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Heart Rate Variability: Impact of Neuroticism and Social Isolation

John Beckius
College of Saint Benedict/Saint John's University, jlbeckius@csbsju.edu

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Abstract

Psychologists are interested in self-compassion and its effects on our biopsychological well-being. A common method found throughout much research in assessing this is through heart rate variability. In the present study, we attempt to see whether or not self-compassion has an impact on one's heart rate variability as a higher HRV indicates one is better able to adapt to stress. Self-compassion was measured beforehand through an online self-compassion survey that contained subscales measuring neuroticism. We also tested to see if social isolation would have an impact on HRV. Social isolation was implemented through a computer program game titled *CyberBall*, in which the researchers programmed the "game" to include or exclude the participants. There were two groups in the study with one starting in the isolation condition and ending in the non-isolation condition and the other starting in the non-isolation condition and ending in the isolation condition. Participants' HRV was measured while they played *CyberBall*. We hypothesized that a lower heart rate variability would be produced during the isolation condition. We unfortunately found no significant change in HRV predicted by this hypothesis. However, our second hypothesis predicted that the more neurotic a participant was, the lower the heart rate variability would be. Results supported this hypothesis and suggest that neuroticism is an important variable when analyzing heart rate variability.

Social evaluative stressors are a part of everyday life that humans face as we are constantly being evaluated by others. Whether it's just by our peers or through job and academic performance appraisals, people must sometimes face harsh criticisms that can result in harming both our biological and psychological well-being. This has lead to a growing amount of research focusing on self-compassion as it has been shown to help one overcome the evaluative stresses we face on a day to day basis. Self-compassion has been described as compassion turned inward and refers to how we relate to ourselves in instances of perceived failure, inadequacy, or personal suffering (Neff, 2016). Neff also describes it to have a positive and negative pole that represents self-kindness versus self-judgment (2016). Self-kindness is the more ideal side of the spectrum as it allows one to be more supportive and understanding toward oneself while self-judgment makes one critical of oneself for any personal shortcomings. One who is more self-kind would more likely be able to overcome evaluative stressors. The self-compassion scale has been used in a significant amount of research that attempts to assess trait levels of self-compassion. The scale was designed to explicitly represent the thoughts, emotions, and behaviors that are linked with the various components of self-compassion (Neff, 2016).

The self-compassion scale consists of self-kindness items, self-judgment items, common humanity items, isolation items, mindfulness items, and over-identified items (Neff, 2003). Subscale scores are computed by calculating the mean of subscale items responses. In order to compute a total self-compassion score, negative subscale items must be reversed scored before calculating subscale means and then one can compute a grand mean of all six subscale means.

Other means of self-compassion training such as meditation has been used in other research in order to reduce social evaluative threat responding (Arch, Brown, Brown, Dean,

Landy, & Laudenslager, 2014). In their studies, Arch et al. investigated whether brief training in self-compassion moderated biopsychological responses to the Trier Social Stress Test in women. Their results showed that in comparison to the no-training control conditions, the self-compassion training helped participants minimize negative biopsychological responses such as sympathetic, cardiac parasympathetic, and subjective anxiety responses.

A study done by Horsten, Ericson, Perski, Wamala, Schenck-Gustaffson, and Orth-Gomer (1999) showed that social isolation was associated with a decrease in heart-rate variability. The researchers explored associations between psychosocial risk factors including social isolation, anger, and depressive symptoms with heart rate variability in 300 healthy women between the ages of 30-65 years old. Social isolation was measured through the use of a condensed version of the Interpersonal Support Evaluation List. The purpose of this tool is to measure perceptions of social support among individuals in the general population. Those who perceived a lack of social support or social isolation were found to be associated with a decreased heart-rate variability.

Another study done by Grippo, Lamb, Carter, and Porges (2007), social isolation was to be related with changes in heart rate and this is what these researchers tested in their methods. Fifteen females were tested over a six week period to see how their heart rates would change whether they were in the isolation group or the paired group (non-isolation). Results showed that for the isolation group, there was an increase in resting heart rate and a decrease in heart rate variability. This shows that social isolation does in fact have a role in predicting changes in heart rate and heart rate variability over a period of time.

Other research has looked more into the relation between self-compassion and psychophysiological measures. Binder, Dundas, Nordby, Osnes, Schanche, Sorensen, Svendsen,

& Visted (2016) looked at the relation between self-compassion and heart rate variability. A heart rate variability that is described to be high indicates healthy heart function and is suggested as a physiological index of emotion regulation capacity, which allows for one to effectively adapt to stressful situations (Binder, Dundas, Nordby, Osnes, Schanche, Sorensen, Svendsen, & Visted, 2016). The researchers found that higher levels of self-compassion predicted higher levels of vagally mediated heart rate variability (vmHRV).

Although a good amount of research has been done in the area, there is still much more to be studied as Silvia, Jackson, and Sopko (2014) question whether or not heart rate variability truly does reflect stable positive emotionality due to past research finding non-linear effects. The researchers in this study had participants complete a wide range of measures that reflected positive psychological functioning and followed through with measuring heart rate variability that was quantified using multiple common HRV metrics. Results showed neither linear nor non-linear effects suggest that the cross-sectional relationship between heart rate variability and positive experience needs more attention and meta-analytic synthesis (Silvia, Jackson, and Sopko, 2014).

In the present study, we tested to see whether or not social isolation would have an impact on heart rate variability. We also tested to see if neuroticism would increase or decrease a participant's HRV. Based on the previous research, we hypothesized that social isolation would decrease a person's HRV and that the more neurotic a person was, the lower his or her HRV would be as well.

Method

Participants

Participants included 9 males and 7 females for a total of 16 undergraduate college students from the College of Saint Benedict and Saint John's University. Participants were required to take part in the research as part of a lab through a Physiological Psychology course.

Materials

Participants were asked to take part in an experiment that measured heart rate variability through a Biopac Machine (Model MP150). Three electrodes were used and attached to the participant's body with the use of gel from the Biopac Machine. An online game titled CyberBall, programmed to exclude or include participants, was played while heart rate variability was measured. A self-compassion survey was also used and administered online through surveymonkey.com. Subscales of the survey included those that measured neuroticism and anxiety. This was taken in individual testing cubicles before heart rate variability measurement took place. The total amount of time to complete both was about 30 minutes.

Procedure

The experiment started by first having participants come into the testing room and read though then sign a consent form. They were then asked to attach three electrodes to their bodies; One on the left side just below the collar bone, one on the right side just below the collar bone, and one on the left side just below the rib cage. Participants were then brought to a computer lab and instructed to provide an identification number as well as complete a 20-question neuroticism survey. After completing the survey, participants were then brought back to the testing room and instructed to attach each of the three leads to the designated electrode on their body. The participants were then asked to sit in a chair, facing a computer screen as they began the

CyberBall program. Participants that completed condition 1 first played the game with the other players including them equally by frequently passing a ball to the participant. This condition lasted for 5 minutes and afterwards were then instructed to just stay still and relax for another 5 minutes before beginning condition 2. The same process took place for those who started in condition 2, however in this condition participants were socially isolated where other players rarely passed them a ball. A new data file was started at the beginning of data collection for each of the 5-minute segments through the use of the Biopac Machine and a computer. Following the completion of this final phase, participants provided the same identification number as they had on the survey to allow for complete anonymity in the analysis. Participants were then allowed to remove the leads and electrodes from their body as they were debriefed to the reality of our study.

Results

We hypothesized that a lower heart rate variability would be produced during the isolation condition of the *Cyberball* game. We unfortunately found no significant change in HRV predicted by this hypothesis. However, we did find that the low neuroticism group showed statistically significant high frequency heart rate variability $F\,(1,8) = 5.86$, $p < .05$. The root mean squared standard deviation (RMSSD) found statistically significant difference between the high and low neuroticism groups $F\,(1,8) = 10.21$, $p < .05$. There was a statistically significant difference between the high neuroticism and low neuroticism groups. The low neuroticism group showed higher RMSSD scores as well as high frequency heart rate variability. There were no statistically significant results between the included and excluded groups.

Discussion

We first hypothesized that heart rate variability would be lower during the isolation condition. Although our results did not show a significant change to support this prediction, there was potential if not due to a small number of participants. It can be safe to say that our results could have been significant given a bigger sample population to work with. Therefore, it can be assumed that a larger amount of people would have helped to replicate the past research showing that a higher amount of self-compassion results in a larger heart rate variability.

This was seen in the research done by Horsten, Ericson, Perski, Wamala, Schenck-Gustaffson, and Orth-Gomer (1999) as social isolation was associated with a decrease in heart-rate variability. This study contained a much larger sample as 300 healthy women between the ages of 30-65 years old were used.

The second hypothesis predicted that the more neurotic a participant was, the lower the heart rate variability would be. Results were significant and supported this hypothesis. These results suggest that neuroticism is an important factor to consider when analyzing heart rate variability.

A concern with the study is the low number of participants as well as in the selection of participants. A larger number of participants could have been better able to generalize about the population and potentially look at other factors that mar vary and influence results. Participants were made up of students in an introductory psychology class and received PRIA credits for participating. Because they had to partake in the experiment for credits, participants could have felt less incline to give well thought out and honest answers on the survey.

Future studies could examine other methods of measuring self-compassion such as through meditations or repeating positive words of encouragement. They could also examine how other social isolation tasks and conditions impact heart rate variability such as through real-life events rather than through a computer program.

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