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## Report

## Is compassion for others stress buffering? Consequences of compassion and social support for physiological reactivity to stress

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## ABSTRACT

The present study examined the role of compassion for others and social support in physiological stress reactivity. In this experiment, participants who had previously completed an online assessment of compassion experienced a social stress task in front of either two supportive or neutral evaluators, while their blood pressure, cortisol, high frequency heart rate variability (HF-HRV), and liking for the evaluators were monitored. Participants' compassion for others interacted with social support condition to buffer their physiological reactivity to stress. When provided with social support during the task, higher trait compassion was associated with lower blood pressure reactivity, lower cortisol reactivity, and higher HF-HRV reactivity. Higher compassion was also associated with greater liking for the supportive evaluators. These relationships were not observed for participants in the neutral condition, regardless of their trait compassion. Compassion for others may increase our ability to receive social support, which may lead to more adaptive profiles of stress reactivity.

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"If you want others to be happy, practice compassion. If you want to be happy, practice compassion." – Dalai Lama

Psychologists, philosophers, and spiritual leaders like the Dalai Lama have long argued that receiving compassion from others, or social support, is beneficial to our wellbeing. The more social support available to us the more protected we are from disease and even death (e.g. Broadhead et al., 1983). Those diagnosed with diseases, such as cancer (e.g. Cassileth, Walsh, & Lusk, 1988) or cardiovascular disease (e.g. Brummett et al., 2001), live longer the more social support they receive. A lack of social support has been associated with increased risk for morbidity and mortality (e.g. Hawkey, Masi, Berry, & Cacioppo, 2006; House, Landis, & Umberson, 1988). Ultimately, when others express concern for us it may satisfy our fundamental need to belong and feel connected (Baumeister & Leary, 1995), which results in benefits for physical and psychological wellbeing. Further, practicing a concern for others through acts of altruism (Midlarsky & Kahana, 1994; Weinstein & Ryan, 2010), volunteerism (Oman, Thoresen, & McMahon, 1999),

and a communal relationship orientation (Black, Cook, Murry, & Cutrona, 2005; Clark, Ouellette, Powell, & Milberg, 1987) is also associated with physical and psychological benefits.

While past research, and the quote above, might suggest that social support and compassion exert independent effects on wellbeing, we propose an interaction hypothesis. We predict that social support is most beneficial for those best able to take advantage of it: individuals high in compassion. The present study takes a classic social psychological (e.g. person by situation; Lewin, 1936) approach to examine the protective effects of individual differences in compassion, and situational social support, for physiological reactivity to an acute stressor. We propose that greater compassion will moderate physiological reactivity by increasing the effectiveness of social support provided during a stressful experience.

## Compassion

We define compassion as concern for the wellbeing of others. Compassion motivates support giving and is elicited by perceiving others as vulnerable, distressed or in need (Batson, 1991; Goetz, Keltner, & Simon-Thomas, 2010). Compassion can be viewed as an emotion that facilitates intimate bonds with others (Shiota, Keltner, & John, 2006). Maintaining compassion for others (e.g. communal role) is related to enhanced psychological wellbeing (Sheldon & Cooper, 2008). Individuals taught to develop compassion for others within the short span of a laboratory setting feel a

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greater sense of positive connectedness and improved positive mood compared to controls (Hutcherson, Seppala, & Gross, 2008). In addition to the psychological benefits associated with compassion, a few studies have also reported physical benefits. For example, individuals who show greater compassion for their spouses have a lower risk for mortality (Brown, Nesse, Vinokur, & Smith, 2003). College students who are more concerned about their peers show higher self-esteem, self-efficacy, and lower ambulatory blood pressure (Piferi & Lawler, 2006).

### Why does compassion for others benefit the self?

One pathway through which compassion may be related to wellbeing is by improving the perception (Lemay & Clark, 2008; Piferi & Lawler, 2006) and actualization (Crocker & Canevello, 2008) of available social support. Individuals who show greater compassion for others also perceive others to have greater compassion for them (e.g. Crocker & Canevello, 2008; Lemay & Clark, 2008; Piferi & Lawler, 2006). In a study examining how compassion evolves over time, Crocker and Canevello (2008) found that increases in compassion predicted increases in feelings of closeness, connectedness, trust, and social support. Moreover, this effect did not appear to be solely in the eye of the beholder. Participant's partners also reported reciprocating more support the more participants showed increases in their compassion.

Thus rather than influencing wellbeing directly, or when social support is absent, a concern for others may influence wellbeing by increasing the efficacy of available social support. As reviewed above, compassionate individuals create supportive environments by fostering relationships with those who reciprocate support (Crocker & Canevello, 2008). Moreover, because compassionate individuals approach interpersonal situations with affiliative goals (Crocker, Olivier, & Nuer, 2009; Horowitz et al., 2001), they may be more poised to take advantage of social support when it is offered than those low in compassion. Evidence from the relationships literature suggests that a communal relationship orientation is positively related to wellbeing primarily among those who perceive their orientation to be reciprocated (Buunk, Doosje, Jans, & Hops-taken, 1993). Consequently, we propose that individuals with a greater concern for others (e.g. compassion) will be better prepared to benefit from social support than individuals low in compassion.

### Social support and physiological stress

In the present study we examined how compassion for others moderates physiological stress reactions while engaging in a laboratory stressor known to activate the stress response (Dickerson & Kemeny, 2004). One way social support has been proposed to protect health is by reducing physiological reactivity during acute stress (Cohen & Wills, 1985; Lepore, 1998). Some of the physical indices of better physiological regulation that have been linked to greater social support include, reduced cardiovascular reactivity (e.g. Lepore, Allen, & Evan, 1993; Thorsteinsson & James, 1999), reduced hypothalamic–pituitary–adrenal (HPA) axis reactivity (Heinrichs, Baumgartner, Kirschbaum, & Ehlert, 2003), increased parasympathetic nervous system reactivity (e.g. Willemen, Goossens, Koot, & Schuengel, 2008) and better immune function (see Uchino, Cacioppo, and Kiecolt-Glaser (1996) for a review).

Not all research manipulating social support, however, finds palliative effects for reactivity during acute stressors. For example, Taylor and colleagues (2010) did not find reduced reactivity (i.e. cortisol, blood pressure) among participants facing supportive vs rejecting evaluators. In related work, women giving a speech to a supportive confederate did not evidence lower blood pressure than

women giving a similar speech to a neutral confederate (Westmaas & Jamner, 2006). Finally, consistent with our own moderation hypothesis, Lepore (1995) demonstrated that support only reduced blood pressure for participants low in cynicism. Given the conflicting findings regarding the effectiveness of social support in the context of acute stress, it is important to examine both potential moderators of social support effects, as well as, multiple markers of the physiological stress response (e.g., sympathetic, parasympathetic, neuroendocrine).

As one measure of sympathetic activation, blood pressure reactivity has been examined extensively in studies of social support (e.g. Uchino et al., 1996). Importantly, high blood pressure is a well known risk factor for the development of chronic hypertension and cardiovascular disease. Therefore, examining the role of compassion and social support in reducing blood pressure reactivity may increase our understanding of the stress buffering relationship between social support and long term health.

Although less extensively studied in the social support literature, high frequency heart rate variability (HF-HRV) was also assessed in the present study as an indicator of parasympathetic function. HF-HRV measures variability in heart rate due to parasympathetic influence (via the vagus nerve; Porges, 2007). Higher heart rate variability (HF-HRV) indicates more parasympathetic influence on the heart (e.g. Martens, Greenberg, & Allen, 2008; Porges, 2007). Research has shown that low heart rate variability is associated with hypertension (Singh et al., 1998), diabetes (Liao et al., 1995), and depression (Rottenberg, Clift, Bolden, & Salomon, 2007). In contrast higher heart rate variability is generally associated with positive physiological and psychological outcomes. For example, Egizio et al. (2008) found that women who reported more positive social functioning also exhibited slight increases in heart rate variability during an acute stressor. More directly related, children experienced significant increases in heart rate variability after being reunited with a parent following a stressful lab experience (Willemen et al., 2008). In short, higher heart rate variability (HF-HRV) has been commonly associated with healthier functioning, both physically and socially.

Cortisol is another biomarker that has been shown to be reactive to acute social-evaluative stress (see Dickerson & Kemeny (2004) for a review). During acute stress the HPA axis is activated leading to the adrenal release of cortisol (Dunn & Berridge, 1990). Prolonged exposure to high concentrations of circulating cortisol in the body can have severe consequences for physical health (e.g. McEwen, 1998). Social support has been shown to significantly reduce cortisol reactivity in response to a laboratory stressor (Heinrichs et al., 2003; Kirschbaum, Klauer, Filipp, & Hellhammer, 1995; but see Taylor et al., 2010). In the current research, we examine whether compassion for others moderates the effectiveness of social support by impacting parameters sensitive to support – cortisol, blood pressure, and heart rate variability (HF-HRV).

### Study overview and hypotheses

In the current research, women experienced a modified Trier social stress test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993). We manipulated social support within the context of the TSST by varying the behavior of the two evaluators. In the supportive condition, the evaluators provided emotional support (e.g. Lepore, 1995; Taylor et al., 2010; Westmaas & Jamner, 2006). We chose a more conservative “neutral” condition (e.g. Westmaas & Jamner, 2006) as our comparison condition rather than an “alone” condition (e.g. Lepore, 1995; Taylor et al., 2010) or a “rejection” condition (e.g. Taylor et al., 2010). Thus, the physical presence of evaluators and social evaluative concerns remain constant across both conditions and only social support varies.

During this experience blood pressure, salivary cortisol, and heart rate variability (HF-HRV) were monitored. We hypothesized that compassion would moderate the palliative effect of social support during an acute psychosocial stressor. Women who report more compassion will benefit more from the supportive interviewers than women who are low in compassion. Specifically we hypothesized that when the interviewers are supportive, compassion would be negatively related to systolic and diastolic arterial blood pressure, negatively related to cortisol, and positively related to HF-HRV. We did not expect compassion to predict physiological wellbeing in the absence of social support.

## Method

### Participants

Participants ( $N = 59$ ) were a community sample of San Francisco, CA residents. All participants were healthy European–American women (Age:  $M = 27.89$ ,  $SD = 6.74$ ) who had no prior history of smoking, or medication use known to influence hormonal and cardiovascular measures (e.g. birth control, heart medication). Participants were provided \$100 as compensation for their participation.

### Procedure

Participants were instructed to complete an online battery of questionnaires prior to the experiment. These questionnaires included demographic measures as well as our measure of compassion.

### Compassion

We assessed compassion using the compassion subscale of the dispositional positive emotion scales (Shiota et al., 2006). The six items were assessed on a 1 (not at all) to 7 (very much) scale (e.g. I am a very compassionate person; It is important to take care of people;  $\alpha = .88$ ). Higher numbers indicated greater compassion for others.<sup>1</sup>

### Experimental session

After completing the online measures, participants were scheduled for a laboratory session at least one week later. During this session, participants were connected to physiological equipment and asked to perform the social stress test.

### Cardiovascular monitoring

Upon arrival to the laboratory, electrocardiogram (ECG), impedance cardiogram (ICG), and blood pressure sensors were applied to the participant. All physiological variables were recorded using BioPac hardware with AcqKnowledge acquisition software at a sampling rate of 1000 Hz.

### Social stress task

After the 5 min baseline period, participants were instructed to give a speech to two evaluators (one male one female). Participants were told they would have 5 min to mentally prepare during which time they were introduced to the evaluators. After the prep-period was over, participants performed the speech task, an interview task, and a mental math task. Each task was 5 min in length for a total of 15 min of task time.

<sup>1</sup> We conducted separate covariance analyses for each ancillary measure controlling for both the main effect and interaction with support condition on step one of the regression models. All of our effects remained significant: compassion significantly predicted each of the dependent variables in the social support condition.

### Social support manipulation

In order to manipulate social support, participants were randomly assigned to perform the social stress task to either two supportive or two neutral evaluators. In the support condition, evaluators were instructed to interrupt after 30 s into the participant's speech and provide verbal praise for the participant's performance (e.g. "You are doing a great job") while also providing positive non-verbal feedback (e.g. smile, nod) throughout the task. In order to ensure our neutral condition was as methodologically similar to our support condition as possible, neutral evaluators were also instructed to interrupt after 30 s; however, the evaluators simply re-stated the task instructions while maintaining flat non-verbal feedback. Thus, we kept the social-evaluative component of the stressor constant across conditions and manipulated the supportiveness of the situation.

### Measures

#### Arterial blood pressure

Blood pressure data were collected continually with a blood pressure cuff, which took samples every 15 s during the stress task. Using MindWare's blood pressure analysis software, we calculated systolic and diastolic arterial blood pressure values at each minute of the experiment. Based on established procedures (Kamarck, Jennings, Debski, Glickman-Weiss, & Johnson, 1992), we used the last minute of the five minute baseline as our baseline measure and the average of five minutes of speech as our stress measure.

#### Cortisol

We examined salivary cortisol 60 min after arrival (baseline) and 20 min after the onset of the stress task (peak). For each measurement, participants were given 5 min to provide approximately 2 ml of saliva (unstimulated passive drool via straw into polystyrene vial). Samples were stored at  $-80^{\circ}\text{C}$  until analyzed in batch at Dr. Clemens Kirschbaum's laboratory at U. Dresden, Germany (see Rohleder, Wolf, & Kirschbaum (2003) for procedural description). Samples were analyzed for salivary cortisol (nmol/L) using a commercial immunoassay with chemiluminescent detection (IBL, Hamburg/Germany) using an EIA ELISA kit (Diagnostic System Laboratories, Webster, TX, USA). The intra-assay coefficient of variation was less than 8%.

#### High Frequency Heart Rate Variability (HF-HRV)

HF-HRV was assessed following procedures outlined by the Task Force of The European Society of Cardiology and The North American Society of Pacing and Electrophysiology (1996). To calculate HF-HRV, frequency domain analyses were performed on the digital recording of inter-beat-intervals using Mindware's HRV module. Artifacts were edited manually, and the data were submitted in 5 min blocks to a Fast Fourier Transform to obtain the spectral frequency distribution. HF-HRV was derived from the high frequency band (.12–.40 Hz). Because we used impedance cardiography, we were also able to assess the effects of respiration. We used the average of five minutes of baseline as our baseline measure and the average of five minutes of the speech segment as our stress measure.

#### Manipulation check

As a manipulation check, participants were asked to indicate how helpful they thought the evaluators were on a 0–6 scale. Higher numbers indicate that the evaluators were perceived as more helpful.

#### Ancillary measures

In order to more fully demonstrate that compassion is a unique predictor of our dependent variables we assessed a number of

potentially related constructs. We included variables known to predict reactivity in this context (e.g. cynicism), as well as, other relational and emotional variables to bolster the distinctiveness of compassion.

#### Defensiveness

In previous research (Westmaas & Jamner, 2006), defensiveness has been operationalized as a concern with approval from others (e.g. Crown & Marlowe, 1960). We assessed this variable with three items (“I am worried about what other people think of me”;  $\alpha = .88$ ).

#### Cynicism

To measure cynicism, we used two items (e.g. “I find it easy to trust others” (reverse scored);  $r = .78, p < .001$ ) designed to assess a general distrust of others (e.g. Lepore, 1995).

#### Pessimism

We assessed pessimism with five items (e.g. “I often feel hopeful”, reverse scored;  $\alpha = .87$ ) reflecting a lack of hope about the future (e.g. Carver, 2000).

#### Negative affect

Generalized negative affect was assessed with eight items (e.g. distressed, upset, sad;  $\alpha = .87$ ).

#### Global self-esteem

Self-esteem was assessed with Rosenberg’s (1965) measure of trait self-esteem (e.g. “I feel that I am a person of worth, at least on an equal basis with others”;  $\alpha = .89$ ).

#### Self-efficacy

We assessed the belief in the personal ability to control outcomes with Pearlin and Schooler’s (1978) mastery scale (e.g. “I can do just about anything I really set my mind to do”; seven items;  $\alpha = .86$ ).

#### Loneliness

Loneliness was assessed with four items (e.g. “I often feel lonely because I have few close friends with whom to share my concerns”;  $\alpha = .71$ ).

#### Perceived support

We assessed perceived support with two items measuring the extent to which participants felt they could turn to others for help (e.g. “I can depend on people when I need help”;  $r = .60, p < .001$ ).

#### Social power

We also assessed the extent to which individuals felt in control over their relationships with others (e.g. “In my relationships with others, I can get people to listen to what I say”; eight items;  $\alpha = .87$  Anderson and Galinsky (2006)).

Finally, participants were thanked and debriefed.

## Results

### Preliminary analyses

There were no differences between support conditions for baseline systolic or diastolic blood pressure ( $t$ 's  $< 1.45, n.s.$ ), baseline cortisol ( $t(59) = .94, p = .35$ ), baseline HF-HRV ( $t(56) = .83, p = .41$ ), or for compassion ( $t(59) = .94, p = .35$ ). Moreover, compassion for others was not significantly correlated with any of the baseline physiological measures. These analyses indicate successful random assignment. The overall sample mean for compassion was 5.17

**Table 1**

Partial correlations among dependent variables at peak stress within condition (controlling for age and baseline physiological values).

Dependent variables	1	2	3	4
1. Systolic blood pressure		.90***	.24	-.21
2. Diastolic blood pressure	.96***		.25	-.19
3. Cortisol	.39*	.29		-.36*
4. HF-HRV	-.58***	-.50**	-.34	

Note: correlations reported above the diagonal are for the neutral condition, and correlations below the diagonal are for the social support condition; HF-HRV = high frequency heart rate variability.

\*  $p < .10$ .

\*\*  $p < .05$ .

\*\*\*  $p < .01$ .

( $SD = .94$ ). Partial correlations between dependent variables at peak stress (controlling for baseline and age) are reported in Table 1.

As an indication that our social support manipulation was successful, participants in the support condition perceived the evaluators to be significantly more helpful ( $M = 4.59, SD = 1.4$ ) than the neutral condition ( $M = 1.9, SD = 1.52; t(57) = 7.06, p < .01$ ). We also tested whether compassion moderated the effect of perceived helpfulness by condition (see analysis strategy below). There was no main effect of compassion ( $\beta = .14, p = .16$ ) on perceived helpfulness and the interaction was also not significant (Step 2:  $\Delta R^2 = .00; F(1, 53) = .21, p > .60$ ).

### Ancillary measures

Consistent with the idea that compassion is distinct, our measure was not significantly related to defensiveness ( $r = .11, p = .38$ ), cynicism ( $r = -.14, p = .28$ ), pessimism ( $r = -.01, p = .95$ ), negative affect ( $r = .02, p = .89$ ), global self-esteem ( $r = .24, p = .07$ ), efficacy ( $r = .16, p = .44$ ), loneliness ( $r = .14, p = .27$ ), perceived social support ( $r = .04, p = .80$ ), or social power ( $r = .10, p = .44$ )<sup>1</sup>.

### Analysis strategy

Because our compassion variable was negatively skewed in both conditions<sup>2</sup>, we reflected the variable and took the inverse (Tabachnick & Fidell, 2007). Using this transformation higher numbers still mean more compassion for others. To test the hypotheses of the present study, hierarchical regression analyses were conducted on each of the dependent variables. For the physiological variables, baseline values were entered on Step 1 (Wilder, 1962)<sup>3</sup>, the main effect of compassion (transformed and centered at the mean) and support condition (0 = neutral, 1 = support) were entered on Step 2, and the interaction on Step 3. We used age as a covariate in all physiological analyses reported below. Details on the full models are presented in Table 2, the highest order significant effect for each analysis is interpreted below. Note that the degrees of freedom for our physiological variables fluctuate due to missing data and equipment artifact.

### Did compassion predict physiology during stress<sup>4</sup>?

#### Systolic blood pressure

There was no main effect of either support condition or compassion on systolic pressure during stress. Consistent with predictions,

<sup>2</sup> Analyses conducted using the untransformed compassion variable do not change the nature nor the significance of the effects.

<sup>3</sup> Analyses using reactivity scores do not change the nature of the effects reported in the manuscript.

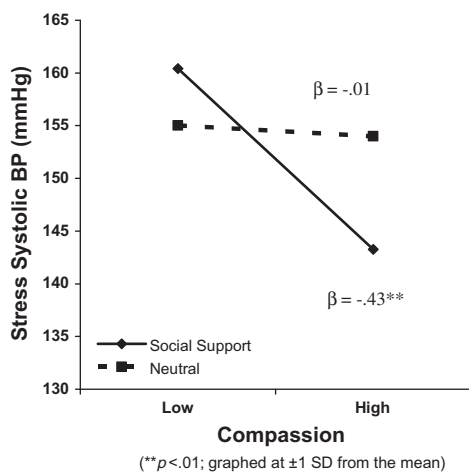
<sup>4</sup> The calculations for baseline values of the physiological variables differ due to different recommendations regarding reactivity analysis.

**Table 2**

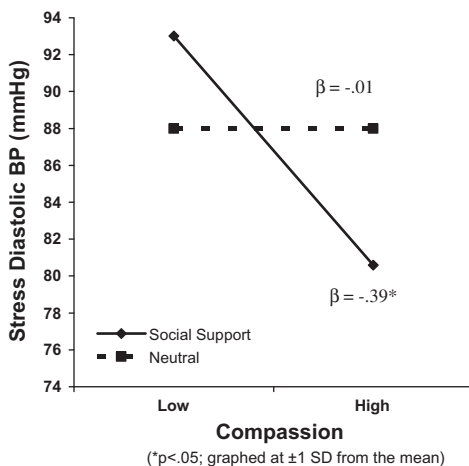
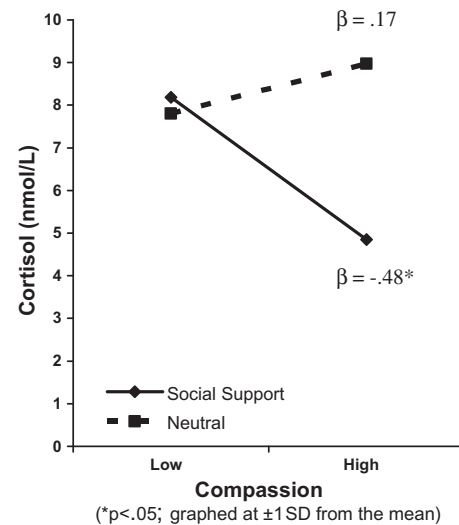
Model summary of hierarchical regression analyses examining systolic BP, diastolic BP, cortisol, and HF-HRV during stress.

Analysis	Systolic BP		Diastolic BP		Cortisol		HF-HRV	
	$\beta$	$\Delta R^2$	$\beta$	$\Delta R^2$	$\beta$	$\Delta R^2$	$\beta$	$\Delta R^2$
<i>Step 1</i>								
Baseline	.84***	.67***	.85***	.67***	.53***	.28***	.23*	.06
Age	-.10		-.13		.00		-.03	
<i>Step 2</i>								
Condition	-.05	.02	-.04	.02	-.24**	.05	.28**	.19***
Compassion	-.15*		-.14		-.03		.36***	
<i>Step 3</i>								
Interaction	-.25**	.03**	-.22*	.03*	-.39***	.08***	.27*	.05*

Note: BP = blood pressure; HF-HRV = high frequency heart rate variability; interaction = compassion x condition.

\*  $p < .10$ .\*\*  $p < .05$ .\*\*\*  $p < .01$ .**Fig. 1.** Decrease in systolic blood pressure as a function of compassion by social support condition.

the interaction between support condition and compassion was significant (Step 3:  $\Delta R^2 = .03$ ;  $F(1, 43) = 5.27$ ,  $p = .02$ ; see Fig. 1). In the social support condition, the more compassion participants reported the lower their systolic pressure during stress ( $\beta = -.43$ ,

**Fig. 2.** Decrease in diastolic blood pressure as a function of compassion by social support condition.**Fig. 3.** Decrease in cortisol as a function of compassion by social support condition.

$p < .01$ ). Alternatively, in the neutral condition there was no relationship between compassion and systolic pressure ( $\beta = -.01$ ,  $p > .90$ ).

#### Diastolic blood pressure

No main effects were observed. As predicted, there was an interaction between support condition and compassion (Step 3:  $\Delta R^2 = .03$ ;  $F(1, 43) = 3.85$ ,  $p = .05$ ; see Fig. 2). In the social support condition, the more compassion participants reported the lower their diastolic pressure during stress ( $\beta = -.39$ ,  $p = .01$ ). In contrast, no relationship between compassion and diastolic pressure was observed in the neutral condition ( $\beta = -.01$ ,  $p > .90$ ).

#### Cortisol reactivity

Although the main effect of support condition was significant ( $\beta = -.24$ ,  $p = .04$ ; compassion:  $p > .70$ ), this effect was qualified by the predicted interaction (Step 3:  $\Delta R^2 = .08$ ;  $F(1, 49) = 6.65$ ,  $p = .01$ ; see Fig. 3). As expected, greater compassion was associated with lower cortisol during stress in the support condition ( $\beta = -.48$ ,  $p = .02$ ). Compassion was unassociated with cortisol in the neutral condition ( $\beta = .17$ ,  $p = .22$ ).

#### HF-HRV

We observed no effect of compassion or condition on respiration at baseline or peak stress, nor was respiration correlated with

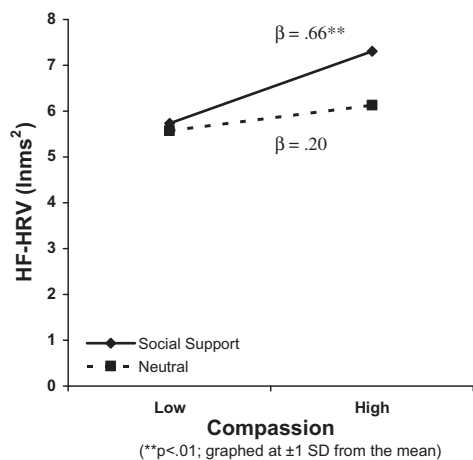


Fig. 4. Increase in HF-HRV as a function of compassion by social support condition.

HF-HRV<sup>5</sup>. Thus, we did not include it in the model (i.e. Denver, Reed, & Porges, 2007). Only the main effects of support condition ( $\beta = .28$ ,  $p = .03$ ) and compassion ( $\beta = .36$ ,  $p < .01$ ) were significant. Although the predicted interaction was marginal (Step 3:  $\Delta R^2 = .05$ ;  $F(1, 47) = 3.05$ ,  $p = .08$ ), we examined the simple slopes within each condition to test our a priori hypothesis and to remain consistent with our previous analyses (Rosenthal, Rosnow, & Rubin, 2000; see Fig. 4).

Consistent with predictions, compassion was most strongly associated with higher HF-HRV in the support condition ( $\beta = .66$ ,  $p < .01$ ). The relationship between compassion and HF-HRV tended to be positive in the neutral condition but it was not significant ( $\beta = .20$ ,  $p = .20$ ). We further probed these relationships by testing whether the lines differed significantly from each other at high levels of compassion (1 SD above the mean of compassion) and did not at low levels of compassion (1 SD below the mean of compassion). Consistent with expectations there were no differences between support conditions at low levels of compassion ( $\beta = .06$ ,  $p = .71$ ) and there were at high ( $\beta = .52$ ,  $p < .01$ ).

## Discussion

In our study, individual differences in compassion for others interacted with receiving support during a stressful experience to predict reactivity to an acute stressor. This study sheds light on one pathway through which compassion may influence physiological wellbeing (e.g. improving the effectiveness of social support received). Consistent with predictions, when participants were given social support, the higher their compassion the lower their systolic and diastolic blood pressure, the lower their cortisol, and the higher their HF-HRV during the speech task. This relationship lends support to the argument that those who are more compassionate may also be more benefited by support, particularly during acute stress situations. In contrast, these relationships were not observed for participants who did not receive social support during the stressor, regardless of the level of compassion they reported.

Our findings have important implications for the stress buffering model of social support (Cohen & Wills, 1985). Although many

previous studies have noted the benefits of receiving social support (e.g. Uchino et al., 1996), our study suggests that stress buffering effects may not be universal. This work adds to research demonstrating that individual differences influence the effective receipt of social support (e.g. Lepore, 1995; Westmaas & Jamner, 2006). Lepore (1995) found that only participants low in cynicism benefited from social support. Westmaas and Jamner (2006) found that only those low in defensiveness responded to social support with lowered blood pressure. Our finding that compassion moderates the effectiveness of social support adds to the literature demonstrating that social support may not be universally beneficial.

## Limitations and future directions

Although we attempted to measure and rule out a wide variety of potential third variables, it is still possible that the effects of compassion are driven by an as yet unmeasured variable. In the current work we demonstrated that compassion was empirically distinct from variables used in previous research moderating reactivity to social support (i.e. cynicism, defensiveness) as well as a number of relational (i.e. insecure attachment, loneliness) and emotional (i.e. self-esteem, negative affect) variables. This is consistent with other work demonstrating that compassion is distinct from similar variables (e.g. efficacy, self-esteem, power, love; Goetz et al., 2010; Shiota et al., 2006; van Kleef et al., 2008). In addition, Taylor and colleagues (2010) also found that individual differences in efficacy, self-esteem and loneliness did not predict physiological stress reactivity for participants provided with social support during an acute stressor. An important avenue of future research will be to examine whether manipulating compassion also leads to increasing the effectiveness of social support received.

These results may be limited to women, as we did not include men in this sample. Through the evolution of differential parenting patterns females may respond to stressors differently than men, particularly when those stressors are psychosocial and present opportunities for affiliation (Taylor et al., 2000). The female stress system is associated with increases in oxytocin, female reproductive hormones, and opioid peptides that act to attenuate HPA and sympathetic stress responses. The increase in oxytocin and decrease in cortisol can enhance affiliative behaviors (Carter, 1998) and may be the physical process driving the effects observed in the present study. In the current study, however, we did not observe a main effect of social support – women provided support did not benefit relative to women not provided support. Thus, although these are important findings which may preclude the generalizability of our findings to men, they do not limit our finding that compassion moderates the impact of social support for women.

Moreover, although previous research has related stress reactivity to long term health outcomes (e.g. Matthews, 2005), we recognize that acute stress does not always lead to poorer health. While we do argue that one pathway through which compassion may be protective of health is through a social support-acute stress reduction pathway, we do not limit our findings to the possibility that other mechanisms may provide compassionate individuals with benefits to long term health (e.g. Brown et al., 2003) that go beyond protection from acute stress.

The current study examined how individual differences in compassion predict better stress outcomes when social support is provided. One potential mediator of the observed findings could be expectancies of reciprocity. Research has shown that those who are highly concerned for others project those feelings onto others during interpersonal interactions, which increases the expectation that interaction partners are concerned for them (Lemay & Clark, 2008). Research has also shown that violating expectations during

<sup>5</sup> We analyzed respiration rate to determine if there was an effect of stress or social support in a mixed model ANOVA where time (baseline, stress) was the within subjects variable and condition (support, neutral) was the between subjects variable. There was no effect of time, condition, and no interaction for respiration rate. Respiration rate was not correlated with baseline or peak HF-HRV. In addition, we analyzed the effect of respiration on HF-HRV fluctuations using the residualized regression approach suggested by Grossman and Taylor (2007). These analyses did not change the results, thus respiration was removed from the analyses.

social interactions is significantly more stressful than satisfying them (e.g. Mendes, Blascovich, Hunter, Lickel, & Jost, 2007).

While we did not assess expectancies directly, if expectancies are a mediator of the present findings, then we should see evidence of expectancy violation for compassionate participants who did not receive social support (e.g. a violation of expectations to be supported). Analyses of the simple slopes, however, for the neutral condition suggest otherwise; compassion did not predict greater stress reactivity in the absence of social support. More research is needed to understand the possible mechanisms that lead compassion for others to buffer individuals from acute stress.

Based on our findings, compassion may be associated with health in part through its interaction with receiving support by reducing acute stress reactivity. Those participants who reported greater compassion were more adept at receiving support. It is important to note that not all types of social support are likely to have the same relationship with stress (Uchino et al., 1996). Our manipulation of social support was closest to the provision of emotional support (e.g. Lepore, 1995). Other forms of social support, like providing informational support, may not effectively match the demands of acute psychosocial stressors for compassionate individuals and, thus, may not be associated with benefits to recipients (Uchino et al., 1996).<sup>6</sup>

### Implications and conclusions

In the current study, we demonstrated that compassion for others can benefit the self. Higher compassion was associated with lower stress reactivity among women offered social support during a stressor. Our findings were consistent across diverse markers of physiological stress reactivity (i.e. cortisol, blood pressure, HF-HRV) and were not diminished by the inclusion of plausible covariates (e.g. self-esteem, cynicism, insecure attachment). As suggested, our data have important implications for the study of compassion and social support, as well as the development of interventions aimed at improving psychological and physical health through a stress reduction pathway (Helgeson & Cohen, 1996). Important areas of future research will be to examine whether advocating for more positive social bonding and greater compassion for others can improve an individual's ability to receive support from his or her social network which, in turn, may lead to important benefits for stress reactivity. Although this work focuses on the benefits of compassion for social support, there are instances where compassion may increase stress. For example, giving support to others may be negatively associated with health over time if that support is not, or cannot be, reciprocated (Epel et al., 2004). Nevertheless, our data lend credence to the Dalai Lama's belief that compassion for others may ultimately serve to benefit the self, particularly when compassion is reciprocated by others in stressful situations.

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<sup>6</sup> Although it may be argued that our neutral condition could be perceived as informational support, traditional studies manipulating this form of support go beyond restating directions by also giving participants strategies to succeed (Uchino, 2004). Moreover, participants in the neutral condition did not find the evaluators helpful.

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