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INDIVIDUAL DIFFERENCES IN ANXIETY FACTORS EFFECTS AUTONOMIC RESPONSES IN MEDICINE STUDENTS

Leyla Sahin[1]*, Oya Ogenler[2], Ozge Selin Cevik[1], Gulhan Orekici[3], Tolgay Ergenoglu[1]

[1]Department of Physiology, Faculty of Medicine, Mersin University, Campus Ciftlikkoy, PO Box 33343, Mersin, Turkey.
[2]Department of History of Medicine and Ethics Faculty of Medicine, Mersin University, Campus Ciftlikkoy, PO Box 33343, Mersin, Turkey.
[3]Department of Biostatistics and Medical Informatics, Faculty of Medicine, Mersin University, Campus Ciftlikkoy, PO Box 33343, Mersin, Turkey.

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Corresponding author: Leyla Sahin

Department of Physiology, Faculty of Medicine, Mersin University, Campus Ciftlikkoy, PO Box 33343, Mersin, Turkey.

ABSTRACT

Aims: Nowadays neuronal mechanisms that underlie our emotional states, like anxiety or empathy has started to investigate by researchers. Anxiety consists of somatic, cognitive, behavioral components and adversely associated with self-efficacy and empathy. In this study, we consider how empathy acts when medicine students face to different conditions like death or malignant disease. **Main Methods:** To research empathic responses to the different stimulus, we used skin conductance level (SCL) in preclinical medical students. Researchers selected ten visual images about malignant diseases and death. Together with SCL, we also examined the effect of heart rate on empathy. In protocol, participants said their subjective ratings based on verbal expressions after the visual images. We analyzed the phasic SCL when subjects were seen visual images and verbal expressions. **Key findings:** According to our analysis, there are significant differences visual and verbal images phasic SCL differed from tonic SCL ($p<0.05$). We also found significant differences when images were grouped by age, like adult or child. Our participants phasic SCL were higher when images included adult individuals' disease ($p=0.030$). Especially in woman subjects, phasic SCL are highest when images were verbal expressions. For hearth rate responses, there was significant difference between basal and other states ($p=0.001$). However, subject's sex did not affect hearth responses ($p>0.05$). **Conclusion:** For empathy and anxiety research, SCL is a good indicator of individual emotional state, but hearth rate is still not obvious parameter for it. The present study shows us that importance of the age of target and participant's sex differences.

KEYWORDS: Anxiety, Electrodermal activity, Empathy, Skin conductance level, Skin conductance response.

1. INTRODUCTION

Anxiety is a mental manner that elicited in estimation of threat or potential threat and may influence empathic responding. Anxiety is a normal human experience, but extreme or inappropriate anxiety becomes an illness. In daily life, socially anxious individuals may suppress their expressions to protect from probable rejection.[1] Nevertheless, many studies have examined the neural basis of empathy, our knowledge about how empathic processes are affected by different conditions like anxiety is very rare.[2] Deardorff[3] suggested that there is an inverse relationship between empathy and anxiety. It should be defined theoretically that empathy involves sensitivity to another's needs, while anxiety is concern with the self.[4] Empathy, simply defined as the ability to understand and share the emotions of others. It constitutes a central part of human social interactions that are essential for our adaptive functioning.[5,6] It includes mainly two components as emotional and cognitive. The emotional component is shared another person's motion and cognitive component is understood capacity another person's motion. Medical students experience a decline in empathy, as well as an increase in depression, anxiety during their graduate education due to stress.[7-9]

Neuroimaging and behavioral studies with animals and humans have been explained neural mechanisms of empathy. While explaining the underlying mechanism of empathy some of them use electrodermal activity (EDA). The electrodermal activity is physiological method that elicits activation of the autonomic nervous system in emotion, attention, arousal and psychopathology.[10,11] The electrodermal activity is formed from activities of sympathetic and cholinergic inducible 'sudorific eccrine sweat glands' and 'non-sudorific dermal-epidermal tissues'. The eccrine sweat glands increase sweat secretion as activation of sympathetic and cholinergic nerves and lead to changes in EDA. In the other word, it has been claimed that electrodermal activity can give indirect information about sympathetic nervous system activation.[12,13]

We can clarify changes in sympathetic activity that related to empathy with EDA. Westbury and Neumann[14] found that, subjective ratings of empathy and phasic skin conductance response **(**SCR) increased when visual stimuli is phylogenetically closer to humans. Sometimes subject's responses to the stimuli can change by situation. The stimulus salience is a variable that contributes to empathy-related responding. Salient stimuli like include child objects elicit stronger responses than less salient stimuli. According to this, individuals may exhibit stronger empathy-related responses towards young objects in negative circumstances.[15] Batson et al.[16] described that participants reported lower empathy-related feelings for human adult than all the other objects. Additionally Prguda[5] showed that, participants more oriented to the human stimuli than nonhuman stimuli as reflected by SCR. We can understand from that, type of stimuli is important for the response; on the other hand gender also effects the EDA. This gender effect has been seen in Batson et al.,[17] and Han et al.,[18] studies. In comparison to males, female gave higher subjective ratings of empathy.[19] Relationship between empathy and EDA can explain some abnormal psychopathic tendencies. Hawes and Dadds[20] show that individuals with high levels of antisocial behavior show consistent deficits in empathic arousal across childhood and adolescence. Blair[21] assumed that, these abnormal responses might be evident for psychopathic tendencies while seen in childhood.

The present study researches the relationship between the anxiety and physiological arousal that exert by exposure to the images related to death and diseases. More specifically, the main goal of this study is to analyze the relationship between physiological measures (skin conductance level, heart rate) and anxiety-related responses while medicine students see (visual images) and respond to questions (verbal image) about various patients' photos.

2. MATERIALS AND METHODS

2.1. Participants

All experimental protocols were approved by the Mersin University Ethics Committee in human experimentation. The sample consisted of 43 male/female University students with ages ranging from 20 to 25. The informed consent was obtained from participants. The participants were predominantly third year medical students. The short-form version of the State-Trait Anxiety Inventory by Spielberger et al.[22] was used to pre-screen participants. Participants who scored above moderate on depression, anxiety and/or stress were excluded prior to completing the experimental task. It was deemed that participants who scored above moderate one either of the scales might find the experimental task distressing.

2.2. Electrophysiological recording

EDA was measured by using a MP 30 system (MP30; Biopac Systems Inc., Santa Barbara, CA) and the electrophysiological recordings took place in a dimly lit, electrically and acoustically shielded experimental room. Before the recordings, subjects were allowed to adapt to the system in room for 5 min. After the subject had washed his hands with soap, skin conductance (SC) was recorded from 0.8-cm diameter Ag/AgCl bio-potential electrodes attached to the distal phalanges of the first and second fingers of the dominant hand. EDA recorded as a constant voltage technique and sampling the absolute, via direct current skin conductance at the rate of 20 samples per second.

Electrodes were connected to the MP30 system. The incoming signals of skin response were converted to digital signals via an MP30 data acquisition unit and processed with off-line analysis. There are two main components to the overall complex referred to EDA as follow:

Tonic EDA: A period of 2 min was allowed at the start of recording in order to register non-specific SCL ($\mu mho/cm^2$) during a no-stimuli period. Phasic EDA: The experimental stimuli comprised colored still photographs of infant and adult human in intensive care unit, cancer patients, and injured people. The mean SCL ($\mu mho/cm^2$) values were calculated also off-line for phasic EDA.

2.3. Apparatus

Participants completed the experiment individually in a sound proof room. A Dell T7250 (Intel Premium processor 1.73 GHz 2 GB RAM) computer displayed the experiment's stimulus, prompts for subjective ratings and recorded subjective responses. Participants said their ratings in a low sound to the researcher. The experiment stimuli are consist of coloured photographs of adult and young human in negative situation like cancer or traffic accident. All images were searched from internet by researches and 10 visual images were selected about malignant disease. For all of the participants, the stimuli were presented by Panasonic LCD projector (PT-LC56E,

100-240 V- 2.5-1.0A 50/60 Hz). A second computer is used to record physiological responses.

2.4. Procedure

Firstly participants informed about content of experiment. After they completed the DASS-21, a demographics questionnaire, the physiological recording equipment was subsequently attached. A 5 min rest period was conducted to measure baseline physiological responses. The experimenter then gave the participants instructions about task. They were asked to say their subjective ratings on 9- point scale (where 0 = no empathy and 9 = very high empathy) when see verbal expressions following each photograph. Experimenter record the participant's ratings with keyboard to the BIOPAC Systems.

The images were presented in randomized order and the participants were randomly assigned to one of ten sequences. Each image was displayed for 10 s and followed by the verbal image that consist of expression with previous image to make the subjective ratings. After participants entered the last rating, an intertrial-interval passed, which was randomly varied between 15 and 20 s and during this time the screen remained black. The pilot study was done to different range of ages before the experiment.

2.5. Statistical analysis

The results were analyzed by SPSS 16.0 statistic software. In all cases, $p<0.05$ was considered to be significant. All data were presented as mean±SD. The comparison between the groups was done with repeated measures analysis of variance (ANOVA).

3. RESULTS

3.1. Relations between the variables

Phasic Skin Conductance Level: According to our analysis, there are significant differences visual and verbal images phasic SCL differed from tonic SCL ($p<0.05$). Phasic SCL values of visual images are significantly higher to tonic SCL $F(1,42)= 6.33$, $p=0.016$, (Table 1). Phasic SCL values of verbal images are significantly higher to tonic SCL $F(1,42)= 17.70$, $p=0.001$, (Table 1). There is significant differences between visual and verbal images phasic SCL $F(1,42)= 9.17$ $p=0.004$.

Hearth Rate (HR): Like in SCL, HR values significantly changed through the three situation ($p<0.05$). HR values of visual images are significantly higher to basal $F(1,42)= 12.62$, $p=0.001$, (Table 2). HR values of verbal images are significantly higher to basal $F(1,42)= 29.09$ $p= 0.001$ (Table 2). There is significant differences between visual and verbal images HR values $F(1,42)= 16.52$, $p=0.001$ (Table 2).

Subjective Ratings: There is not any correlations between participant's subjective ratings and phasic SCL $p>0.05$.

3.2. Relations between images and participants' sex

Phasic Skin Conductance Level: Images were divided as child and adult in two aged groups. We analyzed the phasic SCL of verbal and visual images, if there is a difference between images group and sex of participants. Phasic SCL did not differ according to participants' sex $F(1,41)= 5.03$, $p>0.05$. Phasic SCL responses are high when images consist of adult people $F(1,41)= 5.03$, $p=0.030$. In men participant, visual phasic SCL higher than verbal phasic SCL and women's phasic SCL are high when stimuli consists verbal images. But there is not any significant interaction between participant's sex and phasic SCL, there is a trend in results $F(1,41)= 3.88$, $p =0.056$.

Hearth Rate: HR values did not differ according to participants' sex and type of images $P>0.05$.

Table 1: The effect of stimuli types on Electrodermal Activity.

	Visual Images (SCL) (n=43)	Verbal Images (SCL) (n=43)	Tonic (SCL) (n=43)
Electrodermal Activity (μmho/cm^2)	0.131±0.09$^{*, ****}$	0.242±0.27**	0.089±0.08***

*, $p<0.05$ vs tonic SCL
**, $p<0.01$ vs tonic SCL
***, $p<0.01$ vs mean of visual and verbal
****, $p<0.05$ vs verbal

Table 2: The effect of stimuli types on Hearth Rate.

	Visual Images (n=43)	Verbal Images (n=43)	Basal (n=43)
Hearth Rate (HR) (bpm)	87.235±15.4$^{\#,\#\#}$	89.308±15.58$^{\#}$	82.95±12.96

#, $p<0.01$ vs basal
##, $p<0.01$ vs verbal

4. DISCUSSION

Sympathetic activity viewed as a major component in emotional experience and electrodermal responses may therefore considered as inherent aspects of emotional behavior. EDA used as marker of sympathetic arousal, which included sympathetic-adrenal- medullary (SAM) system.[23,24] Therefore EDA is most commonly studied response systems in psychophysiological research. Some other physiological measures such as HR can accompany to the EDA responses.[24]

In this study, we investigated effects of anxiety level on EDA in preclinical medical students. They saw different pictures of negative situations like cancer disease or accident and said their subjective ratings. Contrary to our expectations, their subjective ratings did not correlate with phasic SCL. But phasic SCL does not always correlate with the subjective ratings. In some situation, process of emotion regulation, subjective experience may be down regulated; on the other hand the physiological response is up regulated. It could be that, they were not honest enough to say their real feelings about situations like death or disease. In contrast, Marci and his colleagues[25] demonstrated that SCR and the level of empathy were highly correlated.

In our study, phasic SCL of verbal and visual images are higher than tonic stage. Especially in women participants phasic SCL are highest when stimuli consist of verbal expressions. According to this, maybe we can say that participants influenced by the stimuli but did not reflect it to the subjective ratings. Also, Gross[26] found that subjects were reduced their facial expressions and subjective reports, but displayed an increase in psychophysiological response. When considered about position of woman in society, may be they need to act like a sensitive person to the different negative circumstances. Because their SCL responses did not increase when they saw the people in position like cancer or death. Just women participants' SCL is highest when they need to respond question (verbal image). Moreover, Butler and colleagues[27] made an experiment that, the participants has watched Holocaust documentary together and then discussed their reactions, one of them was instructed to suppress their emotional expressions during the discussion, the others free to express. Participants who suppressed their emotions were more stressful, as indexed by increase in blood pressure. These findings suggest that disrupting emotional situation has the potential to decrease social functioning.[28] Furthermore, it showed that anxiety and empathy level was higher in woman than men.

Together with EDA, HR also used as an indicator of sympathetic activity. In our results, HR responses are higher than basal when stimuli consist of verbal and visual images But when participants were grouped by their sex in the HR analysis there is not any difference between men and women. For this situation, maybe we have to consider about the differences of parasympathetic activity of hearth between individuals. Magnitude of HR changes in response to particular emotional stimulus.[29] Sympathetic and parasympathetic nervous systems also control HR responses. Because of HR changes are influenced by both parasympathetic and sympathetic factors, it is not possible to generalize the effect of emotional stimuli on HR responses.[30] Moreover it is affected by emotion type, for instance Sohn[31] studies showed that when children feel sadness and happiness turned out phasic and tonic HR deceleration, which was significantly different from the HR responses in anger. Sohn[31] also showed the effects of ages on HR, basal HR in children was found to be higher than in adults and shows decrease with age.

Especially in mammals, empathy is crucial for living in social groups and facilitated by the perceived similarity between the object and subject.[28] In our study, all the pictures were included humans who are phylogenetically closer to our subject. Based on the Batson[17] study, individuals may exhibit stronger empathy-related responses towards young objects in negative circumstances than older objects. Our participants phasic SCL were higher when images included adult individuals, it means that they had deep empathy to the adult subjects rather than baby or child. Maybe it has to be considering that, our participants selected from student who has no baby or child that causes the decrement in responses to the stimuli. If our subject's EDA responses to the adult and child object had been same, we would have considered about anxiety. However, when it comes to the adult image their responses became higher because of their relationship with their parents. According to this, we have to consider that increment in EDA responses reflect anxiety level, it also demonstrate empathy level of individuals.

Our results also demonstrated that measurable exact data as physiological responses (heart rate, electrodermal activity, respiration etc.) more reliable than emotional responses only based on questionnaire's study. Because of questionnaire studies may be affected environmental stimulus and personal factors, it is not consistent method to evaluate emotional responses alone.

5. CONCLUSION

SCL is a good indicator of individual emotional state, but hearth rate is still not obvious parameter for it. The present study shows us that importance of the age of target and participant's sex differences in emotional studies. We demonstrated that SCL both correlate with anxiety and empathy level. To reduce the risk of anxiety and develop treatments for both women and men, we need to figure out the processes underlying our emotional states more detailed.

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Disclosure of interest

The authors report no conflicts of interest.

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