How is Mindfulness Linked to Negative and Positive Affect? Rumination as an Explanatory Process in a Prospective Longitudinal Study of Adolescents

Michael J. Tumminia
School of Education
University of Pittsburgh
Pittsburgh, PA
ORCID ID: 0000-0001-5962-481X

Blake A. Colaianne, MEd
Department of Human Development and Family Studies
Penn State University
University Park, PA
ORCID ID: 0000-0001-5111-5527

Brian M. Galla, PhD
School of Education
University of Pittsburgh
Pittsburgh, PA
ORCID ID: 0000-0003-4895-6311

Robert W. Roeser, PhD
Department of Human Development and Family Studies
Penn State University
University Park, PA
ORCID ID: 0000-0003-3326-5921

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Abstract

Research shows greater mindfulness is associated with less negative affect and more positive affect. Fewer studies have examined the mediating psychological processes linking mindfulness to these outcomes in adolescents. This three-wave, prospective longitudinal study examines rumination—the tendency to engage in repetitive and negative self-focused thinking—as one potential explanatory process. High school students (N = 599, Mage = 16.3 years; 49% girls) completed a short-form version of the Five Facet Mindfulness Questionnaire, in addition to self-report measures of rumination and negative and positive affect three times over the course of a school year. Autoregressive, cross-lagged panel models tested reciprocal, prospective associations between mindfulness, rumination, and negative and positive affect, while accounting for prior levels of each construct, within-wave covariances, and gender and grade level. The results showed that the nonjudgment mindfulness facet (and the total mindfulness score) predicted cross-wave reductions in rumination, that in turn predicted cross-wave reductions in negative affect. No evidence for mediation was found for positive affect, or for any of the other mindfulness facets (describe, acting with awareness, and nonreactivity). This study provides suggestive evidence that individual differences in mindfulness, and in particular nonjudgmental acceptance, prospectively predict less negative affect through lower rumination.

Introduction

Adolescence is a developmental period of heightened stress and emotional volatility, attributable to an array of environmental influences and normative changes in brain systems (Powers and Casey 2015). It is also a period of increased risk for mental health problems, especially among girls (Merikangas et al. 2010). A growing body of research suggests that mindfulness is associated with adaptive stress coping (Zenner et al. 2014), and lower negative affect and greater positive affect (Galla 2016). Yet few studies have examined if specific coping processes mediate the cross-time relations between mindfulness and affect. This study focuses on rumination, defined as the tendency to engage in unconstructive repetitive thought implicating the self in relation to life stressors, as one potential coping process that may mediate the association between mindfulness and affect in adolescents. The hypothesis tested is that more mindful adolescents are better able to disengage from ruminating about life stressors, and therefore, favorably shape their affective experience in an on-going way (Amada and Shane 2019). The current study used a yearlong, three-wave longitudinal dataset to examine cross-time associations between individual differences in mindfulness, rumination, and affect, and specifically, whether rumination mediates the association between mindfulness and affect in a community sample of high school-aged adolescents.

In the psychological research literature, mindfulness is commonly defined as a mental faculty involving two interrelated, but distinct components: the self-regulation of attention and an acceptance of present moment experience (Bishop et al. 2004). The attention component denotes a wakeful and conscious observing of immediate subjective experience (e.g., thoughts, emotions, bodily sensations), and the acceptance component refers to a nonjudgmental and nonreactive orientation toward whatever happens to arise in conscious awareness. Mindfulness is

viewed both as a set of mental faculties whose expression varies naturally across individuals (Brown and Ryan 2003)andasa skill that can be cultivated through various meditative practices (Analayo 2004). The current investigation focused on individual differences in mindfulness and utilized a short-form version of the Five Facet Mindfulness Questionnaire (Baer et al. 2006) previously validated in high school-age adolescents (Abujaradeh et al. 2020). The Five Facet Mindfulness Questionnaire captures facets of attention regulation (Acting with Awareness, Observing) and acceptance (Nonjudgment, Nonreactivity), and facets related to the labeling of internal experiences with words (Describe).

Prior cross-sectional research in adolescent samples suggests that greater mindfulness—as assessed via selfreport questionnaires—reliably negatively correlates with negative affect (e.g., Brown et al. 2011), and positively correlates with positive affect (e.g., Ciarrochi et al. 2011). Longitudinal studies have extended these cross-sectional studies to test the prospective relationships between mindfulness and negative and positive affect. These studies indicate that individual differences in mindfulness predict cross-time reductions in negative affect and depressive symptoms and increases in positive affect, across several weeks (Ciesla et al. 2012), months (Galla et al. 2020; Royuela-Colomer and Calvete 2016), and even up to one (Ciarrochi et al. 2011) and 2 years later (Calvete et al. 2019). However, less work has been devoted to understanding the mediating processes that might account for these associations.

One potential process through which mindfulness might impact such outcomes is rumination. Rumination is defined as a maladaptive form of coping that involves repetitively and passively focusing on negative feelings and thoughts (Skinner et al. 2013), particularly regarding the self in the face of difficult or stressful life experience. Rumination is an effort on the part of the individual to understand the causes and consequences of such experiences (NolenHoeksema

1991). However, by fixating on unpleasant feelings and implicating a flawed self as a cause of the difficulty, engaging in rumination actually exacerbates and perpetuates negative affect (Moberly and Watkins 2008) and reduces positive affect (Feldman et al. 2008).

Understood properly as unconstructive, repetitive thought (Watkins 2008), rumination is in some ways a conceptual opposite of mindfulness, such that an aware (e.g., intentional), attentive, and nonjudgmental acceptance of experience should serve to disengage from the tendency to dwell on and repetitively judge and react to thoughts and feelings implicating the self in relation to difficult life experiences. Specifically, those who are more mindful should be more likely to (a) notice that their attention has been captured by a repetitive cycle of judgment and selfrecrimination, and also (b) adopt a more compassionate and kind, rather than critical and condemnatory, relation to an on-going stream of unpleasant feelings and thoughts. Indeed, research with adult samples suggests that individuals who report greater mindfulness have lower levels of rumination that, in turn, predicts lower depressive symptoms (Desrosiers et al. 2013; Jury and Jose 2019).

Despite theoretical arguments linking mindfulness to rumination in adolescents, the evidence is mixed with regard to its mediating role on affect. Two longitudinal studies with adolescents have investigated rumination as a process linking mindfulness with negative affect (Ciesla et al. 2012; Royuela-Colomer and Calvete 2016). In one prospective study, adolescents self-reported their mindfulness using acting with awareness, nonjudgment, and nonreactivity facets of the Five Facet Mindfulness Questionnaire, and then completed self-report measures of stress frequency (e.g., “How many major stressful events occurred in your life today?”), dysphoric affect (e.g., sad, blue, unhappy), and rumination for seven consecutive days (Ciesla et al. 2012). A series of multilevel regression models revealed that individual differences in

nonjudgment and nonreactivity predicted lower daily dysphoric affect through less rumination. This study offered the first evidence that rumination might explain the relationship between mindfulness and negative affect in adolescents.

A more recent study examined whether rumination mediated the relationship between mindfulness and depressive symptoms over a 4-month period (RoyuelaColomer and Calvete 2016). Adolescents completed the Five Facet Mindfulness Questionnaire at baseline, in addition to self-report measures of rumination and depressive symptoms at baseline and 4-month follow-up. Structural equation models showed that, controlling for baseline levels of rumination and depressive symptoms, nonreactivity and acting with awareness had direct effects on depression but not rumination. Thus, contrary to findings reported in Ciesla et al. (2012), no evidence for mediation was observed. Generally, methodological limitations of prior studies constrain conclusions that can be drawn. Though prior work has demonstrated temporal precedence between mindfulness and the outcome (e.g., depressive symptoms, dysphoric affect), neither study demonstrated temporal precedence for all three variables, while simultaneously controlling for prior levels. To establish such temporal precedence across the independent variable, the mediator, and the dependent variable, at least three time points are required (Cole and Maxwell 2003). The current study meets this requirement. Moreover, Ciesla et al. (2012)did not account for the shared variance among mindfulness facets, but instead examined each facet'sassociationswith rumination and dysphoric affect separately across multiple models (cf., Royuela-Colomer and Calvete 2016). Finally, both studies focused solely on negative affect outcomes, but did not examine how rumination may contribute to positive affect. On the one hand, rumination has been found to both increase negative affect and reduce positive affect, so one might expect rumination to mediate the associations of mindfulness with both. On the other

hand, reducing suffering may not be the same as increasing f lourishing (Seligman and Csikszentmihalyi 2000), so it is possible that rumination—which involves negative selffocus—may be more strongly associated with negative affect but less so with positive affect. The current study thus attempts to clarify the nature of these associations examined in prior work by establishing temporal precedence across all variables, by modeling mindfulness facets simultaneously to account for their covariation, and by examining both negative affect and positive affect as outcomes.

The Current Study

The current study tested rumination as a psychological process linking mindfulness to less negative affect and greater positive affect in high school-age adolescents. In this threewave longitudinal study spanning an entire academic year, students completed self-report questionnaires assessing mindfulness facets, rumination, and negative and positive affect. Drawing on three waves of data allowed the establishment of temporal precedence between the independent variable (mindfulness), mediator (rumination), and the dependent variables (negative and positive affect)—an important pre-condition for testing directional relationships (Cole and Maxwell 2003), and the first test of its kind in adolescent samples. Autoregressive, cross-lagged panel models were used to test the hypothesis that rumination would mediate the association between mindfulness and both negative and positive affect, while controlling for prior levels of all constructs, within-wave covariances, and demographic characteristics. The mediational hypothesis was examined using both the facets of mindfulness considered separately and when aggregated into a total mindfulness score.

Method

Participants

Data were collected from 599 adolescents (Mage= 16.27 years, SD=1.15, range=13.92–19.67) from a large suburban public high school in the Northeastern United States[1]. It was not feasible to include every enrolled student, so recruitment occurred through a random selection of teachers in each grade level. The aim was to capture a representative sample of the overall student population by recruiting between 110 and 150 students per grade. The sample size therefore reflects the maximum number of students who were eligible to participate and who did so within the allotted time provided by the school. According to self-reported demographic information, 80% of students identified as White and 49% identified as girls, which appears representative of the school's population based on publicly available data (National Center for Education Statistics 2018). Approximately 19% of the sample were freshmen (first-year students), 24% were sophomores (second-year students), 28% were juniors (third-year students), and 29% were seniors (fourth-year students).

Procedure

All procedures were approved by the University of Pittsburgh Human Research Protection Office. Prior to data collection, schools sent an informational letter to parents that also contained an opt-out permission form. Students provided assent during the first assessment. Students who were not available during the first assessment were still allowed to participate and were given one more opportunity to provide assent during the second assessment. This means that some students did not provide data for the study until later in academic year. Students were included in the analysis if they provided data during at least the first or second assessment wave (and thus provided assent). Students completed a battery of self-report questionnaires assessing

[1] Data from this project have been used in other papers (Abujaradeh et al. 2020; Colaianne et al. 2020), including the validation study of the short-form Five Facet Mindfulness Questionnaire employed in this analysis. The hypothesis tested here is novel and does not overlap with other papers drawn from this dataset.

mindfulness, rumination, and negative and positive affect (and other measures not reported here) three times during a single academic year. The three assessment waves, henceforth referred to as T1, T2, and T3, occurred in September, January, and April, respectively. Students accessed the survey on a secure website (Qualtrics Survey System) administered during normal school hours on school computers. Students' responses to a single attention check embedded in each survey ("For this question, select 'rarely true'") suggested they were mostly attentive when completing the survey (valid percent of "rarely true" responses: T1=89.8%; T2=84.7%; T3= 82.7%).

Measure

The measures reported here were central to testing our main hypotheses. Descriptive statistics for each measure, including alphas, are reported in Table 1.

Mindfulness. Students completed a 20-item short-form version of the Five Facet Mindfulness Questionnaire taken from prior research (Abujaradeh et al. 2020). This 20-itemmeasure assesses individual differences in five facets of mindfulness, including Acting with awareness("I find it difficult to stay focused on what's happening in the present"), Describe("I can usually describe how I feel at the moment in considerable detail"),Observe ("I pay attention to sensations, such as the wind in my hair or sun on my face"),Nonjudgment ("When I have distressing thoughts or images, I judge myself as good or bad depending on what the thought or image is about"), and Nonreactivity("In difficult situations, I can pause without immediately reacting"). A validation study using data from this study indicated that a four factor hierarchical model (excluding the Observe subscale and a single item from the Describe subscale) provided best fit to the data (Abujaradehetal.2020).Thus, the Observe subscale was excluded from analyses. Each facet was assessed using four items, except for Describe, which contained three items (item 32, "My natural tendency is to put my experiences into words,"was dropped due to a

low standardized factor load ing; see Abujaradehet al. 2020). This resulted in 15items in total. Items were rated from1= never or very rarely true to 5 = very often or always true. Each of the facet's items were averaged to compute a composite score; a total mindfulness score was computed by averaging all 15 items. Higher values indicated greater mindfulness.

Rumination. Students completed four items adapted from the Multidimensional Measure of Academic Coping (Skinner et al. 2013). Items (e.g., when something bad or stressful happens to me… "I keep thinking about it over and over") were endorsed from 1 = not at all true for me to 4 = very true for me. Items were averaged to compute a total rumination score, with higher values indicating more rumination.

Negative and positive affect. Students reported their negative and positive affect in the past week using the 10-item Positive and Negative Affectivity Schedule, Short Form (Mackinnon et al. 1999). Five items were used to capture negative affect (i.e., depressed, upset, scared, nervous, afraid) and five items were used to capture positive affect (i.e., alert, excited, enthusiastic, inspired, determined). Items were endorsed using a five-point scale from 1 = not at all to 5 = extremely. The negative affect items and the positive affect items were averaged separately to compute a total negative and positive affect score, respectively. Higher values indicated higher negative or positive affect.

Demographic characteristics. Students self-reported their gender and grade level. In analyses reported below, gender was scored using a dummy code, where boys served as the reference category (coded 0 = boy and 1 = girl), and grade level was scored as a continuous variable (1 = first year, 2 = second year, 3 = third year, 4 = fourth year).

Analytic Plan

To maximize statistical power (and avoid post hoc exclusions), all students who participated in the study were included in the analysis regardless of their degree of missing data. A total of 532 out of 599 (88.8%) students provided data for at least one key variable at T1; 539 (90.0%) students provided data for at least one variable at T2; and 470 students (78.5%) provided data for at least one key variable at T3. A total of 591 (98.7%) students provided data for all variables during at least one assessment wave, whereas 377 (62.9%) students provided data for all variables during all three assessment waves[2]. Participants who provided data for all variables during all three assessment waves did not differ significantly ($p < 0.05$) on mindfulness, rumination, or negative and positive affect compared to participants who did not provide full data. Proportion of full data did not differ significantly ($p < 0.05$) by gender (girls vs. boys; $\chi^2(1) = 0.06$, $p = 0.812$) or race (White vs. other races/ethnicities; $\chi^2(1) = 0.34$, $p = 0.561$). Proportion of full data did differ significantly by grade level ($\chi^2(3) = 29.61$, $p < 0.001$), with students in earlier grade levels being more likely to provide full data. Overall, 77.5–90.0% of data were available for key variables across assessment waves (see Table 1).

All analyses were conducted using Mplus v8.4 (Muthén and Muthén 1998–2017), with the exception of alphas and tests of demographic differences among variables, which were conducted using SPSS v26 (IBM Corp 2019). Students with missing data were included in all models by using full information maximum likelihood, which produces less biased estimates compared with conventional methods of dealing with missing data, such as listwise deletion (Schafer and Graham 2002). The sample for all analyses is 599. Model fit was assessed using common indices and their corresponding cutoffs, according to standard conventions

[2] As a robustness check, we reran the main analyses excluding the 8 (1.3%) students who did not provide at least one full wave of data during the study. Results of this reanalysis were substantively the same as those using the full sample.

(Schumacker and Lomax 2010). Values close to 0.90 or 0.95 for the comparative fit index (CFI) generally indicate good fit, and values of 0.05–0.08 for the root mean square error of approximation (RMSEA) generally indicate good fit.

The main hypothesis that rumination would mediate the associations between mindfulness and negative and positive affect was tested using autoregressive, cross-lagged panel models with 5000 bootstrapped samples and bias-corrected confidence intervals. Mediation is inferred when the 95% bootstrapped confidence interval of the indirect effect does not include zero (Preacher and Kelley 2011); significance levels were set to $p < 0.05$. In a single model, cross-lagged paths were specified between the four mindfulness facets (independent variables), rumination (mediator), and negative and positive (dependent variables), which estimated prospective associations of one variable on the others. Wave-to-wave stability (autoregressive) paths and within-wave covariances among all variables were also included. As discussed below, gender and grade level were also included as predictors of all T2 and T3 variables, and were allowed to covary with all T1 variables.

To enhance parsimony and interpretability (and to reduce model complexity), a series of models were tested where cross-lagged paths (M2), autoregressive paths (M3), T2 and T3 residual covariances (M4), and their combination (M5), were constrained to be time-invariant. These models were compared with a fully unconstrained baseline model (M1). Model comparisons were evaluated using chi-square difference tests, change in CFI, and change in RMSEA, where a non-significant chi-square difference test, $\Delta CFI \leq 0.01$, and $\Delta RMSEA \leq 0.015$ would indicate that the more restrictive model does not fit worse than the unrestricted model (Chen 2007). The more constrained (parsimonious) model was used if at least two of the three criteria were satisfied in a particular model comparison.

All analyses used the maximum likelihood (ML) estimator, because the robust maximum likelihood estimator (MLR) is not permitted in bootstrapped analysis in Mplus v8.4. Variables did not demonstrate evidence of substantial deviations from normality, with skewness (−0.27 to 0.77) and kurtosis (−0.82 to 0.56) values well within the −2 to 2 range that is conventionally considered to be acceptable (Field 2013).

Deidentified data and syntax to reproduce major findings are available on the Open Science Framework: https://osf.io/utqza/?view_only=9288bf0ed51643fa9dfeaaa044cc7630.

Results

Descriptive Statistics and Bivariate Correlations

Table 1 shows estimated means and standard deviations (using full information maximum likelihood), alphas, and available *n* for all variables. Bivariate correlations among variables, shown in Table 2, were in the expected directions: at each assessment wave, mindfulness facets were negatively correlated with rumination, *r*s = −0.16 to −0.46, and negative affect, *r*s = −0.29 to −0.54, and positively correlated with positive affect, *r*s = 0.06–0.34. Moreover, within-wave bivariate correlations were substantially greater in magnitude between rumination and negative affect, *rs* = 0.53–0.56, compared to correlations between rumination and positive affect, *rs* = −0.05 to −0.14.

Demographic differences in variables were examined next (see Online Resource for full results). Independent samples *t*-tests examining gender differences showed that girls reported lower T1 and T2 nonreactivity than boys did, but they did not differ significantly on any other mindfulness facets or the total mindfulness score during the three assessment waves. Girls also reported significantly higher rumination and negative affect during all three assessment waves compared to boys. No gender differences were found for positive affect during any assessment

wave. One-way ANOVAs revealed significant grade level differences for the T1 and T2 total mindfulness score, T1 positive affect, and T2 rumination. No grade level differences were found for rumination, negative affect, or positive affect during the remaining assessment waves (see Online Resource for full results of these tests of demographic differences). Given these differences, gender and grade level were entered as covariates in all models.

Autoregressive, Cross-Lagged Panel Model Mediation Analysis

Preliminary analysis revealed that each of the constrained models fit the data as well as the unconstrained model (see Table 3). Thus, for parsimony and interpretability results are reported from the most constrained model (M5) in which cross-lagged paths, autoregressive paths, and T2 and T3 within-wave residual covariances were time-invariant (T1 covariances were allowed to freely estimate).

The final model (depicted graphically in Fig. 1) provided acceptable fit to the data: $\chi^2(119) = 315.21$, $p < 0.001$, CFI = 0.955, RMSEA = 0.052. The Online Resource provides a complete reporting of the unstandardized and standardized path estimates, including 95% confidence intervals and *p* values. All autoregressive paths were significant, with standardized betas between 0.50 and 0.63, suggesting that each variable demonstrated cross-time stability.

Turning to the mediation analysis, the nonjudgment mindfulness facet prospectively predicted lower rumination ($b = -0.07$, SE = 0.03, $p = 0.034$), holding constant prior levels of all other mindfulness facets (describe, acting with awareness, nonreactivity), rumination, and negative and positive affect, in addition to gender and grade level. Levels of rumination in turn prospectively predicted increased negative affect ($b = 0.12$, SE = 0.03, $p < 0.001$), thus mediating the association between nonjudgment and negative affect (unstandardized indirect effect = −0.008, 95% CI [−0.016, −0.001]). Levels of rumination did not predict positive affect

($b = -0.01$, SE = 0.03, $p = 0.697$); consequently, no evidence for mediation was found for rumination linking nonjudgment to positive affect (unstandardized indirect effect = 0.001, 95% CI [−0.003, 0.007]).

None of the other mindfulness facets significantly predicted lower rumination: describe ($b = -0.02$, SE = 0.03, $p = 0.395$), acting with awareness ($b = 0.00$, SE = 0.03, $p = 0.993$), or nonreactivity ($b = -0.05$, SE = 0.03, $p = 0.100$). Thus, no evidence was found for rumination as a mediator linking these mindfulness facets to either negative affect or positive affect.

Beyond tests of primary mediation hypotheses, the analysis revealed several other significant cross-lagged associations between mindfulness facets and outcomes. Levels of the nonreactivity mindfulness predicted increased positive affect ($b = 0.12$, SE = 0.04, $p = 0.004$). By contrast, levels of rumination prospectively predicted lower acting with awareness ($b = -0.12$, SE = 0.03, $p < 0.001$), nonjudgment ($b = -0.08$, SE = 0.04, $p = 0.016$), and nonreactivity ($b = -0.08$, SE = 0.03, $p = 0.003$). Levels of negative affect also predicted lower nonjudgment ($b = -0.10$, SE = 0.04, $p = 0.004$). Finally, mindfulness facets were themselves shown to predict other facets. Specifically, acting with awareness ($b = 0.05$, SE = 0.03, $p = 0.043$) and nonreactivity ($b = 0.07$, SE = 0.03, $p = 0.025$) each predicted higher describe.

Reanalysis Using the Total Mindfulness Score

Though the main analysis focused on treating mindfulness facets as four separate, but interrelated predictors of the mediator and outcomes, the data were reanalyzed using the total mindfulness score at each assessment wave (calculated as an average of all 15 mindfulness items). Model specifications were identical to those of the main analysis. Here again, the cross-lagged paths, auto-regressive paths, and T2 and T3 within-wave residual covariances were constrained to be time-invariant (see Online Resource for model comparisons and full reporting

of results). This model (depicted in Fig. S1) provided acceptable fit to the data: $\chi^2(38) = 126.35$, $p < 0.001$, CFI = 0.967, RMSEA = 0.062. Results of this reanalysis replicated those of the main analysis: levels of total mindfulness significantly predicted lower rumination ($b = -0.13$, SE = 0.05, $p = 0.008$), holding constant prior levels of rumination, and negative and positive affect, and gender and grade level. Levels of rumination in turn significantly predicted greater negative affect ($b = 0.12$, SE = 0.03, $p < 0.001$), thus mediating the association between total mindfulness and negative affect (unstandardized indirect effect = −0.016, 95% CI [−0.033, −0.005]). Rumination did not significantly predict positive affect ($b = -0.01$, SE = 0.04, $p = 0.713$), and so no evidence for mediation was observed in the association between total mindfulness and positive affect (unstandardized indirect effect = 0.001, 95% CI [−0.007, 0.011]).

Discussion

Mindfulness has been reliably linked to lower negative affect and greater positive affect (Galla 2016) and more effective coping (Zenner et al. 2014) during adolescence. Yet less research has examined whether mindfulness may be associated with affective outcomes through its connection to stress coping. The current investigation used data from a three-wave, longitudinal study with high school students to test the hypothesis that one of the reasons that adolescents with greater mindfulness experience better affective outcomes (operationalized in this study as lower negative affect and greater positive affect) is that they are less likely to ruminate about stressful life events and their presumed causes and implications.

Results of autoregressive, cross-lagged panel models with indirect effect analysis showed that higher levels of the nonjudgment mindfulness facet prospectively predicted longitudinal reductions in rumination that, in turn, prospectively predicted longitudinal reductions in negative

affect. These results were observed while holding constant the other mindfulness facets (acting with awareness, describe, nonreactivity), prior levels of rumination and negative and positive affect, within-wave covariances among variables, and gender and grade level. None of the other mindfulness facets were shown to prospectively predict rumination, despite significant within-wave correlations. Moreover, and contrary to expectations, rumination did not predict positive affect. Replicating the nonjudgment findings, significant mediation for negative affect was observed in analyses using a total mindfulness score, rather than treating the facets as separate simultaneous predictors.

Overall, the results of this study suggest that adolescents with greater mindfulness experience less rumination and negative affect over the course of one school year. Prior research in adolescent samples has been equivocal with regard to these associations, with one study finding evidence for mediation (Ciesla et al. 2012) and another not (Royuela-Colomer and Calvete 2016). The current study provided a strong empirical test of mediation, in that it was able to establish temporal precedence, and thus directional relations, across mindfulness facets, rumination, and negative affect, while also controlling for prior levels of all variables.

The results also add theoretical clarity to the specific mindfulness facets that predict rumination. Only the nonjudgment facet was shown to longitudinally predict rumination. Rumination involves an unconstructive repetitive judging of thoughts, as well as an over-identification with thoughts (Watkins 2008). Such an orientation to experience (measured with items such as, “when something stressful happens, I just can’t stop thinking about it”) is the conceptual opposite to the nonjudgment facet of mindfulness, in which an on-going stream of unpleasant feelings and beliefs trigged by difficult life events can be acknowledged and accepted as is without further elaboration. This idea aligns with emerging theories of mindfulness on the

central role that nonjudgmental acceptance plays in effective stress coping (Lindsay and Creswell, 2017). Consistent with a previous longitudinal study with adolescents (Ciesla et al. 2012), the acting with awareness facet, which captures conscious self-regulation of attention, did not predict rumination. Likewise, neither describe nor nonreactivity predicted rumination, and when taken together, these results suggest that nonjudgment and the items used to capture it (e.g., "I criticize myself for having irrational or inappropriate emotions" [reverse coded]) may offer a direct antidote to rumination.

These basic developmental findings lend additional support to current efforts to implement universal mindfulness programs in secondary schools in order to strengthen mindfulness and reduce rumination and depressive symptoms during a period when these increase substantially, especially among girls (Raes et al. 2014). Our results are also generally consistent with intervention research showing that mindfulness-based training programs can reduce rumination and negative affect in adolescents (Sibinga et al. 2016). Specific recommendations for practice are not warranted from the present results, but insofar as nonjudgment is related to adaptive stress coping (in the form of less rumination) and subsequent negative affect during adolescence, then mindfulness programs that focus on helping adolescents cultivate the skill of nonjudgment could be beneficial. Future studies could also test whether training in nonjudgmental acceptance is especially beneficial for youth who are prone to ruminating in response to difficult and stressful experiences.

Results also revealed reciprocal relations between mindfulness, rumination and negative affect. That is, mindfulness showed prospective, directional associations on rumination and negative affect as discussed above, and rumination and negative affect also showed prospective, directional associations on adolescents' subsequent mindfulness. These findings might reflect the

complex developmental processes involving increased coordination of so-called "top-down" regulatory systems and "bottom-up" affective, motivational systems that are occurring during adolescence (e.g., Burkhouse et al. 2017). Thus, the expression of mindfulness, which is presumably supported by cognitive control regulatory process (Tang et al. 2015), both influences and is influenced by bottom-up processes of emotional and cognitive reactivity during adolescence, and our findings show how negative affect and the tendency to repetitively dwell on and react to negative feelings and thoughts (e.g., rumination) could hinder adolescents' subsequent ability to maintain and deploy sustained attention in a nonjudgmental manner toward present moment experiences. Again, these findings suggest ruminative and other coping processes as malleable targets for intervention in mindfulness-based programs for adolescents (Roeser and Pinela 2014).

Results (described in Online Resource) also showed that girls reported greater rumination and negative affect than boys, as might be expected based on prior literature (Jose and Brown 2008; Merikangas et al. 2010). The complexity of structural equation models and concerns about adequate sample size restricted testing gender differences in the hypothesized mediation model. Despite mean-level differences between girls and boys, however, prior research has not found clear evidence for differential structural relationships between mindfulness, rumination, and affective outcomes (Royuela-Colomer and Calvete 2016). This would suggest that the basic mechanistic framework tested here is invariant with respect to gender, but future research with larger samples should test this directly.

Why did rumination mediate the association between mindfulness and negative affect, but not positive affect? Recall that while the nonjudgment facet (and the total mindfulness score) did predict lower rumination, rumination did not in turn predict positive affect. This suggests that

rumination may be more closely tied to feeling upset, scared, and depressed than to feeling excited, inspired, and determined. Indeed, bivariate correlations between rumination and negative affect were roughly four times greater in magnitude than correlations between rumination and positive affect. These results appear to affirm broader observations made previously (Seligman and Csikszentmihalyi 2000) that removing causes of suffering (e.g., rumination) may not be sufficient to simultaneously potentiate well-being. Insofar as greater mindfulness is associated with positive affect, then such an association may depend more on positive mindsets, skills, or relationships. Future research can investigate whether other variables with known associations to youth flourishing, including value-behavior concordance (Warren and Wray-Lake 2017) and prosocial purpose (Yeager et al. 2014), might link mindfulness to positive affect.

Finally, data revealed that mindfulness facets support the development of other facets. Both acting with awareness and nonreactivity predicted longitudinal increases in describing skills 3 months later. It is possible that conscious self-regulation of attention and a nonreactive stance toward negative experiences allows adolescents to better process and articulate their experience, rather than getting "caught up" in thoughts and emotions. Understanding how the different subskills that constitute mindfulness development over the first three decades of life is another area in need of more research (Roeser and Eccles 2015).

This study has several limitations. The first is external validity. Though the gender and racial and ethnic characteristics of the current sample appeared representative of the school's population, the sample was racially and socioeconomically homogenous. Future studies should test whether the observed associations generalize to samples that do not share the demographic characteristics of the sample examined here. Moreover, though the analysis is rooted in theory

and prior research, the current results should be considered preliminary until they can be replicated using preregistered designs. Second, the results are based exclusively on self-report data, so it not possible to rule out that method effects may have inflated observed relationships among variables. Future studies could minimize this possibility by incorporating multi-method (e.g., ecological momentary assessments) and multi-informant assessments (e.g., teacher and parent reports) to corroborate self-report measures. Third, lower reliabilities of some mindfulness facets (describe with words, nonreactivity) may have underestimated the magnitude of associations with other variables. The replication of the primary mediation results using the total mindfulness scale somewhat mitigates the potential bias stemming from lower reliabilities of specific facets, but future research could utilize full scale mindfulness measures were feasible to increase reliability. Fourth, and finally, this study is correlational, thus causal inferences regarding the associations among mindfulness, rumination, and negative and positive affect are not warranted. Future experimental research is needed to test rumination as an explanatory process linking mindfulness training with greater affect in adolescents.

Conclusion

A growing body of research shows greater mindfulness is associated with less negative affect and more positive affect in adolescents. However, the psychological processes linking mindfulness to these outcomes remains unclear. The current study used data from a prospective, three-wave longitudinal study to test rumination as one explanatory process. The results showed that the association between the nonjudgment facet of mindfulness (and the total mindfulness score) and negative affect was mediated by reductions in rumination. In other words, high school students who were better able to observe difficult experiences with curiosity and openness were less likely to dwell upon the causes and consequences of such experiences, and as a result, they

were less upset, depressed, and nervous. No evidence for mediation was found for the other mindfulness facets or for positive affect as an outcome. Additional research is needed to examine alternative processes that might explain the associations between mindfulness and greater positive affect during adolescence. Understanding the psychological processes by which mindfulness influences affective outcomes can advance intervention efforts aimed at strengthening stress coping capacities and fostering greater resilience during adolescence.

References

Abujaradeh, H., Colaianne, B., Roeser, R. W., Tsukayama, E., & Galla, B. M. (2020). Evaluating a short-form five facet mindfulness questionnaire in adolescents: evidence for a four-factor structure and invariance by time, age, and gender. *International Journal of Behavioral Development*, *44*, 20–30. https://doi.org/10.1177/0165025419873039.

Amada, N. M., & Shane, J. (2019). Mindfulness as a promoter of adaptive development in adolescence. *Adolescent Research Review*, *4*(1), 93–112. https://doi.org/10.1007/s40894-018-0096-1.

Analayo. (2003). *Satipatthana: The direct path to realization*. Windhorse.

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*, 27-45. https://doi.org/10.1177/1073191105283504

Bishop, S. R., Lau, M., Shapiro, S. L., Carlson, L. E., Anderson, N. D., Carmody, J., Segal, Z. V., Abbey, S., Speca, M., Velting, D., & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice, 11*, 230-241. https://doi.org/10.1037/0033-2909.88.3.588

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*, 822-848. https://doi.org/10.1037/0022-3514.84.4.822

Brown, K. W., West, A. M., Loverich, T. M., & Biegel, G. M. (2011). Assessing adolescent mindfulness: Validation of an adapted mindful attention awareness scale in adolescent

normative and psychiatric populations. *Psychological Assessment, 23*, 1023-1033. https://doi.org/10.1037/a0021338

Burkhouse, K. L., Jacobs, R. H., Peters, A. T., Ajilore, O., Watkins, E. R., & Langenecker, S. A. (2017). Neural correlates of rumination in adolescents with remitted major depressive disorder and healthy controls. *Cognitive, Affective, & Behavioral Neuroscience, 17*(2), 394-405. https://doi.org/10.3758/s13415-016-0486-4

Calvete, E., Morea, A., & Orue, I. (2019, March 01). The role of dispositional mindfulness in the longitudinal associations between stressors, maladaptive schemas, and depressive symptoms in adolescents [journal article]. *Mindfulness, 10*, 547-558. https://doi.org/10.1007/s12671-018-1000-6

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling, 14*, 464-504. https://doi.org/10.1080/10705510701301834

Ciarrochi, J., Kashdan, T. B., Leeson, P., Heaven, P., & Jordan, C. (2011). On being aware and accepting: A one-year longitudinal study into adolescent well-being. *Journal of Adolescence, 34*, 695-703. https://doi.org/10.1016/j.adolescence.2010.09.003

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*, 760-770. https://doi.org/10.1080/15374416.2012.698724

Colaianne, B. A., Galla, B. M., & Roeser, R. W. (2020). Perceptions of mindful teaching are associated with longitudinal change in adolescents' mindfulness and

compassion. *International Journal of Behavioral Development*, *44*(1), 41–50. https://doi.org/10.1177/0165025419870864.

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

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

Feldman, G. C., Joormann, J., & Johnson, S. L. (2008). Responses to positive affect: A self-report measure of rumination and dampening. *Cognitive Therapy and Research, 32*(4), 507-525. https://doi.org/10.1007/s10608-006-9083-0

Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). SAGE Publications.

Galla, B. M. (2016). Within-person changes in mindfulness and self-compassion predict enhanced emotional well-being in healthy, but stressed adolescents. *Journal of Adolescence*, *49*, 204–217. https://doi.org/10.1016/j.adolescence.2016.03.016.

Galla, B. M., Tsukayama, E., Park, D., Yu, A., & Duckworth, A. L. (2020). The mindful adolescent: Developmental changes in nonreactivity to inner experiences and its association with emotional well-being. *Developmental Psychology*, *56*(2), 350–363. https://doi.org/10.1037/dev0000877.

IBM Corp. (2019). *IBM SPSS Statistics for Windows, Version 26*. IBM Corp.

Jose, P. E., & Brown, I. (2008). When does the gender difference in rumination begin? Gender and age differences in the use of rumination by adolescents. *Journal of Youth and Adolescence, 37*(2), 180-192. https://doi.org/10.1007/s10964-006-9166-y

Jury, T. K., & Jose, P. E. (2019). Does rumination function as a longitudinal mediator between mindfulness and depression? *Mindfulness, 10*, 1091-1104. https://doi.org/10.1007/s12671-018-1031-z

Lindsay, E. K., & Creswell, J. D. (2017, Feb). 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

Mackinnon, A., Jorm, A. F., Christensen, H., Korten, A. E., Jacomb, P. A., & Rodgers, B. (1999, 9//). A short form of the Positive and Negative Affect Schedule: evaluation of factorial validity and invariance across demographic variables in a community sample. *Personality and Individual Differences, 27*, 405-416. https://doi.org/10.1016/S0191-8869(98)00251-7

Merikangas, K. R., He, J.-p., Burstein, M., Swanson, S. A., Avenevoli, S., Cui, L., Benjet, C., Georgiades, K., & Swendsen, J. (2010). Lifetime prevalence of mental disorders in U.S. adolescents: Results from the National Comorbidity Survey Replication–Adolescent Supplement (NCS-A). *Journal of the American Academy of Child & Adolescent Psychiatry, 49*(10), 980-989. https://doi.org/10.1016/j.jaac.2010.05.017

Moberly, N. J., & Watkins, E. R. (2008, Sep). Ruminative self-focus, negative life events, and negative affect. *Behaviour Research and Therapy, 46*(9), 1034-1039. https://doi.org/10.1016/j.brat.2008.06.004

Muthén, L. K., & Muthén, B. O. (2017). *Mplus user's guide* (8th ed.). Muthén & Muthén.

National Center for Education Statistics. (2018). *Common Core of Data (CCD): Public school data 2015-16, 2017-18 school years*. https://nces.ed.gov/ccd/schoolsearch/index.asp

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

Powers, A., & Casey, B. J. (2015). The adolescent brain and the emergence and peak of psychopathology. *Journal of Infant, Child, and Adolescent Psychotherapy*, *14*(1), 3–15. https://doi.org/10.1080/15289168.2015.1004889.

Preacher, K. J., & Kelley, K. (2011). Effect size measures for mediation models: Quantitative strategies for communicating indirect effects. *Psychological Methods, 16*, 93-115. https://doi.org/10.1037/a0022658

Raes, F., Griffith, J., Van der Gucht, K., & Williams, J. M. (2014, 2014/10/01). School-based prevention and reduction of depression in adolescents: A cluster-randomized controlled trial of a mindfulness group program. *Mindfulness, 5*(5), 477-486. https://doi.org/10.1007/s12671-013-0202-1

Roeser, R. W., & Eccles, J. S. (2015). Mindfulness and compassion in human development: Introduction to the special section. *Developmental Psychology*, *51*, 1–6. https://doi.org/10.1037/a0038453.

Roeser, R. W., & Pinela, C. (2014). Mindfulness and compassion training in adolescence: a developmental contemplative science perspective. New Directions for Youth Development, *2014*(142), 9–30. https://doi.org/10.1002/yd.20094.Galla, B. M. (2016). Within-person changes in mindfulness and self-compassion predict enhanced emotional

well-being in healthy, but stressed adolescents. *Journal of Adolescence*, *49*, 204–217. https://doi.org/10.1016/j.adolescence.2016.03.016.

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

Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods, 7*, 147-177. https://doi.org/10.1037//1082-989X.7.2.147

Schumacker, R. E., & Lomax, R. G. (2010). *A beginner's guide to structural equation modeling* (3rd ed.). Routledge.

Seligman, M. E. P., & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. *American Psychologist, 55*, 5-14. https://doi.org/10.1037//0003-066X.55.1.5

Sibinga, E. M. S., Webb, L., Ghazarain, S. R., & Ellen, J. M. (2016). School-based mindfulness instruction: An RCT. *Pediatrics, 137*(1), 1-8. https://doi.org/10.1542/peds.2015-2532

Skinner, E., Pitzer, J., & Steele, J. (2013). Coping as part of motivational resilience in school: A multidimensional measure of families, allocations, and profiles of academic coping. *73*, 803-835. https://doi.org/10.1177/0013164413485241

Tang, Y.-Y., Holzel, B. K., & Posner, M. I. (2015). The neuroscience of mindfulness meditation. *Nature Reviews Neuroscience, 16*(4), 213-225. https://doi.org/10.1038/nrn3916

Warren, M. T., & Wray-Lake, L. (2017, Jul). Does mindfulness prepare adolescents for value-behavior concordance? Examining the role of value content. *Journal of Adolescence, 58*, 56-66. https://doi.org/10.1016/j.adolescence.2017.04.011

Watkins, E. R. (2008). Constructive and unconstructive repetitive thought. *Psychological Bulletin, 134*(2), 163-206. https://doi.org/10.1037/0033-2909.134.2.163

Yeager, D. S., Henderson, M., Paunesku, D., Walton, G. M., D'Mello, S., Spitzer, B. J., & Duckworth, A. L. (2014, October). Boring but important: A self-transcendent purpose for learning fosters academic self-regulation. *Journal of Personality and Social Psychology, 107*, 559-580. https://doi.org/10.1037/a0037637

Zenner, C., Herrnleben-Kurz, S., & Walach, H. (2014). Mindfulness-based interventions in schools: A systematic review and meta-analysis. *Frontiers in Psychology, 5*(603). https://doi.org/10.3389/fpsyg.2014.00603

Table 1

Estimated Sample Means, Standard Deviations, and Observed Alphas and Sample Size for each Variable (N = 599)

Variables	Estimated Mean	Estimated *SD*	Alpha	Available *n*
Describe T1	3.38	0.83	0.66	532
Acting with Awareness T1	3.06	0.90	0.88	532
Nonjudgment T1	3.67	0.88	0.81	532
Nonreactivity T1	3.17	0.74	0.62	532
Rumination T1	2.78	0.89	0.95	522
Negative Affect T1	2.36	0.87	0.85	524
Positive Affect T1	3.45	0.74	0.76	524
Describe T2	3.38	0.79	0.67	537
Acting with Awareness T2	2.95	0.87	0.86	538
Nonjudgment T2	3.55	0.93	0.85	536
Nonreactivity T2	3.11	0.71	0.61	537
Rumination T2	2.80	0.89	0.95	531
Negative Affect T2	2.46	0.89	0.85	532
Positive Affect T2	3.40	0.75	0.79	531
Describe T3	3.31	0.78	0.69	469
Acting with Awareness T3	2.93	0.86	0.85	469
Nonjudgment T3	3.56	0.92	0.88	468
Nonreactivity T3	3.17	0.72	0.68	468
Rumination T3	2.76	0.89	0.95	465
Negative Affect T3	2.49	0.89	0.87	464
Positive Affect T3	3.40	0.75	0.79	464

Notes: T1 = Time 1 (September), T2 = Time 2 (January), T3 = Time 3 (April); Rumination was on a 1 to 4 scale, all other variables are on a 1 to 5 scale; Auxiliary variables (gender and grade level) were included as missing data correlates.

Table 2

Bivariate Correlations (N = 599)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Describe T1																				
2. Acting with Awareness T1	**.29**																			
3. Nonjudgment T1	**.39**	**.34**																		
4. Nonreactivity T1	**.16**	**.21**	**.21**																	
5. Rumination T1	**-.22**	**-.30**	**-.43**	**-.33**																
6. Negative Affect T1	**-.29**	**-.37**	**-.51**	**-.29**	**.53**															
7. Positive Affect T1	**.24**	**.26**	.14	**.21**	**-.14**	**-.17**														
8. Describe T2	**.54**	**.31**	**.36**	**.23**	**-.23**	**-.29**	**.19**													
9. Acting with Awareness T2	**.18**	**.68**	**.31**	**.19**	**-.35**	**-.37**	**.13**	**.38**												
10. Nonjudgment T2	**.24**	**.24**	**.62**	**.15**	**-.33**	**-.39**	**.02**	**.35**	**.39**											
11. Nonreactivity T2	**.18**	**.25**	**.21**	**.56**	**-.35**	**-.30**	**.15**	**.22**	**.26**	**.18**										
12. Rumination T2	**-.19**	**-.26**	**-.40**	**-.28**	**.69**	**.50**	-.07	**-.30**	**-.42**	**-.46**	**-.32**									
13. Negative Affect T2	**-.19**	**-.31**	**-.40**	**-.20**	**.46**	**.66**	**-.09**	**-.31**	**-.44**	**-.49**	**-.30**	**.55**								
14. Positive Affect T2	**.11**	**.20**	.07	**.24**	**-.11**	**-.10**	**.50**	**.18**	**.23**	.06	**.27**	**-.09**	**-.14**							
15. Describe T3	**.54**	**.30**	**.30**	**.18**	**-.21**	**-.23**	**.22**	**.65**	**.29**	**.28**	**.20**	**-.25**	**-.24**	**.22**						
16. Acting with Awareness T3	**.19**	**.65**	**.30**	**.23**	**-.31**	**-.37**	**.17**	**.33**	**.66**	**.32**	**.21**	**-.36**	**-.36**	**.21**	**.39**					
17. Nonjudgment T3	**.31**	**.28**	**.62**	**.15**	**-.32**	**-.43**	**.11**	**.30**	**.33**	**.65**	**.14**	**-.40**	**-.43**	.07	**.39**	**.43**				
18. Nonreactivity T3	**.19**	**.22**	**.19**	**.44**	**-.29**	**-.24**	**.26**	**.21**	**.15**	**.17**	**.59**	**-.27**	**-.24**	**.26**	**.33**	**.23**	**.24**			
19. Rumination T3	**-.20**	**-.27**	**-.35**	**-.16**	**.56**	**.44**	**-.09**	**-.26**	**-.31**	**-.36**	**-.29**	**.68**	**.45**	-.07	**-.31**	**-.42**	**-.45**	**-.30**		
20. Negative Affect T3	**-.23**	**-.31**	**-.40**	**-.21**	**.42**	**.59**	**-.14**	**-.25**	**-.35**	**-.38**	**-.27**	**.46**	**.64**	**-.15**	**-.33**	**-.44**	**-.54**	**-.29**	**.56**	
21. Positive Affect T3	**.18**	**.18**	.08	**.18**	**-.10**	**-.10**	**.51**	**.12**	**.16**	.03	**.24**	-.08	**-.12**	**.60**	**.27**	**.18**	**.10**	**.34**	-.05	**-.19**

Notes: T1 = Time 1 (September), T2 = Time 2 (January), T3 = Time 3 (April); Bolded values are significant at $p < .05$.

Table 3

Fit Indices and Model Comparisons for the Primary Cross-Lagged Panel Model (N = 599)

	Model Fit Indices					Model Fit Comparisons				
Model (M)	χ^2	*df*	CFI	RMSEA	Model Comparisons	$\Delta\chi^2$	Δdf	*p*	ΔCFI	ΔRMSEA
M1: baseline	245.60	49	.955	.082						
M2: time-invariant cross-lagged paths	287.34	91	.955	.060	M2 vs. M1	41.74	42	.482	0.000	-0.022
M3: time-invariant autoregressive paths	261.39	56	.953	.078	M3 vs. M1	15.79	7	.027	-0.002	-0.004
M4: time-invariant residual covariances	267.12	70	.955	.069	M4 vs. M1	21.52	21	.428	0.000	-0.013
M5: M2 + M3 + M4	315.21	119	.955	.052	M5 vs. M1	69.61	70	.491	0.000	-0.030

Notes. χ^2 = chi-square; *df* = degrees of freedom; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; Δ = change in parameter. Gender and grade level were included as covariates.

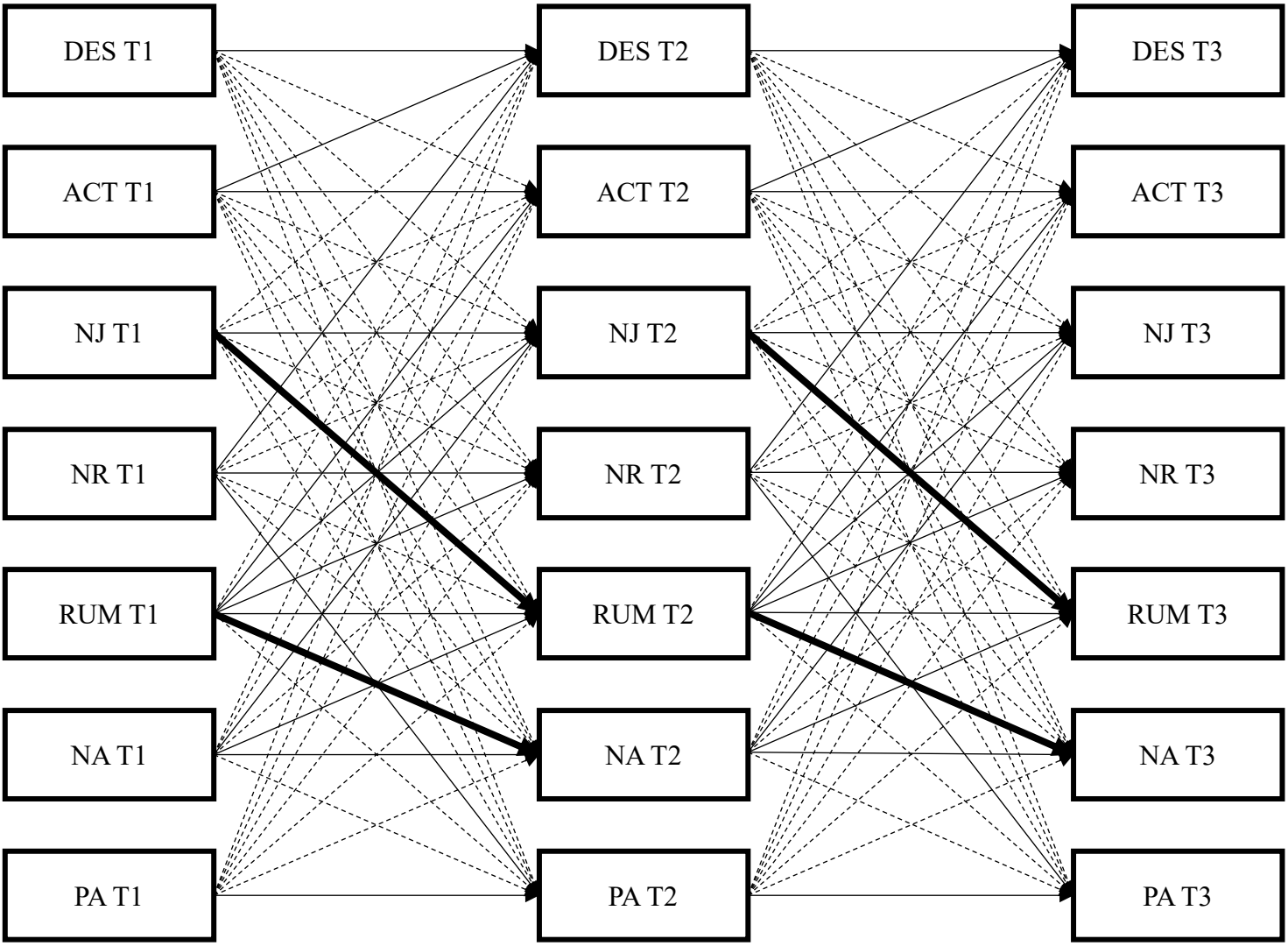

Figure 1. Autoregressive, cross-lagged panel model with mindfulness facets, rumination, and positive and negative affect. Cross-lagged paths, autoregressive paths, and T2 and T3 within-wave residual covariances were constrained to be time-invariant (T1 covariances were freely estimated). Within-wave covariances and covariates of gender and grade level were included (but are not displayed to ease presentation). DES = describe, ACT = acting with awareness, NJ = nonjudgment, NR = nonreactivity, RUM = rumination, NA = negative affect, and PA = positive affect. T1, T2, and T3 represent assessment waves one, two, and three, respectively. Solid lines represent paths that are significant at the $p < .05$ level; Dotted lines represent nonsignificant paths. Bolded lines represent a significant indirect effect.