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# Dispositional Mindfulness and Memory Problems: the Role of Perceived Stress and Sleep Quality

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**Abstract** There is a growing body of evidence exploring the beneficial effects of mindfulness on stress, sleep quality, and memory, though the mechanisms involved are less certain. The present study explored the roles of perceived stress and sleep quality as potential mediators between dispositional mindfulness and subjective memory problems. Data were from a Boston area subsample of the Midlife in the United States study (MIDUS-II) assessed in 2004–2006, and again approximately 1 year later ($N$ = 299). As expected, higher dispositional mindfulness was associated with lower perceived stress and better sleep quality. There was no direct association found between mindfulness and subjective memory problems; however, there was a significant indirect effect through perceived stress, although not with sleep quality. The present findings suggest that perceived stress may play a mediating role between dispositional mindfulness and subjective memory problems, in that those with higher mindfulness generally report experiencing less stress than those with lower mindfulness, which may be protective of memory problems in everyday life.

**Keywords** Mindfulness · Meditation · Perceived stress · Sleep quality · Memory problems · Memory

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## Introduction

Over the past decade, mindfulness has received increased attention by researchers and practitioners in psychology and neuroscience (Chiesa et al. 2011; Tang and Posner 2013). Currently, there are two major conceptions of mindfulness. One is informed by Eastern philosophy and meditative practice and is often described as, "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally" (Kabat-Zinn 1994). Recent studies investigating mindfulness and various meditative techniques have shown great promise for clinical applications, especially in the area of stress reduction and with the treatment of various disorders (Keng et al. 2011). These meditation techniques have been shown to raise mindfulness in the practitioner, and the changes are shown to endure for two or more months beyond practice (Baer 2003; Miller et al. 1995). The other conception of mindfulness takes an approach based in cognitive science and is described as a cognitive style which involves the self-regulation of one's attention and a creative and open engagement with one's environment (Hart et al. 2013). Although, these two schools of thought are often considered to be distinct from one another, they do have significant overlap, particularly concerning present-centered awareness, self-regulatory processes, and openness to experience (Hart et al. 2013; Siegling and Petrides 2014).

Mindfulness training has been linked to increases in working memory capacity and improvements in executive functioning, sustained attention, and selective attention (Chambers et al. 2008; Chiesa et al. 2011; Jha et al. 2010; Zeidan et al. 2010). Studies that have focused on dispositional mindfulness outside of meditative practice have found similar relationships with working memory and sustained attention (Anicha et al. 2012; Ruocco and Direkoglu 2013). To the authors' knowledge, there have been no studies to date

regarding mindfulness and subjective reports of memory problems. Additionally, there have been inconsistent associations between subjective memory problems and objective memory performance (Lenehan et al. 2012), so it is not yet certain how mindfulness may relate to subjective memory problems. It is plausible that mindfulness is negatively related to memory problems, as mindfulness may improve memory and therefore lessen memory problems. But, it may conversely be positively related, as higher mindfulness may allow the person a heightened awareness of their experiences of memory problems. Since mindfulness has been shown to be associated with memory performance, it is reasonable to suspect that it may also be related in some way to memory problems. Subjective memory problems are a significant issue throughout adulthood and can be predictive of various negative health outcomes, such as depression and Alzheimer's disease, sometimes without any sign of memory performance decline (Hahn and Lachman 2015; Oijen et al. 2007). Since there are few methods of treatment, a link between mindfulness and subjective memory problems may suggest a potential treatment or preventative option in mindfulness-based interventions.

Although a relationship between mindfulness and memory problems has not previously been investigated, both constructs have been related to stress and sleep quality. One of the most well-known meditation programs, mindfulness-based stress reduction (MBSR), has been shown to be effective for the treatment of various physical and psychological disorders and across many different populations, especially in regard to reductions in perceived stress (Baer et al. 2012; Bohlmeijer et al. 2010; Kvillemo and Branstrom 2011; Warnecke et al. 2011). Dispositional mindfulness has also been found to be negatively related to perceived stress and stress-related symptoms, and positively related to stress tolerance (Bao et al. 2015; Roberts and Danoff-Burg 2010; Trousselard et al. 2010).

Mindfulness-based practices, due to their beneficial effects on stress and mood, have been shown to improve sleep quality and aid in the treatment of insomnia (Britton et al. 2010; Ong et al. 2008). Meditation may also decrease the practitioners need for sleep and offer similar restorative functions to non-REM sleep; however, more research is needed in this area (Kaul et al. 2010). Apart from meditative practice, dispositional mindfulness has been shown to have positive relationships with sleep quality (Caldwell et al. 2010; Howell et al. 2008, 2010).

Research shows that stress, sleep quality, and memory are not only related to mindfulness but also are inter-related. Poor sleep quality has been shown to negatively affect working memory, attentional set shifting, and abstract problem solving (Fulda and Schulz 2001; Nebes et al. 2009; Oken et al. 2011). Similar relationships between sleep and memory performance have been found while using physiological measures of sleep (Durmer and Dinges 2005; Kopp et al. 2006). High levels or occurrences of perceived stress, psychosocial stress, and stressful life events have been linked to subjective memory problems, as has sleep quality (Elfgren et al. 2010; Hancock and Larner 2009; Potter et al. 2009; Ronnlund et al. 2013; Sims et al. 2010; VonDras et al. 2005).

The aim of the present study was to investigate the relationships between dispositional mindfulness, perceived stress, sleep quality, and memory problems. With data collected from a Boston area subsample of the Midlife in the United States (MIDUS-II) study, we tested a two-mediator model using the PROCESS macro, provided by Hayes (2013). Based on the literature that mindfulness training improves cognition, we hypothesized that dispositional mindfulness would be associated with fewer reported memory problems. As an alternative hypothesis, we considered the possibility that mindfulness could predict greater memory problems, as it may lead the individual to a greater awareness of memory issues. We hypothesized that higher mindfulness would be related to lower perceived stress and better sleep quality and that these would, in turn, be related to fewer memory problems. Additionally, we hypothesized that perceived stress and sleep quality would mediate the relationship between mindfulness and memory problems. This was informed by the previous research linking higher mindfulness to lower perceived stress and better sleep quality, which have, in turn, been linked to better memory performance and fewer memory problems.

## Method

### Participants

Participants ($N = 299$) were from the Boston longitudinal study (BOLOS-II). This was a subsample of the Midlife in the United States (MIDUS-II; Brim et al. 2004) national longitudinal survey conducted from 2004 to 2006. The mean age was 58.90 (SD = 12.62) with a range from 34 to 85 and 53 % female.

### Procedure

Data are from a subsample of participants from the second wave of the Midlife in the United States (MIDUS-II; Radler & Ryff 2010) study who also participated in a satellite study from the Greater Boston area, the Boston longitudinal study (BOLOS-II). MIDUS-II and BOLOS-II examine a range of factors influencing physical and mental health in mid-late life, including behavioral, psychological, social, biological, cognitive, and neurological variables. Participants in MIDUS were recruited over telephone by random-digit dialing (RDD), with a response rate of 70 %. The participants were assessed over the telephone and mailed survey for both MIDUS-II and BOLOS-II. Measurements for BOLOS-II were taken within

1 year of the MIDUS-II measurements. For the present study, dispositional mindfulness and all covariates were measured during MIDUS-II and the mediators and outcome variables during BOLOS-II. For further information regarding the sample, refer to Agrigoroaei and Lachman (2011).

## Measures

The descriptive information for all measures is included in Table 1. All demographic variables, mindfulness, episodic memory, self-rated physical health, openness, and neuroticism were taken from the MIDUS-II survey, and the mediators and dependent variables, i.e., perceived stress, sleep quality, and memory problems, were assessed one to 2 years later, during the follow-up for BOLOS-II.

**Mindfulness** The mindfulness scale consisted of nine items: "Because of your religion or spirituality, do you try to be (1) more engaged in the present moment, (2) more sensitive to the feelings of others, (3) more receptive to new ideas, (4) a better listener, (5) a more patient person, (6) more aware of small changes in my environment, (7) more tolerant of differences, (8) more aware of different ways to solve problems, and (9) more likely to perceive things in new ways." Answers were given on a five-point Likert-type scale (5 = "strongly disagree;" 1 = " strongly agree"). All items were recorded and summed up so that higher scores reflect higher mindfulness. Cronbach's $\alpha$ for this scale was 0.96 for the present study. The items for this scale were developed using the conceptualization of mindfulness presented by Langer and Moldoveanu (2000).

**Memory Problems** Memory problems were assessed with the everyday memory questionnaire (EMQ; Sunderland et al. 1983). Each of the eleven items presents an event involving memory failure (ex., On how many days did you go back to check whether you had done something that you meant to do, such as turning off the oven?) and asks for a numeric response of how many days over the past week (0–7) the particular memory failure occurred. A total score for memory problems was computed by averaging the numerical responses over the eleven items. Possible total scores ranged from 0 to 7. Higher scores indicate a higher occurrence of memory problems. Cronbach's $\alpha$ for this scale was 0.85.

**Perceived Stress** The daily inventory of stressful events (DISE; Almeida et al. 2002) was administered. Each of the seven items presents a stressful event (ex., On how many days did you have an argument or disagreement with anyone?) and are presented in two parts. The first part of each item asks for a numeric response of how many days during the past week (0–7) the particular stressful event occurred. The second part measures severity, asking, "Overall, how stressful was this for you?" using *p* a Likert scale (1 = Not at all; 4 = Very) According to the scoring procedure outlined in Mroczek and Almeida (2004), a total perceived stress score was calculated by computing the mean of the severity scores over the seven items. The possible total scores may range from 0 to 4. Higher scores indicate a higher level of perceived stress. Cronbach's $\alpha$ was 0.73 for this scale.

**Sleep Quality** The sleep quality measure included five questions, three of which asked the participant for a numeric answer (1, In the past week, what is the average number of hours

**Table 1** Descriptive statistics for all variables

| | *N* | Min | Max | Mean | SE | SD |
|---|---|---|---|---|---|---|
| Mindfulness | 249 | 9 | 45 | 32.70 | 0.47 | 7.44 |
| Perceived stress | 259 | 1.00 | 3.83 | 1.81 | 0.04 | 0.62 |
| Sleep quality | 257 | −2.08 | 1.09 | 0.00 | 0.06 | 1.00 |
| Memory problems | 258 | 0.00 | 5.64 | 1.27 | 0.06 | 1.01 |
| Education level | 261 | 2 | 12 | 8.29 | 0.16 | 2.53 |
| Age | 257 | 34 | 85 | 58.90 | 0.79 | 12.62 |
| Gender | 262 | 1 | 2 | 1.53 | 0.03 | 0.50 |
| Self-rated physical health | 262 | 1 | 5 | 3.71 | 0.06 | 1.05 |
| Openness | 248 | 1.86 | 4.00 | 3.10 | 0.03 | 0.48 |
| Neuroticism | 253 | 1.00 | 3.75 | 2.03 | 0.04 | 0.62 |
| Episodic memory | 258 | −2.77 | 3.00 | 0.00 | 0.06 | 1.00 |

*N* total # of participants, *Min* minimum score, *Max* maximum score, *Mean* mean statistic, *SE* standard error of the mean, *SD* standard deviation

you slept per night?; 2, In the past week, how many days did you wake up rested?; and 3, In the past week, on how many days did you get up at night?). The final two questions (4, How tired were you this week?; and 5, How well did you sleep this week?) were followed by a 4-point Likert scale (1 = Not at all; 4 = Very tired; and 1 = Not at all; 4 = Very well, respectively). Items 1, 3, and 5 were based on items from the Pittsburgh sleep quality index (PSQI; Buysse et al. 1988). Items 2 and 4 were included as additional measures of subjective sleep quality. Item 1 was scored as in the PSQI (>7 h = 4; 6–7 h = 3; 5–6 h = 2; and <5 h = 1). Items 2 and 3 were numerical responses ranging between 1 and 7 days. Items 3 and 4 were reverse-coded so that higher scores across all the five items will indicate higher sleep quality. Due to differing scales between items, all the items were standardized and averaged. A z-score was computed for the total score of this scale. Cronbach's $\alpha$ for this scale was 0.72.

**Socio-Demographic Variables** We examined age, gender (1 = men, 2 = women), and highest level of education in years (1 = 1–6 years; 2 = 7–8 years; 3 = 9–12 years; 4 = GED; 5 = high school diploma; 6 = 1–2 years college; 7 = 3+ years in college; 8 = associates degree; 9 = bachelor's degree; 10 = some graduate school; 11 = master's degree; and 12 = PhD, MD, or JD). Because measures of dispositional mindfulness typically show positive associations with age and education, and females tend to report higher mindfulness than males (Höfling et al. 2011; Leigh and Neighbors 2009), these were included as covariates.

**Episodic Memory** In MIDUS-II, seven cognitive dimensions were tested using the brief test of adult cognition by telephone (BTACT; Lachman and Tun 2008; Tun and Lachman 2008). Following exploratory and confirmatory factor analysis (Lachman et al. 2010), two inter-correlated, $r$ (4027) = 0.43, $p < 0.001$, cognitive factors were computed—episodic memory (immediate and delayed word recall of 15 words) and executive functioning (all other measures). The episodic memory variable is included as a covariate, in order to investigate subjective memory problems while controlling for an objective form of memory performance. This variable was standardized as a z-score.

**Self-Rated Physical Health** The participants rated their physical health on a 5-point scale: In general, would you say your physical health is (1) excellent, (2) very good, (3) good, (4) fair, or (5) poor? This variable was reverse-coded so that a higher score indicated better health.

**Openness and Neuroticism** Personality traits were assessed with the midlife development inventory (MIDI; Lachman and Weaver 1997). There were 31 self-descriptive adjectives used to assess six personality traits (extraversion, neuroticism, openness, agreeableness, conscientiousness, and agency), and participants were asked to rate each given adjective as to how it described them. The rating for each adjective was given on a four-point Likert scale (1: a lot; 2: some; 3: a little; and 4: not at all). Personality trait scales were constructed by calculating the mean across each set of items. Some items were reverse-coded so that higher scores reflect a higher standing in each dimension. Although the MIDI assesses six dimensions of personality, only the openness and neuroticism scales were used for the present study. There were seven adjectives used for the openness trait (creative, imaginative, intelligent, curious, broad-minded, sophisticated, and adventurous) with a Cronbach $\alpha$ of 0.73, and four adjectives for neuroticism (moody, worrying, nervous, and calm) with a Cronbach $\alpha$ of 0.65. Openness is typically highly correlated with mindfulness, and because there is some theoretical overlap, we included this as a covariate (Giluk 2009). We controlled for neuroticism because it is often highly correlated with stress and memory problems (Neupert et al. 2008).

### Data Analyses

Data were analyzed using the SPSS statistical package (SPSS Windows, version 21.0; SPSS Inc., Chicago, IL, USA). First, we computed Pearson product–moment correlation coefficients (Table 2). Following this, a mediation analysis using the PROCESS macro provided by Hayes (2013) was conducted. This method uses a regression-based path analytical framework for estimating the total, direct, and indirect effects in both simple and multiple mediator models. This macro generates bias-corrected bootstrap confidence intervals, which indicate significance if the interval does not encompass zero. The indirect effect was tested using the bootstrapping method with 5000 bootstrap samples. The PROCESS macro offers various measures of effect size for the indirect effect, and the completely standardized indirect effect was chosen as the most appropriate for this analysis (Preacher and Kelley 2011). This macro utilizes listwise deletion for missing data. The model included mindfulness as the independent variable, perceived stress and sleep quality as two parallel mediators, and memory problems as the dependent variable. Age, gender, education level, self-rated physical health, openness, neuroticism, and episodic memory were significantly correlated with one or more of the main variables and thus, were included in the model as covariates.

## Results

The bivariate correlations displayed in Table 1 show that, as predicted, mindfulness is negatively associated with perceived

**Table 2** Pearson product–moment correlation coefficients between all independent and dependent variables and covariates

| | Mindfulness | perceived stress | Sleep quality | Memory problems | Age | Gender | Education | Self-rated physical health | Openness | Neuroticism |
|---|---|---|---|---|---|---|---|---|---|---|
| Perceived stress | −0.12* | | | | | | | | | |
| Sleep quality | 0.12 | −0.25** | | | | | | | | |
| Memory problems | 0.07 | 0.25** | −0.06 | | | | | | | |
| Age | 0.07 | −0.26** | 0.08 | 0.14* | | | | | | |
| Gender | 0.18** | 0.17** | −0.05 | −0.00 | −0.11 | | | | | |
| Education | −0.06 | −0.05 | 0.14* | −0.04 | −0.09 | −0.07 | | | | |
| Self-rated physical health | −0.08 | −0.16* | 0.30** | −0.21** | −0.17** | 0.00 | 0.21** | | | |
| Openness | 0.18** | −0.06 | 0.100 | −0.11 | 0.00 | −0.02 | 0.33** | 0.19** | | |
| Neuroticism | −0.14* | 0.37** | −0.33** | 0.15* | −0.19** | 0.07 | −0.04 | −0.11 | −0.17** | |
| Episodic memory | 0.04 | 0.08 | 0.13* | 0.01 | −0.28** | 0.19** | 0.20** | 0.22** | 0.10 | −0.01 |

*Correlation is significant at the 0.05 level (two-tailed)

**Correlation is significant at the 0.01 level

stress ($r = -0.12$, $p < 0.05$) and that perceived stress was positively related to memory problems ($r = 0.25$, $p < 0.001$). Contrary to predictions, there were no significant correlations between mindfulness and sleep quality ($r = 0.12$, $p > 0.05$), or between sleep quality and memory problems ($r = -0.06$, $p > 0.05$).

The mediation model results are presented in Fig. 1. All path coefficients presented are standardized. Results without covariates are also included. There was no significant direct or total effect of mindfulness on memory problems, though this is not a necessary precondition for mediation. As predicted, the bias-corrected bootstrap confidence intervals (CI) indicate that the indirect effect through perceived stress was significant, $M = -0.005$, SE = 0.003, $CI_{95} = -0.0124$ to $-0.0003$. As a measure of effect size, the completely standardized indirect effect through perceived stress indicates a relatively small effect, $ab_{cs} = 0.033$, $CI_{95} = 0.0860$ to 0.0016. However, contrary to predictions, the indirect effect through sleep quality was not significant, $M = 0.002$, SE = 0.002, $CI_{95} = -0.0010$ to 0.0085. The completely standardized indirect effect through sleep quality was $ab_{cs} = 0.013$, $CI_{95} = -0.0082$ to 0.0568. If zero is not within the 95 % confidence interval, it can be concluded that the indirect effect is significantly different from zero at $p < 0.05$. A pairwise contrast comparing both indirect effects revealed that the indirect effect through perceived stress was significantly larger in magnitude than the indirect effect through sleep quality, $M = -0.011$, SE = 0.004, $CI_{95} = -0.0200$ to $-0.0010$. Results show perceived stress to be a significant mediator between mindfulness and memory problems. Those with higher dispositional mindfulness reported less stress, which was in turn related to fewer memory problems.

## Discussion

As expected and consistent with past research, those with higher dispositional mindfulness scores were more likely to have lower stress levels. However, there was no direct relationship found between mindfulness and memory problems, although this is not a necessary precondition for indirect mediation paths (Rucker et al. 2011). Dispositional mindfulness may not directly influence experiences of memory problems in daily life, though the present findings suggest that it may indirectly influence subjective memory problems through its relationship with perceived stress. Thus, higher dispositional mindfulness may be protective of subjective memory problems, which are prevalent for people of all ages. Additionally, interventions that are designed to increase mindfulness may be of benefit to those with subjective memory problems, though more research is needed. In MIDUS-II, the participants were asked if they practiced "relaxation/meditation," however, so few answered affirmatively that this was not investigated further. In future work, it would be interesting to investigate whether meditative practice acts as a moderator in any of these relationships.

There were some limitations of the study to consider. The mindfulness items were asked with regard to a religious/spiritual context, and this could have affected the responses of non-religious participants. Additionally, the mindfulness scale was a shortened version of the original scale developed by Bodner and Langer (2001) that was designed specifically for MIDUS-II. At the time that MIDUS-II was being developed, the mindfulness/mindlessness scale (MMS; Bodner and Langer 2001) was the only scale available to measure dispositional mindfulness. Given the long MIDUS interview, all the

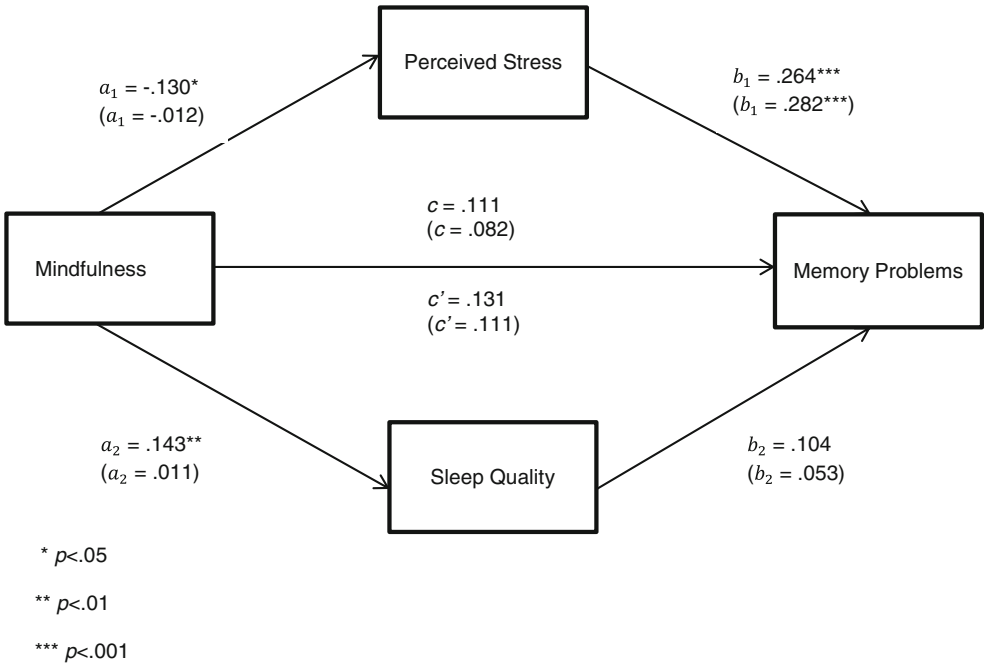


**Fig. 1** The effect of mindfulness on memory problems is mediated by perceived stress and not sleep quality ($N = 224$). Covariates in the model were age, gender, education, self-rated physical health, openness, neuroticism, and episodic memory. Results without covariates are shown in parentheses ($N = 236$)

measures are administered in a shortened, but reliable form. However, the validity of this short form has not been measured in other studies. Nevertheless, the scale reliability (internal consistency) was good, and the relationships between the scale and other variables are consistent with the existing literature on mindfulness.

Mindfulness was measured approximately 1 year prior to the outcome and mediators, and it is not yet known how stable dispositional mindfulness may be over time in individuals. The literature shows that older adults typically report higher mindfulness. Though speculative, it is possible that mindfulness may increase with age or fluctuate over time. This may help explain some of the relatively small relationships between mindfulness and the other variables. Still, it is not likely that a dispositional measure would change dramatically over 1 year, so any impact this may have had is likely to be minor.

It should be noted that since MIDUS-II, there have been numerous psychometric scales developed to measure dispositional mindfulness. The scale used in the present study was based on the MMS (Bodner and Langer 2001). The theoretical framework used to develop the MMS is somewhat different from that of the concept of mindfulness based on Eastern philosophy and meditation, though there is considerable overlap, particularly concerning present-centered awareness, self-regulatory processes, and openness to experience (Hart et al. 2013; Siegling and Petrides 2014). The five facet mindfulness questionnaire (FFMQ; Baer, et al. 2006) is currently the most widely used scale for the measurement of dispositional mindfulness. Hart et al. (2013) suggest that the MMS may map onto the "observing" and "acting with awareness" factors of the FFMQ and may represent a substructure of Kabat-Zinn's model of mindfulness. Although the present study does present interesting preliminary findings, future work concerning mindfulness and memory problems may benefit from the more comprehensive measure that the FFMQ provides. Because the MMS puts more focus on mindfulness in regard to the individual's external experience, it may be that people who are able to perceive stressors from multiple perspectives tend to appraise the stressors less severely. It may well be the case that the "non-judging and non-reactive to inner experience" facets of mindfulness measured by the FFMQ yield a larger effect concerning perceived stress and memory problems based on their focus toward inner experience.

Although there were two time-points in the present study, the data were still correlational in nature and as such, cannot be used to imply causation. Nevertheless, these results do provide valuable preliminary work that can help inform future studies. Further work should also consider whether a similar relationship would be found for objective memory performance. Although sleep quality yielded no indirect effect on subjective memory, it was positively related to episodic memory, so it would be interesting in future studies to examine it as a mediator between mindfulness and objective memory performance. It is necessary to note the change that the inclusion of covariates brings to the model. Although the beta coefficients did not change much, the significance levels for some paths did. Aside from demographics, it is important that future research take into consideration both neuroticism and physical health, as these show moderate relationships with all of the main variables.

The present study offers novel findings regarding the role of perceived stress in linking mindfulness and subjective memory problems. Future studies that examine mindfulness

and memory should be encouraged to consider both subjective and objective measures of memory, as they represent different aspects of cognition. Understanding ways to reduce subjective memory problems is an area that is of significant concern throughout adulthood. Subjective reports of memory problems have been shown to be predictive of dementia and Alzheimer's disease and have also been linked to anxiety and depression. Furthermore, there are currently few established options available for treatment (Engvig et al. 2014). Although more research is needed, the present findings suggest that techniques, which are designed to increase mindfulness and reduce stress, may potentially serve as effective treatment and preventative strategies.

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**Compliance with Ethical Standards**

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

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