International Journal of Advanced Science and Technology
Volume 9, August, 2009

Electro-Dermal Activity, Heart Rate, Respiration under Emotional Stimuli in Schizophrenia

Sungwon Park

Department of Nursing, Hyechon University, Daejeon, 333, S. KOREA
swpark@hu.ac.kr

Abstract

Patients with schizophrenia are known to be impaired in several areas of emotional processing, including psychophysiological reactivity. This study investigates the preliminary autonomic reactions and recognition of schizophrenic patients according to basic emotional conditions. The parameters such as electrodermal activity (Skin conductance response, skin conductance level), heart rat, and respiration were measured by using emotion evoked stimuli. We found out that there were no differences of accuracy for recognition with the target emotion between groups. Also, we found out that in anger (heart rate), fear (electrodermal activity, respiration), and sadness (heart rate, respiration) condition, there was a difference of physiological responses between groups.

Keywords: *Emotion; Autonomic nervous system; schizophrenia*

1. Introduction

Emotion is a prominent feature of life and is thought to play a central role in a wide range of human processes including social bonding, intrapsychic dynamics, memory and cognition, as well as physical health and illness (Levenson et al., 1991). Schizophrenia patients deceased ability to build interpersonal relationships has been widely known and their lack of ability to express, perceive, and experience emotion may be one possible reason.(Kohler and Martin, 2006). Inappropriate or blunted affect - one of the typical symptoms of schizophrenia- suggests that individuals with schizophrenia have difficulties in expressing their emotions (Sass, 2007) and they also present insufficient ability to perceive others' or their own emotions. The overall problems in the schizophrenic patients' emotion processing mechanism may significantly affect the schizophrenic patients' level of social function and relationship.

Ekman et al. (1983) reported that emotions such as anger, disgust, fear, amusement, sadness and surprise have a discriminative pattern when related to the reaction of the autonomic nervous system. The results of previous studies performed on the emotion specific autonomic nervous system pattern has proven controversial and have raised issues that have not as yet been sufficiently discussed (Christie & Friedman, 2004). In particular, schizophrenic patients are thought to experience emotion in a slightly different way from normal people when they're exposed to specific situations or conditions. In some cases, they experienced stronger emotions when they were exposed to unpleasure emotional situations then they did to pleasurable ones (Sass, 2007). In some severe cases, they were not willing to pursue pleasurable activity since they didn't

have any expectation for experiencing pleasures in their lives. The responses that occur when one's emotional reactions are induced can categorized into three parts; subjective report, physiologic reaction, and physical activity (Volz et al., 2003). Studies about physiological reactions of emotion have significance in terms of their ability to measure one's emotional responses objectively and express them numerically.

Emotion-processing mechanisms always accompany physiological reactions such as changes in muscle activity or internal organ function (Bradley and Lang, 2000). Arousal, one of the components of emotion-response, is associated with stress, anxiety and fear (Foote, 2000) and physiological manifestations of arousal include increased blood pressure, heart rate, sweating, hyperventilation, and musculoskeletal restlessness (Noteboom et al., 2001).

The increased level of physiological arousal as the result of stressful life events and excessive expressed emotion of family members related with both positive symptoms and relapse of the disorder in patients who are in the process of recovery (Zahn and Pickar, 2005; Sass, 2007). In one study, patients with chronic schizophrenia showed a high level of arousal when exposed to neutral emotional stimuli, which may be explained by highly sensitive responsivity (Kring and Neal, 1996). On the contrary, in some studies about schizophrenics' emotion-response, electrodermal activity and heart rate were typically diminished (Sass, 2007).

It can be said that diminished reactivity could be caused by attempts to avoid stimulus by reducing attention to environmental stimulation or by attention defects (Dawson et al., 1994). It is also believed that schizophrenia patients exhibit cognitive disturbance regarding negative emotions when at an elevated level of arousal. In particular, they display cognitive disturbance for fear and anger, emotions whose arousal levels are relatively higher than sadness (Mandal & Palchoudhury, 1989), No autonomic reaction occurred in response to neutral stimuli, which can be interpreted as attempts at self defense or dysfunctional coping response to processing confusing stimuli (Straube and Oades, 1992). Another possible explanation of non-responsivity may be passive avoidance as a coping strategy in which patients decrease their attention to surrounding stimuli (Zahn and Pickar, 2005).

Despite the results of previouse study are not sufficient, if the fact that certain emotional situations can cause problems in emotion processing would be taken into consideration, intervention a patient to identify emotional situations that induce hyperarousal or non-responsivity, regulate those situations, and modify maladaptive coping into adaptive based on the patient's defense level could be a possible treatment option. Recent trends put more importance on psychosocial aspect of treatment such as improvement of negative symptoms, cognitive function, and emotion processing; nevertheless, in Korea, measuring physiological response to emotion in schizophrenic patients was barely studied.

Most of the preexisting research was simple comparison of positive emotion and negative emotion. In addition there was a paucity of studies focusing on physiological responses according to differentiated emotion. In this research, we try to identify the differences of physiological responses between the schizophrenia patients and the normal subjects, by measuring autonomic response under specified emotional conditions.

2. Methods

2.1. Subjects

16 outpatients meeting DSM-IV criteria for schizophrenia are recruited from the rehabilitation center in the Deajeon. 17 matched(age, gender) controls are recruited through college bulletin boards. All of the patients were taking low potency medication at the time of the study, 7 patients were receiving atypical antipsychotic medications, and 9 patients were receiving typical antipsychotic medications. Mean dose in chlorpromazine equivalents was 310. 90 mg(SD=220) per day.

As assessed by an interview and a questionnaire, all controls are healthy and drug-free at the time of testing. They have no past history of psychiatric or neurological illnesses. Exclusion criteria for all participants are neurological disorder, communication difficulties, respiratory diseases, cardiovascular disease, auditory or visionary problems, and substance dependence within the past 6 months. All participants have given informed consent to participate in these studies as approved by the research ministry of the University of Hyechon, and as consistent with the Declaration of Helsinki.

2.2. Emotional stimuli

Two-minute video clips, each containing one of the five emotions ('anger,' 'disgust,' 'fear,' ‘sadness’ and 'joy'), are selected from Korean movie films and TV shows. Then the selected video clips were presented to one hundred male and female college students one by one via a large-screen TV. The students were asked to choose one of the five emotions they felt while watching the films and rate the intensity of their emotion on a five-point scale(extremely weak -extremely strong).

As a result, the clip received the highest intensity rating over all, showed over 80% agreement and over 4 point intensity was selected as a stimulus for each emotion. After that, four experts in psych/mental health reviewed the clips and evaluated the influence they could have on the participants. Figure 1.

Figure 1. Emotional evoked stimuli

2.3. Procedure

Experiments were conducted in a five-by-two-and-a-half square meter soundproof chamber. In the chamber, a comfortable chair for subjects was placed in the middle and thirty-eight inch TV was set in front of the chamber to present the stimuli. At the right

upper-hand corner of the TV a CCTV was placed to monitor subjects' behaviors. Outside of the chamber, a stimuli-controlling computer, a monitor to observe subjects' behavior, a MP150 system to measure autonomic reaction, and a computer to analyze data from the MP150 system were used.

The participants were assessed according to their mood on that day and had some time to get familiar with the experimental settings. They received an explanation about the procedure while electrodes to measure autonomic reaction were applied. Physiological signals were measured for thirty seconds before the emotion stimuli were presented ('resting period') and for two minutes during each presentation of emotion-stimulus ('emotion period'). After each emotion stimulus was presented, the participants were asked to check the induced emotion with the emotional experience questionnaire and took a rest for two minutes. The same process was repeated five times for each participant. By presenting the emotion stimuli randomly to each subject, I tried to exclude the order effects. The total experimental time for one subject was one hour. Figure 3.

Figure 2. Measure Devices

Figure 3. Room for Experiment

2.4. Measure

2.4.1. Physiological measures

To represent autonomic activity, electrocardiograms (ECG), electrodermal activity (EDA), and electromyography (EMG) were measured with the MP150 system developed by Biopac Systems Inc. Moreover, AcqKnowledge (version 3.8.1) of MP150WS was utilized for data coding and analyses. ECG (Lead I type) was analyzed by modifying the average heart rate(HR) and respiratory rate(RR) into frequencies per minute (Bpm) by placing one electrode on pulsation areas at each wrist respectively. EDA, manifested by sweating reactions of the autonomic nervous system, measures skin conductance levels (SCL) and skin conductance responses(SCR). SCL is tonic reactions for stimuli. The average SCL during sweating was used for analysis. SCR means phasic reactions for stimuli. A certain measurement of the reactions (over 0.1uS) for five minutes was used for the analysis. EMG, manifesting facial muscle activity, is measured using censors which are placed on the corrugator of the upper eye brow and the orbicularis around lip. The ECG and EDA were sampled at 256HZ and EMG was 1000HZ.

2.4.2. Emotional Experience assessment

To verify that the films elicited the targeted emotional states, participants' self-reported emotional experience to the film was assessed using a questionnaire ('anger,' 'disgust,' 'fear,' 'sadness' and 'joy'). To complete this tack subjects needed to answer the questions that asked which emotion they felt from the provided emotion stimuli.

2.5. Statistical analysis

SPSS version 12.0 is utilized for statistic analysis. To identify the differences of variables between the two groups, a Mann-Whitney U test was done.

3. Results

3.1. Subjective Emotional Experience

The results from the analyses of subjective emotion- recognition for the five presented emotion stimuli showed that there were no statistically significant differences between the two groups.

3.2. Differences between the two groups

In heart rate, the normal controls presented a higher response (U= 46.00, p = .001) to anger stimuli and a lower response (U= 33.00, p =.000) than the patients. In SCR, the controls showed a higher response (U= 80.50, p =.045) to fear stimuli than the patients.
In SCL, the normal controls presented a higher response (U= 81.00, p =.049) to fear stimuli than the patients. In respiration, the normal controls presented a higher response to disgust (U= 79.50, p =.041) and fear(U= 69.50, p =.015) than patients. On the other hand, in sadness condition, the controls showed a lower response (U= 64.00, p =.009) than the patients.
In responding to joy stimuli, however, each parameter showed no significant differences between the two groups. Figure 4,5,6,7.

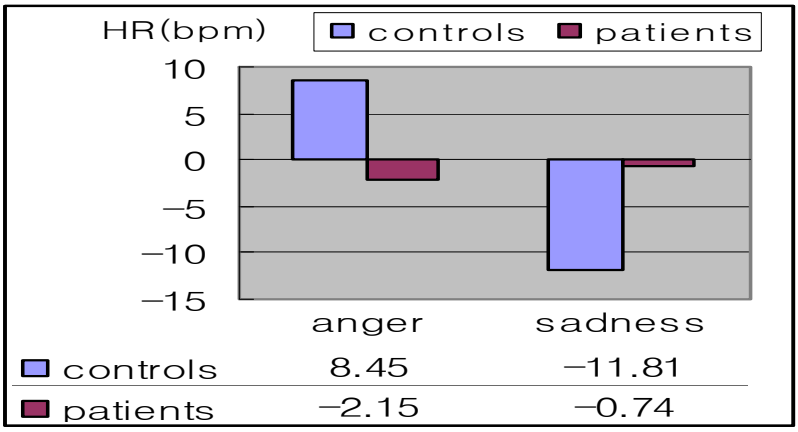


Figure 4. Heart rate between groups (HR; heart rate)

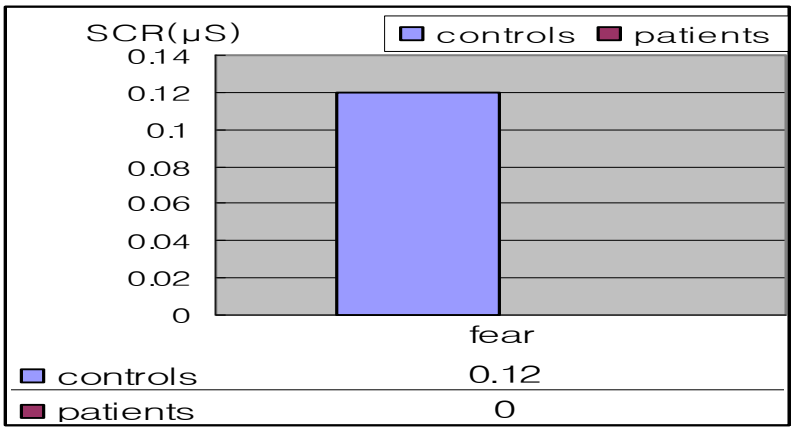


Figure 5. SCR between groups (SCR; = skin conductance response)

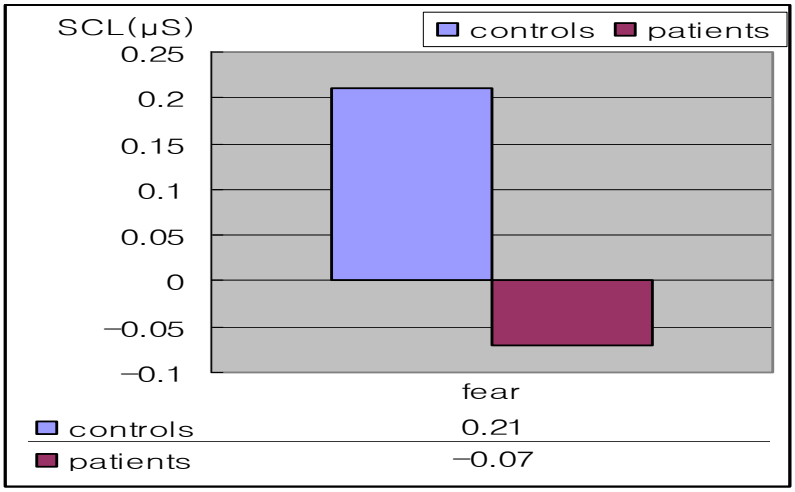


Figure 6. SCL between groups (SCL; skin conductance level)

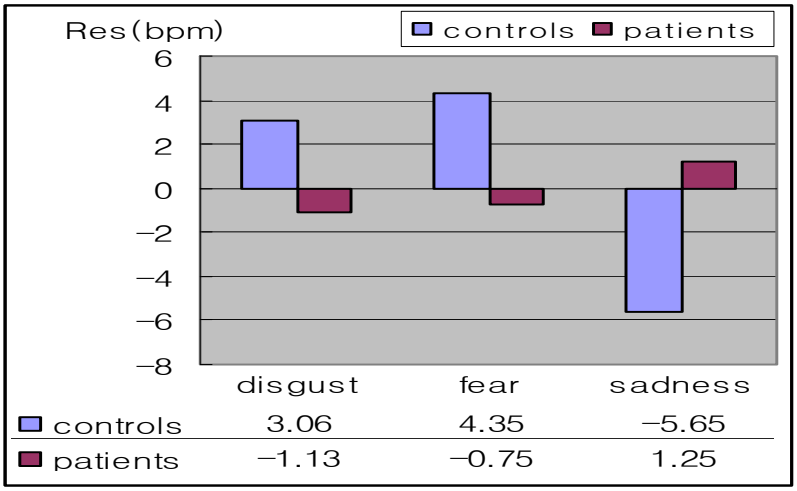


Figure 7. Respiration between groups (Res; Respiration.)

4. Conclusions

From the research results, we could identify that schizophrenic individuals may have differences partially in physiological activity as compared to normal people. Not all the autonomic indicators responded to all of the specific emotion stimuli and no one specific physiological variable which responded to all condition was identified. Arousal can be considered a factor in emotion experience, to be accepted as a physiological indicator with validity, however, more research should be done with more various and specified conditions to induce emotion and more physiological variables.

In this research, we have limited participants of chronic schizophrenic patients; further study should be conducted in specifying patients' subtypes and chronicity of the disorder because the physiological variable may significantly differ among individuals. In particular, the effects of medication or pathological factors in physiological responses to emotion can not be completely excluded. In addition, the induced emotion stimuli cannot be as same as the real emotion situation.

Therefore, real-life based emotion process studies are needed. Finally, emotional factors induce one's physiological response, which, in turn, can affect his/her symptoms and a subsequent relapse. Taking this into consideration, we should pay significant attention to the defect in emotion-processing mechanisms in schizophrenics as a significant target for treatment modalities.

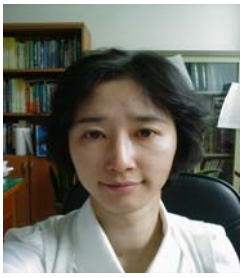
Acknowledgement

This work was supported by the Korea Science and Engineering Foundation (KOSEF) grant funded by the Korea government (MOST) (No. R01-2007-000-20392-0)

References

[1] M.M Bradley,.and P.J. Lang, Affective reactions to acoustic stimuli. Psychophysiology 37, .2000, pp.204-215
[2] P. Ekman, R. W. Levenson, and W. V. Friesen, Autonomic nervous system activity distinguishes among emotions. Science., 221(4616), 1983, pp. 1208-10.
[3] I. C. Christie, and B. H. Friedman, Autonomic specificity of discrete emotion and dimensions of affective space: a multivariate approach. International Journal of Psychophysiology, 51(2), 2004, pp.143-53.
[4] M. E. Dawson, K. H. Nuechterlein, A. M. Schell, M. Gitlin, and J. Ventura, Autonomic abnormalities in schizophrenia: state or traitindicator? Archives of General Psychiatry, 51, 1994, pp. 813-824.
[5] K.S. Ernst, A.M. Kring, M.A. Kadar, J.E. Salem, D.A. Shepard, and P.T. Loosen, Facial expression in schizophrenia. Biological Psychiatry, 40, 1996, pp.556-558.
[6]C.G. Kohler, and E.A Martin,. Emotional processing in schizophrenia. Cognitive . Neuropsychiatry 11, 2006, pp. 250-271.
[7] A.M. Kring, and J.M. Neal,. Do schizophrenic patients show a disjunctive relationship among expressive, experiential, and psychophysiological components of emotion? Journal of Abnormal Psychology, 105, 1996, pp. 249-257.
[8] R.W. Levenson, L.L. Carstensen, and W.V. Friesen. Ekman P. Emotion, physiology, and expression in old age. Psychology & Aging, 6(1), 1991, pp. 28-35.
[9] M. K. Mandal, and S. Palchoudhury, Identifying the components of facial emotion and schizophrenia. Psychopathology 22, 1989, pp.295-300.
[10] J. T. Noteboom., M. Fleshner, and R.M. Enoka,. Activation of the arousal response can impair performance on a simple motor task. Journal of Appl. Physiology. 91, 2001, pp. 821-231.
[11] L. Sass,. Contradictions of emotion in schizophrenia. Cognition & Emottion
. 21, 2007 351-390.
[12] E.R. Straube, and R.D. Oades,. Schizophrenia: Empirical research and findings (Chapter 5. Responses of the autonomic nervous system to external stimuli, San Diego, CA: Academic Press. pp. 1992, pp. 159-182.
[13] M. Volz, A.O. Hamm, P. Kirsch, and E.R. Rey,. Temporal course of emotional startle modulation in schizophrenia patients. International Journal of Psychophysiology. 49, 2003, pp. 123-137.
[14] T.P. Zahn,., and D. Pickar, Autonomic activity in relation to symptom ratings and reaction time in unmedicated patients with schizophrenia. Schizophrenia Research. 79, 2005, pp.257-270.

Authors



Sungwon Park received the B.S., M.S. and Ph.D. degrees in Nursing from Yonsei University, Seoul, Rep. of Korea, in 1998, 2002 and 2005 respectively. Since 2006, she has been working in Hyechon University as an assistant professor. Her research interests include psychiatric nursing, e-health care system, schizophrenia, social emotion, medical application, ubiquitous health care system and social cognitive functions.