

Depersonalization Experiences in Undergraduates Are Related to Heightened Stress Cortisol Responses

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Abstract: The relationship between dissociative tendencies, as measured with the Dissociative Experiences Scale and its amnesia, absorption/imaginative involvement, and depersonalization/derealization subscales, and HPA axis functioning was studied in 2 samples of undergraduate students ($N = 58$ and 67). Acute stress was induced by means of the Trier Social Stress Test. Subjective and physiological stress (i.e., cortisol) responses were measured. Individuals high on the depersonalization/derealization subscale of the Dissociative Experiences Scale exhibited more pronounced cortisol responses, while individuals high on the absorption subscale showed attenuated responses. Interestingly, subjective stress experiences, as indicated by the Tension-Anxiety subscale of the Profile of Mood States, were positively related to trait dissociation. The present findings illustrate how various types of dissociation (i.e., depersonalization/derealization, absorption) are differentially related to cortisol stress responses.

Key Words: Dissociation, acute stress, cortisol response, Trier Social Stress Test.

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Dissociative experiences include subjective phenomena like derealization, absorption, and memory complaints. In their mild form, such experiences are quite common in the normal population (e.g., Ross et al., 1991). Yet, they are particularly pronounced in certain diagnostic categories (e.g., depersonalization disorder, borderline personality disorder; post-traumatic stress disorder; schizophrenia; see, e.g., Holmes et al., 2005; Merckelbach et al., 2005). Although there is an impressive amount of literature on the topic of dissociation, researchers in this domain have primarily focused on the alleged traumatic etiology of dissociative experiences (see for a review, Giesbrecht and Merckelbach, 2005; Kihlstrom, 2005). Although research on distal antecedents (i.e., dysfunctional family environment) related to dissociation has re-

vealed clinically highly relevant findings, relatively little is known about the more proximal mechanisms involved in dissociation.

One line of research that might shed light on proximal mechanisms involved in dissociation is the one directed at hypothalamic-pituitary-adrenal (HPA) axis functioning in depersonalization disorder (DPD; Simeon et al., 2001; Stanton et al., 2001). Unfortunately, the 2 studies that investigated the matter yielded conflicting results. Stanton et al. (2001) found a trend toward lower basal cortisol levels of patients with DPD when compared with individuals with major depressive disorder. However, the authors acknowledge that HPA axis dysfunction “may be more sensitively detected by examining of the response of the HPA axis to provocation challenge” (Stanton et al., 2001, p. 88). In line with this suggestion, Simeon et al. (2001) evaluated HPA axis functioning in DPD by means of a low-dose dexamethasone administration. These authors showed that DPD is associated with HPA axis dysregulation. More specifically, DPD was found to be related to diminished negative feedback control of cortisol. The authors also found that DPD patients have elevated levels of plasma cortisol. Interestingly, these findings are in stark contrast to the dysregulations encountered in individuals suffering from posttraumatic stress disorder (PTSD). In PTSD, such dysregulations are often characterized by enhanced negative feedback (Stein et al., 1997; Yehuda et al., 1993).

Findings of Simeon et al. (2001) suggest that persistent dissociation, and especially the depersonalization component of dissociation, should be associated with diminished negative feedback control of cortisol. Therefore, we expect dissociative tendencies to be related to heightened levels of cortisol following a stressor. However, their study did not include a stressor. The goal of the present study was therefore to investigate the relationship between dissociative tendencies and HPA axis functioning in a nonclinical sample under conditions of acute stress. Given that the dissociative symptoms typical for clinical groups have their low-intensity counterparts in the general population (Bernstein and Putnam, 1986; Leonard et al., 1999), we recruited a nonclinical sample. In doing so, we hoped to exclude the confounding influence of comorbidity on HPA axis functioning. To induce stress, we exposed undergraduate students to the Trier Social Stress Test (TSST; Kirschbaum et al., 1993). With this laboratory task, acute stress can be induced in a reliable way. On the basis of the Simeon et al. (2001) results, we expected higher levels of trait dissociation generally, and the deper-

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sonalization/derealization subscale of the Dissociative Experiences Scale (DES) in particular, to go along with heightened levels of cortisol following the stressor. The relationship between the cortisol response and pathological dissociation, as measured by the Dissociative Experiences Scale Taxon (Waller et al., 1996), and the other facets of dissociative experiences, notably absorption and amnesia, will also be investigated.

STUDY 1

Methods

Participants

Participants were 58 undergraduate students enrolled at Maastricht University. Twenty-nine of them were women. Their mean age was 19.93 years ($SD = 3.33$; range, 17–41 years). Participants suffering from cardiovascular diseases, endocrine disorders, or who were taking medication were excluded from the study. Participants gave written consent prior to taking part and were compensated through a small amount of money. Participants were asked to refrain from eating, drinking, and smoking for at least 1 hour prior to the beginning of the testing session. The study was approved by the standing ethical committee of the Faculty of Psychology, Maastricht University.

Psychometric Instruments

Dissociative Experiences Scale (Bernstein and Putnam, 1986, Cronbach's $\alpha = 0.92$). The DES is a self-report scale asking respondents to indicate on 100 mm Visual-Analogue Scales to what extent they experience 28 dissociative phenomena in daily life. Examples of such phenomena include feelings of depersonalization, derealization, and psychogenic amnesia. In their meta-analytic study, van IJzendoorn and Schuengel (1996) provided evidence for the sound psychometric properties of the DES. A subset of 8 DES items forms the Dissociative Experiences Scale Taxon (DES-T; Cronbach's $\alpha = 0.67$; Waller et al., 1996). This taxon is thought to be especially sensitive to pathological dissociation. DES-T scores can be obtained by averaging across DES items 3, 5, 7, 8, 12, 13, 22, and 27 (e.g., Eisen and Carlson, 1998).

In addition to the DES-T, separate subscale scores were also calculated following the 3-factor solution proposed by Ross et al. (1995), Sanders and Green (1994), and Carlson et al. (1991). These were amnesia (Cronbach's $\alpha = 0.81$), absorption and imaginative involvement (Cronbach's $\alpha = 0.83$), and depersonalization and derealization (Cronbach's $\alpha = 0.66$).

Profile of Mood States

The Profile of Mood States (POMS; McNair et al., 1992) is a widely used self-report measure to quantify typical and persistent mood reactions to current life situations. In the present study, subjective stress experiences were assessed using its Anger-Hostility and Tension-Anxiety subscales. Participants indicate to what extent they agree with adjectives describing their current mood or feelings on 5-point scales (anchors: 0 = not at all, 4 = extremely). Adjectives include

“annoyed,” “angry,” and “grumpy” for the subscale Anger-Hostility and “nervous,” “tensed,” and “panicky” for the Tension-Anxiety subscale. Total scores for the 2 subscales were calculated by adding up all item scores. The POMS has excellent psychometric properties (Lezak, 2004; Wald and Mellenberg, 1990).

Trier Social Stress Test

The TSST (Kirschbaum et al., 1993) combines both social and cognitive stress. It consists of 3 stages, each lasting 5 minutes: a preparation period, a free speech, and a mental arithmetic task. Thus, participants are first told to prepare a speech for a job interview, which they subsequently have to give. After the speech, a mental arithmetic task is administered. Every time the participant makes an error, she/he has to start over. The participants are aware of the fact that both the speech and the mental arithmetic task are videotaped and observed by the experimenter. The participant has to remain standing during these 2 last stages. The TSST is a reliable method to induce psychological stress in the laboratory (see Kirschbaum and Hellhammer, 1994) and was found to provoke the most pronounced physiological (cortisol) reaction as compared with other stress induction procedures (Dickerson and Kemeny, 2004).

Procedure

Participants were tested individually in our laboratory with the experimenter present. All experimental sessions took place in the afternoon (between 14:00 and 17:00 hours) to reduce variability in the cortisol response due to fluctuations of cortisol levels over the day (Kirschbaum and Hellhammer, 1994). Participants first completed the DES. Next, premanipulation cortisol levels were sampled and participants completed the first POMS. Then, participants were exposed to the TSST (Kirschbaum et al., 1993). Immediately after the TSST, a second cortisol sample was obtained, and the POMS was readministered. A third and fourth cortisol sample were taken 20 and 40 minutes after the TSST, respectively (see e.g., Smeets et al., in press).

Saliva Sampling and Free Cortisol Analysis

Cortisol data were obtained using Salivettes (Sarstedt, Nümbrecht, Germany). Salivettes are small cotton swabs on which participants gently chew for a 1-minute period. Next, the swab is put into a small plastic tube. Immediately upon collection, the uncentrifuged saliva samples were stored at -40°C . Salivary-free cortisol levels were determined in duplicate by direct radioimmunoassay, including a competition reaction between ^{125}I iodohistamine-cortisol and anticortisol serum made against the 3-CMO-BSA conjugate. Via a conventional “second antibody” method, separation of free and antibody-bound ^{125}I iodohistamine⁹ cortisol was performed after overnight incubation of 100 μL saliva at 4°C . To reduce sources of variability, all 4 samples from an individual were analyzed in the same assay. Mean intra- and interassay coefficients of variation ranged from 4.3% to 8.3%, respectively.

TABLE 1. Pearson Product-Moment Correlations Among the Dissociative Experiences Scale (DES), the Dissociative Experiences Scale Taxon Total Score (DES-T), the Amnesia, Absorption, and Depersonalization Subscale of the DES, the Pre- and Postmanipulation Scores on the Anger-Hostility and the Tension Anxiety Scale of the Profile of Mood States (POMS) for an Undergraduate Sample ($N = 58$)*

POMS	DES	DES-T	DES Subscales		
			Amnesia	Absorption	Depersonalization
Anger-Hostility					
Pre	0.09	-0.06	-0.01	0.16	0.05
Post	0.28 [†]	0.15	0.12	0.30 [†]	0.37 [†]
Tension-Anxiety					
Pre	-0.08	-0.12	-0.14	-0.03	-0.02
Post	0.36 [†]	0.22	0.27 [†]	0.40 [†]	0.30 [†]

*Only relevant correlations are shown.
[†]Correlation is significant at the 0.05 level (2-tailed).

Results

Dissociative Experiences

The mean DES score was 16.6 ($SD = 9.8$). This score corresponds to values previously reported for student samples (Merckelbach et al., 2002). Mean scores for the DES-T, the amnesia, absorption, and depersonalization/derealization subscale were 9.1 ($SD = 8.1$), 11.8 ($SD = 10.1$), 24.1 ($SD = 13.6$), and 7.2 ($SD = 7.5$), respectively.

Subjective Stress Experiences

Mean scores on the Anger-Hostility and the Tension-Anxiety POMS subscales were 1.0 ($SD = 2.9$) and 5.2 ($SD = 2.5$) obtained prior to the TSST and 2.5 ($SD = 3.3$) and 9.0 ($SD = 3.0$), after the TSST, respectively. Paired samples t tests indicated that for both Anger-Hostility and Tension-Anxiety, postmanipulation scores were higher than premanipulation scores [$t(57) = 3.24$, $p < 0.01$ and $t(57) = 8.95$, $p < 0.01$, respectively]. This shows that our TSST manipulation was successful in inducing psychological stress.

Table 1 presents Pearson product-moment correlations between DES, DES-T, and the subscales of the DES and the POMS subscales. Dissociation was related neither to the POMS Anger-Hostility nor to the Tension-Anxiety subscales prior to the manipulation (i.e., at baseline). However, dissociation correlated positively with the Tension-Anxiety and the Anger-Hostility subscale after the manipulation.

Through stepwise regression, we explored to what extent subjective stress experiences after the TSST, as measured by the POMS Anger-Hostility and the Tension-Anxiety subscales, were predicted by dissociative tendencies (DES and its subscales, DES-T), while controlling for the respective POMS subscale prior to the TSST, age, and gender. For the POMS Anger-Hostility subscale, this analysis resulted in a model that accounted for 27% (R^2) of the variance (Table 2). The model included the POMS premanipulation scores and the DES depersonalization/derealization subscale. This subscale of the DES accounted for 12.53% of the variance. For the POMS Tension-Anxiety subscale, this analysis resulted in a model that accounted for 25% (R^2) of the variance (Table 2). The model included the POMS premanipulation

scores and the DES absorption subscale. This DES subscale accounted for 16.97% of the variance.

Cortisol Reaction

Cortisol responses of 1 participant were identified as outliers and were omitted from all subsequent analyses. Mean baseline cortisol level was 3.99 nmol/L ($SD = 1.82$). Repeated measures ANOVA with the 4 measurement times as within-subject factor revealed a significant main effect of time [$F(3,54) = 11.48$, $p < 0.01$] indicating that our manipulation elicited significant physiological stress reactions (i.e., increased cortisol levels) in participants.

To quantify the cortisol response, we calculated the area under the curve with respect to increase (AUC_I). This parameter was calculated following the recommendations of Pruessner et al. (2003). All correlations between DES and its subscales, and cortisol stress response parameters fell short of significance ($r < 0.10$, $p > 0.47$). In addition, baseline cortisol levels were unrelated to dissociation scores ($r < 0.16$, $p > 0.22$).

STUDY 2

Our finding that dissociation is not related an attenuated cortisol response during acute stress, i.e., TSST, is in sharp contrast with the proposed HPA axis dysfunction. However,

TABLE 2. Summary of Stepwise Multiregressions on the POMS Anger-Hostility and Tension-Anxiety Subscale (Study 1; $N = 58$)

	<i>B</i>	<i>SE</i>	<i>Beta</i>	<i>t</i>	<i>p</i>
POMS Anger-Hostility					
POMS Anger-Hostility premanipulation	0.41	0.13	0.36	3.14	<0.01
DES depersonalization subscale	0.15	0.05	0.35	3.07	<0.01
POMS Tension-Anxiety					
DES absorption subscale	0.09	0.03	0.41	3.53	<0.01
POMS Tension-Anxiety premanipulation	0.36	0.14	0.30	2.59	0.01

due to our relatively small sample size, the aforementioned null findings have to be interpreted with caution and require replication. Therefore, we conducted a second study, which parallels the procedure of study 1, while employing a modified version of the TSST.

Methods

A sample of 67 (33 woman) undergraduate students enrolled at Maastricht University participated in our second study. Their mean age was 19.70 years ($SD = 1.76$; range: 18–27 years). After completion of the DES, they all underwent our slightly modified version of the TSST. This time we made the TSST even more stressful. During this TSST, the job interview was replaced by a speech about their personality to make this task more personally relevant. Furthermore, the difficulty of the arithmetic task was increased by having participants solve a number of difficult subtractions. The modified TSST was of the exact same duration as the TSST during study 1. Our cortisol sampling procedure closely mirrored the one employed during study 1. Subjective stress experiences were not measured during study 2.

Results

Dissociative Experiences

The mean DES, DES-T, amnesia, absorption, and depersonalization/derealization subscale scores were 22.3 ($SD = 11.0$), 13.2 ($SD = 9.3$), 15.0 ($SD = 11.0$), 33.1 ($SD = 14.9$), and 11.5 ($SD = 10.7$), respectively.

Cortisol Reaction

Mean baseline cortisol levels were 7.4 nmol/L ($SD = 5.9$). Repeated measures ANOVA with the 4 measurement times as within-subject factor revealed a significant main effect [$F(3,64) = 21.51, p < 0.01$], indicating that our manipulation significantly increased cortisol levels.

During study 2, the cortisol responses were quantified in the same way as in study 1. Overall, cortisol responses in study 2, as indexed by the area under the curve with respect to increase, were significantly higher than those in study 1 [$t(122) = 3.01, p < 0.01$]. Unlike in study 1, the more pathological manifestations of dissociation, notably the DES-T and the depersonalization/derealization subscale of the DES, were related to the cortisol stress response, as indexed by the area under the curve with respect to increase (Table 3). In addition, the more benign manifestation of dissociation, absorption, was related to lowered baseline cortisol levels.

To index the unique influence of the various facets of dissociation on the cortisol stress response, we conducted a forward stepwise multiple regression analyses. In these analyses, the stress response, as indexed by the area under the curves served as dependent variable, while gender, age, and baseline cortisol levels were controlled for. Table 4 presents the summary of the multiple regressions. The analyses resulted in a model consisting of baseline cortisol levels, gender, depersonalization/derealization, and absorption. This model accounted for 31% (R^2) of the variance in the cortisol stress response. Interestingly, the depersonalization/derealization subscale was *positively* related to the cortisol stress

TABLE 3. Pearson Product-Moment Correlations Among the Dissociative Experiences Scale (DES), the Dissociative Experiences Scale Taxon Total Score (DES-T), the Amnesia, Absorption, and Depersonalization Subscale of the DES, Cortisol Baseline Levels, and Area Under the Curve with Respect to Increase (AUC_i) for an Undergraduate Samples (Study 2; $N = 67$)

DES Subscales	Baseline	AUC_i
DES	-0.20	0.14
DES-T	-0.17	0.27 [†]
Amnesia	0.01	0.01
Absorption	-0.24 [†]	0.04
Depersonalization	-0.18	0.29 [†]

*Only relevant correlations are shown.

[†]Correlation is significant at the 0.05 level (2-tailed).

TABLE 4. Summary of the Stepwise Multiple Regression on the Glucocorticoid Stress Response, as Indexed by the Area Under the Curve for an Undergraduate Sample (Study 2: $N = 67$)

Area Under the Curve	<i>B</i>	<i>SE</i>	<i>Beta</i>	<i>t</i>	<i>p</i>
Cortisol premanipulation	-3.15	1.16	-0.30	-2.72	0.01
Gender	42.37	13.26	0.34	3.19	<0.01
DES depersonalization subscale	2.50	0.77	0.43	3.26	<0.01
DES absorption subscale	-1.18	0.56	-0.28	-2.12	0.04

response, while experiences of absorption exhibited a *negative* relationship.

DISCUSSION

The main findings of our 2 studies can be catalogued as follows. The elevated levels of both subjective distress (study 1) and physiological stress (both studies) showed that we were effective in inducing acute stress by means of the TSST procedure used in both studies. Interestingly, individuals high on dissociation experienced a *pronounced increase* in subjective stress as measured with the Tension-Anxiety and the Anger-Hostility subscale of the POMS. These increases were mainly carried by individual differences in absorption and depersonalization/derealization, respectively. Our findings concerning the cortisol response were less straightforward. In study 1, dissociation was unrelated to the cortisol stress response. However, in study 2, which was designed to be more stressful than study 1, heightened levels of DES-T and the depersonalization/derealization subscale of the DES were positively related to the cortisol response. The subsequent regression analysis implied that this finding was due to individual differences in the frequency of depersonalization/derealization experiences. Moreover, this analysis signifies that the benign manifestation of dissociation (i.e., absorption) was negatively related to the cortisol response.

Thus, HPA axis dysregulation is not limited to individuals suffering from DPD (Simeon et al., 2001) but does also

occur, albeit in a milder form and under acute stress conditions, in healthy individuals who report a high frequency of depersonalization/derealization experiences. Interestingly, the absorption subscale of the DES exhibited an opposite relationship with the cortisol response. Thus, while a malign manifestation of dissociation, i.e., depersonalization/derealization, was found to be related to heightened cortisol responses, possibly due to diminished negative HPA axis feedback, absorption appeared to be related to a suppression of cortisol responses. The finding that absorption goes along with a suppression of cortisol responses is in line with that of Morgan et al. (2004, 2001), who investigated peritraumatic dissociation and stress-related hormones in a sample of healthy military personnel participating in survival school training. Their data suggested that individuals who dissociate extensively during this extremely stressful experience dampen their peripheral stress-related physiology during acute stress (see, for similar findings, Koopman et al., 2003).

In study 1, we found that dissociative experiences, notably their absorption and depersonalization/derealization components, are positively correlated with subjective distress during acute stress, a finding which replicates the findings of Griffin et al. (1997) in their sample of traumatized women. However, this pattern is difficult to reconcile with “the ‘shut-down’ symptomatology typically characteristic of dissociative states” (Simeon et al., 2003, p. 93). Thus, the findings of Griffin et al. (1997) appear not to be limited to clinical samples, but probably represent a more general tendency of high dissociators to experience stressful events as more distressing than low dissociators. Germane to this issue is previous research (e.g., Mulder et al., 1998) showing that dissociation levels are related to current mental disorders in the general population. Thus, it might also be the case that the link between dissociation and subjective distress during acute stress is not due to dissociation levels per se (i.e., direct), but is mediated by current psychiatric disorders (i.e., indirect). However, as we did not quantify general psychopathology in study 1, neither possibility can be ruled out.

Note that the present studies have 2 methodological limitations. First, we focused on a single physiological measure, namely cortisol. Of course, the cortisol response is a widely used and valid measure of physiological and psychological stress responses (Dickerson and Kemeny, 2004). However, an interesting additional parameter would be heart rate, as defensive reactions are specifically associated with heart rate acceleration (e.g., Verschuere et al., 2004). Germane to this issue is a study of Koopman et al. (2004) showing that dissociative symptoms, notably feelings of derealization and identity alteration, in delinquent adolescents are related to a lowered mean heart rate during a stressful interview. This finding led the authors to speculate that “perhaps differences in physiological responses such as heart rate are associated with experiencing particular dissociative symptoms rather than dissociative symptoms in general” (Koopman et al., 2004, p. 53). Therefore, future studies should preferably look at the relationship between dissociative subscales and a broad range of physiological measures including cortisol and heart rate. Psychophysiological studies

conducted along these lines might broaden our understanding of the different processes implicated in dissociation. Also our samples exhibited rather homogenous (i.e., low) dissociation levels. Therefore, a replication of our findings in clinical groups exhibiting severe dissociative symptoms would be highly informative, although ethical issues arise when using the TSST in such groups. Second, we focused on the relationship between dissociative tendencies and HPA axis functioning. Future research in this area might benefit from quantifying acute (i.e., peritraumatic) dissociative responses as a response to acute stress and how it overlaps with dissociation as a trait. On a related note, 2 studies have investigated how peritraumatic dissociation during actual trauma relates to subsequent physiological reactions to trauma narratives. Griffin et al. (1997) reported reduced physiological arousal in female victims of recent rape who experienced heightened levels of peritraumatic dissociation. On the contrary, Nixon et al. (2005) found heightened levels of peritraumatic dissociation being related to heightened responsivity in victims of a motor vehicle accident or physical assault (see, for similar results, Giesbrecht et al., in press; Ladwig et al., 2002). Thus, both studies yielded conflicting findings. Moreover, these studies did not investigate dissociation as a trait.

To conclude, we found that individuals with raised dissociative levels report *more* subjective stress. Moreover, the benign manifestation of dissociation (i.e., absorption) was related to *decreased* cortisol responses, while the malign one, notably depersonalization and derealization, was related to *increased* levels of cortisol. In more general terms, our results highlight the importance of HPA axis dysregulations in depersonalization and derealization experiences. In keeping with recent work (Holmes et al., 2005), they also illustrate that it is important to differentiate between various types of dissociation because types might differentially related to stress responses.

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