Psychoneuroendocrinology (2014) 43, 41—51

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/psyneuen

Mood and autonomic responses to repeated exposure to the Trier Social Stress Test for Groups (TSST-G)

Maria Boesch [a,b], Sandra Sefidan [a,b], Ulrike Ehlert [a], Hubert Annen [b], Thomas Wyss [c], Andrew Steptoe [d], Roberto La Marca [a,*]

[a] Clinical Psychology and Psychotherapy, University of Zurich, Zurich, Switzerland
[b] Military Academy, Swiss Federal Institute of Technology ETH Zurich, Zurich, Switzerland
[c] Swiss Federal Institute of Sports Magglingen SFISM, Magglingen, Switzerland
[d] Department of Epidemiology and Public Health, University College London UCL, London, United Kingdom

Received 26 August 2013; received in revised form 4 February 2014; accepted 5 February 2014

KEYWORDS
Trier Social Stress Test for Groups;
Repeated stress provocation;
Autonomic nervous system;
Salivary alpha-amylase;
Heart rate;
Heart rate variability

Summary
Introduction: A group version of the Trier Social Stress Test (TSST-G) was introduced as a standardized, economic and efficient tool to induce a psychobiological stress response simultaneously in a group of subjects. The aim of the present study was to examine the efficacy of the TSST-G to repeatedly induce an affective and autonomic stress response while comparing two alternative protocols for the second examination.
Methods and materials: Healthy young male recruits participated twice in the TSST-G 10 weeks apart. In the first examination, the TSST-G consisted of a combination of mental arithmetic and a fake job interview (TSST-G-1st; $n = 294$). For the second examination, mental arithmetic was combined with either (a) a defensive speech in response to a false shoplifting accusation (TSST-G-2nd-defence; $n = 105$), or (b) a speech on a more neutral topic selected by the investigators (TSST-G-2nd-presentation; $n = 100$). Affect ratings and salivary alpha-amylase (sAA) were determined immediately before and after the stress test, while heart rate (HR) and heart rate variability (HRV) were measured continuously.

Abbreviations: ANS, autonomic nervous system; BL, baseline; HPA axis, hypothalamic—pituitary—adrenal axis; HR, heart rate; HRV, heart rate variability; Intro, introduction; PANAS, positive and negative affect schedule; Rec, recovery; RMSSD, square root of the mean of the sum of the squares of differences between adjacent normal-to-normal intervals; sAA, salivary alpha-amylase; S1, speech task; S2, mental arithmetic task; TSST(-G), Trier Social Stress Test (for Groups); TSST-G-1st, first exposure to TSST-G including both subgroups (defence and presentation); TSST-G-2nd-defence, second exposure to TSST-G with a defensive speech; TSST-G-2nd-presentation, second exposure to TSST-G with speech on a more neutral topic.

* Corresponding author at: Department of Clinical Psychology and Psychotherapy, University of Zurich, Binzmuehlestrasse 14/Box 26, CH-8050 Zurich, Switzerland. Tel.: +41 44 635 73 62; fax: +41 44 635 73 59.
E-mail address: r.lamarca@psychologie.uzh.ch (R. La Marca).

http://dx.doi.org/10.1016/j.psyneuen.2014.02.003

Results: TSST-G-1st resulted in a significant increase of negative affect, HR, and sAA, and a significant decrease in positive affect and HRV. TSST-G-2nd, overall, resulted in a significant increase of HR and sAA (the latter only in response to TSST-G-2nd-defence) and a decrease in HRV, while no significant affect alterations were found. When comparing both, TSST-G-2nd-defence and -2nd-presentation, the former resulted in a stronger stress response with regard to HR and HRV.
Discussion: The findings reveal that the TSST-G is a useful protocol to repeatedly evoke an affective and autonomic stress response, while repetition leads to affective but not necessarily autonomic habituation. When interested in examining repeated psychosocial stress reactivity, a task that requires an ego-involving effort, such as a defensive speech, seems to be significantly superior to a task using an impersonal speech.

1. Introduction

Stress is an omnipresent phenomenon in everyday life, and it is associated with alterations of biological variables. Pathophysiologic mechanisms are thought to constitute a major pathway through which stress leads to the development or aggravation of some mental disorders (e.g. anxiety disorders, depression) as well as somatic diseases (e.g. cardiovascular disease, type 2 diabetes mellitus; Chrousos, 2009). Health-related research often focuses on changes in physiologic stress systems (e.g. to examine the effects of a treatment or intervention). Therefore, examination of changes in psychobiological stress reactivity requires the application of valid repeatable stress provocation tools. Since factors such as novelty and unpredictability are important determinants of stress provocation (Dickerson and Kemeny, 2004), repeated stress exposure poses a challenge for the correct choice of a stressor and makes interpretation of response alterations difficult.

Kirschbaum et al. (1993) developed a standardized stress-provoking procedure, the Trier Social Stress Test (TSST), inducing a psychobiological stress response in humans. The original TSST consists of a free speech and a mental arithmetic task (serial subtraction) in front of an audience. Extensive evidence supports the effectiveness of the TSST in inducing a multidimensional stress response (Dickerson and Kemeny, 2004; Campbell and Ehlert, 2012). Two major physiologic stress systems, the hypothalamic—pituitary—adrenal (HPA) axis and the autonomic nervous system (ANS) with its sympathetic and parasympathetic branch, have repeatedly been shown to respond to the TSST acutely. While biomarkers like cortisol (Schoofs and Wolf, 2011; Hellhammer and Schubert, 2012), salivary alpha-amylase (sAA) (Nater et al., 2006; Schoofs and Wolf, 2011), and heart rate (HR) (Nater et al., 2005; Hellhammer and Schubert, 2012) increase, heart rate variability (HRV) decreases in response to the TSST (Nater et al., 2006; Strahler et al., 2010). Taken together, the TSST is a powerful psychosocial stress task inducing an acute stress response of all main physiologic stress systems.

To maintain the efficacy of the TSST in provoking stress-induced responses with repeated applications, some changes to the stress protocol are advised. To avoid participants presenting a memorized speech or remembering the sequence of correct responses to the mental arithmetic task on the second assessment session, different adaptations of the TSST subtasks have been used in the past: While during the first exposure, the original protocol of the TSST (Kirschbaum et al., 1993) is often applied, during the second exposure the job interview scenario is slightly adapted (Kirschbaum et al., 1995; Schommer et al., 2003; Petrowski et al., 2012) or replaced by a defensive speech in response to a false shoplifting accusation (Saab et al., 1989; Burleson et al., 2003). For the mental arithmetic subtask, most authors change the initial number of the serial subtraction task for the second exposure (Kirschbaum et al., 1995; Schommer et al., 2003; Petrowski et al., 2012). Repeated exposure to the TSST has produced different changes in various physiological stress systems. The cortisol response usually habituates to repeated exposure to minimally changed stress tasks (Kirschbaum et al., 1995; Schommer et al., 2003; Wüst et al., 2005; Kudielka et al., 2006), whereas the stress response of sAA (Gerra et al., 2001; Schommer et al., 2003; von Känel et al., 2006), HR (Gerra et al., 2001; Schommer et al., 2003; von Känel et al., 2006; Jönsson et al., 2010) and HRV (Petrowski et al., 2012) show very little habituation to repeated stress exposure.

Even though the TSST is very effective, it requires significant resources in terms of staff and, therefore, financial means. Much effort is required for each individual participant. In case of repetition, twice the resources are needed. Therefore, more economic stress test procedures are desirable, especially when resources are scarce or subject samples are large. In 2006 Childs et al. applied, for the first time, a method of administering the TSST in a group setting. Individual persons and groups of two or three healthy volunteers were simultaneously monitored for salivary cortisol and HR responses to the TSST, with significant results in both parameters, and HR showed an even higher peak in the group setting compared to the single setting. Subsequently, the new protocol of the Trier Social Stress Test for Groups (TSST-G) was evaluated and published by von Dawans et al. (2011). These authors examined groups of six participants and included, additionally, a specific control condition (a single-blind control condition containing all factors except the psychosocially stressful components, i.e. socio-evaluative threat and uncontrollability). von Dawans et al. (2011) replicated and extended the findings presented by Childs et al. (2006). In fact, they found that the TSST-G induced significant increases in salivary cortisol and HR. In comparison with the control condition, the TSST-G produced larger stress reactions in both parameters. Until now no study has examined whether the application of the TSST-G also provokes sAA and HRV changes, and whether a repetition of the TSST-G can effectively induce a biopsychological stress response.