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"I Want to Hold Your Hand": The Strength of Touch in Reducing Binaural Beats Induced Fear

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Abstract

The purpose of this study was to determine if human contact results in the reduction of fear. Anxiety is the most common mental illness in the U.S. that effects approximately 40 million people. Moreover, college students typically experience high levels of fear and anxiety, with 3 out of 4 college students in 2017 reporting feelings of overwhelming anxiety. High levels of anxiety and fear makes them susceptible to various deleterious effects. One method of remedying fear and anxiety is human contact. But the question remains, 1) does it matter who the physical contact comes from (stranger vs. companion), and 2) will the benefits of physical contact on pain generalize to fear/anxiety? Also, when someone is experiencing fear, their brain emits a frequency of 6 Hz (theta waves), and binaural beats have been shown to induce these theta waves. During this study participants (N = 63) were split into 3 conditions: hand holding, proximity, and no contact. Participants listened to theta wave (6 Hz; measured by EEG) binaural beats masked by pink noise and rated feelings of anxiety and fear both before and after their assigned condition. It was expected that the hand holding condition would result in the greatest reduction of fear and production of theta waves, with no contact having no effect, and proximity being intermediate. Results suggest that human contact has no effect on fear/anxiety reduction. Limitations of this study and how they have contributed to non-significant findings are discussed.

Keywords – fear, anxiety, binaural beats, theta

1. Introduction

Most adults experience anxiety, an unpleasant feeling stemming from an undefined threat, at some level. Specifically, up to 63% of young adults in college report feelings of overwhelming anxiety[1]. These feelings of anxiety toward a threat typically yield fearful emotions and a stress response, which subsequently impairs multiple systems such as cardiovascular[2], immune[3], respiratory[4], and sleep[5]. Young adults in college who tend to seek relief from stress and anxiety by avoiding certain stressors through unhealthy methods are particularly susceptible to these deleterious responses. Moreover, college students consume high levels of alcohol[6], and show an increased history of harm to others, prevalence of mental health issues, as well as high rates of suicide and self-harm[7]. In fact, the 2nd leading cause of death in college students is suicide[8]. With the previous points in mind, it is imperative that alternative and healthier methods of stress and anxiety management are explored.

In general, the presence of social support plays a vital role in an individual's ability to navigate negative emotions. Social support is a good mediator for relieving feelings of stress, anxiety, and depression[9]. An active form of social support is physical touch, which consequently mediates perceived pain[10, 11,12] and communicates positive feelings[13]. However, it remains unclear if the benefits of physical contact are present regardless of who is providing the contact. There is some evidence to suggest that the relationship between individuals participating in physical contact is not a deciding factor in the effectiveness of that contact, with both close-others and strangers reducing reported pain intensity and theta power compared to having no physical contact following pain exposure[14]. In contrast, there is evidence that the relationship of those who are participating in physical contact does matter to the individual threatened by pain[15]. Still there is intermediate evidence that shows the mere presence of another mediates negative feelings, but that this relationship is strengthened by those in one's own in-group[16]. The focus of previous studies has been on the reduction of pain perception/intensity, and it remains unclear whether these findings generalize to other emotions like fear and anxiety. Additionally, it remains unclear if people who are not complete strangers nor close others can benefit from the effects of social support. The current study aims to explore these two points.

A study by Pluck & López-Águila[17] demonstrated that binaural beats, which are different tones (ex: 400Hz & 404Hz) that are integrated into a single tone and affect self-reported mood, were effective in producing increased self-reported feelings of fear. The purpose of the current study was to determine if feelings of anxiety and fear induced by binaural beats could be reduced through human contact in a college population. The college culture, especially at smaller universities, is unique in that there is a shared sense of identity and pride between students. These unique qualities add to previous studies[14,15,16] that investigated relationships between close and non-close others. In the current study, binaural beats at a frequency of 6 Hz were used in an attempt to induce those feelings of fear/anxiety, and the reduction of that fear was tested by having participants either hold hands, sit in close proximity, or have no form of contact. It was predicted that the hand holding condition would have the greatest effect in both physiology and self-report, with no contact performing the worst, and proximity being intermediate.

2. Method

2.1 Participants

Participants included southern university students (N = 63; M_{Age} = 20.11, SD =3.85; 12 Males, 49 Females, 2 Non-binaries; 18 Black/African Americans, 32 White/Caucasians, 6 Asians, 5 Other). All participants completed the study for course credit.

2.2 Materials

2.2.1 anxious feelings

Anxious feelings (AFF) were measured on a 4-point scale (0 – "Disagree" to 3 – "Agree") with the question "I am feeling slightly anxious/fearful"

2.2.2 general anxiety feelings

This Generalized Anxiety Disorder (GAD) questionnaire [18] was modified for the purposes of our study and thus we have referred to it as GAF. GAF was used to assess participants' everyday feelings of anxiety. Participants were asked to rate 7 statements on a scale of how often the feelings occurred (0 - "not at all" to 3 - "Everyday"). Questions were specific to general feelings of anxiety like, "I feel anxious about my life or current situation" and "I find it difficult to stop worrying". Scores across items were summed, and higher scores indicate higher feelings of anxiety. A score of 0 – 5 indicates minimal anxiety, 5 – 9 indicates mild anxiety, 10 – 14 indicates moderate anxiety, and 15 – 21 indicates severe anxiety.

2.2.3 exposure to meditation and binaural beats

A form with two questions asked participants if they had ever previously participated in meditation or been exposed to binaural beats. Participants either answered "0-no", "1-unsure", or "2-yes". Raw scores were taken to determine the exposure level of each participant.

2.2.4 feelings towards human interaction and contact

Additionally, a 6-item questionnaire was used to assess participants' feelings towards physical contact with others. Subjects were asked to rate 6 statements on a scale of 0 ("Disagree") to 3 ("Agree"). An example question would be "I usually feel uncomfortable when I'm in close proximity with people I do not know". Scores form the questions were averaged, and higher scores indicate a higher aversion to human contact.

2.3 Procedures

Participants were recruited in couples when possible and each pair was randomly assigned to one of two conditions (Proximity or Hand Holding). If only one participant was recruited, they were placed in the no contact condition. All participants gave written consent prior to participating in the study. Then three EEG electrodes (BIOPAC Systems Inc. v. 4, BIOPAC Student Lab 4), were attached to participants' scalp following BIOPAC Student Lab Manual protocol. Throughout the study, EEG data and self-reported emotions were collected in continuous segments (timepoint 1 (no binaural beat), timepoint 2 (after 6 minutes of theta wave exposure), and after 6 minutes of contact exposure (timepoint 3)). Soundwaves in the theta range via binaural beats are particularly significant because they excite fear in a non-specific way[16]. Participants then completed the set of questionnaires and were debriefed before leaving.

2.4 Statistical Analysis

This was a between-group quasi-experimental design. As described in the Student Lab Manual protocol, for each continuous segment mentioned above, average EEG frequency was determined by averaging the wavelength of 5 different peaks within the segment. A multivariate analysis of covariance (general linear model) was performed to examine the effect of human contact on physiological (EEG) and self-reported fear response. Previous exposure to binaural beats and their feelings toward human touch were included as covariates. Based on similar research[14] with an effect size of 0.52 our sample size of 63 should have provided (estimated power = 99%) based on Cohen's power table[19].

3. Results

Contrary to the hypothesis, human contact had no effect on the reduction of physiological fear response as measured by EEG, $F(4,108) = 1.78$, $MSE = 3.51$, $p = 0.138$, see Figure 1. Additionally, human contact had no effect on the reduction of self-reported fear responses, $F(4,106) = 0.87$, $MSE = 0.94$, $p = 0.487$, see Figure 2.

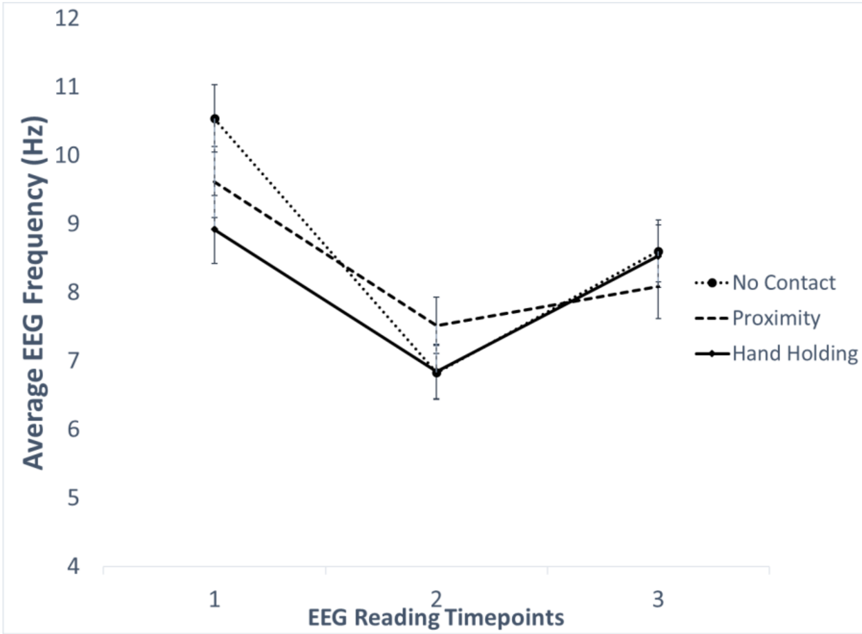

Figure 1: Average EEG (Hz) readings (error bars represent standard error) from various time points of binaural beat exposure (time points 1: baseline before theta exposure, 2: after 6 minutes of theta exposure, and 3: after 6 minutes of contact condition).

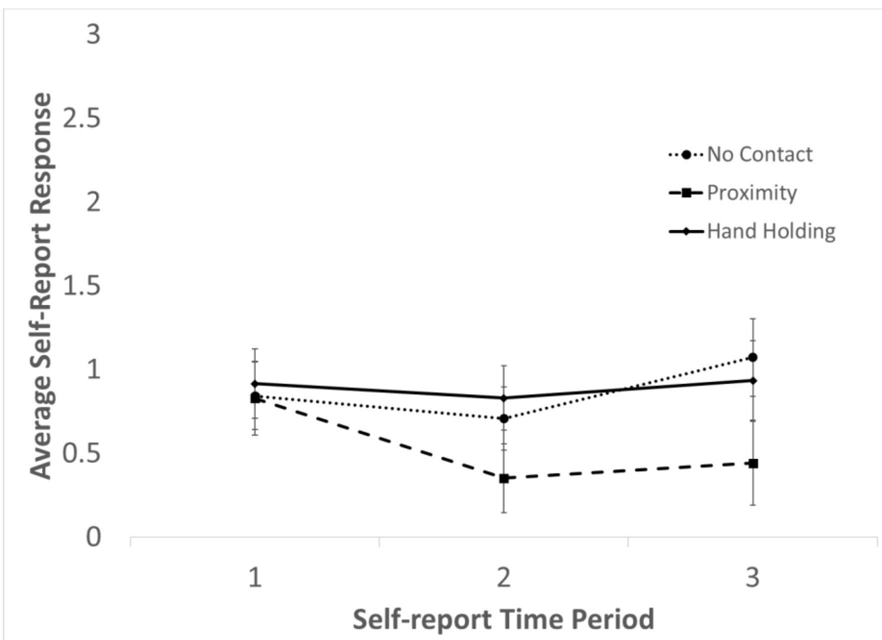

Figure 2: Average self-report response (error bars represent standard error) from various time points while being exposed to theta binaural beats (time points 1: baseline before theta exposure, 2: after 6 minutes of theta exposure, and 3: after 6 minutes of contact condition).

4. Discussion

The purpose of this study was to determine if fear induced by binaural beats could be reduced by physical contact with others. While our findings do not support our original hypothesis, the results still add to research in the fields of physical contact, binaural beats, and social support as they relate to the college population. Because our participants were students at a small university (6,000 students) who were enrolled in at least one psychology course, our population was not truly comprised of complete strangers, nor were they close others. College students have a shared sense of identity because of their commonalities (they are a part of the same university, and possibly take the same classes, attend the same events, and share many of the same struggles). These commonalities add a sense of community among college students, making them apart of the same in-group, and were thus expected to increase the effects of physical contact like the findings of Qi and colleagues[16]. Because of their commonalities, our population could be considered intermediate to complete strangers and close others. For this reason, we predicted human contact would produce changes in brain frequencies and self-report like the study completed by Che and colleagues[14], who found that when comparing close others and complete strangers, hand holding in both groups was effective in reducing self-reported pain intensity and theta activity as measured by EEG[14]. When comparing these findings with our study, which focuses on fear/anxiety, instead of pain, the results do not generalize. Instead, our findings are more consistent with the results of Coan and colleagues, who found that the relationship between those who are participating in physical contact is the determining factor in whether the contact is beneficial[15]. Similarly, while Che and colleagues argue that close-others provide no benefit above strangers, it was only a close-other that resulted in reduced heart rate and reported pain unpleasantness compared to no-hand-holding, with strangers being intermediate [14], which when considered with all previous literature may suggest that a close other is necessary for physical contact to be fully effective. Future research with college students may then want to begin with having students interact in order to familiarize themselves with each other and makes salient their commonalities so that they do not consider each other strangers.

Upon further examination of our results, a trend was observed between timepoint 1 (no binaural beat; $M = 9.69$, $SE = 0.28$) & 2 (after 6 minutes of theta wave exposure; $M = 7.06$, $SE = 0.23$) suggesting that physiological responses approached the theta range across all conditions. After 6 minutes of contact exposure (timepoint 3; $M = 8.41$, $SE = 0.26$) the two experimental groups (Proximity and Hand Holding) increased brain frequency into alpha range; however, the No Contact group, also seemed to exhibit this increase in frequency. This contradicts the original hypothesis as well as previous literature found a decrease in theta activity[14]. There are two possible explanations for this pattern: competing internal forces and external distractions.

The average person's brain oscillates at a frequency of 8 Hz (in the alpha range); however, individuals who normally experience high levels of anxiety naturally oscillate at the higher end of the alpha range[20], which might suggest their natural oscillation is a competing internal force and would be working more greatly against the binaural beats compared to less anxious individuals. Our sample, which was 77% female, exhibited mild to moderate anxiety as measured by GAF (see Figure 3).

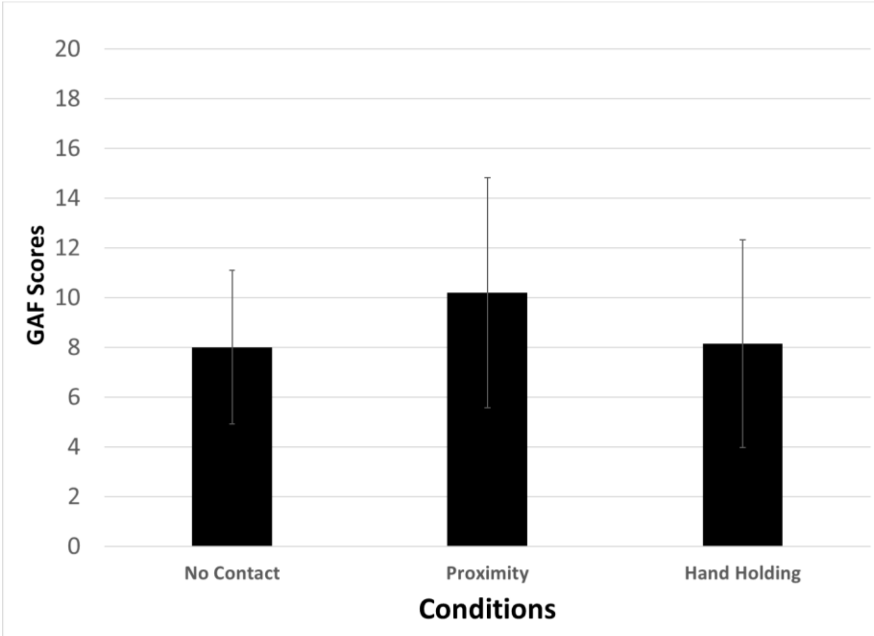

Figure 3: Sum of General Anxiety Form (GAF) scores across for each condition (error bars represent standard deviation).

This mild/moderate trait anxiety may be the reason all conditions showed a decrease in brain wave activity, but they never reached the input frequency of 6 Hz (see Figure 1). Research also shows that females in general are more anxious than males[21], with those of college age being no exception[22]. Therefore, our results may not generalize to males or individuals with lower anxiety (GAF scores less than 1). Overall this could suggest that the binaural beat manipulation was moderately successful, but not long-lasting or completely effective.

Individuals may also have been susceptible to other unintentional environmental distractions and thus the effects of the binaural beats were not retained. Participants were visually stimulated by the researcher pulling up questionnaires on the computer and had to disengage in physical contact to answer the questions. López-Caballero and Escera[23] had similar non-significant findings when binaural beats were interrupted by pink noise exposure prior to measuring mood, suggesting that the theta frequency may be exceptionally sensitive to distractions. Overall, longer segments of data collection could be beneficial both in getting all participants closer to the input frequency and allowing a larger window for data to be analyzed.

Furthermore, the pattern of self-report data, measured by AFF (Figure 2), was inconsistent with the pattern of the physiological data. We expected for individuals to consciously experience fear/anxiety (at timepoint 2 when brain frequency was in the theta range) and report relatively high scores followed by a decrease in fear/anxiety scores after human contact (during timepoint 3). Generally, the data would suggest that none of the groups consciously experienced fear or anxiety during the experiment. These observed pattern discrepancy between the self-report and physiological data could be due to the nonspecific nature of binaural beats. For this study we chose to use binaural beats to induce fear/anxiety in a nonspecific fashion; however, for fear or anxiety to be felt by the individual, there must be communication between their emotional (typically amygdala)[24] and cognitive brain regions (the cortex). EEG studies have shown that measurable fear is only present in certain areas of the brain. When anxiety is felt, there is increased communication between these regions. This lack of specificity could be the reason participants did not report feeling anxious or fearful. There is a possibility that the cortex, where we measured (and confirmed via EEG) was not communicating with the amygdala and allowing the individual to consciously recognize fear or anxiety. A way to remedy this would be to change the method of inducing fear so that the emotions are attributable to the stimulus. For example, participants could watch a scary movie, be asked to recount a time when they felt anxious/scared or use a classical conditioning paradigm like the methods of Che and colleagues[14]. Binaural beats could be played simultaneously with this exposure to ensure a fear response. Additionally, other methods to quantify change in brain activity could be used, such as different EEG systems, fMRI, or NIRS.

Our findings add to the limited body of binaural beat research to provide insight on methodological procedures and suggest it is unclear whether binaural beats can or should be used to induce emotions. Additionally, our research may raise questions about the use of binaural beats for therapeutic effects. Binaural beats of different frequencies have already been used for various therapeutic reasons such as increased relaxation[25], enhanced mood & recall[26], and to modify concentration/focus[27]. However, research has not shown how long lasting these effects are and our findings would suggest they may be temporary and susceptible to distraction. Additionally, our findings add to the ongoing research in the area of physical contact and mood, but still, additional research addressing our limitations is needed.

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