THE EFFECT OF CREATIVITY ON CORTISOL SAMPLING WITH MOOD STATES

By

KEANU NICHOLAS CRAWSHAW

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Approved by:

William D. S. Killgore, Ph.D.
Department of Psychiatry

Abstract

The present study examined the relationship between creativity, stress, and mood. It was hypothesized that those with higher creativity would exhibit decreased cortisol activation given that any stressors present are not significantly valanced by emotion. Specifically, participants in the negative mood condition with lower levels of creativity would experience increased cortisol activation; those in the positive mood condition with high levels of creativity would experience decreased cortisol activation; and those in the neutral mood condition would have minimal cortisol activation. Participants took part in a multiphase study consisting of an overnight study visit where multiple personality and emotional state variables were collected to examine which facets are important in predicting optimal performance. One hundred and twenty participants completed personality questionnaires and cortisol sampling within the study. Participants were randomly assigned to receive positive, negative, or neutral mood inductions throughout the study. Results demonstrated that creativity had no significant effect on individual cortisol levels at baseline nor throughout the study visit. A small sample size, the state of the participants before taking part in the stress test, and the indirect measurements of creativity and mood conditions all posed as limitations in the present study. Future research should utilize a similar study design but include more participants, mood induction with a greater degree of negative and positive conditions, and a uniform participant state.

The Effect of Creativity on Longitudinal Cortisol Sampling

Stress is an integral part of everyday life. The stress response to aversive stimuli and its respective biochemical components are what have allowed humans to withstand the tests of time and evolution. In the modern world, stress tends to serve as a reminder of importance, anxiety, and general worry. Copious amounts of research have been published on the psychophysiological mechanisms of stress, such as the research by Kemeny (2003) and Pearlin (1989) who examine the psychobiology and the sociology of stress, respectively. However, very few bodies of literature exist that thoroughly measure the relationship between stress and abstract neural functions—like creativity. Talbot et al. (1992) and Luis et al. (2020) explore this relationship in their respective empirical studies which were both conducted in an organizational setting. Both Talbot et al. (1992) and Luis et al. (2020) suggest that severe stress can reduce creativity, or that one cannot be creative under severe stress. However, Luis et al. (2020) suggests that this is only the case with what the authors dub as “hindrance stressors”, saying that “challenge stressors”, or stressors that are challenging but not overwhelming promote creativity. Talbot also posits that negative attitudes and relationships increase stress and in turn reduce creativity. Yeh et al. (2015) supports these mixed findings, stating that valence of emotions plays a role in the interaction of creativity and stress. The current literature is mixed and does not specify whether creativity negatively or positively correlates with stress, and does not include mood as a predictor of the interaction.

A Configurational Understanding of Creativity

Creativity can be defined in several ways. An operational definition of creativity is the ability to produce an idea that is new, effective, and useful (Flowers & Garbin, 1989)

but this differs from the conceptual definition. Creativity is traditionally conceptualized as the ability to produce creative products with ease, or the capacity to be imaginative and original (Flowers & Garbin, 1989). Flowers & Garbin (1989) address creativity in the terms of creating a product as well as what other factors may influence creative processes (see Figure 1). The authors state that creativity can be influenced by three factors: relative “looseness” of involuntary organizational processes, the power of executively controlled processes, and sudden insight. Individuals who have “loose” cognitive organizational processes may be able to represent information in novel ways. Those with better control over their executive processes may be better at creating new representations. Lastly, individuals who use spontaneously generated mental constructions in creative thought are able to operate upon data that was not obtained from normal input (p. 4).

Figure 1

Multifaceted Model of Creativity

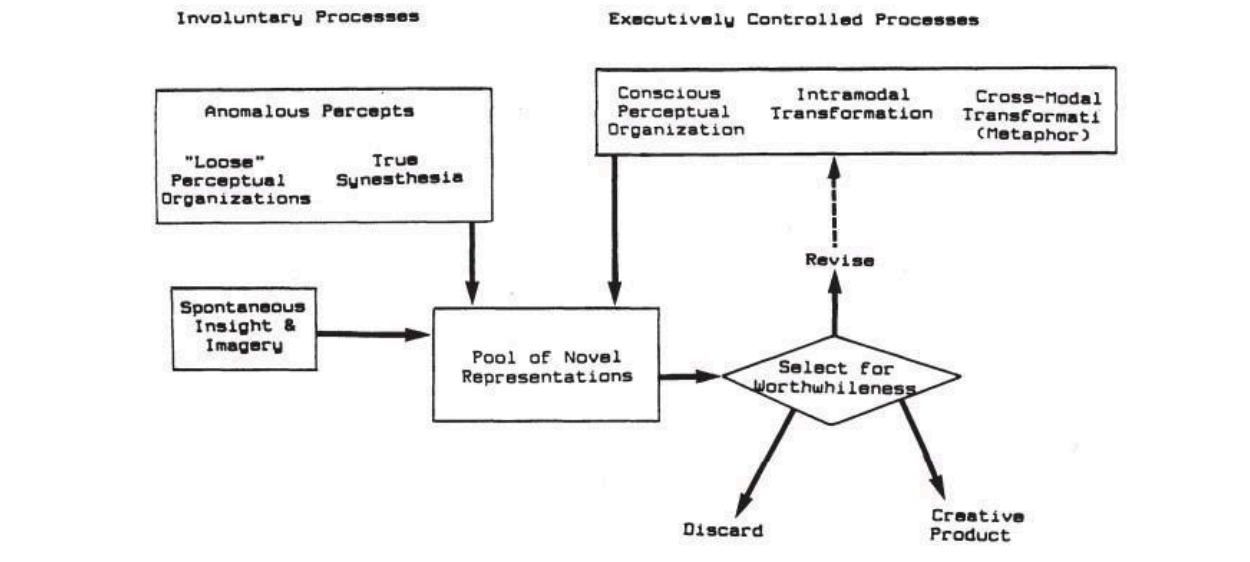


Figure 1: The representation of the creative model that was proposed and included in the work by Flowers & Garbin (1989).

Using this model, stress would be considered an involuntary process that could affect anomalous perceptions, spontaneous insight and imagery, and inevitably novel representations. Under significant stress, a more creative individual would then be unable to develop a creative product in response to a stressful situation, which in turn would lead to more stress, which is a prime example of a hindrance stressor as mentioned by Luis et al., (2020). By the same model, a less creative individual would also develop a similar reduction in creative production. However, if the stress is moderate and not valanced significantly by negative emotions, divergent thinking could be enhanced because involuntary processes such as attention and working memory may be sharpened, allowing for increased generation of novel ideas and/or representations, due to the baseline firing activity of the default mode network (Shofty et al., 2022).

Divergent thinking ability can be defined using the Big Five Personality traits. Jirásek & Sudzina (2020) conducted a study on 170 university students who answered only three items from the HEXACO-60 as well as the Big Five Personality Inventory. The Big Five Personality Inventory measures the five personality dimensions of extraversion, openness to experience, neuroticism, conscientiousness, and agreeableness (John et al., 1991). The HEXACO-60 is a 60-item personality test that measures the same traits as the Big Five Personality trait test, plus one additional factor (Ashtonj, 2009). The three items the university students answered were meant to directly address their creative traits. These items are: “I would enjoy creating a work of art, such as a novel, a

song, or a painting," "People have often told me that I have a good imagination," and "I don't think of myself as the artistic or creative type" (p. 5) The study design involved measuring creativity using the three items from the HEXACO, and personality traits with the Big Five Personality Inventory; the means of corresponding items represented the final measures. Results of the study indicated that creativity can accurately predict when a participant has higher scores on the openness to experience and extraversion facets of the Big Five Personality Inventory. While extraversion was shown to be weakly correlated with creativity, the aesthetics and ideas subscales of openness were shown to be strongly positively correlated with creativity. This study also found a negative relationship between conscientiousness and creativity, suggesting those with higher conscientiousness were less creative. The findings of Sung & Choi (2009) concur with the findings of Jirásek & Sudzina. The authors posit that high openness to experience leads to flexibility and willingness to accept other perspectives for unfamiliar ideas. Extraversion was thought to predict creativity consistently because those with high extraversion are more prone to seek stimulation and prudently address problems, which enhances creative thinking and performance in turn.

The Stress Response

Kemeny (2003) defines stress as a "stimulus, a response to a stimulus, or the physiological consequence of that response" (p. 1). The author lists stressors as anything that threatens a major goal which includes physical integrity and well-being. Kemeny notes that it is not the stressors themselves that cause severe responses but the controllability, ambiguity, level of demand placed, novelty, and duration of the stressors that influence the severity of psychological and physiological responses.

Stress responses are regulated by autonomic nervous system activity; specifically, the sympathetic nervous system. Upon activation of the sympathetic nervous system, the neurotransmitter norepinephrine is released, signaling the release of adrenaline into the bloodstream. Heilman (2016) touches upon this subject by adding that excess norepinephrine can inhibit creative processes. According to Kemeny (2003), the stress response includes activation of the hypothalamic-pituitary-adrenal axis. This activation can be caused by exposure to acute stressful psychological events, such as giving a speech or performing difficult cognitive tasks.

However, appraisal is critical for the stress response to occur (Kemeny, 2003). Cognitive appraisal is “the process of categorizing a situation in terms of its significance for well being” (Kemeny, 2003, p. 4). Primary appraisal is defined by threats and secondary appraisal is defined by perception of resources that are available to meet the demands of the stressor. The appraisal of the stimuli as a threat or a challenge affects the stress response. Experiencing a threat occurs when perceived demands in a situation outweigh perceived resources and experiencing a challenge occurs when resources approximate or exceed demands. Luis et al., (2020) and Yeh et al., (2015) mention challenge stressors or “good stress” can promote creativity and enhance working memory.

In addition to the perception and appraisal of the stimuli, an individual’s perceived amount of control over the outcome can influence the stress response. Kemeny (2003) states that uncontrollable circumstances are more likely to activate the stress response than circumstances that the individual or organism perceives to be controllable. While

these skills are important in regulating stress responses, these skills may be more inherent within individuals with certain personality characteristics.

Creativity and Stress

Yeh et al., (2015) conducted an experiment to determine the effect of stressors on cortisol and negative emotions, while also measuring the effects on working memory and creativity. According to the authors, working memory plays a significant part in the creative process; the efficiency of memorized routines specifically is indicative of the efficacy of the creative process. The authors posit that mood is a reliable predictor of creativity and cite research that the valence of negative emotions is closely related to the release of stress hormones like cortisol. Additionally, Zenasni & Lubart (2002) found through previous literature that dopamine helps facilitate attention and make cognitive perspectives more flexible which in turn leads to more creativity.

In utilizing working memory, a learner acquires and processes new information and is able to retain information that is relevant to solve a specific problem. Yeh et al., (2015) find that working memory capacity is necessary and required for “cognitive flexibility, abstract thinking, strategic planning, and processing speed in long term memory”(p. 144). A creative process then makes up the retrieval, integration, and retention of knowledge as well as moderating connections between cues and activation of knowledge.

Yeh et al., (2015) examine emotion from a relational standpoint to working memory and stress hormones. Both objective and subjective factors make up emotion, with subjective referring to emotional experiences like being happy or sad, and cognitive processes that involve attributes such as perception or evaluation of emotion. The

objective factor of emotion involves physical arousal. These subjective and objective factors interact with one another through neural and hormonal systems with emotional experiences impacting long term retention intervals and the endogenous release of the stress hormone cortisol. Mood activation for negative emotions has been shown to be correlated with depressed mood (von Langen et al., 2005), which subsequently affects working memory performance.

Mood Valence and Divergent Thinking

High arousal of negative emotions can reduce the production of original ideas and ultimately decrease creativity. However, emotional states that are promotion focused or involve challenge stressors rather than hindrance stressors can lead to an expanded attentional scope and increase creative performance (Luis et al., 2020; Yeh et al., 2015). The effect of stressors and subsequent release of cortisol on creative representations depends on the severity and type of said stressor. In this way, stressors may either enhance creativity by stimulating working memory or by decreasing creative performance through highly activated and negatively valenced emotions.

In the context of the study, mood valence occurs when participants are placed into a mood induction condition, which influences how they feel throughout the duration of the study. For example, a positive mood induction condition would place the participant in a positive mood throughout the experiment while a negative mood induction condition would do the opposite. Mood state has been linked to divergent thinking through a negative interaction (Talbot et al., 1992; Yeh et al., 2015; Zenasni & Lubart, 2002; Akbari & Hommel, 2012; Du et al., 2021). Zenasni & Lubart (2002) conducted a mood induction experiment to determine if such intervention fostered

creativity. The results of that study showed that participants who were induced into a positive mood consistently engaged in creative behaviors. Mood was induced through the life-event recall technique, where participants were asked to describe either a happy, sad, or neutral event from their life in writing. Performance was measured on the Candle Task and Remote Association Test. The Candle Task involves having participants visualize being in a room with a table pushed up against a wall, with a candle, a box of drawing pins, and a book of matches on the table. The challenge is to affix the lit candle to the wall so that it will not drip wax onto the table (Dabell, 2019). The Remote Association Test entails providing a single word to a group of words that links each word together; for example when given a list of “square/cardboard/open,” the word that would bind these words together would be “box.” Previous literature indicated that a positive mood may lead to creative behaviors because a positive mood helps facilitate positive elements present in memory (Zenasni & Lubart, 2002).

The authors also tested whether negative mood affected creative behaviors; they interestingly found that individuals in a negative mood are driven to look for solutions to return to a neutral state of mind. Thus, fluency and idea flexibility are tactics for “mood repair.” The authors suggest that negative moods inform individuals of what they deem to be an insufficient performance, which leads to greater effort to produce more ideas. Mood has ties with stress, which also negatively impacts creativity. If mood is negatively valenced and stress is too great, the individual can be overwhelmed. Negative mood can be a result of a major life event that induces stress. This type of stress can foster negative attitudes and negative relationships (Talbot et al., 1992), and such life events are referred to as hindrance stressors by Luis et al., (2020). Ultimately negative mood,

its resultant increase, and stress levels cause less pronounced creativity (Yeh et al., 2015).

The duality of the results found in that study support the mixed results regarding the relationship between stress and creativity. Positive mood was associated with increased creativity, but negative mood was also found to be positively correlated with creativity through quantitative idea production, but not originality. Du et al., (2021) suggests that negative mood induces creativity through rumination and reflective thinking, but also found that rumination was positively associated with state anxiety, stress, anxiety, and depression. This matches the results of Shofty et al., (2022) who found that increased activity through stimulation of the DMN results in decreased ability to perform on the AUT. The DMN is classically linked to depressive-like traits like rumination reflective thinking (Shofty et al., 2022). Reflection and ruminative thinking may fall under the category of “challenge stressors” that can positively impact creative ideation. However, the finding that negative mood impacts quantitative idea generation but not qualitative further complicates what psychophysiological and neurobiological mechanisms underlie creativity.

Akbari & Hommel (2012) proposed that one potential mechanism lies within individual dopaminergic levels. Prior literature suggests divergent thinking tasks can be improved by inducting positive mood (Zenasni & Lubart, 2002). An improved positive mood state is accompanied with an increase in dopamine levels, and this increase is associated with greater cognitive flexibility on creative tasks. The authors used eye-blink rates (EBR) as a measure of dopamine levels and found that positive mood induction produced higher EBR. EBR has been found by several studies to be an indirect but

reliable clinical marker of dopamine levels (Karson, 1983). However, the results suggest a limitation of positive mood induction on individual dopaminergic levels; results showed that only participants with below-median EBRs benefited from positive mood induction. This is because EBR is thought to represent a measure of the neural processes underlying positive mood changes in individual dopamine levels. Creativity in this study was measured through the Alternate Uses Task (AUT), which asks participants to write down as many possible uses of a common household item that they can think of.

Other researchers such as Heilman (2016) suggest that elevated levels of norepinephrine suppress neural pathways and networks that are important for creative innovation. Highly stressful stimulation that caused an increase in norepinephrine resulted in a reduction of cognitive flexibility and creativity. The correlation of the findings of Akbari & Hommel (2012) with the findings of Heilman (2016) further provide evidence for the findings that creativity can both negatively and positively correlate with stress through mood induction.

Based on the aforementioned studies, it is clear that the relationship between mood, stress, and creativity is not well understood. Therefore, we carried out a study to determine the effect of stress on creativity under positive, neutral, or negative mood states. We hypothesized that if an individual in the positive mood condition has higher creativity as assessed by the Neuroticism, Extraversion, Openness Personality Inventory (NEO-PI), they will experience decreased cortisol activation provided the relevant stressors are not significantly swayed by highly activated negative emotions. Individuals with low levels of creativity in the negative mood condition will experience

increased cortisol activation, more than the neutral mood condition. Individuals in the neutral mood condition will experience increased cortisol activation.

Methods

Participants

One-hundred and twenty participants, ages 18-30, with a mean age of 21.5 years and standard deviation of 2.1 years were included in this study (N_{males}=58, $N_{females}$=62). Table 1 lists the demographic information for the participants.

Table 1:

Demographics

Education		Race		Ethnicity		Income	
Some college, no degree	64	White	69	Not Hispanic or Latino	79	No income	6
High school graduate	23	Black or African American	13	Hispanic or Latino	40	<$10,000	33
Bachelor's degree	19	American Indian or Alaska Native	9			$10,000-$20,000	20
Master's degree	4	Asian	15			$20,000-$35,000	13
Associate's degree	10	Native Hawaiian or other Pacific Islander	2			$35,000-$50,000	8
		I do not know or	12			$50,000-$75,000	10

	I do not wish to disclose		
		$75,000-$100,000	3
		>$100,000	7

Procedure

An experimental, between-subjects design was used to test the hypothesis that creativity is correlated with cortisol levels depending on mood condition. Participants were told to prepare a five-minute speech about their dream job to be delivered to a panel of three 3 judges. Participants were notified of the speech in the morning, but they did not actually give the speech until late afternoon. This was done to monitor stress levels across the day as the time for the speech approached. After the speech, participants were told to perform a five-minute arithmetic task of serial subtraction in front of the panel. Participants' stress levels were measured through saliva cortisol samples, of which 11 were taken throughout the course of the day. The materials section below outlines when each sample was taken and before what task if any. Participants completed the NEO-PI as a part of the study design after the speech writing and presenting task. For mood induction, participants were randomized to either a negative, neutral, or positive condition. For each condition, participants were instructed to listen to a piece of classical music that matched the valence of the condition, while simultaneously reading self-reflective statements and writing down a memory associated with their assigned mood condition. Throughout the day, participants repeated this task to sustain the mood. Data used for this study includes cognitive

batteries and biological specimens. All data used comes from the repositories of the Social, Cognitive, and Affective Neuroscience Lab (SCAN Lab) at the University of Arizona.

The goal of the overall study was to develop a statistical model to be able to screen and select individuals fit for combat medic positions. These statistical models combine emotional state determinants as well as personality traits to predict cognitive performance of individuals under stress. Phase one involved using a Trier Social Stress Test (TSST). Phase two utilized sleep deprivation and a physical stress task to validate the statistical models from phase 1. The present study takes advantage of the cortisol levels measured during phase 1 and the mood induction of phase 2 to determine if individuals who test for higher creativity managed their stress better, taking into account mood conditions.

Materials

Creativity

Creativity in this study was measured using the Revised NEO Personality Inventory (NEO-PI) (Costa et al., 2008). The NEO-PI measures the same five dimensions of personality as the Big Five Personality Inventory, with several sub-facets for each trait. Participants were asked to answer items pertaining to the NEO-PI 3, which is updated from the NEO-PI-R. All big five personality traits were measured along with subfacets of each personality trait. The T scores for the Extraversion and Openness to Experience facets were used to determine an individual's level of creativity.

Stress

In this study, cortisol measures were used to measure an individual's psychophysiological reaction to stress. Eleven measures of cortisol were taken; Figure 2 below shows the timing and concentration of cortisol collection. Cortisol measures were taken through saliva sampling. Participants were told to place a cotton swab under their tongue after pooling as much saliva in their mouths as possible. Participants were then instructed to wait for two minutes and place it into a storage tube only if the swab was saturated.

Figure 2

Cortisol Collection Times

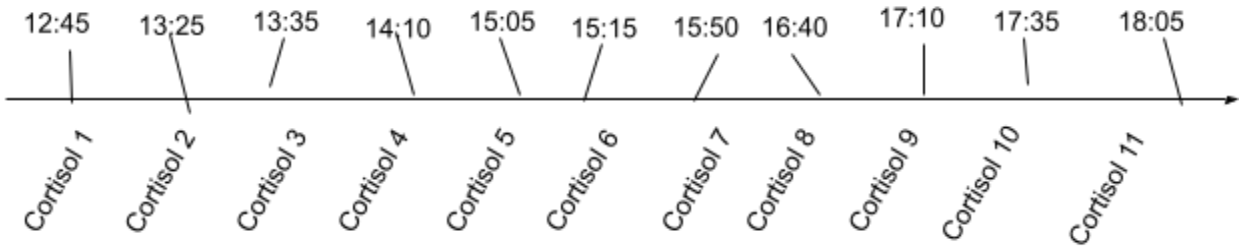


Figure 2: A visual representation of the cortisol concentration collection over time. Cortisol measures one and two were taken at baseline. Measure three was taken immediately after speech preparation, measure four 35 minutes after speech preparation. Measure five was taken 55 minutes after speech preparation, measure six immediately after a stressful reminder, seven 35 minutes after the reminder, eight 55 minutes after the reminder. Measure nine was taken immediately after the speech and oral subtraction, 10 was taken 25 minutes after the speech and subtraction, and 11 during recovery.

Mood Induction

Participants were included as a part of one of three mood conditions: positive, negative, or neutral. The neutral condition served as a control group where participants did not experience any mood induction. Participants in the positive mood condition were asked to recall a positive memory while listening to positively toned music. Participants assigned to the negative mood condition were told to recall a negative or unpleasant memory while listening to negatively toned music.

Ethical Considerations

During study recruitment, development, conduction, and data collection all participants were given transparency and were given the choice to enroll in the study and to stop if they so chose. Study protocol was approved by the University of Arizona's Institutional Review Board, Department of Defense, and Office of Human Research Oversight. All participants provided informed consent as per the regulations of these boards. No coercion was used within the study. Deception was used during a study task; participants were informed of the deception upon completion of the study, along with a debriefing form.

Analysis

A total of 109 participants were included in the dataset after the data from three participants was removed due to the presence of significant outliers for the creativity variable. Table 2 shows the mean and standard deviation of all independent and dependent variables. Extraversion and Openness scores are derived from the NEO-PI, so the numbers representing the means and standard deviation for each are presented as T-scores of those facets. For analysis purposes, data for extraversion and openness scores were split into high and low categories.

Based on the data, a two-way Analysis of Variance (ANOVA) will be used to determine the effects of extraversion and openness on cortisol levels, and estimated marginal means to determine the interaction between mood conditions and high and low extraversion and openness.

Results

Our results demonstrated there was no significant effect of high or low openness on individual cortisol levels. Similar results were demonstrated for both high and low extraversion on cortisol levels. Mood induction was found to have no significant effect. Table 3 shows the results of the ANOVAs. Table 2 shows the mean and standard deviation for extraversion and openness scores and cortisol measurements. Figures 3-12 demonstrate the estimated marginal means of both high and low openness and extraversion for each mood condition and vice versa.

Table 2:

Descriptives

Variable		Statistic
Extraversion Score	Mean	50.54
	Std. Deviation	12.23
Openness Score	Mean	59.69
	Std. Deviation	11.12
Cortisol 1	Mean	.26
	Std. Deviation	.15
Cortisol 2	Mean	.21
	Std. Deviation	.14
Cortisol 3	Mean	.19

	Std. Deviation	.09
Cortisol 4	Mean	.23
	Std. Deviation	.18
Cortisol 5	Mean	.15
	Std. Deviation	.10
Cortisol 6	Mean	.14
	Std. Deviation	.09
Cortisol 7	Mean	.16
	Std. Deviation	.10
Cortisol 8	Mean	.13
	Std. Deviation	.08
Cortisol 9	Mean	.22
	Std. Deviation	.14
Cortisol 10	Mean	.23
	Std. Deviation	.14
Cortisol 11	Mean	.18
	Std. Deviation	.10

Table 3:

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.024	2	.012	.563	.571
2		.073	2	.036	1.795	.171

Table 3: Model 1 demonstrates the effect of extraversion and openness on cortisol measure 1, and model 2 demonstrates the effect of extraversion and openness on the second cortisol measure.

Figure 3

Estimated Marginal Means for Neutral Mood, High and Low Openness

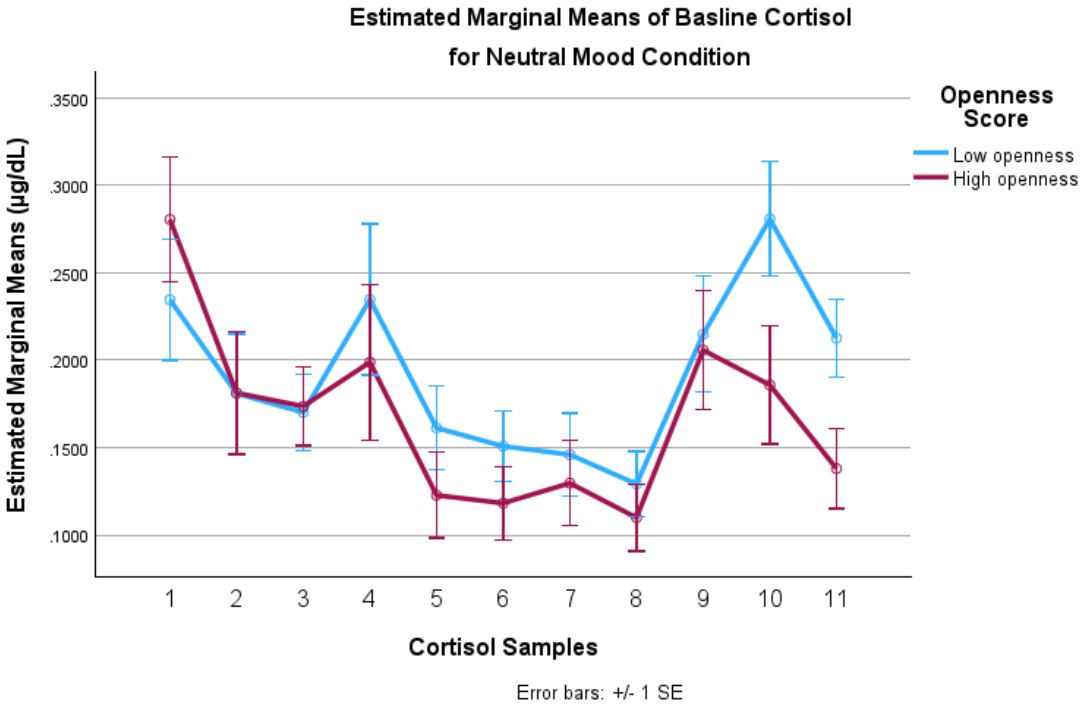


Figure 4

Estimated Marginal Means for Positive Mood, High and Low Openness

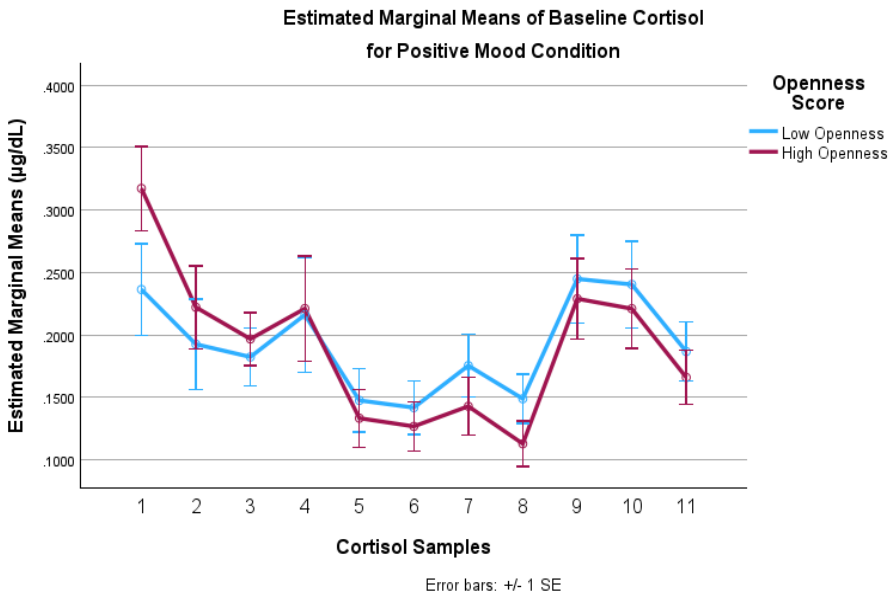


Figure 5

Estimated Marginal Means for Negative Mood, High and Low Openness

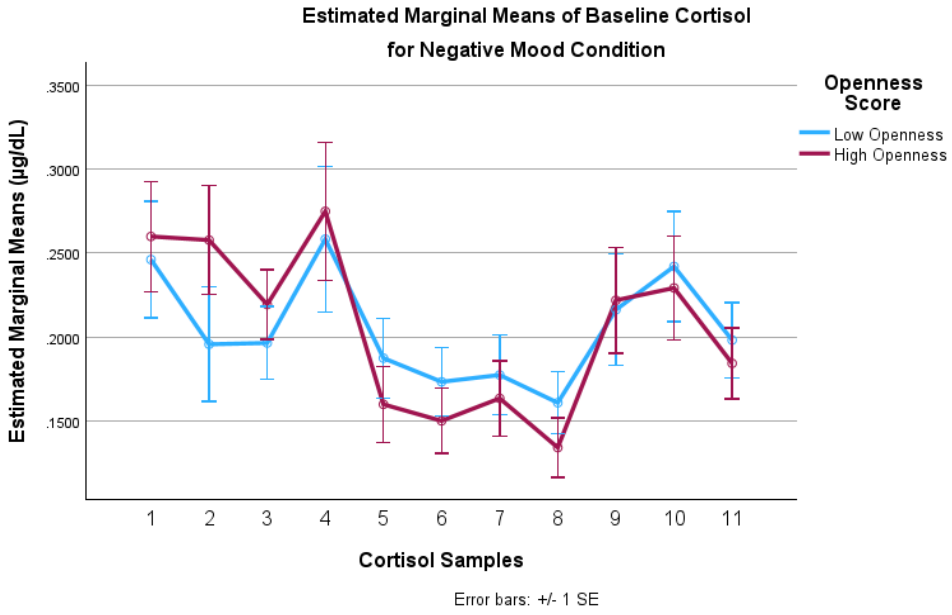


Figure 6

Estimated marginal means for Low Openness, all Mood Conditions

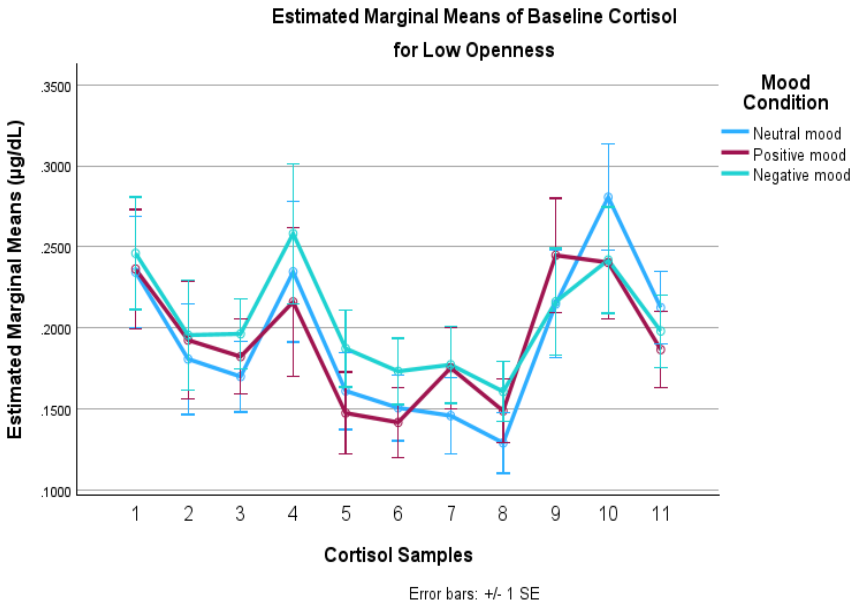


Figure 7

Estimated Marginal Means for High Openness, all Mood Conditions

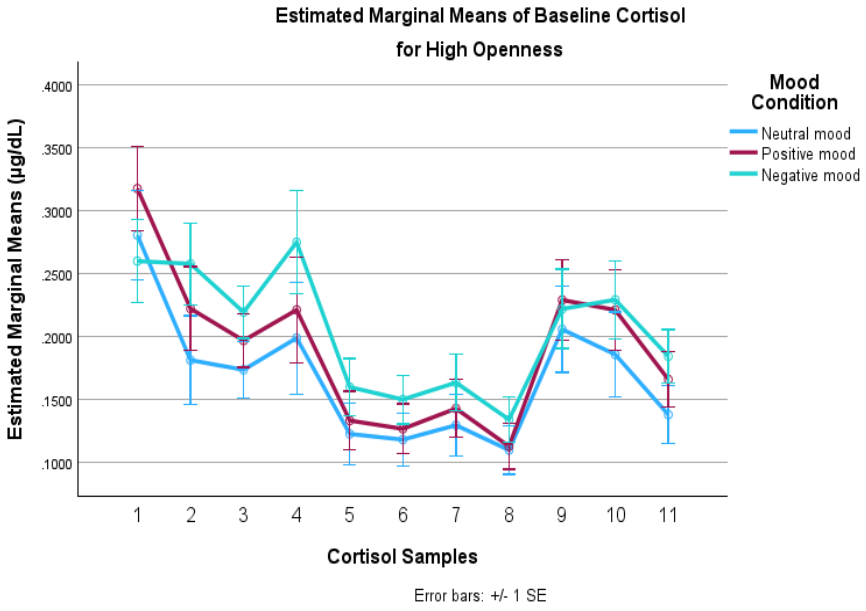


Figure 8

Estimated Marginal Means for Low Extraversion, all Mood Conditions

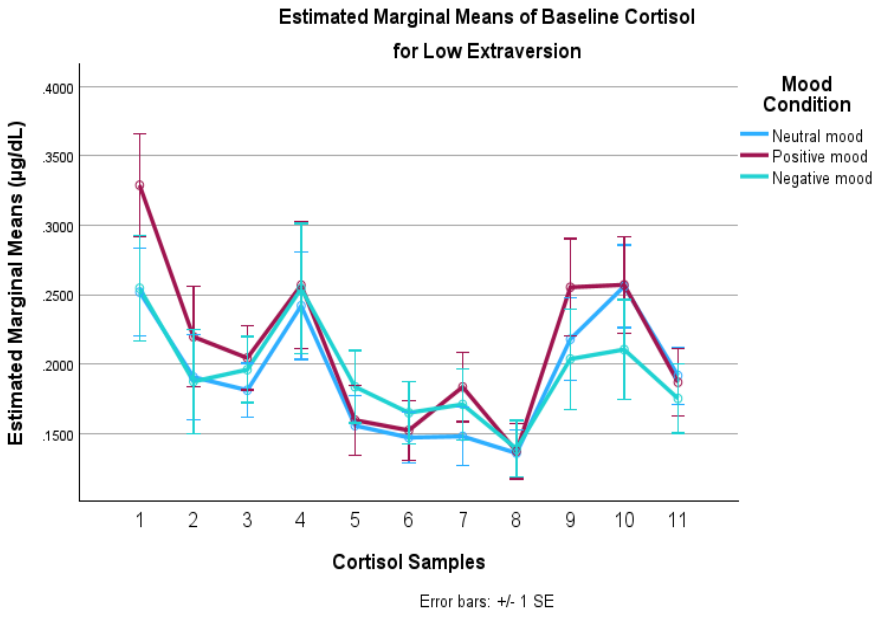


Figure 9

Estimated Marginal Means for High Extraversion, all Mood Conditions

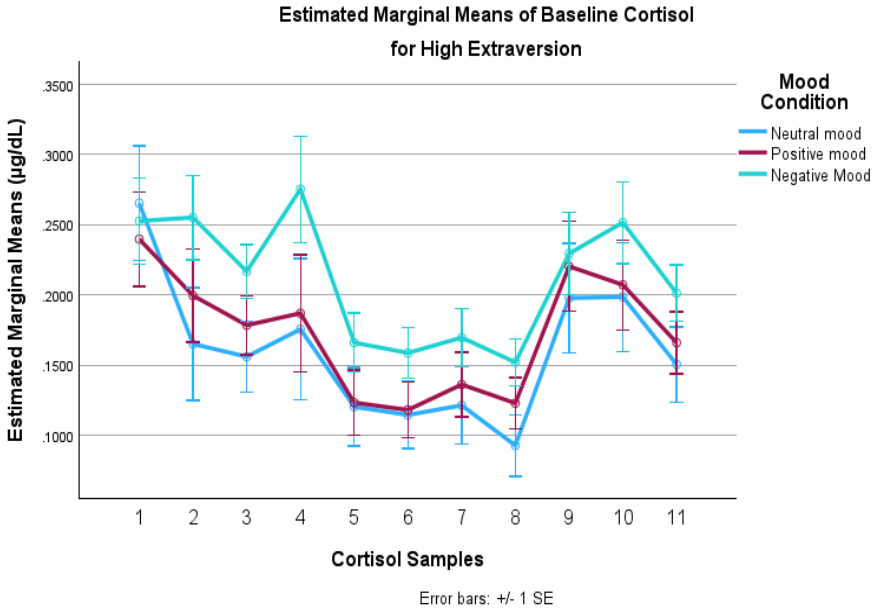


Figure 10

Estimated Marginal Means for Neutral Mood, High and Low Extraversion

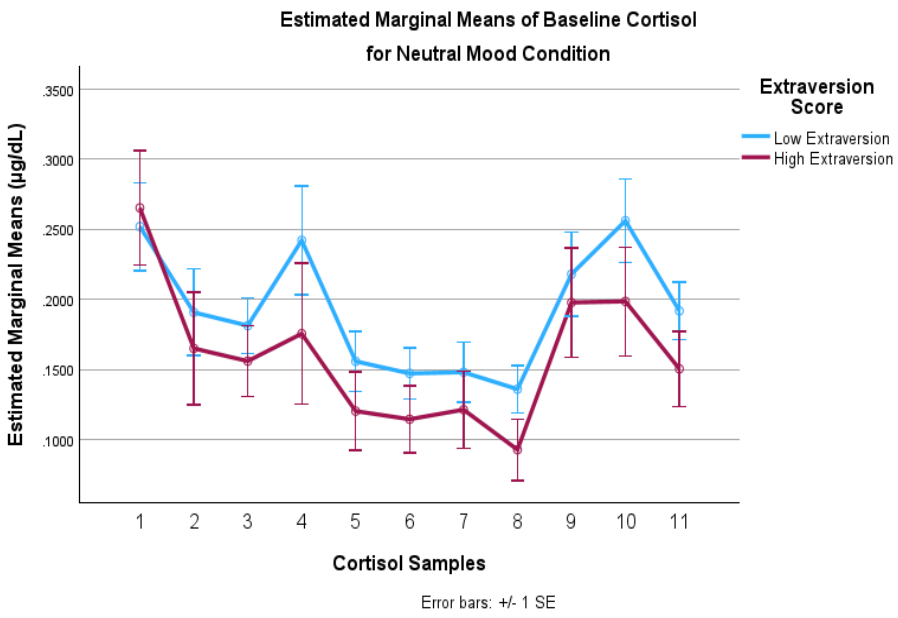


Figure 11

Estimated Marginal Means for Positive Mood, High and Low Extraversion

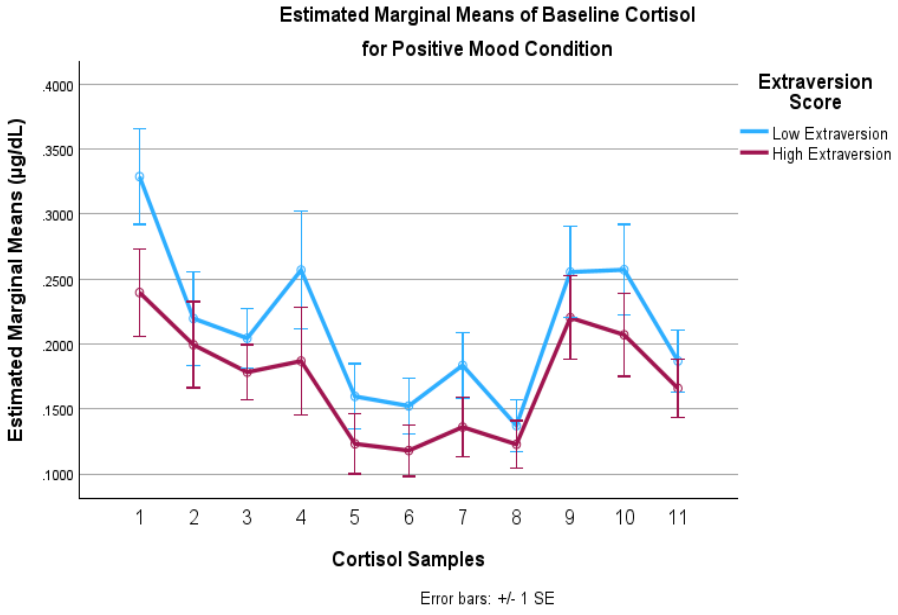
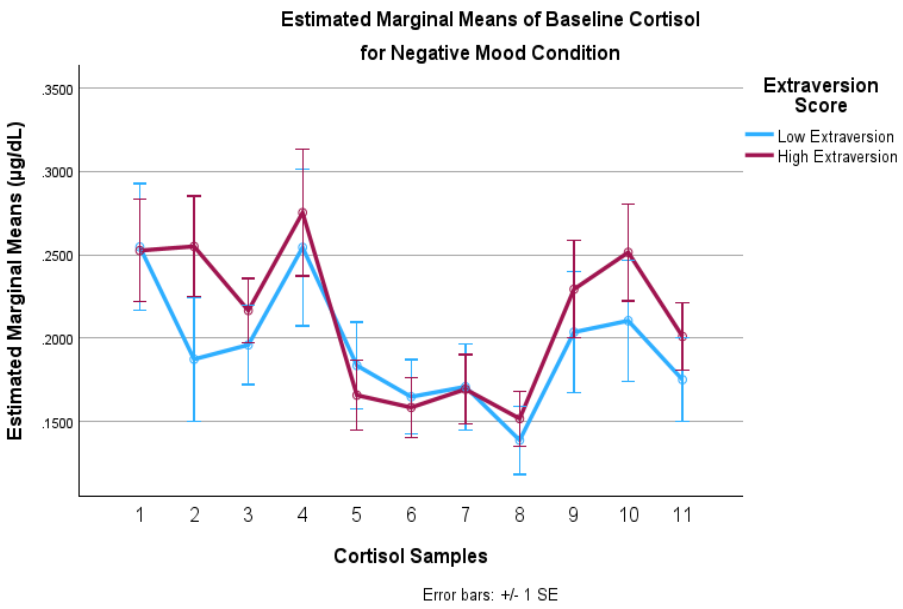


Figure 12

Estimated Marginal Means for Negative Mood, High and Low Extraversion



Cortisol sample four tended to be high for low openness for each mood condition, and high for the negative mood condition for high openness, as seen by figures six and seven. Cortisol sample eight showed a downward trend for each mood condition for the low and high openness sample, as seen by figures six and seven. Sample four also displayed a spike for all mood conditions for low extraversion. Cortisol sample 10 spiked for the neutral mood condition for low extraversion and negative mood condition for high extraversion. Cortisol sample four was taken 35 minutes after speech preparation, cortisol sample eight 55 minutes after a stressful reminder, and cortisol sample 10 25 minutes after oral subtraction. Cortisol levels for high openness for each mood condition trended downwards. Low openness, high, and low extraversion had no clear trend.

Discussion

Overall results do not support the hypothesis. Creativity did not influence individual stress levels as measured by cortisol at baseline or throughout the experimental paradigm while interacting with mood state inductions. Previous literature

from Sung & Choi (2009) and Jirasek & Sudzina (2020) strongly suggests that creativity can be measured using the openness and extraversion traits, and the NEO-PI is a widely accepted personality test that reliably measures the Big Five. Cortisol sampling has been shown to be a strong indicator of stress levels in the brain, as indicated by Yeh et al., (2015), Kemeny (2003), and Heilman (2016). The addition of a mood factor is the novel concept that is examined in this paper, but has been hypothesized by Yeh et al., (2015), Zenasni & Lubart (2002), Akbari & Hommel (2012), and Du et al., (2021) to have a significant impact on creativity.

The results of this study show that the facets of extraversion and openness that the present study used to measure creativity are not correlated with stress reactivity and were not significantly moderated by mood states. This could be due to the conditions of the participants during the speech making and presenting task. It is likely that the condition of impromptu speech making and giving is not enough to induce significant stress in participants. While the usage of extraversion and openness to determine creativity are reliable, an objective measure of creativity might show greater effects due to higher accuracy as opposed to self-report measures. Additionally, though mood conditions were present, the valence of either the positive or negative condition may not have been strong enough to significantly influence stress reactivity.

While previous research has focused on the relationship of creativity and stress or mood and creativity or some mixture of the two, these results give insight towards the relationship of all three variables to each other. The results of this study do not fit with the theory that creativity plays a role in responses to stress.

The findings of this study should be interpreted in light of several limitations. The limitations of this study include a small sample size which may have contributed to insignificant results. The methods of this study did not take into account the state of the participants before taking part in the stress test; the quantity and quality of sleep, food intake, and various other factors affecting participants during the time of sample collection all pose confounding factors to the study design. Furthermore, the reliability of the data is impacted by indirect measurements of creativity and the valence of the mood conditions. Du et al., (2021) suggests that extremely valenced emotions have an impact on creative ideation; future research should seek to determine if valence truly does define the extent of creative processes. Future research should also take all confounding variables due to participant lives into account and utilize a more standardized measure of creativity.

Establishing a link between creativity, stress, and mood could cause a cascade of research to emerge that could ultimately benefit society. Results that prove a negative correlation between creativity and stress would be invaluable to employers, schools, parents, and a plethora of other things. Knowing how to mediate stress by influencing one's mood of creative thoughts could reduce the occurrences of stress related disorders such as anxiety, be a useful tool to students who have trouble completing assignments due to stress, and help employers retain employees and improve productivity. Creativity has been traditionally difficult to understand and operationalize, but realizing the impact it may have on regulating things like stress can lead to a better understanding of how abstract thinking has influence over the body.

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