Accepted for publication in "Clinical Psychological Science"

Mechanisms of Repetitive Thinking: Introduction to the Special Series

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Abstract

Repetitive thinking about negative experience, such as worry and rumination, is increasingly recognized as a transdiagnostic process underlying various forms of psychopathology including anxiety and depression. Recent theoretical models have emphasized the role of impaired attentional control and the habitual nature of negative biases in the development and maintenance of pathological repetitive thought. In this introduction, we provide a brief overview of these theories and of how the articles in the special series provide experimental evidence concerning these basic mechanisms underlying rumination and worry, and their relation to clinical dysfunction. Together the research summarized in these articles instantiates these theoretical frameworks and provides convergent evidence confirming the value of adopting a transdiagnostic approach that focuses directly on fundamental mechanisms of psychopathology, instead of on diagnostic criteria.

Keywords: rumination; worry; attentional control, transdiagnostic, research domain criteria

Mechanisms of Repetitive Thinking: Introduction to the Special Series

One feature of human experience that adaptively transforms our individual lives is our motivation to mentally revisit past events and to wonder about the future. These same pursuits, unfortunately, can become maladaptive when they focus and refocus repetitively on our emotionally troublesome personal experiences. Repetitive thinking (RT) about the past and the future has become a central phenomenon in research on transdiagnostic processes underlying various forms of psychopathology (Nolen-Hoeksema & Watkins, 2011; Olatunji, Naragon-Gainey, & Wolitzky-Taylor, 2014) . We use the term RT to represent worry and rumination, both of which involve self-focused repetitive thinking about negative self-relevant topics. Worry has been defined as relatively uncontrollable thoughts and images, laden with negative affect (Borkovec, Robinson, Pruzinsky, & De Pree, 1983), whereas rumination has been defined as repetitive and passive thinking about one's mood and its consequences (Nolen-Hoeksema, 1991). Worry is typically future-oriented, whereas rumination looks most often to the past. Experimental investigations of processes underlying psychopathology have revealed patterns common across diagnostic categories and thereby inspired the National Institute of Mental Health to initiate the Research Domain Criteria (RDoC) initiative (Insel et al., 2010; Sanislow et al., 2010). Commonalities or patterns are sought and detected across neural, behavioral, genetic, and self-report measures. RT is an excellent example of such a pattern. Although not fully developed, the RDoC approach encourages us to imagine new treatment possibilities. Conceptualizing disorders with respect to converging patterns could stimulate the development of a new generation of interventions focused on changing the processes of disordered thought and affect (De Raedt, Vanderhasselt, & Baeken, in press). According to Sanislow and colleagues (2010, p. 631), for example, this potential arises from "uncoupling research efforts from clinically familiar categories to focus directly on fundamental mechanisms of psychopathology."

In the first contribution to the special series, Mor and Daches review theories that propose cognitive impairments as causal contributors to ruminative thinking. To illustrate the means of inferring cause, a large section of the review is devoted to initial findings from methods of cognitive bias modification (CBM)—methods that seek to produce differences in future thoughts and affective states through training specific cognitive procedures and, more generally, to show that if you understand a phenomenon you can cause it to occur or to diminish. When aimed at patterns other than RT, these procedures have been central in encouraging RDoC approaches (e.g., Mathews & Mackintosh, 2000).

The remaining articles in the special series describe experimental evidence regarding the basic mechanisms underlying rumination and worry and their relation to clinical dysfunction. We invited papers from research groups who have been instrumental in identifying the mechanisms of RT and its consequences. As an introduction to the special series, we briefly mention some of the theoretical frameworks, described more fully by Mor and Daches, in order to highlight how the contributions to the series extend our understanding of RT.

Several approaches to understanding rumination point to impaired attentional control. Recently, Koster, De Lissnyder, Derakshan, and De Raedt (2011) proposed that the vicious cycle of ruminative thinking and negative mood is maintained by two interrelated processes. The first process involves reduced conflict signaling in situations where negative self-evaluative thinking is evoked because in depressed patients such thinking is congruent with their current depressogenic beliefs. The second process involves an impaired ability to exert attentional control when faced with negative events or ongoing thoughts. This impairment to disengage intensifies negative mood, interferes with problem solving and task performance, and leads to continued rumination and further impairment in attention control and conflict signaling. In short, this impaired disengagement hypothesis proposes a bidirectional circular influence between attentional control and RT (also see Hertel, 1997).

When the self-control of attention is impaired, more automatic tendencies (habits) are perpetuated. Habits of attending, interpreting, and remembering that are infused with negative biases form the basis of rumination, according to Hertel (2004). The habit perspective emphasizes distinctions among sources of attentional control, because it acknowledges that external sources also can and do control attention, and that fact offers directions for ruminative change. Habits can be broken.

With somewhat similar distinctions between sources of control relevant to RT in anxiety, Attentional Control Theory (ACT; Eysenck, Derakshan, Santos, & Calvo, 2007) emphasizes top-down and bottom-up attentional processes. Worry disrupts the balance between a stimulus-driven "bottom-up" attentional system and a top-down goal-directed attentional system by increasing the influence of the former to the detriment of the latter. This would cause hypervigilance for threat and the consolidation of biased cognitive processes, such as the ones identified by Hirsch and Mathews (2012) and relevant to their contribution to the series (described below).

Although there is a wealth of research on the relationship between rumination and attentional control, few studies have investigated worry-related attentional processes in the context of a non-emotional primary task. In their contribution to the series, Fox, Dutton, Yates, Georgiou, and Mouchlianitis examined the association between attentional control on nonemotional tasks and the ability of worriers or non-worriers to suppress worry-related intrusive thoughts (Study 1). They measured whether deficits in attentional control induced by fear conditioning would be larger for individuals showing high trait-worry. In line with bi-directional perspectives (e.g., Eysenck et al. 2007; Koster et al., 2011), increased worry might impair control processed by increasing cognitive load, but impaired control should also lead to difficulties in suppressing worry. To address these issues, Fox et al. conducted an attention-training experiment (Study 2) with high worriers performing an emotionally neutral flanker task. They sought to discover whether the control deficit induced by the preceding fear-

conditioning task could be reduced, and whether this reduction would improve the ability to inhibit negative intrusive thoughts.

First, in line with other studies (e.g. Hayes, Hirsch, & Mathews, 2008), their findings indicate that the experience of worry-related negative thought intrusions is associated with a general deficiency in attentional control. In the first experiment, high worriers, compared to low worriers, showed increased distractibility from fear-conditioned angry faces presented as to-be-ignored distractors during the neutral flanker task and greater difficulty in suppressing worry. In the second experiment, they again found strong positive correlations between attentional control and the suppression of negative thought intrusions. Although four sessions of attentional-control training was not effective when measured in standard ways, pre/post-training improvement in control was correlated with the decrease in thought intrusions on the worry assessment task.

In a recent review and reformulation of the contribution of attentional control to RT, Whitmer and Gotlib (2013) proposed that negative mood narrows attentional scope, constricting the array of percepts, thoughts, and actions that are activated in working memory or available for selection from memory. This narrowed scope increases the likelihood that thoughts become repetitive and thus ruminative. In turn, increased rumination exacerbates negative mood and further narrows the scope and repetitiveness of thought. Again, we see the mechanisms of the vicious cycle.

The attentional-scope model (Whitmer & Gotlib, 2013) is based on studies that provided only indirect evidence for attentional narrowing, because the studies mainly investigated working memory processes. To fill this gap, Grol, Hertel, Koster, and De Raedt (this issue) designed a study to assess more directly the relation between rumination and attentional breadth. Rumination is typically thought to be characterized by narrowed internal attention (thoughts and images), it may also narrow visual attention to self-related information

available in the external environment. A narrowed visual focus should affect the likelihood of thoughts adaptively shifting to topics or events unrelated to self.

One of the experiments reported by Grol et al. showed that narrowed attention to self was related to the tendency to brood, in particular. In the first experiment, however, Grol et al. assessed the causal influence of rumination on the breadth of visual attention by first inducing a ruminative or problem-solving reaction to a scenario with the potential to engender thoughts that were of either type. Consequently, they found that at high levels of trait rumination, the induction of the ruminative style led to a narrower focus of attention on self. More generally, these outcomes showed that RT can affect subsequent cognitive phenomena (also see Hertel, Mor, Ferrari, Hunt, & Agrawal, 2014).

Causal relations across situations are also implied by the differential activation hypothesis, devised by Teasdale and Barnard (1993). They suggested that the link between negative thoughts and negative mood is strengthened by having experienced past depressive episodes. Compared to never-depressed individuals, individuals who have recovered from depressive episodes show stronger relations between rumination and negative mood. According to Koster, Fang, and Marchetti (this issue), however, the relation is not so linear. The relation between rumination and negative mood might increasingly become characterized by more *variability* in both mood and thinking patterns, as well as by lower levels of *predictability over time*.

To investigate this hypothesis, Koster et al. collected daily electronic records of self-reported mood and rumination kept by individuals recovered from depression and from never-depressed controls. The relationship between mood and rumination was modeled by using a dynamic systems approach in which each part of the system interacts with the others over time. The concept of entropy within dynamic systems captures the unpredictability of states within the system—in this case, the transition between states reflecting different patterns of mood and rumination. As expected, formerly depressed participants reported less positive

mood and more momentary rumination than did the never depressed group. The difference between the groups in entropy scores was nonsignificant; that is, the relationship between mood and rumination was no less random in formerly depressed individuals than never depressed individuals. However, entropy predicted levels of depression six months later after controlling for current levels of depression, and marginally predicted levels of future brooding.

During a lifetime, depressive episodes are triggered by progressively milder stressors (Monroe & Harkness, 2005). Based on this observation, De Raedt and Koster (2010) argued that the stress system plays a major role in the development of vulnerability for affective disorders. By integrating cognitive and neurobiological research, they developed a conceptual framework in which attentional control processes are crucial to the understanding of susceptibility to stressors across time. An important aspect of increasing vulnerability to depression across time is a consistent pattern of decreased prefrontal activity, mediated by serotonin metabolism. Serotonin metabolism is controlled by the hypothalamic pituitary adrenal (HPA) axis that, in turn, becomes more reactive to stressors with the accumulation of depressive episodes. Reduced prefrontal activation would cause reduced attentional control, expressed in difficulties to disengage from negative external information and dysfunctional inhibitory control over negative elaborative self-referent thought processes triggered by stressors, leading to rumination and sustained negative affect.

Examined in simpler terms, evidence for the correspondence of depressive symptoms and control deficits in a variety of cognitive tasks has not been consistently obtained (De Lissnyder, Koster, Derakshan, & De Raedt, 2010). Quinn and Joormann (this issue) argue that this correspondence is likely to be revealed primarily when the measure of control is affected by stress. Indeed, a deficit in control has emerged as an important factor that may underlie the ability to effectively cope with stressors (Compas, Campbell, Robinson, & Rodriguez, 2009), and so momentary stress could be an important moderator of the control/depression relation

(De Raedt & Koster, 2010). Of even greater relevance to the special series, the control/depression relation should arguably be moderated by individuals' maladaptive ruminative habits (Hertel, 2004).

Quinn and Joormann chose performance on the n-back task (in this case, 2-back), scheduled before and after a stress induction, to index differences in executive control. The induction of stress was accomplished by asking the student participants to perform an arithmetic task and prepare a speech to be videotaped and shown to others; both tasks were described as measures of their intelligence. Poorer performance following the induction of stress was experienced by students who reported more symptoms of depression, but only if they also reported higher levels of brooding, the maladaptive component of rumination. The habit of ruminating is associated with poor control, and the association is revealed in performance when the habit is fueled by current conditions of stress.

Moving beyond the attentional-control accounts of RT, a number of theoretical models of worry and rumination have proposed that other cognitive features are involved in the onset, maintenance, and negative consequences of pathological RT (Hirsch & Mathews, 2012; Watkins, 2008). One dimension that has been highlighted is the *style* of RT, whether it is visual or verbal, abstract or concrete. In addition to depleted or misdirected control of attention, Hirsch and Mathews proposed that high levels of verbal thinking about possible negative outcomes strongly characterize worry. According to Hirsch, Perman, Hayes, Eagleson, and Mathews (this issue), however, the extent to which verbal negative thinking style maintains worry has been somewhat unresolved.

In pursuit of the causal role of thinking style in the maintenance of worry, Hirsch et al. examined whether the effects of style were general or specific to the valence of thought content. High worriers were randomly assigned to practice imagery or verbal processing and to focus on either negative or positive outcomes of their current main worry. The authors assessed effects of each manipulation on the frequency of negative thought intrusions that

occurred during baseline and post-worry phases of focused breathing and on perceived threat and mood during worry. Negative imagery significantly reduced intrusions relative to negative verbal worry, however positive imagery was no better than negative imagery at reducing intrusions, and no difference obtained between positive imagery and positive verbal thinking. Moreover, we found it interesting that only valence influenced the subjective ratings of worry outcomes (i.e. cost, concern, and ability to cope), irrespective of thinking style; positive valence reduced the negativity of these projected outcomes. Thus, consistent with the framework developed by Hirsch and Mathews (2012), the frequency of negative intrusions, which often act as a precursor to worry, was influenced by thinking style (verbal) and the valence of thought content (negative) acting together.

In parallel, the processing-mode theory, which has been used as a framework to explain the cognitive basis and consequences of ruminative disposition and RT more generally (Watkins, 2008; Watkins, Moberly, & Moulds, 2008), hypothesizes that depressive rumination is characterized by abstract processing that involves thinking about the implications of emotional events. This abstract mode of processing focuses on causes, meanings, implications, significance, and consequences of feelings and events, as opposed to a concrete mode of processing focused on direct, detailed, concrete experience and the unfolding of how events occur. In particular, experimental evidence points to negative consequences of implicational thinking associated with an abstract processing mode when applied to difficulties and negative events (Watkins, 2008). Linking back to the habit perspective on rumination (Hertel, 2004), a habitual tendency to adopt an abstract processing style in response to negative events is hypothesized to contribute to depressive rumination (Watkins & Nolen-Hoeksema, 2014).

Watkins, MacLeod, Grafton, and Weinstein (this issue) identify a gap in the literature on processing style. To date, the empirical studies designed to test processing-mode theory, by assessing the degree to which people who vary in ruminative disposition engage in a

processing mode that favors implicational thinking, have relied solely on self-report measures of processing style. Self-reports of cognitive phenomena commonly lack validity (Nisbett & Wilson, 1977). To fill this gap, Watkins et al. developed an indirect measure of the degree to which judgments of likelihood for differentially emotional subsequent events is influenced by the emotional tone of previous events. Processing-mode theory predicts that heightened ruminative disposition will be characterized by an increased tendency to extrapolate from the emotional tone of current events, to anticipate the likely emotional tone of future events. This prediction was not supported in Study 1, which assessed self-reported expectancy ratings for subsequent events. Instead, ruminative disposition was associated with a negative expectancy bias for subsequent events. In Study 2, however, emotional extrapolation was assessed with a behavioral index of comprehension latency, and support for the prediction was obtained. These divergent findings highlight the value of examining performance measures when investigating RT. Together, both Hirsch et al. and Watkins et al. highlight the importance of examining both thinking style (e.g., abstract-verbal; concrete-visual) and the selective processing of negative information (e.g., negative expectancy bias; negative thought content) in studies of RT, whether it be anxious worry or depressive rumination.

In conclusion, the articles collected for the series further instantiate extant frameworks used to understand rumination and worry. These frameworks and their supporting evidence provide clear examples of the advantage of taking a procedural, transdiagnostic perspective in the study of cognitive phenomena associated with anxiety and depression. Each investigation extends our understanding from the point of view of the procedural metaphors of cognitive psychology and neuroscience. Soon gone are the days of believing that clinical psychology can advance merely by describing peoples' thoughts and labeling them according to diagnostic criteria.

Authors' Contributions

RDR drafted the outline of this manuscript, all authors (RDR, PH, & EW) contributed, EW and PH revised. All authors approved the final version of the paper for submission.

Acknowledgements

The preparation of the special series was supported by Grant BOF10/GOA/014 of the Special Research Fund for a Concerted Research Action of Ghent University awarded to Rudi De Raedt, and a grant for an International Research Community of the Research Foundation Flanders: Changing automatic processes in psychopathology.

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