SCHOLARLY REVIEW

Interaction of Sensitivity and Stress on an Individual's Likelihood of Depression

By Er (Carol) Yue

Acknowledgement

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Author Biography

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Abstract

Environmental sensitivity is an individual's ability to process and perceive external stimuli. Within a population, sensitivity greatly varies. Self-reported measures of sensitivity like sensory processing sensitivity (SPS) have been shown to have a positive correlation with stress. However, not many studies have explored Respiratory Sinus Arrhythmia (RSA) as a measure of sensitivity. This study hopes to investigate the relationship between RSA and depressive symptoms when stress acts as a moderator. Through a correlational design and moderation analysis, this study seeks to prove that higher sensitivity signals more susceptibility to the impacts of stress and therefore more depressive symptoms. Examining data from a majority Hispanic sample, this paper found significant correlations between stress and depressive symptoms as well as stress and biological sex. When stress acts as a moderator, the results support the hypothesis. However, certain limitations include the lack of a generalizable sample due to factors such as race and unavoidable external validity from conducting all measures in a lab. Since this current study pointed out a vulnerable population – sensitive people – future research could focus on the prevention of depression or assistance of individuals experiencing depression. Overall, this paper hopes to provide further insight into the traits of sensitivity and depression.

Keywords: Environmental Sensitivity, Stress, Depression, Respiratory Sinus Arrhythmia, Sensory Processing Sensitivity, Mental Health, Highly Sensitive Person, Vagal Tone

Introduction

Environmental sensitivity is a common trait shared across many species; it is defined as an individual's ability to perceive, process, and react to external stimuli in their given environment (Pluess, 2015; Wolf et al., 2008). Sensitivity greatly varies between individuals, meaning one can be anywhere from more to less reactive (Pluess, 2015). However, a specific individual's level of sensitivity is consistent across all given environmental conditions, whether supportive or adverse. A highly sensitive individual is more susceptible to the positive, nurturing effects of a supportive environment and the stressful effects of a negative one (Belsky & Pluess, 2009). Sensitivity is a heritable trait whose genetic components have been found to explain up to half (47%) of the variation within populations (Assay et al., 2020). The remaining 53% are explained by an individual's constantly changing environment and other predetermined or formed temperament factors that uniquely shape the individual (Assary et al., 2020).

An individual's sensitivity is most commonly measured by the Highly Sensitive Person Scale (HSP) (Aron & Aron, 1997). This self-reported scale is designed for adults. It consists of 27 items which are ranked on a 1-7 Likert-type scale. Items range from questions related to feelings and emotions such as "Do other people's moods affect you?" to more phenotypic, measurable ones like "Do you tend to be more sensitive to pain?" (Aron & Aron, 1997). Based on this scale, the Highly Sensitive Child Scale (HSC) has been derived (Assary et al., 2018). This newly modified 1-5 Likert scale is shortened to 12 items that are adjusted for children and adolescents. The HSC scale separates children into three different groups: low (approx. 25–35%), medium (approx. 41–47%), and high sensitivity (20–35%) (Assary et al., 2018). Various studies have modified and adapted the HSC scale to benefit their research (Weyn et al., 2021).

Environmental sensitivity acts as an umbrella term for an observed trait. Many theories that fall under the term have attempted to categorize it more specifically. The Differential Susceptibility Theory (DST) proposed by Jay Belsky suggests that some children are naturally more prone to influences of both negative and positive environments (Belsky, 2013). DST discusses potential childcare and upbringing strategies to support children with various sensitivity levels so that they can best thrive throughout their lives. An alternative theory that has gained popularity is Sensory Processing Sensitivity, a proposed trait of retrospection and consciousness about one's environment. The expression of this trait in certain individuals leads to a more reactive processing of stimuli which renders behaviors categorized as sensitive (Aron & Aron, 1997). From a neurological standpoint, SPS has been found to increase activity in regions of the brain such as the cingulate and premotor areas, which are associated with attention, empathy, self-other processing, and action planning. This neural activity is often observed in individuals who scored as highly sensitive on the HSP scale, indicating the expression of their SPS trait (Acevedo et al., 2014).

While the original and simpler model of SPS is one-dimensional, the revised and multi-dimensional version has gained more usage. SPS is divided into three sub-divisions: Aesthetic Sensitivity (AES), Ease of Excitement (EOE), and Low Sensitivity Threshold (LST) (Aron & Aron, 1997). Aesthetic sensitivity is the skill of noticing and appreciating beauty and art; ease of excitement is a measure of how easily a stimulus overwhelms the individual; and low sensitivity threshold refers to one's sensory arousals due to outside stimuli. The three factors of SPS are found to have different effects and act upon an individual's sensitivity differently (Aron & Aron, 1997).

Studies have shown a positive correlation between SPS and both Positive and Negative Affect (Belsky et al., 2009; Lionetti et al., 2019). Positive Affect is an individual's susceptibility to beneficial moods like joy and the extent to which they can experience it. Negative Affect explores the interaction between the individual and sad, stressful emotions. Individuals ranking higher on the HSC scale tend to feel their emotions more deeply and have a higher susceptibility to both Positive and Negative Affect (Lionetti et al., 2019).

Stress is to some degree similar to Negative Affect. Although studies on stress and sensitivity are limited, multiple studies have shown a positive correlation between SPS and stress (Benham 2006; Kenemore et al., 2023). In a mainly Hispanic and female sample, Kenemore et al. measured self-reported stress using the Perceived Stress Scale (Cohen & Williamson, 1988). They found SPS to

have a positive correlation (r = .457) with stress and a similar correlation (r = .453) with symptoms of illness assessed by the Cohen-Hoberman Inventory for Physical Symptoms (Cohen & Hoberman, 1983; Kenemore et al., 2023). With stress negatively correlating with health (r = -.465), the researchers concluded that SPS could potentially lead to higher risks of illness with stress being the moderator (Kenemore et al., 2023). A similar study found an almost identical correlation (r=.482) between SPS and stress. However, both studies relied on a convenient sample of Hispanic females and therefore further experimentation would be necessary to declare a universal relationship between SPS and stress.

Although previous studies have explored the correlation between environmental sensitivity, stress, and their resulting health impacts, most of those studies were conducted using self-reported scales of sensitivity like the HSP scale. In this study, I attempted to add to previous studies by using a rarely-used biological and testable measure of sensitivity: Respiratory Sinus Arrhythmia (RSA). Biological measures are more precise and accurate because they directly reflect an individual's body whereas self-perception can often be skewed or influenced. Based on past research, this study hypothesizes a strong relationship between an individual's sensitivity and the strain of stress on their mental well-being. I propose that higher placings on the sensitivity scale signal that an individual's mental health is more susceptible to the impacts of stress and may experience this stain to a stronger degree.

Method

Participants

A convenient sample of volunteers (N = 137) from the local community participated in the study. The sample had an almost even distribution of sex with only one more female than male (50.4%, n_{female} = 69). Participants' ages were split into categories with intervals of ten years; the mean was between 40 and 50 years old. Hispanic participants accounted for half the sample (48.2%, $n_{hispanic}$ = 66); the other half consisted of predominantly White and Asian participants. Black and Native American participants made up less than 3% of the sample. All participants had a high school degree with more than half also receiving at least a bachelor's degree (64.4%). Reported income started at $20,000 and participants had an average income in the high $60,000s.

Design

The current study uses secondary data. I used a Pearson's R correlation test and moderation analysis to test my hypotheses. All data was processed and calculated by the IBM SPSS Statistics software. Participants were asked to come to the research lab for all measurements and surveys. Upon arrival, participants received two surveys, the first regarding demographic information and the second regarding stress. All information regarding demographics and identity was voluntarily given and self-reported. Participants also had their sensitivity tested through heart rate monitoring devices which calculated their resulting RSA. Lastly, all participants received a $100 prize money as gratification.

Measures

Measure 1 Sensitivity

As previously mentioned, sensitivity was measured by Respiratory Sinus Arrhythmia (RSA) using electrocardiogram. RSA refers to the natural variation of heart rate between inhalation and exhalation caused by the vagus nerve (Yasuma & Hayano, 2004). RSA is used as an index for vagal tone which has been proven to indicate sensitivity. A higher RSA score, or heart rate variability (HRV), indicates higher sensitivity in the individual.

Measure 2 Stress

Stress was indexed by daily hassles – inconveniences throughout the day like traffic jams that may disturb an individual's planned routine. Participants were given daily scenarios which they were asked to rate between 0-2 based on the amount of stress they predicted to receive from each scenario. An average was taken from all ratings, constituting the participant's degree of stress.

Measure 3 Depressive Symptoms

Amount of Depressive Symptoms was used in the study as a scale for mental health. The Youth Self Report (YSR) developed by Achenbach and Rescorla was selected as a measuring device for depressive symptoms (Achenbach et al., 2001). YSR is widely used to measure emotional and behavioral well-being in all ages. A series of questions determine the test-taker's score, with higher scores indicating more depressive symptoms. YSR doesn't have a cut-off for clinical depression, however, it is a good indication for possible onset.

Results

Descriptive statistics showed a mean RSA of 6.09 (sd = 1.15) and a mean depressive symptom of 4.96 (sd = .27) (see Table 1).

No significant correlations were shown directly between sensitivity and stress or sensitivity and depressive symptoms. However, stress had a positive correlation with depressive symptoms (r = .322) and also a positive correlation with sex (r = .267) (see Table 2). Female participants were found to experience and report higher levels of stress compared to their male counterparts.

To test my hypothesis that higher sensitivity with higher stress levels results in more depressive symptoms, I conducted a moderation analysis and tested stress as a moderator. The resulting relations between sensitivity and depression at low, medium, and high stress varied (see Fig 1). Under both low and medium levels, sensitivity didn't have a significant impact on an individual's degree of depressive symptoms. However, under high stress levels, more sensitive individuals showed more depressive symptoms. Therefore, stress is a key determinant for the relationship between sensitivity and depressive symptoms.

Discussion

Through the correlational analysis of second-hand data, I was able to examine the relationship between sensitivity, stress, and the resulting health consequences. My hypothesis is that higher sensitivity indicates that an individual is more susceptible to the impacts of stress, resulting in an increased likelihood of mental illness onset. Initially, correlational data did not show a significant or direct correlation between sensitivity and perceived stress or sensitivity and depressive symptoms. However, the statistics showed a positive correlation between stress and depressive symptoms as well as stress and sex. When stress was adjusted to be the moderator between sensitivity and depressive symptoms, the results aligned with my hypothesis. The data showed that high sensitivity paired with higher stress levels will likely result in more depressive symptoms.

The conclusions that were formed from this study aligned with multiple previous studies. Past studies using stress as a moderator between signs of illness and SPS yielded a similarly positive correlation (Benham, 2006; Kenemore et al., 2023). This demonstrates the interchangeability of RSA and SPS as sensitivity measures, suggesting a possible combination for an ultimate future measurement. Furthermore, studies conducted with the measure of RSA showed similar results. When the effect of vagal tone on children's development was examined in relation to their socio-economic status (SES), researchers found that children with higher vagal tones in lower SES populations were less likely to perform the targeted behavior (Sturge-Apple et al., 2016). As lower SES backgrounds are often associated with more stress, this research confirms that higher sensitivity paired with higher stress has significant effects on an individual's development (Baum et al., 1999). The study by Sturge-Apple et al. could be combined with the current study which would be an interesting area for exploration.

However, this study faced certain limitations. First, the study lacked a generalizable sample for certain variables. For example, this study had a majority Hispanic sample, making it potentially inapplicable to other ethnic groups. Furthermore, for all studies that include self-reported measures, participants' answers vary daily and are easily skewed by their environment, like being watched by researchers. Being in an unfamiliar research lab also makes external validity unavoidable. In future studies, fixing or working around these challenges may lead to better and more accurate results.

In addition, the current study focused on daily hassles as the primary cause of stress. However, many other types of stress can be examined. Short-term stressors like big projects or an interview, are interesting and crucial for future evaluation as they are faced by a wide range of people. In the moment, these short-term stressors may override daily hassles and produce different or similar results which would greatly contribute to our understanding of stress and wellbeing.

Furthermore, research could zoom in on the differences created by demographic variables. The impact that development and age have on an individual's response could provide new insight into methods of helping children and adolescents alleviate stress and depressive symptoms. Since this research points out a high vulnerable population to depressive symptoms – sensitive individuals – perhaps different studies could dive into solutions and prevention measures for depression.

However, despite the limitations of this study, it is important to acknowledge the results and use them as a springboard for further research. Depression is a universal problem with limited understanding. This study points out the population most vulnerable to depressive symptoms as a way to strengthen assistance for them in the future. Sensitivity can often be perceived as vulnerability and therefore a personal flaw, however, in reality, it is simply a trait and can be beneficial at many moments. Learning about sensitivity can raise our awareness about ourselves and lead to a better understanding of the complex creatures humans are.

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Table 1

Descriptive Statistics for Sensitivity and Depressive Symptoms

	n	Min	Max	Mean	Standard Deviation
Sensitivity (RSA)	84	2.35	8.44	6.09	1.15
Depressive Symptoms	132	.00	25.00	4.96	.27

Note. This table shows the descriptive statistics generated by the IBM SPSS Statistics software from the data of this study. The table demonstrates the number of valid inputs (n), minimum value (min), maximum value (max), mean, and standard deviation.

Table 2

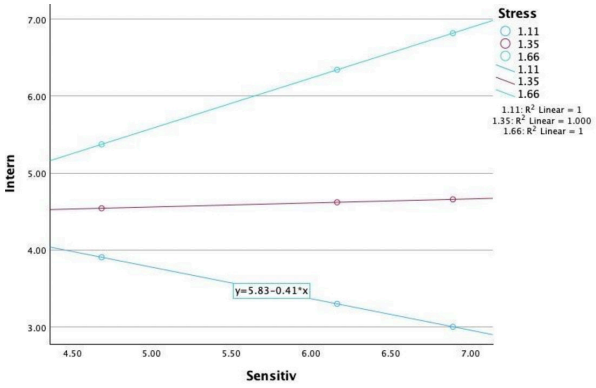
Correlation Table for all Variables

	Sensitivity (RSA)	Stress Index	Depressive Symptoms
Sensitivity (RSA)	1	—	—
Stress Index	-.016	1	—
Depressive Symptoms	.035	.322**	1
Age	-.050	-.054	-.009
Sex	-.019	.267**	-.142
Race	-.133	.109	.067
Education	.125	-.117	.057
Income	-.051	-.169	-.032

Note. This table shows the correlation between all relevant variables of the study. All correlations were calculated by IBM SPSS Statistics.

** Correlation is significant for reporting

Figure 1
Relationship between Sensitivity and D.S. with Stress as Moderator



Note. This figure illustrates the relationship between sensitivity (Sensitiv) and depressive symptoms (Intern) with stress as the moderator. The topmost green line illustrates a high-stress scenario; the middle red line represents medium stress; the bottom blue line represents a low-stress scenario. This table is generated by PROCESS Macro v4.3 by Andrew F. Hayes, an add-in for IBM SPSS Statistics.