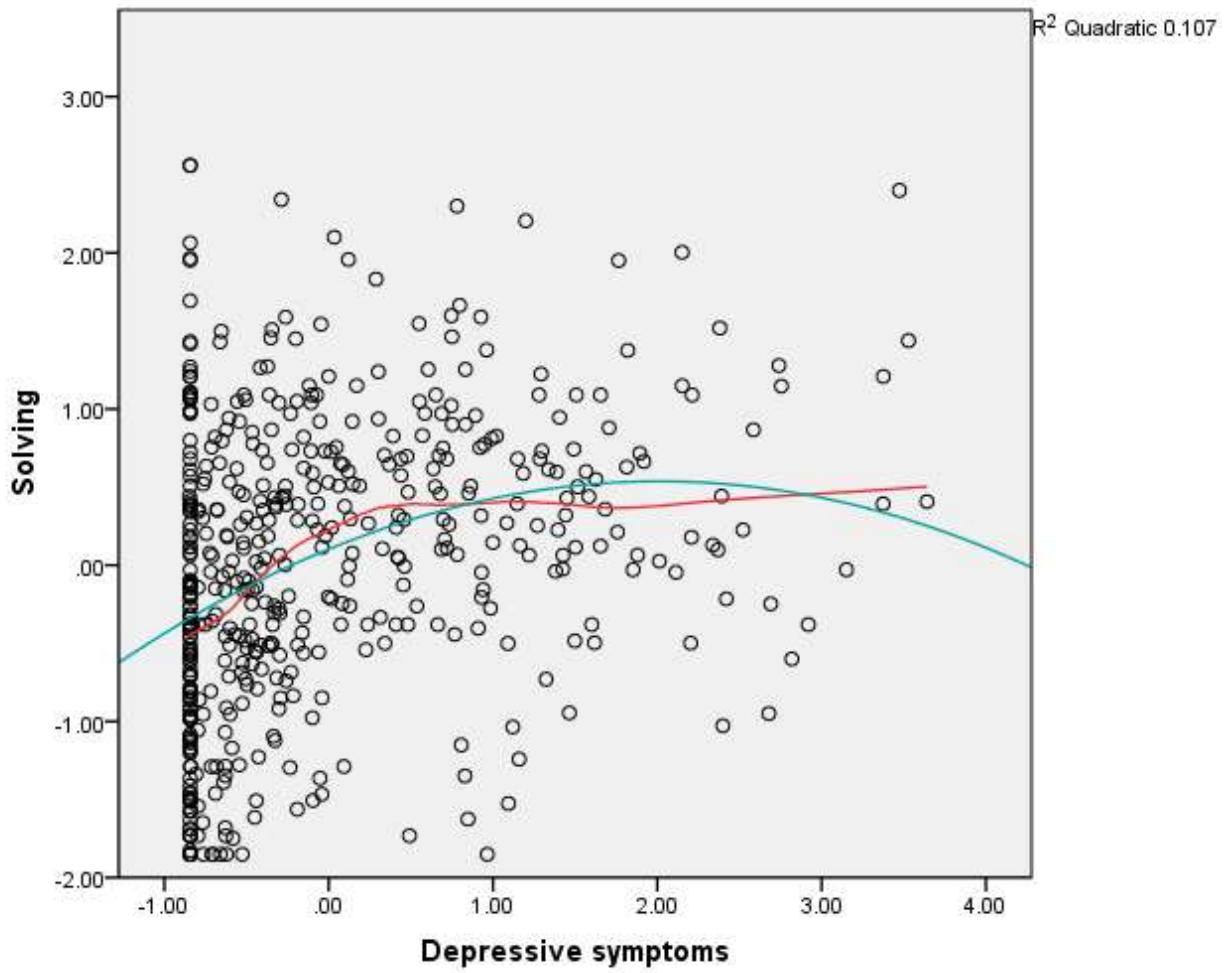
Note. Data are factor scores fitted with LOESS and quadratic curves.

Appendix E

Linear regression examining rumination factors as predictors of depression, excluding "Understanding circumstances"

Rumination factor	*B*	*SE*	*p*
Symptoms	0.64	0.06	<.01
Sadness	0.04	0.07	.54
Solving	-0.03	0.03	.29

Linear regression examining rumination factors as predictors of depression, excluding "Symptom-based thoughts"

Rumination factor	*β*	*SE*	*p*
Sadness	0.09	0.09	.34
Stressors	0.71	0.11	<.01
Solving	-0.17	0.03	<.01

Appendix F

Circular model with Sadness and Solving
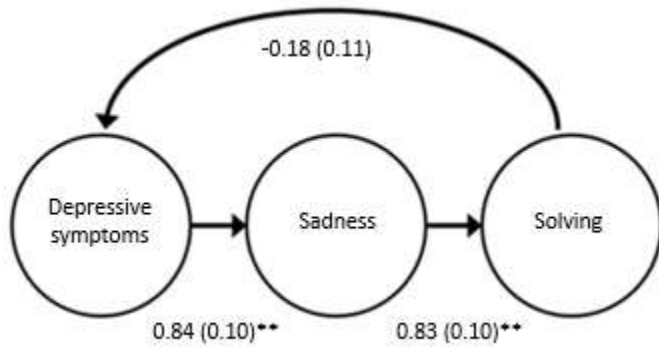
Note: AIC = 35673.44; BIC = 36178.71; Sample-size adjusted BIC = 35797.83

Circular model with Symptoms and Solving
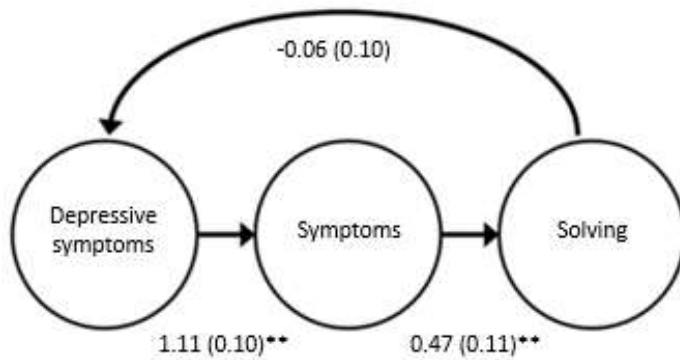
Note. AIC = 33655.46; BIC = 34135.47; Sample-size adjusted BIC = 33773.63
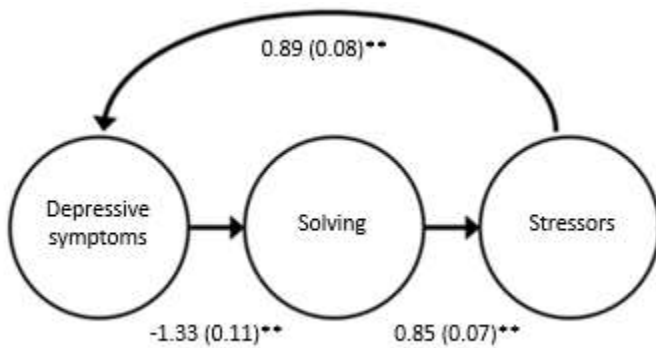
Circular model with Solving and Symptoms
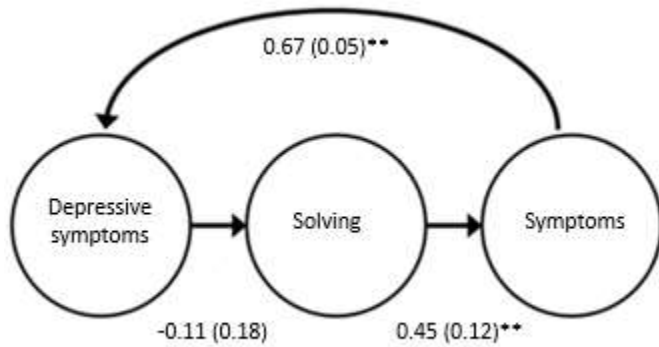
Note. AIC = 33655.464; BIC = 34135.472; Sample-size adjusted BIC = 33773.631

Circular model with Solving and Sadness
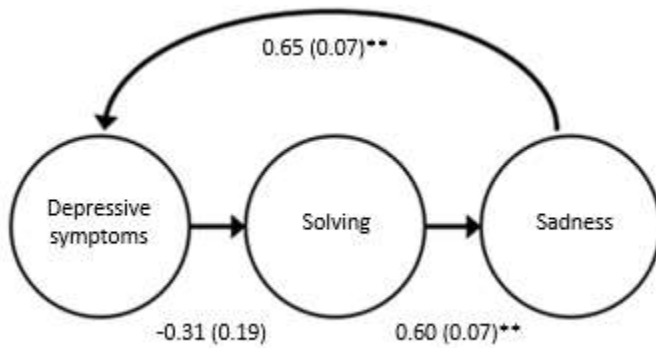
Note. AIC = 35673.44; BIC = 36178.714; Sample-size adjusted BIC = 35797.83
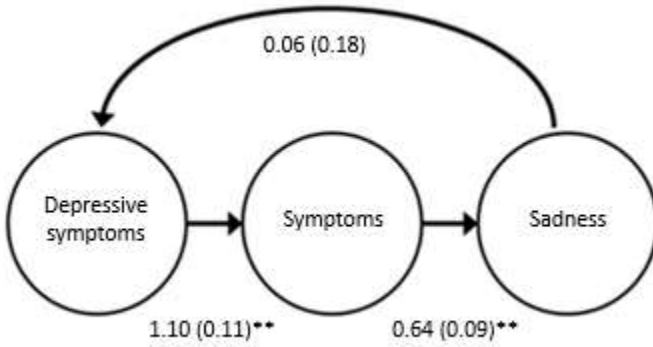
Circular model with Solving and Stressors

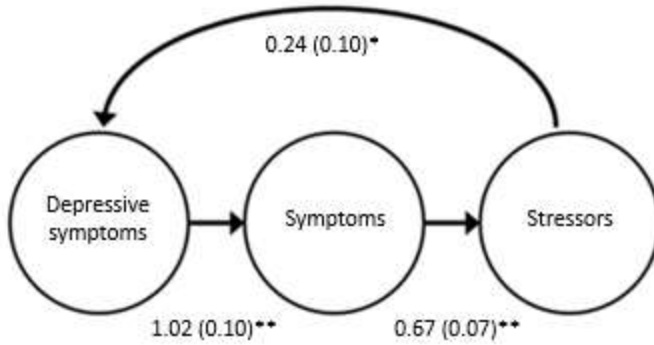*Note.* AIC = 41542.59; BIC = 42123.66; Sample-size adjusted BIC = 41685.64

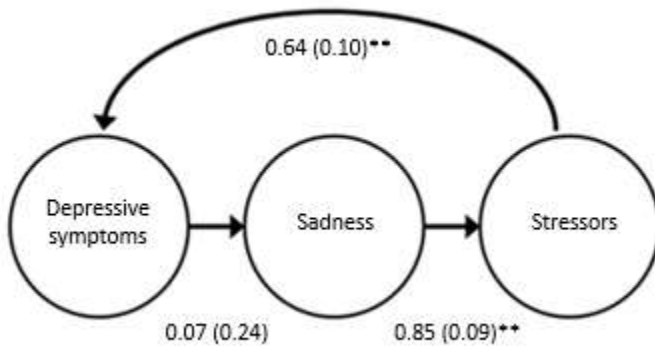*Circular model with Symptoms and Sadness*

Note. AIC = 31908.17; BIC = 32388.17; Sample-size adjusted BIC = 32026.33

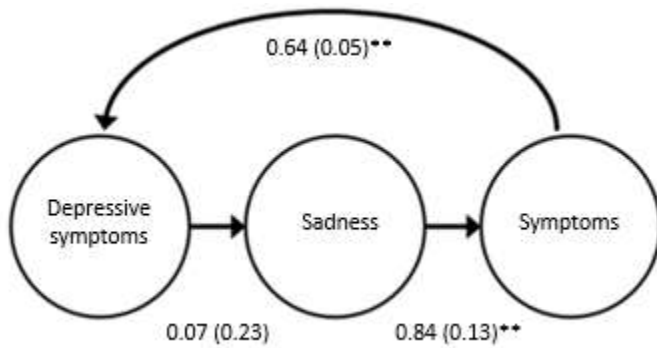*Circular model with Symptoms and Stressors*

Note. AIC = 37750.72; BIC = 38306.52; Sample-size adjusted BIC = 37887.54
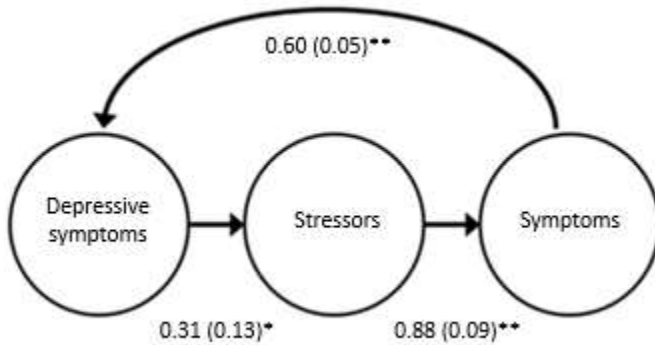
Circular model with Sadness and Stressors

Note. AIC = 39736.66; BIC = 40317.73; Sample-size adjusted BIC = 39879.71

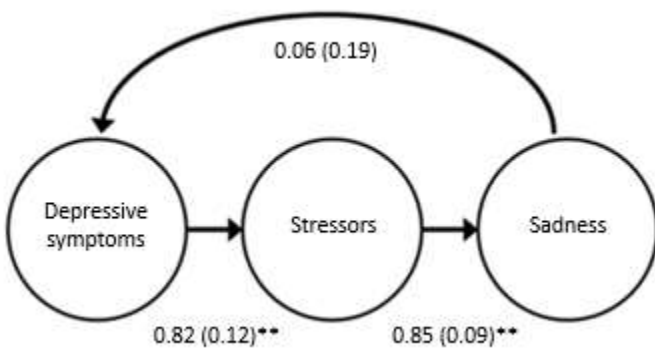*Circular model with Sadness and Symptoms*

Note. AIC = 31908.17; BIC = 32388.17; Sample-size adjusted BIC = 32026.33

Circular model with Stressors and Symptoms

Note. AIC = 37750.72; BIC = 38306.518; Sample-size adjusted BIC = 37887.54

Circular model with Stressors and Sadness

Note. AIC = 39736.66; BIC = 40317.73; Sample-size adjusted BIC = 39879.71

Appendix F

Results of linear terms in quadratic models testing non-linear effects of rumination factors on depression at follow-up

We tested for non-linear associations between the rumination factors and depressive symptoms at follow-up. We found evidence of non-linear associations between *Symptoms*, *Stressors* and *Solving* and depression at follow-up, but not between *Sadness* and depression at follow-up (reported in the manuscript). In all cases, the linear relation was significant (*Symptoms*: β =1.70, *SE*=.24, *p*<.01, *Sadness*: β = 1.01, *SE*= .16, *p*<.01, *Stressors*: β = 1.46, *SE*=.22, *p*<.01, *Solving*: β =0.31, *SE*=.10, *p*<.01).

Plot depicting association between Symptoms and depression at follow-up
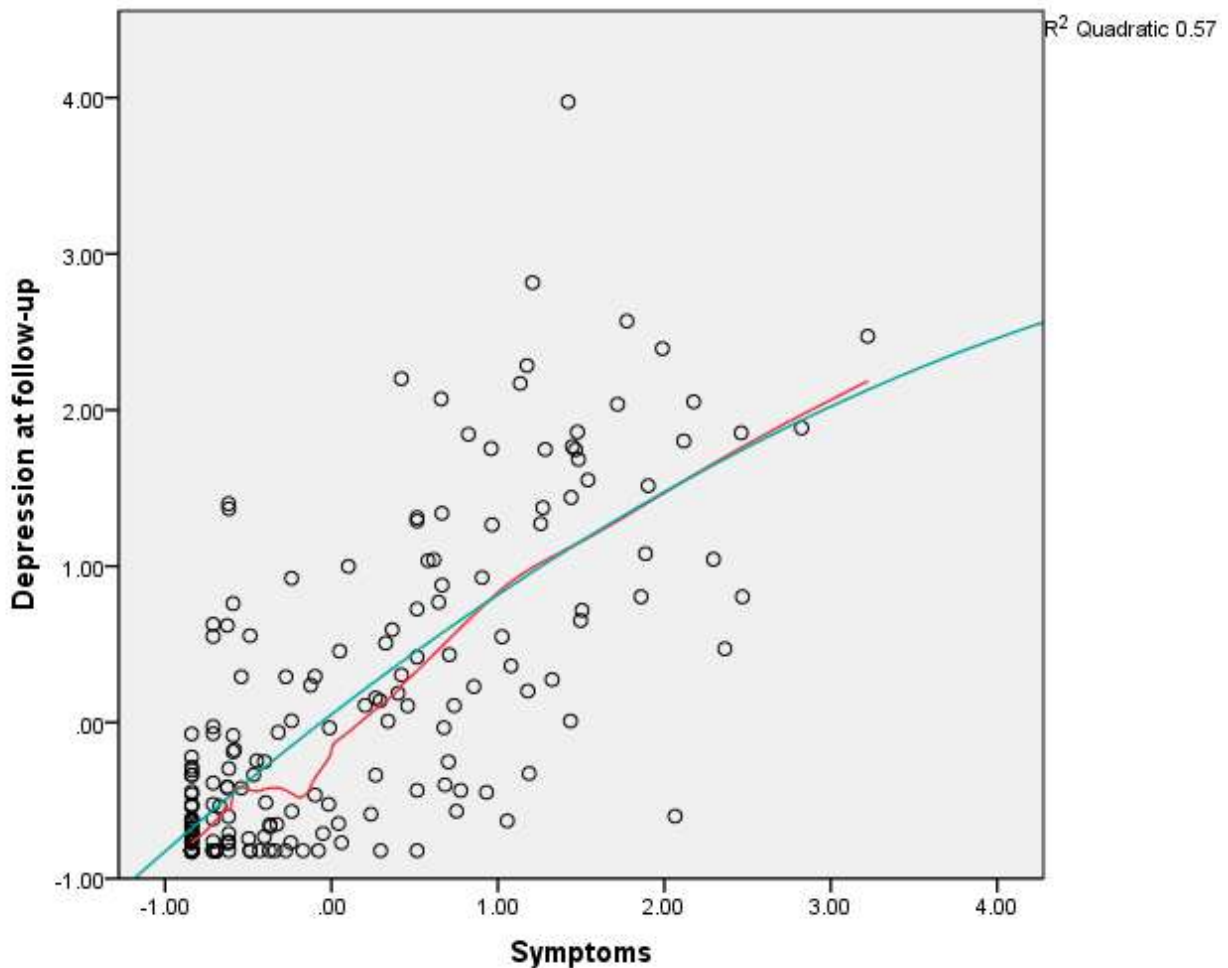
Note. Data are factor scores fitted with LOESS and quadratic curves.

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Plot depicting association between Sadness and depression at follow-up
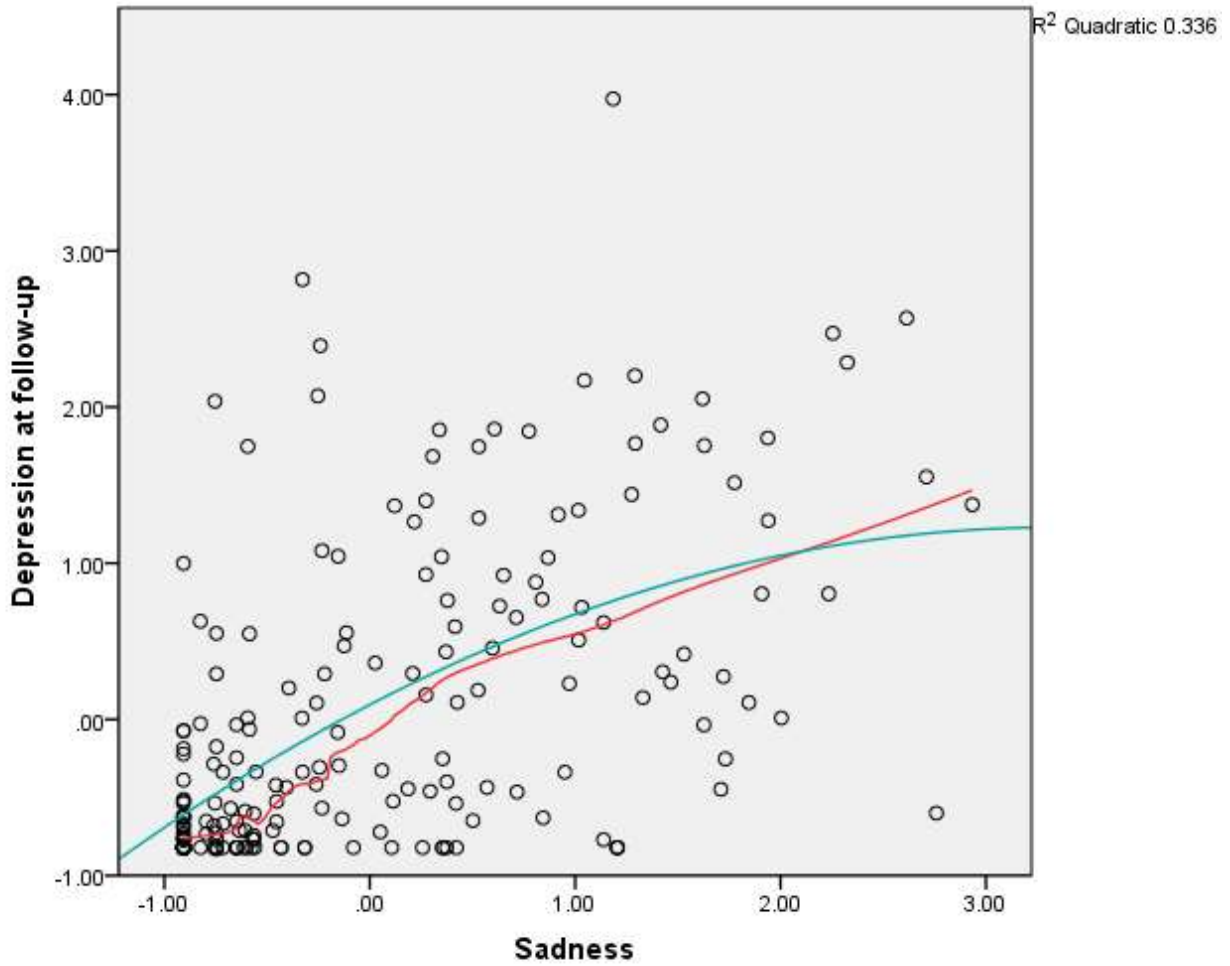
Note. Data are factor scores fitted with LOESS and quadratic curves.

Plot depicting association between Stressors and depression at follow-up
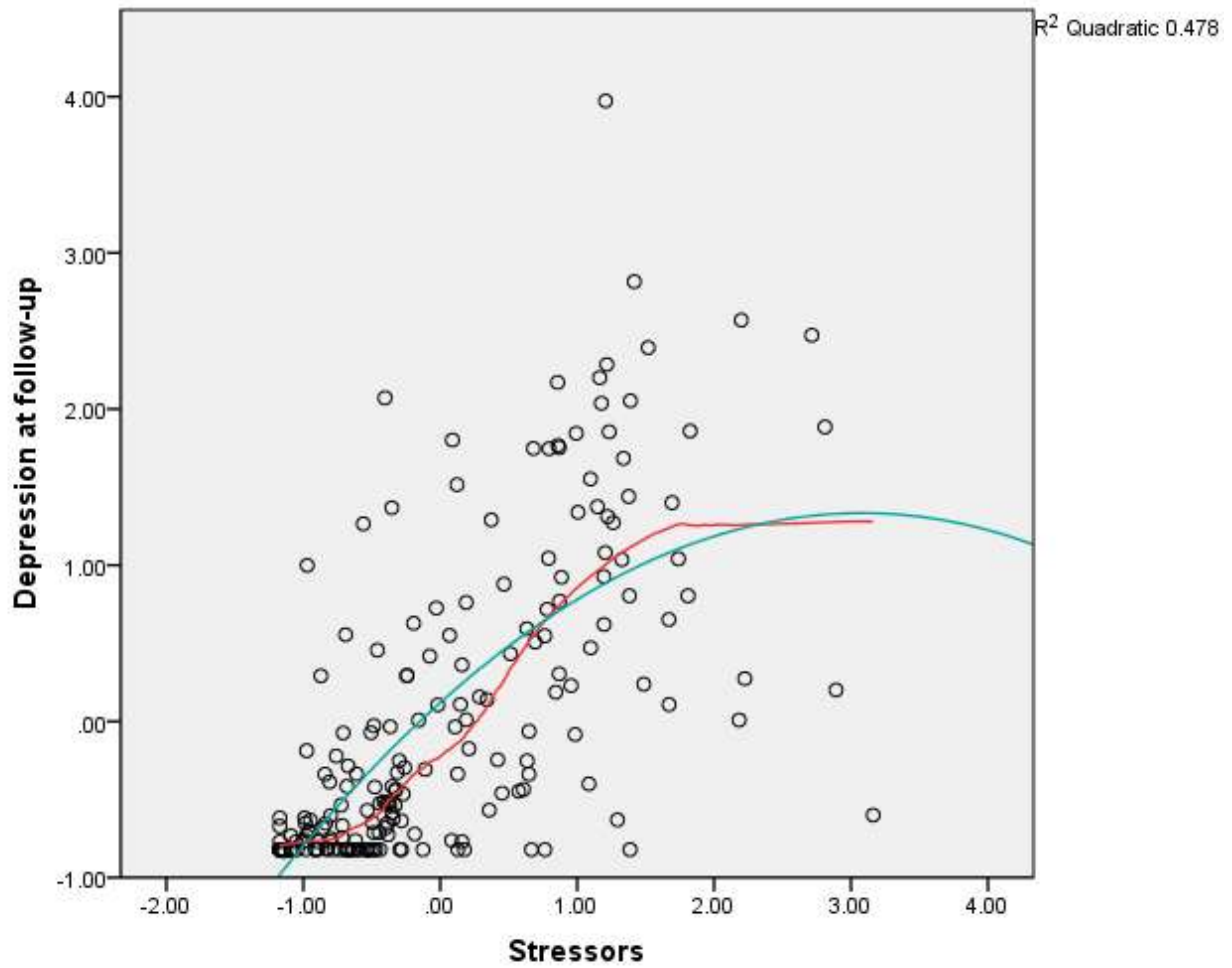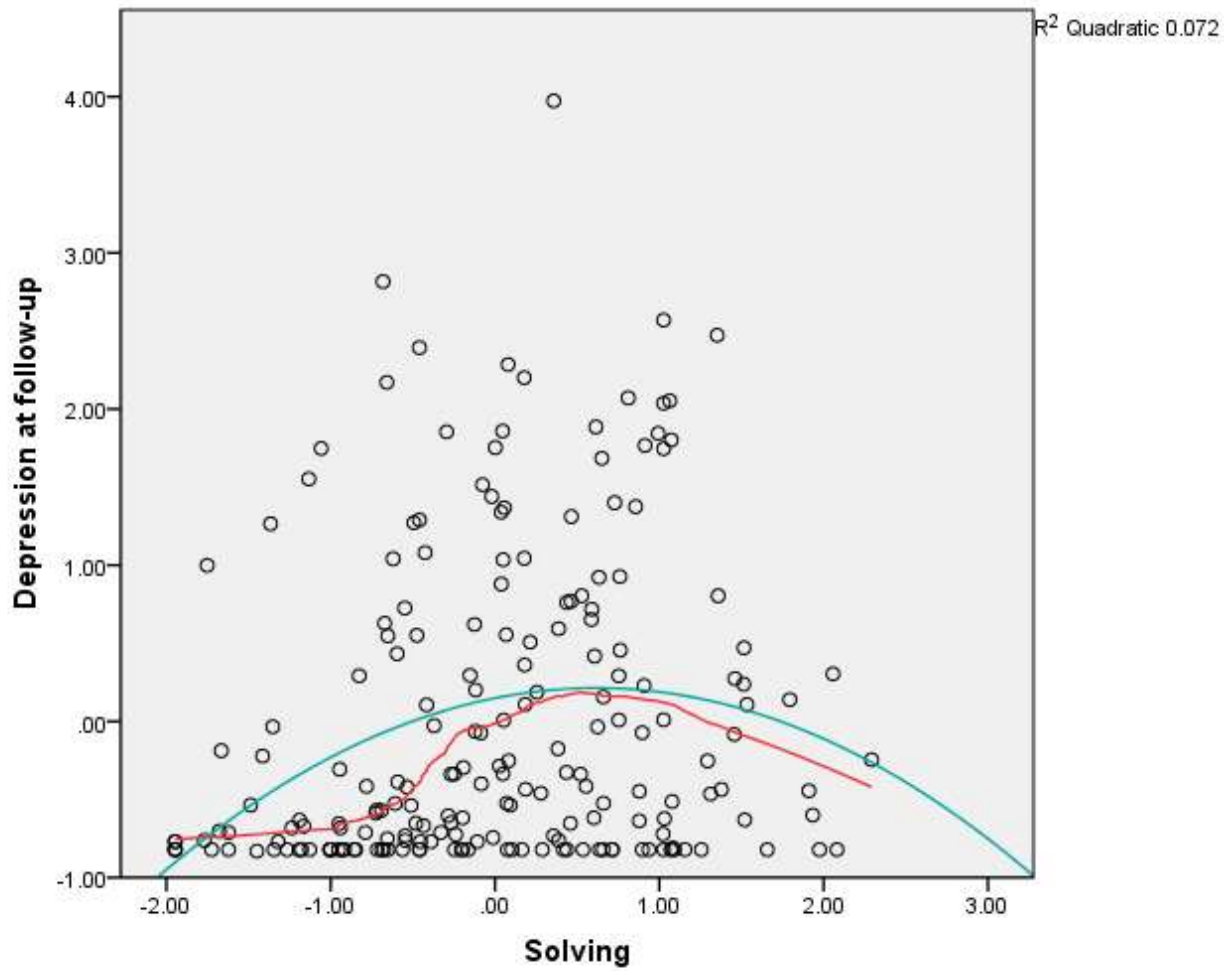

R² Quadratic 0.478

Note. Data are factor scores fitted with LOESS and quadratic curves.

Plot depicting association between Solving and depression at follow-up

Note. Data are factor scores fitted with LOESS and quadratic curves.

Appendix G

Results of outlier analyses

In the 480 participants who were within 3 standard deviations of the mean on the MMPI, BDI scores had a mean of 9.76 (SD = 11.35), and they ranged from 0–51. Most (n = 328) participants reported minimal symptoms, 51 had mild depression, 52 had moderate depression, 34 had severe depression, and 15 participants had missing scores.

We repeated the confirmatory factor analysis and the model fit the data well, RMSEA = 0.048 (95% CI: 0.042, 0.053), CFI = 0.98, TLI = 0.98. All rumination factors correlated with current depression (Symptoms: r (478) = .28, p <.01; Sadness: r (478) = .18, p <.01; Stressors: r (478) = .21, p <.01; Solving: r (478) = .11, p <.01).

We re-analyzed data of the 203 participants (who were within three standard deviations of the mean on the MMPI) who completed follow up questionnaires. All rumination factors were associated with depressive symptoms at follow up (Symptoms: r (201) = .24, p <.01; Sadness: r (201) = .15, p <.01; Stressors: r (201) = .18, p <.01; Solving: r (201) = .16, p = .01). However, only Symptoms uniquely predicted depression at follow up, β = .53, SE = .15, p <.01, and Solving were marginal negative predictors, β = -.08, SE = .04, p = .06. Depressive symptoms at follow up were not uniquely related to Sadness: β = -.03, SE = .10, p = .80, or Stressors: β = .18, SE = .19, p = .34.

CHAPTER 5

Examining rumination in response to sadness over a stressor: An expressive writing study

Abstract

To integrate different perspectives on depressive rumination, a recent study factor analyzed four rumination questionnaires and compared across the emerging factors. Factors involving thoughts about depressive symptoms and sadness (i.e., *Symptoms* and *Sadness* respectively) were least frequently endorsed. Causal thoughts about negative situations (i.e., *Stressors*) occurred more frequently, and thoughts about problem-solving (i.e., *Solving*) were most frequently endorsed. Although these findings suggest that rumination is most aptly characterized by problem-solving, it is unclear how the presence of sadness affects the relative frequency of the rumination factors. To address this issue, we used a writing paradigm to induce sadness in a sample of 240 undergraduates, and we assessed emotion and rumination factors during writing. Items from the *Solving*, *Stressors*, and *Sadness* factors were endorsed more frequently than items from the *Symptoms* factor. When we examined unique associations between emotions and rumination during writing, sadness was positively related to *Stressors* and negatively related to *Solving*. *Stressors* was additionally positively related to anxiety and negatively related to calmness. Our results suggest that even in the presence of sadness, rumination includes thoughts about problem-solving, as well as about the causes of stressors and about sadness. We discuss our findings in the context of other research on depressive thinking and describe their limitations.

Introduction

Rumination is a cognitive characteristic of depression, referring to intense and persistent thoughts about a depressive episode, such as its symptoms, their causes, and their consequences (Nolen-Hoeksema & Morrow, 1993). There are different theories about the content of ruminative thinking (for a review, see Smith & Alloy, 2009). Some researchers posit that rumination is focused on sad feelings (Conway, Csank, Holm & Blake, 2000), while others suggest that it involves thinking about stressful events (Robinson & Alloy, 2003), or attempts to understand and cope with complicated problems (Andrews & Thomson, 2009).

One recent study aimed to integrate these theoretical approaches by conducting a joint factor analysis of four measures of depressive rumination (See Chapter 4). The analysis yielded four rumination factors: *Symptoms*, thoughts about the symptoms of depression (e.g., tiredness, a lack of motivation and concentration); *Sadness*, attempts to clarify the source of sad feelings or their meaning; *Stressors*, attempts to understand stressful events or problems (primarily their cause); and *Solving*, thoughts about how to cope with circumstances or solve problems. Comparing across the factors, items from the *Solving* and *Stressors* factors were more commonly endorsed than items from *Symptoms* or *Sadness* (Chapter 4). This finding suggests that rumination may be most aptly characterized by attempts to understand stressors and cope with problems, and not by a focus on depressive symptoms or sadness.

According to most cognitive models, depressive rumination occurs in response to sadness or distress (Morrow & Nolen-Hoeksema, 1990), and studies suggest that it fluctuates according to the presence or absence of sadness following negative or stressful events (Smith & Alloy, 2009; Vanderhasselt, Brose, Koster, & De Raedt, 2017). In the joint factor analysis (described in Chapter 4), participants retrospectively reported their naturally-occurring thoughts from the past two weeks, and not the thoughts they were having in the presence of sadness over a stressful event or problem. Although the joint factor analysis may have captured various forms of ruminative thinking, it is unclear how the presence of sadness over a stressor affects the relative prevalence of these thoughts. To address this issue, the current study induces sadness related to a stressor using a writing paradigm and assesses ruminative

thoughts during writing.

The Role of Stressors and Sadness

The impact of sadness following negative events on the implications of ruminative thinking for depression has received considerable empirical support. In prospective, longitudinal studies, the tendency to ruminate when sad or distressed following stressful life events (e.g., an earthquake or the loss of loved ones) predicts depression months later (Michl, McLaughlin, Shephard & Nolen-Hoeksema, 2014; Nolen-Hoeksema, 1991; Nolen-Hoeksema & Davis, 1999). This effect persists even when many relevant factors, such as baseline depression, social support, gender, and other concurrent stressors, are controlled (Nolen-Hoeksema, Parker, & Larson, 1994). One study that tracked ruminative thinking in students over the course of their mid-term exams found that in the weeks students reported a higher incidence of stressful events, they had a higher ruminative response style. These events explained a third of the variance in rumination throughout the study period. Furthermore, the association between stress and rumination was a better predictor of depression after exams than a baseline trait tendency to ruminate, suggesting that stress-related fluctuations in rumination play an important role in the course of depression (Vanderhasselt et al., 2017). Although this study did not measure emotion, empirical research suggests that rumination is strongly associated with negative emotion (for reviews, see Mor & Winquist, 2002 and Thomsen, 2006). Rumination is a response to both naturally-occurring and experimentally-induced sadness, and it seems to increase the duration of negative feelings only if sadness is already present, either by its natural occurrence, experimental induction, or when individuals are currently depressed (Morrow & Nolen-Hoeksema, 1990; Nolen-Hoeksema & Morrow, 1993; Nolen-Hoeksema, Morrow & Frederickson, 1993).

Researchers have argued that the type of ruminative thinking that affects depression might only emerge when individuals are sad or distressed. Ruminations can be useful for gaining insight into problems and emotions (Lyubomirsky & Nolen-Hoeksema, 1993), but rumination in the presence of sadness has been proposed to interfere with the ability to think clearly and problem-solve (Lyubomirsky & Nolen-Hoeksema, 1995). This would suggest that when individuals are sad, they may not think about the causes of their stressors and problems or attempt to solve them. Instead, they might focus on other

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thoughts (e.g., about sadness or other symptoms of depression), which are thought to exacerbate depression (Conway et al., 2000; Nolen-Hoeksema & Morrow, 1993).

The Content of Rumination as Reflecting Stressors or Sadness

Given that stressors and sadness are implicated in the onset of depressive rumination, researchers have proposed different theories about the content of its thoughts based on these triggers. Robinson and Alloy (2003) posit that rumination involves thoughts that focus on a stressful event, and this stress-reactive rumination is characterized by negative attributions and hopeless thoughts about the event (e.g., it underscores personal flaws or shortcomings, its consequences are broad and enduring). Andrews and Thomson (2009) posit that rumination forms part of a response to complicated, personal problems, which involve costly trade-offs and competing goals. Because these problems are difficult to solve, ruminative thoughts reflect a sustained and effortful analysis of these problems (referred to as analytical rumination). Analytical rumination has two components: causal analysis, or thoughts about the cause of problems, and problem-solving analysis, attempts to cope with problems under difficult circumstances or constraints (Bartoskova et al., 2018).

Other researchers suggest that sadness and other symptoms of depression are the focus of ruminative thoughts. Conway and his colleagues (2000) argue that ruminative thoughts are strictly focused on attempts to understand the nature, meaning and cause of sadness, as well as on the intense, repetitive, and intrusive nature of these thoughts (referred to as rumination on sadness; Conway et al., 2000). Nolen-Hoeksema's ruminative responses style theory (1991) posits that rumination broadly involves a passive focus on distress, including depressive symptoms and their consequences. However, subsequent revisions to this theoretical approach have shifted the focus of rumination from thoughts about depressive symptoms to two widely-cited types of thinking: brooding, which reflects a tendency to engage in self-criticism to identify the source of distress, and reflective pondering, a tendency to contemplate about thoughts and (primarily) feelings (Treynor et al., 2003). Although reflective pondering involves some focus on external events as way to identify the cause of depression, it is primarily characterized by a focus on the self, and one's thoughts and feelings.

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The Current Study

Stressors and sadness are triggers for depressive rumination (Moberly & Watkins, 2008), and the importance of these triggers are reflected in its content. Accordingly, it is useful to study ruminative thinking in response to triggers. It is possible that rumination occurs in the absence of sadness following a negative circumstance (Lyubomirsky & Nolen-Hoeksema, 1995), or in the presence of sadness that is unrelated to an event or life stressor (e.g., following a laboratory mood induction). In the current study however, our aim was to understand rumination in response to sadness over an ecologically-valid stressor, such as a negative event or personal problem.

Expressive writing (EW) is a useful paradigm for examining rumination in response to sadness. EW instructs individuals to write their deepest thoughts and feelings about a negative experience or problem for at least 15 minutes (Pennebaker & Beall, 1986). Studies tracking emotional changes over the course of EW find that it consistently increases sadness during writing, and only sometimes impacts happiness and calmness (See Chapter 2). These emotional changes are likely the result of many features of EW, but changes in sadness may in part depend on the negative valence and personal nature of the writing topic (Greenberg, Wortman & Stone, 1996; Chapter 3). EW therefore allows us to examine ruminative thinking in response to sadness induced by a personal, negative issue.

Although there have been studies of how multiple sessions of EW impact rumination over time (e.g., Gortner, Rude, & Pennebaker, 2006; Sloan, Marx, Epstein & Dobbs, 2008), research on the types of ruminative thoughts that occur during EW is limited. This topic has been investigated in two studies where participants reported on their emotions and the analytical rumination components (i.e., causal analysis and problem-solving analysis) during EW about a problem or a control writing task. Although there was linguistic evidence of both causal analysis and problem-solving in the EW tasks, expressive writers reported more causal analysis relative to control writers, but not more problem-solving analysis. They were also sadder than control writers during writing, suggesting that when individuals are sad over an important, personal problem, they might think about the cause of their problems, but not necessarily about how to solve them (Chapter 2). However, these EW studies only measured rumination from one

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theoretical perspective (i.e., analytical), and they do not allow for a comparison between different rumination factors (e.g., *Symptoms*, *Sadness*).

In the current study, we assessed emotion and the four rumination factors (discussed above) during EW. Because sadness seems related to the personal nature and negative valence of the EW topic (Chapter 3), we wanted individuals to choose an issue that was important to them (be it an event, problem, experience, or circumstance). Accordingly, we asked participants to complete EW about an important issue affecting them negatively. When asking participants to report retrospectively on their thinking during writing, we used items from the four rumination questionnaires included in the joint factor analysis (from Chapter 4). These questionnaires were developed based on four theories of depressive rumination (i.e., a ruminative response style, rumination on sadness, stress-reactive rumination, analytical rumination). Including items from these questionnaires allowed us to compare across the four rumination factors derived from the joint factor analysis. We also assessed emotions before and during writing, and we examined associations between emotions and the rumination factors during writing.

Consistent with previous research, we expected participants to become sadder during EW. Sadness during EW also appears to co-occur with the causal analysis subtype of analytical rumination (Chapter 2). Because causal analysis and problem-solving analysis conceptually resemble the rumination factors *Stressors* and *Solving*, we expected *Stressors* to be related to sadness during writing. However, the association between *Solving* and depressive symptoms is complex (Bartoskova et al., 2018; Chapter 4). *Solving* is positively linked to depression in bivariate correlations. However, based on research supporting a circular association between depression, causal analysis, and problem-solving analysis (Bartoskova et al., 2018), in Chapter 4, we found that depression predicted *Stressors*, which predicted *Solving*, and *Solving* reduced depression in a negative feedback loop. We therefore expected that *Solving* might be negatively related to sadness, but only when its shared covariance with the other rumination factors (e.g., *Stressors*) is controlled. Given that the link between *Solving* and depression is complicated by other rumination factors, and that linguistic analyses of EW tasks still evidence content related to problem-

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solving (Chapter 2), we did not have clear predictions about the relative prevalence of items from the *Solving* factor during EW. Similarly, *Symptoms* and *Sadness* were not commonly endorsed factors of rumination in previous work (see Chapter 4). However, negative emotions induced by EW might prompt writers to think about sadness and other depressive symptoms. Although we anticipated these factors to be related to sadness during writing, it was unclear how this relation would affect their prevalence during writing.

Methods

Participants

We collected data from 254 undergraduate Psychology students, recruited from our university's research participant pool. Before completing analyses, we excluded data from 14 participants because they either did not follow instructions and completed questionnaires prematurely, they were noted by the experimenter to be inattentive, or they did not complete the writing task. Our final sample consisted of 240 participants (197 females, 39 males), and their mean age was 19.00 years (*SD*=1.61). Most participants (41%) self-identified as white, 19% were South Asian, 13% were East Asian, 9% were of a mixed cultural background, 5% were West Asian, 5% were black, and 4% were South East Asian.

Measures

Valence-Arousal Mood Profile (VAMP; Maslej, Rheaume, Barbic, & Andrews, unpublished). To measure emotional state, we used the VAMP. It contains 16 adjectives, which the participants use to rate how they currently feel on a 5-point Likert scale from 1 (*not accurate as a self-description*) to 9 (*extremely accurate as a self-description*). Each of these adjectives corresponds to one of four emotions: happiness, sadness, anxiety, and calmness, and each emotion is represented by 3–5 adjectives. When scoring, the responses to each adjective are summed for each emotion category, and the participant receives an overall score for happiness, sadness, anxiety, and calmness.

Beck Depression Inventory-II (BDI-II; Beck, Brown, & Steer, 1996). The BDI–II contains 21 items assessing depressive symptoms, with higher scores representing greater severity of depression. Scores from 0–13 are thought to reflect minimal levels of depression, 14–19 reflects mild depression, 20–

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28 indicates moderate depression, and 29–63 indicates severe depression (Beck et al., 1996). The BDI-II has excellent internal consistency as well as high content and construct validity (Beck et al., 1996; Richter, Werner, Heerlein, Kraus & Sauer, 1998).

Rumination questions. We administered 62 items from the four rumination questionnaires submitted to the joint factor analysis (described in Chapter 4). We adapted the instructions to capture participants' thoughts during the writing task (i.e., "Below are some statements describing what you may have thought during the writing task. For each statement, please select the rating that best fits what you thought while writing"). All items were presented in a random order and rated on a 4-point Likert scale, from 1 (*not at all*) to 4 (*the whole time*). These questions included 13 items from the Rumination on Sadness Scale (Conway et al., 2000), 9 rumination items from Stress-Reactive Rumination Scale (Robinson & Alloy, 2003), and 18 items from the Analytical Rumination Questionnaire (Barbic et al., 2014), which included six items assessing causal analysis and problem-solving analysis (Bartoskova et al., 2018). We included 21 items from the depression, brooding, and reflective pondering subscales of the Ruminative Response Styles Questionnaire (Nolen-Hoeksema, 1991), excluding one item (i.e., "wrote down what you were thinking about and analyzed it"). We anticipated this item would be highly endorsed given all participants were asked to complete a writing task. Forty items from these rumination questions make up the four rumination factors (Chapter 4): 7 items belong to the *Symptoms* factor, 8 items form *Sadness*, 15 items form *Stressors*, and 9 items form *Solving*. Items from each factor are presented in Appendix A.

Procedure

All participants completed the study in a separate room to maintain a sense of privacy. After providing their consent to take part, participants completed a VAMP as an assessment of their baseline emotions, and the BDI to assess baseline depressive symptoms. Next, participants received booklets with writing task instructions, which prompted them to write their deepest thoughts and feelings about an extremely important emotional issue that has affected them and their lives in a negative way. Each participant wrote for a total of 25 minutes, and completed a second VAMP mid-task (i.e., after 15 minutes

of writing). Participants wrote with a pen or pencil on blank lined paper. After the writing task, participants completed the rumination questions. They chose which issue they discussed in the EW task from a list of 10 issues and completed a brief demographics questionnaire. Finally, participants were debriefed, offered access to mental health resources on campus if needed, and provided with a course credit for completing the study. All questionnaires in the study were completed on the computer.

Statistical Analysis

First, we examined responses on the BDI to gauge the severity of depression in our sample, and we examined the types of issues participants wrote about in their EW tasks. To determine if EW successfully induced sadness, we compared emotions before and during writing using Wilcoxon signed-rank tests. We compared average ratings of items from each rumination factor during writing with Wilcoxon rank-sum tests.

To determine how emotions were related to the rumination factors during writing, we generated correlations and assessed unique effects in a series of multiple regressions. We wished to account for the covariance shared between the factors, so we generated four regression models specifying each emotion (i.e., sadness, happiness, anxiety, calmness) as dependent variables and all rumination factors as independent variables. In each model, we included each emotion at baseline to control for its effects on emotion during writing.

Because our sample was predominantly female, we wished to assess whether emotion and rumination during EW differed according to gender. We repeated analyses restricting our sample to the 39 males in our study, and we assessed for qualitative differences between these findings and the findings from our overall sample.

Results

Depression

Participants had a mean score of 12.57 (*SD*=8.67) on the BDI. Most (*n*=147) participants had little to no symptoms (i.e., scores of 0–13), 49 participants had a mild level of depression (i.e., a score of 14–19), 23 participants were moderately depressed (i.e., a score of 20–28), and 14 were severely

depressed (or had a BDI score of 29 or higher). Scores were missing for 7 participants.

EW Topics

Most participants either had difficulties with grades (13%), an issue with a romantic relationship (13%), or concerns about their self-esteem or image (13%). The remaining participants wrote about an interpersonal conflict (12%), loss or bereavement (11%), an issue with their health (9%), integrating into university (e.g., trouble with making friends) (6%), and family issues (e.g., parental divorce) (5%).

Emotion during EW

As compared to before writing, participants became sadder, less happy, and less calm during writing (sadness: $Z=7.24$, $p<.01$, $r=0.47$; happiness: $Z=-11.00$, $p<.01$, $r=0.71$; calmness: $=-7.38$, $p<.01$, $r=0.48$). There was no change in anxiety, $Z=0.04$, $p=.97$, $r=0.00$.

Rumination during EW

On average, items from the *Symptoms* factor were least frequently endorsed ($M=1.88$, $SD=0.76$). These thoughts were reported less frequently than *Sadness* ($M=2.37$, $SD=0.61$), $Z=-7.60$, $p<.01$, $r=0.49$, *Stressors* ($M=2.32$, $SD=0.63$), $Z=-6.82$, $p<.01$, $r=0.44$, and *Solving* ($M=2.28$, $SD=0.64$), $Z=-6.40$, $p<.01$, $r=0.41$. There were no differences in the endorsement of items from the other rumination factors (*Sadness* and *Stressors*: $Z=-0.95$, $p=.34$, $r=0.06$; *Sadness* and *Solving*: $Z=1.81$, $p=.07$, $r=0.12$; *Stressors* and *Solving*: $Z=0.82$, $p=.41$, $r=0.05$). Figure 1 depicts the rumination factors during writing.

Associations between Rumination Factors, Emotions, and Depression

Correlations between emotions during writing and the rumination factors are presented in Table 1. All rumination factors are correlated with one another, but *Sadness* and *Stressors* shared the strongest association. The association between *Symptoms* and *Solving* was the weakest. *Symptoms*, *Sadness* and *Stressors* positively correlated with sadness and anxiety during writing, and they negatively correlated with happiness and calmness. *Solving* was not correlated with any emotions during writing.

Unique Associations between Rumination Factors and Emotions during Writing

Sadness. Baseline sadness predicted sadness during writing, $β=.46$, $SE=0.06$, $p<.01$. Sadness during writing was positively related to *Stressors*, $β=.33$, $SE=.10$, $p<.01$, and it was negatively related to

Solving, *β*= -.22, *SE*=.07, *p*<.01. However, sadness during writing was not uniquely related to *Symptoms*,

β= -.02, *SE*=.09, *p*=.87, or *Sadness*, *β*=.11, *SE*=.11, *p*=.30,

Happiness. Only baseline happiness predicted happiness during writing, *β*= -.86, *SE*= .04, *p*<.01.

Happiness during writing was not uniquely related to any of the rumination factors (*Symptoms*: *β*= .19,

SE=.10, *p*=.06; *Sadness*: *β*= -.03, *SE*= .10, *p*= .77; *Stressors*: *β*= -.17, *SE*=.10, *p*=.09; *Solving*, *β*=.10,

SE=.06, *p*=.10).

Anxiety. Baseline anxiety predicted anxiety during writing, *β*=.71, *SE*=.04, *p*<.01. Anxiety was

uniquely related to *Stressors*, *β*=.20, *SE*=.09, *p*=.03, but not any of the other rumination factors

(*Symptoms*: *β*= .00, *SE*= .07, *p*=.96; *Sadness*: *β*= -.02, *SE*=.08, *p*=.82; *Solving*: *β*= -.08, *SE*=.06, *p*=.24).

Calmness. Baseline calmness predicted calmness during writing, *β*= .65, *SE*=.05, *p*<.01.

Calmness during writing was negatively related to *Stressors*, *β*= -.33, *SE*= .11, *p*<.01, but it did not share

unique associations with the other rumination factors (*Symptoms*, *β*= .07, *SE*= .10, *p*=.49; *Sadness*, *β*=.12,

SE=.10, *p*=.27; *Solving*, *β*= .13, *SE*=.07, *p*=.07)

Effects of EW on Emotion and Rumination in Males

When we examined changes in emotion during EW in our sample of males (*n*=39), there were no

qualitative differences in results for happiness, anxiety, and calmness. Changes in sadness were not

statistically significant, but followed the same trend (i.e., an increase during writing). For results

involving the rumination factors during EW, there were also no qualitative differences. Appendix B

contains full results for these analyses.

Discussion

In our study, we compared the prevalence of items from four factors of rumination in response to

sadness over an important, negative issue induced with an EW paradigm. EW made participants sadder,

less happy, and less calm. During EW, the *Sadness* and *Stressors* factors were endorsed more than

Symptoms; however, only *Stressors* was uniquely associated with sadness, anxiety, and calmness during

writing. Interestingly, participants reported items from the *Solving* factor as much as *Sadness* and

Stressors, even though this factor was negatively associated with sadness induced by EW. Items from *Symptoms* were least common, and they were not associated with any emotions we measured during writing. Overall, our findings suggest that during EW, the *Stressors* and *Solving* factors are commonly endorsed, and they are the only factors uniquely related to the sadness during writing.

Items from the *Sadness* factor were as common as items from *Stressors* and *Solving*, but items from *Symptoms* were not. Rumination is widely conceptualized as intense and repetitive thinking about a depressive episode, which includes a focus on sadness and symptoms, as well as their causes and consequences (Nolen-Hoeksema & Morrow, 1993). However, modifications and alternatives to this theoretical approach have de-emphasized thoughts about symptoms and proposed a focus on sadness and feelings (Conway et al., 2000; Treynor et al., 2003), which is consistent with our finding. Furthermore, *Symptoms* was among the least common rumination factors when participants were asked about their thoughts from the past two weeks (Chapter 4). Our study adds to this finding by showing that even when individuals are sad or distressed over an important issue, they do not seem to think about depressive symptoms, suggesting that depressive rumination is not characterized by these types of thoughts.

Although *Sadness* was not a commonly endorsed rumination factor in previous research (Chapter 4), participants in our study may have thought about sadness because this was one of the emotions induced by EW. Many items in this factor reflect attempts to understand the nature and meaning of sadness in an effort to gain information about oneself or the world. According to the affect-as-arousal model (Clore & Storbeck, 2006), an emotion's valence and arousal provide information about the environment. Valence is hypothesized to signal whether circumstances are negative or positive, and arousal clarifies their importance, with a higher arousal indicating greater importance (Storbeck & Clore, 2008). The increase in sadness during EW (as well as a decrease in happiness and calmness) may have prompted participants to think about these emotional cues as ways to gain information about their issues, explaining why items from this factor were elevated during EW. However, the *Sadness* factor was not uniquely related to sadness or any other emotions induced by EW, which we would have expected if participants' thoughts reflected changes in their emotions. Alternatively, various *Sadness* items describe

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attempts to understand the cause of negative feelings, which likely involves the issue that participants described in their writing task. In the context of EW, *Sadness* may be a precursor to *Stressors*, in that it involves thinking about the situation that is causing sadness and other negative feelings. Consistent with this explanation, these two factors share the strongest association.

Overall, our findings show that in the presence of sadness, items from *Stressors* and *Sadness* are as commonly endorsed as items from *Solving*. We cannot formally compare between the current study's results and the joint factor analysis in Chapter 4, given there are differences in the sample sizes and their characteristics. However, it appears that while the prevalence of thoughts about problem-solving remain unchanged, thoughts about sadness or stressors seem to be elevated during EW. This suggests that rumination includes thoughts about sadness, at least when it occurs in response to distress (Conway et al., 2000). Given the utility of causal thinking for problem-solving (Andrews & Thomson, 2009; Barbic et al., 2014), when considering a particularly important, negative issue, the focus of rumination might shift from problem-solving to attempts to understand the issue and why it occurred. To determine how the content of rumination might change according to the nature of a stressor, future research might measure different types of ruminative thoughts (e.g., the four rumination factors) when writing about different events.

That items from the *Solving* factor were as commonly endorsed during EW as items from *Stressors* and *Sadness* seems somewhat inconsistent with previous work. In these studies, EW did not promote the analytical rumination component, problem-solving analysis (Chapter 2); however, there is an important distinction between problem-solving analysis and the *Solving* factor of rumination. Problem-solving analysis refers to coping with issues under situations of constraint, which involves learning from past mistakes and managing competing goals. This component is a part of the *Solving* factor, but other items from this factor reflect general aspects of problem-solving, such as generating potential solutions and figuring out what to do first. In fact, linguistic analyses of EW tasks find evidence of general problem-solving, but not problem-solving analysis (Chapter 2). *Solving* might be as common as other rumination factors during EW to the degree that this factor reflects general attempts at problem-solving, and not problem-solving analysis.

It is interesting that the *Solving* factor was commonly endorsed, even though this factor was negatively related to sadness induced by the EW task. This finding is consistent with the complex association between problem-solving and depression observed in previous work (Bartoskova et al., 2018; Chapter 4). In the joint factor analysis, *Solving* correlated positively with depressive symptoms, but when it was paired with *Stressors* in a circular model, it was a negative predictor of depression. In the current study, *Solving* was unrelated to sadness in a correlation, but when we examined their unique association, it was negative and significant. Thus, the nature of the association between *Solving* and depression or sadness appears to depend on other rumination factors. Despite being negatively associated with the sadness during writing, items from the *Solving* factor may have been commonly endorsed because they tend to co-vary with other ruminative thoughts. In other words, thinking about the meaning or cause of sadness or trying to understand why stressors occurred might inevitably involve thinking about ways to address the situation that triggered the sadness or cope with stressors.

Researchers have proposed that sadness interferes with the ability to think clearly and problem solve (Lyubomirsky & Nolen-Hoeksema, 1995). Our results suggest that even in the presence of sadness over an important issue, depressive rumination includes thoughts about problem-solving. One might argue that because these thoughts are negatively related to a sadness, they do not form part of depressive rumination. However, rumination may be a two-stage process of reacting to a difficult problem or circumstance, which involves causal thinking and problem-solving (Bartoskova et al., 2018). In our study, *Stressors* and *Solving* were related to each other, and they were the only factors of rumination uniquely related to sadness in response to writing about an important negative issue. However, sadness was positively related to *Stressors* and negatively related to *Solving*. Thus, both factors seem to be implicated in depression, just in different ways. According to the analytical rumination hypothesis, causal thinking is promoted by depression, and problem-solving might rely on causal thinking to effectively reduce symptoms (Barbic et al., 2014; Bartoskova et al., 2018). Thus, thoughts about problem-solving may play an important role in the rumination process.

Although our study suggests that rumination in the presence of sadness involves thoughts about

problem-solving, our study does not address the quality or efficacy of these thoughts. Thus, it remains unclear whether sadness or depression prevents clear thinking or effective problem-solving (Lyubomirsky & Nolen-Hoeksema, 1995). Individuals who are depressed generate fewer solutions to interpersonal problems (Lyubomirsky & Nolen-Hoeksema, 1995), but sad individuals also outperform happy individuals on decision-making tasks, when the induced emotions are relevant to the task at hand (Au, Chan, Wang, & Vertinsky, 2003). We found that rumination in the presence of sadness is characterized by attempts to solve problems; however, it is unclear whether the efficacy of these attempts is affected by the presence of sadness or distress. Another issue is that we only assessed a single session of writing, which does not allow us to examine how rumination, and its connection with emotion, changes over time. A future study might assess the prevalence of rumination factors over multiple sessions of EW to determine whether *Solving* negatively predicts the impact of stressors with continued EW.

Another limitation of our study is that our sample was predominantly female. In our attempt to assess whether our findings differed according to gender, we found that EW did not significantly affect sadness in males. It is unclear whether this result was the effect of a small sample size or whether it reflects a true gender difference in the effects of EW on emotion. Nevertheless, the prevalence of the rumination factors did not qualitatively differ; males still reported items from the *Sadness*, *Stressors*, and *Solving* factors more than *Symptoms*.

Our findings suggest that even when writing expressively about an important, negative issue, common ruminative thoughts include attempts to problem-solve and understand the causes of stressors. Furthermore, these thoughts are uniquely related to sadness during writing in a potentially functional way. Consistent with previous work (Chapter 4), our study does not support the notion that depressive rumination is devoid of instrumental or goal-oriented thoughts (Nolen-Hoeksema, 1991; Conway et al., 2000), and supports the emergence of various types of thoughts in response to sadness over a stressor.

References

Alloy, L. B., Abramson, L. Y., Hogan, M. E., Whitehouse, W. G., Rose, D. T., Robinson, M. S., ... & Lapkin, J. B. (2000). The Temple-Wisconsin Cognitive Vulnerability to Depression Project: lifetime history of axis I psychopathology in individuals at high and low cognitive risk for depression. *Journal of Abnormal Psychology, 109*(3), 403–418.

Andrews, P. W., & Thomson, J. A. (2009). The bright side of being blue: Depression as an adaptation for complex problems. *Psychological Review, 116*(3), 620–654.

Au, K., Chan, F., Wang, D., & Vertinsky, I. (2003). Mood in foreign exchange trading: Cognitive processes and performance. *Organizational Behavior and Human Decision Processes, 91*(2), 322–338.

Barbic, S. P., Durisko, Z., & Andrews, P. W. (2014). Measuring the bright side of being blue: A new tool for assessing analytical rumination in depression. *PloS One, 9*(11), e112077.

Bartoskova, M., Sevcikova, M., Durisko, Z., Maslej, M., Preiss, M., & Andrews, P. W. (2018). The Form and Function of Depressive Rumination. *Evolution and Human Behavior, 39*(3), 277–289.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck Depression Inventory-II.* San Antonio, TX: Psychological Corporation.

Clore, G. L., & Storbeck, J. (2006). Affect as information about liking, efficacy, and importance. In J. Forgas (Ed.), Affect in Social Thinking and Behavior (pp. 123–142). New York, NY: Psychology Press.

Conway, M., Csank, P. A., Holm, S. L., & Blake, C. K. (2000). On assessing individual differences in rumination on sadness. *Journal of Personality Assessment, 75*(3), 404–425.

Gortner, E. M., Rude, S. S., & Pennebaker, J. W. (2006). Benefits of expressive writing in lowering rumination and depressive symptoms. *Behavior Therapy*, *37*(3), 292–303.

Greenberg, M. A., Wortman, C. B., & Stone, A. A. (1996). Emotional expression and physical health: Revising traumatic memories or fostering self-regulation? *Journal of Personality and Social Psychology*, *71*(3), 588–602.

Lyubomirsky, S., & Nolen-Hoeksema, S. (1995). Effects of self-focused rumination on negative thinking and interpersonal problem-solving. *Journal of Personality and Social Psychology, 69*(1), 176–190.

Maslej, M.M., Frontjes, L., Srikanth, N., & Andrews, P.W. (Chapter 3). Why does expressive writing affect emotion? Considering the impact of valence and cognitive processing.

Maslej, M.M., Mulsant, B., & Andrews, P.W (Chapter 4). The nature of depressive rumination and its connection to symptoms.

Maslej, M.M., Rheaume, A.R., Barbic, S., & Andrews, P.W. (Unpublished manuscript). The Valence-Arousal Mood Profile (VAMP).

Maslej, M.M., Rheaume, A.R., Schmidt, L., & Andrews, P.W. (Chapter 2). Changes in emotion and causal analysis during expressive writing about a personal problem.

Michl, L. C., McLaughlin, K. A., Shepherd, K., & Nolen-Hoeksema, S. (2013). Rumination as a mechanism linking stressful life events to symptoms of depression and anxiety: Longitudinal evidence in early adolescents and adults. *Journal of Abnormal Psychology*, *122*(2), 339–352.

Moberly, N. J., & Watkins, E. R. (2008). Ruminative self-focus, negative life events, and negative affect. *Behaviour Research and Therapy*, *46*(9), 1034–1039.

Mor, N., & Winquist, J. (2002). Self-focused attention and negative affect: a meta-analysis. *Psychological Bulletin*, *128*(4), 638–662.

Morrow, J., & Nolen-Hoeksema, S. (1990). Effects of responses to depression on the remediation of depressive affect. *Journal of Personality and Social Psychology, 58*(3), 519–527.

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology, 100*(4), 569–582.

Nolen-Hoeksema, S., & Davis, C. G. (1999). " Thanks for sharing that": Ruminators and their social support networks. *Journal of Personality and Social Psychology*, *77*(4), 801–814.

Nolen-Hoeksema, S., Morrow, J., & Fredrickson, B. L. (1993). Response styles and the duration of episodes of depressed mood. *Journal of Abnormal Psychology*, *102*(1), 20–28.

Nolen-Hoeksema, S., Parker, L. E., & Larson, J. (1994). Ruminative coping with depressed mood

following loss. *Journal of Personality and Social Psychology, 67*(1), 92–104.

Pennebaker, J. W., & Beall, S. K. (1986). Confronting a traumatic event: toward an understanding of

inhibition and disease. *Journal of Abnormal Psychology*, *95*(3), 274–281.

Richter, P., Werner, J., Heerlein, A., Kraus, A., & Sauer, H. (1998). On the validity of the Beck

Depression Inventory. *Psychopathology*, *31*(3), 160–168.

Robinson, M. S., & Alloy, L. B. (2003). Negative cognitive styles and stress-reactive rumination interact

to predict depression: A prospective study. *Cognitive Therapy and Research, 27*(3), 275–291.

Sloan, D. M., Marx, B. P., Epstein, E. M., & Dobbs, J. L. (2008). Expressive writing buffers against

maladaptive rumination. *Emotion*, *8*(2), 302–306.

Smith, J. M., & Alloy, L. B. (2009). A roadmap to rumination: A review of the definition, assessment,

and conceptualization of this multifaceted construct. *Clinical Psychology Review, 29*(2), 116–

128.

Storbeck, J., & Clore, G. L. (2008). Affective arousal as information: How affective arousal influences

judgments, learning, and memory. *Social and Personality Psychology Compass, 2*(5), 1824–1843.

Thomsen, D. (2006). The association between rumination and negative affect: A review. *Cognition and

Emotion, 20*(8), 1216–1235.

Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric

analysis. *Cognitive Therapy and Research, 27*(3), 247–259.

Vanderhasselt, M. A., Brose, A., Koster, E. H., & De Raedt, R. (2016). Co-variation between stressful

events and rumination predicts depressive symptoms: An eighteen months prospective design in

undergraduates. *Behaviour Research and Therapy, 87,* 128–133.

Figure 1

Rumination factors during writing

Note. Error bars are 95% confidence intervals.

Table 1

Bivariate correlations between rumination factors, depression, and emotions

	Rumination factors				Emotions			
	Symptoms	Sadness	Stressors	Solving	Sadness	Happiness	Anxiety	Calmness
Symptoms	*	0.63 (0.05)**	0.72 (0.37)**	0.26 (0.07)**	0.49 (0.05)**	-0.40 (0.06)**	0.39 (0.06)**	-0.42 (0.06)**
Sadness		*	0.75 (0.37)**	0.46 (0.06)**	0.48 (0.06)**	-0.34 (0.06)**	0.37 (0.06)**	-0.33 (0.07)**
Stressors			*	0.47 (0.05)**	0.51 (0.05)**	-0.34 (0.06)**	0.49 (0.06)**	-0.44 (0.06)**
Solving				*	0.01 (0.07)	0.04 (0.06)	0.11 (0.07)	-0.02 (0.07)

**p<.01

Supplementary Sections

Appendix A

Rumination factor items

Symptoms

I thought 'won't be able to do my job if don't snap out'.
I thought of feelings of fatigue.
I thought of hard to concentrate.
I thought 'feel passive and unmotivated'.
I thought 'why can't get going'.
I thought about how I don't feel up to doing anything.
I kept thinking about my lack of motivation and wondered about whether it will ever return.

Sadness

I thought about why I feel this way.
I analyzed my personality to try to understand why I'm depressed.
I thought about my feelings.
I repeatedly analyzed and kept thinking about the reasons for my sadness.
I searched my mind repeatedly for events or experiences in my childhood that may help me understand my sad feelings.
I questioned and kept wondering about the meaning of life to find clues that may help me understand my sadness.
I repeatedly thought about what sadness really is by concentrating on my feelings and trying to understand them.
I got the feeling that if I thought long enough about my sadness, I would find that it has some deeper meaning and that I would be able to understand myself better because of it.

Stressors

I thought 'what did I do to deserve this'.
I thought 'why do I always react this way'.
I thought about recent situation and wished it went better.
I thought 'why do I have problems other people don't have'.
I thought 'why can't I handle things better'.
I thought about my failures and shortcomings.
I tried to figure out what I had done wrong.
I thought about what I could have done to avoid these problems.
I thought about how a stressful event was all my fault.
I thought about what the occurrence of a stressful event means about me.
I thought about how things could have gone differently.
I thought about how terrible a stressful event was.
I thought about a stressful event and wished it had gone better.
I thought about the causes of a stressful event.
I thought about how things like this always happen to me.

Solving

I tried to find the answer to my problems.
I tried to figure out the best option for dealing with my dilemma.
I tried to figure out how I could stick to my goals.
I thought about my options for dealing with my problems.
I thought about all the aspects of the problems I was facing that needed to be solved.
I tried to learn from my mistakes.
I tried to figure out which of the problems I was facing were the most important and what I should do first.
I tried to figure out how to make the best out of a bad situation.
I tried to find a way to resolve an important issue.

Appendix B

Re-analysis of data using only males (n=39)

Emotion during EW

As compared to before writing, males did not become significantly sadder during writing, $Z= -1.01$, $p=.32$, $r=0.16$. During writing, males became less happy, $Z= 4.53$, $p<.01$, $r=0.73$, and less calm, $Z= 2.76$, $p<.01$, $r=0.44$. However, anxiety did not change, $Z= 0.95$, $p=.35$, $r=0.15$.

Rumination during EW

During writing, items from *Symptoms* were less commonly reported than items from *Sadness* ($W=463.5$, $p<.01$), *Stressors* ($W=532$, $p=.03$) and *Solving* ($W=465$, $p<.01$). There were no differences in the prevalence of other rumination factors (*Sadness* and *Stressors*: $W=872$, $p=.18$; *Sadness* and *Solving*: $W=783$, $p=.83$; *Stressors* and *Solving*: $W=861.5$, $p=.22$).

CHAPTER 6

General Discussion

Summary of Findings

In this dissertation, I examined depressive thinking from the perspective of the *analytical rumination hypothesis* of depression (Andrews & Thomson, 2009). This hypothesis posits that depression is a reaction to difficult or complicated personal problems, and its symptoms promote a state of sustained and effortful thinking devoted to understanding and solving them, referred to as analytical rumination. Analytical rumination functions in two stages to resolve the problem and alleviate the depressive episode (Andrews & Thomson, 2009; Bartoskova et al., 2018). First, depressive symptoms promote a causal analysis (CA) of the problem, to understand why it happened or how it could have been avoided. CA leads to problem-solving analysis (PSA), or finding ways to effectively deal with the situation. In turn, progress at solving the problem reduces symptoms. Given the potential utility of this hypothesis for understanding the etiology and course of depression, it is important to empirically evaluate its predictions about the content of depressive thinking, which was the aim of the studies reported in this dissertation.

My first question was whether sadness in response to an important life stressor promoted analytical rumination, including its two stages. In Chapter 2, I used an expressive writing (EW) paradigm to assess emotions and thoughts in response to writing one's deepest thoughts and feelings about a personal problem (Pennebaker, 1997). In two studies, EW participants were sadder and reported engaging in more CA, but not more PSA, than participants who wrote about neutral topics (i.e., control writers). In Chapter 3, I modified the EW task to examine why EW about a problem affected emotion, exploring two possibilities: writing about negative problems produces congruent emotions, or considering a problem involves analytical or effortful processing, which is associated with negative emotion. The first study showed that writing about hypothetical problems (which participants were not experiencing) induced a negative emotional state, as compared to control writing. I examined the effect of the writing topic's valence in a second study. In it, participants considered a scenario involving a decision between two jobs

that was either framed positively (as a promotion) or negatively (as a job loss), and they completed an EW task about the scenario. Participants who wrote about the negative scenario became sadder and less happy than they were before writing. Although participants who wrote about the positive scenario did not become sadder during writing, they became less happy, potentially indicating a decrease in heuristic thinking (Bless et al., 1996). Overall, studies from Chapters 2 and 3 suggest that emotional changes during EW may be related to thinking effortfully about a problem. When individuals are sad in response to writing about an important personal problem, their analytical thoughts appear to be restricted to CA, which is consistent with the first stage of analytical rumination (Bartoskova et al., 2018).

However, there are many potential thoughts that individuals might entertain when they are sad (Smith & Alloy, 2009), and so my second question concerned the degree to which depressive thinking is better characterized by analytical rumination or other conceptualizations of rumination. Various perspectives have been proposed about the content of rumination, for example, that it involves thoughts about depressive symptoms, their causes, and consequences (Nolen-Hoeksema & Morrow, 1993), a specific focus on sad feelings (Conway, Csank, Holm & Blake, 2000), or preoccupations with stressful events (Robinson & Alloy, 2003). To compare across these perspectives, in Chapter 4, I completed a joint factor analysis of four rumination questionnaires, including a measure of analytical rumination. I administered these questionnaires to an online sample who reported on their thoughts and depressive symptoms from the past two weeks. The factor analysis yielded four factors of rumination. Items belonging to two factors, *Symptoms* (thoughts about depressive symptoms) and *Sadness* (attempts to understand its source or meaning), were least frequent. Items from the *Stressors* factor (primarily involving causal thoughts about negative situations) occurred more frequently, and items from the *Solving* factor (considering solutions or ways to cope) were most frequent. Associations between these two factors were also consistent with the two stages of analytical rumination (Bartoskova et al., 2018): *Solving* was a negative predictor of depressive symptoms, but only when it was paired with *Stressors*. Given the conceptual resemblance of these two factors with analytical rumination as defined by Andrews and colleagues (Andrews & Thomson, 2009; Barbic, Durisko & Andrews, 2014; Bartoskova et al., 2018),

findings from Chapter 4 suggest that analytical rumination has a prominent role in the content of depressive thinking.

However, ruminative thinking relevant to the study of depression might only emerge when individuals are sad or distressed (Nolen-Hoeksema & Morrow, 1993), and experimental control of sadness was absent in Chapter 4. To assess whether the prevalence of the rumination factors is affected by the presence of sadness in response to an important, negative issue, in Chapter 5, I measured the rumination factors during EW, which is a trigger of sadness (see Chapter 2). Items from the *Stressors*, *Sadness*, and *Solving* factors were more commonly endorsed than *Symptoms*, suggesting that even in response to sadness over a stressor, depressive rumination is characterized by thoughts related to analytical rumination.

Discussion of Findings

Depressive Thinking and Problem-Solving

In the clinical literature, most depressive rumination is considered harmful and unproductive, exacerbating depressive symptoms and interfering with instrumental behaviour (Nolen-Hoeksema, Wisco, & 2008). Accordingly, the most common intervention, cognitive-behavioural therapy, attempts to treat depression by challenging or correcting ruminative thoughts (Beck, Rush, Shaw & Emery, 1979). The presence of sadness is thought to play a role by activating negative thoughts, which are intensified by ruminative thinking. Rumination then clouds judgment and impairs an individual's ability to come up with good solutions to problems (Lyubomirsky & Nolen-Hoeksema, 1995). Although people report that their ruminative thoughts help them gain insights into their problems and emotions (Lyubomirsky & Nolen-Hoeksema, 1993), ruminating when sad or depressed has been proposed to interfere with the ability to think clearly and problem-solve (Lyubomirsky & Nolen-Hoeksema, 1995).

However, the notion that sadness interferes with clear thinking is inconsistent with my findings from Chapter 3. When participants considered a situation that required analytical thinking (i.e., considering a hypothetical problem or deliberating between two jobs), they became sadder. Even when this situation was framed positively, they became less happy. Compared to the emotional changes from

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my other EW studies where topics of writing were personal or not hypothetical (e.g., Chapters 2 and 5), decreases in sadness or happiness were smaller; however, they could not be attributed to personal experience with the writing topic, or in the case of happiness, to its valence. These emotional changes may have been due to the depth of participants' processing. Sadness has been linked to an effortful, analytical, and detail-oriented style of thinking, as compared to happiness which appears to be characterized by automatic and heuristic thinking. When recalling information in a memory test, for example, happy participants are more likely than sad participants to rely on mental shortcuts or fall prey to lures (Bless et al., 1996; Storbeck & Clore, 2005). Happy participants are more susceptible to bias, relying on stereotypes when making judgments about people (Park & Banaji, 2000). They tend to process information in a less systematic and detailed way when forming judgements about statistical or interpersonal relationships (Ambady & Gray, 2002; Sinclair & Mark, 1995). An increase in sadness or a loss of happiness during EW about hypothetical topics may suggest that participants are relying less on these superficial processing strategies, since the topics of writing demand effortful or analytical thinking. If sadness interfered with clear thinking, writing expressively about these topics should not have induced a negative emotional state.

Furthermore, findings from various studies in my dissertation suggest that problem-solving is a common topic of people's naturally occurring thoughts, even in the presence of sadness over a negative personal problem or issue (i.e., during EW). In Chapter 2, I completed a linguistic analysis of participants' writing tasks, assessing for content cueing CA and problem-solving. EW tasks contained more CA and problem-solving content than control writing tasks. Similarly, in Chapter 5, items from the *Solving* rumination factor were endorsed as commonly as items from other factors (i.e., the *Sadness* and *Stressors* factors) and more than items from the *Symptoms* factor. Like the linguistic analysis, this *Solving* factor captured many thoughts related problem solving, such as thinking about options for solutions or deciding what to do first. Even though EW consistently induced sadness in participants, there was evidence of problem-solving in their thinking and writing. Thus, ruminating when sad does not seem to be devoid of productive thinking (Lyubomirsky & Nolen-Hoeksema, 1995).

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Under certain circumstances, however, depressed individuals might not engage in problem-solving right away. In addition to the linguistic analysis in Chapter 2, participants retrospectively reported on their thoughts during EW. In both studies, EW participants consistently reported engaging in more CA than control writers, but not more PSA, which reflects attempts to problem-solve under difficult or constrained conditions. These conditions could require trade-offs between competing demands, and PSA involves considering how to take appropriate action while maintaining goals and learning from past mistakes or failures (Bartoskova et al., 2018). The absence of PSA relative to control writing might be interpreted as evidence that sadness reduces the ability to engage in problem-solving, resulting in a persistent focus on the cause of problems. At the same time, when problems are complicated and resist simple attempts at resolution, it may be useful to engage in CA at the expense of problem-solving (Barbic et al., 2014). CA involves trying to understand one's role in the situation, which can include expressions of self-criticism and blame as well as upward counterfactuals, or thoughts about how a situation might have gone better (Roese, 1997). Research suggests that negative events or personal failures often trigger upward counterfactual thinking. Importantly, the causal inferences derived from these counterfactuals are useful for generating ideas about appropriate actions to take to achieve a desired outcome (for a review of this literature, see Epstude & Roese, 2008). Thus, CA might be necessary to generate effective solutions to problems that are particularly difficult or complicated, or at least to help prevent mistakes or avoid similar problems in the future. When participants were asked to write about their most important personal problems in Chapter 2, they may have been engaging in CA and not PSA because of CA's utility for PSA.

Links between Problem-Solving, Depression, and Emotion

One consistent finding emerging from my dissertation studies is that problem-solving shares complex links with depressive symptoms and other ruminative thoughts. My findings from Chapter 4 show that, although the *Solving* factor correlates positively with depressive symptoms, it can be a negative predictor of symptoms, but only when it is paired with the *Stressors* factor in a circular model. In this model, depressive symptoms promote causal thoughts (i.e., *Stressors*), which lead to problem-solving thoughts (i.e., *Solving*), which in turn, reduces symptoms. Similarly, in Chapter 5, the *Solving* factor did

not correlate with any emotions during EW. However, when its associations with the other rumination factors (e.g., *Stressors*) were controlled in a multiple regression, *Solving* was a negative predictor of sadness. This regression could not elucidate the direction of this association. It is possible that if depression is triggered by complicated issues that cannot be easily solved without causal thinking, sadness promotes causal thinking at the expense of problem-solving during EW, accounting for the unique negative relation between sadness and *Solving*. However, research suggests that the links between depressive symptoms and rumination are best characterized as multidirectional (Pössel & Black, 2013), and findings from Chapter 4 provide evidence for a reverse effect (i.e., when depression promotes *Stressors*, *Solving* reduces depression). The specificity of the circular association to these two factors again implies that causal thoughts may be necessary for effective problem-solving to occur (Barbic et al., 2014). However, causal thoughts also lead to problem-solving, which may also account for *Solving*'s relation to sadness during EW. Future research might consider examining whether the difficulty or complexity of a stressor modulates CA and PSA, to determine why and when these stages of analytical rumination emerge. The direction of their association might also be elucidated with a longitudinal design.

Overall, my studies suggest that depressive thinking is multifaceted and dynamic. Most of the existing research on depressive rumination has been guided by its conceptualization as a stable, characteristic style of responding to sadness, which forms part of a stress–diathesis model of depression (Beck, 2005). According to this model, the pairing of a stressful event with a cognitive vulnerability or diathesis (i.e., an attitude characterized by hopelessness and negative attributions) produces rumination, which triggers depression (Metalsky, Halberstadt & Abramson, 1987; Ruscio et al., 2015). Accordingly, rumination has been primarily studied using measures that ask participants what they tend to think about or do when they feel sad or distressed (Morrow & Nolen-Hoeksema, 1990; Nolen-Hoeksema & Morrow, 1993; Nolen-Hoeksema et al., 1993). However, research is beginning to suggest that depressive thinking fluctuates in response to triggering events (Vanderhasselt, Brose, Koster & De Raedt, 2016). Findings from my dissertation additionally suggest that depressive thinking changes over time, with different temporal combinations of thoughts being better predictors of depression than one form of rumination

measured as a stable trait or tendency. Consistent with this idea, Thomsen (2006), in a review of emotion and rumination, proposes that rumination is associated with negative affect in its initial stages, but it may have positive, instrumental effects over time.

Emotions as Reactions to Stressors

In my dissertation, I used EW as a paradigm to study depressive thinking, but the emotional changes I observed during writing are worth noting. In all studies that asked participants to write about a personal topic, EW consistently affected sadness. The nature of the issues participants described in their EW was diverse, but it was consistent with proposed triggers for sadness. Many participants wrote about academic difficulties (e.g., poor performance on an exam or in an academic program) or issues with their self-esteem or self-image. These types of issues involve personal failure or dissatisfaction, which is thought to engage sadness and depressive thinking (Beck & Freeman, 1990). Many participants also wrote about romantic relationship problems or interpersonal conflicts, which could promote sadness because they involve social or romantic rejection or managing difficult relationships (Andrews & Thomson, 2009; Nesse, 1993).

Two aspects of EW topics that seemed to impact sadness most were their negative and personal nature. In Chapter 2, the topic of EW was an important personal problem, which made expressive writers sadder during writing than control writers. In Chapter 3, participants wrote about negative, hypothetical problems that they were not affected by, and the effects of these writing topics on sadness were smaller and not always statistically significantly different from control writing. Although these changes in sadness may have been in part due to thinking analytically about the problems, results across the two chapters also suggest that sadness felt during EW is partially related to the negative nature of the writing topic and its personal connection with the writer. These findings are consistent with another study showing that participants writing about a traumatic event that they imagined, but did not personally experience, felt less depressed after writing than participants writing about a real event (Greenberg, Wortman & Stone, 1996). It may also support the notion that negative events need to be subjectively important to an individual to trigger depression (Abramson, Metalsky & Alloy, 1989; Haaga, Ersnt &

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Dyck, 1991; Metalsky, Halberstadt & Abramson, 1987).

I also found that, although EW impacted sadness, it did not impact anxiety. This result is perhaps not surprising, given that EW seems to promote analytical rumination, and there are well-evidenced links between sadness and analytical thinking (Andrews & Thomson, 2009; Forgas, 2013). Nevertheless, that negative emotions induced by EW were specific to sadness generally supports my use of this paradigm to capture thoughts that characterize depressive states, and not those characterizing other co-morbid negative conditions, like anxiety.

Study Limitations

Given the complex and dynamic associations between depressive symptoms and thoughts, an obvious limitation of my dissertation studies is that they involve single sessions of EW. Thus, they can only provide experimental evidence for the first stage of analytical rumination, since observing longer-term changes in emotion and thinking (i.e., the expected increases and decreases in symptoms in ways that reflect progress on solving the triggering problem) requires multiple sessions of writing. In longitudinal studies of EW, increases in negative emotions during single sessions of EW appear to attenuate over the course of several sessions (Pascual-Leone, Yeryomenko, Morrison, Arnold, & Kramer, 2016). Two studies that incorporated the EW paradigm in the treatment of clinically depressed patients found that some patients reported temporary increases in symptoms that coincided with peaks in processing in their EW entries, and these patients were most likely to report improvements in depression after the therapy was complete. Conversely, the absence of a spike in symptoms was associated with avoidance, reduced processing, and worse long-term outcomes (Hayes, Beevers, Feldman, Laurenceau & Perlman, 2005; Hayes et al., 2007). It is possible that fluctuations in symptoms or peaks in processing are indices of problem-solving and other ruminative thoughts (Bartoskova et al, 2018). Future research might use similar methods to examine how spikes and dips in depressive symptoms over the course of multiple EW sessions are associated with the various rumination factors and whether certain combinations of factors (like *Stressors* and *Solving*) predict reductions in symptoms over time.

A related issue concerns a limited follow-up in Chapter 4. This study used a prospective

longitudinal design to examine whether the various rumination factors affected depression one month later. The factor *Symptoms* (describing a focus on the cognitive and somatic symptoms of depression and their consequences) was the only significant predictor of future depression, suggesting that these types of thoughts exacerbate depression. The effect of *Solving* was negative, but only marginally significant, so my findings suggest that the *Solving* factor may not have consequences for future depression. However, evidence of its complex, short-term connections with depression and other rumination factors (e.g., *Stressors*) nevertheless suggests that I should be cautious about interpreting the implications of any given factor based on its ability to predict depressive symptoms at follow-up. For instance, whether *Solving* reduced depression could have depended on what participants were ruminating about before they were having these thoughts or which problems these thoughts were targeting.

Changes in depression are not linear, which underscores the shortcoming of conducting longitudinal studies with only one follow-up. Even in observational studies of untreated participants, fluctuations in depressive symptoms have been reported (Tang & DeRubeis, 1999), and these fluctuations do not always have predictive value. For instance, experiencing sudden reductions in symptoms does not make remission any more likely (Kelly, Roberts & Bottonari, 2007), with both reductions and temporary increases in symptoms being associated with better long-term outcomes for depression (Tang & DeRubeis, 1999; Tang, DeRubeis, Hollon, Amsterdam, & Shelton, 2007; Vittengl Clark, & Jarrett, 2005). When I assessed the impact of the rumination factors on depression at a single point in time, I may have captured participants at different fluctuations in their depressive symptoms. My findings might have differed if I had measured depression after a different follow-up period (e.g., two months instead of one), which can help explain why longitudinal associations between depression and certain rumination types (e.g., reflective pondering) have not been consistent in studies that include one follow-up (e.g., 12 or 13 months after a baseline assessment; Nolen-Hoeksema & Davis, 2004; Treynor, Gonzalez & Nolen-Hoeksema, 2003).

Finally, although one of my key findings is that depressive rumination commonly involves thoughts about problem-solving and attempts to understand stressors, I did not evaluate the quality or

utility of these thoughts for improving real-life outcomes. Researchers have proposed that depressed individuals have ineffective problem-solving skills (Nezu, 1987), and this claim has received some empirical support (e.g., Marx, Williams, & Claridge, 1992). However, most studies showing these depressive deficits in objective assessments of problem-solving have either only assessed the quantity, not quality, of solutions (Gotlib & Asarnow, 1979), or used measures that have no personal connection to the depressed individuals (Marx & Schulze, 1991), raising the possibility of deficits emerging because depressed individuals are already engaging in problem-solving about their own problems or stressors (Andrews & Thomson, 2009). Other studies have also not found associations between depression and problem-solving (Davila, Hammen, Burge, Paley, & Daley, 1995; Doerfler, Mullins, Griffin, Siegel, & Richards, 1984). Nevertheless, it is possible that while thoughts about problem-solving might occur frequently, the presence of sadness or depression could render them ineffective. Examining the effects of these problem-solving thoughts and analytical rumination on individuals' subsequent actions and behaviours remains a topic for future research.

Implications for Treatment

Overall, my findings suggest that depressive thinking can be conceptualized according to the *analytical rumination hypothesis* of depression. This hypothesis posits that depressive symptoms and thoughts are normal adaptive responses to complicated personal problems and stressors. Since these responses function to resolve triggering problems, therapeutic interventions for depression might be most effective when they encourage patients to engage with their depressive thoughts, instead of suppressing them.

Working through difficult emotions and thoughts is a component of one of the oldest treatments for depression, short-term psychodynamic psychotherapy (Dreissen et al., 2015). Based in psychoanalytic theory which emphasizes the role of the unconscious, this approach to treatment focuses on the individual's internal world and promotes the expression and analysis of emotions and thoughts (Driessen et al 2015). Expressive versions of psychodynamic psychotherapy in part examine how individuals (through their thoughts and actions) contribute unwillingly to the problems that maintain their depression

(Luyten & Blatt, 2012), and they emphasize insight as being curative (Driessen et al., 2010). In this way, psychodynamic psychotherapy might promote CA, and the insights gained from this analysis may help individuals navigate their issues (i.e., to problem-solve). Psychodynamic psychotherapy can be an effective and enduring treatment for depression, although its effects tend to be smaller when compared with other treatments, like cognitive-behavioural therapies (for meta-analyses, see Driessen et al., 2010, Driessen et al., 2015). However, researchers argue that clinical studies with short follow-up periods do not capture the full benefits of psychodynamic psychotherapy, since its effects take time to emerge (Taylor, 2008). Indeed, the effects are comparable to those of other treatments after several months (Driessen et al., 2010, 2015). If depression is caused by complicated personal problems (Andrews & Thomson, 2009), working through feelings and thoughts related to these problems in a way that produces useful insights may be a slow process.

Another widely-used treatment is exposure therapy, which is the first-line psychotherapeutic intervention for anxiety-related conditions. During exposure therapy, the patient engages with their emotional responses to stressful or challenging circumstances to understand and overcome them (Stanton, Kirk, Cameron, & Danoff-Burg, 2000). This often involves attempting to habituate the emotional response, or confront and correct erroneous cognitions (Craske et al., 2008; Foa & Rothbaum, 1998). Anxiety and fear are subjectively unpleasant emotions, but they encourage adaptive responses to a perceived threat, like vigilance and avoidance (Russell, Maslej & Andrews, 2015). Coming to understand that the feared stimulus or thought is not a threat, by repeatedly encountering it or changing perceptions about it, eventually assuages the emotion and its associated responses.

Exposing patients to negative emotions and thoughts appears to be helpful for depression as well. For example, a procedure that teaches recovered depressed patients to become aware of their depressed thoughts and feelings at times of potential relapse has been shown to reduce rates of relapse and recurrence (Teasdale et al., 2000). From a traditional, clinical standpoint, asking patients to be aware of their depressive emotions and thoughts may be beneficial because this awareness also involves challenging them (Hunt, 1998). However, many newer therapies, such as mindfulness-based cognitive

therapy or acceptance and commitment therapy, have been successful by teaching patients to simply become aware of their depressive emotions and thoughts (Hayes, Strosahl, & Wilson, 1999; Segal, Williams, Teasdale, & Gemar, 2002). These therapies can reduce depressive symptoms, relapse rates, and improve quality of life in various domains (Kuyken et al., 2008; Ma & Teasdale, 2004; Teasdale et al., 2000).

Psychodynamic and exposure-based therapies for depression may be beneficial because they promote depressive thinking. Findings from my dissertation suggest that this thinking commonly involves attempts to cope with problems and understand stressors (primarily their causes), and when these thoughts occur together, they may reduce depressive symptoms. The emotional changes that underlie these thoughts (i.e., sadness, a loss of happiness) are subjectively unpleasant, but they may be useful for inducing effortful and analytical thinking about the problem or stressor, and eventually recovering from the depressive episode. Overall, my studies collectively suggest that depression, like fear and anxiety, can be conceptualized as a natural, adaptive response to environmental stressors. Re-examining depressive thinking from this perspective has provided some insights into its nature, its association with the symptoms of depression, and its potential function.

References

Abramson, L. Y., Metalsky, G. I., & Alloy, L. B. (1989). Hopelessness depression: A theory-based subtype of depression. *Psychological Review*, *96*(2), 358–372.

Ambady, N., & Gray, H. M. (2002). On being sad and mistaken: Mood effects on the accuracy of thin-slice judgements. *Journal of Personality and Social Psychology, 83*(4), 947–961.

Andrews, P. W., & Thomson Jr, J. A. (2009). The bright side of being blue: depression as an adaptation for analyzing complex problems. *Psychological Review*, *116*(3), 620–654.

Barbic, S. P., Durisko, Z., & Andrews, P. W. (2014). Measuring the bright side of being blue: A new tool for assessing analytical rumination in depression. *PloS One*, *9*(11), e112077.

Bartoskova, M., Sevcikova, M., Durisko, Z., Maslej, M. M., Barbic, S. P., Preiss, M., & Andrews, P. W. (2018). The form and function of depressive rumination. *Evolution and Human Behavior*, *39*(3), 277–289.

Beck, A. T. (1991). Cognitive therapy: A 30-year retrospective. *American psychologist*, *46*(4), 368–375.

Beck, A. T. (2005). The current state of cognitive therapy: a 40-year retrospective. *Archives of General Psychiatry*, *62*(9), 953–959.

Beck, A. T., & Freeman, A. (1990). *Cognitive therapy of personality disorders.* New York: Guilford.

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

Bless, H., Clore, G. L., Schwarz, N., Golisano, V., Rabe, C., & Wolk, M. (1996). Mood and the use of scripts: Does a happy mood really lead to mindlessness? *Journal of Personality and Social Psychology, 71*(4), 665–679.

Conway, M., Csank, P. A., Holm, S. L., & Blake, C. K. (2000). On assessing individual differences in rumination on sadness. *Journal of Personality Assessment*, *75*(3), 404–425.

Craske, M. G., Kircanski, K., Zelikowsky, M., Mystkowski, J., Chowdhury, N., & Baker, A. (2008). Optimizing inhibitory learning during exposure therapy. *Behaviour Research and Therapy*, *46*(1),

5–27.

Davila, J., Hammen, C., Burge, D., Paley, B., & Daley, S. E. (1995). Poor interpersonal problem solving

    as a mechanism of stress generation in depression among adolescent women. *Journal of*

    Abnormal Psychology, *104*(4), 592–600.

Doerfler, L. A., Mullins, L. L., Griffin, N. J., Siegel, L. J., & Richards, C. S. (1984). Problem-solving

    deficits in depressed children, adolescents, and adults. *Cognitive Therapy and Research*, *8*(5),

    489–499.

Driessen, E., Cuijpers, P., de Maat, S. C., Abbass, A. A., de Jonghe, F., & Dekker, J. J. (2010). The

    efficacy of short-term psychodynamic psychotherapy for depression: a meta-analysis. *Clinical*

    Psychology Review, 30(1), 25–36.

Driessen, E., Hegelmaier, L. M., Abbass, A. A., Barber, J. P., Dekker, J. J., Van, H. L., ... & Cuijpers, P.

    (2015). The efficacy of short-term psychodynamic psychotherapy for depression: A meta-analysis

    update. *Clinical Psychology Review, 42,* 1–15.

Epstude, K., & Roese, N. J. (2008). The functional theory of counterfactual thinking. *Personality and*

    Social Psychology Review, *12*(2), 168–192.

Foa, E. B., & Rothbaum, B. O. (1998). *Treating the trauma of rape: Cognitive-behavioral therapy for*

    PTSD. New York: Guilford Press.

Forgas, J. P. (2013). Don't worry, be sad! On the cognitive, motivational, and interpersonal benefits of

    negative mood. *Current Directions in Psychological Science*, *22*(3), 225–232.

Gotlib, I. H., & Asarnow, R. F. (1979). Interpersonal and impersonal problem-solving skills in mildly and

    clinically depressed university students. *Journal of Consulting and Clinical Psychology*, *47*(1),

    86–95.

Greenberg, M. A., Wortman, C. B., & Stone, A. A. (1996). Emotional expression and physical health:

    Revising traumatic memories or fostering self-regulation? *Journal of Personality and Social*

    Psychology, *71*(3), 588–602.

Haaga, D. A., Dyck, M. J., & Ernst, D. (1991). Empirical status of cognitive theory of depression.

Psychological Bulletin, *110*(2), 215–236.

Hayes, A. M., Beevers, C. G., Feldman, G. C., Laurenceau, J. P., & Perlman, C. (2005). Avoidance and processing as predictors of symptom change and positive growth in an integrative therapy for depression. *International Journal of Behavioral Medicine*, *12*(2), 111–122.

Hayes, A. M., Feldman, G. C., Beevers, C. G., Laurenceau, J. P., Cardaciotto, L., & Lewis-Smith, J. (2007). Discontinuities and cognitive changes in an exposure-based cognitive therapy for depression. *Journal of Consulting and Clinical Psychology, 75,* 409–421.

Hayes, S. C., Strosahl, K. D., & Wilson, K. G. (1999). *Acceptance and commitment therapy: An experiential approach to behavior change*. Guilford Press.

Hunt, M. G. (1998). The only way out is through: Emotional processing and recovery after a depressing life event. *Behaviour Research and Therapy*, *36*(4), 361–384.

Kelly, M. A., Roberts, J. E., & Bottonari, K. A. (2007). Non-treatment-related sudden gains in depression: The role of self-evaluation. *Behaviour Research and Therapy*, *45*(4), 737–747.

Kuyken, W., Byford, S., Taylor, R. S., Watkins, E., Holden, E., White, K., ... & Teasdale, J. D. (2008). Mindfulness-based cognitive therapy to prevent relapse in recurrent depression. *Journal of Consulting and Clinical Psychology*, *76*(6), 966–978.

Luyten, P., & Blatt, S. J. (2012). Psychodynamic treatment of depression. *Psychiatric Clinics, 35*(1), 111–129.

Lyubomirsky, S., & Nolen-Hoeksema, S. (1993). Self-perpetuating properties of dysphoric rumination. *Journal of Personality and Social Psychology*, *65*(2), 339–349.

Lyubomirsky, S., & Nolen-Hoeksema, S. (1995). Effects of self-focused rumination on negative thinking and interpersonal problem solving. *Journal of Personality and Social Psychology*, *69*(1), 176–190.

Ma, S. H., & Teasdale, J. D. (2004). Mindfulness-based cognitive therapy for depression: replication and exploration of differential relapse prevention effects. *Journal of Consulting and Clinical Psychology*, *72*(1), 31–40.

Marx, E. M., & Schulze, C. C. (1991). Interpersonal problem-solving in depressed students. *Journal of Clinical Psychology*, *47*(3), 361–367.

Marx, E. M., Williams, J. M., & Claridge, G. C. (1992). Depression and social problem solving. *Journal of Abnormal Psychology*, *101*(1), 78–86.

Metalsky, G. I., Halberstadt, L. J., & Abramson, L. Y. (1987). Vulnerability to depressive mood reactions: Toward a more powerful test of the diathesis–stress and causal mediation components of the reformulated theory of depression. *Journal of Personality and Social Psychology*, *52*(2), 386–393.

Morrow, J., & Nolen-Hoeksema, S. (1990). Effects of responses to depression on the remediation of depressive affect. *Journal of Personality and Social Psychology*, *58*(3), 519–527.

Nesse, R. M. (1993). Evolutionary explanations of emotions. *Human Nature, 1*(3), 261–289.

Nezu, A. M. (1987). A problem-solving formulation of depression: A literature review and proposal of a pluralistic model. *Clinical Psychology Review*, *7*(2), 121–144.

Nolen-Hoeksema, S., & Davis, C. G. (2004). Theoretical and methodological issues in the assessment and interpretation of posttraumatic growth. *Psychological Inquiry*, *15*(1), 60–64.

Nolen-Hoeksema, S., & Morrow, J. (1993). Effects of rumination and distraction on naturally occurring depressed mood. *Cognition & Emotion*, *7*(6), 561–570.

Nolen-Hoeksema, S., Morrow, J., & Fredrickson, B. L. (1993). Response styles and the duration of episodes of depressed mood. *Journal of Abnormal Psychology*, *102*(1), 20–28.

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science*, *3*(5), 400–424.

Pascual-Leone, A., Yeryomenko, N., Morrison, O. P., Arnold, R., & Kramer, U. (2016). Does feeling bad, lead to feeling good? Arousal patterns during expressive writing. *Review of General Psychology*, *20*(3), 336–347.

Park, J., & Banaji, M. R. (2000). Mood and heuristics: The influence of happy and sad states on sensitivity and bias in stereotyping. *Journal of Personality and Social Psychology*, *78*(6), 1005–

1023.

Pennebaker, J. W. (1997). Writing about emotional experiences as a therapeutic process. *Psychological Science*, *8*(3), 162–166.

Pössel, P., & Black, S. W. (2014). Testing three different sequential mediational interpretations of Beck's cognitive model of the development of depression. *Journal of Clinical Psychology*, *70*(1), 72–94.

Robinson, M. S., & Alloy, L. B. (2003). Negative cognitive styles and stress-reactive rumination interact to predict depression: A prospective study. *Cognitive Therapy and Research, 27*(3), 275–291.

Roese, N. J. (1997). Counterfactual thinking. *Psychological Bulletin*, *121*(1), 133–148.

Ruscio, A. M., Gentes, E. L., Jones, J. D., Hallion, L. S., Coleman, E. S., & Swendsen, J. (2015). Rumination predicts heightened responding to stressful life events in major depressive disorder and generalized anxiety disorder. *Journal of Abnormal Psychology*, *124*(1), 17–26.

Russell, M. J., Maslej, M. M., & Andrews, P. W. (2015). Role of evolution. In McCabe, R., & Milosevic, I. (Eds.), *Phobias: The psychology of irrational fear, An Encyclopedia* (pp. 130–133). Santa Barbara: ABC-CLIO.

Segal, Z. V., Teasdale, J. D., Williams, J. M., & Gemar, M. C. (2002). The mindfulness-based cognitive therapy adherence scale: Inter-rater reliability, adherence to protocol and treatment distinctiveness. *Clinical Psychology & Psychotherapy*, *9*(2), 131–138.

Sinclair, R. C., & Mark, M. M. (1995). The effects of mood state on judgmental accuracy: Processing strategy as a mechanism. *Cognition & Emotion*, *9*(5), 417–438.

Smith, J. M., & Alloy, L. B. (2009). A roadmap to rumination: A review of the definition, assessment, and conceptualization of this multifaceted construct. *Clinical Psychology Review*, *29*(2), 116–128.

Stanton, A. L., Kirk, S. B., Cameron, C. L., & Danoff-Burg, S. (2000). Coping through emotional approach: Scale construction and validation. *Journal of Personality and Social Psychology*, *78*(6), 1150–1169.

Storbeck, J., & Clore, G. L. (2005). With sadness comes accuracy; with happiness, false memory: Mood

and the false memory effect. *Psychological Science, 16*(10), 785–791.

Tang, T. Z., & DeRubeis, R. J. (1999). Sudden gains and critical sessions in cognitive-behavioral therapy for depression. *Journal of Consulting and Clinical Psychology, 67*(6), 894–904.

Tang, T. Z., DeRubeis, R. J., Hollon, S. D., Amsterdam, J., & Shelton, R. (2007). Sudden gains in cognitive therapy of depression and depression relapse/recurrence. *Journal of Consulting and Clinical Psychology, 75*(3), 404–408.

Taylor, D. (2008). Psychoanalytic and psychodynamic therapies for depression: The evidence base. *Advances in Psychiatric Treatment, 14*(6), 401–413.

Teasdale, J. D., Segal, Z. V., Williams, J. M. G., Ridgeway, V. A., Soulsby, J. M., & Lau, M. A. (2000). Prevention of relapse/recurrence in major depression by mindfulness-based cognitive therapy. *Journal of Consulting and Clinical Psychology*, *68*(4), 615–623.

Thomsen, D. (2006). The association between rumination and negative affect: A review. *Cognition and Emotion, 20*(8), 1216–1235.

Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research, 27*(3), 247–259.

Vanderhasselt, M. A., Brose, A., Koster, E. H., & De Raedt, R. (2016). Co-variation between stressful events and rumination predicts depressive symptoms: An eighteen months prospective design in undergraduates. *Behaviour Research and Therapy, 87,* 128–133.

Vittengl, J. R., Clark, L. A., & Jarrett, R. B. (2005). Validity of sudden gains in acute phase treatment of depression. *Journal of Consulting and Clinical Psychology, 73*(1), 173–182.