The Cognitive Vulnerability to Depressive Rumination in People Diagnosed with Major Depressive Disorder

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OVERVIEW

This research project focuses on the cognitive process of rumination and its association to depression. *Part one* of the project is a literature review, which aimed to provide a comprehensive summary of the current state of research on the relations between rumination and the major cognitive processes in people with depression. A systematic search identified 25 studies in the existing literature which fulfilled the basic requirements of studying rumination and at least one other cognitive process with valid measure(s) or experimental manipulations in people with a diagnosis of major depressive disorder. These studies covered 8 domains of cognitive deficits and biases related to rumination. They included overgeneralised memory, memory biases, thinking biases, attentional biases, inhibitory deficits, impairments in general resource allocation, maladaptive thought control strategies, and problem-solving deficits. The review investigated the conclusions made by these studies in terms of their suggestions on the interrelations between depressive symptoms, rumination, the cognitive process in question. Particular attention was paid to each study's conceptualisation of rumination, and whether it addressed subcomponents of rumination which underlie its negative effects.

Part two consisted of the empirical paper. The empirical study focussed on the ability of one particular hypothesis - the mood-as-input model -to explain the mechanisms underlying the perseverative thinking style which characterised depressive rumination. Using a rumination interview paradigm, it compared participants with major depressive disorder (MDD) with healthy controls for the extent of their perseverative thinking during the rumination task. The performance of each participant in both the depressed and control group was also measured and contrasted across two experimental conditions. In each these conditions, participants were asked to adopt either an 'as-much-as-can" or a "feel-like-continuing" stop-rule as guidelines for decision making on how and when to terminate the task. Results indicated that the interaction of

depressive symptoms and 'stop-rule' significantly influenced perseveration in all participants. Participants' changes of mood during the rumination task, as well as their spontaneous selection of stop-rule in their daily life were also explored.

Finally, the critical appraisal in *part three* offered a reflection on the my motivations for undertaking this research and some reasons for the important decisions made in the process. It also provided further discussions on the designs and methodologies of the experimental study, and the research and clinical implications of its findings.

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PART 1: LITERATURE REVIEW

The association between rumination and the common cognitive deficits and biases related to depression

Abstract

Aims: This review article summarised existing studies which investigated the associations between rumination and other cognitive processes in people with depression. *Methods:* A systematic literature search was undertaken to identify studies which examined rumination and at least one form of cognitive deficit or bias using valid measurements and/or experimental manipulations. The selected studies all included participants with a diagnosis of major depressive disorder or a current major depressive episode in their samples. *Results:* A total of 25 studies fitted the inclusion criteria. They covered rumination and other cognitive processes across 8 domains, which included overgeneralised memory, memory biases, thinking biases, attentional biases, inhibitory deficits, impairments in general resource allocation, maladaptive thought control strategies, and problem-solving deficits. All of these processes corresponded to the common cognitive correlates of depression. *Conclusions:* Results indicated that these cognitive biases and deficits relate differentially to different sub-components of rumination, thus reinforcing the hypothesis that rumination is not a unitary construct. However, the diversity of ruminative processes had not been addressed by the majority of the reviewed studies. The present findings presented various cognitive mechanisms that might be underlying the detrimental effects of maladaptive rumination, but current discussions on the nature of these mechanisms remained inconclusive. A number of general suggestions on research designs and methodological recommendations for specific studies were discussed.

Introduction

The role of rumination in depression

Rumination typically refers to a process of perseverative thinking that is self-focussed, recursive and persistent in nature. Substantial evidence now suggests that rumination is a central component of affective disorders, in particular depression (see Thomsen, 2006). The concept of rumination is therefore considered important to the continuing development of both the cognitive theory of and psychological interventions for depression. However, despite the robust literature, there is not a clear and agreed definition of rumination. Different theorists have debated the ways in which rumination is linked to depressive symptoms, as well as to other cognitive processes (Smith & Alloy, 2009). There also seems to be a lack of consensual understanding on the mechanisms underlying the negative effects of rumination.

Different definitions of rumination

The most widely applied and supported theory of rumination is the Response Style Theory (RST) (Nolen-Hoeksema, 1991; Nolen-Hoeksema, Wisco & Lyubormirsky, 2008). In RST, rumination is understood as a repetitive style of thinking about the causes, consequences, and symptoms of one's negative affects. It is a direct, automatic, and trait-like tendency of responding to emotional distress. The Rumination Response Scale (RRS), a subscale in the Response Style Questionnaire (RSQ) developed by Nolen-Hoeksema and Morrow (1991) has been used in the majority of relevant studies to measure trait tendency to ruminate in response to depressive mood. However, this conceptualisation of rumination has been challenged as emerging findings continue to show that distinct processes such as brooding and reflection (Mor & Winquist, 2002;

Treynor, Gonzalez and Nolen-Hoeksema, 2003); Watkins, 2008) satisfy this definition of rumination (e.g. Teasdale & Green, 2004). Therefore, it raises questions about the validity of rumination as a unified construct. In fact, recent research supports the idea that rumination consists of separate processes.

Theoretically, the RST proposes a direct relationship between rumination and emotional distress. Because of this, it may not have invited rumination research to incorporate the increasing evidence that rumination can cause as well as be caused by various cognitive processes. In view of these more recent findings, Treynor et al. (2003) attempted to identify different dimensions of rumination by factor-analysing the items in the RRS. After removing the items which overlapped with general depressive symptoms, they identified two separate factors measured by the remainder of the RRS, namely, brooding, a tendency towards moody pondering, and reflection, a neutral contemplation on facts. However, some problems remained as the authors acknowledged that this distinction accounted for only half of the variance of their study's data, suggesting more factors are underlying the original concept of rumination.

Recently, increasing evidence on brooding and reflection has shown that they are differentially related to different cognitive processes. For instance, brooding seemed to be related to attentional bias for sad faces for people with depression (Joormann, Dkane & Gotlib, 2006), reduced inhibition of negative materials in working memory (Joormann & Gotlib, 2010), and increased negative cognitive style (Lo, Ho, & Hollon, 2008). Reflection was not found to be related to any of these cognitive deficits, except for negative cognitive style, which it negatively related to. These findings suggested that the various sub-components of rumination may exert different effects on depression via separate cognitive processes.

Another major theory of rumination, the self-regulatory executive function (S-REF) model (Wells & Matthews, 1994, 1995), defines rumination in a broader context than the RST. Here,

rumination is not a direct and habitual response to low mood, but a partly controlled strategy for emotional regulation. It embeds rumination in the structure of a cognitive model of emotional self-regulation. This potentially allows for a characterisation of the different mechanisms underlying the unhelpful effects of rumination, specifically in terms of their associations with the cognitive processes linked to depression. However, so far most rumination studies from this perspective are concerned with a particular part of the model, i.e., metacognitions. Therefore, the literature has yet to see rumination as conceptualised in S-REF being widely considered. One of the reasons for this might be that the multiple measures of rumination as suggested by the model do not lend themselves as easy tools for research and data interpretation.

Maladaptive subtypes of Rumination

Overall, recent research on different subtypes of repetitive and self-focussed thinking has shown that they differentially relate to cognitive biases and deficits associated with depression. Therefore, these findings generally reinforced the idea that there are both adaptive and dysfunctional aspects of rumination. For instance, a series of studies conducted by Watkins and colleagues have shown that the induction of evaluative and analytic, as opposed to concrete and experiential, self-focussed thinking caused a higher level of over-generalised memory in both depressed and healthy (e.g. Watkins & Teasdale, 2001, 2004; Watkins, Teasdale, & Williams, 2000), as well as formerly depressed individuals (Crane et al., 2007). In addition, a study has found that, when compared to concrete self-focussed thinking, it was the abstract and less concrete nature of depressive thoughts, rather than the self-focus quality per se, which impaired social problem-solving skills in people with depression (Watkins & Moulds, 2005). Taken together, these studies suggest that various cognitive factors may contribute to the

detrimental effects of rumination. Hence, depressive rumination may not be a unitary construct. However, it is admittedly not reflected by most rumination research to date.

One of the main concerns of this review is to survey the different ways studies have conceptualised rumination. As an examination of rumination's various definitions is likely to have implications for understanding the mechanisms underlying its negative effects, it may help us comprehend the existing evidence on rumination in relation to wider cognitive processes. Therefore, it may pave the way for a conceptualisation of rumination based on empirically endorsed connections with other depressive cognitions. It is also likely to be clinically valuable, as it may illuminate the cognitive mechanisms underlying the maladaptive effect of rumination, which psychological interventions could target. For these reasons, it is important that the present review attends to studies that addressed the relations between rumination and common cognitive processes associated to depression.

Rumination and the Cognitive Correlates of Depression

A number of reviews have summarised the common cognitive biases and deficits in depression (e.g. Matthews & McLeod, 2005; Baune, Miller, McAfoose, Johnson, Quirk & Mitchellm, 2010; Joormann & D'Avanzato, 2010; Gotlib & Joorman, 2010). They outlined the two main areas of cognitive correlates of depression, i.e. cognitive biases and general deficits in cognitive processes. The specific processes identified so far include biases in recall and overgeneralisation in memory (e.g. Lyubomirsky, Caldwell & Nolen-Hoeksema, 1998; Teasdale & Green, 2004); increased intrusive thoughts (Wenzlaff, 2002); attributional biases (e.g. Lo, Ho & Hollon, 2008, 2010); biases in attention, and deficits in executive functions (e.g. Joorman, 2006; De Lissnyder, et al., 2010); and flexibility in the allocation of general cognitive resources (e.g. Levens, Muhtadie, Gotlib 2009).

In parallel to the research on cognitive deficits in depression, there has also been a growing literature on the connection between rumination and various cognitive processes. In fact, research evidence has been showing an increasingly complex picture of how rumination associates with common depressive cognitions. However, there has not been any systematic review of the existing findings to date.

The Current Review

In view of this, the current review aims to provide a comprehensive summary of the studies that examined how various cognitive processes relate to rumination in the context of depression. In reviewing the literature, it was noted that the range of studies exploring rumination and depressive cognitive processes has become quite broad. These studies vary in their definitions of rumination, as well as how relevant they are to the topic in question in terms of their focuses and designs. For example, conclusions about depressive rumination were drawn from studies which included measures of rumination as an adjunct to their hypotheses and used non-clinical samples with dysphoric moods. In order to ensure the robustness of our findings, the present review will consider only studies which included participants who met the criteria for the diagnosis of major depressive disorder (MDD).

It offers a review of their findings, and comments on their design and methodological strengths and weaknesses. For this purpose, this review restricts the studies included to those that recruited participants who fulfilled the criteria for a diagnosis of major depressive disorder or a current depressive episode. It is hoped this will give this critical summary relevance to future theoretical research, as well as clinical studies of depressive rumination that seek to identify relevant mechanisms that psychological interventions could effectively target.

In order to address the related issue of the variance in how rumination is defined in rumination studies to date, this review will also look at the specific mechanisms authors focussed on when they refer to rumination and whether they are differentially related to the relevant cognitive processes being studied.

Research Questions

For these reasons, the current review aims to address the following questions:

1) Is rumination related to cognitive biases and deficits in depression?

2) What is the nature of these relations as indicated by existing findings?

METHODOLOGY AND INCLUSION CRITERIA

Search Strategies

The studies included in the reviews were identified through searches on a number of online databases with systematic search strategies, as well as from the reference lists of relevant review and empirical research papers.

Searches were conducted separately on the PsycINFO, Medline, and Web of Science databases, limiting results to English language, peer-reviewed journal articles published from the beginning of 1990 to 2011.

A number of initial scoping searches using a wide variety of search terms were carried out in an attempt to identify all the studies that examined cognitive processes suggested to associate with rumination in depression. Keyword searches using the search terms combination *depression and ruminat*ion yielded a total of 1262 results. Additional terms *dysphoria, affective disorder and mood disorder* were used in conjunction with *depression,* and *brooding, repetitive,* and *reflection* with *rumination* in further search runs in order to allow for variations in keywords.

To search for studies which addressed specific cognitive processes or mechanisms related to rumination in depression, a search run using the terms *cognition or cognitive and depression and rumination* was conducted and yielded 790 results. As a wide range of cognitive processes were covered in the literature, and the naming for them by different authors was not always consistent, supplementary terms were required to broaden the search criteria to cover all studies that addressed the relevant cognitive processes. For a comprehensive investigation of the cognitive processes that were identified to be associated with rumination in depression, and hence suitable search terms, the author surveyed four relevant literature review articles (Matthews & McLeod, 2005; Baune, Miller, McAfoose, Johnson, Quirk & Mitchellm, 2010; Joormann & D'Avanzato, 2010; Gotlib & Joorman, 2010). Subsequently, the terms *attention, memory, executive, inhibit*, beliefs, thought, problem, solving* and *bias* were added to the search terms. In the final search run, the key terms *Depress** or *dysphori** or *mood** or *affect** AND *Ruminat** or *repetitive* or *brooding** or *reflection** AND *Cognit** or *attention**or *memor** or *executive** or *inhibit** or *bias* were used.

Truncated terms were used to allow for variation in keywords, such as rumination and ruminative, dysphoria or dysphoric. The above search generated 129 results. These results were scanned by their titles for relevance, and then by their abstracts to determine whether they

met the inclusion criteria. A total of 83 studies were chosen for detailed further appraisal against the inclusion criteria.

Inclusion Criteria

In addition to the above mentioned search limits, further search criteria were used to restrict the search outcomes to:

1) Articles that reported case-control empirical or quantitative studies

2) Studies that used adult participants who met the DSM-IV diagnostic criteria for major depressive disorder (MDD)

3) Studies that addressed at least one specifically defined cognitive process, which was hypothesised to be associated with rumination in depression

4) Studies that reported the outcomes of one or more quantitative measures of the cognitive process(es) addressed.

Moreover, studies which only examined mindfulness, both as a cognitive style or a practice, were excluded because of a lack of valid and reliable measurement of this construct. Out of the 83 of papers identified for detailed appraisal based on the above considerations, 27 of them were selected to be included in the systematic review.

Results

Studies included in the review

A total of 25 studies were included in the current review. 27 studies were initially found using the above search parameters, of which two were excluded because they lacked a specific measure for rumination or the cognitive processes they examined (Yook, Kim, Suh & Lee, 2010; Radenborgh, Jong-Meyer & Huffmeier, 2010).

The 25 reviewed studies were categorised according to the cognitive processes they explored in relation to depressive rumination. The following groups were identified: studies exploring reduced specificity in memory (n=5) and memory biases (n=1); studies looking at cognitive or thinking biases (n=6) and attentional biases (n=2); studies investigating deficits in inhibition (n=5); impairment in allocation of general cognitive resources (n=1) and thought control (n=2); and finally studies examining deficits in problem solving (n=3). Details of the studies are summarised in Table 1.

Table 1. Studies investigating the associations of rumination with biases and deficits in cognitive processes in people with depression

Study	Sample	Cognitive process(es) investigated	Measure(s) of rumination	Main findings
Watkins, Teasdale & Williams (2000)	Depressed (N=48, 54% MDD; 75% past MDD; 17% dysthmia)	Overgeneral autobiographical memory	n/a	Rumination induction moderately increased, while distraction induction significantly decreased categorical memory recalled by depressed participants.
Watkins & Teasdale (2001)	MDD, N=36	Self-focus, analytical thinking and overgeneral autobiographical memory	n/a	Induction of analytical thinking rather than self-focus significantly increased overgeneral memory.Induction of self-focussed thinking affected moods.
Raes et al. (2005)	MDD, N=24	Reduced specificity of (or overgeneral) autobiographical memory and social problem solving deficits	RRS; Rumination on Sadness Scale (RSS) (Conway, Csank, Holm, & Blake, 2000)	Trait-rumination, ineffective problem-solving and reduced memory specificity were significantly associated. Regression analyses showed that reduced memory specificity mediated the association between rumination and problem-solving effectiveness.
Raes et al. (2006a)	MDD, N=26	Overgeneral autobiographical memory, working memory, semantic memory, verbal learning, delayed verbal recall, recognition memory, and source memory	RRS; Rumination on Sadness Scale (RSS)	Rumination was found to be related to both overgeneral autobiographical memory and poor source memory.
Raes et al. (2006b)	MDD, N=28	Reduced autobiographical memory specificity	Rumination on Sadness Scale	Reduced autobiographical memory specificity predicted poor outcome of depression. This prediction was found to be mediated by rumination.

Study	Sample	Cognitive process(es) investigated	Measure(s) of rumination	Main findings
Joorman, Dkane & Gotlib (2006)	MDD, N=64 Formerly depressed, N=36 Social phobia, N=20 Never disordered, N=91	Memory and attentional biases	RRS (brooding and reflection subscales) (Treynor et al., 2003)	Brooding and reflection were differentially correlated to biased recalls of words associated with sadness and social threats. These correlations lost significance when depressive symptoms were partialled out.The correlation between brooding and attentional bias for sad faces, however, remained significant even when current depressive symptoms were taken into account.
Spasojevic & Alloy (2001)	Initially non-depressed students, N=137	Negative cognitive styles	RRS	Longitudinal study found that an initial association between trait-rumination and negative cognitive styles is significantly related to the number of subsequent depressive episodes in the following 2.5 years. Further analysis showed that trait-rumination mediated the relation between negative cognitive styles and prognosis of depression.
Robinson & Alloy (2003)	Initially non-depressed students, N=148	Negative cognitive styles	RRS; The Stress-Reactive Rumination Scale (SRRS; Alloy et al., 2000; Robinson,1997)	Stress-reactive rumination (measured by the SRRS), but not symptom-focussed rumination (measured by RRS), interacted with negative cognitive styles to predict frequency and duration of depressive episodes in the subsequent 2.5 years.
Lam, Checkley & Sham (2003)	MDD, N=109	Hopelessness, biased attributional styles, and maladaptive attitudes	RRS	Trait-rumination is associated to levels of Hopelessness, biased attributional styles, and maladaptive attitudes. However it did not predict, in retrospect, the number of past depressive episodes.

Study	Sample	Cognitive process(es) investigated	Measure(s) of rumination	Main findings
Rimes & Watkins (2005)	MDD, N=30 Healthy controls, N=30	Analytical and evaluative self-focussed ruminative thinking; Global negative self-judgements	RRS	In depressed participants, induction of the analytical self-focus condition increased ratings of the self as worthless and incompetent, whereas the experiential self-focus induction resulted in no significant change in such judgements.
Lo, Ho & Hollon (2008)	Depressed (MDD, N=35; Dysthmia, N=3) Healthy controls (college students, N=115)	Brooding, reflection, and negative cognitive styles	RRS (brooding and reflection subscales) (Treynor et al., 2003)	Brooding , not reflection, mediates the relationship between negative cognitive styles and depression.
Lavender & Watkins (2004)	Depressed (current major depressive episode), N=30 Non-depressed, N=15	Biases in future thinking	n/a	In the depressed group, rumination induction increased both negative and positive future thinking, although the effect was only significant for negative future thinking once baseline levels of hopelessness were controlled for.
Donaldson, Lam & Matthews (2007)	MDD, N=36 Non-depressed, N=36	Attentional bias towards emotionally-valenced words	RRS	Results showed that depression is associated with an attentional bias towards negative information. This bias is stronger in individuals who underwent rumination induction.
Raes, Hermans & Williams (2007)	MDD, N=26	Negative bias in perception of emotional facial expressions	RRS	Rumination was positively related to a negative bias in the judgment of facial expressions, even after controlling for dysfunctional attitudes and depressive symptoms.
Watkins & Brown (2002)	Depression, N=14 Non-depressed controls, N=14	Deficit in inhibitory executive control	n/a	Rumination induction produced a significant increase in both ruminations and a failure of inhibitory executive control (as indicated by a tendency towards stereotyped counting responses to a number generation task) in depressed patients.
Lau, Christensen, Hawley, Gemar & Segal (2007)	MDD, N=43 Anxious, non-depressed, N=32 Healthy controls, N=36	Inhibitory deficit for negative information; Negative thinking	RRS	Participants with MDD demonstrated impairments in reading stories embedded with distracter words. The impairment was most pronounced for negatively valenced adjectives, relative to both control groups. These impairments correlated with self-report measures of negative thinking and rumination.

Study	Sample	Cognitive process(es) investigated	Measure(s) of rumination	Main findings
Joorman & Gotlib (2010)	MDD, N=22;Remitted major depression, N= 47 Healthy controls, N=32	Inhibitory deficit in the processing of negative material	RRS (brooding and reflection subscales) (Treynor et al., 2003)	In depressed patients, inhibitory deficit was positively associated with brooding, but negatively associated with reflection, after depression severity was controlled for. Neither inhibitory deficits nor any relations between inhibition and rumination were found in the formerly depressed group.
Goeleven, de Raedt, Baert & Koster (2006)	MDD (inpatients, N=20); Formerly depressed, N=20; Healthy controls, N=20	Deficient inhibition of emotional information	RRS	Compared to never-depressed controls, depressed patients showed a specific failure to inhibit negative information, whereas inhibition function for positive material was unaffected. Formerly depressed individuals demonstrated impaired inhibition of negative and positive information. Rumination predicted inhibitory deficit of negative information, but did not do so over and above depressive symptoms.
Joormann & Gotlib (2008)	MDD, N=23; Healthy controls, N=40	Impairment in updating of working memory contents	RRS	Compared to controls, depressed participants were shown to have experienced greater intrusion by negative words they were previously presented and asked to treat as 'irrelevant'. This indicates that depression is associated with difficulties removing irrelevant negative material from working memory. The intrusion effects for negative words were correlated with self-reported rumination.
Levens, Muhtadie & Gotlib (2009)	MDD, N=24; Never-depressed, N=24	Impaired allocation of general cognitive resource	RRS (brooding and reflection subscales) (Treynor et al., 2003)	Depressed participants performed worse than non-depressed participants in the high-interference, but not the low-interference, condition in the dual-task experimental paradigm. This indicates that depressed participants experienced deficit in the controlled allocation of resources to resolve dual-task interference. The degree to which depressed participants were impaired in the high-interference condition was significantly correlated with rumination.

Study	Sample	Cognitive process(es) investigated	Measure(s) of rumination	Main findings
Watkins & Moulds (2009)	MDD, N=52; Recovered depressed, N=36 Never depressed, N=49	Thought Control Strategies (distraction, social control, worry,self-punishment and reappraisal); Thought suppression	RRS brooding and reflection subscales) (Treynor et al., 2003)	Rumination was significantly correlated with worry and thought intrusions; and moderately correlated with thought suppression, distraction and self-punishment. Regression analysis suggested that rumination predicts thought suppression.
Szasz (2009)	MDD, N=46	Thought suppression	RRS	Both thought suppression and depressive rumination are related to depression. The impact of thought suppression on depression is completely mediated by depressive rumination.
Watkins & Baracaia (2002)	MDD, N=32 Recovered depressed, N=26 Never depressed, N=26	Social problem-solving deficits	RRS	Relative to never-depressed participants, depressed and formerly depressed patients showed significantly greater impairments in their problem-solving after receiving state-oriented induction. These impairments were improved by a process-focussed thinking procedure.
Watkins & Moulds (2005)	MDD, N=40 Non-depressed, N=40	Abstract self-focus and concrete self-focus rumination; Problem-solving	n/a	Compared to abstract self-focus, the concrete self-focus induction procedure improved social problem-solving in depressed patients.
Donaldson & Lam (2004)	Depressed (current major depressive episode), N=36 Non-depressed, N=26	Social problem-solving	RRS	Depressed patients with higher levels of trait-rumination reported poorer mood and showed less effective problem- solving. Depressed patients who underwent a rumination induction procedure experienced a deterioration in their mood and gave poorer problem solutions. Rumination induction did not have an impact on mood or problem-solving in control participants

Note. MDD = Major depressive disorder; RRS= The ruminative responses scale, a subscale of the Response style questionnaire (RSQ) (Nolen-Hoeksema and Morrow, 1991); N stands for sample size

Study Characteristics

Of the 25 studies reviewed, 8 employed experimental designs to manipulate participants' ruminative states and the other 17used correlational designs to study the relation of rumination and other cognitive processes. All but three longitudinal studies (Spasojevic & Alloy, 2001; Robinson & Alloy, 2003; Raes, Hermans, Williams, Beyer & Eelen, 2006) used a cross-sectional design. Excepting the studies by Spasojevic and Alloy (2001) and Robinson and Alloy (2003), who included initially healthy participants at the outset of their longitudinal study, all studies included participants with depression as a part of their sample. Depressed participants in all except for one study (Watkins & Brown, 2002) were determined as meeting the DSM-IV criteria for MDD or a current major depressive episode through SCID interviews by qualified clinicians. Studies included a mixed proportion of inpatients, outpatients, and volunteers. 15 out of the 25 reviewed studies had a healthy control group. Of these, 5 included an experimental group of participants who were formerly depressed, and 2 included other comparison groups consisting of individuals with other affective disorders (see Table 1).

In terms of measures for rumination, 20 out of the 25 reviewed studies used a valid measurement of trait rumination. 19 of these studies used the RRS from the RSQ (Nolen-Hoeksema & Morrow, 1991), of which 5 separately analysed scores from its brooding and reflection subscales. 3 used the rumination on sadness scale (RSS) (Conway, Csank, Holm & Blake, 2000) and 1 adopted the stress-reactive rumination scale (SRRS) (Alloy et al., 2000). In the studies that did not include a trait-rumination measure, state-rumination was induced by experimental manipulations and examined as independent variables. 12 studies regarded and measured rumination only as conceptualised by the Response Style Theory (i.e. self-focussed, repetitive thinking in response to depressive symptoms). 5 considered the brooding and

reflection subcomponents, 2 examined the self-focussed analytical versus self-focussed experiential thinking, and 1 studied abstract versus concrete self-focussed rumination.

Over-generalised memory and memory biases

A substantial body of evidence has shown that depressed individuals are characterised by memory biases, such as a higher accessibility to negative memory (see Mathews & MacLeod, 2005), and a reduced specificity of memory contents (see William et al., 2007). The latter, overgeneral memories, was often associated with rumination (e.g. Kao, Dritschel, Astell, 2006; Watkins, Williams & Hermans, 2008; Debeer, Hermans & Raes, 2009). However, to date only 5 studies including participants with current depression were identified.

Preliminary evidence for the effect of rumination on categorical (or overgeneral) memory came from Watkins, Teasdale and Williams's (2000) findings. The authors randomly assigned their depressed/dysphoric participants (n=42) into two groups receiving inductions using either a rumination or distraction induction task. The rumination task was designed by Nolen-Hoeksema and Marrow (1993), in order to increase the degree of self- and symptom-focus in a person's thinking. The overgeneral memory was measured by the autobiographical memory task (AMT), a test designed by Williams (1995) in which participants were instructed to recall memories prompted by emotionally positive, negative and neutral cue words. Specificities of these memories were then subject to independent ratings. The results showed that rumination moderately increased the amount of categorical memory recalled, while distraction significantly reduced that, irrespective of their mood change.

A caveat for this study is that the authors did not separately examine the clinically depressed and dysphoric participants, or include a healthy control group. It is therefore unclear if the main

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effects of rumination are specifically related to depression. Furthermore, the authors analysed the recalled memories from the AMT across the three groups of emotionally varied cue words together. Given the previous findings which suggested that dysphoric individuals preferentially process negative information (Williams, Watts, MacLeod & Matthews, 1997), separate analyses might yield a larger effect of rumination on memory with emotional contents.

The same authors conducted a follow-up study, which compared the effects of two different mechanisms, self-focus and analytical thinking, which might underline the effect of rumination reported in their previous findings (Watkins & Teasdale, 2001). The authors randomly assigned their depressed participants (n=36) into four equal groups. Each group received an experimental induction characterised by one of the four combinations of high or low self-focus, and high or low self-analytical thinking. They compared the three groups for their mood changes as well as performance in the AMT following the inductions. They found that whereas only high self-focus increased low mood, only a high self-analytical thinking style increased overgeneral memory in their participants, without showing any effect of interaction of the two processes. Thus the results suggested a double dissociation between the self-focus and analytical aspects of rumination, with the latter alone affecting memory in depressed individuals.

As in their previous study, this study did not include a non-depressed control group. Also worth noting is that neither of these studies accounted for the variations in the participants' pre-induction tendency to rumination, such as by taking trait-rumination measures. Because of this the variation in participants' predisposition to rumination may potentially have confounded the effects of the induction procedures.

More recently, Raes and his colleagues conducted three studies which have revealed more details regarding the relations between overgeneral autobiographical memory and rumination in depression. First, Raes, Hermans, Williams, Demytternaere, Sabbe, Pieters and Eelen (2005)

examined the role of overgeneral memory in the well-demonstrated relationships between rumination and social problem-solving deficits in depression (e.g. Lyubomirsky & Nolen-Hoeksema, 1995; Watkins & Baracaia, 2002). Using a correlational design, the authors compared their depressed participants' (n=24) tendency to ruminate, memory specificity using a recall task (AMT), and their social problem-solving skills. The tests found memory specificity to be significantly related to both problem-solving skills and rumination, and reported that the former relations remained significant even after they controlled for the levels of rumination and working memory capacity. Further analysis showed that reduced memory specificity mediates the relation between rumination and lowered social problem-solving skills in people with depression. Together they suggest the possibility that rumination affects problem-solving skills in depression partly through its effects on autobiographical rather than working memory. However, the ability to draw such a depression-specific and causal conclusion was limited by the lack of a non-depressed control group and the correlational nature of the study, respectively.

To explore the relation between overgeneral autobiographical memory and other areas of memory functioning in depression, Raes et al. (2006) assessed various memory performances of depressed patients (n=26). They also reported measures of trait-rumination in the study. Confirming earlier findings, trait rumination was positively related to the level of overgeneral memory. Rumination was also found to be correlated with reduced working memory and poor source memory (the recognition of long-term episodic memory), all irrespective of the variations in depressive symptoms. To test rumination's role in the hypothesis that recalling specific memory required working memory capacity (Conway, Pleydell-Pearce, 2000), the authors tested its relation with overgeneral memory again, after controlling for the working memory scores. The results suggested a direct relation between trait-rumination and overgeneral autobiographical memory. This study used a correlational design, which, as mentioned above, precludes its results from showing the directions of the reported relations. In addition, this study

used the Letter-Number Sequencing task (LNS), which might not be the most appropriate test of working memory functioning associated with the retrieval of autobiographical memory. An experimental design using a dual-task paradigm might be preferable in future studies of the specific role of working memory in the relations between rumination and autobiographical memory.

Finally, Raes, Herman, Williams, Beyer and Eelen (2006) sought to verify previous evidence which showed reduced memory specificity as a predictor of depression (Dalgleish et al, 2001; Peeters et al., 2002), and whether this can be explained by rumination. 28 inpatients with depression were measured for their depressive symptoms and memory specificity (using the AMT) across a 7 month period. Subsequent regression analysis showed that reduced autobiographical memory specificity recalled at emotionally negative cue words predicted significantly poorer outcomes in depression. However, the significance disappeared when the authors factored in the participants' levels of trait-rumination. This indicated that rumination at least partially mediated the relationship between reduced memory specificity and depressive symptoms. However, as the authors acknowledged, this study had a small sample size, which might affect the robustness of the evidence by limiting the statistical power of the analyses. Furthermore, although the authors adopted a prospective design, which is apt to provide evidence for a mediational relationship, future studies may benefit from also assessing the relations between reduced memory specificity and rumination to more strongly demonstrate the mediating role of rumination.

With regard to the depressive bias in memory content, only Joormann, Dkane and Gotlib (2006) have so far explored how it relates to rumination as a part of their study. In comparison with formerly depressed and socially phobic patients, as well as healthy controls, the authors measured the brooding and reflection levels of their depressed participants (n=64) and explored

their corresponding relations to bias in a self-referential encoding recall task. It required the participants to recall emotional words they previously decided to be self-referential. Brooding, but not reflection, was positively correlated to sad and socially threatening words, but negatively to happy words. This was consistent with earlier reports of negative memory biases with rumination (e.g. Matt, Vazque & Campbell, 1992; Ridout et al., 2003). However, this relation disappeared when the authors controlled for the depressive symptoms of the participants, suggesting that the memory bias was an artefact of the depressive symptoms, rather than the consequence of rumination per se. As this is the only study yet to look at this relation in the context of current depression, further studies will be required to establish this finding. This study suffers the common limitations of a correlational study. One may also query the generalisability of this finding to other aspects of memory recall, such as autobiographical memory, due to the specificity of single-word recall.

Collectively, these studies presented evidence which support a close relation between trait-rumination and overgeneral recall of autobiographical memory. Rumination, as a temporary state of highly self-focussed and analytical thinking, was also shown to reduce memory specificity for people with depression. Evidence is sparse and less consistent with other aspects of memory functioning. While some data suggested working memory to be related, other common depressive cognitions such as negative bias in encoding and recall did not seem to have a direct relation with rumination. Lastly, two different formulations of rumination subtypes (i.e. high-low self-analytic thinking; brooding and reflection) were adopted by the different research groups, and both seem to be developing in terms of evidence which explains their underlying mechanisms.

Thinking Biases

Clinical evidence has shown that depression is characterised by negative biases in interpretation and appraisal (e.g. Butler & Mathews, 1983; Alloy et al., 2000; Fresco, Alloy & Reilly-Harrington, 2006), although this has not always found support in empirical studies (Lawson & MacLeod, 1999; Bisson & Seara, 2007). More recent studies have demonstrated that these negative biases are related to higher rumination (Robinson & Alloy, 2003; Watkins, 2004), and that their interactions with rumination predict depressive symptoms (Cielas & Roberts, 2007). One possible explanation is that thinking biases tend to create rigid, automatic and negative thought responses to dysphoria, which interacts with the heightened tendency to ruminate to create a cognitive-affective vicious cycle that exacerbates depressive symptoms (Teasdale, 1999; Siemer & Reisenzein, 2007). Six studies that examined these effects in depressed patients have been identified.

Early support for the role of rumination came from the findings of two longitudinal studies that looked at the effects of rumination and negative cognitive styles on the development of depressive symptoms over time. Spasojevic and Alloy (2001) followed 137 originally non-depressed college students for 2.5 years and found that an initial association between the tendency of responding to low mood with rumination and strong negative cognitive styles as measured by the Cognitive Style Questionnaire (CSQ) was significantly related to their number of depressive episodes over the tested period. Further mediational analyses reported that rumination explained the association between negative cognitive biases and the frequencies of major depressive episodes.

From the same study project, Robinson and Alloy (2003) extended the above findings by distinguishing trait self-focussed rumination as conceptualised by the RST and a more specific tendency to ruminate on self-referential thoughts following stressful events (or stress-reactive

rumination, SRR) (Alloy et al., 2000). They monitored the development of depressive symptoms in 148 depressed patients for 2.5 years, and reported that participants who showed higher initial negative cognitive styles (on CSQ) and SRR had the highest incidence and duration of major depressive episodes. When controlled for the main effects of SRR and negative cognitive styles alone, they found that the interaction between these two variables significantly predicted later depressive episodes. This finding was later supported by a study which showed that rumination predicts changes in depression more strongly among individuals with high levels of negative cognition (Cielas & Roberts, 2007). Interestingly, they did not find the same interaction effect for ruminative responses to depressive symptoms as measured by the full RRS. They concluded that although rumination in response to depressed affect was related to the maintenance of depression, there was a unique component of SRR that contributed to the onset and persistence of depressive episodes.

As part of their study, Lam, Smith, Checkley, Rijsdijk, and Sham (2003) investigated the associations of rumination scores on the RRS to hopelessness, biased attributional style (e.g. a global, internal and stable interpretation of negative events), maladaptive attitudes, and the numbers of past depressive episodes in 109 outpatients with depression. Regression analyses of their data suggested that rumination predicted all factors except for the retrospective lifetime episodes of depression, after controlling for the effects of gender and depressive symptoms. The latter is consistent with the findings of Robinson and Alloy (2003) which suggested that although rumination as formulated by the RST might maintain depressive symptoms, it does not predict the onset or the number of past depressive episodes. Studies with a prospective design may serve as a next step to verify the predictive role of the different subtypes of rumination. It is also unclear if the findings were specific to depressed patients, as the study did not include any control study group.

An empirical study carried out by Rimes and Watkins (2005) extended these findings. Comparing depressed patients (n=30) with non-depressed controls (n=30), they measured the effect of analytical self-focus, a subcomponent of rumination, on their self-reported levels of negative self-judgements. Participants reported for their worthlessness, lovability, competence and acceptability, before and after they undertook either a self-focussed analytical thinking or an experiential self-focussed induction procedure. The results showed that, after controlling for depressed moods, analytical self-focus significantly caused increases in negative self-judgement, especially worthlessness and incompetence, in depressed patients alone. Hence they suggested a specific and causal effect of self-focussed analytical thinking on cognitive biases in depression. In the light of these findings, it might be inferred that rumination increases risk of future depression partly through increasing maladaptive cognitive biases. However, along with Lam et al.(2003) study, it relied exclusively on self-report measures. Therefore, at least some of their results may be affected by response biases and demand effects.

Further evidence for the effect of rumination on depressive cognitions was reported by Lo, Ho and Hollon (2008). They contrasted the associations of brooding and reflection (subscales of RRS) separately with negative cognitive styles (on ASQ) between depressed patients (n=38) and healthy college students (n=115). Brooding, but not reflection, mediated the association between negative cognitive styles and depressive symptoms in both groups. These results strengthened the differentiation between brooding and reflection as two subtypes of rumination as postulated by Treynor et al. (2003). Compared with the findings of Rimes and Watkins (2005), the results may also suggest that brooding is a more general process than self-analytical thinking, as it seems to explain the effects of unhelpful cognitions in both depressed and non-depressed individuals. This study did not document any formal diagnostic procedure, which needs to be considered before generalising its results to clinical populations. It also had a relatively small sample size for a formal mediational analysis, which might limit the statistical

power of the test. Future studies aiming to verify these findings may consider using a prospective or empirical design in order to better elucidate the mediating role of brooding.

Hopelessness is a hallmark symptom of depression (Abraham, Alloy & Metalsky, 1989). A studyby Lavender and Watkins (2004) investigated the effect of rumination on depressed patients' (n=30)biases in future thinking . Using a future thinking task, they compared depressed patients with healthy controls (n=30) in terms of their abilities to imagine positive and negative events, after either a rumination or distraction induction. Rumination increased the level of negative future thinking only in depressed patients. This suggested that rumination may at least partially account for the experience of hopelessness in depression. The study's strength is that the authors measured the verbal fluency of all participants, hence controlling for the variation of the thought-generation abilities in the sample during the experiment; the control participants were also matched for age, IQ and gender. However, although the authors measured the mood changes before and after the induction tasks, they did not control for them in their analyses. Therefore, the changes in the participants' future thinking might also be explained by the changes in their mood-states.

Attentional Biases

Although impairments of attentional control were frequently referred to in studies of rumination and cognitive dysfunction, such as inhibitory deficit and set-shifting (e.g. Davis & Nolen-Hoeksema, 2000; Whitmer & Banich, 2007), they were not tested directly in empirical studies. On the other hand, more research was focussed on the related area of attentional bias. Although most past evidence showed an absence of biased attention in depression, recent empirical studies had shown a few exceptions, for example, perceptual biases of facial expression (e.g. Carton et al., 1999); biases for stimuli presented for long post-conscious

duration in attention tasks were reported of people with dysphoria (e.g. Mogg, Bradley & Williams, 1995; Mathews, Ridgeway & Williamson, 1996). A review of the literature has yielded two studies which investigated rumination and attention in people with depression. This small number perhaps reflects the overall lack of research on this subject.

As the first study which empirically explored the relations between attention and rumination in depression, Donaldson, Lam and Mathews (2007) tested the effect of rumination and distraction induction on attentional bias for emotional materials in patients diagnosed with MDD (n=36) and healthy controls (n=36). Participants' levels of trait rumination were also assessed. Attentional bias was measured by a dot probe task, in which participants were presented pairs of words (neutral and negative) for either 500ms or 1000ms, and asked to respond to dot stimuli that replaced either of the words. A bias is indicated by quicker responses to dots that replaced negative rather than neutral words. The results reported that depressed patients demonstrated biased attention towards negative information only when stimuli were presented for a longer post-conscious duration, i.e. 1000ms. Although the bias was not influenced by rumination or distraction inductions, it was significantly related to trait-rumination.

One possible explanation is that rumination induction might not be a good enough analogue of naturally occurring rumination. Since this is the first experiment which tested the effect of rumination on attention, future research may use a longer, or a different, induction procedure to replicate this finding. Besides, given the close relations of attentional control with different cognitive processes, it is possible that the effect shown in this study might not be a specific one. This may be examined by including measurement of relevant cognitive processes in future studies.

Raes, Hermans and Williams (2006) examined the association between rumination and perception of emotional facial expressions, another attentional bias previously reported in

depression. For this purpose they measured 26 depressed patients for their tendency to see negative emotions in facial expression (using the Perception of Facial Expressions Questionnaire, PFEQ) and their trait-rumination using the RRS. They found that rumination was significantly related to the level of negative expression perceived by the participants, even after their maladaptive thinking patterns, and their depressive and anxiety symptoms were controlled for.

Finally, as part of the study conducted by Joormann, Dkane and Gotlib (2006), 64 depressed participants undertook a dot-probe task in which they were asked to look at a series of pictures showing emotional facial expression. Analyses of the experiment's results suggested that depressed individuals had a significant attentional bias towards sad faces. This bias was found to be related to their brooding scores on the RRS, but not their reflection scale scores, even when the results took into account their initial depressive symptoms.

Inhibition Deficits

Major depression has been associated with deficits in executive function. Specific areas of impairments included the inhibition of irrelevant materials in working memory, attentional set-shifting, and problem-solving (see Joormann, 2005; Gotlib & Joormann, 2010). Although executive dysfunction may be a primary effect of depression, research evidence has demonstrated that it may also result from interference by rumination.

Watkins and Brown (2002) used a random number generation task to test capacities to inhibit habitual counting in depressed (n=14) and non-depressed participants (n=14) after they received either a rumination or distraction induction. They demonstrated that depressed participants who were induced to ruminate had a significantly stronger tendency to count

habitually than the non-depressed participants, indicating a lower ability to inhibit pre-potent and irrelevant responses. On the other hand, depressed participants who undertook distraction induction achieved on par with the non-depressed participants in the task. For this reason, the authors concluded that inhibitory deficits in depressed patients resulted from the interference of rumination–which takes up the cognitive resources required for the effective inhibition of irrelevant information from the working memory–rather than a fundamental impairment in executive functioning.

One of this study's strengths is that it examined the participants' ruminative states during the experimental tasks; this allowed it to make conclusions about the disruption of ruminative thinking on these tasks due to its competition for cognitive resources. However, the authors did not establish a baseline performance for the random number generation task, and therefore could not control for the effects of individual variability in the participants' original inhibition capacities.

Adding to previous findings, Lau, Christensen, Hawley, Gemar and Segal (2007) looked at the inhibitory deficits of emotional materials in depression. They compared depressed outpatients (n=43) with both non-depressed anxious (n=32) and healthy (n=36) volunteers for levels of trait-rumination, negative thinking, and cognitive inhibition. To assess cognitive inhibition, participants were asked to read out loud stories embedded with distractors made up of positive, neutral or negative words. The time participants took to read through the stories was taken to reflect their abilities to inhibit the processing of emotional thoughts triggered by the distractors. Depressed patients performed significantly slower on the tasks with negative distractor words, but similarly to the other two groups on the tasks with positive and neutral words, indicating a specific deficit of inhibition of negative materials. Furthermore, regression analyses showed that this was also positively correlated to and predicted the frequency of negative thinking and

rumination. Therefore, as well as showing a valence-specific inhibition deficit in depressed individuals, these results also suggested that people with depression may have a weakened ability to inhibit the activation of repetitive negative thoughts. However the correlational analysis used by this study does not allow it to conclude whether the inhibitory deficit in depression is a causal risk factor for rumination.

Further evidence of the link between rumination and dysfunctional inhibition of negative information was demonstrated in a study by Joormann and Gotlib (2010). Using a negative priming task with emotional word stimuli, they reported a reduced ability to inhibit negative words that participants had been asked to ignore (or reduced negative priming effect) by depressed patients (n=22), compared to remitted (n=47) and never depressed participants (n=32). They also assessed rumination using the RRS, and compared brooding and reflection subscale scores with the outcomes of negative priming of different groups. They found that in depressed patients, inhibitory deficit was positively associated with brooding, but negatively associated with reflection, after depression severity was controlled for. This provided evidence for a dissociation between the two subtypes of rumination in relation to inhibitory deficits. It was worth noting that neither inhibitory deficits nor any relations between inhibition and rumination were found in the formerly depressed group, suggesting that inhibitory deficits may remit with other depressive symptoms in recovery. Instead its severity seemed to vary with the use of adaptive or maladaptive repetitive thinking.

Using a negative priming task with emotional faces as stimuli, Goeleven, de Raedt, Baert and Koster (2006) reported apparently opposite results. They compared the response times of 20 depressed inpatients, 20 formerly depressed and 20 non-depressed controls, to happy, neutral and negative faces they were earlier instructed to ignore. Although the depressed participants showed the predicted inhibitory deficit (or lower negative priming effect) for sad faces, no

relation was reported between that and rumination. A possible explanation for this finding may lie in the use of visual stimuli (emotional faces) in this study, which may not have a direct relation with verbal thinking, in which rumination is conducted. Moreover, this study did not examine separately the relation of inhibition with reflection and brooding, which are both parts of the rumination response scale (RRS). As reflection and brooding were shown to have opposite associations to depressive cognitions in previous research, analysis using the combined score may mask more specific relations between a subtype of rumination and inhibition.

Most studies on inhibitory deficit in depression so far have investigated the impairment in controlling access of irrelevant information to working memory, such as studies using the negative priming paradigm. However, a small but growing literature has explored other hypotheses of the mechanisms underlying inhibitory deficits.

Joormann and Gotlib (2008) looked at inhibitory dysfunction at a relatively later stage of information processing, namely the mechanism of removing irrelevant materials to update cognitions in working memory, and its relation to rumination. They used a recognition task where participants were instructed to respond according to emotional word stimuli which were either shown earlier to them as 'relevant' or 'irrelevant', or were completely new. Then they compared participants' response latencies for the irrelevant words and new words, as the index of the interference of irrelevant (and supposedly ignored) emotional words on their working memory functions. It was found that participants diagnosed with MDD were significantly slower in response to the 'irrelevant', negative words than healthy controls. All their performances were otherwise comparable to the controls, which suggested that depressed patients were more susceptible to the residual activation of cognitions in working memory that were declared to be no longer relevant, and that there is a bias in this effect for negative materials. In addition, this

effect was found to be correlated with rumination as a response style in depressed patients, after their depressive symptoms were controlled for.

It was noted that this study yielded positive relations of brooding as well as reflection with increased interference of irrelevant information to working memory in depressed patients. This suggested that interference of irrelevant materials on working memory is related to a higher tendency of general repetitive thinking rather than just maladaptive pondering. Also, this study included a sub-group of healthy controls which undertook a sad mood induction. As they did not demonstrate any impairment in their responses to irrelevant negative words, the effect shown in the depressed patient group could not be explained by low mood alone. However, it is unclear if an induced negative mood state is comparable to negative mood in major depression; therefore mood as an explanation for the differences shown between groups cannot be completely ruled out.

Impairment in Allocation of General Cognitive Resources

An alternative hypothesis for the mechanism which underlies cognitive deficits in depression is the executive dysfunction in allocating cognitive resources to resolve competing task demands in complex situations (Hasher, Zacks & May, 1999). Deficits in cognitive resources allocation had been suggested to be a result of , as well as a contributing factor to habitual rumination (Hertel, 1998; Beevers, 2005).

To examine this hypothesis, Gotlib, Muhtadie and Levens, (2009) assessed individuals diagnosed with MDD and never-depressed controls using a dual-task paradigm, and explored how rumination was related to their performances. In the dual-task condition, all participants were asked to undertake a recency-probes task (a task used to examine interference of outdated materials on working memory) and a tracking task concurrently, in order to increase

the load on effective cognitive resources allocation to resolve competing task demands. The response times of each group were compared to those when tasks were carried out separately. The results showed that response times were significantly delayed when depressed patients carried out the dual-task condition. Otherwise, depressed and non-depressed participants exhibited comparable results in all other conditions. In addition, the authors found a significant relation between brooding and impaired resources allocation, which was only restricted to the depressed group. Overall these results seemed to support the hypotheses that depressive cognitive deficits lie in impairments to a general mechanism, rather than specific cognitive processes, and they are related to maladaptive rumination. However, the findings from this study were not able to draw a conclusion on the mechanism that underlies the exclusive effect of increased cognitive load on depressed patients. Also, due to the limitations of correlational study, empirical research will be required in the future to explore the causality in the relations between rumination and resources allocation deficits.

Thought Controls and Suppression

Previous research has found that thought suppression under stress can lead to an increase in the accessibility and thus the frequency of suppressed thoughts. It was proposed that such an ironic effect was due to the failure of suppression owing to depletion of cognitive resources by stressful experiences, and a parallel process activated by suppression which remained vigilant of signs of unwanted and distressing thoughts as targets for further suppression effort (Wegner, 1994; Wenzlaff & Wegner, 2000). Depression is a disorder characterised by persistent negative thoughts. Indeed, past research has shown an association between thought suppression and depression (Spinhoven & van der Does, 1999; Wenzlaff et al., 2001; Wenzlaff, Rude, & West, in 2002; Wenzlaff, Meier, & Salas, 2002). In a longitudinal study, Wenzlaff and Luxton (2003)

supported these findings through demonstrating that thought suppression and stress predicted an increase in rumination in undergraduate students. However it remained unclear what cognitive mechanisms underlie this relation.

Watkins and Moulds (2009) attempted to extend previous evidence by examining the interrelations between thought suppression, rumination, and other thought control strategies by comparing the measures of these factors in individuals who are currently depressed (n=52), formerly depressed (n=36), and healthy controls (n=49). They reported that whereas self-reported rumination was significantly correlated with thought suppression across the whole sample, there was not a specific relation between them among people with current diagnoses of MDD. Surprisingly, they also demonstrated no relation between rumination and any thought control strategies measured, including distraction. In addition, the results contrasted with previous studies and showed that suppression was not linked to depression. On the other hand, thought suppression was related to a number of thought control strategies such as distraction and self-deprecating thoughts. Although they partly supported past studies by showing an association between rumination and thought suppression, taken together, these results suggested that depression is linked to rumination through a different set of mechanisms to those that linked it to thought suppression. Future study may help clarify their relationship through exploring the interactional effects of rumination and thought suppression on depression.

However, it needs to be noted that even though the RRS measured trait-like tendency to ruminate in response to depressed moods, its items do not specifically tap one's responses to intrusive thoughts the way those used in this study's Thought Control Questionnaire (TCQ) do. This mismatch in measuring instruments may in part explain the lack of relationship demonstrated between rumination and other thought control strategies. Also, this study relied

entirely on self-reported measures. Therefore its outcomes might have been influenced by demand effects and the beliefs of the participants.

In another recent study, Szasz (2009) investigated the relationship between rumination and thought suppression in 43 Romanian inpatients with high depressive symptoms. Consistent with most previous findings, the author reported significant interrelations between depression, rumination and thought suppression. In a further mediational analysis, he showed that thought suppression's relation to depression was mediated by rumination. The author proposed that the mediational effect might be explained by the ironic effect of thought suppression (Wegner, 1994), which leads to heightened frequencies of unwanted thoughts. There are a number of limitations to this study, however. First, the White Bear Suppression Inventory used in this study as an objective measure of thought suppression was criticised for having significant overlaps with the RRS, which was also used (Watkins & Moulds, 2009). This might confound the result which suggested that rumination explained the effect of suppression. Also, the author did not establish the diagnostic statuses of the depressed patients in the study, hence did not control for the potential influences of other psychopathologies (e.g. anxiety and worries) on participants' measures of thought intrusion and suppression.

Problem-solving Deficits

Deficits in social problem-solving have long been identified as characteristic of clinical depression (e.g. Beck, 1976; Nezu & Ronan, 1985; Nezu, 1986). More recently, researchers suggested that rumination as a cognitive habit has an important role in both the onset and maintenance of social problem-solving difficulties in depression. For instance, Lyubomirsky and Nolen-Hoeksema (1995) first posited that rumination may impair problem-solving through its effect on depressive mood. On the other hand, rumination, conceptualised in the S-REF theory

as a goal-directed self-regulatory strategy (Wells & Matthews, 1994, 1995), may also persist

due to failure in achieving personal goals because of poor problem-solving. Several recent

studies have examined these formulations and revealed possible mechanisms which underlie

the influence of rumination on impairment in social problem-solving.

Adopting Kuhl's (1981, 1994) conceptualisation of state-oriented rumination (or analytical

thinking about the cause and consequence of one's mood states and external problems),

Watkins and Baracaia (2002) investigated its effects on depression-related social problem-

solving impairment. Depressed (n=32), formerly depressed (n=26) and never-depressed (n=26)

participants were subject to the Mean-End Problem-Solving Task (MEPS), in which they

provided solutions for hypothetical social problems, after they undertook either a state-oriented

rumination or process-focussed thinking induction. A third group of participants were assigned

to a no-induction condition as control. Relative to never-depressed participants, who did not

show impairment in either conditions, the depressed and formerly depressed patients showed

significant impairments in their problem-solving after the state-oriented induction. This outcome

was similar to those of the depressed patients in the no induction condition, which suggested

that they had state-oriented rumination as their default thinking style. On the contrary, the

results of depressed and formerly depressed participants were substantially improved by the

induction of process-focussed thinking; they achieved on par with the healthy controls.

On the whole, these results suggested that rumination impairs problem-solving in people with

depression. In particular, the impairments demonstrated by formerly depressed participants

implied that ruminative traits may also increase one's vulnerability to problem-solving deficits,

although this could not be confirmed as the authors did not include any trait-rumination measure

in this study. In addition, the analyses in this study did not control for differences in levels of

despondency between the 3 participant groups. Therefore it was not possible to discriminate if rumination influences problem-solving directly or via the effects of negative mood.

In a similar study, Watkins and Moulds (2005) examined the influence of abstract self-focussed vs. concrete self-focussed thinking on the social problem-solving abilities of people with depression. They compared 40 depressed and 40 non-depressed participants' performance on the MEPS before and after an abstract or concrete thinking induction task. Consistent with the reduced concreteness theory (Stober & Borkovec, 2002), the induction of concrete thinking increased the solution effectiveness of and number of solutions generated by participants with depression. Near significant opposite effects were found after the abstract thinking induction procedure. No such change was shown in the non-depressed group. Past research has shown that depressed individuals tend to have less concrete, but more abstract and overgeneral contents in their ruminative thinking (Watkins & Moulds, 2007). Therefore these findings provided evidence for the hypothesis that rumination impairs problem-solving abilities in depression by being less detailed and concrete, rather than, as purported previously by the RST by Nolen-Hoeksema (1991), being self-focussed in nature alone. Unlike the previous study by Watkins and Baracaia (2002), this study established the baseline performance (before the inductions) of their participants in the problem-solving task. This allowed the authors to identify the specific influence of the element of rumination which caused the depression-related impairment in problem-solving.

Although both trait and experimentally induced states of rumination are frequently examined in research of depressive cognitions, few studies explicitly distinguished their influences. In their study, Donaldson and Lam (2004) contrasted trait and induced rumination in terms of their relations with the problem-solving abilities of participants diagnosed with depression. Their results showed that induced rumination impaired problem-solving in depressed but not control

participants. This effect was paralleled by a significant relation between trait rumination and lowered MEPS performance in depressed patients only. Indeed, problem-solving was found to be predicted by the interaction between trait and induced rumination in depressed patients. This implied that variance in trait-rumination interfered with the effect of rumination induction. This finding highlighted the importance of isolating the effect of induction procedures by controlling for degrees of trait-rumination in considering past and conducting future studies.

Evaluations and Discussions

As the above review shows, rumination is undoubtedly related to a variety of cognitive processes which characterise depression. However, it is also clear that the current literature falls short of providing a consensual understanding of the nature of these relations, and how they might contribute to the negative effects of rumination. In this respect, several important issues have been raised for discussion.

Conceptualisations of rumination in the reviewed studies

20 studies reviewed used at least 1 objective measure of rumination. 19 of these studies involved the examination of trait-rumination using the RRS. In most cases, conclusions were drawn on the basis of the RRS scores on the relation between rumination and the cognitive processes in question. On the one hand, the RRS provides a quantified measure of rumination, and hence lends itself to easy comparisons with other measurable constructs. However this approach constricts the study of rumination to the assumptions of the Response Style Theory, which formulated rumination as a direct and automatic response to depressive mood (Nolen-

Hoeksema, 1993; Nolen-Hoeksema, Wisco & Lyubomirsky, 2008), and is not embedded within models of wider cognitive processes. Criticism of the RRS also drew attention to the overlap of its items with depressive symptoms measures such as the BDI-II (Conway, Csank, Holm & Blake, 2000), and the lack of factor-analysis (Roberts, Gilboa & Gotlib, 1998; Treynor et al., 2003), suggesting that it might have problems of content validity.

As shown by recent literature reviews, rumination remains a multifaceted construct that lacks a clear and unified definition. Different models such as the RST and the S-REF have basic differences and are not necessarily complementary. Therefore, a bias in focussing on the understanding of rumination as measured by the RRS in research, without explicating its underlying assumptions, runs the risk of neglecting other dimensions of rumination, such as its role in emotional regulation (Wells & Matthews, 1994, 1995) and other functions (Thomsen, 2006. This is likely to have precluded exploration of the cognitive routes through which rumination impacts on depressive symptoms. This might have, to some extent, prevented the integration of rumination research with evidence of other relevant cognitive processes, and therefore the agreement of a cohesive definition that draws on multiple theories and models.

The current review shows that the literature has seen a growing shift away from this fixed position towards explorations of various components of rumination and their cognitive underpinnings. Among the reviewed studies, 5 discriminated between brooding and reflection by conducting separate analyses on these subscales of the RRS. 2 studies looked at the different effects of analytical versus experiential thinking, and 1 study compared rumination as a response to stress (SRR) and that to depressed mood (Robinson & Alloy, 2003). This has allowed the emergence of causal explanations of cognitive biases, such as overgeneral memory and negative biases in self-referential thinking (Watkins & Teasdale, 2001; Rimes & Watkins, 2005), by aspects of rumination like self-analytical thinking. However there is as yet little

consensus on the core elements that distinguish between the adaptive and maladaptive elements of rumination.

A separate issue arising from the review was related to the debate of trait- versus state-rumination as markers of depression. Although studies have repeatedly demonstrated the prevalence of rumination as a trait-like tendency among remitted depressed patients, it has also been shown that negative mood states exacerbate cognitive biases, and therefore elevate the current state of ruminative thinking (e.g. Barnhofer, Chittka, Nightingale, Visser & Crane, 2010). It is therefore reasonable to speculate that the level of trait-rumination could interfere with the effect of experimental induction of a ruminative state. This may confound the investigation of rumination as either a maintenance or vulnerability factor for the onset of a particular cognitive

deficit. It was noticed that of the 8 reviewed studies that used experimental procedures to induce ruminative states as part of their manipulated conditions, only 2 partialled out the their participants' initial differences in trait-rumination in their data analyses (Donaldson & Lam, 2004; Donaldson, Lam & Mathews, 2007). In addition, only Donaldson and Lam (2004) reported differential effects of trait- and state-rumination.

Overall research designs

Regarding the investigation of rumination, 14 adopted a correlational design, looking at the co-occurrence of rumination and other cognitive variables. 8 studies had an experimental element, most of which used induction procedures to examine the effect of induced rumination on a particular cognitive process. In addition, there were 2 longitudinal studies (Spasojevic & Alloy, 2001; Robinson & Alloy, 2003), both of which followed their participants for 2.5 years and evaluated the temporal relations between rumination, thinking biases and depressive symptoms.

The use of a correlational design in the majority of the studies might reflect the ease in administrative terms of this approach. These studies served to test and generate hypotheses on relations between variables, but are unable to provide conclusions on the causality and the directionality of the observed relationships.

Designs, methodologies and the nature of relationships between rumination and cognitive processes

This review's results have demonstrated intricate patterns of how rumination might be related to various cognitive correlates of depression. Whereas some of these connections showed clear causal effects of rumination on cognitive processes, or vice versa, others remained unclear beyond correlations. This section provides an overview of the current state of affairs of the evidence on how rumination and different cognitive processes are linked, offers a critical review on how these findings might be limited by design and methodological issues, and also highlights the areas that need to be addressed in future studies.

Memory

Empirical studies have shown that rumination causes increases in overgeneral memory in depressed patients (Watkins, Teasdale & Williams, 2000; Watkins & Teasdale, 2001). One of these studies showed that this effect comes specifically from high self-analytical thinking, rather than the more general self-focussed component of rumination. It seemed that the depressogenic effect of rumination is at least partly mediated by overgeneral memory, as a later longitudinal study demonstrated that trait-rumination explained the relation between low memory specificity and poorer outcomes of depression (Raes et al., 2006b). However this effect was yet

to be verified empirically. It is also unclear if these relations are unique to depression due to comorbidities of the participants and the lack of case controls in these studies. The effect of rumination appeared to extend beyond overgeneral autobiographical memory. Raes et al. (2005) showed that overgeneral memory mediated the effect of rumination on social problem-solving in depression patients, offering suggestions on the mechanism underlying the depressogenic effect of rumination. Relations were also found with other memory processes, such as reduced working memory and poor source memory (Raes et al., 2006a). The directions and causality of these relations remain inconclusive, however, due to the cross-sectional and correlational designs of these studies.

In terms of methodology, it is worth noting that all 5 studies of overgeneral memory reviewed used the Autobiographical Memory Test (AMT) (Williams, 1995) as their measurement tool for memory specificity. Previous critiques of the AMT had shown that the nature of the stimuli (e.g. verbal or visual cues) and the ways they were presented could moderate performance on the task through experimenter bias or the 'imageability' of the stimuli (see Williams et al., 1999; Vreeswijk & Wilde, 2004 for details). On review of the named studies, there was little consistency over the nature of the stimuli used and their presentation methods, which ranged from oral, tape-recorded to visual presentations. The use of a standard AMT procedure is therefore warranted in future research.

Review of the literature has revealed that despite strong evidence for preferential recalls of negative memory in depression, there is relatively little research on how such biases might be related to rumination. The only study identified in the literature reported no direct relation between brooding or reflection and memory bias (Joormann, Dkane & Gotlib, 2006). As the only study in this area to date, more future research is warranted to verify this result.

Thinking Biases

Studies on the interrelations between rumination, negative cognitive styles, and depression presented a mixed picture of the most relevant components of rumination. First, although preliminary findings from a longitudinal study reported that high levels of negative cognitive styles and trait-rumination together predicted the number of prospective episodes of major depression (Spasojevic & Alloy, 2001), later studies failed to replicate this finding (Checkley & Sham 2003; Robinson & Alloy, 2003). They instead suggested that such a prediction might be underlined by overlapping but different ruminative mechanisms. For example, Robinson and Alloy (2003) found that stress-reactive rumination (SRR) moderated the effect of negative cognitive styles on future depression, and Rimes and Watkins (2005) reported that it was the self-analytical, rather than self-focussed, aspect of rumination which increased negative self-judgement in depression.

This discrepancy might in part be an artefact of the different focuses these studies put on trait- and state-ruminations. For instance, while the inductions of analytical and self-focussed ruminative states increased maladaptive cognitive styles only in depressed participants (Rimes & Watkins, 2005; Lavender & Watkins, 2006), suggesting rumination maintains depressive symptoms, a trait-like tendency to engage in brooding seemed to be related to high negative cognitive styles in both healthy and depressed individuals (Lo, Ho & Hollon, 2008), indicating that trait rumination increases one's vulnerability to developing depression. Although the interference between trait- and state-rumination alone is unlikely to be enough to explain these mixed findings, it highlights the importance for future studies to discriminate between the influences of trait- and state-ruminations.

Another methodological issue pertains to the predominance of self-report measures of negative cognitive styles in the literature. 5 out of the 6 reviewed studies used the Cognitive Style

Questionnaires (CSQ) or the Attributional Style Questionnaire (ASQ) as their primary measure of maladaptive cognitions. A methodological limitation related to self-report measures is their susceptibility to participants' interpretations as well as demand characteristics. The relevance of these problems to research on depressive cognitions has been recognised by recent reviews (Gotlib & Joormann, 2010; Joormann & D'Avanzato, 2010). Overall, studies which used self-report measures were more likely to report the presence of maladaptive cognitive styles in depressed patients than experimental studies, which results tended to be more equivocal.

Attentional biases

Research on attentional deficits in depression and rumination is in its beginning stage. The current review has identified 2 studies on attentional biases in depression, which showed an overall relation between trait rumination and an attentional bias towards negative information (both negative words and sad facial expressions) for participants with depression (Donaldson et al., 2007; Raes et al., 2007). The same relation was however not replicated in the induction of a ruminative state, suggesting a dissociation between trait- and state-rumination. As evidence on attentional biases in depression so far is mixed, attempts to look for any differential effects of the various components of rumination on attentional biases might be a fruitful topic for future studies. Besides, no study to date has looked at the connection between rumination and impairment attentional control, although it has been implied as a mechanism underlying several other areas of executive dysfunction (e.g. Davis & Nolen-Hoeksema, 2000; Whitmer & Banich, 2007). In addition, recent neuropsychological evidence has suggested that rumination might be related to the deficit in attentional disengagement from negative material in working memory (Koster, De Lissynder, Derakshan & De Raedt, 2010). These studies indicate that the interrelation between attentional control on rumination might be a promising area for future research.

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Inhibitory deficits

Strong evidence suggests that rumination is related to deficits in inhibition of irrelevant materials during information processing of people with depression. Of the studies covered in this review, both of those which investigated the effect of an induced ruminative state (Watkins & Brown, 2002) and measured trait rumination (Lau et al., 2007; Joormann & Gotlib, 2010) showed relations to inhibitory deficits exclusively in depressed patients. In addition, the studies reported that these deficits disappeared after depressed patients undertook a distraction induction, and were absent in formerly depressed patients. Taken together, they provided support to the hypothesis that inhibitory deficits in depression are the result of interference by rumination and other depressive symptoms, rather than a fundamental executive impairment. Additional findings suggested that these effects by rumination might be limited to verbal information, as one study found no relation between rumination and the biased inhibitory deficits of sad faces in depressed patients (Goeleven et al., 2006), suggesting that other mechanisms might also underlie depression-related inhibitory deficits.

A related question raised by the collective findings in the literature is how rumination is related to the valence-specificity of inhibitory deficits in depression. Although rumination was connected to inhibitory deficits of negative information in the majority of the reviewed findings, research has also shown that it relates to inhibitory dysfunctions of general information when only emotionally neutral stimuli were used in experiments (e.g. MacQueen et al., 2000; Watkins & Brown, 2002). Therefore, it is reasonable to speculate that participants' performance in experimental paradigms which employ emotionally-valenced stimuli (e.g. negative affective priming task) might reflect the effects of other common depressive cognitive processes, like interpretive and attributional biases, along with those of rumination. Future research may remedy these

methodological problems by controlling for the effects of other related cognitive processes for a focal and direct test of the effects of rumination on inhibitory deficits.

Thought control and suppression

The current review's results suggested that research on rumination and thought suppression in depression is still in an early stage. Only one study to date has demonstrated the possibility that rumination may mediate the connection between depressive symptoms and thought suppression (Szasz, 2009). Although this lent support to the existing hypothesis about the ironic effect of thought suppression on the persistence of rigid and repetitive thinking (Wegner, 1994), other research effort was not able to replicate these findings (Watkins & Moulds, 2009). Overall, both studies included in this review had a correlational design, which did not allow them to draw conclusions on the causal effect of thought suppression on rumination. Moreover, there seemed to be debates on the suitability of existing measurement tools on thought control for research on rumination. Particular concerns were raised about whether RRS, the most commonly used measure of trait-rumination, was able to capture the hypothesised effect on repetitive thinking by thought suppression. Also, the RRS seemed to have a high level of overlap with the White Bear Suppression Inventory, which might have led to false positives in research outcomes. These issues suggest that a diversification of assessment tools and empirical studies might be fruitful avenues for future research.

Problem-solving

Research has demonstrated that specific components of ruminative states impair social problem-solving for people with depression. In particular, the inductions of state-oriented, self-

analytical (Watkins & Baracaia, 2002) and abstract thinking (Watkins & Mould, 2005) were shown to directly cause deficits in a problem-solving task for depressed patients. In addition to state-rumination, Donaldson and Lam (2004) also reported a significant relationship between trait-rumination and impaired problem-solving abilities in depressed patients. This suggested that problem-solving deficit is a vulnerability factor to, as well as a symptom of depression. Longitudinal studies of the long-term effects of rumination and poor problem-solving on the development of depression in the future may serve to confirm this finding.

Limitations of the Present Review

One of this review's potential limitations is the difficulty involved in deciding on the parameter of the research areas to be included. The increasing interest in rumination and its connections to cognitive deficits and maladaptations have given rise to several strands of studies in the literature. The current review purposefully focuses on exploring findings related to well-defined processes of cognitive functions commonly found in depression to afford specific attention to mechanisms underlying rumination's effects on clinical depression.

However, this means this review needed to narrow its coverage to the exclusion of other well-researched, but more general cognitive constructs which offer explanations for rumination such as metacognitive beliefs (e.g. Papageorgeou & Wells, 2001, 2003; Watkins & Moulds, 2005). This review also did not cover clinical research on rumination and mindfulness (e.g. Broderick, 2005). This is due to the lack of evidence on the link between the effects of mindfulness and well-studied and specific cognitive processes to date. However it was possible that this approach had overlooked data due to the difficulties in unpicking relevant information on cognitive processes, which could be deduced from the intricacies in the results of these studies.

Although the current review focusses on studies with depressed participants, it needs to be reminded that a large literature on rumination and cognitions exists which included participants from non-clinical populations. Despite being out of the current review's scope, they have reported valuable findings that shed light on the cognitive routes through which rumination relates to depressive symptoms such as dysphoria. They were not included here partly due to the current review's aim to highlight the researched phenomenon in the context of major depression, which implies a set of vulnerability factors that is exclusive to this subset of the population. This is also because this review would otherwise become too lengthy and ambitious.

Conclusions

With a growing awareness of the centrality of rumination as a vulnerability and maintenance factor for depression, the need for research into the factors underlying its detrimental effects is imminent. Research has consistently uncovered associations of rumination with various cognitive processes. However, there is a persistent lack of integration between these findings and studies of rumination-related psychopathologies. It is for this reason that this literature review set out to investigate the nature of the relations between rumination and the common cognitive biases and impairments related to depression as indicated by the existing body of research. For this purpose, it summarised research studies over the past 20 years that examined rumination and major cognitive processes in the context of a diagnosis of major depressive disorder.

Complex patterns of relations between rumination and depressive cognitive processes emerged from the present findings. These include the identification of a wide range of cognitive features associated with rumination amongst individuals with depression. In particular, rumination was

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shown to be connected with reduced specificity in memory, negative biases in memory recall, cognitive and attentional biases, deficits in inhibition and thought controls, and social problem-solving. All of these correspond to the known cognitive correlates of depression (see Joormann & Gotlib, 2010). Although the majority of the existing theories of rumination (with the exception of the S-REF model) (Wells & Matthews, 1994, 1996) do not propose links between rumination and cognitive processes, theoretical frameworks that unify findings from mainstream cognitive and rumination research have begun to emerge, e.g. the attention deficit hypothesis of rumination (Koster, Lissnyder, Derakshan & Raedt, 2011). The findings covered in this review are therefore potentially of use in offering a collation of data that could facilitate the formulations of new theoretical accounts that bring together these two approaches.

However, despite the wealth of research data that link rumination with various cognitive processes and impairments, the nature of these connections are not yet conclusive. Several reasons have emerged from this literature review, which may provide directions for future research. They include the lack of consistency in the definitions of rumination adopted by the studies in the literature, which warrants further studies to make distinctions between and clarify the different sub-components of rumination. This review also emphasised a number of specific as well as general designs and methodological issues. The latter highlighted the limitations of the correlational design, which constituted a significant proportion of the literature, and the potential problems of not distinguishing the influences of state- and trait-rumination of participants.

Finally, the clear associations between rumination and the common cognitive features of depression demonstrated in this review are likely to have clinical implications for the psychological treatment of depression. Traditional cognitive models of depression place strong emphases on the impacts of negative thought contents on negative mood states, while rarely

addressing maladaptive mental processes like rumination (e.g. Clark & Beck, 1999). This might

offer an explanation to the research findings, which suggested that most recovered depressed

patients continue to suffer from depressive rumination and other residual symptoms (Judd, 1997;

Judd et al., 1999; Paykel et al., 1995). Clinical evidence has long since suggested that

rumination contributes to the relapse of depression. This is consistent with the findings from this

review, which show that rumination has considerable influence on cognitive processes which

could exacerbate negative thoughts, such as thinking and attentional biases, while at the same

time being maintained by other cognitive vulnerability factors of depression like impairments of

inhibition and problem-solving.

For these reasons, from a clinical perspective, the conventional distinction between the content

and process of thoughts may be artificial and even counter-productive. More recent

developments in cognitive therapies have seen therapy research moving away from this position,

and the emergence of treatment models which address the process of depressive cognitions,

e.g. the rumination-focused CBT (Watkins et al., 2007) and mindfulness-based cognitive

therapy (Teasdale et al., 2000). However, many of these research areas, especially treatments

targeting rumination, are still rudimentary. Therefore, the evidence summarised in this review on

the various cognitive factors related to rumination may enable future researchers to more

accurately identify critical cognitive factors that underlie the chronicity and relapse of depression

as targets for clinical intervention.

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PART 2: EMPIRICAL PAPER

The cognitive vulnerability factors for depression from a mood-as-input perspective

Abstract

There is now consistent evidence which shows that rumination increases vulnerability to depression and maintains depressive mood states. It is as yet unclear, however, what mechanisms underlie this effect. *Aims:* This study compared the mood-as-input theory prediction about perseverative rumination in participants with a diagnosis of major depressive disorder (MDD) with healthy controls. It also evaluated the differences in mood changes within a rumination bout between the two experimental groups. *Methods:* A structured rumination interview was used to facilitate participants' reflection on two previous depressive incidents while deploying a specific stop-rule (either an "as-much-as-can" or "feel-like-continuing" stop-rule). *Results:* In line with the mood-as-input hypothesis, degrees of perseveration exhibited by the participants were partly determined by the interaction between diagnosis and stop-rule, with levels of preservation being greatest when depressed participants used the AMAC stop-rule. This suggests a mechanism that may contribute to perseveration in depressive rumination. On the other hand, increases in negative moods over the rumination interview were shown to be influenced only by participants' degree of psychopathologies, rather than their use of stop-rule. This study also explored depressed and control participants' natural thinking styles in terms of stop-rules. Compared to controls, depressed participants reported a biased use of "as-much-as-can" stop-rule in response to negative mood states in their everyday lives. *Conclusions:* Overall, these results suggested that the mood-as-input hypothesis successfully predicted the persistence of rumination in depression, but the detrimental effects of rumination was likely to be influenced by other depression-related factors. The present finding also indicated that depressed individuals may use a default "as-many as-can" stop-rule. The interrelations between depressive moods, default stop-rule use, and trait-rumination were discussed in terms of the

metacognitive model of depression and rumination, in particular, their relations to positive and

negative beliefs about the consequences of rumination.

Introduction

Background to research

Major depressive disorder (MDD) is a debilitating psychological disorder characterised by prolonged and recurrent periods of low mood, a loss of interest and motivation in enjoyable activities, sense of worthlessness and in some cases, suicidal thinking (DSM-IV, APA). Mounting research evidence shows that ruminative thinking is closely related to depression (see Rood, Roelofs, Bögels, Nolen-Hoeksema & Schouten, 2009) . Rumination can be broadly defined as a persistent, repetitive, and self-focussed thinking style concerned with the causes, meanings and consequences of dysphoric mood or stress. It was demonstrated that a tendency to ruminate following stressful life events predicted the retrospective as well as prospective onset, number and length of depressive episodes (Alloy et al., 2000; Robinson & Alloy, 2003). Research has also shown that rumination is a maintaining factor of depressive symptoms (Lyubomirsky & Tkach, 2004; Moberly & Watkins, 2008, 2010). Indeed, the presence of trait rumination has been found to impinge on the outcome of psychological therapy for depression (Siegle, Sagrati & Crawford, 1999; Jones, Siegle & Thase, 2008), and therefore is likely to contribute to future relapses.

Although research in the past two decades has established rumination as a critical cognitive process in the aetiology and persistence of depression, little understanding exists on the mechanism underlying the relationship between rumination and depressive symptoms. The literature contains a range of theoretical models of rumination; most of them vary in their postulations of the content and focus of ruminative thinking. For instance, the response style theory suggests that rumination is a self-focus, repetitive thinking style triggered in response to depressive symptoms (Nolen-Hoeksema, 1991; Nolen-Hoeksema, Wisco & Lyubormirsky,

2008); other models argue that rumination is focussed primarily on negative emotional states (e.g. Conway, Csank, Holm & Blake, 2000); whereas the stress-reactive formulation of rumination argues that depressive rumination is precipitated by stressful life events (Alloy et al., 2001). Despite their variations, however, these models mostly assume a direct relationship between rumination and their precipitating factors, and do not offer an explanative account for the recurrent and perseverative nature of rumination.

One exception to this is the mood-as-input model for perseveration (Martin, Tesser & McIntosh, 1993; Martin 1999). According to this model, rumination is not inherent to low mood or distress. Instead, the effect of mood states depends on the way they are interpreted in the context of a person's 'stop-rule'. 'Stop-rules' are functional concepts used to describe the intuitive decision-making strategies a person uses to determine whether the goal of the current task has been met and, therefore, when to stop their current line of thinking. In other words, rumination is viewed as serving a function of goal-progress or as a problem-solving attempt. In their original study of the mood-as-input model, Martin, Ward, Achee and Wyer (1993) first operationalised the evaluation of goal-progress as the 'As-much-as-can' (AMAC) stop-rule during a word generation task. In this task, participants in either a positive or negative mood were asked to stop the task only when they had reached the goal of generating as many bird names as possible. The results were contrasted with those of the same participants when they were asked to stop when they no longer feel like doing it, or to follow the 'Feel-like-continuing' (FLC) stop-rule. The results showed that participants using the AMAC stop-rule persisted in the task for longer than those using the FLC stop-rule only if they were in a negative mood state. The authors concluded that mood states carry different meaning to the participants according to the stop-rule they adopt. That is, they used their moods to evaluate if they had met their specific and current goal.

Although the mood-as-input model was proposed as a hypothesis for the mechanism underlying perseverative thinking in general, the majority of its research to date has been focussed on pathological worrying (e.g. Startup & Davey, 2001, 2003; Davey, Startup, MacDonald, Jenkins & Paterson, 2005; Davey, Eldridge, Drost & MacDonald, 2007). In a study by Startup and Davey (2001), high-worriers (participants who scored highly on trait worry) were found to spend significantly longer than low-worriers on a worrying task only when they were asked to use an AMAC, rather than a FLC, stop-rule. As high-worriers reported significantly higher levels of low mood than low-worriers in this study, the results confirmed the mood-as-input hypothesis. Furthermore, the AMAC stop-rule was found to be significantly related to trait worry, shame, guilt and metacognitive beliefs about the positive and negative implications of worrying (Davey et al., 2005). These findings suggest the AMAC stop-rule is an important feature of perseverative thinking in worrying.

Compared to worrying, rumination has received relatively little research interest from a mood-as-input perspective. However, evidence from past research has suggested much similarity between these two cognitive processes (e.g. Fresco, Frankel, Mennin, Turk & Heimberg, 2002). Despite the high rate of comorbidity between depression and anxiety, which are by convention related to rumination and worrying, respectively, studies have found that measures of rumination and worrying remained significantly correlated even after depressive and anxious symptoms were controlled for (Segerstrom, Tsao, Alden, & Craske, 2000; Beck & Perkins, 2001). Similarly, Fresco and colleagues (2002) conducted a factor analysis on items from common worry and rumination measures, and found that the factors that emerged from these scales are strongly correlated with each other. In addition, both high-ruminators and -worriers reported to hold beliefs about the usefulness or benefits of these thinking processes (Watkins & Baracaia, 2001; Davey et al., 2005). Therefore, it is reasonable to speculate that there are commonalities in the mechanisms that relate both worrying and rumination to negative moods.

So far, evidence for the mood-as-input model of perseverative rumination came from two empirical studies using a *rumination interview* paradigm (Watkins & Mason, 2002; Hawksley & Davey, 2010). The rumination interview is a structured interviewing procedure adapted from the catastrophising interview task (Vasey & Borkovec, 1992). It was devised as a tool for objectively measuring ruminative perseveration and has been used effectively in previous studies. In their study, Watkins and Mason (2002) reported a pattern of rumination similar to that shown in anxious worry reported by Startup and Davey (2001). They found that individuals who rated highly on trait-rumination tended to perseverate for significantly longer when asked to adopt the AMAC stop-rule. This result was supported by a recent study which compared individuals who underwent positive or negative mood-inductions for the lengths of their rumination while using the AMAC or FLC stop-rules in the same rumination task (Hawksley & Davey, 2010). It demonstrated that people who were asked to use the AMAC stop-rule ruminated for significantly longer than their FLC counterparts only when they began in a negative mood. That is, the interaction of low mood and the use of the AMAC stop-rule contributed to the prolonged rumination they showed in the experiment. These preliminary findings affirmed the goal-progress view of rumination (Martin, Shrira & Startup, 2004), in which subjective mood states are taken by a person as information indicating if sucessfully attained their current goal (as described by the stop-rule).

The view of rumination as a goal-directed activity is consistent with the self-regulatory executive function model (S-REF) of depression (Matthews & Wells, 1996, 2004). It posits that rumination is maintained by metacognitive beliefs that support self- and symptom-focussed rumination as a coping strategy. Studies by Papageorgiou and Wells (2001a, b & 2003) have provided evidence that both high-ruminators and patients diagnosed with MDD hold specific beliefs about the usefulness of rumination. Interestingly, Watkins and Mason's (2002) study showed that people who reported having a high degree of trait rumination exhibit a similar thinking pattern when

they used an AMAC stop-rule, and when they were not asked to use any stop-rule at all. This suggests that high-ruminators may use the AMAC stop-rule by default, although this finding has so far not been verified within a clinical population. For these reasons, it is possible that positive beliefs about the function of rumination may be related to the prolific use of the AMAC stop-rule amongst people with depression.

However, to date, there has been no study investigating the mood-as-input hypothesis, as well as the relation of stop-rule use and metacognitive beliefs about rumination, within a clinical population. Such an investigation is deemed important, as there are a number of ways in which its outcomes may differ from those of studies with non-clinical samples alone. First of all, a growing body of evidence shows that people with a diagnosis of depression differ from non-depressed individuals in both the nature and contents of their ruminative thoughts. It was found that people with depression are more likely to engage in brooding, a maladaptive subtype of rumination, rather than constructive reflection (Treynor, Gonzalez & Nolen-Hoeksema, 2003). Similarly, their thinking was shown to have a reduced level of concreteness and consisted of more abstract thoughts (Stober & Borkovec, 2002; Watkins & Moulds, 2007). These characteristics may lead to the persistence of recurrent thinking, as people with depression are thought to be less effective in producing exact conclusions and solving problems. In other words, they may cause greater perseveration in ruminative bouts alongside the influences of mood states and stop-rule use.

Most research on the mood-as-input model to date has focussed on the effect of moods and stop-rule on perseveration at the outset of a worry or rumination bout. This has resulted in a rather static view of the mechanisms underlying perseverative thinking. The only exception was found in a recent study which sought to investigate the evolutions of moods and stop-rules deployment during a worry bout over the course of a catastrophising task (Davey et al., 2007).

Therefore, little is known about how (or whether) specific mood states change across a single rumination bout. Empirical knowledge of how moods shift during rumination may help explain how perseverative rumination is maintained. One feasible hypothesis is the may be found in th emood-congruent effect, which suggests that individuals' cognitions tend to be biased by their predominant moods, and generate appraisals that would maintain or amplify their existing mood states (e.g. Reynolds & Salkovskis, 1992). Another possibility may be derived from the goal-progress theory , which posits that mood changes become an indicator of goal-progression in the context of a stop-rule. According to this view, lowering moods are interpreted as a signal of not having reached the current goals and for the need to persist in rumination. Together, these two mechanisms may offer an explanation for the reciprocal mechanism which maintains both low moods and rumination.

Aims and hypotheses of the study

The current study's primary aim is to investigate the mechanisms underlying the association between rumination and negative mood states of people with depression. In particular, it examines perseverative rumination from a mood-as-input perspective using the rumination interview paradigm, i.e. to check if people's use of stop-rule has an effect on their rumination over and above the effect of mood states. On the basis of existing evidence in support of the mood-as-input theory, which suggests that moods interact with stop-rule to determine the extent of iterative thinking, this study hypothesises that 1) the interaction between mood states and stop-rule use will produce significant differences in perseveration between depressed and healthy participants, without any independent main effect of mood states or stop-rule. In particular, the mood–as-input hypothesis suggests that, in the context of the AMAC stop-rule, negative mood would be interpreted as an indication that the current goal is not being met,

leading to the continuation of rumination. Therefore, depressed participants are expected to show the most perseveration whilst using the AMAC stop-rule (Martin & Davies, 1998).

Apart from investigating the mechanisms through which stop-rules and moods contribute to perseveration in depressive rumination, this study also examines the constructs that may underlie the use of stop-rule by people with depression. High-ruminators and depressed patients have consistently reported to hold positive and negative beliefs about rumination (Papageorgiou and Wells, 2001 a, b, 2003). This study is expected to replicate these findings and 2) find positive correlations between the participants' rumination scores and their level of metacognitive beliefs about rumination.

Previous findings suggest that high-ruminators are prone to adopting a default AMAC stop-rule (Watkins & Mason, 2002). As depression is found to be related to high levels of trait rumination (Nolen-Hoeksema, 1991), 3) the diagnosis of depression is expected to predict more participants choosing the AMAC than the FLC stop-rule as a better description of their thinking style. The role of relevant factors such as trait-rumination and positive and negative beliefs about rumination in the relation between depression and stop-rule use is also examined. Because the AMAC stop-rule was an analogue for a self-focus, ruminative thinking style, 4) it is hypothesised that trait-rumination and positive beliefs about rumination will at least partially predict the use of the AMAC stop-rule in everyday life. This study makes no prediction about the negative beliefs about rumination.

In order to explore the effects of using different stop-rules on mood states between people with and without depression, this study compares the mood changes between depressed and non-depressed participants during both of the stop-rule conditions in the rumination task. Although the relation between state-rumination and negative affects is now well established (see Thomsen, 2006), preliminary evidence from a study using the catastrophising task with high-

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worrying participants suggested levels of mood changes were primarily related to the degree of psychopathological worrying (Davey et al., 2007). Given the similarity of rumination to worry as an iterative thinking style, it is predicted that, 5) the rumination interview would result in a general increase in sadness (and decrease in happiness). However, the increase is expected to be greater in depressed than healthy participants, in spite of the stop-rule they use. No prediction is made about rumination's effect on anxiety, as there is little prior evidence on the relation between anxious moods and perseveration within a single episode of rumination.

Methods

Participants

Participants with depression were recruited from the treatment list of three outpatient psychological therapy services in the North London Camden and Islington NHS Foundation Trust. They were initially referred to the study via their clinicians (clinical psychologists or primary care mental health workers) who obtained their consent to be contacted for the study. They were then contacted for a brief telephone interview with a view to introducing the study and gathering initial selection information. Individuals were invited to the study if they were fluent in English, aged between 18 and 65, and met the criteria for at least a possible moderately severe depression (score =/> 15) on a PHQ-9 questionnaire. Participants were excluded if they had a current or history of head trauma and neurological impairment. They were also deemed ineligible if they reported a learning disability, alcohol or substance abuse, or a co-morbid mental health disorder (except for anxiety disorders), such as psychotic disorder or bipolar disorder, currently or within the last 6 months. Participants who presented a risk of self-

harm or suicide were also not included in the experimental procedures. All participants included had been on stable or no psychiatric medication for the previous 3 months. Eligible participants were invited for the experiment session. Their diagnostic statuses were determined by the Structured Clinical Interview for the DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 1996), administered by the researcher to establish their diagnosis for depression. Participants were included in the depressed group if they met the criteria for a primary diagnosis of major depression without current or past organic, psychotic or manic features. Control participants were recruited via the University College London (UCL) online subject pool system and adverts on various North London local community websites. The control group consisted of individuals with no current or history of diagnosis of any emotional disorder. All participants were paid £10.00 for their participation.

A total of 25 participants with MDD (aged 23 to 62, mean = 40.96 10 males and 15 females) and 25 healthy control participants (aged 20 to 58, mean = 38.88, 10 males and 15 females) took part in the study. Among the depressed participants, 6 were medication free, 13 were on SSRIs medications, and 7 could not provide details on their medication. All of them were receiving or had received cognitive-behavioural therapy. Participants were also assessed for their educational background as part of the pre-study assessment. They were asked to identify themselves with one of the five categories denoting their highest educational levels, which included: 1- no qualification, 2- GCSE, 3- A-level, 4- bachelor degree, and 5- postgraduate education. Control participants were selected such that they were matched with the clinical group participants in terms of their genders, age-range, and approximate educational levels. They did not receive the diagnostic interview, but had taken part in all other study procedures.

Design

A mixed between-subject, repeated-measure design was used whereby the two participant groups (depressed, control) were compared in terms of their performances in both the AMAC and FLC stop-rule conditions in the rumination interview task. The dependent variable is degrees of perseverative thinking exhibited by participants, which were quantified by the number of questions they answered (or steps they produced) in the rumination interview.

The study also compared the changes of depressed and control participants' mood states (sadness, happiness, anxiety) across both the AMAC and FLC conditions of the rumination interview. Mood states were measured by participants' self-evaluations on visual analogue scales (VAS) (see below). Post-interview mood levels were regressed on pre-interview mood levels. Standardised residuals were saved and used as the dependent variable which denoted their mood changes across each part of the rumination interview.

Assessment tools

Trait rumination measure

Ruminative Response Scale (RRS; Nolen-Hoeksema & Morrow, 1991) is a 22-item self-report measure assessing the tendency to ruminate or repetitively think about negative events after they occur, with rumination hypothesised to be an underlying vulnerability factor for depression (e.g., Nolen-Hoeksema, 2000). The test–retest reliability ($r = 0.67$) and internal consistency (cronbach's alpha = 0.90) of the RRS are adequate (Nolen-Hoeksema, 2000), as are convergent and predictive validity (Nolen-Hoeksema, 2000; Nolen-Hoeksema & Morrow, 1991). Responses are scored on a Likert scale, from 1 (almost never) to 4 (almost always). Treynor,

Gonzalez and Nolen-Hoeksema (2003) demonstrated that once items referring to depression symptoms were removed, the RRS comprises two distinct factors—brooding and reflection.

Symptoms of depression and anxiety

The PHQ-9 is a self-administered 9-item measure examining the severity of symptoms commonly associated with depression using a 4-point Likert scale (0 = not at all, to 3 = nearly every day). Clinical cut-offs of scores 5, 10, 15, and above 20 represent mild, moderate, moderately severe and severe depression respectively. The PHQ-9 has shown strong internal consistency reliability (α = 0.86) and test–retest reliability (r = 0.84), as well as good construct validity (Kroenk & Spitzer, 2001).

The GAD-7 is a 7-item self-report measure examining the severity of anxiety symptoms using the same 4-point Likert scale. Scores range from 0 to 21, with scores of 5, 10, and 15 indicative of mild, moderate, and severe anxiety symptoms. The GAD-7 has demonstrated excellent internal consistency (α = 0.92) and good test–retest and procedural reliability (r = 0.83). The GAD-7 has also shown good convergent, construct, criterion, procedural, and factorial validity in the assessment of GAD (Spitzer, Kroenke, Williams & Lowe, 2006; Kroenke, Spitzer, Williams, Manahan & Lowe, 2007).

Metacognitive beliefs about rumination

The Positive Beliefs about Rumination Scale (PBRS; Papageorgiou & Wells, 2001b) is a 9-item scale that assesses positive metacognitive beliefs about the benefits and advantages of rumination. The PBRS has shown good internal consistency (Cronbach's a = 0.89) and test-retest reliability over 6 weeks (r = 0.85). Respondents are required to indicate the extent to

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which they agree with each of the items on a 4-point rating scale ranging from 1 (do not agree) to 4 (agree very much).

The Negative Beliefs about Rumination Scale (NBRS; Papageorgiou et al., 2001) comprises two subscales assessing negative metacognitive beliefs about rumination. It has good test-retest reliability and high internal consistency (Luminet, 2004). The NBRS-1 is an 8-item subscale that assesses metacognitive beliefs about uncontrollability and harm associated with rumination. The NBRS-2 is a 5-item subscale that assesses metacognitive beliefs about interpersonal and social consequences of rumination. Respondents are required to indicate the extent to which they agree with each of the items on a 4-point rating scale ranging from 1 (do not agree) to 4 (agree very much).

Current mood states

Four visual analogue scales (VAS) were used to record the current subjective mood states of the participants at four different time-points during the rumination interview procedure. They measured for the levels of sadness, happiness, anxiety and the physical alertness of the participants. Each mood scale consists of a 22cm straight horizontal line flanked from on each side by the numbers 0 and 100, each marked by the printed descriptions 'not at all' and 'extremely' below them, respectively. The scales were also marked by the number 50 in the middle, to indicate the mid-point of the line. Participants were asked to put a cross on the scales where they feel best describe their mood-state in question 'at the moment'. The VAS's were administered four times for each participant during the experiment (*Time 1*: immediately before the rumination interview;; *Time 2*: after the first condition of the rumination interview; *Time 3*:

immediately after the neutral mood induction and before the second condition of the rumination interview; and lastly, *Time 4*, immediately after the second condition of the rumination interview).

Procedure

The experiment sessions took place with each participant individually in a standard clinical room in a North London outpatient psychological therapy service. All participants were asked to read the information sheet and fill in an informed consent form. They were then instructed to complete the PHQ-9, GAD-7, PBRS, NBRS and the RRS. Participants considered for the depressed experimental group then took part in the diagnostic interview before the experiment.

The rumination interview and current mood recording

Participants were asked to undertake both parts of the rumination interview, in each of which they were asked to adopt either an AMAC or FLC stop-rule. The orders of the stop-rule conditions were randomly assigned for each participant. They was also counterbalanced in both the depressed and control groups to control for the *order effect*. The two parts of the rumination interview were separated by a 5-minute interval, when the participants took part in a neutral mood induction exercise to minimise any *carry-over effect*.

Participants were asked to complete a VAS mood scale before the first part of the rumination interview. Then they were told they would take part in an interview about two recent events that had made them feel depressed or sad, and asked to think of two such events which had similar emotional impacts on them. Once the participants confirmed that they had identified the events for the interview, they were then given a written instruction for the stop-rule taken from the study by Hawksley and Davey (2010) to ensure comparability of results.

The instruction for the AMAC stop-rule read that they would be "required to continue with the interview until they had fulfilled the goal of exploring the event as much as they can". Whereas the instruction for the FLC stop-rule says that they would be "required to take part in the interview until they did not feel like continuing to do it". The participants were checked for their complete understanding of the stop-rule instructions before they proceeded to the interview. Print-outs of the instructions were placed in front of the participants throughout the interview as reminders of the task requirement during their interviews.

The interviewer first asked the participant to name "one of the incidents" (or "the other incident" in the second part) identified and recalled by them. This was followed by a structured procedure consisting of the interviewer asking repetitively, "What is it about X that made you feel depressed (or sad for the healthy control participants)?", where X is always the participants' answer to the interviewer's previous question. In other words, in the rumination interview, the subsequent question always depends on the previous answer given by the interviewee. This structured and standardised form of interviewing was adopted for the interview in order to minimise any *experimenter bias* in the way the questions are worded. For ease of administering the interview and to facilitate an objective quantification of the length of each rumination interview, participants were asked to limit their response to no longer than one idea or one sentence per answer. The number of answers produced (quantified as 'steps') and the contents of the answers were recorded by the interviewer during the task. Each interview was only brought to a close when the participant indicated that they could think of no more response in the AMAC condition, or they did not want to continue in the FLC condition. The participants were asked to complete three more VAS mood scales; first, immediately after part one of the ruminative interview finished, then immediately before and after the second part of the interview. The procedures for both parts of the interview are exactly the same except for the participants' stop-rule condition.

The neutral mood induction

After the first part of the interview, participants were asked to take a 5-minute break, during which they would be asked to listen to a piece of music and the interviewer would leave the room. They were then asked to put on a pair of headphones connected to an mp3 player containing the music. The same piece of music (the *Waltz in C sharp minor* by Chopin) was used for all participants. The waltz was chosen based on the finding from a previous study which reported that it worked effectively as a neutral mood induction device (Startup & Davey, 2001).

Stop-rule identification

After the rumination interview was completed, each participant was asked to choose the stop-rule that more strongly resembled the thinking style they adopt in response to negative moods in their daily life. They were asked "Between the AMAC and FLC stop-rules, which one could you more strongly identify with?" Participants were encouraged to choose the one they use more often if they could not immediately decide.

Debrief

All participants were fully debriefed on the aim of the study and the purpose of its procedures. They were also given a chance to ask any questions. Participants who may have expressed continued feelings of distress or were upset during the interview were offered an opportunity to

participate in a brief relaxation exercise consisting of mindfulness meditation, instructed by the researcher.

Ethical considerations

This study was reviewed and approved by the North London Research Ethics Committee (ref: 10/H0721/40; See Appendix A). All participants were given verbal and written information about the study and completed an informed consent form before they took part. A substantial body of research has now reported the use of the catastrophising or rumination interview paradigm adopted by the present study. Although the interviewing procedure which involved discussing in depth personal events associated with participants' negative emotions, most participants did not any report lasting effect on their mood states. Potentially risky and vulnerable people were excluded from the study at the screening stage, and it was conducted under the supervision of a qualified clinical psychologist. Participants who expressed any experience of distress after the experiment were offered a relaxation exercise instructed by the researcher. They were advised in the event of any future distress related to this study to contact the experimenter.

Statistical analysis

All statistical analysis was undertaken using the Statistical Package for the Social Sciences (SPSS 18.0). Data assumptions for each procedure were tested prior to analysis. All data were checked for univariate outliers which, when necessary, were removed. In case of skewed data distributions, data transformations were undertaken prior to analysis. An Alpha level of .05 was used for all statistical tests.

The differences in the number of 'steps' produced by the participants of both groups in the rumination interview across the two stop-rule conditions were analysed by a 2(group) x 2(stop-rule) mixed-design ANOVA. The two stop-rule conditions were designed as analogues of different ruminative thinking styles. In order to test the specificity of the analysis outcomes to the experimentally manipulated stop-rules, and to ascertain if trait-rumination influences task performance, the same analysis was repeated with trait-rumination (RRS) scores as a covariate. Higher numbers of steps produced by participants were used as an index of the level of perseverative thinking while using a particular stop-rule.

In order to test whether the diagnosis of MDD and other related factors predict a bias in the natural use of stop-rule, a hierarchical logistic regression analysis was performed. The stop-rule participants reported identifying with most in their daily life was entered as the dependent variable. The diagnostic groups (depressed, control) of the participants were entered as a predictor in the first step. To determine the extent to which depressive symptoms can explain the prediction of a biased stop-rule use by the diagnosis of depression, PHQ-9 scores were added as a predictor in the second step. This was followed by entering the RRS brooding subscale scores in the third step as predictors to determine if trait-rumination predicts the participants' use of stop-rule in their daily life above and beyond depressive symptoms. With the first and second steps unchanged, positive and negative beliefs about rumination scales scores were entered as predictors in the third steps in two separate regression analyses to help clarify the role of metacognitive beliefs in the use of stop-rule.

In order to compare mood changes (sadness, happiness and anxiety) between groups across both conditions of the rumination interview, all post-interview VAS mood ratings were regressed on the pre-interview mood ratings for both stop-rule conditions (AMAC and FLC). Standardised residuals were saved and analysed by 2 x 2 repeated measure ANOVAs with group (depressed,

control) as the between-subject factor, and stop-rule (AMAC, FLC) as the within-subject factor. The assumption of sphericity was checked using the Mauchly's test. The results showed that the assumption was tenable in each case.

Results

Sample characteristics

Table 2. shows the demographic and clinical characteristics of the sample. There are no significant differences between the depressed and control groups in age, $t(48) = 2.017$, $p= .64$, and gender, $X^2(1) = 0$, $p= 1.00$. Educational backgrounds were also compared between groups. Combining categories (1 with 2, and 4 with 5) was necessary to yield cell frequencies large enough for a chi-square analysis. No significant group difference was reported, $X^2(3) = 2.21$, $p=.36$. As previous research has suggested a significantly higher female tendency to engage in rumination in response to low mood (see Nolen-Noeksema & Jackson, 2001), all analyses were initially performed with gender as a between-subject factor. However, there was no significant effect or interactions with gender on any of the dependent variables; therefore all reported analyses were conducted by collapsing across genders. Before commencing the experiment, the depressed group showed significantly higher scores of low mood and general depressive symptom on the PHQ-9, $t(48) = 15.51$, $p<.01$. As the mood-as-input hypothesis predicts that positive and negative moods interact differently with use of stop-rule to produce varied outcomes in perseverative thinking, it renders the participant groups valid for the purpose of the present study. Depressed participants also reported a higher rating on anxiety measured by GAD-7, $t(48) = 8.84$, $p<.01$.

There was a significant difference between the depressed and healthy participants in the total RRS score, t(48)= 5.09, p<0.01 , as well as the ratings on the brooding subscale, t(48)= 5.87, p<0.01 and the reflection subscales, t(48)= 4.61, p<.01. There were significantly higher levels of both positive and negative levels of beliefs about rumination reported by depressed than healthy participants. [PBRS: t(48) = 4.59, p<.01; NBRS: t(48) = 4.04, p<.01]. As the mean total RRS scores for both the depressed and controls groups were significantly correlated with their mean brooding (Depressed: r = .886, p<.01; Controls: r = .805, p<.01) and reflection subscales scores (Depressed: r = .871, p<.01; Controls: r = .680, p<.01), only the total RRS scores were used in further analyses.

Table 2. Demographic and clinical characteristics of the sample

	Control group (N= 25)		Depressed group (N= 25)		Test statistic (t)	p
	Mean	s.d.	Mean	s.d.		
Age (in years)	38.88	12.65	40.96	12.16	2.017	.64
Gender male (female)	10(15)	-	10(15)	-	-	-
PHQ-9	2.80	2.08	16.64	3.95	15.51	<.01
GAD-7	2.64	2.23	14.32	6.22	8.84	<.01
RRS	39.88	10.32	66.40	13.86	5.09	<.01
Brooding	9.40	3.19	15.44	4.047	5.87	<.01
Reflection	9.04	2.39	13.52	4.23	4.61	<.01
PBRS	16.84	4.46	24.80	6.42	4.59	<.01
NPRS	19.24	5.17	29.28	8.99	4.04	<.01

To determine the relation between metacognitive beliefs and rumination, correlations were computed between the participants' trait-rumination (RRS) scores and their PBRS and NBRS scores separately for the depressed and control participants (see Table 3 below).

Table 3. Correlations of RRS scores and PBRS and NBRS scores in depressed and control groups

	RRS	
	Depressed (N= 25)	Controls (N= 25)
PBRS	.407*	.480*
NBRS	.412*	.572**

RRS= Mean total rumination response scale scores; PBRS = Mean positive beliefs about rumination scales score; NBRS = Mean negative beliefs about rumination scales score; *p< .05; **p< .01

Rumination interview

Depression, stop-rules and mood changes in rumination interview

A mood check was conducted to examine the effect of the neutral mood induction on the participants' mood states between the stages of the rumination interview. The aim of the induction procedure was to neutralise the impact on moods of the first stage of the rumination interview before participants commenced the second stage. Analyses using paired-sample t-tests found no significant differences in levels of the VAS ratings for sadness, t(49)=.379, P=.706, happiness, t(49)= -1.78, p=.082 and anxiety, t(49)=.0781, p=.11, of all participants at time 1 (before the beginning of the rumination interview) and time 3 (after the relaxation task). Table 3 shows the mean VAS mood ratings (for sadness, happiness, and anxiety) taken at the 4 time points before and after both stages of the rumination interview.

Participants' self-ratings of mood states using the VAS at different stages of the rumination interview were summarised in Table 4. To calculate mood changes across the interview task, participants' post-interview (time 2 & time 4) mood ratings were adjusted for their pre-interview (time 1 & time 3) ratings by saving the standardised residuals of a linear regression model, with pre-interview mood ratings as the independent variable and post-interview mood rating as the dependent variable. These standardised residuals represent the remaining variation in post-interview mood ratings after that of the pre-interview ratings. Residuals were computed for all mood states measured by VAS, i.e. sadness, happiness and anxiety. They were assessed for normal distribution and then analysed using a 2 (group) x 2 (stop-rule) mixed-design ANOVA. The results showed a general effect which demonstrated increases in negative moods (sadness and anxiety) and decreases in positive mood (happiness) for all participants in both stop-rule conditions of the rumination task (see table 3). In specific, analysis of residuals for sadness indicated a significant main effect of group, $F(1,48)=6.724$, $p=.013$, but no significant main effect of stop-rule conditions, $F(1,48)=.00$, $p=1.00$ or significant group X stop-rule interaction, $F(1,48)=0.049$, $p=.826$. For anxiety, the results showed a significant main effect of group, $F(1,48)=11.932$, $P.01$. However, similar to the results for sadness, there were no significant effects of stop-rule conditions, $F(1,48)=0$, $p=1.00$, or interaction between group and stop-rule, $F(1,48)=0.227$, $p=.636$. That is, depressed participants experienced greater increases in sadness and anxiety than controls during the rumination interview, regardless of the stop-rule they used. With regard to levels of happiness, no significant main effect of group, $F(1,48)=1.13$, $p=.258$ or stop-rule, $F(1,48)=0$, $p=1.00$ or any group X stop-rule interaction was found, $F(1,48)=.192$, $p=.664$. This showed that there was no significant difference in the changes of happiness levels between depressed and control participants.

To control for the influence of individual difference in trait-rumination, the 2 x 2 ANOVA was performed again with RRS scores as a covariate. The results indicated that the effect of group

on changes in sadness was no longer significant, $F(1,47)=2.093$, $p=.155$. Similarly, the main effect of group on changes in anxiety disappeared, $F(1,47)=1.804$, $p=.186$.

Table 4. Mean and standard deviations of VAS mood ratings during the rumination interview for depressed and control participants

	Sadness		Anxiety		Happiness	
	Depressed	Controls	Depressed	Controls	Depressed	Controls
Time 1	41.80 (25.24)	20.12 (22.86)	49.68 (26.31)	25.44 (25.84)	40.12 (25.24)	57.00 (22.71)
Time 2	58.60 (24.68)	35.40 (22.27)	57.80 (25.45)	24.72 (25.15)	31.80 (24.68)	48.92 (23.44)
Time 3	39.12 (25.06)	22.60 (16.01)	35.48 (22.60)	17.48 (20.92)	45.12 (25.06)	57.96 (20.48)
Time 4	40.12 (23.83)	33.96 (23.87)	58.12 (22.12)	25.72 (25.07)	35.60 (23.83)	50.28 (25.74)

Note. Values of standard deviations in parentheses. Time 1 = First condition pre-interview; Time 2 = First Condition post-interview; Time 3= Second condition pre-interview; Time 4 = Second Condition post-interview

Depression, stop-rules and perseveration in rumination interview

An initial analysis examined the order effects (order of the two stop-rule conditions) on the number of rumination steps produced by participants in both experimental groups. The result showed that there was no significant effect of the counterbalancing variable, $F(1,48)=.852$, $p<.01$, suggesting that order effects were not significant.

Figure 1 shows the mean number of rumination 'steps' produced by depressed and control participants while using the AMAC and FLC stop-rules. To test the hypothesis that depression and stop-rule would interact to affect the degree of ruminative perseveration, a 2 x 2 mixed-design ANOVA was conducted, to compare each group (depressed, healthy control) across the two stop-rule conditions of the rumination interview (AMAC, FLC). The results showed that there

was a significant main effect of group, F(1,48)=7.287, p= <.01, stop-rule, F(1, 48)=82.747, p< .01, as well as a significant interaction of group and stop-rule, F(1, 48)=27.912, p<.01, for the number of rumination steps produced. To test the influence of the variation in individual differences in levels of trait rumination in the sample, the 2 x 2 mixed-design ANOVA was repeated with the participants' brooding subscale scores as a covariate. The group X stop-rule interaction remained significant, F(1,48)=12.293, p< .01. However, there was neither a main effect of stop-rule, F(1,48)=3.036, p=.088, nor a main effect of group, F(1,48)=1.002, p=.322 after this adjustment. This means that, after controlling for the influence of trait-rumination, only the interaction between group and stop-rule use continued to have an effect on the number of steps produced by participants in the rumination task.

To clarify these findings, post-hoc analyses showed that participants in the depressed group who used the AMAC stop-rule produced significantly more rumination steps than those who used the FLC stop-rule, t(24) = 8.181, p<.01. Similarly, but to a lesser extent, participants in the control group who used the AMAC stop-rule produced significantly more rumination steps than those used the FLC stop-rule, t(24) = 3.347, p= .03. In addition, the depressed group generated a significantly higher number of steps than the control group while using the AMAC stop-rule, t(48) = 3.476, p< .01, but the groups did not differ from each other significantly when they used the FLC-stop-rule, t(48) = .004, p=.997.
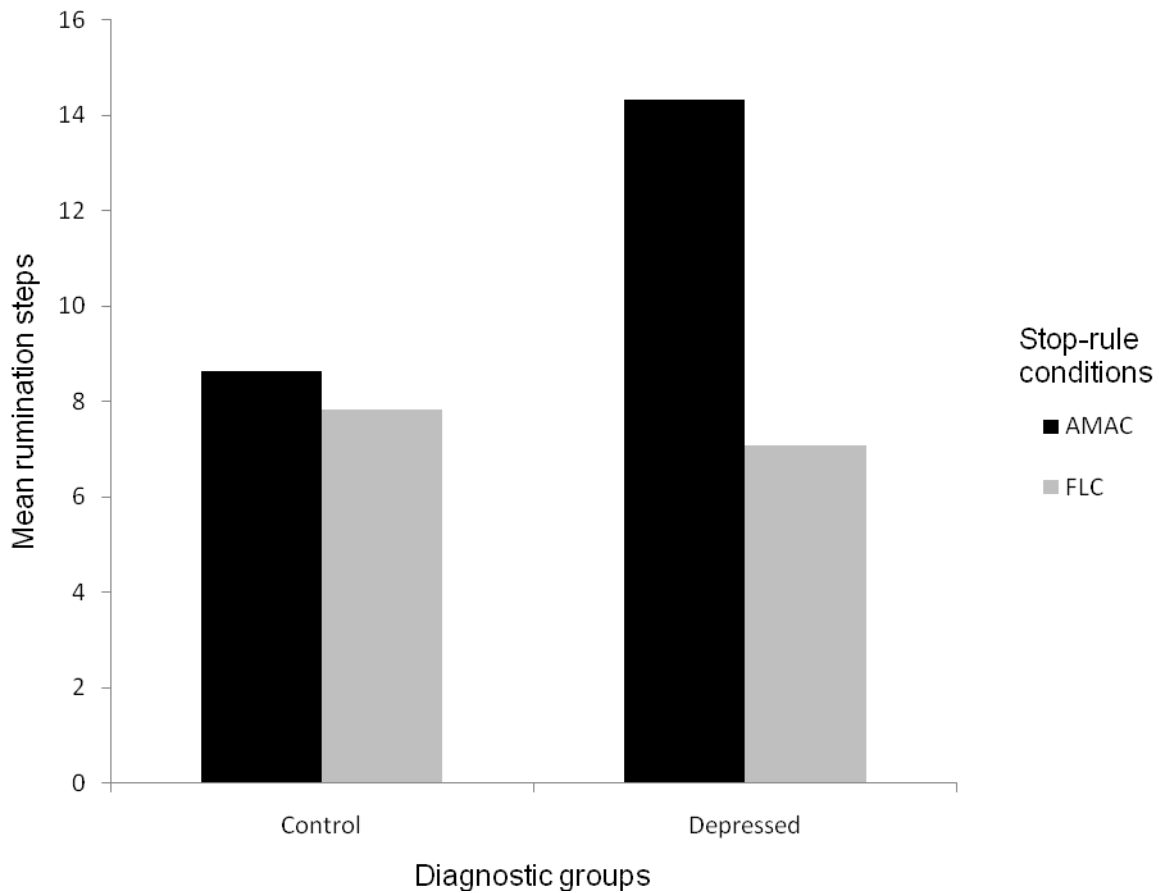
Figure 1. Mean number of rumination steps produced by depressed and control participants in both stop-rule conditions

The use of stop-rule in everyday life

Table 5. Number of participants identifying the use of either default stop-rule in depressed and control groups

	Depressed (N=25)	Control (N=25)
AMAC	22	10
FLC	3	15

Note. AMAC = "as-much-as-can" stop-rule; FLC = "Feel-like-continuing" stop-rule. Chi-square test: $X^2(1)= 12.50$, $p<.01$

Table 4 shows the number of participants who identified AMAC and FLC stop-rules as the best descriptions of their predominant thinking styles, in depressed and control groups. A series of hierarchical logistic regressions were conducted to investigate if a diagnosis of depression and associated factors predicts a biased use of stop-rule in the participants' daily lives. The participants' self-reported tendency of using a particular stop-rule was the dependent variable in all analyses. Entering the participants' diagnostic status (depressed, healthy control) as a predictor, the first step of the analysis showed that a diagnosis of depression significantly predicts the use of the AMAC stop-rule, b= -2.34, p<.01. When depressive symptoms scores (PHQ-9) were added as a predictor in the second step, it significantly predicted stop-rule use, b = -0.532, p= .013, but reduced the prediction of diagnostic status to non-significant, b= 3.92, p= .112. In the third step, there was no significant prediction of stop-rule use when RRS brooding subscale scores were entered as a predictor, b= .004, p= .975, and the prediction of PHQ-9 scores, although slightly reduced, remained significant, b= -.535, p=.025. This means there might be some slight overlaps in the variables measured by the brooding subscale and the PHQ-9.

To test if the levels of positive and negative beliefs about rumination also predict the use of a particular stop-rule, two hierarchical logistic regression analyses were performed with PBRS and NBRS scores separately entered as predictors of stop-rule use in addition to diagnostic status and depressive symptoms scores. The results indicated that neither PBRS scores, b= -0.124, p= .128, nor NBRS scores, b = -0.06, p= .376 predicts the participants' use of stop-rule in daily lives, independently of their diagnostic status and severity of depressive symptoms.

Discussion

Mood-as-input and perseverative rumination in depression

This study aimed to investigate the factors and mechanisms that contribute to perseverative rumination among individuals with MDD and healthy controls using a rumination interview paradigm. In the present sample, results confirmed the prediction derived from the mood-as-input hypothesis (Davey, 2006), and suggested that an interaction between diagnostic group and stop-rule determined the level of perseveration in the rumination task. This challenged the postulation that rumination is a direct response to symptoms of depression (e.g. Nolen-Hoeksema, 1991). As predicted, results showed that participants with MDD were most persistent at the rumination task whilst using an AMAC stop-rule. On the other hand, the extent of perseveration in the FLC condition is comparable between the two experimental groups. These findings are largely consistent with those reported by previous studies, which assessed the performance of non-clinical samples in the rumination interview (Hawksley & Davey, 2010; Watkins & Mason, 2002).

However, the current study also found that participants' performances in the rumination task reflected the independent main effects of diagnosis and stop-rule, which were not found in past studies with non-clinical samples. In this regard, further analysis shows that, when individuals' variation of trait rumination (the RRS scores) was controlled for, the independent effects of diagnosis and stop-rule disappeared, whereas interaction of diagnosis and stop-rule remained.. This suggests that, for people with MDD, dispositional proneness to ruminate may influence their perseveration in thinking through its impact on mood states and the person's intuitive use of stop-rule. This is consistent with the evidence, which shows that trait rumination is associated with increased negative affects in response to stress (Moberly & Watkins, 2008), and the finding

that people with high trait-rumination tend to adopt a default AMAC stop-rule (Watkins & Mason, 2002). Nevertheless, it is also plausible to interpret this finding in terms of the mood-as-input hypothesis, i.e. it reflects that trait-rumination is a consequence of the combination of recurrent low moods and a rigid and persistent use of a particular stop-rule.

The present study attempted to further elucidate the interrelation between depression, trait-rumination and stop-rules. When asked to identify a stop-rule that best describes their thinking strategy in everyday life (i.e. the stop-rule they tend to naturally adopt), depressed participants reported a significant bias towards using the AMAC stop-rule. Although such a bias was predicted by both depressive symptoms and trait-rumination scores, regression analyses showed that only depressive symptoms scores predicted the use of stop-rule independently. In other words, the result did not show trait rumination as having a significant role over and above depressive symptoms in predicting the natural use of AMAC stop-rule in everyday life. This was somewhat surprising, since the AMAC stop-rule was designed as an analogue for the ruminative and repetitive thinking style commonly reported in depression. This suggests that depressive symptoms mediated the influence of trait rumination on the stop-rules people naturally adopt. Specifically, this implies that the adoption of a default AMAC stop-rule by people with depression is related to the severity of their depressive symptoms either *directly* or via other mechanisms related to depression. This interpretation of the results found support in a cross-study comparison of the present findings with a previous study which used the same experimental paradigm (Watkins and Mason, 2002). Together these studies showed that, among individuals with high levels of trait-rumination, depressed participants perseverated for considerably longer than healthy individuals when they were using the AMAC stop-rule.

More research is necessary to clarify how depressive symptoms affect an individual's inclination towards the adoption of a particular stop-rule, but a number of possibilities exist. The literature

on cognitive deficits associated with depression has demonstrated that people with depression tend to have a reduced ability to inhibit pre-potent or habitual responses, which is likely to result in increased inflexibility and difficulties to alter their pattern of thinking (Watkins & Brown, 2002; Deveney & Deldin, 2006; Joormann & Gotlib, 2008). With these inhibitory deficits, people with depression may find it harder than healthy individuals to find alternative strategies to focussing on their depressive symptoms or negative events in order to solve their problems. Secondly, research has found that depressed individuals are characterised by reduced concreteness in their thinking (e.g. Stober & Borkovec, 2002). This has been shown to result in the impairment of problem-solving skills consistently found in depression (Watkins & Mould, 2007). One of the explanations for this is that reduced concreteness limits the generation of detailed, specific and elaborated thinking required to evaluate progress in reaching one's goal. This may render people with depression more likely to focus on changes in their current mood states, as relatively more accessible goal-related information, to gauge their goal-progression (Martin, Strack & Stapel, 2001). As rumination often engenders negative emotions, they are more likely to continue, rather than terminate, the use of rumination as a problem-solving strategy.

A third possible explanation may lie in the tendency for many depressive individuals to set unrealistically high standards for their performances. Previous research on depression and personality style has repeatedly confirmed a positive correlation between depression and perfectionism (e.g. Hewitt & Flett, 1991; Shafran & Mansell, 2001; Flett & Hewitt, 2002; Ashby, Rice & Martin, 2006). This association is at least partly related to the tendency of perfectionists to make self-critical evaluations, thus their increased vulnerability to negative affects and other depressive symptoms (Blatt, Quinlan, Pilkonis, & Shea 1995; Enns, Cox & Clara, 2002). In view of this, depressive participants who set unrealistic demands on themselves to fulfil their current goals were more likely than healthy controls to persist and persevere in their way of thinking.

Although these are plausible hypotheses for the connection between depression and the readiness of depressed individuals to adopt the AMAC stop-rule, it is beyond the scope of the present study to confirm any of them. Future studies which empirically address specific cognitive deficits in depression and take consideration of stop-rule use will be necessary to verify these explanations.

Metacognitive beliefs, natural use of stop-rule and rumination

The current finding that depressive symptoms predict the adoption of a default AMAC stop-rule by depressed individuals over trait-rumination suggests that the natural use of AMAC stop-rule is not simply an analogue representation of trait-rumination, but is related to other depression-related constructs. Plausible candidates include the cognitive deficits related to depression as noted above, as well as metacognitive beliefs about the consequences of rumination. The latter is supported by the current study as positive beliefs about rumination were found to be a significant predictor of natural stop-rule use by participants. This is consistent with the results reported by Davey, Startup, MacDonald, Jenkins & Patterson (2005) in their study on worrying, which showed that metacognitive beliefs about the positive and negative consequences of worrying significantly predicted the use of the AMAC stop-rule in the catastrophising task. This confirms the commonality between worrying and rumination as iterative thinking styles. However, Davey et al. (2005) did not include their participants' symptom scores as a co-predictor. This is relevant as, similar to trait-rumination, the prediction by positive or negative beliefs about rumination in the current study was found not to be independent from depressive symptoms, suggesting that the influences of both trait-rumination and metacognitive beliefs on stop-rule use are mediated by the severity of one's depression.

Although further research is clearly required to clarify the relations between metacognitive beliefs, rumination, depressive symptoms and natural stop-rule use, the present preliminary findings seem to fit well into the *meta-cognitive model of rumination and depression* proposed by Papageorgiou and Wells (2003). According to this model, positive beliefs about rumination motivate sustained rumination in response to low mood, which leads to increases in depressive symptoms. Subsequently, through a feedback loop, depressive symptoms maintain the positive beliefs about rumination (or beliefs about the need to ruminate in order to cope effectively) through their impact on metacognitive efficiency (confidence about one's cognitive abilities due to cognitive deficits related to depression) (see Smith & Alloy, 2009).

It is noted that 'stop-rule' is not a part of the metacognitive model. However, it may be understood in terms of the existing components in the model for the benefit of elucidating the present findings. A useful conceptualisation of stop-rule (AMAC) may be drawn from the study by Papageorgiou and Wells (2001a), who explored depressed patients' positive beliefs about rumination. They reported that the patients' beliefs appeared to reflect themes about rumination as a problem-solving strategy. This is consistent with the mood-as-input model, which formulates stop-rules as problem-solving approaches based on perceived goal-progress (Martin, Achee, Ward & Wyer, 1993). Therefore, stop-rules (especially the AMAC stop-rule) may be considered as an operationalisation of positive beliefs about the benefits of rumination. This is to be distinguished from a causal relation between these beliefs and stop-rule.

This conceptualisation of stop-rule allows it to be interpolated into the metacognitive model for the purpose of understanding its role in relation to the other better-studied components. One way future study may test the current findings about the role of stop-rule in the metacognitive model is to empirically test a tentatively updated metacognitive model, by substituting 'positive

beliefs' in the model with the AMAC stop-rule, while leaving 'positive beliefs' outside of the feedback loop but remaining linked with AMAC stop-rule as a moderating factor.

Mood changes in perseverative rumination

Finally, the present study examined the mood impact of the rumination interview for depressed and healthy individuals when compared across the two stop-rule conditions. The findings reported main effects of diagnostic group on sadness and anxiety change. In other words, depressed participants showed significantly greater increases in both sadness and anxiety than the controls across the rumination task when using both the AMAC and FLC stop-rules. These changes appeared to be unrelated to the effect of the stop-rule used by the participants, as no main effect of stop-rule was found in the analysis. Moreover, an analysis of covariance revealed the effect of depression on mood changes to be a function of trait-rumination (as measured by the RRS), suggesting a relation between trait-rumination and a vulnerability to negative moods. This finding is consistent with existing evidence on negative affects and rumination (see Thomsen, 2006).

Notably, the present findings are very similar to those reported by Davey, Eldridge, Drost & MacDonald (2007). They showed that people who reported to have high trait-worry tended to exhibit increases in negative, but decreases in positive moods, over the course of a catastrophising task regardless of the stop-rule they deployed. To make sense of these findings from a mood-as-input perspective, Davey et al. (2007) carried out an experiment in the same study to examine if worriers' use of stop-rule changes over the course of the catastrophising task. The outcomes found participants reporting a significant shift from using the AMAC to the

FLC stop-rule across the task. Although the scope of this study does not permit the verification of this hypothesis with the present findings, given the similarity between rumination and worrying as perseverative thinking styles (Fresco et al., 2002), it is reasonable to speculate that this phenomenon might generalise to people with depression. In fact, this hypothesis is consistent with anecdotal information provided by a number of participants, who expressed that they stopped the interview in the AMAC condition partly because they found the rumination interview upsetting (which indicates deployment of the FLC stop-rule). If this is the case, then the lack of effect of stop-rule use on mood changes during the rumination task might be explained by the inconsistency of stop-rule use during the task.

Another possible reason for the lack of demonstrated effect of stop-rule manipulation on mood change is the poor adherence of participants to the stop-rule instruction during the rumination task. This is particularly relevant to the depressed group as their higher trait-rumination (dispositional tendency to ruminate) might have overridden the stop-rule instruction as the rumination interview wore on. This explanation would be consistent with the current finding that the level of trait-rumination rather than stop-rule manipulation explained the participants' mood changes. However, depressed participants had produced significantly less steps in the rumination task when using the FLC stop-rule. This demonstrated that the stop-rule instructions had a considerable impact on their perseverative behaviour. Altogether, this indicates that depressed participants might have experienced greater increases in negative mood for each 'step' they produced during the rumination interview. This is possible as research has suggested that trait rumination is related to negative biases in interpretations, appraisals and future thinking in people with depression (Lavender & Watkins, 2004; Rimes & Watkins, 2005; Lo, Ho & Hollon, 2008). In particular, Rimes and Watkins (2005) found that depressed patients who engaged in self-analytical and self-focussed thinking reported a significantly lower self-judgement than non-depressed controls on their lovability, competence and acceptability. It may be possible that,

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due to these cognitive biases, depressed participants had experienced more rapid increases in negative moods than controls over the rumination task.

Another noteworthy finding is the result which showed that depressed participants had experienced greater increases in anxiety than sadness across both conditions of the rumination task. Although the main emotion associated with depression is sadness, this result highlighted that rumination may occur alongside a wide variety of emotions. Past research has most notably reported anxiety, anger and stress (see Thomsen, 2006). More recently, a study which explored the phenomenological experiences of rumination with patients with MDD had reported that their rumination was often accompanied by low mood, anxiety, anger, hopelessness, sense of entrapment, and to a lesser extent, humiliation (Pearson, Brewin, Rhodes & McCarron, 2008). The authors reasoned that this is possibly because depressive rumination is often characterised by complex appraisals, which give rise to complex emotional states. Another explanation is the high comorbidity between depression and anxiety disorders, which is highly applicable for the current depressed participants due to their high-level anxiety symptoms (as measured by GAD-7).

Limitations of the study

It is important to take into account some methodological limitations of the current study when interpreting its results. First, the interpersonal format of the rumination interview inevitably raises questions about its validity as a measuring tool of perseveration in rumination, an essentially intrapersonal process. This is particularly relevant in the context of the goal-progress theory of rumination, which views rumination as a goal-directed behaviour (Martin, Shrira & Startup, 2004). The theory posits that ruminators interpret their mood states as a yardstick of their goal-progress to determine whether they need to continue with their current activity (i.e. rumination)

only in the absence of more accessible goal-related information (Martin, Strack & Stapel, 2001). In this sense, an interpersonal dimension may complicate the measuring, as it may potentially introduce variables which could lend themselves to interpretation as goal-related information, such as the experience of being listened to, interpersonal attention, and the feeling of emotional validation, depending of the goals of the ruminators. If this is the case, factors other than moods may interact with stop-rules to affect the length of perseveration. Nonetheless, past studies using the rumination interview or similar paradigm (e.g. catastrophising interview) have produced mood changes and perseveration similar to a natural rumination or worrying bout (e.g. Watkins & Mason, 2002; Davey et al., 2005, 2007; Hawksley & Davey, 2010), suggesting that the paradigm can effectively imitate the internal iterative thinking process. However, future studies may further mitigate the potential influences of interpersonal factors on the ruminative process by adapting the paradigm, such as by using recorded interview questions or a microphone, instead of a face-to-face interview.

Secondly, the current study included a repeated-measure component in order to control for individual variance, i.e. measuring mood changes and perseveration of the same participants over both stop-rule conditions of the rumination task. However, this design renders the experiment vulnerable to carry-over effect across the two parts of the rumination interview. In order to minimise this disadvantage, the order of the stop-rule conditions was counterbalanced, and a relaxation exercise was introduced in the interval between the two parts of the task. Although the present results indicated that the relaxation task effectively restored the mood states of the participants to their pre-interview levels, it is unclear if other effects of the first interviews, such as negative thoughts, had remained. Additional state measures of cognitions may be introduced to verify this in future research.

Third, although this study recruited participants with clinical depression, it did not analyse the influences of specific vulnerability factors of depression on moods and perseveration except for the levels of trait-rumination. Therefore, other correlates of depression, such as negative attributional styles and cognitive deficits, might have confounded the outcomes of participants' performance in the rumination interview. However, these influences were expected to be small as past research has suggested (trait-) rumination to be a common mechanism which mediates the effects of various risks factors to depression (e.g. Spasojevic & Alloy, 2001).

Finally, this study assessed participants' default stop-rule using a direct question which asked them to identify the stop-rule they tend most to use in their everyday life. Although this self-report method yielded valuable preliminary findings about the different stop-rules depressed and non-depressed participants tend to adopt by default, it is also vulnerable to response biases and demand effects. This may be overcome empirically by introducing a third, no stop-rule condition into the rumination interview, which would allow measurements of the participants' perseverative behaviours while they use the stop-rule they naturally adopt.

Conclusions

This is the first mood-as-input study on depressive rumination which includes participants with diagnosis of major depressive disorder. Using the rumination interview paradigm, the results confirmed the mood-as-input hypothesis (Startup & Davey, 2001, 2003) and showed that the interaction between depressive symptoms and stop-rules significantly influenced the degree of perseverative thinking. However, the results also suggested that compared to the healthy control group, depressed participants' levels of trait-rumination also had an influence on their perseverative behaviours, possibly via its effects on moods and stop-rule use.

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Further testing helped to clarify these results as depressed participants reported a biased tendency to naturally use the AMAC stop-rule to deal with negative emotions in their everyday life. Interestingly, analyses showed that depressive symptoms and metacognitive beliefs about the consequences of rumination, but not trait-rumination, independently predicted natural use of stop-rule. The interrelations between depressive symptoms, metacognitive beliefs, stop-rule use and trait-rumination were considered within the meta-cognitive model of depression and rumination (Papageorgiou & Wells, 2003), which provided an explanatory framework.

Finally, this study examined the participants' mood changes over the rumination interview and showed that depressed participants experienced significantly greater increases in negative mood (sadness and anxiety) than healthy controls, regardless of their stop-rule use. This finding warrants further investigation on the variables within the mood-as-input model, such as shifting of stop-rule within the rumination task, or other factors such as cognitive biases, that affect emotion states in rumination.

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PART 3: CRITICAL APPRAISAL

Introduction

This critical appraisal begins with a reflection on the process behind the current study's conception. This is followed by further discussion on the recruitment process, methodological limitations of the study, and the clinical implications of the results. It is hoped that this reflection process might offer some insights into my motivation for undertaking this study and the rationales for the important decisions made along the way. It may also offer some useful ideas for future research on the mood-as-input model for depressive rumination.

Motivation for the research

The conception of the current research stemmed from my keen interest in working with patients with major depressive disorder. My fascination started, perhaps, at my initial contact with a depressed patient while working as a first-year trainee clinical psychologist in an outpatient psychology service. Withdrawn, uncontrollably sad, and in despair - this person who had struggled with recurrent depressive episodes for the previous 14 years and was referred as 'medication-refractory', I had come to realise, aptly summarised the most common experiences of this debilitating condition.

Although advancements in cognitive-behavioural therapy (CBT) in the past two decades have effectively augmented the traditional antidepressant medication treatment (see Churchill et al., 2001; Christensen, Griffiths, Mackinnon & Brittliffe, 2006), studies have continued to show depression to be characterised by chronicity and high relapse rates (e.g. Paykel et al., 2005). In

addition, risk of relapse was shown to be significantly predicted by the number of previous depressive episodes (Kessing, Hansen, Andersen & Angst, 2004). This suggested that existing treatments had been more successful in reducing symptoms than hindering the progressive course of the disorder.

Consistent with clinical observations, research on factors that increase vulnerability to relapse has reported that patients recovered from depression often suffer from residual symptoms (Judd, 1997; Judd et al., 1999; Paykel et al., 1995). A recent clinical case series demonstrated that CBT modified to target depressive rumination significantly improved symptoms of patients with residual depression (Watkins et al., 2007). These preliminary findings confirmed existing evidence on the effects of rumination on remission, and thus its central role in chronic depression (e.g. Jones, Siegle & Thase, 2008). Although the results from this preliminary study were encouraging and warrant further research, current research effort on treatment for rumination is admittedly scarce. This might partly be due to the absence of a general consensus on the conceptualisation of rumination (see Smith & Alloy, 2009), and a consequent lack of understanding of the mechanisms underlying its influence on depressive symptoms.

I was also repeatedly struck by rumination's predominance as a thinking style amongst patients who had lived with their depressive symptoms for years. This seeming incongruence between my clinical observations and the then current state of research motivated me to embark on a search in the existing literature for theories of rumination. In particular, I focussed on looking for theoretical models containing operationalised constructs that could lend themselves to empirical testing. It was this search that brought my attention to the mood-as-input studies on perseverative worry and rumination.

When this project began in early 2010, there were two published experimental studies examining the mood-as-input hypothesis of rumination (Watkins & Mason, 2002; Hawksley &

Davey, 2010). Due to the small amount of available data, and as none of these studies included participants from a clinical population, there appeared to be a need for a study on rumination from a mood-as-input perspective with a clinical sample with depression.

Recruitment of clinical participants

In retrospect, one of the most time-consuming and labour-intensive parts of the study was the recruitment of clinical participants from mental health services. The 25 depressed participants in this study were all recruited from NHS outpatient psychology services via clinician referrals. Notwithstanding the relatively high availability of patients with depression compared to other conditions, the recruitment process lasted for 9 months and involved 4 Improved Access to Psychological Therapy (IAPT) services within a London NHS Foundation Trust.

The rationale for this referral procedure was that it would protect the participants' confidentiality by limiting my access to their personal details pre-study. It was also meant to provide a least intrusive route to recruitment, as clinicians were required to obtain potential participants' verbal consents before I approached them about the research. Although this procedure safeguarded the ethical integrity of the study's recruitment process, it proved to be logistically inefficient. In hindsight, this may be explained by a number of reasons. First of all, most psychology services were under considerable demands for research opportunities with their patients. For this reason, at any given time most clinicians often had more than one project that they had agreed to introduce to their patients. Therefore, practically, it was difficult for them to commit to offer continuous help with my research.

Secondly, it was noted that patients seldom made immediate decisions about participation once they had been introduced to the study. This is understandable, given the commitment the study required of them. This might have been compounded by the lowered level of motivation related to their depression. As potential participants could only contact me or be approached after discussing their intention to take part with their clinicians (who they usually saw once a week), it took an average of at least 2 to 3 weeks for me to be informed after they had expressed initial interest in taking part. Thirdly, most participants let me know they were only willing to take part in the study if the research session took place in their local psychology service. Due to the consistently high demand on clinical space in these services and their standardised working hours, this common request placed a considerable limitation on my ability to carry out my testing efficiently.

On reflection, it seems that some of these practical difficulties could have been solved by adopting alternative recruitment strategies, without risking the patients' confidentiality or increasing the level of intrusiveness. One way may be to use recruitment posters. Potential participants may learn about the study and make independent decisions about taking part from an information sheet or a poster displayed at psychology services. They may then initiate contact with the researcher in private.

On a management level, psychology services may help facilitate research in general by introducing a generic statement about providing consent for potential contacts from researchers as part of their patients' initial assessment documents. This way, clinicians would not need to obtain consent from their patients for each new research project, and may make direct referrals of suitable patients to researchers, thus saving much time on logistics.

Conception of the study design

The recruitment of clinical participants was also one of my main concerns in designing the study. As the primary aim of the current study was to compare predictions of the mood-as-input hypothesis about a clinical population with non-clinical controls, the group sampling method was by default non-random. Without the benefits of group randomisation, this design potentially opened the test results to influences of pre-test, between-group variations in the participants' characteristics. For this reason, certain measures were adopted to minimise data contamination by these factors.

First, all participants in the control group were matched with the depressed participants in terms of demographic factors that were found to be related to the clinical characteristics of chronic depression, i.e. age, gender, and educational background (Kocsis, Voss, Mann & Frances, 1986). In addition, the design also incorporated a within-subject element. In order to mitigate the effect of individual differences in factors known to be influential on perseverative thinking, such as cognitive deficits related to depression (see Gotlib & Joorman, 2010), participants were asked to undertake the rumination interview in both stop-rule conditions. For this reason, the study adopted a mixed between-subject, repeated-measure design.

Because of the part repeated-measure design, the sample sizes of each participant group were not further divided into separate stop-rule conditions. This had the benefit of reducing the demand for a bigger sample by preserving the power of the statistical analyses. Therefore, this design had proven to be economical, considering the difficulties involved in recruiting participants from a clinical population as described above.

While planning the study, I was also mindful that the influences of other confounding factors that were not reflected in pre-test measurement might be present, such as *carryover effect.*. In other

words, when participants undertook both conditions of the rumination interview within the same research session, the effects of the first condition might remain and affect the outcomes of the second condition. As rumination has consistently been demonstrated to be related to negative affects (Thomsen, 2006), one of the most obvious which participants might carry over to the second part of the interview was a lasting effect of the interview on their mood states. To minimise this problem, the orders of the two experimental conditions were counterbalanced for all participants.

Considerations on the neutral mood induction procedures

In addition, the study also introduced a neutral mood induction procedure (presented to the participants as a relaxation exercise) between the two conditions of the interview, with a view to cancelling out the mood effects of the first condition. Principles of the mood-induction procedure used in a previous mood-in-input study were adopted for this purpose (see Hawksley & Davey, 2010). To induce a neutral mood, participants were asked to listen to a 5-minute piece of mood-suggestive music (Chopin's Waltz in C minor) alone in the intermission between the two experimental conditions. Overall, the procedure was successful. Results of analyses of the outcomes of mood assessment using visual analogue scales (VAS) showed that participants' mood ratings after the relaxation exercise were approximately restored to their pre-interview levels.

However, a few shortcomings of these methods were noted in the administration process. First, there was considerable variability in the participants' responses to the music. Effects opposite to the desired mood states were reported by two participants, who became slightly distressed by the music as it evoked negative thoughts and memories. Secondly, a survey of the literature on

studies which conducted mood-inductions through music revealed that music alone might not automatically induce the intended mood state (see Martin, 1990). Because of this, in addition to listening to the music passively, some of those studied also instructed their participants to use any other means appropriate to get into the target mood states. To enhance the effectiveness of the mood induction for the purpose of the current study, introducing an element of *attentional training* to help engage with the procedure might have been a helpful modification. Past studies have shown that deliberate disengagement of one's attention from stressful cognitions or internal stimuli produced improvement in moods (e.g. Wells, 1990; Schmidt, Richey, Buckner & Timpano, 2009). Therefore, future studies may ask participants to intentionally disengage their attention from their internal thoughts, and direct their attention on external stimuli - the music - during the mood induction task. Based on previous findings of the impact of attentional control on mood states, it is reasonable to expect that this instruction will increase the effectiveness of a mood-induction procedure.

A further issue is that the outcomes of the neutral mood induction procedures might have been subject to *demand effects*. This suggests the possibility that changes in participants' mood states were artificial due to their propensity to comply with experimental demands. The study design and my research resources did not allow such effects to be easily monitored. However, past studies which investigated the efficacy of mood induction by music had examined a number of mood effects which participants are not likely to simulate, such as changes in performances of motor-tasks and skin conductance reactivity (e.g. Clark & Teasdale, 1985; Sutton, 1985). In general, these studies have demonstrated that these measurements tend to be sensitive to music induction. Therefore, though difficult to confirm, the influence of demand effects in the present study was unlikely to be significant.

Reflections on the rumination interview paradigm

Background of the rumination interview task

The current study used the rumination interview task as its dependent measure, which was originally an adaptation of the catastrophising interview procedure developed and used to measure perseverative worrying in past studies (Vasey & Borkovec, 1992; Startup & Davey, 2001; Davey, 2006). The rumination interview in the present study involved asking participants to think of a recent, upsetting incident in each of the two parts of the task. They were then asked a series of *standardised questions* about why the incident made them feel upset. Each participant undertook both parts of the interview, in each of which they were asked to follow either an 'as-much-as-can' (AMAC) or 'feeling like continuing' (FLC) stop-rule, i.e. to answer as much as they can, or to stop answering the questions when they did not feel like continuing, respectively.

This interview task was chosen as the experimental paradigm of this study for several reasons. First, the paradigm provided an objective and controlled manipulation of the variables predicted by the mood-as-input theory to contribute to the persistence of perseverative thinking, i.e. stop-rules and mood states. Secondly, it allowed for the quantification, and hence the objective measurement, of a bout of perseverative rumination by converting progression into the incremental number of questions answered (or 'steps' emitted) by the interviewee (participant). Lastly, variants of the interview task had been used in a number of prior studies, where they demonstrated sensitivity to the variables predicted by the mood-as-input hypothesis to influence the strength and frequency of perseverative thinking (e.g. Startup & Davey, 2001, 2003; Davey, Startup, MacDonald, Jenkins & Paterson, 2005; Davey, Eldridge, Drost & MacDonald, 2007;

Hawksley & Davey, 2010). This suggested that the rumination interview task was a valid analogue of naturally occurring rumination.

Potential limitations of the paradigm

Despite its advantages and evidence in support of its validity as a measure of rumination, however, I have made a number of observations which might have implications for refinement or modification of the paradigm for future applications. First, although the majority of depressed participants experienced increases in negative mood over the course of their interviews, a minority of them (i.e. 2 depressed participants using the AMAC and 3 using the FLC stop-rules) reported improvement (decreases in their sadness) in their mood-states post-interview. This observation warrants comment, as it contradicted the expected results based on the well-researched connection between rumination in depression and negative affects (see Thomsen, 2006). One potentially related issue is that this study did not distinguish between the negative and positive aspects of the ruminative sequence in the analyses (Treynor, Gonzalez & Nolen-Hoeksema, 2003; Watkins, 2008). It was therefore possible that for some of the participants perseveration during the rumination task might have represented adaptive reflection. This highlights the fact that although the mood-as-input hypothesis predicts the variables which influence perseveration, it does not provide an explanation of what determines whether an individual could benefit from a period of rumination. In order to investigate factors which affect the subjective experience of rumination, future studies may examine and compare the themes from the contents of the rumination sequences produced by participants who experience improvement with those who experience deterioration in moods during the rumination task.

Another possibility may be related to the interpersonal format of the rumination task. As mentioned in the discussion section in the empirical paper of the current study, the interaction

during the interview between myself, the researcher, and the depressed participant might have given rise to experiences which were not a part of naturally occurring rumination. This study did not formally document the participants' feedback on how they decided to terminate each part of the rumination interview. However, anecdotal reports suggested that some participants felt that the opportunity to talk about their negative experience provided some forms of emotional relief. This may be accounted for by the effect of my presence, and my appearance to listen non-judgementally, experienced by a participant in distress during the interview. Although I took care to adhere to the standardised procedure of the interview task, which is designed to minimise individual differences of questioning style by researchers and the effects of some of these interpersonal elements, the interactional experience of the interview might unintentionally resemble some of the common factors of psychological therapy enlisted by Imel and Wampold (2008).

Another relevant observation I made pertains to the effectiveness of the current definitions and presentation of stop-rules for participants adopted by the rumination task. Whilst conducting the rumination interview, I noticed a recurrent problem many participants encountered with adhering to the stop-rule instructions, especially with the FLC stop-rule. The FLC stop-rule was devised and used by Martin, Ward, Achee and Wyer (1993) in their original mood-as-input study. It may be understood as an experimental instruction aimed to replicate an experientially-focussed (as opposed to analytically-focussed) thinking style (Watkins & Teesdale, 2001, 2004), which asks a person to continue with their current task as long as they enjoy it (or feel like continuing). To achieve this, a question is presented to each participant, for them to set a goal for the task by asking themselves, '*Do I feel like I want to continue thinking of the reasons that make me feel sad?'* Participants were asked to stop the interview when they no longer enjoyed participating in it.

However, I noticed that a considerable proportion of participants perseverated under the FLC condition. This phenomenon may reflect participants' misunderstanding of the instructions. For example, two participants remarked after the experiment that *'I feel like continuing because I haven't thought this through fully yet and so should continue'.* In these cases, it shows that these participants referred back to the AMAC stop-rule in the FLC condition. Considering depressed participants showed a preference to adopt a default AMAC stop-rule, it is possible that this phenomenon is particularly common among depressed participants.

Another possibility which may explain this observation is, as mentioned above, the adaptive aspect of rumination (e.g. reflection). Participants who perseverated might have genuinely felt like continuing, as the rumination task offered them emotional reliefs or had a cathartic effect. To improve the validity of the FLC stop-rule instruction, and direct participants' attention to their feelings, I suggest a method that uses a concrete description of the thinking style asked of them by linking the FLC stop-rules explicitly to an overall feeling of discomfort or distress. For example, it may be rephrased as, 'stop if you're becoming distressed or uncomfortable about the process'.

Clinical implications

The present study confirmed findings from previous research, which suggested that rumination is a significant factor for the persistence of depression (see Spasojevic & Alloy, 2001). It also supported the mood-as-input prediction of the cognitive mechanisms which underlie the persistence of rumination in people with clinical depression.

Until recently, the predominant models of CBT for depression had not explicitly addressed rumination. This perhaps reflects the emphasis of traditional cognitive models of depression (e.g. Clark & Beck, 1999) on the contents of maladaptive thinking rather than mental processes (see Hollon, Thase, & Markowitz, 2002). A recent case series reported by Watkins et al. (2007) offered some preliminary evidence for the efficacy of targeting patients' ruminative thinking in treatment for chronic and recurrent depression. In this case series, the rumination-focussed model was documented to have focussed on switching depressed patients' maladaptive to more helpful thinking styles through the use of functional analyses, imagery exercises, and behavioural experiments. As a result, the participants reported significant remissions of residual symptoms including depressive rumination.

Given that the results of the present study showed a significant effect of explicit stop-rule manipulations on the degrees of perseverative rumination amongst individuals with depression, elements of the rumination interview paradigm may be eligible for clinical use. Specifically, depressive patients might benefit from in-therapy training on conceptualising ruminative thinking style in terms of the AMAC stop-rule, and the conscious use of FLC stop-rule as a coping strategy to disengage themselves from prolonged perseveration.

These methods have a number of potential advantages. First, the rationale for an intervention targeting stop-rule use is based on a cognitive model consisted of factors that contribute directly to iterative thinking styles; therefore, and as empirical evidence has suggested, it is likely to produce a shift in the patients' thinking style within a short time. In addition, depression is known to be associated with an abstract and analytical thinking style (see Joormann & Gotlib, 2010). Therefore, the understanding of rumination in terms of stop-rule may provide a concrete and experiential definition of rumination. Hence, it might help individuals with depression more easily grapple with their experiences of ruminative thinking in their day-to-day dealings with depressive

symptoms. For these reasons, I believe that the principles of the rumination interview paradigm can offer valuable ideas of treatment methods that may prove to be effective adjuncts to the existing model of rumination-focussed CBT.

Conclusion

On reflection, undertaking this research project has been a challenging yet productive learning process for me. It has broadened my knowledge on the field of depression studies, as well as helped me develop in my journey of maturation as a scientist-practitioner. This applies in particular to methodological considerations in designing a study, and my understanding of the significant differences in practice subtle decisions can make, such as decisions on recruitment and measures to protect the validity of experimental paradigms. Besides the opportunity to conduct research in an area I find passion in, I also feel that this project has been a worthwhile endeavour due to its findings' implications for future rumination studies and clinical research. Overall, I believe this study has reinforced the mood-as-input theory. It has also been successful in providing preliminary evidence for the mechanisms underlying perseverative rumination in people with depression.

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Appendix A

Ethical approval letters

Take out this page to insert letter page 1

Take out this page to insert letter page 2

Take out this page to insert letter page 3

Take out this page to insert letter page 4

Take out this page to insert letter page 5

Appendix B

Participant Information Sheet: For depressed participants

Participant Information Sheet: For healthy volunteers

Participant Consent Form: For depressed participants

Participant Consent Form: For healthy volunteers

GP information letter

INFORMATION SHEET (for depressed participants)

STUDY TITLE: A STUDY OF RUMINATION IN DEPRESSION

Dear ………………………………………..,

We would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully.

Please let us know if you would like more information, and take time to decide whether you would like to participate or not.

What is the purpose of the study?

My name is Jason Chan and I am a second year Clinical Psychologist in training at the University College of London (UCL) and I am conducting this research project as part of the thesis of my doctoral degree.

Rumination refers to a prolonged and repetitive style of thinking. People with low mood or those who suffer from depression often find themselves thinking on and on, for a long period of time about what upset them, and why they are upset.

I am currently exploring how rumination may maintain one's symptoms of depression. In particular, my project will aim to find out whether rumination is connected with low mood, and whether such a connection (if there is one) differ between people with and without a current diagnosis of depression. I am hoping that this study will help mental health professionals gain a more in-depth understanding of the psychological factors that maintain depressive symptoms in some people, and generate knowledge that will inform the continuing development of psychological therapy for depression.

Why have I been invited?

Your name has been identified from the treatment list of one of the mental health services in the Camden and Islington Foundation Trust, and the result of your initial assessment suggested that you may be experiencing symptoms of depression.

<u>And</u>

You have expressed an interest in my project and/ or given consent to be contacted about this project by telephone.

Do I have to take part?

It is wholly your choice as to whether you decide to participate or not. If you do decide to participate you will be asked to sign a form recording your consent.

If you do decide to take part you are still free to withdraw at any time and without giving a reason.

What will happen if I take part?

To participate, you would be asked to take part in one interview session lasting around 1½ hours in an outpatient mental health service clinic in Islington.

The meeting will involve completing several questionnaire-based assessment, and taking part in an interview about your recent experience of depression by the researcher. Once the session finished, you will be given a full explanation of the background of the study and the purpose of the procedures.

Payment and expenses

You will be offered a £10 remuneration for compensation of the expenses (e.g. travel cost, time) incurred on you as a result of taking part in this study.

What are the possible disadvantages of taking part in the study?

It is fully acknowledged that telling your experience of depression may be a difficult process. Some questions I may ask you might feel sensitive. If any of the questions are found to be particularly upsetting you may choose not to continue the study.

What are the possible benefits from taking part in the study?

We can not promise that the study will help you. However, the interview-based experiment you will undertake, should you choose to part take in this project, have been reported by other studies to help people discover alternative, and sometimes more effective way of coping with their negative moods and other psychological distresses associated to rumination.

What if there is a problem?

Any complaint about the way you have been dealt with during the study or any problem you might experienced will be addressed.

If you have any concern about any aspect of this study you should ask to speak to the researcher who will do his best to answer your questions (Telephone number: ███████████). If you remain unhappy and wish to complain formally you can do so by contacting the project's Research Supervisor, Professor Chris Brewin (Telephone number: ███████████).

Will my taking part in the study be kept confidential?

All information collected about you throughout the course of research will be kept strictly confidential. Your name and other identifying information will be kept securely and separately from the outcomes of your questionnaire-based assessments and interviews.

Only anonymised data collected from your session will be looked at by representatives from academic and professional assessment bodies in order to assess the quality of this doctoral research project. All will have a duty of confidentiality to you as a research participant.

Are their any reasons where confidentiality may be breached?

As all participants will be regulated by the Research Ethics Committee of the NHS North Central London Research Consortium (NoCLor) due to your professional status, the following code of conduct will be followed with regards to confidentiality:

1. If you disclose information during the interview which leads to sufficient concern about your safety or the safety of others it may be judged necessary to inform an appropriate third party without formal consent.
2. Prior to this occurrence the researcher's project supervisor will be contacted to discuss any possible concerns, unless the delay would involve a significant risk to life or health.

What will happen to the results of this research study?

The results will be written up in the form of a thesis for the purposes of gaining a Doctoral qualification in Clinical Psychology.

The findings may be shared via academic publication and/or presentations. Participants will not be identified in any report or publication.

Who has reviewed the study?

All research in the NHS is looked at by an independent Research Ethics Committee to protect your safety, rights, dignity and well-being. This study has also been reviewed and given a favourable opinion by academic and clinical professionals in the University College of London (UCL) who has raised no objections on ethical grounds.

Further information and contact details

Should you have any further questions or any concerns during the study please do not hesitate to contact the researcher or his research supervisor on the contact numbers provided below.

If you are interested in potentially participating in this study please fill in the reply slip included with this information sheet and return to Jason Chan (Primary Researcher) via the email address provided.

Should you wish to complain about this study the Independent Complaints Advocacy Service (ICAS) supports individuals wishing to pursue a complaint about the NHS. (See http://www.dh.gov.uk)

The contact details for the areas covered by this study are as follows:

- ICAS North Central London Tel: 0845 120 3784
- ICAS North East London Tel: 0845 337 3059
- ICAS North West London Tel: 0845 337 3065
- ICAS South East London Tel: 0845 337 3061
- ICAS South West London Tel: 0845 337 3063
- ICAS Surrey Tel: 0845 600 8616

Thank you for taking time to read this information.

Kind Regards,

Mr Jason Chan

Chief Investigator

Trainee Clinical Psychologist

████████████████████████

Tel: ████████████

Research Supervisors

Professor Chris Brewin

Research Supervisor

Professor of Clinical Psychology

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Mr. Stuart Linke

Site Supervisor

Consultant Clinical Psychologist

stuart.linke@candi.nhs.uk

Tel: ▮▮▮▮▮▮▮

INFORMATION SHEET (for healthy volunteers)

STUDY TITLE: A STUDY OF RUMINATION IN DEPRESSION

Dear ………………………………………..,

We would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully.

Please let us know if you would like more information, and take time to decide whether you would like to participate or not.

What is the purpose of the study?

My name is Jason Chan and I am a second year Clinical Psychologist in training at University College of London (UCL). I am conducting this research project as part of the thesis of my doctoral degree.

Rumination refers to a prolonged and repetitive style of thinking. People with low mood or those who suffer from depression often find themselves thinking on and on, for a long period of time about what upset them, and why they are upset.

I am currently exploring how rumination may maintain one's symptoms of depression. In particular, my project will aim to find out whether rumination is connected with low mood, and whether such a connection (if there is one) differs between people with and without a current diagnosis of depression. I am hoping that this study will help mental health professionals gain a more in-depth understanding of the psychological factors that maintain depressive symptoms in some people, and generate knowledge that will inform the continuing development of psychological therapy for depression.

Why have I been invited?

You have been identified by the researcher as a suitable candidate for this study because your demographic details, including your age, gender and levels of education fulfil the requirement of the healthy sample population for this study.

And

You have been approached by the researcher and expressed an interest to participate.

Do I have to take part?

It is wholly your choice as to whether you decide to participate or not. If you do decide to participate you will be asked to sign a form recording your consent.

If you do decide to take part you are still free to withdraw at any time and without giving a reason.

What will happen if I take part?

To participate, you would be asked to take part in one interview session lasting around one hour in an outpatient mental health service clinic in Islington.

The meeting will involve completing several questionnaire-based assessments, and taking part in an interview about your recent experience of depression by the researcher. Once the session finished, you will be given a full explanation of the background of the study and the purpose of the procedures.

Payment and expenses

You will be offered a £10 remuneration for compensation of the expenses (e.g. travel cost, time) incurred on you as a result of taking part in this study.

What are the possible disadvantages of taking part in the study?

It is fully acknowledged that talking about your experience of low mood may be a difficult process. Some questions I may ask you might feel sensitive. If any of the questions are found to be particularly upsetting you may choose not to continue the study.

What are the possible benefits from taking part in the study?

The interview-based experiment you will undertake, should you choose to part take in this project, has been reported by other studies to help people discover alternative, and sometimes more effective way of coping with their negative moods and other psychological distresses associated to rumination.

What if there is a problem?

Any complaint about the way you have been dealt with during the study or any problem you might experience will be addressed.

If you have any concern about any aspect of this study you should ask to speak to the researcher who will do his best to answer your questions (Telephone number: ██████████). If you remain unhappy and wish to complain formally you can do so by contacting the project's Research Supervisor, Professor Chris Brewin (Telephone number: ██████████).

Will my taking part in the study be kept confidential?

All information collected about you throughout the course of research will be kept strictly confidential. Your name and other identifying information will be kept securely and separately from the outcomes of your questionnaire-based assessments and interviews.

Only anonymised data collected from your session will be looked at by representatives from academic and professional assessment bodies in order to assess the quality of this doctoral research project. All will have a duty of confidentiality to you as a research participant.

Are there any reasons where confidentiality may be breached?

The following code of conduct will be followed with regards to confidentiality:

3. If you disclose information during the interview which leads to sufficient concern about your safety or the safety of others it may be judged necessary to inform an appropriate third party without formal consent.
4. Prior to this occurrence the researcher's project supervisor will be contacted to discuss any possible concerns, unless the delay would involve a significant risk to life or health.

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What will happen to the results of this research study?

The results will be written up in the form of a thesis for the purposes of gaining a Doctoral qualification in Clinical Psychology.

The findings may be shared via academic publication and/or presentations. Participants will not be identified in any report or publication.

Who has reviewed the study?

All research in the NHS is looked at by an independent Research Ethics Committee to protect your safety, rights, dignity and well-being. This study has also been reviewed and given a favourable opinion by academic and clinical professionals in University College of London (UCL) who has raised no objections on ethical grounds.

Further information and contact details

Should you have any further questions or any concerns during the study please do not hesitate to contact the researcher or his research supervisor on the contact numbers provided below.

If you are interested in potentially participating in this study please fill in the reply slip included with this information sheet and return to Jason Chan (Primary Researcher) via the email address provided.

Should you wish to complain about this study the Independent Complaints Advocacy Service (ICAS) supports individuals wishing to pursue a complaint about the NHS. (See http://www.dh.gov.uk)

The contact details for the areas covered by this study are as follows:

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- ICAS South East London Tel: 0845 337 3061
- ICAS South West London Tel: 0845 337 3063
- ICAS Surrey Tel: 0845 600 8616

Thank you for taking time to read this information.

Kind Regards,

Mr Jason Chan

Chief Investigator

Trainee Clinical Psychologist

███████████████████████

Tel: ███████████

Research Supervisors

Professor Chris Brewin

Research Supervisor

Professor of Clinical Psychology

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Professor Graham Davey

Research Supervisor

Professor of Psychology

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Tel: ███████████

Mr. Stuart Linke

Site Supervisor

Consultant Clinical Psychologist

stuart.linke@candi.nhs.uk

Tel: ███████████

Title of Project: Study on Rumination in Depression

Name of Researcher: Jason Chan

**Please tick
to confirm**

- I confirm that I have read and understand the information sheet dated 6th April 2010 (version 1.0) for the above study.   •

- I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.   •

- I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.   •

- I understand that relevant sections of any of my medical notes and data collected during the study, may be looked at by responsible individuals from University College London, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.   •

- I agree to my GP being informed of my participation in the study.   •

- I agree to take part in the above research study.   •

_____   _____   _____

Name of Participant   Date   Signature

_____

Name of Person taking consent
(if different from researcher)   _____   _____

Date   Signature

_____   _____   _____

Researcher   Date   Signature

When complete, 1 copy for participant: 1 copy for researcher site file: 1 (original) to be kept in medical notes.

UCL **Camden and Islington NHS**
NHS Foundation Trust

Consent Form (for healthy volunteers)

Title of Project: Study on Rumination in Depression

Name of Researcher: Jason Chan

**Please tick
to confirm**

- I confirm that I have read and understand the information sheet dated 25th June 2010 (version 2.0) for the above study.   •

- I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.   •

- I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.   •

- I agree to take part in the above research study.   •

_____   _____   _____
Name of Participant   Date   Signature

_____
Name of Person taking consent   _____   _____
(if different from researcher)   Date   Signature

_____   _____   _____
Researcher   Date   Signature

Research Department of Clinical, Educational and Health Psychology
University College London
4th Floor, 1-19 Torrington Place
London
WC1E 7HB

Tel: +44 (0)20 7679 1897
Fax: +44 (0)20 7916 1989

GP surgery address

--/--/--

Dear Dr.

Re: Patient name
Date of birth:

I am writing to inform you that your patient named above has consented to participate in a research study examining the relationship between rumination and his/her depressive symptoms. He/she will be ask to attend one 60-minute appointment at his/her local psychological therapy clinic. During the appointment, he/she will be asked to complete 4 questionnaires and take part in a structured interview about a recent experience of low mood which may last up to 30 minutes.

This study has received approval from the North London Research Ethics Committee as ethnically sound. Risk to the patient from his/her participation in this study was assessed prior to the study, and no risk to the patient's well-being was determined.

If you would like any further information about this study, please contact me using the details above.

Yours sincerely,

Jason Chan
Trainee Clinical Psychologist
Camden and Islington NHS Foundation Trust

Appendix C

The Positive Beliefs about Rumination Scale

The Negative Beliefs about Rumination Scale

The Ruminative Responses Scale

The Visual Analogue Mood (VAS) Scales

Rumination Interview Stop-rule Instruction: As-much-as much stop-rule

Rumination Interview Stop-rule Instruction: Feel-like-continuing stop-rule

POSITIVE BELIEFS ABOUT RUMINATION SCALE (PBRS)

Developed by Costas Papageorgiou and Adrian Wells

Instructions: Most people experience depressive thoughts at times. When depressive thinking is prolonged and repetitive it is called *rumination*. This questionnaire is concerned about the beliefs that people have about rumination. Listed below are a number of these beliefs. Please read each belief carefully and indicate how much you *generally* agree with each one. Please circle the number that best describes your answer. Please respond to all of the items.

	Do not agree	Agree Slightly	Agree Moderately	Agree very much
1. In order to understand my feelings of depression I need to ruminate about my problems	1	2	3	4
2. I need to ruminate about the bad things that have happened in the past to make sense of them	1	2	3	4
3. I need to ruminate about my problems to find the causes of my depression	1	2	3	4
4. Ruminating about my problems helps me to focus on the most important things	1	2	3	4
5. Ruminating about the past helps me to prevent future mistakes and failures	1	2	3	4
6. I need to ruminate about my problems to find answers to my depression	1	2	3	4
7. Ruminating about my feelings helps me to recognise the triggers for my depression	1	2	3	4
8. Ruminating about my depression helps me to understand past mistakes and failures	1	2	3	4

NEGATIVE BELIEFS ABOUT RUMINATION SCALE (NBRS)

Developed by Costas Papageorgiou and Adrian Wells

Instructions: Most people experience depressive thoughts at times. When depressive thinking is prolonged and repetitive it is called rumination. This questionnaire is concerned about the beliefs that people have about rumination. Listed below are a number of these beliefs. Please read each belief carefully and indicate how much you generally agree with each one. Please circle the number that best describes your answer. Please respond to all of the items.

	Do not agree	Agree Slightly	Agree Moderately	Agree very much
1. Ruminating makes me physically ill	1	2	3	4
2. When I ruminate I can't do anything else	1	2	3	4
3. Ruminating means I'm out of control	1	2	3	4
4. Everyone would desert me if they knew how much I ruminate about myself	1	2	3	4
5. People will reject me if I ruminate	1	2	3	4
6. Ruminating about my problems is uncontrollable	1	2	3	4
7. Ruminating about my depression could make me kill myself	1	2	3	4
8. Ruminating will turn me into a failure	1	2	3	4
9. I cannot stop myself from ruminating	1	2	3	4
10. Ruminating means I'm a bad person	1	2	3	4
11. It is impossible not to ruminate about the bad things that have happened in the past	1	2	3	4
12. Only weak people ruminate	1	2	3	4
13. Ruminating can make me harm myself	1	2	3	4

The Ruminative Reponses Scale (RRS)
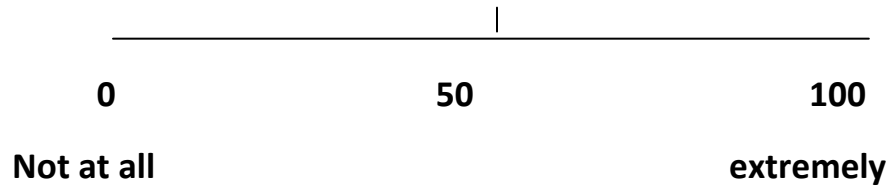
Instructions

Everyone gets upset—sad, blue, nervous—some of the time. People deal with being upset in many different ways. Please read each of the items below and indicate, by marking the appropriate number, whether you *almost never*, *sometimes*, *often* or *almost always* think or do each one when you feel upset. Please indicate what you *generally* do. Please choose which is the most accurate response for *you*, not what you think "most people" would say or do, or what you think you *should* think or do. There are no right or wrong answers.

|		Almost never	Sometimes	Often	Almost always
1.	Think about how alone you feel	1	2	3	4
2.	Think "I won't be able to do my work / job if I don't snap out of this"	1	2	3	4
3.	Think about your feelings of fatigue and achiness	1	2	3	4
4.	Think about how hard it is to concentrate	1	2	3	4
5.	Think "what am I doing to deserve this?"	1	2	3	4
6.	Think about how passive and unmotivated you feel	1	2	3	4
7.	Analyse recent events to try and understand why you feel this way	1	2	3	4
8.	Think about how you don't seem to feel anything anymore	1	2	3	4
9.	Think "why can't I get going?"	1	2	3	4
10.	Think "why do I always react this way?"	1	2	3	4
11.	Go away by yourself and think about why you feel this way	1	2	3	4
12.	Write down what you are thinking about and analyse it	1	2	3	4
13.	Think about a recent situation, wishing it had gone better	1	2	3	4
14.	Think "I won't be able to concentrate if I keep feeling this way"	1	2	3	4
15.	Think "why do I have other problems other people don't have?"	1	2	3	4
16.	Think "why can't I handle things better?"	1	2	3	4
17.	Think about how sad or fed-up you feel	1	2	3	4
18.	Think about all your shortcomings, failings, faults, mistakes	1	2	3	4
19.	Think about how you don't feel up to doing anything	1	2	3	4
20.	Analyse your personality to try to understand why you feel the way you do	1	2	3	4
21.	Go someplace alone to think about your feelings	1	2	3	4
22.	Think about how angry you are with yourself	1	2	3	4

The Visual Analogue Mood Scale

**Please indicate your answer by placing a cross along the 0 – 100 scale.**

1. **Please mark a cross along the scale to indicate how sad you feel at the present moment.**

0　　　　　　　　　　　**50**　　　　　　　　　　　**100**

Not at all　　　　　　　　　　　　　　　　**extremely**

2. **Please mark a cross along the scale to indicate how happy you feel at the present moment.**

0　　　　　　　　　　　**50**　　　　　　　　　　　**100**

Not at all　　　　　　　　　　　　　　　　**extremely**
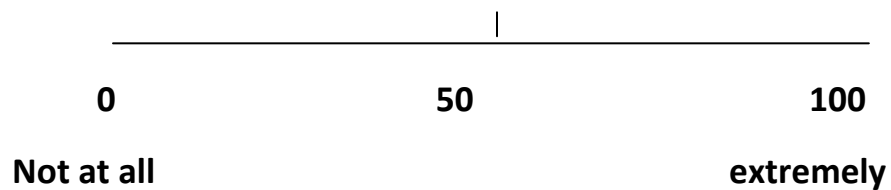
3. **Please mark a cross along the scale to indicate how anxious you feel at the present moment.**

0　　　　　　　　　　　**50**　　　　　　　　　　　**100**

Not at all　　　　　　　　　　　　　　　　**extremely**
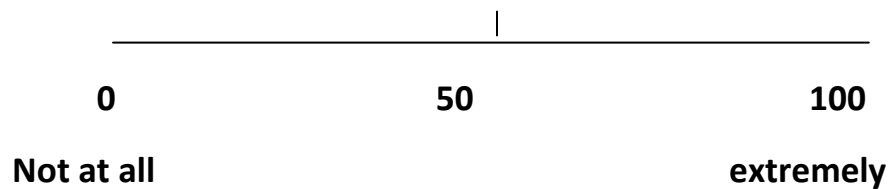
The "As-much-as-can" Stop-rule Instruction

As you take part in the interview, please ask yourself

"Have I reached the goal of thinking about <u>ALL</u> the possible reasons for why this event could have made me feel sad?"

If the answer is "**Yes**" then stop. If the answer is "**No"** then continue thinking.

There is no right or wrong time to stop. Keep reminding yourself of the goal for your interview as you continue. Your goal is :

"Have I reached the goal of considering <u>ALL</u> the reasons for why I might feel sad about the event?"

Stop when you feel you have thought about all the possible reasons that made you feel sad.

The "Feel-like-continuing" Stop-rule Instruction

As you take part in the task, please ask yourself

"Do I feel like I want to continue thinking of reasons for what made me feel sad

about a recent event?"   If the answer is "**Yes**" then continue with the interview.

If the answer is "**No**" stop. There is no right or wrong time to stop. Keep

reminding yourself of the goal for your task as you continue. Your goal is:

"Do I feel like I want to continue thinking of reasons for what made me feel

sad?"

Stop when you feel you no longer enjoy participating in the interview.