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INTRODUCTION

Research on mindfulness meditation has, to date, focused almost wholly on the intrapersonal effects of meditation practice. Numerous reviews and meta-analyses collate the myriad cognitive, emotional, and physiological consequences of meditation practice. Intrapersonal effects of meditation include increased mindfulness (Quaglia, Braun, Freeman, McDaniel, & Brown, 2016), enhanced emotion regulation (Chambers, Gullone, & Allen, 2009), changed body awareness and self-perception (Hölzel et al., 2011), altered brain physiology and anatomy (Fox et al., 2014), attenuated anxiety, depression, and pain (Goyal et al., 2014), as well as improved attentional processing, working memory capacity, and executive functioning (Chiesa, Calati, & Serretti, 2011; Malinowski, 2013).

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RESEARCH ARTICLE

Mindfulness meditation is associated with decreases in partner negative affect in daily life

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Abstract

To date, very little research has examined the extrapersonal effects of mindfulness meditation practice. In this study, we investigated whether individual meditation practice exerted an influence on friends or romantic partners. Thirty-five dyads completed an 8-week single-subject protocol using an A-B-A-B design to compare non-meditation phases with meditation phases. One member of each pair was randomly assigned to meditate daily for 15 min during the B-phases of the study; the other dyad member did not meditate in either the A or B phases. Daily diaries for each participant assessed negative affect, positive affect, and facets of mindfulness. For participants in the intermittent meditation condition, meditation was associated with decreased negative affect, increased positive affect, and higher scores on the mindfulness facets of observing, describing, and nonreactivity to inner experience. Results further demonstrated that the negative affect of non-meditating partners decreased during the weeks that their partner meditated and was lower on days that their partner meditated. We did not find similar results for positive affect or mindfulness at the group level. Exploratory analyses suggested that the extrapersonal effects of meditation days on a partner’s negative affect might be stronger in romantic couples. This study indicates that 15 min of daily meditation in novice meditators can decrease the negative affect of relationship partners.

KEYWORDS

close relationships, daily diary, dyadic, meditation, mindfulness, negative affect

1 | INTRODUCTION

Research on mindfulness meditation has, to date, focused almost wholly on the intrapersonal effects of meditation practice. Numerous reviews and meta-analyses collate the myriad cognitive, emotional, and physiological consequences of meditation practice. Intrapersonal effects of meditation include increased mindfulness (Quaglia, Braun, Freeman, McDaniel, & Brown, 2016), enhanced emotion regulation (Chambers, Gullone, & Allen, 2009), changed body awareness and self-perception (Hölzel et al., 2011), altered brain physiology and anatomy (Fox et al., 2014), attenuated anxiety, depression, and pain (Goyal et al., 2014), as well as improved attentional processing, working memory capacity, and executive functioning (Chiesa, Calati, & Serretti, 2011; Malinowski, 2013).
More recently, research has begun to examine the interpersonal effects of mindfulness meditation. A meta-analysis of correlational studies examining the association of trait mindfulness with relationship satisfaction reported a significant effect size of 0.27 (McGill, Adler-Baeder, & Rodriguez, 2016). Mindfulness has been associated not only with the mindful individual’s own relationship satisfaction, but also with their partner’s satisfaction (Adair, Boulton, & Algoe, 2018; Gillespie, Davey, & Flemke, 2015; Kappen, Karremans, Burk, & Buyukcan-Tetik, 2018; Khaddouma, Coop Gordon, & Strand, 2017; Lenger, Gordon, & Nguyen, 2017). These results were extended in a recent intervention study using Mindfulness-Based Stress Reduction (MBSR; Khaddouma et al., 2017). This study found that increases in mindfulness amongst program enrollees were associated with increased relationship satisfaction among non-enrolled partners. The association between mindfulness and partner relationship satisfaction may be mediated by a number of variables, including changes in emotional transmission between relationship partners (Montes-Maroto, Rodríguez-Muñoz, Antinò, & Gil, 2018; Thompson & Bolger, 1999), a greater capacity to respond constructively to relationship stress (Barnes, Brown, Krusemark, Campbell, & Rogge, 2007), heightened acceptance of partner imperfection (Kappen et al., 2018), or increased perceived responsiveness of a partner (Adair et al., 2018). A number of other plausible mechanisms for the relation between mindfulness and relationship satisfaction have also recently been proposed (Karremans & Kappen, 2017; Karremans, Schellekens, & Kappen, 2017). Notably, because relationship satisfaction is linked with personal well-being more generally (e.g., see Proulx, Helms, & Buehler, 2007), these results indicate that mindfulness may have not only interpersonal consequences, but also extrapersonal effects.

Mindfulness training, more specifically, may have extrapersonal effects. That is, a meditator’s practice may affect another person in ways other than (only) impacting the relationship between two people. Such influence may occur directly through emotional contagion (Hatfield, Cacioppo, & Rapson, 1993). That is, as a result of the effects of mindfulness training on the trainee’s negative and positive emotions (e.g., Fredrickson et al., 2017; May, Weyker, Spengel, Finkler, & Hendrix, 2014), a person in contact with the meditator may pick up the emotional states through mechanisms such as imagination and mimicry (Hatfield et al., 1993). Research has also shown contagion effects for personality traits (Neal, Durbin, Gornik, & Lo, 2017). This suggests the possibility that a meditator may influence the mindfulness of a second person. In addition to direct effects, the influence of the meditator on a second person may also occur indirectly, through improving relationship satisfaction (McGill et al., 2016), which is in turn related to increased positive emotion and decreased negative emotion (Boesch, Cerqueira, Safer, & Wright, 2007).

A small number of studies have looked specifically into extrapersonal effects of mindfulness meditation. In one early study, autistic children of parents receiving mindfulness training exhibited reduced aggression, non-compliance, and self-injury (Singh et al., 2006). Parental mindfulness training also increased the social skills and decreased the aggression of children with developmental disabilities (Singh et al., 2007). These altered behaviors, in turn, enabled the disabled child to have more positive interactions with their siblings. In another setting, teacher mindfulness training led to decreased challenging behaviors and negative social interactions in students (Singh, Lancioni, Winton, Karazsia, & Singh, 2013). Likewise in a clinical context, the clients of clinicians practicing mindfulness reported greater symptom reduction compared to those of non-practicing clinicians (Grepmaier et al., 2007). In one of the first intervention studies to examine the effects of meditation on a romantic relationship partner, Gillespie et al. (2015) found that intimate partners of MBSR graduates reported experiencing less stress after the program. Partners attributed this to their perception that partners were calmer and less reactive. In sum, these studies suggest that meditation can impact numerous types of interaction partners (i.e., child, student, client, romantic partner).

Although these initial studies show promise for extrapersonal effects of mindfulness, much remains to be learned. For example, no research has examined whether mindfulness meditation can impact the daily reports of another’s mindfulness and affect in the context of everyday relationships with extensive interaction, such as those involving friends and romantic partners. In other words, does mindfulness meditation produce a diffusion of influence that can be detected in the daily experiences of interaction partners? Examining this question could enhance our understanding of the range of mindfulness meditation’s influence.

In the current study, we sought to determine if commonly observed intrapersonal effects of meditation could also be detected in non-practicing interaction partners. We focused our examination on mindfulness, positive affect, and negative affect, as mindfulness meditation has been shown to affect these variables in meditators. Only general measures of affect instead of context-specific measures of affect were included as we are interested in whether the effects of mindfulness meditation are contagious, rather than studying the mechanisms through which these effects may occur. We recruited partners who interacted with each other frequently, which included both friends and romantic partners. Diffusion of psychological states has been reported previously in multiple types of relationships such as in family members (Larson & Almeida, 1999) and roommates (Howes, Hokanson, & Loewenstein, 1985). To examine the effects of meditation on non-practicing partners, all interaction partners were asked to complete daily surveys assessing mindfulness and affect for 8 weeks while one dyad member mediated during two non-consecutive 2-week phases of the study (i.e., an A-B-A-B design). All meditators were beginning practitioners with no previous regular practice.

We hypothesized that meditating partners would report decreased negative affect and increased mindfulness and positive affect during meditation periods of the study. Because we used an A-B-A-B experimental design, we expected meditation practitioners to report significant changes in the B-phases (meditation) relative to the preceding A-phases (non-meditation). Of principal interest, we further hypothesized that non-practicing partners would report similar dynamic changes in mindfulness and affect. Importantly, no
distinction was made between phases of the study for the non-practicing interaction partners. Therefore, changes between phases for those individuals should be a function of their partner's practice. In addition, we examined whether non-meditating partners would report lower levels of negative affect and higher levels of positive affect and mindfulness on days that their partner was meditating. For significant effects, we further explored relationship type (friend or romantic) as a moderator, to indicate whether effects were more pronounced in romantic partners than friendship pairs.

2 | METHOD

2.1 | Participants

Pairs of English-speaking participants were recruited from a pool of first-year psychology students at the University of Groningen in the Netherlands and through campus and social media advertisements. Prospective participants were instructed to enroll in the study with a friend, romantic partner, roommate, coworker, or family member with whom they interacted on a daily basis (on average). Participants were not to have previously maintained a regular meditation practice of three or more times per week. Psychology students received program credit for participation; all others were entered into a lottery with a chance to win 50 euros. The study was approved by the Ethical Committee Psychology of the University of Groningen. The study was conducted in accordance with the principles of the Declaration of Helsinki (version 2013). All participants provided written informed consent prior to study participation.

We included participants within a 30-day enrollment period between 16 February and 17 March 2016. We aimed at including 50 dyads; however, members of several dyads did not interact with each other during the study as frequently as required to be included in the analyses. Therefore, the analyzed sample size (70 participants in 35 dyads) was smaller than intended.

One hundred and six participants (53 dyads) began the experiment. Four dyads did not complete the experiment: one dyad voluntarily exited the study because a member was experiencing emotional difficulties unrelated to the study; three dyads were discontinued for ongoing failure to respond to the daily surveys. Ninety-eight participants (49 dyads) completed the experiment.

For inclusion in analyses, dyads had to sufficiently adhere to the experiment so that the hypothesized effects could be expected to occur. Because partner effects depend on partner interactions, we excluded from our analyses those dyads that did not interact with their partners an adequate number of days. To derive an empirical decision threshold, we performed a qualitative cluster analysis by visualizing the distribution of interaction frequencies across dyads. A cluster of dyads with partners who interacted fewer than 40% of the days in the study was discontinuous with dyads interacting more frequently. Since we also would not expect to see substantial partner effects with interaction frequencies much below 50%, we selected the empirically derived 40% as a liberal threshold.

Thirty-five dyads exceeded the interaction frequency threshold. Dyads interacted 73.9% of days in the study (SE = 17.8). Of these 70 participants, 67.1% were female and 88.4% were Caucasian. The average age was 24.2 (SDage = 7.4). Just fewer than two-thirds (62.9%) of the pairs identified as friends; the other 37.1% reported being in a romantic relationship. Most participants (80%) were students.

2.2 | Design and procedure

We utilized a randomized-controlled A-B-A-B single-subject experimental design in this 8-week experiment. Within each dyad, one participant was randomly assigned to an intermittent meditation condition and the other member was assigned to a wait-list control condition. Both participants were sent a survey to complete daily (see Measures 3.2). Participants in the intermittent meditation condition received a mindfulness meditation training session from the first author after a baseline period (A1) of approximately 2 weeks (Mdays = 17.12, SDdays = 4.99). They were asked to meditate using a provided audio file for 15 min/day for the subsequent 2 weeks (B1). Meditation participants then discontinued their meditation practice for 2 weeks (A2), before resuming daily meditation for the final 2 weeks of the study (B2).

In total, meditators practiced an average of 77.31% of the 28 assigned meditation days (SD = 12.46). The average reported duration of participants' meditation sessions was 15.26 min (SD = 3.98). At the beginning of the second 2-week meditation period, meditation participants were offered a refresher training session. Eleven of the 35 participants elected to take the refresher training session.

Wait-list control participants were offered training at the conclusion of the experiment period. Twenty percent of wait-list participants opted to receive meditation training. All wait-list participants were provided the 15-min audio-guided meditation file.

To begin the experiment, participants attended an initial orientation session, wherein they listened to an overview of the experimental design, consented to participate, filled in a background information form, and were assigned to an experimental condition. Participants were told that the study was designed to examine the effects of meditation on the meditator. They were further told that non-meditating partners were needed to serve as a critical control group; without such a control group, the results from the meditators could not be attributed to their practice because it may also be an effect of completing a daily survey. No participants raised questions or objections about this purported rationale. Participants were not informed until the conclusion of the study that the primary purpose of the experiment was to examine the non-meditating partners.

Following the orientation, participants received surveys daily each evening after 17:00 (at a time selected by each participant) for approximately 8-weeks (Mdays = 59.2, SDdays = 5.1; MCompletion% = 84.7, SDCompletion% = 10.7). Participants received weekly follow-up e-mails reporting their survey completion percentage and encouraging continued survey completion. Participants assigned to the meditation condition filled out on average 86.4% (SD = 8.2%) of the daily diary.
reports; those assigned to the non-meditating condition completed on average 82.5% (SD = 12.7%) of the reports.

2.2.1 | Meditation training

The first author, certified as a meditation guide by Shambhala International, led a 1-hr meditation training session for all participants in the meditation condition after the 2-week baseline period. Training began with a rationale for meditation, highlighting our general tendency to identify with our thoughts rather than having a more embodied appreciation of the present. The meditation instructor introduced three components of meditation: (a) posture, (b) breath, and (c) mind. Participants were instructed to sit upright in a chair with their feet flat on the floor, hands resting on their thighs, and eyes cast downward with a soft gaze. The instructor briefly directed participants’ attention to sensations in their body, beginning with the feet and ending with the head. Participants were then instructed to feel their breath as they breathed naturally without trying to alter their breath. Finally, the instructor provided guidance on how to work with mind-wandering: as participants noticed their mind wandering, they were to notice this and very gently return the mind to the feeling breathing. The instructor emphasized the importance of gentleness in noticing and redirecting lapses of attention. After an initial practice period, participants were encouraged to ask questions. Participant then practiced meditation using a 15-min guided meditation audio file prepared by the first author (script and file are available by request). Participants received this file for subsequent daily use.

2.3 | Measures

Negative and positive emotions of the past day were assessed using nine questions drawn from the modified Differential Emotions Scale (Fredrickson, 2013; Fredrickson, Tugade, Waugh, & Larkin, 2003). Questions sampled the four combinations of positive/negative affect and high/low activation of the four-quadrant affect circumplex model (Feldman Barrett & Russell, 1998). Participants rated their highest intensity experiences of sets of emotions (phrased as triplets, e.g., What is the most grateful, appreciative, or thankful you felt?) in the previous 24 hr on visual analogue scales ranging from 0 (not at all) – 100 (extremely). A daily positive emotions metric was created by averaging the responses to five positive emotion triplets (grateful-appreciative-thankful; interested-alert-curious; joyful-gladd-happy; love-closeness-trust; serene-content-peaceful). Likewise, a daily negative emotion metric was created from four averaged negative emotion triplets (angry-irritated-annoyed; contemptuous-scornful-disdainful; sad-downhearted-unhappy; stressed-nervous-overwhelmed). Internal reliability (computed using the deviations from the person mean of each item) was acceptable for both daily positive emotions (α = 0.78) and daily negative emotions (α = 0.73).

Mindfulness over the previous 24 hr was assessed with selected questions from the Five Facet Mindfulness Questionnaire (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Baer et al., 2008). Each of the five facets (observing, describing, acting with awareness, non-judging of inner experience; nonreactivity to inner experience) were represented by two items with high factor loadings in Baer et al. (2006). One non-meditation participant answered at floor or ceiling for most measurements of mindfulness, indicating either lack of engagement with or understanding of these questions. Mindfulness scores for this participant were therefore removed from all analyses. Observing items “I paid attention to sensations, such as the wind in my hair or sun on my face” and “I paid attention to sounds such as clocks ticking, birds chirping, or cars passing” had acceptable internal consistency (α = 0.75). Describing items “It was hard for me to find the words to describe what I was thinking” and “I had trouble thinking of the right words to express how I felt about things” also had acceptable reliability (α = 0.73). The reliability of nonjudging (“I made judgments about whether my thoughts were good or bad”; “I thought some of my emotions were bad or inappropriate and I shouldn’t feel them”; α = 0.72) and nonreactivity (“I perceived my feelings without having to react to them”; “I watched my feelings without getting lost in them”; α = 0.74) were acceptable as well. Acting with awareness (“I was easily distracted”; “I did jobs automatically without being aware of what I was doing”) had unacceptable reliability (α = 0.40). Because of poor reliability, we did not include the mindfulness facet acting with awareness in our analyses.

Participants also reported their meditation practice. They indicated whether they had meditated that day (yes or no), how long they practiced that day (in minutes), and how long ago they had practiced (in hours).

Finally, participants also reported interaction with their study partner. They indicated whether they had interacted that day (yes or no) and how long (in hours) they had interacted. During the initial orientation, the meaning of “interaction” was precisely defined as an in-person or voice-to-voice interaction lasting longer than approximately 3 min. Text-based electronic communication was expressly prohibited as counting as an interaction. However, we cannot rule out that participants may have adopted a more inclusive definition of “interaction” at some point(s) in the 8 weeks of the study.

During the course of data collection, it became clear that vacation and exam periods were important external factors that may have had significant effects on participants’ self-reports. We therefore ascertained if and when either of these events occurred for each participant. On average, individuals had exams on 5.7% of the experimental days, and took vacation during 10.8% of the study period.

2.4 | Data analysis strategy

We conducted several sets of analyses. We first present analyses of the intermittently meditating dyad members. These analyses serve to confirm that the anticipated effects of mindfulness meditation (viz., increased positive affect, increased mindfulness facets, decreased negative affect) did occur for the practitioners. We then present analyses of the non-meditating partners in order to test our principal hypotheses regarding the extrapersonal effects
of meditation practice. Finally, we present exploratory modera-
tion analyses of the observed extrapersonal effect(s) in an effort
to better characterize the possible conditions under which these
effect(s) occur. All analyses were conducted on specific partners—
either the intermittently meditating or non-meditating partner. No
dyadic analyses were conducted because of the statistical compli-
cations attendant on our multilevel A-B-A-B design and the result-
ing power concerns to conduct appropriate dyadic analyses across
study phases.

Our hypotheses predicted changes between the different peri-
ods of our study for both meditators and non-meditating partners.
The effects of meditation were examined for meditating partners
and non-meditators in separate multilevel analyses. From the first
2-week non-meditation period (A1), to the subsequent meditation
period (B1), we expected negative affect to decrease while positive
affect and mindfulness facets increased for both meditating par-
ticipants and their non-meditating partners. For participants in the
meditation condition, we evaluated these directional hypotheses
using one-tailed tests. For non-meditation partners, we evaluated
these directional hypotheses with two-tailed tests since testing
for extrapersonal effects is novel. Following the B1 meditation pe-
riod, we expected either no change, or a rebound to A1 levels, in
the subsequent non-meditation period (A2). These changes were
evaluated with two-tailed tests. Finally, we again had directional
hypotheses concerning changes in affect and mindfulness in the
final meditation period (B2). These directional hypotheses were
again evaluated with one-tailed tests for the meditators and a
two-tailed test for the non-meditators. Because exam and vaca-
tion periods extended over multiple consecutive days for some
participants, we were unable to accurately determine slopes of
change within each experimental period. Therefore, we restricted
our analyses to examining mean differences between periods.
Analyzes of mean differences between study periods constitute
the most rigorous tests of our hypotheses since we predicted spe-
cific changes in the transitions between periods. We also exam-
ned models which included a binary variable for days when the
participant/partner meditated versus days when they did not as an
independent variable. These models provide an overall estimate of
the impact of meditation.

We tested our hypotheses using multilevel models for meditat-
ing partners and non-meditating partners separately with daily data
at level 1 and individuals at level 2. To model differences between
the four periods of the study, we created dummy variables coding for
three periods (B1, A2, B2) such that the statistics for each phase are
relative to the previous period (NB, model intercepts correspond to
A2 period). We modeled these predictors as random effects to cap-
ture individual differences. We also included dichotomous dummy
variables coding for exam days and vacation days as fixed effect
covariates to account for the variance attributable to these two fac-
tors. Level 1 daily data were modeled with an autoregressive (lag-1)
repeated covariance type. The covariance structure for the random
effects, variance components, estimated the variance of each ran-
dom effect. A random intercept was included in all models.

Models of the differences between days when a participant/part-
ner meditated compared to when they did not meditate were
identical to the period models, except that they included a single
dichotomous dummy variable coding for meditation day (1 = medi-
tation day, 0 = no meditation day) rather than three variables coding
for study period. For models of the non-meditating partners, the
meditation variable corresponded to their partners' meditation days.
Meditation was modeled as a random effect.

We consider the analyses of the changes between study peri-
ods to be the primary method for testing our hypotheses. This fol-
ows from the unique aspects of an A-B-A-B experimental design.
Consider the two following possible outcomes: (a) meditation in the
B-periods is associated with dependent variable changes relative to
the non-meditation A-periods, and (b) there is no impact of medita-
tion in the B-periods; however, participants exhibit linear changes
over time in a dependent variable, perhaps as a consequence of daily
survey-completion. In both cases, comparisons of B-periods to A-
periods might show a significant effect. Examining changes between
periods allows us to test more specific hypotheses which distinguish
between meditation-associated changes compared to linear changes
over time. Note that adding a linear variable for time to the model
would also not be an optimal approach, as it would then account
for some of the variance we hypothesize should be explained by the
B-period interventions. Nonetheless, analyses of days when a par-
ticipant/partner meditated compared to when they did not can pro-
vide useful supplementary analyses, indicating the general impact
of meditation days relative to non-meditation days. As a robustness
check, we also compared days in which the meditation intervention
occurred to days in which it did not. Results showed similar effects
and are available upon request.

Finally, we analyzed the moderating influence of relationship
type. Relationship type (friend, romantic) as well as interactions be-
tween relationship type and meditation days were added as fixed ef-
ect predictors to the multilevel model of meditation days described
previously. All other model details remained the same.

3 | RESULTS

3.1 | Effects of meditation on intermittently
meditating participants

Relative to the first 2-week non-meditation period (A1), participants
reported a borderline significant decrease in negative affect in the
subsequent 2-week meditation period (B1), b = −2.78, SE = 1.67,
p = 0.052, one-tailed, 95% CI [−6.15, 0.58]. There was not a signifi-
cant change in negative affect between B1 and the following 2-week
non-meditation period (A2), b = 0.91, SE = 1.33, p = 0.50, 95% CI
[−1.76, 3.58]. In the final meditation period (B2), meditators' nega-
tive affect significantly decreased in comparison with the previous
non-meditation period (A2), b = −5.62, SE = 1.49, p < 0.001, 95% CI
[−8.60, −2.63]. Estimated means of negative affect for each period
are shown in Table 1. In general, intermittent-meditators reported
significantly lower negative affect on meditation days compared to
TABLE 1  Estimated means and standard errors (SE) for each study phase

<table>
<thead>
<tr>
<th>Phase</th>
<th>Negative affect (SE)</th>
<th>Positive affect (SE)</th>
<th>Observing (SE)</th>
<th>Describing (SE)</th>
<th>Nonjudging (SE)</th>
<th>Nonreacting (SE)</th>
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<tbody>
<tr>
<td>Intermittently meditating dyad partners</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Non-meditation phase (A₁)</td>
<td>31.30 (2.06)</td>
<td>58.39 (2.11)</td>
<td>43.90 (3.30)</td>
<td>74.91 (2.42)</td>
<td>69.24 (3.24)</td>
<td>45.40 (2.77)</td>
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<tr>
<td>Meditation phase (B₁)</td>
<td>28.51 (1.67)</td>
<td>63.24 (1.17)</td>
<td>55.59 (2.04)</td>
<td>79.36 (1.67)</td>
<td>67.25 (1.68)</td>
<td>54.14 (1.59)</td>
</tr>
<tr>
<td>Non-meditation phase (A₂)</td>
<td>29.42 (1.33)</td>
<td>62.72 (1.47)</td>
<td>49.36 (2.41)</td>
<td>79.18 (1.40)</td>
<td>68.72 (1.68)</td>
<td>52.77 (2.01)</td>
</tr>
<tr>
<td>Meditation phase (B₂)</td>
<td>23.81 (1.49)</td>
<td>67.48 (1.18)</td>
<td>56.19 (2.11)</td>
<td>81.16 (1.43)</td>
<td>73.18 (2.00)</td>
<td>58.76 (1.82)</td>
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<tr>
<td>Non-meditating dyad partners</td>
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<tr>
<td>Non-meditation phase (A₁)</td>
<td>33.55 (1.98)</td>
<td>57.90 (2.04)</td>
<td>41.33 (3.28)</td>
<td>71.72 (2.10)</td>
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<td>49.20 (3.00)</td>
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<tr>
<td>Meditation phase (B₁)</td>
<td>29.90 (1.59)</td>
<td>56.63 (1.22)</td>
<td>40.79 (1.89)</td>
<td>76.52 (1.49)</td>
<td>73.76 (1.54)</td>
<td>52.49 (2.76)</td>
</tr>
<tr>
<td>Non-meditation Phase (A₂)</td>
<td>27.95 (1.39)</td>
<td>58.61 (1.43)</td>
<td>41.42 (2.33)</td>
<td>77.84 (1.57)</td>
<td>75.80 (1.60)</td>
<td>55.02 (2.05)</td>
</tr>
<tr>
<td>Meditation phase (B₂)</td>
<td>24.17 (1.66)</td>
<td>62.52 (1.20)</td>
<td>43.05 (1.85)</td>
<td>78.92 (1.56)</td>
<td>75.25 (1.83)</td>
<td>56.40 (1.63)</td>
</tr>
</tbody>
</table>

Note: Estimates with an asterisk (*) indicate a significant difference (p < 0.05) from the previous phase (see text for details).

Days in which participants did not meditate, $b = -3.56$, $SE = 1.13$, $p = 0.003$, one-tailed, 95% CI [−5.86, −1.26].

Meditation also exerted the expected effects on the positive affect of intermittently meditating participants. From the non-meditation phase (A₁) of the first meditation period (B₁), participants reported significantly higher positive affect, $b = 4.86$, $SE = 1.17$, $p < 0.001$, 95% CI [2.48, 7.23]. Participants did not exhibit a significant change in positive affect in A₂ relative to B₂, $b = -0.52$, $SE = 1.47$, $p = 0.72$, 95% CI [−3.48, 2.43]. In the final meditation period (B₂), meditators’ positive affect again increased, $b = 4.76$, $SE = 1.18$, $p < 0.001$, 95% CI [2.38, 7.14]. On average, participants’ positive affect increased by 4.31 (SE = 0.87) on days in which they meditated, $p < 0.001$, 95% CI [2.53, 6.09]. With respect to mindfulness, participants in the intermittently meditating condition exhibited the predicted dynamic changes in the observing facet. Participants’ observing scores were higher in the first meditation phase (B₁) compared to the prior non-meditation phase (A₁), $b = 11.69$, $SE = 2.04$, $p < 0.001$, 95% CI [7.55, 15.83]. Observing scores were significantly lower during A₂, $b = -6.23$, $SE = 2.41$, $p = 0.013$, 95% CI [−11.10, −1.36]. Scores significantly increased again for the final B₂ meditation period, $b = 6.84$, $SE = 2.11$, $p = 0.002$, one-tailed, 95% CI [5.28, 11.10]. Intermittently meditating participants had significantly higher observing scores on meditation relative to non-meditation days, $b = 9.31$, $SE = 1.76$, $p < 0.001$, 95% CI [5.74, 12.89].

Results for the describing facet were less unequivocal. Participant scores were significantly higher during the first B₁ meditation period, $b = 4.46$, $SE = 1.67$, $p = 0.006$, one-tailed, 95% CI [1.09, 7.83].

Scores did not significantly change in the next A₂ non-meditation period, $b = 0.18$, $SE = 1.40$, $p = 0.90$, 95% CI [−3.00, 2.64]. Scores again increased, though non-significantly, in the final B₂ meditation period, $b = 1.98$, $SE = 1.43$, $p = 0.088$, one-tailed, 95% CI [−0.93, 4.85]. Altogether, participants reported higher describing scores on meditation days, $b = 3.00$, $SE = 1.10$, $p = 0.005$, one-tailed, 95% CI [0.77, 5.22].

Nonjudging scores for intermittently meditating participants only partially conformed to expectations. Participants did not report significantly higher nonjudging between the B₁ and A₁ periods, $b = -1.99$, $SE = 1.68$, $p = 0.12$, one-sided, 95% CI [−5.38, 1.40]. Nonjudging also did not change between B₁ and A₂, $b = 1.47$, $SE = 1.68$, $p = 0.38$, 95% CI [−1.91, 4.85]. However, nonjudging did significantly increase as expected between the A₂ non-meditation period and the B₂ meditation period, $b = 4.46$, $SE = 2.00$, $p = 0.016$, one-tailed, 95% CI [0.43, 8.49]. More generally, participants’ nonjudging scores did not differ between meditation days and non-meditation days, $b = 0.38$, $SE = 1.20$, $p = 0.377$, one-tailed, 95% CI [−2.07, 2.83].

Nonreactivity showed dynamic changes in the hypothesized directions for intermittently meditating participants. Nonreactivity increased from A₁ to B₁, $b = 8.74$, $SE = 1.59$, $p < 0.001$, 95% CI [5.53, 11.95]. Ceasing meditation practice in A₂ did not alter nonreactivity scores, $b = -1.37$, $SE = 2.01$, $p = 0.489$, 95% CI [−5.43, 2.68]. However, resuming meditation in the B₂ period did lead to further significant increases in nonreactivity, $b = 5.99$, $SE = 1.82$, $p = 0.001$, one-tailed, 95% CI [2.31, 9.68]. Overall, participants’ nonreactivity scores were higher on meditation days, $b = 6.88$, $SE = 1.12$, $p < 0.001$, 95% CI [4.61, 9.15].

To summarize the results from dyad partners in the intermittent meditation condition, meditation significantly decreased negative affect, while increasing positive affect, observing, and nonreactivity in all of the transitions from non-meditating phases to meditation phases in the study. Further analyses comparing meditation days to non-meditation days showed similar significant changes. We found partial support for hypothesized changes in the describing facet of mindfulness. There, scores increased in just one of two transitions from non-meditation to meditation periods, though there was...
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3.2 | Effects of intermittently meditating participants on non-meditating partners

Participants who did not meditate during the study showed changes in negative affect that aligned with periods when their partner meditated. Non-meditating participants’ negative affect declined between periods A1 and B1, \( b = -3.66, SE = 1.59, p = 0.028, 95\% CI [-6.87, -0.44]. \) These participants' scores did not change when their partner suspended meditation practice, from B1 to A2, \( b = -1.95, SE = 1.39, p = 0.168, 95\% CI [-4.74, -0.85]. \) Finally, participants’ negative affect again declined between periods A2 and B2 when their partners resumed meditation practice, \( b = -3.78, SE = 1.66, p = 0.028, 95\% CI [-7.12, -0.43]. \) Importantly, these study periods were experimentally different for only the intermittently meditating participants. We therefore attribute dynamic changes in the non-meditating participants to the changes observed for their intermittently meditating partners. On average, participants reported significantly lower negative affect during days that their partner meditated, \( b = -2.01, SE = 0.96, p = 0.036, 95\% CI [-3.90, -0.13]. \)

As a follow-up, we also examined the impact of reported interaction during a day when participants' partners meditated. The interaction of partner interaction and partner meditation was not significant, \( b = 1.7, SE = 2.01, p = 0.4, 95\% CI [-2.26, 5.65]. \) The main effect of partner interaction was also not significant, \( b = 0.19, SE = 1.86, p = 0.921, 95\% CI [-3.52, 3.90]. \) We interpret these results in the discussion section.

At the level of the whole sample, there were not unequivocal changes in non-meditating partners’ positive affect as a function of their intermittently meditating partners’ practice. Positive affect did not increase from A1 to B1, \( b = -1.27, SE = 1.22, p = 0.30, 95\% CI [-3.72, 1.18]. \) Nor did it change from B1 to A2, \( b = 1.97, SE = 1.643, p = 0.17, 95\% CI [-0.89, 4.83]. \) Positive affect did increase, however, during B2, the final period of meditation for their partners, \( b = 3.91, SE = 1.20, p = 0.002, 95\% CI [1.50, 6.32]. \) Overall, there was not a difference in positive affect on days their partner meditated compared to days their partner did not meditate, \( b = -0.12, SE = 0.86, p = 0.892, 95\% CI [-1.87, 1.64]. \)

We also did not find clear dynamic changes in participants’ mindfulness facets as a function of their partners’ meditation practice. For the observing metric, there were no significant changes between any phase of the study (all \( p > 0.2 \) ) and no overall difference between days their partner did (not) meditate, \( b = -0.80, SE = 1.18, p = 0.5, 95\% CI [-3.2, 1.59]. \) Describing scores increased in just one transition, and there was not an average difference between meditation and non-meditation days.

3.3 | Case example

Though we did not find clear evidence for an impact of mindfulness meditation on a non-meditating partner beyond negative affect, there may nonetheless be effects for particular dyads. A-B-A-B single-subject designs permit visual inspection of results for evidence of alternating intervention responses (Kratochwill et al., 2013). Figure 1 depicts the correlated dynamics between two partners’
positive affect. Data points are visibly higher, on average, for both the intermittent mediator (P1) and their non-meditating partner (P2) during meditation periods relative to non-meditation periods. These results indicate that a diffusion of influence on additional variables than negative affect may be observed in particular dyads, though not in the sample as a whole.

3.4 Exploratory analyses of relationship type as moderator

We examined whether relationship type moderated the non-meditating partners’ dynamic changes in negative affect. There was an interaction between relationship type and partner meditation such that non-meditating romantic partners exhibited a larger decrease in negative affect on days that their partners mediated compared to non-meditating partners in non-romantic dyads, $b = -4.09, \text{SE} = 1.98, p = 0.04, 95\% \text{CI} [-7.98, -0.19]$. The main effect of partner meditation was significantly associated with lower negative affect, $b = -4.62, \text{SE} = 1.58, p = 0.004, 95\% \text{CI} [-7.73, -1.51]$. There was not a main effect of relationship type, though lower negative affect was associated with romantic relationships, $b = -5.88, \text{SE} = 3.85, p = 0.134, 95\% \text{CI} [-13.66, 1.89]$. With only 13 romantic couples in the study, however, these results are only suggestive and should be more rigorously examined.

We further examined whether the observed interaction between relationship type and partner meditation might be explained by the amount of time relationship partners spent together. We examined an additional model which included daily interaction length as a covariate. Interaction length was not a significant covariate, $b = -0.52, \text{SE} = 0.44, p = 0.251, 95\% \text{CI} [-1.41, 0.38]$, suggesting that other mechanisms may be responsible for the greater impact seen in romantic couples.

4 DISCUSSION

The present study demonstrated that mindfulness meditation has extrapersonal effects by influencing the daily reports of a non-meditating partner. We first established that intermittent practice altered levels of affect and facets of mindfulness in dyad members randomly assigned to meditate for alternating periods. For these participants, meditation was associated with decreased negative affect, increased positive affect, and higher scores on the mindfulness facets of observing, describing, and nonreactivity. We then examined whether participants’ non-meditating partners exhibited similar dynamic changes. We found that non-meditating participants’ negative affect varied as a function of their partners’ meditation practice. Specifically, non-meditating partners reported lower negative affect during periods when their partner meditated. Though we did not find additional affects at the group level, particular non-meditating partners may have shown meditation-linked dynamic changes, as we illustrated for positive affect.

Notably, the extrapersonal effect of meditation on a non-meditating partner’s negative affect was not associated with the partners having interacted on a given day. Perhaps this is unsurprising since participants were selected on the basis of high levels of interaction and they indeed interacted an average of 73.9% of the study days. However, these results also suggest that the impact of a partner’s meditation may not be focused on discrete days in which a participant’s partner both meditated and interacted with them. Rather, the effects may be more generally accrued over a period of partner meditation and a range of interaction days. This is consistent with previous research showing that being mindful on one day predicts positive and negative affect the next day in meditators (Snippe, Nyklíček, Schroeters, & Bos, 2015). The temporal course of meditation’s impact on a meditator, as well as their interaction partners, is an important empirical question.

Exploratory analyses helped to further contextualize these dynamic changes. Specifically, participants in romantic relationships showed greater declines in negative affect on days their partner meditated compared to participants in non-romantic relationships. Interestingly, this effect appeared to be unrelated to the amount of time romantic partners spent together. Perhaps the greater impact in romantic relationships is a function of relationship intimacy or the range of conversations and issues likely to be addressed in a romantic relationship relative to a friendship. Further research is required to explore these possibilities.

The emergence of negative affect as a primary outcome variable for the extrapersonal impact of meditation is consistent with the clinical literature. In a meta-analysis of meditation programs in clinical populations, Goyal et al. (2014) found small to moderate effect sizes for anxiety and depression and insufficient evidence for effects on positive mood and attention. Perhaps this also explains why initial reports of the extrapersonal effects of meditation highlighted changes in affective and behavioral regulation in troubled populations, such as disruptive students, children with autism and developmental disabilities, and psychotherapy clients (Grempair et al., 2007; Singh et al., 2006, 2007, 2013). Our results suggest that these changes in negative affect also apply to non-clinical populations.

That we observed an extrapersonal effect is quite notable given that we should expect effects to be relatively small. First, participants assigned to the intermittent meditation condition had not previously had a meditation practice and, in this study, meditated for just 15-min/day. Second, participants did not meditate on approximately 1 out of every 4 days they were asked to practice. Third, individuals vary substantially in their response to meditation (May, Johnson, & Weyker, 2016; May et al., 2014). Fourth, while we recruited participants who agreed that they interacted with their partner every day on average, participants in fact interacted with their partner approximately 3 out of every 4 days in this study. Fifth, non-meditating partners were one degree removed from the practice itself. Sixth, we assessed negative affect over the flow of daily life, rather than in a more controlled setting. And finally, large inter-dyad differences appear to be the norm with respect to emotional interdependence.
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(Sels, Ceulemans, Bulteel, & Kuppens, 2016). For these reasons, our results likely represent the lower boundary for observing a relationship effect of meditation practice. That is, extrapersonal effects can begin to be detected with just 15 min of mindfulness meditation per day, and negative affect may be the first variable to be impacted.

It should be noted that we are unable to rule out placebo or self-selection effects for the meditators. It could be that, because the meditator knew they were meditating, he or she behaved differently with the non-meditating partner. That is, the effect of the meditator on their non-meditating partner may be more related to beliefs about the impact of meditation rather than their impact per se. However, even this may be considered an effect of meditation and a possible mechanism for the observed extrapersonal effect on negative affect. Future research might consider active control dyads where, for example, the meditator is told that meditation may not have an effect because there are substantial individual differences in impact (see May et al., 2014). Self-selection may have also resulted in a non-representative sample. It is possible that especially individuals interested in meditation may have decided to participate in the study and might be more inclined to report benefits from the meditation. Since the target sample in this study were principally the non-meditating partners, this may be less of a concern. Nonetheless, the possible effects of both placebo and self-selection should be carefully considered in future research.

Substantial variability in our sample means that our study was likely underpowered. Therefore, the current findings warrant replication. We found considerable variability over time within individuals, compounded by events such as vacations and exams (for students). Random effects also indicated significant differences between individuals. Higher-powered studies may find additional extrapersonal effects of mindfulness meditation practice beyond negative affect. Power could be increased by, for example, recruiting more dyads that interact every day instead of on many days, using a higher sampling rate than one survey per day, selecting for experienced meditators who may produce stronger or more stable effects, increasing the amount of meditation practice each day, or enhancing adherence by, for example, offering daily group practice. Such design considerations would be particularly important for identifying mediator variables.

Importantly, our results only show an effect of meditation on partners; future research with larger samples is needed to identify the mechanisms which mediate these extrapersonal reductions in negative affect. Many possibilities exist. Perhaps disagreements may be less likely to escalate in relationships where one member meditates due to increases in nonreactivity. Mindfulness may cut patterns of automatic reciprocation of negative partner behavior, thereby diminishing downward affective and relationship spirals (Karremans & Papeis, 2017). Indeed, Lenger et al. (2017) showed that a spouse’s nonreactivity predicts their partner’s relationship satisfaction. This is consistent with earlier qualitative research reporting that partners of MBSR graduates attributed their reported decrease in stress to their partner’s decreased reactivity (Gillespie et al., 2015). Iida and Shapiro (2019) also found associations between mindfulness and decreased variability in a partner’s negative mood. Specifically, nonreactivity in women was associated with decreased negative mood variation in a partner, while nonjudging in men had a similar effect on their partners. Karremans and Kappen (2017) discuss other possible mechanisms in romantic relationships. For example, mindfulness may increase empathy, leading to better perspective-taking and more sensitive relational responding. Mindfulness may also attenuate distressing emotions, promote communication about previously unconscious impulses and feelings, or activate motivational and regulatory resources, all of which may improve the health of a relationship (see also Karremans et al., 2017 for a theoretical model). Examining the mediating role of mindfulness in relationships would be facilitated by the newly developed interpersonal mindfulness scale (Pratscher, Wood, King, & Bettencourt, 2019). Further work could also examine lagged associations to examine more clearly how changes in a meditating partner lead to changes in non-practicing partner. Within individuals, Snippe et al. (2015) found that daily fluctuations in mindfulness predicted positive and negative affect the following day. Whether this association holds across partners remains to be tested.

The current work has important implications. Mindfulness meditation may be a useful complement to therapy for couples in distress (e.g., see Carson, Carson, Gil, & Baucom, 2004), or in relationships where negative affect is prominent. Previous research has examined emotional crossover in romantic relationships, such that one partner’s positive and negative affect predicted their partner’s positive and negative affect (Bolger, DeLongis, Kessler, & Wethington, 1989; Saxbe & Repetti, 2010; Schoebi, 2008; Thompson & Bolger, 1999). The current study suggests that meditation may be a useful lever for modulating negative affect. More broadly, our work highlights that meditation may not only be an individual practice, but a social practice as well. The beneficial effects of meditation can extend beyond individuals, impacting interaction partners as well. To echo the Dalai Lama, “Just as ripples spread out when a single pebble is dropped into water, the actions of individuals can have far-reaching effects” (Dalai Lama 2013, May 10). The extent of this diffusion of influence with respect to meditation practice represents a significant new frontier of inquiry.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ETHICAL STATEMENT

The authors confirm that the manuscript adheres to ethical guidelines specified in the APA Code of Conduct as well as authors’ national ethics guidelines. This includes requirements that research is conducted ethically, results are reported honestly, the submitted work is original and not (self-)plagiarized, and authorship reflects individuals’ contributions.
TRANSPARENCY STATEMENT

The research materials and datasets analyzed during the current study are available from https://unishare.nl/index.php/s/CG242Gfh1mLeZMn.

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