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Phenomenological Analysis of Fear Memory Generation and Extinction in Patients with Epilepsy

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Abstract

Skin conductance response could be used as a clue to emotional formation. The measurement of skin conductance response enables us to objectively capture and observe the changes in emotional states based on physiological activation. Our research aims to create a new system of fear formation and elimination for epilepsy patients. In this study, participants experienced a two-day conditioning and elimination paradigm of differential fear. One stimulus was fear conditioned reflex (CS+) while the other stimulus is not CS- in the acquisition stage. During the following extinction, both stimulus (CS+and CS-) were presented to participants in the absence of the US. The next day, both kinds of stimulus appeared, and selective catalytic reduction was recorded during the recall test. We found that the subjects initially acquired fear of CS+, and then spread to fear of CS-. Finally, after the extinction period, SCR decreased significantly, which makes the model system of fear formation and extinction technology for epileptic patients feasible.

Keywords

Epileptic patients; Fear formation; SCR.

1. Introduction

To date, a wide range of techniques related to electrodermal activity (EDA), which is a term describing electric phenomena occurring on the skin (Johnson&Lubin, 1966), have been developed and utilized in the field of cognitive science. As peripheral responses (including skin conductance response) could act as cues based on which emotions are formed (Christopoulos, 2016), the measurement of skin conductance response (SCR) allows us to objectively capture and observe the changes in emotional states based on the the physiological arousal. One particular area in which the techniques have made tremendous contributions is fear extinction, a process in which conditioned fear response lessen over time. The measurement of skin conductance response (SCR), in particular, has led to a new experimental paradigm in the field, furthering the understanding of fear extinction.

The concept of fear extinction was first coined by Pavlov (Pavlov IP,1927), and the concept has been intensely developed by experimental analysis ever since. Social interaction is known to alter behavior and emotional responses to various events including the fear responses in the fear extinction of the conditioned fear. And the question whether the pair-exposure during

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extinction could persistently work beneficially for the consolidation of the fear extinction memory. Little is known about the mechanism of fear attenuation by pair-exposure but presence of conspecifics has been reported to affect various hormonal levels. Although corticosterone secretion is increased by stressful events, previous studies have reported that the pair situation attenuated the increases due to exposure to a novel environment [7], a fear-inducing animal [8] and fear conditioning [9]. These phenomena are called social buffering, which can mitigate various stress responses through signals such as odor, touch and visual stimulus from conspesifics [10, 11]. However, there has been no study that has investigated the effect of the social buffering during fear extinction on corticosterone levels. Corticosterone has been reported to enhance the excitability of amygdala neurons [12], and increases in corticosterone levels have been correlated with enhanced fear-conditioned memory in rats [13]. Thus, we hypothesized a * Corresponding author. decrease of corticosterone secretion is a factor that leads.to the reduction of fear responses. Whereas, corticosterone affects fear memory by modulating the storage or consolidation phase [14], several other studies have reported that corticosterone treatment [15] and administration of a glucocorticoid agonist [16] facilitated fear extinction. Therefore, attenuation of corticosterone secretion possibly interrupts persistent fear reduction.

Our study has important practical implications, especially in the field of clinical psychology. Fear- and anxiety-related disorders such as PTSD and bipolar disorder are closely associated with fear dysregulation in which inhibition of fear is lacking in patently safe situations. Investigating fear extinction, therefore, provides valuable insights into potential therapeutic method and clinical interventions (Myers,2007).

In this study, participants went through two-day differential fear conditioning and extinction paradigm. One stimulus was fear conditioned (CS+) while another was not(CS-) in the acquisition phase. During following extinction, both stimulus (CS+ and CS-) were presented to participants in the absence of US. On the next day, both stimulus were presented and SCR was recorded during Recall Test.

2. Materials and Methods

2.1. Group Selection

Participants. A total of N = 6 subjects participated in the present study. Subjects were all epileptics (Mean age: 20 years, SD: 5.3 years, 6 Males), the reason why we selected the patients with epilepsy as experimental subjects was that patients with refractory epilepsy required surgical implantation of electrodes after clinical evaluation, and it was more accurate to measure Galvanic Skin Response (GSR) signal.

2.2. Materials

A BIOPAC MP160 multiple electroconductive physiological recorder (EDA module), a BIOPAC electrical stimulator, One Docking Station, Several data cables (Connecting laptop and skin electrical signal recording tool). The software which was programmed to guide the subjects through the experiment was Matlab, and the software used to present and record the GSR data during the experiment was Psychtoolbox.

2.3. Experimental Description

There were 2 conditional stimulate (CS) stimuli in the experiment, which were two pictures of male faces with neutral expressions, black hair and yellow hair respectively, with the same background color and size. In each experimental stage, each CS was randomly presented individually for 4 s with an interval of 8-10 s. The same picture appeared at most twice in a row, and the picture matched by SC+ was randomized. The number of CS appearances varied

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depending on the experimental stage. the CS+ pictures lasted 3.5 s before the start of the electric shock, which lasted 500 ms, and the picture disappeared when the electric shock ended.

2.4. Experimental Procedure

2.4.1. Informed Consent and Experimental Notification

Before the experiment, the experiment leader would ask the subjects to sign the informed consent form (electrical stimulation) and view the experiment task instruction PowerPoint, which contains the experiment procedure and attention points.

2.4.2. Habituation Stage

Subjects were required to rest for 10 minutes before the experiment to keep the GSR signal smooth. After the first stage of the experiment started, the instructions were entered on the Matlab set programming. During this stage, each CS appeared four times individually and randomly and an arrow pointing to the left or right appeared stochastically in the interval of each CS picture, and the subjects had to respond to keep their attention on the screen at all times during the experiment.

2.4.3. Fear Memory Acquisition Stage

Before the acquisition stage, we would turn the optimal shock parameters for the subjects. The intensity of shock was adjusted to a level that the subject reported discomfort but could tolerate it. After tuning, subjects rested for 5 to 10 minutes to prevent affecting the GSR signal data. The second stage was fear memory acquisition stage which include 20 CS+ (8 of them were electrically charged) and 12 CS-, Prior to the acquisition phase, the optimal shock parameters were tuned for the subjects. The intensity of the shock was adjusted to a level that the subject reported as uncomfortable but tolerable. After tuning, subjects rested for 5 to 10 minutes to prevent interference with skin electrical recordings. In the second stage of fear memory acquisition, there were 20 CS+, of which 8 were charged and 12 CS-. Each CS appeared individually at random, and a number from 1 to 10 was arranged below the picture during the experiment, and subjects rated the likelihood of electric shock appearing according to the picture, with 0 being a certainty of no shock and 10 being a certainty of a shock. The subjects' ratings were used to assess their fear memory acquisition circumstances. A 10-minute break was taken at the end of the experiment for the next stage of the experiment.

2.4.4. Fear of Memory Extinct Stage

In the third stage each CS was randomly and individually presented 30 times with a numerical arrangement of 1-10 below each picture, and subjects rated according to the likelihood of being electrocuted. This stage of the experiment was not matched for electric shocks. The above experimental stages were all completed in the same day.

2.4.5. Extinct Memory Recall Stage

The fourth stage of the experiment will be performed on the second day, with 30 separate random appearances of CS each time, without charged CS+, the same as in stage 3, requiring subjects to rate.

3. Conclusions

3.1. Patients in the Group:

6 men are all epilepsy patients. The average age is 20 years old. Are right-handers

3.2. Experimental Results

3.2.1. Acquisition Phase

There were six subjects, with vertical lines for variation on the subjects, the mean for blue contacts, different differences in the test, the range of fluctuations reflected error, when trial4,

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the largest range of fluctuations, the largest difference. When it is rail7, the range of fluctuations is minimal and the difference is minimal.

CS-plus, CS-regardless of the rise and fall, CS-plus is always on top of CS-. The trial average is the SCR reaction, which can be known as a normal distribution, and the t-test is done.

Available BAR Figure:

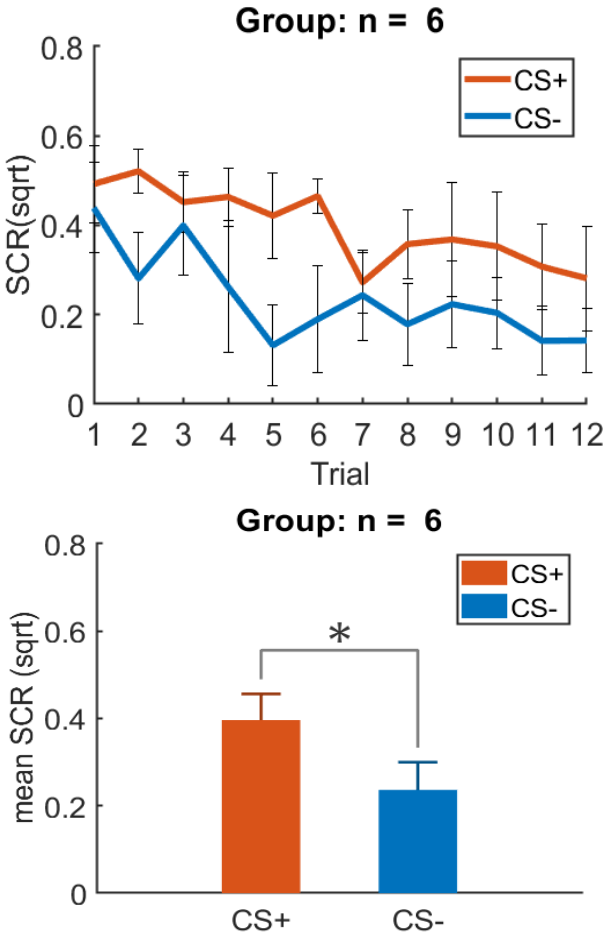

Figure 1. Available BAR

The subjects had significantly higher electrical reactions to the skin of CS-plus than CS-,

This means that the subjects succeeded in learning the fear memory of CS-plus through the acquisition phase. PS: There are only twelvetrils, because the eighttrials of CS plus live are excluded. So the real1 in the figure represents not the first test on the trial, but the first uncharged test after the charged test is eliminated. And the previous live test has learned the fear of CS-plus, because the human learning ability is very strong, followed by more for the intensification of learning.

3.2.2. Retreat Phase

Presented as all thirty trials, because of the common phenomenon (in the acquired memory extraction - the first few tests, the subjects' fear of CS-plus memory is generalized to CS-).), similar to a snake bite, ten years afraid of well ropes, so the initial CS-plus, CS-are very high.

The first six attempts (1-6) and the last six (25-30) of the CS-plus were taken out for the same period.

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It was concluded that the level of skin electrical reaction in the first six trials was significantly lower than that of the last six, which meant that as the regression process progressed, the subjects were able to successfully fade their fear memory of CS-plus.

Supplemental analysis: CS-first six tests and the last six tests were also taken out for the same period of testing, found that the subjects were also able to fade the fear of generalization memory.

PS: Because there is no electric shock in the receding phase, all thirty attempts are presented.

3.2.3. Recall Phase

The change between fluctuations is not obvious.

Taking the first six attempts, the first six attempts of CS plus and the first six attempts of CS- averaged on the subjects. The subjects were then tested at the same time.

Findings: There was no difference in the level of skin electrical response to CS-CS-skin.

Proof: The subjects were able to fade their fear memories of CS-plus, CS-.

At this time, the decline of fear memory has more advantages, extraction is not fear memory, because in the acquisition stage obviously observed CS-higher than CS-high, but after the decline of learning, then the memory extraction. There was no significant difference between the level of fear response to CS plus and CS-.

This means that when extracting, fading memory prevails.

PS: Take the first few attempts to think of it as memory extraction, followed by further fading learning. Bar recalled the variation on the subject for a day.

4. Discussion

This experiment aims to create a novel system of fear formation and fear extinction in epileptic patients. From the results-oriented perspective, the subjects initially acquired fear of CS+ and then generalized to fear of CS-, and finally, there was a significant decrease in SCR after the extinction session, which makes the model system of fear formation and extinction techniques for epileptic patients feasible.

The reason why the electrical skin approach was chosen as the research method is that patients with intractable epilepsy need to implant electrodes surgically after clinical evaluation. As the conductance response of skin sweat glands is measured, this method has a higher accuracy and sensitivity. In general, fMRI has been the method used in most previous studies of fear acquisition and fear extinction. Its working mechanism is to investigate emotions by examining changes in magnetic resonance signals caused by blood oxygen state of venous capillaries in various brain regions, while the common cause of epilepsy is cerebrovascular disease, which greatly reduces the accuracy of fMRI in investigating the emotions in epileptic patients.

A few years ago, many scholars also used the electronormality method to study people's fear acquisition and fear elimination, but most of the researches focused on higher group validity, which meant that most of their subjects were normal healthy people. At the same time, most studies have focused on specific applications of skin electricity such as finding fear-related features, and few studies have proposed a framework for effective systems. In our study, we started from the conductive response of skin electricity and identified the subjects as those who needed special equipment to assist in the conductive response due to their illness.

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