Mindfulness (2024) 15:1208–1219
https://doi.org/10.1007/s12671-024-02363-0

ORIGINAL PAPER

Nonjudgment Mediates the Effect of a Brief Smartphone-Delivered Mindfulness Intervention on Rumination in a Randomized Controlled Trial with Adolescents

Lori M. Hilt[1] · Caroline M. Swords[1] · Nina Austria[1] · Christian A. Webb[2] · Justus Wahl[1] · Layne Eklund[1]

Accepted: 22 April 2024 / Published online: 6 May 2024

Abstract

Objectives Rumination, a risk factor for the development of psychopathology that often emerges during adolescence, has been successfully targeted in mindfulness interventions; however, the mechanism is unclear. Acquiring mindfulness skills may help reduce repetitive ruminative thinking and in turn alleviate negative emotions. The goal of the present study was to test whether changes in trait mindfulness accounted for the reductions in rumination following a brief mindfulness intervention.

Method Ruminative adolescents (n = 152; 59% girls, 18% racial/ethnic minority, mean age = 13.72, SD = 0.89) were randomly assigned to use a mobile app 3 times per day for 3 weeks that delivered brief mindfulness exercises or a mood monitoring only control. They completed questionnaires to assess rumination, mindfulness, and depression at baseline, post-intervention and follow-up at 6 weeks, 12 weeks, and 6 months post-intervention.

Results We ran a parallel causal mediation model with bootstrapping to examine whether changes in facets of mindfulness (Nonjudgment, Nonreactivity, Describe, Awareness, Observe) mediated the effect of treatment group on change in rumination. A significant indirect effect of Treatment Group on Rumination emerged through Nonjudgment. Next, we ran a serial mediation model predicting depressive symptoms during the follow-up period (12 weeks and 6 months post-intervention) from Treatment Group through Nonjudgment (immediate post-intervention) and rumination (at 6 weeks post-intervention). Results from this model were significant.

Conclusions Our findings suggest that a brief mindfulness intervention increases nonjudgmental awareness, thereby reducing rumination and subsequent depressive symptoms. Understanding these mechanisms may help tailor interventions for at-risk youth.

Preregistration This study was registered with Clinicaltrials.gov (Identifier NCT03900416).

Keywords adolescents · rumination · mindfulness · mobile app · nonjudgment · depression

Rumination, the mental act of passively and repetitively dwelling on negative emotions, is a transdiagnostic risk factor for the development and maintenance of psychopathology (Nolen-Hoeksema et al., 2008; Watkins & Roberts, 2020). First studied as a primary risk factor for depression (Nolen-Hoeksema, 1991), rumination was found to impair problem solving and exacerbate negative thinking, thereby worsening depressive symptoms (Nolen-Hoeksema et al., 2008). Individuals who ruminate may do so in an attempt to understand their emotions (Papageorgiou & Wells, 2001); however, the effect of rumination is an increase in negative emotions (Nolen-Hoeksema et al., 2008). Rumination is concurrently associated with several forms of psychopathology and predicts the onset and maintenance of psychopathology (for a review see Watkins & Roberts, 2020). Because rumination is thought to develop into a more stable, trait-like response by adolescence (Shaw et al., 2019), it is important to intervene early to prevent the development of psychopathology, such as anxiety and depression which often begin during adolescence or emerging adulthood (Conley et al., 2023).

✉ Lori M. Hilt
lori.m.hilt@lawrence.edu

[1] Department of Psychology, Lawrence University, 711 E. Boldt Way, Appleton, WI 54911, USA

[2] Department of Psychiatry, Harvard Medical School and McLean Hospital, Boston, MA, USA

Mindfulness interventions, which focus on helping individuals attend to the present moment in a nonjudgmental manner, have successfully reduced rumination. For example, studies of formerly depressed individuals undergoing Mindfulness-Based Cognitive Therapy (MBCT; Segal et al., 2013) have found that the 8-week treatment significantly reduces rumination (e.g., Shahar et al., 2010; Van den Hurk et al., 2012). Based on this work, we examined whether brief mindfulness exercises could reduce rumination in the moment and found that they could with both adolescents (Hilt & Pollak, 2012) and adults (Villa & Hilt, 2014). Given the increased accessibility of mindfulness interventions afforded by digital adaptations (Mrazek et al., 2019), along with evidence of the efficacy of mindfulness-based apps among youth (Conley et al., 2022), we developed a short intervention involving mood monitoring along with brief (1-10 min) mindfulness exercises delivered via mobile app. We found that our app-based mindfulness intervention was acceptable to adolescents (Hilt & Swords, 2021) and it significantly reduced rumination relative to a mood monitoring only control in a group of ruminative adolescents (Hilt et al., 2023). The mechanism by which mindfulness decreases rumination is not well understood. Presumably, acquiring mindfulness skills disrupts and replaces ruminative thinking with a more adaptive approach to negative emotions. However, this has not been directly tested, and knowing this would help in developing targeted and efficient interventions. Thus, the goal of the present study was to examine changes in mindfulness in our randomized controlled trial, and in particular, test whether changes in mindfulness accounted for the reductions in rumination following the intervention.

Rumination can be conceptualized as a form of avoidance (Moulds et al., 2007). Though rumination keeps negative emotions and thoughts in mind, these thoughts are abstract and typically focused on the past (e.g.,w*hy can't I do anything right?),* which appears to limit the emotional impact (i.e., experiential avoidance; Cribb et al., 2006). Thus, mindfulness, which involves a focus on the present in a more concrete manner, may help direct attention in a way that precludes rumination. Furthermore, rumination involves a great deal of negative self-relevant thinking and judgments about the self (Nolen-Hoeksema et al., 2008). Mindfulness, on the other hand, emphasizes a neutral or nonjudgmental approach that involves examining mental events as they are (e.g., *my mind is telling that story again*) rather than engaging with them in a judgmental and immersive way (e.g., Bishop et al., 2004; Kabat-Zinn, 2003). In their Monitor and Acceptance Theory (MAT), Lindsay and Creswell (2017) suggest that both components of mindfulness (i.e., attention to the present moment and nonjudgmental acceptance) are important for effectively regulating emotions. In fact, attention monitoring on its own might increase affective symptoms by bringing greater awareness to them, but nonjudgmental acceptance allows for disengagement from negative content (Lindsay & Creswell, 2017). This might be especially important for decreasing rumination, as rumination has been found to involve difficulty in disengaging from negative stimuli (for reviews, see Koster et al., 2011; Shaw et al., 2019; Watkins & Roberts, 2020). Evidence suggests that mindfulness-based interventions improve attention and executive functioning (Dunning et al., 2019; Zainal & Newman, 2023), and neural correlates of disengagement during focused attention have been documented (e.g., Westbrook et al., 2023), offering a possible mechanism for how mindfulness may alleviate rumination.

The idea that mindfulness and rumination may be antithetical has been supported in the empirical literature. For example, several studies have found a negative correlation between self-report measures of general mindfulness and rumination (e.g., Blanke et al., 2020; Desrosiers et al., 2013; Raes & Williams, 2010). Although many studies have found this negative association, some have not (e.g, Royuela-Colomer et al., 2021). Furthermore, it appears that an examination of the specific facets of mindfulness, rather than conceptualizing mindfulness more generally, has yielded a more robust association between mindfulness and rumination. For example, utilizing the MAT framework (Lindsay & Creswell, 2017), there is evidence that the acceptance-based aspect of mindfulness may allow for disengagement in self-referential processing regions of the brain often associated with rumination (Kross et al., 2009).

One common conceptualization defines mindfulness as comprising five distinct components (Baer et al., 2006). This model includes: Nonjudgment (i.e., experiencing thoughts and feelings without evaluating them as good or bad), Nonreactivity (i.e., allowing thoughts and feelings to enter, pass, and leave one's mind without needing to engage with them), Acting with Awareness (i.e., paying full attention to the present moment), Describing (i.e., assigning words to label the thoughts and feelings one experiences), and Observing (i.e. being consciously aware of internal and external stimuli). The first two components map onto the Acceptance aspect of the MAT framework, while the latter components map onto the Monitoring component (Lindsay & Creswell, 2017). This five-factor model has been measured using the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006) with both adults and adolescents. While factor analysis has supported the factor structure of the FFMQ in multiple samples, some research has suggested that the Observe facet be removed due to inconsistencies, including not loading onto a general mindfulness factor in nonclinical samples (e.g., Baer et al., 2006; Gu et al., 2016).

Research utilizing the FFMQ has shown a robust inverse relationship between the Nonjudgment facet of mindfulness and rumination. For example, one study that employed three separate samples (i.e., undergraduate students, adolescents from the community, and adolescents selected for high levels of rumination), Nonjudgment was the only facet of mindfulness that was negatively correlated with rumination in all three samples (Swords & Hilt, 2021). Similarly, another study with three samples (i.e., undergraduate students, adults from the community, and adults with elevated depression and anxiety) found that Nonjudgment was also uniquely negatively correlated with rumination in all three samples (Thompson et al., 2022). Another study also found that Nonjudgment was inversely associated with rumination among Spanish adolescents (Royuela-Colomer & Calvete, 2016). In addition to cross-sectional associations, two studies have found that Nonjudgment predicted decreased rumination over time, in samples of adolescents (Swords & Hilt, 2021; Tumminia et al., 2020) and emerging adults (Swords & Hilt, 2021). These findings suggest that nonjudgmental awareness may be a mechanism to reduce rumination, though this has not been directly tested in the context of a mindfulness intervention. If nonjudgment is a key factor in how mindfulness may reduce rumination, it likely does so through facilitating disengagement from negative self-relevant information as discussed above.

In addition to Nonjudgment, one other facet of mindfulness has emerged as having a potential relationship with rumination. Acting with Awareness has been inversely associated with rumination concurrently in a sample of adolescents (Royuela-Colomer & Calvete, 2016). Furthermore, in another sample of adolescents, Acting with Awareness predicted decreased rumination one year later (Swords & Hilt, 2021). One intervention study with adults found that participants in the mindfulness group had increases in three facets of mindfulness relative to the control group (i.e., Awareness, Describing, and Nonjudging), and only Acting with Awareness mediated the effect of the intervention on work-related rumination (Querstret et al., 2017). However, it is important to note that the relationship between Acting with Awareness and rumination is not as robust as that of Nonjudgment, and Acting with Awareness could be more related to perserverative negative thinking in general, rather than rumination specifically (e.g., Thompson et al., 2022).

Interest in rumination has been fueled by its status as a transdisagnostic risk factor for the development of psychopathology, especially depression. In fact, MBCT was specifically designed to reduce depressive relapse by targeting rumination (Segal et al., 2013). Facets of mindfulness have also been associated with depression, raising the possibility of serial mechanisms whereby mindfulness training may improve skills in awareness and nonjudgment that in turn reduce rumination and subsequent depressive symptoms. Several studies have found that Nonjudgment is negatively associated with depressive symptoms (e.g., McKeen et al., 2023; Medvedev et al., 2018), though another study found that Acting with Awareness and Nonreactivity (but not Nonjudgment) predicted decreases in depressive symptoms in adolescents (Royuela-Colomer & Calvete, 2016). Studies that utilize mindfulness training and employ multiple time points are needed to more thoroughly examine the relationships among putative mechanisms and outcomes.

We previously reported the primary outcomes from a randomized controlled trial (RCT) examining whether our 3-week mindfulness mobile app intervention could reduce trait rumination among ruminative adolescents relative to a mood monitoring only control condition (Hilt et al., 2023). We found that the intervention did reduce rumination and this effect lasted through the 6-week follow-up period. An exploratory aim of the RCT was to examine whether changes in mindfulness would account for the changes in rumination, and we tested that in the present study. Based on limited past research, we hypothesized that increases in Nonjudgment would account for reductions in rumination, but we also explored potential indirect effects through other facets of mindfulness. Additionally, we examined whether these mechanisms accounted for reductions in depressive symptoms.

Method

Participants

Participants were 152 ruminative adolescents (mean age = 13.71, *SD* = 0.89) recruited from a mid-sized midwestern community between 2019-2020 for an RCT of a mindfulness mobile application (for more details including CONSORT reporting, see Hilt et al., 2023). Participants were recruited by posters, word of mouth, and through letters sent to parents in the local school district. Interested parents and adolescents called the study team to learn more about the study and complete a brief phone screen. Adolescents were eligible to participate if they were between the ages of 12 and 15 years old and their average score on a two-item trait rumination screen indicated that they ruminate at least "sometimes" in response to sadness or stress. Forty participants were ineligible based on these criteria. This two-item screen (comprising questions from the Children's Response Styles Questionnaire that overlap with brooding items from the Ruminative Response Scale) was used in a previous study to select ruminative adolescents (Hilt & Swords, 2021) and the cut-off score has shown to accurately identify adolescents at risk for depression (Young & Dietrich, 2014). Exclusion criteria included being unable to a use a mobile application, insufficient proficiency in the English language, or imminent

suicide concerns. No participants were excluded based on these criteria.

Parents and adolescents self-reported demographic information and psychopathology at baseline. Participants were 58.55% female, 41.45% male; 82.24% White, 10.53% Multiracial, 3.29% Black or African American, 1.97% Asian or Asian American, 1.32% other, and 0.66% Native Hawaiian or Pacific Islander; 89.47% non-Hispanic and 10.53% Hispanic. Parents reported income as the following: range =US$10,000–15,000 to more than US$300,000; median = US$90,000–100,000; 9.21% reported being recipients of a government-assisted food program.

Procedure

After providing consent and assent, participants completed baseline questionnaires and were randomly assigned to use either the experimental (i.e., mindfulness) or control (i.e., mood monitoring only) version of the mobile application. Participants then downloaded the application onto their device, or one borrowed from the lab, and learned how to use it during a practice session with a research assistant's guidance. Sleep and wake times were entered into the application, which provided a window for the application to send three randomized notifications a day to participants to use the app (once in the morning, once in the later afternoon, and once before bedtime). Participants randomized to the mindfulness condition received brief psychoeducation on mindfulness (i.e., a single page handout that a research assistant went over with them involving a one-minute mindfulness exercise followed by explaining the definition of mindfulness). Adolescents and parents were each paid $15 for completing the baseline visit.

During the 3-week intervention period, participants received three notifications a day to use the app. After, adolescents and parents completed online questionnaires. Adolescents were compensated $25, and parents were compensated $5 for post-intervention surveys. Adolescents were additionally given $5 each week they used the app twenty-one times or more to incentivize using the app (up to $15 bonus). To assess for any lasting effects of the intervention, adolescents and parents completed follow up questionnaires again at 6 weeks, 12 weeks, and 6 months post-intervention. For each completed follow-up questionnaire, adolescents were compensated $10, and parents were compensated $5. Parent outcomes are not reported in the present study.

Conditions

Mood Monitoring Control Condition

After receiving a notification to use the app, participants reported on state mood and state rumination. State mood was assessed by asking participants how they were feeling (i.e., sad, anxious, happy, and calm) just before they received the notification to use the app. Participants also reported on state rumination by answering two questions: "how much were you focusing on your emotions" and "how much were you focusing on your problems." Participants responded to questions assessing state mood and rumination with a rating scaled from 0 (*not at all*) to 100 (*extremely*). Participants did not receive mindfulness interventions if randomized to the control version of the app.

Mindfulness Condition

Participants randomized to the mindfulness condition answered the same state mood and rumination questions as the control group. If adolescents rated their anxiety or sadness as greater than or equal to a score of 90, they had an 85% chance of receiving a mindfulness exercise. If adolescents rated anxiety or sadness to be less than a score of 90, adolescents were randomized to receive a mindfulness exercise two-thirds of the time. In doing so, it was more difficult for participants to learn which responses would result in receiving a mindfulness exercise. After each mindfulness exercise, adolescents answered the same questions assessing state mood and rumination they answered before the exercise. Mindfulness exercises were age-appropriate and brief ranging from 3-12 min. The mindfulness exercises were chosen from the public domain to be representative of the most common forms of mindfulness meditation and included bringing awareness to breath, sounds in the environment, and bodily sensations.

Measures

Depressive Symptoms

The Children's Depression Inventory (CDI) is a widely used measure for assessing depressive symptoms in children and adolescents (CDI; Kovacs, 1992). The CDI assesses the frequency and severity of depressive symptoms as reported by respondents over the past two weeks with 27 items, each scored on a scale from 0-2. Higher scores are indicative of greater depressive symptoms. The CDI is a reliable and valid measure used to assess the frequency and severity of depressive symptoms in children and adolescents between the ages of 7 to 17 years (Craighead et al., 1995; Klein et al., 2005). In this sample, the reliability for the CDI was excellent at each time point: $\alpha = 0.90$, $\alpha = 0.92$, $\alpha = 0.91$, $\alpha = 0.92$, $\alpha = 0.92$.

Trait Rumination

The Children's Response Style Questionnaire (CRSQ; Abela et al., 2002) is a 25-item measure that assesses the degree

to which children and adolescents employ the use of three response styles (i.e., rumination, distraction, problem-solving) in response to sadness. Rumination was measured in this study by using the 13-item rumination subscale of the CRSQ. An example item from the rumination subscale is, "When I am sad, I think 'about a recent situation wishing it had gone better'". In line with current conceptualizations of rumination (Nolen-Hoeksema et al., 2008), we asked participants to rate how often they respond to sadness or *stress* in the way described in the item using a 4-point Likert scale (0 = *almost never* to 3 = *almost always*). Past research demonstrates that the CRSQ demonstrates excellent reliability in adolescent samples (e.g., Hilt et al., 2010). The CRSQ demonstrated excellent reliability for rumination in this sample, and we used the first three timepoints in the present analyses ($\alpha = 0.92$, $\alpha = 0.92$, $\alpha = 0.91$).

Trait Mindfulness

Trait mindfulness was assessed using the FFMQ (Baer et al., 2006). The FFMQ is a widely used measure of mindfulness and consists of 39 items in which participants rate on a 5-point Likert scale (1 = *never or very rarely true* to 5 = *very often or always true*) the degree to which an item describes their tendency to engage in one of five dimensions of mindfulness (i.e., observing, describing, acting with awareness, nonjudgment of inner experiences, and nonreactivity to inner experiences). The Observing subscale contains 8 items and measures the individual's ability to attend to internal and external stimuli (e.g., "I notice the smells and aromas of things."). The Describing facet contains 8 items and measures an individual's ability to understand, label, and describe or articulate inner thoughts, feelings, and sensations (e.g., "I am good at finding words to describe my feelings"). The Acting with Awareness facet is comprised of 8 items and measures the ability to bring full awareness to the present moment (e.g., "I find myself doing things without paying attention" (reverse scored). The facet of Nonjudgment contains 8 items and measures an individual's ability to take a non-critical and non-evaluative stance towards their thoughts and feelings (e.g., "I think some of my emotions are bad or inappropriate and I should not feel them" (reverse scored). The Nonreactivity scale contains 7 items and assesses an individual's ability to experience their inner thoughts and feelings without becoming entangled in them (e.g., "Usually when I have distressing thoughts or images, I step back and am aware of the thought or image without getting taken over by it"). The FFMQ has demonstrated reliability in adolescent samples (e.g., Ciesla et al., 2012; Royuela-Colomer & Calvete, 2016). In our sample, reliability for the subscales were good to excellent, and we used the first two time points for present analyses: Observing ($\alpha = 0.79$, $\alpha = 0.81$), Describing ($\alpha = 0.80$, $\alpha = 0.79$), Awareness ($\alpha = 0.84$, $\alpha = 0.87$), Nonjudgment ($\alpha = 0.90$, $\alpha = 0.89$) and Nonreactivity ($\alpha = 0.77$, $\alpha = 0.70$).

Data Analyses

We followed an intention-to-treat approach by imputing data using a random-forest based approach (MissForest package in R; Stekhoven & Bühlmann, 2012; for additional details, see Hilt et al., 2023). There was very little missing data (range = 0-6.6% per variable). First, we tested a parallel mediation model to examine whether any facets of mindfulness accounted for the effect of condition on rumination. Causal mediation was tested using the PROCESS macro (v. 3.5, Model 4; Hayes, 2018) for SPSS (IBM Corp.) which relies on bootstrapping with 5000 resamples to generate bias-corrected confidence intervals. Our outcome variable for the analysis was six weeks post-intervention rumination, with scores taken from the CRSQ. Our predictor variable was condition (i.e., either mindfulness or the mood monitoring control), and our mediator variables were post-intervention mindfulness facets (Nonjudgment, Observe, Describe, Nonreactivity, and Awareness) with scores taken from the FFMQ. Baseline mindfulness facets and baseline rumination were entered as covariates along with age and sex. We conducted a Monte Carlo power analysis (running 5,000 replications and 20,000 Monte Carlo draws per replication) to determine the required sample size for a mediation test (for details, see Schoemann et al., 2017). We used data from two previous studies (Hilt et al., 2023; Hilt et al., 2024) to estimate the association between mediator and outcome (for one $r = 0.55$, and for the other $r = 0.41$; we used the average in the analysis, i.e., $r = 0.48$). We conservatively assumed that the magnitude of the X->M and X->Y path would be half that ($r = 0.24$). The power analysis indicated that we would need at least 142 participants to achieve 0.8 power for a mediation test.

Next, if any facets of mindfulness were significant in the parallel model, we planned to test a serial mediation model (Model 6) with depression scores from the CDI (at 12 weeks and 6 months post-intervention) as the outcome measure. In this model, our predictor variable was condition, our first mediator was any significant mindfulness facet from the parallel model (measured at post-intervention), and our second mediator was rumination (measured 6 weeks post-intervention). Baseline mindfulness facets, baseline rumination, and baseline depression scores were entered as covariates along with age and sex.

Results

Descriptive statistics, including ranges, means, and standard deviations for all timepoints are presented in Table 1. Bivariate correlations among all variables included in the

mediation models are presented in Table 2, separately by condition. Of note, there was a large, negative correlation between rumination and nonjudgment and a smaller negative correlation between rumination and other facets of mindfulness, except for the observe facet which had a small, positive association with rumination. There were moderate, positive associations between rumination and depressive symptoms and small to moderate, negative associations between the facets of mindfulness (except for Observe) and depressive symptoms.

For the parallel mediation model, there was a significant indirect effect of condition on rumination through Nonjudgment only (Fig. 1). Participants in the mindfulness condition had a greater increase in Nonjudgment following the intervention period, and this predicted a greater reduction in rumination during the 6-week follow-up. We obtained a 95% bootstrap confidence interval for the indirect effect (i.e., *ab* path) of condition on rumination through nonjudgment with a lower limit of -2.65 and an upper limit of -0.20, supporting mediation (*ab* = -1.32). There was no evidence that condition influenced rumination independent of its effect

Table 1 Means and Standard Deviations for all Variables by Condition

	Mindfulness Group (n = 72)			Mood Monitoring Control Group (n = 80)		
	Range	*M*	*SD*	Range	*M*	*SD*
Age	12.00-15.75	13.78	0.93	12.00-15.75	13.67	0.86
T1 Rumination	2-37	17.81	9.73	1-37	15.68	8.16
T2 Rumination	1-39	14.54	8.58	0-37	16.33	9.15
T3 Rumination	1-35	13.32	7.93	0-35	14.38	8.36
T4 Rumination	1-38	14.60	8.72	0-36	14.02	8.3
T5 Rumination	2-36	14.25	8.82	0-37	14.27	8.51
T1 Nonjudgment	10-40	25.56	7.46	9-40	27.49	7.58
T2 Nonjudgment	9-40	27.79	6.76	9-40	27.05	7.47
T3 Nonjudgment	8-40	28.09	6.97	8-40	27.88	6.83
T4 Nonjudgment	9-40	27.46	7.33	8-40	27.63	6.98
T5 Nonjudgment	8-40	28.30	7.31	8-40	27.94	6.48
T1 Observe	9-37	22.28	6.23	8-38	21.38	6.20
T2 Observe	9-36	22.70	6.35	8-36	22.10	6.18
T3 Observe	10-33	23.08	5.48	10-35	22.07	5.64
T4 Observe	8-36	23.77	5.59	10-37	22.52	5.76
T5 Observe	10-35	24.11	5.45	8-40	21.62	6.62
T1 Describe	11-38	24.26	5.75	10-40	24.69	5.75
T2 Describe	10-38	25.00	5.93	9-35	23.97	5.07
T3 Describe	12-39	25.08	5.95	10-39	25.22	5.23
T4 Describe	10-37	25.16	5.81	12-40	24.25	5.26
T5 Describe	9-39	25.18	5.91	9-38	24.96	5.27
T1 Awareness	10-36	25.03	6.23	12-38	26.17	5.84
T2 Awareness	8-39	25.42	6.50	9-37	24.96	6.37
T3 Awareness	12-38	25.10	6.11	15-39	25.66	5.33
T4 Awareness	9-35	24.72	5.75	13-39	25.25	5.44
T5 Awareness	11-39	25.04	6.04	9-40	26.06	6.03
T1 Nonreact	7-28	19.58	4.58	9-28	19.44	3.99
T2 Nonreact	10-30	20.12	4.61	10-31	19.72	4.31
T3 Nonreact	9-33	20.22	5.39	11-33	19.64	4.17
T4 Nonreact	11-33	20.89	4.02	13-30	20.09	3.74
T5 Nonreact	11-31	21.08	4.42	7-29	20.05	4.28
T1 Depression	1-38	13.4	8.77	1-31	12.04	7.72
T2 Depression	0-46	11.56	9.48	1-35	12.16	8.53
T3 Depression	0-42	10.75	8.73	1-33	10.80	8.15
T4 Depression	0-35	10.02	8.08	0-33	10.66	8.46
T5 Depression	0-34	9.73	8.25	0-30	10.34	8.69

Table 2 Bivariate Correlations for all Variables Included in Mediation Models, Separately by Condition

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. T1 Rumination	__	0.685**	0.533**	-0.641**	-0.423**	0.222*	0.347**	-0.317**	-0.109	-0.301**	-0.196	-0.114	0.042	0.661**	0.396**	0.343**
2. T2 Rumination	0.655**	__	0.702**	-0.508**	-0.702**	0.246*	0.377**	-0.132	-0.198	-0.389**	-0.406**	-0.111	-0.119	0.613**	0.416**	0.407**
3. T3 Rumination	0.596**	0.747**	__	-0.353**	-0.591**	0.082	0.142	-0.094	-0.167	-0.197	-0.307**	-0.124	-0.169	0.417**	0.411**	0.481**
4. T1 Nonjudgment	-0.738**	-0.546**	-0.426**	__	0.581**	-0.341**	-0.342**	0.147	0.120	0.333**	0.224*	0.026	0.035	-0.434**	-0.284*	-0.307**
5. T2 Nonjudgment	-0.606**	-0.733**	-0.607**	0.680**	__	-0.234*	-0.314**	-0.013	0.189	0.344**	0.453**	0.120	0.120	-0.371**	-0.254*	-0.361**
6. T1 Observe	0.343**	0.208	0.264*	-0.318**	-0.238*	__	0.761**	0.216	0.130	-0.222*	-0.315**	0.497**	0.345**	0.159	0.132	0.087
7. T2 Observe	.0154	0.151	0.120	-0.196	-0.208	0.743**	__	-0.007	0.020	-0.361**	-0.353**	0.317**	0.349**	0.364**	0.334**	0.278*
8. T1 Describe	-0.314**	-0.310**	-0.293*	0.329**	0.303**	0.160	0.195	__	0.541**	0.297**	0.176	0.247*	0.039	-0.529**	-0.394**	-0.229*
9. T2 Describe	-0.219	-0.253*	-0.280*	0.206	0.372**	-0.016	-0.019	0.584**	__	0.244*	0.302**	0.147	0.103	-0.316**	-0.294**	-0.351**
10. T1 Awareness	-0.232*	-0.202	-0.182	0.137	0.294*	-0.135	-0.120	0.400**	0.355**	__	0.690**	0.055	-0.062	-0.522**	-0.480**	-0.411**
11. T2 Awareness	-0.358**	-0.430**	-0.289*	0.249*	0.519**	-0.131	-0.161	0.251*	0.255*	0.645**	__	-0.098	-0.067	0.440**	-0.529**	-0.551**
12. T1 Nonreact	-0.261*	-0.242*	-0.214	0.271*	0.269*	0.155	0.168	0.490**	0.435**	0.117	0.152	__	0.544**	-0.304**	-0.120	-0.072
13. T2 Nonreact	0.012	-0.143	-0.167	0.051	0.120	0.316**	0.394**	0.240*	0.377**	-0.025	-0.004	-0.612**	__	-0.092	-0.101	-0.046
14. T1 Depression	0.656**	0.534**	0.537**	-0.579**	-0.494**	0.136	0.068	-0.566**	-0.322**	-0.466**	-0.323**	-0.412**	-0.169	__	0.763**	0.618**
15. T4 Depression	0.552**	0.532**	0.709**	-0.514**	-0.511**	0.084	-0.035	-0.546**	-0.333**	-0.250*	-0.318**	-0.510**	-0.389**	0.671**	__	0.824**
16. T5 Depression	0.491**	0.462**	0.555**	-0.407**	-0.499**	0.059	-0.031	-0.466**	-0.382**	-0.329**	-0.415**	-0.419**	-0.396**	0.561**	0.831**	__

Correlations for the Mindfulness condition ($n = 72$) are displayed below the diagonal and correlations for the Mood Monitoring Control condition ($n = 80$) are displayed above the diagonal

*$p < 0.05$; **$p < 0.01$

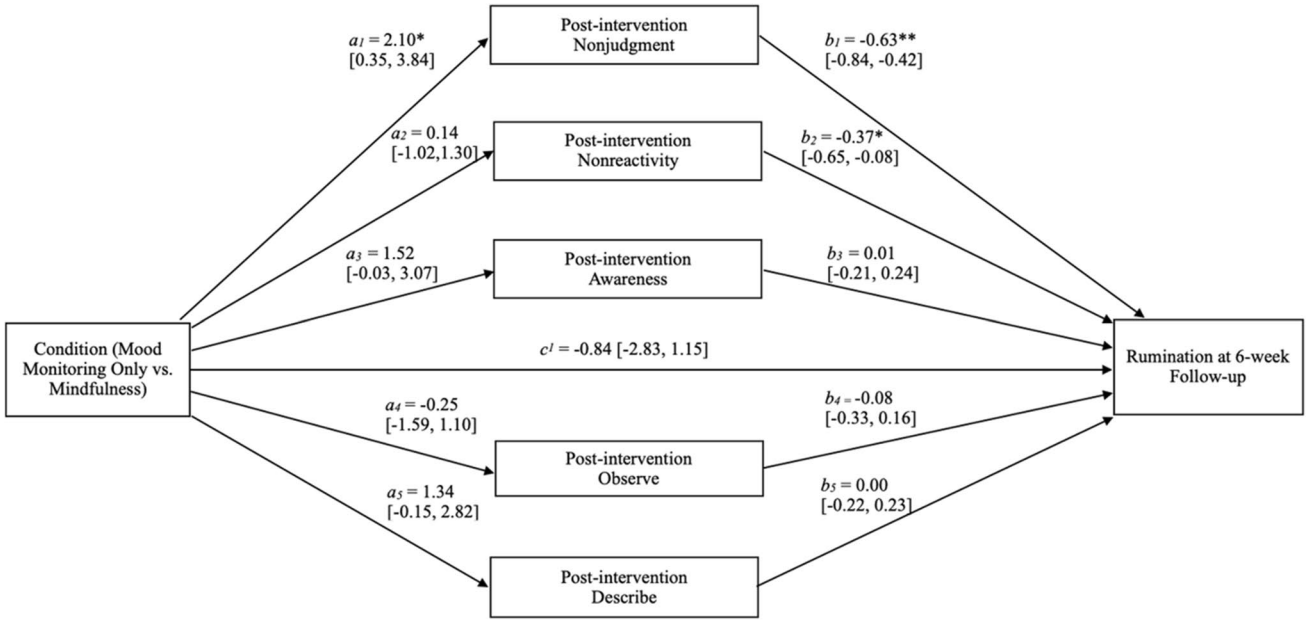

Fig. 1 Parallel Mediation Model. *$p < 0.05$; **$p < 0.01$

on nonjudgment (c^1 path). Thus, our results suggest that the mindfulness intervention decreased rumination through the indirect effect of increased Nonjudgment. In order to examine clinical significance, we also ran the parallel mediation model using a dichotomous outcome for rumination to indicate a clinically reliable change. For this model, we used a cut-off score of 26 or greater, based on research by Young and Dietrich (2014), indicating that an average score of 2+ per item afforded excellent sensitivity and specificity for predicting risk for depression in this age range. The parallel mediation model results held with the outcome of a clinically reliable change in rumination. The 95% bootstrap CI for the indirect effect of nonjudgment [-44.901, -.066] did not overlap zero.

Examination of the *a* paths in Fig. 1 indicate that while only Nonjudgment showed significant changes in the mindfulness condition relative to the control condition, there were marginal effects of condition on the Awareness and Describe facets of mindfulness. Examination of the *b* paths in Fig. 1 indicate that in addition to Nonjudgment, Nonreactivity was significantly associated with changes in rumination (even though it was not associated with differences by condition).

For the serial mediation model, there was a significant indirect effect of condition on depression through Nonjudgment and subsequent rumination (Fig. 2). Participants in the mindfulness condition had a greater increase in Nonjudgment following the intervention period, and this predicted a greater reduction in rumination during the 6-week follow-up, which in turn, predicted a greater reduction in depression symptoms 12 weeks (95% bootstrap CI = -1.06, -0.03), and 6 months (95% bootstrap CI = -0.91, -0.01), post-intervention. Thus, our results suggest that the mindfulness intervention decreased depression symptoms by improving nonjudgmental awareness, and thereby reducing rumination.

The effect of the intervention on Nonjudgment, controlling for baseline levels, was significant at post-treatment, the 6-week follow-up, and the 6-month follow-up. The effect of the intervention on rumination, controlling for baseline levels, was significant through the 6-week follow-up.

Discussion

Rumination, a transdiagnostic risk factor for the development of psychopathology that often emerges during adolescence, has been successfully targeted in mindfulness interventions. However, the mechanism by which mindfulness reduces rumination is unclear. In the present study, we examined whether changes in self-reported trait mindfulness accounted for reductions in rumination following a 3-week mobile mindfulness intervention in the context of an RCT for ruminative adolescents. Using three timepoints, we found that those in the mindfulness group reported increases in nonjudgmental awareness that accounted for decreases in rumination relative to the control group. This was the only facet of mindfulness that mediated changes in rumination. Furthermore, using data from more than three timepoints, we showed that this mechanism accounted for subsequent reductions in depressive symptoms.

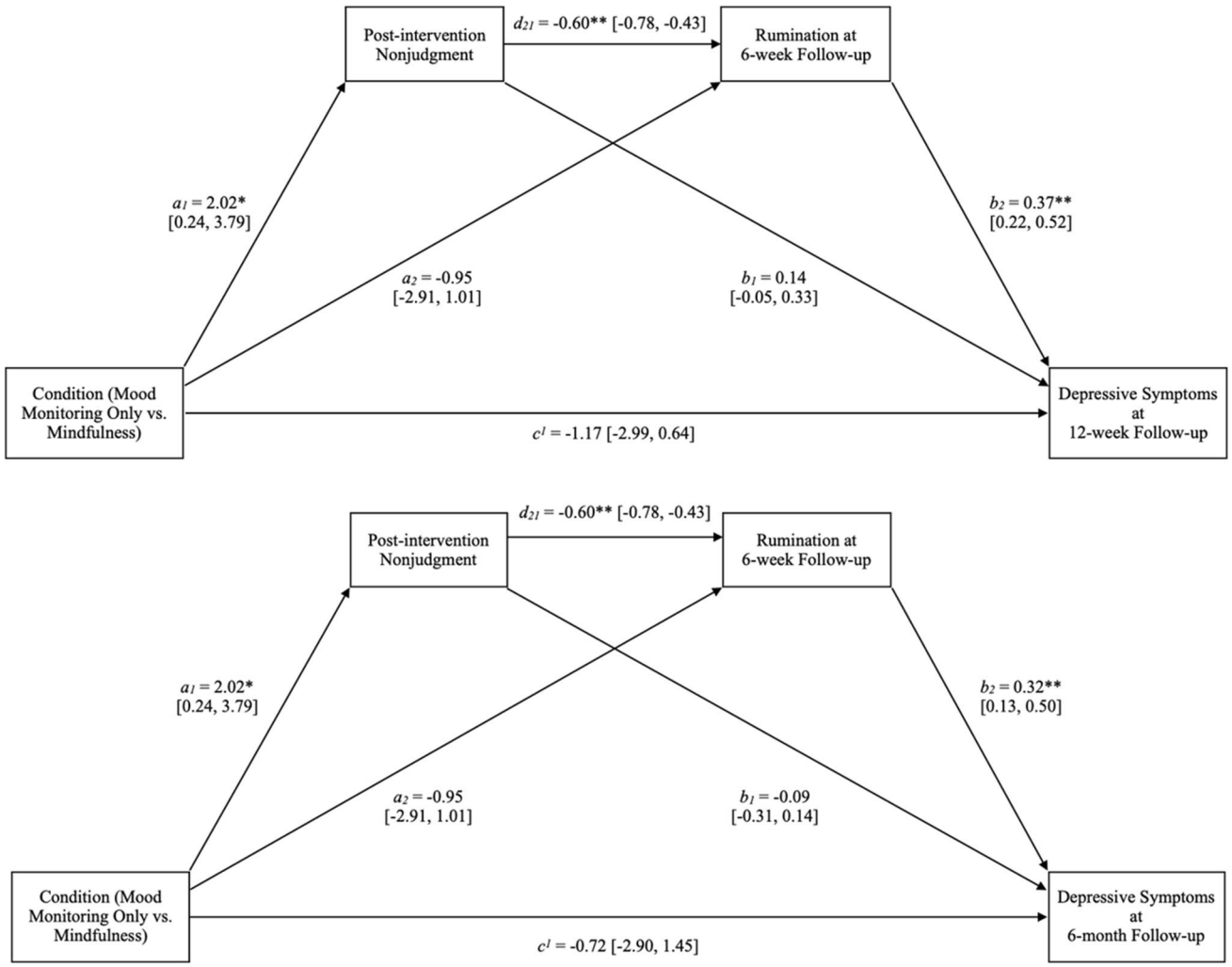

Fig. 2 Serial Mediation Model Predicting Depressive Symptoms at 12 Weeks (top panel) and 6 Months (bottom panel) Post-intervention. *$p < 0.05$; **$p < 0.01$

Whereas many studies have reported a relationship between trait mindfulness and affect (for a review, see Tomlinson et al., 2018), fewer studies have directly tested mindfulness as a mechanism of change. Both changes in mindfulness and changes in rumination have been demonstrated to account for changes in depression in MBCT (for a review, see Van der Velden et al., 2015). The present study replicates these prior findings and extends them in several ways. First, we extend findings to a brief, smartphone-delivered mindfulness intervention. Second, we extend findings from clinical adults to community adolescents. Most importantly, we capitalized on having more than three time points, and tested putative mechanisms serially. By controlling for baseline levels of mediators and outcomes, we can be more confident in the likelihood of causality, as suggested by Van der Velden et al. (2015) in their review. In particular, we demonstrated that the mindfulness intervention improved nonjudgment, which reduced rumination and subsequent symptoms of depression.

Furthermore, although multiple studies have examined mindfulness as a mediator of treatment outcome in the context of psychopathology, the present study examined mindfulness as a mediator of rumination, a transdiagnostic risk factor. Understanding the role of nonjudgment in rumination can help with the prevention of psychopathology. One prior study found that Acting with Awareness, another facet of mindfulness, mediated a reduction in workplace rumination in adults (Querstret et al., 2017). Our study showed that mindfulness, in particular Nonjudgment, affects rumination in adolescence, when it may be possible to modify in the service of preventing psychopathology from developing.

Rising rates of internalizing symptoms among adolescents (for a review, see Conley et al., 2023) underscore the importance of targeting transdiagnostic risk factors. Given the role of Nonjudgment in the reduction of rumination

demonstrated in the present study, it may be worthwhile to further disseminate and develop interventions that specifically enhance nonjudgment among adolescents. Whether this may occur outside of the context of mindfulness interventions is a question for future research.

Findings from the present study support theory and previous research on the relationship between Nonjudgment and rumination. Leading theories of rumination suggest that it involves difficulty disengaging from negative stimuli (e.g., Koster et al., 2011). Thus, a process that facilitates disengagement from negative content, such as nonjudgment of inner experience, should reduce rumination, consistent with the MAT framework (Lindsay & Creswell, 2017).

In addition to Nonjudgment, one other facet of mindfulness, i.e., Nonreactivity, was also associated with reduced rumination. Although the mindfulness intervention did not appear to affect Nonreactivity, those with increases in Nonreactivity had greater reductions in rumination. While prior research has demonstrated a relationship between Nonjudgment and rumination, few studies have found a relationship between Nonreactivity and rumination, at least among those measuring facets of mindfulness using the FFMQ (e.g., Petrocchi & Ottaviani, 2016; Swords & Hilt, 2021). However, prior research has shown that rumination is associated with increased emotional reactivity (e.g., Hilt et al., 2015), which is in line with the present finding.

In addition to testing putative mechanisms within the context of an adolescent RCT, one of the present study's major strengths was employing three or more time points in order to draw more causal conclusions (Cole & Maxwell, 2003). Many previous studies examining mindfulness facets and rumination have been correlational or have included two time points (e.g., Petrocchi & Ottaviani, 2016; Swords & Hilt, 2021; Thompson et al., 2022). Our study replicates and extends the findings of Tumminia et al., 2020, who found that nonjudgment predicted reductions in rumination and subsequent negative affect in a 3-wave longitudinal design with high school students. Notably, the first mediator, Nonjudgment, appeared to have a more durable intervention effect than rumination in the present study. It is also possible that additional factors not measured in the present study may have partially mediated the depressive symptom reduction during the latter follow-up period.

Limitations and Future Research

There are limitations of the study to consider as well. First, we did not assess for a history of depression, so although the age of the sample suggests the likelihood of never being depressed, we do not know how or whether results would generalize to those with a history of depression. Second, our 2-item screener for rumination has not been previously validated and thus may not have accurately captured those adolescents at highest risk for depression. Third, both mindfulness and rumination were measured with self-report. Although this is the case with previous research as well, it would be helpful to develop a multi-method approach to more objectively measure facets of mindfulness to avoid biases inherent in self-report (Van Dam et al., 2018). It may be possible, for example, to develop a task that involves writing about inner experiences, and then code responses on their degree of judgment/nonjudgment. A fourth limitation is that we did not examine the potential role of self-compassion. Although not an explicit target of mindfulness interventions such as MBCT (Neff & Dahm, 2015) or the brief mindfulness intervention we designed, increases in self-compassion may be an implicit mechanism of change given its inverse relationship with rumination (Svendsen et al., 2022). It would be helpful to measure self-compassion in future studies. Another limitation involves generalizability, and future research is needed with more diverse populations. A meta-analysis showed that the Nonjudgment facet of mindfulness has a stronger relationship to psychopathology in Western samples whereas the Describe facet has a stronger relationship in Eastern samples (Carpenter et al., 2019). Finally, it will be important to reproduce our findings in an independent sample. If results replicate, we can be more confident regarding the mechanisms of mindfulness interventions, which may lead to more streamlined approaches that better target outcomes of interest.

Acknowledgements We thank the research assistants who helped with this project, especially Eliana Whitehouse, Eleanor Horner, Liesl Hostetter, Moeka Kamiya, and Elsa Hammerdahl.

Use of Artificial Intelligence No AI tools were used in this research.

Author Contributions Lori M. Hilt: Conceptualization, Formal Analysis, Funding
Acquisition, Investigation, Methodology, Project Administration, Resources,
Writing- original draft, Writing- review and editing. Caroline M. Swords: Methodology, Project Administration, Investigation, Writing- original draft, Writing- review and editing. Nina Austria: Formal analysis, Visualization, Writing- reviewing and editing. Christian Webb: Formal analysis, Writing- review and editing. Justus Wahl: Writing—original draft, Writing- reviewing and editing. Layne Eklund: Writing—original draft, Writing- reviewing and editing.

Funding Funding was provided by a grant from the National Institute of Mental Health of the National Institutes of Health under Award R15MH116303 to LMH. CAW was partially supported by NIMH R01MH116969, NCCIH R01AT011002, the Tommy Fuss Fund and a NARSAD Young Investigator Grant from the Brain & Behavior Research Foundation.

Data Availability Data are available upon request.

Declarations

Conflict of Interest The authors declare that they have no conflict of interest.

Ethics Approval The Lawrence University IRB approved this study.

Informed Consent Informed consent was obtained from parents prior to child participation. A research assistant explained the study to the adolescent and parent and answered questions followed by a parent signing the consent form. Adolescents assented to the study.

References

Abela, J. R., Brozina, K., & Haigh, E. P. (2002). An examination of the response styles theory of depression in third- and seventh-grade children: A short-term longitudinal study. *Journal of Abnormal Psychology, 30*, 515–527. https://doi.org/10.1023/A:1019873015594

Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*(1), 27–45. https://doi.org/10.1177/1073191105283504

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., Segal, Z. V., Abbey, S., Specca, M., Velting, D., & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice, 11*(3), 230–241. https://doi.org/10.1093/clipsy.bph077

Blanke, E. S., Schmidt, M. J., Riediger, M., & Brose, A. (2020). Thinking mindfully: How mindfulness relates to rumination and reflection in daily life. *Emotion, 20*(8), 1369–1381. https://doi.org/10.1037/emo0000659

Carpenter, J. K., Conroy, K., Gomez, A. F., Curren, L. C., & Hofmann, S. G. (2019). The relationship between trait mindfulness and affective symptoms: A meta-analysis of the Five Facet Mindfulness Questionnaire (FFMQ). *Clinical Psychology Review, 74*, 101785. https://doi.org/10.1016/j.cpr.2019.101785

Ciesla, J. A., Reilly, L. C., Dickson, K. S., Emanuel, A. S., & Updegraff, J. A. (2012). Dispositional mindfulness moderates the effects of stress among adolescents: Rumination as a mediator. *Journal of Clinical Child and Adolescent Psychology, 41*(6), 760–770. https://doi.org/10.1080/15374416.2012.698724

Cole, D. A., & Maxwell, S. E. (2003). Testing mediational models with longitudinal data: questions and tips in the use of structural equation modeling. *Journal of Abnormal Psychology, 112*(4), 558–577. https://doi.org/10.1037/0021-843X.112.4.558

Conley, C. S., Hilt, L. M., & Gonzales, C. H. (2023). Internalizing in adolescents and young adults. In L. J. Crockett, G. Carlo, & J. E. Schulenberg (Eds.), *APA handbook of adolescent and young adult development* (p. 478). American Psychological Association.

Conley, C. S., Raposa, E. B., Bartolotta, K., Broner, S. E., Hareli, M., Forbes, N., Christensen, K. M., & Assink, M. (2022). The impact of mobile technology-delivered interventions on youth well-being: Systematic review and 3-level meta-analysis. *Journal of Medical Internet Research Mental Health, 9*(7), e34254. https://doi.org/10.2196/34254

Craighead, W. E., Curry, J. F., & Ilardi, S. S. (1995). Relationship of children's depression inventory factors to major depression among adolescents. *Psychological Assessment*, *7*(2), 171–176. https://doi.org/10.1037/1040-3590.7.2.171

Cribb, G., Moulds, M. L., & Carter, S. (2006). Rumination and experiential avoidance in depression. *Behaviour Change, 23*(3), 165–176. https://doi.org/10.1375/bech.23.3.165

Desrosiers, A., Vine, V., Klemanski, D. H., & Nolen-Hoeksema, S. (2013). Mindfulness and emotion regulation in depression and anxiety: Common and distinct mechanisms of action. *Depression and Anxiety, 30*, 654–661. https://doi.org/10.1002/da.22124

Dunning, D. L., Griffiths, K., Kuyken, W., Crane, C., Foulkes, L., Parker, J., & Dalgleish, T. (2019). Research review: The effects of mindfulness-based interventions on cognition and mental health in children and adolescents–a meta-analysis of randomized controlled trials. *Journal of Child Psychology and Psychiatry, 60*(3), 244–258. https://doi.org/10.1111/jcpp.12980

Gu, J., Strauss, C., Crane, C., Barnhofer, T., Karl, A., Cavanagh, K., & Kuyken, W. (2016). Examining the factor structure of the 39-item and 15-item versions of the Five Facet Mindfulness Questionnaire before and after mindfulness-based cognitive therapy for people with recurrent depression. *Psychological Assessment, 28*(7), 791–802. https://doi.org/10.1037/pas0000263

Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd ed.). Guilford Press.

Hilt, L. M., Aldao, A., & Fischer, K. (2015). Rumination and multimodal emotional reactivity. *Cognition and Emotion, 29*(8), 1486–1495. https://doi.org/10.1080/02699931.2014.989816

Hilt, L. M., McLaughlin, K. A., & Nolen-Hoeksema, S. (2010). Examination of the response styles theory in a community sample of young adolescents. *Journal of Abnormal Child Psychology, 38*(4), 545–556. https://doi.org/10.1007/s10802-009-9384-3

Hilt, L. M., & Pollak, S. D. (2012). Getting out of rumination: Comparison of three brief interventions in a sample of youth. *Journal of Abnormal Child Psychology, 40*, 1157–1165. https://doi.org/10.1007/s10802-012-9638-3

Hilt, L. M., & Swords, C. M. (2021). Acceptability and preliminary effects of a mindfulness mobile application for ruminative adolescents. *Behavior Therapy, 52*(6), 1339–1350. https://doi.org/10.1016/j.beth.2021.03.004

Hilt, L. M., Swords, C. M., & Webb, C. A. (2023). Randomized controlled trial of a mindfulness mobile application for ruminative adolescents. *Journal of Clinical Child and Adolescent Psychology*. https://doi.org/10.1080/15374416.2022.2158840

Hilt, L. M., Vachhani, S., Vaghasia, N., Swords, C. M., & Sage, A. (2024). *Brief app-based mindfulness and mood monitoring intervention for first-year college students: A randomized controlled trial.* [Manuscript submitted for publication].

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice, 10*, 144–156. https://doi.org/10.1093/clipsy.bpg016

Klein, D. N., Dougherty, L. R., & Olino, T. M. (2005). Toward guidelines for evidence-based assessment of depression in children and adolescents. *Journal of Clinical Child & Adolescent Psychology*, *34*(3), 412–432.https://doi.org/10.1207/s15374424jccp3403_3

Koster, E. H., De Lissnyder, E., Derakshan, N., & De Raedt, R. (2011). Understanding depressive rumination from a cognitive science perspective: The impaired disengagement hypothesis. *Clinical Psychology Review, 31*(1), 138–145. https://doi.org/10.1016/j.cpr.2010.08.005

Kovacs, M. (1992). *Children's Depression inventory manual*. Multi-Health Systems.

Kross, E., Davidson, M., Weber, J., & Ochsner, K. (2009). Coping with emotions past: the neural bases of regulating affect associated with negative autobiographical memories. *Biological Psychiatry, 65*(5), 361–366. https://doi.org/10.1016/j.biopsych.2008.10.019

Lindsay, E. K., & Creswell, J. D. (2017). Mechanisms of mindfulness training: Monitor and Acceptance Theory (MAT). *Clinical Psychology Review, 51*, 48–59. https://doi.org/10.1016/j.cpr.2016.10.011

McKeen, H., Hook, M., Podduturi, P., Beitzell, E., Jones, A., & Liss, M. (2023). Mindfulness as a mediator and moderator in the relationship between adverse childhood experiences and depression. *Current Psychology, 42*(8), 6576–6586. https://doi.org/10.1007/s12144-021-02003-z

Medvedev, O. N., Norden, P. A., Krägeloh, C. U., & Siegert, R. J. (2018). Investigating unique contributions of dispositional

mindfulness facets to depression, anxiety, and stress in general and student populations. *Mindfulness, 9*(6), 1757–1767. https://doi.org/10.1007/s12671-018-0917-0

Moulds, M. L., Kandris, E., Starr, S., & Wong, A. C. (2007). The relationship between rumination, avoidance and depression in a non-clinical sample. *Behaviour Research and Therapy, 45*(2), 251–261. https://doi.org/10.1016/j.brat.2006.03.003

Mrazek, A. J., Mrazek, M. D., Cherolini, C. M., Cloughesy, J. N., Cynman, D. J., Gougis, L. J., Landry, A. P., Reese, J. V., & Schooler, J. W. (2019). The future of mindfulness training is digital, and the future is now. *Current Opinion in Psychology, 28*, 81–86. https://doi.org/10.1016/j.copsyc.2018.11.012

Neff, K. D., & Dahm, K. A. (2015). Self-compassion: What it is, what it does, and how it relates to mindfulness. In B. D. Ostafin, M. D. Robinson, & B. P. Meier (Eds.), *Handbook of mindfulness and self-regulation* (pp. 121–137). Springer.

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology, 100*(4), 569–582. https://doi.org/10.1037/0021-843X.100.4.569

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science, 3*(5), 400–424. https://doi.org/10.1111/j.1745-6924.2008.00088.x

Papageorgiou, C., & Wells, A. (2001). Metacognitive beliefs about rumination in recurrent major depression. *Cognitive and Behavioral Practice, 8*(2), 160–164. https://doi.org/10.1016/S1077-7229(01)80021-3

Petrocchi, N., & Ottaviani, C. (2016). Mindfulness facets distinctively predict depressive symptoms after two years: The mediating role of rumination. *Personality and Individual Differences, 93*, 92–96. https://doi.org/10.1016/j.paid.2015.08.017

Querstret, D., Cropley, M., & Fife-Schaw, C. (2017). Internet-based instructor-led mindfulness for work-related rumination, fatigue, and sleep: Assessing facets of mindfulness as mechanisms of change. A randomized waitlist control trial. *Journal of Occupational Health Psychology, 22*(2), 153–169. https://doi.org/10.1037/ocp0000028

Raes, F., & Williams, J. M. (2010). The relationship between mindfulness and uncontrollability of ruminative thinking. *Mindfulness, 1*(4), 199–203. https://doi.org/10.1007/s12671-010-0021-6

Royuela-Colomer, E., & Calvete, E. (2016). Mindfulness facets and depression in adolescents: Rumination as a mediator. *Mindfulness, 7*(5), 1092–1102. https://doi.org/10.1007/s12671-016-0547-3

Royuela-Colomer, E., Fernández-González, L., & Orue, I. (2021). Longitudinal associations between internalizing symptoms, dispositional mindfulness, rumination and impulsivity in adolescents. *Journal of Youth and Adolescence, 50*(10), 2067–2078. https://doi.org/10.1007/s10964-021-01476-2

Schoemann, A. M., Boulton, A. J., & Short, S. D. (2017). Determining power and sample size for simple and complex mediation models. *Social Psychological and Personality Science, 8*(4), 379–386. https://doi.org/10.1177/1948550617715068

Segal, Z.V., Williams, J. M. G., &, Teasdale, J. D. (2013). Mindfulness-based cognitive therapy for depression: A new approach to preventing relapse. (2nd). Guildford Press.

Shahar, B., Britton, W. B., Sbarra, D. A., Figueredo, A. J., & Bootzin, R. R. (2010). Mechanisms of change in mindfulness-based cognitive therapy for depression: Preliminary evidence from a randomized controlled trial. *International Journal of Cognitive Therapy, 3*(4), 402–418. https://doi.org/10.1521/ijct.2010.3.4.402

Shaw, Z. A., Hilt, L. M., & Starr, L. R. (2019). The developmental origins of ruminative response style: An integrative review. *Clinical Psychology Review, 74*, 101780. https://doi.org/10.1016/j.cpr.2019.101780

Stekhoven, D. J., & Bühlmann, P. (2012). MissForest—non-parametric missing value imputation for mixed-type data. *Bioinformatics*, 28(1), 112–118. https://doi.org/10.1093/bioinformatics/btr597

Svendsen, J. L., Schanche, E., Vøllestad, J., Visted, E., Jentschke, S., Karl, A., Binder, P., Osnes, B., & Sørensen, L. (2022). Self-compassion and its association with ruminative tendencies and vagally mediated heart rate variability in recurrent major depression. *Frontiers in Psychology, 13*, 798914. https://doi.org/10.3389/fpsyg.2022.798914

Swords, C. M., & Hilt, L. M. (2021). Examining the relationship between trait rumination and mindfulness across development and risk status. *Mindfulness, 12*(8), 1965–1975. https://doi.org/10.1007/s12671-021-01654-0

Thompson, J. S., Jamal-Orozco, N., & Hallion, L. S. (2022). Dissociable associations of facets of mindfulness with worry, rumination, and transdiagnostic perseverative thought. *Mindfulness, 13*(1), 80–91. https://doi.org/10.1007/s12671-021-01747-w

Tomlinson, E. R., Yousaf, O., Vittersø, A. D., & Jones, L. (2018). Dispositional mindfulness and psychological health: A systematic review. *Mindfulness, 9*, 23–43. https://doi.org/10.1007/s12671-017-0762-6

Tumminia, M. J., Colaianne, B. A., Roeser, R. W., & Galla, B. M. (2020). How is mindfulness linked to negative and positive affect? Rumination as an explanatory process in a prospective longitudinal study of adolescents. *Journal of Youth and Adolescence, 49*(10), 2136–2148. https://doi.org/10.1007/s10964-020-01238-6

Van Dam, N. T., Van Vugt, M. K., Vago, D. R., Schmalzl, L., Saron, C. D., Olendzki, A., Meissner, T., Lazar, S. W., Kerr, C. E., Gorchov, J., Fox, K. C. R., Field, B. A., Britton, W., Brefcynzki-Lewis, J. A., & Meyer, D. E. (2018). Mind the hype: A critical evaluation and prescriptive agenda for research on mindfulness and meditation. *Perspectives on Psychological Science, 13*(1), 36–61. https://doi.org/10.1177/1745691617709589

Van den Hurk, P. A., Van Aalderen, J. R., Giommi, F., Donders, R. A., Barendregt, H. P., & Speckens, A. E. (2012). An investigation of the role of attention in mindfulness-based cognitive therapy for recurrently depressed patients. *Journal of Experimental Psychopathology, 3*(1), 103–120. https://doi.org/10.5127/jep.0248

Van der Velden, A. M., Kuyken, W., Wattar, U., Crane, C., Pallesen, K. J., Dahlgaard, J., Fjorback, L. O., & Piet, J. (2015). A systematic review of mechanisms of change in mindfulness-based cognitive therapy in the treatment of recurrent major depressive disorder. *Clinical Psychology Review, 37*, 26–39. https://doi.org/10.1016/j.cpr.2015.02.001

Villa, C.D., &, Hilt, L. M. (2014). Brief instruction in mindfulness and relaxation reduce rumination differently for men and women. *International Journal of Cognitive Therapy*, *7*, 320–333. https://doi.org/10.1521/ijct_2014_07_02

Watkins, E. R., & Roberts, H. (2020). Reflecting on rumination: Consequences, causes, mechanisms and treatment of rumination. *Behaviour Research and Therapy, 127*, 103573. https://doi.org/10.1016/j.brat.2020.103573

Westbrook, C. A., Dutcher, J., Kusmierski, S., Creswell, J. D., Akpan, E., & Hallion, L. S. (2023). Neural correlates of mindful disengagement from worry. *Journal of Psychopathology and Clinical Science, 132*(1), 38–50. https://doi.org/10.1037/abn0000804

Young, C., & Dietrich, M. (2014). Screening for rumination and brooding may be a feasible method of identifying adolescents at high risk for depression. *Journal of Pediatric Nursing, 29*(6), 688–695. https://doi.org/10.1016/j.pedn.2014.04.010

Zainal, N. H., & Newman, M. G. (2023). Mindfulness enhances cognitive functioning: A meta-analysis of 111 randomized controlled trials. *Health Psychology Review*. https://doi.org/10.1080/17437199.2023.2248222