



The Relationship Between Negative Affect, State Mindfulness, and the Role of Personality

Johannes A. Karl^{1,2} · Ronald Fischer^{1,3}

Accepted: 17 September 2022 / Published online: 10 October 2022

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2022

Abstract

Objectives Are affective states influencing state mindfulness and can this explain the link between personality and mindfulness? Mindfulness is commonly thought to decrease negative affect, but a number of studies have reported reductions in mindfulness in negative affect situations. This highlights a potential mechanism explaining previously observed negative relationships between individual differences such as Neuroticism and mindfulness, via their shared relationship with negative affect.

Methods In an experiment, 331 participants were exposed to a negative affect stimulus to investigate whether previously established relationships between Neuroticism, Behavioral Inhibition, and Mindfulness are due to differences in negative affect reactivity. It was expected that participants high on Neuroticism and Behavioral Inhibition to show greater negative affect reactivity which in turn would reduce their state Non-Judgmental Acceptance and Acting with Awareness.

Results While change in negative affect was related to lower Non-Judgmental Acceptance and Acting with Awareness, negative affect reactivity did not mediate the relationship between Neuroticism/BIS and these state mindfulness facets. Importantly, only Non-Judgmental Acceptance and Acting with Awareness facets of mindfulness were affected by negative affect change, but not Attention. This indicates that greater negative affect might require allocation of cognitive resources to stress-related processes such as threat monitoring, reducing mindful emotion processing but not attention.

Conclusions The current study found that situational mindfulness might be influenced by state affect highlighting the need to more strongly consider the environmental factors which can shape affect in mindfulness interventions.

Trial Registration Open Science Framework (<https://osf.io/kmyh2>).

Keywords Mindfulness · Affect · Personality · Reinforcement sensitivity · Neuroticism

Why are some individuals more mindful than others? While therapeutic approaches conceptualize mindfulness as a state that can be influenced by practice, mindfulness can also be thought of as a relatively stable individual difference variable that is involved in emotional processing (Baer et al., 2006). One of the unanswered questions is what may drive individual and temporal differences in mindfulness (Karl & Fischer, 2022). Recent definitions highlight the link between trait and state mindfulness: Trait mindfulness is generally

conceptualized as “the general tendency of a person to show characteristics of nonjudgmental awareness of present-moment experience in their everyday life” (Krägeloh, 2020, p. 64). This view of mindfulness is reflective of the whole trait theory (Fleeson, 2001; Fleeson & Jayawickreme, 2015) which views traits as mean descriptors of underlying density distributions of related states. In line with the whole trait theory, perspective studies have shown that changes in state mindfulness result in changes in trait mindfulness (Kiken et al., 2015), raising the question what influences fluctuations in state-mindfulness. Recent evidence suggests that affect may play a role (Suelmann et al., 2018), raising the possibility that temporary induced negative affect states can reduce individual’s ability to be mindful. In turn, this effect might provide a potential mechanism linking individual differences in personality, reinforcement sensitivity, and mindfulness.

✉ Johannes A. Karl
johannes.karl@dcu.ie

¹ Victoria University of Wellington, Wellington, New Zealand

² School of Psychology, Dublin City University,
Glasnevin, Dublin 9, Ireland

³ Instituto D’Or de Pesquisa & Ensino, Rio de Janeiro, Brazil

There are a range of measures capturing mindfulness as both a state and trait which allow us to make some progress in examining possible dynamics. In a joint factor-analysis of the items of various trait mindfulness scales, the Five Facet Mindfulness Questionnaire emerged (FFMQ, Baer et al., 2006). The FFMQ contains five facets thought to measure trait mindfulness: Observing (attending to or noticing internal and external experiences), Describing (ability to express in words one's experience), Acting with Awareness (attending to one's present moment activity), Non-Judging of inner experience (accepting thoughts and emotions), and Non-Reactivity to inner experience (ability to detach from thoughts and emotions). Accompanying these more stable trait measures, temporally transient state-like measures of mindfulness (such as the Multidimensional State Mindfulness Questionnaire: Blanke & Brose, 2017) were developed that assess state mindfulness as a multi-dimensional construct and which were shown to be aligned with their respective trait conceptualizations. In their work, they extracted three dimensions of state mindfulness, two of which (Acting with Awareness and Non-Judgmental Acceptance) were based on their respective FFMQ counterparts, whereas Present-Moment Attention was based on the Cognitive and Affective Mindfulness Scale (Feldman et al., 2007). Examining the empirical overlap between the MSMQ facets and their trait counterparts, Blanke and Brose (2017) found robust positive relationships. The MSMQ facets can therefore be considered state measurements of their corresponding trait counterparts, with the caveat that not all trait components within the FFMQ are being captured with this state measure.

Advancing the understanding of potential origins of trait mindfulness requires the integration of (a) previously observed correlations of personality and reinforcement sensitivity traits with trait mindfulness (Dolatyar & Walker, 2020; Giluk, 2009; Hanley & Garland, 2017; Karl & Fischer, 2019) and (b) observations that state differences may give rise to trait differences (Kiken et al., 2015). This integration is aligned with emerging insights from neuroscience (Friston & Kiebel, 2009). This predictive coding perspective suggests that computational limitations of the human brain require that individuals do not react to their unfiltered experience, but rather simulate the experience in advance and prepare the situationally appropriate response. This simulation process is shaped by a range of bottom-up factors such as biological differences in reinforcement sensitivity or differences in personality and top-down factors such as culturally normative expectations. In the case of mindfulness, the expectation is that the different experiences of situations shaped by underlying individual differences in emotion regulation result in differences in state mindfulness, which over time consolidate into stable trait differences of mindfulness.

Two personality trait models have received the widest research in their relation to mindfulness. First, the most widely employed conceptualization of personality is the Five Factor model (McCrae & Costa, 1996) which differentiates between five domains of personality: Neuroticism, Conscientiousness, Openness, Agreeableness, and Extraversion. Second, the reinforcement sensitivity theory (RST) focuses on biological differences in motivational systems which are thought to underlie other theories of personality such as the Five Factor Model of personality (Corr & Cooper, 2016). There are at least three major systems: the Behavioral Approach System (BAS), which is activated to obtain incentives; the Fight-Flight-Freeze System (FFFS), which is activated in response to immediate aversive stimuli; and the Behavioral Inhibition System (BIS), which is activated to avoid aversive stimuli and to process conflicts between equally valued goals (e.g., deciding on two equally attractive job offers). These two personality approaches have been shown to be linked both theoretically (Smits & Boeck, 2006) and empirically (Fischer & Karl, 2020). While all aspects of the RST and the Five Factor model show empirical relationships with mindfulness, the most commonly and most strongly associated aspects are BIS (Dolatyar & Walker, 2020; Karl & Fischer, 2019; Reese et al., 2015) and Neuroticism (Giluk, 2009), respectively.

Specifically, higher Neuroticism and BIS scores are associated with lower trait Non-Judging, Non-Reactivity, Acting with Awareness, and Describing. Individuals with higher levels of Neuroticism or BIS are more likely to experience anxiety and engage in rumination. This in turn taxes processing resources and reduces the ability of individuals to effectively regulate their emotions. Importantly, the expected negative relationship between Neuroticism and BIS on one side and mindfulness on the other side might be facet specific. For example, mindfulness facets such as Observing capture external attention in addition to internal attention. Beyond awareness to internal sensations, such as thirst, hunger, or tiredness and how such states may affect one's thoughts, Observing also includes awareness to external stimuli, such as sounds and smells. Higher Neuroticism and BIS entail heightened sensitivity to external stimuli that may signal threat (Drabant et al., 2011). Threat monitoring is a core motivational function of the BIS (Mathews & Mackintosh, 1998) and an important behavioral component of Neuroticism (Borghuis et al., 2020; Drabant et al., 2011; Norris et al., 2007; Robinson et al., 2007), with individuals high on either of the personality traits spending more time monitoring their environment and when encountering potentially threatening stimuli experiencing them as more threatening and higher in negative valence (Berenbaum & Williams, 1995; Canli et al., 2001; Larsen & Ketelaar, 1991; Thake & Zelenski, 2013). This perceptual bias towards both more extensive monitoring and more negatively evaluating

incoming information leads to consistently higher levels of negative affect for high BIS and Neuroticism individuals (Larsen & Ketelaar, 1991). Importantly, Neuroticism might increase negative affect due to both higher emotional reactivity and reduced emotion regulation (Kalokerinos et al., 2020).

Turning to Observing as part of Mindfulness, it has been argued that this facet is partially involved in external (and internal) threat monitoring and anxious arousal (Desrosiers et al., 2013). Because of these externally (and internally) oriented monitoring mechanisms, it is plausible to argue that Observing might share some empirical overlap with both BIS and Neuroticism. Indeed, previous studies investigating the relationship between Neuroticism, BIS, and Observing found weak positive relationships between these two personality constructs and the Observing facet of mindfulness (Karl & Fischer, 2019) and Observing has also shown positive relations with anxiety and hyper-arousal (Desrosiers et al., 2014; Raphiphatthana et al., 2016).

These processes have possible relevance for mindfulness interventions. While a reduction of negative affect is generally considered an outcome of mindfulness interventions (Schroevers & Brandsma, 2010), experience of negative affect might actually impact mindfulness. Indeed, state mindfulness has been found to be negatively related to negative affect (Suelmann et al., 2018). Importantly, negative affect appears to impact mindful state acceptance (Non-Reactivity) more strongly than observing of external and internal stimuli (Awareness of present-moment experience) (Suelmann et al., 2018). This differentiation might be due to capacity limitations in processing information when experiencing negative affect which leaves less resources available for cognitively demanding emotion regulation approaches such as exercising top-down control to be non-reactive. In contrast, negative affect does not affect the ability to pay attention to external stimuli and might even orient cognitive resources to external monitoring (Amstadter, 2008). Returning to the cognitive capacity limitations of the human brain and connecting it to the observations of Neuroticism/BIS/Mindfulness associations, the greater attention to possible threats coupled with the negative emotional reactivity component and limitations in processing the negative emotional information may lead to lower levels of Non-Reactivity. Overall, this implies the possibility that self-awareness and emotion regulation components of mindfulness might be negatively impacted by BIS and Neuroticism via temporally increased negative affect in specific situations. In other words, Neuroticism/BIS might predispose individuals to interpret incoming information as more threatening and greater in negative valence, which in turn reduces the ability of individuals to engage in Non-Judgmental Acceptance and Acting with Awareness, but not general Present-Moment Attention. Note that this approach takes a componential approach to

mindfulness, where changes in one facet may have follow-on effects for a second facet (Lindsay & Creswell, 2017).

The current study tests the proposed relationships between mindfulness, changes in negative emotional states, and their interaction with individual differences in personality traits in three main hypotheses. H1: Individuals with higher Neuroticism and BIS will report a greater increase in negative affect as result of a negative affect stimulus. In turn, H2: Greater negative affect as a consequence of the stimulus presentation will negatively predict Non-Judgmental Acceptance and Acting with Awareness but not Present Moment Attention. Bringing these hypotheses together, H3 predicted: Neuroticism/BIS will predict greater change in negative affect following the stress exposure, which in turn will predict lower Non-Judgmental Acceptance and Acting with Awareness.

Methods

Participants

Participants were recruited through an introductory course to psychology at a New Zealand university and received course credits for participation. We calculated the necessary effect size for testing our most complex hypothesis (H3) using a Monte-Carlo simulation (Schoemann et al., 2017) for a simple mediation case in which the interaction effect of Neuroticism/BIS and negative affect pre-intervention is mediated through negative affect post-intervention. While no prior research is available on the proposed model, we based our expected correlations on previous research (Suelmann et al., 2018; Thake & Zelenski, 2013) addressing the relationships between the individual variables. We assumed $r=0.20$ for the path between the interactive effect of pre-intervention Negative affect \times Neuroticism/BIS and negative affect post-intervention. For the path between negative affect post-intervention and Non-Judgmental Acceptance, we assumed $r=-0.30$. We assumed complete mediation and a standard deviation of all variables of 0.50. The simulation indicated that we would need a sample size of 214 participants to obtain a lower bound power of 0.80 to detect the mediation effect. Because our power analysis is based on approximations from previous research, we aimed to double the recommended sample size resulting in a target N of 428 to ensure sufficient power. Due to COVID-19, we were forced to end data collection early. We initially recruited 333 undergraduate students. We only selected participants that agreed to be exposed to potentially disturbing materials, such as a horror movie. Of the initial participants, 2 participants opted out of the study during the experiment. These participants were removed from the final data set. Our sample was largely female (71%) with an average age

of 19.34 years ($SD = 3.70$) and largely indicated no meditation (16.62%), yoga (18.73%), or mindfulness (30.51%) experience.

Procedure

Participants took part in the experiment in groups of maximally ten participants. Upon arriving in the laboratory and agreeing to participate, participants answered the personality (BFI-2) and reinforcement sensitivity (RST-PQ) trait measures as well as responded about their current emotional state (PANAS), and their state mindfulness (MSMQ). They then watched a clip that has been validated in previous research to induce negative affect (Blair Witch Project; 3:57 min Schaefer et al., 2010). As a manipulation check, all participants completed the PANAS a second time. The participants then played Tetris for 5 min as a filler task to obscure the intent of the study. Finally, they filled out another instance of the MSMQ. We show a flow diagram of the experiment in Fig. 1.

Measures

Negative Affect We assessed negative affect using the negative affect subscale of the PANAS (Thompson, 2007). Participants responded on a 1 to 5 Likert scale. The 10 items of the PANAS were prefaced by the statement: “Thinking about yourself and how you feel right now, to what extent do you feel [affect term].”

State Mindfulness We assessed state mindfulness using the Multidimensional State Mindfulness Questionnaire (Blanke & Brose, 2017). Participants responded on a 1 to 7 Likert scale. The items of the MSMQ at time one were prefaced by the statement: “Since waking up this morning...” and at time two by: “In the period since the last video....”

Neuroticism We assessed participants’ personality using the BFI-2 (Soto & John, 2017). Participants responded on a 1 to 5 Likert scale. The items of the BFI-2 were prefaced by the statement: “Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please

indicate for each statement the extent to which you agree or disagree with that statement. I am someone who....”

Behavioral Inhibition System We assessed participants’ reinforcement sensitivity using the RST-PQ (Corr & Cooper, 2016). Participants responded on a 1 to 4 Likert scale. The items of the RST-PQ were prefaced by the statement: “Below are a list of statements about everyday feelings and behaviors. Please rate how accurately each statement describes you in general. Do not spend too much time thinking about the questions and please answer honestly. Your answers will remain confidential.”

We report the reliability of all measures in Table 1 and the intercorrelation of all measures in Table 2. The measures showed good reliability.

Data Analyses

To test our hypotheses, we fitted three separate bivariate latent change score models for each of the mindfulness facets. Following recent recommendations (Cáncer et al., 2021; Kievit et al., 2018) in each model, we fixed the autoregression of variables to one and fixed the loading of each variable post exposure on their respective latent change factor to one. In each model, we estimated the self-feedback

Table 1 Reliability (Cronbach’s alpha and omega) coefficients at the different time-points

	α	ω
BIS	.915 [.902, .928]	.917 [.903, .930]
Neuroticism	.908 [.894, .923]	.911 [.896, .925]
Negative Affect T1	.776 [.737, .814]	.798 [.763, .832]
Negative Affect T2	.798 [.762, .835]	.844 [.817, .870]
Acting with Awareness T1	.649 [.583, .715]	.712 [.651, .772]
Acting with Awareness T2	.786 [.745, .826]	.800 [.764, .837]
Non-Judgmental Acceptance T1	.716 [.663, .769]	.723 [.672, .774]
Non-Judgmental Acceptance T2	.642 [.577, .708]	.671 [.613, .728]
Present Moment Attention T1	.825 [.791, .858]	.835 [.804, .865]
Present Moment Attention T2	.825 [.791, .858]	.835 [.804, .865]

α = Cronbach’s alpha reliability, ω = omega total reliability

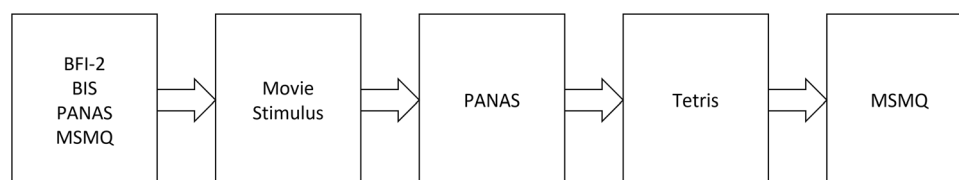


Fig. 1 Process diagram of the experiment. Note: BFI-2 — Big Five Inventory 2; BIS — Behavioral Inhibition System; PANAS — Positive Negative Affect Scale; MSMQ — Multidimensional State Mindfulness Questionnaire

Table 2 Intercorrelation of all measures

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9
1. Neuroticism	3.02	0.83									
2. BIS	2.72	0.55	.78**								
3. Acting with Awareness T1	3.7	1.33	-.21**	-.25**							
4. Non-Judgmental Acceptance T1	4.77	1.53	-.46**	-.50**	.30**						
5. Present-Moment Attention T1	4.57	1.1	-.25**	-.19**	.31**	.22**					
6. Negative Affect T1	1.75	0.74	.48**	.44**	-.27**	-.44**	-.12*				
7. Acting with Awareness T2	4.19	1.54	-0.08	-.14*	.11	.10	-.10	-.16**			
8. Non-Judgmental Acceptance T2	4.86	1.44	-.14*	-.23**	.13*	.31**	-0.03	-.30**	.46**		
9. Present-Moment Attention T2	4.75	1.39	-.14**	-.09	0	0.06	.12*	-0.09	.38**	.16**	
10. Negative Affect T2	1.96	0.79	.27**	.28**	-.13*	-.31**	0.02	.56**	-.26**	-.46**	-0.03

*** $p < .001$; ** $p < .01$; * $p < .05$

path and the cross-domain coupling between variables. To test the mediation, in each model, we predicted the negative affect change score by either Neuroticism or BIS. Finally, in each model, we predicted change in the respective mindfulness variable from the latent change in negative affect. In a supplementary analysis, we modeled the inverse relationship with mindfulness predicting negative affect change.

Results

We ran a manipulation check on negative affect to test whether our negative affect manipulation was effective. The mean of negative affect at time two was significantly higher ($g = -0.29 [-0.40, -0.18]$, $p < 0.001$ representing a small effect) after watching the video compared to before the video, indicating that our manipulation was effective in increasing negative affect.

Overall, we did not find support for our first hypothesis. Neither BIS nor Neuroticism significantly related to the rate of latent change in negative affect from pre- to post exposure (see Figs. 2 and 3). Supporting our second hypothesis, we found that greater latent change in negative affect was related to more negative latent change in mindfulness for all state facets, except Present-Moment Attention. Focusing on our third hypothesis, we did not find a significant mediation of either Neuroticism or BIS on Acting with Awareness, Non-Judgmental Acceptance, or Present-Moment Attention mindfulness states through negative affect changes. In addition, we examined the reversed effects of mindfulness change on negative affect change. We show these reversed effects in comparison to our main model in Table 3.

Examining the patterns beyond our hypotheses, we found that Present-Moment Attention at baseline was related to significantly greater negative affect change. Furthermore, examining the self-feedback paths, we found that higher baselines of each construct were related to significantly

lower rates of latent change in their respective constructs. To examine the possibility that differences in the baseline might be due to environmental circumstances at the start of the COVID-19 pandemic, we compared the overall negative affect score of our sample with a sample of 158 participants of a comparable population collected 1 year prior to the pandemic. Overall, we found that our current sample reported significantly greater negative affect at baseline compared to this sample prior to the pandemic ($\Delta\mu = 0.15$, 95% CI [0.02, 0.28], $t(336.92) = 2.23$, $p = 0.027$, $d = 0.21 [0.02, 0.40]$). We were unable to check whether these baseline differences influence change rates.

Discussion

This study aimed to contribute to a better understanding of possible mechanisms underlying the previously observed negative relationships between Neuroticism/BIS and mindfulness traits (Giluk, 2009; Reese et al., 2015). We studied mindfulness states before and after experimental manipulation of negative affect. Some support for our predictions was found implying that negative affect may influence mindfulness facets, but the overall mechanisms appear to be more complex.

The first prediction was that individuals high on BIS or Neuroticism would show a greater increase in negative affect from pre-intervention to post-intervention. This hypothesis was not supported. One likely reason might have been the already high level of negative affect for high Neuroticism and BIS individuals at the baseline. One plausible cause for this elevation might have been the perceived threat of the unfolding COVID-19 pandemic. In line with this possibility, we found elevated baseline levels of negative affect compared to a comparable cohort from a year earlier. Our experimental manipulation may not have been effective in raising negative affect in those that are already highly nervous about

Fig. 2 Bi-variate latent change score model including Neuroticism. Results are presented on separate lines (ordered from the top) for Acting with Awareness, Non-Judgmental Acceptance, and Present-Moment Attention. * $p < .05$, ** $p < .01$, *** $p < .001$

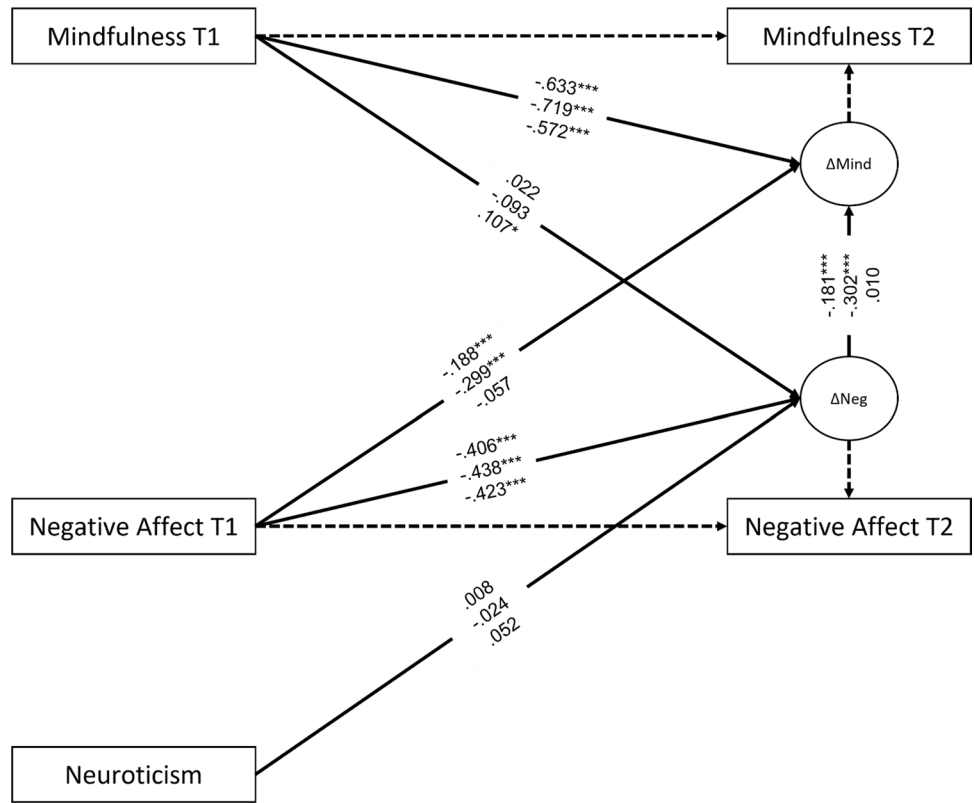


Fig. 3 Bi-variate latent change score model including BIS. Results are presented on separate lines (ordered from the top) for Acting with Awareness, Non-Judgmental Acceptance, and Present-Moment Attention. * $p < .05$, ** $p < .01$, *** $p < .001$

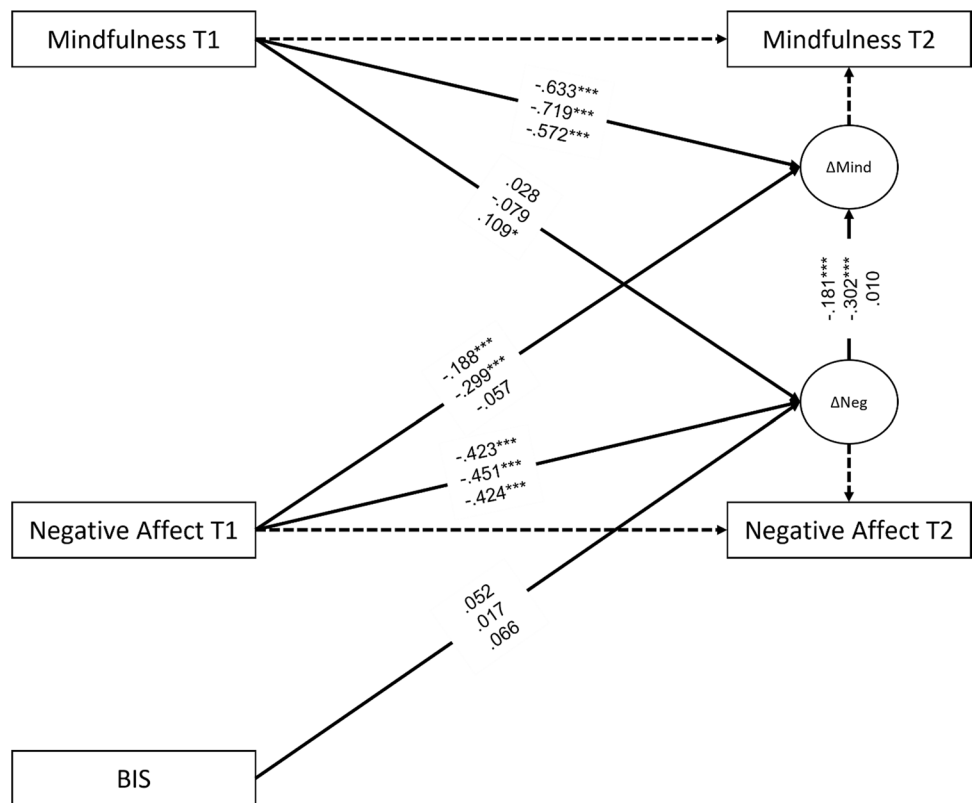


Table 3 Relationship between mindfulness change and negative affect change

	Mindfulness to negative affect	Negative affect to mindfulness
Neuroticism model		
Acting with Awareness	-.244 [-.369, -.119]	-.181 [-.273, -.090]
Non-Judging	-.422 [-.543, -.302]	-.302 [-.396, -.209]
Attention	.016 [-.113, .144]	.010 [-.095, .116]
BIS model		
Acting with Awareness	-.241 [-.365, -.117]	-.181 [-.273, -.090]
Non-Judging	-.422 [-.543, -.301]	-.302 [-.396, -.209]
Attention	.016 [-.112, .143]	.010 [-.095, .116]

the pandemic. However, the manipulation was overall successful in raising negative affect in the sample in general. It may be possible that individuals high in Neuroticism/BIS pay selective attention to contextually relevant information and that our stimulus was not relevant in the unfolding pandemic environment. Possible selectivity effects studied within the motivated cognition literature may require further attention for mindfulness research (Godfrey et al., 2020).

The second hypothesis focused on the effect of negative affect changes on mindfulness. In support of this hypothesis, greater latent change in negative affect was related to more negative latent change in mindfulness. Importantly, only changes in Non-Judgmental Acceptance and Acting with Awareness were negatively related to changes in negative affect, but not Present-Moment Attention. This finding was in line with predictions that individuals experiencing an increased state of negative affect would find it more difficult to be Non-Judgmentally Accepting towards those emotional states and show lower Acting with Awareness (Suelmann et al., 2018). Negative affect might orient individuals towards threatening stimuli leaving less cognitive resources for emotional processing (Milojevich et al., 2019). Interestingly, we also found the possibility of significant reverse paths with mindfulness change being negatively related to affect change in line with previous studies (Carpenter et al., 2019). This strongly suggests that the relationship between mindfulness and negative affect might not be uni-directional but rather reciprocal. Such reciprocal relationships have been reported between mindfulness and positive affect (Gotink et al., 2016), which may point towards more complex and interdependent processes between affective processing and mindfulness.

Finally, our third hypothesis about the proposed mediation process of personality on mindfulness via affective shifts in response to negative stimuli was not supported, which follows from the lack of support for our first hypothesis. Overall, the study shows that mindfulness states, especially facets capturing self-awareness (Acting with Awareness) and emotional processing (Non-Judgmentally Acceptance) appear to be related to negative affect, but that these patterns are unrelated to more stable personality differences.

Limitations and Future Research

The current study was limited by a reliance on a young adult sample with little meditation experience. A second limitation and outside of our experimental control is the context of our study, which coincided with the beginning of the COVID-19 pandemic. Our results suggest that participants had already elevated baseline stress, which might have obscured potential relations between personality and negative affect. Furthermore, as noted in our results, we found baseline effects on latent change across all variables. These effects may reflect a regression to the mean. For negative affect, due to ethical concerns, we had to include explicit warnings about the nature of the horror movie, which may have elevated negative affect scores for some individuals, especially for those high on Neuroticism and BIS, which in turn may have been masking any potential effects of individual differences on negative affect reactivity observed in previous studies (Thake & Zelenski, 2013). Together with the noted higher baseline levels compared to pre-pandemic populations, these temporal effects need further study. Additionally, while the MSMQ represents the state mindfulness measure which has the greatest overlap with the most commonly used multi-dimensional measure of trait mindfulness (the FFMQ), two trait facets (Observing and Non-Reactivity) are not captured by this state measure. This leaves questions about dimensions such as Observing and Non-Reactivity open for future research. Additionally, while we applied an experimental pre-post paradigm in our current study, it is still correlational and therefore is open to alternative explanations due to common methods bias (Podsakoff et al., 2012), which limits causal insights. In addition, future studies could build on the current study by expanding the current design to incorporate a control group which does not receive an affect manipulation to further untangle the observed effects. Finally, while a number of studies beyond ours have examined the relationship between mindfulness and affect over time (Gotink et al., 2016; Suelmann et al., 2018), these studies have generally found low levels of auto-correlation among mindfulness facets. These patterns raise questions about the temporal scale at which change takes

place. Future studies might utilize recent methodological developments in the field of network modeling (Burger et al., 2022) to disentangle the relationship between mindfulness and affect at the within-lagged, within-contemporaneous, and between-subjects levels to more clearly separate these levels.

Author Contribution JAK: designed the study, collected and analyzed the data, and wrote the paper. RF co-designed the study, informed the analysis, and co-wrote the paper.

Declarations

Informed Consent Ethical approval was given by the School of Psychology Human Ethics Committee under delegated authority of Victoria University of Wellington's Human Ethics Committee. All participants provided consent to the current study by responding to a consent question presented as part of the study in the affirmative.

Conflict of Interest The authors declare no competing interests.

Open Science Statement This study was pre-registered prior to the end of the data collection and analysis and our time-stamped predictions made available on the OSF (https://osf.io/kmyh2/?view_only=b34e990319454fd6b4d0a4c9a587d2a2). The pre-registered code, the code used in the analysis, and data to reproduce the analyses are freely available on the OSF (https://osf.io/ub8qg/?view_only=dde5666d3b8d4621be2e69a952204e79).

References

- Amstadter, A. (2008). Emotion regulation and anxiety disorders. *Journal of Anxiety Disorders*, 22(2), 211–221. <https://doi.org/10.1016/J.JANXDIS.2007.02.004>
- 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>
- Berenbaum, H., & Williams, M. (1995). Personality and emotional reactivity. *Journal of Research in Personality*, 29(1), 24–34. <https://doi.org/10.1006/JRPE.1995.1002>
- Blanke, E. S., & Brose, A. (2017). Mindfulness in daily life: A multidimensional approach. *Mindfulness*, 8(3), 737–750. <https://doi.org/10.1007/s12671-016-0651-4>
- Borghuis, J., Bleidorn, W., Sijtsma, K., Branje, S., Meeus, W. H. J., & Denissen, J. J. A. (2020). Longitudinal associations between trait neuroticism and negative daily experiences in adolescence. *Journal of Personality and Social Psychology*, 118(2), 348–363. <https://doi.org/10.1037/pspp0000233>
- Burger, J., Hoekstra, R. H. A., Mansueto, A. C., & Epskamp, S. (2022). *Network estimation from time series and panel data*. Routledge.
- Cáncer, P. F., Estrada, E., Ollero, M. J. F., & Ferrer, E. (2021). Dynamical properties and conceptual interpretation of latent change score models. *Frontiers in Psychology*, 12. <https://www.frontiersin.org/article/10.3389/fpsyg.2021.696419>
- Canli, T., Zhao, Z., Desmond, J. E., Kang, E., Gross, J., & Gabrieli, J. D. E. (2001). An fMRI study of personality influences on brain reactivity to emotional stimuli. *Behavioral Neuroscience*, 115(1), 33–42. <https://doi.org/10.1037/0735-7044.115.1.33>
- 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>
- Corr, P. J., & Cooper, A. J. (2016). The Reinforcement Sensitivity Theory of Personality Questionnaire (RST-PQ): Development and validation. *Psychological Assessment*, 28(11), 1427–1440. <https://doi.org/10.1037/pas0000273>
- Desrosiers, A., Klemanski, D. H., & Nolen-Hoeksema, S. (2013). Mapping mindfulness facets onto dimensions of anxiety and depression. *Behavior Therapy*, 44(3), 373–384. <https://doi.org/10.1016/j.beth.2013.02.001>
- Desrosiers, A., Vine, V., Curtiss, J., & Klemanski, D. H. (2014). Observing nonreactively: A conditional process model linking mindfulness facets, cognitive emotion regulation strategies, and depression and anxiety symptoms. *Journal of Affective Disorders*, 165, 31–37. <https://doi.org/10.1016/j.jad.2014.04.024>
- Dolatyar, K., & Walker, B. R. (2020). Reinforcement sensitivity theory and mindfulness. *Personality and Individual Differences*, 163(1), 110089. <https://doi.org/10.1016/j.paid.2020.110089>
- Drabant, E. M., Kuo, J. R., Ramel, W., Blechert, J., Edge, M. D., Cooper, J. R., Goldin, P. R., Hariri, A. R., & Gross, J. J. (2011). Experiential, autonomic, and neural responses during threat anticipation vary as a function of threat intensity and neuroticism. *NeuroImage*, 55(1), 401–410. <https://doi.org/10.1016/j.neuroimage.2010.11.040>
- Feldman, G., Hayes, A., Kumar, S., Greeson, J., & Laurenceau, J.-P. (2007). Mindfulness and emotion regulation: The development and initial validation of the Cognitive and Affective Mindfulness Scale-Revised (CAMS-R). *Journal of Psychopathology and Behavioral Assessment*, 29(3), 177–190. <https://doi.org/10.1007/s10862-006-9035-8>
- Fischer, R., & Karl, J. A. (2020). The network architecture of individual differences: Personality, reward-sensitivity, and values. *Personality and Individual Differences*, 160(1), 109922. <https://doi.org/10.1016/j.paid.2020.109922>
- Fleeson, W. (2001). Toward a structure- and process-integrated view of personality: Traits as density distributions of states. *Journal of Personality and Social Psychology*, 80(6), 1011–1027. <https://doi.org/10.1037/0022-3514.80.6.1011>
- Fleeson, W., & Jayawickreme, E. (2015). Whole trait theory. *Journal of Research in Personality*, 56, 82–92. <https://doi.org/10.1016/j.jrp.2014.10.009>
- Friston, K., & Kiebel, S. (2009). Predictive coding under the free-energy principle. *Philosophical Transactions of the Royal Society b: Biological Sciences*, 364(1521), 1211–1221. <https://doi.org/10.1098/rstb.2008.0300>
- Giluk, T. L. (2009). Mindfulness, Big Five personality, and affect: A meta-analysis. *Personality and Individual Differences*, 47(8), 805–811. <https://doi.org/10.1016/J.PAID.2009.06.026>
- Godfrey, H. K., Walsh, A. T., Fischer, R., & Grimshaw, G. M. (2020). The role of attentional control in cognitive deficits associated with chronic pain. *Clinical Psychological Science*, 8(6), 1046–1053. <https://doi.org/10.1177/2167702620925744>
- Gotink, R. A., Hermans, K. S. F. M., Geschwind, N., De Noij, R., De Groot, W. T., & Speckens, A. E. M. (2016). Mindfulness and mood stimulate each other in an upward spiral: A mindful walking intervention using experience sampling. *Mindfulness*, 7(5), 1114–1122. <https://doi.org/10.1007/s12671-016-0550-8>
- Hanley, A. W., & Garland, E. L. (2017). The mindful personality: A meta-analysis from a cybernetic perspective. *Mindfulness*, 8(6), 1456–1470. <https://doi.org/10.1007/s12671-017-0736-8>
- Kalokerinos, E. K., Murphy, S. C., Koval, P., Bailen, N. H., Crombez, G., Hollenstein, T., Gleeson, J., Thompson, R. J., Rycyeghem, D. M. L. V., Kuppens, P., & Bastian, B. (2020). Neuroticism may not

- reflect emotional variability. *Proceedings of the National Academy of Sciences*, 117(17), 9270–9276. <https://doi.org/10.1073/pnas.1919934117>
- Karl, J. A., & Fischer, R. (2019). Individual differences and mindfulness. *PsyArXiv*. <https://doi.org/10.31234/OSF.IO/Z2CX6>
- Karl, J. A., & Fischer, R. (2022). The state of dispositional mindfulness research. *Mindfulness*, 13(6), 1357–1372. <https://doi.org/10.1007/s12671-022-01853-3>
- Kievit, R. A., Brandmaier, A. M., Ziegler, G., van Harmelen, A.-L., de Mooij, S. M. M., Moutoussis, M., Goodyer, I. M., Bullmore, E., Jones, P. B., Fonagy, P., Lindenberger, U., & Dolan, R. J. (2018). Developmental cognitive neuroscience using latent change score models: A tutorial and applications. *Developmental Cognitive Neuroscience*, 33, 99–117. <https://doi.org/10.1016/j.dcn.2017.11.007>
- Kiken, L. G., Garland, E. L., Bluth, K., Palsson, O. S., & Gaylord, S. A. (2015). From a state to a trait: Trajectories of state mindfulness in meditation during intervention predict changes in trait mindfulness. *Personality and Individual Differences*, 81, 41–46. <https://doi.org/10.1016/j.paid.2014.12.044>
- Krätzeloh, C. (2020). Mindfulness research and terminology science. *마음 공부 Mindful Practice*, 1, 53–84.
- Larsen, R. J., & Ketelaar, T. (1991). Personality and susceptibility to positive and negative emotional states. *Journal of Personality and Social Psychology*, 61(1), 132–140. <https://doi.org/10.1037/0022-3514.61.1.132>
- 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>
- Mathews, A., & Mackintosh, B. (1998). A cognitive model of selective processing in anxiety. In *Cognitive therapy and research* (Vol. 22). Springer. <https://doi.org/10.1023/A:1018738019346>
- McCrae, R., & Costa, P. T. (1996). Toward a new generation of personality theories: Theoretical contexts for the Five-Factor Model. In J. S. Wiggins (Ed.), *The Five Factor Model of personality: Theoretical perspectives* (pp. 51–87). Guilford.
- Milojevich, H. M., Norwalk, K. E., & Sheridan, M. A. (2019). Deprivation and threat, emotion dysregulation, and psychopathology: Concurrent and longitudinal associations. *Development and Psychopathology*, 31(3), 847–857. <https://doi.org/10.1017/S0954579419000294>
- Norris, C. J., Larsen, J. T., & Cacioppo, J. T. (2007). Neuroticism is associated with larger and more prolonged electrodermal responses to emotionally evocative pictures. *Psychophysiology*, 44(5), 823–826. <https://doi.org/10.1111/j.1469-8986.2007.00551.x>
- Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology*, 63(1), 539–569. <https://doi.org/10.1146/annurev-psych-120710-100452>
- Raphiphatthana, B., Jose, P. E., & Kielpikowski, M. (2016). How do the facets of mindfulness predict the constructs of depression and anxiety as seen through the lens of the tripartite theory? *Personality and Individual Differences*, 93, 104–111. <https://doi.org/10.1016/j.paid.2015.08.005>
- Reese, E. D., Zielinski, M. J., & Veilleux, J. C. (2015). Facets of mindfulness mediate behavioral inhibition systems and emotion dysregulation. *Personality and Individual Differences*, 72, 41–46. <https://doi.org/10.1016/j.paid.2014.08.008>
- Robinson, M. D., Ode, S., Moeller, S. K., & Goetz, P. W. (2007). Neuroticism and affective priming: Evidence for a neuroticism-linked negative schema. *Personality and Individual Differences*, 42(7), 1221–1231. <https://doi.org/10.1016/j.paid.2006.09.027>
- Schaefer, A., Nils, F., Sanchez, X., & Philippot, P. (2010). Assessing the effectiveness of a large database of emotion-eliciting films: A new tool for emotion researchers. *Cognition and Emotion*, 24(7), 1153–1172. <https://doi.org/10.1080/02699930903274322>
- 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>
- Schroevers, M. J., & Brandsma, R. (2010). Is learning mindfulness associated with improved affect after mindfulness-based cognitive therapy? *British Journal of Psychology (London, England : 1953)*, 101(Pt 1), 95–107. <https://doi.org/10.1348/000712609X424195>
- Smits, D. J. M., & Boeck, P. D. (2006). From BIS/BAS to the Big Five. *European Journal of Personality*, 20(4), 255–270. <https://doi.org/10.1002/per.583>
- Soto, C. J., & John, O. P. (2017). The next Big Five Inventory (BFI-2): Developing and assessing a hierarchical model with 15 facets to enhance bandwidth, fidelity, and predictive power. *Journal of Personality and Social Psychology*, 113(1), 117–143. <https://doi.org/10.1037/pspp0000096>
- Suelmann, H., Brouwers, A., & Snippe, E. (2018). Explaining variations in mindfulness levels in daily life. *Mindfulness*, 9(6), 1895–1906. <https://doi.org/10.1007/s12671-018-0932-1>
- Thake, J., & Zelenski, J. M. (2013). Neuroticism, BIS, and reactivity to discrete negative mood inductions. *Personality and Individual Differences*, 54(2), 208–213. <https://doi.org/10.1016/j.paid.2012.08.041>
- Thompson, E. R. (2007). Development and validation of an internationally reliable short-form of the positive negative affect schedule (PANAS). *Journal of Cross-Cultural Psychology*, 38, 227–242. <https://doi.org/10.1177/0022022106297301>

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.