Dissociable Associations of Facets of Mindfulness with Worry, Rumination, and Transdiagnostic
Perseverative Thought

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Acknowledgments

LSH's efforts were supported in part by a grant from the National Institute of Mental Health (K01MH116328). The authors would like to thank Susan Kusmierski for her assistance with data collection.

Abstract

Objectives: Perseverative thought, an umbrella term encapsulating thoughts that are repetitive and difficult-to-control (e.g., worry; rumination), is a major feature and mechanism of anxiety and depression. Mindfulness-based interventions show promise for reducing perseverative thought and improving present-moment focus, but efforts to tailor or optimize these interventions remain rare. Given the multifaceted nature of mindfulness, a nuanced understanding of how each facet (awareness; nonjudgment; nonreactivity; describing) incrementally relates to different facets of perseverative thought may help to inform and expedite treatment development.

Methods: We tested hypothesized associations between dissociable facets of mindfulness and perseverative thought in three well-powered, independent samples ($N = 289$ undergraduate students; $N = 286$ crowdsourced participants; $N = 277$ community participants with elevated anxiety or depression).

Results: Consistent with predictions, and across all three samples, greater present-moment awareness, nonjudgment, and nonreactivity were all uniquely (incrementally) and inversely related to transdiagnostic perseverative thought. Nonreactivity was inversely and incrementally related to trait worry, beyond variance shared with transdiagnostic perseverative thought, rumination, and other mindfulness facets. Nonjudgment was similarly uniquely related to rumination. Unexpectedly, present-moment awareness predicted higher trait worry when other facets were controlled. Findings were robust to sensitivity analyses controlling for general distress.

Conclusions: The present study establishes and replicates in three independent samples a broad inverse association between present-moment awareness and transdiagnostic perseverative thought, and specific associations between nonreactivity with trait worry, and nonjudgment with

trait rumination. Experimental research is needed to test hypothesized causal pathways to inform theory and development of transdiagnostic and personalized treatments.

Keywords: *worry; rumination; mindfulness; perseverative thought; repetitive thought*

Perseverative thought is an umbrella term for a style of thinking that is repetitive, typically unconstructive, and largely involuntary -- ranging from spontaneous but accepted to actively resisted. Various forms of perseverative thought, such as worry and rumination, have been identified as major features and mechanisms of anxiety, depression, and related forms of psychopathology (e.g., American Psychiatric Association, 2013; Nolen-Hoeksema et al., 2008). An important feature of perseverative or repetitive thought that may help to account for its mechanistic role in psychopathology is its tendency to capture mental capacity (Ehring et al., 2011). Preoccupying thoughts consume attentional resources, which shifts attention away from the present moment and results in an experience that is colloquially known as being “stuck in one’s head”. This “stuckness” can be a significant clinical problem, especially when it interferes with attention and concentration (Armstrong et al., 2011; Beckwé et al., 2014), as these subjective impairments are in turn associated with increased distress and functional impairment (Hallion et al., 2018). Perhaps as a result, interventions that emphasize present-moment attention, such as mindfulness-based interventions, have generated considerable enthusiasm as a potential intervention strategy for reducing perseverative thought and its associated symptoms (e.g., Gu et al., 2015).

Mindfulness, a nearly 3,000-year-old construct that developed primarily in the context of Buddhist scholarship, has garnered increasing scientific interest for its potential role in treatment of a range of psychological and physiological problems (e.g., Creswell, 2017; Van Dam et al., 2018). Mindfulness has been defined as the intentional, nonjudgmental (i.e., accepting) awareness of present-moment experience (Baer et al., 2006; Creswell, 2017). Because mindfulness requires an individual to engage with the present moment by definition, it is arguably incompatible with — or even antithetical to — dwelling on one’s thoughts. Consistent

with this proposition, a growing body of research suggests an inverse association between trait (i.e., habitual) perseverative thought and trait mindfulness (Baer et al., 2006; Brown & Ryan, 2003; Evans & Segerstrom, 2011; Raes & Williams, 2010). Additionally, there is some compelling, albeit preliminary, evidence that mindfulness-based treatments may be efficacious for a range of perseveration-related problems (e.g., Creswell, 2017; Gu et al., 2015; Hofmann et al., 2010; Webb et al., 2019), and that reductions in perseverative thought may be a major mechanism by which mindfulness-based treatments exert their effects (van der Velden et al., 2015).

Despite these promising results, mindfulness-based treatments vary widely in form and content (see e.g., Van Dam et al., 2018), and there is still considerable room for improvement in both study design and treatment outcomes (Creswell, 2017; Van Dam et al., 2018; van der Velden et al., 2015). One of the relatively few dismantling studies in this area found that training both awareness and acceptance of present-moment experience was more effective for reducing cortisol and systolic blood pressure reactivity in stressed adults compared to training awareness alone (Lindsay et al., 2018). This finding suggests that a clearer understanding of how each of the various facets of mindfulness relate to psychopathology may help to inform treatment development, both with respect to transdiagnostic treatment targets, and in terms of tailored treatments -- for example, matching exercises targeting different facets of mindfulness to different clinical presentations.

It is now generally accepted that perseverative thought can be conceptualized in several ways. These include traditional categorical conceptualizations, which at a minimum include worry, which is described as future-focused and is often associated with anxious distress (Borkovec et al., 2004) and rumination, which can be past- or present-focused and which

typically involves negative self-appraisal, especially in the case of depressive rumination (also known as brooding; Nolen-Hoeksema, 1991; Nolen-Hoeksema et al., 2008). More recently, latent variable modeling studies have found support for a perseveration or cognitive dyscontrol dimension, which reflects a general tendency to experience thoughts that are repetitive, uncontrollable, or intrusive, irrespective of the content of those thoughts (e.g., Ehring et al., 2011; Harvey et al., 2004), with some studies also identifying other potential dimensions, such as valence (Hallion et al., 2021). Hybrid models have also been developed, offering evidence of shared general perseverative qualities, as well as unique features specific to different manifestations of perseverative thought (e.g., Hallion et al., 2021; McEvoy et al., 2010). This latter framework is arguably the most widely-accepted currently within the perseverative thought community and has received fair empirical support (e.g., Topper et al., 2014).

Similar to the multifaceted nature of perseverative thought, there is also strong support for a multifaceted conceptualization of mindfulness (e.g., Baer et al., 2006). One prominent theoretical model of mindfulness, and its corresponding self-report measure (the Five Facet Mindfulness Questionnaire; FFMQ; Baer et al., 2006) describes five dissociable facets that collectively comprise the construct of mindfulness: (1) the tendency to experience thoughts and feelings without judging or evaluating them as good or bad (Nonjudgment); (2) letting thoughts and feelings enter, pass through, and leave one's mind without the need to engage with or react to them (Nonreactivity); (3) paying full attention to the present moment, reflected in the ability to avoid behaving automatically or absent-mindedly (Acting with Awareness); (4) taking note of or assigning words to label the thoughts and feelings one experiences (Describing); and (5) being consciously aware of internal and external stimuli including thoughts, feelings, bodily sensations, and sensory input (Observe). One minor caveat to this model is that the Observe facet fails to

show measurement invariance across meditating and non-meditating samples, with poor factor structure and construct validity in non-meditators (Aguado et al., 2015; de Bruin et al., 2012; Curtiss & Klemanski, 2014; Gu et al., 2016). In non-meditators, the Observe facet appeared to tap maladaptive self-focus associated with lower overall mindfulness and greater distress (Baer et al., 2008; Aguado et al., 2015).

There are some compelling theoretical reasons to propose that different facets of mindfulness might relate differentially to both shared and unique features of perseverative thought. For example, self-criticism has been identified as a central feature of rumination (Bernstein, Heeren, & McNally, 2017). Nonjudgment, which involves adopting a value-neutral or non-evaluative attitude toward one's thoughts and feelings, is directly at odds with self-criticism, and therefore might be reasonably expected to show an inverse association with especially self-critical or negatively self-referential forms of rumination, such as brooding (Desrosiers, Klemanski, & Nolen-Hoeksema, 2013; Treynor et al., 2003). Nonreactivity, on the other hand, is the ability to tolerate potentially distressing thoughts and emotions without feeling compelled to react to them (e.g., by trying to avoid or change them). According to prominent theoretical models of worry, worry functions primarily as a maladaptive strategy for controlling one's emotional experiences; for example, to avoid distressing mental imagery (Borkovec, Alcaine, & Behar, 2004), positive emotional stimuli (Lewis et al., 2019), or a negative emotional contrast (Newman & Llera, 2011). If these models are correct, they would most likely predict a specific inverse association between nonreactivity and trait worry. Finally, in contrast to these specific hypothesized associations, the ability to act with awareness; that is, to fully attend to one's current actions and experiences without getting "caught up in [one's] thoughts," appears to

be at odds with perseverative thought more generally, but it does not suggest a theoretical link to any one form of perseverative thought specifically beyond their shared features.

To date, most research into the association between mindfulness and perseverative thought has relied on global measures of one or both constructs. These studies have reliably found inverse associations between total scores on measures of mindfulness and perseverative thought. For example, one recent study found that trait mindfulness was negatively and moderately related to trait rumination and worry in an unselected adult sample (Parmentier et al., 2019). However, that study did not attempt to establish whether mindfulness was related to worry or rumination specifically beyond their shared variance or qualities. As such, the precise nature of those associations is unknown. A study in undergraduate students was among the first to administer a measure of general perseverative tendencies alongside traditional measures of worry and rumination (Gustavson et al., 2018). Using commonality analysis, that study found an incremental association between transdiagnostic perseverative tendencies and a global measure of mindfulness, beyond variance explained by the association between mindfulness and worry or rumination specifically. However, that study did not distinguish between facets of mindfulness, which limits the extent to which the findings can inform theory or treatment development for transdiagnostic versus specific manifestations of perseverative thought.

A few studies have begun to parse the facets of mindfulness by considering the extent to which each facet accounts for incremental variance in traditional measures of either worry or rumination. These studies have tended to find that nonreactivity, nonjudgment, and acting with awareness inversely and incrementally relate to trait worry (Curtiss & Klemanski, 2014; Fisak & von Lehe, 2012), with some studies suggesting stronger associations for nonjudgment and nonreactivity specifically (Brown et al., 2015). Similar findings have been found for rumination,

which has been linked to lower levels of nonjudgment and acting with awareness (Kearns et al., 2016; Petrocchi & Ottaviani, 2016). Another study that administered measures of mindfulness (excluding the Observe facet), worry, and rumination to a large sample of Dutch undergraduates (de Bruin et al., 2012) found small-to-moderate, inverse zero-order associations between each facet with worry and rumination, with somewhat larger values for nonjudgment with worry and rumination, and nonreactivity with worry specifically. However, because these studies did not probe conceptual or methodological overlap between worry and rumination, it is not clear whether previous findings are specific to worry and rumination per se, or whether some or all of these associations might be better explained by shared features of worry and rumination (i.e., transdiagnostic perseverative thought) or shared method variance (i.e., self-report).

While previous studies have considered associations between mindfulness facets and worry or rumination in isolation, no studies to our knowledge have examined the relations between mindfulness and perseverative thought from a multifaceted perspective, with the goal of identifying transdiagnostic (shared) versus specific (unique) relations. There is also a shortage of research investigating these associations in non-undergraduate samples, as well as a lack of research demonstrating replicability across independent samples. Clarifying these associations, including demonstrating replicability of findings across independent samples, is important to provide a strong foundation for the development and refinement of broadly-applicable, transdiagnostic mindfulness-based interventions for general perseverative thought, as well as more targeted or focused interventions tailored to specific presenting concerns.

The present study investigated these questions in three well-powered, independent samples: an undergraduate student sample; an online crowdsourced sample of adults; and a community sample of adults selected for elevated symptoms of anxiety and/or depression. In line

with theoretical perspectives and extending previous empirical work, we predicted that: (1) acting with awareness would be uniquely (incrementally) related to transdiagnostic perseverative thought beyond variance explained by the other facets, but would not differentially relate to worry versus rumination (brooding); (2) nonreactivity would be uniquely associated with worry after controlling for variance shared with transdiagnostic perseverative thought, brooding, and the other mindfulness facets; and (3) nonjudgment would be uniquely related to brooding after controlling for variance shared with transdiagnostic PT, worry, and the other mindfulness facets. We did not have specific hypotheses about the describing facet.

Methods

Participants

Sample 1. Participants were 289 undergraduate students ages 18 – 29 (M age = 18.96, SD = 1.48) who participated in either of two larger experimental studies on the effects of worry on cognition. Participants earned course credit for participation. Participants were 54% female, 45% male, and one participant identified as gender non-binary. The racial/ethnic distribution was 82% White, 7% Black or African-American, 4% Asian, 7% multiracial or other race, and 5% identified as Hispanic or Latinx.

Sample 2. Participants were 286 adults ages 18 – 74 (M age = 37.50, SD = 11.0; 52% cisgender women, 47% men, 0.4% transgender women; 84% White; 13% Black or African American; 5% Asian; 2% other; 10% Hispanic or Latino/a/x) recruited via Amazon Mechanical Turk (mTurk) as part of a larger study on perseverative thought (see Hallion et al., 2021 for additional study details). Participants were recruited in March and April 2018, which precedes a possible quality decline beginning in Summer 2018 (Chmielewski & Kucker, 2019). The validity

and utility of mTurk as a platform for accessing and assessing clinical and subclinical populations has been supported in several studies (e.g., Shapiro, Chandler, & Mueller, 2013). Participants were required to reside in the United States, have a minimum previous task approval rating of 99%, and were excluded if they failed one or more of 17 attention checks. As part of the larger study, participants also rated three thoughts that had “been on [their] mind a lot,” on variety of characteristics, including perseveration-related items (repetitiveness; uncontrollability; intrusiveness; data not analyzed for the present study) and were excluded if they failed to endorse at least one perseveration-related item at a severity greater than zero (range: 0 – 4) for at least one thought. Please see the Supplemental Materials or the manuscript for the larger study (Hallion et al., 2021) for additional detail. Participants signed an electronic waiver of consent and were paid \$7 after completing the questionnaires, which took around 55 minutes.

Sample 3. Participants were 277 adults ages 18 – 74 (M age = 32.59 years, SD = 12.53) with elevated symptoms of anxiety and/or depression (within 1 SD of the clinical M of the Depression Anxiety and Stress Scales – 21 item version [DASS-21] as reported in Antony et al., 1998). Participants were recruited via a National Institute of Health-funded Honest Broker participant registry and via professional listservs, Internet message boards, and clinician referrals as part of the larger study described above (see Sample 2). Identical to Sample 2, eligible participants endorsed at least one perseveration-related thought characteristic (uncontrollability; intrusiveness; repetitiveness) at a severity ≥ 1 for at least one of three self-nominated thoughts. Participants were 76% cisgender women, 21% cisgender men, and 3% other gender; 85% White, 5% Black or African-American, 4% Asian, 4% multiracial, and 5% identified as Latinx.

Procedures

Sample 1 was recruited as part of a laboratory-based experimental study investigating the impact of worry on cognition (see Hallion et al., 2020). Participants completed a computer task with debriefing, followed by a series of validated self-report measures via Qualtrics. Samples 2 and 3 were recruited online as part of a larger study investigating the latent structure of perseverative thought (see Hallion et al., 2021). Participants completed a series of validated self-report measures in a pseudorandomized order via Qualtrics.

Measures

Perseverative Thought. The Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011) is a 15-Likert item self-report questionnaire that measures the extent to which an individual typically experiences uncontrollable, repetitive, attention-consuming thoughts (e.g., “I get stuck on certain issues and can’t move on”). This scale yields high internal consistency and high retest reliability across clinical and non-clinical samples (Ehring et al., 2011). Please see Table 1 for internal consistency (Cronbach’s α) and descriptive statistics for all measures.

Trait Worry. The Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990) is a 16-item measure of uncontrollable habitual worry (e.g., “I am always worrying about something”). Validation studies suggest that the PSWQ has strong test-retest reliability and convergent and discriminant validity across samples, including anxious adults, unselected college student samples, and adults recruited via the internet (Evans & Segerstrom, 2011). The measure also displays good test-retest reliability over 10 weeks (Evans & Segerstrom, 2011).

Brooding. The Ruminative Response Questionnaire-10 item version (RRS-10; Treynor et al., 2003) is a self-report questionnaire that assesses ruminative styles of responding to negative mood. The RRS-10 was derived from the original, 22-item RRS (Nolen-Hoeksema, 1991) via

factor analysis, to remove potentially confounding items that relate directly to depression symptoms, and is comparable to the 22-item RRS in terms of reliability and convergent and predictive validity vis-à-vis depression symptoms (Treynor et al., 2003). The Brooding subscale of the RRS-10 is comprised of 5 Likert items and assesses the tendency to dwell passively and self-critically on one's symptoms or personal shortcomings (e.g., *"think about all your shortcomings, failings, faults, mistakes,"* [Treynor et al., 2003]). The five-item Reflection subscale was not included in study conceptualization or analyses because it has been proposed to reflect a different, less maladaptive form of rumination (Treynor et al., 2003).

Trait Mindfulness--Sample 1. The Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) was initially developed via a factor analytic study of five independently developed mindfulness questionnaires. A five-factor structure was derived, which has since been replicated across a range of samples (Baer, 2018). The five facets represent one major way in which trait mindfulness is currently conceptualized, and include: Acting with Awareness (e.g., *"I find myself doing things without paying attention,"* reverse-scored); Nonreactivity (e.g., *"When I have distressing thoughts or images I am able just to notice them without reacting"*); Nonjudgment (e.g., *"I believe that some of my thoughts are abnormal or bad and I shouldn't think that way,"* reverse-scored); Describing (e.g., *"I'm good at finding words to describe my feelings"*); and Observe (e.g., *"When I take a shower or a bath, I stay alert to the sensations of the water on my body"*). Consistent with recommendations based on research demonstrating poor psychometric properties for the Observe subscale in non-meditating and mixed meditating and non-meditating samples (e.g., Aguado et al., 2015; Baer, 2018; Baer et al., 2006, 2008; Curtiss & Klemanski, 2014; Gu et al., 2016), the Observe facet was excluded from study conceptualization and analyses. The FFMQ (excluding the Observe facet) shows good convergent and discriminant

validity, internal consistency, and incremental validity in predicting psychological symptoms across clinical (e.g., adults with mood and anxiety symptoms) and non-clinical samples (Baer et al., 2006, 2008; Bohlmeijer et al., 2011).

Trait Mindfulness-- Samples 2 and 3. The Five Facet Mindfulness Questionnaire-15 item version (FFMQ-15; Baer et al., 2012) is an abbreviated form of 39-item FFMQ (Baer et al., 2006) administered in Study 1. Psychometric studies suggest that the FFMQ-15 is comparable to the FFMQ-39 in terms of convergent validity, factor structure in meditating and non-meditating samples, sensitivity to treatment effects, and relations to perseverative thought specifically (Baer et al., 2012; Gu et al., 2016).

Psychological Distress – Samples 2 and 3. The Depression, Anxiety, and Stress Scales – 21 item version (DASS-21; Henry & Crawford, 2005) is a self-report measure with three subscales pertaining to depression, fear, and chronic anxiety or stress. The total score of the DASS-21 has been validated as a nonspecific measure of internalizing-related psychological distress.

Analytic Plan

Pearson correlations were conducted to examine zero-order relations between each facet of mindfulness, transdiagnostic PT, worry, and brooding. To assess the incremental contributions of each facet of mindfulness to transdiagnostic PT, we conducted a hierarchical linear regression with transdiagnostic perseverative thought (PTQ) included as the dependent variable and the four of-interest mindfulness facets (Awareness; Nonjudgment; Nonreactivity; Describing) entered simultaneously on Step 1 as predictors. Because transdiagnostic perseverative tendencies are subsumed under the worry and brooding constructs, we did not control for worry or rumination

in this model. Awareness was hypothesized to be an incremental predictor of transdiagnostic PT. Although we expected to see generally inverse relations based on previous research and theory between the other facets and PT, incremental relations of Nonjudgment, Nonreactivity, and Describing to transdiagnostic perseverative thought were considered exploratory, particularly for the first sample. Analyses were treated as confirmatory for the replication samples; however, we did not generate new theoretical predictions to account for these relations.

To test the hypothesis that Nonreactivity would relate specifically to worry (i.e., beyond its relationship to general perseverative tendencies and ruminative tendencies specifically) we conducted a hierarchical linear regression with trait worry as the dependent variable, transdiagnostic perseverative thought and brooding entered on Step 1, and the four mindfulness facets entered on Step 2. To test the hypothesis that Nonjudgment would relate specifically to rumination (brooding), we repeated the hierarchical regression, this time with transdiagnostic perseverative thought and trait worry entered on Step 1, and the four facets of mindfulness entered on Step 2.

To further probe the robustness of the findings and examine internalizing symptoms (anxiety and depression) as a potential third variable confound, given their well-established association with both perseverative thought and mindfulness, we conducted sensitivity analyses in Samples 2 and 3 in which the DASS-21 total score was entered as a covariate on the first step. The findings were essentially unchanged, so these analyses are presented in the Supplemental Materials and are not described further in the main text.

All data are available at the Open Science Framework (<https://osf.io/p63kj/>).

Results

Preliminary analyses

Missing data represented 2 – 3% of values for Samples 1 and 2 and 11% of values for Sample 3. Order of administration of questionnaires was pseudorandomized for Samples 2 and 3. Little's MCAR test was nonsignificant for all samples (all $p > .20$), consistent with a pattern of data missing at random. Missing data were therefore handled using pairwise deletion.

Correlational analyses

Pearson correlations revealed significant and generally moderate zero-order associations between the facets of mindfulness and trait perseverative thought measures across the samples (see Table 2). Relations tended to be fairly stable across the samples, with some measures showing somewhat attenuated correlations in Sample 3.

Relationship of mindfulness facets to transdiagnostic PT

In linear regression analyses predicting transdiagnostic perseverative thought, the expected inverse incremental relationship emerged for Awareness across all three samples (i.e., greater Awareness was related to lower transdiagnostic perseverative thought; see Table 3). Similar inverse incremental relations also emerged for Nonjudgment and Nonreactivity across samples. Describe did not contribute incremental variance to explaining transdiagnostic perseverative thought beyond variance explained by the other facets in any sample.

Incremental relationship of mindfulness facets to worry and rumination

As predicted, Nonreactivity emerged as a significant incremental predictor of trait worry across all three samples, beyond variance shared with transdiagnostic PT, brooding, and the other facets of mindfulness. The relationship was negative, such that being less reactive to internal experiences was associated with lower trait worry. Unexpectedly, Awareness showed a positive

(albeit small) incremental relationship to trait worry across samples, such that greater present-moment awareness was modestly associated with higher (more severe) trait worry. All variance inflation factors (VIF) were under 2, suggesting that multicollinearity was not a problem and therefore unlikely to account for this finding. The other mindfulness facets (Describe and Nonjudgment) did not incrementally relate to trait worry.

For the analyses predicting brooding, the expected incremental relationship with Nonjudgment emerged across all three samples: a stronger tendency to take a negative evaluative stance toward internal experiences was associated with more severe brooding (i.e., after controlling for variance shared with transdiagnostic PT, trait worry, and the other facets of mindfulness). All other facets were nonsignificant predictors across analyses.

The pattern of results was identical in sensitivity analyses controlling for general distress (DASS-21).

Discussion

The present study tested and replicated three hypothesized relations between dissociable facets of mindfulness and those of PT, namely worry, rumination (brooding), and general (transdiagnostic) perseverative tendencies. Across three large, independent samples, several robust patterns emerged. As predicted, present-moment awareness of one's actions (Acting with Awareness) was negatively and incrementally associated with a general tendency to perseverate in all three samples, beyond the variance explained by the other mindfulness facets. The tendency to maintain a nonjudgmental attitude toward thoughts and experiences (Nonjudgment) and the ability to notice internal experiences without reacting to them (Nonreactivity) each also accounted for incremental variance in transdiagnostic perseverative thought for each sample. Also as predicted, nonjudgment of internal experiences was specifically and inversely related to

trait brooding, such that a stronger tendency to negatively evaluate internal experiences was related to more brooding in daily life. This relationship was significant both in zero-order correlations and in regression analyses controlling for variance shared with transdiagnostic PT, trait worry, and other facets of mindfulness. Nonreactivity to internal experiences showed the hypothesized specific inverse relationship with trait worry, such that greater nonreactivity was associated with lower trait worry. This relationship was again significant both in zero-order correlation analyses and after accounting for variance explained by transdiagnostic PT, brooding, and other facets of mindfulness.

Of note, the pattern of results remained unchanged in sensitivity analyses controlling for internalizing-related psychological distress. This robustness suggests that the observed associations between perseverative thought and mindfulness are unlikely to be accounted for by their shared associations with anxiety and depression. Taken together, the emergence of nonreactivity, nonjudgment, and awareness as incrementally related to transdiagnostic perseverative thought beyond variance shared with other mindfulness facets and with internalizing-related distress is broadly consistent with a framework in which distinct attitudes or orientations towards thoughts matter theoretically (e.g., for understanding the general tendency to be “stuck in one’s head”) and clinically (e.g., for optimizing interventions to target this transdiagnostic process).

By contrast, one unexpected finding was that awareness was positively incrementally related to trait worry after the other facets were controlled, albeit with a small effect size (standardized betas $\leq .11$). In other words, while increased awareness of one’s actions was incrementally associated with a lower tendency toward perseverative thought overall, it was associated with somewhat higher trait worry after other mindfulness facets, general perseverative

tendencies, and brooding were controlled. Although preliminary, these findings suggest that awareness may not be helpful in its own right, if that awareness occurs in the absence of a nonjudgmental and nonreactive stance. This interpretation is broadly consistent with previous work dismantling the contributions of awareness and acceptance training to reducing stress reactivity (Lindsay et al., 2018). Within a causal framework, one might also consider that unique features of worry (e.g., future-orientation; an emotional avoidance function) or high worriers (e.g., disproportionately elevated anxiety) might even enhance present-moment attention (e.g., facilitating detection of threats). This interpretation is especially plausible given that the Awareness facet taps self-focused attention, which has a robust association with various forms of psychopathology (e.g., Ingram, 1990). The present findings are correlational, and as such, causal relations cannot be inferred. Nevertheless, if these relations were substantiated in an experimental context, it would suggest that increasing self-awareness in the absence of adequate training in other facets of mindfulness (e.g., nonreactivity) would be unlikely to have a beneficial effect on worry, and could potentially be harmful.

Although findings were consistent in general across samples, there were some minor differences in the patterns of results across the samples that are worth noting. First, the zero-order correlations between the mindfulness facets and perseverative thought measures were somewhat weaker overall in the elevated symptom sample relative to the undergraduate and crowdsourced samples. This result may be due in part or in whole to the somewhat compressed distributions of the perseverative thought measures in the elevated symptom samples relative to the other samples. As noted above, participants in the crowdsourced and elevated symptom samples were required to endorse at least subthreshold (i.e., non-zero) repetitiveness, uncontrollability, or intrusiveness of at least one recent thought as part of the larger study from

which they were recruited in order to be included in those studies (see Supplemental Materials). Although that selection criterion increases the clinical relevance and utility of the findings, it may also have contributed to a more compressed distribution of perseverative thought characteristics in those samples. In either case, the overwhelming tendency was for relations to be maintained across all three samples, suggesting that inverse relations between most facets of perseverative thought and mindfulness are observed across the full range of perseverative thought severity.

Limitations and Future Research

The present findings should be interpreted in light of several strengths and limitations. A major strength of the present work the emphasis on replication across three well-powered, independent samples differing in potentially relevant demographic variables (e.g., age; educational status) and clinical characteristics (e.g., perseverative thought severity). Two samples also had modest representation of non-cisgender participants, which has been relatively rare in previous research. At the same time, a limitation of the studies is the relative homogeneity of the samples in terms of racial/ethnic diversity. Another potential limitation is that participants in the elevated symptom sample were not formally diagnosed or required to be treatment-seeking. Detailed information about treatment history was not available, so it remains possible that some participants previously completed a course of mindfulness-based therapy, which could be expected to increase mindfulness and decrease perseveration. However, the high incidence and severity of self-reported anxiety and depression in that sample, and the absence of a clear theoretical or clinical rationale for predicting that these relations would manifest differently as a function of diagnostic or treatment-seeking status, increases confidence in the applicability of the results to clinical populations.

Another limitation is that the cross-sectional nature of the study design precludes us from drawing causal inferences about the nature of these relations. However, the present findings may nevertheless have theoretical implications for understanding clinically significant worry and rumination independent of questions of causality, and they suggest clear directions for experimental work aimed at establishing causality and intervention potential. In any scenario, replication of the present findings in a mindfulness-naïve treatment-seeking sample would be valuable, as would experimental work examining the extent to which facets can be dissociated and manipulated (e.g., via targeted exercises) for the purposes of developing interventions.

A final limitation is the use of a single validated self-report measure for each primary construct of interest. While it remains a strength that the present findings replicated across samples, future research should consider the extent to which the findings replicate across measurement approaches. Future studies would also benefit from incorporating additional methodologies to assess mindfulness (e.g., behavioral tasks; neural or psychophysiological indices) to mitigate some of the limitations of introspection associated with reliance on self-report measures (e.g., Van Dam et al., 2018). Alternatively, or additionally, future studies could consider a latent variable modeling approach that extracts shared variance from multiple validated measures of each construct of interest. Taken together, although areas for improvement remain, the present study is nevertheless larger, more representative, and more demonstrably replicable compared to much of the previous work in this area (e.g., Barnes & Lynn, 2010; Cash & Whittingham, 2010; de Bruin et al., 2012).

Future studies should also consider the extent to which the present findings generalize across different theoretical models — and measures — of mindfulness (e.g., Van Dam et al., 2018). Although the Five Facet Model and its corresponding measures are prominent and

widely-used within the basic mindfulness literature (Baer et al., 2006; Van Dam et al., 2018), other models and measures also warrant consideration. For example, another popular conception of mindfulness argues for a two-facet model, consisting of present-moment awareness and acceptance (i.e., without distinguishing between nonjudgment and nonreactivity; Lindsay & Creswell, 2017; Van Dam et al., 2018). Extending the present findings to that model, one might predict that present-moment awareness and acceptance would each relate to general perseverative tendencies, while acceptance specifically might incrementally relate to trait worry and brooding equally. To the extent that these models are used to inform the development of interventions, it will be important to consider the extent to which the present findings are informative within those theoretical contexts.

Taken together, the present findings provide robust evidence for shared and unique relations between perseverative thought (transdiagnostic; worry; rumination) and the various facets of mindfulness across three well-powered, independent samples. Whereas present-moment awareness, nonjudgment, and nonreactivity to present-moment experiences each showed a negative incremental relationship to general perseverative tendencies (transdiagnostic perseverative thought), specific associations emerged between trait worry and nonreactivity on the one hand, and brooding and nonjudgment on the other. Preliminary evidence for a positive incremental relationship between present-moment awareness and trait worry also emerged, suggesting that increased awareness in the absence of nonreactivity is associated with greater, rather than lesser, worry severity. High worriers in particular may perceive themselves as being more conscientious during tasks due to their level of worry about them, which is at odds many items on the Awareness subscale (e.g., “I rush through activities without being really attentive to them”).

Despite the robustness of the present findings, additional and methodologically varied research is needed to evaluate the potential implications of the present findings for theory and treatment development. It would be valuable, for example, for experimental research to assess the effects of independently manipulating various facets of mindfulness via training exercises. For example, would exercises designed to increase present-moment awareness result in a momentary decrease in perseverative thought? Perhaps more ambitiously, might exercises promoting nonreactivity and nonjudgment, respectively, differentially impact momentary experiences of worry and rumination? Pending results from such studies, treatment development efforts might be focused toward developing transdiagnostic and modularized interventions, with core modules that emphasize long-term enhancement of present-moment awareness, nonreactivity, and nonjudgment; and optional supplemental modules based on specific presenting symptoms, such as exercises to enhance nonjudgment when the presenting concern is rumination specifically.

Conflict of Interest and Ethics Statement

The authors have no conflicts of interest to declare. The present study was approved by the University of Pittsburgh Institutional Review Board and has been conducted in keeping with the ethical standards of the 1964 Declaration of Helsinki and its subsequent amendments.

Author Contributions

JST assisted with study conceptualization and data analysis, and was primarily responsible for drafting and revising the manuscript. NJO assisted with study conceptualization and drafting the manuscript. LSH was primarily responsible for study conceptualization and data analysis, and assisted with drafting and revising the manuscript.

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Table 1

Clinical Characteristics

	Sample 1 Undergraduate Student <i>N</i> = 286 – 289			Sample 2 Crowdsourced <i>N</i> = 276 – 280			Sample 3 Anxious/Dysphoric <i>N</i> = 227 – 232		
	<i>M</i> (<i>SD</i>)	Range	α	<i>M</i> (<i>SD</i>)	Range	α	<i>M</i> (<i>SD</i>)	Range	α
FFMQ-T-NO ^a	98.09 (15.16)	48 – 141	.88	43.21 (8.28)	21 – 60	.87	36.93 (6.76)	17 – 58	.79
Awareness	24.05 (5.42)	8 – 36	.85	11.70 (2.52)	5 – 15	.85	9.20 (2.12)	3 – 15	.68
Nonjudgment	26.63 (6.82)	8 – 40	.89	11.56 (2.89)	3 – 15	.87	9.69 (2.89)	3 – 15	.81
Nonreactivity	21.26 (4.17)	9 – 32	.73	9.09 (2.67)	3 – 15	.73	8.39 (2.46)	3 – 15	.75
Describe	26.05 (6.21)	8 – 40	.88	10.86 (3.08)	3 – 11	.87	9.64 (2.98)	3 – 15	.87
PTQ ^b	29.23 (11.45)	0 – 60	.94	22.99 (12.76)	0 – 60	.96	35.33 (10.60)	3 – 60	.94
PSWQ ^c	52.06 (14.35)	17 – 80	.94	49.71 (18.05)	16 – 80	.97	61.76 (12.53)	26 – 80	.93
RRS-10 Brooding ^c	10.46 (3.62)	5 – 20	.75	9.87 (3.63)	5 – 20	.86	13.02 (3.46)	6 – 20	.76

Note. PTQ = Perseverative Thinking Questionnaire. PSWQ = Penn State Worry Questionnaire. RRS = Ruminative Responses Scale. FFMQ-T-NO

= Five Facets Mindfulness Questionnaire total score except Observe subscale.

^a Sample 1 completed the long-form version of the FFMQ, whereas Samples 2 and 3 completed the short form (15-item) version. Score distributions therefore differ between samples and were not compared directly. ^bSample 3 > Sample 1 > Sample 2, $p < .001$. ^cSample 3 > Sample 1 and Sample 2, $p < .001$.

Table 2

Zero-order Correlations Between the Relevant Four Facets of Mindfulness, Transdiagnostic PT, Worry, and Rumination.

	Sample 1 (Undergraduate) / Sample 2 (Crowdsourced)								Sample 3 (Elevated Anxiety/Depression)						
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7
1. FFMQ-T-NO	—	.75	.77	.68	.75	-.64	-.56	-.64	—						
2. Awareness	.71	—	.51	.30	.46	-.53	-.35	-.48	.56	—					
3. Nonjudgment	.70	.36	—	.41	.36	-.63	-.53	-.64	.72	.31	—				
4. Nonreactivity	.56	.19	.24	—	.34	-.44	-.51	-.41	.61	.16	.23	—			
5. Describe	.67	.33	.14 ^{ns}	.29	—	-.32	-.27	-.36	.67	.13	.27	.21	—		
6. PTQ	-.64	-.54	-.48	-.39	-.30	—	.72	.71	-.55	-.33	-.47	-.39	-.22	—	
7. PSWQ	-.47	-.27	-.43	-.44	-.16	.66	—	.64	-.36	-.08 ^{ns}	-.28	-.35	-.20	.63	—
8. RRS-Brooding	-.52	-.34	-.55	-.23	-.21	.56	.49	—	-.39	-.20	-.41	-.22	-.18	.57	.48

Note. FFMQ-T-NO = Five Facet Mindfulness Questionnaire total score, excluding the Observe subscale. PTQ = Perseverative

Thought Questionnaire; PSWQ= Penn State Worry Questionnaire; RRS-Brooding = Brooding subscale of the Ruminative

Responses Scale.

The first set of values below the diagonal represent the undergraduate student sample. Values above the diagonal represent the crowdsourced sample. Values below the second diagonal represent the elevated anxiety/depression sample.

All values are statistically significant at $p < .05$ except where noted. ^{ns} = not statistically significant at $p < .05$.

Table 3

Summary of regression analyses

Undergraduate Sample					Crowdsourced Sample					Anxious/Dysphoric Sample					
	<i>B</i>	<i>SE</i> (<i>B</i>)	β	<i>p</i>	ΔR^2	<i>B</i>	<i>SE</i> (<i>B</i>)	β	<i>p</i>	ΔR^2	<i>B</i>	<i>SE</i> (<i>B</i>)	β	<i>p</i>	ΔR^2
DV: Transdiagnostic Perseverative Thought (Perseverative Thinking Questionnaire)															
Model					.45**					.48**					.34**
Awareness	-0.78	0.12	-0.37	<.001		-1.33	0.29	-0.26	<.001		-0.86	0.27	-0.18	.002	
Nonjudgment	-0.47	0.08	-0.28	<.001		-1.87	0.24	-0.42	<.001		-1.21	0.21	-0.34	<.001	
Nonreactivity	-0.64	0.13	-0.23	<.001		-0.91	0.24	-0.19	<.001		-1.17	0.22	-0.28	<.001	
Describe	-0.13	0.09	-0.07	.142		0.08	0.21	0.02	.719		-0.18	0.19	-0.05	.355	
DV: Trait Worry (Penn State Worry Questionnaire)															
Step 1					.50**					.55**					.42**
PTQ	0.66	0.08	0.53	<.001		0.77	0.09	0.55	<.001		0.63	0.07	0.52	<.001	
RRS-Brooding	0.61	0.22	0.15	.005		1.25	0.30	0.25	.001		0.66	0.22	0.18	.003	
Step 2					.06**					.05**					.03*
Awareness	0.29	0.14	0.11	.032		0.73	0.36	0.10	.043		0.86	0.31	0.15	.006	
Nonjudgment	-0.19	0.11	-0.09	.094		-0.27	0.35	-0.04	.435		0.16	0.25	0.04	.534	
Nonreactivity	-0.74	0.16	-0.21	<.001		-1.50	0.30	-0.22	<.001		-0.61	0.27	-0.12	.028	
Describe	0.16	0.11	0.07	.138		0.07	0.27	0.01	.787		-0.21	0.22	-0.05	.337	

DV: Brooding (RRS-10 Brooding Subscale)													
Step 1					.34**					.54**			.35**
PTQ	0.09	0.02	0.28	<.001		0.15**	0.02	0.52	<.001		0.15**	0.02	0.44 <.001
PSWQ	0.05	0.02	0.18	.005		0.05**	0.01	0.26	.001		0.06**	0.02	0.20 .003
Step 2					.09**					.06**			.03*
Awareness	-0.01	0.04	-0.01	.902		-0.08	0.07	-0.06	.270		-0.03	0.09	-0.01 .816
Nonjudgment	-0.18	0.03	-0.35	<.001		-0.33	0.07	-0.26	<.001		-0.24*	0.07	-0.18 .004
Nonreactivity	0.05	0.05	0.05	.303		-0.00	0.06	-0.00	.965		0.07	0.08	0.04 .455
Describe	-0.03	0.03	-0.06	.242		-0.08	0.05	-0.07	.127		-0.03	0.06	-0.02 .747

Note. PTQ = Perseverative Thought Questionnaire; PSWQ = Penn State Worry Questionnaire; RRS-Brooding = Brooding subscale of the Ruminative Responses Scale

** $p < .001$, * $p < .01$