The Effects of Worry and Rumination on Affect States and Cognitive Activity

Katie A. McLaughlin, Yale University

Thomas D. Borkovec, Nicholas J. Sibrava, Pennsylvania State University

The effects of worry and rumination on affective states and mentation type were examined in an unselected undergraduate sample in Study 1 and in a sample of individuals with high trait worry and rumination, high rumination, and low worry/rumination in Study 2. Participants engaged in worry and rumination inductions, counterbalanced in order across participants to assess main and interactive effects of these types of negative thinking. During mentation periods, the thought vs. imaginal nature and the temporal orientation of mentations were assessed 5 times. Following mentation periods, negative and positive affect, relaxation, anxiety, and depression were assessed. Both worry and rumination produced increases in negative affect and decreases in positive affect. Worry tended to generate greater anxiety, and rumination tended to generate greater depression. Interactive effects were also found indicating that worry may lessen the anxiety experienced during subsequent rumination. Moreover, worry lessened the depressing effects of rumination. Worry was associated with significantly greater thought than imagery, compared to rumination. Rumination involved a progression from mentation about the past to mentation about the future over time. Implications for understanding the generation of negative affect and comorbid anxiety and depression are discussed.

Address correspondence to Katie McLaughlin, Department of Psychology, Yale University, P.O. Box 208205, New Haven, CT 06520, USA; e-mail: katie.mclaughlin@yale.edu.

CONSIDERABLE RESEARCH indicates extensive co-morbidity of anxiety and mood disorders (Brown & Barlow, 1992; Brown, Campbell, Lehman, Grisham, & Mancill, 2001; Kessler et al., 1994; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995; Kessler et al., 1998), especially for generalized anxiety disorder (GAD) and major depression (Brown et al., 2001; Kessler, DuPont, Berglund, & Wittchen, 1999; Kessler et al., 1996). Two causal explanations for such high comorbidity of anxiety and mood disorders have been put forth (see Barlow, 2002). Having one disorder may serve as a risk factor for developing another. Alternatively, anxiety and mood disorders may develop from the same underlying predisposition. Negative affect is a stable dispositional characteristic that involves experiencing negative emotional states (Watson & Clark, 1984) that may serve as this underlying predisposition to the development of anxiety and mood disorders. Within Clark and Watson's (1991) tripartite model, negative affect represents a non-specific distress factor common to both anxiety and depression and is considered to be a predisposing factor to the experience of both (Clark, Watson, & Mineka, 1994). Despite their co-occurrence and mutual association with high negative affect, depression has been uniquely associated with low positive affect, and anxiety has been uniquely associated with autonomic arousal (Clark & Watson, 1991).

Evidence for this model has consistently been found in studies using factor analysis of mood and anxiety symptom questionnaires with student, community, and clinical samples (Watson, Clark, et al., 1995; Watson et al., 1995b), as well as with children and adolescents in psychiatric inpatient facilities (Joiner, Catanzaro, & Laurent, 1996). Congruent with the construct of negative affect,

Zinbarg and Barlow (1996) factor-analyzed self-report measures of anxiety symptoms in a large clinical sample and found one higher-order factor (vulnerability to anxiety and depression) that discriminated individuals with an anxiety disorder or a mood disorder from individuals with no psychopathology.

Another investigation using a large clinical sample provided compelling support for the importance of negative affect and positive affect as higher-order dimensions relevant to emotional disorders (Brown, Chorpita, & Barlow, 1998). Structural modeling techniques revealed three higher-order factors among patients meeting criteria for major depression, GAD, social phobia, panic disorder/agoraphobia, and obsessive-compulsive disorder, namely, (a) negative affect, (b) positive affect, and (c) autonomic arousal. Negative affect had significant paths to all of the disorders, whereas positive affect had paths only to major depression and social phobia. Autonomic arousal was significantly related only to panic disorder/agoraphobia and GAD, and the relationship with GAD was negative in direction, in line with research documenting autonomic suppression in GAD (Borkovec & Hu, 1990; Borkovec, Lyonfields, Wiser, & Deihl, 1993; Thayer, Friedman, & Borkovec, 1996). GAD and major depression had the strongest relationship with negative affect in this study.

The role that negative affect plays as a potential predisposing factor to anxiety and depression is thus well supported. Less well documented are the actual causal processes associated with the construct of negative affect that may explain the high comorbidity between anxiety and mood disorders and that may lead an individual to become anxious or depressed at a given moment in time.

A specific type of mental activity, recurrent negative thinking, is likely to be an important mediator of the relationship between trait negative affect and state experiences of anxiety and depression. Two types of such thinking importantly related to anxiety and depression are worry and rumination, respectively. In the case of worry, Barlow and DiNardo (1991, p. 115) proposed that GAD and worry are "fundamentally a presenting characteristic of all anxiety disorders with the possible exception of simple phobia." Worry also occurs frequently in major depression (Chelminski & Zimmerman, 2003), thus suggesting that this mental process may contribute to co-occurring anxious experience in depressed individuals. On the other hand, Watson and Clark (1984) describe individuals high in negative affect as also having the tendency to ruminate and dwell on their mistakes. Both rumination about past events and worry about potential future events may thus play a causal role in the creation of depressed and anxious affect, respectively, and may represent important mechanisms by which trait negative affectivity leads to state depression and anxiety within both chronically depressed and chronically anxious individuals.

Worry predominantly involves anxious affect during repetitive thought about possible future threats (Borkovec, Robinson, Pruzinsky, & DePree, 1983) but has also been demonstrated to elicit feelings of depression (Andrews & Borkovec, 1988). Rumination, on the other hand, typically involves repetitive thought about past events, current mood states, or failure to achieve goals (Martin & Tesser, 1996; Nolen-Hoeksema, 1991). Different types of rumination have been posited in the literature, and depressive rumination as defined by Nolen-Hoeksema (1991) has undoubtedly received the most attention. This type of rumination is defined as "thoughts that focus one's attention on one's depressive symptoms and on the implication of these symptoms" (Nolen-Hoeksema, 1991, p. 569). Rumination from this point of view represents a repetitive and passive response to depressed or dysphoric mood and has been demonstrated to be a vulnerability factor in the development of depression (Just & Alloy, 1997), to prolong the length of depressive episodes (Nolen-Hoeksema, Morrow, & Fredrickson, 1993), and to exacerbate negative mood (Nolen-Hoeksema & Morrow, 1993). Evidence also suggests that rumination predicts the future occurrence of anxiety and is an important factor in anxious depressed comorbid conditions (Nolen-Hoeksema, 2000).

Depressive rumination represents one type of rumination that involves thought specifically about depressive symptoms. While depressive rumination is clearly an important contributor to the generation of negative affect for individuals who are already experiencing depressive symptoms, other types of rumination are likely common and may be experienced by individuals who are not already experiencing dysphoric mood. Martin and Tesser (1996) conceptualize rumination as a thought process related to failure to achieve or make progress toward goals. Rumination in this sense emerges from self-regulation theories (see Carver & Scheier, 1990; Pyszczynski & Greenberg, 1987) that credit the generation of negative affect to attention focused on discrepancies between current states and desired goals. This type of global rumination has been demonstrated to occur following failure feedback in laboratory studies (DiPauli & Campbell, 2002) and to maintain negative affect (McIntosh & Martin, 1992).

Global rumination may be a construct that is useful to examine in relation to the generation of

negative affect for a number of reasons. Depressive rumination has been found to generate negative affect only in individuals who are already experiencing dysphoria or who are depressed (e.g., Lyubomirsky & Nolen-Hoeksema, 1995; Nolen-Hoeksema & Morrow, 1993). Depressive rumination has been shown to prevent alleviation of negative mood in nondysphoric individuals (Morrow & Nolen-Hoeksema, 1990), but not to actually generate negative mood. Because global rumination can occur in the absence of depressive symptomatology, examination of this type of rumination may provide important clues to the process by which negative thinking creates negative affect in individuals not already experiencing chronic negative mood. Global rumination may also represent the foundation of the depressive cognitive process from which depressive rumination in Nolen-Hoeksema's sense emerges. Failures and mistakes are ubiquitous human experiences that can serve as initial triggers for heightened self-focused attention (Ingram, 1990), global rumination (Martin, Tesser, & McIntosh, 1993), and depression (Millar, Tesser, & Millar, 1988). Global rumination about past mistakes and failures is likely involved in the generation of the negative mood states that are a prerequisite for engagement in depressive rumination.

Although most studies have examined worry in relation to anxiety (e.g., Mathews, 1990) and rumination in relation to depression (e.g., Nolen-Hoeksema, Parker, & Larson, 1994), one study has examined the effects of these processes concurrently (Segerstrom, Tsao, Alden, & Craske, 2000). Repetitive thought of either kind was found to be related to both anxious and depressed symptoms. In a student sample, rumination was not uniquely associated with depression, and worry was not uniquely associated with anxiety. In a clinical sample, however, rumination was more strongly associated with depression. These results demonstrate that repetitive thought about negatively valenced material may be a characteristic of negative affect or contribute to the development of negative mood states regardless of what specific type of mentation is involved and that worry and rumination can generate both depressive and anxious symptoms.

Although worry and rumination share the characteristics of repetitive, self-referent mentation focused on negative material, experimental investigations directly comparing their impact on cognitive and affective states have not yet been conducted. Moreover, it is quite likely that both processes occur during an emotional episode. If this were the case, worry and rumination may inter-

actively influence each other. Emotion influences cognitive processing by selectively strengthening the associative networks related to specific emotional states, and an emotional state may serve as a prime that increases the likelihood of retrieval of information related to that specific state (e.g., Bower, 1981). Therefore, worried processing and its effects may be different after a depressive/ruminative network has been activated, and vice versa. Evidence that different forms of negative mentation do indeed interact was found in a recent investigation using worry and trauma recall inductions (Behar, Zuellig, & Borkovec, 2005). Worry and rumination may be generative of one another as well. A worry episode is likely to include within it the periodic recall of past loss or failure. Such memories provide evidence to the individual that bad things can happen, that one may have little control, and that one can fail in life. Mentations of this nature can create periodic moments during a worry episode in which a sense of hopelessness about the future prevails, and depressed affect would thus momentarily predominate. Rumination about a past loss or failure also has implications for one's future, potentially generative of periodic moments of worrying and thus anxious experience. Thus, many episodes of recurrent negative thinking are likely to involve the sequential occurrence of both worry and rumination. If this were the case, it would provide a plausible explanation for the findings that each type of recurrent negative mentation generates both anxiety and depression and thus provide an explanation for their frequent comorbidity.

The present investigation examined the similarities and differences of experimentally induced worry and rumination on affect and cognitive activity and how these processes interact with one another. For affective variables, we were interested in positive and negative affect in general as well as the specific states of anxiety and depression. Inducing both worry and rumination in a within-participants design allowed us to assess the impact of each mentation type on affect, and the counterbalancing of the order of the two inductions as a between-group factor allowed us to assess their interactive effects. Two cognitive variables were of interest. The first was the extent to which verbal thought versus imagery occurred in each type of negative mentation. The predominance of thought in worry has already been well established (Borkovec & Inz, 1990; Freeston, Dugas, & Ladouceur, 1996) and has contributed to the development of a cognitive avoidance theory for worry wherein this process precludes the emotional processing of anxious material (see Borkovec, Alcaine, & Behar, 2004). Characterizing the thought/imagery nature

of rumination could aid in elucidating potential functions and consequences of rumination for future research. The second cognitive variable was the extent to which each type of negative mentation was related to the past, the present, and the future. Although it was expected that worry content would relate mostly to the future, whereas rumination content would be related to the past (as forced by our instructions to participants), we wished to assess the degree to which content from a different temporal orientation would intrude in each process and whether that content would change over time during the induction of each process.

Specific hypotheses were as follows:

1. Worry and rumination will both lead to increases in negative affect.
2. Rumination only will be associated with decreases in positive affect.
3. Worry and rumination will both lead to increased anxiety and depression and decreased relaxation.
4. Worry and rumination will interact such that (a) engaging in both types of mentation will be associated with more intense negative affect, and (b) worrying before engaging in rumination will be associated with decreased anxiety during subsequent rumination (see Behar et al., 2005).

Study 1

METHOD

Participants. Undergraduate participants ($n = 60$) enrolled in an introductory psychology class were 73.33% female ($n = 44$) and 26.67% male ($n = 16$). Participants were predominantly Caucasian (88.5%), with the remainder being African American (3.3%) and Hispanic (1.6%); 6.6% did not report their ethnicity.

Design. A 2 (induction order) ×2 (presence or absence of intervening uninstructed mentation period) repeated-measures design was utilized to examine the effects of worry and rumination independently and in interaction with each other. All conditions involved an uninstructed mentation period (baseline) to establish pre-induction levels of affect and cognitive activity, followed by inductions of worry and rumination. Half of the participants were randomly assigned to engage in worry and then in rumination; the other half engaged in the inductions in the opposite order. Within each of these groups, half engaged in another uninstructed mentation period between the two inductions. This intervening uninstructed mentation period was designed to (a) assess any carryover effects in cognition or affect from the two mentation inductions

and (b) to assess whether recovery from the first induction would occur and thus preclude interactive effects on the second induction.

Presession measures. Beck depression inventory (BDI). The BDI is a 21-item measure designed to assess the severity of depressive symptoms (Beck, Rush, Shaw, & Emery, 1979). Items each represent a symptom of depression and are responded to on a 4-point Likert scale ranging from 0 to 3, with 0 representing a low level of intensity for each symptom and 3 representing a high level of intensity. The BDI has excellent psychometric properties, including internal consistency and convergent and divergent validity; these have been demonstrated in numerous studies (Beck, Steer, & Garbin, 1988). The BDI demonstrated good reliability in this sample ($\alpha = 0.79$).

Penn state worry questionnaire (PSWQ). The PSWQ is a 16-item measure designed to assess trait worry (PSWQ: Meyer, Miller, Metzger, & Borkovec, 1990). Items are answered on a 5-point Likert scale ranging from 1 (*not at all typical*) to 5 (*very typical*). This measure has very good internal consistency, with alpha values ranging from 0.86 to 0.93 in college and clinical samples (Molina & Borkovec, 1994). The PSWQ correlates more highly with the cognitive as opposed to somatic features of anxiety (Meyer et al., 1990), indicating construct validity of the measure. The PSWQ demonstrated excellent reliability in this sample ($\alpha = 0.94$).

Mood and anxiety symptoms questionnaire (MASQ). The MASQ (Watson & Clark, 1991b) is a 90-item measure designed to assess trait symptoms of anxiety and depression. All items are answered on a 5-point Likert scale ranging from 1 (*not at all*), to 5 (*extremely*). The scale consists of five scales intended to assess the three factors of anxiety and depression conceptualized in the tripartite model: general distress, anhedonic depression, and anxious arousal (Watson & Clark, 1991a). The five specific scales are General Distress: Mixed Symptoms; General Distress: Anxious Symptoms; General Distress: Depressive Symptoms; Anhedonic Depression, and Anxious Arousal. The subscales have been demonstrated to be reliable and to have convergent validity (Watson et al., 1995b). The MASQ demonstrated excellent reliability in this sample ($\alpha = 0.91$).

Dependent measures. Following each mentation period, participants completed the Positive and Negative Affect Scale (PANAS: Watson, Clark, & Tellegen, 1988), a 20-item measure assessing positive and negative affect. The state form of the PANAS was used, which asks participants to "indicate the extent to which you feel this way

right now, that is, how you feel right at this moment." Participants respond on a 5-point Likert scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). The PANAS has excellent internal consistency and has demonstrated convergent, discriminant, and predictive validity in a number of investigations (e.g., Waiker & Craske, 1997; Watson & Walker, 1996). Participants also rated their current feelings of relaxation, anxiety, and depression on 5-point Likert scales.

Procedure. Participants were randomly assigned to one of the four conditions. Sessions were run in groups of 15 in a classroom with each group of 15 representing one experimental condition. Before the experimental procedures began, participants were asked to write down their three most worrisome topics and the three topics about which they ruminated the most. Worry was defined as intrusive thoughts or images about potential future events or catastrophes that produce negative feelings when they occur. Rumination was defined as intrusive thoughts or images about past mistakes or failures that cause negative feelings when they occur. Examples of worry and rumination topics were also given. Definitions of thoughts, "words that you say to yourself in your head or talking to oneself," and images, "pictures in your mind," were also provided. After a 5-minute baseline mentation period ("Close your eyes and think about anything you wish"), worry (or rumination, depending on condition assignment) was induced for 5 minutes with the following instructions:

> "During this period, we would like you to create a worrisome (ruminative) state. Please refer to your list of worrisome (ruminative) topics. When the experimenter asks you to begin, please close your eyes and worry (ruminate) about your most worrisome (most negative) topic, in the way that you usually worry (ruminate) about it, but as intensely as you can, until the experimenter asks you to stop and to open your eyes. If you normally worry (ruminate) about only one topic at a time, please try to do the same during this period. However, if your thoughts change to another worry (rumination) topic during this period feel free to allow these thoughts to continue. It is all right to change topics during this period if the changes occur naturally during the worry (rumination) process."

After this first induction, half of participants in each induction order then engaged in another 5-minute uninstructed mentation period followed by the induction of the other type of negative cognitive process, and the other half began the other type of cognitive process without this intervening uninstructed period.

The following assessments were obtained for each period. Every 60 seconds, the participants were interrupted and asked to (a) write down the exact content of their mentation at that time; (b) circle on a rating sheet whether their mental activity involved something that happened in the past, was happening in the present moment, or might happen in the future; and (c) circle whether their mental content involved primarily imagery, verbal-linguistic thought, or "other." If they experienced a mentation as some combination of thoughts and images, they could report a percentage of each. After each mentation sampling, they closed their eyes and resumed their assigned cognitive process. At the end of each period, participants completed the PANAS and the 1-item measures of relaxation, anxiety, and depression.

RESULTS

Throughout this section, all within-subjects analyses involving inductions utilize three-way ANOVAs with time (baseline, first induction period, second induction period) as a within-subjects factor, and order (worry first, rumination first) and presence of an intervening mentation period (present, absent) as between-subjects factors. Because no effects were found for presence of an intervening mentation period in any of the analyses, this factor will not be reported in the remainder of this section.

Preliminary analyses. The mean score on the BDI was 7.78 ($SD = 4.98$) and the mean score on the PSWQ was 47.62 ($SD = 12.99$), indicating that the sample, as a whole, was not depressed or high in trait worry at the time of the study. On the MASQ the sample mean for General Distress–Mixed Symptoms was 21.30 ($SD = 10.99$), the mean for General Distress–Anxious Symptoms was 10.23 ($SD = 7.05$), the mean for Anxious Arousal was 8.23 ($SD = 9.85$), the mean for General Distress–Depressive Symptoms was 14.42 ($SD = 9.05$), and the mean for Anhedonic Depressive Symptoms was 55.50 ($SD = 14.35$). These scores are below the means found in both student and adult samples used to validate the MASQ (Watson et al., 1995b), further indicating that this sample did not experience high trait anxiety or depression. The PANAS (Watson, Clark, & Tellegen, 1988) was administered five times during the study. The reliability of the PANAS was good in this sample (αs ranging from 0.75 to 0.88; average α = 0.83).

To ensure that no condition differences existed prior to the inductions, two-way ANOVAs (order

and presence/absence of intervening mentation period) were performed on baseline measures of negative affect, positive affect, rated relaxation, anxiety, depression, percentage thoughts, and percentage images. Chi-square analyses were conducted to assess equivalence among conditions on reports of past, present, and future mentation. No significant between-groups effects emerged. In all analyses, the effect of the intervening thought period was not significant. This factor is not reported in subsequent analyses.

Emotion effects during inductions. Negative and positive affect. Three-way repeated-measures ANOVAs were conducted separately on the PANAS negative and positive affect scores. The expected main effect of time was significant for negative affect, $F(2, 112) = 57.83, p < .001, \eta^2 = 0.51$. Negative affect increased from baseline to the induction periods. Simple within-subjects contrasts revealed that negative affect was higher during the first induction period, $F(1, 56) = 118.56, p < .001$, and the second induction period, $F(1, 56) = 62.16, p < .001$, than at baseline. No order effects emerged. See Table 1 for means and standard deviations of all mood variables during baseline and induction periods.

It was hypothesized that only rumination, and not worry, would produce decreases in positive affect. The three-way repeated-measures ANOVA revealed a main effect of time, $F(2, 112) = 22.03, p < .001, \eta^2 = 0.28$. Positive affect decreased from baseline to the induction periods. Simple within-subjects contrasts revealed that positive affect was lower during the first induction period, $F(1, 56) = 23.16, p < .001$, and the second induction period, $F(1, 56) = 29.92, p < .001$, than at baseline. Contrary to prediction, no between-groups (order of worry versus rumination) effects were found.

Relaxation, anxiety, and depression ratings. Three-way repeated-measures ANOVAs were conducted separately on relaxation, anxiety, and depression scores. A main effect of time emerged for relaxation ratings, $F(2, 112) = 54.44, p < .001, \eta^2 = 0.49$. Relaxation decreased from baseline to the induction periods. Simple within-subjects contrasts revealed that relaxation was lower during the first induction period, $F(1, 56) = 101.69, p < .001$, and the second induction period, $F(1, 56) = 54.27, p < .001$, than at baseline. No order effects were found.

A main effect of time also emerged for anxiety ratings, $F(2, 112) = 16.44, p < .001, \eta^2 = 0.23$, and a significant Time × Order interaction, $F(2, 112) = 4.78, p < .02, \eta^2 = 0.08$, indicated differential worry versus rumination effects. Examination of the simple effect of time within order in the worry condition revealed a significant effect of time, $F(2, 58) = 14.90, p < .001, \eta^2 = 0.34$, and a within-subjects quadratic trend, $F(1, 29) = 26.94, p < .001, \eta^2 = 0.48$. When worry was the first induction, anxiety increased from baseline to the worry induction and decreased from the worry induction to the rumination induction (see Table 1). Examination of the simple effect of time within the rumination condition revealed a significant effect of time, $F(2, 58) = 6.17, p < .004, \eta^2 = 0.18$, and a linear within-subjects trend, $F(1, 29) = 11.84, p < .002, \eta^2 = 0.29$. When rumination was the first induction, anxiety increased from baseline to the rumination induction and increased again from the rumination induction to the worry induction.

A main effect of time was found for depression, $F(2, 112) = 27.70, p < .001, \eta^2 = 0.33$, revealing that depression increased from baseline to the induction periods. Simple within-subjects contrasts

Table 1
Means and standard deviations of mood variables during baseline and induction periods in study 1 and study 2

DV	Baseline	First induction		Second induction	
		Worry	Rumination	Worry	Rumination
Study 1					
NA	16.23(8.14)	26.03(8.60)	24.17(9.40)	24.20(9.57)	25.20(9.13)
PA	19.70(6.10)	16.17(4.76)	17.67(6.59)	17.50(6.89)	14.83(4.33)
R	3.05(1.08)	1.90(.84)	1.97(.89)	2.03(1.00)	1.90(.80)
A	2.42(1.14)	3.43(.82)	2.80(1.19)	3.13(.97)	3.03(1.00)
D	1.98(1.10)	2.77(1.17)	3.27(1.31)	2.90(1.24)	2.93(1.26)
Study 2					
NA	16.71(6.91)	19.78(7.45)	23.58(9.27)	22.94(8.32)	20.78(8.00)
PA	20.46(6.67)	17.00(6.48)	17.88(8.38)	18.70(8.91)	15.88(6.27)
R	3.19(1.13)	2.54(1.22)	2.02(0.98)	2.10(1.02)	2.39(1.10)
A	2.57(1.16)	2.95(1.04)	2.94(1.24)	3.24(1.17)	2.78(1.07)
D	1.89(1.12)	2.39(1.26)	2.82(1.30)	2.54(1.22)	2.61(1.26)

Note. NA = Negative Affect; PA = Positive Affect; R = Relaxation; A = Anxiety; D = Depression. Standard deviations in parentheses.

Table 2
Mean percentage of thoughts and images during baseline, worry, and rumination in study 1 and study 2

	% Thoughts	% Images	% Neither
Study 1			
Baseline	61.08	37.65	1.27
Worry	70.18	29.32	0.5
Rumination	60.53	35.92	3.55
Study 2			
Baseline	66.62	30.04	3.34
Worry	79.54	16.97	3.49
Rumination	70.57	27.27	2.16

revealed that depression was higher during the first induction period, $F(1, 56) = 50.11$, $p < .001$, and the second induction period, $F(1, 56) = 35.58$, $p < .001$, than at baseline. No order effects were found.

Thoughts and images. Repeated-measures ANOVAs performed on mean percentage of thoughts reported during mentation periods revealed a significant interaction between time and order of induction, $F(1, 56) = 5.67$, $p < .005$, $\eta^2 = 0.10$. The amount of thought increased from baseline to the worry induction, whereas it decreased from baseline to the rumination induction. See Table 2 for mean percentage of thought-based and imagery-based mentation reported during baseline, worry, and rumination.

These analyses were not repeated for imagery, because the amount of imagery experienced by participants was inversely proportional to the amount of thought-based mentation that they experienced. Participants reported the percentage of thought, imagery, or other mentation they experienced at each thought sampling moment. The "other" category accounted for less than 3% of reported mentations during each 5-minute period. As such, the results for imagery are simply reversed in comparison to the results for thought-based mentation.

Temporal orientation effects. Overall, worry was associated primarily with future-oriented mentations (77.7%), whereas past-oriented mentations predominated during rumination (77.0%). The baseline uninstructed period contained a comparatively even distribution of past (22.0%), present (35.0%), and future (43.0%) mentation. To analyze change over time within each mentation period, a repeated-measures marginal homogeneity test for nondichotomous categorical variables was performed (Daniel, 1995; Hollander & Wolfe, 1973). After collapsing over between-group conditions, this test was performed three times: once on the baseline periods, once on worry periods, and once on rumination periods. Each test compared each of the five sampling moments within each

mentation period to all other sampling moments in that mentation period. No significant effects were found during the baseline periods or the worry periods. However, a significant change over time emerged during the rumination period. Participants began ruminating about the past, but demonstrated a linear trend toward increasing mentations about the present and finally the future (see Fig. 1). The results of the marginal homogeneity test revealed that the first sampling moment involved less thought about the past than the third, $p < 0.016$, fourth, $p < 0.001$, and fifth, $p < 0.001$, sampling moments. The second sampling moment involved less thought about the past than the fourth, $p < 0.008$, and the fifth, $p < 0.001$, sampling moments. Finally, the third sampling moment involved marginally less thought about the past than the fourth sampling moment, $p < 0.064$, and less than the fifth sampling moment, $p < 0.012$.

Connection between worried and ruminative thoughts. At the end of the experiment, participants were asked if they thought a relationship existed between listed worry and rumination topics. Specifically, they were asked to indicate if any of the worries on their list of worrisome topics were directly related to a past negative event that they had experienced. Eighty-five percent of participants reported that at least one of their three most worrisome topics was related to such an event. Additionally, participants were asked if any of the past events reflected in their three rumination topics contributed to any of their list of current worries. A similarly high percentage (81.6%) of participants reported such a relationship in at least one of their three ruminative topics.
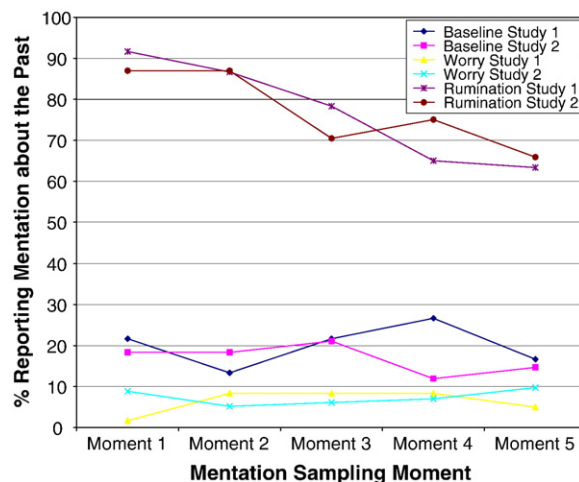

FIGURE 1 Percentage of participants reporting mentation about the past at each mentation sampling moment collapsed across conditions in Study 1 and Study 2.

Study 2

METHOD

Participants. The 109 undergraduate students who participated came from three trait groups [high worry and rumination (W/R), high rumination only (R), and control (C)]. W/R participants were identified by having a score of more than one standard deviation above the normative mean on both the PSWQ and on the Ruminations Inventory (see Screening Measures section below). R participants had a score on the Ruminations Inventory one standard deviation above the mean and a score of the PSWQ within .5 standard deviation of the mean. The C group fell within .5 standard deviations of the mean of both the PSWQ and the Ruminations Inventory. We originally wished to select a group of high worriers who did not score highly on trait rumination, but this proved to be impossible. Of over 1,500 individuals screened, only two high trait worriers did not also score high on rumination.

The sample was 75.2% female ($n = 82$) and 24.8% male ($n = 27$). As in Study 1, the majority of the sample reported their ethnicity as Caucasian ($n = 94$, 86.2%), while the remainder of the participants were from Asian ($n = 5$, 4.6%), Hispanic ($n = 5$, 4.6%), African American ($n = 1$, 0.9%), Native American ($n = 1$, 0.9%), and other ($n = 3$, 2.8%) ethnic backgrounds. The mean age of the sample was 18.6 years old. Participants were randomly assigned to order of induction. The breakdown of participant by order cell sizes was as follows: 34 W/R participants (19 in the worry first condition, 15 in the rumination first condition), 40 R participants (20 in the worry first condition, 20 in the rumination first condition), and 35 C participants (20 in the worry first condition, 15 in the rumination first condition).

Design. Study 2 employed the same procedures as Study 1, with one exception; no intervening thought period was used given the absence of an effect associated with it in Study 1. A repeated-measures design was again utilized to examine the effects of worry and rumination independently and in interaction with each other. All conditions involved an uninstructed mentation period (baseline) to establish pre-induction levels of affect and cognitive activity, followed by inductions of worry and rumination. Half of the participants were randomly assigned to engage in worry and then in rumination; the other half engaged in the inductions in the opposite order. All participants engaged in worry and rumination in direct succession with no intervening thought period. Study 2 allowed a replication of worry and rumination effects found in Study 1 and examined whether the mood, thought vs. image, and temporal orientation findings would follow a similar pattern in individuals who differed in trait worry and trait rumination.

Screening measures. The PSWQ, described in Study 1, demonstrated excellent reliability in this sample ($\alpha = 0.96$).

Rumination scale. The Ruminations Inventory (RI) is a 10-item measure designed to assess ruminative thought that is repetitive and aversive (Martin et al., 1993; McIntosh & Martin, 1992). This scale assesses the type of rumination used in the induction procedures more clearly than measures of depressive rumination (e.g., the Response Style Questionnaire) that focus on responses to depressed mood. This measure has been used in previous studies of repetitive thought and global rumination (e.g., Segerstrom, Stanton, Alden, & Shortridge, 2003) and has demonstrated construct validity (McIntosh & Martin, 1992). Participants respond on a 1 (*does not describe me well*) to 7 (*describes me well*) scale. Sample items from this measure include, "When I have a problem, I tend to think about it a lot of the time" and "I seldom think about things that happened in the past." Two of the items on this scale are focused on thought that was unrelated to our definition of rumination in this study (Items 4 and 7). These items assess future-oriented thought that is more similar to worry than rumination (e.g., "I often think about what my life will be like in the future) and were thus removed before using the measure to select participants. The RI with these items removed demonstrated good reliability in this sample ($\alpha = 0.88$).

Presession measures. As in Study 1, the BDI and the MASQ were administered to all participants. The BDI demonstrated good reliability in this sample ($\alpha = 0.87$), as did the MASQ ($\alpha = 0.89$).

RESULTS

Presession measures. Two-way ANOVAs (Trait Status × Order of Induction) were performed on the presession questionnaires to examine differences among the three trait groups and to verify initial equivalence between induction order conditions. No order differences were found. Trait groups differed in baseline depression, worry, distress, and anxiety, with the C group reporting lesser amounts of these variables than the W/R or R groups. The W/R group reported higher levels of worry than the R group at baseline (see Table 3).

Preliminary analyses. ANOVAs were conducted on affect and cognitive measures obtained during the baseline mentation period to determine whether any between-groups differences existed

Table 3
Results of univariate ANOVAs comparing groups on presession measures: study 2

Measure	df	F	p	Scheffe			Mean(SD)		
				C-W/R	C-R	W/R-R	C	R	W/R
General Distress: Mixed Symptoms									
BDI	(2, 106)	14.79	.001	.001	.001	.89	4.91 (4.20)	11.33 (6.49)	11.79 (7.03)
PSWQ	(2, 106)	48.55	.001	.001	.001	.02	33.31 (10.45)	52.08 (11.95)	59.27 (11.90)
RI	(2, 106)	48.11	.001	.001	.001	.37	41.91 (7.75)	56.48 (5.64)	54.18 (7.09)
MASQ	(2, 106)	20.12	.001	.001	.001	.59	14.69 (7.23)	26.13 (10.33)	27.91 (10.88)
General Distress: Anxious Symptoms									
MASQ	(2, 106)	10.60	.001	.001	.001	.84	6.89 (5.35)	12.20 (6.38)	12.85 (6.43)
Anxious Arousal									
MASQ	(2, 106)	7.09	.001	.004	.01	.89	4.57 (5.21)	10.43 (8.59)	10.76 (9.55)
General Distress: Depressive Symptoms									
MASQ	(2, 106)	17.06	.001	.001	.001	.99	8.14 (7.16)	19.25 (10.43)	18.97 (9.68)
Anhedonic Depression									
MASQ	(2, 106)	27.28	.001	.001	.001	.99	51.63 (9.87)	70.70 (12.92)	70.39 (14.25)

Note. C=control group, R=high-rumination group, W/R=high-worry high-rumination group, BDI=Beck Depression Inventory; PSWQ=Penn State Worry Questionnaire; RI=Ruminations Inventory; MASQ=Mood and Anxiety Symptom Questionnaire. C-W/R represents the *post hoc* comparison between the control group and the high-worry high-rumination group. C-R represents the *post hoc* comparison between the control group and the high-rumination group. W/R-R represents the *post hoc* comparison between the high-worry high-rumination group and the high-rumination only group.

prior to the first induction period. Order of induction and trait status were between-groups factors, and negative affect, positive affect, rated relaxation, anxiety, and depression, percentage thoughts, and percentage images were dependent variables. No significant differences emerged based on order of induction. Two chi-square analyses were performed to determine whether baseline differences in report of past, present, or future mentation existed due to trait status or order of induction. No between-groups differences emerged. As expected, there were numerous baseline differences between the three status groups prior to the first induction period on negative affect, positive affect, relaxation, anxiety, and depression. As determined by Scheffe's *post hoc* comparisons, the C group had more positive and less negative affect than did the W/R and R participants groups, which did not differ from each other.

The PANAS was administered five times during the study. The reliability of the PANAS was good in this sample (αs ranging from 0.77 to 0.83; average $\alpha = 0.81$).

Emotional effects during inductions. Negative and positive affect. Three-way repeated-measures ANOVAs were conducted separately on the PANAS negative and positive affect scores. A main effect of time was found for negative affect, $F(2, 206) = 45.59$, $p < .001$, $\eta^2 = 0.31$. Negative affect increased from baseline to the induction periods. Simple within-subjects contrasts revealed that negative affect was higher during the first induction period, $F(1, 103) = 74.75$, $p < .001$, and the second induction period, $F(1, 103) = 55.05$, $p < .001$, than at baseline. No order effects or group effects (C, W/R, R) emerged. See Table 1 for means and standard deviations of all mood variables during baseline and induction periods.

The three-way repeated-measures ANOVA for positive affect also revealed a main effect of time, $F(2, 206) = 29.04$, $p < .001$, $\eta^2 = 0.22$, which was qualified by a Time × Order interaction, $F(2, 206) = 6.07$, $p < .003$. Examination of the simple main effect of time within the worry condition revealed a significant effect of time, $F(2, 116) = 41.14$, $p < 0.001$, $\eta^2 = 0.42$, and a within-subjects linear trend, $F(1, 58) = 55.43$, $p < .001$, $\eta^2 = 0.49$. When worry was the first induction, positive affect decreased from baseline to the worry induction and decreased again from the worry induction to the rumination induction (see Table 1). When the simple main effect of time was examined within the rumination condition, a significant effect of time was also found, $F(2, 98) = 4.37$, $p < 0.015$, $\eta^2 = 0.08$, as well as a within-subjects quadratic trend, $F(1, 49) = 7.92$, $p < .007$, $\eta^2 = 0.14$. When rumination was the first induction, positive affect decreased from baseline to the rumination induction and increased from the rumination induction to the worry induction.

Relaxation, anxiety, and depression. Three-way repeated-measures ANOVAs were conducted separately on relaxation, anxiety, and depression scores. A main effect of time emerged for relaxation ratings, $F(2, 206) = 51.84$, $p < .001$, $\eta^2 = 0.34$. Relaxation decreased from baseline to the induction periods. Simple within-subjects contrasts revealed that relaxation was lower during the first induction period, $F(1, 103) = 76.89$, $p < .001$, and the second induction period, $F(1, 103) = 66.10$, $p < .001$, than at baseline. No order or group effects were found.

A main effect of time also emerged for anxiety ratings, $F(2, 206) = 7.65$, $p < .001$, $\eta^2 = 0.07$, as well as a marginally significant Time × Order interaction, $F(2, 206) = 2.35$, $p < .098$. Examination of the simple effect of time within the worry condition revealed a significant effect of time, $F(2, 116) = 3.14$, $p < .047$, $\eta^2 = 0.05$, and a within-subjects quadratic trend, $F(1, 58) = 4.89$, $p < .031$, $\eta^2 = 0.08$. As in Study 1, when worry was the first induction, anxiety increased from baseline to the worry induction and decreased from the worry induction to the rumination induction (see Table 1). Examination of the simple effect of time within the rumination condition revealed a significant effect of time, $F(2, 98) = 7.42$, $p < .004$, $\eta^2 = 0.13$, and a linear within-subjects trend, $F(1, 49) = 10.42$, $p < .002$, $\eta^2 = 0.21$. As in Study 1, when rumination was the first induction, anxiety increased from baseline to the rumination induction and increased again from the rumination induction to the worry induction. No group effects were found.

A main effect of time was found for depression, $F(2, 206) = 32.15$, $p < .001$, $\eta^2 = 0.24$, as well as a Time × Order interaction, $F(2, 206) = 3.82$, $p < .025$, $\eta^2 = 0.04$. Examination of the simple effect of time within the worry condition revealed a significant effect of time, $F(2, 116) = 13.18$, $p < .001$, $\eta^2 = 0.19$, and a within-subjects linear trend, $F(1, 58) = 20.62$, $p < .001$, $\eta^2 = 0.26$. When worry was the first induction, depression increased from baseline to the worry induction and increased again from the worry induction to the rumination induction (see Table 1). The simple effect of time examined within the rumination condition revealed a significant effect of time, $F(2, 98) = 21.66$, $p < .001$, $\eta^2 = 0.31$, and a quadratic within-subjects trend, $F(1, 49) = 26.31$, $p < .001$, $\eta^2 = 0.35$. When rumination was the first induction, depression increased from baseline to the rumination induction and decreased from the rumination induction to the worry induction.

Thoughts and images. Repeated-measures ANOVAs performed on mean percentage of thoughts reported during mentation periods revealed a main effect of time, $F(2, 206) = 8.92$, $p < .001$, which was qualified by a significant interaction between time and order of induction, $F(2, 206) = 7.40$, $p < .001$, $\eta^2 = 0.10$. The amount of thought increased from baseline to the worry induction, whereas it decreased from baseline to the rumination induction. See Table 2 for mean percentage of thought-based and imagery-based mentation reported during baseline, worry, and rumination. As in Study 1, imagery-based mentation was inversely proportional to thought-based mentation, so analyses were not repeated for imagery-based mentation.

Temporal orientation effects. To examine temporal orientation effects over time, a repeated-measures marginal homogeneity test was performed on each type of mentation period (baseline, worry, rumination) collapsed across trait status and order of induction. As in Study 1, no significant patterns involving temporal orientation during the worry period or the baseline period were found. Rumination again was associated with a progression from thoughts about the past to thoughts about the future (see Fig. 1). The results of the marginal homogeneity test revealed that the first sampling moment involved less thought about the past than the third, $p < 0.008$, and fifth, $p < 0.001$, sampling moments. The second sampling moment involved less thought about the past than the third, $p < 0.019$, and the fifth, $p < 0.001$, sampling moments. Finally, the fourth sampling moment involved less thought about the past than the fifth sampling moment, $p < 0.001$.

Connection between worried and ruminative thoughts. As in Study 1, participants were asked at the end of the session to report any relationships between their worries and ruminations. Again, most participants (74.5%) reported that at least one of their three worry topics was connected to a past negative event reflected in their ruminations, and 94.3% reported that at least one of their rumination topics contributed to one or more of their worries.

Discussion

MOOD EFFECTS

A primary aim of the current investigation was to identify how worry and rumination were involved in the generation of negative mood states. Worry and depressive rumination were both associated with increases in anxiety, depression, and negative affect and with decreases in positive affect in Study I and in Study 2. We found that the type of negative mood generated by either thought process was very

similar. Importantly, worry and rumination generated negative mood in individuals not already experiencing chronic negative affect or negative thinking, and the influences of these processes on negative mood for these individuals were not different than for individuals already experiencing chronic negative thinking and negative mood. Worry and rumination are likely involved in the generation of state experiences of negative mood, even for individuals who are not chronically anxious or depressed. The negative mood states generated by these thought processes may lead to engagement in other types of negative perseverative thought, such as depressive rumination. Chronic engagement in these types of perseverative thinking may lead to the chronic negative mood experienced by individuals with emotional disorders.

Consistent with our hypotheses, worry and rumination both generated negative affect. Contrary to our hypotheses, however, worry and rumination each led to decreases in positive affect, although rumination had a larger impact on positive affect than worry in Study 2. These findings have implications for the tripartite model of anxiety and depression (Clark & Watson, 1991). Given that worry and rumination each lead to the generation of negative affect and decrements in positive affect, engagement in these processes is implicated in the development of both anxiety disorders and depression. Because these thought processes can lie upstream in the emotion generative process (i.e., can occur in the absence of state negative mood), engagement in worry and rumination can be viewed as a pathway to both state and trait negative affectivity. Moreover, a tendency to engage in negative perseverative thinking, including both worry and rumination, may be involved in the development of comorbid anxious-depressed conditions given that these processes generate negative affect, the shared component of anxiety and depression thought to be responsible for their high comorbidity (e.g., Watson, Clark, et al., 1995a; Zinbarg & Barlow, 1996). The comorbidity of GAD and major depression may be particularly associated with engagement in these thought processes given the observed high associations between these conditions and negative affect (e.g., Brown et al., 1998).

Manipulation of both worry and rumination in a single study allows us to conclude that both processes similarly lead to the generation of state negative mood. These findings are in accord with prior findings in studies conducted separately on worry and rumination indicating that negative thinking of any type generates negative affectivity (Segerstrom et al., 2000), that worry occurs in depression (Chelminski & Zimmerman, 2003), and that rumination predicts the onset of anxiety (Nolen-Hoeksema, 2000). These findings suggest that there are at least some shared components with similar emotional effects of these two types of perseverative thought that focus on negatively valenced self-referent topics. Because each type of negative thinking can create emotional states considered characteristic of emotional disorders (increased negative affectivity, anxiety, and depression, and decreased positive affectivity and relaxation), it may well be that the commonly found high correlations between anxiety and depression and the frequent comorbidity of anxiety and mood disorders are partly due to the occurrence of either or both types of negative thinking.

What specific shared processes might be involved in the generation of similar emotional effects remain to be elucidated, but we speculate that such processes may have to do with two factors: (a) temporal orientation during a negative thinking episode and (b) the type of cognitive set adopted during negative thinking. Worries about the future are necessarily based in one way or another upon life experiences with negative events in the past, and thus there is the likelihood that thoughts about both will occur in any worrisome episode (with thoughts about the future being conducive to anxiety and thoughts about the past being conducive of depression). Ruminative thoughts about past negative events, on the other hand, have meaning for us at least partly in terms of the implications of those occurrences for our present and our future, thus making it likely that thoughts about both the present and the future will occur during rumination as well, with similar emotional consequences. In both of our studies, the reports of our participants linking the vast majority of their past rumination topics and future worry topics supported this possibility. Furthermore, thought sampling in both studies revealed that worry is predominantly about the future but also contains content about the past and that rumination is predominantly about the past but also contains content about the future, increasingly so as the ruminative process unfolds. During any type of negative thinking, when we are focused on the past, we are likely going to experience depression, and when we focus on the future, we will likely experience anxiety. Irrespective of whether the problem we are contemplating in our negative thinking has to do with the past or the future, if our cognitive set is one of hopelessness, we will likely experience depressed affect, and if our set is that we need to keep trying to solve a problem, anxiety will likely be the predominant emotion.

We hypothesized that engaging in both worry and rumination would be associated with more intense negative affect than engaging in either process alone. This hypothesis was not supported in the current study. The influence of the intervening mentation period in Study 1 did not influence the emotional effects of engaging in worry and rumination. We also did not find that negative affect, anxiety, or depression ratings were higher in the second induction period as compared to the first. It is likely that the short time spent engaging in worry and rumination in this study was related to our findings that engaging in both thought processes did not lead to increases in negative affective states as compared to engaging in only one. Moreover, it may be that a ceiling effect was involved with our finding that negative affective states were not more intense in the second induction period as compared to the first.

Another aim of this investigation was to identify interactive or catalytic effects of worry and rumination when they occur sequentially. Despite the similarities in affective states generated by each process, evidence additionally suggested some differentiation in the emotional effects of the two types of negative thinking when they occurred together. The emergence of the Order × Time interaction effects from first induction to second induction for anxiety in both studies was consistent with our hypothesis that worry would inhibit anxiety in subsequent rumination. In Study 2's sample in which two-thirds of the participants were selected for high levels of trait worry or rumination, a number of differential effects emerged. First, a Time × Order interaction emerged for positive affect. Apparently, sufficient depression was caused by worry (Andrews & Borkovec, 1988) to also create reduced positive affect. Moreover, the decrease in positive affect experienced during worry was further exaggerated by a subsequent rumination period. A Time × Order interaction was also found for depression. Rumination caused a greater increment in depressed affect from the neutral period to its induction period than did worry. Given that these results were not replicated across the two studies, it is possible that either the degree of trait negative affectivity in the participant samples moderated the individual results of each study or that these were chance findings. Nevertheless, the Time × Order interactions indicate that shifting from worry to rumination led to decreases in anxious states and increases in depressive states, and shifting from rumination to worry created the opposite pattern. Thus, when the two types of negative thinking occur sequentially, worry is indeed associated with a predominance of anxious

affect, and rumination creates a predominance of depressive affect.

These same interaction effects also support the possibility of catalytic effects of one type of negative thinking on the other, although these effects were moderated somewhat by the use of unselected versus selected samples. In Study I, the greatest amount of anxiety occurred in the worry induction when it occurred first, and the least anxiety was generated during rumination when it occurred first. We had thought that worry might mute the degree of anxiety experienced during subsequent rumination, given prior research indicating worry's cognitive avoidance function that results in an inhibition of emotional processing (see Borkovec et al., 2004). We did find that reported anxiety decreased from the worry induction to the rumination induction and that anxiety increased from the rumination induction to the worry induction. In Study 2, however, the pattern corresponded exactly to predictions based on the cognitive avoidance theory of worry: the least amount of anxiety was reported by participants who engaged in rumination after having experienced worry; the greatest degree of anxiety occurred in worry following a period of rumination.

Behar and colleagues (2005) found this identical pattern of catalytic effects on anxiety using worry and trauma recall inductions in a selected sample, two-thirds of whom had high anxiety levels (GAD and/or PTSD), but did not find the interaction in their unselected sample. As Behar and colleagues pointed out, however, the counterbalanced order designs used in these investigations cannot rule out the rival hypothesis that rumination (or trauma recall) may have facilitated the amount of anxiety experienced during subsequent worry. This appears to be a reasonable possibility, given that thinking about a past negative event contained in both the rumination and trauma recall inductions provides historical evidence to the individual that bad things can and do happen, thus potentially increasing the subjective probability that the bad things anticipated in worry may indeed happen and increasing the amount of anxiety experienced during the worrying.

Catalytic effects were also found for depression, although these effects were significant only in Study 2. The greatest amount of depressive affect occurred in rumination when it was induced first, and worrying first created the least amount of depression. Depression experienced during worry increased during subsequent rumination, while depression experienced during rumination decreased during subsequent worry. Again, rival interpretations are possible. Either worry can lessen

the depressing effects of rumination, rumination can facilitate the depressing effects of worry, or both processes can occur. In the first case, the potential inhibiting effects of worry on emotional processing would generalize to depression as well. In the second case, evidence that bad things have happened in the past could create a greater sense of uncontrollability and hopelessness about potential bad events in the future.

Finally, our inability to select a group of high worriers who did not also engage in high levels of rumination is worth noting. It is likely that our use of a global definition of rumination in this study led to our inability to find a group high in worry only. It makes sense that individuals who experience intense, chronic, and uncontrollable worry about the future also experience intense and uncontrollable perseverative negative thought about past failures and mistakes. Reflection on past mistakes and failures signals to the individual that similar events may happen in the future and likely provides evidence that worry is necessary. This notion is supported by our findings in both studies that most worries had specific associations with past failures and mistakes. Had we focused on depressive rumination, it is unclear whether we would have been able to find a high worry group that did not also engage in high levels of depressive rumination.

THOUGHTS AND IMAGES

Both studies were consistent in their demonstration that worry and rumination both involve a predominance of thought (as opposed to imagery) and that worry is characterized by a significantly greater degree of thinking than is rumination. Both processes thus contrast with trauma recall, wherein imagery was found to be the predominating type of cognitive activity (Behar et al., 2005). We did expect rumination to have less thought than worry, given that the instructed content for the rumination induction had to do with a past event that actually happened. However, because rumination was characterized by more thought than imagery, the question can be raised as to whether rumination may not also represent a process that lessens emotional processing, analogous to the effects of worry. Like worry, rumination worsens rather than resolves negative emotional states (Morrow & Nolen-Hoeksema, 1990; Nolen-Hoeksema & Morrow, 1993). Also like worry, rumination has been found to be associated with overgeneral memory and a high level of abstract as opposed to concrete processing (e.g., Watkins & Teasdale, 2001; Williams, 1996). Both bodies of research suggest the potential for rumination to have an impact on the processing of emotion. Future research would

usefully test directly whether or not it can have this function. Our own data indicated the possibility that rumination can lessen anxiety during subsequent worrying. An enigma in this issue exists, however. Worry and rumination do appear to show a fundamental difference at the most primitive of emotional processing levels: Worry is associated with a suppression of amygdala activation (Hoehn-Saric, Lee, McLeod, & Wong, 2005), whereas rumination is characterized by sustained amygdala activity (Siegle, Granholm, Ingram, & Matt, 2001; Siegle, Steinhauer, Thase, Stenger, & Carter, 2002).

LIMITATIONS

The focus of this study was on examining the independent and interactive effects of global rumination and worry. However, the majority of research on rumination has examined depressive rumination as defined by Nolen-Hoeksema (1991). We chose to examine global rumination for a number of theoretical and methodologic reasons, but this choice limits our ability to contribute to the larger body of work on depressive rumination.

Another limitation was our decision to select high worriers and ruminators, not individuals with anxiety disorders or major depression, to participate in Study 2. We did not find any group differences in Study 2, which may have resulted from our selection of high worriers and ruminators instead of individuals with diagnosed emotional disorders. It is likely that individuals with GAD and major depression would have reported higher levels of negative affect, anxiety, and depression and lower levels of positive affect and relaxation had they been included. However, we have no reason to believe that the results would have been qualitatively different had individuals with clinical diagnoses participated in the study. Nevertheless, replication of these results in clinical samples remains an important goal for future research.

The worry and rumination periods in this study were 5 min, which is relatively short in comparison to the actual time that individuals in a negative perseverative thinking episode likely spend worrying and ruminating. Previous research has demonstrated that worry inductions of 5 min are adequate to induce emotional and cognitive effects of worry (Behar et al., 2005). Engaging in these processes over longer periods of time may be associated with more intense changes in mood, but there is no reason to believe that the affective and cognitive effects of these processes are qualitatively different over longer periods of time.

The use of one-item measures to assess mood throughout the study represents another potential

limitation. Given that one of our primary interests was examining the interaction of worry and rumination, we did not want participants to complete lengthy measures of state anxiety, depression, and relaxation that would allow significant dissipation of emotional effects during questionnaire completion. These scales represented the primary outcome measures in a similar study (Behar et al., 2005) that was interested in examining catalytic effects of two types of recurrent negative thinking (worry and trauma recall), and we believe that their inclusion was essential to our goal of describing catalytic effects. In fact, the interactions between worry and rumination were described almost exclusively in terms of differences in reported anxiety and depression using these scales. Given that our results largely mirror results of Behar et al. (2005), we are further convinced that the use of these scales is appropriate.

Finally, because we chose to instruct participants that worries were related to potential future negative events and that ruminations were related to past events, assessment of temporal orientation was originally included as a manipulation check. When we found the change from past to present and future orientation across time in the rumination condition, we interpreted these finding to mean that over time, thinking about negative things that have happened in the past potentially leads to worries about the future. However, these findings could also be interpreted to mean that individuals were not actually ruminating at the end of the induction period and the rumination induction was not successful. We do not believe this to be the case, given that mentations were focused on past-oriented material at the start of the rumination induction and that the progression to future-oriented thought is consistent with theory on the functions of perseverative thought (see Borkovec et al., 2004).

CONCLUSIONS

Worry and rumination lead to similar increases in negative affect, anxiety, and depression and to decreases in positive affect and relaxation. These processes are clearly important in the generation of negative mood for individuals with and without emotional disorders. Worry and rumination also appear to interact to affect mood. Anxiety experienced during worry decreases when rumination follows, and depression experienced during worry increases when rumination follows. Conversely, anxiety experienced during rumination increases when worry follows, and depression experienced during rumination decreases when rumination follows. These findings indicate that the order in which negative perseverative thinking unfolds during any given episode has implications for the intensity of anxiety and depression

experienced. Finally, both worry and rumination involve a predominance of thought-based mentation, although worry is associated with a greater degree of thoughts as compared to imagery. These findings may have implications for the influence of rumination on subsequent emotional processing.

FUTURE DIRECTIONS

Recurrent negative thinking is a fundamental component of emotional disorders. The independent effects of different types of such thinking (e.g., worry, rumination, and trauma recall) have been examined in much prior research, whereas interactions among these different types of thinking are only beginning to be explored. Future research should continue to examine potential catalytic effects of different types of negative thinking, for example, rumination and trauma recall. The influence of these types of thinking on one another should also be examined over longer periods of time and in contexts other than a laboratory setting, potentially using experience sampling methods.

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