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Tuning Fear: Enhancing Virtual Reality Therapy with Music for Katsaridaphobia

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Abstract

Phobias have been proven to be the catalyst of anxiety, depression, post-traumatic stresses, and mental health disorders, illustrating the importance of further research required to maximize the effectiveness of phobia treatment. Previous researchers explored the different categories of therapy that serve as a medical treatment to help patients confront their fears, in addition, exposure therapy has been identified as the most effective form of medical treatment for phobias. Exposure therapy, a psychological treatment whose purpose is to advocate a positive emotional and physiological state. The diverse sorts of presentation treatments incorporate heart rate variability (HRV) biofeedback, vivo reality, virtual reality presentation treatment, and numerous more. Numerous restorative organizations joined HRV biofeedback and virtual reality exposure therapy to presentation treatment, in any case, no investigation has utilized music to make strides in the productivity of presentation treatment. The disclosure of these past ponders spurred my inquiry to examine the degree to which music impacts the adequacy of vivo reality introduction treatment to patients with katsaridaphobia, the fear of cockroaches. The technique apparatuses utilized to conduct the inquiry include Fear of Cockroaches Questionnaire (FCQ), expert-reviewed vivo reality exposure therapy, heart rate monitor (HRM), and a correlational content analysis of the influence of the different categories of music on the patients' heart rate as displayed on the HRM.

Key Words: Post-Traumatic Stress, Exposure Therapy, Phobias, Virtual Reality, Trauma, Anxiety, Fear

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Introduction

Phobias are classified as an extreme fear of objects or situations regarding the activity and communication in the amygdala and the motor neurons. These conditioned responses of fear are conditioned through associative learning and maintained through operant or classical conditioning (Neufeld, Mintz, 2001). The treatment of phobias is necessary due to their interference in daily lives. For instance, phobias that cause an individual to avoid social situations can lead to negative cognitive processing that provokes isolation (Wodele, 2019). Additionally, the limitations of an individual's daily activities can lead to severe anxiety and depression. Nevertheless, the symptoms are varied due to the impact of genetic predisposition. For instance, families linked with excess dopamine are associated with aggression and poor impulse control; on the other hand, families linked with an undersupply of serotonin and norepinephrine are associated with depression.

Despite the influence of genetic predisposition on the release of hormones and neurotransmitters, phobias provoke anxiety and other mental illnesses regarding the association of physical sensation and the 'danger' perceived by the amygdala and the frontal lobe. In the meantime, an individual's phobia is reinforced each time they decide to avoid the stimulus. As individuals avoid their fear stimulus, associative learning convinces the amygdala and thalamus to perceive the stimulus as 'danger' (Shin, et al., 2009). Moreover, Richard Kaae, a certified entomologist, identified society's most feared phobia: cockroaches. He claimed that tens of millions around the world fall victim to the fear of cockroaches. As these clients refuse to receive treatment, many develop anxiety regarding the limitations of their lives caused by living with cockroaches (Nuwer, 2014). Because the fear of cockroaches has been identified as maladaptive, this study involves treating clients with katsaridaphobia, the fear of cockroaches.

Upon thorough investigation of existing literature, exposure therapy, including cognitive-behavioral therapy integrated with exposure therapy, has emerged as the predominant medical intervention for individuals suffering from phobias. During exposure therapy sessions, patients are carefully situated in a secure environment, often under the guidance of seasoned professionals. Moreover, they are encouraged to directly confront their phobia or distressing memories when exposed to the feared stimuli. In contrast to talk therapy or music therapy, exposure therapy entails subjecting patients to real-life simulations of their fears, thereby eliciting brain activity, particularly within the amygdala and regions associated with the fight-or-flight response. Professionals adeptly lead patients through the process, assisting them in gradually modifying their behavioral responses to their fears (Sissons, 2020). Throughout the course of therapy, associative learning occurs as neural plasticity permits adaptation and reshaping of the amygdala's perception of the feared stimuli, resulting in a reduction of fear neuron activity regulated by the parasympathetic nervous system (Gallagher, 2013). As patients engage in exposure therapy, the amygdala gradually acclimates to the fear-inducing stimuli, facilitating the brain's reorganization of the neural fear pathway (Hauner, et al., 2012).

In accordance with the Pavlovian conditioning model, the formation of a phobia occurs when a neutral stimulus (NS) is presented or followed by an unconditioned or aversive stimulus (US). Over time, brain activity in the amygdala activates, perceiving the neutral stimulus as threatening, thereby eliciting a conditioned response (CR) to avoid or escape the object (Lissek, et al., 2007). For the purpose of exposure therapy, the concept of counterconditioning (also called stimulus substitution) is incorporated to decrease the fear response. In this case, counterconditioning occurs when clients learn to associate a new response with the stimulus that elicits an unwanted behavior.

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Literature Review

The credibility, validity, and reliability of the sources were ensured through scrutiny of the sources, the authors' background information, indicated references, and the publication date. The selected sources were located through keyword searches. The databases indicated from the selected sources were examined, analyzed, and compared. To comprehend why this study analyzes the utilization of music in vivo exposure therapy, it is important to review and analyze the existing research on this subject.

Researchers from the BioMed Central research organization conducted research regarding exposure therapy enhanced with the therapeutic add-on of HRV biofeedback. The purpose of this study is to assess the effect of HRV biofeedback on the efficiency of exposure therapy to treat arachnophobia. The study demonstrated the effectiveness of the utilization of HRV biofeedback in exposure therapy by requiring the experimental groups to receive specific motor-pseudo biofeedback related tasks then to perform a task during therapy session. The study showed that "positive results in terms of reduced depression scores and increased HRV have also been shown for patients with depression" (Schäfer, et al., 2018). Similarly, analysts from the Logician Colleges in Nitra, found in Slovakia, joined the concept of the actuation of the autonomic apprehensive framework to form an adjustment of virtual reality (VR) treatment. The team analyzed the effectiveness of biofeedback VR exposure therapy by investigating the correlation of the effects of biofeedback on self-confidence.

Moreover, the research explained that excess dopamine neurotransmitters and a lack of norepinephrine are associated with poor impulse control and mental disorders related to arousal. The research also demonstrated that higher self-confidence is achieved when biofeedback is utilized in the therapy session. The team claimed, "the modification of exposure therapy by means of virtual reality is a promising strategy, especially in cases of anxious disorder," (Slepecky, et al., 2018). In essence, both studies concluded that exposure therapy has been proven efficient for the treatment of phobia and anxiety. In addition, exposure therapy can be modified with the utilization of other elements that advocate the reduction of anxiety regarding the release of different neurotransmitters. Nonetheless, the studies are limited as they do not examine the evaluation of the long-term effects of exposure therapy. Because both studies demonstrated an inconsistent correlation between psychological fear, perceived fear, and arousal, further research is necessary to investigate other suitable equipment that will decrease fear response when utilized with exposure therapy.

Unlike studies conducted by the BioMed Central and the Philosopher Universities in Nitra, research conducted by Cold Spring Harbor Laboratory (CSH) examined the factors of the establishment of a phobia by researching the neurological components of classical conditioning. The study illustrated that associative learning of fear occurs when a neutral stimulus (NS) is presented or followed by an unconditioned or aversive stimulus (US). Over a period of time, brain activity in the amygdala activates, perceiving the neutral stimulus as threatening, which therefore elicits a conditioned response (CR) to avoid or escape the object. Additionally, the researchers concluded, "there is tremendous clinical value to optimizing inhibitory learning during exposure therapy to both enhance treatment efficacy in general and to compensate for the deficits that are present within the anxious individual," (Craske, et al., 2014). Similarly, another study conducted by CSH exemplified the active brain activity during fear learning by explaining 5-HT3 receptors' involvement in anxiety-related behaviors and regulation of inhibitory GABA neurons. (It has been proven that the 5-HT3 displays a similar function to the serotonin neurotransmitter).

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The study concludes that "the 5-HT3A receptor could be a key molecule for regulation of fear extinction, and a potentially important therapeutic target for disorders of regulation in the fear system." Nonetheless, 5-HT3A receptors' role in each brain region that contributes to fear extinction can still be questioned. (Kondo, et al., 2014). As a consequence, both studies indicate that associative learning plays a major role in fear extinction because fear learning optimizes the release of neurotransmitters. However, they are limited since they failed to address the utilization necessary to optimize associative or inhibitory learning. Additionally, more research is required to elucidate the maximization of exposure therapy and the optimal application conditions necessary for enhancing associative and fear learning by targeting inhibitors to reduce anxiety.

Moreover, since memory reconsolidation plays a major part in fear termination and learning, analysts from PMC assessed the mediation of the vagus nerve stimulation framework and fear termination. Memory reconsolidation regarding the vagus nerves system (VNS) to traumatic events has been examined with regards to associative learning and the formation of new memory. It has been demonstrated that utilization to enhance associative learning regarding fear extinction is feasible due to modulating synaptic plasticity in the hippocampus by the VNS. In conclusion, the researchers inferred that the "VNS can accelerate extinction of conditioned fear for both recently learned and remote memories," (Noble, et al., 2018). In a similar vein, research conducted by researchers from the HHS Public Access investigated the extinction of fear acquired from exposure therapy through the cognitive perspective. The research demonstrated the synaptic alternation of long-term memory in the hippocampus by illustrating the neurological anatomical circuitry (including the inhibitory and excitatory neurotransmitters). Furthermore, this research expanded on PMC's research regarding the VNS's influence on memory formation. Researchers from HHS Public Access concluded, "the enlargement of fear extinction/exposure treatment with an extent of diverse drugs acting as cognitive enhancers to reinforce termination recollections speaks to a critical approach to upgrading treatment adequacy," (Singewald, et al., 2015). As a consequence, it has been demonstrated that stress experienced during exposure therapy is capable of enhancing memory consolidation via activating the sympathetic nervous systems and the hypothalamus. Both studies suggest that inhibitory neurotransmitters are the key to memory reconsolidation during exposure therapy. The data collected from these studies indicate the importance of further research to completely elucidate the most effective treatment that enhances the control of the PNS and the release of inhibitory neurotransmitters during exposure therapy.

As Wolpe (1995) proposed, the concept of exposure therapy comes in a form of behavioral therapies that encourage the reduction of fear response through counterconditioning and behavior analysis. Moreover, pre-existing research has proven that plasticity and habituation allow the exposure to the conditioned fear stimulus to reduce the conditional fear reactions. It has also been demonstrated that utilizations to exposure therapy help a client's impulse control, which contributes to fear extinction. Therefore, while some studies advocate the utilization of exposure therapy with VRs and biofeedback methods to promote associative learning, others argue that the control of the PNS and the release of neurotransmitters commanded by the hippocampus are responsible for memory reconsolidation during the exposure therapy. Yet, few studies incorporate music, an antidepressant that reduces anxiety and stress by promoting the release of inhibitory neurons that contribute to the enhancement of fear extinction memory during the therapy session.

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Nonetheless, despite music being labeled as a 'potential method of therapy' that reduces anxiety, pre-existing research does not designate the incorporation of music to exposure therapy as a method of phobia treatment. As stated by researchers from HHS Public Access, "it appears sound to prescribe combined treatment including exposure-based psychotherapy alongside antidepressants counting SSRIs such as fluoxetine, as there's more prove supporting than refuting such a technique at the minute," (Singewald, et al., 2015). Therefore, the purpose of this research is to maximize the effectiveness of exposure therapy by addressing this gap. To explore and analyze the maximization of exposure therapy to treat phobias, the guiding research question is: how does music influence the effectiveness of vivo exposure therapy to patients with katsaridaphobia?

The inquiry about the influence of music on exposure therapy will be interesting because it will look at the degree to which the utilization of music in vivo exposure therapy treatment impacts fear termination (measured by the time required for a client's heart rate and blood pressure to return to the initial state). Additionally, because previous research did not indicate the utilization of music to, a major antidepressant, to exposure therapy, my research will therefore fill in the gap in knowledge on this subject. Particularly, the inquiry will arbitrarily allot 20 members who scored above the median or higher on the Fear of Cockroaches Survey to the exploratory bunches and the control gathering. The participants randomly assigned to the experimental group will be required to undergo exposure therapy utilized with different types of music. Moreover, to follow the ethical guidelines, the study will not mention the participants' private information.

Contributions to research are significant because they highlight feasible methods to maximize exposure therapy through the investigations of antidepressants and its psychological influence on neural activity to promote fear extinction. It will research fear responses and extinction enhanced through the incorporation of pre-existing research and concepts regarding neural circuits, amygdala activation, associative learning, and, most importantly, possible utilization to maximize exposure therapy. This would be instrumental as neurological concepts and memory reconsolidation will be expanded and researched in this study. With this knowledge, the maximization of exposure therapy to treat phobias will reduce the limitations in an individual's daily life when fear extinction is learned. Clients will be able to reduce their fear response and arousal neural activity when encountering the fear stimulus. The outcomes of this ponder will contribute to the diminishment of uneasiness and anxiety of people within the Bangkok community, which can lead to social benefits such as increment in workers' efficiency within the long run.

Hypothesis

The prediction of the outcome of this research is that when participants are uncovered to upbeat music amid the vivo exposure therapy treatment session, the treatment session energizes the improvement of acquainted learning and fear termination, on the other hand, participants that are uncovered to terrifying music amid the treatment session will result within the decrease of fear termination. This hypothesis was developed based on conclusions of studies examining the release of dopamine, serotonin, and prolactin neurotransmitters and hormones regarding amygdala activity (Cochran, et al., 2013). These studies showed a correlation between the release of inhibitory neurotransmitters and hormones and the reduction of an individual's fear response. Therefore, antidepressants such as music that release inhibitory neurotransmitters and hormones will influence the effectiveness of exposure therapy and fear extinction.

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Methodology

The first step in carrying out the research was to select participants to participate in the research that would serve as a sample of the community. An objective test, the Fear of Cockroaches Questionnaire (FCQ), was adapted from a study regarding generalized anxiety and anxiety-based diagnostic features of phobias (Scandola, et al., 2010). The FCQ was selected as it provides information that could be easily standardized and was relatively cost effective. Additionally, the FCQ was chosen as a part of the method due to the advocacy of the questionnaire's ability to reach out to more people from different areas than time consuming case studies for interviews. In order to ensure the accuracy of the research, the FCQ was sent to all of the high-school students in Thai-Chinese International School. The objective test was targeted towards students who were troubled with katsaridaphobia. The adapted version of the FCQ is shown in Appendix A.

The participants that scored above the median score are qualified for a diagnosis. There are a total of eight questions in the FCQ with a total score of 40. The higher the FCQ score, the more afraid of cockroaches the participants are. The representative sample of this research has been chosen through the process of random selection in order to advocate generalizability and to avoid subject to bias. To avoid group conformity, the participants were required to undergo therapy one at a time, all supervised by a clinical psychologist. A total of 54 volunteers took the FCQ objective test. For the next step of the experiment, the 20 participants that received the diagnosis of katsaridaphobia will undergo vivo exposure therapy. The participants that scored the highest on the FCQ were chosen to evaluate the 'decrease in fear' after the therapy through the form of behavior analysis. If participants that scored low on the FCQ were chosen for this experiment, the fear response recorded wouldn't be as clear, which would lead to a vague behavior analysis of fear extinction. In addition, the correlational quasi experimental design was chosen because the external validity could be enhanced as the independent variable could be manipulated to determine the association between fear extinction and music. The quasi-experimental design allowed higher internal validity because the study involved real world interventions instead of artificial designs. Moreover, independent variables were employed, and the experiment proceeded with precise control.

In expansion, the 20 members were haphazardly doled out to the 3 exploratory bunches and the control bunch. Members that were doled out to the exploratory bunches were required to observe a video of cockroaches whereas diverse sorts of music were being played for four and a half minutes. Each group includes 5 participants randomly assigned. The 3 different experimental groups include: exposure therapy utilized with cheerful music that advocates the release of dopamine, sorrowful music that advocates the release of prolactin and inhibitory dopamine, scary music that advocates the release of adrenaline and noradrenaline. The different types of music selected are displayed and explained in Figure 1. Furthermore, the operational definition of the increase and decrease of fear is demonstrated by an increase of blood pressure and pulse on a heart rate monitor. All participants' blood pressure and pulse will be measured a day prior to the experiment, just before (10 minutes before) the experiment, during the experiment, and right after (5 minutes after) the experiment.

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Figure 1: Impacts of Hormones/Neurotransmitters on Physiological Arousal.

Experimental Groups	Secreted hormone/ neurotransmitter	How does it affect emotional and physiological states?
Ominous Tune	Adrenaline and Noradrenaline	The adrenaline and noradrenaline secreted by the adrenal gland causes pulse to increase rapidly as more blood is pumped, which causes arousal that promotes stress and anxiety.
Pleasant Tune	Dopamine	The discharge of dopamine, a neurotransmitter connected with the remunerated framework of the brain, comes about in an expanded heart rate and blood weight as the average remote bundle (remunerated framework of the brain) is actuated.
Melancholic Tune	Prolactine, dopamine inhibitors	The release of prolactin, a hormone that is linked to stress and neurogenesis, will increase one's heart rate. On the other hand, the release of dopamine inhibitors will decrease the firing potential of fear neurons, which will activate the parasympathetic neural system and decrease both the blood pressure and pulse.

Finally, the descriptive-interpretive and correlational analysis method was utilized to analyze and interpret the database. Line graphs were employed to illustrate the correlation between the effectiveness of exposure therapy utilized with different types of music. The fluctuations of blood pressure and pulse were depicted in each line graph to showcase the variations in fear levels. The chosen method of analysis facilitated the extraction of data from various aspects for comparison. Patterns and general trends observed between blood pressure, pulse, and the different types of music in the graphs enabled meaningful comparisons regarding the effectiveness of music in vivo exposure therapy. These comparisons were further scrutinized for additional implications, limitations, and conclusions. In essence, the methodology chosen to analyze and interpret this study exemplified the feasible procedures to maximize the effectiveness of exposure therapy concerning associative learning and fear extinction. This, as described in the conclusion and discussion, provides an effective qualitative analysis of fear extinction.

Ethics

Because this study involves human subjects, ethics must be carefully considered. The protocol of this research and experiment has been approved by the school board. In accordance with the American Psychological Association's Moral Standards of Analysts and Code of Conduct, a clinically certified expert must be present to administer the test in order to ensure the participants' security. Therefore, the entire experiment was reviewed and supervised by a clinical psychologist. Additionally, to adhere to the guidelines, the participants' personal information was kept confidential. The participants were allowed to withdraw from the study at any time, and no deceit or deception was involved. After the experiment was conducted, all participants were debriefed.

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Results and Data Analysis

The FCQ survey served as a representative sample of adolescents in Bangplee, Thailand. This survey yielded results from 54 high school students at Thai-Chinese International School. The data of the 20 participants who scored the highest on the survey were scrutinized and analyzed. The FCQ scores and fear response (indicated as blood pressure and pulse) of the control group are displayed in Figure 2. The scores of the experimental group exposed to happy music will be displayed in Figure 3, the scary music group in Figure 4, and the sad music group in Figure 5. As shown in the tables below, participants with high FCQ scores demonstrated higher blood pressure and pulse before, during, and after therapy compared to those who scored lower. There was a total of 8 questions on the FCQ, where each question measures the participants' fear response and anxious feelings toward encountering their fear stimulus. The greater the fear response, the higher the FCQ score. The 20 participants with the highest scores were selected to participate in this experiment, with scores ranging from 24 to 38.

Figure 2: FCQ and Fear Extinction (control group)

Participant	FCQ score	SYS/DIA (day before therapy	Pulse (day before therapy)	SYS/DIA (right before therapy)	Pulse	SYS/DIA (2min during therapy)	Pulse	SYS/DIA after	Pulse
1	35	143/93	65	134/87	74	128/86	75	126/94	78
2	32	155/105	92	87/73	97	117/74	90	114/92	71
3	38	127/87	87	107/70	96	120/82	102	105/70	97
4	27	125/ 93	105	129/90	107	123/84	103	118/85	108
5	32	127/79	87	122/84	97	117/74	90	114/92	71

Figure 3: FCQ and Fear Extinction (happy music)

Participant	FCQ score	SYS/DIA (day before therapy	Pulse (day before therapy)	SYS/DIA (right before therapy)	Pulse	SYS/DIA (1.5min therapy)	Pulse	SYS/DIA after	Pulse
6	34	97/71	86	125/80	95	120/86	103	99/80	106
7	26	96/64	84	123/84	93	115/82	101	115/80	109
8	25	140/91	92	113/76	93	131/76	99	120/91	103
9	28	105/72	82	134/82	97	108/91	92	107/77	94
10	35	112/86	105	108/76	81	103/80	83	105/65	89

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Figure 4: FCQ and Fear Extinction (scary music)

Participant	FCQ score	SYS/DIA (day before therapy	Pulse (day before therapy)	SYS/DIA (right before therapy)	Pulse	SYS/DIA (1.5min therapy)	Pulse	SYS/DIA after	Pulse
11	36	125/75	75	152/109	88	131/87	91	108/78	84
12	38	119/89	80	147/103	83	149/106	90	143/105	88
13	32	132/86	96	126/77	63	117/82	68	113/71	82
14	27	127/87	90	107/76	97	106/69	97	103/71	112
15	36	110/78	81	117/87	110	120/84	93	122/81	88

Figure 5: FCQ and Fear Extinction (sad music)

Participant	FCQ score	SYS/DIA (day before therapy	Pulse (day before therapy)	SYS/DIA (right before therapy)	Pulse	SYS/DIA (1.5min therapy)	Pulse	SYS/DIA after	Pulse
16	26	108/61	88	123/76	103	101/71	84	98/69	85
17	34	131/91	92	123/86	80	127/87	84	117/75	90
18	28	124/91	85	119/80	116	111/79	119	82/72	124
19	28	106/80	67	123/71	76	99/62	70	117/82	99
20	28	122/88	82	123/82	99	119/85	104	126/87	118

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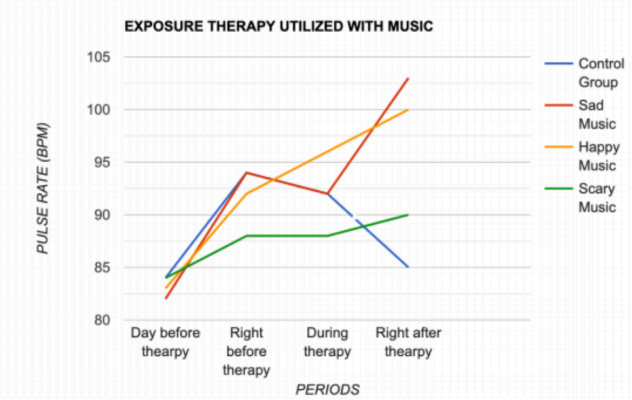
Qualitative Data

Fear extinction, as demonstrated by the increase and decrease of pulse, is displayed in the average scores of the participants indicated in Figure 6. As shown in the chart below, the pulse of the participants in the happy music and sad music groups increased significantly. The pulse of those in the control group increased gradually and then decreased while that of those in the scary music group remained constant.

Figure 6: Pulse and Fear Extinction



On the other hand, fear extinction, demonstrated by the increase and decrease of systolic and diastolic blood pressure, is displayed in the graphs below. The fear extinction of the control group is depicted in Figure 7, while that of the happy music group is shown in Figure 8, the scary music group in Figure 9, and the sad music group in Figure 10.

Figure 7: Control Group's Blood Pressure and Fear Extinction

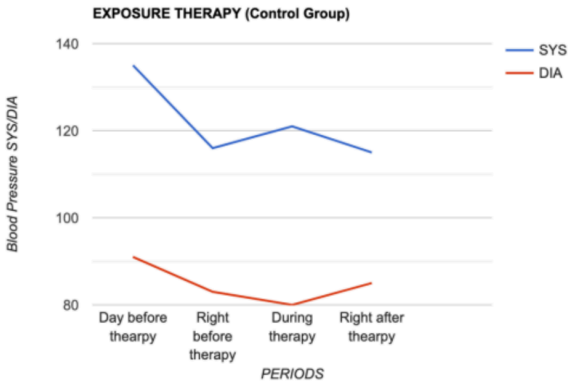


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Figure 8: Happy Music Experimental Group's Blood Pressure and Fear Extinction

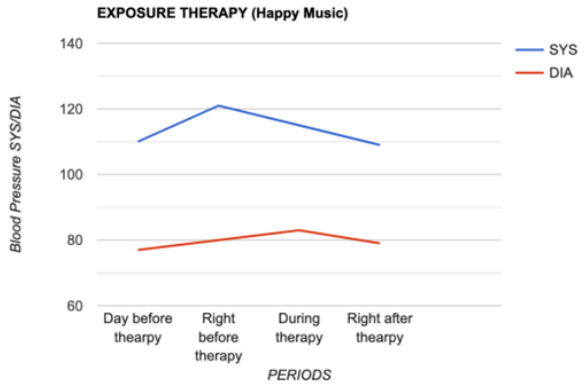


Figure 9: Scary Music Experimental Group's Blood Pressure and Fear Extinction

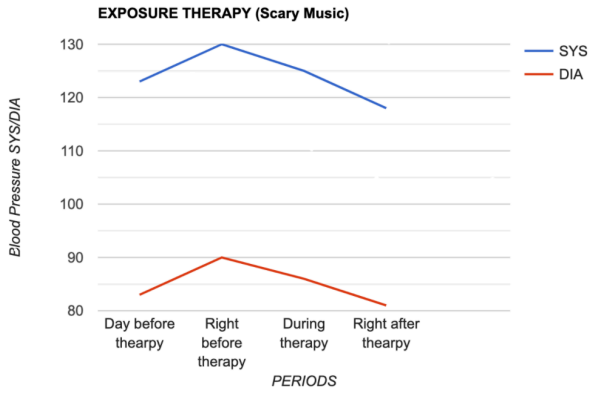
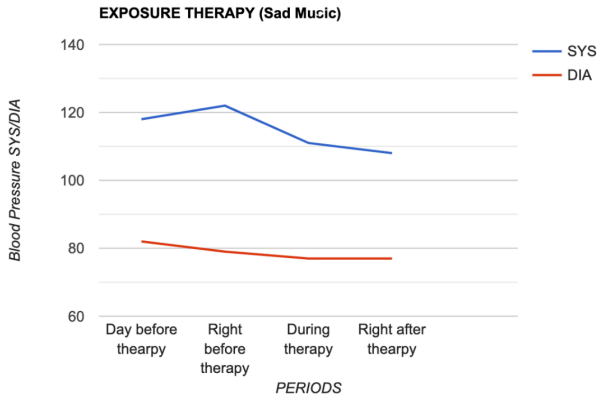


Figure 10: Sad Music Experimental Group's Blood Pressure and Fear Extinction



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Discussion

As there were no other provocative stimuli observed within the control group, participants were able to maintain their focus on the video. In this case, none of the participants displayed any uncomfortable body language such as avoiding eye contact, crossing their arms, or squinting their eyes. Instead, they were focused on the video, and their emotional state remained neutral. As demonstrated in Figure 7, the systolic blood pressure rapidly decreased during the first few minutes. After a few minutes, the blood pressure remained rather constant. Conversely, the diastolic blood pressure remained constant throughout the whole experiment. Despite the absence of an antidepressant, the participants' fear response decreased because they were able to associate the stimulus as 'non-dangerous' after exposure. Therefore, when music is not being utilized with exposure therapy, the participants' emotional state remains catatonic, and their physiological state becomes less aroused after exposure.

On the other hand, as shown in Figure 8, the systolic blood pressure of the participants in the happy music experimental group increased right before the therapy and decreased as the therapy continued. The diastolic blood pressure gradually increased and reached its climax during the therapy and then rapidly decreased. The participants were more talkative and displayed comfortable gestures during the therapy. They were laughing and smiling as they underwent the therapy. As mentioned, the utilization of happy music advocates the release of dopamine, which causes the participants to be aroused and excited. As demonstrated, the utilization of happy music in exposure therapy generates a positive (aroused) emotional state and slightly decreases the fear response.

In addition, as explained in Figure 9, the blood pressure of the participants in the scary music experimental group increased and reached its climax right before the therapy. After the participants were exposed to the fear stimulus, the blood pressure began decreasing gradually. The participants displayed uncomfortable gestures such as excessive blinking, covering their eyes, and scowling as they underwent the therapy. As the utilization of scary music promotes the release of adrenaline and noradrenaline, the participants seemed anxious and stressed during the therapy. Similar to the utilization of happy music, the utilization of scary music causes the participants to be aroused. As exemplified, the utilization of scary music in exposure therapy generates a negative emotional state and an aroused physiological state, which slightly decreases the fear response.

Finally, as shown in Figure 10, both the systolic and diastolic blood pressure of the participants in the sad music experimental group remained rather constant throughout the whole experiment. Similar to the reactions of the participants within the controlled group, the participants were focused on the video and did not display any gestures. As the utilization of sad music promotes the release of prolactin and dopamine inhibitors, the participants were less aroused and relaxed. Based on the graph, it can be concluded that the utilization of sad music in exposure therapy generates a catatonic emotional state and a slight to no decrease in the fear response.

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Conclusion

Through the qualitative data analyzed, it has been proven that the utilization of cheerful music results in a more positive emotional state (smiles and laughter) but a more aroused physiological state. On the other hand, the utilization of sad music results in a more catatonic emotional state (no facial expressions) and a stable physiological state, while the utilization of scary music results in a negative emotional state (scowls and frowns) and an aroused physiological state.

As this study falls within the category of cognitive behavior therapy, a form of psychotherapy that aims to improve mental health by promoting positive cognition and altering undesired behaviors, the advantages and disadvantages must be considered. If the participants are unwilling to cooperate with the therapist, or if they are unwilling to acknowledge the diagnosis, the therapy will be considered ineffective. Nonetheless, cognitive behavior therapy is a standardized psychotherapy process that promotes a healthy mental state. By utilizing different antidepressants such as music in exposure therapy, the expression of fear response presented in each experimental group varies regarding the different neurotransmitters and hormones released.

Furthermore, as mentioned in previous research, the process of counterconditioning phobias allows associative learning to alter the amygdala's activity and allows memory reconsolidation to take place. In this case, the different types of neurotransmitters influenced by both genetics and environmental factors (such as music, an antidepressant) have different effects on fear termination. Nevertheless, the data collected are not enough to prove that music, an antidepressant, positively influences cognition mentally or physiologically. Still, the correlation between the type of music, blood pressure, and pulse demonstrates that different types of music affect fear response differently. It is significant to note that the various neurotransmitters and hormones released when different types of music are played result in different emotional and physiological changes.

Limitations

To completely elucidate the effects of music on fear extinction, further studies that research the influence of genetic predispositions on associative learning are necessary. This is because genetic disposition influences the regulation of neurotransmitters such as dopamine, adrenaline, and many more. For instance, participants with a genetically predisposed excess release of dopamine are more easily aroused. Therefore, it is important to consider the influence of genes and arousal in this study. By the same token, the operational definition selected to measure the participants' physiological states (blood pressure and pulse) is not suitable for this study. Researchers could not distinguish if the participants were stressed, anxious, or excited when both the scary music and happy music experimental groups' participants displayed high blood pressure and pulse. Consequently, it is important for future studies to determine suitable equipment to measure 'fear response' and 'fear extinction' that both indicate one's change in emotional state and physiological state.

Moreover, due to the concept of selective attention, the participants can only pay attention to a limited array of sensory stimuli. As mentioned in the 'Results' section, some participants in the scary music experimental group were not paying attention to the video. They displayed excessive blinking and were unfocused. Because of this, the fear responses may be disoriented. Nevertheless, the possibilities for the

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maximization and expansion of antidepressants to maximize exposure therapy are unlimited. Future research should examine different aspects of the factors that will influence the fear response during therapy, such as the influence of genetic predisposition on fear extinction, a more applicable measurement of fear response, and how selective attention affects fear responses.

Implications

The results of this study inspire further experimentation and inquiries to pathopsychological and cognitive applications. In this study, exposure therapy utilized with happy music promotes a positive emotional state, allowing participants to enjoy the therapy session. Yet, participants assigned to the scary music group displayed a negative emotional state and did not enjoy the therapy session. These findings evoke further examination on the extent to which music can alter cognitive processes during exposure therapy. Moreover, relevant literature revealed that neurotransmitters and receptors associated with impulse control play a major role in fear extinction. While this study accomplished the primary goal of introducing the influence of happy, sad, and scary music on exposure therapy, it has been proven that the different types of music play an important role in fear extinction and the participants' physiological and emotional state. Plus, because the decrease in fear response stimulates a positive mental health, fear extinction accelerates employees' work productivity in the workforce. Not only does exposure therapy decrease fear response, but it also reduces anxiety and stress. In addition, when the fear stimulus no longer generates stress and anxiety, the limitations in an individual's life will be decreased, which generates good mental health.

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Appendix A

SCANDOLA, BASTIANELLI, SPOTO and VIDOTTO, Fear of Cockroaches Questionnaire, Review of Psychology, 2010, Vol. 17, No. 2, 111-117

Fear of Cockroaches Questionnaire (FCQ) Questionario sulla Paura agli Scarafaggi

Instructions: The items in this inventory refer to attitudes, feelings, and behaviors related to different situations. Read one item at a time and consider whether the statements describe you or not. Choose the answer corresponding to the symbol ranging from 0 to 5, bearing in mind that:

⓪= *Completely disagree*

⑤ = *Completely agree*

Please tick the answer that matches your feeling of this last period of time, as recently as possible. Based on what you imagine, try to answer all questions. If something is not clear to you, feel free to ask for explanations and clarifications. Finally, double-check that you have answered all questions.

I am scared to enter a room where I have seen a cockroach before.	⓪①②③④⑤
I will do anything to get away from a cockroach.	⓪①②③④⑤
Sometimes I think of being stung or bitten by a cockroach.	⓪①②③④⑤
If I see a cockroach, it will take a long time for me to forget about it.	⓪①②③④⑤
If I see a cockroach, I will leave the room.	⓪①②③④⑤
If I see a cockroach, I will ask someone else to kill it.	⓪①②③④⑤
If a cockroach is present, I will panic.	⓪①②③④⑤
Cockroaches are one of my worst fears.	⓪①②③④⑤

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