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The effects of extraversion, self-esteem, and perceived control on the subjective and physiological stress response to an acute stressor

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Declaration on cooperation with other master's students

This master's thesis was carried out within the overarching research project "Muskiba: Effects of music listening on stress and skin barrier recovery" led by Dr. Jasminka Majdandžić. Therefore, the contents of this thesis may incidentally show overlap (in terms of e.g. appendices) with theses by other students co-supervised by Jasminka Majdandžić.

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Abstract

Acute stress provokes different stress responses, depending on individuals' personal characteristics and experiences. This master's thesis focusses on the variables extraversion, self-esteem, and perceived control and explores how these factors affect the intensity of stress responses to an acute stressor. The anticipated negative effect of extraversion on changes in subjective and physiological stress was hypothesized to be mediated by higher self-esteem. Higher perceived control was expected to be a mediator in the negative association between self-esteem and changes in both stress measures in response to the stress test. 52 female participants were tested in a laboratory study using the TSST to induce stress. The NEO-FFI and RSES were used to assess extraversion and self-esteem. Subjective stress, measured via ratings on a VAS, and physiological stress, assessed through HR, were both collected at baseline and during the TSST (HR) or right after the TSST via a retrospective assessment (VAS) as indicators for stress. Perceived control was also retrospectively assessed via a VAS. Four mediation analyses were performed, in which only the path between extraversion and self-esteem was significant in the expected direction. Explorative extreme case analyses were performed to detect trends in data that could not be found in mediation analyses due to insufficient sample size and variance in variables. These analyses showed the tendency that individuals higher in extraversion in this sample experienced lower increase in physiological stress in response to acute stress. Higher self-esteem and perceived control could also be protective factors when facing stress, as participants higher in these variables showed smaller changes in subjective and physiological stress between measures at baseline and during the TSST. If this pattern reinforces itself in a bigger sample, this would imply that by enhancing self-esteem or perceived control, stress responses to acute stressors could be reduced, leading to positive health outcomes.

Keywords: extraversion, self-esteem, perceived control, personality traits, subjective stress, physiological stress, acute stress, stress response, stress test, TSST

Content

Introduction

Stress is a phenomenon that affects everyone and has become an unavoidable part of everyday life. However, there are differences in the way people react to stressful situations, which makes the study of individual personality traits and their influence on stress response an interesting research field. Investigating how different characteristics and their interplays affect stress perception and response does not only provide more detailed insights in human behavior but can also contribute to useful interventions teaching how to better deal with daily and acute stress situations. Therefore, this master's thesis focuses on the role of extraversion, self-esteem, and perceived control in stress responses triggered by an acute stress test.

Theoretical background

Stress

Definition of stress

Stress is defined as "a bodily or mental tension resulting from factors that tend to alter an existent equilibrium" (Lovallo, 2015, p. 32).These threats to the equilibrium can be caused by either physical or psychological stressors. Physical stressors can have a direct negative impact on one's physical health and well-being, such as extreme temperatures, diseases, or toxin. Psychological stressors act on a more indirect way on one's well-being through thoughts and interpretations of situations or stimuli that do not cause actual harm but threaten one's safety. Examples for this kind of stressor are the loss of loved ones and failure regarding important life goals or relationships. Despite these major life events, daily hassles can cause stress responses as well (Lovallo, 2015; Nater et al., 2020).

In his experimental work with animals, Hans Selye discovered a universal stress response pattern which he called *general adaption syndrome*. This syndrome summarizes stress responses as three major physical changes: decrease in the size of organs from the immune system, increase of the adrenal glands as well as gastric ulcers. These reactions occurred as a response to stress, regardless of the kind of stressor (Lovallo, 2015).

Apart from physical changes, the general adaption syndrome describes three stages of reaction to a stressor: alarm reaction, stage of resistance, and stage of exhaustion. First, the stressor is registered and a reaction is initiated (alarm reaction), then metabolic adjustments to preserve life and restore homeostasis are maintained as long as possible to overcome the stressor (stage of resistance). During this phase, organisms are unable to cope with a second stressor that may arise, even if it is milder than the one which the organism is currently trying

to deal with. If there are not enough biochemical substrates to keep up the compensatory reaction, the organism will die (stage of exhaustion). After being exposed to a certain stressor for a long time, the organism's resources are very low for a certain period, making it difficult to deal with a new stressor right away. On the other hand, if an organism is frequently exposed to the same stressor with a moderate intensity, it could get used to it and therefore develop the ability to better cope with this kind of stressor even over a longer period of time. This indicates that stress can have either positive or negative long-term effects, depending on its severity and available resources (Lovallo, 2015).

As an extension of the term *homeostasis*, which refers to restoring balance and turning back to the state before encountering with a stressor, the term *allostasis* was defined. This describes the fact that establishing balance due to severe or long-term exposure to stress often comes at a cost to the organism, such as negative effects on one's health. Many resources are needed for maintaining balance, which are lacking elsewhere, leading to adverse long-term consequences (Lovallo, 2015).

When talking about stress, the psychological as well as the physiological side of stress must be considered. Before a stress response occurs, evaluation processes take place to determine if a potential stressor can be managed. These processes explain why people react differently to various stressors as not every individual rates a situation as equally stressful (Nater et al., 2020).

The psychological side of stress

Stress can vary in intensity, depending on the size and importance of the stressor and one's ability to cope with this challenge. To decide whether a potential stressor is a threat or not, Lazarus and Folkman (1984) developed the *transactional stress model*. When one is confronted with a stimulus, two appraisal processes are activated. Primary appraisal helps to categorize a situation as being positive, irrelevant, or harmful. A positive or irrelevant stimulus can be ignored, while a harmful stimulus, which could either be a challenge or threat, enters the secondary appraisal process. In this step, available resources and coping strategies are analyzed. Coping responses can be divided into problem focused and emotion focused coping. Problem focused strategies target the stressful stimulus itself by trying to alter the origin of the situation. Emotion focused strategies do not try to change the event but to minimize emotional disruption caused by the stressor. If one judges a potential stressor as harmful and feels like not having enough resources to deal with this situation, the physiological stress response begins (Lazarus & Folkman, 1984).

The physiological side of stress

There are two parallel pathways involved in the physiological stress response, the sympathetic adrenal medullary axis (SAM axis) and the hypothalamic pituitary adrenal axis (HPA-axis) (Lovallo, 2015; Nater et al., 2020).

The SAM-axis is the faster pathway and includes the sympathetic nervous system (SNS) which is part of the autonomic nervous system (ANS) and is responsible for mobilizing energy and activating the organism to prepare for a fight-or-flight response. The SNS is activated by a release of norepinephrine from the locus coeruleus in the brain stem. Once the signals of the SNS reach the adrenal medulla, the stress hormones epinephrine and norepinephrine are released triggering an activation of the cardiovascular and respiratory system resulting in physiological symptoms like elevated heart rate (HR) and blood pressure or rapid breathing (Kaluza, 2018; Lovallo, 2015).

The slower pathway (HPA-axis) starts with the hypothalamus which releases the corticotropin-releasing hormone (CRH) into the anterior pituitary gland resulting into a release of adrenocorticotropic hormone (ACTH) into the bloodstream. As ACTH reaches the adrenal cortices, the stress hormone cortisol is set free. By providing more energy through glucose and by increasing blood pressure, cortisol prepares the organism for a long-lasting fight-or-flight reaction (Kaluza, 2018; Lim, 2021). In addition, cortisol has a short-term positive effect on the immune system and improves its function, but long-term exposure to cortisol due to chronic stress reverses this effect and weakens the immune system (Nater et al., 2020).

Thus, prolonged exposure to stress can lead to several negative health outcomes including mental disorders like anxiety or substance use as well as severe physiological problems including cardiovascular disease or diabetes (Lim, 2021; Quick et al., 2014). If confronted with just a small amount of stress defined as eustress, positive consequences such as better efficiency and enhanced motivation can arise (Lim, 2021).

Extraversion

Extraversion is a personality trait associated with characteristics like openness, talkativeness, and sensation seeking. Extraverted individuals enjoy social situations and interactions and look out for a higher amount of stimulation than introverted people (Costa & McCrae, 1992). Personality changes towards an increase in extraversion are associated with better physical and mental health (Magee et al., 2013). Concerning physical health, individuals higher in extraversion showed better physical functioning, less health-related

problems with work or other daily activities, less bodily pain, and more general health. Positive effects of extraversion on mental health are expressed by better social functioning, less emotional problems, and lower depression and anxiety scores (Magee et al., 2013). Furthermore, people high in extraversion tend to use more adaptive emotion regulation strategies like cognitive reappraisal and are less likely to use maladaptive strategies like emotional suppression (Gross & John, 2003). As the use of emotional suppression is linked to greater sympathetic activation (Gross & Levenson, 1997), the better capability of extraverted individuals to adaptively regulate their emotions could be one explanation for findings showing that extraversion is associated with a reduced ANS activity (Jonassaint et al., 2009). In addition, people high in extraversion seem to use more efficient coping strategies like problem-solving or seeking social support (Amirkhan et al., 1995).

The relationship between personality traits and stress responses is a much-researched topic but there are still contradicting findings regarding the intensity of stress response in extraverted individuals. A few studies even failed to find an association between extraversion and stress (Brouwer et al., 2015; Coyle et al., 2020; Garcia-Banda et al., 2011; Kirschbaum, Bartussek, et al., 1992).

Most of the time, highly extraverted individuals showed lower physiological and/or subjective stress responses to stress inducing procedures compared to introverted individuals (Bibbey et al., 2013; Chopra et al., 2019; Evans et al., 2016; Garces-Arilla et al., 2023; Jonassaint et al., 2009; O'Riordan, Young, Tyra, et al., 2023; Schneider et al., 2012; Xin et al., 2017). Some of these studies used the Trier Social Stress Test (TSST; Kirschbaum et al., 1993), a stress inducing task also used in this thesis. Extraversion was associated with significantly lower saliva cortisol and negative affect (NA) in healthy participants (Xin et al., 2017) as well as with lower cortisol reaction in a sample of patients with chronic major depressive disorder (CMDD) following the TSST (Chopra et al., 2019). Bibbey et al. (2013) could only detect a positive effect of extraversion on self-reported stress but no effect on cortisol levels or HR reactivity during different stress tests including one speech task similar to the TSST.

The results of two studies using a modified version of the TSST pointed in the other direction indicating that individuals higher in extraversion exhibit higher HR reactivity (O'Riordan, Young, & Ginty, 2023) and higher cortisol responses (Oswald et al., 2006). One possible explanation for these findings is that the TSST does not provide any kind of social interaction or social feedback except for standardized instructions and it is not possible to use

social coping strategies like asking a person around oneself for help, which is a common method used by extraverted individuals when facing stressful situations (O'Riordan, Young, & Ginty, 2023; Oswald et al., 2006). Therefore, extraverted participants may have not been able to rely on their usual coping strategies helping them when facing acute stress. Another explanation focuses on the transmarginal inhibition, which is an autonomous mechanism that protects against over-stimulation and leads to a reduction in arousal. This mechanism is activated earlier in introverted individuals whereas extraverted individuals show a higher tolerance for stimulation. It is possible that the transmarginal inhibition is activated during the TSST only in introverted participants resulting into lower arousal values at the end compared to extraverted participants whose arousal was not automatically reduced (Eysenck, 1997).

Lü et al. (2018) used a job interview situation, which was equal to the first half of the TSST, to induce stress in participants. The research group manipulated the interview situation to discriminate between a high-intensity and moderate-intensity social stress situation. Participants in both groups had 30 seconds of preparation time to apply for a job as a high school teacher and were told that their performance is videotaped and evaluated by two confederates and, only for the high-intensity group, three more professionals. The two groups differed in the amount of feedback they received with the moderate-intensity group only being told to continue when pausing the speech, while participants in the high-intensity group received further information like their performance falling behind other participants. Results demonstrate that only in the moderate-intensity condition, participants higher in extraversion showed lower HR reactivity compared to participants lower in extraversion. On the other hand, in the high-intensity condition highly extraverted individuals exhibited higher HR reactivity (Lü et al., 2018). As extraverted people are higher in sociability, the moderate-intensity social situation may not have been as demanding and therefore did not lead to an increase in HR reactivity. The high-intensity condition, however, required more effort even for participants high in extraversion and as a consequence resulted in elevated HR reactivity (Lü et al., 2018). This finding supports the transmarginal inhibition hypothesis as one explanation for the results could be that in the high-intensity situation, this mechanism could have led to a reduction in arousal only for participants lower in extraversion resulting in lower stress responses than individuals higher in extraversion (Eysenck, 1997; Lü et al., 2018).

Self-esteem

Self-esteem is defined as the appreciation for and acceptance of oneself (Pruessner et al., 2005) and is related to numerous positive outcomes especially regarding stress. There is a strong connection between self-esteem and happiness showing that people high in self-esteem are significantly happier and less depressed than those low in self-esteem (Baumeister et al., 2003). Self-esteem is also associated with more positive interpersonal interactions and social support (Lakey et al., 1994). In addition, people with high self-esteem seem to use more efficient coping strategies and are more optimistic when facing stress (Baumeister et al., 2003; Lo, 2002). This could explain why self-esteem is negatively associated with daily and chronic stress (Pruessner et al., 2005) and stressful life events (Lakey et al., 1994).

Regarding laboratory experiments including stress inducing procedures, high self-esteem seems to be a protective factor buffering stress responses. Individuals higher in self-esteem showed lower cortisol reactions following the TSST (Kirschbaum et al., 1995; Pilgrim et al., 2010) or other stress tests (Pruessner et al., 1999, 2005). Furthermore, they reported lower subjective stress and showed less HR reactivity after a color-word-interference task and a three-minute speaking task (O'Donnell et al., 2008).

Looking at the association between self-esteem and extraversion there is evidence indicating that individuals higher in extraversion show higher self-esteem as well (Amirazodi & Amirazodi, 2011; Francis & James, 1996; Robins et al., 2001). Rani et al. (2023) found a negative association between extraversion and anxious self-esteem and a positive connection between extraversion and self-confidence. Both anxious self-esteem and self-confidence are factors from the *Self-esteem scale for university students* (Zafar et al., 2012), the questionnaire used in that study to assess self-esteem. Both factors include items describing characteristics of either being anxious (e.g. sad, worried, withdrawn) or self-confident (e.g. knowing one's strengths, being confident about achieving goals). The inclusion of self-confidence as a factor of self-esteem in this scale also represents the close connection and sometimes even overlap between these two characteristics. Self-confidence is rather defined as a feeling of confidence regarding one's competences whereas self-esteem is usually described as the general attitude towards the self (Casale, 2020). A higher anxious self-esteem and lower self-confidence as well as lower extraversion were associated with more mental health problems in university students. Given all these interconnections, anxious self-esteem and self-confidence turned out to be mediators in the relationship between extraversion and

mental health problems (Rani et al., 2023). Another study only found an indirect effect from extraversion to self-esteem over positive affect and social support (Swickert et al., 2004).

Perceived control

Perceived control in this thesis is defined as the feeling of control over the situation participants had during the stress induction procedure. Uncontrollability can be caused by different aspects of a situation, including loud and unstoppable noises, difficulty of tasks, or receiving incorrect feedback (Dickerson & Kemeny, 2004). For the TSST, a feeling of uncontrollability could be produced by the lack of information or social interaction. A review including 208 laboratory studies revealed a significant positive association between uncontrollability and cortisol stress response after an acute stress test (Dickerson & Kemeny, 2004). Another study that used the TSST as a stress inducing task could replicate this finding by showing that lower cortisol responses were predicted by higher perceived control over the situation (Liu et al., 2021). Higher perceived control is also associated with reduced daily stress (Sanz & Villamarín, 2001) and the use of more problem-oriented coping instead of emotion-oriented coping strategies (Stumpf et al., 1987).

Literature indicates a positive correlation between self-esteem and perceived control or internal locus of control (Judge et al., 2002; Stupnisky et al., 2007). Internal locus of control describes the feeling of capacity to influence outcomes by one's own skills and effort while individuals with a more external locus of control feel that results are determined by faith, luck, or other environmental factors (Judge et al., 2002; Shubina, 2017). There is another association between self-esteem and self-efficacy which describes the belief to be able to master difficult or challenging situations (Gecas, 1989). However, the effect of self-esteem on perceived control is mostly investigated in the context of academic achievement (Ross & Broh, 2000; Stupnisky et al., 2007) while no studies could be found examining how self-esteem affects perceived control during acute stress.

Research gap and relevance

Especially for extraversion, there are contradicting results regarding its association with stress responses to the TSST. In contrast to other stress inducing procedures, the TSST has little to no social feedback or interaction and therefore might lead to higher stress responses even in individuals high in extraversion (O'Riordan, Young, & Ginty, 2023). On the other hand, extraversion had a buffering effect on stress responses in studies using stress inducing procedures including the TSST (Chopra et al., 2019; Xin et al., 2017). Therefore,

one aim of this study was to further investigate the relationship between extraversion and stress responses to the TSST and contribute to a better understanding of this association.

Another focus of this thesis was the role of self-esteem in the relationship between extraversion and stress response. Based on the presented literature, extraversion is positively associated with self-esteem and negatively associated with stress (Chopra et al., 2019; Robins et al., 2001). As there is also evidence that self-esteem is negatively correlated with stress responses (Pruessner et al., 2005), it might act as a key factor linking extraversion and stress responses to an acute stressor. Previous research only investigated these personality characteristics and their relationship to stress in isolation which is why this thesis aimed to generate results on the interplay of extraversion and self-esteem considering self-esteem as a possible mediator.

Similar to self-esteem, perceived control is positively associated with self-esteem and negatively associated with stress (Judge et al., 2002; Liu et al., 2021). Therefore, it could partially explain the negative relation between self-esteem and stress response to an acute stressor. No studies could be found investigating the effects of self-esteem on perceived control during acute stress tests or considering the mediating role of perceived control in the association between self-esteem and subjective or physiological stress responses. Because of that, the third aim of this thesis was to investigate the role of perceived control as a potential mediator between self-esteem and stress response.

Based on the presented interconnections between extraversion, self-esteem, and perceived control as well as the lack of research investigating multiple of these characteristics in one model, there is the need to investigate these factors and their effects on the stress response to an acute stressor in more elaborate models. This leads to a better understanding of possible influencing factors on the stress response and can offer further insights into individual differences in stress responses. As stress is a prevalent issue in everyday life, better understanding how these three constructs interact has practical implications as well. By identifying specific pathways through which these factors influence stress responses, the results can contribute to the advancement of tailored interventions and coping strategies to better deal with stressful situations. If self-esteem and perceived control turn out to be underlying mechanisms mediating stress responses, interventions can be designed to target them directly, potentially leading to better health outcomes.

Research questions and hypotheses

Research questions

Based on the findings and research gaps presented above, the following two overarching research questions will be explored in this thesis. Sub-questions focus on the respective paths of the mediation models:

Q1: Does self-esteem mediate the association between extraversion and the subjective and physiological stress response to an acute stressor?

> **Q1.1:** Is there an association between extraversion and the subjective and physiological stress response to an acute stressor?
>
> **Q1.2:** Is there an association between extraversion and self-esteem?

Q2: Does perceived control mediate the association between self-esteem and the subjective and physiological stress response to an acute stressor?

> **Q2.1:** Is there an association between self-esteem and the subjective and physiological stress response to an acute stressor?
>
> **Q2.2:** Is there an association between self-esteem and perceived control over the stressful situation?

Hypotheses

The following hypotheses are derived from the presented research questions and focus on each path of the mediation models examined:

H1: Extraversion is associated with a lower increase in stress in response to the acute stressor.

> **H1.1** Participants with higher scores on the scale *Extraversion* (NEO-FFI) show a lower increase in *perceived stress* (VAS) in response to the acute stressor.
>
> **H1.2** Participants with higher scores on the scale *Extraversion* (NEO-FFI) show a lower increase in *physiological stress* (HR) in response to the acute stressor.

H2: Participants with higher scores on the scale *Extraversion* (NEO-FFI) show higher scores of *self-esteem* (RSES).

H3: Self-esteem mediates the association between extraversion and increase in stress in response to the acute stressor.

> **H3.1** The association between higher scores on the scale *Extraversion* (NEO-FFI) and a lower increase in *perceived stress* (VAS) in response to the acute stressor is mediated by higher scores of *self-esteem* (RSES).

H3.2 The association between higher scores on the scale *Extraversion* (NEO-FFI) and a lower increase in *physiological stress* (HR) in response to the acute stressor is mediated by higher scores of *self-esteem* (RSES).

H4: Higher self-esteem is associated with a lower increase in stress in response to the acute stressor.

H4.1 Participants with higher scores of *self-esteem* (RSES) show a lower increase in *perceived stress* (VAS) in response to the acute stressor.

H4.2 Participants with higher scores of *self-esteem* (RSES) show a lower increase in *physiological stress* (HR) in response to the acute stressor.

H5: Participants with higher scores of *self-esteem* (RSES) show higher scores on the item for *perceived control over the stressful situation* (VAS).

H6: Perceived control mediates the association between self-esteem and increase in stress in response to the acute stressor.

H6.1 The association between higher scores of *self-esteem* (RSES) and a lower increase in *perceived stress* (VAS) in response to the acute stressor is mediated by higher scores on the item for *perceived control over the stressful situation* (VAS).

H6.2 The association between higher scores of *self-esteem* (RSES) and a lower increase in *physiological stress* (HR) in response to the acute stressor is mediated by higher scores on the item for *perceived control over the stressful situation* (VAS).

Methods

The study used for this master's thesis is part of the research project "Effects of music listening on stress and skin barrier recovery" which started in 2019 and is led by Dr. Jasminka Majdandžić. Aim of this project was to investigate how listening to music affects stress responses induced by an acute stressor and how stress and music listening influence recovery of superficial injuries to the skin barrier.

Study design

The study was designed as a randomized controlled trial (RCT) in which participants were assigned to one of three listening conditions serving as the main independent variable in this project. They either listened to relaxing music (experimental condition), an audiobook (active control condition) or they lay in silence (passive control condition). Participants in the music or audiobook condition could choose between five playlists (ambient, guitar, jazz, lo-

fi, or lounge) or audiobooks (biology, history, cosmology, philosophy, or physics) which had been validated in a pilot study.

As one focus of this project was the effect of relaxing music on stress, there were several stress measures as dependent variables. First, subjective stress was measured through self-report-questionnaires. Second, physiological stress was assessed via HR / respiratory sinus arrhythmia and electrodermal activity (EDA). Third, participants had to provide saliva samples in order to collect salivary alpha-amylase and cortisol. All these stress measures took place eight times throughout the experiment. The other main interest of this project was the effect of music on skin barrier recovery which was measured through trans epidermal water loss (TEWL), an indicator for immune function.

Before the experiment started, participants were asked to fill out several online questionnaires to assess different trait variables. Some of these questionnaires focused on life stress measuring the constructs chronic stress, perceived stress, state and trait anxiety, abuse and neglect in childhood, and stress reactivity. Other instruments covered coping, emotion regulation, and resilience as potentially protective factors when facing stress. The Big-Five personality traits as well as self-esteem were also assessed before the test session. These are also the two constructs of main interest in this thesis. Covering psychological and somatic symptoms, the most common mental disorders, depressiveness, premenstrual syndrome (PMS), and fatigue were measured as well. Focusing on music there were several questionnaires asking about music preferences, musicality, music empathizing/music systemizing (cognitive style of music listening), the use of music-related mood-regulation strategies, and openness to absorbing and self-altering experiences.

During the laboratory study, participants had to complete additional questionnaires several times asking about current mood, positive affect, stress, perceived control, anxiety, urge to leave, primary and secondary appraisal, and ratings of the audio stimulus.

Sample

The number for the target sample size was drawn from empirical estimates based on effect sizes for path a and b of a mediation analysis (Fritz & MacKinnon, 2007). Medium effect sizes were reported for the association between extraversion and self-esteem (Amirazodi & Amirazodi, 2011) as well as self-esteem and stress responses (Yang et al., 2014). Effect sizes for the correlation between self-esteem and perceived control in a meta-analysis were reported to be between medium to large effects (Judge et al., 2002). Furthermore, medium sized effects of perceived control on cortisol responses after the TSST

could be observed (Liu et al., 2021). Therefore, there have consistently been observed medium effect sizes for each path a and b of the planned mediation analyses, resulting in a total target sample size of $N = 78$ (Fritz & MacKinnon, 2007).

Participants were recruited primarily online via social media platforms like Facebook or Instagram or via a mailing list by the University of Vienna. Some participants were also gathered through the snowball system. Participants received a monetary compensation of €45 after completing the assessment.

A flyer shared online or in person already contained the main exclusion criteria. After expressing interest via email, a telephone screening was conducted with potential participants where exclusion criteria were discussed more detailed. There were a lot of criteria participants must fulfill in order to take part in this study which is because salivary cortisol and alpha-amylase are susceptible to interferences (Strahler et al., 2017).

Only individuals between the age of 18 and 35 who were assigned female at birth were included in this experiment. As the female hormone cycle impacts the HPA axis and ANS activity (Kirschbaum et al., 1999), a regular menstrual cycle, no hormonal contraception, and no intake of medication that affects hormones were preconditions for participation. For the same reason, females who were pregnant or breastfeeding were excluded from the study. The release of (stress) hormones differs between each phase of the menstrual cycle (Kirschbaum et al., 1999), which is why all participants were tested in the same menstrual cycle phase, namely at the beginning of the follicular phase, to obtain a more homogenous sample to better detect effects of the stress inducing procedure on changes in physiological stress measures.

As smoking (Canals et al., 1997; Kirschbaum, Wüst, et al., 1992), excessive alcohol use (Badrick et al., 2008) and drug intake (Parrott et al., 2014) have an effect on cortisol levels, females who regularly consumed cigarettes, alcohol or drugs were excluded from the experiment. Weight is another factor influencing HPA axis activity (Mårin et al., 1992) and must therefore be controlled. Females were only included in the study if their body mass index (BMI) was between 18 and 25kg/m^2.

At the time of the experiment, individuals should not have a current flu or chronic somatic illnesses including: allergies or hypersensitivity reactions, cardiovascular diseases, pulmonary and respiratory diseases, liver diseases, hypertension or extremely low blood pressure, chronic pain, kidney and urinary tract diseases, Diabetes Mellitus or other metabolic diseases, diseases of the digestive tract, neurological diseases, infectious diseases, thyroid

abnormality, diseases of the skeletal system or muscle diseases, as well as blood disorders or any other health-related anomalies like tumors or meningitis. Females with mental disorders like depression, psychosis, anxiety disorders, or eating disorders within the last five years were excluded as well. In addition, participants were not allowed to use psychotropic medication within two weeks before the experiment and were excluded if they took in cardiovascular medication like beta-blockers.

Participants needed to be fluent in German to guarantee that they fully understood the instructions and questionnaires. In addition, they were not included if they had a tropical stay in the last six month or a vaccination in the last two weeks before the experiment. Furthermore, they were excluded if they had visual impairments not correctable with glasses or contact lenses or if they had a (dental) surgery within the last eight weeks.

To ensure that the stress test takes place unbiased, participants were not allowed to have any previous experiences with the TSST or know a person conducting the study. There were also a few music-related criteria including no hearing impairment or chronic tinnitus, no music-related profession or music-related studies, and no absolute hearing. Since a tape-stripping procedure was necessary to measure effects of stress and music on wound healing, participants could only be included if they had no chronic or acute inflammatory skin diseases, allergies to adhesive tape and eczema, rashes, or burn marks on the volar forearm. They were excluded as well if they took in immunosuppressive drugs like prednisone.

Materials

Extraversion

Extraversion was measured by the NEO-Fünf-Faktoren-Inventar (NEO-FFI; Borkenau & Ostendorf, 2007), which is the German version of the NEO-Five-Factor-Inventory (Costa & McRae, 1989). This questionnaire consists of 60 items split into five scales corresponding to the Big-Five personality traits *extraversion, agreeableness, openness, conscientiousness* and *neuroticism* (Kanning, 2009). The questionnaire used in the present study only included items from the scales *Neuroticism*, *Extraversion,* and *Openness* and therefore consisted of only 36 statements. Participants were required to mark on a five-point Likert scale how much they agree with each statement. The response levels comprise the categories *strongly disagree, disagree, neutral, agree and strongly agree* and range from 0 to 4. As *Unipark*, the platform used for the online questionnaires, automatically codes the lowest category with 1 instead of 0, the response range had to be recoded in order to enable comparisons with representative samples, where response levels usually range from 0 to 4.

Four out of the twelve items for extraversion are reverse-coded statements in which higher numbers indicate lower extraversion (Kanning, 2009). Participants were instructed to fill out the complete NEO-FFI but only the twelve items from the scale *Extraversion* were relevant for further analyses. An example item from the scale *Extraversion* is "Ich habe gerne viele Leute um mich herum" which translates into "I like having lots of people around me".

Internal consistency was calculated for the present data to test if this scale was suitable to assess extraversion in this sample. The analysis revealed a good internal consistency with a Cronbach α of .86. The correlations between the subscales of the NEO-FFI are low, indicating that they all measure different independent personality traits (Kanning, 2009).

Self-esteem

To assess self-esteem, participants were asked to complete the German version of the Rosenberg Self-Esteem Scale (RSES; Von Collani & Herzberg, 2003), which was originally developed by Rosenberg (1965). This questionnaire offers a comprehensive overview of one's positive and negative attitudes toward oneself and is the most utilized tool für assessing global self-esteem (Von Collani & Herzberg, 2003). Participants had to indicate how much each of the ten statements applies to them and mark their answer on a four-point response scale, which, after being recoded, ranges from 0 (*does not apply at all*) to 3 (*fully applies*). Half of the items are negatively devised with higher values indicating lower self-esteem. An example statement for the assessment of self-esteem is "Alles in allem bin ich mit mir selbst zufrieden" which translates into "All in all, I am satisfied with myself" (Von Collani & Herzberg, 2003).

In the present sample, internal consistency of the German version of the RSES was excellent with Cronbach α of .93. Due to the low number of items, the scale is a very economic measuring instrument (Von Collani & Herzberg, 2003).

Perceived control

Perceived control over the stressful situation was assessed by a 100mm visual analogue scale (VAS). The item used here is called "In der Situation hatte ich alles unter Kontrolle." which translates into "I had everything under control in that situation". Participants were asked to mark their answer on a scale ranging from 0 (*not at all*) to 100 (*very much*). This item had to be answered right after the TSST was over and served as a retrospective evaluation of perceived control during the stress test.

Stress

The stress response is divided into changes in subjective and physiological stress from baseline to during/after the TSST. Subjective stress was, like perceived control, measured via items on a 100mm VAS. For the baseline stress measurement, an item called “Wie sehr fühlen Sie sich gestresst?”, which translates into “How stressed do you feel?”, was used. To assess stress during the TSST, an item asking about subjective stress in retrospect had to be used and was answered by the participants right after the TSST. This item was called “Die Situation war stressig für mich” which translates into “The situation was stressful for me”. Again, participants had to answer these questions by drawing a line on the scale with zero as the minimum, indicating that participants did not feel stressed at all, and 100 as the maximum, showing that they felt very stressed. Compared to the Perceived Stress Scale (PSS, Cohen et al., 1983), another instrument often used to measure subjective stress, the VAS was equally good at discriminating different stress levels between groups (Lesage et al., 2012).

Physiological stress was initially planned to be assessed via heart rate variability (HRV) which was recorded using a sensor called “Ecg Move 4” on a chest strap. HRV describes the variability of the time between consecutive heart beats. Activation of the SNS and parasympathetic nervous system (PNS) influence the speed of the heartbeat, with HRV providing insights in the adaptability of the cardiovascular system and the ability to respond to different stimuli. Thus, HRV reflects the balance of SNS and PNS activity and is therefore a valid and often used measurement to assess physiological stress (Kim et al., 2018; Rajendra Acharya et al., 2006).

Unfortunately, there were issues in the evaluation process of this HRV data leading to a lot of missing values which would have resulted in an even smaller sample size. To ensure a larger sample and thus a greater probability of recognizing existing effects, differences in HR between measurements at baseline and during the TSST were used instead of HRV. The activation of the SNS due to stress leads to an acceleration of HR indicating a stronger physiological stress response (Lovallo, 2015). Therefore, larger differences in baseline HR and HR during the stress test indicate higher physiological arousal, which is an index of stress.

The assessment of subjective and physiological stress took place eight times during the study. To test the hypotheses mentioned above, only the baseline measure (T1) and the physiological measurement during and retrospective subjective evaluation right after the acute stressor (T3; peak stress) were needed in this case. The physiological peak stress value

was calculated using the mean value of an interval containing HR which was recorded in the last five minutes of the TSST. The difference between mean HR during this time window and mean HR during a five-minute measurement period at baseline (T1; last five minutes of acclimatization period) was computed to obtain change scores, representing increase or decrease of HR in response to the acute stressor. Change scores for subjective stress ratings were computed by the difference of values from the retrospective assessment of subjective stress after the TSST (T3) and participants' rating of current stress at baseline (T1).

Trier Social Stress Test

The Trier Social Stress Test (TSST; Kirschbaum et al., 1993) is a common task to induce moderate stress in laboratory settings. The TSST consists of an anticipation period in which participants receive instructions and have time to prepare for the task, and a test period. The test period is divided into two parts, a five-minute job interview and a five-minute mental arithmetic task (Kirschbaum et al., 1993). The TSST started by walking the participant in the test room where a committee consisting of one male (active stressor) and one female (passive stressor) person dressed in white coats was already waiting. In the instruction provided by the experimenter, participants were told that they had to prepare a speech convincing the committee that they were the right candidate for a job they were applying for. They were informed that the committee was educated in behavioral observation and that the whole process was videotaped to make further analyses of the participants performance, which in fact was both not true. Participants were told that they should only talk about their personal characteristics and qualities, as the committee already had their resume containing their educational and work experience. In our experiment, the preparation time was three minutes whereas in the original proposal paper of the TSST, preparation time was set for 10 minutes (Kirschbaum et al., 1993). During this time, participants were allowed to take notes, but these notes were not allowed to be used during the speech.

After the preparation time was over, the participant had to stand on a marked position in front of the committee. At this point, the experimenter left the room, the passive stressor pretended to turn on the camera, and the active stressor gave the command to start delivering the speech. Participants had to talk five minutes about themselves while the committee maintained a neutral facial expression and did not provide any other form of verbal or non-verbal feedback except for instructions. If participants stopped talking before the five minutes were over, they were told "You still have some time left. Please continue!" after 20 seconds of silence. After five minutes, participants were instructed to the mental arithmetic task. They

had to serially subtract the number 17 from 2043 and had to start from the beginning if they made a mistake. In the original paper by Kirschbaum (1993) participants were required to subtract 13 from 1022. Again, the committee sat in silence neutrally looking at the participants with only providing instructions like looking into the camera or starting from the beginning but no other forms of verbal or non-verbal feedback. After five more minutes, the TSST was over and the experimenter walked the participant out of the room.

Both the structure of the tasks as well as the withholding of social support by not showing facial expressions and limiting conversation to a minimum lead to significant changes in physiological and subjective stress responses (Kirschbaum et al., 1993; McRae et al., 2006). The TSST results in a significant increase in ACTH, growth hormone (GH), prolactin and cortisol as well as an significant increase in HR, which are all physiological indicators of stress (Kirschbaum et al., 1993).

Procedure

If potential participants fulfilled all the required inclusion and exclusion criteria, an appointment for the test session was made at the end of the telephone screening. The exact date was calculated according to the participant's menstrual cycle and had to be in the follicular phase. After the appointment had been made, an individual code was assigned to the participant and a link to *Unipark*, an online survey tool, was sent to them, where participants were asked to complete 19 self-evaluation questionnaires for the assessment of the variables mentioned above (see *study design* for an overview of the variables). Those questionnaires had to be completed before the test session started. Two days prior to the appointment, participants received a reminder email with detailed information about the test date and place, a checklist with things to consider the days and hours before the experiment (i.e. no caffeine intake from the evening before the test day) and if the online questionnaires had not been completed by that time, a reminder for that was also included in the email.

Every test session started at 1pm and lasted about four hours. Throughout the entire experiment, one participant, one experimenter and one assistant who was responsible for the skin measurements were present. In addition, two more members of the research group, one male and one female, were sitting in the committee during the TSST.

After the participant had arrived, a 30-minute acclimatization period started in which necessary preparations were made. Participants were asked to fill out an informed consent form as well as a questionnaire to control for possible interference factors like caffeine intake or a stressful arrival. In addition, participants received the instruction for how to provide

saliva samples throughout the study and the area for the tape stripping was marked using a stamp. Two sensors from the company *movisens* to measure HR and EDA were attached using a chest strap for the HR sensor and a wrist strap for the EDA sensor. Participants were instructed on how to set markers on the EDA sensor before every physiological stress measurement which were necessary to match the timepoints of physiological and subjective stress data. In addition, participants in the music or audiobook condition selected the respective playlist.

After acclimatization, the first of eight stress measurements (T1) took place. The process was always the same, participants had to set a marker on the EDA sensor by tipping on it with two fingers with which a two-minute period started during which participants should not speak or swallow to collect saliva and fill out questionnaires at the same time. After the two minutes, they were asked to collect the saliva in a little tube called salicap and if necessary, complete the questionnaires. With this procedure, subjective, physiological, and salivary stress values were gathered at the same time. After this baseline stress assessment, seven more measurements took place throughout the test session: before TSST, after TSST, before music listening, after music listening and three more times at intervals of 30 minutes.

For the TSST, the experimenter and the participant changed to another room in which the committee was already waiting. The participants received a standardized instruction about the first part of the TSST (job interview) and three minutes to prepare their speech. After preparation time, the second stress measurement (T2) was conducted. As the TSST started, the experimenter left the room and came back after the third stress measurement (T3), which also included questionnaires to retrospectively evaluate ones feelings and thoughts during the stress test, was done to guide the participants back to the initial test room.

The TEWL measurements started by assessing the skin barrier integrity first, then the tape stripping procedure took place which was followed by the first TEWL impaired measurement. After the fourth stress measurement (T4), the audio intervention started. Participants were walked to a deck chair and instructed to lie down for the next 30 minutes and listen to the chosen playlist or audiobook. If participants were assigned to the silent control condition, they had to lie in silence. In every condition, participants wore over ear headphones and were instructed not to move too much or to fall asleep. Light was dimmed and the experimenter and assistant left the room. After the 30-minute listening condition, the fifth stress measurement (T5) was conducted while still sitting on the deck chair.

Afterwards, another TEWL measurement took place followed by approximately 30 minutes of reading magazines provided by the research group and then another stress (T6) and TEWL measurement. This block was repeated two more times until stress data from eight timepoints was collected and all in all five TEWL impaired measurements took place. In the final debriefing phase, participants received more detailed information about the purpose of the study and were allowed to ask questions. All the sensors were removed, and participants filled out the information to receive the monetary compensation.

Out of all measurements throughout the test session, only the self-report and physiological stress data from T1 and T3 as well as the information about perceived control from T3 were needed for this thesis. The other variables of interest (extraversion and self-esteem) were assessed via online questionnaires before the test session.

Statistical Analysis

Analyses to test the hypotheses were conducted using IBM SPSS Statistics (Version 29.0). Hypotheses 1 to 3 as well as 4 to 6 were each tested by two mediation analyses using the SPSS macro PROCESS (Hayes, 2018), which allows to test all three paths of a mediation in one single analysis. This approach relies on bootstrapping and is therefore a very robust procedure which is resistant to possible breaches of preconditions.

For the first mediation analysis, sum scores of the scale *Extraversion* of the NEO-FFI (Borkenau & Ostendorf, 2007) served as independent variable, differences in subjective stress ratings between baseline and T3 were the dependent variable and sum scores of self-esteem from the RSES (Von Collani & Herzberg, 2003) were investigated as a potential mediator. The second mediation analysis contained the same independent and mediator variable but differed in terms of the dependent variable. For this analysis, differences in HR from baseline to T3 functioned as dependent variable.

For mediation analyses three and four, sum scores of self-esteem (RSES; Von Collani & Herzberg, 2003) represented the independent variable and scores of the item about perceived control in the VAS were used as the mediator variable. Again, these two analyses solely differed regarding the dependent variable with mediation analysis three using differences in subjective stress ratings and mediation analysis four using differences in HR from baseline to T3 as dependent variable.

The target sample size of 78 could not be reached because of delays in the start of the study due to COVID-19 and missing data in relevant variables. Therefore, sample size was too small to detect small or medium effects, which could explain the large number of non-

significant results. Furthermore, the sample consisted of very homogenous participants with similar scores in especially extraversion and self-esteem and a rather small range of values. Therefore, a descriptive approach was used as an explorative analysis for visually comparing participants with very high and very low scores on the relevant variables. This so-called extreme case analysis does not allow to draw conclusions about associations between variables as it does not produce significance values but offers insights into trends in the data.

Results

Descriptive statistics

Sample description

At the time of analysis, data was available from 66 test subjects who participated in this study. In eight cases, retrospective stress ratings at T3 were missing, HR was not usable from four participants, and responses to the item about perceived control were missing twice. Therefore, 14 people had to be excluded, resulting in a final sample size of $N = 52$ female participants. Participants' age was between 19 and 33 years with a mean of 24.12 (SD = 3.50). The sample was very homogenous in terms of nationality, educational level, and vocational training, with most women being from Austria (59.6%), having completed their A-levels (88.5%), in Austria called Matura, and attending university (78.8%). Regarding employment and relationship status as well as housing situation, the sample was more heterogeneously distributed. See Table 1 and 2 for a more detailed presentation of demographic variables.

Table 1

Sample description 1 (N = 52)

	M	*SD*	Range
Age	24.12	3.50	19-33
BMI	21.00	1.90	17.67-25.39
People in the same household	2.17	1.02	0-5

Table 2

Sample description 2 (N = 52)

	Absolute values (n)	*Relative values (%)*
Sex		
Female	52	100%
Nationality		
Austria	31	59.6%
Germany	9	17.3%
Croatia	2	3.8%
Hungary	2	3.8%
Switzerland	1	1.9%
France	1	1.9%
Italy	1	1.9%
Russia	1	1.9%
Ukraine	1	1.9%
Chile	1	1.9%
Columbia	1	1.9%
China	1	1.9%
School education		
A-levels	46	88.5%
Secondary school	2	3.8%
Advanced technical college entrance qualification	1	1.9%
Others	3	5.8%
Vocational training		
University	41	78.8%
No vocational training	5	9.6%
Apprenticeship	2	3.8%
University of applied sciences	1	1.9%
Others	3	5.8%
Employment		
In training	19	36.5%
Less than part-time	17	32.7%
At least part-time	11	21.2%
Unemployed	3	5.8%
Full-time	2	3.8%

Housing situation		
In a shared apartment	23	44.2%
With a partner	12	23.1%
Alone	11	21.2%
Others	6	11.5%
Relationship status		
Single	26	50%
In a partnership	25	48.1%
Others	1	1.9%

Extraversion

The responses of each participant to items from the scale *Extraversion* of the NEO-FFI (Borkenau & Ostendorf, 2007) were added to compute a sum score with higher values representing higher extraversion. As the answer scale ranged from 0 (*strongly disagree*) to 4 (*strongly agree*), sum scores between 0 and 48 were possible. Sum scores in this sample were not normally distributed, as assessed by Shapiro-Wilk-Test, $p < .05$, with a range of 8 to 40 and a mean of 24.90 ($SD = 7.93$). Compared to a representative norm sample of women between the age of 18 and 33 ($N = 245$), which is a similar range as in the sample used for this thesis, the mean for the scale *Extraversion* of that sample was 27.85 ($SD = 5.91$) and thereby slightly higher than the mean in the present sample. A norm table containing percentile ranks for women between the age of 18 and 33 revealed that 33.90% reached a score lower or as high as 25 in this scale (Körner et al., 2008). This shows that in the sample used for the following analyses, mean extraversion scores were below average compared to a representative norm sample. Figure 1 illustrates the distribution of extraversion scores in this sample.

Self-Esteem

The same procedure was performed for evaluating the answers from the RSES (Von Collani & Herzberg, 2003). Answer values were between 0 (*does not apply at all*) and 3 (*fully applies*) which leads to a possible sum score between 0 and 30 with higher values indicating higher self-esteem. Participants' sum scores in this sample were between 6 and 30 with a mean of 22.58 ($SD = 6.67$). Shapiro-Wilk-Test was significant for self-esteem values in this sample ($p < .05$), demonstrating no normal distribution. Visual inspection of the histogram revealed a left-skewed distribution in the data, showing that more participants scored higher on self-esteem (see Figure 2).

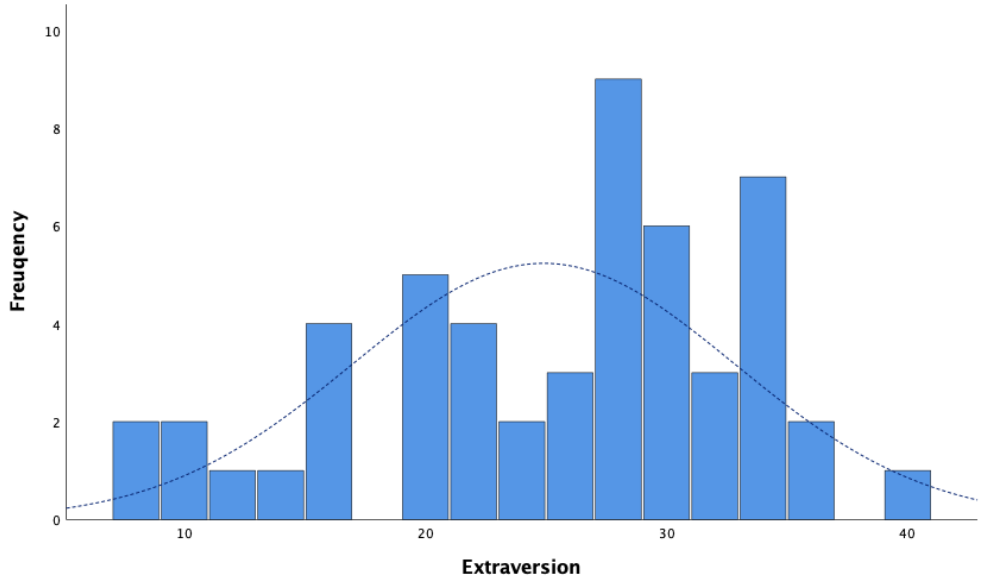

Figure 1. Distribution of Extraversion Scores. Blue bars illustrate the distribution of sum scores of the Extraversion scale from the NEO-FFI (Borkenau & Ostendorf, 2007). The dashed line illustrates the normal distribution curve.

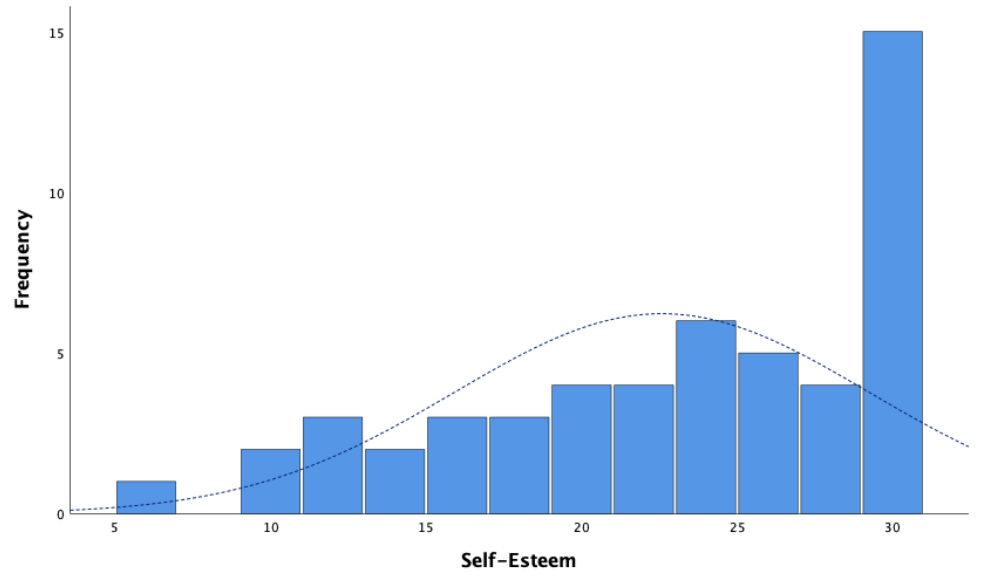

Figure 2. Distribution of Self-Esteem Scores. Blue bars illustrate the distribution of Self-Esteem sum scores from the RSES (Von Collani & Herzberg, 2003). The dashed line illustrates the normal distribution curve.

Perceived control

Participants had to retrospectively rate their perception of control over the TSST situation on a VAS ranging from 0 to 100. This possible range of values was identical with the actual range in this sample, with a mean value of 32.98 (*SD* = 26.75). Ratings in this item were not normally distributed, as tested by Shapiro-Wilk-Test, $p < .05$. Figure 3 shows an illustration of the distribution of perceived control values, revealing a right-skewed distribution in the data.

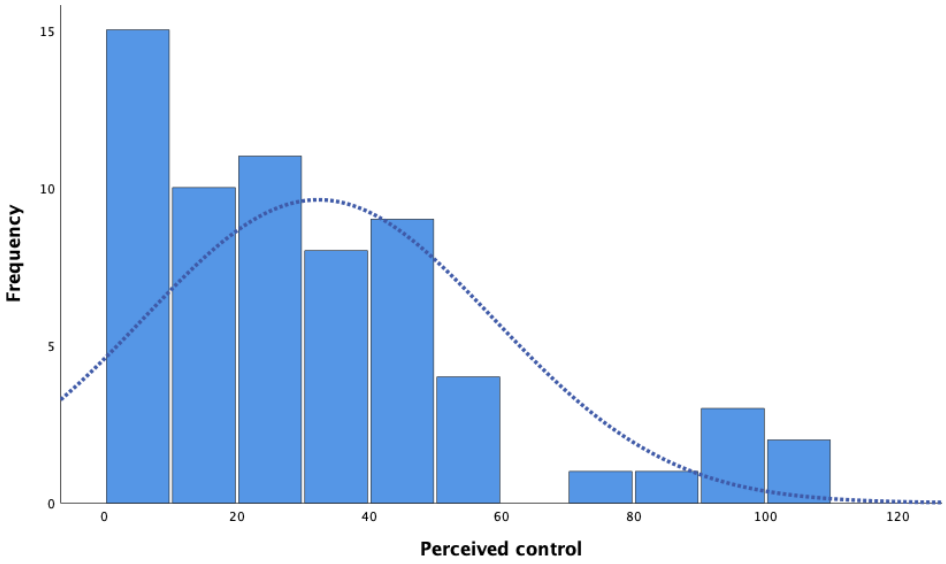

Figure 3. Distribution of perceived control values. Blue bars illustrate the distribution of perceived control scores from the VAS. The dashed line illustrates the normal distribution curve.

Stress

Subjective stress was measured using a VAS ranging from 0 to 100 with higher values indicating higher subjective stress. To generate a value representing changes in subjective stress between baseline and T3, the difference between those two time points was computed. Higher values indicate greater changes between baseline and T3 and therefore higher increase in subjective stress in response to the TSST. Negative change scores mean lower subjective stress ratings at T3 compared to baseline measures. Change scores in this sample ranged from -40 to 100 with a mean of 57.35 (*SD* = 32.16). Shapiro-Wilk-Test was significant for these change scores ($p < .05$), indicating no normal distribution. Figure 4 illustrates the distribution of change scores for subjective stress ratings between baseline and T3.

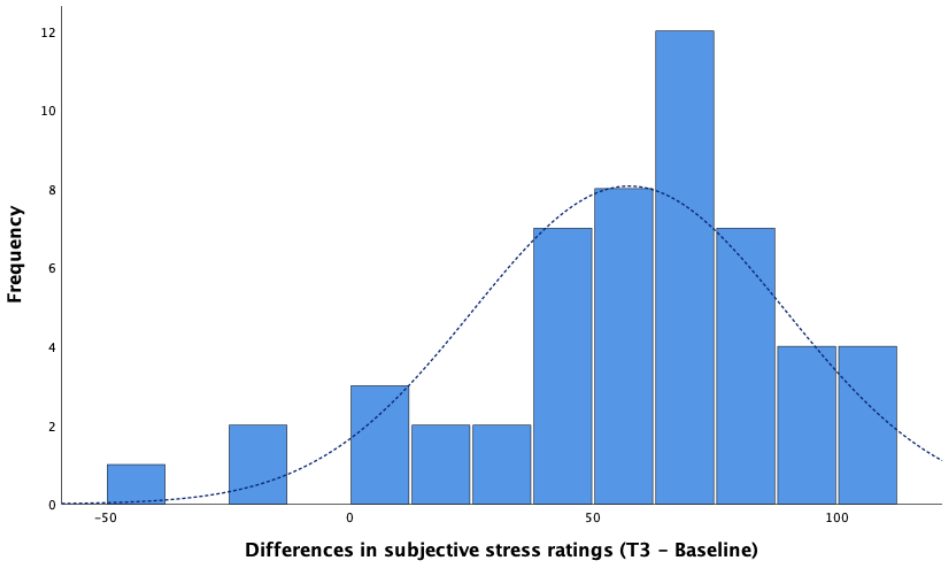

Figure 4. Distribution of change scores for subjective stress ratings. Blue bars illustrate the distribution of differences in subjective stress ratings between baseline and T3. The dashed line illustrates the normal distribution curve.

Physiological stress was measured via HR with the mean HR of five-minute measuring periods representing HR values for baseline and T3. The difference between those time points was used to compute change scores for physiological stress. Higher change scores represent greater differences between HR at T3 and baseline, indicating higher increase in physiological arousal as index for physiological stress in response to the TSST. As for changes in subjective stress ratings, negative values mean higher HR at T3 compared to baseline. Change scores for HR ranged from -15.66 to 64.85 with a mean of 21.52 (*SD* = 14.50). Scores were normally distributed, as tested by Shapiro-Wilk-Test, p = .22. Figure 5 graphically illustrates the distribution of change scores for HR between baseline and T3.

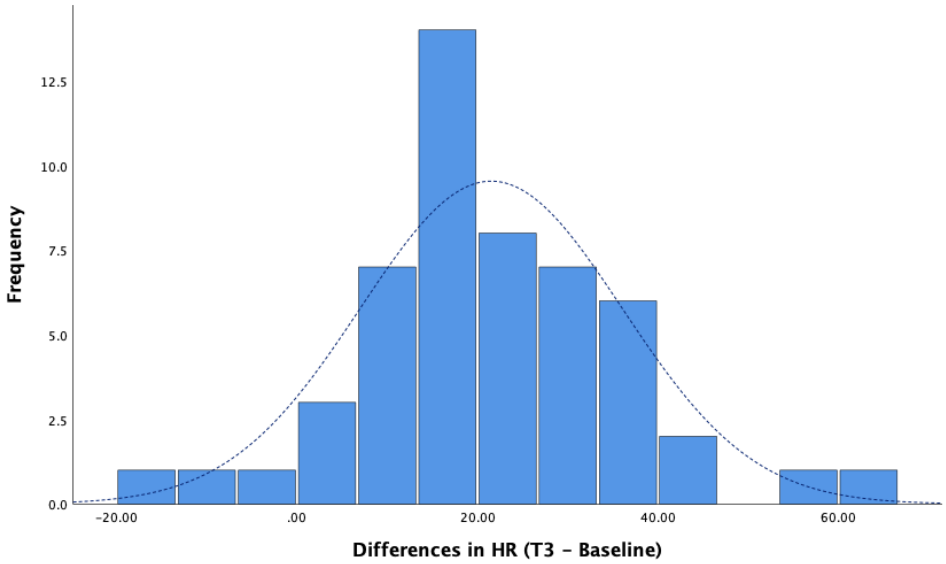

Figure 5. Distribution of change scores for physiological stress ratings. Blue bars illustrate the distribution of differences in HR between baseline and T3. The dashed line illustrates the normal distribution curve.

Preconditions

Hypotheses were tested using a regression based approach in SPSS via the PROCESS macro (Hayes, 2018). This approach uses a bootstrapping method whereby no requirements are placed on the distribution of the data. Bootstrapping is in general a very robust procedure, however, Hayes (2018) listed some preconditions that should be tested before performing analyses with this macro.

As the approach is based on a linear regression, linearity between the variables should be present in order to produce valid results. Linearity was tested via visual inspections of a matrix scatterplot. Therefore, all variables included in each mediation analysis were inserted in this plot as matrix variables, resulting in a three-by-three diagram depicting relations between each combination of variables. To check linearity, fit lines using the loess-method (*locally estimated scatterplot smoothing*) were added to the scatterplot. As all of these lines in every mediation analysis looked appropriately straight, linearity can be considered fulfilled (Hayes, 2018).

Other preconditions like normality of residuals and homoscedasticity do not play a major role in the analyses as violations of them (almost) completely get compensated by the use of robust bootstrapping approaches (Hayes, 2018). In addition, preconditions about

independence of measurements and chronological order can be derived from the study design and can be considered fulfilled. Therefore, the used data met all the relevant criteria for the mediation analyses performed.

Manipulation check

To test if the TSST induced a significant amount of stress, one paired t-test each was performed for subjective and physiological stress measures. Self-reported stress ratings at baseline (M = 14.38, SD = 15.71) were lower than during the stress test (M = 71.73, SD = 27.31). This difference, -57.35, 95% CI [-66.30, -48.39], was statistically significant, $t(51)$ = -12.86, $p < .001$, with the effect with Cohens d = 1.78 being classified as large (Cohen, 1992).

Like subjective stress, mean HR was lower at baseline (M = 82.69, SD = 12.33) compared to the measurement during the TSST (M = 104.21, SD = 16.66). This difference, -21.52, 95% CI [-25.56, -17.48], was statistically significant, $t(51) = -10.70$, $p < .001$. The effect with Cohens d = 1.48 can be classified as large (Cohen, 1992).

Extraversion, self-esteem, and stress

The first research question focuses on the relationship between extraversion and stress response as well as the mediating role of self-esteem. Extraversion was expected to be negatively associated with changes in subjective and physiological stress (H1) and positively associated with self-esteem (H2). Self-esteem was expected to mediate the association between extraversion and changes in stress (H3). Two mediation analyses using the SPSS macro PROCESS (Hayes, 2018) were performed to test these hypotheses. Visualizations of the relationships are presented in Figure 6 and 7 using the standardized path coefficients. Table 3 and 4 contain detailed presentations of statistical parameters for each path in these mediation analyses.

A total effect of extraversion on changes in subjective stress ratings (H1.1) could not be observed, B = .14, p = .82. A total effect of extraversion on changes in physiological stress (H1.2) could also not be observed, B = -.16, p = .58. Despite some authors arguing that a significant total effect between independent and dependent variable is a precondition for performing a mediation analysis (Baron & Kenny, 1986), others state that even when this effect is not significant, a mediation could still be possible (Rucker et al., 2011). Therefore, the full mediation analyses are reported.

There was a significant effect of extraversion on self-esteem (H2), B = .47, p = < .001, showing that participants higher in extraversion also reached higher scores in self-esteem. There could not be found an effect of self-esteem on the increase of subjective, B = .33, p =

.68, or physiological stress, $B = .10$, $p = .82$. Because of these non-significant paths, the indirect effect of self-esteem on the association between extraversion and changes in subjective, $B = .15$, 95% Bootstrap-CI [-.55, .80], or physiological stress, $B = .05$, 95% Bootstrap-CI [-.30, .47], was also not significant, which can be seen from the fact that the confidence intervals contain the number 0. Therefore, self-esteem did not mediate the association between extraversion and stress increase due to the TSST in this sample (H3).

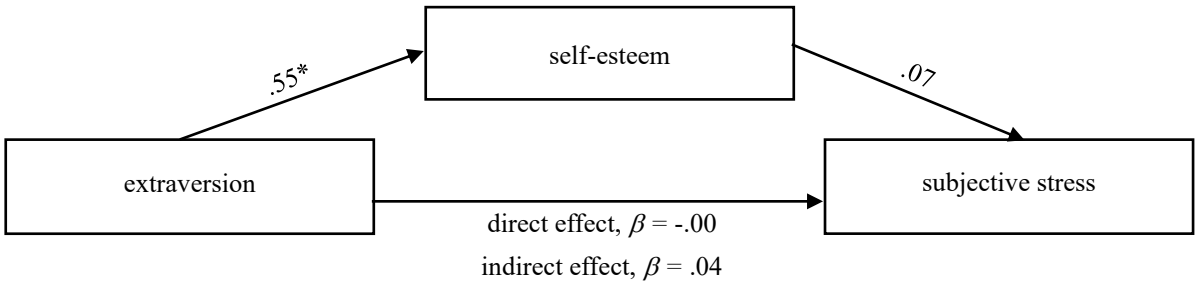

Figure 6. Visualization for the mediation of the association between extraversion and changes in subjective stress over self-esteem. N = 52, bootstrapping with 5000 samples. Numbers depict standardized path coefficients. * = significant at a significance level $\alpha = .05$.

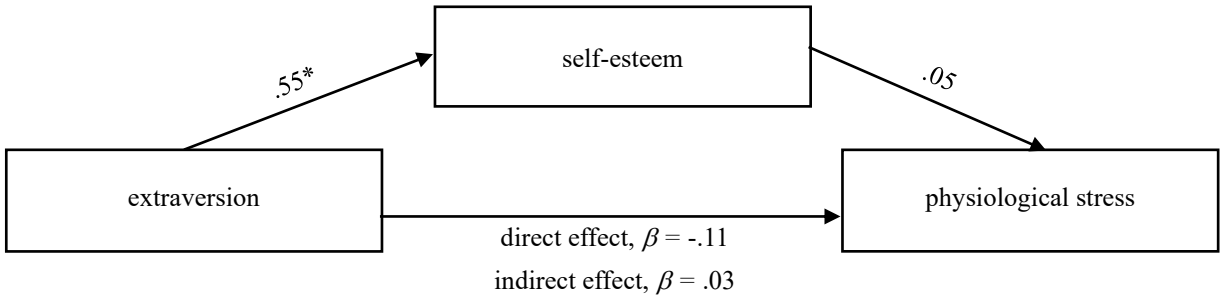

Figure 7. Visualization of the mediation of the association between extraversion and changes in physiological stress over self-esteem. N = 52, bootstrapping with 5000 samples. Numbers depict standardized path coefficients. * = significant at a significance level $\alpha = .05$.

Table 3

Model paths with statistical parameters for the mediation of the association between extraversion and changes in subjective stress over self-esteem

	model paths	*B*	*SE*	*β*	*t*	*p*
a:	extraversion → self-esteem	.47 [.28, .65]	.09	.55	5.06	< .001*
b:	self-esteem → subjective stress	.33 [-1.26, 1.92]	.79	.07	.42	.68
c:	extraversion → subjective stress (without considering the mediator)	.14 [-1.07, 1.35]	.60	.03	.23	.82
direct effect						
c′:	extraversion → subjective stress (after considering the mediator)	-.02 [-1.42, 1.39]	.70	-.00	-.03	.98
indirect effect						
ab:	extraversion → self-esteem → subjective stress	.15 [-.55, .80][a]	.34[a]	.04[a]	–	–

Note. N = 52; B = unstandardized coefficient; 95% confident intervals in square brackets; *SE* = standard error; β = standardized coefficient.

[a] = bootstrapping with 5000 samples.

* = significant at a significance level α = .05.

Table 4

Model paths with statistical parameters for the mediation of the association between extraversion and changes in physiological stress over self-esteem

	model paths	*B*	*SE*	*β*	*t*	*p*
a:	extraversion → self-esteem	.47 [.28, .65]	.09	.55	5.06	< .001*
b:	self-esteem → physiological stress	.10 [-.80, 1.01]	.45	.05	.23	.82
c:	extraversion → physiological stress (without considering the mediator)	-.16 [-.75, .42]	.29	-.09	-.55	.58
direct effect						
c′:	extraversion → physiological stress (after considering the mediator)	-.21 [-.85, .43]	.32	-.11	-.65	.52
indirect effect						
ab:	extraversion → self-esteem → physiological stress	.05 [-.30, .47][a]	.20[a]	.03[a]	–	–

Note. N = 52; B = unstandardized coefficient; 95% confident intervals in square brackets; *SE* = standard error; β = standardized coefficient.

[a] = bootstrapping with 5000 samples.

* = significant at a significance level $\alpha = .05$.

Self-esteem, perceived control, and stress

The second research question investigates the association between self-esteem and changes in subjective and physiological stress and its mediation by perceived control. Higher self-esteem was expected to be associated with lower changes in subjective and physiological stress (H4) as well as higher perceived control (H5) during the TSST. Lastly, perceived control was expected to mediate the association between self-esteem and increases in subjective and physiological stress (H6). Even though the mediation analyses from the first research question revealed that there could not be found a significant effect of self-esteem on stress responses in this sample, the following mediation analyses were still performed to see if there was a potential indirect effect over perceived control. Figures 8 and 9 visualize the relationships between the three variables using standardized coefficients. A detailed description of statistical parameters is presented in Table 5 and 6.

Expected based on the first mediation analysis, a total effect of self-esteem on changes in subjective stress (H4.1) could not be observed, $B = .32$, $p = .63$. Furthermore, no significant total effect of self-esteem on the increase of physiological stress (H4.2) could be found, $B = -.04$, $p = .93$. There was no significant effect of self-esteem on perceived control (H5) in this sample, $B = .59$, $p = .22$. Perceived control was also not significantly associated with changes in subjective, $B = -.48$, $p = .07$, or physiological stress, $B = -.04$, $p = .57$. Therefore, an indirect effect of perceived control on the increase of subjective, $B = -.28$, 95% CI [-.97, .18], or physiological stress, $B = -.02$, 95% CI [-.18, .06], could not be observed, meaning that perceived control was no significant mediator in the relationship between self-esteem and stress responses (H6).

Table 5

Model paths with statistical parameters for the mediation of the association between self-esteem and changes in subjective stress over perceived control

	model paths	*B*	*SE*	*β*	*t*	*p*
a:	self-esteem → perceived control	.59 [-.36, 1.54]	.47	.15	1.24	.22
b:	perceived control → subjective stress	-.48 [-.99, .04]	.26	-.40	-1.87	.07
c:	self-esteem → subjective stress (without considering the mediator)	.32 [-1.01, 1.65]	.66	.07	.48	.63
direct effect						
c′:	self-esteem → subjective stress (after considering the mediator)	.60 [-.69, 1.90]	.64	.12	.93	.35
indirect effect						
ab:	self-esteem → perceived control → subjective stress	-.28 [-.97, .18][a]	.30[a]	-.06[a]	–	–

Note. $N = 52$; B = unstandardized coefficient; 95% confident intervals in square brackets; *SE* = standard error; β = standardized coefficient.

[a] = bootstrapping with 5000 samples.

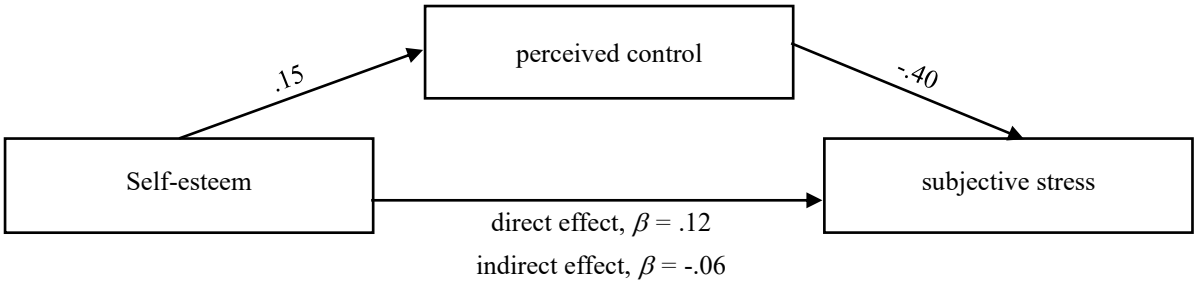

Figure 8. Visualization of the mediation of the association between self-esteem and changes in subjective stress over perceived control. $N = 52$, bootstrapping with 5000 samples. Numbers depict standardized path coefficients.

Table 6

Model paths with statistical parameters for the mediation of the association between self-esteem and changes in physiological stress over perceived control

	model paths	*B*	*SE*	*β*	*t*	*p*
a:	self-esteem → perceived control	.59 [-.36, 1.54]	.47	.15	1.24	.22
b:	perceived control → physiological stress	-.04 [-.18, .10]	.07	-.07	-.58	.57
c:	self-esteem → physiological stress (without considering the mediator)	-.04 [-.79, .72]	.38	-.02	-.09	.93
direct effect						
c′:	self-esteem → physiological stress (after considering the mediator)	.-.01 [-.79, .77]	.39	-.01	-.03	.98
indirect effect						
ab:	self-esteem → perceived control → physiological stress	-.02 [-.18, .06][a]	.06[a]	-.01[a]	–	–

Note. $N = 52$; *B* = unstandardized coefficient; 95% confident intervals in square brackets; *SE* = standard error; *β* = standardized coefficient.

[a] = bootstrapping with 5000 samples.

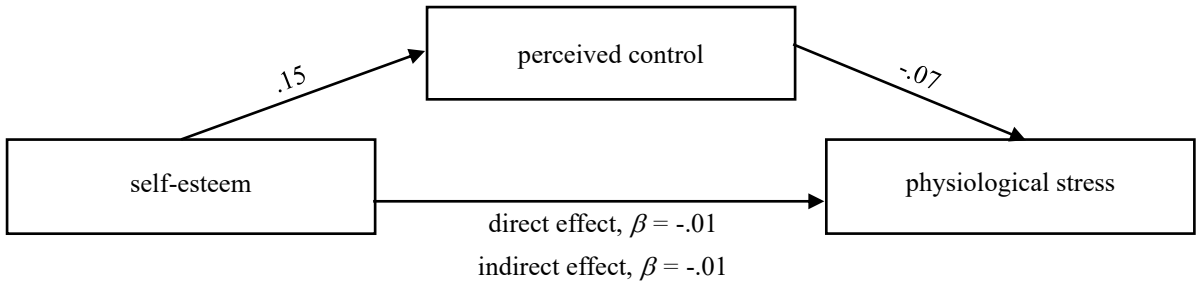

Figure 9. Visualization for the mediation of the association between self-esteem and changes in physiological stress over perceived control. N = 52, bootstrapping with 5000 samples. Numbers depict standardized path coefficients.

Explorative extreme case analyses

Due to the insufficient sample size to detect small to medium effects with a power of .80 and low variance in most variables, explorative extreme case analyses were performed. In these analyses, participants with the highest and lowest scores in each variable were compared in a descriptive manner with respect to each hypothesized path from the mediation analyses. Thereby, trends in the data could be detected which were not visible in the mediation analyses.

Therefore, exploratory data analyses were performed in SPSS generating lists of extreme cases. Participants were then, based on their scores in the variables extraversion, self-esteem, and perceived control, grouped into "high values" or "low values" groups. Bar charts were generated to graphically compare these two groups. It is important to note that these analyses do not allow any conclusions to be drawn about significant differences but merely serve to detect any trends in the data.

Extraversion, self-esteem, and stress

Five participants appeared to have lower scores than the rest of the sample in extraversion, with values between 8 and 12 and a mean of 9.20 (*SD* = 1.64). They were compared to seven participants in the "high value" group, with scores ranging from 34 to 40 and a mean of 35.29 (*SD* = 2.22). As can be seen in Figure 10, women low in extraversion showed slightly smaller changes in subjective stress ratings from baseline to T3, indicating that they felt less stressed during TSST. Differences in physiological stress from baseline to T3 point in the other direction with participants low in extraversion experiencing bigger changes in HR compared to those high in extraversion, supporting expected associations in H1.2 (Figure 11). Furthermore, participants lower in extraversion also scored lower in self-

esteem, as can be seen in Figure 12. This comparison also supports the assumed correlation between extraversion and self-esteem (H2).

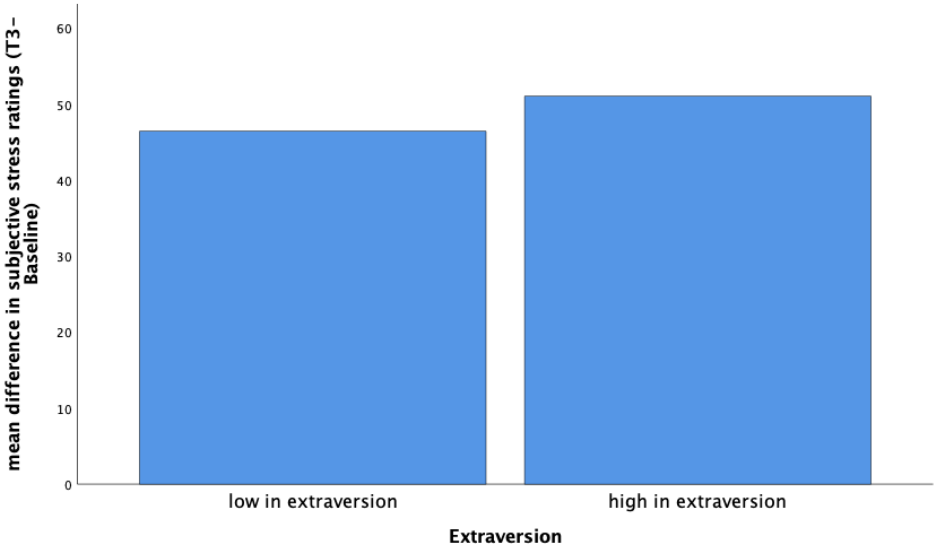

Figure 10. Mean difference in subjective stress ratings of participants scoring low vs. high in extraversion. n = 5 for low in extraversion, n = 7 for high in extraversion.

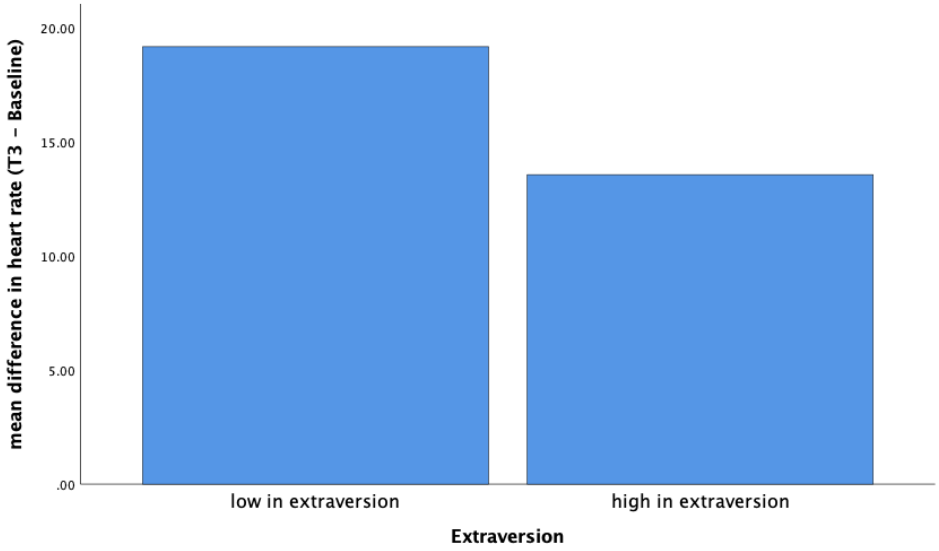

Figure 11. Mean difference in HR of participants scoring low vs. high in extraversion. n = 5 for low in extraversion, n = 7 for high in extraversion.

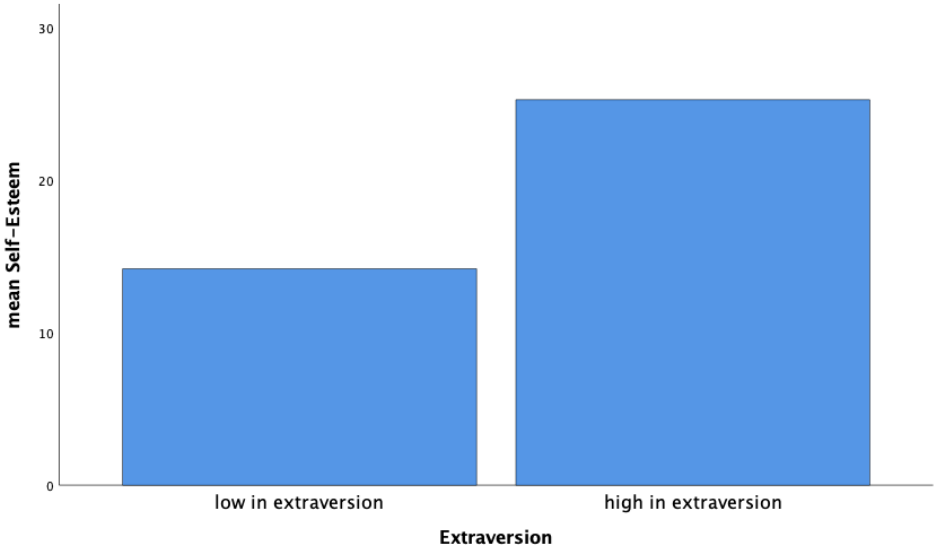

Figure 12. Mean self-esteem of participants scoring low vs. high in extraversion. n = 5 for low in extraversion, n = 7 for high in extraversion.

Self-esteem, perceived control, and stress

Regarding self-esteem, values of five participants were put together into the "low values" group with scores ranging from 6 to 11 and a mean of 9.60 (*SD* = 2.01). On the opposite side, ten women reached the score 30, which is the highest score possible, and were therefore defined as "high values" group. Visual comparisons of mean differences of subjective stress ratings and HR from baseline to T3 showed larger differences for participants lower in self-esteem. Consistent with H4, these bar charts (Figure 13 and 14) show a trend in the data for individuals higher in self-esteem being less stressed in response to the TSST. The comparison of these two extreme groups regarding mean perceived control showed that those low in self-esteem felt less in control, supporting H5 (Figure 15).

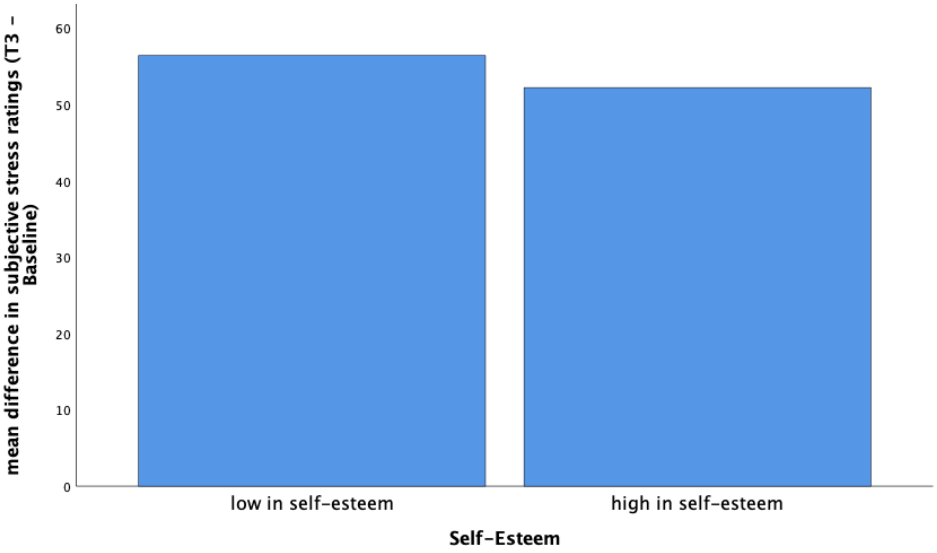

Figure 13. Mean difference in subjective stress ratings of participants scoring low vs. high in self-esteem. n = 5 for low in self-esteem, n = 10 for high in self-esteem.

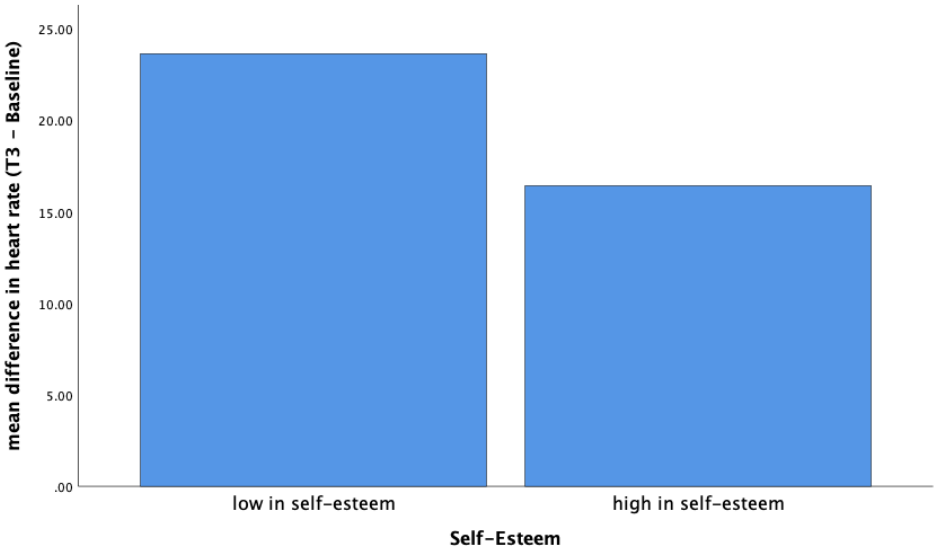

Figure 14. Mean difference in HR of participants scoring low vs. high in self-esteem. *n* = 5 for low in self-esteem, *n* = 10 for high in self-esteem.

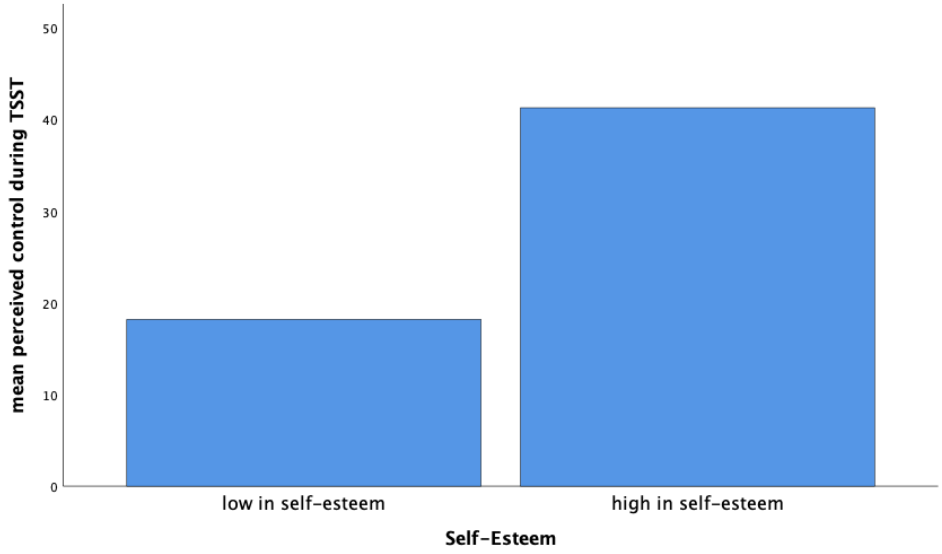

Figure 15. Mean perceived control of participants scoring low vs. high in self-esteem. $n = 5$ for low in self-esteem, $n = 10$ for high in self-esteem.

Perceived control and stress

To visually investigate trends between perceived control during the stress test and changes in subjective and physiological stress, six participants each were put together in extreme groups. Values of participants lowest in perceived control ranged from 0 to 5 with a mean of 2.17 ($SD = 1.84$). The range of women's scores highest in perceived control was between 75 and 100 with a mean of 92.83 ($SD = 9.66$). As can be seen in Figure 16 and 17, participants low in perceived control showed larger mean differences in both subjective stress ratings and HR between baseline and T3 measures. These trends support the assumption that higher perceived control could have a protective effect on stress responses.

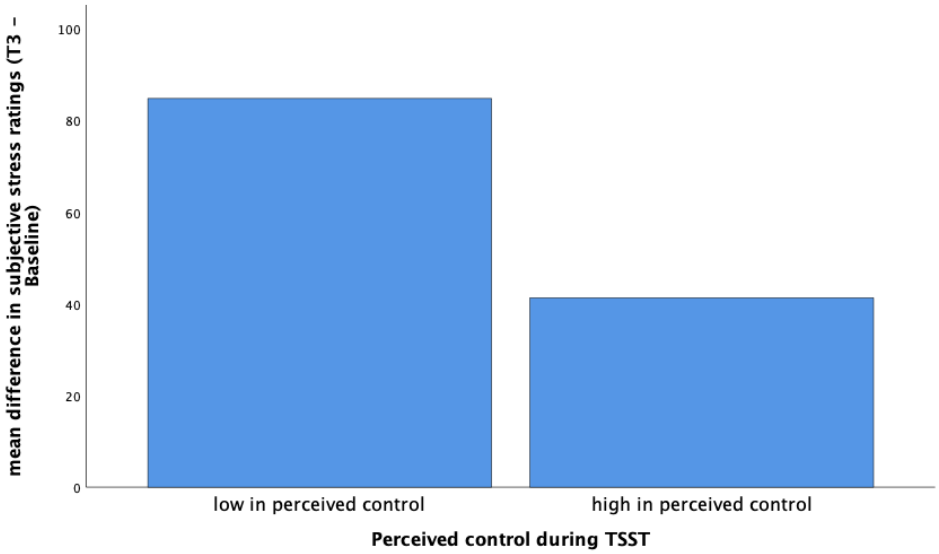

Figure 16. Mean difference in subjective stress ratings of participants scoring low vs. high in perceived control. $n = 6$ for both low and high in perceived control.

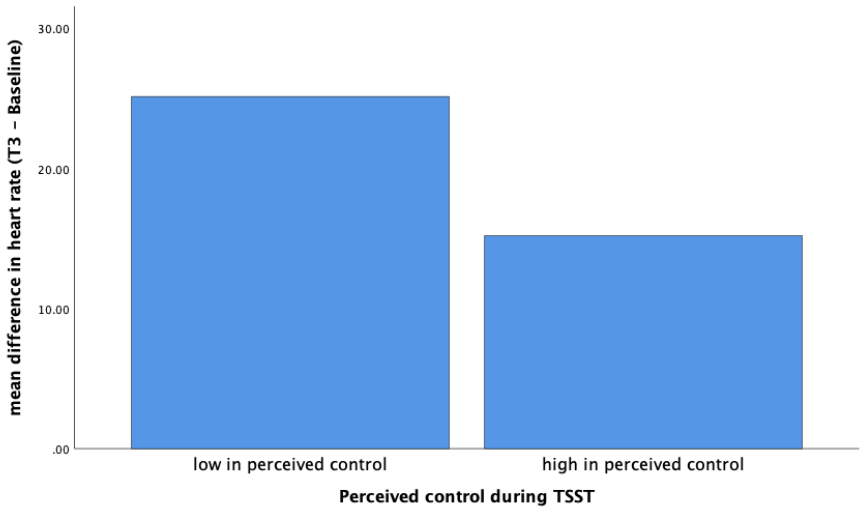

Figure 17. Mean difference in HR of participants scoring low vs. high in perceived control. $n = 6$ for both low and high in perceived control.

Discussion

Aim of this study was to investigate differences in stress responses to an acute stressor between participants and to explore whether these differences can be attributed to individual levels of extraversion, self-esteem, and perceived control. More precisely, extraversion was hypothesized to be negatively associated with the increase in subjective and physiological stress in response to an acute stressor. Furthermore, self-esteem was investigated as a

potential mediator of the relation between extraversion and changes in stress in response to an acute stressor, as there had been found both positive effects of extraversion on self-esteem (Robins et al., 2001) and negative associations between self-esteem and stress (Pruessner et al., 2005). Therefore, self-esteem could (partially) explain the association between extraversion and changes in stress responses. Another factor often found to influence the intensity of stress responses to acute stressors is participants' perceived control over the stressful situation (Liu et al., 2021). Especially in the academic context, self-esteem seems to have a positive effect on perceived control (Stupnisky et al., 2007). Due to the lack of considering effects of self-esteem on perceived control when facing stress, this master thesis also aimed to generate more elaborate models investigating perceived control as a linking factor between self-esteem and changes in subjective and physiological stress responses to an acute stressor.

Interpretation of results

In order to investigate any differences in subjective and physiological stress responses, stress first had to be induced in the participants. The TSST, an instrument known to reliably increase stress in individuals (Kirschbaum et al., 1993), was chosen for this study. Results of two paired t-tests, one for physiological and one for subjective stress, revealed that the TSST significantly increased HR and subjective stress ratings in this sample. This shows that, in accordance to previous findings (Chopra et al., 2019; Kirschbaum et al., 1993; McRae et al., 2006) the TSST worked as a valid instrument for stress induction in this sample as well. Especially for changes in subjective stress ratings (d = 1.78), but also for physiological stress measures (d = 1.48), the effects can be classified as large, indicating large differences between stress at baseline and during the TSST (Cohen, 1992).

In the first research question, effects of extraversion and self-esteem on changes in subjective and physiological stress in response to the stress test were explored. Mediation analyses revealed no significant total effect of extraversion on differences in either subjective or physiological stress measures between baseline and T3. In this sample, differences in extraversion did therefore not significantly affect how stressed participants felt during the TSST. This result does not support H1 in which negative associations between extraversion and changes in subjective and physiological stress were expected. This expectation was mostly based on results by Xin et al. (2017) and Chopra et al. (2019). Both used the TSST to induce stress and found a negative association between extraversion and saliva cortisol and negative affect in their samples showing that participants higher in extraversion were less

stressed by the TSST compared to those lower in extraversion. However, previous research led to inconsistent results with other studies demonstrating no effects (Kirschbaum, Bartussek, et al., 1992) or even positive correlations between extraversion and stress responses to the TSST (O'Riordan, Young, & Ginty, 2023; Oswald et al., 2006).

It is important to note that the total sample size ($N = 52$) did not reach the target sample size ($N = 78$) needed to detect medium sized effects with a power of .80. This is probably the main reason why no significant total effect of extraversion on stress responses could be observed in this sample. Another explanation could be too little variance in extraversion values which means that there might not be enough cases for varying levels of extraversion to investigate significant effects of different levels of this personality trait. Furthermore, the relation between extraversion and stress could be moderated by perceived intensity of the TSST. Such an effect of intensity of the stress test was observed by Lü et al. (2018) who found higher stress responses in participants higher in extraversion if the stress test was more intense. In their study, high intensity was defined by more stress promoting comments, supporting the assumption that a bumpier speech, characterized by more breaks and hesitation, leads to more instructions by the active stressor and therefore to higher stress responses. Some participants might have talked fluently without bigger breaks, leading to less stress promoting instructions by the active stressor making the TSST less intense for those participants. Others might have had bigger problems explaining why they were suitable for a certain job, leading to more comments like continuing the speech or focusing on personal characteristics rather than previous work experiences, increasing the intensity of the TSST.

Despite the small sample size, a significant effect of the independent variable on the mediator could be found with individuals scoring high in extraversion also reaching high values in self-esteem. This result is consistent with previous findings also demonstrating clear positive associations between extraversion and self-esteem (Amirazodi & Amirazodi, 2011; Rani et al., 2023; Robins et al., 2001). Furthermore, self-esteem was even found to be a significant mediator of the association between extraversion and mental health problems (Rani et al., 2023), supporting the consideration of self-esteem as a mediator between extraversion and stress. However, no significant indirect effect of self-esteem on differences in subjective or physiological stress values could be detected in this sample. Therefore, the two mediation analyses for the first research question turned out to be non-significant except for the path between extraversion and self-esteem. This might again be due to insufficient sample size, as past research has found effects of self-esteem on subjective or physiological

stress (Kirschbaum et al., 1995; Pilgrim et al., 2010), which supports the mediation considerations.

Extreme case analyses were performed to further investigate associations between the variables extraversion, self-esteem, and stress in this sample and detect trends in data which could not be seen in mediation analyses due to the too small and homogenous sample used for these analyses. Five participants with very low scores were compared to seven participants with the highest values in extraversion regarding mean differences in subjective stress ratings, HR, and mean self-esteem.

Inspection of the bar charts showed slightly smaller differences in subjective stress between baseline and T3 for individuals scoring low in extraversion compared to those high in extraversion. This comparison suggests that in this sample, participants lowest in extraversion felt less subjectively stressed than participants with the highest values, which would go against the expectation from H1.1. However, the difference between the "low value" and "high value" group is very small and no conclusions can be drawn beyond that anyway, as it is only a descriptive comparison that solely shows trends in the data. Therefore, in the current sample, participants lower in extraversion showed slightly smaller differences in subjective stress ratings, but that could change quickly if additional people were included in the sample.

Interestingly, those low in extraversion showed bigger mean differences in HR between baseline and T3, showing that changes in physiological stress seemed to be higher in participants with lower levels of extraversion. This comparison supports the expected association between extraversion and physiological stress (H1.2), but it contradicts the results on subjective stress as it would be expected that subjective and physiological stress change in the same direction. However, the two bar charts depict a smaller increase in subjective but higher increase in physiological stress for participants low in extraversion compared to those scoring highest in extraversion. These trends regarding extraversion and subjective and physiological stress responses are also in contrast to results of a study only observing positive effects of extraversion on subjective stress ratings, but no effect of extraversion on HR reactivity or cortisol (Bibbey et al., 2013).

There are several possible explanations for these inconsistent trends. First, subjective stress was assessed after the TSST was done, asking participants how stressed they felt during the stress test. This requires retrospective evaluations of subjective stress which might be influenced by retrospective memory biases and therefore might not be as reliable as objective

stress measures like HR which was measured directly during the TSST (Campbell & Ehlert, 2012). Second, subjective ratings can always be influenced by other factors like participants moods at the time of answering the questionnaire. As subjective stress ratings were collected after the TSST was over, participants may have felt relieved and thus rated their subjective stress during the TSST as less high. Another influencing factor could have been social desirability, as participants knew that their answers will be seen by the experimenter and in order to appear more relaxed, they could have underrated their subjective stress level. Third, elevated HR could also have other explanations except for stress. It could for example be attributed more to performing and carrying out the task instead of the feeling of stress (Campbell & Ehlert, 2012). As the item in the VAS explicitly asked about how stressed participants felt, this could also explain the discrepancy between subjective stress ratings and HR.

Besides the visual comparisons of participants low and high in extraversion regarding mean differences in subjective stress ratings and HR, another bar chart visualizes the difference between these two groups concerning mean self-esteem. In accordance with the significant result of the mediation analyses, individuals lower in extraversion also showed lower self-esteem than those high in extraversion.

In the second research question, self-esteem was investigated as independent variable which was expected to be negatively associated with differences in subjective and physiological stress values between baseline and T3. Furthermore, perceived control during the TSST was tested as potential mediator of this relationship. As there could not be found a significant effect of self-esteem as a mediator on changes in subjective or physiological stress, it is not surprising that the total effect of self-esteem on differences in subjective or physiological stress values in mediation analyses for the second research question turned out to be non-significant as well. This means that in this sample, the anticipated positive effect of self-esteem on stress could not be found, although it has been observed several times in the past (Kirschbaum et al., 1995; Pilgrim et al., 2010). Again, sample size and therefore statistical power was too small to detect small to medium effects which could explain the non-significant results. It is also possible that other factors not considered in these analyses might had an influence on the association between self-esteem and changes in subjective or physiological stress. Such factors could be the use of different coping styles or appraisal processes which might mediate or moderate this effect.

Moreover, no significant effect of self-esteem on perceived control could be found, showing that higher self-esteem did not significantly correlate with higher perceived control during the stress test. No studies could be found exploring the relation of self-esteem and perceived control during stress inducing procedures, as most research is conducted in the field of academic achievements. There, self-esteem is positively associated with higher perceived control and more internal locus of control (Ross & Broh, 2000; Shubina, 2017; Stupnisky et al., 2007). But even outside the academic context, there seems to be a positive relation between self-esteem and locus of control as well as self-efficacy (Gecas, 1989; Judge et al., 2002), which was the basis for the assumption, that this association would also be found in the present study. Although results from the mediation analyses were not significant, visual extreme case analysis revealed great differences between participants with very low scores in self-esteem compared to those scoring very high in self-esteem. Here, the "low values" group showed considerably less perceived control, supporting the expected association. However, no definite conclusions can be drawn from that analysis, but it still shows a clear trend in data, which could indicate that sample size was simply too small to detect a significant effect.

Finally, neither the path between perceived control and differences in subjective stress ratings, nor between perceived control and differences in HR turned out to be significant. Even though the association between perceived control and differences in subjective stress ratings was not significant, *p*-value was .07 and therefore close to the significance level of .05. This makes it highly plausible, that with a bigger sample size, this association would turn out significant, suggesting that higher perceived control could lead to lower increase in subjective stress ratings in response to the TSST. This result would also be supported by previous research observing lower cortisol responses and thus less stress in participants who felt more in control during the TSST (Liu et al., 2021). However, the effect of perceived control on differences in HR was further away from being significant ($p = .57$), demonstrating again differences in subjective and objective stress measures. Both perceived control and subjective stress were assessed by one item each on a VAS asking about retrospective evaluations of control and stress during the TSST. Therefore, biases in answers in both items could be possible due to distorted perception or influence of the current mood after the TSST.

This summary of results for the second research question illustrates that neither path a nor path b reached significance, leading to no significant indirect effect of perceived control

on the association between self-esteem and differences in subjective or physiological stress values. As with research question one, extreme case analyses were also carried out for the paths of mediation models from the second research question to detect any trend in the data.

Five participants scored lowest in self-esteem and were compared to 10 participants achieving the highest values in self-esteem. Regarding mean differences in subjective stress ratings between baseline and T3, individuals low in self-esteem showed slightly bigger differences indicating that they felt more stressed in response to the TSST compared to those high in self-esteem. This difference was even bigger for HR with participants low in self-esteem experiencing a greater increase in HR in response to the stress test. Both trends support the assumption that higher self-esteem could be a protective factor in relation to acute stress.

There could also be observed trends in data supporting the expected associations between perceived control and increase in subjective or physiological stress. Six participants each scored very low or very high in perceived control and were therefore grouped together. Those who felt very little in control during the TSST showed considerably larger differences in subjective stress ratings between baseline and T3 measures. This could have already been expected based on the close to significant path from mediation analysis three. A smaller but still clear difference was also seen in HR with participants low in perceived control showing a greater increase in HR from baseline to T3. Both graphs support considerations about higher perceived control buffering stress responses during the TSST.

All in all, results from all four mediation analyses showed no significant total, direct or indirect effects between the variables extraversion, self-esteem, perceived control, and changes in subjective or physiological stress. Only the path between extraversion and self-esteem was significant, supporting the anticipated positive association between those personality characteristics. However, most descriptive comparisons through extreme case analyses suggest that the considerations regarding the mediation models were justified and that significant effects could be discovered with a larger sample size.

Limitations

Results need to be interpreted with caution as there are several limitations of this study. First, sample size was too small to reach enough power for detecting small to medium effects. This is also reflected in the fact that only one effect (the association between extraversion and self-esteem) reached significance. Although most extreme case analyses generated supporting results for the hypotheses, they cannot be regarded as proof for the

assumptions, as they are only descriptive comparisons without significant information content. However, these analyses provide promising findings for further research in this field.

The small sample size also means that there is less variance in the data especially regarding the variables extraversion and self-esteem. Most participants scored below average in extraversion, making it difficult to detect differences in varying levels of extraversion as there are hardly participants on the other end of the spectrum they could be compared to. The same might be true for self-esteem, but just in the other direction. Many participants scored very high in self-esteem, compared to only a few with low self-esteem. As a rather equal distribution of these values is necessary to investigate the influence of different levels on other variables like stress, the variation in the present sample does not represent optimal conditions for the conducted analyses.

Moreover, subjective stress ratings at T3 were assessed via retrospective evaluations of participants' feeling of stress during the TSST. This goes along with several limitations. First, participants might felt relieved after the stress test was over, leading to an increase in mood from during to after the TSST. As the questionnaire for assessing subjective stress had to be completed after the TSST, this better mood could have possibly influenced their stress ratings. Second, together with the retrospective questionnaire, participants also had to answer other items including one asking for their current feeling of stress. Thus, they had to state how stressed they felt during the TSST and right after the TSST. As both questionnaires were handed out together, the order in which they were answered could have influenced the retrospective stress rating.

The change score for the increase of subjective stress in response to the TSST was computed using the current stress assessment at baseline and the retrospective stress assessment at T3. Thereby, two very similar but still different scales were combined to compute change scores. This approach is not appropriate for scientific investigations since only values obtained by the same measures with equal psychometric properties should be used for computing new scores, representing a great limitation of this thesis. However, there were several reasons why this approach was still performed. First, the retrospective item had to be used as indicator for subjective stress to enable comparisons between subjective and physiological stress values with the latter one being measured via HR during the TSST. Therefore, the item for subjective stress should also measure stress during the same time. As it was not possible to actually assess subjective stress during the TSST, retrospective evaluations had to be used. Second, in order to investigate changes in subjective stress in

response to the TSST, there was the need to compare this retrospective evaluation with subjective stress at another timepoint before the TSST. However, the assessment of subjective stress after the TSST was the only retrospective measurement, every other rating asked for participants' current feeling of stress. Therefore, this retrospective stress value had to be compared to the current stress value at baseline. Third, although there was another questionnaire asking about current stress after the TSST, which was handed out together with the retrospective evaluation, the retrospective item was still used. This had the reason that the current stress rating after the TSST does not reflect subjective stress induced by the TSST but rather the feeling after the TSST was over, which could highly be influenced by a feeling of relieve. This influencing factor was tried to be reduced by asking participants about their stress during the TSST, resulting in the retrospective evaluation of perceived stress.

Furthermore, the time window used for computing peak stress from mean HR during the TSST was from five minutes before the TSST ended until its end. As the TSST contains of a five-minute speaking task and a five-minute arithmetic task, this means that physiological stress was assessed only during the second part. This might not be the perfect approach to assess peak stress as participants might differ in their perception of stressfulness of the speaking and arithmetic task. Some could have been more afraid of delivering a speech and therefore felt more stressed during the first part, others might have had bigger difficulties with mathematical calculations. Thus, it is possible that for some participants, mean HR was higher during the first half of the TSST while others experienced higher HR during the arithmetic task. Only considering HR during one of these parts might have led to wrong outcomes for peak stress as some participants might have already recovered from the stress of the speech task during the arithmetic task. A better approach could have been to compute mean HR during both parts of the TSST, leading to a more comprehensive understanding of physiological stress induced by the TSST. This would have also led to even better comparisons between subjective and physiological stress, as subjective stress ratings asked about the whole stress test and not just the arithmetic part.

For both subjective and physiological stress values, differences between baseline measures and T3 measures were used to compute the increase in stress in response to the TSST. However, there is a problem with this approach, as it is highly influenced by participants baseline stress levels. Some might have been more stressed due to the general testing situation or lack of knowledge about what is going to happen during the session, leading to higher baseline stress values. An attempt was made to avoid this by including a 30-

minute acclimatization phase in the study design before the first stress measurement took place. Thereby, effects of, for example, a stressful arrival or nervousness about the unfamiliar test situation were tried to be reduced to a minimum but could not be completely avoided. Higher baseline stress values, in turns, could have led to a smaller stress increase in response to the TSST, resulting in smaller mean differences between baseline and T3. As only this difference was used for the analyses, differences in baseline stress were not considered. Another approach would have been to just use T3 values as indicators of stress, but this would have made the investigation of stress increase due to the TSST impossible because of the lack of other subjective or physiological stress values to be compared to.

Furthermore, the criteria for participants to be included in this study were very strict, which leads to both positive and negative effects. A great advantage is that the sample was very homogenous and therefore potential confounding variables could be better controlled. For example, participants' BMI had to be in a defined range as overweight is known to influence activity of the HPA axis and therefore leads to altered stress responses compared to normal weight participants (Mårin et al., 1992). On the other hand, generalizability of results is limited to a small subpopulation consisting of non-pregnant or breastfeeding, normal weight women between the age of 18 and 35 with a regular menstrual cycle and no severe mental or somatic illnesses. These strict inclusion criteria had to be set to obtain a homogenous sample, leading to a better controllability of interference factors and a better detection of possible effects, but do not allow to draw a lot of conclusions on the general population.

In addition, this research project started shortly before the COVID-19 pandemic reached Austria in 2020, leading to a lot of unplanned challenges. Lockdowns and official regulations made it hard and sometimes even impossible to carry out test sessions, which resulted in a slower collection of data. Another major limitation due to COVID-19 were the differences in test conditions regarding social distance and the wearing of face masks. Some participants, those before the pandemic started and those who were tested after the last regulations were dropped, did not have to wear face masks during the test session or take care of social distance. For other participants, social distance had to be maintained and face masks had to be worn during the study, except for the TSST, leading to differences in the course of the study and interactions between participants and experimenters and therefore not consistent test conditions. COVID-19 did not only affect the study because of differing regulations that had to be met, but also in terms of changing life circumstances of

participants. For some, the pandemic could have been accompanied by negative changes in the education or employment situation, which may have led to an increase in worries and daily stress. Others may have experienced severe social isolation also influencing their current state of health. This raises the question if a difference in stress responses between participants before, during, and after the COVID-19 pandemic could be observed as participants might have dealt with varying severity of daily stress.

Implications

Although most results of the mediation analyses were not significant, descriptive comparisons via explorative extreme case analyses as well as the integration of previous findings show that the investigation of the influences and interconnections between extraversion, self-esteem, and perceived control in relation to stress represents a field of research which is worth further investigations. Future studies in this field should be conducted with a bigger sample size which is sufficient to detect medium or even small effects. By reaching a higher number of participants, more heterogeneity in variable levels is expected, leading to better preconditions for planned analyses. Furthermore, a greater diversity in participants could be another aspect to add to this study. Thereby, differences between gender, age, or other variables could be investigated, also contributing to a better generalizability of results.

Concerning stress assessment, future studies could be improved by altering the timing of physiological stress measurements. As there might be differences between participants in stress during the speech task and the arithmetic task of the TSST, physiological stress should not only be assessed during the second half, but rather include HR during the speech task as well. It would also be informative to investigate if participants actually react differently to the speech and arithmetic part and further focus on individual characteristics that could explain these differences. Regarding subjective stress ratings, future research should also consider potential distorting influences of post-stressor mood or order of questionnaire completion when retrospectively assessing subjective stress. This could be improved by defining a strict order of the items that have to be answered, with those asking about retrospective evaluations coming first. Another approach could be to interrupt the TSST by making participants mark their current subjective stress level on a VAS between the speech and arithmetic part and then computing a mean of the retrospective and between-TSST assessment.

Another focus could be drawn on how COVID-19 and the associated changes in life affected the stress responses to the acute stressor. By conducting comparative analyses

between participants tested before, during, and after the pandemic, the impact of pandemic-related factors like changes in life circumstances, social distance or wearing of face masks on stress responses induced by an acute stressor could be investigated.

Further research could also explore other moderating or mediating effects on the association between personality traits and stress responses. Both self-esteem and extraversion are associated with the use of more adaptive coping strategies (Amirkhan et al., 1995; Baumeister et al., 2003; Lo, 2002) which could mediate their effects on changes in stress induced by acute stressors. Furthermore, based on the assumption that participants might have experienced the TSST with varying degrees of intensity, the number of instructions and comments by the active stressor could get investigated as defining intensity and leading to different stress responses. Besides perceived intensity, experiences with job interviews could also moderate the association between personality traits and stress responses. For the first part of the TSST, participants had to apply for a job which might be easier for those who already had several job interviews and therefore know better how to present themselves.

The conducted analyses provide not only informative insights for future scientific research, but also imply that different personality characteristics might influence individual stress responses to acute stressors. Although most effects were not significant, extreme case comparisons indicate that extraversion, self-esteem, and perceived control could still play an important role in relation to stress. Descriptive results suggest that individuals lower in extraversion or self-esteem experienced more subjective and/or physiological stress, indicating that a lower expression in these variables might be disadvantageous when facing acute stress. Inspection of bar charts also indicates that by enhancing perceived control, both subjective and physiological stress could be reduced. As there was also observed a trend in the data showing that participants higher in self-esteem also felt more in control during the TSST, perceived control could play an important role in the relation between self-esteem and stress. This has practical implications for better coping with stress and enhancing intervention strategies. Prioritizing enhancement of perceived control or self-efficacy in daily life could be a promising approach for stress management interventions. Furthermore, by knowing that low levels of extraversion or self-esteem could lead to higher feelings of stress, interventions should focus on practicing other coping and resilience improving strategies especially in individuals low in extraversion or self-esteem to mitigate their possible negative effects on the perception of stress.

Conclusion

In this master thesis, the effects of extraversion, self-esteem, and perceived control on the increase of subjective and physiological stress in response to an acute stress test were explored. There was a significant positive effect of extraversion on self-esteem, but no other significant associations between the other variables and stress could be found. However, this master thesis still contributes to current scientific and practical knowledge as promising trends in data could be observed. They suggest that especially higher perceived control, but also higher self-esteem and extraversion, could have a positive effect on acute stress and attempts should therefore be made to enhance these characteristics or compensate for low expressions by training other coping strategies. This could lead to developing a better way of dealing with stress, going along with positive health outcomes and the development of resilience.

References

Amirazodi, F., & Amirazodi, M. (2011). Personality traits and self-esteem. *Procedia - Social and Behavioral Sciences*, *29*, 713–716. https://doi.org/10.1016/j.sbspro.2011.11.296

Amirkhan, J. H., Risinger, R. T., & Swickert, R. J. (1995). Extraversion: A "hidden" personality factor in coping? *Journal of Personality*, *63*(2), 189–212. https://doi.org/10.1111/j.1467-6494.1995.tb00807.x

Badrick, E., Bobak, M., Britton, A., Kirschbaum, C., Marmot, M., & Kumari, M. (2008). The relationship between alcohol consumption and cortisol secretion in an aging cohort. *The Journal of Clinical Endocrinology & Metabolism*, *93*(3), 750–757. https://doi.org/10.1210/jc.2007-0737

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. https://doi.org/10.1037/0022-3514.51.6.1173

Baumeister, R. F., Campbell, J. D., Krueger, J. I., & Vohs, K. D. (2003). Does high self-esteem cause better performance, interpersonal success, happiness, or healthier lifestyles? *Psychological Science in the Public Interest*, *4*(1), 1–44. https://doi.org/10.1111/1529-1006.01431

Bibbey, A., Carroll, D., Roseboom, T. J., Phillips, A. C., & De Rooij, S. R. (2013). Personality and physiological reactions to acute psychological stress. *International Journal of Psychophysiology*, *90*(1), 28–36. https://doi.org/10.1016/j.ijpsycho.2012.10.018

Borkenau, P., & Ostendorf, F. (2007). *NEO-Fünf-Faktoren-Inventar nach Costa und McCrae* (NEO-FFI; 2. neu normierte und vollständig überarb. Aufl.). Göttingen: Hogrefe.

Brouwer, A.-M., Van Schaik, M. G., Korteling, J. E., Van Erp, J. B. F., & Toet, A. (2015). Neuroticism, Extraversion, Conscientiousness and stress: Physiological correlates. *IEEE Transactions on Affective Computing*, *6*(2), 109–117. https://doi.org/10.1109/TAFFC.2014.2326402

Campbell, J., & Ehlert, U. (2012). Acute psychosocial stress: Does the emotional stress response correspond with physiological responses? *Psychoneuroendocrinology*, *37*(8), 1111–1134. https://doi.org/10.1016/j.psyneuen.2011.12.010

Canals, J., Colomina, M. T., Domingo, JoséL., & Domènech, E. (1997). Influence of smoking and drinking habits on salivary cortisol levels. *Personality and Individual Differences*, *23*(4), 593–599. https://doi.org/10.1016/S0191-8869(97)00093-7

Casale, S. (2020). Gender differences in self-esteem and self-confidence. In B. J. Carducci & C. S. Nave (Eds.), *The wiley encyclopedia of personality and indivudal differences*. Wiley Blackwell.

Chopra, K., Katz, J. L., Quilty, L. C., Matthews, S., Ravindran, A., & Levitan, R. D. (2019). Extraversion modulates cortisol responses to acute social stress in chronic major depression. *Psychoneuroendocrinology*, *103*, 316–323. https://doi.org/10.1016/j.psyneuen.2019.02.008

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155–159. https://doi.org/10.1037/0033-2909.112.1.155

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, *24*(4), 385. https://doi.org/10.2307/2136404

Costa, P. T. Jr., & McCrae, R. R. (1992). Four ways five factors are basic. *Personality and Individual Differences*, *13*(6), 653–665. https://doi.org/10.1016/0191-8869(92)90236-I

Costa, P. T. Jr., & McRae, R. R. (1989). *The NEO-PI/NEO-FFI manual supplement*. Psychological Assessment Resources.

Coyle, D. K. T., Howard, S., Bibbey, A., Gallagher, S., Whittaker, A. C., & Creaven, A.-M. (2020). Personality, cardiovascular, and cortisol reactions to acute psychological stress in the Midlife in the United States (MIDUS) study. *International Journal of Psychophysiology*, *148*, 67–74. https://doi.org/10.1016/j.ijpsycho.2019.11.014

Dickerson, S. S., & Kemeny, M. E. (2004). Acute stressors and cortisol responses: A theoretical integration and synthesis of laboratory research. *Psychological Bulletin*, *130*(3), 355–391. https://doi.org/10.1037/0033-2909.130.3.355

Evans, B. E., Stam, J., Huizink, A. C., Willemen, A. M., Westenberg, P. M., Branje, S., Meeus, W., Koot, H. M., & Van Lier, P. A. C. (2016). Neuroticism and extraversion in relation to physiological stress reactivity during adolescence. *Biological Psychology*, *117*, 67–79. https://doi.org/10.1016/j.biopsycho.2016.03.002

Eysenck, H. J. (1997). Personality and experimental psychology: The unification of psychology and the possibility of a paradigm. *Journal of Personality and Social Psychology*, *73*(6), 1224–1237. https://doi.org/10.1037/0022-3514.73.6.1224

Francis, L. J., & James, D. J. (1996). The relationship between Rosenberg's construct of self-esteem and Eysenck's two-dimensional model of personality. *Personality and Individual Differences*, *21*(4), 483–488. https://doi.org/10.1016/0191-8869(96)00095-5

Fritz, M. S., & MacKinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological Science*, *18*(3), 233–239. https://doi.org/10.1111/j.1467-9280.2007.01882.x

Garces-Arilla, S., Fidalgo, C., Mendez-Lopez, M., Osma, J., Peiro, T., Salvador, A., & Hidalgo, V. (2023). Female students' personality and stress response to an academic

examination. *Anxiety, Stress, & Coping*, 1–13. https://doi.org/10.1080/10615806.2023.2264208

Garcia-Banda, G., Servera, M., Chellew, K., Meisel, V., Fornes, J., Cardo, E., Perez, G., Riesco, M., & Doctor, R. M. (2011). Prosocial personality traits and adaptation to stress. *Social Behavior and Personality: An International Journal*, *39*(10), 1337–1348. https://doi.org/10.2224/sbp.2011.39.10.1337

Gecas, V. (1989). The social psychology of self-efficacy. *Annual Review of Sociology*, *15*, 291–316.

Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology*, *85*(2), 348–362. https://doi.org/10.1037/0022-3514.85.2.348

Gross, J. J., & Levenson, R. W. (1997). Hiding feelings: The acute effects of inhibiting negative and positive emotion. *Journal of Abnormal Psychology*, *106*(1), 95–103. https://doi.org/10.1037/0021-843X.106.1.95

Hayes, A. F. (2018). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (2nd ed.). Guilford Press.

Jonassaint, C. R., Why, Y. P., Bishop, G. D., Tong, E. M., Diong, S. M., Enkelmann, H. C., Khader, M., & Ang, J. (2009). The effects of Neuroticism and Extraversion on cardiovascular reactivity during a mental and an emotional stress task. *International Journal of Psychophysiology*, *74*(3), 274–279. https://doi.org/10.1016/j.ijpsycho.2009.09.012

Judge, T. A., Erez, A., Bono, J. E., & Thoresen, C. J. (2002). Are measures of self-esteem, neuroticism, locus of control, and generalized self-efficacy indicators of a common core construct? *Journal of Personality and Social Psychology*, *83*(3), 693–710. https://doi.org/10.1037/0022-3514.83.3.693

Kaluza, G. (2018). *Gelassen und sicher im Stress*. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-55986-4

Kanning, U. P. (2009). NEO-Fünf-Faktoren-Inventar nach Costa und McCrae (NEO-FFI). *Zeitschrift für Arbeits- und Organisationspsychologie A&O*, *53*(4), 194–198. https://doi.org/10.1026/0932-4089.53.4.194

Kim, H.-G., Cheon, E.-J., Bai, D.-S., Lee, Y. H., & Koo, B.-H. (2018). Stress and heart rate variability: A meta-analysis and review of the literature. *Psychiatry Investigation*, *15*(3), 235–245. https://doi.org/10.30773/pi.2017.08.17

Kirschbaum, C., Bartussek, D., & Strasburger, C. J. (1992). Cortisol responses to psychological stress and correlations with personality traits. *Personality and Individual Differences*, *13*(12), 1353–1357. https://doi.org/10.1016/0191-8869(92)90181-N

Kirschbaum, C., Kudielka, B. M., Gaab, J., Schommer, N. C., & Hellhammer, D. H. (1999). Impact of gender, menstrual cycle phase, and oral contraceptives on the activity of the hypothalamus-pituitary-adrenal axis. *Psychosomatic Medicine*, *61*(2), 154–162. https://doi.org/10.1097/00006842-199903000-00006

Kirschbaum, C., Pirke, K.-M., & Hellhammer, D. H. (1993). The 'Trier Social Stress Test' – A tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology*, *28*(1–2), 76–81. https://doi.org/10.1159/000119004

Kirschbaum, C., Prussner, J. C., Stone, A. A., Federenko, I., Gaab, J., Lintz, D., Schommer, N., & Hellhammer, D. H. (1995). Persistent high cortisol responses to repeated psychological stress in a subpopulation of healthy men. *Psychosomatic Medicine*, *57*(5), 468–474. https://doi.org/10.1097/00006842-199509000-00009

Kirschbaum, C., Wüst, S., & Strasburger, C. J. (1992). 'Normal' cigarette smoking increases free cortisol in habitual smokers. *Life Sciences*, *50*(6), 435–442. https://doi.org/10.1016/0024-3205(92)90378-3

Körner, A., Drapeau, M., Albani, C., Geyer, M., Schmutzer, G., & Brähler, E. (2008). Deutsche Normierung des NEO-Fünf-Faktoren-Inventars (NEO-FFI). *Zeitschrift Für Medizinische Psychologie*, *17*(2–3), 133–144.

Lakey, B., Tardiff, T. A., & Drew, J. B. (1994). Negative social interactions: Assessment and relations to social support, cognition, and psychological distress. *Journal of Social and Clinical Psychology*, *13*(1), 42–62. https://doi.org/10.1521/jscp.1994.13.1.42

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer Publishing Company.

Lesage, F.-X., Berjot, S., & Deschamps, F. (2012). Clinical stress assessment using a visual analogue scale. *Occupational Medicine*, *62*(8), 600–605. https://doi.org/10.1093/occmed/kqs140

Lim, A. (2021). *Open neuroscience initiative* (1st Edition).

Liu, Q., Wu, J., Zhang, L., Sun, X., Guan, Q., & Yao, Z. (2021). The relationship between perceived control and Hypothalamic–Pituitary–Adrenal axis reactivity to the Trier Social Stress Test in healthy young adults. *Frontiers in Psychology*, *12*, 683914. https://doi.org/10.3389/fpsyg.2021.683914

Lo, R. (2002). A longitudinal study of perceived level of stress, coping and self-esteem of undergraduate nursing students: An Australian case study. *Journal of Advanced Nursing*, *39*(2), 119–126. https://doi.org/10.1046/j.1365-2648.2000.02251.x

Lovallo, W. R. (2015). *Stress & health: Biological and psychological interactions* (Third edition). SAGE Publications, Inc.

Lü, W., Xing, W., Hughes, B. M., & Wang, Z. (2018). Extraversion and cardiovascular responses to recurrent social stress: Effect of stress intensity. *International Journal of Psychophysiology*, *131*, 144–151. https://doi.org/10.1016/j.ijpsycho.2017.10.008

Magee, C. A., Heaven, P. C. L., & Miller, L. M. (2013). Personality change predicts self-reported mental and physical health. *Journal of Personality*, *81*(3), 324–334. https://doi.org/10.1111/j.1467-6494.2012.00802.x

Mårin, P., Darin, N., Amemiya, T., Andersson, B., Jern, S., & Björntorp, P. (1992). Cortisol secretion in relation to body fat distribution in obese premenopausal women. *Metabolism*, *41*(8), 882–886. https://doi.org/10.1016/0026-0495(92)90171-6

McRae, A. L., Saladin, M. E., Brady, K. T., Upadhyaya, H., Back, S. E., & Timmerman, M. A. (2006). Stress reactivity: Biological and subjective responses to the cold pressor and Trier Social stressors. *Human Psychopharmacology: Clinical and Experimental*, *21*(6), 377–385. https://doi.org/10.1002/hup.778

Nater, U. M., Ditzen, B., & Ehlert, U. (2020). Psychosomatische und stressabhängige körperliche Beschwerden. In J. Hoyer & S. Knappe (Eds.), *Klinische Psychologie & Psychotherapie* (pp. 1221–1235). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-61814-1_54

O'Donnell, K., Brydon, L., Wright, C. E., & Steptoe, A. (2008). Self-esteem levels and cardiovascular and inflammatory responses to acute stress. *Brain, Behavior, and Immunity*, *22*(8), 1241–1247. https://doi.org/10.1016/j.bbi.2008.06.012

O'Riordan, A., Young, D. A., & Ginty, A. T. (2023). Physiological reactivity and habituation to acute psychological stress: The influence of trait extraversion. *Biological Psychology*, *181*, 108599. https://doi.org/10.1016/j.biopsycho.2023.108599

O'Riordan, A., Young, D. A., Tyra, A. T., & Ginty, A. T. (2023). Extraversion is associated with lower cardiovascular reactivity to acute psychological stress. *International*

Journal of Psychophysiology, *189*, 20–29. https://doi.org/10.1016/j.ijpsycho.2023.04.004

Oswald, L. M., Zandi, P., Nestadt, G., Potash, J. B., Kalaydjian, A. E., & Wand, G. S. (2006). Relationship between cortisol responses to stress and personality. *Neuropsychopharmacology*, *31*(7), 1583–1591. https://doi.org/10.1038/sj.npp.1301012

Parrott, A. C., Sands, H. R., Jones, L., Clow, A., Evans, P., Downey, L. A., & Stalder, T. (2014). Increased cortisol levels in hair of recent Ecstasy/MDMA users. *European Neuropsychopharmacology*, *24*(3), 369–374. https://doi.org/10.1016/j.euroneuro.2013.11.006

Pilgrim, K., Marin, M.-F., & Lupien, S. J. (2010). Attentional orienting toward social stress stimuli predicts increased cortisol responsivity to psychosocial stress irrespective of the early socioeconomic status. *Psychoneuroendocrinology*, *35*(4), 588–595. https://doi.org/10.1016/j.psyneuen.2009.09.015

Pruessner, J. C., Baldwin, M. W., Dedovic, K., Renwick, R., Mahani, N. K., Lord, C., Meaney, M., & Lupien, S. (2005). Self-esteem, locus of control, hippocampal volume, and cortisol regulation in young and old adulthood. *NeuroImage*, *28*(4), 815–826. https://doi.org/10.1016/j.neuroimage.2005.06.014

Pruessner, J. C., Hellhammer, D. H., & Kirschbaum, C. (1999). Low self-esteem, induced failure and the adrenocortical stress response. *Personality and Individual Differences*, *27*(3), 477–489. https://doi.org/10.1016/S0191-8869(98)00256-6

Quick, J. D., Horn, R. S., & Quick, J. C. (2014). Health consequences of stress. In J. M. Ivancevich & D. C. Ganster (Eds.), *Job stress: From theory to suggestion* (1st Edition). Routledge.

Rajendra Acharya, U., Paul Joseph, K., Kannathal, N., Lim, C. M., & Suri, J. S. (2006). Heart rate variability: A review. *Medical & Biological Engineering & Computing*, *44*(12), 1031–1051. https://doi.org/10.1007/s11517-006-0119-0

Rani, S., Saleem, S., & Zahra, S. T. (2023). The mediating role of self-esteem in personality and mental health problems in university students with traumatic experiences. *Journal of Postgraduate Medical Institute*. https://doi.org/10.54079/jpmi.37.2.3159

Robins, R. W., Tracy, J. L., Trzesniewski, K., Potter, J., & Gosling, S. D. (2001). Personality correlates of self-esteem. *Journal of Research in Personality*, *35*(4), 463–482. https://doi.org/10.1006/jrpe.2001.2324

Rosenberg, M. (1965). Rosenberg Self-Esteem Scale (RSE). *Acceptance and Commitment Therapy*, 61.

Ross, C. E., & Broh, B. A. (2000). The roles of self-esteem and the sense of personal control in the academic achievement process. *Sociology of Education*, *73*(4), 270–284.

Rucker, D. D., Preacher, K. J., Tormala, Z. L., & Petty, R. E. (2011). Mediation analysis in social psychology: Current practices and new recommendations. *Social and Personality Psychology Compass*, *5*(6), 359–371. https://doi.org/10.1111/j.1751-9004.2011.00355.x

Sanz, A., & Villamarín, F. (2001). The role of perceived control in physiological reactivity: Self-efficacy and incentive value as regulators of cardiovascular adjustment. *Biological Psychology*, *56*(3), 219–246. https://doi.org/10.1016/S0301-0511(01)00095-3

Schneider, T. R., Rench, T. A., Lyons, J. B., & Riffle, R. R. (2012). The influence of Neuroticism, Extraversion and Openness on stress responses: Personality and stress responses. *Stress and Health*, *28*(2), 102–110. https://doi.org/10.1002/smi.1409

Shubina, I. (2017). Locus of control, feeling of happiness and self-esteem: Interrelation analysis. *International Journal of Scientific Research and Management (IJSRM)*, *5*(11), 7563–7575. https://doi.org/10.18535/ijsrm/v5i11.27

Strahler, J., Skoluda, N., Kappert, M. B., & Nater, U. M. (2017). Simultaneous measurement of salivary cortisol and alpha-amylase: Application and recommendations. *Neuroscience & Biobehavioral Reviews*, *83*, 657–677. https://doi.org/10.1016/j.neubiorev.2017.08.015

Stumpf, S. A., Brief, A. P., & Hartman, K. (1987). Self-efficacy expectations and coping with career-related events. *Journal of Vocational Behavior*, *31*(1), 91–108. https://doi.org/10.1016/0001-8791(87)90037-6

Stupnisky, R. H., Renaud, R. D., Perry, R. P., Ruthig, J. C., Haynes, T. L., & Clifton, R. A. (2007). Comparing self-esteem and perceived control as predictors of first-year college students' academic achievement. *Social Psychology of Education*, *10*(3), 303–330. https://doi.org/10.1007/s11218-007-9020-4

Swickert, R., Hittner, J. B., Kitos, N., & Cox-Fuenzalida, L.-E. (2004). Direct or indirect, that is the question: A re-evaluation of extraversion's influence on self-esteem. *Personality and Individual Differences*, *36*(1), 207–217. https://doi.org/10.1016/S0191-8869(03)00080-1

Von Collani, G., & Herzberg, P. Y. (2003). Eine revidierte Fassung der deutschsprachigen Skala zum Selbstwertgefühl von Rosenberg. *Zeitschrift für Differentielle und Diagnostische Psychologie*, *24*(1), 3–7. https://doi.org/10.1024//0170-1789.24.1.3

Xin, Y., Wu, J., Yao, Z., Guan, Q., Aleman, A., & Luo, Y. (2017). The relationship between personality and the response to acute psychological stress. *Scientific Reports*, *7*(1), 16906. https://doi.org/10.1038/s41598-017-17053-2

Yang, J., Yang, Y., Li, H., Hou, Y., Qi, M., Guan, L., Che, X., Chen, Y., Chen, W., & Pruessner, J. C. (2014). Correlation between self-esteem and stress response in Chinese college students: The mediating role of the need for social approval. *Personality and Individual Differences*, *70*, 212–217. https://doi.org/10.1016/j.paid.2014.06.049

Zafar, N., Saleem, S., & Mahmood, Z. (2012). The development of a self-esteem scale for university students. *FWU Jounal of Social Sciences*, *6*(1), 26–37.

Figures

Tables

List of abbreviations

ACTH – adrenocorticotropic hormone

ANS – autonomic nervous system

BMI – body mass index

CMDD – chronic major depressive disorder

CRH – corticotropin-releasing hormone

EDA – electrodermal activity

GH – growth hormone

HPA-axis – hypothalamic pituitary adrenal axis

HR – heart rate

HRV – heart rate variability

NEO-FFI – Neo-Fünf-Faktoren-Inventar

PMS – premenstrual syndrome

PNS – parasympathetic nervous system

PSS – Perceived Stress Scale

RCT – randomized controlled trial

RSES – Rosenberg Self-Esteem Scale

SAM-axis – sympathetic-adrenal-medullary axis

SNS – sympathetic nervous system

TEWL – trans epidermal water loss

TSST – Trier Social Stress Test

VAS – Visual Analogue Scale

Appendix

Zusammenfassung

Akuter Stress löst je nach den persönlichen Merkmalen und Erfahrungen der Menschen unterschiedliche Stressantworten aus. Diese Masterarbeit konzentriert sich auf die Variablen Extraversion, Selbstwertgefühl und wahrgenommene Kontrolle und untersucht, wie diese Faktoren die Intensität der Stressantworten auf einen akuten Stressor beeinflussen. Es wurde angenommen, dass der negative Effekt von Extraversion auf Veränderungen des subjektiven und physiologischen Stresses durch ein höheres Selbstwertgefühl mediiert wird. Weiters wurde erwartet, dass eine höhere wahrgenommene Kontrolle den negativen Zusammenhang zwischen Selbstwertgefühl und Veränderungen in beiden Stressmaßen als Antwort auf den Stresstest mediiert. 52 Teilnehmerinnen wurden in einer Laborstudie unter Verwendung des TSST, einem stressinduzierenden Verfahren, getestet. Das NEO-FFI und die RSES wurden verwendet, um Extraversion und Selbstwertgefühl zu messen. Subjektiver Stress, erhoben anhand einer VAS, und physiologischer Stress, gemessen anhand der HR, wurden beide bei Studienbeginn und während des TSST (HR) oder direkt nach dem TSST mittels retrospektiver Einschätzungen (VAS) ermittelt. Wahrgenommene Kontrolle wurde ebenfalls retrospektiv anhand einer VAS gemessen. Es wurden vier Mediationsanalysen durchgeführt, bei denen nur der Pfad zwischen Extraversion und Selbstwertgefühl in der erwarteten Richtung signifikant war. Explorative Extremgruppenvergleiche wurden durchgeführt, um Tendenzen in den Daten zu erkennen, die in den Mediationsanalysen aufgrund der unzureichenden Stichprobengröße und Variation der Variablen nicht gefunden werden konnten. Diese Analysen zeigten die Tendenz, dass Personen mit höheren Werten in Extraversion möglicherweise weniger Zuwachs in physiologischem Stress erleben, wenn sie akutem Stress ausgesetzt sind. Ein höheres Selbstwertgefühl und ein höheres Maß an wahrgenommener Kontrolle könnten ebenfalls schützende Faktoren sein, wenn sie mit Stress konfrontiert sind, da Teilnehmerinnen mit höheren Werten dieser Variablen geringere Veränderungen bei subjektivem und physiologischem Stress zwischen den Messungen zu Beginn und während des TSST zeigten. Wenn sich dieses Muster in einer größeren Stichprobe bestätigt, deutet das darauf hin, dass durch eine Steigerung des Selbstwertgefühls oder der wahrgenommenen Kontrolle die Stressantwort auf akute Stressoren verringert werden könnten, was sich positiv auf die Gesundheit auswirken würde.

Schlüsselwörter: Extraversion, Selbstwertgefühl, wahrgenommene Kontrolle, Persönlichkeitsmerkmale, subjektiver Stress, physiologischer Stress, Stressantwort, TSST