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A brief mindfulness intervention reduces depression, increases nonjudgment, and speeds processing of emotional and neutral stimuli☆

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ABSTRACT

Anxiety and mood disorders are common in university students but most students are not receiving treatment. The university setting presents a unique opportunity to provide interventions for at-risk students who may not otherwise seek services. Mindfulness interventions have been successfully adapted for use with individuals reporting symptoms of depression, anxiety, and other forms of psychological distress. The present quasi-experimental study addressed whether non-treatment-seeking university students screened for moderate-to-high levels of distress would benefit from a brief mindfulness intervention relative to a control group. Participants completed self-report measures of depression, anxiety, distress, and mindfulness as well as a dot-probe measure of processing of emotional and neutral information before and after a mindfulness or no-intervention control group. As expected, anhedonic depression symptoms and judging of experiences decreased in the mindfulness but not control group. Also consistent with prediction, the mindfulness group showed reaction time evidence of "even-handed" facilitated processing of all stimuli (pleasant, neutral, and unpleasant) within a dot-probe task from pre- to post-intervention. Psychological distress, anxious arousal, and worry decreased, and several facets of self-reported mindfulness increased in both groups. Results indicate that a brief mindfulness intervention may be helpful for non-treatment-seeking university students in decreasing anhedonic depression symptoms, judgment of experiences, and encouraging facilitated processing of emotional and neutral information. Implications for using brief mindfulness interventions in early intervention and prevention efforts with university students are discussed.

1. Introduction

Psychological disorders are common in university students. Prevalence estimates range as high as 50% (e.g., Blanco et al., 2008), with anxiety and mood disorders being the most prevalent (e.g., Auerbach et al., 2016; Blanco et al., 2008). Although many students are affected by psychological problems, most are not receiving treatment (Auerbach et al., 2016; Blanco et al., 2008; Eisenberg, Hunt, Speer, & Zivin, 2011; Garlow et al., 2008). Barriers to treatment in the university student population include believing that an intervention is not needed, preferring to self-manage symptoms, perceived lack of time, and stigma (Czyz, Horwitz, Eisenberg, Kramer, & King, 2013).

The university setting presents a unique opportunity to engage in prevention by providing interventions for at-risk students with symptoms of full or subthreshold psychological disorders who may not otherwise seek out services. Several studies have successfully offered interventions to university students at risk of depression (Gortner, Rude, & Pennebaker, 2006; Seligman, Schulman, & Tryon, 2007; Seligman, Schulman, DeRubeis, & Hollon, 1999) and anxiety (Kenardy, McCafferty, & Rosa, 2003, 2006; Schmidt et al., 2007). Other studies have successfully provided universal interventions offered to all students in the prevention of psychological distress (for review see Conley, Durlak, & Dickson, 2013).

Mindfulness interventions have a growing evidence base and could be a preventative tool for university students who may be at risk of depression, anxiety, or other forms of psychological distress. In fact, mindfulness interventions have been successfully offered to university students in universal prevention efforts (Conley et al., 2013; de Vibe et al., 2018; Eustis et al., 2017; Galante et al., 2018) and in combatting issues such as anxiety, depression, psychological distress, and substance

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use (e.g., Bowen & Marlatt, 2009; Danitz, Suvak, & Orsillo, 2016; Jain et al., 2007; Sears & Kraus, 2009). Screening university students with measures of psychological distress can identify and predict DSM anxiety and depression diagnoses (Lang, Norman, Means-Christensen, & Stein, 2009; Petkus et al., 2010), and targeting interventions to non-treatment seeking, potentially at-risk individuals may help prevent full-blown manifestations of DSM disorders. No studies to our knowledge have offered mindfulness interventions to non-treatment-seeking university students who were screened to have moderate-to-high levels of psychological distress, an issue addressed in the present study.

The present study's primary goal was to assess whether a brief mindfulness intervention was associated with depression, anxiety, and/or general psychological distress reduction relative to a no-treatment control group in a non-treatment-seeking university student sample screened for moderate-to-high levels of psychological distress (Danitz et al., 2016; Sears & Kraus, 2009). Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1990) and adaptations of MBSR are widely-used, 8-week interventions (for review, see Carmody & Bear, 2009). A briefer, 5-session mindfulness intervention (Sass, Berenbaum, & Abrams, 2013) adapted from MBSR and Mindfulness-Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2002) was offered in the present study, based on studies showing that briefer mindfulness interventions may be beneficial for individuals who may not otherwise engage in longer-term interventions (Canby, Cameron, Calhoun, & Buchanan, 2015; Carmody & Baer, 2009; Jain et al., 2007; Sass et al., 2013).

A second goal of the study was to assess whether processing of emotional and neutral stimuli changed from pre- to post-intervention. Typically, individuals reporting anxiety and depression symptoms favor unpleasant or threatening information (for review see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van Ijzendoorn, 2007; Glinder, Beckjord, Kaiser, & Compas, 2007; Gotlib & Joorman, 2010). Within the dot-probe task, biased or enhanced processing of unpleasant or threatening information is often interpreted as faster RT to probes following unpleasant or threatening compared to neutral stimuli. Mindfulness training, with a focus on accepting and allowing *all* experiences, including pleasant, neutral, and unpleasant ones, may encourage "even-handed" processing of unpleasant, pleasant, and neutral stimuli. This hypothesis is consistent with studies indicating that mindfulness training can reduce biased processing of emotional information (De Raedt et al., 2012; Flook, Goldberg, Pinger, Bonus, & Davidson, 2013; Ortner, Kilner, & Zelazo, 2007; Verhoeven, Vrijsen, van Oostrom, Speckens, & Rinck, 2014) and facilitate processing of both emotional and neutral information (Malinowski, Moore, Mead, & Gruber, 2017). Therefore, we predicted that individuals who participated in mindfulness training would show evidence of facilitated processing of emotional *and* neutral information from pre- to post-intervention (faster reaction time (RT) prompted by probes replacing unpleasant, pleasant, and neutral words from pre- to post-intervention) within the context of a dot-probe task (DPT).

Conversely, the control group was expected to show either: (1) no change in processing probes replacing emotional or neutral stimuli from pre-post intervention given that there was no systematic training regarding processing of emotional or neutral information, or (2) changes in processing probes following neutral stimuli only, following a large body of work indicating that anxious, depressed, and/or psychologically distressed participants can show disrupted processing of unpleasant and/or pleasant stimuli (e.g., Bar-Haim et al., 2007; Glinder et al., 2007; Gotlib & Joorman, 2010). Following this second idea, we predicted that probes replacing neutral and not emotional words would become faster from pre-to-post intervention in the control group, given that these stimuli should be more easily processed by distressed participants than emotional stimuli.

Finally, we included a measure of mindfulness in order to explore whether self-reported mindfulness would increase from pre- to post-intervention following mindfulness training. We predicted that individuals who participated in the mindfulness and not the control intervention would show increases in self-reported mindfulness (e.g., Canby et al., 2015; Carmody & Baer, 2009).

2. Method

2.1. Participants

This study was approved by the first author's University Institutional Review Board in line with the ethical conduct of human research. After providing informed consent, students were screened using the Brief Symptom Inventory-18 (BSI-18; Derogatis, 2001), a short 18-item instrument designed to measure psychological distress in both clinical and community samples. Participants were screened in the classroom setting (n = 579) or online (n = 411). Consent, BSI-18, and permission to contact forms took approximately 10 min for participants to complete. Of the 990 participants screened, 21 participants were excluded for missing one or more BSI-18 screening items, and 11 were excluded due to endorsing a lack of fluency in the English language required for completing the questionnaires and computer task. Of the 958 remaining participants, 547 had a total raw score of 11-45 (corresponding to a standardized T score of 55-76, respectively), with a mean raw BSI-18 score in the qualifying sample of 24.1, SD = 8.4. This BSI-18 range is in line with other studies involving moderate-to-highly distressed university student samples (e.g., Liang & West, 2011; Renshaw & Cohen, 2014).

Fifty-five (48 female, mean age = 20.8, SD = 4.8) individuals who completed written informed consent and indicated that they were available for 7 weeks (including pre, intervention, and post-test measures) were enrolled in the intervention portion of the study. Of these 55 participants, 24 were assigned to the mindfulness group when they indicated that they could attend one of three pre-determined group times over 5 weeks. Thirty-one participants were assigned to the no-treatment control group who indicated that they were not available during one of the mindfulness group times. Of the 55 participants, 47 indicated having no previous meditation or mindfulness experience, 6 indicated meditating "a little" (e.g., "breathing exercises a few times a month") and 1 person indicated meditating "frequently." Of the 24 participants originally assigned to the mindfulness group, 2 indicated class or work schedule changes that conflicted with the group times and were reassigned to the control group prior to the onset of the 5-week mindfulness or control period (n = 22 mindfulness, n = 33 control). Three mindfulness groups were conducted; two consisting of 7 people, and one consisting of 8 people. Two of the groups were run in the Fall semester, beginning in late October after most students took midterm exams through mid-November, before a week-long Thanksgiving break, approximately 3 weeks before final exams. The third group began in late February and ran through March. Midterm exams would likely have occurred in early March for many students, and the group ended over a month before final exams began.

Of the 22 participants who began in the mindfulness groups, 2 did not complete the post-test session (one due to feeling too busy, and one did not provide a reason). Of the 33 participants assigned to the control group, 10 did not complete the post-test session (6 due to feeling too busy and/or having excess employment-related demands, and 4 did not provide a reason or indicated lack of interest). See Fig. 1 for a description of participant flow through the study.

Participants completed baseline measures approximately 9 days before the groups began (mean = 8.6, SD = 4.9) and 8 days after the groups ended (mean = 8.0, SD = 6.4). Groups did not differ in age, F (1, 54) = 2.12, p = .149, or gender balance, χ^2 (1, n = 55) = 0.437, p = .509, or any of the baseline outcome measures (see Tables 1 and 2). Participants identified as 55% Caucasian, 16% African American, 20% Hispanic, and 9% Other/multiracial.

The pre and post sessions took approximately 1 h each to complete. All participants were paid $10 for the pre session and $20 for the post session (the higher amount for the post session was intended to

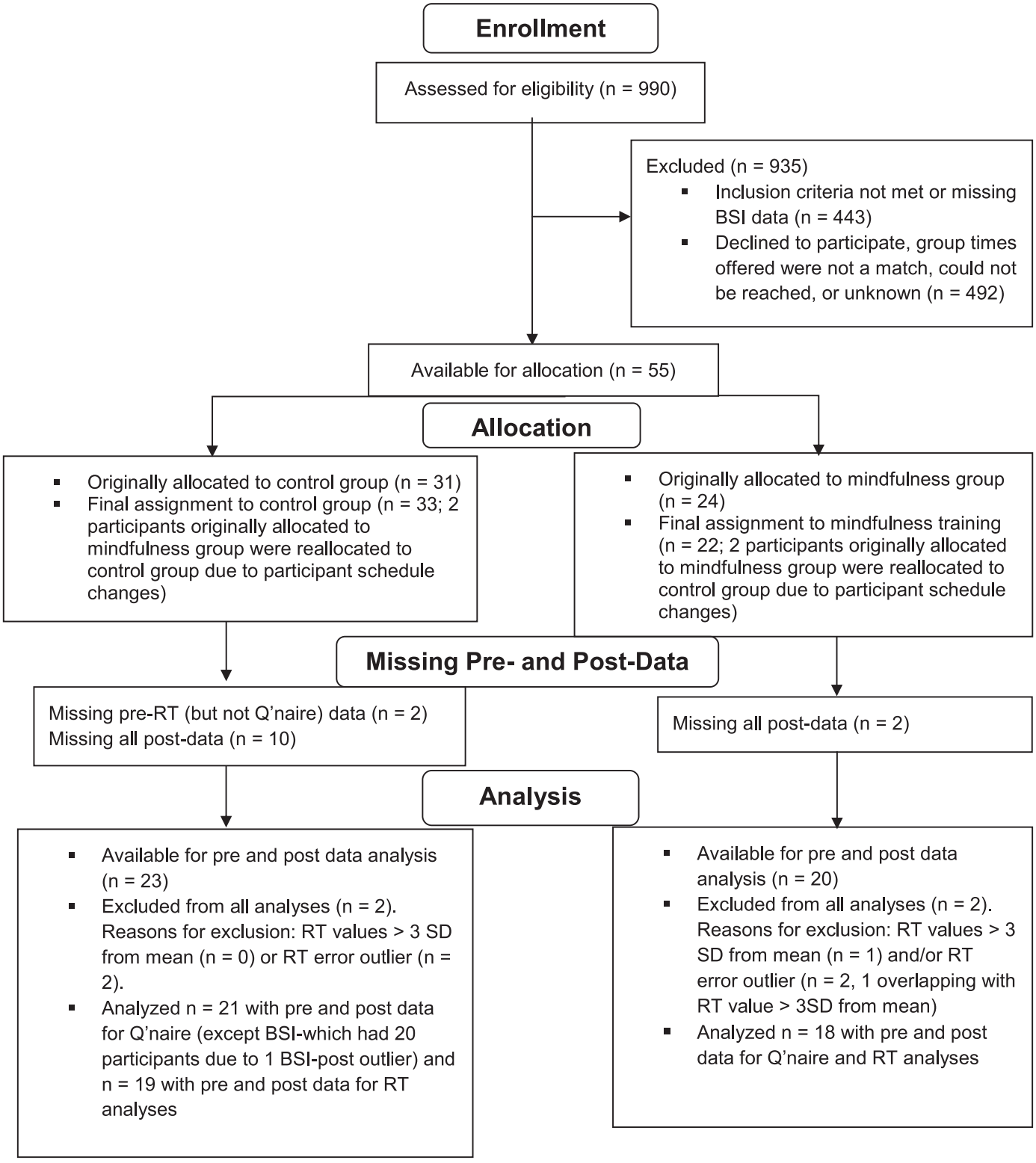

Fig. 1. Flow of participants through study.

incentivize completion of the post-test assessment). In addition, only those who participated in the mindfulness group were required to pay a nominal $25 fee at the outset of the sessions for the groups. Participants were reimbursed $5 for each of the sessions they attended to motivate session attendance. In other words, overall payment to both groups for completion of the pre and post assessments was the same (total of $30), but individuals in the mindfulness group could additionally lose $5 for each unexcused session that they missed, of the $25 they paid from their own money at the beginning of the groups.

2.1.1. Pre- and post-questionnaire measures

The BSI-18 is a short, 18-item instrument used to screen for psychological distress. It consists of anxiety (sample item: "Feeling so restless you couldn't sit still"), depression (sample item: "Feeling no

Table 1
Group pre- and post-intervention questionnaire measures and lack of baseline group differences.

	Control		Mindfulness		Baseline
	Pre	Post	Pre	Post	Group
	M SD	M SD	M SD	M SD	F (p)
BSI-18	31.4 (8.5)	26.0 (8.5)	33.4 (9.6)	23.2 (6.9)	0.5 (0.481)
MASQ-AD8	18.2 (5.6)	17.3 (6.9)	20.0 (4.6)	15.7 (4.5)	1.2 (0.282)
MASQ-AA	28.0 (6.2)	25.8 (6.7)	29.4 (10.1)	23.9 (6.0)	0.3 (0.577)
PSWQ	59.0 (14.8)	54.8 (15.4)	59.7 (14.7)	55.8 (15.2)	0.0 (0.889)
FFMQ Aware	21.7 (4.6)	23.6 (6.6)	22.2 (5.7)	23.7 (5.0)	0.1 (0.762)
FFMQ Describe	25.3 (4.5)	26.2 (6.2)	23.0 (7.8)	25.5 (7.1)	1.3 (0.260)
FFMQ Nonjudge	25.3 (6.4)	26.1 (7.7)	22.9 (5.9)	27.9 (4.5)	1.4 (0.244)
FFMQ Nonreact	21.4 (4.1)	22.5 (3.9)	19.6 (5.3)	18.6 (6.2)	1.5 (0.236)
FFMQ Observe	27.0 (4.5)	26.6 (6.8)	25.2 (6.7)	25.5 (6.8)	1.0 (0.320)

Note. BSI-18 = Brief Symptom Inventory-18; MASQ-AD8 = the 8-item subset of the Anhedonic Depression subscale of the Mood and Anxiety Symptom Inventory; MASQ-AA = the Anxious Arousal subscale of the Mood and Anxiety Symptom Inventory; FFMQ = Five Factor Mindfulness Questionnaire. Data in this table reflect $n = 39$ (21 controls, 18 mindfulness) available for questionnaire analyses, except post-BSI data which included $n = 38$ (20 controls, 18 mindfulness). F and p values correspond to baseline univariate ANOVAs comparing baseline outcome measures between the mindfulness and control group on each questionnaire measure.

Table 2
Group pre- and post-intervention RT scores and lack of baseline group differences.

	Control		Mindfulness		Baseline
	Pre	Post	Pre	Post	Group
	M SD	M SD	M SD	M SD	*F (p)*
PUP	529.0 (72.9)	495.5 (73.3)	553.2 (74.0)	515.8 (72.6)	0.7 (0.400)
PUU	528.3 (76.8)	501.0 (76.4)	550.4 (74.0)	512.9 (69.5)	1.2 (0.278)
PNP	517.7 (70.1)	504.6 (56.0)	545.9 (71.5)	520.0 (71.6)	1.2 (0.284)
PNN	535.6 (83.8)	498.8 (76.0)	546.7 (83.5)	518.9 (76.9)	0.2 (0.653)
UNU	519.9 (69.4)	501.9 (68.9)	552.8 (76.7)	517.3 (72.6)	2.8 (0.101)
UNN	527.1 (84.4)	498.7 (67.5)	555.2 (72.3)	511.9 (70.8)	1.1 (0.295)
NN	527.3 (76.5)	496.0 (70.9)	542.3 (69.6)	516.8 (64.1)	0.5 (0.464)

Note. PUP and PUU correspond to pleasant-unpleasant word pairs where the probe replaced pleasant and unpleasant, respectively. PNP and PNN correspond to pleasant-neutral word pairs where the probe replaced pleasant and neutral, respectively. UNU and UNN correspond to unpleasant-neutral word pairs where the probe replaced unpleasant and neutral, respectively. NN corresponds to neutral-neutral word pairs where the probe replaced neutral. Data in this table reflect $n = 37$ participants with available data for RT analyses (19 controls, 18 mindfulness). F and p values correspond to baseline univariate ANOVAs comparing baseline RT between the mindfulness and control group for each emotion condition.

interest in things"), and somatization (sample item: "Pains in heart or chest") symptoms rated on a scale of 0 (not at all) to 4 (always) over the past week. The total score (or Global Severity Index, GSI) is considered the best indicator of psychological distress as measured by the BSI-18 (Derogatis, 2001), and is the indicator reported in the present study. The BSI-18 has good internal consistency and adequate convergent and discriminant validity (Derogatis, 2001; Zabora et al., 2001). Cronbach's α was 0.85 in the present study for pre and 0.91 for post BSI-18.

A 17-item Anxious Arousal (AA) subscale and an 8-item subset of the Anhedonic Depression (AD8) subscale of the Mood and Anxiety Symptom Questionnaire (MASQ; Watson et al., 1995; Watson et al., 1995) were used in the present study. The MASQ-AA subscale measures somatic and arousal symptoms of anxiety (sample items: "Heart was racing or pounding," "Felt dizzy or lightheaded") on a scale of 1 (not at all) to 5 (extremely). Cronbach's α was 0.85 in the present study for pre and 0.79 for post MASQ-AA. The MASQ-AD8 subscale (Nitschke, Heller, Imig, McDonald, & Miller, 2001) measures depression or loss of interest items (sample items: "Felt like it took extra effort to get started," "Felt withdrawn from other people") rated on a scale of 1 (not at all) to 5 (extremely). Cronbach's α was 0.74 in the present study for pre and 0.84 for post MASQ-AD8. The MASQ-AA and MASQ-AD8 scales have shown high convergent and discriminant validity in distinguishing anxiety from depression (e.g., Nitschke et al., 2001; Watson et al., 1995).

The Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990; Molina & Borkovec, 1994) is a 16-item measure of chronic worry (sample items: "I worry all the time," "Once I start worrying, I can't stop") rated on a scale of 1 (not at all typical) to 5 (very typical). The PSWQ has high internal consistency and good convergent and discriminant validity (e.g., Brown, Antony, & Barlow, 1992). Cronbach's α was 0.82 in the present study for pre and 0.81 for post PSWQ.

The Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006), is a 39-item measure of a general tendency to be mindful in daily life. The five factors include: acting with awareness, describing, nonjudging of experiences, nonreactivity to experiences, and observing or noticing thoughts, feelings, sensations, and perceptions. Sample items include, "I criticize myself for having irrational or inappropriate emotions," and "I pay attention to how my emotions affect my thoughts and behavior." The FFMQ has good predictive and construct validity as well as adequate internal consistency for each subscale (e.g., Baer et al., 2006; Baer et al., 2008). Cronbach's α was 0.77 in the present study for pre- and 0.87 for post-FFMQ-observe, 0.87 for pre- and 0.88 for post-FFMQ-describe, 0.84 for pre- and 0.86 for post- FFMQ-Act with Awareness, 0.88 for pre- and 0.90 for post- FFMQ-nonjudge, and 0.75 for pre- and 0.86 for post-FFMQ-nonreact.

2.2. Pre- and post-DPT measure

A DPT measure of emotional information processing was included in the present study. In this task, participants see two stimuli (e.g., words, faces, or pictures). One of the stimuli is usually emotional and one is neutral. Immediately following the stimulus presentation, a probe (such as the letter "E" or "F") appears in the location of the emotional or neutral stimulus. A typical task is for participants to indicate the identity of the probe as quickly as possible. Biased attention to emotional stimuli is inferred when participants are faster to identify a probe that replaced an emotional than neutral stimulus. In previous studies employing psychologically distressed participants, several patterns of effects have been observed, including evidence of biased responding (i.e., responding faster to probes following unpleasant compared to neutral) and a lack of evidence of biased responding (i.e., no difference in responding to probes following emotional or neutral stimuli, for discussion see Glinder, Beckjord, Kaiser, & Compas, 2007).

In the present study, participants sat 100 cm from a computer screen. Each trial began with a fixation cross for 500 ms, followed by pleasant-unpleasant, unpleasant-neutral, pleasant-neutral, and neutral-neutral word pairs that were presented 5 cm apart above and below a central fixation cross for 500 ms in lower case letters in Arial 24-point font. After word offset, participants indicated the identity of a probe ("E" or "F") using a keypad. Probes appeared for 1500 ms.

The DPT consisted of seventy-two each of pleasant-unpleasant, unpleasant-neutral, pleasant-neutral, and neutral-neutral word pairs (for a total of 288) that were presented in a different randomized order to each participant before and after participation in the mindfulness or control group. The same word list was used for the pre and post task. All emotional and 95% of the neutral words were selected from a database (Bradley & Lang, 1999) with normative ratings of valence and arousal. The remaining neutral words were selected from MacLeod, Rutherford, Campbell, Ebsworthy, and Holker (2002) and Kucera and Francis (1967) based on ratings of valence and arousal. Emotional (pleasant and unpleasant) words were matched on emotional arousal level (mean = 5.5 for both word categories on a scale of 1 = low to

9 = high). Average valence for pleasant and unpleasant words was 7.2 and 2.8, respectively (on a scale of 1 = unpleasant to 9 = pleasant). Mean arousal was 4.0 and mean valence was 5.0 for neutral words.

2.3. Mindfulness intervention

The mindfulness intervention included five weekly 75 min sessions. Sessions were co-facilitated by authors SS and LL who each practiced mindfulness consistently (SS for over a decade, and LL for over 3 years). In addition, author SS participated in a year-long formal MBSR training in 1999–2000 and also attended several day-long retreats as well as a weekend silent meditation retreat. SS was also trained in working with individual therapy clients and skills groups using mindfulness techniques. Author LL was formally introduced to mindfulness practice during dialectical behavior therapy training over a decade ago, and has worked with clients using mindfulness concepts since that time. Both facilitators each also have approximately 14 and 15 years working with university-aged students in a university setting (SS primarily as a professor and research mentor but also as a mindfulness instructor, LL primarily as a mental health counselor but also a course instructor).

Sessions were adapted from MBSR (Kabat-Zinn, 1990) and MBCT (Segal et al., 2002) and replicated the session content and structure detailed in Sass et al., 2013. Briefly, the first week provided an introduction to mindfulness practice and included eating a raisin mindfully and a basic sitting practice with awareness of breath. The second week focused on thoughts and included a basic sitting practice with awareness of thoughts. The third week focused on emotions and included a body scan practice. The fourth week focused on kindness and compassion toward oneself and others and included a lovingkindness meditation practice. Finally, the fifth week focused on integrating what was learned from the sessions and how to bring mindfulness skills into everyday life. A walking meditation symbolizing the generalization of mindfulness into everyday life was introduced and practiced, and barriers and supports to practice after the group ended were discussed.

Participants in the mindfulness group attended approximately 4 total sessions (mean = 4.2, *SD* = 1.1). Participants were given resources and recordings to support voluntary home practice. These resources included a daily practice log where participants could record time, length, and quality of their practice, and a resource list with freely available recordings of mindfulness practices, which included a link to guided audio recordings from the University of California - Los Angeles' Mindful Awareness Research Center and the University of California-San Diego Health's Center for Mindfulness. Links to freely available online meditation timers were also provided for those who did not want to use guided audio. Participants were encouraged to practice for a minimum of 15 min, six days a week. Participants practiced twice per week on average between sessions (mean = 2.3, *SD* = 2.0) for an average of 36 total minutes each week (mean = 35.6, *SD* = 40.4).

2.4. Questionnaire and DPT analysis strategy

For questionnaire analyses, a mean 3 SD above or below a given questionnaire or subscale mean was considered an outlier (n = 1 BSI-18-post outlier from the control group; removed from analyses involving BSI-18-post data). For DPT analyses, trials with errors (4% of pre and post data), with RT 3 SD above or below each participant's mean RT (calculated separately for each emotion condition; 1% of pre and post data), or that were less than 200 ms (1% of pre and post data) were removed from analysis. Error and RT outliers were then examined across participants. Four participants had error outliers greater than 3 SD from the group's condition mean (n = 4; 2 control, 2 mindfulness) and one participant had an RT outlier greater than 3 SD from the group's condition mean (n = 1 control; overlapping with one of the error outliers). Questionnaire analyses were conducted excluding participants who had RT or error outliers, as a pattern of low effort was evident in those participants. The resulting available sample for questionnaire analyses was 39 (21 controls, 18 mindfulness) except for analyses involving post-BSI data (20 controls, 18 mindfulness). Two control participants were missing baseline RT due to experimenter error, therefore participants available for both pre and post RT analyses were 37 (19 controls, 18 mindfulness).

To test hypotheses that psychological distress, anhedonic depression, anxious arousal, and worry would decrease, and self-reported mindfulness would increase in the mindfulness but not control group, a 2 (Group: Mindfulness, Control) x 2 (Time: Pre, Post) repeated-measures ANOVA was conducted for each questionnaire (BSI-18, MASQ-AD8, MASQ-AA, PSWQ) as well as the five subscales of the FFMQ.

In order to test the hypothesis that individuals participating in the mindfulness but not control group would show faster RT from pre- to post-intervention prompted by probes replacing both emotional and neutral words, a 2 (Group: Mindfulness, Control) x 2 (Time: Pre, Post) x 7 (Emotion: pleasant-unpleasant word pairs where the probe replaced either the unpleasant or pleasant word, pleasant-neutral where the probe replaced either the pleasant or neutral word, unpleasant-neutral where the probe replaced either the unpleasant or neutral word, and neutral-neutral where the probe replaced a neutral word) repeated-measures ANOVA was conducted using RT data. P-values reflect the Huynh–Feldt correction for sphericity where appropriate.

3. Results

3.1. Baseline scores

There were no baseline differences between groups on any of the outcome measures, (see Tables 1 and 2).

3.1.2. BSI-18

In the absence of a main effect of Group, F (1, 36) < 0.001, p = .989, partial $\eta 2$ < 0.001, BSI-18 scores decreased over time, F (1, 36) = 25.83, p < 0.001, partial $\eta 2$ = 0.418. A Group x Time trend, F (1, 36) = 3.86, p = .057, partial $\eta 2$ = 0.097, was followed up with separate Time ANOVAs for each group, following the hypothesis that BSI reduction would be greater in the mindfulness than control group. BSI-18 scores decreased 4.6 points from pre-post in the control group, F (1, 19) = 6.17, p = .022, partial $\eta 2$ = 0.245, and decreased 10.3 points from pre-post in the mindfulness group, F (1, 17) = 19.86, p < .001, partial $\eta 2$ = 0.539, (see Fig. 2). At post-test, 5 of the 7 individuals in the control group and 3 of the 8 individuals in the mindfulness group who scored in the clinical range (BSI-18 T score of 70 or above) at baseline remained in this range at post-test. Groups did not differ on post-BSI-18 scores, F (1, 37) = 1.25, p = .271, partial $\eta 2$ = 0.033.

3.1.3. MASQ-AD8

In the absence of a main effect of Group, F (1, 37) = 0.004, p = .951, partial $\eta 2$ < 0.001, AD8 scores decreased over time, F (1, 37) = 8.76, p = 0.005, partial $\eta 2$ = 0.191. A Group x Time trend, F (1, 37) = 3.75, p = 0.060, partial $\eta 2$ = 0.092, was followed up with separate Time ANOVAs for each group, following the hypothesis that depression levels would decrease in the mindfulness and not control group. As expected, anhedonic depression scores decreased in the mindfulness, F (1, 17) = 11.09, p = .004, partial $\eta 2$ = 0.395, and not control group, F (1, 20) = 0.57, p = .460, partial $\eta 2$ = 0.028 (see Fig. 3). Groups did not differ in post-MASQ-AD8 scores, F (1, 38) = 0.73, p = .398, partial $\eta 2$ = 0.019.

3.1.4. MASQ-AA

In the absence of a main effect of Group, F (1, 37) = 0.01, p = .930, partial $\eta 2$ < 0.001, or a Group x Time interaction, F (1, 37) = 2.39, p = .131, partial $\eta 2$ = 0.061, MASQ-AA scores decreased over time, F (1, 37) = 12.39, p = .001, partial $\eta 2$ = 0.251.

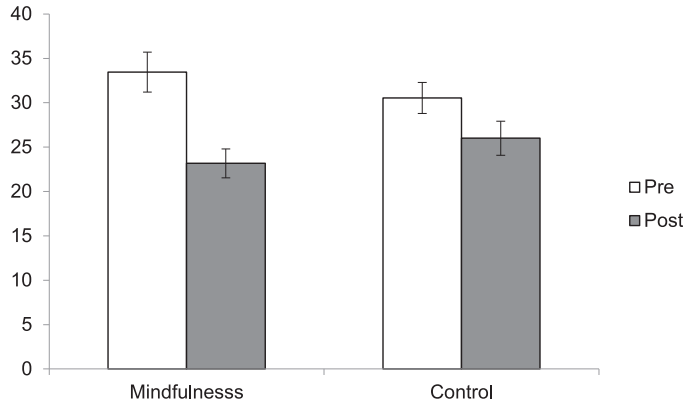

Fig. 2. Psychological distress. Error bars represent + /- 1 SE. Brief Symptom Inventory-18 (BSI-18) scores decreased from pre- to post-intervention in the mindfulness and control group.

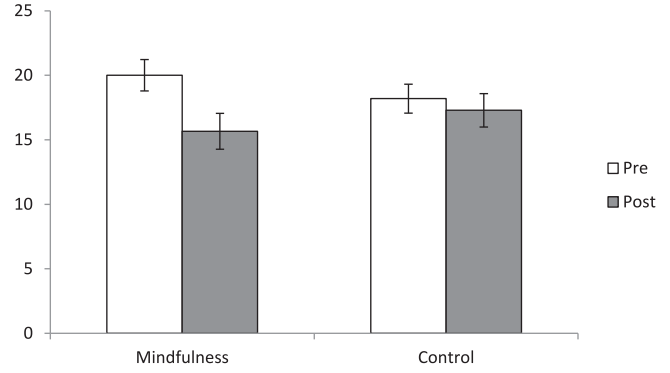

Fig. 3. Anhedonic depression. Error bars represent + /- 1 SE. Mood and Anxiety Symptom Questionnaire- Anhedonic Depression (MASQ-AD8) scores decreased from pre- to post-intervention in the mindfulness and not control group.

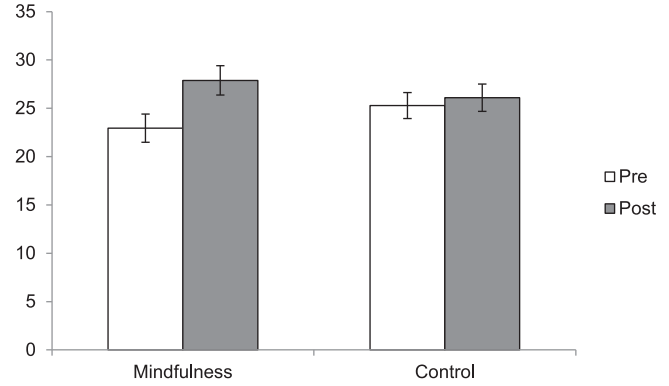

Fig. 4. Five-factor mindfulness nonjudging of experiences scores. Error bars represent + /- 1 SE. Five Factor Mindfulness Questionnaire-Nonjudging subscale (FFMQ-Nonjudge) scores increased from pre- to post-intervention in the mindfulness but not control group.

3.1.5. PSWQ

In the absence of a main effect of Group, F (1, 37) = 0.03, p = .858, partial η2 = 0.001, or a Group x Time interaction, F (1, 37) = 0.02, p = .880, partial η2 = 0.001, PSWQ scores decreased over time, F (1, 37) = 11.70, p = .002, partial η2 = 0.240.

3.1.6. FFMQ-nonjudge

In the absence of a main effect of Group, F (1, 37) = 0.02, p = 0.883, partial η2 = 0.001, nonjudge scores increased over time, F (1, 37) = 12.14, p = 0.001, partial η2 = 0.247. A Group x Time interaction, F (1, 37) = 6.27, p = 0.017, partial η2 = 0.145, was followed up with separate Time ANOVAs for each group. As expected, the mindfulness group, F (1, 17) = 12.29, p = .003, partial η2 = 0.420, and not the control group, F (1, 20) = 0.75, p = .398, partial η2 = 0.036, showed an increase in nonjudge scores over time (see Fig. 4). Groups did not differ in post-nonjudge scores, F (1, 38) = 0.75, p = .391, partial η2 = 0.020.

3.1.7. FFMQ-act with awareness

In the absence of a Group, F (1, 37) = 0.04, p = .854, partial η2 = 0.001, or Group x Time effect, F (1, 37) = 0.08, p = .785, partial η2 = 0.002, FFMQ Act with Awareness scores increased over time, F (1, 37) = 5.87, p = .020, partial η2 = 0.137.

3.1.8. FFMQ-describe

In the absence of a Group, F (1, 37) = 0.61, p = .438, partial η2 = 0.016, or Group x Time effect, F (1, 37) = 1.08, p = .305, η2 = 0.028, FFMQ Describe scores increased over time, F (1, 37) = 5.39, p = .026, partial η2 = 0.127.

3.1.9. FFMQ-nonreact

A Group effect, F (1, 37) = 4.12, p = .050, partial η2 = 0.100 was evident, with higher scores in the control than mindfulness group, in the absence of a Time, F (1, 37) < 0.001, p = .995, partial η2 < 0.001, or a Group x Time interaction, F (1, 37) = 2.37, p = .132, partial η2 = 0.060.

3.1.10. FFMQ-observe

Group, F (1, 37) = 0.61, p = .439, partial η2 = 0.016, Time, F (1, 37) = 0.01, p = .917, partial η2 < 0.001, and Group x Time effects were not evident, F (1, 37) = 0.242, p = .626, partial η2 = 0.007.

3.1.11. RT

In the absence of a main effect of Group, F (1, 35) = 0.83, p = 0.370, partial η2 = 0.023, RT became faster over time, F (1, 35) = 11.43, p = 0.002, partial η2 = 0.246. An Emotion x Time interaction, F (6, 210) = 2.92, p = .009, partial η2 = 0.077, was qualified by a Group x Emotion x Time interaction, F (6, 210) = 2.36, p = .032, partial η2 = 0.063. Separate Emotion x Time ANOVAs were conducted for each group, following the hypothesis that the mindfulness group would show facilitated attentional processing of probes following emotional and neutral stimuli from pre- to post-intervention, and the control group would either show no processing changes, or facilitated processing only of probes following neutral stimuli.

Consistent with prediction, within the mindfulness group, in the absence of a main effect of Emotion, F (5.74, 97.64) = 0.54, p = .767, partial η2 = 0.031, a main effect of Time, F (1, 17) = 12.45, p = 0.003, partial η2 = 0.423, was evident, indicating faster RT from pre- to post-intervention following probes replacing all word types, regardless of

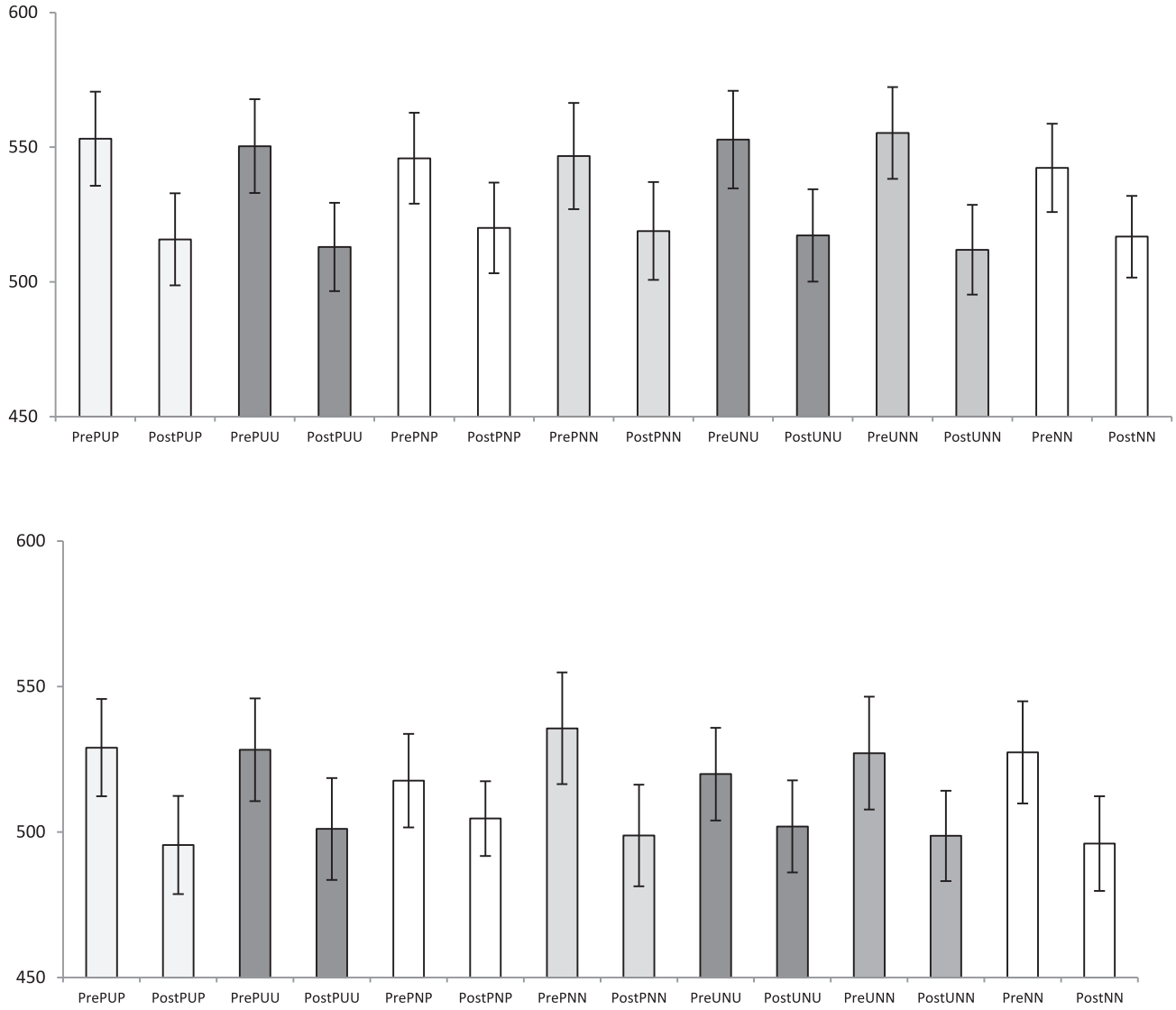

Fig. 5. Reaction time data for pre and post word pairs. The mindfulness group is displayed on the top and the control group is displayed on the bottom. PUP and PUU correspond to pleasant-unpleasant word pairs where the probe replaced pleasant and unpleasant, respectively. PNP and PNN correspond to pleasant-neutral word pairs where the probe replaced pleasant and neutral, respectively. UNU and UNN correspond to unpleasant-neutral word pairs where the probe replaced unpleasant and neutral, respectively. NN corresponds to neutral-neutral word pairs where the probe replaced neutral. Error bars represent + /- 1 SE. The mindfulness group showed speeded RT to all word types from pre- to post-training. The control group showed speeded RT to probes replacing pleasant words within pleasant-unpleasant word pairs and probes replacing neutral words within neutral-neutral word pairs from pre- to post-control, but these effects did not survive Bonferroni correction.

whether they were emotional or neutral (see Fig. 5).

Within the control group, in the absence of main effects of Emotion, F (5.16, 92.94) = 0.83, p = .538, partial η2 = 0.044, or Time, F (1, 18) = 3.29, p = 0.087, partial η2 = 0.154, an Emotion x Time interaction, F (5.71, 102.71) = 2.97, p = .012, partial η2 = 0.141, emerged. Separate Time ANOVAs were conducted for each emotion category. RT became faster for probes following neutral words within neutral-neutral word pairs, F (1, 18) = 4.57, p = .047, partial η2 = 0.202, and for probes following pleasant words within pleasant-unpleasant word pairs, F (1, 18) = 5.06, p = .037, partial η2 = 0.220 (see Fig. 5). However, neither of these survived a Bonferroni correction of p = .007 (α divided by 7 simple effects tests for the 7 levels of Emotion). RT did not become faster for probes replacing any other word type (i.e., following unpleasant words within pleasant-unpleasant word pairs, F (1, 18) = 2.78, p = .113, partial η2 = 0.134, following unpleasant words within unpleasant-neutral word pairs, F (1, 18) = 1.43, p = .248, partial η2 = 0.073, following pleasant words within pleasant-neutral word pairs, F (1, 18) = 1.20, p = .287, partial η2 = 0.063, following neutral words within pleasant-neutral word pairs, F (1, 18) = 4.13, p = .057, partial η2 = 0.187, or following neutral words within unpleasant-neutral word pairs, F (1, 18) = 2.80, p = .111, partial η2 = 0.135). At post, no effects were evident, Group, F (1, 36) = 0.29, p = .595, partial η2 = 0.008, Emotion, F (5.21, 187.6) = 1.11, p = .359, partial η2 = 0.030, or Condition x Emotion, F (5.21, 187.6) = 0.61, p = .698, partial η2 = 0.017.

4. Discussion

The present study evaluated whether a brief mindfulness intervention targeted to non-treatment-seeking university students reporting moderate-to-high levels of psychological distress would be associated with a reduction in self-reported depression, anxiety, and psychological distress, as well as increased self-reported mindfulness compared to a no-treatment control group. Furthermore, we assessed whether mindfulness training would be associated with “even-handed” or similar processing of emotional and neutral stimuli in a behavioral task from

pre-to-post intervention compared to a control group.

Consistent with prediction, anhedonic depression levels decreased in the mindfulness and not control group. In the present study, participants' mean baseline MASQ-AD8 score was 19, slightly lower than a score of 21, which has been predictive of someone in a current or past major depressive episode in a university student sample (Bredemeier et al., 2010), suggesting that the present sample had significant depression symptomology. Present results are consistent with recent studies showing that mindfulness interventions can be a cost-effective alternative to reduce current depression symptoms (Strauss, Cavanagh, Oliver, & Pettman, 2014; Sundquist et al., 2015) including in participants with comorbid anxiety and depressive symptoms (Vøllestad, Nielsen, & Nielsen, 2012). In a meta-analysis of twelve RCTs of mindfulness-based interventions in participants experiencing a current episode of a depressive or anxiety disorder, depression symptom severity reduced in several cases (Strauss et al., 2014). In addition, mindfulness interventions have been helpful in preventing depressive relapse in those with recurrent depressive episodes (e.g., Kuyken et al., 2008; Teasdale et al., 2000). Taken together, these studies suggest that mindfulness-based interventions may be useful for people experiencing current and recurrent depression symptoms. While the mindfulness and control group data are consistent with hypotheses in the present study, it is important to note that present results followed up a trend-level omnibus Group x Time interaction, underscoring the need to replicate these results in future research.

As expected, the mindfulness group showed a pattern of speeded processing of probes replacing each word type (pleasant, unpleasant, neutral) from pre- to post-training within the DPT, suggesting that mindfulness training may encourage "even-handed" engagement with all stimuli, regardless of emotional tone or intensity. In other words, emotional information was not "sticky" in that it was processed in a similarly speeded fashion as nonemotional information from pre-to-post mindfulness training. Consistent with prediction, the control group showed no change in processing probes replacing emotion words in certain contexts (unpleasant or pleasant words paired with neutral words, unpleasant words paired with pleasant words) or probes replacing neutral words within pleasant-neutral or threat-neutral word pairs. The control group did show evidence of facilitated processing to probes in two contexts: (1) probes replacing neutral words within neutral-neutral word pairs and (2) probes replacing pleasant words within pleasant-unpleasant word pairs.

Faster RT prompted by probes replacing neutral words within neutral-neutral word pairs may suggest that neutral words within a neutral context were easier to process than neutral words within an emotional context, perhaps because the emotional context of emotion-neutral word pairs drew processing resources away from responding to the probe. Faster RT to probes replacing pleasant within pleasant-unpleasant word pairs could be interpreted as avoidance of unpleasant words over time or facilitated processing of pleasant words. The former interpretation is consistent with a large literature on biased responding in anxious and depressed participants in the presence of unpleasant stimuli (e.g., avoidance, delayed disengagement, e.g., Bar-Haim et al., 2007). The latter interpretation presumes that processing probes after pleasant information may become easier over time, yet if pleasant information were facilitated more generally, faster responding should have also occurred following probes replacing pleasant words within pleasant-neutral word pairs, and it did not. Present data are therefore more consistent with avoidance of unpleasant information rather than facilitated processing of pleasant information in the absence of a mindfulness intervention. It is important to note that speeded processing of probes replacing neutral words within neutral-neutral word pairs and of probes replacing pleasant words within pleasant-unpleasant word pairs did not survive Bonferroni correction for multiple comparisons, and should be interpreted cautiously pending replication.

As expected, self-reported nonjudgment increased in the mindfulness and not control group, suggesting that mindfulness training may have allowed participants to accept internal phenomena such as emotions and thoughts without judging or evaluating them. Contrary to expectation, no other mindfulness subscale within the FFMQ was differentially affected by mindfulness training. Indeed, act with awareness and describe FFMQ scores increased in both groups, suggesting that these subscales were interpreted in a manner that was non-specific to mindfulness training. For example, "I am easily distracted" (act with awareness) or "I can easily put my beliefs, opinions, and expectations into words" (describe) might change over time as a function of participating in university-level classes that require focus and systematic training in how to articulate one's beliefs and opinions as one engages in university course content, irrespective of mindfulness training. A lack of difference in a mindfulness measure of awareness and acceptance was also evident immediately post-intervention in a study of university students comparing a wait-list control group with hatha yoga and body scan interventions (Call, Miron, & Orcutt, 2014), suggesting that measures of mindfulness might not always be sensitive to changes that are specific to mindfulness but may involve more general mechanisms involved in being a university student. This possibility remains to be tested in future research.

Consistent with prediction, the mindfulness group showed distress reduction from pre- to post-intervention. The control group also showed distress reduction from pre- to post-intervention, with a smaller effect size than the mindfulness group. Present data are consistent with other student samples in showing a reduction in psychological distress as a function of mindfulness training (e.g., Jain et al., 2007; Shapiro, Schwartz, & Bonner, 1998). That distress reduction also occurred in the control group in the present study suggests several possibilities. First, the student participants may have engaged in activities readily available in a university campus setting such as socializing with peers and friends, participating in campus community events, or making use of other campus resources such as the gym. Second, psychological distress may not be selectively benefitted by mindfulness interventions in general (for review see Goyal et al., 2014), and it may be that a different measure (e.g., the MASQ-AD8 measure used in the present study) would be a better method in screening university student participants who would selectively benefit from a brief mindfulness intervention. On the other hand, only 3 of the 8 participants with clinically significant BSI-18 scores at baseline remained so post-intervention in the mindfulness group, while 5 of the 7 participants with clinically significant BSI-18 scores at baseline remained so post-intervention in the control group. This pattern of effects suggests that the mindfulness intervention may have benefitted those reporting clinical levels of psychological distress more than no intervention at all, and that BSI-18 might be fruitfully used in targeting clinical levels of psychological distress in university student populations, a possibility that remains to be explored in future research.

Anxious arousal and worry decreased in both groups in the present study, suggesting that the passage of time or engagement in activities related to a university setting may be sufficient for anxiety (but not depression) reduction in a non-treatment-seeking student sample, rather than effects that were specific to mindfulness. This result is consistent with a recent meta-analysis of meditation programs that included anxiety as an outcome measure, in that a range of outcomes with respect to anxiety were observed, including no differences in anxiety levels between meditation and control groups (Goyal et al., 2014). Further, some anxiety measures may not be sensitive to differences between meditation and control groups while others may be more sensitive (e.g., Hoge et al., 2013). Future research employing university student samples should use a range of anxiety measures in investigating the extent to which anxiety symptom reduction may be specific to mindfulness training.

While a strength of the present study is the use of a control group, a limitation is that random assignment was not used due to limited mindfulness group options and a lack of participants who indicated that they were available at the times they were offered. This quasi-

experimental design could have created beneficial effects in the mindfulness group if those who believed they would benefit from mindfulness were more likely to participate in the intervention rather than the control group. However, importantly, despite a lack of randomization, groups did not differ at baseline on any of the outcome measures, suggesting that differences in baseline psychological distress, anxiety, depression, mindfulness, and reaction time prompted by emotional and neutral stimuli did not influence the choice to participate in the mindfulness group. Another limitation of the present study was the use of a non-active control group, making it difficult to ascertain whether differences between groups in anhedonic depression reduction, nonjudgment increases, or RT facilitation were due to the presence or absence of a mindfulness intervention or due to nonspecific factors. It is possible that some of the supportive but non-specific elements of the mindfulness training condition were responsible for differences between groups. In addition, the mindfulness and not the control group was incentivized to complete participation in the mindfulness groups by having to pay $25 at the outset of the groups, which was reimbursed at the rate of $5/session for every session attended. This may have increased participation rates in the mindfulness relative to the control group, and future studies may consider parallel incentive structures for the control group. Other limitations of the present study included a relatively small sample size, with replication needed using large samples, and a lack of follow-up assessment points further out in time from when the groups ended, raising the question of how long decreases in depression symptoms or increases in non-judging would persist in those with mindfulness training, another issue to be investigated in future research.

A limitation common in the mindfulness literature that was also present in our study was the use of a self-report measure of mindfulness as a sole indicator of changes in mindfulness. While behavioral measures of mindfulness are few to date, mindfulness intervention studies would benefit from attempting to include a behavioral measure of mindfulness, such as breath counting accuracy (e.g., Levinson, Stoll, Kindy, Merry, & Davidson, 2014). Such measures may index changes in mindfulness skill unavailable to conscious awareness or self-report, and may be less influenced by demand characteristics such as pressure to report increased mindfulness skills on a face-valid self-report measure (for review see Levinson et al., 2014).

The present study has a number of strengths, including the use of a behavioral (RT) measure of change in processing of emotional and neutral stimuli, the inclusion of a control group who was identical to the experimental group at baseline on outcome measures, and including multiple measures of psychological distress symptoms (BSI-18, MASQ-AA, MASQ-AD8, PSWQ). Present data support providing brief mindfulness interventions to university students who may not otherwise seek out psychological services. More specifically, anhedonic depression symptoms decreased, nonjudgment of experiences increased, and RT became facilitated for each stimulus type (pleasant, neutral, and unpleasant), consistent with a lack of biased processing of emotional stimuli that is often evident in psychologically distressed participants (e.g., Bar-Haim et al., 2007; Glinder et al. 2007; Gotlib & Joorman, 2010).

Present results add to a growing literature supporting mindfulness interventions in the university context, and suggest that even when moderately-to-highly distressed students do not seek a distress reduction intervention, they may benefit nonetheless when they take advantage of being offered one. This fact has prevention implications within the university setting. Mental health issues such as depression and anxiety disorders often onset during young adulthood (e.g., Bandelow & Michaelis, 2015; Klein et al., 2013), a time that often coincides with or precedes university attendance. Untreated mental health issues are associated with lower grades, attrition, and disrupted social functioning (e.g., Auerbach et al., 2016), affecting young people's long-term professional success, earning potential, and the quality and quantity of interactions with peers, teachers, and other social contacts. Screening students who are likely to benefit from mindfulness interventions could aid overworked university mental health staff in providing limited outreach services to those who need them most. Indeed, mindfulness interventions are offered successfully in a group format, a more cost and time-effective method than individual mental health options. Ultimately, targeting interventions to students who would benefit from but may not otherwise seek mental health services is a worthwhile goal in optimizing personal and professional success in students within higher education and beyond.

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Conflict of interest

The authors declare that they have no conflict of interest.

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