Open Access

OBM Integrative and Complementary Medicine

LIDSEN Publishing Inc.

Original Research

Mindful Attention and Awareness Prospectively Predicts Stress in Daily Life: A Multilevel Modeling Approach

Daniel Szoke, Holly Hazlett-Stevens *

Department of Psychology, University of Nevada, Reno, NV, USA; E-Mails: daniel_szoke@rush.edu; hhazlett@unr.edu

* **Correspondence:** Holly Hazlett-Stevens; E-Mail: hhazlett@unr.edu

Academic Editor: Marcus Henning

Special Issue: Mindfulness Approaches to Stress and Anxiety Reduction: New Research and Applications

OBM Integrative and Complementary Medicine
2025, volume 10, issue 4
doi:10.21926/obm.icm.2504042

Received: June 17, 2025
Accepted: October 03, 2025
Published: October 09, 2025

Abstract

Chronic stress increases a person's vulnerability for physical and mental health conditions that take root in the "common soil" of inflammation. Dispositional, or trait, mindfulness has been identified as a protective factor against perceived stress. However, the theory that trait mindfulness can prospectively predict lower perceived stress in natural settings has yet to be thoroughly tested. The current study used a daily diary prospective design to observe perceived stress in response to difficult events. Participants completed a baseline survey capturing their levels of mindful attention and awareness and neuroticism. Then, participants completed one week of daily surveys in which they indicated their levels of perceived stress and the number of difficult events they experienced. Mindful attention and awareness negatively predicted daily fluctuations in perceived stress, even when controlling for time, neuroticism, and the number of difficult events experienced. The interaction between mindful attention and awareness and daily difficult events proved non-significant in a model predicting daily fluctuations in perceived stress. Visual analysis showed modest support for the moderation hypothesis. Mindful attention and awareness was a significant predictor of perceived stress, including in natural settings and with a prospective time course. Findings

support the use of mindfulness-based interventions that increase mindful attention and awareness to decrease perceived stress.

Keywords
Mindfulness; perceived stress; neuroticism; stressful events

1. Introduction

Americans consistently rate their level of perceived stress as higher than where they believe a healthy level falls [1]. In some instances, stress is positive and serves an adaptive function, such as enhancing performance or motivation. Hans Selye famously proposed that the fundamental purpose of the stress response is adaptation to changing environmental conditions, and this "general adaptation syndrome" is a natural and necessary aspect of living [2]. However, chronic stress has been linked to increased risk for cardiovascular disease, anxiety and mood disorders, as well as decreased functioning of the immune system [3]. In contrast, mindfulness – a purposeful, non-judgmental awareness of the present moment – is the center piece of one of the most empirically supported stress-reduction programs, Mindfulness-Based Stress Reduction (MBSR) [4]. MBSR participants consistently report lower levels of stress and demonstrate better overall physical and mental health [5] and even exhibited reduced post-stress inflammatory responses [6]. In the absence of formal mindfulness training, each individual also has a naturally occurring, dispositional level of mindful awareness. Dispositional (or trait) mindfulness refers to a person's general tendency to be attentive and aware of present-moment experiences in daily life, and is distinct from state mindfulness, which reflects momentary mindful awareness that can fluctuate with training or situational factors [7]. However, the question of whether a person's dispositional level of mindfulness impacts their perceived stress in natural settings has yet to be thoroughly explored. The current study uses a daily-diary design to examine perceived stress *in situ*, thereby increasing ecological validity, or the extent to which phenomena unfold in natural contexts rather than only under laboratory conditions.

Jon Kabat-Zinn, who developed MBSR, proposed that cultivated mindfulness allows a person to use mindful awareness in response to a difficult event [4]. Such a person can notice automatic reactivity, such as an elevated heart rate, sweaty palms, and possibly even initial neurotic appraisals such as "I am probably going to lose my job." Holding these reactions with mindful awareness means observing them as they arise and pass away, without fully believing such thoughts. Mindful awareness does not necessarily reduce the occurrence of difficult circumstances, rather it allows a person to change their relationship with the stressor, allowing for coping which buffers the impact of the stressors on their overall level of perceived stress. Without training in mindfulness, each difficult event that a person experiences is likely to lead to greater overall perceived stress. With training in mindfulness, an individual becomes less reactive to stressors, meaning that the number of difficult events that a person experiences is less likely to lead to higher perceived stress.

While it is well established that those with experience in the area of mindfulness and stress reduction report lower levels of stress [5], researchers have turned their attention to the question of whether those without formal training or even informal experiences with mindfulness meditation

reap similar benefits from a naturally occurring level of mindfulness, or dispositional mindfulness. To establish a well-validated measure of dispositional mindfulness, Brown and Ryan [8] created and tested the Mindful Attention Awareness Scale (MAAS) which is, "focused on the presence or absence of attention to and awareness of what is occurring in the present moment… foundational to mindfulness" (p. 824).

Studies in laboratory settings confirm that dispositional mindfulness, as measured by the MAAS, is related to lower physiological stress reactivity during and after stressful tasks [9, 10]. Weinstein and colleagues [11] also found that MAAS scores prospectively predicted a person's perceived level of stress on the Perceived Stress Scale one month later. This was true even after controlling for neuroticism, a personality trait related to the tendency to experience emotional instability. Neuroticism is closely related to an individual's tendency to perceive events as stressful, so it is necessary to control for neuroticism in the measurement of perceived stress [12]. The finding that dispositional mindfulness predicted an individual's level of perceived stress one month later over and above the predictive ability of neuroticism provides strong evidence that dispositional mindfulness is an important factor in describing unique variance in an individual's overall level of perceived stress.

Neuroticism has been found to be positively associated with over-identification, or the tendency to, "become carried away with, wrapped up in, (or) completely absorbed by their own feelings" [13] (p. 88), and over-identification is considered the antithesis of mindful awareness in relation to one's own emotional experiences [13]. Over-identification has been found to lead to a downward spiral of more negative experiences across multiple studies and levels of analysis [14].

Beyond the negative implications for neuroticism, those with higher dispositional mindfulness are less likely to over-identify with each experience. One who is dis-identified from their thoughts and emotions experiences a liberation of awareness from typical schemas about the self, the world, and others. This decentering and dis-identification with negative experiences triggers what Garland and colleagues [15] termed an "upward spiral" of emotion regulation. The upward spiral is derived from the mindfulness-to-meaning theory, which posits that engaging mindful awareness allows for decentering and therefore greater flexibility in cognitive appraisal and reappraisal of situations, such that default schemas are interrupted and stimuli can be re-interpreted with acknowledgement of the full context in which the stimulus occurred. In sum, those with lower neuroticism may be less likely to interpret events as stressful in part due to a lesser identification with the difficult stimulus; engaging mindful awareness may predict an even further reduction in perceived stress as it allows for decentering and activates dis-identification resulting in a positive spiral of emotion regulation. Controlling for neuroticism in statistical analyses will lead to a greater understanding of the unique role of dispositional mindfulness in the reduction of perceived stress.

Outside of laboratory settings, Weinstein and colleagues [11] also confirmed a negative relationship between mindful attention and awareness and daily perceived levels of stress. MAAS scores predicted intra-individual fluctuations in perceived stress, such that those with a higher MAAS score at baseline reported lower daily perceived stress, both when asked about stress in response to their identified "most stressful event" and their overall level of stress with beta weights of -0.34 and -0.29, respectively. However, one limitation to these findings is that participants responded to single item, unvalidated questions about their level of perceived stress. Additionally, this study did not control for the predictive ability of neuroticism. More recent research found that both dispositional mindfulness and self-compassion buffered the effects of COVID-19 related stress

specifically on depression and anxiety symptoms [16]. However, this study did not involve a prospective design, and furthermore, neuroticism was not measured. Both of these investigations provide preliminary evidence that dispositional mindfulness buffers against daily perceived stress. However, further prospective research is needed to build on these findings by using an empirically validated measure of perceived stress, controlling for neuroticism, and capturing the number of stressful events experienced. Beyond theoretical implications, these questions have practical relevance for stress-management efforts in applied settings. If higher dispositional mindful attention and awareness prospectively predicts lower perceived stress in daily life, this result would support integrating mindfulness-based components into organizational or campus-based programs (e.g., brief skills training) that aim to mitigate day-to-day stress burden.

The current study aimed to answer three questions. First, when stressful events occur, do people report higher perceived stress? Although this relationship has been well established in previous research, we intended to verify replication of this result using the current daily diary study methods. Second, does mindful attention and awareness predict daily fluctuations in perceived stress, even when controlling for neuroticism? Third, does mindful attention and awareness moderate the relationship between stressful events and perceived stress? The hypotheses for the current study are as follows:

1. People will rate their perceived stress as higher on days in which they report experiencing a greater number of difficult events.
2. Mindful attention and awareness will significantly predict daily fluctuations in perceived stress, even when controlling for neuroticism, such that higher mindful attention and awareness will be related to lower daily reports of perceived stress.
3. The relationship between the number of difficult events experienced and perceived stress, controlling for neuroticism, will be moderated by mindful attention and awareness.

To answer these research questions with a high level of ecological validity, a daily diary study was conducted. After enrolling in the study and consenting to participate, participants reported on their level of mindful attention and awareness as well as their level of neuroticism, age, gender, and socioeconomic status. Participants then received instructions from trained research assistants concerning the monitoring portion of the study. During the daily diary monitoring portion of the study, participants reported how many difficult events they experienced since their last daily assessment, using the Daily Inventory of Stressful Events, and their overall level of perceived stress, using the Perceived Stress Scale.

2. Methods

2.1 Participants

A sample of 73 undergraduate students was collected using the psychology subject pool online sign-up system. An undergraduate student population was selected due to findings that the life and developmental transitions occurring in the lives of undergraduate students make this population highly vulnerable to high levels of stress [17]. No exclusion criteria were used.

The current study was conducted from November 2020 until March 2021 during the COVID-19 pandemic, a period characterized by elevated uncertainty, disruptions to daily life, and increased psychological stress across populations. For example, in a cross-sectional survey conducted during the pandemic, people consistently reported elevated anxiety, depression, and perceived stress [18].

This timing provided an especially informative period for studying daily perceived stress and difficult events. Stressors were likely more frequent and/or unpredictable during this public health emergency, and if an individual's baseline stress levels were elevated, individual differences in coping or trait mindfulness may have been more pronounced.

2.2 Measures

There were 8 timepoints in which data were collected from each participant. The first timepoint occurred via videoconference with one participant and one research assistant on a Zoom video call. Data were collected via electronic survey. The remaining 7 time points occurred in 24-hour increments, starting the day immediately following the participant's baseline data collection in the study. These timepoints were matched such that each participant chose a time between 7pm and 11pm and completed the survey at that same chosen time each day.

2.2.1 Demographics

Participants reported their gender identity, age, and socio-economic status (SES). Participants were able to select from several gender identity options or chose to self-identify. SES was captured by the selection of a family annual income bracket [19]. No analyses were planned a priori for these data.

2.2.2 Difficult Events

The number of difficult events that each participant encountered was measured using a self-report version of the Daily Inventory of Stressful Events (DISE) [20], based on the original telephone interview designed to capture daily stressful events for a large epidemiological study aimed at understanding the types of daily stressors the average American experienced.

Categories of stressful events include having an argument/disagreement, work or school related event, experiences of discrimination, and a close friend or relative related event since filling out their previous survey. Inherent to the hypotheses in the current study, we altered text in the measure instructions to omit the word "stressors" in order to capture the number of difficult events that participants experienced, even if they choose not to label them as "stressors". Additionally, because we removed the word stressors from the stem, we altered the following categories: "event related to work or school that other people would consider stressful", "event with a close friend or relative that other people would consider stressful", and, "anything else that other people would consider stressful". No formal pilot testing of this modification was conducted, but because the content domains and response format were unchanged, we expected the construct validity to remain intact. Nevertheless, this assumption could be evaluated with further psychometric research of this modification. Participants received training and additional instructions reminding them to count each event once, and if it falls into multiple categories, to select the category that best fits the event. The total number of events was tallied, and their sum constituted the number of difficult events that occurred.

2.2.3 Perceived Stress

In line with other dispositional mindfulness and stress studies, participants' appraisal of stress was measured using the Perceived Stress Scale (PSS). Specifically, the ten-item scale was used [21]. The ten-item scale consistently achieved internal reliability between $\alpha = 0.74$ and $\alpha = 0.91$, evaluated across six subsequent studies [22].

2.2.4 Mindful Attention and Awareness

Participants reported their experiences of attention and forgetting in daily living using the Mindful Attention Awareness Scale (MAAS) [8]. This 15-item scale includes items such as, "I drive places on 'automatic pilot' and then wonder why I went there" and "I find myself doing things without paying attention". Participants respond on a 6-point scale ranging from "almost always" to "almost never". Higher scores are indicative of higher mindful awareness and have been linked to certain neuropsychological variables, including smaller amygdala size and lower neuroendocrine responses to stressful situations [9, 23]. The scale was recently reevaluated to confirm its strong internal reliability ($\alpha = 0.89$) [24].

2.2.5 Neuroticism

Participants' level of neuroticism was measured using the neuroticism subscale from the Big Five Inventory [25]. This subscale includes 8 items such as, "I am someone who worries a lot" and "I am someone who can be moody." Previous studies have reported strong internal consistency for this measure, with an average Cronbach's alpha of 0.80 [26].

2.3 Procedure

2.3.1 Time Point 1

After consenting to participate in the study, participants completed electronic survey measures of mindful attention and awareness, neuroticism, and demographic information. Participants were compensated with two research participation credits after attending the baseline survey session. After completing the baseline survey, participants received verbal instructions from a research assistant about completing their remaining daily diaries. Participants were reminded to separate out their feelings of overall stress from the number of difficult events they experienced. Research assistants used a standardized script and were trained to answer questions that participants may have about the daily surveys. Research assistants used the Gmail add-on "Boomerang" to automate messages with survey links to each participant, set to arrive in nightly, 24-hour increments at a time of the participant's choosing, between 7:00 P.M. and 11:00 P.M. In order to maximize data collection and minimize missing data, research assistants requested the participants do one or more of the following to ensure daily survey participation: turn on email notifications, set a daily alarm, tie filling out the daily survey with a regular nighttime behavior (e.g., brushing teeth), and/or add the daily survey to their daily task lists.

2.3.2 Time Points 2-8

Participants completed daily surveys using the links e-mailed to them each day. Daily surveys included measures of difficult events and perceived stress. Participants received one additional research participation credit upon completion of each daily survey.

2.4 Ethics Statement

Before participant recruitment began, all methods and procedures were approved by the Institutional Review Board at the University of Nevada, Reno. All of the approved recruitment and data collection procedures were followed to ensure that this research was conducted in an ethical manner. The authors have declared that no competing interests exist.

All surveys were administered through a secure, password-protected online platform hosted on university servers. Data were encrypted and participants' responses were linked only to randomly generated identification codes. No identifying information (e.g., names, email addresses, IP addresses) was stored with survey responses. Access to the raw data was restricted to the research team and overseen by the university Institutional Review Board, ensuring that confidentiality and data security were maintained throughout the study.

2.5 Analysis Plan

Power analyses were conducted a priori using G*Power 3.1 for multiple regression models, which provided a conservative proxy for our planned multilevel analyses. This approach was appropriate for our primary between-person analysis (e.g., dispositional mindfulness predicting perceived stress) and indicated that 73 participants was sufficient to detect medium effects with 95% power. In practice, the multilevel design, with 494 repeated observations, provided additional leverage for detecting within-person effects. By contrast, cross-level interactions were treated as exploratory, consistent with simulation work showing that substantially larger samples are required to detect small moderation effects.

Data were analyzed using multilevel modeling to account for the nested structure of daily observations (Level 1) within individuals (Level 2) [27]. Models were estimated in R 4.0.4 using the lme4 package [28]. Daily perceived stress was operationalized as participants' daily PSS scores. Within-person difficult events were calculated as each participant's number of difficult events minus their own mean number of events across the week. Time was modeled as the numbered day, centered at the midpoint of the study. Dispositional mindfulness (MAAS) and neuroticism (BFI-N) were group-mean centered. Following conservative recommendations, degrees of freedom were based on the number of participants rather than the number of observations. Statistical significance was evaluated at $\alpha = 0.05$.

3. Results

3.1 Descriptive Statistics

Participants predominately identified as white and female. The average family income bracket was \$60,000–\$69,000. Full demographic information is presented in Table 1.

Table 1 Demographic Information.

	% of sample (n)
Gender Identity	
Woman	72% (53)
Man	27% (20)
Prefer to self-identify	0% (0)
Race	
White	69% (50)
Asian	26% (19)
Hispanic or Latino/a	18% (13)
Black or African American	11% (8)
Native Hawaiian or Pacific Islander	3% (2)
American Indian or Native American	0% (0)
Other (self-identified as “Middle Eastern” and “Arab”)	3% (2)
Family income	
Less than $30,000	22% (16)
$30,000 to $59,999	23% (17)
$60,000 to $99,999	23% (17)
$100,000 or more	32% (23)

Participants in this sample reported an average daily perceived stress score of 1.96 on the PSS-10, which is consistent with previous studies involving college students [29]. The internal reliability of the PSS-10 was good ($\alpha = 0.89$). The average of the MAAS scores was 3.4, which is slightly lower than previous studies involving undergraduate students ($m = 4.0$) [24]; this measure also achieved good internal reliability ($\alpha = 0.87$). The participants’ average level of neuroticism was 3.1, consistent with previous studies conducted with undergraduate students [30]. The BFI-N had good internal reliability ($\alpha = 0.80$). Means, standard deviations, and correlations can be found in Table 2.

Table 2 Means, standard deviations, and correlations of baseline data (N = 73).

Variable	*M*	*SD*	1	2	3
1. Average perceived stress	2.0	0.7	1		
2. MAAS	3.4	0.8	-0.4*	1	
3. BFI-N	3.1	0.7	0.5*	-0.4*	1

Note: * indicates $p < 0.05$.

Participants completed an average of 6.8 daily surveys, amounting to a total of 17 missing observations across 13 participants (96.67% completion rate). The average number of daily difficult events that each participant reported was 2.87. The most common category of stressful event was an event related to work or school and the least common category was discrimination on the basis of race, sex, or age. To see a full break down of the categories of difficult events reported each day, as well as daily averages of perceived stress, see Table 3.

Table 3 Daily survey data: Average perceived stress and number of difficult events per participant.

	Day 1 N = 73	Day 2 N = 73	Day 3 N = 73	Day 4 N = 73	Day 5 N = 72	Day 6 N = 70	Day 7 N = 60
PSS-10	2.1	2.1	1.9	1.9	1.8	1.9	1.9
Total difficult events	3.6	3.1	2.9	2.3	2.7	2.7	2.4
Argument/disagreement	0.6	0.6	0.6	0.5	0.6	0.6	0.5
Event related to work or school	1.5	1.2	1.2	1.2	1.2	1.5	1.1
Discrimination	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Event with close friend or relative	0.6	0.5	0.4	0.5	0.5	0.4	0.4
Other difficult event	0.9	0.6	0.6	0.4	0.5	0.6	0.5

3.2 Multilevel Model Analysis

Hypothesis 1 stated that participants would rate their perceived stress as higher on days in which they reported experiencing a greater number of difficult events (Figure 1, B_{1j}). Hypothesis 2 stated that participants' level of open attention and awareness would significantly predict daily fluctuations in perceived stress, even when controlling for neuroticism, such that higher open attention and awareness would be related to lower daily reports of perceived stress (Figure 1, γ_{01}). Hypothesis 3 stated that the relationship between the number of difficult events experienced and perceived stress, controlling for neuroticism, would be moderated by open attention and awareness (Figure 1, γ_{11}).

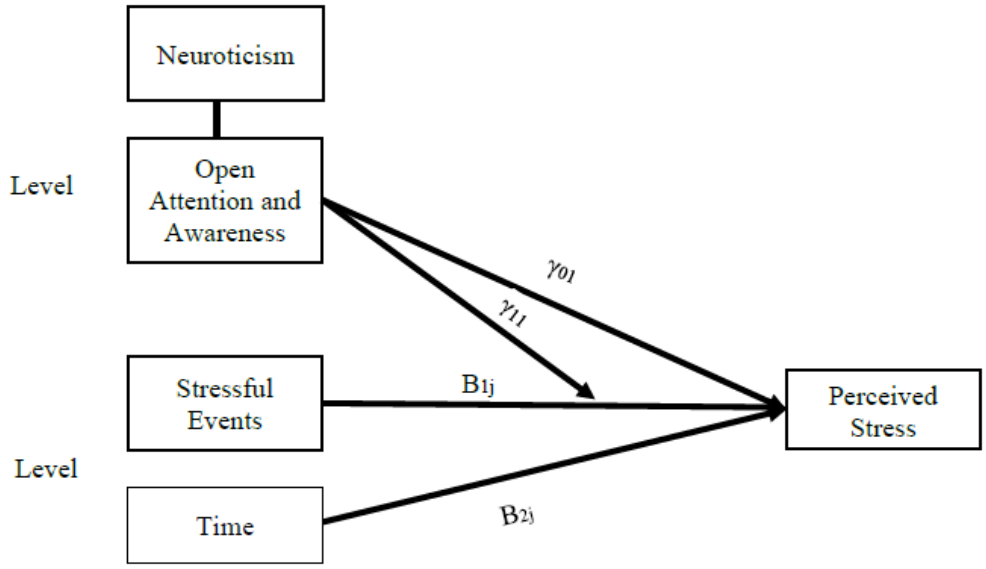

Figure 1 Multilevel Model.

This analysis consisted of 73 (subjects) × 7 (days) = 511 possible observations and an actual total observation of 494 points. We created an unconditional means model to calculate an interclass correlation (ICC) for the outcome, daily perceived stress. The ICC, 0.56, indicated that 56% of the total variance in perceived stress is attributable to between-person variation and the remaining 44% is attributable to within-person variation.

For results of the statistical test of the multilevel model hypotheses, we can review Table 4, specifically the upper portion labeled *fixed effects*. Hypothesis 1 can be examined by reviewing the significant within-Daily Difficult Events estimate of 0.17, meaning that at the midpoint of the study, a participant with average MAAS and BFI-N scores reported higher perceived stress on days in which they reported experiencing more difficult events. Note that because the model included time, results for the focal hypothesis cannot be artifacts of temporal chances over the daily survey period. Hypothesis 1 was supported. Hypothesis 2 can be examined by reviewing the significant MAAS estimate of -0.20, meaning that at the midpoint of the study, a participant with an average BFI-N score and an average number of within-Daily Difficult Events reported lower perceived stress than those with lower MAAS scores. Hypothesis 2 was supported. Hypothesis 3, treated as exploratory due to the underpowered sample size, can be examined by reviewing Model 2 in Table 4, specifically the estimate labeled MAAS score by within-Daily Difficult Events interaction. The estimate was not significant; hypothesis 3 was not supported.

Table 4 Parameter estimates for multilevel model of daily perceived stress (N = 73).

	Model 1, df (69)			***Model 2, df (68)***		
Fixed effects	***B***	***SE B***	***p***	***B***	***SE B***	***p***
Intercept	1.96*	0.07	<0.01*	1.96*	0.07	<0.01*
Time (B_{2j})	-0.02	0.01	0.16	-0.02	0.01	0.16
MAAS (γ_{01})	-0.20*	0.09	0.03*	-0.20*	0.10	0.04*
BFI-N	0.37*	0.10	<0.01*	0.36*	0.10	<0.01*
Within-Daily Difficult Events (B_{1j})	0.17*	0.02	<0.01*	0.17*	0.02	<0.01*
MAAS by Within-Daily Difficult Events (γ_{11})				-0.01	0.01	0.98
Random effects ([co]variances)	***B***	***SE B***	***p***	***B***	***SE B***	***p***
Level 2 (between-person)						
Intercept	0.32*	0.07	<0.01*	0.32*	0.07	<0.01*
Within-Daily Difficult Events	0.01*	0.01	0.03*	0.01*	0.01	0.03*
Intercept & within-Daily Difficult Events	-0.02	0.01	0.11	-0.02	0.01	0.11
Level 1 (within-person)						
Residual	0.29*	0.03	<0.01*	0.29*	0.03	<0.01*
Autocorrelation	0.28*[a]	0.06	<0.01*	0.29[a]*	0.06	<0.01*

[a] We created a model with lag-1 daily perceived stress due to significant autocorrelation of residuals in the model presented. The lag-1 model had the same pattern and significance of effects and removed the significant autocorrelation of residuals.

Visual analysis of hypothesis 3 was planned *a priori* due to the lack of power to assess for moderation given the size of this sample. Figure 2 compares the differences in average slopes between the high and low MAAS score groups and all observations are presented visually in Visual inspection of the two average regression lines in Figure 2 provides modest support for our moderation hypothesis: the slope for the low MAAS score group is steeper than it is for the high MAAS score group. It is important to note that this graph fails to control for neuroticism.

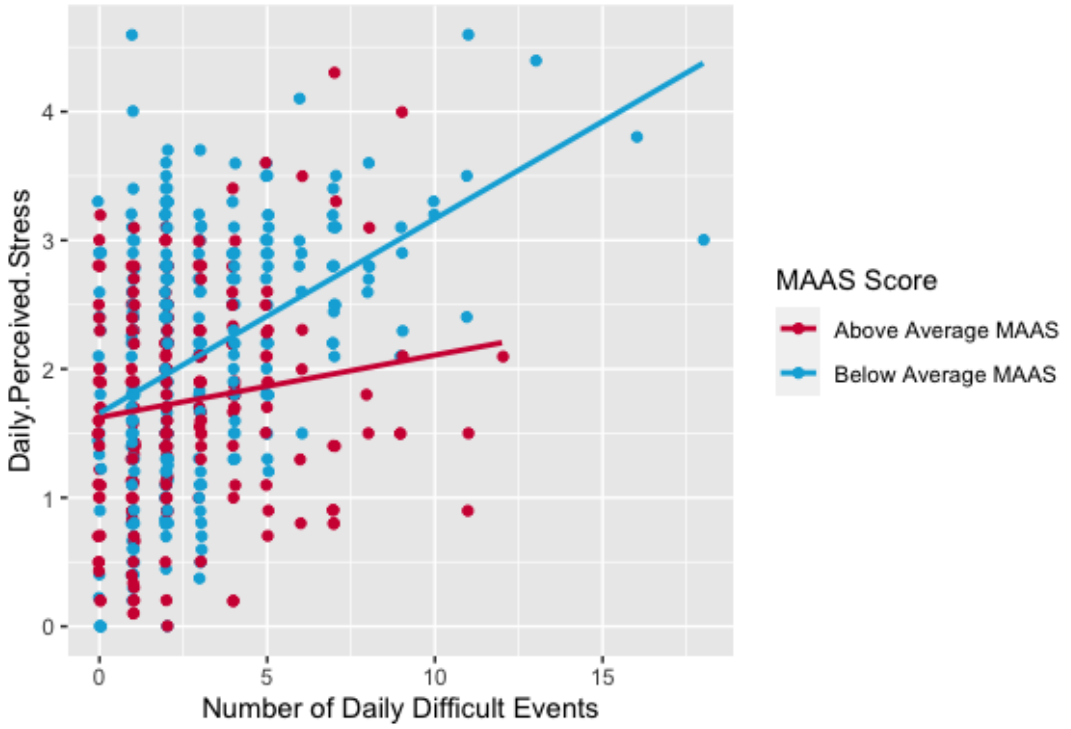

Figure 2 Daily perceived stress and daily difficult events by MAAS score.

4. Discussion

The current study examined relationships between mindful attention and awareness, neuroticism, daily occurrences of difficult events, and perceived stress. Chronic psychological stress has been linked to numerous negative physical and mental health outcomes, ranging from heart disease to major depressive disorder [3, 31]. In multiple studies, mindful attention and awareness, as cultivated by practice of mindfulness meditation, was associated with lower rates of perceived stress [5]. However, *in situ* tests of whether a naturally occurring level of mindful attention and awareness prospectively protects against perceived stress are lacking. Therefore, we collected both baseline self-report trait measures and subsequent daily reports of difficult events and perceived stress to examine these data using a multilevel modeling approach in which both between-person and within-person processes are modeled simultaneously.

The specific within-person variables in the model presented included time, to control for any confounding temporal changes, and a within-person number of daily difficult events. The latter variable allowed for each participant to serve as their own control regarding the number of daily difficult events they reported experiencing. Intraindividual increases in within-person daily difficult events predicted intraindividual increases in participants' levels of daily perceived stress, when controlling for time and the between-persons traits of interest, supporting our first hypothesis. This finding provides validation for the methods used in this study.

The between-persons variables of interest were participants' trait levels of mindful attention and awareness and, to serve as a control, neuroticism. In support of our second hypothesis, interindividual increases in mindful attention and awareness were related to intraindividual decreases in daily perceived stress, controlling for the level of trait neuroticism, time, and the within-person number of daily difficult events. This finding lends support to the value of analyzing

a naturally occurring component of dispositional mindfulness, mindful attention and awareness. Items on this measure ask about attention to the present moment and forgetfulness when leaving the house or hearing someone's name for the first time; these items continue to appear as significant predictors of other important variables, in this case, daily perceived stress. This finding further affirms the theories of Brown and Ryan [8], which posited the value of open attention and awareness on perceived stress and psychological well-being.

Hypothesis 3 stated that open attention and awareness would moderate the relationship between within-person daily difficult events and perceived stress. We planned, *a priori,* to investigate this hypothesis through both statistical and visual analysis due to a lack of statistical power to answer this question. The statistical analysis was non-significant. We conducted a visual inspection of plotted regression lines comparing participants with higher versus lower dispositional mindfulness. This descriptive analysis allowed us to examine whether the pattern of slopes was consistent with the hypothesized moderation, even in the absence of a statistically significant interaction. The steeper slope among participants low in mindfulness provided modest descriptive support for our prediction, although we interpret this cautiously given the limited power to detect cross-level interactions. We believe that this evidence provides support for a future study involving a larger number of subjects with a greater number of observations to provide the necessary power to answer this question statistically.

Although our analyses target the attentional-monitoring facet of mindfulness measured by the MAAS, mindfulness is broader and includes attitudinal qualities, most prominently nonjudgment, acceptance, and compassion, that plausibly facilitate stress reduction via appraisal and regulation pathways. Accordingly, the MAAS effect reported here should be viewed as a conservative estimate of mindfulness's influence; future work using multidimensional measures or latent constructs could test whether attitudinal components explain additional variance in daily perceived stress.

There are several limitations to the current study. This examination included a sample of undergraduate students. Findings from this study are limited in scope and researchers should use caution when attributing the results presented here to other populations. Also missing from the current study is an experimental manipulation, therefore, we are careful not to make any causal claims about the observed data. However, as Bolger and Laurenceau [27] described, intensive longitudinal designs can build confidence that causal processes investigated in laboratory settings actually occur in nature. The findings in this paper build on previous empirical work that has shown the causal ability of mindfulness-based interventions to increase mindful attention and awareness and in turn decrease perceived stress and physiological stress responses, and laboratory studies showing the negative relationship between MAAS scores and physiological stress responding [8, 10, 11]. A future study could explore an experimental manipulation with extensive longitudinal data. Further, we modified the DISE instructions by replacing the word "stressors" with "difficult events" without conducting formal pilot testing; however, the robust support for our first hypothesis (i.e., that greater numbers of daily difficult events predicted higher perceived stress) provided indirect evidence that the measure retained its intended construct validity.

Additionally, the current study specifically tested the role of dispositional mindful attention and awareness, a component of mindfulness. Missing from the mindful attention and awareness measure is the relational component of mindfulness; the element that is non-judgmental, compassionate, and accepting. A future study should explore more fully the role of mindful awareness in reducing perceived stress. Findings in the current study are specifically limited to

mindful attention and awareness as measured and should not be mistaken for the broader construct of mindfulness.

Finally, cultural context may shape both how mindfulness is expressed and how stress is appraised and reported. For example, attentional facets of mindfulness emphasized in Western operationalizations (e.g., present-moment attention and awareness) can co-occur with relational or acceptance-based emphases in other traditions. Cultural norms around emotion, stigma, and coping may play a strong role in both the experiencing and reporting of perceived stress. These considerations suggest that associations between dispositional mindfulness and perceived stress may vary across cultural groups and highlight the value of testing these relationships in more diverse samples. In the current study, we acknowledge a potential homogeneity and view our predominantly undergraduate, White, female-identified sample as an only an initial step toward broader generalization.

Taken together, the findings in the current study validate a method of exploring daily difficult events and perceived stress and provide further evidence of the prospective predictive ability of a component of trait mindfulness, mindful attention and awareness, on daily perceived stress. This further affirms the use of interventions, such as MBSR and MBCT, in clinical settings to increase open attention and awareness and lower perceived stress. The current findings add to the broader literature documenting that dispositional mindfulness can buffer the negative effects of stressful events by bringing study methods into participants' daily lives. Furthermore, this study was designed just before the COVID-19 pandemic began, and all data were collected during the pandemic. Results from the current study therefore replicated findings from previous research during this critical time in history.

To strengthen causal inference and generalizability, future studies should combine randomized experimental manipulations (e.g., brief mindfulness meditations or multi-session mindfulness skills training) with intensive longitudinal assessment, allowing tests of short-term within-person change and cross-level moderation under greater power. Designs with larger cluster counts and longer monitoring windows (e.g., 14–21 days) would improve precision for small cross-level interactions. Recruitment that intentionally diversifies age, socioeconomic status, and cultural background, and samples outside university settings (e.g., community, clinical, and workplace cohorts), will clarify boundary conditions and cultural variability in the association between mindfulness and perceived stress. Finally, multidimensional or latent representations of mindfulness that include attitudinal facets (nonjudgment/acceptance/compassion) alongside attention/awareness can test whether broader mindfulness accounts for additional variance in daily perceived stress beyond MAAS-indexed attention.

Trait neuroticism also negatively predicted daily perceived stress, and burgeoning evidence concerning cutting edge psychotherapies shows modest reductions in levels of neuroticism directly following a 16-week mindfulness and CBT intervention called the Unified Protocol [32, 33]. While we wait for follow-up studies concerning the longevity of these neuroticism reductions and studies conducted with larger community samples, mindful attention and awareness is a trait that is both inexpensive and amenable to change. Mindfulness meditation remains a free and accessible way to change an individual's level of mindful attention and awareness, and in turn, reduce the individual's level of psychological and physiological stress [5]. Findings presented in the current study will allow researchers to continue to build an understanding of significant factors that may lead to lower perceived stress, and in turn, better health in the mind-body system.

Author Contributions

Both authors were responsible for project development and design. Dr. Szoke conducted data collection, statistical analysis, and manuscript writing under Dr. Hazlett-Stevens' supervision.

Competing Interests

The authors have declared that no competing interests exist.

References

1. American Psychological Association. Stress in America: Stress and Current Events. Stress in America™ Survey [Internet]. Washington, D.C.: American Psychological Association; 2019. Available from: https://www.apa.org/news/press/releases/stress/2019/stress-america-2019.pdf.
2. Jackson M, Ramsden E, Cantor D. Chapter 1 Evaluating the role of Hans Selye in the modern history of stress. In: Stress, shock, and adaptation in the twentieth century. Rochester, NY: University of Rochester Press; 2014. pp. 21-48.
3. Schneiderman N, Ironson G, Siegel SD. Stress and health: Psychological, behavioral, and biological determinants. Annu Rev Clin Psychol. 2005; 1: 607-628.
4. Kabat-Zinn J. Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness. New York, NY: Bantam Books; 2013.
5. de Vibe M, Bjørndal A, Fattah S, Dyrdal GM, Halland E, Tanner-Smith EE. Mindfulness-based stress reduction (MBSR) for improving health, quality of life and social functioning in adults: A systematic review and meta-analysis. Campbell Syst Rev. 2017. doi: 10.4073/csr.2017.11.
6. Rosenkranz MA, Davidson RJ, MacCoon DG, Sheridan JF, Kalin NH, Lutz A. A comparison of mindfulness-based stress reduction and an active control in modulation of neurogenic inflammation. Brain Behav Immun. 2013; 27: 174-184.
7. Tang YY, Hölzel B, Posner M. Traits and states in mindfulness meditation. Nat Rev Neurosci. 2016; 17: 59.
8. Brown KW, Ryan RM. The benefits of being present: Mindfulness and its role in psychological well-being. J Pers Soc Psychol. 2003; 84: 822-848.
9. Brown KW, Weinstein N, Creswell JD. Trait mindfulness modulates neuroendocrine and affective responses to social evaluative threat. Psychoneuroendocrinology. 2012; 37: 2037-2041.
10. Kadziolka MJ, Di Pierdomenico EA, Miller CJ. Trait-like mindfulness promotes healthy self-regulation of stress. Mindfulness. 2016; 7: 236-245.
11. Weinstein N, Brown KW, Ryan RM. A multi-method examination of the effects of mindfulness on stress attribution, coping, and emotional well-being. J Res Pers. 2009; 43: 374-385.
12. McCrae RR. Controlling neuroticism in the measurement of stress. Stress Med. 1990; 6: 237-241.
13. Neff K. Self-compassion: An alternative conceptualization of a healthy attitude toward oneself. Self Identity. 2003; 2: 85-101.
14. Kross E, Ayduk O. Making meaning out of negative experiences by self-distancing. Curr Dir Psychol Sci. 2011; 20: 187-191.

15. Garland EL, Farb NA, R. Goldin P, Fredrickson BL. Mindfulness broadens awareness and builds eudaimonic meaning: A process model of mindful positive emotion regulation. Psychol Inq. 2015; 26: 293-314.
16. Beshai S, Salimuddin S, Refaie N, Maierhoffer J. Dispositional mindfulness and self-compassion buffer the effects of COVID-19 stress on depression and anxiety symptoms. Mindfulness. 2022; 13: 3028-3042.
17. Cohen LH, Burt CE, Bjorck JP. Life stress and adjustment: Effects of life events experienced by young adolescents and their parents. Dev Psychol. 1987; 23: 583-592.
18. Turna J, Zhang J, Lamberti N, Patterson B, Simpson W, Francisco AP, et al. Anxiety, depression and stress during the COVID-19 pandemic: Results from a cross-sectional survey. J Psychiatr Res. 2021; 137: 96-103.
19. Diemer MA, Mistry RS, Wadsworth ME, López I, Reimers F. Best practices in conceptualizing and measuring social class in psychological research. Anal Soc Issues Public Policy. 2013; 13: 77-113.
20. Almeida DM, Wethington E, Kessler RC. The daily inventory of stressful events: An interview-based approach for measuring daily stressors. Assessment. 2002; 9: 41-55.
21. Cohen S, Williamson G. Perceived stress in a probability sample of the United States. In: The social psychology of health: Claremont symposium on applied social psychology. Newbury Park, CA: Sage Publications, Inc.; 1988. pp. 31-67.
22. Lee EH. Review of the psychometric evidence of the perceived stress scale. Asian Nurs Res. 2012; 6: 121-127.
23. Taren AA, Creswell JD, Gianaros PJ. Dispositional mindfulness co-varies with smaller amygdala and caudate volumes in community adults. PLoS One. 2013; 8: e64574.
24. MacKillop J, Anderson EJ. Further psychometric validation of the mindful attention awareness scale (MAAS). J Psychopathol Behav Assess. 2007; 29: 289-293.
25. John OP, Donahue EM, Kentle RL. The big five inventory—versions 4a and 54. Berkeley, CA: University of California, Berkeley, Institute of Personality and Social Research; 1991.
26. John OP, Naumann LP, Soto CJ. Paradigm shift to the integrative big five trait taxonomy. In: Handbook of personality: Theory and research. New York, NY: Guilford Press; 2008. pp. 114-158.
27. Bolger N, Laurenceau JP. Intensive longitudinal methods: An introduction to diary and experience sampling research. New York, NY: Guilford Press; 2013.
28. Bates D, Mächler M, Bolker B, Walker S. Fitting linear mixed-effects models using lme4. J Stat Softw. 2015; 67: 1-48.
29. Roberti JW, Harrington LN, Storch EA. Further psychometric support for the 10-item version of the perceived stress scale. J Coll Couns. 2006; 9: 135-147.
30. Extremera N, Fernández-Berrocal P. Perceived emotional intelligence and life satisfaction: Predictive and incremental validity using the Trait Meta-Mood Scale. Pers Individ Differ. 2005; 39: 937-948.
31. Finlay-Jones R, Brown GW. Types of stressful life event and the onset of anxiety and depressive disorders. Psychol Med. 1981; 11: 803-815.
32. Barlow DH, Farchione TJ, Bullis JR, Gallagher MW, Murray-Latin H, Sauer-Zavala S, et al. The unified protocol for transdiagnostic treatment of emotional disorders compared with diagnosis-

specific protocols for anxiety disorders: A randomized clinical trial. JAMA Psychiatry. 2017; 74: 875-884.

33. Sauer-Zavala S, Fournier JC, Steele SJ, Woods BK, Wang M, Farchione TJ, et al. Does the unified protocol really change neuroticism? Results from a randomized trial. Psychol Med. 2021; 51: 2378-2387.