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The Mediating Role of Self-Esteem on the Relationship between
Emotion Regulation Strategies and Anxiety

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Statement on the use of AI

For the statistical analysis, the AI program “StatsBot” from the University of Vienna was used as a tool to guide statistical decisions and facilitate understanding in dealing with statistical programs. In addition, “DeepL-Write” an advanced AI-generated translation tool was used to improve grammar and wording, especially for the translation of the abstract.

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Abstract

Objectives

Emotion regulation has been identified as both a risk and protective factor for the development of anxiety. Emerging research also suggests that emotion regulation strategies may influence self-esteem, a variable known for its anxiety-buffering effect. This study aims to examine whether self-esteem mediates the relationship between the two specific emotion regulation strategies - cognitive reappraisal and expressive suppression – and both state anxiety and trait anxiety.

Method

A total of 78 participants completed self-report measures assessing habitual emotion regulation (Emotion Regulation Questionnaire, ERQ), self-esteem (Rosenberg Self-Esteem Scale, RSES) and trait anxiety (State-Trait Anxiety Inventory, STAI-T). State anxiety was assessed at two time points during a laboratory session using a single-item Visual Analog Scale (VAS), following exposure to the Trier Social Stress Test (TSST). For exploratory analyses, state anxiety was also assessed prior to the experimental setting using STAI-S. Correlation analyses (Pearson's r and Spearman's ρ) and mediation analyses using Hayes' PROCESS macro were conducted to test the mediating role of self-esteem.

Results and conclusion

The conducted confirmatory analyses indicate a significant full mediation, with self-esteem mediating the relationship between both emotion regulation strategies and trait anxiety. The planned mediation analysis with state anxiety as the dependent variable did not yield significant results. However, the findings of the exploratory analyses suggest a potential mediating role of self-esteem in the relationship between emotion regulation strategies and state anxiety. These results underscore the importance of self-esteem in the interplay between emotion regulation and anxiety, particularly with regard to long-term anxiety outcomes. Further research with larger and more diverse samples is needed to confirm and extend these findings.

Keywords: Emotion regulation strategies, cognitive reappraisal, expressive suppression, self-esteem, state anxiety, trait anxiety

Zusammenfassung

Ziele

Emotionsregulation wird in der Forschung sowohl als Risiko- als auch als Schutzfaktor im Hinblick auf die Entwicklung von Angst diskutiert. Bisherige Studien legen zudem nahe, dass Emotionsregulationsstrategien einen Einfluss auf das Selbstwertgefühl ausüben können - eine Variable, die nachweislich eng mit Angst assoziiert ist und als ein zentraler angstpuffernder Mechanismus gilt. Ziel der vorliegenden Studie ist es daher zu untersuchen, inwieweit das Selbstwertgefühl die Beziehung zwischen zwei spezifischen Emotionsregulationsstrategien – kognitiver Neubewertung und expressiver Unterdrückung - sowie State-Angst und Trait-Angst mediiert.

Methode

Insgesamt nahmen 78 Personen an der Studie teil. Die habituelle Nutzung von Emotionsregulationsstrategien wurde mittels des Emotion Regulation Questionnaire (ERQ) erfasst, das Selbstwertgefühl mit der Rosenberg Self-Esteem Scale (RSES) und die Trait-Angst über die Trait-Skala des State-Trait Anxiety Inventory (STAI-T). Die State-Angst wurde im Laborkontext zu zwei Messzeitpunkten nach dem Trier Social Stress Tests (TSST) mittels visueller Analogskala (VAS) erhoben. Zusätzlich wurden zwei exploratorische Analysen durchgeführt, in denen State-Angst vor Beginn des experimentellen Settings mit der STAI-S gemessen wurde. Zur Überprüfung der Mediationshypothesen wurden Korrelationsanalysen (Pearson's r , Spearman's ρ) sowie Mediationsanalysen mit Hayes' PROCESS macro durchgeführt.

Ergebnisse und Schlussfolgerungen

Konfirmatorische Analysen zeigen eine signifikante vollständige Mediation, bei der das Selbstwertgefühl den Zusammenhang zwischen beiden Emotionsregulationsstrategien und Trait-Angst mediiert. Die geplante Mediationsanalyse mit State-Angst als abhängiger Variable ergab keine signifikanten Ergebnisse. Exploratorische Ergebnisse deuten jedoch auf einen möglichen vermittelnden Effekt des Selbstwertgefühls auf die Beziehung zwischen Emotionsregulationsstrategien und State-Angst hin. Diese Resultate betonen die Relevanz des Selbstwertgefühls für das Zusammenspiel von Emotionsregulation und Angst, insbesondere im Hinblick auf deren langfristige Auswirkungen. Zur Bestätigung und Erweiterung dieser Ergebnisse sind weitere Studien mit größeren und diverseren Stichproben erforderlich.

Schlüsselwörter: Emotionsregulationsstrategien, kognitive Neubewertung, expressive Unterdrückung, Selbstwertgefühl, State-Angst, Trait-Angst

Introduction

The human experience is fundamentally shaped by emotions, which emerge in response to both positive and negative stimuli encountered in daily life (Gross, 1998). They differ in terms of valence, intensity, duration and the speed at which they arise and subside (Suri et al., 2013). As Moors (2017) notes, a broad spectrum of such emotional states ranging from joy, fear, sadness, happiness, boredom and pride, is embedded in the everyday vocabulary of human languages. However, defining emotion remains challenging due to its subjective and variable nature. Consequently, diverse theories regarding the nature and function of emotions from disciplines such as philosophy, sociology, biology, and psychology have emerged, each capturing this complex phenomenon in their own way (Frenzel et al., 2023).

From an evolutionary perspective, emotions serve adaptive functions by providing relevant information and activating physiological and cognitive mechanisms (Roth et al., 2019). For instance, fear can automatically trigger a fight or flight response via the autonomic nervous system, directing attention towards potential threats. This illustrates the essential survival function of emotions, particularly in early human environments (Greene et al., 2013). However, although emotions continue to play a central role in human functioning, their adaptive value has shifted in response to modern societal demands. In contrast to the immediate physical threats faced by early humans, contemporary challenges, such as political instability, global (climatic and epidemic) crises, and the continuous rise of digitalization, require individuals to manage more complex and often abstract emotional experiences (Glazer, 2021; Shanker, 2012).

While emotions, such as fear, can be helpful in threatening situations, they may also prevent goal achievement when they conflict with social expectations or personal aspirations (Gross & Cassidy, 2019). As a result, the ability to regulate emotional experiences and expressions has become crucial for adaptive behavior, enabling individuals to navigate external demands and achieve long-term goals throughout the life span (Roth et al., 2019; Wang & Saudino, 2011).

Emotion regulation has thus emerged as a critical factor for psychological well-being and effective functioning in the modern world. Numerous studies have shown that effective emotion regulation is linked to positive outcomes like life satisfaction, well-being and academic and interpersonal functioning, as well as decreased symptoms of anxiety and depression, and a decreased risk of developing psychopathologies (Aldao et al., 2010; Garnefski et al., 2001; Goldin et al., 2008; Gross & John, 2003). Conversely, individuals who struggle with regulating their emotional responses are more prone to prolonged distress and higher vulnerability to psychological, physical, and social health issues, such as anxiety, depression and cognitive

impairments (Aldao et al., 2010; Goldin et al., 2008; Gross, 2015; J. T. Gross & Cassidy, 2019; Kivity & Huppert, 2018; Lincoln et al., 2022; Roth et al., 2019a). In fact, difficulties in emotion regulation are recognized as a contributing factor to many psychiatric disorders. The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) suggests that emotion regulation difficulties play a role a substantial number of psychiatric disorders, with some disorders explicitly referencing these issues in their diagnostic criteria. For example, "difficulty controlling worry" is a key feature of generalized anxiety disorder (GAD), while posttraumatic stress disorder (PTSD) is characterized by "efforts to avoid feelings" (Amstadter, 2008). Theorists further argue that deficiencies in emotion regulation serve as a risk factor for the development of psychopathologies including mood, anxiety, substance use, personality and eating disorders (Aldao et al., 2010; Naragon-Gainey et al., 2017).

This highlights the central role of emotion regulation across psychiatric conditions. Within this spectrum, anxiety disorders may be especially relevant, as they are among the most prevalent worldwide, affecting around 4% of the population (World Health Organization [WHO], 2023). As a result, extensive research has focused on understanding the relationship between emotion regulation and anxiety symptoms. A meta-analysis by Aldao et al. (2010) found that different emotion regulation strategies are associated with anxiety symptoms. Specifically, adaptive strategies tend to have a low-to-moderate negative correlation with anxiety, while maladaptive strategies exhibit a moderate positive correlation (Aldao et al., 2010). These findings highlight the dual role of emotion regulation in both mitigating and exacerbating anxiety symptoms (Cisler & Olatunji, 2012).

In addition to emotion regulation, self-esteem has emerged as another key factor in the development and maintenance of anxiety symptoms. Recent cross-sectional studies have consistently demonstrated a medium-to strong negative correlation between self-esteem and anxiety, suggesting that individuals with lower self-esteem tend to experience higher anxiety symptoms and vice versa (Lee & Hankin, 2009; Riketta, 2004; Watson et al., 2002). Furthermore, emotion regulation strategies have been found to be closely linked to self-esteem, with adaptive strategies being positively correlated with self-esteem and maladaptive strategies showing a negative correlation (Gómez-Ortiz et al., 2016; J. J. Gross & John, 2003a; Mouatsou & Koutra, 2023; Nezlek & Kuppens, 2008).

Given these associations, exploring the interplay between emotion regulation, self-esteem, and anxiety could provide valuable insights into the mechanisms underlying anxiety symptoms. This study specifically aims to investigate the mediating role of self-esteem in the relationship between emotion regulation strategies and anxiety. Specifically, the current research intends to

clarify whether self-esteem acts as a significant mediator that influences how emotion regulation strategies impact anxiety levels. Regarding the high prevalence of anxiety disorders, understanding this dynamic could contribute to more targeted and effective preventative or therapeutic interventions.

Emotion Regulation

“People not only have emotions, they also handle them.” (Frijda, 1986, p. 401)

The number of studies on emotion regulation has grown dramatically over the last 20 years, making it a popular field of study (Cutuli, 2014; Lincoln et al., 2022). Gross (1998) defines emotion regulation as “processes by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions” (Gross, 1998, p. 275). The duration, intensity, valence, and initiation of emotions, as well as emotional reactions in the behavioral, perceptual, and physiological domains, are all believed to be influenced by emotion regulation systems (Wang & Saudino, 2011). They are thought to be automatic or conscious and used to up- or down-regulate both negative and positive emotions (Lincoln et al., 2022). In his Process Model of Emotion Regulation, Gross (1998) describes different strategies of emotion regulation, which will be discussed further in the following chapters.

Process Modell of Emotion Regulation

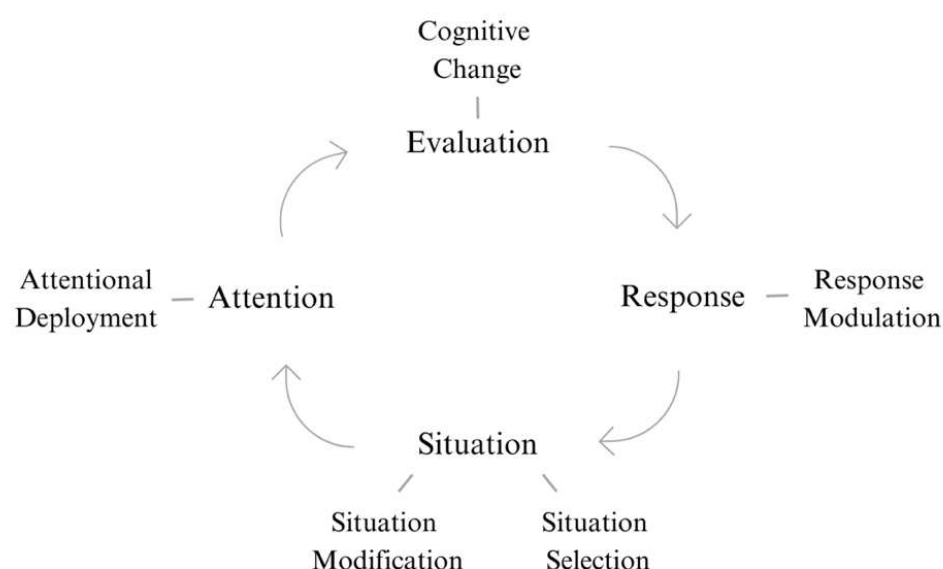
The Process Modell of Emotion Regulation has been extensively researched and is widely used (Roth et al., 2019). It provides a framework for the emotion regulation process by identifying different emotion regulation strategies that unfold during an emotional response. One approach to differentiate between different emotion regulation strategies is to determine where they primarily impact the emotion-generative process (DeSteno et al., 2013). As shown in Figure 1, emotions are developed through many iterative cycles during person-situation transactions that hold special significance for the individual in light of current active goals (Moors, 2017).

This emotion-generative process is thought to be influenced by the four elements (1) situation, (2) attention, (3) evaluation and (4) response, that together shape the emotional experience and response of an individual. These components not only influence how emotions are generated but also serve as anchor points for categorizing different emotion regulation strategies. Five distinct families of emotion regulation techniques can be identified based on where they have an impact on the emotion-generative process (see Figure 1).

Situation-focused strategies involve selecting or modifying a situation to influence an emotion. For instance, seeking or avoiding emotionally charged situations (1 - situation selection), or altering the situation itself (1 - situation modification). These situations can be both experienced or imagined. Attentional strategies alter emotions by shifting the focus within a given situation, influencing what aspects of the situation are being viewed (2 - attentional deployment). Cognitive strategies modify emotional responses by changing how a situation is being interpreted or by changing one's own perspectives or goals (3 - cognitive change). Lastly, response modulation strategies try to alter emotions by directly influence emotion-related behavior and physiological responses (4 - response modulation).

Figure 1

The Emotion-Generative Process & Emotion Regulation Strategies (Own representation based on Gross, 2013, p. 8.)



Strategies

As emotions unfold over time, different emotion regulation strategies exert their influence at distinct stages of the emotion generative process. This temporal differentiation forms the basis for the classification into *antecedent-focused* and *response-focused* strategies. Antecedent-focused strategies target the situational, attentional, and evaluational aspects of the emotion-generative process, aiming to change the emotional trajectory before the emotion fully emerges (Gómez-Ortiz et al., 2016). In contrast, response-focused strategies come into play later, once the emotion is already generated, and primarily modulate its outward expression rather than its

experiential or physiological components (Cisler & Olatunji, 2012). Because of this timing, antecedent-focused strategies are believed to have a stronger impact on altering emotional experiences, whereas response-focused strategies primarily regulate emotional expression with limited influence on the underlying emotional state (Gross & John, 2003).

Beyond this temporal classification, emotion regulation strategies are frequently classified as either *adaptive* or *maladaptive*. This distinction results in the consequences associated with the strategies: while those strategies that appear to have positive effects on health are considered adaptive, those strategies that are associated with psychopathologies are viewed as maladaptive (Aldao et al., 2010). However, categorizing these strategies as exclusively adaptive or maladaptive is too simplistic, as their effectiveness depends on various factors such as the specific context, individual, and goal (Naragon-Gainey et al., 2017). For instance, in certain situations, such as when short-term functioning is critical, a typically maladaptive strategy may prove more effective than one generally considered as adaptive, despite potential long-term costs. This suggests that the effectiveness of an emotion regulation strategy is not inherently fixed but depends on its flexible and context-sensitive application. Thus, the classification of strategies as adaptive or maladaptive should be interpreted more as a reflection of habitual reliance on specific strategies, that might either enhance psychological well-being or alleviate psychological distress, than as a reflection of the strategy itself (Naragon-Gainey et al., 2017). In this thesis, adaptive and maladaptive emotion regulation are not seen as fixed characteristics of specific strategies but rather as patterns of habitual use that shape long-term health outcomes. Among the most extensively studied strategies are the antecedent-focused and typically adaptive *cognitive reappraisal* and the response-focused and generally maladaptive *expressive suppression* (Wu et al., 2024a).

Cognitive Reappraisal

Cognitive Reappraisal is an emotion regulation strategy that falls under cognitive change. By reinterpreting an emotion-triggering situation, cognitive reappraisal changes the perceived meaning and thereby modulates the resulting emotional response (Gross & John, 2003; Lazarus & Alfert, 1964). An example for cognitive reappraisal used to regulate negative emotions could be reframing a failed job interview as a valuable learning opportunity. This positive reinterpretation of an emotionally challenging situation allows individuals to better cope with stress. As an antecedent-focused strategy, it intervenes relatively early in the emotion-generative process, making it particularly effective in down-regulating emotional experiences and behavior (Goldin et al., 2008).

A substantial body of research highlights the affective, cognitive, social and physiological benefits of cognitive reappraisal (Roth et al., 2019). For instance, Gross and John (2003) found that individuals who frequently employ cognitive reappraisal report and express fewer negative emotions and more positive emotions. Moreover, these individuals are more likely to be accepted by their peers and maintain more harmonious interpersonal relationships (Gross & John, 2003). Cognitive reappraisal has also been linked to overall psychological well-being. A recent meta-analysis by Wu et al. (2024) demonstrated a moderate positive correlation between cognitive reappraisal and life satisfaction. Additionally, cognitive reappraisal appears to be negatively correlated with symptoms of anxiety and depression (Schäfer et al., 2017). Consistent with this, Aldao et al. (2010) found a robust negative relationship between reappraisal and various forms of psychopathology in their meta-analysis.

In sum, cognitive reappraisal is widely considered as an *adaptive emotion regulation strategy* due to its consistent association with long-term psychological well-being. Research links its use to higher life satisfaction, lower levels of depression and anxiety, enhanced self-esteem, and more satisfying interpersonal relationships (Garnefski et al., 2001; Goldin et al., 2008; Gross & John, 2003).

Expressive Suppression

Expressive suppression is an emotion regulation strategy that targets emotion-related behavioral expressions. It aims to modify emotional responses by inhibiting, masking or reducing the display of emotions (Gross & Cassidy, 2019; Soto et al., 2011). An example is the suppression of the urge to cry during an argument with a superior, in order to maintain composure and prevent emotional escalation. As a response-focused strategy, expressive suppression intervenes relatively late in the emotion-generative process. Because it targets the external expression of emotion rather than the underlying emotion itself, research indicates that expressive suppression has minimal impact on the subjective and physiological experience of emotion (Cutuli, 2014; Goldin et al., 2008). In fact, findings indicate that it may even lead to increased sympathetic activation of the cardiovascular system (Goldin et al., 2008). One possible explanation for this observed physiological arousal is that, since expressive suppression does not address the underlying emotion, the emotion remains unresolved (Cutuli, 2014).

Although expressive suppression may serve short-term functional purposes in specific cultural or social contexts, habitual use has been consistently linked to adverse outcomes. These include cognitive impairments, diminished self-esteem, reduced interpersonal functioning, and

elevated symptoms of depression, anxiety and general psychopathology (Goldin et al., 2008; Gross, 2013; Gross & Cassidy, 2019; Kivity & Huppert, 2018; Lincoln et al., 2022).

Empirical evidence supports this pattern: Gross and John (2003) found that while suppression reduces the expression of negative emotions, it does not diminish their subjective experience. More importantly, expressive suppression has been found to diminish both the subjective experience and outward expression of positive emotions (Gross & John, 2003), which may contribute to a decline in overall well-being. Additionally, Roth (2019) argues that the inability to openly engage with emotional experience may lead to unresolved emotions resurfacing as rumination, a process strongly associated with depression (Thomsen et al., 2011). Indeed, expressive suppression has been negatively associated with psychological well-being and positively associated with symptoms of anxiety and depression (Aldao et al., 2010; Schäfer et al., 2017).

Social consequences are also reported in the context of expressive suppression: Individuals who habitually rely on expressive suppression report lower relationship satisfaction, fewer close friendships, and reduced social support (Butler et al., 2003; Lopes et al., 2005). This may stem from the disruption of emotional sharing and reduced opportunities for emotional support which are all key components in building intimacy and trust. Furthermore, suppression has been linked to feelings of inauthenticity and the sense of deceiving others, which may undermine self-concept and contribute to a lower self-esteem (Roth et al., 2019).

Finally, a recent meta-analysis by Wu et al. (2024) found a negative correlation between expressive suppression and life satisfaction. Notably, this association was significant only in individuals aligned with Western cultural values, but not in those endorsing Eastern values. This finding underscores the importance of cultural context in understanding the effects and adaptiveness of emotion regulation strategies.

In summary, expressive suppression is widely considered a *maladaptive emotion regulation strategy*. While it may offer situational benefits in the short term, especially in certain cultural or social settings, its long-term use is associated with reduced psychological well-being, impaired interpersonal functioning, and increased vulnerability to mental health problems (Goldin et al., 2008; Gross, 2013; Gross & Cassidy, 2019; Kivity & Huppert, 2018; Lincoln et al., 2022). It is particularly ineffective at reducing negative emotional experiences and may diminish the experience and expression of positive emotions, thereby contributing to a range of the previously described negative outcomes.

Determinants of Emotion Regulation

Emotion regulation is shaped by a range of individual and contextual factors, as well as by the specific goals people pursue (Frenzel et al., 2023). On an individual level, people differ in the number of strategies they can access, their habitual use of certain strategies, and the flexibility and effectiveness with which they apply them (Ford & Troy, 2019; Rottweiler et al., 2018). Even personality traits have been linked to specific emotion regulation strategies: extraversion, for example, has been associated with approach-oriented rather than avoidance-oriented situation modification, while neuroticism tends to predict greater reliance on suppression (Hughes et al., 2020).

Moreover, beliefs about emotional controllability and self-efficacy play an important role: individuals who believe that emotions can be shaped and controlled are more likely to engage in active regulation (Suri et al., 2013). Similarly, emotional awareness and differentiation are crucial, as they enable individuals to accurately recognize the need for regulation and to select appropriate strategies (Lian et al., 2025). In addition, emotion regulation abilities also evolve across the lifespan, shifting from more behavioral strategies in early childhood to more cognitively based strategies in adolescence and adulthood (Wang & Saudino, 2011).

Beyond individual traits, contextual factors also significantly influence emotion regulation. The emotional intensity of a situation, for instance, can affect which strategies are used. Research indicates that individuals are more likely to use cognitive reappraisal under conditions of moderate emotional intensity, while expressive suppression is more common in highly intense situations (McRae & Gross, 2020). This may be due to underlying neural mechanisms that shift from flexible cognitive processing to more rigid, habitual responses under high stress (Miklósi et al., 2014). For example, it has been found that the prefrontal cortex - a brain region involved in cognitive control and executive functions - is strongly activated during cognitive reappraisal. However, under increased stress, the function of the prefrontal cortex can be impaired or reduced, which could limit the effectiveness of cognitive reappraisal and lead to those affected relying more heavily on expressive suppression as a regulatory strategy.

Cultural and social contexts further shape emotional regulation, as societal norms influence what is considered acceptable emotional behavior (Chang, 2020; Ford & Mauss, 2015). For example, Matsumoto et al. (2008) found cultural differences in emotion regulation between individualistic and collectivistic societies: individuals from individualistic cultures (e.g., USA) reported less use of expressive suppression than those from collectivistic cultures (e.g., China), while non-significant differences were found for cognitive reappraisal (Matsumoto et al., 2008).

A recent meta-analysis by Wu et al. (2024) further showed that the relationship between expressive suppression and life satisfaction has been found to be moderated by cultural values: while suppression was negatively associated with life satisfaction in Western populations, this association was not significant in Eastern populations. One possible explanation is that Western cultures emphasize self-expression, which conflicts with expressive suppression, whereas Eastern cultures value self-restraint, making expressive suppression a more culturally congruent strategy (Schunk et al., 2021; Wu et al., 2024).

Finally, the goals individuals pursue in a given context strongly influence strategy selection (Suri et al., 2013). Hedonic goals aim to maximize positive and minimize negative emotions, while instrumental goals focus on achieving desired outcomes. Accordingly, individuals may engage in cognitive reappraisal to serve hedonic goals, whereas expressive suppression may be used in emotionally demanding situations when instrumental goals are prioritized.

As shown, a variety of factors contribute to the interindividual variability in emotion regulation strategy use. However, systematic differences have been observed across populations. One such group comprises individuals experiencing elevated anxiety symptoms. These individuals tend to rely more heavily on specific regulatory patterns, which may contribute to - or even maintain - their heightened anxiety (Amstadter, 2008; Cisler & Olatunji, 2012).

The following chapter explores the relationship between emotion regulation strategies and anxiety in more detail.

Emotion Regulation and Anxiety

Even though a wide range of emotions such as anger, sadness or fear require regulation, anxiety holds a particularly central role due to its strong implications for mental health and well-being. Anxiety itself can be described as a “state of diffuse arousal following the perception of a real or imagined threat” (Amstadter, 2008, p. 3). It is a future-oriented, self-focused emotion that is unpleasant and activating, yet can sometimes facilitate adaptive responses such as anticipatory problem solving. Although the term *anxiety* is often used interchangeably with *fear*, they represent distinct constructs. Fear is typically defined as an acute alarm response to an identifiable danger and is closely associated with immediate defensive reactions (e.g., fight-or-flight response). Anxiety, on the other hand, refers to anticipatory preparation for potential future threats. Despite these differences, the two share overlapping neurobiological characteristics and behavioral responses, such as increased arousal and vigilance (Greene et al., 2013).

Under normal circumstances, anxiety is a transient emotional state. Most individuals are able to regulate their anxiety through self-regulatory strategies such as cognitive reappraisal, selective attention or suppression (Hartley & Phelps, 2010). However, when anxiety becomes excessively intense, frequent, or disproportionate to the actual threat, it may deplete cognitive resources and impair daily functioning, ultimately increasing the risk of psychopathology (Amstadter, 2008; Cisler & Olatunji, 2012).

According to the World Health Organization, 301 million people worldwide – approximately 4% of the global population - were living with anxiety disorders in 2019 (WHO, 2023), making them the most prevalent class of mental disorders. These include generalized anxiety disorder (characterized by excessive worry), panic disorder (characterized by recurrent panic attacks), social anxiety disorder (characterized by intense fear in social situations), specific phobias (characterized by intense fear of specific objects or contexts), among others (WHO, 2023). Despite their differences, all anxiety disorders share the core features of excessive and/or persistent fear and worry (Amstadter, 2008), typically accompanied by physical tension as well as behavioral and cognitive symptoms, which can cause significant distress and interfere with everyday life (WHO, 2023).

The *biopsychosocial model* provides a comprehensive framework for understanding the development and maintenance of psychopathologies, including anxiety disorders. According to this model, biological factors (e.g., genetic predispositions, hormonal responses, neurocircuitry), psychological factors (e.g., cognitive styles, personality traits, emotion regulation strategies) and social factors (e.g., interpersonal relationships, cultural norms, life stressors) interact dynamically

to shape an individual's vulnerability or resilience to psychopathology (Wittchen et al., 2020). In line with the *diathesis-stress model*, this framework suggests that depending on an individual's biological and psychological predispositions, external stressors may or may not trigger the onset of psychopathology (Goforth et al., 2011). This perspective helps explain interindividual differences in the development of anxiety disorders despite exposure to similar stressors.

These models further emphasize that psychopathological anxiety is not merely a reaction to external events but is also deeply shaped by internal regulatory mechanisms. In this context, emotion regulation strategies play a pivotal role: while adaptive strategies, such as cognitive reappraisal are associated with reduced anxiety symptoms, maladaptive strategies such as expressive suppression are more often linked to increased anxiety (Aldao et al., 2010; Amstadter, 2008; Cisler & Olatunji, 2012). Thus, individual differences in the habitual emotion regulation may function as both protective and risk factors in the experience of anxiety and the development of anxiety-related psychopathology.

Cognitive Reappraisal and Anxiety

Numerous studies have shown that cognitive reappraisal is negatively associated with anxiety symptoms (Aldao et al., 2010; Amstadter, 2008; Kivity & Huppert, 2018). It is hypothesized that by changing the meaning of an anxiety-provoking situation, this strategy can reduce the perceived threat and thereby the resulting anxiety response. Neuroimaging studies support this notion by showing that during cognitive reappraisal, prefrontal brain regions involved in top-down emotion regulation are activated, while activity in regions implicated in fear and anxiety responses (e.g. the amygdala) is reduced (Cisler & Olatunji, 2012). In line with these findings, a meta-analysis of fMRI studies revealed that individuals with anxiety disorders show reduced recruitment of prefrontal regions when performing cognitive reappraisal tasks (Picó-Pérez et al., 2017). This impairment may explain why cognitive reappraisal is used less frequently and less successfully in anxious individuals.

Research on cognitive behavioral therapy (CBT), a widely used and evidence-based treatment that aims to reduce anxiety symptoms by improving cognitive reappraisal skills (Beck, 2005), has further explored how improvements in cognitive reappraisal skills can alter anxiety symptoms. For example, Goldin et al. (2013) found that individuals with social anxiety disorder improved their cognitive reappraisal performance both behaviorally and neurobiologically following CBT treatment. Moreover, longitudinal data indicates that weekly increases in cognitive reappraisal predict subsequent decrease in social anxiety symptoms during CBT treatment (Lincoln et al., 2022). However, other studies have challenged these findings, suggesting that

improvements in anxiety symptoms are better predicted by a reduction in expressive suppression than by an increase in cognitive reappraisal alone (Lincoln et al., 2022).

Expressive Suppression and Anxiety

Expressive suppression aims to inhibit the outward expression of emotions after the emotional response has already been triggered. In contrast to cognitive reappraisal, this strategy does not modify the emotional experience itself, which may remain unresolved (Cutuli, 2014).

Theorists argue that excessive reliance on expressive suppression to regulate emotions places individuals at a higher risk of exhibiting higher levels of threat-related emotional arousal (Dryman & Heimberg, 2018). A study by Bardeen and Daniel (2017) for example suggests that individuals who rely excessively on expressive suppression, to the exclusion of other regulatory strategies, may be at higher risk for developing an attentional bias towards threat (ABT), which can be understood as the tendency to allocate attention towards threatening stimuli over neutral stimuli (Bardeen & Daniel, 2017). Meta-analytic findings further indicate that ABT is present across all anxiety disorders (Cisler & Koster, 2010).

Empirical evidence in general suggests that individuals who frequently suppress their emotions in an attempt to manage anxiety may paradoxically worsen their symptoms. For example, in a study with PTSD patients, frequent use of suppression was associated with higher symptom severity (Amstadter, 2008). Similarly, a systematic review by Dryman et al. (2018) found that individuals with social anxiety tend to rely heavily on suppression while struggling to apply effective reappraisal strategies. Supporting this, a longitudinal study showed that higher baseline levels of expressive suppression predicted an increase in social anxiety symptoms after three months (Dryman & Heimberg, 2018).

Overall, a growing body of research emphasizes the central role of emotion regulation in anxiety. The ineffective use of adaptive strategies such as cognitive reappraisal, and the excessive use of maladaptive strategies such as expressive suppression, both appear to contribute significantly to the development and maintenance of anxiety symptoms. Therefore, in accordance with the biopsychosocial stress model, maladaptive strategies may act as vulnerabilities that increase the risk for the onset and persistence of anxiety disorders, while adaptive strategies can serve as protective resources that buffer against psychopathology.

State and Trait Anxiety

Although emotion regulation appears to play a key role in anxiety, it is important to examine how regulatory strategies interact with different forms of anxiety. In particular, the distinction

between state and trait anxiety can help clarify how emotion regulation influences short- and long-term anxiety responses.

State anxiety refers to a person's current level of anxiety, typically experienced as a transient emotional reaction to negative events (Fernandes et al., 2022). For example, a person may experience heightened state anxiety before an exam. In contrast, trait anxiety describes a general tendency to react with anxiety across various situations and is considered a relatively stable personality trait (Leal et al., 2017). Individuals high in trait anxiety experience anxiety more frequently and intensely, and as Leal et al. (2017) point out, state and trait anxiety are significantly intercorrelated – meaning that those with high trait anxiety also tend to exhibit high state anxiety.

Distinguishing between these two forms is crucial when examining how emotion regulation strategies influence anxiety. Cognitive reappraisal may alleviate both state and trait anxiety by reframing the anxiety-inducing situations and modifying the emotional response. Expressive suppression, however, appears to have a more complex and ambivalent impact: On the one hand, suppression can reduce visible signs of anxiety, which may support short-term functioning in socially or emotionally demanding situations. On the other hand, because it does not resolve the emotional experience itself (Cutuli, 2014), repeated use may contribute to unresolved emotional distress and reinforce chronic anxiety patterns over time (Roth et al., 2019). This hypothesis is supported by findings suggesting that individuals with higher levels of trait anxiety are more likely to habitually rely on maladaptive strategies such as expressive suppression (Aldao et al., 2010; Fernandes et al., 2022; Kivity & Huppert, 2018).

While much research has established general links between emotion regulation and anxiety, fewer studies have differentiated between effects on state vs. trait anxiety. Examining these dynamics may offer valuable insights into the mechanisms that contribute to the development, maintenance, or escalation of anxiety over time.

Nonetheless, focusing exclusively on the role of emotion regulation in anxiety may overlook broader psychological processes. Recent research suggests that emotion regulation strategies also play a critical role in the development of self-esteem - a construct strongly associated with anxiety. Exploring the influence of emotion regulation on self-esteem may thus shed light on the interplay of factors that ultimately contribute to anxiety. The following chapter explores this connection in more detail.

Emotion Regulation and Self-Esteem

Over the past few decades, the concept of self-esteem has taken on a central role in psychological research (Mouatsou & Koutra, 2023). Rosenberg et al. (1995) defined self-esteem as “the individual’s positive or negative attitude toward the self as a totality” (p. 141). In contrast to related constructs such as self-knowledge or self-efficacy, self-esteem reflects the affective, evaluative component of the self-concept – namely, how individuals feel about themselves (Leary & Baumeister, 2000). Psychological theories suggest that people are inherently motivated to maintain or enhance their self-esteem (Rosenberg et al., 1995; Sowislo & Orth, 2013).

According to the *sociometer theory*, this motivation is rooted in the fundamental human need for belonging (Cameron & Stinson, 2017). The theory posits that self-esteem functions as an internal gauge of perceived social value, reflecting the degree to which individuals see themselves as valued members of desirable groups and relationships. When individuals perceive low relational value, their self-esteem tends to decrease, which in turn motivates behavior aimed at increasing social inclusion. This process not only promotes interpersonal harmony but also yields adaptive benefits essential for survival (Leary & Baumeister, 2000; Sowislo & Orth, 2013).

Another influential framework is the *terror management theory*, which argues that awareness of mortality conflicts with the intrinsic human desire for life, giving rise to existential anxiety (Rossi et al., 2020). Within this framework, self-esteem serves as a psychological buffer by connecting individuals to broader systems of meaning and value. In doing so, it helps reduce anxiety and acts as a protective shield against existential threats and stressors (Manna et al., 2016). This “anxiety-buffering” function of self-esteem is supported by numerous cross-sectional studies reporting medium to strong negative correlations between self-esteem and anxiety levels (Lee & Hankin, 2009; Riketta, 2004; Watson et al., 2002).

Consistent with these theoretical perspectives, empirical findings link higher self-esteem to a wide range of positive life outcomes (Zeigler-Hill, 2010). It is associated with better psychological well-being, more effective coping with stressful events, stronger relationship satisfaction, and higher socioeconomic status (Orth et al., 2012; Shackelford, 2001; Twenge & Campbell, 2002). In contrast, low self-esteem has been identified as a risk factor for various mental health issues, including depression and anxiety disorders (Sowislo & Orth, 2013). Moreover, individuals with low self-esteem often report greater difficulties with emotion regulation (Guil et al., 2019).

The relationship between emotion regulation and self-esteem was first highlighted by Gross and John (2003), who proposed that the habitual use of specific regulation strategies may

shape how individuals evaluate themselves (Fernandes et al., 2022). Specifically, they suggested that those who regularly engage in cognitive reappraisal are more likely to view themselves as competent and worthy. One explanation for this self-esteem-enhancing effect lies in the nature of cognitive reappraisal itself, which involves reframing emotionally challenging situations in ways that preserve self-worth. For example, a failed job interview might be interpreted as a learning opportunity rather than a personal failure.

In contrast, expressive suppression, which entails inhibiting the outward expression of emotions, has been linked to lower self-esteem (Gross & John, 2003). This connection is partly explained by the fact that frequent suppression can impair effective emotional processing and coping, thereby undermining positive self-evaluations. Another potential explanation is the feeling of inauthenticity that may result from suppressing emotional expression. In this sense people who try to suppress their feelings may feel inauthentic, which can have a negative impact on their self-esteem (Roth et al., 2019). This hypothesized pattern has been consistently supported: while habitual use of cognitive reappraisal is positively associated with higher self-esteem, frequent reliance on expressive suppression predicts lower self-esteem (Cutuli, 2014; Mouatsou & Koutra, 2023; Nezlek & Kuppens, 2008).

However, the relationship between emotion regulation and self-esteem may be bidirectional. Emerging research suggest that not only can self-esteem be influenced by regulation strategies, but it may also shape which strategies individuals are likely to use. For example, Shafir et al. (2017) found that individuals with lower self-esteem were more likely to use maladaptive strategies such as distraction, rather than more adaptive approaches like cognitive reappraisal.

In summary, the relationship between self-esteem and emotion regulation appears to be dynamic and reciprocal (Mouatsou & Koutra, 2023). On one hand, the strategies individuals use can impact how they feel about themselves; on the other, their level of self-esteem may guide the selection of regulatory strategies (Shafir et al., 2017).

Emotion Regulation, Anxiety and Self-Esteem

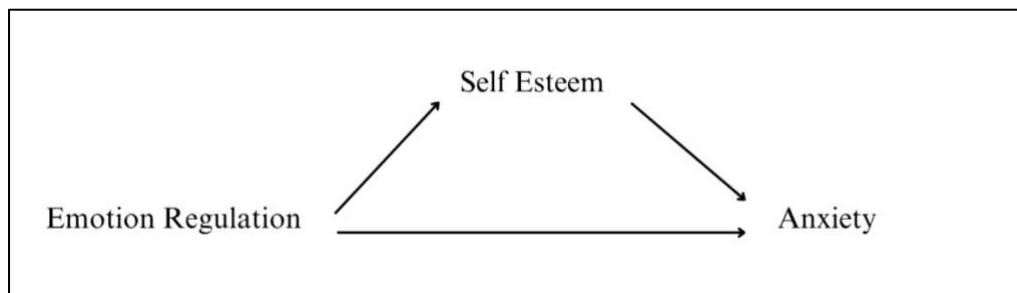
As outlined in the preceding chapters, emotion regulation plays a central role in shaping both self-esteem and anxiety. On one hand, the frequent use of adaptive regulation strategies such as cognitive reappraisal has been associated with higher self-esteem and lower levels of anxiety. On the other hand, habitual use of maladaptive strategies such as expressive suppression has been linked to reduced self-esteem and increased anxiety symptoms (Aldao et al., 2010; Fernandes et al., 2022; Kivity & Huppert, 2018; Mouatsou & Koutra, 2023; Nezlek & Kuppens, 2008).

Moreover, self-esteem itself is widely regarded as a protective psychological resource. Elevated self-esteem has been shown to buffer against the development of anxiety, fostering emotional resilience and psychological well-being (Crocker & Park, 2004; Doron et al., 2013). In contrast, individuals with lower self-esteem appear more vulnerable to trait anxiety, a relationship observed consistently across age groups and genders (Doron et al., 2013; Guil et al., 2019; Sowislo & Orth, 2013). Numerous cross-sectional studies report moderate to strong negative correlations between self-esteem and anxiety levels (Lee & Hankin, 2009; Riketta, 2004; Watson et al., 2002).

Given these established associations, it is plausible to hypothesize that self-esteem may serve as a mediating variable in the relationship between emotion regulation and anxiety. In other words, the way individuals regulate their emotions may shape their level of self-esteem, which in turn influences their experience of anxiety. This model aims to clarify how these three constructs interact. A visual representation of this general mediation model is presented in Figure 2. It posits emotion regulation as the independent variable, anxiety as the dependent variable, and self-esteem as the mediator.

Figure 2

General Proposed Model of Mediation



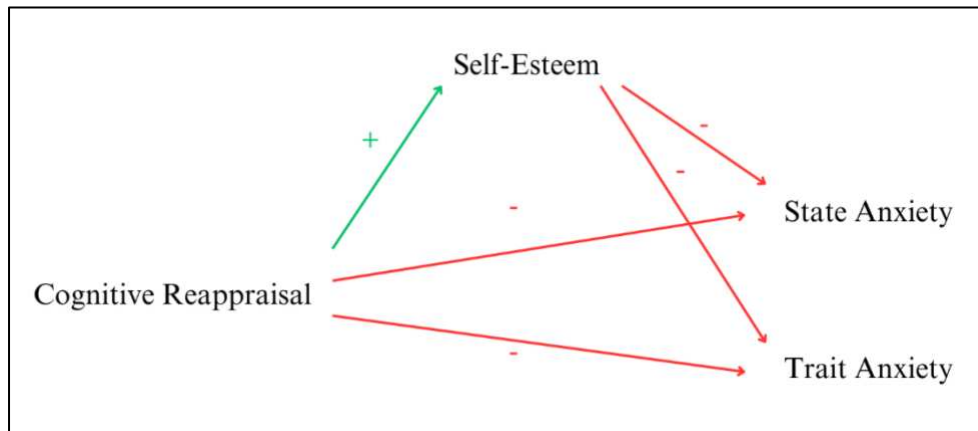
Proposed Models

The mediation models proposed in this thesis are illustrated in Figures 3 and 4, each corresponding to one of the two emotion regulation strategies: cognitive reappraisal and expressive suppression.

Cognitive Reappraisal is widely recognized as an adaptive strategy associated with reduced anxiety and higher self-esteem (Aldao et al., 2010; Fernandes et al., 2022; Nezlek & Kuppens, 2008; Yalçınkaya-Alkar, 2020). Building on these findings, the first model hypothesizes that cognitive reappraisal negatively predicts both state and trait anxiety, with self-esteem acting as a mediator in this relationship (see Figure 3). The rationale is that frequent use of cognitive reappraisal may enhance self-esteem, which in turn buffers against anxiety.

Figure 3

Proposed Model of the Mediating Role of Self-Esteem between Cognitive Reappraisal and State/Trait Anxiety

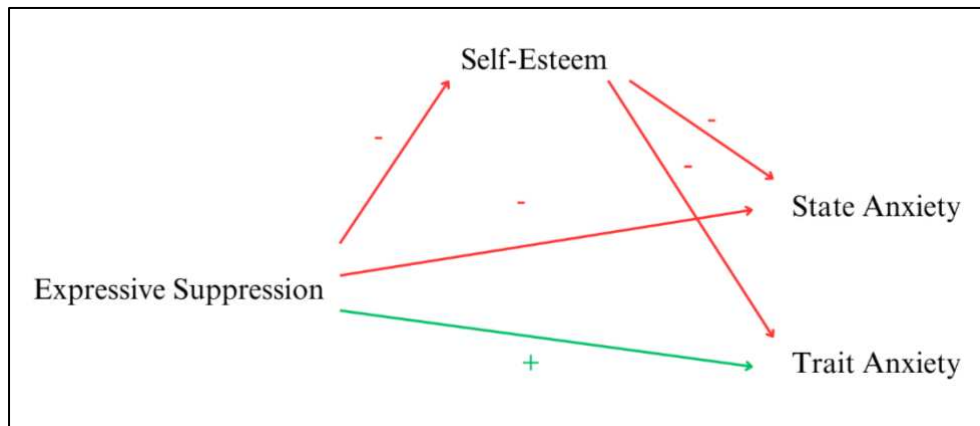


In contrast, expressive suppression has consistently been linked to lower self-esteem and elevated anxiety symptoms (Aldao et al., 2010; Fernandes et al., 2022; Mouatsou & Koutra, 2023; Qu et al., 2024). Therefore, the second model posits that expressive suppression negatively affects self-esteem, while positively predicting trait anxiety. However, as expressive suppression is often employed in response to emotionally intense situations, it may also provide short-term relief (Goldin et al., 2008; McRae & Gross, 2020). It is therefore hypothesized that expressive suppression may reduce state anxiety, albeit at the cost of long-term psychological well-being (see Figure 4). As Figure 4 shows, expressive suppression is expected to indirectly increase state anxiety through its negative impact on self-esteem. At the same time, expressive suppression is hypothesized to have a direct negative effect on state anxiety. Therefore, the direct and indirect pathways of expressive suppressions on state anxiety appear to have opposing effects, ultimately representing a suppression effect, meaning that the two effects can partially cancel each other out.

These dual-pathway models are intended to reflect the nuanced and context-dependent nature of emotion regulation strategies, acknowledging both their immediate and long-term impact on anxiety.

Figure 4

Proposed Model of the Mediating Role of Self-Esteem between Expressive Suppression and State/Trait Anxiety



Research Question

Although the relationship between emotion regulation strategies and anxiety has been widely studied, the role of self-esteem in this relationship remains less clear. The present study addresses this gap by examining whether the influence of emotion regulation on anxiety is direct, or whether it is at least partially mediated by self-esteem. Based on the above, the central research question is as follows:

Does Self-Esteem mediate the relationship between the Emotion Regulation Strategies and Anxiety?

Q1: Does self-esteem mediate the relationship between cognitive reappraisal and both state and trait anxiety?

Q2: Does self-esteem mediate the relationship between expressive suppression and both state and trait anxiety?

Understanding these mechanisms may offer new insights into the psychological processes underlying anxiety. Since emotion regulation strategies have been described as both a protective and risk factor in relation to anxiety symptoms, investigating the mediating role of self-esteem may help clarify whether these strategies exert their effects directly or through their impact on self-esteem. The results could have important implications for both theory and therapeutical interventions.

Hypotheses

Based on the theoretical framework and existing empirical evidence discussed in the prior chapters, the following hypotheses are being proposed:

Cognitive Reappraisal Hypothesis (H1)

H1.1: Cognitive reappraisal has a total effect on both state and trait anxiety, independent of self-esteem.

H1.2: Cognitive reappraisal has a direct effect on self-esteem.

H1.3: Self-esteem mediates the relationship between cognitive reappraisal and both state and trait anxiety.

Expressive Suppression Hypothesis (H2)

H2.1: Expressive suppression has a total effect on both state and trait anxiety, independent of self-esteem.

H2.2: Expressive suppression has a direct effect on self-esteem.

H2.3: Self-esteem mediates the relationship between expressive suppression and both state and trait anxiety.

Methods

Study Design

This thesis is part of the *Music and Skin-barrier Recovery II* (MuSkiBa2) study, led by Dr. Jasminka Majdandžić and Univ.-Prof. Dr. Urs Markus Nater at the University of Vienna (Faculty of Psychology, Music & Health Lab). The research project investigates the relationship between music listening, stress and skin barrier recovery. The current study focuses on the main variables of emotion regulation, self-esteem and anxiety. Female participants aged 18-35 with at least moderate proficiency in German were recruited between March 2020 and April 2025 via social media, flyers, and word-of-mouth. Participants were screened via telephone interview to ensure they met the strict inclusion criteria. Exclusion criteria included, among other things, the use of hormonal contraceptives, smoking, and specific chronic diseases or disorders that could act as confounding variables. Once participants completed the screening process, and were found to be eligible for the study, they were asked to fill out online questionnaires via Unipark as part of the pre-screening protocol.

Among these questionnaires were those relevant for this thesis, including the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003), which assesses the two emotion regulation strategies of cognitive reappraisal and expressive suppression; the Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1979) which measures global self-esteem; and the State-Trait-Anxiety Inventory (STAI-T; Spielberg et al., 1983), which assesses trait anxiety. The questionnaires were all administered in German and will be discussed in further detail below. Completing the questionnaires took approximately 20-30 minutes and was mandatory prior to participation in the laboratory session, which took place at the faculty building. However, no specific requirements were given regarding the exact time, duration or location for filling out the online questionnaire.

The overall research project consists of two separate experiments, namely *MuSkiBa1* and *MuSkiBa2*. Although both are similar in design and nature, they can be distinguished from each other through the stress-inducing TSST-task, that only participants in MuSkiBa2 undergo. This task will be explained in detail later. Following the TSST, participants were randomly assigned to one of three conditions: listening to music, listening to an audiobook or sitting in silence.

To answer the previously stated research questions, only participants from the MuSkiBa2 study (experiment with the stressor) were analyzed at two timepoints, both of which occurred before the respective condition exposure. Therefore, participants from all three experimental conditions (music, audiobook, and silence condition) were included in the analysis, making a

detailed discussion of each condition unnecessary. The dependent variables were trait and state anxiety. Trait anxiety was measured via the online questionnaire at one single timepoint prior to the laboratory study (STAI-T). State anxiety, however, was assessed using a single-item scale at three timepoints: at baseline (M1), immediately after the TSST (M3), and following a short recovery period (M4; see Figure 5). To examine changes in state anxiety while controlling for individual differences in baseline levels, delta (Δ) values were calculated by subtracting baseline scores from the post-stressor scores (see Table 3). Specifically, $\Delta M3-M1$ represents the immediate stress-induced increase in state anxiety after exposure to the stressor, whereas $\Delta M4-M1$ represents state anxiety change after the recovery phase. Both delta values were included as outcome measures to capture potential latency effects of the emotion regulation strategies, as their influence may manifest either directly after the stressor or at a later time-point. In the following analyses, these delta values, which reflect changes in anxiety levels, served as the dependent variables. The independent variables were the two emotion regulation strategies – cognitive reappraisal and expressive suppression - measured once at the beginning of the study through the online questionnaire. Self-esteem, which was proposed as a potential mediator, was also assessed at a single timepoint via Unipark survey.

Sample

The sample consisted solely of female participants between the ages of 18 and 35. The decision to focus on this specific demographic group was made to control for age- and gender-related effects. Additionally, all participants were tested during the follicular phase of their menstrual cycle, to control for hormonal fluctuations that may influence the variables of interest and introduce potential confounds.

Participants were mainly recruited through flyers that were either printed and distributed at various locations in Vienna or posted online using digital platforms such as Facebook, WhatsApp, Instagram, and Studo. Once potential participants contacted the recruitment team via email, they were interviewed to verify whether they met the study's inclusion criteria. Participants needed to be fluent in German, as all questionnaires and the tasks-instructions were provided exclusively in German.

Furthermore, participants had to meet several health-related criteria: they had to be generally healthy, have a body mass index (BMI) between 17 and 25, and must not suffer from chronic illnesses (e.g. chronic heart disease or chronic pain), mental health disorders (e.g. clinical depression or anxiety disorders), or any type of allergy. In addition, participants were excluded if they were using any hormonal contraceptives, consuming alcohol excessively (more

than 8 standard drinks per week), or taking any drugs or medications that might alter their hormonal profile.

Finally, participants were required to have no previous experience with the TSST and must not work in a profession that is heavily associated with music (e.g., professional musicians, music teachers). These criteria were applied to minimize variability and ensure homogeneity in the sample with regard to the factors under investigation.

Materials and Measures

Emotion Regulation Questionnaire (ERQ)

The German version of the Emotion Regulation Questionnaire is a self-report measure designed to assess the habitual use of two emotion regulation strategies: cognitive reappraisal and expressive suppression. It has been frequently used in empirical research, with studies showing systematic and stable individual differences in the use of these strategies over time (Gross & John, 2003).

The questionnaire consists of 10 items, with 6 items assessing cognitive reappraisal (e.g., *“When I’m faced with a stressful situation, I make myself think about it in a way that helps me stay calm”*) and 4 items measuring expressive suppression (e.g., *“I keep my emotions to myself”*). Respondents rate their agreement with each statement on a 7-point Likert scale ranging from 1 (“strongly disagree”) to 7 (“strongly agree”). Total scores range from 6 to 42 for cognitive reappraisal and 4 to 28 for expressive suppression. Higher scores indicate more frequent use of the respective strategy (Gross & John, 2003; Mouatsou & Koutra, 2023). The ERQ was translated and validated for a German-speaking population by Abler and Kessler (2009). Both subscales demonstrate good internal consistency, with Cronbach’s alpha values of 0,76 for cognitive reappraisal and 0,74 for expressive suppression (Abler & Kessler, 2009).

Rosenberg Self-Esteem Scale (RSES)

The Rosenberg Self-Esteem Scale (RSES) is one of the most commonly used instruments to assess global self-esteem. It captures individuals’ overall positive and negative evaluations of themselves and is valued for its robust psychometric properties across different populations (Mouatsou & Koutra, 2023; Von Collani & Herzberg, 2003).

The scale of the questionnaire consists of 10 items, five of which are reverse-coded (e.g., *“At times I think I am not good at all”*). Participants respond using a 4-point Likert scale ranging from 1 (“strongly disagree”) to 4 (“strongly agree”). After reverse-scoring the appropriate items, participants’ responses are summed to obtain a total score ranging from 10 to 40, with higher

scores reflecting greater self-esteem. The scale is considered unidimensional in structure (Mouatsou & Koutra, 2023). The RSES was translated and validated for German-speaking populations by Ferring and Filipp (1996) and later revised by Van Collani and Herzberg (2003). The revised version demonstrates strong internal consistency, with a Cronbach's alpha of 0,85 (Von Collani & Herzberg, 2003).

State Anxiety (Single-Item Scale)

State anxiety was assessed using a single-item visual analog scale (VAS) with the prompt: *“Wie groß schätzen Sie Ihre Angst im Moment ein?”* Participants indicate their current anxiety level on a scale from 0 (“not anxious at all”) to 100 (“very anxious”). This measure was administered at multiple time points throughout the study. To account for interindividual differences in baseline anxiety, change scores (delta values) were calculated by comparing pre- and post-stressor values. Furthermore, to assess potential latency effects of emotion regulation strategies, two post-stressor measurements were analyzed: state anxiety at marker point 3 and state anxiety at marker point 4 (see Figure 5).

Trait Anxiety (STAI-T)

Trait anxiety was assessed using the trait anxiety subscale (STAI-T) of the State-Trait-Anxiety Inventory (STAI). This inventory is a widely used standard instrument in stress and anxiety research, known for its strong reliability and validity (Guillén-Riquelme & Buela-Casal, 2014). The STAI-T comprises 20 items that measure the general tendency to experience anxiety over time (e.g. *“I worry too much over something that really doesn't matter”*). Participants respond using a 4-point Likert scale ranging from “almost never” to “almost always”, how much they agree with the respective statements. After reverse-coded items are recoded, a total score is calculated by summing all responses, with final scores ranging from 20 to 80. Higher scores indicate greater trait anxiety. A cut-off score of 39-40 is often used to identify clinically relevant anxiety levels (Addolorato et al., 1999).

Although the original STAI only included the stable trait component of anxiety, it was expanded to include a subscale for state anxiety (STAI-S), which measures an individual's current level of anxiety, where anxiety is understood as a temporary emotional state characterized by tension, concern, nervousness, inner restlessness and autonomic nervous system activity. It also consists of 20 items in which participants can respond to statements about their current level of anxiety on a 4-point Likert scale ranging from “not at all” to “very much”. The two scales can be

used independently of each other but enable a differentiated assessment of both state anxiety and trait anxiety and their connection to each other (Spielberger et al., 1983).

The STAI demonstrates high test-retest reliability ranging from $r = 0,73$ to $0,86$ (Spielberger et al., 1983), and strong convergent validity with other anxiety measures, such as the Manifest Anxiety Scale ($r = 0.73 - 0.90$). Furthermore, the meta-analysis of Guillén-Riquelme & Buela-Casal (2014) demonstrated that the STAI is sensitive to the level of anxiety of individuals and can reliably detect patients with an anxiety diagnosis. The German version of the STAI was translated and validated by Laux et al. (1981).

Tasks

Trier Social Stress Test

Ever since its invention in 1993 by Kirschbaum and colleagues, the Trier Social Stress Test (TSST) has been recognized as the gold standard for experimentally inducing acute psychological stress (Kirschbaum et al., 1993). The test is based on the idea of generating stress through public speaking under socially evaluative and unpredictable conditions, two key elements known to reliably elicit physiological and psychological stress responses.

In terms of physiological responses, the TSST consistently activates the hypothalamic-pituitary-adrenal (HPA) axis and the autonomous nervous system (ANS), resulting in elevated cortisol levels and increased heart rate - both considered reliable biomarkers of stress (Allen et al., 2017; Kirschbaum et al., 1999). In addition to these physiological effects, the TSST also triggers significant psychological responses, such as increased subjective stress, anxiety, and emotional insecurity (Hellhammer & Schubert, 2012). While physiological parameters can be measured continuously during the test, psychological effects are typically assessed before and after the TSST using visual analogue scales. The TSST lasts approximately 15 minutes and is divided into three parts:

1. A three-minute preparation period, during which participants are instructed to prepare a short speech,
2. A five-minute free speech, and
3. A five-minute mental arithmetic task.

During the preparation phase, participants are instructed to imagine a job interview and prepare a short self-presentation. The focus should be exclusively on personal strengths and qualities, rather than past work experiences. Participants are not permitted to use their notes during the actual

presentation, as it is intended to be delivered spontaneously. Importantly, no information is given in advance about the duration of the speech or the details of the upcoming arithmetic task.

In the current study, the TSST was conducted immediately after the initial measurement (see Figure 5). Participants were guided into a separate room where the evaluation committee, consisting of an active stressor (male) and a passive stressor (female), was already waiting. The committee members were seated behind a desk, dressed in white lab coats, with a visible video camera, microphone and writing materials in front of them. They were introduced to participants as behavioral psychology experts. Just before the interview began, the passive stressor demonstratively activated the camera, although no actual recording was made, in order to increase the sense of social evaluation. The active stressor then instructed the participants to begin their self-presentation. Throughout the speech, the committee maintained neutral facial expressions, avoided verbal and nonverbal feedback, and pretended to take notes during the task. The active stressor was the only one allowed to speak and give instructions, while the passive stressor remained silent throughout the entire procedure.

If participants finished their speech before the five minutes elapsed, the active stressor remained silent for 20 seconds before asking participants to continue. To further elevate stress, the active stressor occasionally posed challenging or uncomfortable follow-up questions (e.g. „What do you consider to be your weaknesses?“) or remind participants to maintain eye contact with the camera and speak clearly into the microphone.

Following the interview, participants performed a mental arithmetic task, which involved counting backwards from 2043 in steps of 17. If they made an error, the active stressor pointed it out and instructed them to restart from 2042. Participants were also encouraged to speed up if they hesitated or calculated too slowly.

Procedure

All experimental sessions took place at a standardized time, starting at 1:00 pm and ending at around 5:00 pm. This fixed schedule was implemented to control for differences in cortisol levels due to the nature of the cortisol cycle, which fluctuates throughout the day, usually peaking in the morning. Upon arrival at the laboratory, participants were welcomed and presented with an informed consent form, which detailed the purpose of the study, all procedures involved, data usage, and the right to withdraw at any time without providing a reason.

The experiment began with a baseline phase: Participants first completed a questionnaire, assessing their current well-being, recent caffeine consumption, and other factors relevant to the

study. The experimenter then explained how to provide a saliva sample, which was used for cortisol analysis. A chest strap equipped with a Movisens sensor was then placed around each participant's upper torso to measure heart rate. Additional Movisens sensors and electrodes were attached to the non-dominant hand to record skin conductance. For the assessment of transepidermal water loss (TEWL), measurement points were marked with a stamp on the participant's non-dominant forearm, approximately 2 cm below the elbow. These spots were later used for tape-stripping and subsequent skin barrier recovery assessments.

Depending on their assigned experimental condition, participants were allowed to choose between five instrumental music playlists or one of five science-related audiobooks - or not choose at all if they were in the "silent" condition. After baseline, participants were instructed to tap the Movisens sensor to mark the time point, complete a subjective stress questionnaire, and provide a saliva sample (following a two-minute period of refraining from swallowing).

Participants were then guided to a separate room for the Trier Social Stress Test (TSST), which consisted of a mock job interview followed by an arithmetic task (see chapter "Trier Social Stress Test"). Immediately after completing the TSST, participants provided another saliva sample and completed another questionnaire.

After the TSST, participants returned to the laboratory room for the start of the skin barrier recovery procedure. First, baseline transepidermal water loss (TEWL) values were collected using a TEWL device. The outermost layer of the skin (stratum corneum) was then impaired using adhesive tape strips, which served as the starting point for evaluating skin barrier recovery over time.

Participants subsequently underwent a 30-minute recovery phase, during which they sat in an armchair and - depending on their assigned condition – either listened to their chosen music or audiobook or remained in silence for 30 minutes. To ensure methodological consistency, the same headphones were used across all conditions.

After the recovery period, several follow-up measurements of subjective stress, salivary cortisol, and TEWL were taken at fixed time points. During the waiting periods between measurements, participants were allowed to read science-related magazines provided in the room.

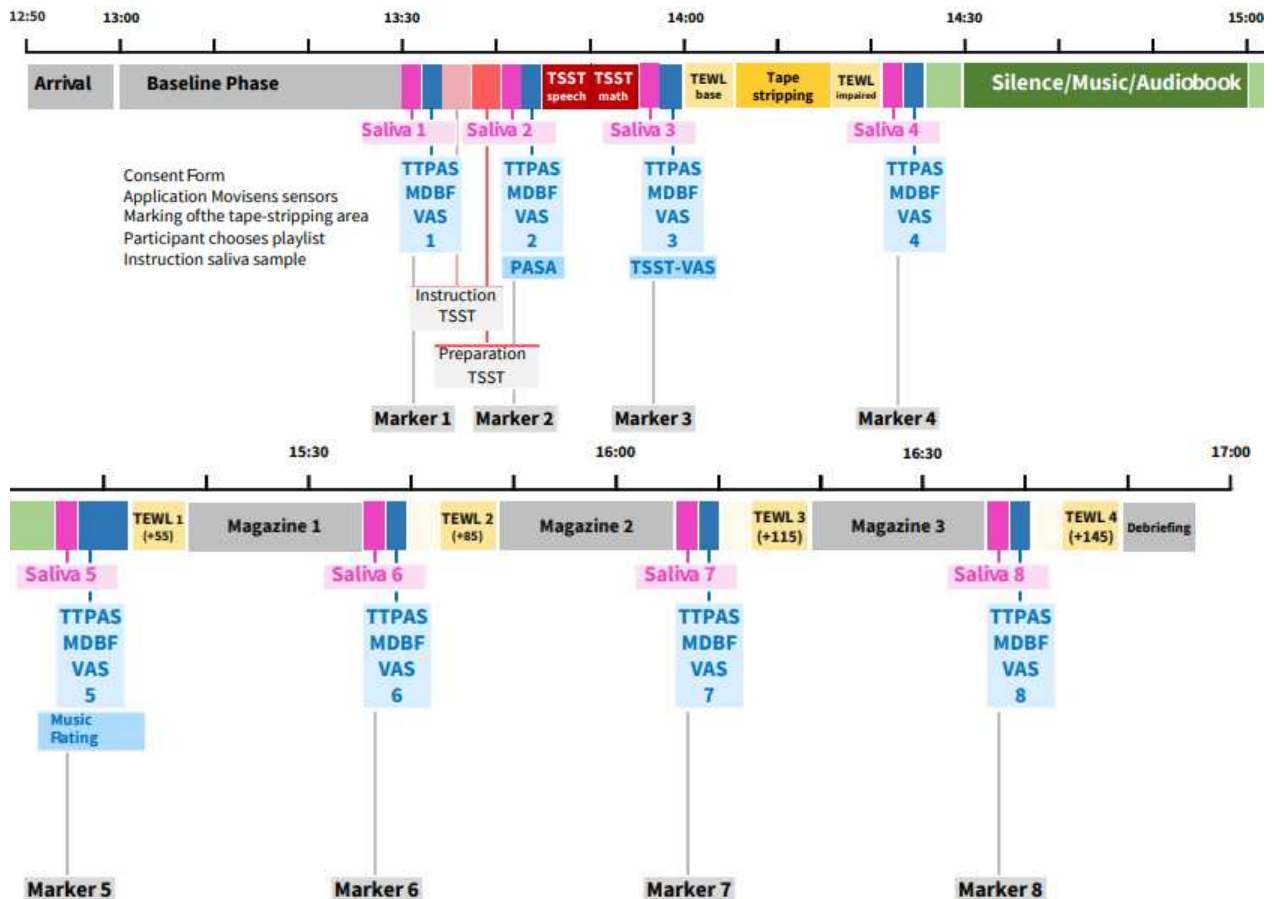
At the end of the experimental session, a comprehensive debriefing was conducted. Participants were informed about the true purpose of the study and the deceptive nature of the TSST, including the fact that no audio or video recordings were actually made. Finally,

participants completed a form with their bank details to receive financial compensation. Those who completed the full protocol received €45 for MuSkiBa2.

The study was conducted in accordance with ethical standards and approved by the Ethics Committee of the University of Vienna (procedure number: 00494)

Figure 5

MuSkiBa 2 – Study timeline



Note. TTPAS: Types of Positive Affect Scale; MDBF: Der Mehrdimensionale Befindlichkeitsfragebogen; VAS: Visual Analogue Scale; PASA: Primary Appraisal Secondary Appraisal.

Statistical Analysis

All statistical analyses of this thesis were conducted using *IBM SPSS Statistics* (Version 29), including the *PROCESS macro v4.2* by Andrew F. Hayes for mediation analysis. Prior to carrying out the mediation analyses, assumption checks were performed: Normality was assessed with the Kolmogorov-Smirnov test. Outliers were examined using boxplots and standardized z-scores, with values exceeding |3.0| standard deviations considered extreme (Lehmann, 2013).

Multicollinearity was tested with Variance Inflation Factor (VIF) and Tolerance values (Bortz & Schuster, 2011).

In addition, to guide the selection of appropriate statistical procedures, correlation analyses were performed. While Pearson's r is preferred for its statistical power and applicability to continuous, normally distributed variables, it is sensitive to deviations from normality. In contrast, Spearman's ρ is a non-parametric alternative that is less affected by such deviations but is based on ranked data, which can lead to a loss of information. Given the detected deviations from normality, both correlation types are reported to ensure transparency. However, as the PROCESS macro relies on Pearson correlations, the Pearson correlation matrix was used as the basis for the subsequent mediation analysis to maintain consistency with the analytical approach.

Finally, mediation analyses were carried out to determine whether self-esteem mediates the relationship between the emotion regulation strategies (cognitive reappraisal and expressive suppression), and anxiety (state and trait). Using the PROCESS macro, total, direct and indirect effects were estimated. The indirect effects were tested using a bootstrap method (5,000 intervals) with confidence intervals that ensure robust and reliable estimates. To control for potential confounding variables, the following covariates were included: age, level of education, and current education status. This was made to isolate the effects of the predictors of interest, as prior research has shown age and educational status to be associated with both anxiety and the use of certain emotion regulation strategies (Bjelland et al., 2008; Grenier et al., 2019; Smrtnik Vitulić & Prosen, 2016; Wang & Saudino, 2011).

Results

Sample Description

The final sample consisted of $N = 78$ participants, all of whom were recruited and tested over a five-year period from February 2020 until April 2025. As shown in Table 1, the mean age of the participants was 24.26 ($SD = 4.00$). The majority of the sample were either Austrian ($n = 47$) or German ($n = 14$). A large proportion of the sample (91%) held at least a high school diploma, and 78.2% were currently enrolled in university, indicating a sample with a high level of education.

Table 1

Sample Description (N=78)

Variable	<i>N (%)</i>
Age (Mean, <i>SD</i>)	24.26 (4.0)
Nationality	
Austria	47 (60.2)
Germany	14 (18.0)
Other	17 (21.8)
Level of Education	
High School Diploma	71 (91.0)
Secondary School	2 (2.6)
University	1 (1.3)
Other	4 (5.1)
Ongoing Education	
Apprenticeship	2 (2.6)
Technical School	2 (2.6)
University	61 (78.2)
Other	3 (3.8)
None	10 (12.8)

Note. *SD* = Standard deviation.

As shown in Table 2, participants' ages ranged from 18 to 34 years, with a mean age of 24.26. Scores for cognitive reappraisal ranged from 12 to 42 points (out of a possible 6-42; $M = 29.18$, $SD = 6.24$), while expressive suppression scores varied between 4 and 26 points (out of a possible 4-28; $M = 14.96$, $SD = 5.41$). Self-esteem scores ranged from 16 to 40 points (out of a possible 10-40; $M = 32.45$, $SD = 6.02$), indicating generally high levels of self-esteem across the sample and suggesting a potential ceiling effect for this variable, as previously mentioned. Trait anxiety scores ranged from 20 to 66 points (out of a possible 20-80; $M = 38.64$, $SD = 9.80$).

State anxiety was assessed at three time points: baseline (M1), immediately after the TSST (M3), and following a short recovery period (M4). Absolute state anxiety scores ranged from 0 to 65 at baseline ($M = 9.48$, $SD = 12.05$), from 0 to 100 directly after the TSST ($M = 34.19$, $SD = 29.19$), and from 0 to 64 after recovery ($M = 11.36$, $SD = 14.48$). These results are in line with theoretical expectations, showing an overall increase in state anxiety immediately after the TSST, followed by a decrease as participants recovered, although individual differences were observed.

Table 2

Descriptive Statistics of Variables of Interest

Variable	<i>N</i>	<i>M</i>	<i>SD</i>	Scores	
				Min	Max
Age	78	24.26	4.00	18	34
Cognitive Reappraisal	78	29.18	6.24	12	42
Expressive Suppression	78	14.96	5.41	4	26
Self-Esteem	78	32.45	6.06	16	40
Trait Anxiety	78	38.64	9.80	20	66
State Anxiety (Baseline, M1)	78	9.48	12.05	0	65
State Anxiety (Post-TSST, M3)	78	34.19	29.19	0	100
State Anxiety (Recovery, M4)	78	11.36	14.48	0	64

Note. *N* = Number of participants; *M* = Mean; *SD* = Standard deviation; M1 = Baseline (pre-TSST); M3 = marker 3 (post-TSST); M4 = marker 4 (recovery).

To account for intra-individual differences, delta (Δ) values of state anxiety were calculated and used for all subsequent statistical analyses. Given potential latency effects of emotion regulation strategies, two post-stressor time points (M3 and M4) were compared relative to baseline (M1). As can be derived from Table 3, from baseline to post-TSST (M3 – M1), the mean increase in state anxiety was 24.71 ($SD = 30.25$), with individual changes ranging from a decrease of 46 points to an increase of 99 points. This suggests that the stressor generally increased state anxiety, although substantial variability in responses was observed. From baseline to recovery (M4 – M1), the mean change was 1.88 ($SD = 14.45$), indicating that, on average, state anxiety returned close to baseline levels, though some individuals showed higher or lower recovery scores.

Table 3

Delta Values of State Anxiety

Variable	<i>N</i>	<i>M</i>	<i>SD</i>	Scores	
				Min	Max
State Anxiety Δ (M3 - M1)	78	24.71	30.25	-46	99
State Anxiety Δ (M4 - M1)	78	1.88	14.45	-49	56

Note. *N* = Number of participants; *M* = Mean; *SD* = Standard deviation; Δ indicates change relative to baseline (M1). M3 - M1 = change from baseline to post-TSST; M4 - M1 = change from baseline to recovery.

Assumption Checks

To assess the assumption of normality, the Kolmogorov-Smirnov test was employed. The results indicated significant deviations from normal distribution for the variables *self-esteem* ($p = .029$) and *state anxiety* at both measurement points (marker 3 and marker 4; $p < .001$), suggesting non-normality in these variables. In addition, visual inspection of scatterplots revealed a potential ceiling effect for self-esteem, as a substantial number of participants scored at the upper end of the scale. This may partly explain the violation of normality.

To detect potential outliers, both boxplots and standardized z-scores were examined. Z-scores can be viewed as a mechanism to determine the magnitude by which an observation diverges from all the other observations of a given dataset. It is expressed in the number of standard deviations from the mean value (Aggarwal et al., 2019). The commonly used threshold for z-scores is three standard deviations from the mean. As no z-scores exceeded $SD > |3.0|$, no extreme outliers were identified in this dataset (Lehmann, 2013). To rule out multicollinearity,

Variance Inflation Factor (VIF) and Tolerance scores were assessed. The VIF was 1.013 and the Tolerance 0.988, indicating that multicollinearity between the independent variables can be ruled out (Bortz & Schuster, 2011).

Correlation Analyses

The correlations among the variables of interest are presented in Table 4. This correlation matrix forms the foundation for the subsequent mediation analyses, as it illustrates the hypothesized relationships between the constructs. According to the *causal step approach*, a necessary condition for mediation is a statistically significant association between the independent variable and the dependent variable (Fritz & MacKinnon, 2007). In the absence of such a relationship, the proposed mediation pathway lacks empirical support, making further mediation analyses redundant or uninformative. Thus, this correlation analysis acts as a necessary preliminary step for the planned mediation models.

As mentioned in the previous chapter, both Pearson's *r* and Spearman's *rho* are reported in Table 4 to ensure transparency, given the observed deviations from normality. As can be derived from Table 4, while small differences in effect sizes are present, the direction and overall pattern of correlations remain consistent across both correlation matrices.

Table 4

Pearson and Spearman's Correlation

Variable	1	2	3	4	5	6
1. CR	-	-.111 (-.40)	.231* (.170)	-.261* (-.170)	.096 (.078)	.113 (.005)
2. ES		-	-.494** (-.445**)	.366** (.372**)	.050 (.032)	.037 (.018)
3. SE			-	-.772** (-.789**)	-.034 (-.080)	.091 (-.007)
4. TA				-	.089 (.130)	.014 (.066)
5. SA3					-	.450* (.481*)
6. SA4						-

Note. *N* = 78. Pearson correlations are presented above the diagonal, Spearman correlations are presented above the diagonal in brackets; **p* < .05; ***p* < .01; CR = Cognitive Reappraisal; ES = Expressive Suppression; SE = Self-Esteem; TA = Trait Anxiety; SA3 = State Anxiety at marker 3; SA4 = State Anxiety at marker 4.

Cognitive Reappraisal

As shown in Table 4, cognitive reappraisal was significantly positively correlated with self-esteem ($r = 0.231, p = .021$) and significantly negatively correlated with trait anxiety ($r = -0.261, p = .010$). These results are consistent with previous research and support the hypothesized relationships. However, no significant associations were found between cognitive reappraisal and changes in state anxiety at either of the two time points (marker 3 or 4), as measured by the delta values reflecting deviations from baseline. Based on these findings, only one mediation model meets the necessary criteria for further analysis: specifically, the model, in which self-esteem mediates the relationship between cognitive reappraisal and trait anxiety.

Consequently, *Hypothesis 1* (Cognitive Reappraisal Hypothesis) can only be partially tested, focusing exclusively on trait anxiety.

Expressive Suppression

Expressive suppression showed significant negative correlations with self-esteem ($r = -0.445, p < .01$) and significant positive correlations with trait anxiety ($r = 0.372, p < .01$). These outcomes are also in line with the theoretical assumptions and prior empirical findings. However, again, no significant associations were observed between expressive suppression and changes in state anxiety at either time point (marker 3 or 4). Given these results, the proposed mediation model involving expressive suppression, self-esteem and trait anxiety is empirically supported and will be further examined through mediation analysis.

In summary, for expressive suppression as well, only part of *Hypothesis 2* (the Expressive Suppression Hypothesis) will be explored. Due to the absence of significant correlations with state anxiety on any of the variables of interest, this outcome variable, measured with a single visual analogue scale following a stressor, will be excluded from further confirmatory analyses. The focus will remain solely on trait anxiety.

Mediation Analyses

A mediation analysis was conducted using PROCESS macro for SPSS (Model 4; Hayes, 2022) to examine whether self-esteem mediates the relationship between (a) cognitive reappraisal and trait anxiety, and (b) expressive suppression and trait anxiety. As previously noted, participant age, level of education and current education status were included as covariates, as research has identified these variables as potential confounders in the relationships of interest.

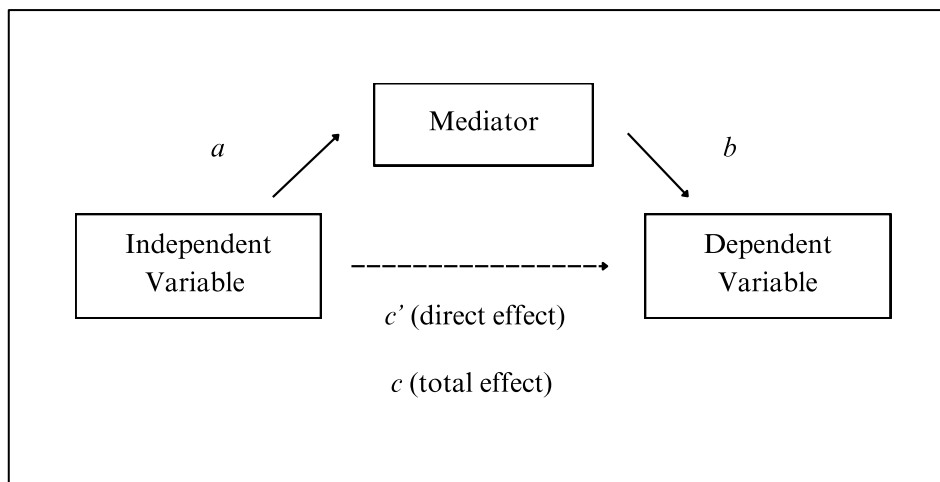
As visualized in Figure 6, the analysis follows the logic of the causal step approach, which states that four conditions must be met to establish mediation:

1. The total effect of the independent variable (IV) on the dependent variable (DV) must be significant (path c)
2. The IV must significantly predict the mediator (path a)
3. The mediator must significantly predict the DV while controlling for the IV (path b)
4. The direct effect of the IV on the DV, controlling for the mediator must be non-significant or remains significant but is reduced (path c')

When the first three conditions are met, and the direct effect (condition 4) becomes non-significant, full mediation is assumed. If the direct effect remains significant but is reduced, partial mediation is indicated.

Figure 6

Visualization of Mediation



In addition, power considerations were guided by the recommendations of Fritz and McKinnon (2007), who emphasize that in order to calculate the required sample size for detecting a mediation effect, each individual path within the mediation model must be included in the power analysis.

For expressive suppression, previous research suggests medium-to-strong effect sizes for both paths, resulting in a minimum required sample size of approximately $N = 78$ when using percentile bootstrap methods (Fritz and McKinnon, 2007).

In contrast, the effect of cognitive reappraisal on self-esteem has been found to be smaller in earlier studies, typically ranging from small-to-medium. According to Fritz and McKinnon (2007), this would require a sample size of at least $N = 126$ to reliably detect mediation effects. Given the current sample size of $N = 78$, the mediation model involving cognitive reappraisal may be underpowered – an important consideration when interpreting the results.

Cognitive Reappraisal, Self-Esteem and Trait Anxiety

The individual paths of the mediation analysis for cognitive reappraisal are shown in Table 5. Using PROCESS macro v4.2 (Model 4), the analysis tested whether self-esteem mediates the relationship between cognitive reappraisal and trait anxiety, controlling for age, level of education, and current education status.

The results show that cognitive reappraisal significantly predicted self-esteem ($b = 0.231$, $SE = 0.109$, $p = .038$), and self-esteem significantly predicted lower trait anxiety ($b = -1.217$, $SE = 0.125$, $p < .001$). The direct effect of cognitive reappraisal on trait anxiety was not significant ($b = -0.142$, $SE = 0.120$, $p = .241$), whereas the total effect was significant ($b = -0.424$, $SE = 0.176$, $p = .019$). The indirect effect via self-esteem was statistically significant, as the 95% bias-corrected bootstrap confidence interval (based on 5,000 samples) did not include zero $[-0.357, -0.0045]$. However, since the confidence interval closely borders to zero, the results should be interpreted with caution - replications of the analysis in some cases included zero, indicating potential instability of results.

Table 5

Mediation Analysis – Cognitive Reappraisal, Self-Esteem and Trait Anxiety

Paths	b	SE	t	p	95% confidence interval	
					Lower	Upper
CR → SE (a)	0.2313	0.1093	2.1157	.0378	0.0134	0.4491
SE → TA (b)	-1.2170	0.1248	-9.7537	<.001	-1.4657	-0.9683
CR → TA (direct effect c')	-0.1421	0.1201	-1.1834	.2405	-0.3814	0.0973
CR → TA (total effect c)	-0.4235	0.1763	-2.4019	.0189	-0.7750	-0.0721
Indirect effect bootstrapped (ab)	-0.1793	-	-	-	-0.3570	-0.0045

Note. CR = Cognitive reappraisal; SE = Self-esteem; TA = Trait anxiety; Covariates: Age, Level of education, Ongoing education.

Expressive Suppression, Self-Esteem and Trait Anxiety

The mediation analysis for expressive suppression followed the same procedure and is reported in Table 6. Again, the model controlled for age, level of education and current

educational status. The aim was to examine whether self-esteem mediates the relationship between expressive suppression and trait anxiety.

As shown in Table 6, expressive suppression significantly predicted lower self-esteem ($b = -0.5663$, $SE = 0.112$, $p < .001$), and lower self-esteem significantly predicted higher trait anxiety levels ($b = -1.2699$, $SE = 0.142$, $p < .001$). The direct effect of expressive suppression on trait anxiety was not significant when controlling for self-esteem ($b = -.0382$, $SE = 0.158$, $p < .810$), whereas the total effect was significant ($b = .6810$, $SE = 0.196$, $p < .001$). Importantly, the bootstrapped 95% confidence interval for the indirect effect did not include zero [0.4323, 1.0254], indicating a statistically robust mediation effect.

Table 6

Mediation Analysis – Expressive Suppression, Self-Esteem and Trait Anxiety

Paths	b	SE	t	p	95% confidence interval	
					Lower	Upper
ES → SE (a)	-0.5663	0.1122	-5.0495	<.001	-0.7899	-0.3428
SE → TA (b)	-1.2699	0.1420	-8.9438	<.001	-1.5530	-0.9869
ES → TA (direct effect c')	-0.0382	0.1580	-0.2415	.8099	-0.3532	0.2769
ES → TA (total effect c)	0.6810	0.1963	3.4688	.0009	0.2898	1.0723
Indirect effect bootstrapped (ab)	0.7192	-	-	-	0.4323	1.0254

Note. ES = Expressive suppression; SE = Self-esteem; TA = Trait anxiety; Covariates: Age, Level of education, Ongoing education.

Exploratory Analyses

To further investigate the lack of significant findings related to state anxiety, two exploratory analyses were conducted using an alternative measurement: the state anxiety subscale of the State-Trait Anxiety Inventory (STAI-S), which was administered prior to the laboratory experiment. This approach provides an opportunity to examine whether the previously observed null-findings for state anxiety replicate when the variable is measured with a different instrument and at a different time point.

As shown in Table 7, state anxiety measured using the STAI-S was significantly correlated with all variables of interest. Cognitive reappraisal showed a significant negative correlation with

state anxiety ($r = -0.297, p < .01$), while expressive suppression demonstrated a significant positive correlation ($r = 0.290, p < .01$). This pattern was contrary to the proposed model, which hypothesized a negative correlation between expressive suppression and state anxiety. Finally, state anxiety was negatively associated with self-esteem ($r = -0.535, p < .001$).

Table 7

Exploratory Correlation-Matrices

Variable	1	2	3	4
1. CR	-	-0.111 (-0.40)	0.231* (0.170)	-0.297** (-0.188*)
2. ES		-	-0.494** (-0.445**)	0.290** (0.331**)
3. SE			-	-0.535** (-0.576**)
4. SA- (STAI-S)				-

Note. $N = 78$. Pearson correlations are presented above the diagonal, Spearman correlations are presented above the diagonal in brackets; * $p < .05$; ** $p < .01$; CR = Cognitive Reappraisal; ES = Expressive Suppression; SE = Self-Esteem; SA = State Anxiety measured with STAI-S.

Cognitive Reappraisal, Self-Esteem and State Anxiety

The first exploratory mediation analysis examined whether self-esteem mediates the relationship between cognitive reappraisal (independent variable, IV) and state anxiety (dependent variable, DV), as measured via the STAI-S. The results are summarized in Table 8. The total effect of cognitive reappraisal on state anxiety was significant, $b = -0.0244, p = .0078$, indicating that greater use of cognitive reappraisal was associated with lower state anxiety. However, when self-esteem was included as a mediator, the direct effect was reduced and became non-significant ($b = -0.0147, p = .0682$). Cognitive reappraisal was positively associated with self-esteem as the mediator ($b = 0.2313, p = .0378$), which in turn was significantly associated with lower state anxiety ($b = -0.0419, p < .001$). The indirect effect, tested via bootstrapping (5,000 samples), yielded a 95% confidence interval of $[-0.0197, 0.0001]$, which narrowly included zero, suggesting marginal support for the mediation effect.

Table 8*Mediation Analysis – Cognitive Reappraisal, Self-Esteem and State Anxiety*

Paths	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95% confidence interval	
					Lower	Upper
CR → SE (a)	0.2313	0.1093	2.1157	.0378	0.0134	0.4491
SE → SA (b)	-0.0419	0.0083	-5.0688	<.001	-0.0584	-0.0254
CR → SA (direct effect c')	-0.0147	0.0080	-1.8515	.0682	-0.0306	0.0011
CR → SA (total effect c)	-0.0244	0.0089	-2.7339	.0078	-0.0422	-0.0066
Indirect effect bootstrapped (ab)	-0.0097	-	-	-	-0.0197	0.0001

Note. CR = Cognitive reappraisal; SE = Self-esteem; SA = State anxiety; Covariates: Age, Level of education, Ongoing education.

Expressive Suppression, Self-Esteem and State Anxiety

The second exploratory mediation analysis used expressive suppression as the independent variable, self-esteem as the mediator and state anxiety measured via the State-Trait Anxiety Inventory as the dependent variable. The findings are reported in Table 9. The total effect of expressive suppression on state anxiety was significant, $b = 0.0265$, $p = .0129$, indicating that higher use of expressive suppression was associated with increased state anxiety. However, when self-esteem was included as a mediator, the direct effect became non-significant ($b = 0.0009$, $p = .9296$). Expressive suppression was negatively associated with self-esteem as the mediator ($b = -0.5663$, $p < .001$), which, in turn, was significantly related to lower state anxiety ($b = -0.0419$, $p < .001$). The bootstrap confidence interval for the indirect effect did not include zero, supporting a statistically significant mediation ($b = 0.0256$, 95% CI [0.0129, 0.0402]).

Table 9*Mediation Analysis - Expressive Suppression, Self-Esteem and State Anxiety*

Paths	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95% confidence interval	
					Lower	Upper
ES → SE (a)	-0.5663	0.1122	-5.0495	<.001	-0.7899	-0.3428
SE → SA (b)	-0.0452	0.0095	-4.7329	<.001	-0.0642	-0.0262
ES → SA (direct effect c')	0.0009	0.0106	0.0887	.9296	-0.0202	0.0221
ES → SA (total effect c)	0.0265	0.0104	2.5503	.0129	0.0058	0.0473
Indirect effect bootstrapped (ab)	0.0256	-	-	-	0.0129	0.0402

Note. ES = Expressive suppression; SE = Self-esteem; SA = State anxiety; Covariates: Age, Level of education, Ongoing education.

Summary of Results

Confirmatory Analyses

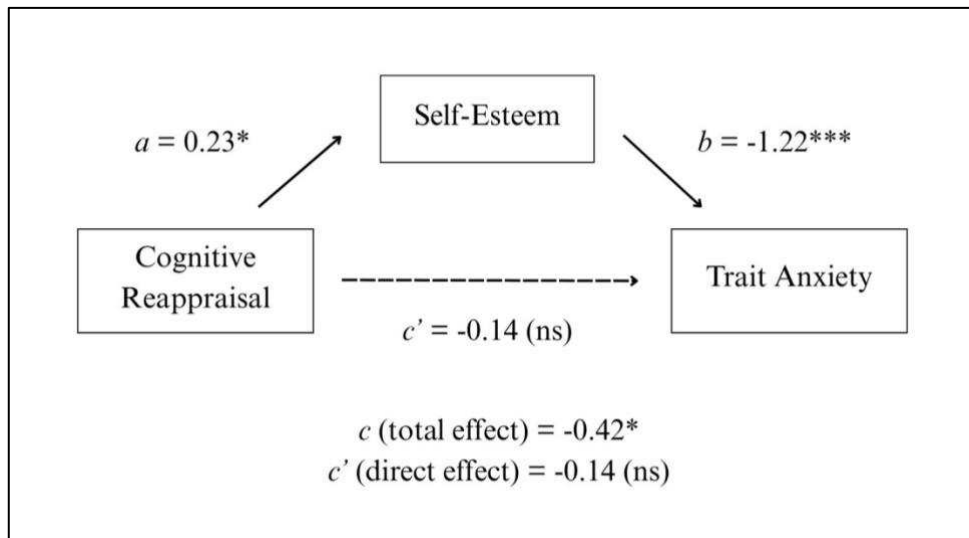
The results of the statistical analyses are consistent with existing literature on emotion regulation strategies and their relationships with self-esteem and *trait anxiety*.

As hypothesized, cognitive reappraisal was positively correlated with self-esteem and negatively correlated with trait anxiety. In line with the causal step approach, the results of the mediation analysis suggest that self-esteem fully mediates the relationship between cognitive reappraisal and trait anxiety. While this emotion regulation strategy showed a significant total effect on trait anxiety, its direct effect became non-significant once self-esteem was included as a mediator. This pattern is illustrated in Figure 7.

However, interpretation of this mediation should be made with caution. The bootstrapped confidence interval for the indirect effect only narrowly excluded zero, and in some replications, zero was included, indicating potential instability of the effect. Additionally, the a priori power analysis indicated that a larger sample size than $N = 78$ was required to detect a mediation effect, suggesting that the current sample may have been underpowered. In summary, while the proposed direction and mediation pathway are empirically supported, further research with larger and sufficiently powered samples is needed to confirm these findings with greater robustness.

Figure 7

Visualization of Mediation for Cognitive Reappraisal and Trait Anxiety



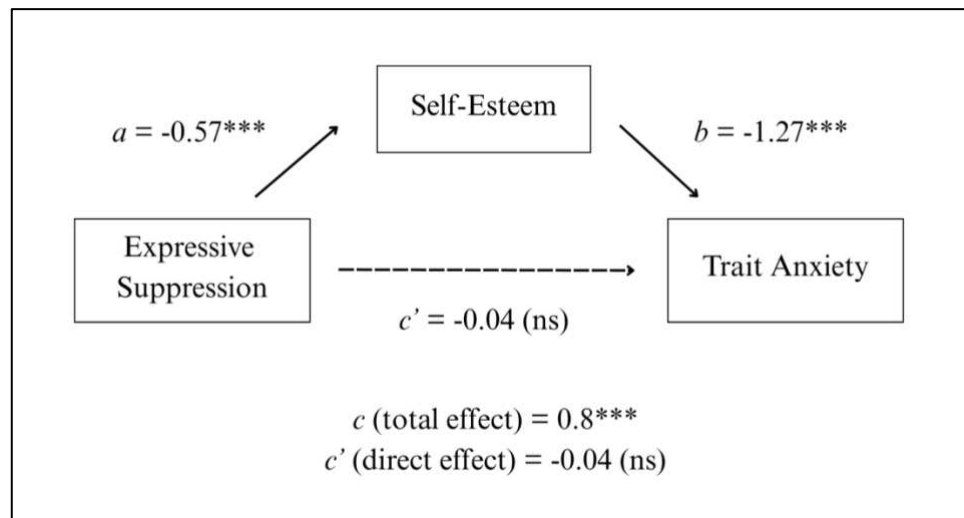
Note. $^* p < .05$; $^{**} p < .01$; $^{***} p < .001$; *ns* = not significant.

In contrast to cognitive reappraisal, the findings related to expressive suppression offer clearer support for the hypothesized relationships. Expressive suppression was significantly negatively correlated with self-esteem and positively correlated with trait anxiety. The mediation analysis confirmed a full mediation model, indicating that expressive suppression increases trait anxiety indirectly by reducing self-esteem. This relationship is visualized in Figure 8.

Unlike the model for cognitive reappraisal, the indirect effect of expressive suppression proved to be statistically robust. The bootstrap confidence interval did not include zero suggesting a stable and significant mediation effect. This robustness may be attributed to the stronger effect sizes observed for expressive suppression, which, according to the power analysis, require a smaller sample size to detect significant effects.

Figure 8

Visualization of Mediation for Expressive Suppression and Trait Anxiety



Note. * $p < .05$; ** $p < .01$; *** $p < .001$; ns = not significant.

Lastly, no confirmatory analysis was conducted with *state anxiety* as the dependent variable, as no significant correlations were found between this variable - at either of the two timepoints (see Figure 5, marker point 3 and 4) - and any other variables of interest (see Table 3).

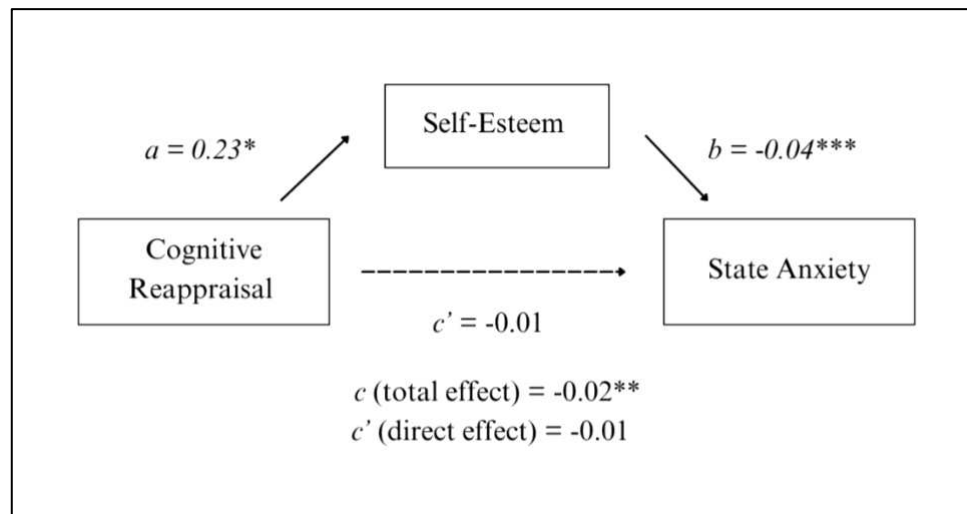
Exploratory Analyses

To further examine the null-findings, two exploratory mediation analyses were carried out using an alternative measure of state anxiety, assessed prior to the laboratory session using the validated STAI-S subscale. These exploratory analyses revealed potential mediation effects of self-esteem on the relationship between emotion regulation strategies and *state anxiety*.

For cognitive reappraisal, the results indicated no significant mediation effect, as the bootstrap confidence interval for the indirect effect narrowly included zero. However, the previously significant total effect on state anxiety became non-significant after including self-esteem as a mediator, suggesting a possible trend toward partial mediation. A visualization of this mediating model is presented in Figure 9.

Figure 9

Visualization of Exploratory Mediation for Cognitive Reappraisal and State Anxiety

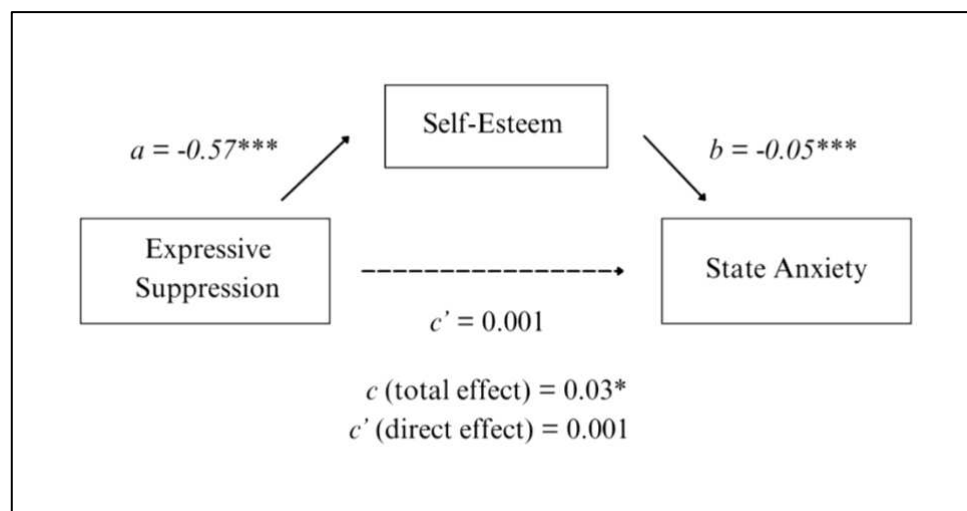


Note. $^*p < .05$; $^{**}p < .01$; $^{***}p < .001$; ns = not significant.

In contrast, the findings for expressive suppression supported a full mediation model. The bootstrap confidence interval for the indirect effect excluded zero, and the total effect on state anxiety became non-significant once self-esteem was included as a mediator. Contrary to theoretical expectations, expressive suppression exhibited a positive total effect on state anxiety. This finding raises the possibility that expressive suppression may not offer even short-term benefits for anxiety reduction and might instead contribute to increased state anxiety. This exploratory mediation model is depicted in Figure 10.

Figure 10

Visualization of Exploratory Mediation for Expressive Suppression and State Anxiety



Note. $^*p < .05$; $^{**}p < .01$; $^{***}p < .001$; ns = not significant.

Discussion

The aim of this study was to investigate the mediating role of self-esteem in the relationship between two emotion regulation strategies - cognitive reappraisal and expressive suppression - and anxiety, differentiated into state and trait components.

A correlation matrix revealed significant associations between both emotion regulation strategies, self-esteem and trait anxiety. Accordingly, two separate *confirmatory mediation analyses* were conducted, each including one emotion regulation strategy as the independent variable, self-esteem as the mediator, and trait anxiety as the dependent variable. Both analyses supported the hypothesized full mediation models. Specifically, cognitive reappraisal demonstrated a significant total negative effect on trait anxiety, which became non-significant once self-esteem was included in the model. A similar pattern was observed for expressive suppression: its significant total positive effect on trait anxiety also became non-significant when self-esteem was included. Taken together, these findings suggest that self-esteem fully mediates the relationship between both emotion regulation strategies and trait anxiety.

However, caution is warranted in interpreting the findings for cognitive reappraisal. In several replications of the analysis, the bootstrap confidence interval for the indirect effect narrowly included zero, indicating some instability in the mediation effect. As previously discussed, this may be partly due to the smaller effect sizes of cognitive reappraisal, suggesting that a sample size larger than $N = 78$ may be required to achieve sufficient statistical power.

Given that the correlation matrix showed no significant associations between *state anxiety* and any other variables of interest, no confirmatory mediation analyses were conducted with state anxiety as the dependent variable. One possible explanation for these null findings involves measurement limitations: state anxiety was assessed using a single-item visual analogue scale, which may have lacked the necessary psychometric sensitivity and variability. This limitation likely contributed to violations of normality and reduced statistical power, impairing the detection of significant associations.

Although the item demonstrated strong face-validity by directly asking participants how anxious they felt in that moment (e.g., “*Wie groß schätzen Sie Ihre Angst im Moment ein?*”), it may have inadvertently measured a different construct than anxiety. Specifically, the German term *Angst* may have been interpreted by some participants as “fear” rather than “anxiety.” Therefore, it is possible that participants who misunderstood this item as fear may have actually felt anxious but did not report it because they focused on their fear instead.

Another explanation may lie in how state anxiety was operationalized. Using delta values accounts for participants' baseline anxiety levels, but this approach also has important limitations: Participants with higher baseline anxiety may have shown smaller delta values simply because of a ceiling effect, which can underestimate their actual stress responses. As a result, it may appear as though these individuals were not anxious at all, even though their absolute anxiety levels were high. While delta scores are useful for examining relative increases or decreases from baseline, absolute state anxiety values would have been a more valid measure for the present research question, since the aim of the study was to capture interindividual differences in state anxiety levels. This raises a validity concern that should be considered when interpreting the findings. Future research may benefit from reporting both absolute and delta values in order to capture interindividual and intraindividual differences in state anxiety responses and provide a more comprehensive understanding.

Furthermore, contextual factors may explain the absence of significant associations between the emotion regulation strategies and state anxiety. The use of the Trier Social Stress Test (TSST), a well-established stress induction paradigm, may have influenced participant's choice of emotion regulation strategy. Prior research suggests that in highly emotional or socially evaluative contexts, individuals tend to rely more on expressive suppression than on cognitive reappraisal (McRae & Gross, 2020). Given the socially threatening nature of the TSST, it is plausible that participants were more inclined to suppress visible emotional responses in front of the "behavioral experts", even if they typically favor cognitive reappraisal in daily life. This potential strategy shift may help explain the lack of the proposed correlation between emotion regulation strategies and state anxiety.

Moreover, research by Hellhammer and Schubert (2012) supports the effectiveness of the TSST in significantly elevating perceived stress, anxiety and emotional insecurity. In their study, psychological stress responses peaked immediately after the TSST but declined rapidly thereafter. A post hoc Bonferroni correction revealed that participants reported significantly higher levels of perceived stress, anxiety, and emotional insecurity during the TSST compared to post-TSST ratings (Hellhammer & Schubert, 2012). These findings suggest that post-TSST psychological measures may be biased due to partial recovery from the stressor. Additionally, participants' anxiety ratings were generally lower than ratings of perceived stress and emotional insecurity - patterns that were also observed in the present study. This implies that the TSST may be more effective in eliciting perceived stress than state anxiety. It is even possible that the TSST induced such a uniformly high level of stress across participants that individual differences in emotion regulation have minimal influence on resulting state anxiety levels.

Given these considerations for state anxiety as the independent variable, two *exploratory mediation analyses* were further conducted using a more comprehensive and psychometrically robust measure: the STAI-S subscale, consisting of 20 items that capture various facets of state anxiety, administered prior to the laboratory session. These exploratory analyses aimed to assess whether the lack of significant findings could be attributed to insufficient measurement quality.

Indeed, the results of the exploratory analyses revealed a potential mediation effect of self-esteem in the relationship between emotion regulation strategies and state anxiety. Cognitive reappraisal showed a significant negative total effect on state anxiety, while expressive suppression showed a significant positive total effect. When self-esteem was introduced as a mediator, both total effects became non-significant, suggesting a full mediation effect. However, in contrast to theoretical expectations, expressive suppression was positively associated with state anxiety, even in the short term. This finding implies that expressive suppression may not even provide the hypothesized short-term benefits of reducing state anxiety, but instead further increases the emotional state.

In conclusion, the results of this study align with existing literature on emotion regulation strategies and its relationship with self-esteem and anxiety. The empirical findings of the present study provide partial support for Hypotheses 1 and 2. For **Hypothesis 1**, cognitive reappraisal was found to have a significant direct effect on both trait anxiety (H1.1) and self-esteem (H1.2). Additionally, self-esteem showed to significantly mediate the relationship between cognitive reappraisal and trait anxiety (H1.3). A similar pattern could be observed for **Hypothesis 2**: expressive suppression demonstrated significant direct effects on trait anxiety (H2.1) and self-esteem (H2.2), with self-esteem again mediating the link between expressive suppression and trait anxiety (H2.3). However, since no confirmatory hypotheses were conducted with state anxiety as the dependent variable, support for Hypotheses 1 and 2 remains limited to trait anxiety. The exploratory analyses further suggest that a similar mediation model may apply to state anxiety, particularly when assessed with a validated multi-item instrument. Thus, the proposed models can be partially confirmed, although further research - particularly with larger sample sizes and improved measures of state anxiety - is necessary to strengthen and replicate these findings.

Strengths & Limitations

One strength of this thesis lies in its differentiation between state and trait anxiety, enabling a more nuanced understanding of the interplay between emotion regulation strategies, self-esteem and anxiety. Furthermore, the assessment of state anxiety following a standardized stress

paradigm (TSST) strengthens internal validity by ensuring that acute anxiety was measured at the same time point and under similar conditions for all participants.

In terms of psychometric instruments, this study employed well-validated and widely used tools (ERQ, RSES, STAI), known for their strong psychometric properties. However, each measurement also presented limitations. The ERQ assesses the habitual use of cognitive reappraisal and expressive suppression but does not capture other regulation strategies or the flexibility with which individuals adapt these strategies to specific contexts. Moreover, emotion regulation was not assessed in real time during the TSST, making it unclear whether participants used their typical strategies or adjusted them in response to the laboratory stressor. Most importantly, emotion regulation strategies were not experimentally manipulated – participants were not instructed to use a specific strategy – therefore no causal inferences can be drawn. It remains unclear, whether emotion regulation influences anxiety, or whether anxiety levels shape individuals' use of regulation strategies.

The RSES showed signs of a ceiling effect, with a large number of participants scoring at the upper limit of the scale. This may have contributed to violations of normality in the self-esteem distribution. One possible explanation involves self-deception or impression management, both common issues in self-report instruments. Indeed, a broader limitation of this study is its exclusive reliance on self-report measures, which require participants to consciously reflect on their emotions and behaviors - a process that may, in itself, influence the very constructs being assessed. This concern is especially relevant for the measurement of state anxiety, where participants were asked to evaluate their emotional state.

In general, the assessment of state anxiety via a single-item visual analogue scale represents a methodological limitation itself. On the one hand, a single item lacks psychometric depth, limiting score variability and potentially contributing to the statistical constraints such as non-normal distributions. On the other hand, the German translation of the item may have introduced semantic ambiguity: participants might have interpreted *Angst* as “fear” rather than “anxiety,” thereby skewing responses. To address these concerns, the STAI-S was used for exploratory analyses. However, because participants completed this scale before entering the laboratory environment, uncontrolled variability may have been introduced: it was not possible to control for prior exposure to stressors, which may have affected state anxiety levels.

Additionally, while the a priori power analysis indicated that a sample size of $N = 78$ was sufficient to detect effects related to expressive suppression, it also showed that a larger sample ($N = 126$) would be required to reliably detect effects associated with cognitive reappraisal. As

such, findings related to this variable may be underpowered, particularly evident in the instability of the bootstrap confidence interval for the indirect effect, which included zero in some replications.

Finally, the characteristics of the sample represents both a strength and a limitation. Focusing on a homogeneous group of healthy, highly educated young women (ages 18–35) enhanced internal consistency and reduced the impact of extraneous variables. However, this also limits generalizability. It would have been useful to include participants suffering from anxiety disorders, as this would have added more variance to the sample.

Conclusion & Future Directions

This study underscores the central role of self-esteem in the relationship between emotion regulation strategies and anxiety. The full mediation model indicates that the observed correlations between cognitive reappraisal and trait anxiety and between expressive suppression and trait anxiety are entirely channeled through self-esteem. These findings suggest that self-esteem should not merely be treated as a covariate, but rather as a key mechanism underlying the impact of emotion regulation on anxiety. These insights carry practical implications: interventions aimed at reducing anxiety may not only target the modification of maladaptive emotion regulation strategies, but also actively foster and strengthen individuals' self-esteem.

The findings further align with previous research indicating that maladaptive strategies (e.g. expressive suppression) are more strongly associated with anxiety levels, than adaptive ones. Therefore, as Aldao et al. (2010) already proposed, the existence of negative emotion regulation strategies might be worse than the non-existence of adaptive strategies. This supports the notion that reducing maladaptive strategies may be a more effective initial therapeutic goal than solely enhancing adaptive ones.

Interestingly, the associations between emotion regulation strategies and trait anxiety were stronger than those with state anxiety, suggesting that such strategies may be more closely tied to enduring patterns of anxiety rather than short-term anxiety.

Despite its valuable contributions, this study also has several limitations that should be addressed in future research. Given its cross-sectional design, no causal inferences can be made. Therefore, longitudinal studies are necessary to clarify the directionality of effects. It is yet to be determined whether expressive suppression causally contributes to elevated trait anxiety, or whether individuals with higher trait anxiety are more predisposed to adopt expressive suppression as a regulation strategy. Longitudinal designs can also help identify whether emotion regulation difficulties act as a risk factor for the development of psychopathology (e.g. anxiety

disorders), or whether psychopathological symptoms impair emotion regulation abilities – or both. As proposed by Cisler & Olatunji (2012) a bidirectional relationship is likely, in which poor regulation increases vulnerability to psychopathology, which in turn further impairs emotion regulation, creating a vicious cycle.

Furthermore, because the ERQ does not distinguish between the frequency of use and effectiveness of emotion regulation strategies, interpretation of results should be approached with caution. It remains unclear whether high trait anxiety is associated with the overuse, underuse, or ineffective use of specific strategies effectively (Lincoln et al., 2022). Further studies should employ more nuanced assessments of emotion regulation processes to clarify these distinctions.

To enhance generalizability, future research should aim to include more diverse samples, including male participants and individuals with clinically diagnosed anxiety. Such diversity would enable subgroup analyses, offering deeper insights into how emotion regulation, self-esteem, and anxiety interact across genders, cultural contexts, and clinical statuses.

Given existing evidence on the importance of strategy congruence with social norms, further investigation into cultural and gender-specific patterns of emotion regulation is warranted. For instance, while men have been found to use expressive suppression more frequently - and this strategy is linked to higher anxiety levels - it remains paradoxical that women report a 1,66 times higher prevalence of anxiety disorders (Javaid et al., 2023). As literature on cultural differences already suggests, the relationship between emotion regulation and anxiety may vary between subgroups, depending on whether a strategy is stereotypical congruent or non-congruent with a group's identity (Schunk et al., 2021; Wu et al., 2024). As men are typically regarded as more rational and less emotionally expressive, the use of expressive suppression may be less psychologically detrimental for them than for women, for whom emotional expressiveness is more socially expected. Therefore, the current findings cannot be generalized to broader populations and must be interpreted specifically within the context of healthy, young women. Future research should explore this phenomenon of strategy congruence vs. non-congruence across different subgroups to develop a more comprehensive understanding of the dynamics between emotion regulation, self-esteem and anxiety.

Regarding state anxiety, future studies are advised to use multi-item, psychometrically validated instruments administered after stress induction to more accurately capture acute anxiety responses. Additionally, experimental manipulation, such as instructing participants to apply a particular regulation strategy, could offer a clearer insight into the short-term effects of different emotion regulation approaches.

In summary, this study contributes to a better understanding of the relationship between emotion regulation strategies and anxiety, highlighting self-esteem as a central mediator. By addressing both state and trait anxiety, the findings expand existing literature and underscore the central role of self-esteem in the relationship between emotion regulation strategies and anxiety.

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List of Abbreviations

ABT:	Attentional bias towards threat
ANS:	Autonomic nervous system
APA:	American Psychological Association
BMI:	Body mass index
CBT:	Cognitive Behavioral Therapy
CR:	Cognitive reappraisal
DV:	Dependent variable
DSM:	Diagnostic and Statistical Manual
ER:	Emotion regulation
ERQ:	Emotion Regulation Questionnaire
ES:	Expressive suppression
GAD:	Generalized Anxiety Disorder
HPA axis:	Hypothalamic–pituitary–adrenal axis
IV:	Independent variable
MDBF:	Der Mehrdimensionale Befindlichkeitsfragebogen
MuSkiBa II:	Music and Skin-barrier Recovery II
PASA:	Primary Appraisal Secondary Appraisal
PTSD:	Posttraumatic Stress Disorder
RSES:	Rosenberg Self-Esteem Scale
SA:	State anxiety
SE:	Self-esteem
STAI:	State-Trait Anxiety Inventory
STAI-S:	State Subscale of the State-Trait Anxiety Inventory
STAI-T:	Trait Subscale of the State-Trait Anxiety Inventory
TA:	Trait anxiety

TEWL:	Transepidermal water loss
TSST:	Trier Social Stress Test
TTPAS:	Types of Positive Affect Scale
VAS:	Visual analogue scale
VIF:	Variance Inflation Factor
WHO:	World Health Organization