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ORIGINAL PAPER

The Association Between Trait Mindfulness and Cardiovascular Reactivity During Marital Conflict

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Abstract Because stress from marital conflict negatively impacts cardiovascular health, understanding the association between trait mindfulness and cardiovascular functioning in the context of marital conflict may translate into physical health benefits. In this study, data from married couples ($N = 90$) were collected to examine the intrapersonal and interpersonal associations between trait mindfulness and cardiovascular reactivity in response to a conflict discussion task. Actor–partner interdependence models showed that partners' individual trait mindfulness scores were significantly related to their own levels of blood pressure during conflict and recovery, and partners' levels of trait mindfulness were significantly related to their own heart rate variability during conflict discussion but not during conflict recovery. In addition, husbands' levels of trait mindfulness were significantly related to wives' cardiovascular reactivity during conflict; likewise, wives' levels of trait mindfulness were significantly related to husbands' cardiovascular reactivity during conflict. Findings suggest that higher levels of trait mindfulness may be linked with healthy cardiovascular functioning for individuals and their romantic partners.

Keywords Cardiovascular reactivity · Couples · Marital stress · Mindfulness

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Introduction

Marital conflict is a stressor associated with a number of markers of cardiovascular reactivity (e.g., increases in heart rate, blood pressure, cardiac output, and cardiac sympathetic activation (Robles and Kiecolt-Glaser 2003; Smith et al. 2009). Because cardiovascular reactivity is an important determinant of cardiovascular health (Robles et al. 2014), identifying factors that help spouses physiologically adapt to or recover from stressful conflict discussions will inform the development of effective and empirically based interventions that reduce risk related to cardiovascular functioning for individuals and couples (Robles and Kiecolt-Glaser 2003; Smith et al. 2009). Trait mindfulness—the tendency to have an undistracted and non-evaluative awareness of the present moment—may be a factor that assuages cardiovascular reactivity during and following stressful discussions between spouses. However, despite previous research that has provided evidence that trait mindfulness is linked with some physiological markers of stress responses in the context of romantic relationships (e.g., Laurent et al. 2015, 2016), better understanding is needed of the association between trait mindfulness and cardiovascular reactivity during and following marital conflict.

Not only is trait mindfulness linked to the health of the marital relationship (Carson et al. 2004) but it is also related to a number of factors that promote physical health. For example, trait mindfulness is related to increased physical activity, reduced likelihood of smoking, and improved diet (Loucks et al. 2015b; for review, see Loucks et al. 2015a). In addition, higher levels of trait mindfulness are associated with markers of healthy cardiovascular functioning, such as lower blood pressure and improved cardiac efficiency (i.e., decreased cardiac sympathovagal tone, vasomotor tone, vascular resistance, and ventricular workload, May et al. 2016; Tomfohr et al. 2015). Marital conflict typically elicits negative

emotional reactions and activates the stress response, but higher levels of trait mindfulness may lessen the stress response during stressful discussions and promote recovery after the discussions are finished. A better understanding of the cardiovascular correlates of trait mindfulness in responding to social stressors, such as marital conflict, could translate into health benefits.

Trait mindfulness may influence spouses' responses to stressful discussions through emotional regulation by abating worry and anxiety, reducing the avoidance and suppression of emotions, and ultimately promoting appropriate engagement with emotions (Chambers et al. 2009). Consistent with this view, trait mindfulness is positively associated with emotion regulation (Goodall et al. 2012; Gratz and Roemer 2004). Trait mindfulness may also play a role in attributions for partner behaviors that occur during marital conflict and impact stress. Individuals with high levels of trait mindfulness are more likely to make benign attributions of partner transgressions (Kimmes et al. 2017). What is more, trait mindfulness has been shown to foster positive reappraisal, which may assuage the stress response during couple conflict (Garland et al. 2011; Ortner et al. 2007). By assuaging emotional reactions to conflict and promoting more benign interpretations of partner behavior, trait mindfulness may play a critical role in physiological responses to marital conflict.

In recent years, researchers have begun to explore the role that trait mindfulness plays in physiological stress responses. In one study, researchers found an indirect effect from mindfulness to lower hypothalamic–pituitary–adrenal activation via reduced attachment avoidance (Hertz et al. 2015). In another study, couples were assigned to either a brief mindfulness induction condition or a control condition and 1 week later engaged in a conflict discussion during a laboratory visit (Laurent et al. 2015). Dynamic salivary alpha-amylase reactivity/recovery and post-stress cortisol recovery showed that participation in the mindfulness condition was associated with better stress regulation for those who had high levels of trait mindfulness (top 25% of participants) than those with low levels of trait mindfulness (bottom 16% of participants). Although the association between trait mindfulness and endocrine responses during couple conflict has been examined, researchers have not yet explored whether trait mindfulness is associated with cardiovascular reactivity during couple conflict.

Trait mindfulness in one partner may also play a role in the cardiovascular responses of the other partner. Previous researchers have used the interpersonal perspective in personality and clinical psychology as an integrative framework in exploring the way in which individuals may influence their own and each other's cardiovascular functioning through their interactions (e.g., Grove et al. 2017; Smith et al. 2004). According to the interpersonal perspective, intrapersonal traits guide behavioral responses that occur during interpersonal interactions, and these behaviors have an impact on the other partner's subsequent behavior and physiological responses (Gallo and Smith 1998; Smith et al. 2014). Empirical support has been found for key elements of the interpersonal perspective. Researchers have demonstrated that the presence of specific intrapersonal traits predict the type of behavioral responses (e.g., controlling behaviors) that will be exhibited during marital interactions (e.g., Smith et al. 1990). Exposure to aversive partner behaviors during interactions has also been shown to predict cardiovascular reactivity (Brown and Smith 1992; Nealey-Moore et al. 2007; Smith et al. 2012). It is possible that the level of trait mindfulness in one spouse may be associated with behaviors during marital interaction and, by extension, the other spouse's cardiovascular response.

In addition to research on the role of trait mindfulness at the intrapersonal level, studies regarding the interpersonal impact of trait mindfulness are beginning to accumulate. For example, in one study, it was found that when the female partner had a high level of trait mindfulness, the male partner was more likely to display less anger and hostility during a conflict discussion (Barnes et al. 2007). In another study, individuals who were in a romantic relationship participated in a mindfulness intervention program. At baseline and following completion of the program, the individuals, as well as their romantic partners (none of whom participated in the mindfulness intervention program), were assessed on trait mindfulness using the Five Facet Mindfulness Questionnaire (Baer et al. 2006). When participants who completed the mindfulness intervention showed improvement in the non-reactivity facet of trait mindfulness, relationship satisfaction increased in their partners (Khaddouma et al. 2016). The findings of these studies are consistent with the view that individuals high in trait mindfulness may be more likely to behave in ways that are conducive to an attenuated stress response in their partners. It is reasonable to expect, therefore, that trait mindfulness in one spouse may ultimately influence their partner's level of cardiovascular reactivity during and following conflict discussions.

The present study examined the intrapersonal and interpersonal relations between trait mindfulness and markers of cardiovascular reactivity during and immediately following a marital conflict discussion. The four markers of cardiovascular reactivity examined were (1) heart rate (HR), (2) systolic blood pressure (SBP), (3) diastolic blood pressure (DBP), and (4) cardiac sympathovagal tone, which were assessed via normalized values of the low frequency from the main spectral components of the heart rate variability (nLF). Cardiovascular parameters were collected during a resting period (e.g., baseline), during a stressful (conflict) discussion task, and then a recovery period (recovery). We used the actor–partner interdependence model (APIM) to examine the way in which each partner's level of trait mindfulness related to the other partner's cardiovascular functioning. We expected that for both

husbands and wives, there would be a negative association between trait mindfulness and changes in the four markers of cardiovascular reactivity during the conflict discussions (Hypothesis 1a) and in the recovery period following the conflict discussions (Hypothesis 1b). Based on research showing that trait mindfulness may have interpersonal effects, we hypothesized that husbands' and wives' trait mindfulness would be negatively associated with the four markers of cardiovascular reactivity in their spouse during conflict and recovery, relative to baseline (Hypotheses 2a and 2b).

Method

Participants

Participants were 90 married couples (M_{age} = 38.81 years, *SD* = 10.80 for husbands; M_{age} = 37.35 years, *SD* = 10.78 for wives) recruited from the community (i.e., local libraries, stores, laundry-mats, churches, etc.). Couples interested in participating were initially screened for the following inclusion criteria: (1) being between the ages of 20 and 60 years old, (2) being married for at least 1 year, and (3) having no history of hypertension or other heart problems, or be medically stable if so. Couples were paid $120 for their participation. In terms of race, husbands were identified as African American (11%), White (85%), and as more than one race (4%), and wives were identified as African American (10%), White (87%), and as more than one race (3%). On average, couples had been married for 12.55 years (*SD* = 9.44). Health demographics include the following: height (*M* = 182.69 cm, *SD* = 8.11 for husbands; *M* = 167.83 cm, *SD* = 6.10 for wives), weight (*M* = 93.31 cm, *SD* = 15.58 for husbands; *M* = 78.16 cm, *SD* = 20.05 for wives), and body mass index (BMI; *M* = 29.01, *SD* = 10.04 for husbands; *M* = 29.74, *SD* = 19.98 for wives).

Procedure

Prior to coming into the laboratory, participants completed an online survey that included the five-item version of the Mindfulness Attention Awareness Scale (MAAS), identified conflict topics, and assessed physical health history and demographics. Participants, who met the inclusion criteria outlined earlier, were instructed to abstain from caffeine, alcohol, strenuous physical exercise, or any hypertensive or blood pressure affecting medications for at least 24 h prior to coming to the lab, and refrain from eating at least 3 h beforehand. When dyads arrived at the lab, height, weight, and waist and arm circumference were measured followed by an investigator connecting participants to blood pressure monitors and electrocardiogram leads. Data collection was conducted between 16:00 and 19:00 in a quiet, dimly lit, temperature-controlled room (73 ± 2 °F) to assure a controlled setting and minimize potential diurnal variations in vascular activity.

Following a resting period, participant baseline beat-by-beat finger BP and heart rate variability (HRV) were collected. Baseline measurements were collected after a 10-min resting period during which spouses were seated facing opposite walls with their backs to one another. Within 5 min from the resting period, brachial BP was used to calibrate beat-by-beat finger BP waveforms in order to obtain hemodynamic variables during a 5-min baseline measurement period. After baseline hemodynamic variable measurements were recorded, investigators obtained the affective baseline of individual participants in the dyad via participants' responses to the State-Trait Personality Inventory (STPI).

Then subjects participated in a conflict discussion task followed by a recovery period—all while beat-by-beat finger BP and HRV were collected. The discussion task was exactly 6 min long, with alternating 1-min speaking and listening intervals for each individual, with counterbalanced speaking orders. The conflict task involved discussing topics of contention that the couples had identified in the initial survey. STPI scores were again collected following the discussion task.

Instructions for the format and topic of the discussion were individually read; participants were told to speak for their entire allotted time and for each person not to speak until their turn has been signaled by a prerecorded sound. Investigators then instructed participants to follow audio-recorded instructions that guided the dyad through the alternating speaking and listening intervals. Instructions for the discussion task were reiterated on the audio recording. The research assistant then turned on audio-recorded instructions and left the room. After each discussion task, participants completed post discussion state affect ratings. At the conclusion of the follow-up questions, the investigator thanked and debriefed participants.

Measures

Demographics Participant demographics were obtained online and in person. Information regarding age, race/ethnicity, gender, and relationship length was collected during participants' completion of an initial survey. In the laboratory, participants' height was measured to the nearest 0.5 cm using a stadiometer, and body weight was measured to the nearest 0.1 kg using a Seca scale (Sunbeam Products Inc., Boca Raton, FL, USA). BMI was calculated as weight in kilograms divided by the square of height in meters.

State Anxiety and Anger State affect was assessed via the STPI (Spielberger 1980). The STPI is a 12-item measure of state anxiety and anger (six items each) used to assess how participants feel in the moment. Sample items of the anxiety subscale include "I feel worried," and "I am relaxed" (reverse coded), and sample items of the anger subscale include "I am

annoyed," and "I feel friendly" (reverse coded). Answers are given on a 4-point Likert scale ranging from "not at all" to "very much so." Both subscales have been sensitive and reliable in similar experimental studies (Nealey-Moore et al. 2007).

Trait Mindfulness Trait mindfulness was measured using a five-item version of the 15-item MAAS (Brown and Ryan 2003). Van Dam et al. (2010) established the five-item version of the MAAS by fitting the data from responses to the original MAAS to a graded item response theory model and found that five of the items in the MAAS demonstrated high discriminatory values that cover the span of trait mindfulness. Subsequent research has provided support for the internal consistency, construct validity, and concurrent validity of the five-item version of the MAAS (e.g., Osman et al. 2016; Smith et al. 2017).

The items in the five-item MAAS include "It seems I am 'running on automatic,' without much awareness of what I'm doing"; "I rush through activities without being really attentive to them"; "I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there"; "I do jobs or tasks automatically, without being aware of what I'm doing"; and "I find myself doing things without paying attention". Responses are on a 6-point scale ranging from 1 = *almost always* to 6 = *almost never*, with higher scores indicating higher frequency in the use of an open receptive state of mind informed by an attention and a sensitive awareness of what is occurring in the present. Internal validity of the short version of the MAAS in this sample was α = .88.

Cardiovascular Measurements Measurements of HR, SBP, and DBP were collected via beat-to-beat blood pressure as these indices have been demonstrated to be predictive in the development of hypertension (Reule and Drawz 2012). Beat-to-beat blood pressure (BP) was recorded while participants were seated using finger plethysmography (NIBP-100 Biopac Inc., Goleta, CA, USA). This method has shown accurate measurement of BP changes when compared with intra-arterial blood pressure (Imholz et al. 1991). The NIBP-100 obtains brachial BP using an integrated brachial BP cuff and reconstructs brachial BP waveforms from finger arterial waveforms by applying an inverse transfer function, a waveform filter, a level correction, and a level calibration. In an attempt to avoid imposing additional stress to the participants, investigators did not control for breathing frequency.

Cardiac sympathovagal tone was collected via measurement of HRV through three-lead electrocardiogram. Normalized values of the low frequency from the main spectral components of the heart rate variability (nLF) served as an index of cardiac sympathovagal tone. Cardiac sympathovagal tone represents the contribution of the sympathetic influence on the balance of the autonomic state resulting from sympathetic and parasympathetic influences (Burr 2007; May et al. 2016; Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology 1996). Research indicates that increased cardiac sympathovagal tone over extended durations can lead to greater risks of cardiovascular disease and death (Kemp et al. 2012; Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology 1996). nLF was evaluated through use of WinCPRS (Turku, Finland), a software program that analyzes HRV and automatically detects participants' BP peaks and intervals between heartbeats (RRI). Participant RRI was inspected for artifacts, premature beats, and non-sinus tachycardia episodes. Using the main spectral components of the HRV, we derived both the low frequency (LF; 0.04–0.15 Hz) and the high frequency (HF; 0.15–0.4 Hz) variabilities in HR. The use of absolute units (ms^2) for HF and LF may be obtained in proportion to the total power of HRV, which is expressed in normalized units (n). Since there is structural algebraic redundancy inherent in the normalized spectral HRV measures with respect to each other (nLF = 1-HF), and also with respect to the LF/HF ratio, here we report nLF to denote cardiac sympathovagal tone (see May et al. 2016).

Discussion Task Couples engaged in a conflict discussion task lasting 6 min, with alternating 1-min speaking and listening intervals for each individual. Speaking order was counterbalanced.

Prior to coming to the lab, participants responded to the prompt, "Every couple experiences conflict, even happy couples. Please list, in order, what you feel are the two most important areas that you and your partner continually have conflict about." After individual participants in the dyad listed the conflicts they felt are most important, the partners then listed what each felt are the two conflicts most important to their spouse.

During their lab visit, participants were given an envelope with a slip of paper indicating the conflict listed as most important to (1) them and (2) their spouse (if the most important conflict was the same for both partners, the second conflict listed as most important was selected). After participants read the two listed conflicts, they were instructed to think about "the most recent thing you can remember that your spouse did that really upset you, made you angry, or made you extremely annoyed," and write a few words to remind them of this incident. During the first two 1-min speaking periods of the stressful discussion task, participants talked about the two listed conflicts and were told, "During this minute you will explain why you feel your partner's position on this matter is wrong and why you disagree with it." For the third 1-min speaking period, they were instructed to talk about the recent annoying experience. A research assistant confirmed that both participants in the couple understood the instructions and were willing to discuss the written conflicts.

Data Analyses

Serving as a manipulation check, a 2 (gender) × 3 (baseline, conflict, and recovery) repeated measures MANOVA with Bonferroni pairwise alpha adjustments was used to examine the anxiety and anger scores. Additionally, to evaluate cardiovascular reactivity by gender and time of assessment (baseline, conflict, recovery), repeated measures ANOVAs with Bonferroni pairwise alpha adjustments were conducted on SBP, DBP, HR, and nLF values. This analysis served to demonstrate whether scores for each marker of cardiovascular reactivity during and following conflict discussions were different from baseline scores.

For the main analyses, actor–partner interdependence models (APIM; Kenny 1996) using Amos (version 22.0) were performed to examine the association of husbands' and wives' mindfulness scores on each other's cardiovascular outcomes. APIMs were developed to analyze non-independent data (dyadic data). By partitioning out variance shared across and within partners (Cook and Kenny 2005) APIMs allow for estimation of the association between a predictor and outcome variable within a single individual in the dyad (actor effect) and the association between one member of the dyad's value on the predictor variable and the other member of the dyad's value on the outcome variable (partner effect). However, whether or not data from members of the dyad are distinguishable from one another influences analysis procedures (see Kenny et al. 2006; Kenny and Ledermann 2010). More specifically, if the members of the dyads are distinguishable, then all of the parameters within the model can be freely estimated. Thus, prior to testing APIMs, omnibus tests of distinguishability (I-SAT) were conducted to determine whether data from husband and wife were empirically distinguishable (Olsen and Kenny 2006).

Results

MANOVA analyses in which anger and anxiety scores were the dependent variables yielded a non-significant gender by assessment condition (baseline, conflict, recovery) interaction, $F(2, 177) = 1.20$, $p = .304$. However, a significant effect across baseline, conflict, and recovery emerged. Follow-up repeated measures univariate ANOVAs showed that the effect was evident for anger, $F(2, 178) = 40.00$, $p < .001$, partial $\eta^2 = .311$, Wilks' Lambda = .689 ($M = 8.14$, $SD = 2.04$ baseline; $M = 9.58$, $SD = 3.40$ conflict discussion); and for anxiety, $F(2, 178) = 40.86$, $p < .001$, partial $\eta^2 = .316$, Wilks' Lambda = .684 ($M = 8.65$, $SD = 2.49$ baseline; $M = 10.20$, $SD = 3.19$ conflict discussion). For both anger and anxiety scores, pairwise comparisons indicated significantly higher scores in the conflict condition compared to baseline ($p < .001$).

Factorial repeated measures ANOVAs indicated no gender by assessment condition interactions for SBP, DBP, HR, or nLF, Fs < 1, $p > .05$. However, significant main effects were found across assessment conditions for SBP, $F(2, 178) = 32.42$, $p < .001$, partial $\eta^2 = .282$, Wilks' Lambda = .718; DBP, $F(2, 178) = 72.30$, $p < .001$, partial $\eta^2 = .469$, Wilks' Lambda = .884; HR, $F(2, 178) = 83.77$, $p < .001$, partial $\eta^2 = .499$, Wilks' Lambda = .997; and nLF, $F(2, 178) = 53.87$, $p < .001$, partial $\eta^2 = .391$, Wilks' Lambda = .641. Pairwise comparisons indicated significantly higher scores in the conflict condition compared to baseline for each cardiovascular outcome. Figure 1 shows the values of the cardiovascular indices for the baseline, conflict, and recovery measurements.

APIM models were used to examine the associations between husbands' and wives' mindfulness scores and own and partner's changes in SBP, DBP, HR, and nLF relative to baseline levels for both the conflict discussion and the recovery condition following conflict. Significant findings were found for the APIMs involving SBP and nLF, but none of the results for the APIMs involving HR and DBP reached statistical significance. Consequently, information regarding the findings for SBP and nLF is presented here, and the results involving HR and DBP are available as online supplementary material.

As noted previously, it is important to establish whether dyads that are conceptually distinguishable are empirically distinguishable as the APIM differs for these two types of dyads. In the omnibus test of distinguishability (I-SAT), equality constraints are imposed on the means, variances, and covariances of the manifest variables for both members of the dyad. When this yields a χ^2 that is not significant, showing adequate model fit, the members of the dyads are not empirically distinguishable. This occurred for models examining husbands' and wives' trait mindfulness scores with SBP during conflict discussions, $\chi^2(6) = 8.32$, $p > .05$, as well as husbands' and wives' mindfulness scores with SBP following conflict discussions, $\chi^2(6) = 11.86$, $p > .05$. APIMs were therefore run for indistinguishable dyads and yielded significant associations between husbands' and wives' trait mindfulness and their own SBP scores during conflict discussions ($\beta = -.17$; $p < .05$) and SBP scores following conflict discussions ($\beta = -.17$; $p < .05$). These findings provided some support for Hypothesis 1a and Hypothesis1b. However, no support was obtained for Hypothesis 2a and Hypothesis 2b in regard to SBP as the values for partner effects did not reach statistical significance.

I-SAT models examining husbands' and wives' trait mindfulness scores with nLF during conflict discussions, $\chi^2(6) = 19.49$, $p < .01$, and nLF following conflict discussions, $\chi^2(6) = 20.51$, $p < .01$, were found to be statistically significant. Thus, APIM analyses for distinguishable dyads were conducted. Trait mindfulness significantly related to own nLF during conflict discussions (actor effects) for husbands ($\beta = -.16$; $p < .05$) and wives ($\beta = -.13$; $p < .05$). In contrast, the actor paths from mindfulness to nLF following conflict discussions were not significant for husbands ($\beta = -.11$, $p > .05$) or wives ($\beta = -.10$, $p > .05$). Thus, support was obtained for Hypothesis

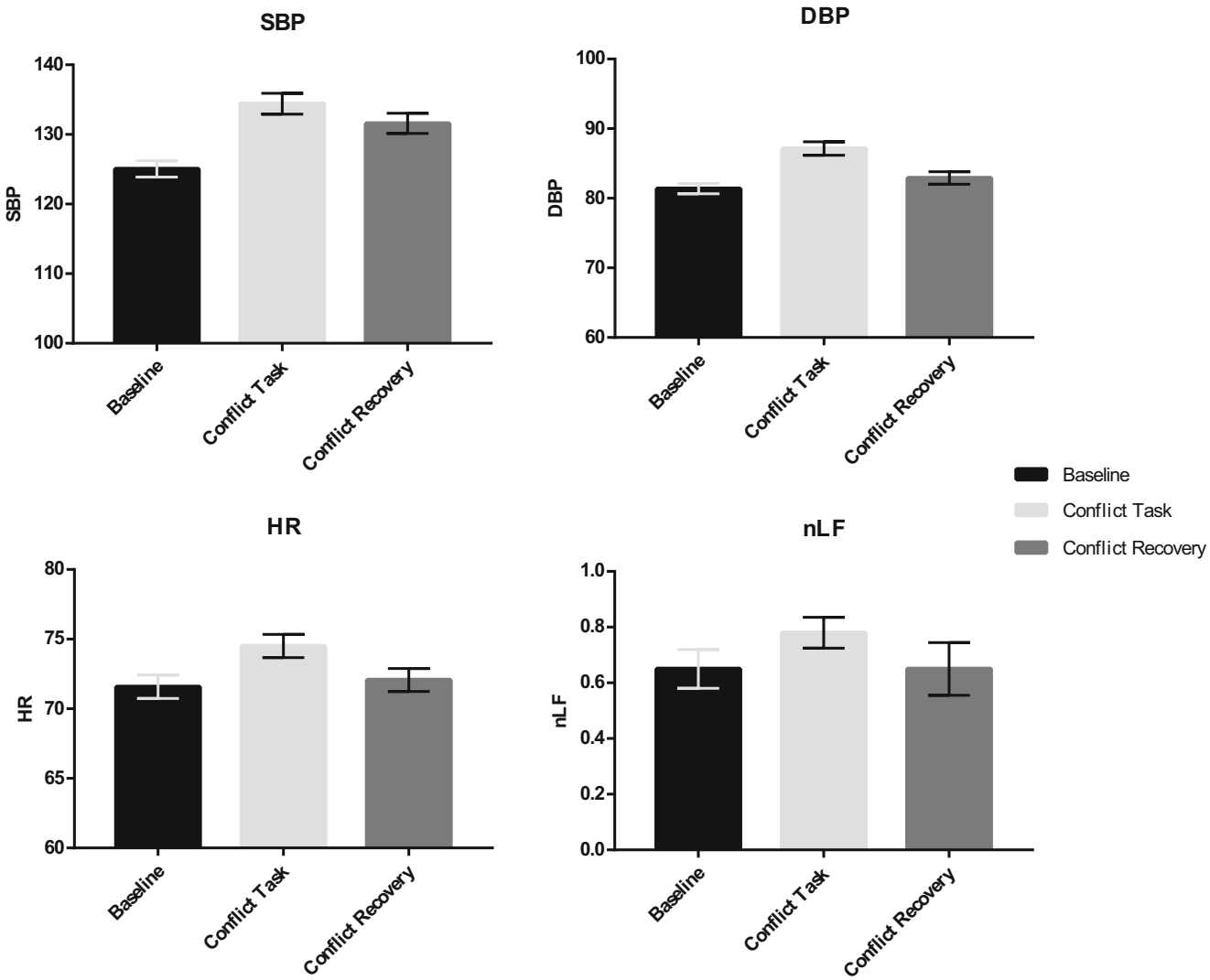

Fig. 1 Cardiovascular values at baseline, during conflict, and at recovery. Mean ± SE. SBP systolic blood pressure, DBP diastolic blood pressure, HR heart rate, nLF normalized low frequency heart rate variability

1a only, and not Hypothesis 1b. In support of Hypothesis 2a, the interpersonal paths from mindfulness to nLF during conflict, partner effects, were statistically significant (husband to wife: $\beta = -.15$, $p < .05$; wife to husband: $\beta = -.22$, $p < .05$). However, no support was obtained for Hypothesis 2b as partner effects following conflict discussions were not significant (husband to wife: $\beta = -.06$, $p > .05$; wife to husband: $\beta = -.07$, $p > .05$). Figure 2 provides a graphical representation of the APIM analyses involving SBP and nLF.

Discussion

The results of this study show that mindfulness is associated with lower levels of activation for some markers of cardiovascular reactivity during stressful conflict discussions and during recovery periods following conflict discussions, relative to baseline. Several APIMs were used to examine the differential contribution of trait mindfulness on self and partner cardiovascular reactivity during a stressful discussion task and in a subsequent recovery period. Although associations were found between trait mindfulness and cardiovascular reactivity within spouses, some evidence was also found for associations between trait mindfulness and cardiovascular reactivity between spouses. Specifically, it appears that higher levels of mindfulness in one individual might contribute to healthy cardiovascular functioning not only for him or her but also for the romantic partner. The findings of this study thus identify a possible mechanism through which mindfulness may impact cardiovascular disease risk factors, namely, cardiovascular reactivity in response to couple conflict.

Regarding the intrapersonal associations, we found that husbands' and wives' trait mindfulness were associated with their own SBP during conflict and recovery, as well as their own cardiac sympathovagal tone during conflict. However, husbands' and wives' trait mindfulness were not significantly

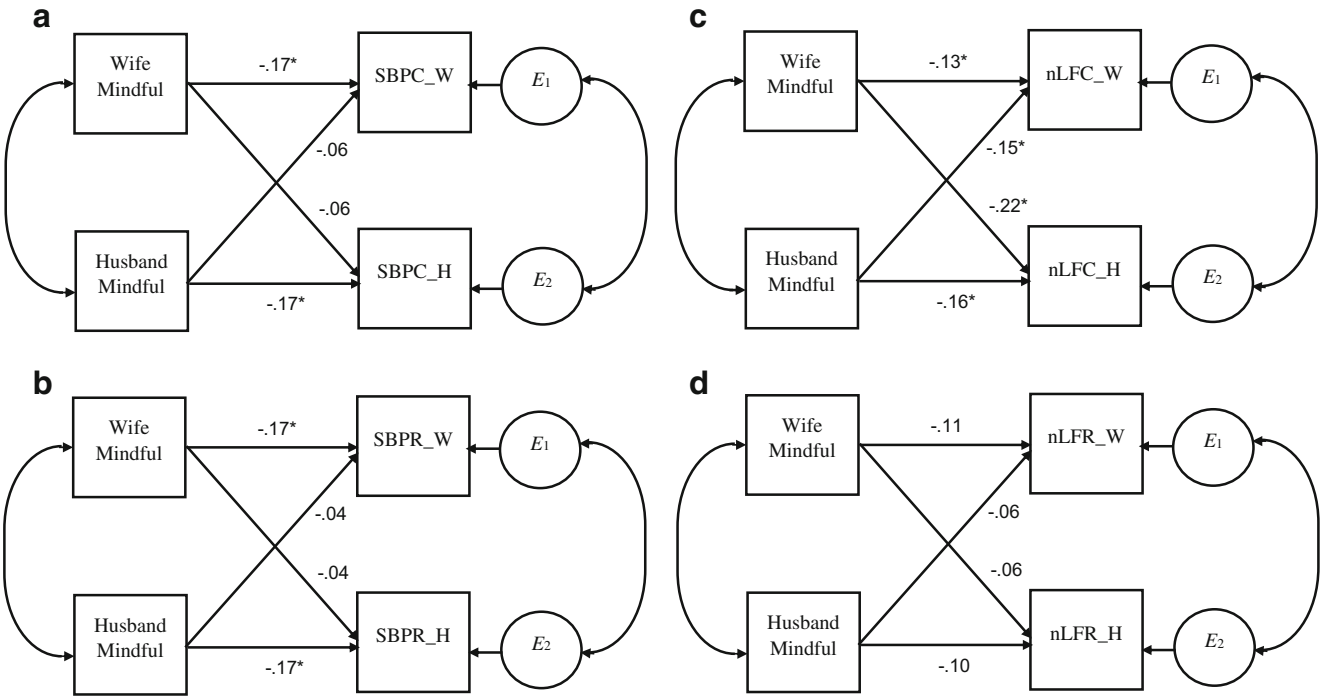

Fig. 2 APIM models examining the effects of husbands' and wives' mindfulness scores on their own and each other's change scores of systolic blood pressure and heart rate variability from conflict to baseline and from recovery to baseline. Panels **a** and **b** show husbands' and wives' mindfulness scores on their own and each other's change scores of systolic blood pressure during conflict (SBPC = SBP conflict minus SBP baseline) and recovery (SBPR= SBP recovery minus SBP baseline), respectively. Panels **c** and **d** show husbands' and wives' mindfulness scores on their own and each other's change scores of heart rate variability during conflict (nLFC = nLF conflict minus nLF baseline) and recovery (nLFR = nLF recovery minus nLF baseline), respectively. * = $p < .05$; All outcomes are change scores. SBPC_W = systolic blood pressure change from conflict to baseline for wives; SBPC_H = systolic blood pressure change from conflict to baseline husbands; SBPR_W = systolic blood pressure change from recovery to baseline for wives; SBPR_H = systolic blood pressure change from recovery to baseline for husbands; nLFC_W = heart rate variability change from conflict to baseline for wives; nLFC_H = heart rate variability change from conflict to baseline husbands; nLFR_W = heart rate variability change from recovery to baseline for wives; nLFR_H = heart rate variability change from recovery to baseline for husbands

associated with their own cardiac sympathovagal tone during recovery. These findings are consistent with research that has demonstrated associations between trait mindfulness and cardiovascular reactivity during stress generally (e.g., Steffen and Larson 2015), as well those showing greater cortisol recovery following conflictual couple discussions specifically (e.g., Laurent et al. 2015). It is possible that mindfulness results in greater calmness in partners leading them to experience less intense conflict and, by extension, reduced cardiovascular reactivity. Future research might examine observed or self-reported conflict intensity to examine this possibility.

Interestingly, in addition to the intrapersonal associations that were found, interpersonal associations were also found. For both husbands and wives, trait mindfulness was significantly linked with the other spouse's cardiac sympathovagal tone during conflict. Specifically, higher levels of mindfulness were associated with smaller changes of cardiac sympathovagal tone in the partner. Thus, the role of trait mindfulness in cardiovascular reactivity may extend beyond the individual and could impact spousal functioning. Based on the interpersonal perspective in personality and clinical psychology, trait mindfulness may bring a quality of awareness to the conflict discussion that may allow for more considered responses, as opposed to reactive responses, and these responses may result in a less pronounced cardiovascular response in the spouse, positively impacting the entire interaction. A mindful, accepting stance during marital conflict may allow spouses to engage in more thoughtful behavioral responses that are conducive to effective communication, rather than engaging in reactive, relationship-threatening behaviors, contributing to less pronounced cardiovascular responses in each spouse.

The associations between spouses identified in this study are consistent with previous findings on the interpersonal impact of trait mindfulness. For example, Barnes et al. (2007) conducted two studies in an effort to better understand the association between trait mindfulness and responses to relationship stress. In the first, a longitudinal design was used to show that trait mindfulness predicted greater capacities to respond constructively to relationship stress. In the second study, however, trait mindfulness was not linked with communication quality, which was assessed using conflict discussions that were videotaped and subsequently coded using five codes from the System for Coding Interactions in Dyads (Malik and Lindahl 2004). It is also possible that trait

mindfulness in one partner may impact the communication patterns of the other partner, which ultimately positively impacts the first partner. In one study, a trend was found to suggest that one partner's level of trait mindfulness was related to more open communication in the other partner (Schellekens et al. 2016). This may provide some preliminary evidence that increases in one partner's level of trait mindfulness may enhance the other partner's communication tendencies. Ultimately, trait mindfulness may impact one's response to relationship conflict, which may bring about more prosocial communication patterns during conflict discussions and, by extension, curb the stress response in the other partner.

Although the APIM models yielded significant results for two of the markers of cardiovascular reactivity (i.e., HRV and SBP), non-significant findings were found for the other two markers (i.e., HR and DBP). Although different components of blood pressure tend to converge on similar associations with outcomes, there are unique contributions of each component, and divergence among them can occur (e.g., Haider et al. 2003; Sesso et al. 2000). This is mostly attributed to BP components being driven by differing mechanisms (for further details, see Vlachopoulos and O'Rourke 2000). Consequently, the combination of significant findings for HRV and SBP with the non-significant findings involving HR and DBP opens the possibility that trait mindfulness may have not played the same role in all cardiovascular outcomes. However, the lack of significant findings involving HR and DBP may also be attributable to the sample size; that is, a larger sample size may have improved statistical power such that significant associations involving HR and DBP described in the hypotheses would have emerged.

In this study, we used a sample of married couples, which is important because trait mindfulness is more likely to benefit people in committed relationships, as opposed to those in low-commitment relationships (Carson et al. 2004; Karremans et al. 2017). In committed relationships, mindfulness may increase partners' likelihood to "regulate potentially relationship-threatening responses into more relationship-benefitting responses, because they are motivated to do so" (Karremans et al. 2017, p. 4). On the other hand, when commitment is low, partners may not be sufficiently motivated to regulate potentially relationship-threatening responses, even if they are mindfully aware of them.

Although previous research has been useful in understanding the role that trait mindfulness plays in cardiovascular reactivity during conflict at the intrapersonal level, conflict is inherently interpersonal, with the actions of each interlocutor affecting the other. In this study, we used a dyadic data-analytic strategy in an effort to examine the intrapersonal and interpersonal processes involved in the link between trait mindfulness and cardiovascular reactivity. Without such an approach, the interpersonal and intrapersonal associations between trait mindfulness and cardiovascular functioning could not be teased apart. Using dyadic modeling is an appropriate strategy that should be used routinely to examine intrapersonal and interpersonal associations among trait mindfulness and cardiovascular functioning.

In this study, we endeavored to better understand the intrapersonal and interpersonal role of trait mindfulness on responses to stressful discussions in married couples, and our findings suggest that clinicians may facilitate healthy cardiovascular responding for both partners during conflict, even if they are only able to increase trait mindfulness in one partner. Thus, we agree with Khaddouma et al.'s (2016) claim that more dyadic research regarding mindfulness "would be beneficial for providers and individuals seeking services for whom couple-based programs are unavailable (e.g., due to lack of services offered in area or residence, lack of providers with couples or family specialty) or not feasible (e.g., due to long-distance relationships and cost of joint enrollment)" (p. 4). Understanding the role of trait mindfulness in romantic relationships may ultimately prove useful in the development of interventions and programs intended to promote relational and physical well-being in married couples.

Limitations and Future Directions

It is important to consider several limitations of this study. First, due to the small sample size, we used eight APIMs to test the hypotheses, instead of just one or two, resulting in an increase in the overall (experiment-wise) Type I error rate. Furthermore, because of the small sample size, no control variables could be included in the APIMs without substantially reducing their power. In a future investigation involving a larger sample of couples, the associations found in this study should be tested with a single APIM that includes relevant covariates in order to handle complex interactions within an APIM framework.

A larger sample of couples would have also provided opportunities to examine variables that potentially mediate the link between trait mindfulness and the markers of cardiovascular reactivity. Future research is needed to elucidate mechanisms through which trait mindfulness in one partner influences cardiovascular reactivity in the other partner in the context of conflict in romantic relationships. As Laurent et al. (2015) pointed out, these mechanisms may include certain communication behaviors during the conflict or types of cognitions related to the partner and the conflict. Future studies are therefore needed to explore individual aspects of communicative functioning, such as expressions of emotional support. It is also important to investigate dyadic aspects of communicative functioning, such as the presence or absence of a pursuit-withdrawal pattern, as potential mediators that could explain the degree to which trait mindfulness relates to cardiovascular reactivity during and following stressful spousal discussions. Finally, future studies may test cognitions involving expectations of conflict or attributions for partner behavior as a mediator in the intrapersonal and interpersonal links between trait mindfulness and cardiovascular reactivity.

Author Contributions JGK conceptualized the research questions, wrote the Introduction and Discussion sections, and collaborated in the data analyses. RWM collaborated in the design and execution of the study, analyzed the data, and wrote parts of the Method and Results sections. GSS collaborated in the data analyses and wrote parts of the Method and Results sections. MEJ wrote part of the Method section. FDF collaborated in the design and execution of the study and collaborated in the writing and editing of the manuscript. All authors contributed to and approved of the final manuscript.

Compliance with Ethical Standards

Ethical Approval All procedures performed in this study were approved by the Florida State University Institutional Review Board and were in accordance with the 1964 Helsinki Declaration and its later amendments.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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

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