

Anxiety Sensitivity Index and Appraisal of Social Concerns as Predictors of TSST-Evoked

Cortisol

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Honors Thesis

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### **Abstract**

Self-report assessments are measures that enable researchers to directly obtain authentic subjective responses from participants by asking various well-designed questions. In clinical psychology, diverse self-report measures have been invented to facilitate the diagnosis of psychopathology. Cognition plays an important role in the development and maintenance of social anxiety disorder. However, little research to date has examined whether results of self-report cognitive assessments on social anxiety could be reliable predictors of the actual fluctuation of cortisol, the stress hormone, in the real-life scenario. This study examined whether Anxiety Sensitivity Index-3 (ASI-3) and Appraisal of Social Concerns (ASC) could be used to infer the potential variations in cortisol evoked by the Trier Social Stress Test (TSST). I hypothesized (1) there was a positive correlation between the scores of self-reports, ASI-3 and ASC, and the changes in TSST-evoked cortisol, and (2) ASI-3 and ASC were positively correlated with each other. 60 female college participants who completed ASI-3, ASC and three TSST-evoked cortisol collections were included in the study. Multiple linear regression and correlation test were performed to test the hypotheses. The results shown there was no significant correlation between ASI-3, ASC, and TSST-evoked cortisol. However, there was a positive correlation between ASI-3 and ASC. The study suggested that there was a gap between the self-report cognitive measures of social anxiety and the actual stress response.

*Keywords:* social anxiety, cognition, anxiety sensitivity, cortisol

Social anxiety is characterized as a hypersensitivity exists in the presence of real events and the anticipation of stressful events (Mirete et al., 2021; Stein et al., 2000). Social anxiety disorder, also known as social phobia, is an anxiety disorder involving discomfort around social interaction, and concern about one's performance being negatively evaluated and embarrassed by others (National Institute of Mental Health, 2018). Typically, this discomfort is experienced as fear and anxiety, and is likely to come along with autonomic arousal, such as diaphoresis, tachycardia, nausea, apnea, etc. (Anxiety and Depression Association of America).

Cognition plays an important role in the development and maintenance of social anxiety disorder (Hofmann, 2007). Based on the Clark & Wells cognitive model of social phobia (1995), the major causal factors of developing social anxiety disorder are negative beliefs about the social self and self-consciousness. Multiple research has demonstrated people with high and low levels of social anxiety perceive and process information potentially relate to social evaluation differently (Rapee et al., 1997; Aue, 2015). To be specific, cognitive distortions and perception biases result in heightened anxiety in social situations, which maintains social phobia consequently. In addition, people with social anxiety tend to have a higher score on self-report cognitive measures of fear of receiving negative evaluations than people with other types of anxiety disorders or mental disorders, or non-clinical population (Heimberg et al., 1988).

Cortisol, also known as the stress hormone, is a good biomarker of the body's physiological response to stress, which is induced by a real or perceived threat. A recent research found there was a cortisol hyperresponsiveness in a young nonclinical population with high social anxiety (Mirete et al., 2021). Another study regarding sports performance demonstrated salivary cortisol response and a decline in performance were positively correlated (Lautenbach et al., 2014). However, a research on salivary cortisol levels among socially anxious adults

established there was a negative association between salivary cortisol and trait shyness, which proposed that this low cortisol response represented a way of coping and adapting to the social situation (Beaton et al., 2006). Nonetheless, anxious arousal and high cortisol level share some symptoms in common: poor attention inhibition, sweating, and blushing (Santos-Longhurst, 2018; Liang, 2021).

Hence, this thesis aimed to assess the relationship between the cognitive assessment of social anxiety symptoms and the physiological measures of stress responses. I hypothesized (1) Anxiety Sensitivity Index (ASI-3) and Appraisal of Social Concerns (ASC) would predict the variation of TSST-evoked cortisol, and (2) there would be a positive correlation between Anxiety Sensitivity Index (ASI-3) and Appraisal of Social Concerns (ASC).

### **Social Anxiety Disorder**

Social anxiety disorder, which was previously identified as social phobia, is a highly prevalent mental disorder associated with significant psychological impairment and lifelong chronicity (Brunello et al., 2000). Social anxiety disorder is the third most common mental disorder and the most common anxiety disorder (Rose et al., 2021). According to diagnostic interview data from National Comorbidity Survey Replication, an estimated 7.1% of U.S. adults have social anxiety disorder in 2003 (Harvard Medical School, 2007).

Social anxiety is characterized as a hypersensitivity exists in both presences of real events and anticipation of stressful events (Mirete et al., 2021; Stein et al., 2000). Individuals who are socially anxious tend to have poorer attention inhibition and exhibit shorter saccade latencies for angry faces than happy and neutral faces, which shows they incline to have less eye movements on angry faces (Liang, 2021). In addition, socially anxious individuals display an exaggerated attention bias to threat. To be specific, they tend to overestimate the likelihood of experiencing

their feared stimuli and the severity of the consequences (Aue, 2015). Also, for individuals with social anxiety, they believe social situations imply danger and fear negative evaluation. Socially anxious people have been found to experience the almost every symptom linked with anxiety (Reich et al., 1988). This anxious arousal leads to a wide range of bodily sensations including sweating, blushing, shaking, or unsteady voice (Clark et al., 1995).

Social anxiety usually starts in early childhood or adolescent, and it affects various aspects of a person's life including social interactions, relationships, work, and academic functioning (American Psychiatric Association, 2017). Despite various negative consequences caused by these expectancy biases, research found there is a high prevalence of comorbid disorders in patients with social anxiety disorder, occurring in as many as 90% of the patients (Koyuncu et al., 2019). It is often comorbid with depression, other anxiety disorders, and alcohol and substance abuse or eating disorder (Brunello et al., 2000). This cascade of comorbidity worsens the disability and symptoms associated with the psychopathologies.

### **Anxiety Sensitivity**

Anxiety sensitivity is defined as an intense fear of arousal-related sensations (Taylor, 2020). It is also called the fear of fear, which refers to the beliefs that anxiety- or arousal-related symptoms can bring negative consequence to oneself (Mantar et al., 2011). Reiss et al. (1985) expectancy model of fear suggested that anxiety sensitivity plays an essential role in the development of anxiety disorders. Fear of anxiety symptoms tend to intensify anxious arousal and anxiety symptoms, which is likely to result in a panic attack eventually, and the occurrence of panic attack in turn heightens anxiety sensitivity, and thus a vicious cycle is formed (Reiss, 1991). In addition, Reiss found Anxiety Sensitivity Index was strongly associated with fearfulness (Reiss et al., 1986).

### **Cortisol & Stress**

Cortisol is a good biomarker of the body's response to stress. The stress response is an adaptive behavior that helps prepare the body to confront the challenges posed by an external or internal environmental stressor and to minimize the chance of being injured. However, if the exposure to a stressor is perceived as intensive, repetitive, and/or prolonged, the stress response turns into a maladaptive behavior which is detrimental to one's physical and mental health and causes negative health consequences, such as heart disease, anxiety, depression, and cognitive impairment (Chu et al., 2021). A research exploring the relationship between cortisol and subjective anxiety found that there was a significant correlation between cortisol hyperresponsive and subjective anxiety in a young, nonclinical population with high social anxiety, which was only shown in the stress stage during the Maastricht Acute Stress Test (Mirete et al., 2021). However, participants with higher social anxiety found to have higher increases in cortisol level (Mirete et al., 2021).

### **Cognition**

Social anxious individuals incline to reinforce negative self-impression by drawing other people's attention towards the self (Clark et al., 1995). Cognitive belief is a central theme in the treatment of social anxiety disorder (SAD). By studying the changes in negative cognitive and negative metacognitive beliefs in SAD patients, Nordahl et al. (2017) found both cognitive and metacognitive beliefs decreased during the treatment of SAD, and the improvement of metacognition is crucial for alleviating SAD symptoms and facilitating symptom recovery.

### **Conclusions**

Social anxiety disorder is a severe, harmful, and highly prevalent mental illness. Individuals who are socially anxious tend to have a cognitive distortion that magnifies other

people's behaviors and perceived those as negative social evaluations about themselves. This continuation of drawing of attention towards one's performance and worries about being negatively judged lead to more maladaptive behaviors and result in negative health implications, including developing anxiety disorder, depression, substance abuse, etc. Therefore, cognition plays a crucial role in the development of social anxiety disorder and the maintenance of social anxiety symptoms. Cortisol is a stress hormone that is secreted when people are facing a threat. Dysregulation of cortisol also leads to major health issues. Hence, this study aims to explore the relationship between the cognitive assessments of social anxiety and the cortisol response, assuming social evaluative threats evoke cortisol reactivity. This study hypothesized self-report cognitive assessments could predict the variation in cortisol level.

## Methods

### Study Design Overview

The study investigated the predictive reliability of self-report measures, to be specific, Anxiety Sensitivity Index (ASI-3) and Appraisal of Social Concerns (ASC) as predictors of Trier Social Stress Test (TSST) evoked cortisol in the general non-clinical population. The study hypotheses were (1) anxiety sensitivity index and appraisal of social concerns would be able to predict the changes in TSST-evoked cortisol, and (2) there would be a positive correlation between Anxiety Sensitivity Index and Appraisal of Social Concerns. The primary independent variables were scores of Anxiety Sensitivity Index and Appraisal of Social Concerns. The dependent variable was TSST-evoked area under the curve increase ( $AUC_i$ ) cortisol. Descriptive data statistics and multiple linear regression analysis were performed on existing data from a hormone and behavior study by McAfee (2020).

### Participants

Participants were recruited from an introductory psychology course at the University of Texas at Austin in the United States. 60 female participants were randomly selected. Regarding the exclusion criteria, participants who smoked cigarettes, used illegal substances, and/or took medication that could influence their hormone levels were excluded from the study. In addition, female participants were required to (1) have a regular menstrual cycle with a length between 27-30 days for the past 6 months, (2) not have started or stopped hormonal birth control in the previous 3 months, and (3) not be pregnant or breastfeeding (McAfee, 2020).

### Material and Measures

*Anxiety Sensitivity Index (ASI-3)*

Anxiety Sensitivity Index is a self-report cognitive measure for assessing an individual's anxiety sensitivity (fear of arousal-related sensations) (Taylor et al., 2007). The ASI-3 is an 18-item multidimensional measure designed to illustrate a more comprehensive portrait of how anxiety sensitivity is related to various forms of psychopathology. By examining the results of factor analysis of responses from U.S. and Canadian non-clinical participants (N=2,361), Taylor et al. (2007) incorporated the three best reproduced aspects in prior research (physical, cognitive, and social concerns) into the Anxiety Sensitivity Index. The questionnaire uses a 5-point Likert scale ranging from 0 (very little) to 4 (very much) to assess participant's sensational condition in terms of how concerned they feel about experiencing the various anxiety symptoms. The maximum score of the ASI-3 is 72, with three subscales (physical, cognitive, and social concerns) that each has a maximum score of 24. All scores are calculated by summing scores across items. Anxiety Sensitivity Index is widely used in both clinical and non-clinical samples and has been shown to have good-to-excellent subscale reliability (Cronbach's  $\alpha$  = .79-91), internal consistency (Cronbach's  $\alpha$  = .88-.93), and good construct validity (Taylor et al., 2007).

#### *Appraisal of Social Concerns (ASC)*

Appraisal of Social Concerns is a 20-item self-report cognitive assessment of social-related cognition and social evaluative threat (Telch et al., 2004). The questionnaire contains a variety of specific outcomes that people could probably face in social situations. Participants were asked to write a number from 0 (not at all concerned) to 100 (extremely concerned) to indicate their subjective feelings based on their own experiences for the past week. The result of Appraisal of Social Concern is calculated by averaging the scores of all items. The maximum score is 100. The measure has excellent internal consistency (Cronbach  $\alpha$  = .94) and test-retest

reliability in a non-clinical sample (Telch et al., 2004). The measure also demonstrates good test-retest reliability ( $r=.82$ ), factor validity, and good convergent and discriminant validity with a clinical sample (Schultz et al., 2006).

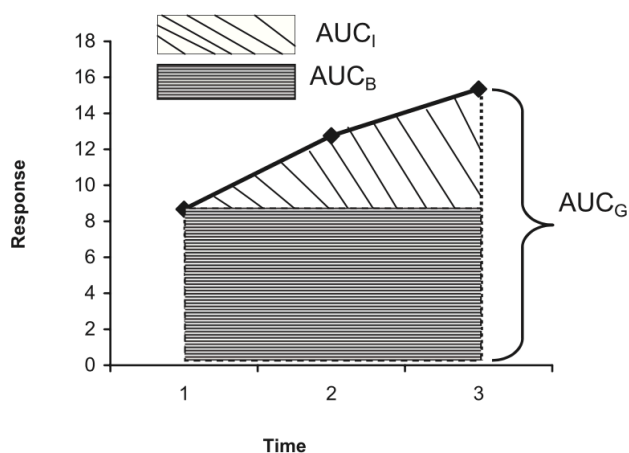
*Trier Social Stress Test (TSST) Evoked Area Under the Curve Increase ( $AUC_i$ ) Cortisol*

The Trier Social Stress Test (TSST) is a well-established paradigm to induce psychological stress in a laboratory setting (Kirschbaum et al., 1993). The TSST includes a 10-minute anticipation period and a 10-minute test period in which participants are asked to deliver a speech and perform mental arithmetic in front of three judges.

The Trier Social Stress Test is a commonly used stimulation for assessing changes in cortisol level. In this study, the cortisol responses were quantified by area under the curve (AUC) (Figure 1). AUC is an established method of quantifying changes in a hormone variable across several timepoints (Pruessner et al., 2003). In this study, area under the curve increase ( $AUC_i$ ) is the key dependent variable, indicating the variation of the cortisol concentration.

**Figure 1**

*Illustration of  $AUC_G$  &  $AUC_i$  Cortisol (Fekedulegn et al., 2007)*



*Note.* The x-axis indicates various timepoints when the cortisol response is collected. The y-axis indicates the cortisol concentration. Area under the curve ground ( $AUC_G$ ) is the overall cortisol

variation across several time points during the study. Area under the curve baseline ( $AUC_B$ ) is the baseline cortisol concentration that is solely based on the cortisol response collected at time point 1. Area under the curve increase ( $AUC_i$ ) indicates the change in cortisol across time points. It is calculated by subtracting  $AUC_B$  from  $AUC_G$ .

### **Procedure**

Participants were enrolled in the study after they completed an initial online consent procedure and several questionnaires including demographic and psychopathology measures, Anxiety Sensitivity Index, and Appraisal of Social Concerns. After participants completed the consent and online questionnaires, they were contacted via email to check their eligibility and schedule the time for doing a Trier Social Stress Test (TSST).

The laboratory testing of TSST-evoked cortisol took place in three rooms: collection room (for waiting and salivary cortisol collection), anticipatory room (for preparing for the TSST), and conference room (for the 10-minute speech and mental arithmetic tests). Participants waited for the arrival of the experimenter in a lobby area close to the lab-space. Once taken back to the lab, participants were directed to the collection room, where the experimenter told participants that they be waiting for 30 minutes, prior to providing their first saliva sample. During this waiting period, participants would watch the nature documentary series “Life” episode “Plants”. Participants were instructed to turn off their smart phones and place them into a container provided by the experimenter. At the end of the 30-minute resting period, the experimenter collected an initial saliva sample.

#### *Trier Social Stress Test (TSST)*

Standard procedures for the administration of the Trier Social Stress Test were followed (Kirschbaum et al., 1993).

Immediately following the initial saliva collection, the experimenter walked participants from the collection room to the conference room. The conference room contained a long, rectangular table, a podium, a microphone in front of the podium, a camera on a small tripod sitting on the table, and three judges wearing long, white lab coats (two female and one male), who were seated at the far end of the table. Following standard protocol, the judges wore neutral facial expressions, and did not communicate with the experimenter or the participant. Only one judge (who is always the opposite sex of the participant) is tasked with all verbal communication.

After the experimenter and participant entered the room, the experimenter played a recording on his/her phone (the voice on the recording was the opposite sex of the participant), informing the participant that in a moment he/she is going to apply for his/her ideal job. There are many candidates for this position, and he/she needs to make him/herself as competitive as possible. Participants were informed that they would have 10 minutes to prepare and afterwards they will give the speech to these three behavioral experts in front of them, who will be assessing both the content of the speech and their non-verbal behavior.

After responding to the questions raised by participants with answers such as “do whatever you think is best”, the experimenter escorted the participant out of the conference room and into the anticipatory room. Participants were informed they could feel free to use paper and pencil to prepare for their speech during this 10-minute preparation time. However, no note is allowed to bring back to the conference room.

Following the completion of the anticipatory period, the experimenter escorted participants back to the conference room. After the experimenter exited, the judge instructed the participants to begin their speech. If participants stopped talking before the 5-minute speech

period was complete, the judge instructed participants to continue speaking. If 10 seconds of silence elapsed, or participants said they did not have any more to say, the judge began to ask participants a series of standard interview questions, drawn from a prepared list of questions. After 5 minutes had elapsed from the time participants began speaking, the judge stopped the participants and asked them to subtract the number 13 from 1,022 and keep subtracting 13 from the remainder as quickly and as accurately as possible. Every time participants made a mistake, the judge would interrupt and ask them to start from the beginning.

After the 5 minutes for the arithmetic task was complete, the judge instructed participants to stop and leave the conference room. The experimenter, who was waiting outside of the conference room then escorted participants back to the collection room.

While returning to the collection room, participants were informed there would be two more saliva collections in 15 minutes and 30 minutes. After that, participants were instructed to resume watching the nature documentary series. After 15 minutes, participants provided a second saliva sample. Participants resumed watching the nature documentary, and after an additional 15 minutes, participants were asked to provide a third saliva sample. Then, participants were fully debriefed and dismissed.

### **Statistical Analysis**

Statistical analyses were performed using R Studio 1.4.1103 and Jamovi 1.6.23.0. The aim of this study is to explore whether self-report cognitive assessments could predict TSST-evoked cortisol and how these assessments were correlated with each other. Hence, the study applied the multiple linear regression test and correlation to perform the statistical analysis. The study hypothesized (1) Anxiety Sensitivity Index and Appraisal of Social Concerns could predict the variation in TSST-evoked cortisol, and (2) there was a positive correlation between Anxiety

Sensitivity Index and Appraisal of Social Concerns. Therefore, a multiple linear regression was performed, taking Anxiety Sensitivity Index, Appraisal of Social Concerns as the independent variables and TSST-evoked cortisol as the dependent variable. In addition, a correlation test was applied to examine the relationship between Anxiety Sensitivity Index and Appraisal of Social Concerns.

### Detailed Analysis Plan

#### Data Collection

The study used data from an existing data set of a hormone and behavior study (McAfee, 2020). A sample of the study data is provided below (Table 1).

**Table 1**

*A sample of the study data*

Participant ID	ASI-3	ASC	Birth Control	AUC <sub>i</sub> _TSST_Cortisol_Log
12	34	87.0	1	39.05164109
17	42	23.0	0	32.73523284
23	25	12.5	0	52.31198341

The score of Anxiety Sensitivity Index (ASI-3) was calculated by summing all 18 items from the results of the ASI-3 questionnaire. There are 6 items in one of each dimension (physical, cognitive, and social concerns). The rating of each item is based on a 5-point Likert scale: “very little” (0 point), “little” (1 point), “some” (2 point), “much” (3 points), and “very much” (4 points) (Taylor et al., 2007). The maximum score of the ASI-3 is 18 items × 4 points per items = 72 points.

The score of Appraisal of Social Concerns (ASC) was calculated by averaging the ratings of all 20 items from the results of the ASC questionnaire. The rating of each item ranges from

“not at all concerned” (0 point) to “extremely concerned” (100 points). Along the scale, the descriptions of each score category were provided: “mildly concerned” (10-20 points), “moderately concerned” (40-60 points), and “very concerned” (70-90 points).

### **Data Transformation**

TSST-evoked  $AUC_i$  cortisol was calculated by subtracting the baseline cortisol ( $AUC_B$ ) from the area formed by three TSST-evoked cortisol datapoints ( $AUC_G$ ). The results of the cortisol response generally had a right skew, and therefore all cortisol data was log transformed (Miller et al., 2013).

### **Descriptive Statistics**

All participants ( $N=60$ ) were female college students ( $M_{age}=18.86\pm 1.01$ ), who were during the mid-luteal phase of their menstrual cycle (McAfee, 2020). Results of Anxiety Sensitivity Index, Appraisal of Social Concerns, and Trier Social Stress Test evoked cortisol would be used to test the study hypotheses. The overall distribution, values of mean and standard deviations, and normality test were computed (Table 2 & Figure 2-4).

**Table 2**

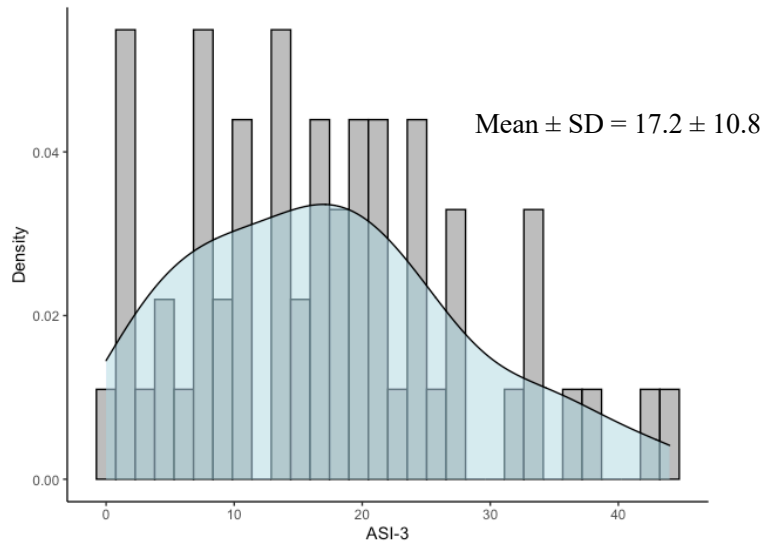
*Descriptive Data of Anxiety Sensitivity Index (ASI3), Appraisal of Social Concerns (ASC), and Trier Social Stress Evoked area under the curve increase cortisol with log transformation (AUCi\_TSST\_Cortisol\_Log)*

Descriptives			
	ASI3	ASC	AUCi_TSST_Cortisol_Log
N	60	60	60
Missing	0	0	0
Mean	17.2	33.9	6.08
Median	17.0	27.5	1.14
Standard deviation	10.8	23.8	25.0
Minimum	0	0.00	-43.8
Maximum	44	89.0	66.1
Skewness	0.487	0.556	0.448
Std. error skewness	0.309	0.309	0.309
Shapiro-Wilk W	0.967	0.947	0.972
Shapiro-Wilk p	0.101	0.011	0.185

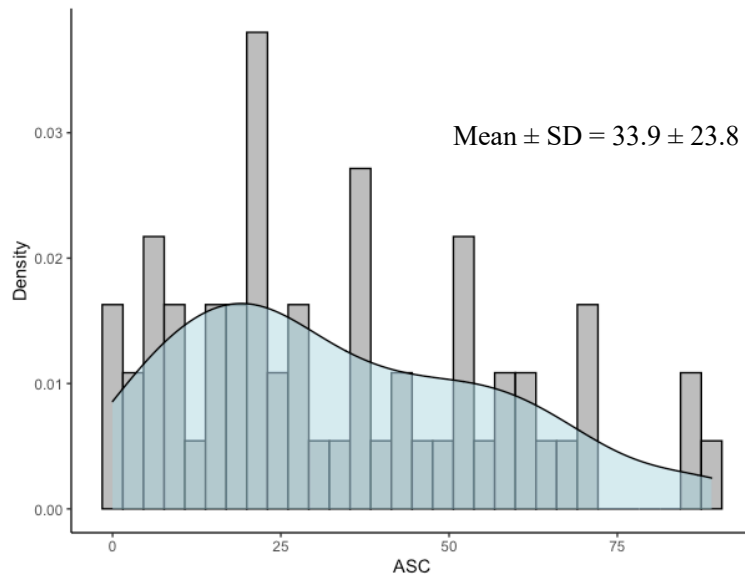
*Note.* According to the results of Shapiro-Wilk normality test, the results of Anxiety Sensitivity Index (ASI3) and TSST-evoked cortisol (AUCi\_TSST\_Cortisol\_Log) were normally distributed (Shapiro-Wilk  $p > .05$ ). The result of Appraisal of Social Concerns (ASC) was not normally distributed (Shapiro-Wilk  $p = .011$ ).

**Figure 2**

*Distribution of Anxiety Sensitivity Index (ASI-3)*



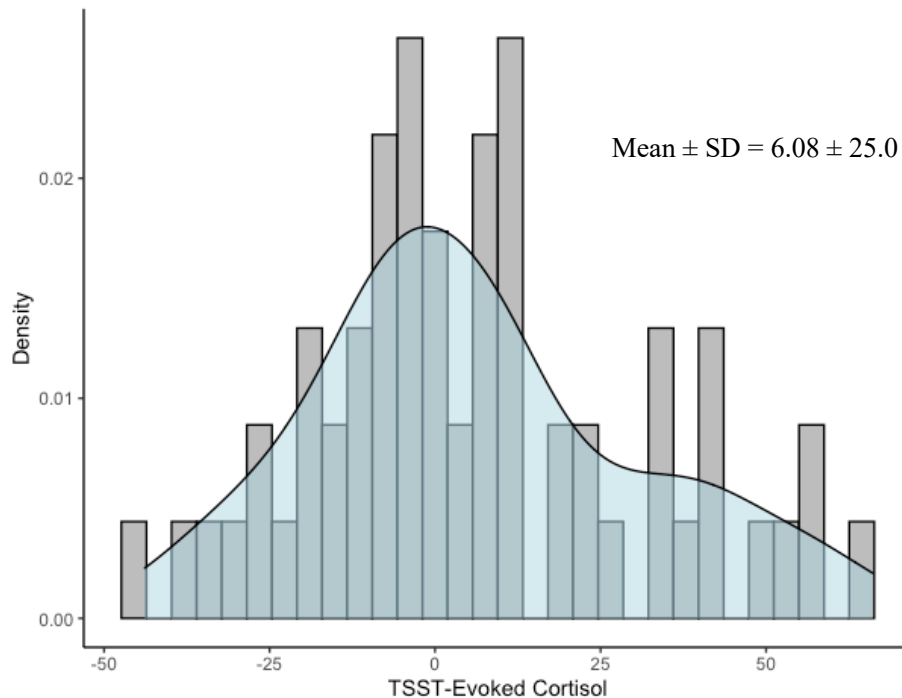
*Note.* Results of Anxiety Sensitivity Index (ASI3) had a mean value of 17.2 with a standard deviation of 10.8. According to the scale created by Taylor et al. (2007), a score ranges from 0 to 17 indicates almost no anxiety sensitivity, a score ranges from 18 to 72 indicates low anxiety sensitivity, and a score ranges from 36 to 53 indicates moderate anxiety sensitivity. Based on the result of the Shapiro-Wilk normality test (Table 2;  $p=.101$ ), the data was normally distributed.

**Figure 3***Distribution of Appraisal of Social Concerns (ASC)*

*Note.* Results of Appraisal of Social Concerns (ASC) had a mean value of 33.9 with a standard deviation of 23.8. According to the scale created by Telch et al. (2004), a score ranges from 0 to 10 indicates almost not at all concerned, a score ranges from 10 to 20 indicates mildly concerned, and a score ranges from 40 to 60 indicates moderately concerned, a score ranges from 70 to 90 indicates very concerned, and a score ranges from 90 to 100 indicates extremely concerned. Based on the result of the Shapiro-Wilk normality test (Table 2;  $p=.011$ ), the data was not normally distributed.

**Figure 4**

*Distribution of Trier Social Stress Evoked area under the curve increase cortisol with log transformation (TSST-Evoked Cortisol)*



*Note.* Results of TSST-evoked cortisol had a mean value of 6.08 with a standard deviation of 25.0. Based on the result of the Shapiro-Wilk normality test (Table 2;  $p=.185$ ), the data was normally distributed.

**Inferential Statistics**

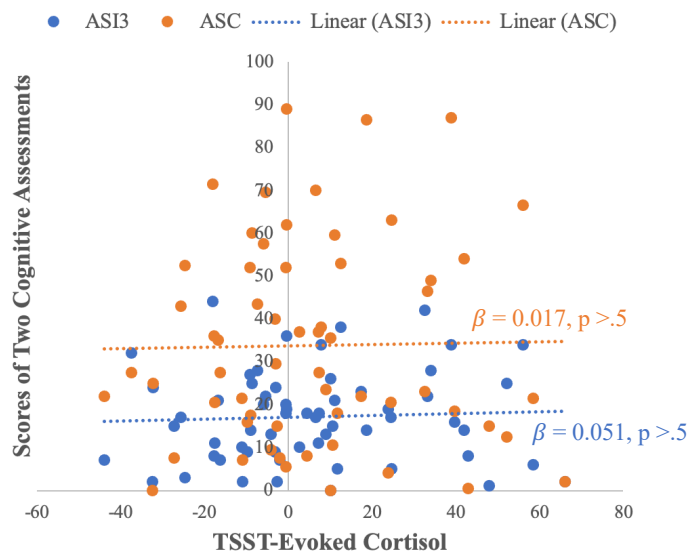
Multiple linear regression and simple linear regression were used for inferential analysis (see Results section). A multiple linear regression model was performed to explore whether and how these Anxiety Sensitivity Index and Appraisal of Social Concerns predicted the variation in TSST-evoked cortisol (Figure 5). Spearman's non-parametric correlation test was performed to explore the relationship between Anxiety Sensitivity Index and Appraisal of Social Concerns (Figure 6).

## Results

This study examined the relationship between self-report cognitive measures and physiological response of cortisol and the association between two self-report assessments. The main statistical models used in this study is multiple linear regression and Spearman's non-parametric correlation test. The result has shown there was no significant correlation between results of Anxiety Sensitivity Index, Appraisal of Social Concerns, and TSST-evoked cortisol (Figure 5;  $p > .05$ ). However, a positive correlation between Anxiety Sensitivity Index and Appraisal of Social Concerns was found, Spearman's  $\rho = .52$ ,  $p < .001$  (Figure 6).

### Figure 5

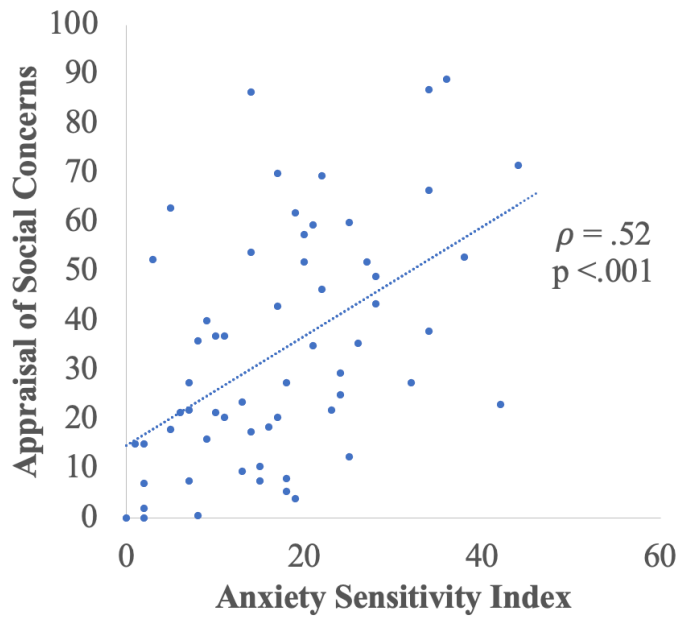
*Multiple Linear Regression on Anxiety Sensitivity Index (ASI3), Appraisal of Social Concerns (ASC), and TSST-Evoke Cortisol*



*Note.* No significant correlation between scores of Anxiety Sensitivity Index, Appraisal of Social Concerns, and TSST-evoked cortisol. 0.28% of the variability in TSST-evoked cortisol was explained by Anxiety Sensitivity Index and Appraisal of Social Concerns.

**Figure 6**

*Spearman's Non-Parametric Correlation Test*



*Note.* Anxiety Sensitivity Index and Appraisal of Social Concerns were positively correlated with each other.

### Discussion

As shown by the Results section, no significant association between Anxiety Sensitivity Index, Appraisal of Social Concerns, and TSST-evoked cortisol was found, which implied that there was a gap between the results of self-report cognitive assessments of social anxiety and physiological responses of cortisol in reality. In other words, cognition is different from emotion. What people think they will behave or feel is not what they really behave or feel in reality, at least from the physiological perspective. However, there was a significant positive correlation between Anxiety Sensitivity Index and Appraisal of Social Concerns, which suggested different self-report cognitive assessments of social anxiety with differential scales could show similar results and have the same overall tendency.

The main hypothesis that self-report cognitive measures Anxiety Sensitivity Index and Appraisal of Social Concerns would be able to predict the variation in TSST-evoked cortisol was rejected with low coefficient values of the explanatory variables and high p-values. Therefore, it shows there was a disconnection between cognitive response and emotional or physiological response, or there was another factor(s) involved in the process of the Trier Social Stress Test. For instance, participants with high social anxious might develop an emotional coping strategy that helps them reduce anxious behaviors when they perceive a social evaluative threat in the social situation. A study using self-compassion and emotion regulation as predictors of social anxiety showed (1) self-compassion predicted lower social anxiety, indicating self-compassion plays an important role in alleviating social anxiety symptoms, and (2) emotion regulation strategies of cognitive reappraisal and expressive suppression combined with compassionate self-responding and refraining from non-compassionate responding could have direct and indirect effect on improve social anxiety (Bates et al., 2021). However, Bates et al. (2021) measured

social anxiety solely based on self-report assessments, their findings did not examine the impact of self-compassion and emotion regulation on physiological response or symptom of social anxiety, which failed to examine whether cognitive thoughts such as coping strategies would potentially impact the physiological response of social anxiety.

However, according to the definition of fear and anxiety in *The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5) (American Psychiatric Association, 2013), “Fear is the emotional response to a real or perceived imminent threat, whereas anxiety is the anticipation of a future threat”. Thus, the emotion that our body evokes differs between fear and anxiety. Assuming this is true for the study, the results of self-report cognitive questionnaires of Anxiety Sensitivity Index and Appraisal of Social Concerns tended to increase the weight of the emotion of anxiety in social anxiety symptoms, whereas the cortisol responses of the Trier Social Stress Test tended to increase the weight of fearfulness in social anxiety symptoms. Although the discomfort arose by social anxiety is experienced as both anxiety and fearfulness, they might represent two distinct aspects of cognition and social anxiety. Further study is needed to clarify the relationship between anxiety and fearfulness as well as cognition and emotional responses in social anxiety.

There were two main limitations exist in the present study. Two self-report cognitive assessments were taken by the participants before the study. By the time they participated in the Trier Social Stress Test in the laboratory, their symptoms of social anxiety or socially anxious behaviors might be different compared to the time when the questionnaires were complete. Another limitation was there was no subjective anxiety measures during the Trier Social Stress Test with the collection of salivary cortisol across various time points.

For the future direction of the present study, in addition to including subjective anxiety measures and cognitive assessments in the procedure on the day of cortisol response collection. I would also look at middle-aged individuals and possibly individuals from a clinical population, since these groups tend to have higher social anxiety and greater stress response. Also, I will look at each stage of the Trier Social Stress Test or any paradigm that induces stress separately. To be specific, the hormone data at the pre-stress, stress, and post-stress stage and their correlations with the predictor variables will be examined independently instead of solely assigning the variation in the hormone as the only dependent variable. In addition, subscales of self-report cognitive assessments and their association with the dependent hormone variable will also be examined separately.

To conclude, this study examined the relationship between the results of self-report cognitive assessments of social anxiety and the cortisol responses evoked by the Trier Social Stress Test. By running multiple linear regression and Spearman's correlation test, the study found (1) there was no significant correlation between Anxiety Sensitivity Index, Appraisal of Social Concerns, and TSST-evoked cortisol, and (2) there was a significant positively correlation between Anxiety Sensitivity Index and Appraisal of Social Concerns. Future study directions include further exploring the relationship between cognition and emotional response in the population with social anxiety, and the association and the differentiation between anxiety (anticipation of the stressor) and fearfulness (real presence of the stress).

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