Personality and physiological reactions to acute psychological stress in a large cohort of middle aged men and women

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Background

* Stable personality traits: - biological substrates
  - affect stress perception

* Previous evidence → inconclusive

* This may reflect a range of methodological problems:
  * small sample sizes
  * predominance of young student samples
  * restricted range of trait scores
  * dichotomized trait variables
  * failure to adjust statistically for a range of possible confounding variables
Present Aims

* Revisit the issue of personality and biological stress reactivity in a substantial cohort who had undergone stress testing and in whom personality traits were measured using the Big Five Inventory.
Big Five Trait Taxonomy

1) **Neuroticism**: tendency toward negative affectivity and an inclination toward impulsive behavior.

2) **Agreeableness**: willingness to be helpful and trusting, and to possess a pro-social orientation.

3) **Openness**: imaginative, creative, attentive to inner feelings, prefer variety, and are flexible in their thinking.

4) **Extraversion**: energetic, sociable, and assertive.

5) **Conscientiousness**: organization, self-discipline, and determination.

(McCrae and Costa, 1987)
Methods

Dutch Famine Birth Cohort Study

Overarching aim: Examine effects of intrauterine famine exposure in the winter of 1944-45 on health in later adulthood.

- 2002-04 Stress testing N = 725
- 2008-09 Big Five Inventory N = 601

Combined sample N = 389

Final sample N = 352

Removal of participants exposed to famine in early gestation N = 37
## Characteristics of final sample

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>M/N</th>
<th>SD/%</th>
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</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>58.23</td>
<td>0.95</td>
</tr>
<tr>
<td>Sex (female)</td>
<td>190</td>
<td>52.5</td>
</tr>
<tr>
<td>Socio-economic status (ISEI-92)</td>
<td>51.29</td>
<td>13.64</td>
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<tr>
<td>Body mass index (kg/m$^2$)</td>
<td>28.76</td>
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<tr>
<td>Alcohol (units of per week)</td>
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<tr>
<td>Current smoker</td>
<td>74</td>
<td>20.5</td>
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<tr>
<td>Anti-hypertensive medication</td>
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<tr>
<td>Anti-depressant or anxiolytic</td>
<td>45</td>
<td>12.4</td>
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</table>
Stress Testing Protocol

Stress 1 = Stroop test
Stress 2 = Mirror drawing test
Stress 3 = Speech test
REC = Recovery period
Results

Stress significantly perturbed biological activity

- **Salivary cortisol (nmol/L)**
  - Baseline: 4.0
  - Average post task: 5.0

- **Heart rate (bpm)**
  - Baseline: 70
  - Average task: 80

- **Systolic blood pressure (mmHg)**
  - Baseline: 120
  - Average task: 160

- **Diastolic blood pressure (mmHg)**
  - Baseline: 64
  - Average task: 78

Statistical analyses:

- **Salivary cortisol**:
  - $F(1, 266) = 41.64, p < .001, \eta^2 = .135$

- **Heart rate**:
  - $F(1, 350) = 110.56, p < .001, \eta^2 = .240$

- **Systolic blood pressure**:
  - $F(1, 351) = 1302.48, p < .001, \eta^2 = .788$

- **Diastolic blood pressure**:
  - $F(1, 351) = 314.62, p < .001, \eta^2 = .473$
Personality and cortisol

Regression models for neuroticism, agreeableness, openness and cortisol reactivity

<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>t</th>
<th>p</th>
<th>R²</th>
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<tbody>
<tr>
<td><strong>Neuroticism and cortisol reactivity</strong></td>
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<tr>
<td>Unadjusted Model</td>
<td>-.19</td>
<td>3.20</td>
<td>.002</td>
<td>.035</td>
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<tr>
<td>Adjusted 1</td>
<td>-.14</td>
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<td>2.27</td>
<td>.02</td>
<td>.016</td>
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</tbody>
</table>

| **Agreeableness and cortisol reactivity** |       |      |      |     |
| Unadjusted Model              | .15   | 2.49 | .01  | .021|
| Adjusted 1                    | .16   | 2.75 | .006 | .025|
| Adjusted 2                    | .16   | 2.73 | .007 | .023|

| **Openness and cortisol reactivity** |       |      |      |     |
| Unadjusted Model              | .19   | 3.31 | .001 | .037|
| Adjusted 1                    | .15   | 2.51 | .01  | .021|
| Adjusted 2                    | .13   | 2.21 | .03  | .015|

Adjusted 1: sex, age, SES

Adjusted 2: alcohol consumption, smoking, BMI, use of anti-hypertensive medication, use of anti-depressant or anxiolytic medication, perceived commitment to the stress task, and baseline cortisol.
Individuals high on neuroticism, and low on agreeableness and openness demonstrated blunted cortisol responses.
# Personality and heart rate

Regression models for neuroticism, agreeableness, openness and heart rate reactivity

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Adjusted 1: sex, age, SES

Adjusted 2: alcohol consumption, smoking, BMI, use of anti-hypertensive medication, use of anti-depressant or anxiolytic medication, perceived commitment to the stress task, and baseline heart rate
Individuals high on neuroticism, and low on agreeableness and openness also had blunted heart rate responses.
## Personality and blood pressure

Regression models for neuroticism, and systolic and diastolic blood pressure

<table>
<thead>
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<table>
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SBP= systolic blood pressure, DBP= diastolic blood pressure

Adjusted 1: sex, age, SES

Adjusted 2: alcohol consumption, smoking, BMI, use of anti-hypertensive medication, use of antidepressant or anxiolytic medication, perceived commitment to the stress task, and baseline SBP/DBP
Individuals high on neuroticism demonstrated blunted blood pressure reactivity.
Personality and stress task ratings

* In contrast, high neuroticism and low openness were associated with higher reported stress, and lower reported control following exposure to stress tasks

<table>
<thead>
<tr>
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<th>Control</th>
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<tr>
<td><strong>Neuroticism</strong></td>
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<tr>
<td></td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Openness</strong></td>
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<td>.25</td>
</tr>
<tr>
<td></td>
<td>.01</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
Results Overview

- Cortisol + HR reactivity
- SBP + DBP reactivity
- Self reported stressfulness
- Self reported control

Neuroticism
Agreeableness
Openness
Neuroticism
Neuroticism
Openness
Discussion

* Negative constellation of personality traits associated with diminished stress reactions of both of the HPA axis and cardiovascular system.

**Blunted Stress Reactivity**

* Worth noting that the adverse health and behavioural corollaries identified with blunted reactivity are also for the most part, associated with this negative personality profile and, in particular, neuroticism.

Carroll et al, 2011
Lovallo, 2011

Hypothesis: peripheral marker of dysregulation in the brain systems that support emotion and motivation.

Paradox: Self-report and biological responses

* Neuroticism:
  - Repeated adverse perceptions ➔ Chronic stress ➔ Allostasis

* Openness:
  - Emotional suppression + Task variety preference

* Suggest drivers of subjective stress reactions are different from those that drive physiological stress reactivity.
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References


