Trier Social Stress Test

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Synonyms
TSST

Definition
The Trier Social Stress Test (Kirschbaum et al. 1993) is a protocol for the induction of moderate to intense psychosocial stress under laboratory conditions. It comprises a 3 min anticipatory period, a 5 min public speaking task, and a 5 min mental arithmetic task in front of an evaluative panel of two adults. The TSST can be employed in adolescents and adults of all ages; a slightly modified version is used when studying children from the age of 7 years and older (TSST-C). Today, the TSST is the most widely used psychosocial stress protocol in laboratory studies of human subjects and patient populations.

Principles and Role in Psychopharmacology

Stress and Biological Responses to Threat
Psychosocial stress is a major burden for individual and societies alike. The direct and indirect costs of stress amount to billions of Euros and US dollars in many countries because of the fact that approximately 50% of all days of work absence can be attributed to consequences of stress exposure. While such financial effects burden economies significantly, the individual suffering in response to traumatic or chronic psychosocial stress threatens physical and psychological health. In 2001, the World Health Organization (WHO) therefore listed stress “one of the most significant health problems of the twenty-first century.”

In search of mechanisms how stress affects well-being and which measures need to be taken in order to avoid adverse health outcomes, research protocols are required for a reliable induction of stress under laboratory conditions. In animals, different footshock or restraint stress paradigms are widely used. Only relatively few laboratories, however, employ more complex stress protocols that mimic stress exposures in modern human societies.

In human stress research, several paradigms and protocols exist for induction of moderate, acute stress responses. Most of these procedures, such as the cold pressor test or the Stroop test, evoke sympathetic nervous system responses of small or moderate magnitudes. The other most important bodily system, which conveys the brain’s response to threatening and detrimental stimulation to the organs, remains unaffected by such protocols. The hypothalamus-pituitary-adrenal (HPA) axis requires more intense stimulation and threat to the ego before a significant increase in corticotropin-releasing hormone (CRH), adrenocorticotropin hormone (ACTH), or cortisol occurs.

Deliberate stress activation of the human HPA axis has proven to be difficult under ethically acceptable laboratory conditions. Only variable and inconsistent cortisol responses had been obtained with computerized or several other interactive tasks. As revealed in a meta analysis of 208 laboratory stress studies (Dickerson and Kemeny 2004), a combination of social evaluative threat and uncontrollability is required for a reliable and strong ACTH and cortisol release. Social evaluative threat and uncontrollability are key components of the TSST.

The TSST Protocol

The standard TSST protocol requires at least two different rooms and a total of three lab members as a minimum. Upon arrival at the laboratory, subjects are guided to a standard office room for a first rest period of 30–60 min. Then, the experimenter takes them to a second room for the actual stress task. This room is sparsely equipped with two tables and three chairs, a video camera and a microphone. Behind the larger table, two members of an evaluation panel are seated, dressed in white lab coats. The test subject is asked to stand at the microphone facing the seated panel approximately 2 m away. The panel members do not speak at this point yet while the experimenter gives instructions for the TSST to the subject. He or she should imagine having applied for open position at a company or

an institution. Out of many other applications, he or she was invited to present him or herself before an evaluation panel to convince them that he or she was the best candidate for the job based on his or her personal characteristics. The first of two tasks therefore is to give an oral presentation about his or her personal strengths and positive aspects. The subjects are told that a video will be recorded for later analysis of nonverbal signs of stress and a voice frequency analysis. Furthermore, the two panel members are described as trained in the detection of verbal and nonverbal stress signals. In order to prepare this speech, the subjects are given 3 min of preparation time, which they spend sitting at the small desk in the same room. Paper and pencil are provided for sketching the talk; however, the notes cannot be used later in the oral presentation. The experimenter now leaves the subject alone with the two evaluation panel members in the room.

After 3 min, the experimenter asks the test subject to step up to the microphone and to begin with the free speech about him or herself in a clear, loud voice. Most test subjects finish their talk after about 2–3 min of speech time. Then one of the panel members asks them to continue their speech since there was still time left. When the subject halts a second time before the first 5 min are over, the two panel members look at the subject with a neutral facial expression and do not speak for 20 s. Thereafter, they begin to ask personal questions (e.g., “Do you have friends?”). After 5 min exactly, the panel member stop the speech and proceed with a second task. They ask the subjects to perform mental arithmetic, subtracting an odd number from a larger number. Depending on the age of the subject, the difficulty of the problem is adjusted (e.g., for healthy young adults, they have to serially subtract 13, starting at 2011). The subjects are told that upon each error, the panel member would ask them to start anew from the initial number. After 5 min of mental arithmetic, the experimenter enters the room again and takes the subject back to the first room where he or she rests for another 20–120 min depending on the psychological or biological measures taken.

As a mandatory part of every TSST (unless a study on habituation of stress responses is conducted), the subjects have to be fully debriefed after the last psychological or biological measure has been obtained. It has proven helpful to have the two panel members come to the tested subject then (without the white lab coats now) and introduce themselves. They should explicitly explain that the test protocol required them to be nonresponsive and cold in the interaction with him or her.

Small variations of the standard TSST protocol are required when testing retired adults or children and adolescents between ages 7 and 16 years. The variations pertain to the topic of the free speech task only. Test subjects of advanced age will be presented with a fabricated advertisement which calls for people willing to donate their time for working in a nonprofit organization (e.g., helping with experiments with elderly subjects in a psychology department). The experimenter asks the subjects to talk to the evaluation panel as a job applicant, presenting his or her personal strengths and positive characteristics. When testing children, the so-called TSST-C (Buske-Kirschbaum et al. 1997) protocol is used. Here, the experimenter reads the beginning of the story to the child and asks him or her to continue and finish the story as interesting and suspenseful as possible. All other aspects of the standard TSST protocol are also used in the elderly and young study populations.

Responses to the TSST
A wide range of psychological and biological response parameters have been studied in the past 15 years of TSST research (Kudielka et al. 2007). The TSST typically induces moderate to large subjective and physiological responses that peak 1–30 min after cessation of the stressful procedure. Approximately 80–85% of all subjects tested show a substantial increase in the respective parameters from the resting (baseline) period to peak values. Self-reported negative mood changes and moderate increases in anxiety ratings are typical. Endocrine, immunological, and cardiovascular parameters increase by 50–300% over baseline. Table 1 provides an incomplete list of biological parameters, which are significantly changed in response to the TSST.

Repeated Exposure to the TSST
In many instances, a repeated stress exposure is the ideal study design for the investigation of specific treatment effects. For example, the potency of an anxiolytic drug could be tested, or the efficacy of a psychotherapeutic intervention studied using a prepost challenge study design. The TSST can be used for such purposes. Careful attention should be paid, however, whether the crucial TSST response read-out parameter shows habituation effects. When parameters controlled by the sympathetic nervous system are the main read-out variables, the standard TSST protocol can be used repeatedly for the same subjects. ACTH or cortisol responses, however, decline upon the second TSST exposure already (Kirschbaum et al. 1995). HPA axis habituation can be circumvented by changing the test setting (novel rooms/labs, panel members, and experimenters) for each TSST.
Using the TSST as a Group Stress Protocol

Researchers have begun to evaluate a modified TSST protocol for use with groups of 2–6 individuals at the same time (Childs et al. 2006). This allows for investigations of complex interactions between members of a certain peer group, or serves as an economical way of stressing larger numbers of individuals within a brief period of time.

A “Placebo” Version of the TSST

When stressing individuals with the TSST, the researcher might want to differentiate between the specific effects of the social-evaluative stress (“distress”) and the effort component involved (orthostatic responses, speech-induced physiological changes etc.). A simple no-intervention control session cannot provide such information. It is therefore required to contrast the TSST induced subjective and biological responses with responses observed under similar setting and effort conditions, however, without a distress component. Such a “placebo” version of the TSST has been published most recently (Het et al. 2009).

References


Trier Social Stress Test. Table 1. Biological parameters responsive to TSST exposure.

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<tr>
<th>Endocrine</th>
<th>Immunological</th>
<th>Other</th>
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<tr>
<td>ACTH</td>
<td>Neutrophils</td>
<td>Coagulation factors</td>
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<td>Eosinophils</td>
<td>Hemoconcentration</td>
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<td>Tumor-Necrosis factor alpha</td>
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<td>Interleukin 6</td>
<td>Amylase activity</td>
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