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Optimizing expectations and distraction leads to lower cortisol levels after acute stress

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ABSTRACT

Background: A new approach of psychological interventions prior to stress aiming to optimize expectations may have beneficial effects on a person's health status by reducing physiological stress. The purpose of this experiment was to determine whether a brief psychological intervention designed to optimize personal control expectations prior to acute stress would affect perceived and biological stress responsiveness in comparison to two more established interventions (fostering gratitude or distraction) in a healthy sample.

Methods: 74 healthy participants were randomized to one of three psychological interventions prior to stress: (i) writing about ways to influence stress to optimize personal control expectations (EXPECTATION), (ii) writing a gratitude-letter (GRATITUDE) (iii) or a distraction writing task (DISTRACTION). After completing the intervention, the Maastricht acute stress test was administered to induce (psychosocial and physiological) stress. Assessments took place at baseline, post-intervention (15 min writing task) and after stress induction (additional salivary assessments: 15 and 30 min after stress). Main outcomes were expectations, emotions, perceived stress, salivary cortisol and alpha-amylase. Personality traits (eg, optimism) were assessed at baseline.

Results: EXPECTATION specifically increased personal control expectations ($p = .016$, $d = .72$) and GRATITUDE specifically increased gratitude ($p = .026$, $d = .68$). EXPECTATION and DISTRACTION led to lower cortisol concentrations after stress induction than GRATITUDE (time x group interaction: $p < .001$, $d = .88$). We detected no intervention effects on alpha-amylase or perceived stress. Optimism moderated intervention effects on cortisol ($p = .023$, $d = .74$).

Conclusions: Brief psychological interventions aiming to optimize expectations or distraction prior to stress reduce the cortisol response in healthy participants after an acute stressor.

1. Introduction

Stress is known to be a major factor in abnormal psychological and physical conditions (Chrousos, 2009; McEwen, 2012, 2007, 1998; Nater et al., 2013). Recently it was shown that psychological interventions focusing on optimizing expectations improved coping with stress and illness (Rief et al., 2017; Salzmann et al., 2017). However, it is unknown whether a brief single-session intervention to optimize expectations prior to acute stress can reduce stress responsiveness in healthy participants. In this study we compared the impact of a brief intervention aiming to specifically optimize personal control expectations with two more established brief interventions (fostering situational gratitude or distraction) before a stressor on psychophysiological stress reactivity after acute stress in healthy participants.

Expectations play a crucial role in placebo research, are important predictors of the course and outcome for medical interventions − even in surgical patients (Auer et al., 2016), and are thought to be a key mechanism in mental health (Rief and Glombiewski, 2017) and in subjective and physiological stress genesis (Gaab et al., 2005; Lazarus and Folkman, 1987; Ursin and Eriksen, 2010). However, approaches to utilize expectations to improve outcomes have seldom been attempted (Enck et al., 2013). The expectation of being in control or being able to cope with a stressor seems to play an important role, since personal control expectations in general are thought to be associated with a

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reduced psychological and physiological stress response (Dickerson and Kemeny, 2004; Gaab et al., 2005; Mayer et al., 2016; Steptoe and Appels, 1989; Ursin and Eriksen, 2010). There is experimental evidence that a single session (20 min) of writing or imagining one's best possible self (BPS) in the future leads to higher positive outcome expectations and a more positive mood (Peters et al., 2013). However, studies on the acute stress response after inducing positive expectations − especially after inducing personal control expectations prior to stress in a healthy sample − are pending.

Another important, more established contributor to positive outcomes in clinical conditions are positive emotions (Huffman et al., 2011; Millstein et al., 2016). Gratitude interventions were among the most effective mental exercises in reducing distress in a study examining different positive psychology interventions in suicidal patients (Huffman et al., 2014). Experimentally induced positive emotions are associated with more adaptive physiological stress responses (Pressman and Cohen, 2005), that is reduced stress responsiveness or faster recovery from stress (Fredrickson and Levenson, 1998; Liu et al., 2016). Likewise, writing gratitude letters has also proven to be effective in increasing well-being (Layous and Lyubomirsky, 2013; Seligman et al., 2005), and in reducing subjective stress and cortisol levels (Matvienko-Sikar and Dockray, 2016).

Distraction is considered a standard coping style used during or after stressful situations (Lazarus and Folkman, 1987) and is an especially familiar coping strategy to lowering pain intensity during acute pain (Kohl et al., 2013). Recent studies have shown that distraction facilitates the diminishing of cortisol reactions in experimental stress settings (Janson and Rohleder, 2017; Zoccola et al., 2013).

The differential effects of specific expectation and gratitude interventions are not yet thoroughly understood (Huffman et al., 2014; Peters et al., 2013), since most previous researchers administered interventions conducted over a longer time period that were designed to influence a variety of expectations or emotions (e.g., Huffman et al., 2011; Rief et al., 2017).

The primary study aim was to compare the differential effects of brief interventions (expectation vs. gratitude vs. distraction) on subjective and physiological stress responsiveness. The second study aim was to determine, whether the expectation and the gratitude intervention would differentially improve the targeted construct. A direct comparison of different brief interventions' effects on stress responsiveness and a better understanding of underlying mechanisms might be important to design the most effective and applicable interventions for stress reduction. As a third study aim we examined the moderating role of trait optimism and dispositional gratitude on intervention effects, because the fit between the person and an intervention may depend particularly on personality aspects or a person's preference (Layous and Lyubomirsky, 2013).

2. Materials and methods

2.1. Participants

Participants were healthy and aged 18–57 years. We included non-smoking men and women fluent in German and of normal weight (BMI 17–29 kg/m^2). Exclusion criteria were chronic disease, mental disease, acute hay fever or current intake of psychotropic medication or regular medication intake. Women were only included if they were using oral contraceptives. We calculated an adequate sample size of N = 75 to examine the time x group interaction effect with an effect size of f = 0.35, α = .05 and power 1-β = .8 (5 assessment time points; estimated N = 66; we added possible drop-outs 10–15%).

2.2. Procedure and assessment

Participants were recruited via online advertisements and mailing lists; they were told that this study was designed to investigate any associations between personality traits and stress responsiveness. First, a telephone interview was conducted to assess the inclusion and exclusion criteria and provide information for participation as follows: avoid exhaustive physical activity prior to the experiment, avoid drinking caffeine or chewing gum on the day of the experiment, refrain from drinking alcohol and intensive physical exercise the evening before the day of the experiment.

On the day of the experiment, participants gave informed consent before sitting down on a comfortable chair in a light- and temperature-controlled room. All participants received detailed information about the upcoming stressor prior to providing informed consent; they were told that the study goal was to investigate the association between personality and stress responsiveness and that the writing intervention served to assess participants' personality. Patients had to fill in socio-demographic and personality questionnaires. The questionnaires were given and samples for salivary cortisol (sCort) and salivary alpha-amylase (sAA) analyses were taken after 10 min of rest (ie, baseline), after a short psychological intervention (15 min writing task) and immediately after applying the Maastricht acute stress test (MAST) (Smeets et al., 2012). The MAST combines the stressful features of the Trier Social Stress Test (TSST) (Kirschbaum et al., 1993) (psychosocial evaluative threat, uncontrollability, and unpredictability) with the pain of the Cold Pressor Test (Lovallo, 1975) to create a physically and psychologically challenging laboratory stress test that is easy for just one experimenter to administer and is thought to elicit similar physiological reactions in participants compared with the TSST (Smeets et al., 2012). We decided to choose the MAST over the TSST, since the combination of psychosocial and physical stress of the MAST is closer to natural stressors like surgery (with psychosocial and physical stress) and it is easier to administer (Smeets et al., 2012). After a preparation phase (5 min), participants are videotaped and have to put their hands in ice-cold (2 °C) water for six trials of various durations (60s to 90s). Between the ice-water trials, participants are asked to immediately engage in a mental arithmetic test (counting backwards) as fast and accurately as possible, and are given negative feedback when making a mistake. To assess physiological stress response profiles via changes in sCort and sAA, participants provided two additional saliva samples (15 and 30 min after stress induction). Assessments took place between 2 and 6 pm to control for the daily rhythm of salivary markers. Questionnaires assessing age, sex, BMI and all instruments were presented on a computer screen.

For the psychological intervention prior to the stress (MAST), participants were randomized to one of three conditions (see supplementary material: Fig. 5 for instructions): (i) writing about and imagining possibilities and strategies involved in how they dealt successfully with stressors in the past to optimize personal control expectations (EXPECTATION) regarding the upcoming stressful situation, (ii) writing a letter of gratitude to a significant other and thinking about the impact this had on their own lives to foster situational gratitude (GRATITUDE) (Seligman et al., 2005), or (iii) writing about neutral content (a retrospective protocol of the activities during a typical working day) to not involve feelings and to distract participants from the upcoming stressor (DISTRACTION). All interventions were similar in terms of time, attention, and writing. The participants' written materials were checked to ensure they had followed instructions. The participants were randomized (1:1:1) with "WinPepi", version 11.62. Because women using hormonal contraceptives may exhibit a weaker endocrine stress response (Kirschbaum et al., 1999) randomization was stratified for sex. At the end of the experiment, participants received thorough information on the purpose of the experiment and were given either 20 Euros or course credit for their time. This study was registered at www.clinicaltrials.gov (NCT02848014). Data were assessed from 06/2016 to 11/2016. The study protocol was approved by the local Ethics Committee of the University of Marburg. Written informed consent was provided by all participants prior to study entry.