

Relationship Between Neurological Threshold in Sensory Profile, Depression, and Anxiety among Adults

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ABSTRACT

Depression and anxiety are among the most prevalent psychological difficulties in adults. The aim of this study was to explore the relationship between neurological threshold in sensory profile, depression, and anxiety. Three hundred fifty-four healthy adults in the age group of 20 to 45 years old completed PROMIS[®] Depression and PROMIS[®] Anxiety questionnaire and Adolescent/Adult Sensory Profile[®]. Data were analyzed through Pearson Correlation. The findings showed that there was a significant positive relationship between low neurological threshold and anxiety ($r=.381$) and depression ($r=.295$). Furthermore, there was a significant positive relationship between high neurological threshold and anxiety ($r=.115$). However, the relationship between high neurological threshold and depression was not statistically significant. We can conclude that individuals' neurological threshold based on sensory profile might be considered as one of the factors relating to anxiety and depression. This study has implications for mental health professionals and it is recommended to study this component more deeply in future studies.

Keywords: Anxiety, depression, neurological threshold, sensory profile

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INTRODUCTION

Depression and anxiety are among the most common psychological issues in adults that affect their lives and performance (National Collaborating Centre for Mental Health, 2011; Petrie et al., 2019). Also, in a World Health Organization project as World Mental Health Survey among international college students, it was stated that depression and

anxiety are among the most prevalent mental health problems among adult students (Auerbach et al., 2018). These prevalent psychological problems may cause impairments in adults functioning and decline job performance and increase work participation (Steel et al., 2014). As such, depression and anxiety, not only affects individuals' lives, but also it causes social, functional, and financial issues to the societies as well (Organisation for Economic Co-operation and Development, 2012; Seymour & Grove, 2005).

Considering the prevalence and effects of depression and anxiety, it is essential to explore the possible factors that relate to them. Although there is limited evidence available that depression and anxiety are explored from the perspective of sensory processing patterns (Engel-Yeger & Dunn, 2011a; Engel-Yeger et al., 2016; Khodabakhsh et al., 2016a), but still it is unknown how they relate to the sensory processing patterns that represent high/low neurological thresholds in sensory profile. Therefore, the aim of this study was to explore the relationship between neurological threshold in sensory profile, depression, and anxiety among adults.

According to Dunn's sensory model (Dunn, 1997), individuals' sensory profile indicates their sensory processing pattern. In general, sensory processing is the way that the nervous system receives and understands the sensory stimuli from the environment and inside the body, which causes the person to react to the environment (Humphry, 2002). Several studies showed

that extreme sensory processing patterns cause difficulties for individuals to carry out adaptive responses to the environmental sensory stimuli for the situational demands (Bodison & Parham, 2018; Soto et al., 2017).

The two components of sensory profile are neurological threshold and behavioral responses. People may have low or high neurological thresholds and passive or active behavioral responses (Brown & Dunn, 2002). The required amount of stimuli for a neuron or neuron system that can make it respond is called the neurological threshold. At one end of this continuum, thresholds are extremely high; this says it needs a high level of stimulus or many stimuli to reach the threshold and fire the neurons. At the other end of this continuum, thresholds are extremely low; this says it requires a low level of stimulus or very little stimuli to reach the threshold and fire the neurons. Those with higher thresholds would not notice stimuli, while those with lower thresholds would notice many stimuli (Brown & Dunn, 2002).

In this study neurological threshold is the total score that the participants get in their sensory profile, which is developed based on Dunn's (1997) model of sensory processing. In sensory profile, 30 items represent high neurological threshold and 30 items represent low neurological threshold (Brown & Dunn, 2002). In this study, depression and anxiety levels were defined by the total score that participants get from the PROMIS® Anxiety and PROMIS® Depression questionnaires.

According to a study among thirty-five healthy adults, Engel-Yeger and Dunn (2011a) stated that state anxiety and trait anxiety might be related to extreme sensory processing patterns. Moreover, according to the study by Engel-Yeger et al., (2016) among adults with major affective conditions, results showed that depression and anxious/cyclothymic affective temperaments were predicted by extreme sensory processing patterns of sensitivity and sensory avoiding.

Serafini et al. (2017) studied sensory processing patterns among 281 euthymic participants and they found that extreme sensory processing patterns, impulsivity, depression, and hopelessness might show a characteristic pattern in patients with major affective disorders. They stated that higher sensory sensitivity and sensory avoiding, and lower registration of sensory input was correlated with depression (Serafini et al., 2017).

Ahadi and Basharpour (2010) explored the relationship between sensory processing sensitivity, personality dimensions and mental health among university students. Their study results revealed that ease of excitation, which was linked to low neurological threshold, was positively correlated to mental health in aspects of anxiety, disorder in social functioning, and depression. They stated that sensitivity was positively related to anxiety. In their study, low sensory threshold was also positively related to neuroticism, physical problems, anxiety and mental health (Ahadi & Basharpour, 2010).

Besides, several studies in sensory field discovered relationships between some of the psychological issues and intense sensory processing patterns (Ben-Avi et al., 2012; Schaaf et al., 2015; Tomchek et al., 2015). Also, some studies revealed that there is a significant relationship between sensory processing and some of the personality traits, and affects such as depressive mood (Engel-Yeger & Dunn, 2011b; Khodabakhsh et al., 2016b; Kimball et al., 2012).

In a study among 210 college students, Liss et al. (2008) explored the relationships between the three factors of sensory processing sensitivity (ease of excitation, low sensory threshold, and aesthetic sensitivity) and alexithymia, autism symptoms, anxiety, and depression. They found that ease of excitation and low sensory threshold were related to anxiety, depression, autism symptoms, and alexithymia. Khodabakhsh et al. (2016a) also reported a significant relationship between sensory processing patterns and anxiety. In their study among university students, the results indicated that there was a significant positive relationship between the three patterns of sensory processing and anxiety, including sensation avoiding, sensory sensitivity, and low registration. Moreover, they stated that sensory avoiding and sensory sensitivity, which were the two sensory patterns with low neurological threshold, were significant predictors of anxiety (Khodabakhsh et al., 2016a).

According to the mentioned studies, individuals' sensory processing patterns, specifically patterns that include low level of

neurological threshold, experience a higher level of depression and anxiety. Based on the above matters, this research hypothesis were as follows:

1. There is a significant relationship between neurological threshold in sensory processing patterns and anxiety.
2. There is a significant relationship between neurological threshold in sensory processing patterns and depression.

METHOD

Participants and Sampling Procedure

Three hundred and fifty four healthy adults participated in this study. The sampling was done among students at the University of Malaya in Kuala Lumpur, Malaysia. As exclusion criteria, students who had past diagnosed mental disorder or illness and taking any daily medicine were excluded from the sample. The multistage random sampling was applied and from the university, five faculties were chosen randomly including Faculty of Language and Linguistic, Faculty of Science, Faculty of Computer Science and IT, Faculty of Engineering, and Faculty of Education. The classes and laboratories were selected randomly from each of the selected faculties. The data collection was done from 1st October 2014 for one month.

Instruments

To measure high or low neurological threshold, the Adolescent/Adult Sensory

Profile® (AASP) (Brown & Dunn, 2002) was used. There are 60 items in this self-report questionnaire and it is based on Dunn's (1997) model of sensory processing. In general, 30 items represent high neurological thresholds and 30 items that represent low neurological thresholds. In this study, the score for high or low neurological threshold is the total score retrieved from the related items for each of them. In this questionnaire, a five-point Likert scale is used to rate the responses for each item (from 1 = almost never to 5 = almost always). Therefore, the score for low or high threshold ranges from 30 to 150. Based on previous studies, the internal consistency of this instrument is considered as good with alpha values from 0.63 to 0.82 (Brown & Dunn, 2002; Brown et al., 2001; Pearson Education, 2008). In a study among university students, Khodabakhsh (2016) reported the internal consistency of Adolescent/Adult Sensory Profile® as 0.83. In this research, we bought the original instrument and we obtained permission to use the AASP the copyright holder/publisher.

PROMIS® Anxiety Questionnaire is an instrument that includes items related to self-report fear, anxious misery, hyper-arousal, and arousal somatic symptoms (Pilkonis et al., 2011). The PROMIS® anxiety questionnaire contains 29 items with a seven-day period and a five-point scale (from 1 = never to 5 = always). So, the total score in this questionnaire ranges from 29 to 145. In this study, the anxiety score is the total score that the participant gets from the questionnaire. A study reported that

PROMIS® Questionnaire had acceptable psychometric characteristics (Pilkonis et al., 2011). In a study among university students, Khodabakhsh (2016) reported the internal consistency of PROMIS® Anxiety Questionnaire as .94.

PROMIS® Depression Questionnaire is a self-reported questionnaire that includes items such as increased negative mood, reduced positive affect and engagement, and views of self and social cognition (Pilkonis et al., 2011). The Diagnostic and Statistical Manual of Mental Disorders – DSM has considered PROMIS® Depression as an instrument to recommend for assessing the depression (Kuhl et al., 2011). We used the full item bank of PROMIS® Depression questionnaire that contains 28 items in a seven-day period and a five-point scale (from 1 = never to 5 = always). So, the total score in this questionnaire ranges from 28 to 140. In this study, the depression score is the total score that the participant gets from the questionnaire. In a study among university students, Khodabakhsh (2016) reported the internal consistency of PROMIS® Depression Questionnaire as .94.

Besides, the Demographic Questionnaire was designed to collect demographic information of the participants in terms of their age, gender, marital status, nationality, medical history, psychiatric history, and taking psychiatric medication.

Procedure

Ethical approval for this study was received from the University of Malaya to conduct the research. The informed consent forms

were provided for participants to read and sign before participating in the study. In the consent form, it was mentioned that their information would be kept confidential.

We used the Pearson Correlation method to investigate the relationship between neurological threshold in sensory processing patterns, depression, and anxiety in participants.

RESULTS

After collecting and screening the data considering the exclusion criteria, we found that according to the demographic questionnaire, the participants' age was between 20 to 45 years old and the mean age was 29.68 years ($SD = 5.42$). From the participants, there were 244 (68.9%) males, and 110 (31.1%) females. It showed that 230 participants (65%) were single, 117 participants (33.1%) married, four participants (1.1%) divorced, and three participants (0.8%) in other marital status that included separated (1 student) and engaged (2 students).

Regarding the participants' nationality, it was revealed that they were from 24 different nationalities and all of them knew the English Language at a proficient level following the university requirements. The number of students from each nationality and the valid percent of them in the sample were in this order from highest percent to lowest: Iranian 70 (19.9%), Pakistani 43 (12.3%), Indonesian 40 (11.4%), Bangladeshi 39 (11.1%), Chinese 30 (8.5%), Iraqi 30 (8.5%), Nigerian 26 (7.4%), Indian 23 (6.6%), Sudanese 13 (3.7%), Japanese

6 (1.7%), Yemeni 6 (1.7%), Syrian 4 (1.1%), Saudi Arabian 4 (1.1%), Philippine 3 (0.9%), Bruneian 3 (0.9%), Libyan 3 (0.9%), Omani 1 (0.3%), Maldivian 1 (0.3%), Palestinian 1 (0.3%), Zimbabwean 1 (0.3%), Thai 1 (0.3%), Burmese 1 (0.3%), Tanzania 1 (0.3%), and Cameroon 1 (0.3%).

Table 1 shows the descriptive statistics of the variables of this study.

As it is shown in Table 2, regarding the first hypothesis of the research, the results indicated that there is a significant positive relationship between anxiety and low neurological threshold in sensory processing patterns ($r=0.381$). Also, the results showed that there is a significant positive relationship between anxiety and

high neurological threshold in sensory processing patterns ($r=0.115$). Besides, according to the results, the relationship between low neurological threshold and anxiety is stronger than the relationship between high neurological threshold and anxiety.

The results regarding the second research hypothesis is shown in Table 3, which indicates that there is a significant positive relationship between depression and low neurological threshold in sensory processing patterns ($r=0.295$). However, the relationship between high neurological threshold and depression was not statistically significant.

Table 1
Descriptive statistics of variables of the study (N=354)

	Minimum	Maximum	Mean	Std. Deviation
Anxiety	31.60	70.30	53.34	7.45
Depression	38.00	68.00	52.71	6.05
Low Neurological Threshold	40.00	111.00	77.19	14.00
High Neurological Threshold	42.00	107.00	77.21	10.62

Table 2
Pearson correlation between neurological threshold in sensory profile and anxiety (N=354)

	Anxiety	
	Pearson Correlation	Sig. (2-tailed)
Low Neurological Threshold	0.381**	0.000
High Neurological Threshold	0.115*	0.031

Table 3
Pearson correlation between neurological threshold in sensory profile and depression (N=354)

	Depression	
	Pearson Correlation	Sig. (2-tailed)
Low Neurological Threshold	0.295**	0.000
High Neurological Threshold	-0.002	0.968

DISCUSSION

The results of this study are consistent with the findings of Ahadi and Basharpour (2010). As their study showed, there was a positive relationship between sensory processing sensitivity and mental health among university students. They specifically mentioned that ease of excitation, which was the feeling of being overwhelmed by both external and internal demands, positively correlated to mental health in aspects of anxiety, depression, and disorder in social functioning. They stated that sensitivity was positively related to anxiety. In their study, low sensory threshold was also positively related to neuroticism, physical problems, anxiety and mental health (Ahadi & Basharpour, 2010). In line with this study, Liss et al. (2008) found that ease of excitation, low sensory threshold, and aesthetic sensitivity, as the three factors of sensory processing sensitivity, had a positive relationship with depression and anxiety. By considering their findings and the current study results, it might be possible that having lower neurological threshold may be a substantial factor for the experience of anxiety in adults.

Also, the result is in line with the findings of Engel-Yeger and Dunn (2011b) who found strong correlations between anxiety and the sensory patterns with low neurological threshold. In this study, low neurological threshold showed a higher correlation with anxiety level compared to high neurological threshold. Besides, as Benham (2006) found, highly sensitive people experience a higher level of anxiety

and high sensory processing sensitivity was associated with greater perceived stress and more frequent symptoms of ill health (Benham, 2006). In another study, individuals reported their anxiety related to their sensitivity to environmental stimuli (Neal et al., 2002). Pfeiffer and Kinnealey (2003) reported a relationship between sensory defensiveness and anxiety, too. According to Beck's model (Beck, 1979), defensiveness is one of the cognitions that underlie anxiety and harm avoidance is what anxious people are struggling to achieve.

In Beck's cognitive psychopathology model (Beck, 1979), cognitive schemas related to danger and harm to personal well-being is underlying the experience of anxiety. Anxious individuals mentally focus on danger and harm because of the activation of the maladaptive cognitive schemas, leading them to indiscriminately interpret any environmental events as being dangerous. According to this cognitive model, people tend to exaggerate and enlarge the extent of the danger that they may feel in fearful situations. That is the reason that they feel danger and harm even if the input is very less dangerous and harmful. Considering Beck's cognitive model of psychopathology for anxiety, individuals with low neurological threshold are receiving most of the stimuli from their environment because of their low thresholds. They can notice even the small amount of stimuli. Therefore, they may more feel themselves at the target of harm or danger.

In this study, the relationship between high neurological threshold and anxiety was also statistically significant. But the strength of this relationship was less than the relationship between low neurological threshold and anxiety. People with high neurological threshold may feel less danger from the environment, as they do not notice some of the stimuli in their environment because of their high threshold. Hence, they find themselves in overwhelming or uncontrollable situations less than individuals with low neurological threshold.

According to the results of this study, the relationship between neurological threshold and depression was significant. This finding was reported in previous studies by Kimball et al. (2012), Engel-Yeger and Dunn (2011b), and Liss et al. (2008), as these researches reported a positive relationship between sensory sensitivity and negative affect and depressive symptoms.

People who are more sensitive to what happens in their environment regarding their sensory experiences may show depressive symptoms as well (Aron et al., 2005; Brindle et al., 2015). Also, depression has also a positive correlation with ease of excitation and low sensory threshold which are characteristics of sensory sensitivity (Liss et al., 2008).

The result of this research is in line with the outcomes of prior researches that reported the association between symptoms of ill health and high level of sensory sensitivity (Benham, 2006). Moreover, this result is the same as the finding of Pfeiffer et al. (2014) which stated the correlation

between the reduced quality of life and increased sensory sensitivity.

The findings of this study can be discussed from the cognitive theory perspective, too. Based on the cognitive model of psychopathology in Beck's cognitive model, individuals obtain dysfunctional beliefs if they do not process internal or external information without any bias (Beck, 1979). On the other side, if a person has low neurological threshold, he or she may experience being overwhelmed in the majority of circumstances. It happens to them due to receiving countless stimuli from their surroundings. This may make them to blame themselves and to make them think negatively about themselves. They may refer the cause of this overwhelming experience to themselves and believe deficiency in their coping abilities, which are some of the underlying causes of depression based on the Beck (1979) cognitive model of psychopathology.

Considering the mentioned studies, factors that represent low neurological threshold, such as ease of excitation and sensory sensitivity, are related to depression and anxiety. Also, extreme sensory processing patterns can cause psychological difficulties such as depression and anxiety, too. In the current research, we focused on the neurological threshold in individuals' sensory profiles. From this perspective, depression and anxiety had a positive relationship with a high/low neurological threshold. In other words, it seems that as the neurological threshold in sensory profile goes to the extremely low or the extremely

high level, the anxiety and depression level also increases. This study needs deeper investigations on the neurological threshold perspective to depression and anxiety.

CONCLUSION

This study was an attempt to explore depression and anxiety from the perspective of neurological thresholds in sensory processing patterns. As the finding showed, depression and anxiety may be related to the neurological threshold as linked in sensory patterns of people. The result of this study may provide implications for professionals in the mental health field, such as psychologists and counselors.

It is recommended that future studies explore neurological threshold in individuals with clinical anxiety and depression. Conducting a mixed-method study, which is conjoining the quantitative instrument and interview, will be helpful. Using other instruments to investigate low or high neurological threshold is recommended.

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