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ORIGINAL ARTICLE

Metacognitive Appraisals of Perseverative Cognition: A Prospective Test Across Thought Types

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Abstract

Purpose Cognitive-behavioral and metacognitive theories suggest that appraisals of perseverative (repetitive negative) thoughts play a crucial role in determining affective and behavioral outcomes. The current study prospectively tested these theories across thought types by examining the relationship between thought appraisals and later outcomes.

Methods The current study tested the association of negative and positive appraisals of obsessions, worries, and ruminative thoughts to self-reported outcomes at 1-month follow-up ($n = 96$) using an unselected student sample.

Results At 1-month follow-up, prior negative appraisals predicted increasing thought frequency for worry and rumination but not obsessions, while prior positive appraisals predicted increasing thought frequency and negative affect for rumination only.

Conclusions Results suggest that different forms of perseverative thought may differ in the extent to which immediate negative and positive appraisals are related to later outcomes. These results contribute to our understanding of the role of metacognitive appraisals in the persistence of different forms of perseverative thought, and suggest important differences across thought types.

Keywords Obsessions · Worry · Rumination · Transdiagnostic · Metacognition · Repetitive negative thinking

Introduction

Perseverative thought (PT) such as worry, rumination, and obsessional thought, is a feature of a wide range of mental disorders. While there are some differences between these thought types, there are also important similarities. Worry, which is the central feature of generalized anxiety disorder, and rumination, which is most often studied in major depressive disorder, are both characterized by a predominance of verbal thought and an abstract processing style; they differ mainly in temporal orientation, with worry focused on the future and rumination focused on the past or present (Watkins et al., 2005). The obsessions characteristic of obsessive–compulsive disorder (OCD) differ from worry and rumination in several respects, particularly in their tendency to involve imagery rather than verbal thought (Langlois et al., 2000; Wahl et al., 2011). However, like worry and rumination, obsessions are unwanted, associated with loss of mental control, and linked to negative emotions (Wahl et al., 2019).

Importantly, each of these thought types is common among healthy as well as clinical populations (Langlois et al., 2000; Papageorgiou, 2006), raising questions about why only some individuals experience these thoughts as persistent or impairing. Cognitive-behavioral theories suggest that an individual's interpretation of obsessional thoughts plays a crucial role in determining affective and behavioral outcomes (Rachman, 1997; Salkovskis, 1985). According to these classic theories, catastrophic interpretations of normal obsessional or intrusive thoughts (e.g., as personally meaningful or important, or as having potentially serious consequences) lead to avoidance attempts and paradoxical increases in thought frequency. Metacognitive theories of worry and rumination similarly emphasize the important role of interpretations (Papageorgiou & Wells, 2001a; Wells, 1995). However, these theories hypothesize that positive beliefs about the

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usefulness of worry and rumination (for example, in preparing for future events or learning from past mistakes) initially lead to intentional engagement in these ways of thinking. In time, however, increased worry and rumination lead to negative experiences (e.g., loss of productivity associated with PT) that elicit negative appraisals of the thoughts, along with negative affective and behavioral outcomes (e.g., avoidant behavior such as thought control attempts).

However, prior studies of these influential theories have left important questions unresolved. First, most studies have focused on global beliefs about thoughts. Appraisals of *specific* thought occurrences likely derive from, and are moderately correlated with, global beliefs (Obsessive Compulsive Cognitions Working Group, 1997; Purdon, 2001). However, appraisals of specific, recent thoughts explain a significant percentage of variance in outcomes beyond that accounted for by general beliefs (Purdon, 2001) and may be less susceptible to recall errors and biases than global ratings of experience (Mathersul & Ruscio, 2020).

Second, past studies have focused primarily on negative beliefs. Much less is known about positive metacognitive beliefs, despite indications that they increase engagement in unhelpful thoughts (Wells & Matthews, 1994) and undermine motivation to change these thoughts (Westra et al., 2009). Positive beliefs about worry explain variance in worry severity over and above anxiety and depression symptoms (Hebert et al., 2014), predict later cognitive and behavioral avoidance (Sica et al., 2007), and moderate the relationship between stressful life events and subsequent worry (Iijima & Tanno, 2013). Similarly, positive beliefs about rumination prospectively predict increased rumination and negative affect in daily life (Kubiak et al., 2014; Weber & Exner, 2013). There has been less research on positive beliefs about obsessions, perhaps because obsessions are typically conceptualized as unwanted and associated with negative appraisals. However, evidence that positive metacognitive beliefs predict obsessional thoughts and checking behavior (Wells & Papageorgiou, 1998) argues for studying positive beliefs about obsessions as well. If positive beliefs about thoughts—which play a central role in theories of worry and rumination—are also implicated in obsessions, this could pave the way for generalizing models across different thought types.

Third, past studies have been largely cross-sectional. However, reactions to thoughts may have different outcomes in the short- versus long-term. As has long been recognized, avoidance may result in short-term reductions in anxiety but maintain anxiety in the long-term (e.g., Mowrer, 1960; Wolpe, 1958). Longitudinal research has shown that global negative beliefs about worry, rumination, and obsessions prospectively predict increases in anxiety (Ryum et al., 2017), depression (Papageorgiou & Wells, 2009), and OCD (Coles & Horng, 2006; Sica et al., 2007) symptoms, respectively. However, we are aware of only one longitudinal study that evaluated appraisals of *specific* thoughts as predictors of later outcomes. Abramowitz et al. (2007) found that negative appraisals of obsessional thoughts experienced in the month after the birth of a child partially mediated the relationship between global negative beliefs about obsessions (measured pre-birth) and OCD symptoms (measured three months postpartum). This finding suggests that reactions to specific thoughts may be important for understanding later outcomes.

Finally, different forms of PT have traditionally been studied in separate literatures. However, transdiagnostic models sparked questions about the extent to which findings may generalize across thought types (Ehring & Behar, 2020). Recent research examining differences and similarities across different forms of PT suggests that these thoughts may share several process features, such as repetitiveness, uncontrollability, intrusiveness, self-focus, and avoidance (Hallion et al., 2022; Kircanski et al., 2015; Wahl et al., 2019). However, the thought types also differ in several respects (Kircanski et al., 2015; Langlois et al., 2000; Watkins et al., 2005), and meta-analytic research supports their distinctness (Stade & Ruscio, 2022). These mixed findings underscore the need to study other key attributes of PT, such as negative and positive appraisals, which might be involved in the occurrence and persistence of multiple forms of PT.

The primary goal of the current study was to examine how negative and positive appraisals of obsessional, worried, and ruminative thoughts relate to self-reported outcomes measured 1 month later. We expected that the associations between appraisals and outcomes would be identical across the three types of PT examined, consistent with past research showing a similar role of metacognitive beliefs and appraisals across distinct forms of PT (e.g., Abramowitz et al., 2007; Papageorgiou & Wells, 2009; Ryum et al., 2017). We therefore hypothesized that T1 negative appraisals of all thought types would be associated with higher thought frequency, avoidance, and negative affect, as well as lower positive affect and daily functioning at T2. We further expected that predictions made by metacognitive theories of worry and rumination would generalize across all three thought types (Papageorgiou & Wells, 2001a; Wells, 1995), such that T1 positive appraisals of all thought types would be associated with higher thought frequency and avoidance, but also with lower negative affect, and higher positive affect and daily functioning at T2.

Method

Participants

The T1 sample included 265 undergraduate students at a private American university. Approximately half (52%) of participants identified as female and the remainder identified as male. Most were between ages 18 and 22 ($M = 19.5$, $SD = 2.08$). The

sample was 61% White, 24% Asian/Pacific Islander, 8% Black, and 7% other race-ethnicity; 12% identified as Hispanic.

Of the T1 sample, 36% ($n=96$) completed the T2 assessment 1 month later. The subsample that completed the T2 assessment did not differ significantly from the remainder of the sample in demographic or academic characteristics (sex, age, race-ethnicity, GPA), negative or positive appraisals, T1 outcome scores, or use of psychotropic medications. The sole difference was that a larger proportion of those who completed the T2 assessment (18%) were receiving counseling or therapy at T1 compared to those who did not complete the T2 assessment (8%), χ^2 (1, $N=279$) = 6.19, $p=0.019$.

Power analysis was conducted using G*Power. To ensure adequate power for our most stringent test, we focused on the sample size needed to detect whether T1 appraisals predict T2 outcomes. We estimated an effect size of $R^2=0.13$, taken from the most similar prior study (Abramowitz et al., 2007). Other studies examining metacognitive beliefs in worry and OCD have reported similar effect sizes (e.g., Abramowitz et al., 2006; Sica et al., 2007), providing further confidence in this estimate. Power analysis indicated that a sample size of 68 would provide 80% power to detect an effect size of $R^2=0.13$ at $\alpha=0.05$. All analyses exceeded this sample size.

Measures

Obsessional Beliefs Questionnaire (OBQ): 44

The OBQ (Obsessive Compulsive Cognitions Working Group, 2005) is a 44-item scale assessing belief domains linked to OCD including perfectionism/certainty, importance/control of thoughts, responsibility, and overestimation of threat. Each item is rated on a scale from 1 (*disagree very much*) to 7 (*agree very much*). In the present sample, Cronbach's α for each subscale was 0.90-0.93.

Metacognitions Questionnaire (MCQ)

The MCQ (Cartwright-Hatton & Wells, 1997) is a 65-item scale assessing beliefs about worry and intrusive thoughts. It includes subscales measuring positive beliefs about worry; negative beliefs about the uncontrollability of thoughts and corresponding danger; lack of cognitive confidence; negative beliefs about thoughts in general including themes of superstition, punishment, and responsibility; and cognitive self-consciousness. Each item is rated on a scale from 1 (*do not agree*) to 4 (*agree very much*). In the present sample, Cronbach's α for each subscale was 0.78-0.89.

Negative Beliefs about Rumination Scale (NBRS) and Positive Beliefs about Rumination Scale (PBRS)

The NBRS (Papageorgiou & Wells, 2001a) is a 13-item scale assessing negative metacognitive beliefs about rumination. It includes 8 items assessing beliefs about uncontrollability and harm associated with rumination and 5 items assessing beliefs about interpersonal and social consequences of rumination. Each item is rated on a 1 (*do not agree*) to 4 (*agree very much*) Likert-type scale. In the present sample, Cronbach's α was 0.80.

The PBRS (Papageorgiou & Wells, 2001b) is a 9-item scale assessing positive metacognitive beliefs about rumination. Each item is rated on a 1 (*do not agree*) to 4 (*agree very much*) Likert-type scale. In the present sample, Cronbach's α was 0.89.

Modified Cognitive Intrusions Questionnaire (CIQ)

The CIQ (Freeston et al., 1991) contains 53 items assessing features of individual thoughts on the following dimensions: descriptors (e.g., thought frequency, associated emotion), appraisals, and avoidance strategies used in response to the thought (e.g., distraction, suppression). Each item is rated on a 1 (*not at all true*) to 9 (*extremely true*) Likert-type scale. The CIQ has good psychometric properties (Freeston & Ladouceur, 1993; Freeston et al., 1991) and has been used to study obsessional, worried, and ruminative thoughts in undergraduate samples (Langlois et al., 2000; Watkins et al., 2005).

Analyses for the present study focused on negative and positive appraisals (as predictors), and thought frequency and avoidance strategies (as outcomes). We used the version of the CIQ used by Watkins et al. (2005), who added avoidance items having particular relevance for worry and rumination (e.g., "I planned how I can avoid the situation described by the thought;" "I evaluated what the thought and the situation described by the thought mean about me"). We further added two negative appraisal items ("the content of the thought reveals something negative about me;" "the thought might make it difficult to make day-to-day decisions"), three positive appraisal items ("the thought reveals something positive about me;" "the thought might motivate me to get things done;" "the thought might help me to prepare for future events"), and one avoidance item ("I dwelled on the consequences of the situation described in the thought"). These items were adapted from the MCQ (Cartwright-Hatton & Wells, 1997) and the PBRS (Papageorgiou & Wells, 2001a, 2001b). We summed items into face-valid, reliable composites for negative appraisals (12 items; Cronbach's $\alpha=0.85$ for obsessions, 0.86 for worry, 0.86 for rumination) and positive appraisals (7 items; $\alpha=0.73$ for obsessions, 0.74 for worry, 0.72 for rumination).

One avoidance strategies item ("I did nothing; it disappeared by itself") was not included because it does not represent avoidance. The remaining avoidance strategies items, which include cognitive and behavioral avoidance (e.g., distraction, thought suppression, reassurance-seeking, and dwelling on the content or meaning of thought itself) were summed into an avoidance composite (19 items; $\alpha = 0.90$ for obsessions, 0.89 for worry, 0.92 for rumination).

A confirmatory factor analysis was conducted for each thought type to test the goodness-of-fit of the two-factor model of negative and positive appraisals. Negative and positive appraisal factors were allowed to correlate. Fit indices indicated acceptable to good fit for all three thought types (RMSEA 0.05–0.08).

Negative and positive appraisals of all three thought types were significantly correlated with trait measures of metacognitive beliefs at a small to moderate magnitude, suggesting good convergent validity. Negative appraisals of all three thought types were correlated with the MCQ uncontrollability/danger ($r = 0.34$–0.45, $p < 0.01$) and general negative beliefs about thoughts ($r = 0.27$–0.42, $p < 0.01$) subscales, the NBRS ($r = 0.26$–0.31, $p < 0.01$), and the OBQ responsibility/threat ($r = 0.27$–0.29, $p < 0.01$) and perfectionism/certainty ($r = 0.19$–0.31, $p < 0.01$) subscales. Positive appraisals of all three thought types were significantly correlated with the MCQ positive beliefs subscale ($r = 0.22$–0.40, $p < 0.01$). The magnitude of these correlations is similar to what has been seen in previous research comparing momentary to global or trait levels of PT and related beliefs (Purdon, 2001; Rosenkranz et al., 2020).

Positive and Negative Affect Schedule (PANAS)

The PANAS (Watson et al., 1988) assesses negative affect (10 items) and positive affect (10 items), two independent dimensions of emotional experience. Items are rated on a 1 (*very slightly or not at all*) to 5 (*extremely*) Likert-type scale. Participants were asked to complete the PANAS recalling the way they felt at the time they experienced the thought. Past research has found the PANAS to be reliable and valid in undergraduate samples (Watson et al., 1988). In the present sample, Cronbach's α was 0.84–0.87 for negative affect and 0.91–0.93 for positive affect.

Daily Functioning Scale

The Daily Functioning Scale was designed for the present study to assess quality of daily functioning across the domains of social interaction, productivity and focus, energy and physical activity, sleep, and leisure and relaxation. Domains of functioning were adapted from existing measures of daily functioning and well-being among college students (Butler et al., 1994; Steger & Kashdan, 2009) but scale items were created for this study (see Appendix). Fifteen items were rated on a 1 (*not at all*) to 7 (*extremely*) Likert-type scale. Participants completed this measure based on the way they felt and behaved on the day they experienced the thought (e.g., "interacted with other people," "made progress in work or other activities"). Cronbach's α was 0.92 for obsessions, 0.88 for worry, and 0.88 for rumination.

Procedure

Data were collected in 2010 as part of a larger study.

Time 1

Participants completed self-report measures on a secure website. They were provided with definitions and examples of obsessional, worried, and ruminative thoughts that are commonly reported by college students and have been used in previous research with this population (e.g., McLaughlin et al., 2007; Teachman et al., 2006; see Appendix). Participants were asked to recall the most recent time they experienced a thought of each type, briefly describe the content of the thought, and indicate the number of times per week they experience this thought or a similar thought fitting the same definition. They then completed the remainder of the modified CIQ, the PANAS, and the Daily Functioning Scale in reference to the thought. All participants completed the survey in the same order, rating an obsessional thought, then a worried thought, and finally a ruminative thought. The survey took approximately 30 min to complete, and students received research credit for their participation.

Time 2

One month after the T1 assessment, all participants were invited to complete follow-up measures online. Measures included the modified CIQ frequency and avoidance items, the PANAS, and the Daily Functioning Scale. Participants completed these measures based on their experiences during the past week. Only thought frequency was rated separately for each thought type; all other outcomes reflected general experiences over the past week without regard to thought type. The T2 assessment took approximately 15 min, and participants were compensated with entry into a gift card lottery.

Data Analysis

At T1, 260 participants provided an obsessional thought, 253 provided a worried thought, and 245 provided a ruminative thought. Prior to analysis, thought content was examined by both the first author and an independent rater to ensure that each thought was categorized correctly based

on the definitions given to participants. Interrater reliability was good to excellent ($\kappa = 0.71$, 0.98, and 0.89 for obsessional, worried, and ruminative thoughts, respectively). Disagreements were discussed until consensus was reached, and thoughts that were a poor fit for the definitions were excluded from analyses. This yielded a final sample of 245 obsessional, 252 worried, and 237 ruminative thoughts.

Hierarchical multiple regression was used to test T1 appraisals as predictors of T2 outcomes. To provide a stringent test of whether T1 appraisals predicted change in the outcome over time, the T1 outcome was entered on the first step of each analysis as a covariate. All variables were normally distributed except thought frequency, which was positively skewed and was transformed to normality using an inverse transformation (Tabachnick & Fidell, 2007).

Additional, exploratory analyses were completed on T1 data to aid in the interpretation of results. T1 appraisals and outcomes were compared across the three thought types using repeated-measures ANOVA, with significant *F*-tests followed up with dependent samples *t*-tests. Effect sizes (*d*) were calculated for pairwise comparisons. T1 associations between appraisals and outcomes were tested using Pearson's *r*.

Results

Negative and positive appraisals were significantly correlated for each thought type ($r = 0.48$ for obsession, 0.27 for worry, 0.55 for rumination), at magnitudes similar to correlations between negative and positive beliefs as measured by the MCQ (e.g., Ryum et al., 2017). As the magnitude of the correlations suggested that negative and positive appraisals were nonredundant, they were examined in separate analyses. Means for negative and positive appraisals were approximately in the "moderate" range for all three thought types (see Table 1), although there was variability across individual appraisal items (see Tables S1 and S2 in the supplementary material). Overall, worry and rumination were associated with more negative appraisals than obsessions (both $t > 6.61$, $p < 0.001$). Positive appraisals were highest for worry, intermediate for rumination, and lowest for obsessions (all $t > 3.86$, $p < 0.001$).

T1 levels of each outcome explained 2–26% of the variance in T2 outcomes when entered first into the model and T1 negative and positive appraisals did not add significant predictive value above and beyond the T1 outcome in most analyses. The few exceptions related mainly to rumination, and to a lesser extent, worry. Negative appraisals of both worry and rumination at T1 predicted increases in the frequency of these thoughts 1 month later ($R^2 = 0.09$ and 0.16, respectively; see Table 2). Positive appraisals of rumination at T1 also predicted increases in the frequency of rumination ($R^2 = 0.10$) and in the severity of negative affect ($R^2 = 0.14$) at T2 (see Table 3).

Exploratory analyses examined concurrent associations between T1 appraisals and outcomes in order to aid in the interpretation of results from prospective tests. At T1, associations between negative appraisals and outcomes were nearly identical across thought types (see Table 4). Negative appraisals were associated with greater thought frequency, avoidance, negative affect, and functional impairment ($r = 0.16$–0.64, all $p < 0.027$). Negative appraisals were unrelated to positive affect for any thought type ($r = 0.06$–0.13, all $p < 0.084$).

A different pattern emerged for positive appraisals (see Table 4). Across all thought types, positive appraisals were associated with greater avoidance and negative affect, but also with greater positive affect ($r = 0.16$–0.62, all $p < 0.023$). Positive appraisals were not associated with thought frequency for any thought type ($r = 0.02$–0.12, all $p > 0.088$). Positive appraisals were also associated with higher functioning for worry only ($r = 0.17$, $p = 0.015$).

Table 1 Characteristics of obsessional, worried, and ruminative thoughts

Variable	Obsession ($N = 245$)	Cohen's *d*	Worry ($N = 252$)	Cohen's *d*	Rumination ($N = 237$)	Cohen's *d*
Appraisals						
Negative appraisals	4.43 (1.50)[a]	.50	5.12 (1.43)[b]	.07	5.22 (1.49)[b]	.52
Positive appraisals	3.88 (1.43)[a]	.75	4.94 (1.4)[b]	.30	4.51 (1.40)[c]	.22
Outcomes						
Frequency (per week)	2.59 (5.55)[a]	.25	4.35 (8.74)[b]	.16	3.02 (5.57)	.08
Avoidance	4.01 (1.41)[a]	.42	4.56 (1.36)[b]	.12	4.39 (1.54)[b]	.25
Negative affect	2.41 (0.86)[a]	.28	2.63 (0.77)[b]	.13	2.53 (0.79)	.13
Positive affect	1.99 (0.92)[a]	.13	2.10 (0.87)[a]	.35	1.80 (0.82)[b]	.23
Daily functioning	3.71 (1.18)[a]	.16	3.49 (1.04)[b]	.13	3.35 (1.01)[c]	.31

Tests for significant differences between thought types are exploratory. Within each row, *M* (*SD*) for thought types that do not share the same superscript differ at $p < .05$

Table 2 Linear regression analyses testing time 1 negative appraisals as predictors of time 2 outcomes, above and beyond time 1 outcomes

	Obsession		Worry		Rumination	
Outcome	β	ΔR^2	β	ΔR^2	β	ΔR^2
Thought frequency	.16	.03	.31**	.09	.40**	.16
Avoidance	−.06	.00	.10	.01	.06	.00
Negative affect	.06	.00	−.01	.00	.11	.01
Positive affect	−.04	.00	−.09	.01	−.20	.04
Daily functioning	−.12	.01	.03	.00	−.01	.00

$N = 87$ for obsessions, 86 for worry, and 81 for rumination. In each regression model, the T1 outcome was entered as a covariate on the first step and the T1 negative appraisal was entered on the second step as a predictor of the T2 outcome

*$p < .05$. **$p < .01$

Table 3 Linear regression analyses testing time 1 positive appraisals as predictors of time 2 outcomes, above and beyond time 1 outcomes

	Obsession		Worry		Rumination	
Outcome	β	ΔR^2	β	ΔR^2	β	ΔR^2
Thought frequency	.03	.00	.01	.00	.32**	.10
Avoidance	.02	.00	.01	.00	.14	.01
Negative affect	.11	.01	.09	.01	.40**	.14
Positive affect	.02	.00	.05	.00	−.12	.01
Daily functioning	−.01	.00	−.02	.00	.09	.01

$N = 87$ for obsessions, 86 for worry, and 81 for rumination. In each regression model, the T1 outcome was entered as a covariate on the first step and the T1 negative appraisal was entered on the second step as a predictor of the T2 outcome

*$p < .05$. **$p < .01$

Table 4 Time 1 associations (bivariate correlations) between appraisals and outcomes

	Thought frequency	Avoidance	NA	PA	Daily functioning
Negative appraisals					
Obsessions	.21**	.64**	.60**	.09	−.16*
Worry	.29**	.59**	.61**	−.06	−.33**
Rumination	.16*	.64**	.56**	.13	−.25**
Positive appraisals					
Obsessions	.10	.58**	.29**	.29**	.06
Worry	.02	.48**	.16*	.40**	.17*
Rumination	.12	.62**	.36**	.37**	.11

$N = 245$ for obsessions, 252 for worry, and 237 for rumination

Discussion

The current study examined obsessional, worried, and ruminative thoughts with a focus on the relationship of thought appraisals to self-reported outcomes at 1-month follow-up. Data did not support our hypothesis of an identical pattern of associations between appraisals and outcomes across the three types of PT examined. At 1-month follow-up, T1 negative appraisals of both worry and rumination predicted increases in the frequency of these thoughts. For rumination only, T1 positive appraisals also predicted increases in the frequency of rumination and in the severity of negative affect at T2. Unexpectedly, T1 negative and positive appraisals of obsessions did not predict any T2 outcomes. These results suggest different roles for negative and positive appraisals, as well as important differences across thought types.

To our knowledge, ours is the first study to test longitudinal associations between appraisals and outcomes across thought types. Given that negative appraisals have received more research attention for obsessions than for other thought types, it was surprising that negative appraisals did not predict increasing frequency of obsessions over time. Some features of our study design may help explain this result. First, it

is possible that, in an unselected sample, obsessional thoughts are milder and less distressing than worry or rumination, and consequently offer a weaker analogue for studying risk states. Consistent with this possibility, exploratory analyses showed that obsessions were the least frequent thoughts at both time points, and participants were less bothered by their obsessions (as measured by negative appraisals, affect, and functional impairment) than by their worry or rumination. Alternatively, it is possible that the particular appraisals assessed in the present study were less relevant to obsessions than to worry and rumination. For example, two prior longitudinal studies that found a relationship between negative appraisals and later OCD symptoms (Abramowitz et al., 2007; Coles & Horng, 2006) used OCD-specific measures emphasizing threat estimation, perfectionism, and thought-action fusion, in contrast to the domain-general measure of appraisals used in the present study. Those prior studies also used longer follow-up intervals (6 weeks and 8–12 weeks, respectively) than our 4-week interval. We had hypothesized that the pattern of associations between appraisals and outcomes would be identical across thought types because of similarities between cognitive-behavioral and metacognitive theories that have been well-supported in past research (e.g., Abramowitz et al., 2007). However, prior research comparing distinct forms of PT has consistently found that obsessions are structurally and phenomenologically distinct from worry and rumination (Ehring & Behar, 2020; Ehring & Watkins, 2008), which raises the possibility that the present findings reflect a true difference across these thought types in the role of appraisals, which should be investigated in future research.

A second, unexpected finding is that positive appraisals were predictive of negative T2 outcomes exclusively for rumination. We expected that positive appraisals would predict later negative outcomes for all thought types and perhaps especially for worry, which has been a primary focus of metacognitive theories (Wells, 1995). Instead, we found effects highly specific to rumination, replicating previous reports that positive appraisals of rumination predict increasing frequency of ruminative thoughts (Kubiak et al., 2014; Weber & Exner, 2013), and further showing that these appraisals predict increasing negative affect and higher (though not increasing) avoidance 1 month later. Why these associations were unique to rumination is unclear and warrants replication, especially given evidence that positive beliefs about worry predict avoidance over a longer (4-month) follow-up interval (Sica et al., 2007). This pattern does not appear to have resulted from psychometric deficits of positive appraisals of worries or obsessions, which were substantively very similar in reliability and range to positive appraisals of rumination. One possible explanation is that positive appraisals may have interacted with other factors at T1, such as positive affect, which was lower for rumination than for worries and obsessions.

R^2 across all prospective tests were relatively small, with appraisals explaining only 9–16% of variance in outcomes above and beyond T1 outcome. It is not surprising that T1 outcomes were a strong predictor of T2 outcomes, explaining up to 26% of the variance. This could, in part, explain why appraisals did not provide additional predictive power for many outcomes; in many cases there was little variance left over for appraisals to predict. The predictive relationships that remained significant—those in which appraisals predicted escalating thought frequency (for worry and rumination) and negative affect (for rumination)—are particularly robust. We are also encouraged by the similarity of R^2 values in the present study to others examining metacognitive beliefs in worry and OCD (e.g., Abramowitz et al., 2006, 2007; Sica et al., 2007).

To further aid in the interpretation of these unexpected findings, exploratory analyses tested T1 associations between negative and positive appraisals and outcomes. Results were consistent with past cross-sectional research (Kircanski et al., 2015; Wahl et al., 2019), providing further confidence in our measurement of appraisals and outcomes. Negative and positive appraisals each shared a unique pattern of associations with T1 outcomes, at moderate to large magnitude for many outcomes. Although prospective tests did not support generalizing models across thought types, exploratory analyses argue for further study of positive as well as negative experiences of PT across thought types to help clarify the role of positive appraisals.

Findings from the present study suggest several directions for future research. First, following the lead of other investigators (Iijima & Tanno, 2013; Kubiak et al., 2014), we chose a 1-month follow-up interval to allow time for change to occur while balancing concerns about participant retention. However, this interval may have been too short or too long to detect the theorized effects of appraisals on outcomes, or the optimal interval may differ by thought type. As the ideal follow-up period for assessing sequelae of each thought type remains unknown, future studies should use longer follow-up intervals with more frequent assessments, possibly using experience sampling methods. Second, although we extended prior work by studying negative and positive appraisals together, we did not consider the interplay between these processes. Future research should examine whether positive and negative appraisals interact, or whether appraisals interact with other situational or experiential factors—such as stressful events or affective experiences—to predict outcomes (cf. Abramowitz et al., 2007). Third, research should examine whether the present findings extend to thought types not included here, such as pre-or post-event processing associated with social anxiety, or intrusive trauma memories. This would help clarify the boundaries of negative and positive appraisals across different forms of PT.

Several limitations of this work should be considered. First, there was a significant attrition rate with only 36% of

the T1 sample completing the T2 assessment. Although it is encouraging that the T2 subsample remained large ($n = 96$) and did not differ from the full sample on some important indices including T1 negative or positive appraisals or outcomes, it is possible that those who returned for the T2 assessment differed in important (unassessed) ways from those who did not complete the follow-up. Of particular concern is the possibility that students with worsening symptoms may have been more likely to complete the T2 assessment.

Second, participants' reports about their thoughts at both time points were retrospective and subject to recall biases. In particular, the measure of daily functioning may be difficult to meaningfully link to a specific thought, given that participants may have experienced multiple thoughts in any given day. Accurate assessment of thought frequency is also challenging (Rosenkranz et al., 2020), although data suggests that participants are able to self-report with reasonable accuracy and reliability (Rosenkranz et al., 2020; Verkuil et al., 2007). The CIQ was selected, in part, because it has previously been used to assess thought frequency in studies of obsessions, worry, and rumination (e.g., Freeston et al., 1991; Watkins et al., 2005). We strove to minimize recall biases by focusing on the most recent thought of each type, but it would be valuable to replicate the findings using experience sampling methodology that captures appraisals and outcomes closer in time to their occurrence (Rosenkranz et al., 2020).

Third, assessing multiple thought types within-subjects enabled a direct comparison that offered a particularly powerful test of the transdiagnostic hypothesis. However, this design increased participant burden and required parallel hypothesis tests for multiple thought types, increasing the risk of Type 1 error. Further confidence will require replication in new samples. In addition, all participants completed the survey in the same order. Data from similar past research (Gentes & Ruscio, 2015) has not found evidence of order effects, however, future studies should use designs that minimize carryover effects or use a between-subjects design in which each participant contributes only one thought.

Finally, the current study used a nonclinical sample of college students to investigate appraisals of PT. This was a deliberate (as well as a convenient) choice; given that theories begin with thoughts that are normal and common in healthy populations, investigating the pathway from normal thoughts to those that are persistent or impairing requires samples that do not (yet) struggle with their thoughts at a clinically significant level. This also allowed us to enroll a large, diverse sample that was well-powered for the present analyses. Nevertheless, unselected students at a private university differ in a number of ways from general-population and treatment-seeking samples, and those differences may translate into differences in cognitive experiences such as appraisals. There is a need to replicate this work in other samples, especially samples enriched for high levels of maladaptive thoughts, to test whether appraisals prospectively predict which vulnerable individuals will go on to develop mood or anxiety symptoms over time.

Despite these limitations, the present findings contribute to our understanding of how thought appraisals might be involved in the persistence of different forms of PT. The longitudinal study design, along with the focus on appraisals of specific thoughts, is a strength of the present study. These results hint at important similarities and differences across distinct thought types, and support further research on negative and positive thought appraisals across different forms of PT.

Appendix

Thought Definitions

(Obsession): A thought you didn't really want to have that popped into your head unexpectedly, and may be socially unacceptable or contrary to how you try to live your life. Some examples of thoughts of this type include:

1. Driving a car off the road or swerving into traffic
2. Insulting strangers or family
3. That you might have left the stove on
4. That you might have left your home unlocked
5. Sex in public or with an unacceptable person
6. Catching an STD or other disease or illness

(Worry): A thought about a potential negative future event or catastrophe. Some examples of thoughts of this type include:

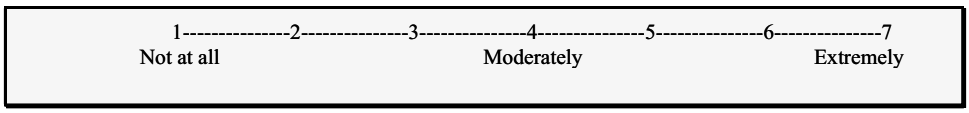
1. That I may never achieve my goals or ambitions
2. That I may not keep up with my work
3. That I may not be able to afford things or pay my bills
4. That I may lose close friends or relationships

(Rumination): A thought about a negative mood or feeling that you are experiencing OR about a past problem or failure. Some examples of thoughts of this type include:

1. That I feel so down
2. That I don't have any energy
3. That I did poorly on an exam
4. That I think I hurt someone's feelings yesterday

Daily Functioning Scale.

This scale consists of a number of words that describe different feelings and activities. Please read each item and indicate to what extent you experienced each feeling or engaged in each activity *on the day you had this thought*.



1. Felt sociable
2. Interacted with other people
3. Felt productive
4. Made progress in work or other activities
5. Felt interested in coursework or other activities
6. Attended to coursework or other activities
7. Felt distracted
8. Avoided work or other activities
9. Procrastinated getting started on your work or other activities
10. Felt energetic or lively
11. Engaged in physical activity
12. Felt well rested
13. Slept well
14. Felt relaxed
15. Engaged in leisure activities

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Declarations

Conflict of Interest The authors declare that they do not have any conflict of interest.

Ethical Approval The measures and methods for this study were approved by the University's Institutional Review Board (IRB).

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