



Cueing an unresolved personal goal causes persistent ruminative self-focus: An experimental evaluation of control theories of rumination



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ARTICLE INFO

Article history:

Received 7 November 2012

Received in revised form

2 April 2013

Accepted 24 May 2013

Keywords:

Rumination

Goals

Control theory

Self-regulation

ABSTRACT

Background and Objectives: Control theory predicts that the detection of goal discrepancies initiates ruminative self-focus (Martin & Tesser, 1996). Despite the breadth of applications and interest in control theory, there is a lack of experimental evidence evaluating this prediction. The present study provided the first experimental test of this prediction.

Methods: We examined uninstructed state rumination in response to the cueing of resolved and unresolved goals in a non-clinical population using a novel measure of online rumination.

Results: Consistent with control theory, cueing an unresolved goal resulted in significantly greater recurrent intrusive ruminative thoughts than cueing a resolved goal. Individual differences in trait rumination moderated the impact of the goal cueing task on the extent of state rumination: individuals who had a stronger tendency to habitually ruminate were more susceptible to the effects of cueing goal discrepancies.

Limitations: The findings await replication in a clinically depressed sample where there is greater variability and higher levels of trait rumination.

Conclusions: These results indicate that control theories of goal pursuit provide a valuable framework for understanding the circumstances that trigger state rumination. Additionally, our measure of uninstructed online state rumination was found to be a valid and sensitive index of the extent and temporal course of state rumination, indicating its value for further investigating the proximal causes of state rumination.

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1. Introduction

Rumination is a specific form of repetitive self-focus that is known to maintain and exacerbate depressive symptoms (Morrow & Nolen-Hoeksema, 1990; Nolen-Hoeksema, 1991, 2000; Spasojevic & Alloy, 2001; Watkins, 2008) and to increase vulnerability to developing depression (Nolen-Hoeksema, 1991, 2000). It is thus important to investigate factors that cause individuals to pathologically ruminate, and the mechanisms by which rumination exacts detrimental effects.

Response Styles Theory (RST; Nolen-Hoeksema, 1991) conceptualises rumination as a stable, trait-like style of responding to depressed mood involving persistent focus on negative emotions. RST emphasises the response style as opposed to cognitive content

and primarily focuses on maladaptive consequences of rumination (Nolen-Hoeksema, 1991; Treynor, Gonzalez, & Nolen-Hoeksema, 2003). Whereas RST considers aspects of personality and early experience that might contribute to habitual tendencies to ruminate, control theory considers proximal, contextual factors that are hypothesised to predict individual occurrences of ruminative thought (Watkins, 2008). Control theories adopt a broader conceptualisation of rumination as “a class of conscious thoughts that revolve around a common theme and occur in the absence of immediate environmental demands requiring the thoughts” (Martin & Tesser, 1996, p. 7). This conceptualisation includes adaptive and maladaptive components of rumination (e.g., Carver & Scheier, 1982; Martin & Tesser, 1996; Watkins, 2008) and provides greater specification of the mechanisms thought to trigger state rumination.

Control theories emphasise the role of focussing on an ideal-actual self-discrepancy in ruminative responses. Unexpected progress (more or less) towards pursuing a goal is hypothesised to

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instigate rumination, which continues until the discrepancy is resolved, either by restoring goal progress or disengaging from the goal. Negative rumination (caused by lack of goal progress) is argued to have a longer time course than positive rumination (caused by unexpected goal progress) because a continuation of the status quo will maintain negative rumination. State rumination is thus argued to predominantly occur in response to the detection of a negative ideal-actual self-discrepancy regarding personally important goals. Control theory predicts that concrete goal-focused rumination functions as a form of problem solving, whereas abstract goal-focused rumination is proposed to interfere with problem-solving (Watkins, 2008). Control theory thus has a much broader conceptualisation of rumination incorporating both adaptive and maladaptive repetitive thoughts about goal discrepancies.

The theories are not inconsistent: depressed individuals are likely to hold the goal of escaping from their persistent negative mood, which both theories predict would result in rumination about their depression (McIntosh, 1996). However, control theory accounts incorporate a broader specification of the content of rumination (for an elaborated consideration of areas of overlap and distinction see Watkins, 2008).

Control theories have been applied to numerous areas of psychology including motivation, psychopathology, and self-regulation (e.g., Burnette, O'Boyle, Van Epps, Pollack, & Finkel, 2012; Watkins, 2011). However, few studies have empirically evaluated whether goal-discrepancies are associated with rumination, and to our knowledge the prediction that unresolved goals causally instigate state rumination has yet to be tested. In a diary study in students, Lavalley and Campbell (1995) found that greater rumination and negative affect were reported after negative events related to self-reported personal goals than after goal-irrelevant negative events. However, because progress on the goals was not directly assessed, the study was unable to test the prediction that lack of goal progress causes rumination.

Moberly and Watkins (2010) used experience sampling methodology, in which negative affect, rumination, and goal appraisals were reported at eight random intervals daily over a week to examine state rumination and goal progress. Consistent with control theory, low goal success was correlated with greater ruminative self-focus and negative affect. Moreover both ruminative self-focus and negative affect were highest when participants' most salient goal was important and progress towards that goal was low. However, this study does not test the causal hypothesis that frustrated goal progress instigates state rumination, which is an important next step to empirically validate a central prediction of control theories of rumination.

The present study thus sought to test this important causal hypothesis. Participants identified and focused on an on-going, unresolved, and personally relevant goal and we then measured subsequent spontaneous rumination about that goal over a 50 min period. In order to directly contrast the impact of thinking about unresolved goals with another form of goal focus, a matched control condition in which the goal was resolved was included. Thus, the experiment examined whether cueing a personally relevant unresolved goal elicited uninstructed state rumination.

To date, empirical investigations of rumination have focused on understanding the consequences of rumination within an RST framework (e.g., Nolen-Hoeksema, 2000; Watkins, 2008). Therefore, an important next step in this field is a systematic empirical investigation of the mechanisms hypothesized to drive state rumination, such as unresolved goals. To date, methodologies have focused on the use of deliberate instructions to ruminate (e.g., Nolen-Hoeksema & Morrow, 1993) to examine the consequences of state rumination. Whilst valuable, this approach leaves the causes of spontaneous uninstructed rumination unexamined. In addition,

it lacks ecological validity, because the content and nature of the resultant rumination may not correspond to the naturally occurring and often involuntary experiences of rumination in daily life.

A further consequence of this focus is that there has been little development of immediate and dynamic measures of uninstructed state rumination. Because ruminative thinking fluctuates over time, it is critical to examine the occurrence of state rumination as it happens. The development and validation of a laboratory measure of state rumination that is sensitive to dynamic change over time is therefore an essential methodological step to directly test hypotheses regarding putative causes of rumination.

We sought to validate a dynamic and immediate measure of state rumination that was sensitive to spontaneous ruminative thoughts over time, by adapting a measure of mind-wandering. The sustained attention to response task (SART; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997) uses a simple go/no-go paradigm that is designed to place minimal demands on controlled processes, and, thereby, provides a valid means of assessing attentional lapses. The SART elicits a repetitive automatic style of responding to the stimuli, thereby increasing the likelihood of mind-wandering. In order to obtain an index of mind-wandering that is not reliant on participant's meta-awareness (Christoff, Gordon, Smallwood, Smith, & Schooler, 2009), the SART has been adapted to pseudo-randomly present thought probes asking participants to indicate where their attention was just focused. Task-unrelated thought during the SART is associated with increased errors of commission (incorrectly responding on no-go trials) (Smallwood et al., 2004). The task thus provides both behavioural and self-report measures of state changes in mind-wandering.

In order to specifically examine state rumination, we modified the thought probes to ask about ruminative thinking about a personal goal. Mood probes were included in order to examine the temporal relationship between rumination and negative affect.

We also examined whether the trait tendency towards pathological rumination increases individual sensitivity to state rumination following cueing an unresolved goal. Individual differences in trait rumination were expected to be associated with state rumination, as assessed using the SART. Such a positive relationship would provide convergent validation of the rumination measure. Few studies have investigated how RST and control theory interact by examining the relationship between trait rumination and reactive state rumination about frustrated goal progress. The most parsimonious integration of these theories predicts that individuals at increased susceptibility to depressive rumination will experience more intrusive rumination following cueing an unresolved goal. Individual differences in trait rumination are predictive of state rumination as assessed using experience sampling (Moberly & Watkins, 2008) and diary study (Puterman, De Longis & Pomaki, 2010) methodologies, but the interaction between trait rumination and state rumination in response to unresolved goals has yet to be directly examined.

In sum, consistent with control theory, we predicted that cueing an unresolved personal goal would cause greater intrusive ruminative thoughts during the modified SART than cueing a resolved goal. We further predicted that trait rumination would moderate the impact of the goal manipulation on subsequent state rumination as assessed by the thought probes. A prominent theory of rumination and cognitive control proposes that on-going rumination acts as a cognitive load (e.g., Watkins & Brown, 2002). Therefore if unresolved goals elicited greater state rumination then they might also be predicted to deplete working memory resources available for the performance of concurrent cognitive tasks such as the SART. We therefore additionally examined the prediction that individuals in the unresolved goal condition would demonstrate impaired behavioural performance (more errors of commission

and/or slowed response times (RTs) to non-targets) relative to individuals in the resolved goal condition. Given the lack of both previous experimental work examining the predictions of control theory of rumination and of theoretical elaboration regarding proximal (as opposed to trait individual difference level) causes of abstract versus concrete rumination, there was insufficient evidence from which to derive a priori predictions regarding process aspects of rumination (abstract versus concrete), and this issue was beyond the scope of the present experiment. Rumination about depressive symptoms is known to exacerbate sadness amongst dysphoric and depressed individuals (e.g., Nolen-Hoeksema & Morrow, 1993) but no previous experimental work has examined the affective consequences of a control theory operationalisation of rumination. We therefore additionally examined whether unresolved goals resulted in greater sadness than resolved goals. In contrast to previous studies inducing rumination, this novel goal manipulation was not focused on depressive feelings and symptoms, we therefore made no specific prediction regarding the association between focussing on unresolved goals and concurrent negative affect.

2. Method

2.1. Participants

39 participants were recruited from the University of Exeter student population, and received course credit or £10 for participating. Participants were required to have normal or corrected to normal vision.

2.2. Measures and materials

2.2.1. Beck depression inventory (BDI-II; Beck, Steer, & Brown, 1996)

The BDI-II is a 21-item questionnaire which assesses the presence and severity of depressive symptoms over the preceding two weeks. Responses range from 0 (e.g., “I do not feel like a failure”) to 3 (e.g., “I feel I am a total failure as a person”). Item scores are summed to generate an overall score; higher scores represent more severe depressive symptoms (range 0–63). The BDI-II has good psychometric properties (Strauss, Sherman & Spreen, 2006), high internal consistency (Dozois, Dobson, & Ahnberg, 1998) and good test-retest reliability (Sprinkle et al., 2002).

2.2.2. Ruminative responses scale (RRS; Nolen-Hoeksema & Morrow, 1991)

The RRS of the Response Styles Questionnaire (RSQ, Nolen-Hoeksema & Morrow, 1991) is a 22-item measure of depressive rumination. Items include “analyze recent events and try to understand why you are depressed” and “think about how alone you feel”. Responses range from 1 (almost never) to 4 (almost always) for what participants “generally do” when they are feeling sad or depressed. Item scores are summed to generate an overall score (range 22–88); higher scores represent a greater trait tendency to depressive rumination. The RRS has high internal consistency, acceptable construct validity, and good test-retest reliability (Nolen-Hoeksema & Morrow, 1991; Treynor et al., 2003).

2.2.3. Visual analogue scales

Visual analogue scales were used to assess current levels of sadness, tension, and self-focus, and therefore index changes in emotional response (e.g., distress) in response to focussing on resolved and unresolved personal goals. Participants indicated on 3 bipolar scales ranging from 0 (very happy; very calm; not at all focused on myself) to 9 (very sad; very tense; extremely focused on myself) how they were feeling “at the present moment”. Scales of

this format have been found to be reliable and sensitive measures of current mood and self-focus (e.g., Watkins & Teasdale, 2001; 2004).

2.2.4. Goal cueing task

The goal cueing task was adapted from Behar, Zellig and Borkovec's (2005) worry induction. The experimental condition, which was predicted to elicit rumination, instructed participants to identify an ongoing and unresolved concern that had repeatedly come into their mind and caused them to feel negative or stressed during the previous week. Examples of appropriate problems were provided, and participants briefly outlined the problem that they had identified prior to the goal focus period. Participants then rated the extent to which their unresolved goal had been bothering them (a) at its worst, and (b) in the past week, and the proportion of their time that they had spent thinking about it during that week. The 10 min goal focus period followed, during which participants worked through a pre-recorded script delivered over headphones, which guided them through focussing on the concern identified. Items in the script included “think about what is important about this difficulty in terms of your personal goals” and “focus on how this problem reflects a lack of progress on important personal goals”. The control condition asked participants to spend the same period of time thinking about a concern that had previously troubled them, but that had since been resolved. Items from the control script included “think about what was important about this difficulty in terms of your personal goals” and “focus on how resolving this problem reflects progress on important personal goals”. Thus, the two versions of the task directly contrasted the impact of self-focus on resolved and unresolved goals. Moreover, because the two goal types were not expected to differ in subjective evaluations of their nature or severity when progress was frustrated, the task was intended to specifically examine goal discrepancies, as opposed to goal importance.

2.2.5. Sustained attention to response task (SART; Robertson et al., 1997)

The modified SART presented participants with 1800 neutral words. Each word was presented individually for 300 ms followed by a 900 ms mask. The majority of trials required participants to respond to the word with a button press (go trials). On a minority of trials (no-go trials), when the word was presented in uppercase, participants were required to withhold their response. The task comprised four blocks, each presenting 450 trials consisting of 45 words repeated ten times in a different order. Within each set of 45 words, 5 uppercase words appeared randomly among 40 lowercase words. There was no discernible break between blocks. Participants were pseudo-randomly (following 60% of no-go trials within each block) probed regarding the focus of their attention immediately prior to the probe. The probes asked participants to select from six response options, which were explained before the task, to describe what they were thinking about just before the probe. These options were: (a) task (i.e., the stimuli or appropriate response); (b) task performance; (c) current physical state (i.e., conditions such as hunger or sleepiness); (d) the concern identified and thought about in the previous task (i.e., the unresolved/resolved goal, and our index of state rumination); (e) other personal worries that were not connected to the problem identified in the previous task; (f) other thought types. Participants pressed a key corresponding to the option that best described the focus of their attention. Participants additionally rated their mood and degree of self-focus following each probe using bipolar computerized scales where they pressed the key (1–9) that best described their degree of sadness, tension and self-focus respectively. The task took 50 min to complete.

2.3. Design and procedure

The current study had a between subjects design with one main independent variable: goal condition (resolved versus unresolved goal). Critical dependent variables were state rumination reported during thought probes and mood during the modified SART. Additionally, error rate and reaction time data from the modified SART were examined.

Participants attended two sessions. In the first session participants completed the BDI-II and RRS.¹ In a second session they completed the goal manipulation followed by the modified SART. Participants were randomly allocated to the unresolved or resolved goal condition. Before and after completing the goal manipulation, participants rated their current level of sadness, tension, and self-focus using the visual analogue scales.

3. Results

3.1. Participant characteristics

77.5% of the sample was female; 19 participants completed the unresolved goal task and 20 completed the resolved goal task. The mean age was 22.95 (S.D. = 7.10). The mean depressive symptoms on the BDI-II was 10.13 (SD = 6.60) and the mean level of trait rumination on the RRS was 45.41 (SD = 11.48). The two conditions (resolved versus unresolved goal) did not reliably differ in symptoms of depression ($p > 0.3$) or trait rumination ($p > 0.9$).

Participants in the unresolved goal condition reported having more thoughts of the goal cued in the past week, $t(37) = 14.94$, $p < 0.001$, $\eta^2 = 0.858$ ($M = 7.11$, $SD = 0.76$) than participants in the resolved goal condition ($M = 2.200$, $SD = 1.240$), and being more bothered by the goal, $t(37) = 12.07$, $p < 0.001$, $\eta^2 = 0.797$ ($M = 7.05$, $SD = 0.97$) than participants in the resolved goal condition ($M = 2.10$, $SD = 1.52$). There was no effect of condition on participants' evaluation of how much the goal had bothered them at its worst ($p > 0.2$), the importance of the goal ($p > 0.5$), the duration of the goal ($p > 0.3$), or how much the goal related to general goals and concerns ($p > 0.1$). Thus, the goals identified in the two conditions did not differ in subjective evaluations of their nature or severity, but participants in the unresolved goal condition reported that the goal was one that was bothering them more than participants in the resolved goal condition.

3.2. Effects of goal manipulation on mood and self-focus

2 (time: pre-goal manipulation, post-goal manipulation) \times 2 (condition: unresolved, resolved) ANOVAs examined the impact of the goal manipulation on participants' sadness, tension and self-focus. There was a significant main effect of time on sadness, $F(1, 37) = 55.94$, $p < 0.001$, $\eta^2 = 0.602$ reflecting sadder mood following the manipulation. There was no main effect of condition, $F(1, 37) = 0.33$, $p > 0.5$, $\eta^2 = 0.009$. There was a trend towards a significant interaction, $F(1, 37) = 3.11$, $p = 0.09$, $\eta^2 = 0.077$. However, simple effects analyses revealed no significant differences between groups either before the manipulation, $F(1, 37) = 0.09$, $p = 0.762$, $\eta^2 < 0.01$, or after the manipulation, $F(1, 37) = 2.10$, $p = 0.156$,

$\eta^2 = 0.05$. There was a significant effect of time in each condition (both p s < 0.001 , η^2 s > 0.3), reflecting a worsening of sad mood following the manipulation. In the 2 \times 2 ANOVA for tension, there was a significant main effect of time, $F(1, 37) = 20.62$, $p < 0.001$, $\eta^2 = 0.358$ reflecting an increase in tension following the manipulation. There was no main effect of condition, $F(1, 37) = 0.21$, $p > 0.6$, $\eta^2 = 0.006$, and the interaction was not significant, $F(1, 37) = 1.22$, $p > 0.2$, $\eta^2 = 0.032$. Thus, the goal manipulation did not differentially influence participants' levels of sadness or tension, indicating that the two goal conditions did not differ significantly in their emotional response to the goal. In the 2 \times 2 ANOVA for self-focus, there was a significant main effect of time, $F(1, 37) = 7.73$, $p = 0.008$, $\eta^2 = 0.173$, reflecting an increase in self-focus following the goal manipulation (mean increase = 0.83). There was no main effect of condition, $F(1, 37) = 2.39$, $p > 0.1$, $\eta^2 = 0.061$, and the interaction was not significant, $F(1, 37) = 0.1$, $p > 0.7$, $\eta^2 = 0.003$. Thus, as intended, the tasks did not appear to differentially prompt participants to focus on themselves and their goals.

3.3. State rumination during the modified SART

There was an effect of goal condition on number of ruminative thoughts during the SART, $t(20.04) = 2.7$, $p = 0.01$, $\eta^2 = 0.171$ (Welch's t -test applied to correct for inequality of variances), reflecting more ruminative thoughts to thought probes in the unresolved goal condition ($M = 14.42$, $SD = 16.71$) than in the resolved goal condition ($M = 3.80$, $SD = 4.09$). The conditions did not differ in the frequency of any other thought types (thoughts of the task, $p > 0.2$; task performance, $p > 0.3$; physical state, $p > 0.5$; other personal concerns, $p > 0.5$; any other thoughts $p > 0.2$). On average, participants in the unresolved goal condition reported ruminative thoughts it on 17.5% of probes, relative to thoughts about the cued goal on 3.4% of probes in the resolved condition. Thus, as predicted, cueing an unresolved goal resulted in more repetitive thought about the goal during the subsequent task than cueing a resolved goal.

A 2 (condition: unresolved goal, resolved goal) \times 4 (time: block 1, block 2, block 3, block 4) mixed ANOVA examined whether rumination about the identified concern was more persistent when this concern was unresolved than when it was resolved. There was a significant main effect of condition, $F(1, 37) = 7.61$, $p = 0.009$, $\eta^2 = 0.171$, and of time, $F(2.45, 90.82) = 4.65$, $p = 0.008$, $\eta^2 = 0.112$, (Huynh Feldt correction applied), and the interaction was significant, $F(2.45, 90.82) = 3.17$, $p = 0.037$, $\eta^2 = 0.079$ reflecting a quadratic trend interaction, $F(1, 37) = 9.19$, $p = 0.004$, $\eta^2 = 0.199$, (Fig. 1). Simple effects analyses revealed that the unresolved goal condition reported significantly more intrusive ruminative thoughts in block 2, $F(1, 37) = 6.94$, $p = 0.012$, $\eta^2 = 0.16$, block 3, $F(1, 37) = 11.62$, $p = 0.002$, $\eta^2 = 0.24$, and block 4, $F(1, 37) = 5.89$, $p = 0.020$, $\eta^2 = 0.14$. The groups did not reliably differ in number of intrusive ruminations during block 1, $F(1, 37) = 1.26$, $p = 0.270$, $\eta^2 = 0.03$.

3.4. Trait rumination and state rumination during the modified SART

Hierarchical regression was used to examine whether trait rumination moderated the effect of the goal manipulation on rumination during the modified SART. Goal condition (1: unresolved goal, 0: resolved goal) and centred RRS scores (RRSc) were entered in block one of the regression, and the interaction term (goal condition \times RRSc) in block 2 (Table 1). The interaction term explained a significant increase in variance of state rumination, $\Delta R^2 = 0.092$, $F(1, 35) = 4.71$, $p = 0.037$. Thus, trait rumination was a

¹ A measure of retrospective subjective state in performance settings (Dundee Stress State Questionnaire; Matthews, Campbell, & Falconer, 2000) and a measure of habitual negative thinking (Habit Index of Negative Thinking; Verplanken, Friberg, Wang, Trafimow & Woolf, 2007) and a measure of working memory capacity (the Automated Operation Span Task (AOSPAN; Unsworth, Heitz, Schrock, & Engle, 2005) were also administered. However, there were not significant relationships with regard to these measures and so data regarding these is not reported here.

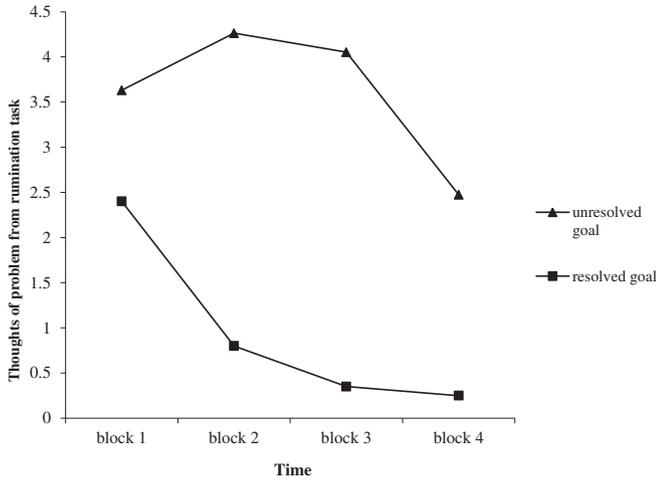


Fig. 1. Mean goal-related ruminative thoughts by time.

significant moderator of the effect of the goal manipulation on ruminative thoughts during the modified SART.

As illustrated in Fig. 2, the unstandardized simple slope for participants 1 SD below the mean for trait rumination was 2.76, this was not significantly different from 0, $t(35) = 0.54, p > 0.5, \eta^2 < 0.01$. The unstandardized simple slope for participants 1 SD above the mean for trait rumination was 18.595, this was significantly greater than 0, $t(35) = 3.63, p = 0.001, \eta^2 = 0.274$. Thus, as predicted, the effect of the goal manipulation on subsequent rumination was greater for participants reporting high levels of trait rumination on the RRS.

3.5. Brooding and reflection and state rumination

Hierarchical regression was used to examine whether trait brooding moderated the effect of the goal manipulation on rumination during the modified SART. Goal condition (1: unresolved goal, 0: resolved goal) and centred RRSbrooding scores (RRSbroodingc) were entered in block one of the regression, and the interaction term (goal condition \times RRSbroodingc) in block 2. The interaction term explained a significant increase in variance of state rumination, $\Delta R^2 = 0.189, F(1, 35) = 12.017, p = 0.001$. Thus, trait brooding was a significant moderator of the effect of the goal manipulation on ruminative thoughts during the modified SART task. The unstandardized simple slope for participants 1 SD below the mean for trait brooding was -1.352 , this was not significantly different from 0, $t(35) = -0.289, p = 0.775, \eta^2 < 0.01$. The unstandardized simple slope for participants 1 SD above the mean for trait brooding was 22.004, this was significantly greater than 0, $t(35) = 4.73, p < 0.001, \eta^2 = 0.390$. Thus, as predicted, the effect of the goal manipulation on subsequent rumination was greater for participants reporting high levels of trait brooding on the RRS.

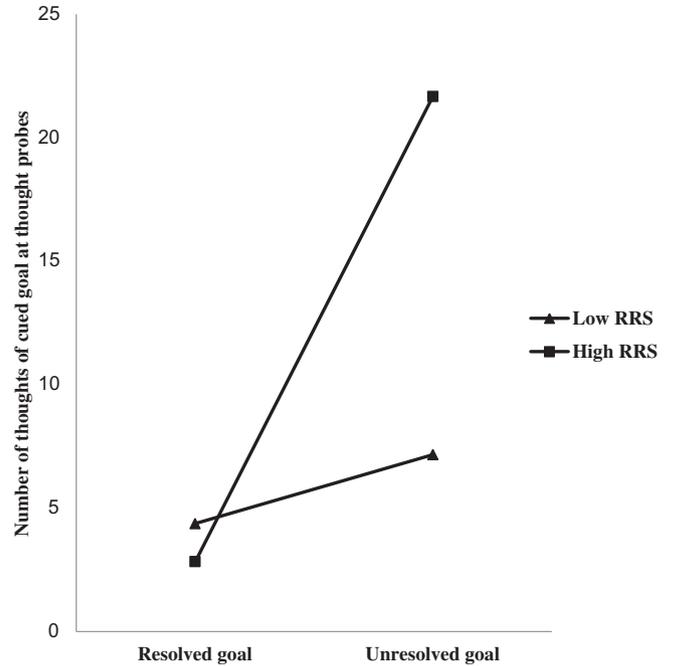


Fig. 2. Simple slopes for state rumination one standard deviation above and below the mean RRS score.

When these analyses were repeated for trait reflection, the interaction term did not explain a significant increase in variance of state rumination, $\Delta R^2 = 0.001, F(1, 35) = 0.029, p = 0.866$. Thus, trait reflection was not a significant moderator of the effect of the goal manipulation on ruminative thoughts during the modified SART task.

3.6. Errors of commission and correct go-trial RTs during the modified SART

Table 2 illustrates the percentage error rates and mean RTs for each condition during each block of the modified SART.

2 (condition) \times 4 (time) mixed ANOVAs examined whether the goal conditions differentially increased errors rates or slowed RTs on the modified SART. There was a significant main effect of condition on errors of commission, $F(1, 37) = 9.14, p = 0.005, \eta_p^2 = 0.198$, reflecting more errors in the resolved goal condition ($M = 88.90, SD = 51.83$) than in the unresolved goal condition ($M = 46.84, SD = 32.28$), and a significant main effect of time, $F(1, 37) = 12.58, p < 0.001, \eta_p^2 = 0.254$, reflecting an increase in error

Table 1 Hierarchical linear regression estimating state rumination during the modified SART task.

	B	S.E.	β
Step 1			
Condition	10.670**	3.773	0.415
RRSc	0.264	0.166	0.233
Step 2			
Condition	10.676*	3.592	0.415
RRSc	-0.744	0.491	-0.048
Condition \times RRSc	0.690*	0.318	0.413

Step 1: $F(2, 36) = 5.220, p = 0.010, R^2 = 0.225$.

Step 2: $F(3, 35) = 5.408, p = 0.004, R^2 = 0.317$.

* $p < 0.05$, ** $p < 0.01$.

Table 2 % Errors of commission and mean RTs for correct go-trials during the modified SART task.

	Block 1	Block 2	Block 3	Block 4
Unresolved	535.57	508.57	495.32	483.71
goal focus	(82.54)	(100.47)	(88.58)	(89.51)
RTs				
Resolved goal	461.90	453.87	447.76	425.52
focus RTs	(110.21)	(95.77)	(102.89)	(90.79)
Unresolved	18.21	24.00	26.63	24.84
goal errors	(13.33)	(20.14)	(18.87)	(18.72)
Resolved	36.10	41.90	48.50	51.30
goal errors	(27.72)	(28.15)	(26.75)	(25.29)

rates as the task progressed. The interaction was not significant ($p > 0.1$).

There was a significant main effect of condition on correct go-trial RTs, $F(1, 37) = 4.34$, $p = 0.044$, $\eta_p^2 = 0.105$, reflecting significantly longer RTs in the unresolved goal condition ($M = 505.82$, $SD = 86.02$) than in the resolved goal condition ($M = 446.05$, $SD = 89.70$), and a significant main effect of time, $F(3, 37) = 6.90$, $p = 0.03$, $\eta_p^2 = 0.157$, reflecting a speeding of responses as the task progressed. The interaction was not significant ($p > 0.5$). There were no significant correlations between frequency of ruminative thoughts during the SART and errors of commission, $r(39) = -0.171$, $p = 0.298$, or RTs to correct go-trials, $r(39) = 0.132$, $p = 0.425$, and this was also the case for trait rumination ($r_s < 0.3$, $p_s > 0.14$).

Thus, participants in the two goal conditions appear to have adopted different thresholds for their speed-accuracy trade-off, such that participants who focused on an unresolved goal were slower and more accurate on the modified SART. Consistent with a cognitive load account, the unresolved goal condition was slower to make a correct response. However, inconsistent with a cognitive load account, the unresolved goal condition made fewer errors of commission. Thus, as a consequence of this differential speed-accuracy trade-off, it is not clear whether ruminating on an unresolved goal impairs or enhances performance on the SART.

3.7. Mood and self-focus during the modified SART

There was no effect of goal condition on sadness, $t(27.44) = 0.79$, $p = 0.43$, $\eta^2 = 0.071$ (Welch's t -test applied), tension, $t(37) = 0.08$, $p = 0.935$, $\eta^2 < 0.001$, or self-focus, $t(37) = 0.94$, $p = 0.353$, $\eta^2 = 0.023$, to the probes in the SART. Thus, there was no evidence that the goal conditions (resolved versus unresolved goals) differentially caused negative affect during the SART. This was also the case when analyses were restricted to responses to the mood probes immediately following the probes in which participants had reported goal-focused thoughts, $t(31) = 0.215$, $p = 0.831$, $\eta^2 < 0.01$.

4. Discussion

The present study tested a key prediction of control theory of rumination: that activating unresolved goals would cause more rumination than activating resolved goals. Consistent with this hypothesis, cueing an unresolved goal resulted in more reported thoughts about that goal when probed during a subsequent SART than cueing a resolved goal. Uninstructed rumination about failures in goal progress was powerful and recurrent when cued in a relatively unconstrained context. Moreover, the modified SART provided a valuable means to examine the occurrence and temporal course of state rumination.

Our study examined whether control theories provide a useful conceptual framework for rumination. To our knowledge, this is the first study to directly examine whether cueing an unresolved goal causally triggers state rumination. Previous research has examined the relationship between goal discrepancies and trait tendencies to ruminate (e.g., McIntosh & Martin, 1992), and between goal-relevant negative events and self-reported self-focus (Lavallee & Campbell, 1995), and shown a correlation between impaired goal pursuit and ruminative self-focus (Moberly & Watkins, 2010). The present study provides direct evidence that when such a discrepancy is cued in an unconstrained context (i.e., the external environment is conducive to mind-wandering) it causes ruminative thoughts about the concern, which re-occur for a considerable period of time. Thus, the findings of this study are consistent with a central prediction of control theory of rumination. Our findings

indicate that this goal-cueing procedure holds potential as an effective means of establishing the goals that operate as ruminative triggers for individuals, which is of value to examine both the causes and consequences of personally-relevant rumination.

The impact of the goal manipulation on subsequent state rumination was moderated by the trait tendency to ruminate, and also by trait brooding but not by trait reflection. Thus, those individuals who have a stronger tendency to habitually ruminate in a maladaptive manner were more susceptible to the effects of the cueing of an unresolved goal. This interaction of trait rumination and goal discrepancies in predicting state rumination suggests a potential integration between RST and control theory accounts of rumination. According to RST rumination occurs primarily in response to sadness, whereas control theories posit that it is cued by goal discrepancies. Our findings suggest rumination may be sensitive not only to fluctuations in negative moods, but also goal progress. Thus high trait ruminators may be more susceptible to reactive state rumination on failures in goal pursuit, which may have self-regulatory consequences. This is the first empirical study to directly link the trait tendency to ruminate with the occurrence of ruminative thoughts triggered by an unresolved personal goal. Consistent with the proposal that trait ruminators experience difficulty disengaging from ruminative content (e.g., Joormann, 2005), the impact of the goal manipulation was persisted for a considerable period of time. The interaction of trait rumination and goal discrepancies thus holds potential value in predicting the temporal course of state rumination. An important next step will be further delineating how the interaction of unresolved goals and trait rumination influences the duration of state rumination, potentially contributing to a comprehensive account integrating RST and control theory.

The study additionally constituted a preliminary validation of a modified version of the SART as an index of state rumination. The modified SART was sensitive to the effects of a goal manipulation, and able to index ruminative thoughts about the goal over an extended period of time. The interaction of both trait rumination and trait brooding with the goal manipulation in predicting state rumination during the modified SART provides convergent evidence that the task constitutes a valid measure of ruminative thought. This task is thus of potential value to examine proximal causes of the onset and maintenance of state rumination.

Individuals who focused on unresolved goals were slower and more accurate on the modified SART than individuals in the resolved goal condition, which indicates differential speed-accuracy trade-off thresholds for the two goal conditions. As a consequence, it is not possible to draw conclusions regarding the prediction that state rumination acts as a cognitive load causing impaired performance on cognitive tasks. We offer no simple explanation for these differential findings for modified SART performance. One speculation is that intrusive ruminative thoughts are more salient than less emotive forms of task-unrelated thought, and thus increase awareness of attentional lapses (due to ruminating), resulting in a compensatory strategy of slowing responding in order to reduce the risk of errors. A useful next step in clarifying the impact of state rumination on attentional lapses during the SART would be to adopt a more constrained version of the task, which cues responses (e.g., Manly et al., 2004), thereby restricting the likelihood of differential speed-accuracy trade-offs, and facilitating a direct examination of the causal influence of rumination upon SART performance.

Experimental condition (resolved versus unresolved goal) did not differentially increase concurrent negative affect. Little research has examined the temporal relationship between goal-focused (as opposed to feelings-focused) state rumination and negative affect. Whilst there has been theoretical elaboration of the relationship

between control theory operationalizations of state rumination and negative affect (e.g., Carver & Scheier, 1998; Martin & Tesser, 1996), to our knowledge, there are no experimental studies that have directly measured state rumination about unresolved goals and concurrent negative affect. On the basis of existing data, it is not possible to draw firm conclusions regarding the nature and temporal course of the relationship between goal-focused state rumination and negative affect. This relationship merits more detailed and systematic examination.

Although we believe that this study constitutes an important advance in the empirical evaluation of theoretical models of rumination, there are a number of limitations. First, our sample consisted primarily of students, so it is unclear to what extent the findings would generalize to a broader population. Second, because this version of the SART permitted considerable variation in speed-accuracy trade-offs, we were unable to directly index failures of sustained attention behaviourally. Third, we limited our examination of the interaction of goal-discrepancies and trait rumination to an unselected sample, therefore the range of trait levels of rumination was largely at the lower end of the spectrum. It will be important to replicate this finding in a clinical sample where there is greater variability and higher levels of trait rumination, enabling a more direct examination of the inter-relations between pathological rumination, goal-discrepancies, negative affect and state rumination. Fourth, whilst the relationship between our measure of state rumination and trait brooding is suggestive of maladaptive rumination, future work that directly addresses process aspects of state rumination such as level of goal construal and emotional tone of goal-focused cognitions (e.g., Watkins, 2008) will be important.

4.1. Conclusion

In sum, we demonstrated that cueing a discrepancy between one's current and desired states on a personal goal causes state rumination. This supports a central prediction of Martin and Tesser's (1996) control theory of rumination. Moreover, this effect persisted for a considerable time, which further supports the proposal that frustrated goal progress is a powerful trigger underpinning state rumination. Additionally, we found that the trait tendency to ruminate interacts with failures in goal progress to predict state rumination.

Declaration of interests

None of the authors has financial interests to disclose.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.jbtep.2013.05.004>.

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