Physiological and Subjective Responses to a Novel Variation of the Trier Social Stress Test

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Introduction

Previous research has established that exposure to stressors, both psychological and physical, leads to the activation of the hypothalamic-pituitary-adrenal (HPA) axis and release of cortisol (Dickerson & Kemeny, 2004). The Trier Social Stress Test (TSST) provides a means to induce acute psychological stress in a laboratory setting as displayed through an increase in salivary cortisol and an increase in subjective distress (Epsin et al., 2013). The original TSST protocol as formulated by Kirshchbaum et al. (1993) consists of a challenging cognitive task followed by an arithmetic test in front of an evaluative committee. A meta-analysis conducted by Dickerson & Kemeny (2004) revealed that the social-evaluative nature of the test combined with the uncontrollability of the task pose a threat to the social self resulting in a significant acute stress experience. Alterations of the original TSST have been developed to include a no-stress control group (our control procedure was modified from Espin et al., 2013).

In the present study, our goal was to use the TSST to increase psychological and physiological stress, as well as to explore the impact of stress on alcohol craving. Salivary cortisol levels were measured at three timepoints (one at baseline and two samples post-stress/no-stress). Self report questionnaires assessed current positive and negative affect, perceived life stress, current anxiety, alcohol craving, alcohol patterns and related consequences, and depressive symptoms. We hypothesized that, 1) participants in the stress condition will have increased cortisol following the TSST and compared to those in the no-stress condition, 2) participants in the no-stress condition will not have increased cortisol levels across the timepoints, 3) those in the stress condition will have changes in mood and increased craving for alcohol more than participants in the no-stress condition.

Methods

Subjects:

All the subjects were college age adults from the University of Dayton (N=73). Participants were randomly assigned to either the stress or the no-stress group. As deception was a part of the experimental procedure, all the participants were thoroughly debriefed afterward. All procedures were approved by the University of Dayton Department of Psychology Research Review & Ethics Committee.

Experimental Design:

- Study sessions took place between 12:30pm - 7:30pm
- Between-subjects design
- Saliva samples were taken at 3 timepoints: T1 = upon arrival to the lab and after consent form signed; T2 = 35 min after T1; T3 = 25 min after T2
- Saliva was collected via passive drool method and stored at -20ºC until analysis for cortisol using an ELISA kit (Salimetrics, State College, PA)

Subjective Measures* completed in Qualtrics:

Some questionnaires were completed both before and after the TSST:

- Positive and Negative Affect Scale (PANAS-10)
- Perceived Stress Scale (PSS)
- State-Trait Anxiety Inventory Short-Form (STAI-6)

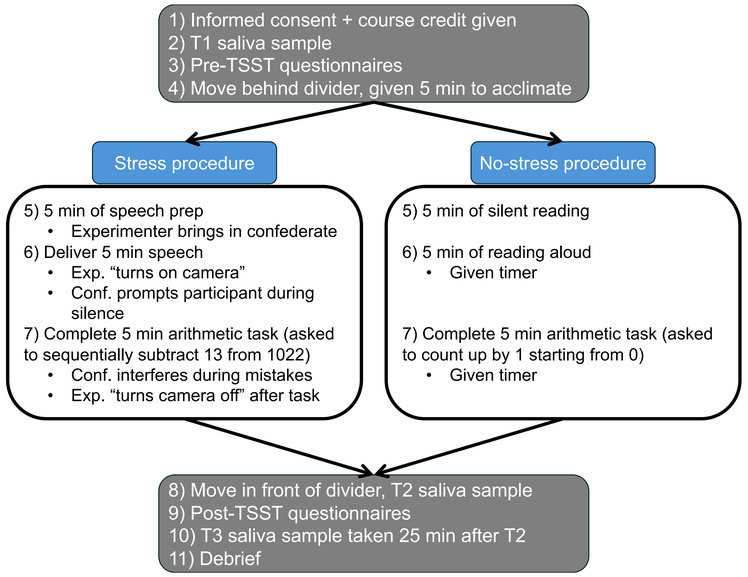
Some were completed only after the TSST:

- Alcohol Use Disorder Identification Test (AUDIT)
- Visual Analog Scale (VAS) for alcohol craving
- Centers for Epidemiological Studies-Depression Scale (CES-D)
- Demographics

Trier Social Stress Test:

- Figure 1 outlines the stress/no-stress TSST procedures
- Participants in the stress condition were asked to prepare and deliver a five-minute speech that would be videotaped and judged by an evaluative committee based on performance and non-verbal behaviors
- Stress participants were told the committee was two men and one women, though it was just one confederate and the experimenter behind the divider
- Participants were given a reference for standard size alcoholic drinks during post-TSST questionnaires
- Female participants were given a calendar to estimate days since their last menstrual period (or allowed to reference a tracking app)
- Each participant was debriefed to explain deception and study goals

Figure 1. TSST stress and no-stress procedures



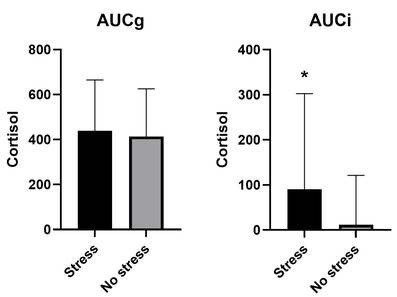
Results

Table 1. Demographics, Anxiety, Depression, Life Stress, and Alcohol-Related Responses

There were no statistically significant differences between the stress and no-stress groups on these measures, nor did anxiety or life stress change over time.

	TSST Stress (n = 36, 83.3% female)		TSST No-Stress (n = 37, 75.7% female)	
	Mean	SD	Mean	SD
Age	19.08	1.05	19.30	1.05
STAI pre-TSST	13.11	1.85	13.41	1.64
STAI post-TSST	12.36	2.22	13.14	1.96
PSS pre-TSST	10.75	4.78	11.87	3.21
PSS post-TSST	10.44	3.90	10.68	3.23
CES-D Score	10.11	4.62	11.54	5.32
VAS (craving)	2.89	5.02	3.03	4.18
AUDIT score	4.75	5.02	6.84	5.19
AUDIT at-risk (%)	10/36 (27.8%)		18/37 (48.6%)	

Figure 2. TSST stress causes more cortisol change than no-stress



*Cortisol data were analyzed with area under the curve (AUC) analyses. Two separate equations were used to reflect total cortisol output (AUCg) and total cortisol change (AUCi) in each group. For AUCg there was no significant difference between the groups, (AUCg: t(67) = 0.476, p = 0.32). For AUCi, there was a significant difference between groups, (AUCi: t(67) = 1.968, *p = 0.03).*

Figure 3. Less positive affect post-TSST

*A two-way ANOVA found no significant Time x Group interaction, but there was a main effect of Time for positive affect (F(1, 71) = 5.75, *p = 0.019]. Participants in both stress and no-stress conditions showed lower levels of positive affect at Time 2 than at Time 1.*

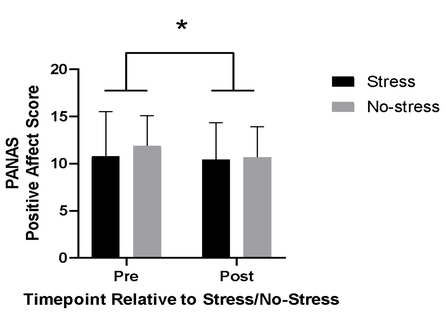


Figure 4. TSST stress induces more negative affect post-TSST relative to no-stress condition and Time 1

*There is a Time x Group interaction for changes in negative affect (F(1, 71) = 10.36, **p=0.002). Post-hoc comparisons showed that participants in the stress condition had higher levels of negative affect at Time 2 than at Time 1 (p = 0.003), and had higher levels of negative affect at Time 2 than those in the no-stress condition at Time 2 (**p = 0.005).*

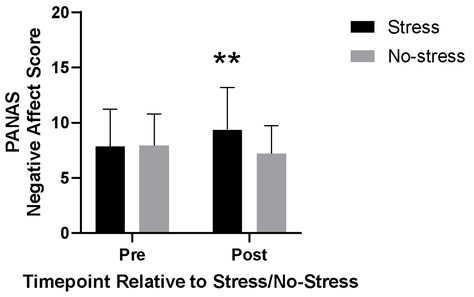
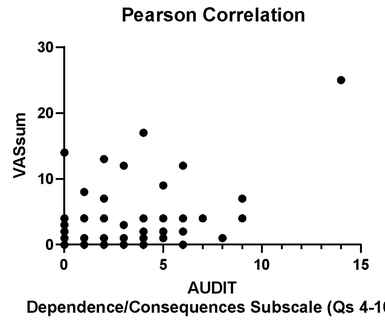


Figure 5. Participants in the TSST stress condition show correlation between alcohol craving and alcohol dependence/consequences



Participants in the stress condition display a significant positive moderate correlation between their craving for alcohol, measured by the sum of their scores on the VAS, and their alcohol dependence/consequences, measured by questions 4-10 of the AUDIT, r = 0.465, p < 0.001.

Conclusions

Our goal was to use the TSST to induce acute stress for the first time in our lab and with the inclusion of a novel no-stress control condition. We supported our hypothesis that the TSST stress group would show greater negative affect at Time 2 relative to Time 1 and relative to the no-stress group at Time 2. Regardless of the stress/no-stress condition, all participants also reported less positive affect at Time 2 compared to Time 1. Despite great variability in cortisol levels within groups, we did observe a group difference with the stress group showing greater cortisol change across the timepoints. In regard to the effect of the TSST on alcohol-related measures, there was no group difference in alcohol craving after the TSST procedure (data not shown), but we observed that after the stress induction, participants with higher AUDIT scores for questions related to dependence/consequences had higher levels of alcohol craving. Future studies will further explore differences in responses between at-risk and not at-risk drinkers. Additionally, future studies will incorporate other measures of the biological stress response and measures of alcohol-related motivation and choice.

References

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*References for subjective measures available upon request

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