Data Article

Data for “Social-evaluative threat: Stress response stages and influences of biological sex and neuroticism”

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**A R T I C L E   I N F O**

Article history:
Received 25 July 2019
Received in revised form 24 September 2019
Accepted 3 October 2019
Available online 13 October 2019

Keywords:
Social-evaluative threat
Gender
Cortisol
Anxiety

**A B S T R A C T**

This Data In Brief article contains supplementary materials to the article “Social-evaluative threat: stress response stages and influences of biological sex and neuroticism” [1], and describes analysis results of an open dataset [2].

Additional information is provided regarding the methods, particularly: the analysis of individual stress response peak times per stress system, and the statistical analysis. Importantly, correlation tables are presented between the different stress systems, both for baseline stress levels as well as for stress responses, and significant associations are displayed in scatter plots.

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1. Experimental design, materials, and methods

Full descriptions of the experimental design, materials, and methods can be found at the primary article [1].
1.1. Social-evaluative threat (SET) manipulation

Social-evaluative threat was induced using a public speaking task. Fig. 1 shows a screenshot of the video audience (with permission).

1.2. Assessments and measures

1.2.1. Traits

We used self-report questionnaires to measure extraversion and neuroticism (Big Five Aspects Scale using twenty items each) [3], as well as related traits such as: BIS-BAS sensitivity (behavioral inhibition and approach scales; using seven items for BIS and twelve items for BAS) [4], social anxiety (Liebowitz Social Anxiety Scale; using 48 items) [5], self-esteem (Rosenberg Self-Esteem Scale; using ten items) [6], need to belong (Need to Belong scale; using ten items) [7,8], rumination (Post-event Rumination Questionnaire; using eight items for positive rumination (excl. items #4, 12, 20) and thirteen items for negative rumination (excl. items #5, 7, 15)) [9,10], and masculinity and femininity (Multifaceted
Gender-Related Attributes Survey; using three items each) [11]. Additionally, English language competence (Cambridge online test using 25 items; www.cambridgeenglish.org/test-your-english/general-english/) was measured as a confounding variable.

Based on relevance in the literature and our hypotheses, only the extraversion and neuroticism traits were selected to be featured in the regression models and in the primary article.

1.2.2. Self-reported appraisals

Resource and demand appraisals (stage one of the stress response [12]) were both assessed with single questions. Demand appraisal was measured with: “How demanding do you expect the upcoming task to be?”, and resource appraisal with: “How able are you to cope with the upcoming task?”. A continuous composite measure of resources and demands was calculated, by subtracting demands from resources, yielding positive values in case of higher resources than demands (challenge) and negative values in case of higher demands than resources (threat).

1.2.3. Cardiovascular physiology

Cardiovascular physiology was recorded to measure the following indices of stage two of the stress response: heart rate (HR), mean blood pressure (BP), pre-ejection period (PEP), and respiratory sinus arrhythmia (RSA), as well as respiratory rate (RR) as a covariate in RSA analyses [13]. Electrocardiography (ECG), impedance cardiography (ICG), and respiration were recorded continuously, while systolic and diastolic BP was measured repeatedly. The ECG and ICG signals were analyzed using ANSLAB [14], according to standard analysis protocols. Mean blood pressure was calculated using the formula: 2/3 diastolic + 1/3 systolic [16].

Additional information is provided for ICG measures that were not discussed in the primary article but are included in the open dataset: cardiac output, total peripheral resistance, and threat-challenge index. Cardiac output (CO in liters per minute) was calculated by multiplying heart rate with stroke volume (as estimated in ANSLAB [14] using the Kubicek formula [15]). Total peripheral resistance (TPR in dyne-seconds * cm⁻²) was computed by dividing mean blood pressure by CO and multiplying that value by 80 [17]. A threat-challenge index for each time point was calculated by subtracting z-transformed-values of TPR from CO [18,19]. Thus, higher values on the TCI indicate a stronger challenge motivational state whereas lower values on the TCI indicate a stronger threat motivational state.
1.2.4. Self-reported affective and motivational states

Affective and motivational responses (stage three of the stress response) were measured using state anxiety and state approach motivation, respectively [10, 20, 21]. State anxiety was measured with the single question: “How anxious do you feel right now?”, and state approach motivation was measured with the single question: “How much are you looking forward to the next part of the study?”.

1.2.5. Endocrine physiology

In order to assess free salivary cortisol (stage four of the stress response), seven saliva samples were collected throughout the experiment and frozen. Analysis was performed using ELISA (DeMediTec Diagnostics, Kiel, Germany) by using two duplicate measures for each saliva sample to increase reliability, and samples with intra-assay coefficients of variability above 25% were repeated.

1.3. Statistical analyses

1.3.1. Outlier detection

Outliers were detected based on significant values on the Grubbs test [22]. This statistic tests the deviation from the sample mean of the largest and smallest observation of a given variable. This test was applied over all variables (with Bonferroni-correction), and repeated until no significant outliers were present (i.e., after one round). Two outliers were excluded in these steps. Subsequently, the regression models using complete observations were tested for outliers in the Studentized residuals of each linear model (with Bonferroni-correction), based on the mean-shift outlier test [23]. One outlier was excluded in this step, resulting in three outlier participants in total.

1.3.2. Missing data management

A description of all missing observations and outliers per variable can be found in Table 1. Variables that did not contain any missing data or outliers are not included in Table 1 (Neuroticism, Extraversion, Resource-demand appraisal, State anxiety 1 through 4, ΔState anxiety, State approach motivation 1 through 4, ΔState approach motivation, Mean blood pressure 1 through 8, ΔMean blood pressure, Cortisol 2 through 7).

1.3.3. Multiple imputation of missing data

Since twenty-four participants had some missing data points due to excessive noise, temporary sensor malfunction, or loose contacts, and another four participants had excluded outlier data points (see section Outlier detection), there were only thirty-eight complete observations in the dataset out of sixty-seven. To avoid the loss of 43.3% of our participants in the analyses, we multiply imputed the missing data using chained equations using the MICE package [24]; a “state of the art” missing data method.

The imputation model did not contain all possible variables, considering the large number of variables in the dataset. Instead, only relevant variables were included for all variables to be imputed (as is recommended: Buuren and Groothuis-Oudshoorn, 2011): sex, age, trait extraversion, trait neuroticism, resource-demand appraisal, and all reactivity variables, as well as the other time points of the same measure; resulting in twenty to twenty-one predictors per variable. This is specified in the predictorMatrixAdj.xlsx file [2]. (For example, HR 1 was predicted by: sex, age, trait extraversion, trait neuroticism, resource-demand appraisal, reactivity variables of: state anxiety, state approach motivation, mean BP, PEP, RSA, RR, and cortisol, as well as the other HR time points: 2, 3, 4, 5, 6, 7, and 8.) Reactivity variables were passively imputed, based on a given formula to compute individual peak minus baseline (Δ; see SET reactivity section in primary article).

Forty-four datasets were imputed, based on the rule of thumb that at least as many datasets need to be imputed as the percentage of incomplete cases [25]. Missing values were imputed by predictive mean matching, since in this method imputations are restricted to the observed values [24]. Two-hundred iterations were allowed to reach convergence.

Plausibility of imputed variables was assessed by comparing them to complete observations using boxplots, strip plots, and density plots, and summary statistics. All subsequent analyses were
performed for each of the imputed datasets and the resulting estimates were pooled according to Rubin’s rules [26].

1.3.4. SET reactivity

SET responses were computed with a reactivity measure of individual peak minus baseline [27], henceforth identified as $\Delta$. The peak represents the individual maximum or minimum value (depending on the measure) during or right after SET (i.e., either early or late anticipation, or early or

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| Variable                      | Number of missing observations | Number of outliers |
|-------------------------------|--------------------------------|--------------------|
| State anxiety 5              | 7                              | 0                  |
| State anxiety 6              | 7                              | 0                  |
| State anxiety 7              | 7                              | 0                  |
| State anxiety 8              | 7                              | 0                  |
| State approach motivation 5  | 7                              | 0                  |
| State approach motivation 6  | 7                              | 0                  |
| State approach motivation 7  | 7                              | 0                  |
| State approach motivation 8  | 7                              | 0                  |
| HR 1                          | 1                              | 0                  |
| HR 2                          | 1                              | 0                  |
| HR 3                          | 2                              | 0                  |
| HR 4                          | 3                              | 1                  |
| HR 5                          | 2                              | 0                  |
| HR 6                          | 2                              | 0                  |
| HR 7                          | 4                              | 0                  |
| HR 8                          | 4                              | 0                  |
| $\Delta$HR                    | 5                              | 0                  |
| PEP 1                         | 6                              | 0                  |
| PEP 2                         | 6                              | 0                  |
| PEP 3                         | 6                              | 0                  |
| PEP 4                         | 6                              | 0                  |
| PEP 5                         | 7                              | 0                  |
| PEP 6                         | 6                              | 0                  |
| PEP 7                         | 8                              | 0                  |
| PEP 8                         | 8                              | 0                  |
| $\Delta$PEP                   | 9                              | 0                  |
| RSA 1                         | 1                              | 1                  |
| RSA 2                         | 1                              | 1                  |
| RSA 3                         | 2                              | 1                  |
| RSA 4                         | 3                              | 1                  |
| RSA 5                         | 2                              | 1                  |
| RSA 6                         | 2                              | 1                  |
| RSA 7                         | 4                              | 1                  |
| RSA 8                         | 4                              | 1                  |
| $\Delta$RSA                   | 4                              | 1                  |
| RR 1                          | 5                              | 0                  |
| RR 2                          | 4                              | 0                  |
| RR 3                          | 3                              | 0                  |
| RR 4                          | 4                              | 0                  |
| RR 5                          | 3                              | 0                  |
| RR 6                          | 3                              | 0                  |
| RR 7                          | 5                              | 0                  |
| RR 8                          | 5                              | 0                  |
| $\Delta$RR                    | 7                              | 0                  |
| Cortisol 1                    | 0                              | 1                  |
| $\Delta$Cortisol              | 0                              | 1                  |

Note. HR = heart rate; PEP = pre-ejection period; RSA = respiratory sinus arrhythmia; RR = respiratory rate; $\Delta$ = individual reactivity.
late first recovery). Additionally, we calculated the area under the curve (AUC with respect to the increase [28]) for the cortisol response, which were strongly correlated, \( r = 0.93, p < .001 \).

2. Data

Raw and analyzed data can be accessed via Mendeley data [2].

In this section, we will report the correlation coefficients of associations between trait predictors (extraversion, neuroticism) and baseline state measures, as well as between different stress response measures. Additionally, scatterplots of significant associations between baseline states and traits and stress responses are provided. Finally, we report on the sex differences in the timing of the peak stress response reactivity.

2.1. Associations between stress response systems

Correlations between stress response systems were computed using Pearson correlations, in particular: between trait predictors (extraversion, neuroticism) and baseline state measures (Table 2), between different stress response measures (Table 2), between trait predictors (extraversion, neuroticism) and baseline state measures per sex (Table 3), and between different stress response measures per sex (Table 3).

For all analyses, alpha was set at .05, and false-discovery rate (FDR) correction was performed to correct for multiple comparisons. Uncorrected \( p \)-values are reported for transparency, with FDR-corrected significance indicated by superscript symbols.

When combining men and women, the only significant FDR-corrected correlations were those between PEP and cortisol, both for baseline and reactivity indices – indicating more sympathetic nervous system (SNS) activity with more hypothalamus-pituitary-adrenal (HPA) axis activity – as well as between baseline and reactivity for RSA, state approach motivation, and state anxiety, and between neuroticism and Δcortisol. No correlations for each sex separately were significant after FDR-correction.

2.2. Scatterplots of significant associations

Scatterplots of significant regression associations between trait predictors (extraversion, neuroticism), baseline state measures, and different stress response measures per sex are shown in Fig. 2. The first imputed dataset (see section: Multiple imputation of missing data) was used for illustration purposes (N = 67).

2.3. Peak timing

Sex differences in the timing of the peak reactivity were assessed using two-sample \( t \)-tests (variances not assumed equal). Sex differences in RSA were tested using a linear regression with RR as covariate. The regression coefficients were then converted into \( t \)-values. To provide confirming evidence of the null hypotheses, Bayes factors were calculated from \( t \)-values using the BayesFactor package [29] with default non-informative priors. Alpha was set at .05, and FDR correction was performed to correct for multiple comparisons. Uncorrected \( p \)-values are reported for transparency, with FDR-corrected significance indicated by superscript symbols.

Results are shown in Table 4. Peak time of the decrease in RSA (corrected for RR) was earlier in women than men and peak time of the decrease in PEP was comparable between men and women. Peak time reactivity of state anxiety, state approach motivation, mean BP, heart rate, RSA (uncorrected for RR), RR, and cortisol did not differ significantly between men and women, although based on Bayes factors there was inconclusive evidence to support neither equal nor different group means.
| Baseline states and traits | Extraversion | Neuroticism | Baseline | Baseline | Baseline | Baseline | Baseline | Resource- | ∆PEP | ∆RSA | ∆State | ∆State | ∆Cortisol |
|----------------------------|--------------|-------------|----------|----------|----------|----------|----------|----------|------|------|---------|--------|-----------|
|                            |              |             | PEP      | RSA      | state    | approach | anxiety  | demand   |      |      | motivation | anxiety |           |
| Extraversion               | r            |             | p        | .005     |          |          |          |          |      |      |          |         |           |
| Neuroticism                | r – .34      |             | p .005   |          |          |          |          |          |      |      |          |         |           |
| Baseline PEP              | r – .14      | .26         | p .266   | .038     |          |          |          |          |      |      |          |         |           |
| Baseline RSA              | r – .15      | .05         | p .241   | .683     | .867     |          |          |          |      |      |          |         |           |
| Baseline state approach motivation | r .09       | .08         | p .484   | .545     | .779     | .927     |          |          |      |      |          |         |           |
| Baseline state anxiety    | r .09        | .01         | p .464   | .965     | .557     | .040     | .479     |          |      |      |          |         |           |
| Baseline Cortisol         | r .22        | – .11       | p .076   | .372     | .001*    | .066     | .491     | .629     |      |      |          |         |           |
| Resource-demand appraisal | r – .04      | .09         | p .734   | .470     | .613     | .709     | .347     | .162     | .210 |      |          |         |           |
| ∆PEP                      | r .20        | .25         | p .125   | .043     | .017     | .208     | .688     | .603     | .504 | .313 |          |         |           |
| ∆RSA                      | r .05        | .13         | p .697   | .315     | .149     | < .001** | .415     | .165     | .465 | .705 | .094     |         |           |
| ∆State approach motivation| r – .12      | .10         | p .336   | .416     | .894     | .124     | .003*    | .220     | .810 | .302 | .785     | .726    |           |
| ∆State anxiety            | r – .11      | – .04       | p .363   | .777     | .092     | .174     | .993     | < .001*** | .790 | .197 | .554     | .075    | .035     |
| ∆Cortisol                 | r – .13      | – .36       | p .290   | .003*    | .712     | .332     | .100     | .087     | .572 | .878 | < .001*  | .232    | .268     | .372     |

Note. Significant correlations are shown in bold (FDR-corrected p < .05); ** = significant at α = 0.01 after FDR correction; * = significant at α = 0.05 after FDR correction. PEP = pre-ejection period, RSA = respiratory sinus arrhythmia; Δ = individual reactivity.
### Table 3
Correlations between trait predictors (extraversion, neuroticism), baseline state measures, and different stress response measures per sex (women above, men below diagonal).

| Baseline states and traits | Extraversion | Neuroticism | Baseline PEP $r$ | Baseline RSA $r$ | Baseline state approach motivation $r$ | Baseline state anxiety $r$ | Baseline Cortisol $r$ | Resource-demand appraisal $r$ | $\Delta$PEP $r$ | $\Delta$RSA $r$ | $\Delta$State approach motivation $r$ | $\Delta$State anxiety $r$ | $\Delta$Cortisol $r$ |
|---------------------------|--------------|-------------|------------------|------------------|---------------------------------|-------------------|-----------------|-----------------------------|-----------------|-----------------|-----------------------------|-----------------|-----------------|
| Extraversion              | $-0.38$      | $-0.34$     | $-0.18$          | $0.01$           | $0.15$                          | $0.38$            | $-0.03$         | $0.43$                       | $-0.03$         | $-0.12$         | $-0.15$                       | $-0.25$         |               |
|                           | $0.035$      | $0.065$     | $0.347$          | $0.951$          | $0.439$                         | $0.040$           | $0.857$         | $0.024$                      | $0.064$         | $0.539$         | $0.432$                       | $0.201$         |               |
| Neuroticism               | $-0.19$      | $0.34$      | $-0.09$          | $0.17$           | $-0.12$                         | $-0.14$           | $0.04$          | $0.01$                       | $0.42$          | $-0.08$         | $0.30$                       | $-0.26$         |               |
|                           | $0.252$      | $0.068$     | $0.637$          | $0.370$          | $0.532$                         | $0.463$           | $0.816$         | $0.950$                      | $0.025$         | $0.689$         | $0.109$                       | $0.162$         |               |
| Baseline PEP              | $0.14$       | $0.17$      | $-0.27$          | $-0.18$          | $-0.40$                         | $0.03$            | $-0.34$         | $0.15$                       | $0.18$          | $0.16$          | $0.06$                       |               |               |
|                           | $0.414$      | $0.326$     | $0.915$          | $0.150$          | $0.344$                         | $0.027$           | $0.873$         | $0.070$                      | $0.431$         | $0.356$         | $0.390$                       | $0.773$         |               |
| Baseline RSA              | $0.09$       | $0.01$      | $-0.03$          | $0.16$           | $-0.19$                         | $0.22$            | $-0.25$         | $-0.49$                      | $-0.27$         | $-0.16$         | $0.12$                       |               |               |
|                           | $0.593$      | $0.583$     | $0.947$          | $0.864$          | $0.412$                         | $0.335$           | $0.261$         | $0.235$                      | $0.111$         | $0.164$         | $0.395$                       | $0.553$         |               |
| Baseline state            | $0.19$       | $-0.02$     | $0.30$           | $-0.01$          | $-0.03$                         | $-0.06$           | $0.13$          | $0.23$                       | $0.05$          | $-0.39$         | $-0.06$                       | $-0.22$         |               |
| approach motivation       | $0.266$      | $0.924$     | $0.083$          | $0.976$          | $0.859$                         | $0.768$           | $0.502$         | $0.276$                      | $0.783$         | $0.032$         | $0.758$                       | $0.251$         |               |
| Baseline state            | $0.07$       | $0.05$      | $0.03$           | $0.32$           | $0.18$                          | $0.09$            | $-0.11$         | $-0.05$                      | $-0.07$         | $-0.17$         | $-0.51$                       | $-0.20$         |               |
| anxiety                   | $0.686$      | $0.776$     | $0.865$          | $0.051$          | $0.276$                         | $0.639$           | $0.564$         | $0.797$                      | $0.710$         | $0.363$         | $0.004$                       | $0.354$         |               |
| Baseline Cortisol         | $0.05$       | $-0.14$     | $-0.38$          | $-0.28$          | $-0.12$                         | $0.02$            | $-0.32$         | $0.02$                       | $-0.08$         | $-0.10$         | $-0.08$                       | $-0.10$         |               |
| Resource-demand appraisal | $-0.06$      | $0.16$      | $0.10$           | $-0.07$          | $0.11$                          | $-0.23$           | $<0.01$         | $-0.18$                      | $-0.15$         | $0.02$          | $-0.16$                       | $-0.22$         |               |
| $\Delta$PEP               | $0.705$      | $0.353$     | $0.566$          | $0.677$          | $0.514$                         | $0.174$           | $0.984$         | $0.342$                      | $0.458$         | $0.914$         | $0.403$                       | $0.251$         |               |
| $\Delta$RSA              | $0.44$       | $-0.27$     | $-0.14$          | $-0.08$          | $-0.09$                         | $0.15$            | $-0.08$         | $0.39$                       | $-0.18$         | $-0.07$         | $-0.35$                       |               |               |
| $\Delta$State approach motivation | $0.01$ | $-0.91$ | $-0.25$ | $-0.15$ | $-0.35$ | $-0.15$ | $0.04$ | $0.25$ | $0.10$ | $-0.15$ | $-0.15$ | $0.16$ |               |
| $\Delta$State anxiety    | $0.608$      | $0.184$     | $0.129$          | $0.376$          | $0.031$                         | $0.384$           | $0.809$         | $0.144$                      | $0.579$         | $0.382$         | $0.441$                       | $0.415$         |               |
| $\Delta$Cortisol         | $0.701$      | $0.079$     | $0.156$          | $0.275$          | $0.883$                         | $<0.01^*$         | $0.971$         | $0.326$                      | $0.614$         | $0.047$         | $0.023$                       | $0.565$         |               |

Note. Men are shown underneath the diagonal in bold; women are shown above the diagonal. * = significant at $\alpha = 0.05$ after FDR correction. PEP = pre-ejection period, RSA = respiratory sinus arrhythmia; $\Delta$ = individual reactivity.
Fig. 2. Scatterplots of significant associations between trait predictors, baseline state measures, and different stress response measures per sex: a) trait neuroticism with ΔPEP, b) trait neuroticism with Δcortisol, c) baseline PEP with ΔPEP, d) baseline RSA with ΔRSA, e) baseline state approach motivation with Δstate approach motivation, f) baseline state anxiety with Δstate anxiety, and g) ΔPEP with Δcortisol.
This work was financially supported by the Doctoral College “Imaging the Mind” of the Austrian Science Fund (FWF; W1233-G17; PhD student Eefje S. Poppelaars; supervising faculty members Eva Jonas, Frank Wilhelm, Johannes Klackl, and Belinda Pletzer) and by Salzburg University’s promotion stipend (to Eefje S. Poppelaars). (All funding sources had no further involvement.)

We thank Tilmann Hüppauff, Maximilian Lüdke, Benjamin Mayer, Tim Schöttelndreier, and Magdalena Zacher for their assistance with data collection. We thank Aditi Arora, Andreas Böhm, Sara Fernández Rodriguez-Cabello, Adrian Lüders, Michael S. Prentice, Elizaveta Prentice, Elie E. Rassi, Frank van Schalkwijk, and Lavinia C. Uscatescu for being part of the pre-recorded video audience.

**Conflict of Interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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