



Perceived transgressor agreeableness decreases cortisol response and increases forgiveness following recent interpersonal transgressions[☆]

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ABSTRACT

Stress associated with interpersonal conflict can adversely impact mental and physical health—especially when it causes activation of the hypothalamic–pituitary–adrenal axis. Among victims of interpersonal transgressions, certain personality characteristics (viz., neuroticism and agreeableness) have been associated in some studies with successful conflict resolution and decreased physiological activity. How victims' perceptions of their transgressors' personalities affect conflict resolution and physiological reactivity, however, has not been examined. Here, we examined the relationships of (a) victims' agreeableness and neuroticism, and (b) victims' perceptions of their transgressors' agreeableness and neuroticism with plasma cortisol responses in women and (in a larger sample of men and women) forgiveness over time. Victims who perceived their transgressors as highly agreeable had (a) lower cortisol responses following a simulated speech to the transgressor, and (b) higher self-reported forgiveness, even after controlling for initial levels of forgiveness. Participants' own agreeableness and neuroticism had negligible associations with cortisol response and forgiveness over time.

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1. Introduction

Interpersonal conflict can cause psychological distress (Bolger et al., 1989; Suls et al., 1998b), and unsuccessful conflict resolution has negative physical health consequences (Witvliet et al., 2001). Certain personality traits apparently can mitigate, or exacerbate, this post-conflict distress (Gunthert et al., 1999; Jensen-Campbell et al., 2003). Most notably, the “Big Five” (John, 1990) or “Five-Factor” (McCrae and Costa, 1987) personality dimension of agreeableness, which measures a generalized positive (vs. negative) orientation toward others (Costa and McCrae, 1985), has been identified as a personality trait that moderates some of the negative interpersonal, psychological, and physiological consequences of interpersonal conflict (Jensen-Campbell and Graziano, 2001; Jensen-Campbell et al., 1996; McCullough and Hoyt, 2002; Meier et al., 2006; Ode et al., 2007). The apparently beneficial effects of agreeableness during conflict negotiation (Jensen-Campbell and Graziano, 2001), and the effects of agreeableness on the regulation of anger and aggression (Meier et al., 2006; Ode et al., 2007), suggest

that in the context of real-life interpersonal conflict, agreeableness may contribute to a reduced HPA-axis response.

However, research involving cortisol reactivity to psychosocial stressors has found mixed evidence for an association between agreeableness and cortisol response, including some evidence for a positive association (Tops et al., 2006; Vickers et al., 1995), some evidence for a negative association (Decker, 2000; Tops et al., 2006), and some evidence for no association at all (Miller et al., 1999; Oswald et al., 2006). Although the link between agreeableness and cortisol secretion appears inconclusive, it is important to note that many studies have involved basal measurements of cortisol (e.g., Decker, 2000) or cortisol reactivity in response to laboratory-based psychosocial stressors that do not involve interpersonal conflict or aggression (e.g., Tops et al., 2006).

Neuroticism—a personality-based tendency to experience negative affect and emotions (Costa and McCrae, 1985; Suls et al., 1998b)—is another personality trait that appears to influence responses to conflict. Following conflict, neurotic people's increased reactivity to stressful events (Suls et al., 1998a) becomes even more problematic: they are more likely to form negative appraisals and to use forms of coping that aggravate conflict, such as reacting with hostility (Gunthert et al., 1999) and less forgiveness (Hoyt et al., 2005; McCullough and Hoyt, 2002). Because personality traits contribute to the ways in which people interpret stressful events (Graziano et al., 1996), and people's psychological interpretations of stressors greatly impact their physiological responses to those stressors (Dickerson and Kemeny, 2004), high levels of

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neuroticism may hinder positive psychophysiological responses to interpersonal conflict specifically.

As is the case for research on the links of agreeableness with cortisol, the results of efforts to elucidate the relationship between cortisol secretion and neuroticism have also yielded mixed results, including some evidence for negative association between neuroticism and cortisol (Miller et al., 1999; Phillips et al., 2005), some evidence for a positive association (Fox et al., 2010; Nater et al., 2010; Portella et al., 2005), and some evidence for no relationship at all (Roy et al., 2001), or gender-specific effects (e.g., Oswald et al., 2006).

1.1. Do victims' perceptions of their transgressors' personalities matter?

In comparison to the amount of previous effort devoted to examining how the personality traits of people who have been the targets of conflict are associated with their interpersonal, psychological, and physiological responses, very little research has examined how the perceived personality traits of their antagonists—that is, the people who are perceived as the transgressors—influence victims' responses. This lacuna seems like an important oversight because a variety of factors related to interpersonal perception influence the resolution of interpersonal conflict (e.g., Exline et al., 2008; Koutsos et al., 2008; Struthers et al., 2008), so victims' perceptions of their transgressors' personalities and the effects of those perceptions on physiological and interpersonal responses to interpersonal transgressions deserve more consideration in their own right.

McCullough (2008) proposed that forgiveness following a transgression is strongly related to the extent to which victims view their transgressors as valuable and non-threatening relationship partners. Agreeableness is a reasonable summary of these characteristics at the level of personality traits (Costa and McCrae, 1995; John, 1990; Luchies et al., 2010). How might a transgressor influence a victim's perception of his or her agreeableness? Following a transgression, apologies, affiliative physical contact, offers of compensation, and self-abasing gestures have been associated with the promotion of reconciliation and forgiveness (for review see McCullough, 2008). Behaviors such as these might make transgressors seem desirable (i.e., valuable and non-threatening) as continuing relationship partners—perceptions that are associated with accelerated forgiveness over time (McCullough et al., 2010). Moreover, in two studies, Tabak et al. (in press) found that perceived transgressor agreeableness mediated the relationship of conciliatory gestures exhibited by the transgressor with forgiveness. These authors speculated that conciliatory gestures facilitate forgiveness via perceived agreeableness because these conciliatory gestures provide information about a transgressor's desirability as a future relationship partner.

Perceived transgressor agreeableness might influence not only subjective psychological processes like forgiveness, but HPA axis activation as well. Psychosocial stress can increase the secretion of cortisol—particularly when those stressors involve appraisals of social threat (Dickerson and Kemeny, 2004). Because agreeable people are typically perceived as trustworthy, generous, and kind (Jensen-Campbell et al., 2003), perhaps they are also less likely to elicit the HPA axis responses that are associated with social threat (Dickerson and Kemeny, 2004) simply because they are perceived as generally less threatening. Indeed, McCullough et al. (2007) found a positive within-persons association of rumination about psychologically painful interpersonal transgressions with salivary cortisol. Among women in particular, the relationship between rumination and cortisol was mediated by fear of the transgressor (i.e., increased social threat; Dickerson and Kemeny, 2004). Based on these findings, along with research demonstrating that women may be more physiologically reactive (as evinced by greater corti-

sol responses) to social rejection than are men (Stroud et al., 2002), it seems likely that among women in particular, perceived transgressor agreeableness not only makes transgressors seem more forgivable, but also, leads to a reduced cortisol response among victims who are asked to think about their transgressors in a laboratory setting.

1.2. The present study

In the present study, we examined the role of victims' perceptions of their transgressors' agreeableness as a predictor of victims' HPA-axis responses to interpersonal transgressions and self-reported forgiveness (which we were able to measure on two occasions, thereby enabling a more rigorous evaluation of possible causal relationships; Finkel, 1995). We predicted that individual differences in victims' perceptions of their transgressors' agreeableness would be negatively associated with the magnitude of cortisol response following a relational stress task conducted approximately one month after the interpersonal transgression. We also hypothesized that perceived transgressor agreeableness would be positively associated with greater longitudinal increases in victims' self-reported forgiveness for their transgressors over time.

2. Method

2.1. Participants

For analyses involving cortisol, participants were 39 female¹ undergraduate psychology students at the University of Miami (mean age = 19.31 years, $SD = 3.45$, range = 17–39 years) who were part of a larger study ($N = 212$) that occurred over the course of several semesters. This subsample included all female participants who had voluntarily consented to blood draws and were also able to attend sessions when we had scheduled a phlebotomist. Chi-squared tests to examine whether the study subsample ($n = 39$) differed from the total sample ($N = 212$) on any of the variables of interest revealed no significant differences between groups. All participants had encountered a significant interpersonal transgression approximately 5 days ($n = 39$, $M = 4.95$; $SD = 3.3$) before enrollment. Participants were not enrolled into the study if the transgression involved: someone whom they did not know, a petty argument that was quickly resolved, a misunderstanding that was easily cleared up, or something the participant did that they regretted. Students who enrolled through their Introduction to Psychology courses received course credit for participation, and all participants were paid between \$60 and \$100 on a *pro rata* basis for completing various aspects of the study. For analyses involving forgiveness, participants comprised a much larger set of participants from the same study ($N = 212$, mean age = 19.32 years, $SD = 2.28$, range = 17–39). In the larger data set, participants had encountered a significant interpersonal transgression approximately 5 days ($N = 212$, $M = 4.58$; $SD = 3.03$) before enrollment.²

2.2. Overview of procedure

Upon enrollment, participants completed several self-report measures (described below). Approximately 25 days after enrollment, they completed a second self-report measure of forgiveness. Several days after completing this second measure of forgiveness, participants attended a laboratory session during which they were asked to prepare and deliver a speech as if they were speaking to the person who had initially harmed them. For the $n = 39$ participants enumerated above, several blood draws were taken before and after the speech to examine individual differences in task-related cortisol secretion.

¹ In addition to the 39 female participants, 9 male participants consented to blood draws during the speech reactivity task. Among male participants there was a non-significant increase in cortisol response and no significant relationships emerged between all variables of interest. Obviously, given the extremely small sample size, we are hesitant to draw any conclusions from these data, so we do not examine the data from men in the present study.

² The reduction in original sample size occurred for the following reasons: Out of the 39 female participants who participated in blood draws, 7 participants did not provide self-reported measures of agreeableness and neuroticism and were consequently not included in analyses. This resulted from the administration of incomplete initial questionnaires. In addition, 7 of the 39 participants did not complete blood draws at time point 3, and 9 participants did not complete blood draws at time point 4. This typically resulted from lack of blood flow.

2.3. Self-report measures completed upon enrollment

2.3.1. Personality variables

Participants completed the agreeableness and neuroticism subscales of the 44-item Big Five Inventory (BFI; John et al., 1991), to describe their own personalities. The items on the 9-item agreeableness subscale (e.g., “Is considerate and kind to almost everyone,” “Likes to cooperate with others,” and “Is generally trusting”) and the 8-item neuroticism subscale (e.g., “Can be moody,” “Can be tense,” and “Is emotionally stable, not easily upset” [reverse-coded]) were rated on a 5 point Likert-type scale (1 = *strongly disagree*, 5 = *strongly agree*) and demonstrated high internal consistency (agreeableness $\alpha = .79$; neuroticism $\alpha = .86$). In addition, participants also rated their perceptions of their transgressors’ personalities on both the agreeableness and neuroticism subscales of the BFI (perceived agreeableness $\alpha = .87$; perceived neuroticism $\alpha = .83$).

2.3.2. Perceived closeness and commitment to the transgressor

Participants rated their perceived closeness and commitment to the offender before the transgression using two 7-point Likert-type scales: (a) “How close were you to the person who hurt you before the transgression?” (0 = *not at all*, 6 = *extremely close*); (b) “How committed were you to the person who hurt you before the transgression?” (0 = *not at all*, 6 = *extremely committed*). Additionally, participants completed Aron et al. (1992) Inclusion of Other in the Self (IOS) Scale. The IOS displays seven pairs of circles ranging from no overlap to almost complete overlap. Instructions ask participants to circle the pair that best describes their relationship with the transgressor. Scores ranged from 1 (no overlap between the circles) to 7 (extreme overlap). As in Bono et al. (2008), these three items were averaged to measure perceived closeness/commitment to the transgressor ($\alpha = .85$).

2.3.3. Perceived painfulness of the transgression

Participants indicated how painful they perceived the transgression to be with a single item that read, “How painful was the offense to you right after it happened?” using a 7-point Likert-type scale (0 = *not very painful at all*, 6 = *worst pain I ever felt*).

2.3.4. Initial measure of forgiveness

We measured participants’ forgiveness of their transgressors in the initial questionnaire packet with the 18-item form of the Transgression-Related Interpersonal Motivations (TRIM) inventory (TRIM-18; McCullough et al., 2006). This self-report measure consists of three subscales. The Avoidance subscale comprises 7 items that measure motivation to avoid contact with a transgressor (e.g., “I live as if he/she doesn’t exist, isn’t around”). The Benevolence subscale comprises 6 items that measure the desire for good to come to the transgressor (e.g., “Even though his/her actions hurt me, I have goodwill for him/her” [reverse-coded]). Positively worded items were reverse-coded so that lower total scores indicated more forgiveness. Items were rated on a 5-point Likert-type scale (1 = *strongly disagree*, 5 = *strongly agree*). We combined the 18 items into a single summary measure of forgiveness ($\alpha = .91$). These initial measures of forgiveness were obtained approximately 8 days ($n = 181$, $M = 8.17$, $SD = 5.8$) after participants had incurred their transgressions.

2.4. Measures obtained during the laboratory visit

2.4.1. Depressive and somatic symptoms

Participants’ depressive symptoms at the time of the laboratory visit were measured on an 11-item (e.g., “depressed mood,” “difficulty concentrating,” “feeling life is pointless”) self-report measure whose items were endorsed with a 5-point Likert-type scale (1 = *very slightly or not at all*, 5 = *extremely*). Internal consistency for these items was adequate ($\alpha = .71$). Participants’ somatic symptoms were assessed using a 5-item (e.g., “headaches,” “faintness/dizziness,” “stomach upset/nausea”) self-report measure whose items were endorsed on the same 5-point Likert-type scale. Internal consistency was adequate ($\alpha = .76$).

2.4.2. Cortisol, progesterone, and estradiol

Plasma concentrations of cortisol were determined using a solid phase Radioimmunoassay (RIA; Siemens Medical Solutions Diagnostics). The antibody employed in the kit has high specificity for cortisol and the minimal detectable level was 0.2 $\mu\text{g/ml}$ (5.5 nmol/l). The intra-assay coefficient of variation (CV) was 5.1% and the inter-assay CV was 4.0% as reported by the manufacturer. Baseline plasma levels of progesterone and estradiol were also assessed via RIA method (Siemens Medical Solutions Diagnostics). The limit of detection for progesterone was 0.02 ng/ml , the intra-assay CV was 4.0%, and the inter-assay CV was 5.7%; the limit of detection for estradiol was 8.0 pg/ml , the intra-assay CV was 4.3%, and the inter-assay CV was 6.8% as reported by the manufacturer. In the current study, four samples of estradiol fell below the level of detection and were therefore set to 0 pg/ml . Our analyses were re-run with the undetectable values treated as missing values rather than arbitrarily set to zero, and results were unchanged. All sample extractions and assays were performed at the Diabetes Research Institute at the University of Miami Miller School of Medicine. All samples were analyzed in duplicate.

2.5. Procedure

2.5.1. Recruitment

Participants were recruited in several undergraduate psychology courses. We provided interested potential participants with initial packets that included the BFI scales and the measures of perceived transgression painfulness and pre-transgression closeness/commitment. If, after participants completed and returned the initial questionnaires, we deemed them eligible for further study participation, we contacted them and scheduled them for several more laboratory visits, including a visit during which they completed the speech task described below.

2.5.2. Follow-up measure of forgiveness

Approximately 3 days ($n = 175$, $M = 3.26$, $SD = 4.5$) before participants’ laboratory visits (see below), participants completed the TRIM inventory for a second time (TRIM 2) on a survey web site for the study ($\alpha = .96$).

2.5.3. Relational stress task and blood draw protocol

Approximately 28 days ($n = 38$, $M = 28.37$, $SD = 5.08$) after enrollment, participants completed a 90-min laboratory session consisting of a speech reactivity task and subsequent post-task questionnaires. The subset of participants who consented to the blood draw procedure completed the same speech task and post-task questionnaires, and also up to six baseline and post-task blood draws.

Participants from whom we obtained blood arrived between 6:00pm and 7:30pm to minimize diurnal fluctuations in cortisol (Lovallo and Thomas, 2000). Upon arrival, participants who consented to having their blood drawn were brought into a laboratory room. A research assistant explained the voluntary blood draw protocol, and participants discussed the procedure with a phlebotomist. Participants were fitted with a plastic intravenous (IV) catheter into their nondominant arm. Then, a first baseline blood sample was drawn into two 6 ml vacutainer tubes with EDTA (this type of tube was used for all subsequent draws). The catheter remained in each participant’s arm for the remainder of the procedure. Participants were instructed to relax and wait for 10 min while the research assistant set up for the next part of the experiment. This period was designed for catheter habituation. Ten minutes later, a second baseline was drawn into one 6 ml tube.

Following the second baseline draw, participants were instructed to spend 4 min preparing a short speech that they would like to give to their transgressor as if the video camera was the person/persons who harmed them. Participants received the following scripted instructions: “For this task, we really want you to relax and ‘get into’ the task so that you can express your feelings to this person without holding anything back—as if you were really talking to this person. Specifically, we would like you to spend a few minutes preparing some thoughts about what you would say to the person who hurt you, focusing on: (a) What you would like to say about the hurtful event, (b) How you are currently feeling about the individual who harmed you as a person, (c) How you feel like acting toward that individual. You will have 4 min to prepare anything that you would like. Feel free to take notes if you would be more comfortable. After the preparation time, you will be asked to give this speech into the video recorder.” After the preparation time, participants delivered the 4-min speech to the camera. Two, five, seven, and ten minutes following the conclusion of the speech, four additional 6 ml tubes of blood were drawn. After the fourth post-speech blood draw, the catheter was removed. Participants then completed the measures of depressive and somatic symptoms and several other questionnaires not relevant to this study.

Participants had 4 min to prepare their speeches, 2 min between preparation and delivery, and 4 min for speech delivery (for 10 min total). We therefore determined that blood draws 12 min, 15 min, 17 min, and 20 min after the beginning of the preparation period would enable us to capture stress related changes in cortisol that our task induced (Dickerson and Kemeny, 2004).

2.6. Statistical analysis

Relationships among the major study variables were explored with Pearson correlations, and subsequently, with multiple regression analyses. We also examined the potential confounding influence of perceived painfulness of the transgression, victims’ self-reported closeness and commitment toward their transgressor, victims’ current depressive and somatic symptoms, and several variables related to the timing with which we obtained our measurements.

The cortisol values were severely right-skewed, as is typical (McCullough et al., 2007), so we natural-log transformed them to approximate a normal distribution. Baseline levels of cortisol were estimated from the mean of the two baseline values. Cortisol was analyzed using a one-way (time [cortisol]) repeated measures ANOVA (using the Greenhouse-Geisser correction when appropriate) and paired samples *t*-tests. We also calculated the area under the curve for cortisol (using the raw cortisol data rather than the natural-log transformed data) with respect to increase (AUC) using the trapezoid formula (see Pruessner et al., 2003). Four measurements of changes in plasma cortisol concentrations after the speech task were estimated by subtracting the mean baseline cortisol value from the concentrations measured at 12, 15, 17, and 20 min after beginning preparation for the speech task. Pearson correlations were used to analyze cortisol change scores and multiple regression analyses were used to analyze AUC.

Table 1
Types of transgressions and transgressors.

Types of transgressors	%	Types of transgressions	%
Girlfriends/boyfriends	52.4	Romantic partner/spouse infidelity	31.6
Same-sex friends	17.5	“Other”	17.5
Relatives other than children or spouses	9.4	Insults or betrayals by a friend	14.2
“Other”	7.5	Rejection or abandonment by a friend or potential relationship partner	11.8
Other-sex friends	6.6	Termination of a romantic relationship	10.4
Casual dating partners	6.1	Neglect or insult by a family member	7.5
Employers	0.5	Neglect by a romantic partner/spouse or ex-romantic partner	4.7
		Insults by people other than family or friends	2.4

3. Results

3.1. Descriptive statistics

Table 1 categorizes the types of transgressors and the types of transgressions reported by participants. The mean level of pain reported by participants on the 7-point scale was 5.04 ($SD = .91$). Recall that scores ranged from 0 to 6, with 6 signifying “the worst pain I ever felt,” so participants clearly felt that the interpersonal transgressions they had experienced were quite painful.

3.2. Means, standard deviations, and intercorrelations of major study variables

Means and standard deviations of major study variables appear in Table 2, and correlations among the major study variables appear in Table 3. As Table 3 shows, there were substantial correlations among participants' ratings of their own personalities, their ratings of their transgressors' personalities, the measures of cortisol, and forgiveness.

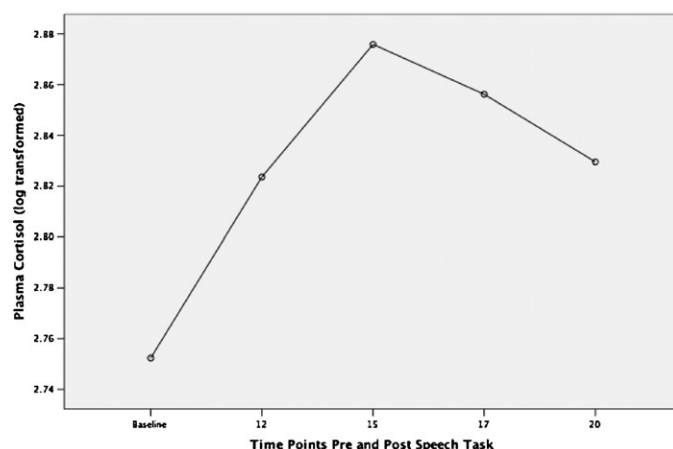
3.3. Does perceived transgressor agreeableness predict HPA-axis response following interpersonal transgressions?

We proceeded to examine the unique contribution of perceived transgressor agreeableness to the prediction of task-related

Table 2
Means and standard deviations for major study variables.

Measure	<i>n</i>	<i>M</i>	<i>SD</i>
Perceived transgressor agreeableness	212	2.95	.92
Participant self-reported agreeableness	205	3.78	.65
Perceived transgressor neuroticism	212	3.20	.86
Participant self-reported neuroticism	205	3.07	.85
Initial level of forgiveness (TRIM-18)	181	3.04	.74
Follow-up level of forgiveness (TRIM-18)	175	2.62	.94
Days from transgression to lab visit	181	32.27	6.97
Days from transgression to forgiveness 1	181	8.17	5.80
Days from transgression to forgiveness 2	175	28.78	5.67
Self-reported closeness and commitment	210	4.72	1.16
Self-reported painfulness of transgression	210	5.04	.91
Cortisol baseline ($\mu\text{g/dL}$)	39	18.0	7.61
Cortisol time 1 ($\mu\text{g/dL}$)	36	18.8	8.88
Cortisol time 2 ($\mu\text{g/dL}$)	33	19.4	8.41
Cortisol time 3 ($\mu\text{g/dL}$)	32	19.21	8.82
Cortisol time 4 ($\mu\text{g/dL}$)	30	18.99	9.17

Note: TRIM = Transgression Related Interpersonal Motivations Inventory.

**Fig. 1.** Mean plasma cortisol (log transformed) measured at baseline and 12, 15, 17, and 20 min post-speech task.

changes in cortisol and forgiveness using multiple regression analyses, which enabled us to control for perceived transgressor neuroticism, victims' self-reported agreeableness and neuroticism, and other potential confounds.

3.3.1. Change in cortisol over time

A one-way (cortisol [time]) repeated measures ANOVA indicated that the relational stress task induced a significant change in cortisol over time, $F(1.93, 55.84) = 3.57, p < .05, n = 30$; Greenhouse-Geisser correction. As Fig. 1 shows, plasma cortisol tended to increase until approximately 15 min after the preparation phase began, at which time it then appeared to begin decreasing. Paired *t*-tests showed significant differences between cortisol at 15 min post-speech task (Time 2; $M = 2.86; SD = .47, n = 33$) and baseline cortisol ($M = 2.75; SD = .43, n = 33$), $t(32) = 2.19, p < .05$, as well as cortisol at 17 min post-speech task (Time 3; $M = 2.85; SD = .48, n = 32$) and baseline cortisol ($M = 2.75; SD = .42; n = 32$), $t(31) = 2.19, p < .05$.

3.3.2. Perceived transgressor agreeableness and cortisol

As Table 3 shows, perceived transgressor agreeableness was negatively associated with all four cortisol change scores. For two of the change scores, the negative associations of perceived transgressor agreeableness and cortisol approached statistical significance ($p = .06$), suggesting that people who perceived their transgressors as highly agreeable experienced smaller increases in cortisol 17 and 20 min after the onset of the speech task. For purely illustrative purposes, we divided the sample into tertiles based on the frequency distribution of perceived transgressor agreeableness (low range = 1–2.59; middle range = 2.6–3.22; high range = 3.23–5). Fig. 2 is a graphic illustration of the means resulting from a two-way (group [low, middle, high perceived agreeableness] by cortisol [time]) ANCOVA using baseline cortisol as a covariate, $F(4.37, 56.83) = 1.48, p = .22, n = 30$; Greenhouse-Geisser correction. This statistical analysis is grossly underpowered due to the small sample size and the artificial creation of discrete groups on the basis of arbitrary cuts in a continuous variable (MacCullum et al., 2002), so we include it here merely to enable a visualization of the fact that participants' task-related cortisol increases varied inversely with their perceptions of their transgressors' agreeableness.

In a multiple regression analysis, we examined whether perceived transgressor agreeableness was associated with the AUC_1 for cortisol while simultaneously controlling for perceived transgressor neuroticism and participants' self-reports of agreeableness and neuroticism. As shown in Table 4, perceived transgressor agreeableness significantly predicted AUC_1 ($\beta = -.60, p < .05, n = 25$). Thus, participants who perceived their transgressors as more agreeable

Table 3
Correlations of major study variables.

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Perceived transgressor agreeableness	.04	-.41**	-.13	-.24**	-.34**	.16	-.2	-.21	-.34 ^a	-.35 ^a	-.36 ^a
Participant self-reported agreeableness (2)	-	-.10	-.33**	-.13	-.14	-.04	.07	.11	.01	.01	-.02
Perceived transgressor neuroticism (3)		-	.15*	.21**	.18*	-.14	.18	.11	.12	.14	.16
Participant self-reported neuroticism (4)			-	.1	.17*	.12	-.04	-.01	-.01	-.03	.03
Forgiveness 1 (TRIM-18) (5)				-	.66**	.12	.03	.04	.04	.05	.09
Forgiveness 2 (TRIM-18) (6)					-	.07	-.03	-.02	-.05	-.01	.02
Baseline cortisol (7)						-	-.00	-.11	-.07	-.12	.18
Cortisol change at time 1 (8)							-	.90**	.88**	.80**	.94**
Cortisol change at time 2 (9)								-	.91**	.88**	.88**
Cortisol change at time 3 (10)									-	.93**	.90**
Cortisol change at time 4 (11)										-	.83**
Cortisol AUC _i (12)											-

Note. TRIM = Transgression Related Interpersonal Motivations Inventory. For all correlations in bold, $n = 154$ – 204 . For un-bolded correlations involving cortisol response, $n = 20$ – 36 .

^a $p = .06$

* $p < .05$

** $p < .01$.

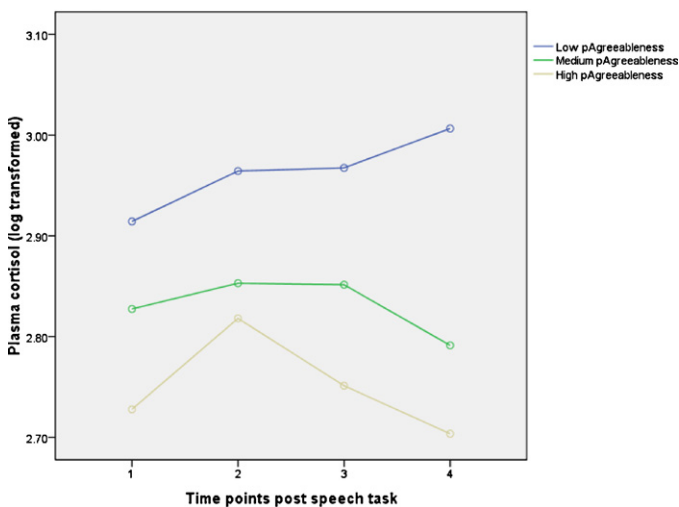


Fig. 2. Mean plasma cortisol (log-transformed values) at four post-task time points for participants separated into low ($n = 9$), medium ($n = 12$), and high ($n = 9$) levels of perceived transgressor agreeableness. Note: pAgreeableness = perceived transgressor agreeableness.

showed significantly less total task-related cortisol response over time with respect to increase. Despite the small sample size, the standardized regression coefficient ($\beta = -.60$) suggests that the unique association of perceived transgressor agreeableness and cortisol response is large. Importantly, perceived transgressor neuroticism, and self-reported agreeableness and neuroticism, were not associated with cortisol response.

3.4. Exploring potential confounds

We evaluated several potential confounds and found that neither self-reported painfulness of the transgression nor closeness/commitment to the transgressor were significantly associated with the AUC_i for cortisol or any of the four cortisol change scores.

Table 4
Predictors of the cortisol area under the curve with respect to increase.

Predictor	<i>B</i>	SE	β
Perceived transgressor agreeableness	-49.29	21.57	-.60*
Participant self-reported agreeableness	12.51	20.37	.14
Perceived transgressor neuroticism	-16.29	16.65	-.25
Participant self-reported neuroticism	12.98	16.97	.17

* $p < .05$.

Table 5
Predictors of the follow-up measure of forgiveness.

Predictor	<i>B</i>	SE	β
Perceived transgressor agreeableness	-.17	.07	-.16*
Participant self-reported agreeableness	-.01	.08	-.01
Perceived transgressor neuroticism	-.01	.07	-.01
Participant self-reported neuroticism	.11	.07	.10
Self-reported painfulness of transgression	.07	.06	.07
Self-reported closeness and commitment	-.02	.05	-.03
Gender	.14	.13	.07
TRIM 1 (initial level of forgiveness)	.79	.07	.63**
Days from transgression to TRIM 1	.04	.01	.19**
Days from transgression to TRIM 2	-.02	.01	-.09

Note: TRIM = Transgression Related Interpersonal Motivations.

* $p < .05$.

** $p < .01$.

We therefore did not evaluate these variables further as potential confounds.

Based on previous research suggesting that menstrual cycle variation may influence cortisol responsivity (Lustyk et al., 2010), we also examined whether baseline levels of plasma progesterone and estradiol were associated with cortisol response. We found a significant negative correlation between baseline cortisol and estradiol ($r = -.34$, $p < .05$, $n = 39$), but estradiol was not related to AUC_i or cortisol change at any of the four time points. Progesterone was not related to any of our cortisol measures.

Lastly, due to the relationships among depression, immune system functioning, and cortisol (Handwerker, 2009; Segerstrom and Miller, 2004), we examined whether participants' current depressive symptoms and somatic concerns were associated with cortisol response. We found that baseline cortisol was significantly and positively associated with depressive symptoms ($r = .32$, $p < .05$, $n = 39$) and somatic concerns ($r = .34$, $p < .05$, $n = 39$), but not with AUC_i or cortisol change at any of the four time points.

3.5. Does perceived transgressor agreeableness predict longitudinal change in forgiveness?

In a multiple regression analysis, we examined whether perceived transgressor agreeableness was associated with longitudinal change in forgiveness even when controlling for a wide variety of potential confounds. As Table 5 shows, victims who perceived their transgressors as higher on agreeableness reported more forgiveness just prior to their laboratory visits ($\beta = -.17$, $p < .05$, $n = 167$). This relationship remained significant even when controlling for self-reported agreeableness and neuroticism, self-reported painfulness of the transgression, self-reported closeness and com-

mitment between the victim and his or her transgressor, the number of days that had elapsed from the transgression to the initial measure of forgiveness, the number of days that had elapsed from the transgression to the second measure of forgiveness, participants' gender, and—importantly—participants' initial levels of forgiveness (TRIM 1; see Table 5). Because we controlled for initial levels of forgiveness, these results suggest that the association of perceived agreeableness with forgiveness might be causal (Finkel, 1995).

4. Discussion

We examined the association of self-reported agreeableness and neuroticism, as well as perceived transgressor agreeableness and neuroticism, with HPA-axis response (via plasma cortisol) and longitudinal changes in self-reported forgiveness for the transgressor. We hypothesized that perceiving transgressors as highly agreeable would be associated with lower post-conflict stress—namely, reduced cortisol response (e.g., McCullough et al., 2007), and more forgiveness (Exline et al., 2008; Koutsos et al., 2008; Struthers et al., 2008). Our results strongly support this hypothesis, and help to make sense of a mixed body of findings regarding the role of agreeableness and neuroticism as predictors of cortisol reactivity in response to social stressors (Fox et al., 2010; Oswald et al., 2006; Phillips et al., 2005; Roy et al., 2001; Tops et al., 2006). Indeed, our findings suggest that the influence of participants' own agreeableness and neuroticism on HPA axis responses to social conflict is quite limited, but that the perceived agreeableness of the people with whom they are in conflict in fact plays a rather substantial role.

Our finding that people are more likely over time to forgive transgressors whom they perceive to be highly agreeable comports well with research highlighting the importance of contextual factors in the resolution of interpersonal conflict, including characteristics of the transgressors themselves (Exline et al., 2008; Koutsos et al., 2008; Powers et al., 2006; Struthers et al., 2008), as well as a recent proposal that people forgive transgressors whom they perceive to be valuable and safe (McCullough, 2008; McCullough et al., 2010)—traits that seem well summarized, at the level of personality, by the agreeableness dimension of the Big Five or Five-Factor personality systems (Costa and McCrae, 1995; John, 1990; Luchies et al., 2010). Indeed, Tabak et al. (in press) recently discovered that conciliatory gestures such as apologies, expressions of contrition, offers of compensation, and non-verbal expressions of shame, guilt, and remorse are effective at quelling revenge and facilitating forgiveness precisely because they make transgressors seem more agreeable—that is, higher in the generalized personality trait that is associated with trustworthiness, cooperativeness, and a generally prosocial orientation toward others.

The fact that perceived transgressor agreeableness influenced task-related cortisol change in addition to self-reported forgiveness over time suggests, therefore, that perceived agreeableness relates to people's computations of the extent to which their transgressors continue to be social threats (Dickerson and Kemeny, 2004; McCullough et al., 2007). Taken together, the present findings give strong encouragement for further research on how the perceived agreeableness of interactants in conflict may influence the interpersonal, psychological, and physiological sequelae of those conflicts, as well as for further research on the behaviors that people consider when they make judgments about transgressors' agreeableness.

4.1. Limitations and future directions

Four limitations of this research should be noted. First, this study was non-experimental, which limits conclusions about causality. Our method of studying real-life transgressions—rather than hypo-

thetical transgressions or transgressions between strangers that can be engineered in the laboratory—improves external validity, but experimentation would help to clarify the causal relations among the variables we have examined here. Nevertheless, the association of perceived transgressor agreeableness with longitudinal changes in forgiveness increases the likelihood that this relationship is at least partially causal in nature (Finkel, 1995).

Second, examining women only in our cortisol analysis prevents us from drawing conclusions about how these processes might operate for men. Previous research indicates that females may be particularly susceptible to cortisol increase following social rejection (Stroud et al., 2002) and real-life interpersonal transgressions in close relationships (McCullough et al., 2007), but future research incorporating men would help immensely in addressing this issue.

Third, although the present study included multiple measurements of cortisol, our measurement time points did not extend far enough out from the offset of the stressor to completely assess cortisol recovery. Future work on the effects of personality on physiological response may benefit from extending blood sampling further to assess cortisol recovery more completely (Dickerson and Kemeny, 2004).

Fourth, based on findings associating forgiveness and reduced physiological stress reactivity (Witvliet et al., 2001), one might speculate that forgiveness mediated the relationship between perceived agreeableness and cortisol response. The present results did not confirm this hypothesis; however, based on previous work demonstrating a link between forgiveness and victims' level of closeness and commitment to their transgressors (Bono et al., 2008), it is possible that commitment moderates the relationship between forgiveness and cortisol response. The present study's sample size precludes us from interpreting such interaction effects, but future research may wish to further examine this question.

5. Conclusion

The present study contributes to and integrates several lines of research, including work on (a) HPA-axis response in paradigms concerning interpersonal conflict and potential social threat (Dickerson and Kemeny, 2004; McCullough et al., 2007), (b) the role of personality—including the personality of the transgressor—in the resolution of interpersonal conflict (Tabak et al., in press), (c) the importance of characteristics of the transgressor in reducing HPA-axis response to conflict (see also Powers et al., 2006) and conflict resolution and forgiveness (Exline et al., 2008; Koutsos et al., 2008; Struthers et al., 2008). Taken together, our results here suggest that following interpersonal conflict, perceptions of transgressors' personalities—particularly, how agreeable they seem—may communicate unique information about their potential value as relationship partners and the extent to which they should be viewed as continuing threats to their victims (Dickerson and Kemeny, 2004; McCullough et al., 2007). This conclusion has considerable implications for understanding how interpersonal transgressions, which are ubiquitous in human social life, are resolved, and for understanding the consequences of those conflict resolutions for physiological functioning, physical health, and mental health.

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