Dear Author,

Please check your proof carefully and mark all corrections at the appropriate place in the proof (e.g., by using on-screen annotation in the PDF file) or Compile them in a separate list. To ensure fast publication of your paper please return your corrections within 48 hours.

For correction or revision of any artwork, please consult [http://www.elsevier.com/artworkinstructions](http://www.elsevier.com/artworkinstructions).

Any queries or remarks that have arisen during the processing of your manuscript are listed below and highlighted by flags in the proof. Click on the 'Q' link to go to the location in the proof.

<table>
<thead>
<tr>
<th>Location in article</th>
<th>Query / Remark: click on the Q link to go</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>Reference(s) given here were noted in the reference list but are missing from the text – please position each reference in the text or delete it from the list.</td>
</tr>
<tr>
<td>Q2</td>
<td>Please check title footnote, and correct if necessary.</td>
</tr>
<tr>
<td>Q3</td>
<td>Please check the hierarchy of the section headings.</td>
</tr>
<tr>
<td>Q4</td>
<td>Uncited references: This section comprises references that occur in the reference list but not in the body of the text. Please position each reference in the text or, alternatively, delete it. Any reference not dealt with will be retained in this section.</td>
</tr>
<tr>
<td>Q5</td>
<td>Please note that the reference style has been changed from a APA style to a Name-Date style as per the journal specifications.</td>
</tr>
<tr>
<td></td>
<td>Please update reference “Tabak et al. (in press)”</td>
</tr>
</tbody>
</table>

Thank you for your assistance.
Perceived transgressor agreeableness decreases cortisol response and increases forgiveness following recent interpersonal transgressions

Benjamin A. Tabak, Michael E. McCullough*

- Perceived transgressor agreeableness is associated with reduced cortisol response.
- Perceived transgressor agreeableness is positively associated with forgiveness.
- Victims' agreeableness and neuroticism were not linked with cortisol or forgiveness.
Perceived transgressor agreeableness decreases cortisol response and increases forgiveness following recent interpersonal transgressions

Benjamin A. Tabak, Michael E. McCullough

Department of Psychology, University of Miami, United States

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.

1. Introduction

Interpersonal conflict can cause psychological distress (Roller 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
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 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 cortisol 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 that 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 nonsignificant 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.

Please cite this article in press as: Tabak, B.A., McCullough, M.E., Perceived transgressor agreeableness decreases cortisol response and increases forgiveness following recent interpersonal transgressions. Biol. Psychol. (2011), doi:10.1016/j.biopsycho.2011.05.001
2.3. 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 α = .79; Neuroticism α = .85). In addition, participants also rated their perceptions of their transgressors’ personalities on both the Agreeableness and Neuroticism subscales of the BFI (perceived Agreeableness α = .87; perceived Neuroticism α = .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, 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 and commitment to the transgressor (α = .85).

2.3.3. Perceived painfullness 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). 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 (α = .71). Participants’ somatic symptoms were assessed using a 5-item (e.g., "headaches," "taintness/dizziness," "stomach upset/nausea") self-report measure whose items were endorsed on the same 5-point Likert-type scale. Internal consistency was adequate (α = .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 test was specific for cortisol and the minimal detectable level was 0.2 μg/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 run with the treated 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.
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 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.

2.3.1. 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 (\( M = 2.75; SD = .42, n = 32, t(31) = 2.19, p < .05 \).

2.3.2. 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 association 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 AUCI for cortisol while simultaneously controlling for perceived transgressor neuroticism, participants’ self-reports of agreeableness and neuroticism, and other potential confounds.

 Please cite this article in press as: Tabak, B.A., McCullough, M.E., Perceived transgressor agreeableness decreases cortisol response and increases forgiveness following recent interpersonal transgressions. Biol. Psychol. (2011), doi:10.1016/j.biopsycho.2011.05.001

Note: TRIM = Transgression Related Interpersonal Motivations Inventory.
Table 3
Correlations of major study variables.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
<th>(11)</th>
<th>(12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived transgressor agreeableness</td>
<td>.04</td>
<td>-.41</td>
<td>-.13</td>
<td>-.24</td>
<td>-.34</td>
<td>.16</td>
<td>-.21</td>
<td>-.34</td>
<td>-.55</td>
<td>-.36</td>
<td></td>
</tr>
<tr>
<td>Participant self-reported agreeableness</td>
<td>.02</td>
<td>-.10</td>
<td>-.33</td>
<td>-.13</td>
<td>-.14</td>
<td>.04</td>
<td>.11</td>
<td>.01</td>
<td>.01</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>Perceived transgressor neuroticism</td>
<td>.01</td>
<td>.17</td>
<td>.12</td>
<td>-.04</td>
<td>-.01</td>
<td>-.03</td>
<td>.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forgiveness (TRIM-18) (5)</td>
<td></td>
<td></td>
<td>-.66</td>
<td>.12</td>
<td>.03</td>
<td>.04</td>
<td>.05</td>
<td>.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forgiveness (TRIM-18) (6)</td>
<td></td>
<td></td>
<td></td>
<td>-.07</td>
<td>-.03</td>
<td>-.02</td>
<td>-.05</td>
<td>-.01</td>
<td>.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline cortisol (7)</td>
<td></td>
<td></td>
<td></td>
<td>-.07</td>
<td>-.00</td>
<td>-.11</td>
<td>-.07</td>
<td>-.12</td>
<td>.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cortisol change at time 1 (8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.02</td>
<td>-.02</td>
<td>-.01</td>
<td>-.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cortisol change at time 2 (9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.01</td>
<td>-.01</td>
<td>-.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cortisol change at time 3 (10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.01</td>
<td>-.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cortisol change at time 4 (11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant self-reported neuroticism</td>
<td>.01</td>
<td>.04</td>
<td>.08</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived transgressor agreeableness</td>
<td>.01</td>
<td>.14</td>
<td>.06</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant self-reported neuroticism</td>
<td>.01</td>
<td>.14</td>
<td>.06</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days from transgression to TRIM 1</td>
<td>.01</td>
<td>.14</td>
<td>.06</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days from transgression to TRIM 2</td>
<td>.01</td>
<td>.14</td>
<td>.06</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

Table 4
Predictors of the follow-up measure of forgiveness.

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

Note: TRIM = Transgression Related Interpersonal Motivations.

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

Based on previous research suggesting that menstrual cycle variation may influence cortisol responsivity (Lustky 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 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 (Handwerger, 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 or cortisol change at any of the four time points.

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.

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 for cortisol or any of the four cortisol change scores.

Table 5
Predictors of the cortisol area under the curve with respect to increase.

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

Note: TRIM = Transgression Related Interpersonal Motivations.
painfulness of the transgression, self-reported closeness and commitment 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 comport 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 et al., 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

Three 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 hypothetical 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.

Uncited reference


References


Please quote this article in press as: Tabak, B.A., McCullough, M.E., Perceived transgressor agreeableness decreases cortisol response and increases forgiveness following recent interpersonal transgressions. Biol. Psychol. (2011), doi:10.1016/j.biopsycho.2011.05.001


