<u>The Effect of Personality on Startle Response</u>

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Abstract

The emotion of fear is often accompanied by increased heart rate, sweating, and trembling. Fear can be the result of startling events experienced in everyday life. Expression of different personality traits may correlate with variation in the degree of physiological response to a startle stimulus. The purpose of this study was to determine if personality is a moderating factor in startle response following a frightening stimuli. We hypothesized that those higher in neuroticism would have more dramatic physiological responses, while those higher in extraversion and openness to experience would display a smaller physiological response. Thirty-one participants completed the Big Five personality test prior to listening to a fear-provoking auditory stimuli. Analysis of experimental results revealed that participants scoring higher in extraversion exhibited a significantly greater degree of muscle contraction ($p = 0.039$) and larger increase in heart rate ($p = 0.007$) in response to a startle stimulus. Participants scoring higher in agreeableness also showed a significantly larger increase in heart rate ($p = 0.003$).

Introduction

Fear is a universal emotion that every person expresses in some form or another. However, people react to fear in different ways (Pascalis, et al., 2013). An important factor that may play a role in someone's response to a fear stimuli is their personality, and more specifically, their levels of neuroticism, extraversion, and openness to experiences. Personality plays a role in moderating an individual's response to a fear provoking stimuli by causing them to be more sensitive (Perkins, et al., 2007). Certain traits can influence an individual to be more reactive to emotionally charged stimuli, such as a jump or a startle, and can elicit more of a physiological response. One such trait includes neuroticism, which is the tendency to be more negative and anxious, and is shown by feelings of worry or fear (Thompson, 2008). Past studies have found that higher anxiety is associated with a larger startle response, meaning that those higher in neuroticism were more likely to respond to a jump scare (Pascalis, et al., 2013). Likewise, it has also been found that the brain pathways between fear and anxiety are separate, but often interact (Pascalis, et al., 2013). This implies that those with more active anxiety pathways are more likely to have active fear pathways in their brains. Another personality trait that influences an individual's response to a startle is extraversion (Corr et al., 1995). It has been found that those higher in extraversion tend to have smaller responses to startles, and are able to habituate to a startle stimuli much faster compared to individuals low in extraversion (Larowe, et al., 2006).

Activation of the sympathetic nervous system in response to a sudden and intense stimulus, like an auditory stimulus, should elicit a mostly involuntary response that can be measured as a startle response. Startle, related to fear, is modulated in the amygdala of the temporal lobe of the brain, and can induce physiological changes such as increased heart rate, muscle contraction, and sweating (Davis M., 2006; Koch, 1999). The activation of the sympathetic nervous system leads to an increase in the release of norepinephrine and epinephrine (Beissner, F., et al., 2013). These hormones work to initiate our “fight or flight” response to protect us from danger by activating physiological systems that facilitate alertness and prepare the muscles for action (Widmaier, E, et al., 2015). One consequence of elevated levels of epinephrine and norepinephrine is an increase in heart rate (Widmaier, et al., 2015). Heart rate has been shown to be positively correlated with a startle response; a more unpleasant stimulus elicits a greater increase in heart rate (Ruiz-Padial et al., 2003). This increase in heart rate can be determined using electrocardiograph (ECG) data. Heart rate has also been shown to progressively increase in the 10 seconds following an auditory startle, whereas motor response tends to be immediate (Seifert et al., 2011). Such a motor response, the classical “jump” response to fear, can be measured using an electromyography (EMG) recorder. The stimulation of the sympathetic nervous system is also responsible for the “sweaty palms” one experiences during fear. This response can be measured as electrodermal activity (EDA), the electrical activity of the skin. EDA has been used across many types of psychophysiological studies as a valid measure of a startle or fear response (Bauer, 1998; Mardaga et al., 2006). Together, these autonomic responses make it possible to measure an individual’s level of fear using physiological measurements.

The purpose of this study is to assess how character traits correlate with individual differences in the response to startle. If frightening auditory stimuli activates the sympathetic nervous system, we hypothesize that individuals scoring higher in neuroticism will display a greater change in heart rate (ECG), skin conductance (EDA), and muscle contraction (EMG), indications of the sympathetic response. We also predict that individuals scoring higher in extraversion and openness to experience will display a smaller change in heart rate, skin conductance, and muscle contraction. We expect that participants self-scoring on the lower end of the spectrum for neuroticism will exhibit less of a startle response, and those self-scoring on the lower end of the spectrum for extraversion and openness will exhibit more of a startle response.

Recognizing differences in personality traits could be instrumental in determining one's success in a specific career field. If there is an interaction between personality traits and a startle response, this could have implications for individuals working in high stress occupations. For example, police officers, surgeons, and military officials are required to maintain a level head in situations where they may be subject to startling events. If personality can predict reactivity, it may be possible to target individuals with personality traits that are predictive of having smaller startle responses, leading to more success in their field. On the other hand, individuals at risk for a larger physiological startle response may be encouraged to undergo further conditioning exercises to habituate to startling events (Staff, 2016).

Materials

Personality Test and Demographic Questionnaire

The Big Five personality test was used to quantify characteristics of extraversion/introversion and neuroticism (Appendix A). The Big Five test has been found to have sufficient reliability and validity in testing personality traits (Morizot, 2014). The test is composed of 44 questions and takes approximately 5 minutes. It was assumed that the participants would experience no emotional response to test-taking process that may alter their baseline physiological state and affect data collection. A demographic questionnaire was administered to collect gender and age data about the participants (Appendix B).

A printed University of Wisconsin - Madison news article in the Science and Technology section, *Some brains are blind to moving objects,* was used as a neutral reading source. It was assumed that this article would not elicit an emotional response in the participant that may alter the physiological responses of interest.

Measurements of heart rate, skin conductance, and muscle contraction were recorded in this study as physiological measures of the startle response. All data were recorded on a Dell Optiplex 7020 desktop computer using a Windows 7 processing system. The Biopac Student Lab System was used for all data collection from BIOPAC instruments including BSL 4 software and MP36 hardware manufactured by BIOPAC Systems, Inc in Goleta, CA (Model MP36E120400276). Heart rate was determined by using the BIOPAC Electrocardiogram (ECG) electrode leads (Model SS2LB, SN 711A14749) and two gel-containing, disposable electrodes (EL503) placed on the right wrist and inner left ankle. Heart rate was determined from ECG data using BIOPAC software and was measured in beats per minute (BPM). Skin conductance was determined by using the BIOPAC EDA Transducer (Model SS3LA/L, SN 12123840) measuring conductance in microsiemens (μS). An isotonic gel (GEL101) was used on the finger transducers as a conducting medium. Muscle contraction was determined by using the BIOPAC Electromyography (EMG) electrode connection (Model SS2LB, SN 908A9538) on the left wrist and forearm. Participants were connected to the EMG via three gel-containing, self-adhesive electrode patches (EL503) and data was recorded in units of millivolts (mV).

The audio clip was created by sourcing rainfall and scream sound effects through YouTube. These sounds were edited together in Garageband, an audio processing software that comes standard on Mac OS X (Apple Inc., SN C02Q42JZFVH7). The final experimental auditory stimulus track consisted of one minute of rainfall sound effect, three seconds of the startling scream sound effect, followed by two additional minutes of rainfall. Beats Solo 2 headphones (Apple Inc., Model B0534, SN FL6PQ3B5GH82) were used to administer the audio clip. The internet links to the Youtube clips used to the experimental audio track can be found below:

Rain: https://www.youtube.com/watch?v=GlO3MdKTpd4

Scream: https://www.youtube.com/watch?v=5kQF4r03yRI

Methods

Participant Selection and Consent

Participation in this study was voluntary and included 30 students (6 males, 22 females) enrolled in Physiology 435 Spring 2018 at the University of Wisconsin-Madison. As a participation incentive, students were informed that they would be entered into a raffle for a $10 Wisconsin Union gift card. Participants were informed that they would be asked to complete a demographic questionnaire, personality inventory test, as well as a simple cognitive task in which they would be subjected to auditory stimuli and monitored for physiological responses. Written consent was necessary for involvement.

Experimental Procedure

Participants were brought to an unfamiliar room, seated, and asked to complete a short demographic survey. They were then given an electronic version of the Big Five personality test, and instructed to honestly and to the best of their ability answer the 44 questions. Participant responses were recorded into a self-scoring spreadsheet that awards numerical scores ranging from negative 15 to positive 38 in five personality-describing categories: extraversion, agreeableness, conscientiousness, neuroticism, and openness. A higher score in a category indicates stronger exhibition of that personality trait.

Upon completion of the test, participants were connected to equipment used for physiological monitoring. Three adhesive, pre-gelled EL503 electrodes were placed on the inside of the participants' left forearm and connected to a set of SS2LB leads in order to record electromyography (EMG) data. One EL503 electrode was placed on the inside of their right forearm and another attached to the inside of the participants' left ankle. These two electrodes were connected to another set of SS2LB leads to measure electrocardiogram (ECG) data, which was used to monitor changes in heart rate (HR). An electrodermal activity (EDA) transducer (Model SS3LA/L) was coated in isotonic gel and attached to the index and middle finger of the participant's left hand. These instruments were connected to the BIOPAC interface and calibrated through the BIOPAC software as the participant sat still with their eyes closed.

Participants were then given a pair of headphones and instructed to sit in a upright, seated position and silently read the article in front of them while listening to a neutral audio stimulus of rainfall. Participants were also instructed to keep their arms on the table and avoid moving their extremities while reading to avoid faulty results. Monitoring of the physiological measures through BIOPAC began simultaneously and as the participant began reading. The rainfall stimulus commenced 15 seconds after data recording began, and continued for exactly one minute. It was then was briefly interrupted by an unexpected stimulus of a loud scream lasting three seconds. The rainfall audio then began again immediately and participants continued reading. Recording of physiological measures was stopped thirty seconds after the scream. The headphones and BIOPAC equipment were then removed from the participant and testing was completed (Figure 1).

Data Analysis

We determined each participant's baseline values for each physiological measure by averaging their muscle contraction (EMG), skin conductance (EDA), and heart rate data during the 60 seconds leading up to the startle stimulus (15s-75s). The physiological reaction to the stimulus was measured as the maximum deviation from baseline values after the startle stimulus (75+s). The average change in each physiological variable was calculated by subtracting the baseline value from the peak value after the induced startle stimulus. For each personality trait (extraversion, agreeableness, conscientiousness, neuroticism, and openness), participants in the top third were placed into the high scoring group and those in the bottom third were placed in the low scoring group. The averages of the high and low groups were then compared using a two sample T-test with the appropriate equal or unequal variances through the data analysis function in Microsoft Excel for Mac version 16.9 (180116). P-values less than 0.05 were considered significant results.

Positive Control

Physiological deviations from resting values were demonstrated by a group member listening to the auditory stimulus and collecting their peak values following the startle. After this stimulus, the group member exhibited a change in heart rate (+22.68 BPM) and changes in skin conductance (+1.133 μS) and muscle contraction (+0.5474 mV). These deviations explicitly represented a significant change as a result of the startle (Figure 2).

Negative Control

Values of resting data were recorded during the first minute of the experiment, during which the participant was listening to the neutral rainfall stimulus. Each participant's heart rate, skin conductance, and EMG data were averaged during this minute and used as physiological baselines. These baseline measurements served as the negative control for each participant. The mean baseline values across the sample are: 0.001438 ± 0.001951mV (EMG), 6.083 μS ± 2.879 (EDA), 79.48 ± 11.56 BPM (HR).

Results

Thirty-one participants completed the Big Five personality test and underwent experimental testing. One participant was excluded from data analysis because they pulled off the headphones during the startle, causing faulty measurements. EMG and ECG data from two other participants were not used in the analysis because their leads detached during the experiment. Of all included participants, the mean maximum deviation from baseline for each physiological variable was: 0.6079 ± 0.6371 mV (EMG, n = 29); 1.729 ± 1.216 μS (EDA, n = 30); 32.32 ± 32.24 BPM (HR, n = 29) (Table 1).

The mean changes in muscle contraction and heart rate were found to be significant when comparing the high and low groups in terms of extraversion. The group of participants who scored high in extraversion had a mean change in muscle contraction of 1.045 ± 0.7891 mV and the group of participants who scored lower in extraversion had a mean change in muscle contraction of 0.3885 ± 0.4493 mV ($p = 0.039$, Figure 6). Participants higher in extraversion showed a mean increase in heart rate of 54.7 ± 38.1 BPM and participants who scored low in extraversion showed a mean increase of 13.7 ± 7.17 BPM ($p = 0.007$, Figure 8). The mean change in skin conductance was found to be insignificant between the high and low groups in terms of extraversion. The group of participants who scored high in extraversion had a mean change in skin conductance of 2.179 ± 1.442 µS and the group of participants who scored lower in extraversion had a mean change in skin conductance of 1.348 ± 0.9646 µS ($p = 0.147$).

The mean change in heart rate was found to be significant when comparing the high and low groups in terms of agreeableness. The participants who scored high in agreeableness had an increase in heart rate of 62.7 ± 38.6 BPM and the group of participants who scored lower in extraversion had an increase in heart rate of 17.6 ± 10.1 BPM ($p = 0.005$, Figure 8). The mean changes in muscle contraction and skin conductance were found to be insignificant between the high and low groups in terms of agreeableness. The group of participants who scored high in agreeableness had a mean change in muscle contraction of 1.064 ± 0.7115 mV and the group of participants who scored lower in agreeableness had a mean change in muscle contraction of 0.5484 ± 0.5702 mV ($p = 0.0905$). The group of participants who scored high in agreeableness had a mean change in skin conductance of 3.740 ± 4.925 µS and the group of participants who scored lower agreeableness had a mean change in skin conductance of 1.655 ± 1.317 μS (p = 0.2250).

Changes in muscle contraction, heart rate, and skin conductance were found to be insignificant between the high and low groups for conscientiousness. The group of participants who scored high in conscientiousness had a mean change in muscle contraction of 0.5288 ± 0.5943 mV and the group of participants who scored lower in conscientiousness had a mean change in muscle contraction of 0.7665 ± 0.6254 mV (p = 0.4437). The group of participants who scored high in conscientiousness had a mean change in heart rate of 41.4 ± 36.0 BPM and the group of participants who scored lower in conscientiousness had a mean change in heart rate of 40.0 ± 37.1 BPM (p = 0.933). The group of participants who scored high in conscientiousness had a mean change in skin conductance of 1.382 ± 0.8629 μS and the group of participants who scored lower in conscientiousness had a mean change in skin conductance of 5.899 ± 7.985 μS (p = 0.1089).

Changes in muscle contraction, heart rate, and skin conductance were found to be insignificant between the high and low groups for neuroticism. The group of participants who scored high in neuroticism had a mean change in muscle contraction of 0.4463 ± 0.5600 mV and the group of participants who scored lower in neuroticism had a mean change in muscle contraction of 0.5785 ± 0.4607 mV (p = 0.5715). The group of participants who scored high in neuroticism had a mean change in heart of 26.9 ± 18.8 BPM and the group of participants who scored lower in neuroticism had a mean change in heart rate of 43.1 ± 43.5 BPM (p =0.300). The group of participants who scored high in neuroticism had a mean change in skin conductance of 5.150 ± 8.291 μS and the group of participants who scored lower in neuroticism had a mean change in skin conductance of 2.042 ± 1.325 μS (p = 0.2718).

Changes in muscle contraction, heart rate, and skin conductance were found to be insignificant between the high and low groups for openness. The group of participants who scored high in openness had a mean change in muscle contraction of 1.057 ± 0.8624 mV and the group of participants who scored lower in openness had a mean change in muscle contraction of 0.4210 ± 0.5025 mV (p = 0.0635). The group of participants who scored high in openness had a mean change in heart rate of 27.1 ± 25.4 BPM and the group of participants who scored lower in openness had a mean change in heart rate of 35.4 ± 37.0 BPM (p = 0.5648). The group of participants who scored high in openness had a mean change in skin conductance of 3.836 ± 7.169 μS and the group of participants who scored lower in openness had a mean change in skin conductance of 1.485 ± 0.800 μS (p = 0.3295).

Discussion

The findings of this study did not align with our hypothesis that participants scoring higher in neuroticism would exhibit larger physiological deviation from baseline than those scoring lower in neuroticism, as there was no statistical significance in any variable between these groups. The study also refuted the hypothesis that individuals scoring higher in extraversion and openness would exhibit smaller physiological deviation from baseline than those scoring lower. There was no statistical significance found for the openness outcomes, and the extraversion outcomes demonstrated the opposite of our hypothesis. Those scoring higher in extraversion exhibited a greater physiological response to the startle response than their low-scoring counterparts. Specifically, these more extraverted individuals displayed a greater motor response, as suggested by the EMG data, and a significantly larger change in heart rate, as suggested by the ECG data. Participants found by the Big Five Personality Test to be more agreeable also exhibited a larger change in heart rate. These findings suggest that an interaction does exist between one's personality and how he or she reacts physiologically to a startle.

The significant interactions between personality and startle response found in this study could be useful in better understanding how personality traits impact behavior, including startle response. Many careers require individuals to react to startle-inducing situations, and a better understanding of how personality traits, such as extraversion and agreeableness, lead to higher startle responses could provide insight on how to improve performance in these situations. The inconsistency of our findings with our predictions indicates that more research is necessary to fully understand the important relationship between personality traits and startle response.

An obvious limitation to this study was the very limited diversity of our participants. The major demographic of our participants were 21 year old, female, college students. Clearly, this sample is not representative of the population as a whole. Future studies should conduct a similar study with a more diverse sample of individuals. Another possible source of error lies in the completion of the personality evaluation, which contained questions some may find sensitive. Variation in the setting in which the participant completed the personality survey could have influenced how the participants answered personality questions. Some of the participants completed the survey in a quiet room, while others filled it out in a loud and trafficked hallway. A lack of participant honesty during the personality inventory could have also compromised the integrity of the personality results. Although results were kept anonymous, it is possible that knowing that their results would be recorded by a classmate influenced participant responses. A possible solution could be to have participants complete the personality survey at home, this would maximize their comfort and hopefully encourage honest answers. There was also variation in the EDA set up between subjects including the tightness of the band, amount of gel on the monitor, and quality of the cleaning between uses. Future studies should attempt to standardize these variations to reduce their contribution to variation in the data.

The findings of this study present many opportunities for follow-up experiments to further investigate the link between personality and the startle response. The Big Five Personality Test, although widely used in the field of psychology, is relatively short and unrigorous and may be limited in its scope and accuracy. Repeating the experiment using a more thorough personality assessor, such as the Minnesota Multiphasic Personality Inventory or Myers-Briggs Type Indicator, could add validity to this study's findings. Additionally, because this study was limited by having only six male participants, a full study into gender differences in the physiological response to a startle stimulus would add further depth and meaning to this study. Finally, it could be interesting to look into other measures of physiological fear response including respiratory rate, eye-blink startle, or time to return to the baseline measurements.

Tables

Table 1

Average Change from Baseline by Personality Trait

		Extraversion		Agreeableness		Conscientiousness		Neuroticism		Openness	
		Low (n=10)	High (n=10)	Low (n=10)	High (n=10)	Low (n=10)	High (n=10)	Low (n=10)	High (n=10)	Low (n=10)	High (n=10)
Physiological Change from Baseline	EMG (mV)	0.3885*	1.045*	0.5484	1.064	0.7665	0.5528	0.5785	0.4463	0.4210	1.057
	EDA (µS)	1.348	2.179	1.655	3.740	5.899	1.382	2.042	5.150	1.485	3.836
	HR (BPM)	13.7*	54.7*	17.6*	62.7*	40.0	41.4	43.1	26.9	35.4	27.1

*Note: * indicates significant difference (p<0.05)*

Figures and Graphs

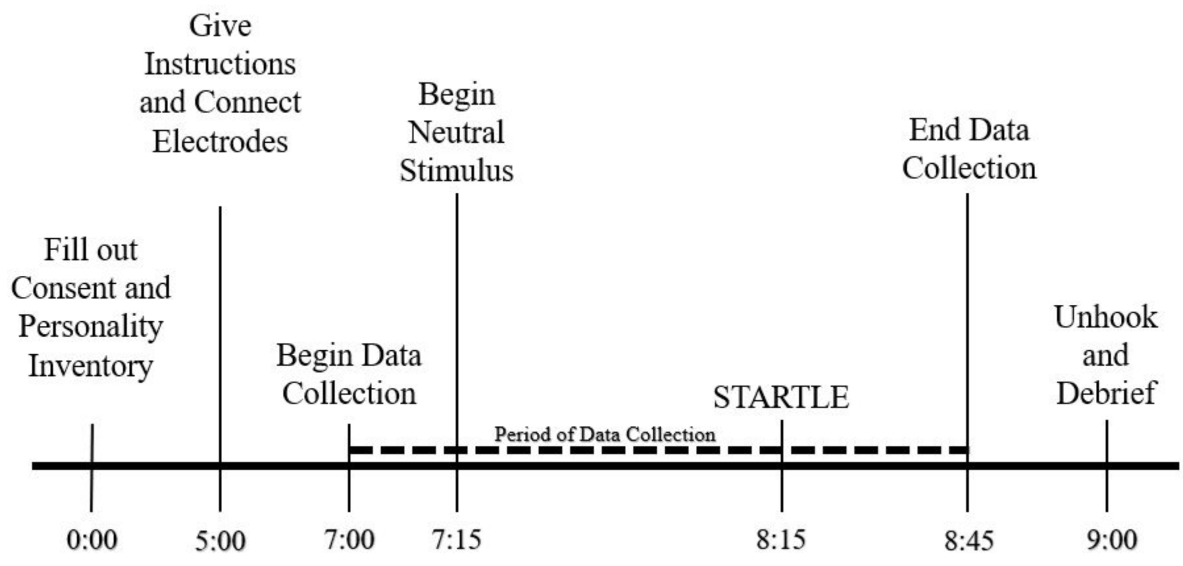

Figure 1. Timeline representation of methodology.

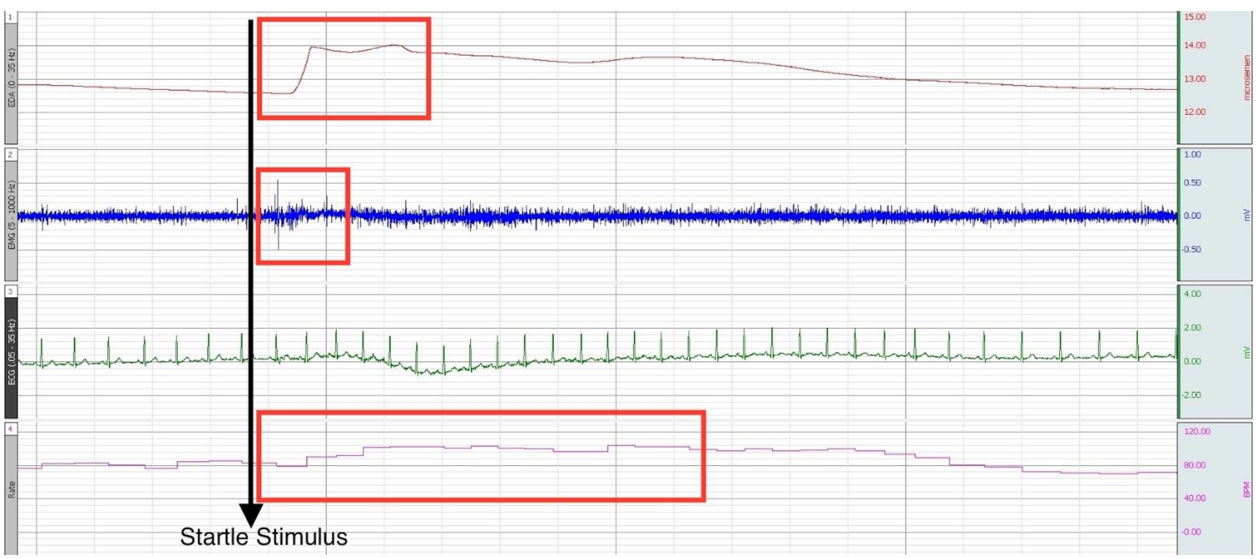

Figure 2. Positive Control Data Example. This figure shows an example of a positive control dataset. The participant's skin conductance (top box), muscle contraction (middle box), and heart rate (bottom box) increased immediately following the start of the startle stimulus, denoted with an arrow.

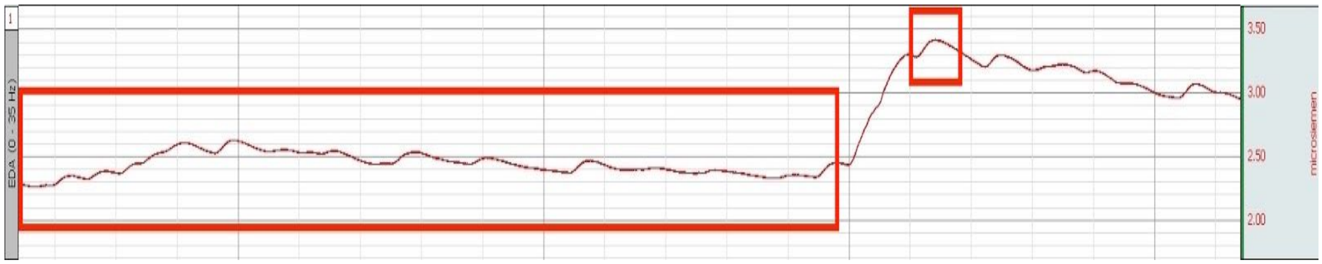

Figure 3. Electrodermal Activity Data. This figure shows an example of raw electrodermal activity data measured in microsiemens, taken directly from the BIOPAC software. The time scale begins at 15 seconds, when the neutral auditory stimulus begins, and ends at the termination of the experiment (105 seconds), 30 seconds after the startle stimulus. The large box on the left encloses the participant's EDA data during the neutral stimulus, which was averaged and used as each participant's physiological baseline skin conductance. As exhibited in the figure, introduction of the startle stimulus causes a spike in the EDA measurements. The smaller box on the right encloses the participants maximum skin conductance, which was used to calculate each participant's maximum deviation from baseline.

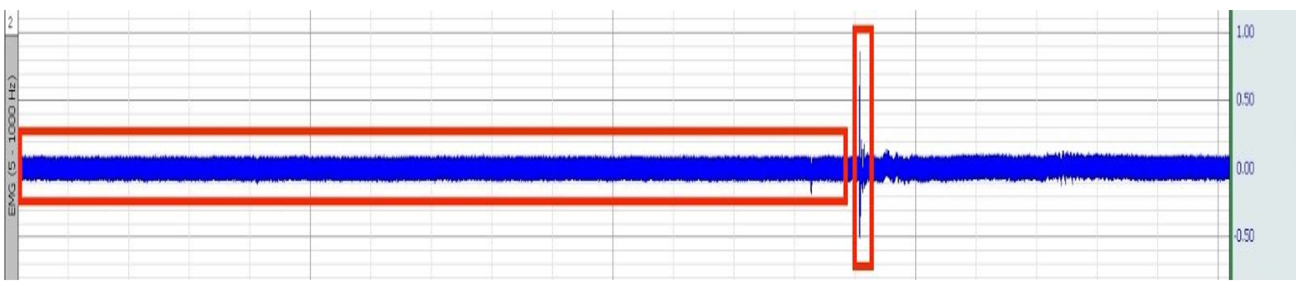

Figure 4. Electromyography Data. This figure shows an example of raw electromyography data measured in millivolts, taken directly from the BIOPAC software. The time scale begins at 15 seconds, when the neutral auditory stimulus begins, and ends at the termination of the experiment (105 seconds), 30 seconds after the startle stimulus. The large box on the left encloses the participant's EMG data during the neutral stimulus, which was averaged and used as each participant's physiological baseline muscle contraction. As exhibited in the figure, introduction of the startle stimulus causes a sharp peak in the EMG measurement. The smaller box on the right encloses the participants maximum muscle contraction, which was used to calculate each participant's maximum deviation from baseline.

Figure 5. Electrocardiograph Data. This figure shows an example of raw ECG heart rate data measured in beats per minute, taken directly from the BIOPAC software. The time scale begins at 15 seconds, when the neutral auditory stimulus begins, and ends at the termination of the experiment (105 seconds), 30 seconds after the startle stimulus. The large box on the left encloses the participant's heart rate during the neutral stimulus, which was averaged and used as each participant's physiological baseline heart rate. As exhibited in the figure, introduction of the startle stimulus causes a lasting increase in heart rate. The smaller box on the right encloses the participants maximum heart rate, which was used to calculate each participant's maximum deviation from baseline.

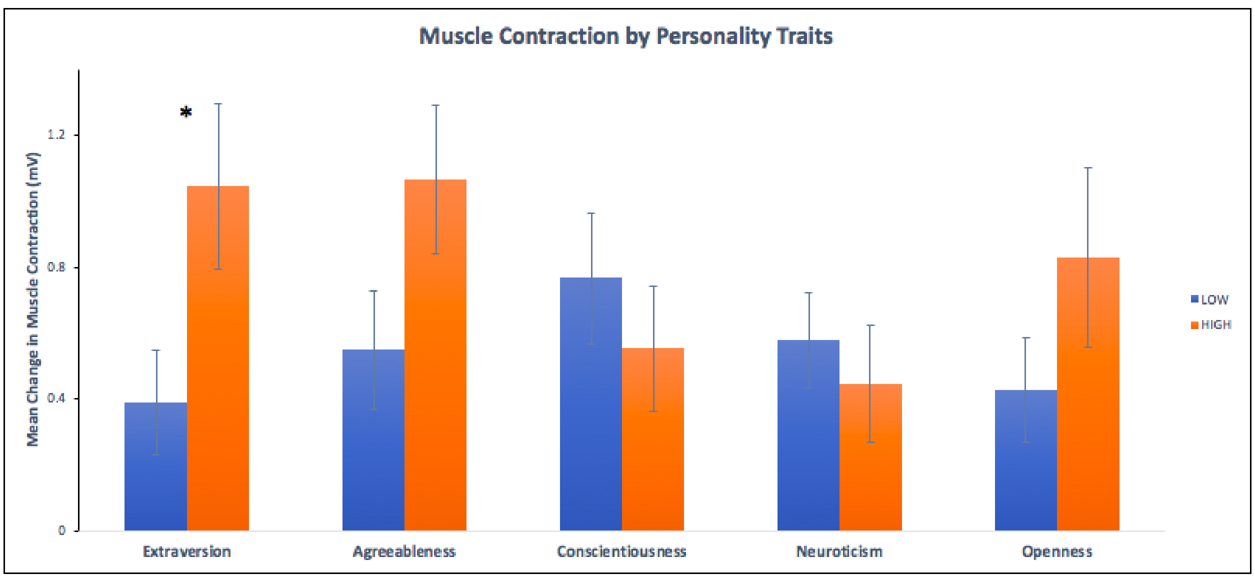

Figure 6. This figure shows the mean electromyography results (mV) for the various personality traits with error bars displaying ± standard error. Low represents the bottom one third of our sample size and high represents the top one third of our sample size (n=29). Extraversion (p-value=0.03934) was found to be statistically significant (*)

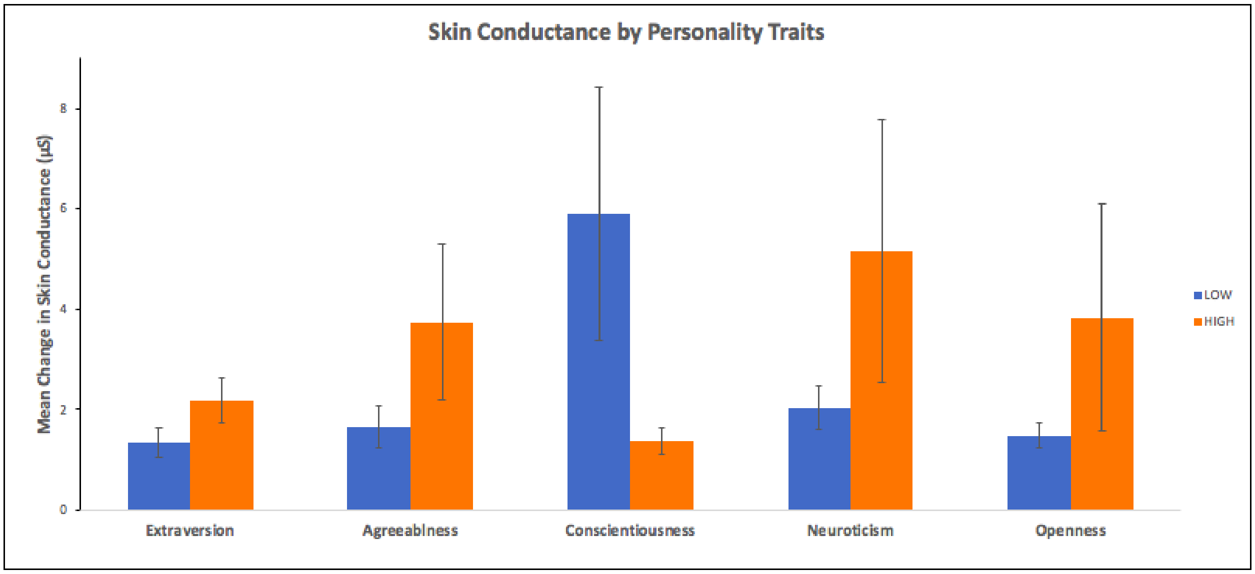

Figure 7. This figure shows the mean electrodermal activity (μS) for the various personality traits with error bars displaying ± standard error. Low represents the bottom one third of our sample size and high represents the top one third of our sample size (n=29).

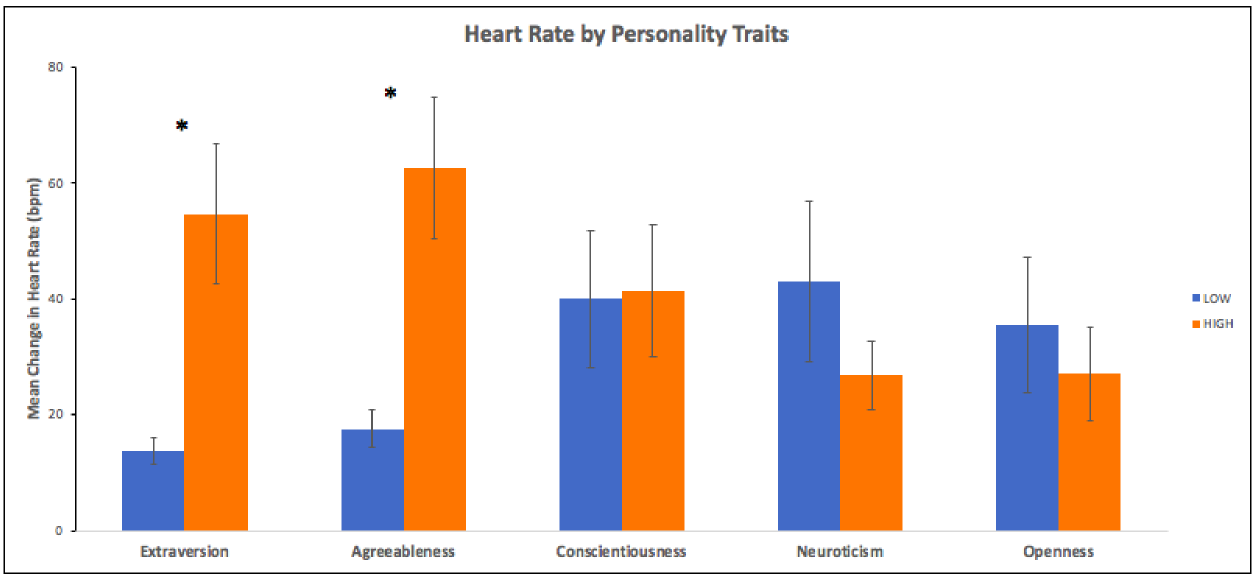

Figure 8. This figure shows the mean electrocardiogram (BPM) for the various personality traits with error bars displaying ± standard error. Low represents the bottom one third of our sample size and high represents the top one third of our sample size (n=29). Extraversion (p-value=0.007422) and agreeableness (p-value= 0.005063) were found to be statistically significant (*).

APPENDIX A

The Big Five Personality Inventory

The Big Five

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement.

Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1	2	3	4	5

I see myself as someone Who…

____1. Is talkative

____2. Tends to find fault with others

____3. Does a thorough job

____4. Is depressed, blue

____5. Is original, comes up with new ideas

____6. Is reserved

____7. Is helpful and unselfish with others

____8. Can be somewhat careless

____9. Is relaxed, handles stress well

___10. Is curious about may different things

____11. Is full of energy

____12. Starts quarrels with others

____13. Is a reliable worker

____14. Can be tense

____15. Is ingenious, a deep thinker

____16. Generates a lot of enthusiasm

____17. Has a forgiving nature

____18. Tends to be disorganized

____19. Worries a lot

____20. Has an active imagination

____21. Tends to be quiet

____22. Is generally trusting

____23. Tends to be lazy

____24. Is emotionally stable, not easily upset

____25. Is inventive

____26. Has an assertive personality

____27. Can be cold and aloof

____28. Perseveres until the task is finished

____29. Can be moody

____30. Values artistic, aesthetic experiences

____31. Is sometimes shy, inhibited

____32. Is considerate and kind to almost everyone

____33. Does things efficiently

____34. Remains calm in tense situations

____35. Prefers work that is routine

____36. Is outgoing, sociable

____37. Is sometimes rude to others

____38. Makes plans and follows through with them

____39. Gets nervous easily

____40. Likes to reflect, play with ideas

____41. Has few artistic interests

____42. Likes to cooperate with others

____43. Is easily distracted

____44. Is sophisticated in art, music, or literature

APPENDIX B

Demographic Questionnaire

Demographic Information

Gender M F Declined

Age: ________

References

Barncard, C. (2016). Some brains are blind to moving objects. Retrieved from https://news.wisc.edu/some-brains-are-blind-to-moving-objects/

Bauer, R. (1998) Physiologic measures of emotion. *Journal of Clinical Neurophysiology*, 15(5), 388-396.

Beissner, F., Meissner, K., Bar, K.-J., & Napadow, V. (2013). The autonomic brain: an activation likelihood estimation meta-analysis for central processing of autonomic function. *Journal of Neuroscience*, 33(25), 10503–10511.

Corr, P. J., Wilson, G. D., Fotiadou, M., Kumari, V., Gray, N. S., Checkley, S., & Gray, J. A. (1995). Personality and affective modulation of the startle reflex. *Personality and Individual Differences,* 19(4), 543-553.

Davis, M. (2006). Neuronal systems involved in fear and anxiety measured with the fear-potentiated startle paradigm. *PsycEXTRA Dataset*.

Janis, I. L., & Feshbach, S. (1954). Personality differences associated with responsiveness to fear-arousing communications. *Journal of Personality,* 23(2), 154-166.

Koch, M. (1999). The neurobiology of startle. *Progress in Neurobiology*, 59(2), 107–128.

Kuppens, P., Allen, N. B., & Sheeber, L. B. (2010). Emotional inertia and psychological maladjustment. *Psychological Science,* 21(7), 984-991.

Larowe, S. D., Patrick, C. J., Curtin, J. J., & Kline, J. P. (2006). Personality correlates of startle habituation. *Biological Psychology,* 72(3), 257-264.

Mardaga, S., Laloyaux, O., & Hansenne, M. (2006). Personality traits modulate skin conductance response to emotional pictures: An investigation with Cloninger's model of personality. *Personality and Individual Differences*, 40(8), 1603–1614.

Morizot, J. (2014). Construct validity of adolescents' self-reported big five personality traits. *Assessment, 21*(5), 580-606.

Pascalis, V. D., Cozzuto, G., & Russo, E. (2013). Effects of personality trait emotionality on acoustic startle response and prepulse inhibition including N100 and P200 event-related potential. *Clinical Neurophysiology*, 124(2), 292-305.

Perkins, A. M., Kemp, S. E., & Corr, P. J. (2007). Fear and anxiety as separable emotions: An investigation of the revised reinforcement sensitivity theory of personality. *Emotion,* 7(2), 252-261

Ruiz-Padial, E., Sollers, J. J., Vila, J., & Thayer, J. F. (2003). The rhythm of the heart in the blink of an eye: Emotion-modulated startle magnitude covaries with heart rate variability. *Psychophysiology*, 40(2), 306–313.

Seifert, J. G., Nelson, A., Devonish, J., Burke, E. R., & Stohs, S. J. (2011). Effects of an auditory startle stimulus on blood pressure and heart rate in humans. *International Journal of Medical Sciences*, 8(3), 192–7.

Staff, L. (2016). Training Police through Virtual Reality. Retrieved from http://lassonde.utah.edu/training-police-through-virtual-reality/

Thompson, E. R. (2008). Development and validation of an international english big-five mini-markers. *Personality and Individual Differences, 45*(6), 542-548.

Widmaier, Eric, Hershel Raff, and Kevin Strang. (2015). "Cardiovascular System." *Vander's Human Physiology*. 14th ed. N.p.: McGraw-Hill Education. 370-86. Print.

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