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ORIGINAL PAPER

Gender Differences in the Associations Between Mindfulness, Self-Compassion, and Perceived Stress Reactivity

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Abstract

Objectives Research has demonstrated that excessive stress reactivity responses are associated with the development of cardiovascular disease and psychopathology. Thus, it is important to identify potential protective factors, such as trait mindfulness or trait self-compassion, that may buffer against excessive stress reactivity.

Methods Undergraduate college students ($n = 137$) completed online self-report measures related to trait mindfulness and trait self-compassion, overall stress reactivity, and several subtypes of stress reactivity (i.e., prolonged reactivity, reactivity to work overload, reactivity to social evaluation, reactivity to social conflict, and reactivity to failure). Multiple regressions were employed with overall stress reactivity and subtypes of stress reactivity as the outcome variables.

Results After controlling for gender and state stress, self-compassion was significantly negatively associated with perceived stress reactivity ($\Delta R^2 = .12$), as was mindfulness ($\Delta R^2 = .04$). Post hoc analyses also demonstrated that self-compassion accounted for significant variance across all but one type of stress reactivity, and it accounted for more variance than mindfulness for most stress reactivity types. Gender emerged as a significant moderator of the association between self-compassion and reactivity to social evaluation, such that the negative association between self-compassion and reactivity to social evaluation was stronger for women than for men.

Conclusions Results warrant future investigations into whether self-compassion interventions can reduce stress reactivity, particularly since existing research demonstrates that self-compassion can be cultivated and thus is modifiable.

Keywords Self-compassion · Mindfulness · Stress reactivity · Social-evaluative stress · Gender differences

Excessive stress burdens have repeatedly been linked to the development of poor health outcomes, such as cardiovascular disease, upper respiratory diseases, and bodily inflammation (Dimsdale, 2008; Schneiderman et al., 2005; Slavich, 2016). Stress also negatively impacts psychological well-being and is associated with depression, anxiety, and substance use disorders (Schneiderman et al., 2005). One mechanism by which stress burdens can lead to negative health outcomes is stress reactivity. Stress reactivity is a person's tendency to respond to stressors and can be measured via physiology, behavior, self-report, or cognitive functioning (Schlotz, 2013). Research has demonstrated that abnormal stress reactivity responses, such as heightened reactivity to stress induction tasks, are associated with cardiovascular disease and psychopathology (Chida & Steptoe, 2010; Lovallo, 2005; Sherwood & Turner, 1995; Zorn et al., 2017). Whether specific psychosocial coping resources (i.e., trait mindfulness and trait self-compassion) are negatively associated with perceived stress reactivity, and how these associations may vary across gender remains unknown.

Given that stress reactivity seems to be a crucial link between stress burdens and negative health outcomes, it is important to identify coping mechanisms that may disrupt this link. Mindfulness is one such mechanism, and mindfulness-based interventions have demonstrated positive stress-buffering effects in studies examining stress reactivity (see Morton et al., 2020 for a review). Mindfulness includes two main components: (1) regulating attention and (2) adopting a curious and accepting stance toward experiencing the present moment (Brown et al., 2007). Studies

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have demonstrated that both trait mindfulness and mindfulness interventions can alter stress reactivity. For example, Lucas-Thompson et al. (2019) demonstrated that higher trait mindfulness predicted reduced self-reported stress reactivity to a widely implemented social-evaluative stressor, the Trier Social Stress Test (TSST; Kirschbaum et al., 1993). Recently, Morton et al. (2020) reviewed 15 mindfulness intervention clinical trials that included administration of the TSST and found that most studies reported reduced self-reported stress reactivity.

Trait mindfulness is a well-known stress-buffering strategy, but other related contemplative traits may also be effective in buffering stress. Specifically, trait compassion has recently emerged as protective mechanism against excessive stress reactivity, particularly when considering compassion directed toward the self (i.e., self-compassion; Breines et al., 2015; Luo et al., 2018). Self-compassion refers to a kind and nonjudgmental way of relating to oneself during difficult times (Neff, 2003). Neff (2003) identified three main subordinate facets of self-compassion, including self-kindness (i.e., treating oneself with warmth and kindness in times of difficulty), common humanity (i.e., understanding that one is not alone in their suffering), and mindfulness. In the context of this definition, mindfulness is the ability to turn toward one's own suffering without judgment and without being overwhelmed by suffering.

Higher levels of trait self-compassion have repeatedly been associated with decreased self-reported indices of stress reactivity measured in stress-induction studies. For instance, one study found that participants high in self-compassion reported less negative affect after undergoing the TSST relative to those lower in self-compassion (Luo et al., 2018). A similar study found that participants higher in self-compassion reported less perceived stress and shame following an arithmetic task similar to the TSST's sequential subtraction task (Ewert et al., 2018). Finally, a randomized controlled trial demonstrated that participants who underwent a brief self-compassion intervention implemented prior to the TSST demonstrated reduced self-reported stress reactivity relative to a control group (Arch et al., 2014).

Most studies examining the effects of mindfulness and self-compassion on stress reactivity employ stress-induction protocols. Stress-induction protocols, such as the TSST, are laboratory-based paradigms that measure stress before, during, and after an induced stressful experience. Studies using stress-induction protocols are generally considered the gold standard in stress-reactivity research (Allen et al., 2016). However, these designs can be costly, time-consuming, and limited in the types of stress reactivity that can be measured. For instance, the TSST is designed as a social-evaluative stress reactivity paradigm (Dickerson & Kemeny, 2004), and may not tap into other types of stress reactivity (e.g., reactivity to work overload). Recently, a self-report measure of perceived stress reactivity, the Perceived Stress Reactivity Scale (PSRS; Schlotz et al., 2011), was developed to examine self-reported stress reactivity during a single time point. While such a self-report measure could never replace stress induction paradigms such as the TSST, a measure like the PSRS has some slight benefits over stress-induction studies. For example, the PSRS includes questions about how participants have typically responded to stressful situations in the past month, whereas stress-induction studies measure stress reactivity during one stressful instance. Individual factors, such as lack of sleep, state anxiety, or social inclusion or exclusion prior to the stress induction, may influence stress response on any given day (Kothgassner et al., 2021, in press; Minkel et al., 2014; Pointer et al., 2012). Thus, a cross-sectional measure may be indicative of more stable levels of stress reactivity than a one-time stress-induction measurement (though there may still be self-reporting bias from participants). Indeed, the PSRS demonstrated excellent four-week test–retest reliability ($r = 0.85$) in a US sample (Schlotz et al., 2011). Furthermore, the PSRS includes various aspects of stress reactivity as measured by each of the five subscales (i.e., prolonged reactivity, reactivity to work overload, reactivity to social conflict, reactivity to failure, and reactivity to social evaluation), whereas stress-induction studies typically examine one or two types of stress reactivity (e.g., social-evaluative stress reactivity; Dickerson & Kemeny, 2004).

To our knowledge of the current literature, only one study examined the stress-buffering influence of mindfulness on a cross-sectional self-report measure of stress reactivity (i.e., the PSRS), and no studies have examined self-compassion in relation to the PSRS. Importantly, stress-buffering would typically refer to whether mindfulness or self-compassion may dampen a stress response measured over multiple time points. However, with a cross-sectional measure such as the PSRS, stress-buffering refers to whether mindfulness and self-compassion are negatively associated the measure since the PSRS asks how individuals have reacted to various stressful situations rather than directly measuring such reactions over multiple time points. In the one study that did examine trait mindfulness and the PSRS demonstrated that pregnant women with higher trait mindfulness reported lower levels of perceived stress reactivity (Hernandez et al., 2019), providing preliminary evidence that mindfulness is positively associated with a broad self-report measure of stress reactivity in a relatively homogenous sample (i.e., pregnant women). However, this same association has not yet been established with trait self-compassion. Furthermore, Hernandez et al. (2019) examined a sample of only women. Due to demonstrated gender differences in stress reactivity (Britton et al., 2019; Schlotz et al., 2011),

additional research examining the associations between mindfulness, self-compassion, and perceived stress reactivity in mixed-gender samples is warranted.

One study examining gender differences found that women consistently reported higher levels of self-reported stress reactivity scores on the PSRS than men (Schlotz et al., 2011). A subsequent study that adapted the PSRS for use in adolescent populations also found that relative to boys, girls reported higher stress reactivity scores overall and on all subscales except for the reactivity to failure subscale (Britton et al., 2019). These findings underscore that women consistently report higher perceived stress reactivity than men for most types of stress reactivity, and thus, gender differences should be considered when measuring mindfulness and self-compassion as potential moderators of self-reported stress reactivity.

There is also a growing recognition of gender differences in trait self-compassion. For instance, a recent meta-analysis of self-compassion comparing men and women across 71 studies demonstrated that men had significantly higher levels of self-compassion with a small effect size ($d = 0.18$; Yarnell et al., 2015). Nevertheless, no studies, to our knowledge, have examined whether the association between self-compassion and stress reactivity might vary as a function of gender. Documenting individuals' possibly distinct self-compassion levels and stress reactivity based on gender will help to inform targeted self-compassion intervention efforts. For instance, it is possible that this research could find that the stress-buffering effect of self-compassion is stronger for women when examining social-evaluative stress reactivity and stronger for men when examining reactivity to social conflict. If such findings emerged, this would suggest that self-compassion interventions may be more effective if they were tailored to teach women how to be self-compassionate during social evaluation and tailored to teach men how to be self-compassionate during social conflict situations.

In summary, mindfulness is a widely studied contemplative quality that demonstrates stress-buffering effects, and more recently, self-compassion has also emerged as a promising coping strategy that has demonstrated stress-buffering effects on self-reported stress reactivity in stress-induction studies. Whether these stress-buffering patterns exist with a broad cross-sectional self-report measure of stress reactivity (i.e., PSRS) remains unknown. Additionally, gender differences have been noted in stress reactivity and trait self-compassion literature; however, the potential for gender to moderate associations among these variables has yet to be fully explored. Thus, this study aims to (1) evaluate whether trait mindfulness and trait self-compassion are negatively associated with self-reported stress reactivity measured with the PSRS total stress reactivity score, (2) evaluate whether gender moderates the negative association between trait self-compassion and self-reported stress reactivity, and (3) conduct post hoc exploratory analyses using the PSRS subscale scores as dependent outcomes in aims 1 and 2 to advance knowledge of how trait mindfulness, trait self-compassion, gender, and self-reported stress reactivity are related.

Method

Participants

Participants were undergraduate students ($n = 160$) at a university in the northeastern United States. Over half of the sample self-identified as White (57.7%) and as cisgender women (60.6%), and had a mean age of 19.4 years

Table 1 Participant characteristics

Variable	*N*	%
Sample size	137	100
Gender[a]		
Cisgender women	83	60.6
Cisgender men	54	39.4
Race/ethnicity		
American Indian or Alaska Native	5	3.6
Asian	24	17.5
Black or African American	9	6.6
Hispanic/Latino	14	10.2
Native Hawaiian or Other Pacific Islander	3	2.2
White	79	57.7
Multiracial	3	2.2
Sexual orientation		
Asexual	2	1.5
Lesbian	3	2.2
Gay	4	2.9
Bisexual	13	9.5
Straight/heterosexual	111	81.0
Questioning or unsure	4	2.9
Household income[b]		
Under $20,000	7	5.1
$20,000–$34,999	5	3.6
$35,000–$49,999	10	7.3
$50,000–$74,999	21	15.3
$75,000–$99,999	28	20.4
Over $100,000	66	48.2

[a]Additional gender identities (e.g., non-binary) were asked about in the demographics questionnaire, but all participants endorsed identities of woman or man. Furthermore, no participants indicated that they were transgender

[b]Household income includes income from parents/caregivers if participants are primarily financially supported by parents/caregivers

(SD = 0.98). Additional sample characteristics are displayed in Table 1.

Procedures

Participants were recruited from an online participant pool and were compensated for their time with course credit for an introductory psychology course; this research was approved by Syracuse University's institutional review board. Students signed up for and consented to the study online and completed the survey at their leisure. A response validity question was included in the stress reactivity scale (i.e., "For this question, please select as your answer 'quite stressful'"). Participants who answered this question incorrectly ($n = 23$) were removed prior to analysis. This resulted in an analytic sample size of 137 participants.

Measures

Stress Reactivity

Stress reactivity was measured with the 23-item Perceived Stress Reactivity Scale (PSRS; Schlotz et al., 2011). This scale includes both a total stress reactivity score and five subscale scores: prolonged reactivity, reactivity to work overload, reactivity to social conflict, reactivity to failure, and reactivity to social evaluation. The PSRS asks about participants' reactions to situations that they may have experienced in the past month. Each question has three answers that indicate varying magnitudes of stress reactivity. An example item includes: "When I make a mistake…" and offers the following response options: "In general, I remain confident," "I sometimes feel unsure about my abilities," or "I often have doubts about my abilities." These answers are scored from 0 to 2, with 0 being less reactive and 2 being more reactive. The scale can be scored as a total stress reactivity score, and by each of the five subscales. Cronbach's alpha and test–retest reliability for the full-scale score in the original US sample were good ($\alpha = 0.87$, $r = 0.85$), as was the Cronbach's alpha for the total stress reactivity score in the current sample ($\alpha = 0.85$). Cronbach's alpha for subscales in the original US sample ranged from 0.62 to 0.77. Cronbach's alphas for each subscale in the current sample were 0.61 for prolonged reactivity, 0.65 for reactivity to failure, 0.68 for reactivity to social conflict, 0.78 for reactivity to work overload, and 0.65 for reactivity to social evaluation.

Trait Self-Compassion

Trait self-compassion was assessed using the Self-Compassion Scale (SCS; Neff, 2003). The SCS asks participants how they typically act toward themselves during difficult times. It includes questions related to the three components of self-compassion (i.e., self-kindness, common humanity, and mindfulness), along with questions related to their negatively-valanced counterparts (i.e., self-judgment, isolation, and overidentification). Self-compassion in this study was measured with a composite score of the positive subscales only (i.e., self-kindness, common humanity, and mindfulness). This is due to recent critiques and psychometric examinations of the SCS that demonstrated the positive and negative scales may be tapping into different constructs (López et al., 2015; Pfattheicher et al., 2017). Numerous researchers have recommended using a score comprised of the positive subscales only as a more accurate measure of self-compassion (Muris & Petrocchi, 2017; Pfattheicher et al., 2017).

Example items from the positive subscales include: "I try to be loving toward myself when I'm feeling emotional pain" and "When something upsets me I try to keep my emotions in balance." All questions are answered on a 6-point Likert scale from 1 (almost never) to 6 (almost always). The SCS demonstrated good reliability in the original psychometric study ($\alpha = 0.92$; Neff, 2003). Cronbach's alpha for the composite score from the positive subscales in this current sample was adequate ($\alpha = 0.88$).

Trait Mindfulness

Trait mindfulness was assessed with the 15-item Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003). The MAAS includes items such as "I find it difficult to stay focused on what is happening in the present" and "I do jobs or tasks automatically, without being aware of what I'm doing." All items are scored on a 6-point Likert scale from 1 (almost always) to 4 (almost never). The MAAS demonstrated good reliability in the original psychometric study for college students ($\alpha = 0.82$; Brown & Ryan, 2003). Cronbach's alpha in this current sample was adequate ($\alpha = 0.91$).

State Stress

State stress was assessed with the 6-item version of the State-Trait Anxiety Inventory (STAI-6; Marteau & Bekker, 1992). This measure was included in the study in order to be able to control for state stress in analyses, as self-reported state stress has demonstrated associations with self-reported stress reactivity (Britton et al., 2019; Schlotz et al., 2011). The STAI-6 is a shortened state measure of the original 40-item scale and is sensitive to changes in stress. Example items include: "I feel calm" and "I am tense." All items are scored on a 4-point Likert scale from 1 (not at all) to 4 (very much so). The STAI-6 demonstrated good reliability in the original psychometric study ($\alpha = 0.82$; Marteau & Bekker, 1992). Cronbach's alpha in this current sample was adequate ($\alpha = 0.84$).

Data Analyses

All analyses were conducted in R version 4.0.3 (R Core Team, 2020). Pearson's *r* correlations were conducted between study variables to examine for potential collinearity. Correlations between the outcome variable (i.e., stress reactivity) and potential covariates (i.e., age, household income, history of adverse childhood experiences, and state stress) were also conducted to control for any significant associations in the subsequent regression analyses. State stress was examined as a potential covariate as research demonstrates that perceived stress reactivity is associated with state stress levels (Britton et al., 2019; Schlotz et al., 2011).

Multiple hierarchical linear regression analyses were conducted to evaluate the amount of variance accounted for by each predictor variable and to be able to meaningfully compare self-compassion and mindfulness. For these analyses, total stress reactivity was entered as the outcome variable. Gender and state stress were entered as predictors in Step 1, self-compassion was entered as a predictor in Step 2, and mindfulness was entered in Step 3. Gender was examined as a moderator of the association between self-compassion and stress reactivity by including an interaction term comprised of gender and self-compassion in the model in Step 4. Post hoc regression and moderation analyses were conducted with each PSRS subscale as the dependent variable to further understand the relationship between self-compassion and stress reactivity. Gender and state stress were also controlled for in post hoc analyses (i.e., entered in Step 1) when these variables were significantly associated with the dependent variable (i.e., each PSRS subscale). For moderation analyses that were significant, stress reactivity was plotted against self-compassion with separate lines for men and women to better interpret the moderation effects.

To be more confident in drawing conclusions from our results, we conducted several supplemental analyses. Because the self-compassion variable includes a mindfulness subscale, we sought to ensure that the composite self-compassion variable and the trait mindfulness variable were tapping into distinct constructs. We conducted Pearson's *r* correlations between the variables, and also between the mindfulness subscale of the SCS and the overall mindfulness score from the MAAS to ensure that they were not highly correlated. We also created a self-compassion composite variable from only the self-kindness and common humanity subscales (i.e., we did not include the mindfulness subscale), and repeated the multiple regression analyses to see if the MAAS mindfulness variable would account for more variance without the SCS mindfulness subscale included in the self-compassion composite score. Additionally, because we wanted to compare the amount of variance in stress reactivity accounted for by self-compassion and mindfulness, we repeated all multiple regression analyses by reversing the order in which these variables were entered into the regression models (i.e., mindfulness was entered prior to self-compassion) and ΔR^2 values were compared.

Results

Pearson correlations between mindfulness, self-compassion, and total stress reactivity were statistically significant in the expected directions. Correlations between self-compassion and stress reactivity subscales were all significant except for the correlation between self-compassion and reactivity to social conflict. This was also true for correlations between mindfulness and stress reactivity subscales. State stress was significantly associated with stress reactivity, and thus, was controlled for in analyses. Other than state stress, none of the potential demographic covariates (i.e., age, household income, or history of adverse childhood experiences) was significantly associated with stress reactivity, and thus, was left out of the regression models, since existing research has not examined whether these variables influence self-reported perceived stress reactivity, with the exception of age (Britton et al., 2019; Schlotz et al., 2011). Age was still left out the models as it was not significantly bivariately associated with any of the stress reactivity variables, and our sample did not vary largely in age like the PSRS development sample (Schlotz et al., 2011). Bivariate correlations between study variables are displayed in Table 2.

Multiple hierarchical linear regression analyses were conducted in several steps with total stress reactivity as the outcome variable. Results of each step are presented in Table 3. Gender and state stress were entered in Step 1; gender, state stress, and self-compassion were entered in Step 2; and gender, state stress, self-compassion, and mindfulness were entered in Step 3. The regression model indicated that these predictors accounted for significant variance ($R^2 = 0.50$, $F(4, 132) = 33.14$, $p < 0.001$) in the model. Overall, self-compassion explained more variance ($\Delta R^2 = 0.12$, $b = -0.83$, $p < 0.001$) in the model compared to mindfulness ($\Delta R^2 = 0.04$, $b = -1.78$, $p < 0.001$).

To test whether gender moderated the relation between self-compassion and stress reactivity, a self-compassion × gender interaction term was added to the model in Step 4. The interaction term did not significantly account for any additional variance ($\Delta R^2 = 0.006$, $b = 0.40$, $p = 0.20$) in the model.

Given that self-compassion and mindfulness both accounted for significant variance in total stress reactivity, we conducted planned post hoc analyses examining associations between self-compassion and mindfulness and each of the stress reactivity subscales. Self-compassion accounted for a significant amount of variance in multiple regression models for each subscale except for prolonged

Table 2 Bivariate correlations and descriptive statistics for study variables

	Age	Income[a]	ACEs	SC	Mind	State stress	Total SR	PrR	RWO	RSC	RFa	RSE
Age	-											
Income	0.07	-										
ACEs	0.08	−0.17	-									
SC	−0.09	−0.05	−0.12	-								
Mindfulness	0.15	0.04	−0.12	.25*	-							
State stress	0.22*	0.01	0.16	−.33*	−.35*	-						
Total SR	0.04	−0.12	0.11	−.40*	−.40*	.48*	-					
PrR	0.09	−0.12	0.08	−.24*	−.37*	.44*	.65*	-				
RWO	−0.04	0.005	0.15	−.34*	−.36*	.43*	.78*	.42*	-			
RSC	0.02	−0.11	0.03	−.15	−.13	.22*	.72*	.22*	.47*	-		
RFa	0.09	−0.05	0.06	−.26*	−.27*	.28*	.58*	.40*	.31*	.34*	-	
RSE	0.01	−0.14	0.05	−.39*	−.30*	.32*	.75*	.36*	.46*	.43*	.24*	-
Mean	19.4	3.87	2.18	13.2	3.7	12.0	21.6	3.4	4.6	5.2	4.1	4.4
SD	0.98	1.4	2.3	3.0	0.90	3.9	7.1	1.8	2.3	2.2	1.4	2.3
Range	18–23.4	0–5	0–11	5.7–20.3	1.3–5.9	6–23	5–39	0–7	0–10	0–10	0–8	0–10

ACEs adverse childhood experiences, *SCS* self-compassion, *Mind* mindfulness, *Total* SR total stress reactivity, *PrR* prolonged reactivity, *RWO* reactivity to work overload, *RSC* reactivity to social conflict, *RFa* reactivity to failure, *RSE* reactivity to social evaluation

[a]Income was coded such that 0 = under $20,000; 1 = $20,000–$34,999; 2 = $35,000–$49,999; 3 = $50,000–$74,999; 4 = $75,000–$99,999; 5 = over $100,000

*Indicates $p < 0.05$

Table 3 Multiple regression results with total stress reactivity as the outcome variable

Steps	Predictor	*b*	*b* 95% CI	Fit	Difference
1				$R^2 = .34$*	
	(Intercept)	13.88*	[10.51, 17.25]		
	Gender	−4.81*	[−6.84, −2.79]		
	State stress	0.80*	[0.55, 1.06]		
2				$R^2 = .46$*	$\Delta R^2 = .12$*
	(Intercept)	29.28*	[22.89, 35.66]		
	Gender	−6.09*	[−7.99, −4.19]		
	State stress	0.56*	[0.32, 0.81]		
	Self-compassion	−0.91*	[−1.24, −0.58]		
3				$R^2 = .50$*	$\Delta R^2 = .04$*
	(Intercept)	32.23*	[28.87, 43.59]		
	Gender	−6.06*	[−7.89, −4.23]		
	State stress	0.44*	[0.19, 0.69]		
	Self-compassion	−0.83*	[−1.15, −0.50]		
	Mindfulness	−1.78*	[−2.82, −0.74]		
4				$R^2 = .51$*	$\Delta R^2 = .006$
	(Intercept)	38.83*	[30.30, 46.35]		
	Gender	−11.30*	[−19.59, −3.01]		
	State stress	0.43*	[0.18, 0.67]		
	Self-compassion	−0.98*	[−1.39, −0.58]		
	Mindfulness	−1.73*	[−2.76, −0.69]		
	SC*gender	0.40	[−0.22, 1.03]		

b represents unstandardized regression weights. *SC* self-compassion

*Indicates $p < .01$

reactivity. Mindfulness accounted for a significant amount of variance in multiple regression models for all PSRS subscales except for reactivity to social conflict.

When self-compassion was added to the models examining subscales of the PSRS, change in accounted for variance was greatest for reactivity to social evaluation ($\Delta R^2 = 0.21$, $b = -0.33$, $p < 0.001$), followed by reactivity to failure ($\Delta R^2 = 0.07$, $b = -0.10$, $p = 0.014$), reactivity to work overload ($\Delta R^2 = 0.07$, $b = -0.20$, $p = 0.002$), reactivity to social conflict ($\Delta R^2 = 0.06$, $b = -0.18$, $p = 0.002$; see Supplemental Table 1). When mindfulness was added, change in accounted for variance was the greatest for reactivity to failure ($\Delta R^2 = 0.05$, $b = -0.35$, $p = 0.009$), followed by reactivity to work overload ($\Delta R^2 = 0.04$, $b = -0.53$, $p = 0.008$), prolonged reactivity ($\Delta R^2 = 0.03$, $b = -0.46$, $p = 0.004$), and reactivity to social evaluation ($\Delta R^2 = 0.03$, $b = -0.49$, $p = 0.01$; see Supplemental Table 1). Gender accounted for significant variance for all subscales except for reactivity to failure, so it was removed from the model for reactivity to failure. State stress did not account for significant variance for reactivity to social evaluation, reactivity to social conflict, and reactivity to failure, so it was removed from the models for those subscales.

For post hoc moderation analyses, a self-compassion × gender term was added to the model for each subscale except for reactivity to failure, as gender was not a significant predictor for that scale. The moderation analysis was significant for only the reactivity to social evaluation subscale ($\Delta R^2 = 0.02$, $b = 0.29$, $p = 0.013$). To visually examine the moderation effect, self-compassion and reactivity to social evaluation scores were plotted separately for men and women (see Fig. 1). Results seem to indicate that at low levels of self-compassion, women report higher levels of reactivity to social evaluation, whereas at higher levels of self-compassion, men and women report similar levels of reactivity to social evaluation.

For the supplemental analyses, Pearson's r correlations between self-compassion and mindfulness ($r = 0.25$, $p = 0.003$), and between the mindfulness subscale of the SCS and the mindfulness score from the MAAS ($r = 0.20$, $p = 0.02$) were small to moderate, indicating that these variables were tapping into distinct constructs. Moreover, results from repeating the main and post hoc regression analysis with self-compassion composite variable consisting of only the self-kindness and common humanity subscales of the SCS demonstrated that self-compassion still accounted for more variance than mindfulness in most of the analyses (see Supplemental Table 2). In other words, the removal of the mindfulness subscale from the self-compassion composite variable did not substantially increase the variance accounted for by the MAAS mindfulness variable.

To further ensure confidence in our results, the main and post hoc analyses were also repeated by first entering mindfulness into the models before entering self-compassion. Results from these analyses demonstrated that regardless of order, self-compassion consistently accounted for more variance than mindfulness for overall stress reactivity, reactivity to social evaluation, reactivity to social conflict, and reactivity to work overload (see Supplemental Table 3). Conversely, mindfulness consistently accounted for more variance than self-compassion for prolonged reactivity. Results were mixed for reactivity to failure, such that self-compassion accounted for more variance when entered into the model first, whereas mindfulness accounted for more variance when it was entered first.

Discussion

This study demonstrated that trait self-compassion and trait mindfulness were significantly associated with overall stress reactivity when controlling for gender and state stress. Furthermore, self-compassion accounted for more variance than

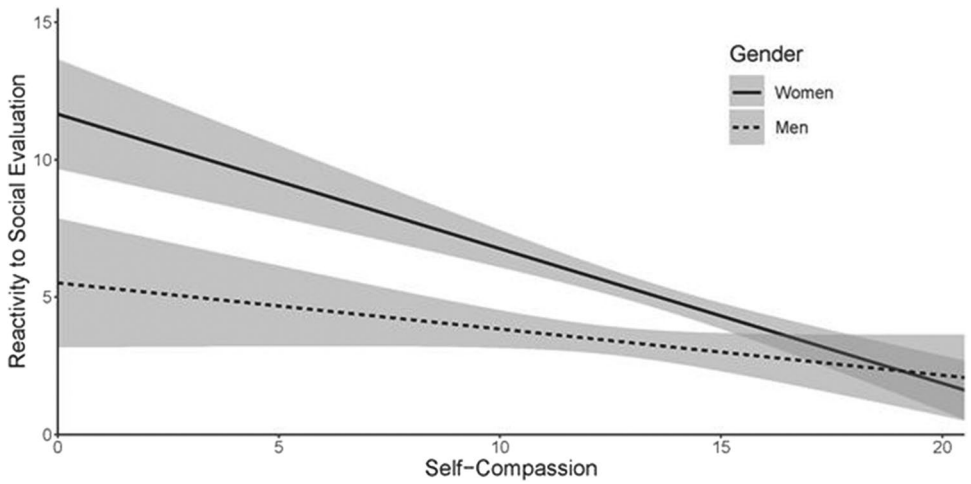

Fig. 1 Moderation effect of gender on the association between self-compassion (SCS; Neff, 2003) and reactivity to social evaluation (PSRS subscale; Schlotz et al., 2011). Shading indicates 95% confidence interval

mindfulness across most regression analyses. Given consistent evidence that trait mindfulness and mindfulness interventions demonstrate stress-buffering effects (Brown et al., 2012; Hernandez et al., 2019; Morton et al., 2020), these results may indicate that self-compassion may have just as much (or more) potential as a coping mechanism for dealing with stressful situations as mindfulness.

Post hoc analyses provided further information about the relationship between self-compassion, mindfulness, and stress reactivity. Self-compassion consistently accounted for more variance in models than did mindfulness for most subscales. Self-compassion had the strongest correlation with and accounted for the most variance in the model when reactivity to social evaluation was the dependent variable compared to all other subscales. This finding suggests that self-compassion may be a more potent coping strategy when facing social-evaluative stress. This could be because during social-evaluative stress, there is the possibility that one may be judged negatively by others (Poppelaars et al., 2019), and if the individual being evaluated by others has high levels of self-compassion, this potential negative judgment may be less concerning.

Indeed, the results from this study corroborate previous study findings demonstrating that higher levels of self-compassion predict lower levels of stress reactivity to the most widely implemented laboratory task for social-evaluative stress, the TSST (Breines et al., 2015; Luo et al., 2018). This corroboration with stress induction study results may provide more confidence in future cross-sectional stress reactivity research, at least as a starting point. A cross-sectional measure is a less time- and resource-intensive way to expand stress reactivity research into populations that are underrepresented in stress reactivity research. For instance, few studies have examined stress reactivity among sexual minority people, but the studies that have are already beginning to find important differences in stress reactivity profiles for sexual minority people when compared to heterosexual people, and how stress reactivity relates to sexual minority-specific processes (e.g., concealment of identity, stigma; Juster et al., 2015, 2019; Mereish & Miranda, 2020). Cross-sectional research like the current study can reach more and larger samples of sexual minorities (and other populations) as a way to understand stress reactivity in underrepresented populations that could inform future hypotheses for stress-induction studies.

Post hoc moderation analyses demonstrated that gender was a significant moderator of the relation between self-compassion and reactivity to social evaluation. To further understand this moderation effect, participants' self-compassion and reactivity to social evaluation scores were plotted separately for men and women (see Fig. 1). The graph demonstrates that self-compassion may have a stronger stress-buffering effect for women than for men. This stronger effect for women may be due to several factors described in previous studies (though not assessed in the current study). Researchers have demonstrated that women may have more negative feelings after a social-evaluative stressor, and are more reactive to social-evaluative stressors if there is perceived sexism (Kelly et al., 2008; Townsend et al., 2011). The reactivity to social evaluation subscale asks participants how they react to being criticized by others, having to speak in public, and how they feel when they make a mistake (Schlotz et al., 2011). Women may more readily bring to mind instances of social evaluation in which their identity as a woman was devalued (i.e., social-identity threat; Steele et al., 2002), thus, reacting more strongly to social-evaluative stress. This may be why a coping strategy in which women can hold warmth and positive regard for themselves (i.e., self-compassion) during instances of social identity threat may be particularly effective in mitigating social-evaluative stress reactivity. Future research should consider exploring the role of perceived sexism during instances of social evaluative threat to explore the relation of gender identity and stress reactivity.

The findings related to PSRS subscale, reactivity to social evaluation, seem to highlight that self-compassion could be a more potent coping skill when it comes to stressful situations that include a social-evaluative component (e.g., presentations, job interviews) than stressful situations that do not have a social-evaluative component (e.g., having too much work to do). This has many practical implications, as social evaluation plays a large role throughout educational and occupational trajectories. Research has demonstrated that during times of heightened social-evaluative academic and job stress, people exhibit increased cortisol production (Stetler & Guinn, 2020), which is implicated in the development of sustained stress-related health issues (McEwen, 2008). Based on these results, future research should examine whether self-compassion may promote resiliency to academic and occupational stress by buffering against stress reactivity in social-evaluative situations. Longitudinal studies are also needed to further investigate the causal directions for self-compassion and social-evaluative stress reactivity.

Limitations and Future Research Directions

This study has several limitations. First, participants were well-educated and upper-middle-class. As such, these results may not generalize to other populations; further research with participants from diverse educational and financial backgrounds is necessary to determine generalizability. This is particularly important when examining stress reactivity, as there is evidence that stress reactivity, when measured via stress-induction studies, may be altered in populations from disadvantaged background (e.g., those with more adverse

childhood experiences, higher poverty; Fearon et al., 2017). Another limitation of the sample was that participants were undergraduate students. Although the mindfulness measure we used has demonstrated good psychometric properties in student samples, researchers have raised concerns about how questionnaire items with mindfulness-related words (e.g., "paying attention") are read, understood, and interpreted based on participants' background knowledge and experience with mindfulness (Grossman & Van Dam, 2011). Moreover, there are questions about whether participant reports of their own levels of mindfulness are even accurate (Grossman & Van Dam, 2011).

Although the cross-sectional design has the benefit of being much less time- and resource-intensive compared to stress-induction studies, there are limitations with cross-sectional designs. One limitation to cross-sectional survey studies is the common method bias, which means that self-report measures (e.g., PSRS, SCS) may demonstrate a spurious correlation by virtue of being presented together in the same survey (Podsakoff et al., 2003, 2012). A cross-sectional measure does not allow us to examine stress over multiple time points, which is how stress-buffering effects are typically measured (Morton et al., 2020). We hypothesize that future research using a stress induction paradigm would demonstrate the same gender differences in the effects of trait self-compassion on self-reported stress reactivity. Furthermore, cross-sectional studies make it impossible to determine causality; namely, whether higher self-compassion and mindfulness lead to lower stress reactivity or lower stress reactivity leads to higher self-compassion and mindfulness. Experimental intervention studies manipulating self-compassion and measuring stress reactivity pre- to post-intervention are needed to clarify the causal direction. Based on the results of this study, we hypothesize that a self-compassion intervention implemented prior to the TSST would attenuate the stress reactivity response, and that this effect may be stronger for women than for men.

There were also some limitations related to the measures used in this study. The self-report measure of stress reactivity does have some notable strengths; in particular, it reduces the time- and resource-intensiveness of typical stress-reactivity studies that implement stress-induction protocols. However, measuring self-reported stress reactivity comes with its own limitations. This method relies on participants to report on their stress reactivity to situations within the past month, rather than assessing reactivity through more objective measures (e.g., heart rate, cortisol). Future research should incorporate both self-report and physiological measures to establish consistency across measures. This would provide more confidence in self-report measures of stress reactivity and provide more confidence that it such a measure may be clinically relevant. Importantly, one study has established that the reactivity to social evaluation subscale of the PSRS is associated with cortisol reactivity to the TSST, but the sample was limited to men only (Schlotz et al., 2011). Thus, there is a need for more studies to establish consistency across cross-sectional self-report measures like the PSRS and physiological measures.

The measure we used to assess trait mindfulness, the MAAS, also has limitations. The items on the MAAS are all worded negatively (e.g., "I break or spill things because of carelessness, not paying attention, or thinking of something else"), and several researchers have questioned whether it is measuring mindfulness or other constructs, such as mindlessness (Sauer et al., 2011) or perceived inattention (Van Dam et al., 2010). Moreover, since the MAAS is a unidimensional scale, researchers have argued that it may only be measuring a specific aspect of mindfulness, such as acting with awareness (Coffey & Hartman, 2008), and that the measure is missing different aspects of mindfulness, such as non-judgment or acceptance (Baer et al., 2006; Sauer et al., 2013). Future studies may opt to use a multidimensional measure of mindfulness (Baer et al., 2006).

An additional measurement limitation is related to the self-compassion measure (i.e., the SCS). Research has suggested that the positive and negative subscales of the SCS may be measuring different constructs. We corrected for this issue by creating a composite of only the positive subscales of the SCS, as recommended by numerous researchers (Muris & Petrocchi, 2017; Pfattheicher et al., 2017). However, the scale was not originally developed for this purpose. Recently, a different self-compassion scale was developed and psychometrically validated based on solid theoretical underpinnings of the construct of self-compassion (Gu et al., 2020), and may be a better option for future studies to implement.

A final limitation is that while this study advances knowledge of gender differences between men and women for self-compassion and stress reactivity, it is important to note that many people identify their gender outside of the gender binary (i.e., nonbinary) or identify as a different gender than their sex assigned at birth (i.e., transgender). Notably, we assessed for transgender and nonbinary identities in this study, and no participants endorsed a nonbinary or transgender identity. Future work should specifically examine how mindfulness, self-compassion, and stress reactivity are related in gender minority populations, particularly since those with transgender and/or nonbinary identities report increased stress relative to cisgender samples (Lefevor et al., 2019).

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Author Contribution ECH designed and executed the study, analyzed the data, and wrote the first draft of the paper. JRS collaborated in the

writing and editing of the final manuscript. JCF collaborated in the writing and editing of the final manuscript.

Data Availability All data are available at Open Science Framework (https://osf.io/28dp3/).

Declarations

Ethics Approval All study procedures were reviewed and approved by Syracuse University's institutional review board.

Consent to Participate Participants provided electronic informed consent to participant in this study prior to beginning the survey.

Competing Interests The authors declare no competing interests.

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