PERSONALITY TRAIT PREDICTORS OF PSYCHOPHYSIOLOGICAL CHANGES FOLLOWING TWO STRESS-MANAGEMENT WORKSHOPS IN COLLEGE STUDENTS

By

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ABSTRACT

College and graduate school are periods in life often filled with challenges and transitions. Multi-component psychosocial approaches to stress management and student wellness are likely to offer the greatest benefit, while individual responses to these approaches are expected to differ. In a circumscribed analysis of the first wave of a larger randomized controlled trial, data were evaluated from 20 college-aged students (16 female, 4 male) randomly assigned to complete one of two workshops. One workshop (YES+) focused on yogic breathing and social connectedness and the other workshop (WOW!) focused on cognitive stress management techniques. Both workshops entailed 18 hours training across four consecutive days. Questionnaires regarding perceived stress and personality were collected pre- and post-workshop, in addition to EKG data in the context of a laboratory psychosocial stress induction. While YES+ demonstrated a pre-post workshop increase in Conscientiousness scores on the Big-5 Personality Inventory, improvements on heart rate metrics related to the stress induction task were most prominently observed for WOW!.When collapsing across both groups, baseline Agreeableness was a personality predictor of intervention-related reductions in heart rate during the experimental stress task. These results have important implications for understanding benefits that may be obtained from student wellness workshops in terms of adaptive stress physiology in daily life.

INTRODUCTION

The transition from high school to college brings about many life changes and challenges that can increase one's stress. There are numerous and varied sources of stress experienced by college students (Brown, 1992). Young adults typically move away from home, become affiliated with different communities and social groups, carry the weight of increased financial and academic responsibility, all while in the midst of a significant transition in developmental stage (Darling, McWey, & Howard, 2007). The stress associated with these changes can have major implications on a student's health and well-being, as it is correlated with a decrease in sleep time (Ari & Shulman, 2012), an increase in alcohol intake (Park & Levenson, 2002), lower academic performance (Murff, 2005; Park & Levenson, 2002), and increased rates of anxiety and/or depression (Rawson, Bloomer, & Kendall, 1994).

Varner conducted a study to examine the impact of chronic stress and trauma on psychological and neuropsychological functioning of college students (Varner 2014). Of the 129 participants, there were 76 females and 52 males with 86.5% of participants in the range of 18-20 years old (full range: 18-32). All of the participants were enrolled in various sections of an Introductory Psychology course. Participants completed surveys that assessed their trauma experiences and chronic stress levels. The participants also completed several neuropsychological tests. The number of total traumatic life events for participants ranged from 0 to 32, with 19% of participants stating that they had experienced 9-10 stressful events. Participants reported current levels of perceived stress on the PSS ranging from 12-38. Participants reported levels of anxiety on the State Trait Anxiety Inventory (total score is comprised of two subtypes, trait and state) ranging from 21-67. The results of this study showed that there was not a significant difference in neuropsychological performance for students who have experienced trauma or chronic stress versus those who have not, as indexed by measures of inhibition, working memory, attention, cognitive flexibility, or explicit memory. However, the number of traumatic events the student had experienced and the level of chronic stress experienced by the student impacted the psychological well-being of students measured by perceived stress, depression, and posttraumatic stress. Additionally, individuals reporting increased events showed an increase in anxiety on the trait anxiety inventory, but not on the combined STAI-II score. These findings show implications for students who have experienced multiple traumatic events. Students who have experienced multiple events were at an increased risk for psychological symptoms of perceived stress, depression, and posttraumatic stress.

Aiming to evaluate the impact of interventions to combat the stress associated with this time of transition, Baghurst and Kelley performed a study targeting college students across the span of a semester (Baghurst & Kelley, 2014). 531 college students (293 male and 238 female, mean age 21.4 years) were randomly assigned to participate in one of four different types of classes. The classes were (1) Stress Management, (2) Physical Activity, and (3) Cardiovascular Fitness, and (4) a non-stress management related course (i.e. history). Each participant took three surveys at the beginning of the semester and sixteen weeks later, at the end of the semester. The three surveys were: Perceived Stress Scale (PSS), Test Anxiety Survey (TAS), and the Personal Burnout Scale (PBS). The results showed that participants experienced a significant reduction in scores on the PSS, TAS, and

PBS for the Stress Management class and the Physical Activity Class. There was a reduction on the PSS but an increase on the PBS and the Cardiovascular fitness. Additionally, participants showed an increase in stress on the PSS for the control condition (non-stress management related course). This study showed the effects of various types of classes on stress. The results showed that physical activity was the optimal course for stress reduction given the significant reductions on all three of the measures, which parallels prior research by Brown demonstrating physical activity as a primary mediator of stress reduction in college-aged participants. While the cardiovascular fitness class showed significant reduction in perceived stress, it showed a significant increase on the personal burnout scale (Brown, 1992).

Another study was conducted in South Korea to measure the effectiveness of a stress coping program on nursing students (Kang, Choi, & Ryu, 2009). There were 41 participants in this study, all had received a junior or senior level status as a nursing student and were participating in clinical practice. The intervention was a stress coping program that was based on mindfulness meditation. Each session of the program lasted between 1.5 and 2 hours. The program aimed to reduce stress, anxiety, and depression. Stress was measured using the Psychosocial Well-being Index - Short Form (PWI-SF) and depression was measured using the Beck Depression Inventory. Anxiety was measured using an anxiety assessment inventory. The results of the study showed a significant difference in both stress and anxiety. Reductions were seen in both of these categories ($p \leq .02$), with a trend-level difference in the depression scores ($p = 0.06$). This study showed that a mindfulness-based coping program has positive implications for stress reduction in nursing students.

Smith et al. conducted a pilot study in order to compare the effects of a mindfulness-based stress reduction intervention and a cognitive-behavioral stress reduction intervention (Smith et al., 2008). This study included participants who were not students, but the types of interventions are still important to stress research in student populations, as these interventions can be modified to suit a college population. The participants in this study were 50 adults (mean age of 44.94 years old) who had never had a substance abuse issue or acute mood disorder. Both of the interventions used were 8-week courses. The mindfulness-based stress reduction intervention had weekly three-hour sessions. These sessions incorporated breathing practices, body scans, Hatha yoga, meditation and group discussion. This intervention also emphasized the importance of mindful and healthy eating. The Cognitive-behavioral stress reduction intervention also met for 3 hours each week. This intervention focused on cognitive stress-management strategies, such as practice in identifying “irrational” thoughts and replacing them with “rational” thoughts. Techniques learned also included guided visualization and progressive muscle relaxation. The measures used in this study were the Beck Depression Inventory II, a visual analog scale to measure energy level, a mindfulness and meditation survey, the Perceived Stress Scale, the Psychological Well-Being Scale and the Binge Eating Scale (BES). Results showed that the mindfulness-based intervention was associated with reduction greater reduction across all measures than the cognitive-based intervention. This study draws more attention to mindfulness as a stress-combating strategy. The study shows that mindfulness stress reduction interventions can have a positive impact on people who are experiencing stress.

Only recently has research begun to examine personality traits as predictors of intervention outcomes. Indeed, stress depends on the perception of the beholder, therefore

stress is highly influenced by the individual who is experiencing the stress. Recent definitions of stress have been modified to include the impact of one's perception on an event. Reactions to stress are defined as '*dealing with problems and situations or contending with them successfully*'. Responses to stressors are an innate or acquired way of responding to a changing environment or situation (Lazarus & Folkman, 1986). Romano concluded that stressors do not cause stress themselves, but the interaction between stressors and our perceptions cause us to feel stressed (Romano, 1992).

Exploring this important role of personality, Barkan and colleagues explored how varying levels of the Big Five personality dimensions (openness to experience, agreeableness, neuroticism, conscientiousness, and extroversion) impacted the willingness of participants to employ the four major components of a mindfulness-based stress reduction (yoga, sitting meditation, informal meditation, and body scanning) during the intervention and at a 6 month follow-up (Barkan et al., 2016). The participants of the study were 200 adults (age 60 and older, 62% female) from Rochester, New York. Results indicated that openness was correlated with the use of the four techniques during the intervention and at the 6-month follow-up, while agreeableness was correlated with use of the meditation techniques during the intervention. This study targeted stress interventions in older adults, rather than college students. However, the examination of personality traits as predictors of implementation of the mindfulness-based stress reduction techniques raises an important question: How do individual differences make people more or less likely to respond positively and show improvement in response to certain interventions? This study opens the door for researchers to further explore personality dimensions and effectiveness of stress-fighting interventions for varying age populations.

Given the encouraging albeit sparse evidence in the literature thus far, here we performed a circumscribed analysis of Big Five Inventory personality traits in the context of a larger randomized controlled trial study evaluating the effects of two different psychosocial wellness workshops (WOW! and YES+) on stress physiology and various measures of well-being. Stress physiology was measured during an experimental stress-induction task performed both pre and post-workshop. WOW! (Wisdom On Wellness!) is a psycho-educational workshop that focuses on cognitive and physiological aspects of stress. The workshop is comprised of group discussion, thought tracking activities, and journaling in order to reframe the way participants perceive and handle stress. YES+ (Your Enlightened Side, plus more) is a yogic breathing workshop that focuses on the Sudarshan Kriya Yoga technique. Activities in YES+ are designed to facilitate social connectedness, mindfulness, and acceptance-based approaches to stress reduction.

Our first prediction as a form of "manipulation check" for the stress-induction task was that self-reported anticipation of math-related stress would correlate with the increase in heart rate during the math portion of the stress-induction task. For workshop-related changes, we hypothesized that both groups would show reductions in perceived stress. In terms of between-group outcomes, we hypothesized that WOW! participants would demonstrate increases in Conscientiousness due to the emphasis on cognitive approaches to stress-management, while YES+ participants would increase in openness through means of social connection and acceptance-based approaches to stress-management. Although the current sample size is insufficient to appropriately examine unique predictors of treatment outcomes within each group, we hypothesized that both groups as a whole would demonstrate a correlation between baseline Agreeableness and post-workshop

improvements in perceived stress as well as heart rate metrics during the stress-induction task.

MATERIALS AND METHODS

Participants and procedure

Twenty participants (12 WOW!, 8 YES+) were included for analysis, who comprise the first wave of a larger 3-wave RCT study. Participants in the study were screened and allowed to participate if they met the following criteria: 18-35 years of age, currently hold student status (undergraduate, graduate, etc.), and have no history of panic disorder, psychosis, or mania. Additionally, potential participants were not eligible to participate in the study if they reported current substance dependence or current use of psychoactive medications.

Participants were quasi-randomized to either YES+ or WOW! workshops, by grouping individuals with known others together and ensuring equal distribution across workshop groups. Participants were asked to complete online questionnaires and attend a pre-workshop and a post-workshop lab visit within two weeks before and after their scheduled workshop. During each lab visit, electrocardiography (ECG) data were collected at baseline, during the Maastricht Acute Stress Test (MAST), and across multiple recovery time points (Figure 1). The lab visits began with a resting period and a five-minute interval for baseline ECG measurements. The stress-induction task (lasting 15 minutes) followed the resting period. Post-stress inductions measures were taken five mutes after the task was complete. 30-minute post-stress task onset and 45-minute post-stress task onset were taken at their respective times. 10 minute rest periods were allotted between measurements at post-stress, 30-min post-stress, and 45-min post-stress.

All participants provided informed written consent during a brief interview. Ethics approval was obtained from the IRB at the University of Arizona.

Workshops

Your Enlightened Side+ (YES+)

The workshop totaled 18 hours across 4 consecutive days and was taught by a trained facilitator. The workshop focuses on the Sudarshan Kriya breathing technique along with two preparatory breathing practices called Ujjayi and bhastrika. Meditation, yoga, and interpersonal practices that encourage social connectedness were also conducted.

Wisdom on Wellness (WOW!)

The workshop was held on the same days of the week and at the same times as YES+ (totaling 18 hours), counterbalanced in order over multiple waves of data collection. The workshop was psycho-educational and conducted in a focus-group setting format. WOW! focuses on physiological and cognitive components of stress. Activities involving cognitive reappraisal and evidence-based approaches, group discussions, and lectures are conducted.

Self-report measures

Anticipated math-related stress

With the aim of capturing subjective appraisal to correlate with objective stress physiology, participants were asked as part of the baseline questionnaires to rate their anticipated stress "calculating math out loud in front of someone" on a 0-7 likert scale.

The Big Five Inventory (BFI)

The BFI is a 44-item inventory that measures an individual's level of each of the Big Five Factors (dimensions) of personality (Goldberg, 1993). Each of the factors is further categorized in personality facets. The five personality traits outlined by the BFI are openness to experience, extroversion, agreeableness, conscientiousness, and neuroticism. Internal consistency for the BFI was high at both T1 and T2 across groups (Cronbach's α = .81 and .80, respectively).

Perceived Stress Scale (PSS)

The PSS is a 10-item inventory that measures the extent to which an individual appraises one's own life circumstances as stressful (Cohen, Kamarck, & Mermelstein, 1983). The PSS is one of the most widely used self-report scales for measuring psychological distress (Leon et al., 2007). Internal reliability values were high at T1 and T2, similar to the BFI (Cronbach α = .83 and .88, respectively).

Physiological Measures

Participants' heart rates were recorded during the MAST at T1 and T2 (pre and post intervention). During data analysis, widely used metrics of heart rate and heart rate variability were computed based on the IBI series data using CMetX (Allen, Chambers, & Towers, 2007).

Experimental Stress Induction

The Maastricht Acute Stress Test (MAST) was used during the laboratory visits to experimentally induce stress (Smeets et al., 2012) (Figure 2). The MAST was made up of a 10 minute acute stress phase that combines aspects of widely used Cold Pressor Test and Trier Social Stress Test. However, the MAST adds a component of uncertainty by switching between the two tasks at unpredictable time intervals. During the hand immersion trials, participants immersed their dominant hand and wrist into a bucket of ice water (approximately 2° C) for 60 second and 90 second intervals. In between hand immersions, participants were instructed to remove their hand, place their hand on a towel and immediately began a mental arithmetic task in which they were asked to count backwards from 13, 17, or 18 starting from a randomly selected number between 2013 and 2073. The research staff member frequently instructed participant to count more quickly and to start over when mathematical mistakes were made.

Statistics

Primary outcome measures included both self-reported scores and physiological values of heart rate. Self-report measures included PSS total score and subscale scores of the 5 personality dimensions on the BFI. Primary physiological outcomes measures were heart rate (HR) and respiratory sinus arrhythmia (RSA). For these ECG variables, all

statistical analyses were conducted twice, once using absolute values and once using baseline-corrected values. Baseline-corrected values were calculated using a percent change formula ([recording block - baseline]/baseline*100), yielding a similar scale for all variables as opposed to the effect of using simple difference calculations.

Paired t-tests (two-tailed) were used to test change in self-report scores at T1 vs. T2 per each group. For ECG variables, mixed-model ANOVA's were evaluated to test main effects of Group (WOW!, YES+), Time (T1, T2), and Block (Baseline, Pre-MAST, 1st Immersion, 1st Math, 2nd Immersion, 2nd Math, 3rd Immersion, 3rd Math, 4th Immersion, 4th Math, 5th Immersion, Post-MAST, 30-min Post-MAST, and 45-min Post-MAST), as well as two-way and three-way interactions. Linear correlations (Pearson) were used to test the relationship between self-report measures and ECG variables. Statistical analyses were conducted with SPSS version 23 (IBM Corp., Armonk, NY).

RESULTS

Participant Characteristics

Table 1 displays pertinent baseline values for each group. Participants randomized to WOW! and YES+ demonstrated a similar distribution of age (19.58 ± 2.47 vs. 20.13 ± 2.42 years, $p = .634$), although gender trended towards a between-group difference (66.67 vs. 100% female, $p = .074$). Similarly, anticipated math-related stress, as well as baseline PSS scores and BFI personality trait values were equivalent between groups, with the exception of BFI Openness, which exhibited a trend-level difference suggesting greater baseline Openness in YES+ ($p = .081$).

Perceived Stress and Personality

For the PSS, no main effects or interactions were observed in the omnibus two-way ANOVA tests (Table 2).

For the BFI subscales, there was a significant main effect of Group for Openness, $F(1,18) = 4.56$, $p = .047$ (Table 2), driven by increased scores in YES+ relative to WOW! at both T1 and T2 ($p = .041$ and .026, respectively) (Figure 3). In addition, a trend was observed for the Group x Time interaction for Conscientiousness, $F(1,18) = 3.76$, $p = .068$. Specifically, an increase in Conscientiousness scores from T1 to T2 was observed for YES+ ($p = .081$). No main effects or interactions were evident for any other BFI dimensions.

Heart Rate Metrics

Raw Values

As expected, a significant effect for Block was observed for HR, $F(13,234) = 26.34$, $p < .001$ (Table 3). In addition, an interaction for Time x Block was observed, $F(13,234) = 4.92$, $p < .001$. A trend for the Group x Time x Block three-way interaction was also observed, $F(13,234) = 1.72$, $p = .058$, due to a decrease from T1 to T2 for the 3rd Math period specifically for WOW! ($p = .038$) (Figure 4). No other main effects or interactions were observed for HR.

A significant effect for Block was observed for RSA, $F(13,208) = 3.62$, $p < .001$ (Table 4). No other main effects or interactions were observed for RSA.

Baseline-Corrected Values

Significant main effects of Time and Block were observed for baseline-corrected HR, $F(1,18) = 18.46$, $p < .001$ and $F(13,234) = 21.17$, $p < .001$, respectively (Table 4). A trend for a Group x Time interaction was also observed, $F(1,18) = 4.14$, $p = .057$. As expected, a significant main effect of Block was observed, $F(13,234) = 25.17$, $p < .001$. In addition, interactions were also observed for Time x Block, $F(13,234) = 5.12$, $p<.001$, and Group x Time x Block, $F(13,234) = 1.78$, $p = .047$. A pattern of decreased baseline-corrected HR values across multiple blocks during stress induction as well as recovery was most prominent for WOW! (Figure 5).

As expected, a significant main effect of Block was also observed for baseline-corrected RSA, $F(13,208) = 3.60$, $p < .001$. There was a trend towards an increase from T1 to T2 during the third immersion for the YES+ group only ($p = .081$) (Figure 5). No other main effects or interactions were observed for baseline-corrected RSA.

Additional HR Metrics

Similar to HR, interbeat interval (IBI) showed a significant main effect for Block and a significant interaction for Group x Time (Table 3). Additionally, IBI showed a significant Group x Time x Block interaction, despite this three-way interaction not reaching significance for HR. Several other measures of heart rate variability showed similar results to RSA. MSD, RMSSD, and PNN50 all showed a significant main effect of Block, with RMSSD additionally demonstrating a Time x Block interaction.

Mirroring the results of baseline-corrected HR, baseline-corrected IBI showed significant main effects for Time and Block, a significant interaction for Time x Block, and Group x Time x Block interaction (Table 4). However, of the baseline-corrected measures of heart rate variability, only MSD showed a significant main effect of Block.

Measures of within-block fluctuation (i.e. standard deviation of RSA and HRV measures across all 30-second segments within each recording block) similarly showed a significant main effect of Block for both raw and baseline-corrected values. Additionally, the baseline-corrected measure of HRV standard deviation showed a significant main effect for Time and a significant Group x Time interaction.

Correlations Between Subjective Ratings and HR Metrics

Anticipated Math

The predicted positive correlation of self-reported math-related stress with HR during the math portions of the MAST at T1 was addressed using baseline-corrected HR specifically during the third math and fourth math. Math-related stress scores were positively correlated with HR during both these math periods ($r = 0.38$, $p = .043$, and $r = .51$, $p = .006$, respectively) (Figure 6).

Agreeableness

The predicted negative correlation between baseline BFI- Agreeableness and percent change from T1 to T2 in baseline-corrected HR was addressed using the third math. The relationship trended towards a negative correlation ($r = -0.40$, $p = .079$) (Figure 7).

DISCUSSION

The results suggest that both workshops have the potential to positively impact physiological stress responses in college students. The significant interaction of Time x Block for baseline-corrected HR, along with post-hoc examination indicated that HR during the MAST was lower at T2 than T1 across groups combined. While the pattern was evident for each group individually during portions of the MAST, only WOW! demonstrated an improved post-MAST recovery. This result has important implications, provided that these improvements in stress physiology would generalize from this simulated stress-induction to stressful situations in daily life. College students are particularly vulnerable to a variety of sources of stress (Brown, 1992), so the need for meaningful and effective interventions for this population is of great importance.

Additionally, the YES+ group showed a trend towards increased RSA at T2 relative to T1 during the third immersion. One of central practices taught in YES+ is a breathing technique called Sudarshan Kriya. The emphasis on breath that takes place in YES+ is consistent with this finding, as RSA is a measure of heart rate variability that is in parallel with the breath. WOW! does not include any breath-related or mindfulness based techniques to manage stress, so the change in YES+ and lack of change in WOW! fits with the aims and practices of each separate workshop. Lower heart rate from T1 to T2 and higher RSA from T1 to T2 are representative of a change in stress response that could potentially have positive implications on wellbeing and emotion regulation. The results in this paper only include the participants in the first wave of a three-wave study, so it is possible that with an increase in the number of participants, the effects seen would be supported with greater strength.

Our hypothesis related to the "manipulation check" was supported by the results. Self-reported anticipation of math-related stress correlated with the increase in heart rate during the math blocks of the stress-induction task, as shown by the baseline-corrected HR during the 3rd and 4th math blocks. This direct relationship between subjective and objective indices of stress response strengthens the interpretation of the workshop-related changes in HR as psychophysiological indicators of stress physiology that participants might anticipate facing in real life situations.

Our hypotheses related to workshop-related changes in overall perceived stress and personality scales, however, were not entirely supported. We predicted that both groups would show reductions in perceived stress; however, neither group demonstrated a significant change from T1 to T2. Interestingly, the results related to between-group outcomes showed the opposite effects that were predicted in our hypotheses. We hypothesized that WOW! participants would show an increase in Conscientiousness and that YES+ participants would show an increase in Openness. Though neither group showed a change in Openness, YES+ participants demonstrated an increase in Conscientiousness and WOW! participants did not. Our hypothesis related to Agreeableness predicted a correlation between baseline Agreeableness and improvements in both perceived stress and stress response measures by heart rate metrics. Baseline agreeableness and percent change from T1 to T2 in baseline-corrected HR demonstrated a negatively correlated effect that trended toward significance. However, baseline Agreeableness was not correlated with changes in perceived stress following the interventions.

The trend towards a negative correlation between baseline BFI Agreeableness and change in T1 to T2 baseline-corrected HR during the third math illustrates that personality can act as a predictor on treatment outcome and stress response. Higher agreeableness was correlated with a decrease in change from T1 to T2 baseline-corrected HR during the third math, which could be related to several components of the trait. Agreeableness could be associated with greater buy-in to the interventions and/or a higher likelihood to adhere to the instructions and techniques learned during the interventions. This finding is somewhat supported by Barkan et al.'s mindfulness-based stress reduction study, in which openness was correlated with use of these techniques during the intervention and at the 6-month follow-up, while agreeableness was correlated with use of the techniques during the intervention itself (Barkan et al., 2016). As mentioned prior, the present paper only includes participants from the first wave of a larger study, so upon completion of the entire study, it is possible that the effects of personality may be illustrated with more clarity.

This study shows that personality is related to the effectiveness of stress-management interventions. Both physiological (heart rate metrics) and self-report measures (PSS) were used to explore the changes in perceived stress and stress responses during an experimental stress task pre and post intervention. Future research should focus on refining how personality traits can act as predictors of treatment outcomes. Continued research on personality and stress-management workshops will allow researchers to modify and tailor interventions to optimally treat populations of people depending on their personality traits. Additionally, this study has shed light on the differences in outcomes of two distinct types of stress-management workshops. The definition of stress has evolved over many years, but an integrative definition is now most widely accepted. Cohen and colleagues define stress as a process that involves a stimulus, appraisal, and a response (Cohen, Kessler, & Gordon, 1997). Because increasing emphasis has been put on the appraisal of a situation and the response to the situation as key components of stress, interventions must also emphasize these parts of the stress experience. Stressors, stress responses, and optimal strategies are unique to each individual. Therefore, it is important that treatment interventions do not maintain a "one-size-fits-all" approach. Future research should continue to explore the ways in which personality traits predict the effectiveness of each type of workshop on treatment outcomes.

Though this paper only includes the participants in the first wave of a three-wave larger study, important findings related to perceived stress, HR and RSA during an experimental stress task, personality implications, and effectiveness of different types of workshops have been shown. Once the entire study is complete, it is possible that many of the trends seen in the first wave may either strengthen or conversely, remain specific to the first wave participants. With an increased sample size, the variation in personality traits within the sample will also lend itself to clearer distinctions in terms of personality dimensions and between-subjects effects for participants in each workshop.

LIMITATIONS

There are several limitations in this study. Given the nature of the experimental design, participation in this study requires many steps and consistent follow-through on the part of the participants over the course of up to one month. Because of this, it is likely

that many of the participants who completed the T1 laboratory visit, workshop, and the T2 laboratory visit share personality traits, such as conscientiousness. This could cause a lack in variation in personality, which would have made generalization to a college population challenging. Additionally, this could have influenced our ability to make comparisons within the groups based on high or low levels of each personality trait. Because of the somewhat demanding nature of the study, retention rates were low, making sample sizes per workshop much lower than anticipated.

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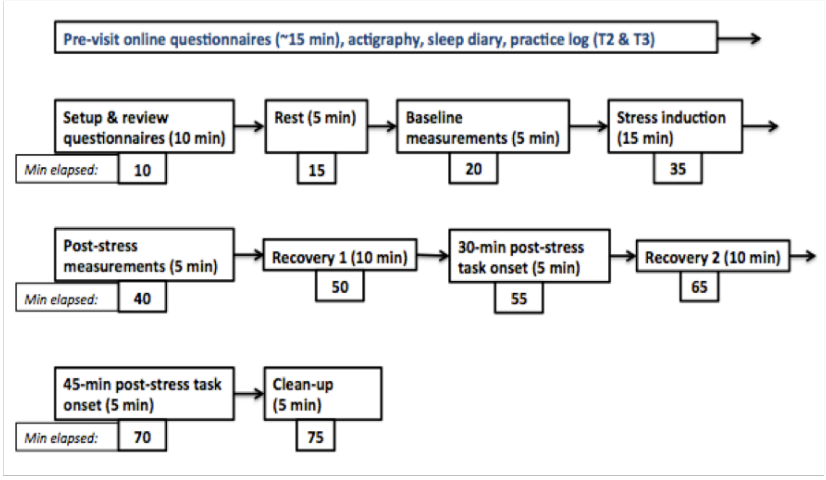

Figure 1. Laboratory visit overview. Participants were outfitted with a lead II EKG setup, respiratory belts, and pulse monitor. Following baseline recordings, psychophysiology measurements were collected during stress induction, as well as multiple recovery time points.

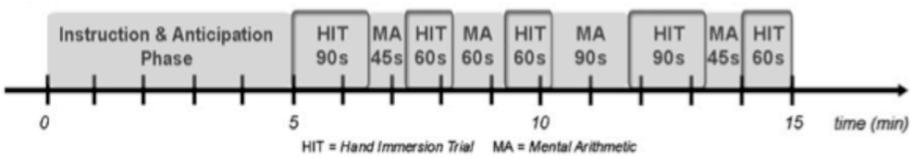

Figure 2. Overview of Maastricht Acute Stress Test (MAST). Adapted from Smeets et al. Psychoneuroendocrinology, 2012.

Table 1. Participant demographic information

	WOW!	YES+	*p*
Total, N	12	8	
Age, M (SD)	19.58 (2.47)	20.13(2.42)	.634
Gender, % female	66.67	100.00	.074
Stress rating-Math	3.42 (2.31)	3.25 (3.24)	.894
PSS-Total	16.17 (6.21)	16.75 (6.09)	.838
BFI-Extraversion	27.25 (8.49)	27.13 (5.54)	.971
BFI-Conscientiousness	34.25 (5.89)	31.13 (3.04)	.186
BFI-Neuroticism	20.33 (4.10)	23.25 (5.23)	.179
BFI-Openness	28.67 (6.49)	34.00 (6.02)	.081
BFI-Agreeableness	38.67 (4.52)	36.75 (4.86)	.379

PSS, Perceived Stress Scale; BFI, Big-Five personality Inventory
*p < .05

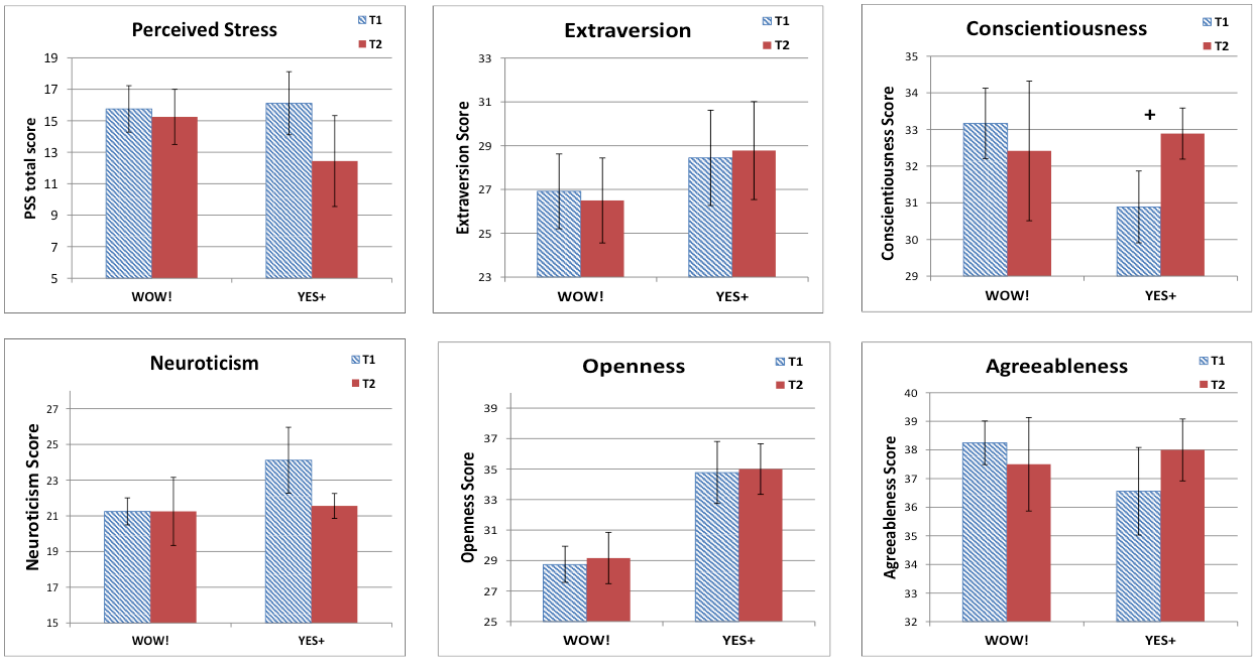

Figure 3. Questionnaire scores at T1 and T2 for WOW! and YES+. While no significant T1-T2 changes were observed for perceived stress, extraversion, neuroticism, openness, or agreeableness for either group, a trend towards increased Conscientiousness was observed for YES+. **+**p <.10

Table 2. F values for questionnaire measures

	GROUP	TIME	GROUP x TIME
PSS- Total	0.12	2.21	0.99
BFI- Extraversion	0.16	0.30	0.97
BFI- Conscientiousness	0.41	1.01	3.76
BFI- Neuroticism	0.83	2.09	2.09
BFI- Openness	4.56*	0.001	0.10
BFI- Agreeableness	0.45	1.03	1.71

PSS, Perceived Stress Scale; BFI, Big-Five personality Inventory
*p < .05

Table 3. F values for EKG variables (raw).

	GROUP	TIME	GROUP x TIME	BLOCK	GROUP x BLOCK	TIME x BLOCK	GROUP x TIME x BLOCK
HR	0.02	0.29	0.55	26.34***	0.40	4.92***	1.72
IBI	0.01	0.50	0.87	27.12***	0.39	4.53***	1.90*
RSA	2.35	0.01	0.13	3.62***	0.85	0.99	1.19
HRV	3.23	0.69	0.10	1.46	0.40	0.79	1.21
SD RSA	2.85	1.06	0.15	7.89***	0.96	1.02	0.66
SD HRV	0.31	1.93	0.02	4.76***	0.72	1.29	0.67
MSD	2.41	0.04	0.49	3.86***	1.03	1.26	0.66
RMSSD	3.24	0.001	0.72	3.23***	1.37	1.81*	0.37
PNN 50	3.94	0.04	0.28	3.8***	0.93	1.23	0.79

HR, Heart Rate; IBI, Inter-beat Interval; RSA, Respiratory Sinus Arrhythmia, HRV, Heart Rate Variability; SD RSA, Standard Deviation of Respiratory Sinus Arrhythmia; SD HRV, Standard Deviation of Heart Rate Variability, MSD, Mean Successive Differences; RMSSD, Root Mean Square of Successive Differences; PNN 50, Number of pairs of successive NN intervals that differ by more than 50 ms.
*p < .05
**p < .01
***p < .001

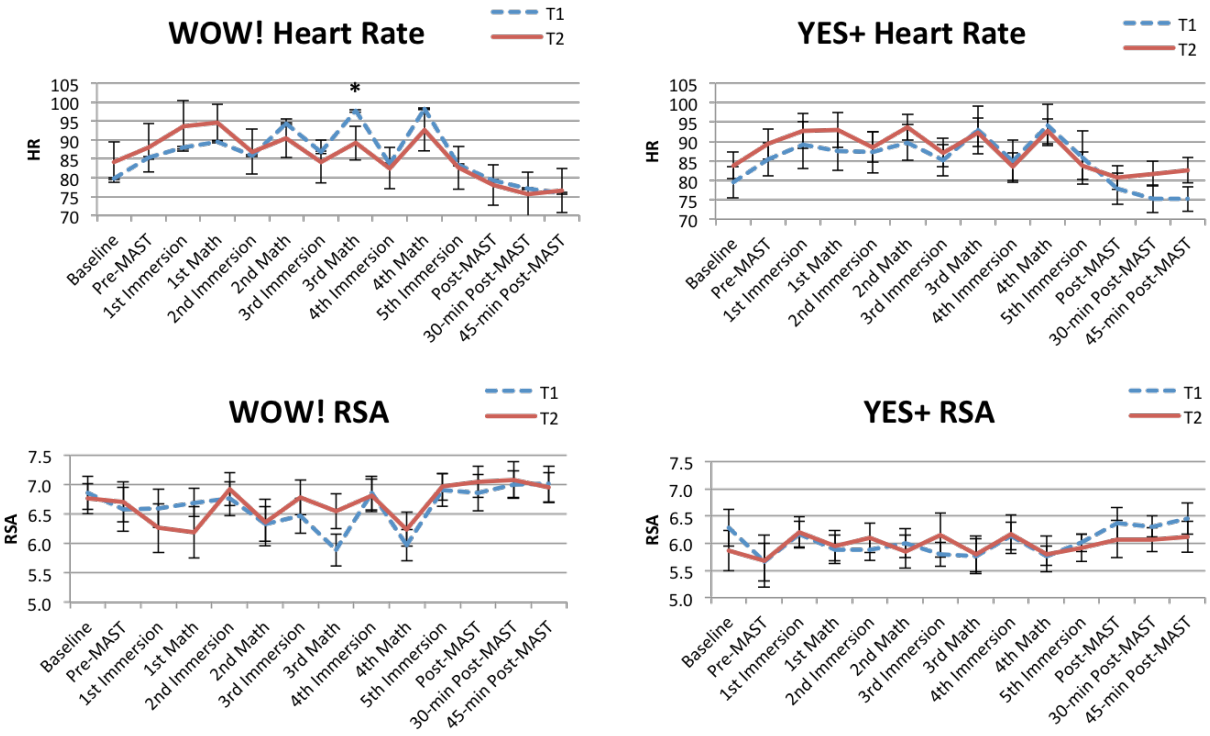

Figure 4. Mean heart rate and respiratory sinus arrhythmia for WOW! and YES+ at T1 and T2. A significant decrease in HR during the 3rd Math block from T1 to T2 was observed for WOW!. No other significant changes were observed for WOW! or YES+. *p < .05

Table 4. F values of baseline-corrected EKG variables

	GROUP	TIME	GROUP x TIME	BLOCK	GROUP x BLOCK	TIME x BLOCK	GROUP x TIME x BLOCK
HR	0.10	18.46***	4.14	25.17***	0.35	5.12***	1.78*
IBI	0.30	19.72***	4.24	29.08***	0.46	4.43***	1.94*
RSA	0.02	2.94	0.70	3.60***	0.71	0.80	1.39
HRV	0.94	0.19	0.80	1.49	0.35	0.76	1.17
SD RSA	1.22	0.04	0.46	6.77***	1.05	0.81	1.05
SD HRV	0.09	5.68*	7.51*	4.78***	0.72	1.57	1.14
MSD	0.27	2.59	0.09	4.16***	0.54	1.01	1.02
RMSSD	0.22	1.96	0.25	3.34	0.45	1.05	0.79
PNN 50	0.01	0.27	2.80	1.74	0.52	0.89	1.43

HR, Heart Rate; IBI, Inter-beat Interval; RSA, Respiratory Sinus Arrhythmia, HRV, Heart Rate Variability; SD RSA, Standard Deviation of Respiratory Sinus Arrhythmia; SD HRV, Standard Deviation of Heart Rate Variability, MSD, Mean Successive Differences; RMSSD, Root Mean Square of Successive Differences; PNN 50, Number of pairs of successive NN intervals that differ by more than 50 ms.
*p < .05
**p < .01
***p < .001

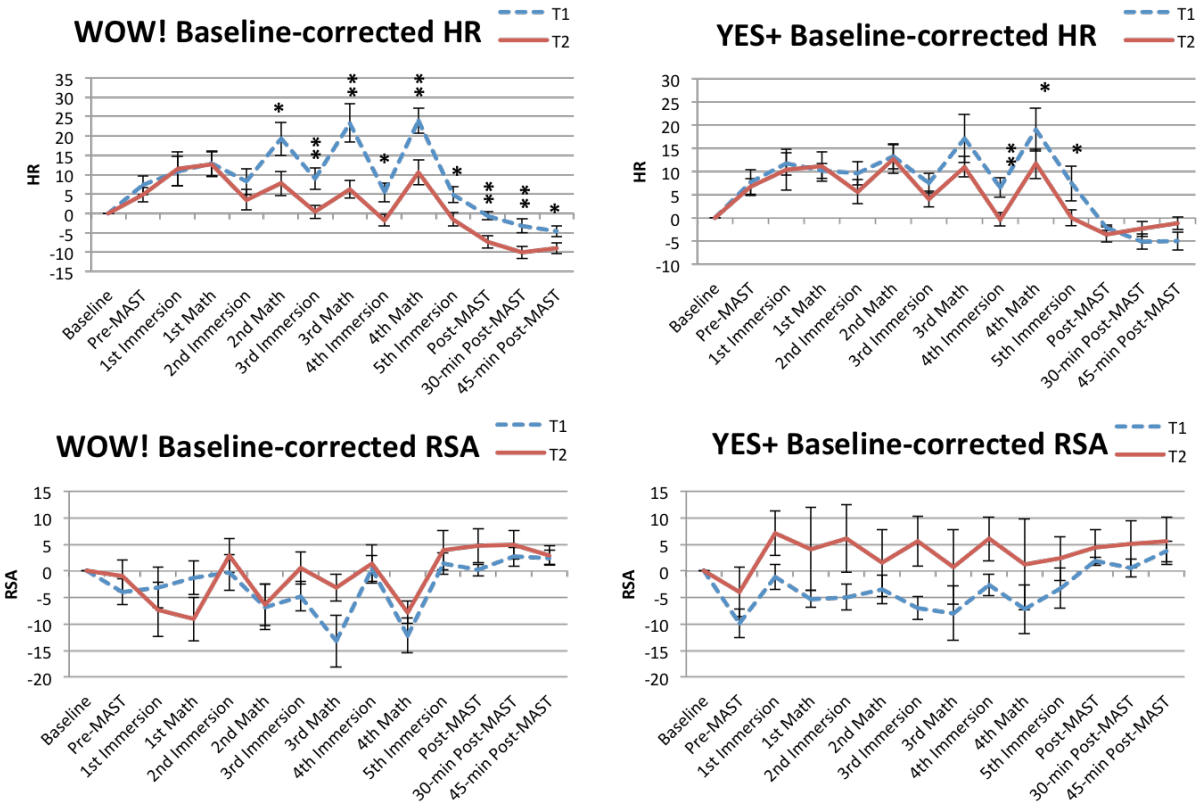

Figure 5. Mean baseline-corrected heart rate and respiratory sinus arrhythmia for WOW! and YES+ at T1 and T2, revealing multiple blocks both during the stress-induction task, as well as recovery, with significant decreases from T1 to T2 for WOW!. A similar pattern was observed for YES+, though only for limited blocks during the stress-induction and no changes for the recovery blocks. *p < .05, **p < .001

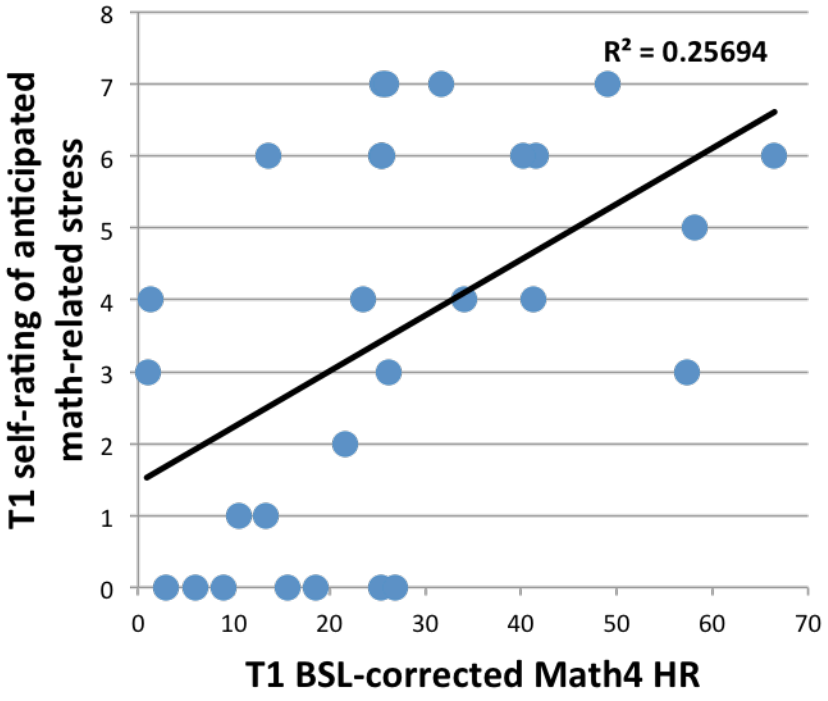

Figure 6. Self-rating of anticipated stress during a math-related task was associated with T1 baseline-corrected heart rate during the fourth math trial of the MAST (r = .51, p = .006).

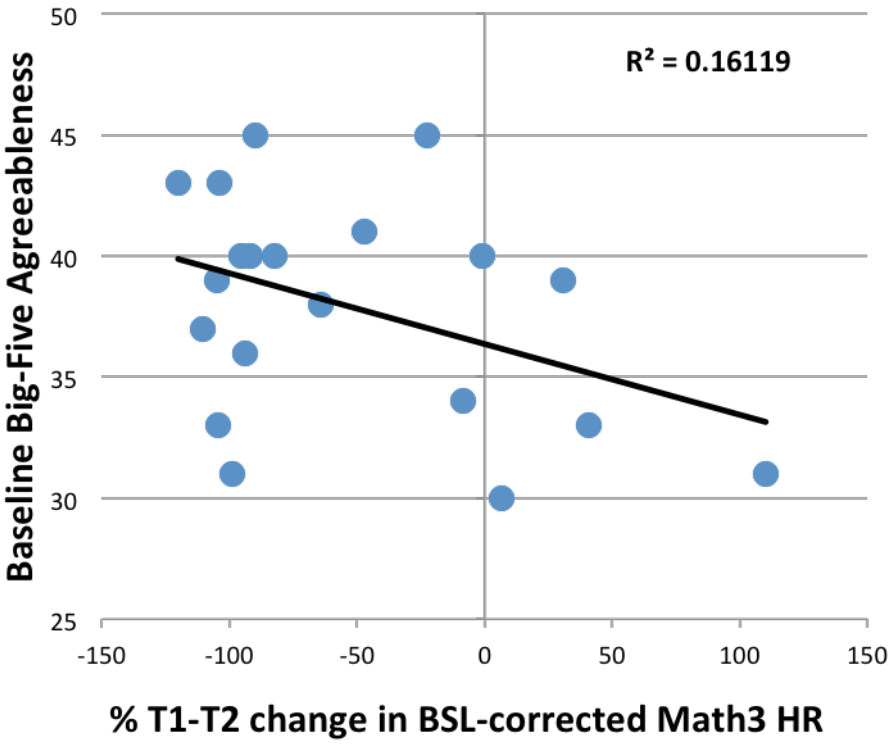

Figure 7. Baseline levels of Big-Five Agreeableness was associated with a decrease in T1 to T2 percent change in baseline-corrected heart rate during the third math trial of the MAST (r = -.40, p = .079).