Introduction

Major Depression involves an aggregation of behavioural, emotional and cognitive symptoms; including feelings of sadness, hopelessness and worthlessness, loss of interest or pleasure in almost all activities, fatigue, disrupted sleep and concentration, and suicidal ideation (American Psychiatric Association, 2000). For many individuals, these symptoms endure for extended periods. For example, 50% percent of depressed participants in the prospective Collaborative Depression Study (Katz & Klerman, 1979) were still depressed six months later (Keller, Shapiro, Lavori, & Wolfe, 1982) and 12% were still depressed five years later (Mueller et al., 1996). Worse still, depression is likely to return soon after apparent improvement (i.e., relapse) or following episodic recovery (i.e., recurrence). Over 75% of individuals who experience one depressive episode are likely to experience another episode in their lifetimes (Boland & Keller, 2009).

Over the past few decades, researchers have sought to identify risk factors that make some individuals more likely than others to experience chronic forms of depression (See Gotlib & Hammen, 2009, Part II). Risk factors may take several forms, such as genetic, neurophysiological or psychosocial. However, cognitive researchers have focused on identifying an underlying cognitive vulnerability to depression. Cognitive vulnerability has been defined as "an integral and stable feature of the person that predisposes him or her to the development of psychopathology under specified conditions" (Ingram, Miranda, & Segal, 1998, p.87); where the features and precipitous conditions may be unique to each disorder. With respect to depression, these researchers assume that vulnerable individuals harbour negative self-referential cognitions that, when activated by stressful experiences, can initiate, reactivate or exacerbate depressive symptoms.

Historically, this so-called *diathesis-stress* view of depression has been presented by several prominent theorists. Notably, Beck's Cognitive Theory (CT; 1967, 1987) proposed

that vulnerable individuals possess dysfunctional attitudes reflecting themes of loss, rejection, worthlessness and abandonment that are embedded within cognitive structures, or self-schemas. When activated by relevant life stressors, negative self-schemas are believed to negatively influence the subsequent encoding, interpretation and retrieval of information, which initiates a depressive cognitive cycle (Bower, 1981; Ingram, 1984; Teasdale, 1988).

Because these models concern the likelihood of experiencing future depression, empirical support for a putative cognitive vulnerability should establish that it temporally precedes depression onset (Ingram, et al., 1998) and is not merely a consequence or scar of the disorder (Lewinsohn, Steinmetz, Larson, & Franklin, 1981; Riskind & Alloy, 2006). Cross-sectional designs that compare high and low depression groups fulfill neither criterion; comparisons of formerly- and never-depressed groups (i.e., remitted designs) can establish independence of biases from symptoms; but only prospective designs that measure cognitions prior to depression onset can establish both independence from symptoms and temporal precedence (Ingram, et al., 1998). Additionally, only studies that examine the effects of life stress on putative cognitive vulnerabilities in the prediction of future depression can adequately test diathesis-stress hypotheses.

Although relatively few in number, prospective studies have provided support for diverse risk factors for depression, including cognitive, genetic, neurophysiological and psychosocial (Gotlib & Hammen, 2009). In recent years, researchers have increasingly examined how various risk factors may combine to provide a comprehensive view of cognitive vulnerability to depression (e.g., Beck, 2008). Several theorists have suggested that existing research knowledge may be effectively integrated by incorporating a dual-process perspective (Beck, 2008; Beevers, 2005; Carver, Johnson, & Joormann, 2008;

Haeffel et al., 2007). This thesis presents a series of studies that examine the validity and viability of Beevers' (2005) dual-process model of cognitive vulnerability to depression.

Dual Processing and Depression

Dual-process theories advocate that people possess two distinct but interrelated information processing systems (for review, see Evans, 2008), that have been found to map onto separate neurological systems (Lieberman, 2003; Lieberman, Gaunt, Gilbert, & Trope, 2002; Lieberman, Jarcho, & Satpute, 2004). A number of dual-process theories have been applied to diverse psychological fields, including reasoning (Evans, 2003; Sloman, 1996), judgement and decision-making (Slovic, Peters, Finucane, & MacGregor, 2005), personality and social cognition (Epstein, Pacini, Denes-Raj, & Heier, 1996; Smith & DeCoster, 2000), and other types of psychopathology (e.g., anxiety; Ouimet, Gawronski, & Dozois, 2009).

Although these theories differ in some respects, they all posit two systems that differ in character and function. First, an *implicit system* purportedly involves processes that are automatic, spontaneous, effortless, affect-oriented and guided by associative memory constructs. Smith and DeCoster (1999) referred to implicit processing[1] as a pattern completion mechanism, where exposure to a stimulus activates associations between that stimulus and previously encoded experiences, which manifest as responses that occur without awareness, control or intention. Thus, past experience has an ongoing facilitative effect on the implicit processing of daily experiences and stimuli (Beevers, 2005). Typically, we are only aware of the output from the system (hereafter referred to as *implicit cognitions*), (Smith & DeCoster, 2000).

[1] Smith and DeCoster (2000) referred to implicit and explicit processing as associative and rule-based, respectively. The two systems have been given various names by different theorists. The generic terms implicit and explicit have been used in this thesis.

In contrast, an *explicit system* is characterized by motivated and effortful processing that involves expenditure of cognitive resources, operates slowly, and is guided by symbolically represented rules that can be learned quickly during a single experience. Unlike the simultaneous action of implicit processing, explicit processing operates sequentially by completing a series of individual steps (Smith & DeCoster, 2000). Explicit interpretations and responses to new situations involve the conscious retrieval of relevant information. Thus, explicit processing involves an awareness of system input and processes, as well as output from the system (hereafter referred to as *explicit cognitions*).

Researchers have tended to assess depression-related cognitive biases in the context of predictions made by specific cognitive theories. However, extant research evidence can also be classified according to its implicit or explicit status. Cognitive biases associated with depression may be considered explicit if they have been identified by measures that require participants' deliberate consideration (e.g., self-report questionnaires). In contrast, depression-related cognitive biases may be deemed implicit if they have been assessed by methods that capture automatic processes such as uncontrolled, unconscious, goal-independent, fast or efficient (e.g., reaction-times, memory associations), (Moors, Spruyt, & De Houwer, 2010). For example, the Self-worth Implicit Association Test (IAT; Greenwald & Farnham, 2000) measures the strength of an individual's associations between positive and negative descriptors and the categories "me" and "not-me". Faster assignment of descriptors to "me" occurs when word pairings match an individual's implicit self-concept.

Implicit Cognitions and Depression

Most implicit cognitions associated with depression have been studied as information processing biases that arise from latent negative self-schemata (for reviews, see Ingram, et al., 1998; Joormann, 2009; Scher, Ingram, & Segal, 2005). Depressive schemata are

theorised to develop in a manner consistent with slow-forming implicit associations, where repeated adverse life experiences influence the development of negatively biased self-knowledge, associative memory and emotion networks over time (e.g., Beck, 1967; Ingram, et al., 1998; Rose & Abramson, 1992; Teasdale, 1988).

Several implicit cognitive biases have been associated with past, current, and/or future depression. Observed biases include heightened memory for (recognition of) previously presented negative emotional or self-referential stimuli, automatic associations with undesirable future events, low implicit self-esteem, self-deprecating reflexive interpretations of ambiguous stimuli, greater selective attention toward negative self-related or emotional stimuli and greater difficulty inhibiting or disengaging attention from it (for review, see Study 1). Additionally, in line with diathesis-stress predictions, subsequent depressive symptoms of vulnerable individuals have been predicted by interactions between self-reported numbers of stressful life events and implicit self-esteem (Steinberg, Karpinski, & Alloy, 2007) and increases in negative attentional biases following a sad mood induction (Beevers & Carver, 2003).

Notably, Steinberg et al.'s (2007) results were obtained when implicit self-esteem was assessed by the IAT but no interactions emerged when self-esteem was assessed by an alternative implicit measure. Indeed, despite the importance of their hypothesized role in depression, several reviewers have concluded that implicit depression-related cognitive biases have not been consistently observed (Gotlib & Joormann, 2010; Wisco, 2009; cf. Unresolved and Under-Explored Issues).

Explicit Cognitions and Depression

Explicit depression-related cognitions have been studied as negative conscious beliefs about the self and the future and as depressive cognitive styles. Beck (1967, 1987, 2008) recognised explicit (self-reported) negative self-referential attitudes in depression as

surface level evidence of schematic dysfunction, while other researchers have positioned explicit cognitive styles as primary risk factors for depression (e.g., Hopelessness Theory (HT); Abramson, Metalsky, & Alloy, 1989; Hankin, Lakdawalla, & Lee, 2005).

Supporting both views, currently depressed or dysphoric individuals have reported more dysfunctional attitudes (derived from CT), maladaptive attributions for negative events (derived from HT), low self-esteem, pessimistic predictions for their personal futures, preferential recall of negative self-referential or emotional material, and self-deprecating deliberate interpretations of ambiguous material than non-depressed or non-dysphoric individuals (for reviews, see Abramson et al., 2002; Joormann, 2009; Matt, Vázquez, & Campbell, 1992). However, the results of prospective studies have been less consistent than cross-sectional analyses. Although several studies have found that negative explicit cognitive biases predicted future depression onset or symptoms (e.g., Alloy et al., 2006; Hankin, Fraley, & Abela, 2005; Johnson, Joormann, & Gotlib, 2007; Orth, Robins, Trzesniewski, Maes, & Schmitt, 2009; Weich, Churchill, & Lewis, 2003), other studies have failed to find a relationship (e.g., Hamilton & Abramson, 1983; Lewinsohn, Joiner, & Rohde, 2001; Otto et al., 2007).

With some exceptions (see Orth, Robins, & Meier, 2009), research has tended to support hypothesized interactions between explicit depressive cognitions and stress in the prediction of subsequent depression (for reviews, see Abramson, et al., 2002; Ingram, et al., 1998; Joormann, 2009). For example, undergraduates' self-reported dysfunctional attitudes and/or attributional styles have interacted with exam performance (Joiner, Metalsky, Lew, & Klocek, 1999) and with the discrepancy between expected and actual exam performance (Brown, Hammen, Craske, & Wickens, 1995; Hankin, Abramson, Miller, & Haeffel, 2004) to predict depressive symptoms several days later. Similarly, numbers of stressful life events experienced by participants between initial and follow-up

assessments have interacted with explicit self-esteem (Haeffel, et al., 2007), negatively biased self-referential memory (Bellew & Hill, 1991; Reilly-Harrington, Alloy, Fresco, & Whitehouse, 1999), and dysfunctional attitudes and/or attributional styles (Haeffel, 2010; Hankin, et al., 2004; Metalsky & Joiner, 1992; Reilly-Harrington, et al., 1999) to predict depression up to two years later.

A Dual-Process Model of Cognitive Vulnerability to Depression

Beevers (2005) proposed a dual process model that brings together previous research, by viewing cognitive vulnerability to depression as an interaction between implicit and explicit processing[2]. The model recognises Forgas and colleagues' (2000) dual-process view of healthy mood regulation, which posits that homeostasis of daily mood is achieved through an interaction between systems. Implicit processing is thought to maintain current mood by gathering mood-congruent information, but when an affective threshold is reached, explicit processing is employed to seek mood-incongruent information in order to change current mood. Accordingly, Forgas and Ciarrochi (2002) found that individuals' responses to social tasks following mood manipulations were initially mood-congruent, but were spontaneously replaced by mood-incongruent reactions over time.

Beevers (2005) suggested that a similar interaction may be involved in depression. As shown in Figure 1, an initial, automatic, response to an event represents the preconscious activation of schematic pattern completion mechanisms of the implicit system (Bower, 1981; Ingram, Bernet, & McLaughlin, 1994; Smith & DeCoster, 2000; Teasdale, 1988). If the activated self-schemas are negative, then immediate negative affect will be experienced. Corrective explicit processing may then be employed to reinterpret the negative event, override the implicit negative response, and relieve negative affect. This is especially likely to occur when implicit responses conflict with explicit expectancies.

[2] Beevers referred to implicit and explicit processing as associative and reflective, respectively, and Forgas and colleagues referred to the systems as substantive and motivated.

However, in some situations, negatively biased self-referent implicit processing may not be effectively corrected by explicit processing, which may give rise to negative explicit cognitions (Beevers, C.G., personal communication, 15 February 2008), and maintain or amplify dysphoric mood. Although not elaborated by Beevers, the model differentiates between explicit content (i.e., *explicit cognitions*; what one thinks) and explicit processes (i.e., how one thinks); a distinction that has been empirically supported (Ciesla & Roberts, 2007).

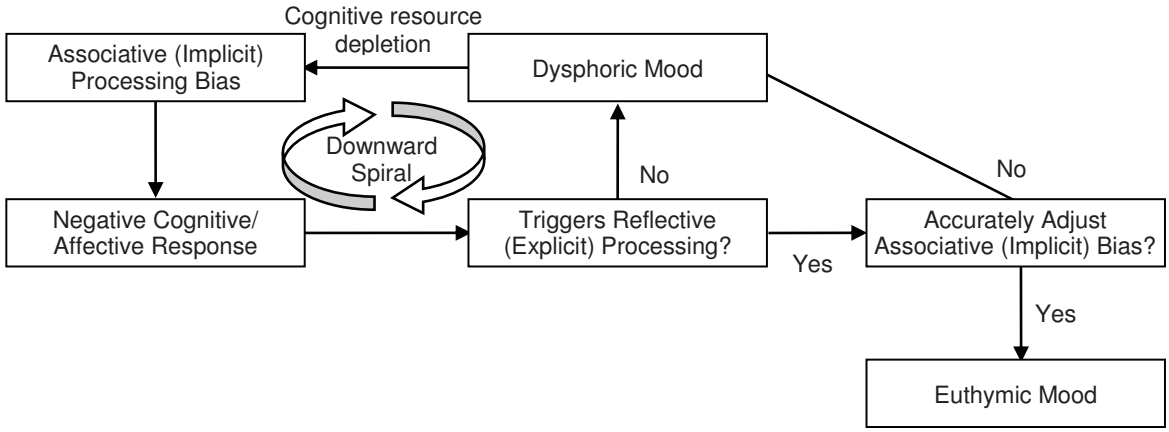

Figure 1. A dual-process model of cognitive vulnerability to depression.
Notes: From Beevers (2005), p.981. Parenthesized implicit and explicit labels added.

Beevers (2005) suggested that at least three situations may result in negatively biased implicit processing remaining uncorrected by explicit processing. First, explicit processing may be appropriately triggered but insufficient cognitive resources are available to perform corrective explicit override. This may occur when the cognitive demands of high levels of life stress deplete the resources required to effectively employ explicit processing. Second, biased implicit cognitions may not violate explicit expectancies and the need for corrective processing is not realised. Third, attempts to override negative

implicit responses may involve maladaptive explicit processing strategies that further deplete the resources required to employ effective strategies.

If corrective explicit processing does not occur, activated implicit biases will negatively influence the pattern completion of subsequent implicit processing and lead to further dysphoria. Together, hyperactive negative implicit cognitions and deficits in corrective explicit processing may create a feedback loop which results in a downward spiral into deeper depression. In this way, negatively biased self-referential implicit processing is positioned as the foundation of cognitive vulnerability to depression and impaired corrective explicit processing is proposed to play a secondary role.

Empirical Support for the Dual-Process Model

A considerable body of research evidence is consistent with Beevers' (2005) dual-process model of cognitive vulnerability to depression. A summary follows.

Implicit biases, dysphoric mood and automaticity. Of fundamental importance, evidence supports the model's premise that negatively biased implicit self-referential cognitions are associated with inducing and maintaining dysphoric mood. For example, Conner and Feldman Barrett (2005) conducted two studies that examined the predictive validity of undergraduates' implicit self-esteem for their self-reported spontaneous affective experiences over 28 and 17 days. In both studies, implicit self-esteem assessed by the IAT predicted levels of negative affect over and above the influence of explicit self esteem measured by the Rosenberg Self-Esteem Scale (Rosenberg, 1965). Similarly, Haeffel and associates (2007) found that implicit self-esteem assessed by the IAT predicted immediate negative affective responses to a laboratory stressor (an anagram failure paradigm) but explicit cognitive styles did not.

The dual-process view that automatic pattern-completion mechanisms are at play in negative self-related implicit processing has also been empirically supported. The results

of a series of studies by Verplanken and colleagues (2007) suggest that implicit self-esteem is associated with the automaticity (process) of negative self-thinking, rather than with the negative cognitive content itself. Further, participants' automatic negative thinking processes predicted depression nine months later after controlling for the predictive effects of intervening stress and explicit negative self-beliefs.

Automatic processing and deficits in effortful control. Evidence also supports the view that depression involves disruptions to effortful, but not automatic, processing (e.g., Bargh & Tota, 1988; Hammar, Lund, & Hugdahl, 2003a; for review, see Hartlage, Alloy, Vázquez, & Dykman, 1993). For example, Hammar and colleagues (2003a; 2003b) used a visual search paradigm to investigate automatic and effortful processing in depressed and non-depressed groups. Depressed participants performed similarly to controls in a single distractor condition, but took longer to detect targets in the more complex two-distractor condition. Further, depressed participants' impairment on effortful, but not automatic, visual search tasks remained unchanged six months later despite decreases in depressive symptoms; suggesting that these processing characteristics may represent relatively stable vulnerability factors.

Deficits in effortful regulatory processes are also consistent with several cognitive processes and phenomena exhibited by depressed individuals (for review, see Gotlib & Joormann, 2010). For example, compared to non-depressed or non-dysphoric groups, depressed or dysphoric individuals have exhibited difficulties in ignoring and disengaging attention from negative information (Caseras, Garner, Bradley, & Mogg, 2007; Joormann & Gotlib, 2008), and depressed, dysphoric and formerly-depressed individuals have demonstrated behavioural slowing following negative error feedback manipulations (Compton et al., 2008; Holmes & Pizzagalli, 2007; Santesso et al., 2008). Further, shortages in executive control have been connected to the depression-related tendency to

recall general rather than specific autobiographical memories (Dalgleish et al., 2007) and attentional deficits have been associated with a tendency to utilise a maladaptive explicit processing strategy (Levens, Muhtadie, & Gotlib, 2009; Whitmer & Banich, 2007).

Hyperactive bottom-up and hypoactive top-down processing. Further evidence of hyperactive implicit processing and deficits in explicit effortful control may be found in the results of neurophysiological research. Depressed individuals have demonstrated increased activity in limbic brain regions associated with emotional responses (bottom-up processing) and decreased activity in frontal regions that regulate limbic activity (top-down processing), (for reviews, see Beck, 2008; Carver, et al., 2008; Davidson, Pizzagalli, Nitschke, & Putnam, 2002).

Amygdala activation during emotional processing has predicted depression severity (Peluso et al., 2009) and the risk for lifetime hospitalization for depression (Dannlowski et al., 2008). Beck (2008) likened this amygdalar hyper-reactivity to "a neurophysiological correlate of cognitive bias" (p. 973). Indeed, recent neurophysiological studies have found that amygdalar hyperactivity is significantly associated with depressive attentional biases that occur at an automatic level (Monk et al., 2008; Suslow et al., 2010). For example, Suslow and colleagues (2010) used functional magnetic resonance imaging (fMRI) to assess amygdala reactivity to subliminal backward-masked presentations of faces with happy and sad expressions. Although explicit awareness of presented stimuli was at chance level for both depressed and control participants, depressed participants exhibited increased amygdala reactivity to sad faces and reduced reactivity to happy faces compared to control participants.

Several fMRI studies have revealed that depressed participants not only exhibit sustained amygdala reactivity while performing emotional tasks compared to non-depressed individuals, but they also demonstrate decreased prefrontal cortex activity while

completing effortful tasks (e.g., Holmes & Pizzagalli, 2008a, 2008b; Siegle, Thompson, Carter, Steinhauer, & Thase, 2007). Holmes and Pizzagalli (2008a, 2008b) found evidence of hypoactive top-down processing in depression by measuring the event-related brain potentials of clinically depressed and control participants while they performed a modified Stroop task that incorporated performance feedback. After committing errors, depressed participants failed to recruit cognitive control from the dorsolateral prefrontal cortex. Importantly, depression-related abnormalities in the engagement of the prefrontal cortex have also been observed during down-regulating of negative affect (Johnstone, van Reekum, Urry, Kalin, & Davidson, 2007). Overall, evidence suggests that dysregulated top-down processing in depression is coupled with accentuated bottom-up processing, resulting in the dominance of the latter.

Depletion of cognitive resources. Beevers (2005) suggested that depression-vulnerable individuals may apply explicit processing to adjust negatively-biased implicit responses and relieve dysphoria if they have sufficient cognitive resources available. However, situations that strain explicit processes may deplete those resources, rendering them unable to effect corrective explicit processing. Consistent with this view, several studies have observed biases amongst depression-vulnerable individuals only when their cognitive resources have been experimentally depleted by cognitive load or time pressure (e.g., Wenzlaff & Bates, 1998; Wenzlaff & Eisenberg, 2001). For example, Wenzlaff and colleagues (2001) assessed the performance of groups of at-risk, never-depressed and currently dysphoric students on a task involving identifying words imbedded in a letter-grid. Without imposition of a cognitive load, the at-risk group detected similar numbers of negative words to never-depressed participants. However, when required to simultaneously remember an eight digit number, at-risk students identified negative words at a higher rate that was equivalent to dysphoric students.

Life stress, intrusive thoughts, and engaging in ineffective processing strategies may similarly deplete the cognitive resources required to employ corrective processing. Indeed, high levels of life stress and efforts to suppress intrusive thoughts have been associated with compromised explicit processing, such as impaired reasoning (Baradell & Klein, 1993; Beevers & Scott, 2001; Klein & Barnes, 1994) and performance on cognitive tasks (Klein & Boals, 2001; Klein & Bratton, 2007). By allocating resources to stressful events, vulnerable individuals may no longer have sufficient resources to correct negatively biased implicit processing, causing unwanted thoughts to enter consciousness (Wegner, Erber, & Zanakos, 1993). Ironically, depressed individuals' efforts to suppress intrusive thoughts and negative memories tend to fuel more intrusive thoughts and memories that require suppression (Dalgleish & Yiend, 2006), thereby perpetuating a self-loading system (Wegner, et al., 1993; Wenzlaff, et al., 2001). Accordingly, thought suppression tendencies have predicted increased vulnerability to depression for individuals whose cognitive resources have been further depleted by cognitive load (E. R. Watkins & Moulds, 2007; Wenzlaff & Bates, 1998) or life stress (Beevers & Meyer, 2004).

Similarly, engaging in ineffective self-regulation strategies may expend the cognitive resources required to engage corrective explicit processing. One well-researched maladaptive explicit self-regulation strategy is depressive rumination (Nolen-Hoeksema, 1991). Rumination is defined as repeatedly focusing on the existence, causes, meaning, and consequences of depressive symptoms (Nolen-Hoeksema, 1991); a behaviour that has been associated with increased depression severity (Nolen-Hoeksema & Morrow, 1991), episode duration (Nolen-Hoeksema, 1991; Nolen-Hoeksema, Morrow, & Fredrickson, 1993), and onset of depressive episodes (Nolen-Hoeksema, 2000; Spasojevic & Alloy, 2001). In line with dual-process theory, recent studies have found that rumination in depressed or dysphoric individuals is associated with deficits in cognitive control,

involving difficulties preventing the entry of negative emotional information to working memory and effecting its removal when it is no longer relevant (e.g., Joormann, 2006; Joormann & Gotlib, 2008; Joormann & Gotlib, 2010; Levens, et al., 2009).

Expectancies are not violated. If explicit processing is triggered when explicit cognitions are incongruent with implicit cognitions, then corrective explicit processing is unlikely to be employed if explicit expectancies are congruent with negatively biased implicit output. Supporting this possibility, depressed individuals have exhibited greater automaticity than non-depressed individuals when explicitly endorsing dysfunctional self-beliefs (Beevers, 2005). For example, Sheppard and Teasdale (2000) asked participants to agree or disagree with a series of dysfunctional self-statements from the DAS. Non-depressed participants demonstrated significantly slower latencies for incongruent responses (e.g., agreeing with a dysfunctional self-belief) than for congruent responses (e.g., disagreeing with a dysfunctional self-belief). However, depressed individuals exhibited similar latencies to congruent and incongruent responses. These results suggest that non-depressed individuals engaged explicit processing to reassess their incongruent response, whereas doing so did not prompt reappraisal by depressed participants because it did not violate their expectancies (Beevers, 2005).

Acknowledging Teasdale et al. (2001), Beevers (2005) also suggested that the depression-related tendency to endorse extreme responses to items on depression measures, such as “totally agree” or “totally disagree” may be associated with failure to initiate corrective implicit processing. Total explicit agreement with negative self-statements may represent complete accordance with negative implicit self-schemata which would be unlikely to trigger reappraisal of the belief. Accordingly, increased risk for depression relapse or recurrence has been associated with low metacognitive awareness (Teasdale et al., 2002) and poor change in extreme forms of thinking during treatment

(Beevers, Keitner, Ryan, & Miller, 2003). Similarly, the inability to generate a balanced array of alternative attributions for negative life events, or low explanatory flexibility, has been found to interact with stressful life events to predict high levels of future depressive symptoms of undergraduates (Fresco, Rytwinski, & Craighead, 2007; Haeffel, 2010). Further, explanatory flexibility appears to be relatively independent from the cognitive content of explanatory styles (Fresco, et al., 2007).

Inadequate explicit processing strategies. Occasions may also arise when depression-vulnerable individuals attempt to correct negatively-biased implicit output, but employ ineffective explicit processing strategies. Beevers (2005) suggested that ineffective explicit strategies reflect faulty rule-based learning. For example, depressed individuals tend to ruminate over their depressive symptoms because they believe it will detect ways to ease their symptoms (Papageorgiou & Wells, 2001; Papageorgiou & Wells, 2003; E. Watkins & Moulds, 2005) and appear to follow an explicit rule to search for as many reasons as possible to explain their current state (E. Watkins & Mason, 2002).

As previously reported, rumination may increase the likelihood of depression by depleting the cognitive resources required to engage corrective processing (e.g., Joormann, 2006; Joormann & Gotlib, 2008; Joormann & Gotlib, 2010; Levens, et al., 2009). Additionally, recent evidence supports Beevers' (2005) proposition that rumination may perpetuate depression by amplifying negatively biased implicit processing (e.g., Donaldson, Lam, & Mathews, 2007; Williams & Moulds, 2010). For example, Donaldson, Lam, and Mathews (2007) found depressed participants who reported high, but not low, levels of habitual rumination demonstrated attentional biases for negative words in a dot-probe task. Similarly, Williams and Moulds (2010) found that applying an explicit ruminative strategy adversely affected the way in which dysphoric undergraduates subsequently processed intrusive negative memories. Specifically, dysphoric participants

who underwent a rumination induction before describing an intrusive self-referential memory rated it as more negative, distressing and evocative of a negative emotional response than individuals who underwent a distraction induction.

Unresolved and Under-Explored Issues

Empirical support for Beevers' (2005) dual process model of cognitive vulnerability to depression has been accumulating from diverse fields of psychological research (Beck, 2008; Carver, et al., 2008). However, to date, some aspects have not been thoroughly examined and initial investigations of other aspects have obtained conflicting results. Brief descriptions of three pertinent issues follow.

The Uncertain Predictive Validity of Implicit Cognitive Biases

Despite their pivotal theoretical role in depression, an uncomfortably large number of studies of implicit depressive cognitions have failed to observe depression-related negative biases (for reviews, see Gotlib & Joormann, 2010; Joormann, 2009; Mathews & MacLeod, 2005; P. C. Watkins, 2002; Wisco, 2009). Some reviewers have concluded that information-processing biases in depression only emerge when vulnerable individuals employ elaborative or conceptual (i.e., explicit) cognitive processes (P. C. Watkins, 2002; Wisco, 2009), or attempt to stop or inhibit the processing of negative material after it has become the focus of attention (Gotlib & Joormann, 2010).

Additionally, some uncertainty surrounds the valence of implicit self-esteem in depression, with some studies finding that depression is associated with paradoxically high self-esteem (see De Raedt, Schacht, Franck, & De Houwer, 2006; Franck, De Raedt, & De Houwer, 2007). It is possible that varying definitions of implicitness and diverse measurement strategies (De Houwer & Moors, 2007; Fazio & Olson, 2003; Moors, et al., 2010) may have contributed to the diversity of findings from implicit cognition research in depression. Considering the hypothesized role of implicit processes in dual-process

perspectives on depression, determining the overall predictive validity of implicit depressive cognitive biases across cognitive domains (e.g., attention, memory) represents an integral research goal.

The Latent Structure of Implicit and Explicit Cognition

Surprisingly little research has addressed the dual-process model's premise that implicit and explicit cognitions represent two separate categories of cognitive phenomena, by examining the cohesiveness amongst depressive cognitions considered to fall within implicit and explicit categories or the relative independence or co-occurrence of the two categories of cognitions.

Evidence tends to suggest that implicit and explicit depression-related biases represent separate constructs. For example, studies that have simultaneously assessed both types of cognition have often observed low correlations between implicit and explicit depressive biases, such as explicit dysfunctional attitudes and implicit self esteem (Gemar, Segal, Sagrati, & Kennedy, 2001) and implicit and explicit self esteem (Bosson, Swann, & Pennebaker, 2000; Haeffel, et al., 2007). Some evidence also suggests that explicit depressive cognitions may represent a unified cognitive construct. Several factor-analytic studies have directly investigated the latent structure of selected explicit depressive cognitions (Adams, Abela, & Hankin, 2007; Garber, Weiss, & Shanley, 1993; Gotlib, Lewinsohn, Seeley, Rohde, & Redner, 1993; Hankin, Lakdawalla, Carter, Abela, & Adams, 2007; Joiner & Rudd, 1996; Reno & Halaris, 1989). Although these studies involved different samples, methods and emergent factors, the overall pattern of results suggests that explicit depressive cognitions represent a separate construct from depressive symptomatology (Adams, et al., 2007).

However, other research results suggest that various implicit measures of depressive cognitions may not be measuring the same latent cognitive factor. Correlations between

different implicit biases are rarely reported, and weak intercorrelations have been observed between different implicit measures of the same cognitive construct (Bosson, et al., 2000; Gotlib et al., 2004). For example, Bosson and colleagues (2000) assessed four implicit and four explicit measures of self-esteem, and observed high intercorrelations between the explicit measures but low intercorrelations amongst implicit measures. Overall, evidence suggests that the underlying structure of implicit and explicit depression-related cognitions may not conform to the simple two-factor structure implied by the dual-process model.

Connecting the Pieces: Implicit Biases, Life Stress, and Depleted Resources

The model proposes that underlying negative implicit processing may be exposed when life stress depletes the cognitive resources required to employ corrective explicit processing. As reported earlier, previous research has addressed separate pieces of this diathesis-stress prediction. Evidence suggests that: 1) negative implicit biases of vulnerable individuals emerge under experimental conditions that deplete cognitive resources (e.g., Wenzlaff & Bates, 1998; Wenzlaff & Eisenberg, 2001), 2) life stress can deplete cognitive resources (e.g., Klein & Boals, 2001; Klein & Bratton, 2007), and 3) negative implicit processing interacts with life stress to predict subsequent depression symptoms (e.g., Haeffel, et al., 2007; Steinberg, et al., 2007). However, to our knowledge, no study has assessed the interactive relationship between depleted cognitive resources, life stress and implicit cognitive vulnerability in the prediction of future depression.

The Current Research

Beevers' (2005) dual process model of cognitive vulnerability to depression may effectively integrate several theoretical accounts and disparate empirical findings into one coherent structure. Viewing cognitive vulnerability to depression from a dual-process perspective may improve our understanding of the recurring and chronic nature of depression and elucidate the development of cognitive vulnerability. Importantly, if

supported, the dual process model may inform the development of more effective approaches to prevention and treatment.

Although a variety of psychotherapies have been developed to treat depression (see Hollon, Thase, & Markowitz, 2002), the most widely used intervention, Cognitive Therapy (Beck, Rush, Shaw, & Emery, 1979), focuses on modifying explicit negative self-beliefs. This approach can bring lasting relief from symptoms, especially if therapy is continued or maintained (Hollon, et al., 2002). However, two year relapse/recurrence rates can be unacceptably high for certain patient groups; including individuals who do not experience rapid large decreases in symptoms during therapy (73%; Tang, DeRubeis, Hollon, Shelton, & Amsterdam, 2007) or have experienced less than five previous depressive episodes (63%; Bockting et al., 2005). Doubtful long-term efficacy is consistent with Beevers' (2005) model, which suggests that therapeutic targeting of explicit processes may achieve relief from dysphoria by boosting explicit corrective processes so they can curtail negative implicit cognitions. However, implicit self-referential biases may remain latent and subsequently precipitate depression when activated by a relevant life stressor. Thus, the model suggests that Cognitive Therapy, alone, may not reliably effect long-term relief from depression because it gives insufficient attention to modifying negative implicit processes – as the hypothesized primary underlying risk factor for depression.

This thesis includes four studies that aimed to assess the validity and viability of Beevers' (2005) dual-process model of cognitive vulnerability to depression by investigating aspects that have not yet been adequately examined. The first meta-analytic study addressed apparent inconsistencies in the literature regarding the existence and strength of implicit negative self-referential cognitive biases in depression. The meta-analysis primarily aimed to determine whether a reliable relationship exists between

negative self-referential implicit cognition and depression, and if that relationship is moderated by several factors in a manner that is consistent with models of cognitive vulnerability to depression. The study also aimed to help to clarify contentious issues surrounding measurement of implicit cognitive biases in depression.

The second study used confirmatory and exploratory factor-analysis to investigate the underlying structure of several implicit and explicit self-referential depression-related cognitive biases in an undergraduate sample. This study aimed to determine whether explicit and implicit depression-related cognitions could be explained by a two-factor dual-process model, and/or to identify an alternative underlying structure that provided a better fit for the data.

Study three examined the structure of implicit and explicit cognitive biases in the same sample from a different perspective, by using latent profile analysis to identify how several implicit and explicit self-referential cognitions coexist within individuals. The study had two primary objectives. First, it aimed to identify dual-process cognitive profiles associated with depression in an undergraduate sample and to assess their relationship with current and future depression. Second, it aimed to identify dual-process cognitive profiles that may represent subtypes of depression.

The fourth study used multi-group multiple regression to compare the interactive effects of implicit self-esteem and life stress in the prediction of future depressive symptoms of undergraduates with high and low thought suppression tendencies; a behaviour that has previously been associated with cognitive resource depletion. The study aimed to assess the dual-process model's predictions that cognitive vulnerability to future depression is conferred by negative implicit processing under life stress, and that the activation of this vulnerability is associated with diminished cognitive resources.

Overall, this research project aimed to:

1. Assess the relationship between negative self-referential implicit processing and past, current and future depressive symptoms or diagnosis reported in previous research.
2. Investigate the construct validity (criterion and nomological) of various implicit and explicit measures of cognitions associated with depression.
3. Determine the underlying factor structure of four implicit and four explicit measures of depression-related cognitive biases.
4. Identify dual-process cognitive latent profiles associated with depression and determine their predictive relationship with current and future depression.
5. Determine whether depression may encompass dual-process cognitive subtypes.
6. Determine whether hyperactive negatively-biased implicit processing confers vulnerability for future depression onset or escalation.
7. Assess whether negative implicit cognitive biases may be exposed when insufficient cognitive resources are available to employ corrective explicit processing.

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STATEMENT OF ORIGINALITY
Study 1

We, the PhD candidate and the candidate's Principal Supervisor, certify that the following text, figures and diagrams are the candidate's original work.

Type of work	Page number/s
All aspects, except for the assistance described in the Statement of Authors' Contributions (below).	N/A

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STATEMENT OF AUTHORS' CONTRIBUTIONS
Study 1

We, the PhD candidate and the candidate's Principal Supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the candidate's contribution as indicated in the *Statement of Originality*.

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Other authors	Don Hine – editorial and methodological advice	10%
	Einar Thorsteinsson – statistical instruction and checking accuracy of coding	10%

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Research Progression to Study 2

Study 1 determined that negatively-biased implicit self-referential cognitions were significantly associated with past, current and future depression across a considerable body of previous research. Additionally, the findings supported several tenets of theoretical models of cognitive vulnerability to depression. These results validated further investigation of Beevers' (2005) model, which posits that negative implicit processing represents the foundation of cognitive vulnerability to depression. Although Study 1 found reliable associations between depression and four types of implicit cognitive biases, it did not assess interrelationships between them. Dual-process theory implies that cohesiveness should be observed amongst implicit cognitive biases, and that implicit and explicit biases should represent two distinct cognitive constructs. Study 2 aimed to clarify and extend the results of Study 1 by examining the interrelatedness and underlying structure of several implicit and explicit cognitive biases associated with depression, and by formally testing the two-factor structure implied by the dual-process model.

Exploring the Factor Structure of Implicit and Explicit Cognitions Associated with Depression

Wendy J. Phillips & Donald W. Hine

Article submitted for publication

STATEMENT OF ORIGINALITY
Study 2

We, the PhD candidate and the candidate's Principal Supervisor, certify that the following text, figures and diagrams are the candidate's original work.

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Research Progression to Study 3

The results of Study 2 did not support the simple two-factor latent structure implied by the dual-process model of depression. The exploratory factor analysis solution suggested that observation of depression-related cognitive biases may be confounded by other relationships between variables, and that factor analytic methods may not be appropriate to assess the structure of dual-process cognitive biases. Study 3 attempted to redress this issue by employing an alternative strategy that focussed on identifying shared patterns of implicit and explicit cognitions across individuals. The study aimed to identify dual-process cognitive profiles associated with depression in the same undergraduate sample (N = 306) and to assess their relationships with current and future depression. It also aimed to identify dual-process cognitive profiles in a dysphoric sub-sample (n = 57) that may represent cognitive subtypes of depression.

A Latent Profile Analysis of Implicit and Explicit Cognitions Associated with Depression

Wendy J. Phillips, Donald W. Hine & Navjot Bhullar

Article submitted for publication

STATEMENT OF ORIGINALITY
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Research Progression to Study 4

Dimensionally distributed biases observed in Study 3 were consistent with the dual-process notion that depression involves negatively biased implicit and explicit cognitions. Further, the LPA indicated that possessing negative implicit and explicit cognitive biases was associated with an increased likelihood of experiencing high levels of future depressive symptoms. However, the failure to observe qualitatively distinct dual-process cognitive profiles (and the non-significant prospective analysis of multiple cognitive variables) prevented assessment of the proposal that negative implicit processing confers cognitive vulnerability to depression. Study 4 addressed this hypothesis, along with the notion that implicit biases may be exposed when insufficient cognitive resources are available to effect corrective explicit processing. To extend and facilitate comparison with existing relevant research, the focus of Study 4 was narrowed to implicit self-esteem; a variable that was assessed by a measure with several automatic features (NLPT). The study aimed to assess the predictive role of implicit self-esteem to future depression under life stress for groups of undergraduates who were likely to differ in their susceptibility to experience cognitive resource depletion due to differences in habitual thought suppression.

Thought suppression moderates the predictive contribution of implicit self-esteem to future depression

Wendy J. Phillips & Donald W. Hine

Article submitted for publication

STATEMENT OF ORIGINALITY
Study 4

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STATEMENT OF AUTHORS' CONTRIBUTIONS
Study 4

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General Discussion

According to Beevers' (2005) dual-process model of cognitive vulnerability to depression, two cognitive systems interact to precipitate depression. A depression-vulnerable individual's automatic cognitive responses (i.e., implicit cognitions) are posited to reflect activated negative self-schemas associated with the implicit system (Bower, 1981; Ingram, Bernet, & McLaughlin, 1994; Smith & DeCoster, 2000; Teasdale, 1988). Under some conditions, effortful explicit processing may override negative automatic responses and relieve negative affect. However, depression may arise if effortful processes fail to curtail negative implicit responses. Further, uncorrected implicit processing may intensify dysphoria by influencing subsequent negative implicit processing and/or by spurring negative explicit cognitive content and maladaptive processes that deplete the cognitive resources required to override implicit output. This research aimed to investigate previously unexamined or under-explored aspects of Beevers' dual-process account. Its main objectives were to:

1. Assess the relationship between negative self-referential implicit processing and past, current and future depressive symptoms or diagnosis reported in previous research.
2. Investigate the construct validity (criterion and nomological) of various implicit and explicit measures of cognitions associated with depression.
3. Determine the underlying factor structure of four implicit and four explicit measures of depression-related cognitive biases.
4. Identify dual-process cognitive profiles associated with depression and determine their predictive relationship with current and future depression.
5. Determine whether depression may encompass dual-process cognitive subtypes.
6. Determine whether hyperactive negatively-biased implicit processing confers vulnerability for future depression onset or escalation.

7. Assess whether negative implicit cognitive biases may be exposed when insufficient cognitive resources are available to employ corrective explicit processing.

Overview of Findings Addressing the Research Objectives

Given that negative implicit self-related processing is posited to underlie vulnerability to depression, Objective 1 represented an essential point requiring validation. Study 1 addressed this objective by meta-analysing the relationship between negative self-referential implicit cognition and depression reported in the depression literature over the past 25 years. The meta-analysis of 89 effect sizes from a pooled sample of 7032 participants revealed an overall small to medium relationship between negative implicit cognition and depression, with a significant weighted average effect size of $r = .23$. Additionally, moderator analyses involving an expanded set of 202 effect sizes identified significant relationships between depression and effects relating to all assessed aspects of implicit cognition (i.e., attention, interpretation and self-beliefs, memory, and self-esteem), and that negative implicit biases significantly predicted past, current and future depression. These results supported the fundamental premise of Beevers' (2005) model and validated its further investigation.

Moderator analyses within the meta-analysis also addressed Objectives 2 and 7. Objective 2 was partially addressed by an analysis that assessed the relative ability of a range of implicit measures to predict depression. Although fifteen of the eighteen measures entered into the analysis produced significant effect sizes, considerable variability in effect size was observed ($r = .07$ to $r = .59$). This result suggests that relationships between implicit cognition and depression may be affected by the unique psychometric properties of the implicit measure used.

Another moderator analysis addressed Objective 7, by revealing that the association between implicit cognition and depression was influenced by experimental manipulations

during cognitive tasks. As predicted, the largest effect size related to studies that utilized both a negative mood induction to activate negative implicit biases and a cognitive load to impede effortful cognitive control. However, studies that used a cognitive load procedure generated a significantly larger mean effect size than studies that used no manipulation, whereas studies that employed a sad mood induction did not. This result suggests that disruptions to explicit corrective processing may facilitate the emergence of depression-related negative implicit cognitions to a greater extent than direct stimulation of hyperactive negative implicit processing.

Although Study 1 found reliable associations between depression and four types of implicit cognitive biases, it did not assess interrelationships between biases. Dual-process theory implies that cohesiveness should be observed amongst implicit cognitive biases, and that implicit and explicit biases should represent two distinct cognitive constructs. Study 2 aimed to address Objectives 2 and 3, by examining the interrelatedness and underlying structure of four implicit and four explicit depression-related cognitions (i.e., self-esteem, memory for self-descriptive and/or emotional stimuli, and negative self-beliefs) in a sample of undergraduates (N = 306). Confirmatory (CFA) and exploratory (EFA) factor analyses failed to support the hypothesized two factor dual-process model. Most of the CFA fit indices suggested poor fit, and the factor loadings for implicit self-esteem and all memory variables indicated weak relationships with their respective latent variables. A subsequent EFA produced a three factor solution that assessed self-appraisal, explicit memory and implicit memory, respectively.

Weak correlations between the EFA's memory factors and depressive symptoms, and positive loadings for both positive memory bias variables, suggested that the factor solution did not capture depression-related memory biases. We suggested that the memory variable loadings may represent: 1) individual differences in performance on explicit and

implicit memory tasks, 2) individual differences in sensitivity to *all* emotional stimuli, or 3) similarities in the cognitive processes harnessed by functional properties of each measure (e.g., degree of consciousness; Moors, Spruyt, & De Houwer, 2010). Similarly, we suggested that the loading of implicit and explicit dysfunctional beliefs onto the same factor may be explained by conceptual and/or processing similarities between the Dysfunctional Attitude Scale (DAS; Weissman & Beck, 1978) and the Scrambled Sentences Task (SST; Wenzlaff, 1993).

Overall, the results of Study 2 indicated that the latent structure of the measures did not clearly differentiate between implicit and explicit cognitive biases. The EFA solution suggested that observation of depression-related cognitive biases may be confounded by other relationships between variables, and that factor analytic methods may not be appropriate to assess the structure of dual-process cognitive biases. Consequently, Study 3 used an alternative strategy to address Objective 3, which focussed on identifying shared patterns of implicit and explicit cognitions across individuals.

Latent Profile Analyses (LPA) of the eight implicit and explicit depression-related cognitions in the same sample ($N = 306$) indicated that our third explanation for Study 2's EFA results is most likely. When the cognitive variables were analysed according to similarities between individuals, implicit and explicit memory variables loaded in a manner consistent with biases associated with participants' current depressive symptoms. Specifically, dysphoric individuals tended to achieve high scores on implicit and explicit measures of memory for negative material and low scores on both measures of memory for positive material; whereas non-dysphoric individuals tended to respond in a converse manner. If the memory variables primarily reflected individual differences in task performance or general sensitivity to emotional stimuli, then groups of individuals within the sample would be expected to exhibit similar levels of recognition or recall for positive

and negative stimuli. Because the LPA indicated that this was not the case, similarities in the cognitive processes accessed by functional features of each measure were more likely to underlie the EFA solution.

Study 3 also addressed Objectives 4 and 5. The dual-process perspective implies that vulnerable individuals possess cognitive profiles comprising multiple negative implicit and/or explicit cognitive biases which may take either a quantitative or a qualitative form. The LPA of the total sample produced a three-profile solution exhibiting quantitative distributions of both implicit and explicit indicators ranging from negative, through intermediate, to positive. Patterns of biases across the profiles were associated with incremental decreases in current depressive symptoms. Logistic regression indicated that the profile solution predicted depressive status three months later; where possessing a negative cognitive profile was associated with a significantly greater likelihood of subsequently experiencing clinical levels of depressive symptoms than a positive profile. Further, possession of a negative cognitive profile significantly predicted future depressive status but the eight continuous cognitive variables did not.

In contrast, LPA of a dysphoric sub-sample (n = 57) identified two qualitatively distinct cognitive profiles, which may represent cognitive subtypes of depression. One profile (SCHEM) comprised multiple negative biases and was associated with levels of symptoms indicative of mild to moderate depression, and the other profile (NEGMEM) featured positive or non-significant biases on all cognitions except for implicit negative memory and was associated with levels of symptoms consistent with mild depression. We suggested that dysphoria associated with the latter profile may reflect either: 1) activated memory networks associated with low mood which may not involve pervasive spreading activation (Bower, 1981; Ingram, 1984; Teasdale, 1988) or, 2) the early stages of depressive onset implied by dual-process theory, where implicit negative memory biases

precede and/or activate other implicit and explicit depressive cognitions (Beevers, 2005; Smith & DeCoster, 2000).

Study 3's failure to observe qualitatively distinct profiles in the total sample (and its non-significant regression of multiple cognitive biases predicting future depression) prevented assessment of Objective 6 (i.e., whether negative implicit processing confers vulnerability to depression). Further, Study 3 did not assess the effects of life stress on cognitive biases in the prediction of future depressive symptoms. Life stress is proposed to deplete the cognitive resources required to effectively employ corrective explicit processing, which may expose latent negative implicit self-schemas that underlie vulnerability to depression. Consequently, Study 4 aimed to address diathesis-stress aspects of the dual-process model outlined in Objectives 6 and 7. To extend and facilitate comparison with existing relevant research, the focus of Study 4 was narrowed to implicit self-esteem; a variable assessed by an implicit measure with several automatic features - the Name Letter Preference Task (NLPT; Nuttin, 1985). The study assessed the predictive role of implicit self-esteem to future depression under life stress for groups of undergraduates (N = 131) who were presumed to differ in their likelihood of experiencing depleted cognitive resources due to different levels of habitual thought suppression.

As hypothesised, multi-group multiple regression found that thought suppression moderated the role of implicit self-esteem in predicting future depression in the presence of life stress. Low implicit self-esteem predicted high levels of Time 2 depressive symptoms under high life stress for participants with high thought suppression tendencies who were likely to experience cognitive resource depletion. Conversely, implicit self-esteem was not associated with subsequent depression for low thought suppression participants whose resources were less susceptible to the impact of life stress. This result supports the dual-process proposal that negative implicit processing confers vulnerability

to depression, and is consistent with the view that this vulnerability may be exposed when cognitive resources are diminished.

Theoretical Implications

Several findings of this research are consistent with three key components of Beevers' (2005) dual-process account. First, the results of Studies 1, 3 and 4 support the view that negative implicit cognitions are associated with depression. The dual-process model posits negatively biased implicit self-related processing as the origin of cognitive vulnerability to depression, yet most narrative reviewers of previous research had concluded that depression-related implicit cognitive biases had not been consistently observed (for reviews, see Gotlib & Joormann, 2010; Joormann, 2009; Mathews & MacLeod, 2005; Watkins, 2002; Wisco, 2009). Contrary to research consensus, Study 1 determined that, on average, negative implicit self-referential biases across multiple cognitive domains significantly predicted past, current and future depression across studies conducted over the past 25 years. Additionally, Study 3 found that generally negative biases on four implicit cognitions were associated with high levels of current depressive symptoms in an undergraduate sample, and Study 4 found that low implicit self-esteem predicted high levels of subsequent depressive symptoms under high life stress for individuals with high thought suppression tendencies who were deemed likely to experience depleted cognitive resources.

Second, Study 3's results support the dual-process premise that both implicit and explicit negative cognitive biases are involved in current and future depression. Possession of a cognitive profile comprising generally negative biases on four implicit and four explicit cognitions was associated with relatively high levels of current depressive symptoms and predicted a significantly greater likelihood of experiencing clinical levels of symptoms three months later compared to participants with profiles comprising

generally positive cognitions. Unfortunately, a non-significant logistic regression of the eight continuous cognitive indicators prevented assessment of the relative contributions of implicit and explicit biases to future depression.

Third, results support the dual-process notion that depression may occur when insufficient resources are available to override activated negative implicit cognitions. Support was indicated by Study 1's meta-analytic finding that mood and cognitive load manipulations moderated the relationship between implicit cognition and depression observed across previous research, and Study 4's finding that implicit self-esteem moderated the effects of life stress on future depression for individuals with high, but not low, thought suppression tendencies (i.e., with high and low likelihood of cognitive resource depletion). Study 4's results also extend previous diathesis-stress research (e.g., Haeffel et al., 2007; Klein & Boals, 2001; Klein & Bratton, 2007; Steinberg, Karpinski, & Alloy, 2007; Wenzlaff & Bates, 1998; Wenzlaff & Eisenberg, 2001), by supporting the existence of an interactive relationship between depleted cognitive resources, life stress and implicit cognitive vulnerability in the prediction of future depression.

However, the current research found little evidence to support a fourth and fundamental component of the dual-process model; the presumption that implicit and explicit cognitions represent two distinct categories of cognitive phenomena that arise from separate processing systems. The profiles observed in Study 3's LPA of the total sample are consistent with the dual-process hypothesis that negative implicit processing may precipitate explicit depressive cognitions and depression, but the profiles do not provide information about the independence of implicit and explicit cognitions as system outputs or their relative contributions to future depression. Although the NEGMEM profile from the dysphoric subsample LPA provides some indication of independence between implicit memory and explicit output, greater support would have been provided by the

identification of profiles within the total sample that comprised conflicting levels of implicit and explicit cognitions. A non-dysphoric profile comprising low implicit and high explicit self-cognitions also would have allowed assessment of Beevers' (2005) hypothesis that vulnerability to future depression is primarily conferred by latent negative implicit self-schematic processing. The results of Study 2's CFA and EFA also failed to support the existence of two distinct categories of cognitive output. Instead, the EFA produced a three factor solution that only partially captured depressive biases. This finding will be discussed under "Measurement Implications".

Overall, the majority of the current research results are consistent with Beevers' (2005) dual-process model. However, in the absence of support for the existence of two distinct categories of cognitive phenomena arising from separate systems, the results of Studies 1 and 3 are also consistent with alternative single system views of cognitive vulnerability to depression that incorporate automatic and deliberate negative self-related cognitions. For example, earlier theoretical perspectives (Beck, 1967, 1987; Bower, 1981; Ingram, 1984; Teasdale, 1988) proposed that vulnerable individuals possess self-beliefs involving loss, rejection, worthlessness and abandonment that are embedded within cognitive structures, or self-schemas, which function as automatic information processors that negatively influence subsequent responses to life events.

Compared to Studies 1, 2 and 3, the results of Study 4 provide greater support for the dual-system model and are less amenable to a single system interpretation. However, they are also consistent with perspectives that recognise the role of deficient cognitive control in depression but do not specifically propose a dual-system interaction. For example, in their recent literature review, Gotlib and Joormann (2010) concluded that the relationship between negatively biased cognitive processing and dysregulated emotion in depression involves inhibitory processes and deficits in working memory, ruminative responses to

negative moods and life events, and deficits in the ability to utilise positive stimuli to regulate negative mood. From this perspective, depression is characterized by negatively biased processing of emotional material and deficits in the gating of negative stimuli to and from working memory (i.e., inhibition and cognitive control). Given that negative mood and life events have been associated with the activation of mood-congruent cognitions, individuals who have sufficient resources available to exert cognitive control may be more likely to successfully override the effects of negative biases under life stress.

Measurement Implications

Although Study 1 identified an overall significant relationship between negative implicit cognition and depression across previous research, effect sizes varied widely according to measurement strategy (r = .07 to r = .59). Additionally, Study 2's factor analyses failed to support the existence of two distinct categories of cognitive output. These theoretically problematic findings may be explained by multiple types of implicit processes and/or similarities and differences between assessment methods.

Evans (2008) identified four types of implicit cognitive processes that: 1) access information processing modules, 2) retrieve knowledge acquired by associative learning, 3) once required explicit effort but have become automatic through repetition and, 4) automatically retrieve explicit knowledge. These different implicit processes require different measurement strategies. De Houwer and colleagues (2007; 2009) defined implicit measures as measurement outcomes produced by psychological attributes via automatic processes that may include one or more functional properties (e.g., unconscious, uncontrolled, goal-independent, efficient, fast). Implicit measures may also be classified according to measurement procedures, such as whether or not the assessment is direct or indirect (De Houwer, 2009). Direct implicit measures result from tasks where participants

self-assess the construct being measured, whereas indirect measures reflect researchers' interpretations of participants' responses to (apparently unrelated) tasks.

The results of Study 1 indicated that direct implicit measures of cognitive biases were, on average, more strongly associated with depression than indirect measures across previous studies. Most measures that achieved strong effect sizes were direct; including the Self-Descriptiveness Judgement Task, Scrambled Sentences Task (SST) and Personal Future Task. Similarly, the results of Study 3 indicated that the direct SST was a stronger predictor of depressive symptoms in the current sample than the two indirect implicit measures, the NLPT and the Word Stem Completion Task (WSCT). Direct measures have the functional property of conscious awareness of the construct being assessed (De Houwer, 2009).

As previously noted, the results of Study 3 indicated that Study 2's three factor EFA solution most likely reflected cognitive processes accessed by the various measures. Indeed, the EFA discriminated between three implicit processes identified by Evans (2008) that were assessed by the four implicit cognitive measures; that is, accessing information-processing (WSCT), retrieving knowledge acquired by associative learning (NLPT), and automatically retrieving explicit knowledge (SST). The only factor associated with depressive symptoms comprised the SST, DAS and Rosenberg Self-Esteem Scale (RSE; Rosenberg, 1965). These three measures were also the strongest discriminators of current depressive symptoms in Study 3's LPA of the total sample. The SST involves the automatic retrieval of explicit knowledge and the RSE and DAS, as explicit self-report measures, involve deliberate retrieval of explicit knowledge. Together, the results of Studies 1, 2 and 3 suggest that cognitive measures that directly retrieve explicit knowledge via conscious processes, automatically or deliberately, provide the strongest markers of an individual's depressive status. However, this conclusion is primarily based on observed

relationships with current depression and may not necessarily apply to assessment of cognitive vulnerabilities for future depression.

Appropriate selection of implicit measures to assess cognitive vulnerabilities may be informed by the current finding that measurement properties influence relationships between cognitive constructs and depression. Specifically, this finding prompts consideration of the cognitive processes implicated by Beevers' (2005) dual-process model. Evans (2008) suggested that different dual-process theories may address different types of implicit processes. Beevers proposed that two forms of learning (associative and rule-based) produce two forms of knowledge (implicit and explicit; Sloman, 1996; Smith & DeCoster, 2000) and that automatic information processing is directed by activated associative networks (see Bower, 1981; Ingram, et al., 1994; Smith & DeCoster, 2000; Teasdale, 1988). Therefore, Beevers' hypothesis that implicit processing underlies cognitive vulnerability to depression implies that negative cognitive biases assessed by implicit measures that access associative learning and/or information processing may represent the strongest predictors of future depression. These (mainly) indirect measures include unconscious properties (De Houwer, 2009).

Although the research dataset prohibited assessment of the relative contributions of implicit and explicit measures of cognitive biases to future depression (recall that the multiple regression model using all 8 cognitive measures as predictors was not statistically significant), the correlation matrix (Study 3, $N = 306$) provides some support for the measurement predictions implied by Beevers' (2005) model. Among measures that correlated significantly with depressive symptoms, relationships with depression decreased from Time 1 to Time 2 for measures that retrieve explicit knowledge (SST, RSE, and DAS), whereas correlations increased at follow-up for indirect measures that tap associative learning (NLPT) or, less decisively, information processing (WSCT). These

trends may also be observed in previous research (Haeffel, et al., 2007; Rude, Wenzlaff, Gibbs, Vane, & Whitney, 2002). Additionally, Study 4 found that the NLPT interacted with life stress to predict subsequent depressive symptoms for selected participants, and previous studies have found similar predictive interactions between life stress and biases assessed by implicit measures that access associative learning (e.g., IAT; Haeffel, et al., 2007; Steinberg, et al., 2007) or information processing (e.g., Dot Probe; Beevers & Carver, 2003). However, to our knowledge no prospective studies have assessed predictive interactions between stress and implicit measures that retrieve explicit knowledge.

In sum, two main factors may underlie observed psychometric issues. First, varied correlations between implicit measures of cognitive biases and depression (and low correlations between implicit measures) may be due to functional differences between measures that assess implicit processes that access explicit knowledge, knowledge acquired by associative learning, and information processing. Second, the failure to identify distinct categories of implicit and explicit depression-related cognitions may reflect the dominance of cognitive processes harnessed by the measurement strategies, including an overlap between explicit measures and implicit measures that automatically retrieve explicit knowledge. Results suggest that negative cognitions assessed by implicit and explicit measures with conscious functional properties provide the strongest indicators of current depression, and provide some support for the notion that implicit measures with unconscious functional properties (that retrieve associative learning or information processing) may appropriately assess cognitive vulnerabilities. However, overall, the results shed little light on the relative involvement of various processes and measurement properties to future depression.

Treatment Implications

The most widely used current intervention, Cognitive Therapy (CT; Beck, Rush, Shaw, & Emery, 1979), aims to modify aberrant explicit self-beliefs by teaching patients to systematically test the accuracy of those beliefs. The results from Study 3 provide general support for this approach, indicating that explicit self-esteem and implicit and explicit dysfunctional beliefs represented the most reliable discriminators of current depressive symptoms. However, although CT is strongly associated with immediate symptomatic improvement, its capacity to prevent future relapse and recurrence is less consistent (Tang, DeRubeis, Hollon, Shelton, & Amsterdam, 2007) and maintenance treatment beyond symptomatic recovery is often required to prevent subsequent episodes (Hollon, Thase, & Markowitz, 2002).

Dubious long-term efficacy of CT has been particularly associated with certain patient groups. For example, Bockting and colleagues (2005) found that CT predicted significantly lower two year relapse/recurrence rates than Treatment as Usual (TAU) for patients with five or more previous depressive episodes (46% vs 72%), but predicted slightly increased relapse/recurrence for patients with fewer than five previous episodes (63% vs 59%). Additionally, Tang et al. (2007) found that patients who did not exhibit sudden gains (i.e., rapid large decreases in symptoms) during CT were significantly more likely to suffer relapse/recurrence over two years than individuals who experienced sudden gains (73% vs 34%).

Dual-process theory suggests that CT may relieve dysphoria by training individuals to use explicit processes to override activated negative implicit vulnerabilities. From this perspective, sudden gains during treatment may reflect an individual's ability to acquire and apply rule-based learning. Previous research has indicated that the extent of an individual's explicit processing may reflect a dispositional preference (Epstein, Pacini,

Denes-Raj, & Heier, 1996) or an awareness of a need to override implicit responses (Stanovich & West, 2008). However, evidence suggests that explicit processing is ultimately determined by cognitive capacity (Evans, 2008; Feldman Barrett, Tugade, & Engle, 2004; Smith & DeCoster, 2000; Stanovich & West, 2008). Although individuals with high cognitive ability may not employ explicit processing more often than individuals with lower cognitive ability, they are more successful when they do (Evans, 2008). Reduced recurrence rates associated with high numbers of previous depressive episodes may also be interpreted from a dual-process view, in which therapy may reactivate previously acquired explicit skills. Smith and DeCoster (2000) note that structures created by the rule-based system can leave enduring memory traces, which can be subsequently retrieved when sufficient attention and resources are available.

Results of this research indicate that both negatively-biased implicit and explicit processing are associated with current depression and may confer vulnerability to subsequent depression onset, relapse or recurrence. Consequently, treatment efficacy may be maximised by strategies that address both implicit and explicit processes. Beevers' (2005) suggested three ways that both processes could be targeted to eradicate underlying implicit vulnerabilities or reduce their effects.

First, therapies could change conscious expectancies to maximise the likelihood of corrective explicit processing occurring (Beevers, 2005). For example, Mindfulness Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2002) trains recovered depressed individuals to maintain positive explicit expectancies and to monitor their implicit responses. If individuals are consciously aware that their negative implicit responses are incompatible with their explicit goals, that awareness should trigger explicit self-regulatory processing. Accordingly, evidence suggests that MBCT reduces discrepancies between individuals' actual and ideal self-perceptions (Crane et al., 2008),

and that meditation (a component of MBCT) reduces discrepancies between implicit and explicit self-esteem (Koole, Govorun, Cheng, & Gallucci, 2009). Preliminary evidence also suggests that MBCT may reduce attempts to suppress unwanted thoughts (Hepburn et al., 2009). Clinical studies have indicated that relapse/recurrence rates following TAU plus MBCT compared to TAU alone are significantly lower for individuals with at least three prior depressive episodes (Godfrin & van Heeringen, 2010; Ma & Teasdale, 2004).

Second, strategies could change patterns of activation determined by associative network structures (Beevers, 2005). Repeatedly engaging in corrective explicit processing may change biased implicit cognitions through a process of consolidation (McClelland, McNaughton, & O'Reilly, 1995). Gotlib and Joormann (2010) reviewed several studies that reported reductions in depressive symptoms following modification of cognitive biases. For example, repeatedly preventing memories from entering awareness has been found to impair their subsequent deliberate recollection (Anderson & Green, 2001) and depressed individuals have been trained to forget negative material (Joormann, Hertel, LeMoult, & Gotlib, 2009). Interventions to modify attentional biases have been shown to involve increased activity in the prefrontal cortex (Browning, Holmes, Murphy, Goodwin, & Harmer, 2010); a brain region associated with deficits in executive control in depression (Siegle, Thompson, Carter, Steinhauer, & Thase, 2007). Siegle, Ghinassi and Thase (2007) trained depressed participants to selectively attend to one sound at a time while not attending to depressive thoughts. Participants who received the intervention exhibited greater decreases in depressive symptoms than TAU participants, and displayed normalization of disrupted brain mechanisms in fMRI scans.

Reductions in depressive symptoms following attentional training away from sad faces and scenes (Wells & Beevers, 2010) or depression-related words (Baert, De Raedt, Schacht, & Koster, 2010) have also been observed amongst mildly dysphoric

undergraduate participants. However, unlike Siegle et al.'s (2007) auditory training, Baert and associates found that training away from negative words did not reduce symptoms of clinically depressed participants (or moderately dysphoric undergraduates). Thus, further research is needed to isolate attentional processes whose modification may potentially normalize neurobiological deficits associated with cognitive biases in clinically depressed samples. However, this need may be bypassed by treatments that directly target neurological abnormalities. Evidence suggests that repetitive transcranial magnetic stimulation (rTMS) of the left dorso-lateral prefrontal cortex reduces symptoms of clinically depressed individuals (George et al., 2010) by improving their ability to exert attentional control (Vanderhasselt, De Raedt, Leyman, & Baeken, 2009).

Third, therapies could incorporate both affective and cognitive strategies to learn new implicit associations and explicit interpretations (Beevers, 2005). For example, Emotion-Focused Therapy (Greenberg & Watson, 2005) aims to generate new cognitive structures by focussing on emotional experiences and the meanings attributed to them. Similarly, Exposure-Based Cognitive Therapy (Hayes, Beevers, Feldman, Laurenceau, & Perlman, 2005; Hayes et al., 2007) incorporates elements of mindfulness meditation, affective engagement, activation of negative self-views, cognitive analysis and interpretation. Both approaches have reported successful therapeutic outcomes.

Future Directions

This research found several results that were consistent with Beevers' (2005) dual-process theory. However, the web-based delivery precluded the use of measures requiring precision-timing, which ruled-out assessment of attentional biases. Several researchers have suggested that the ability to regulate movement of negative information to and from working memory determines whether or not activated negative cognitions result in intense or prolonged negative affect (Gotlib & Joormann, 2010; Joormann, Yoon, & Zetsche,

2007; Koster, De Lissnyder, Derakshan, & De Raedt, 2010). Koster and colleagues' (2010) Impaired Disengagement Hypothesis proposes that appraisals of negative stressors signal cognitive conflict in individuals with positive self-views, which prompts attentional disengagement from negative thoughts. However, such signalling may not occur when an individual possesses negative self-views; which results in prolonged rumination, impaired problem-solving, and persistent negative affect. Parallels between this perspective and dual-process theory are immediately apparent. Consequently, future dual-process research should include assessment of attentional factors.

The results of Studies 1, 2 and 3 suggest that relationships between negative cognitive biases and depression may be influenced by the functional properties of psychological measures and the cognitive processes they access. De Houwer and colleagues (De Houwer, 2009; De Houwer & Moors, 2010; De Houwer, Tiege-Mocigemba, Spruyt, & Moors, 2009; Moors, et al., 2010) recently developed criteria which enables measures to be classified as implicit if they possess one or more specific features of automaticity. However, to date, little research has assessed the functional characteristics of specific implicit measures (De Houwer, 2009). Research that identifies implicitness features of measures would facilitate investigations into their roles as moderators of the relationship between implicit cognitive biases and depression. Determining the relative predictive power of specific automatic properties (e.g., unconscious versus fast) in depression may inform the development and selection of appropriate treatment strategies.

Relatedly, future research may directly examine the dual-process implication that implicit measures of depressive cognitions that access associative learning or information

processing (e.g., NLPT[1], IAT) should represent stronger predictors of future depression than implicit measures that automatically retrieve explicit knowledge (e.g., SDJT, SST) under high life stress.

Study 3's identification of a dysphoric cognitive profile characterised by implicit memory for negative stimuli also warrants further investigation. Prospective studies may investigate the possibility that this profile represents a precursor to more severe forms of depression by replicating the current result and reassessing cognitive biases at follow-up. This would identify which biases behave like symptoms of disorder (i.e., returning to normal/positive following recovery) and which cognitions remain stable despite decreases in depressive symptoms (i.e., as cognitive vulnerabilities).

The results of Study 4 invite several possible avenues of future exploration. First, future studies should validate the relationship between thought suppression and susceptibility to cognitive resource depletion by replicating Study 4's results and simultaneously assessing the interactive effects of thought suppression and life stress on cognitive resources. This could be achieved by measuring cognitive inhibition and control at Times 1 and 2, using methods such as negative priming (see Gotlib & Joormann, 2010) or neuroimaging (see Carver, Johnson, & Joormann, 2008), and determining whether decreases over time are predicted by an interaction between high thought suppression tendencies and life stress. Second, future research could investigate the possibility that the deleterious effects of high thought suppression tendencies under high life stress (Beevers & Meyer, 2004) are contingent upon possessing negative implicit self-views.

Third, research may directly assess differences between the cognitive characteristics of individuals with high thought suppression tendencies (High TS) observed in Study 4,

[1] Inconsistent and unreliable scoring methods may underlie the weak effect size obtained for the NLPT in Study 1. LeBel & Gawronski (2009) assessed five adequate scoring algorithms and found an optimal inter-item correlation for the NLPT of r =.34 which is highly comparable to that of the explicit RSE, r = .36.

and the characteristics of individuals with high levels of explicit depressive cognitions (High Risk) observed by Steinberg and colleagues (2007). Unlike High Risk participants, High TS participants with high implicit self-esteem at Time 1 reported low levels of depression at Time 2 after experiencing high life stress. These findings suggest that high implicit self-esteem may perform a protective function for High TS, but not High Risk, individuals in the presence of life stress. If so, further studies could utilise these groups to identify factors or conditions that facilitate or hinder the beneficial effects of high implicit self-esteem under stress.

Lastly, Study 4 indicated that high levels of Time 2 depression were associated with low implicit self-esteem for High TS participants but were non-significantly associated with high implicit self-esteem for Low TS participants. Future researchers may examine the possibility that relatively large proportions of participants with low thought suppression tendencies or high resource availability may partially explain several paradoxical relationships between high implicit self-esteem and depression observed in Study 1 (e.g., De Raedt, Schacht, Franck, & De Houwer, 2006).

When designing this research, we hoped to assess the relative ability of eight cognitive vulnerabilities to predict future depression. However, after controlling for Time 1 depressive symptoms, both logistic and multiple regression models were not significant. Power analysis indicated that the eight predictors may explain a significant increase in variance if a larger sample is recruited (Follow-up n = 580). A larger sample may also enable the assessment of the relative contribution of each cognitive bias to subsequent depressive symptoms in interaction with life stress. Such an analysis would more comprehensively investigate Beevers' (2005) prediction that negative implicit processing underlies cognitive vulnerability to depression, which may be triggered by high life stress.

Recent efforts to integrate depression findings from various research arenas –

including cognitive psychology, psychopathology, behavioural genetics and cognitive neuroscience – have made inroads toward achieving a holistic understanding of cognitive vulnerability to depression (Beck, 2008; Carver, et al., 2008; De Raedt, Koster, & Joormann, 2010). Most of these views incorporate elements that are consistent with dual-process theory. Studies that examine connections between variables derived from traditionally separate psychological research domains (e.g., genetic and cognitive; Beevers, Ellis, Wells, & McGeary, 2010; Beevers, Pacheco, Clasen, McGeary, & Schnyer, 2010) offer great scope for furthering understanding of the origin, function and effects of dual-process mechanisms involved in depression.

Conclusion

Overall, this research provides qualified support for Beevers' (2005) dual-process model of cognitive vulnerability to depression. Several results are consistent with the model. First, results suggest that cognitive vulnerability to depression is conferred by negatively biased implicit self-referential processing. Second, they indicate that possession of negatively biased implicit and explicit cognitions, together, carry risk for future depression. Third, results are consistent with the view that negative implicit self-related cognitions may be exposed when corrective explicit processing cannot be employed due to depleted cognitive resources. However, the research produced little evidence to support the notion that implicit and explicit cognitive phenomena represent output from two distinct processing systems. This may be due to similarities and differences in the cognitive processes and measurement properties of various assessment strategies. Despite this unresolved issue, the current research identified cognitive characteristics amongst vulnerable individuals that may set the stage for a self-perpetuating cycle into depression. Consequently, interventions that target both implicit and explicit processes may offer the greatest hope for long-term relief from depression.

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