Laurentian University

The Therapeutic Benefits of Yelling

A thesis submitted to the Faculty of Psychology in partial fulfillment of the requirements for the degree of

Honours Bachelor of Science in Psychology

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Abstract

Yelling has been used as a form of healing in Indigenous cultures (Nabigon, 2010). Research suggests benefits to therapies that incorporate yelling (Karle, Corriere, & Hart, 1973). However, the physiological impact of yelling has not been investigated. The current study explores EEG measurements of yelling as compared to its derivatives (deep breathing and a vocal control). Ten participants from Laurentian University were recruited. Results of relative spectral power analysis provide evidence of a significant increase in relative gamma power following the yelling condition only ($F_{(14,98)} = 2.87$, $p=.001$, $\eta^2=.291$). POMS scores confirm that there was a significant total mood disturbance reduction following the yelling condition only ($t_{(9)}=3.68$, $p=.005$). Findings support strategies designed to enhance health and well-being.

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Therapeutic Benefits of Yelling

Previous studies have considered yelling and deep breathing in conjunction with other components, such as therapy or meditation, and have identified increases in alpha activity (which is indicative of increased relaxation as will be discussed later) measured by the electroencephalogram (EEG) (Karle, Corriere & Hart, 1973; Arambula, Peper, Kawakami, & Gibney, 2001). With regards to studies concerning a therapy called Primal therapy which involves yelling as a potential constituent of the therapy, increased alpha activity was identified as a result (Brown, 1973; Karle, Corriere & Hart, 1973; Hoffmann & Goldstein, 1981). In considering deep breathing during meditation and during vigorous activity, an increase in alpha activity was also acknowledged through EEG measures (Travis, Blasdell, Liptak, Zisman, Daley, & Douillard, 1996). In each of these studies, either yelling or deep breathing are a component of the process that resulted in increased alpha activity. It may be possible however, that yelling is the key component associated with increased alpha activity in Primal therapy. Likewise, deep breathing may be the key component associated with the increased alpha activity during meditation and vigorous exercise. Yelling will be broken down into two derivatives (deep breathing and a vocal control component) in order to investigate the effects of the yell as well as each of its elements separately. It is the aim of this study to investigate the specific effects of yelling, deep breathing and a vocal control (this will be discussed further in the methods section) on brain activity. This will allow for the analysis of whether it is the yelling that causes a significant effect on brain activity, or if the effect lies in one of its derivatives (deep breathing or the sound component).

The idea of this study originated from a teaching of the Indigenous culture. This culture identifies seven natural healing methods; yelling being one of them (Hyatt, A., 2013; McCabe, G., 2008; Nabigon, A., 2010; Nabigon, H., 2006). Yelling will be the focus of this study. These healing methods are identified as ways to release negative emotion and recover from past traumas (Nabigon, 2010). Yelling has been considered on its own from this perspective; it is not combined with another component as it is when associated with Primal therapy (therapy being the additional component). There is a lack of previous investigation into the objective measurement of the neurophysiological changes associated with yelling using quantitative EEG (QEEG).

As means of investigating this Indigenous healing method from an objective perspective and isolating what is potentially the key component of Primal therapy responsible for producing an increase in alpha activity, this study involves the QEEG to measure the neurophysiological impact of yelling. This will be compared to the impacts of deep breathing and a vocal control to discern significant differences in neurophysiological activity, at rest, as a result of each condition.

Yelling as a Healing Method within the Indigenous Culture

Within the Indigenous culture, the Cree Medicine Wheel is utilized as a tool which refers to the four directions (East, South, West, and North) to illustrate the concepts of human development (Hyatt, 2013; McCabe, 2008; Nabigon, 2010; Nabigon, 2006). Nabigon (2010) and Nabigon (2006) simplify that the North Door, or north direction, of the Medicine Wheel is the direction that addresses the concept of caring as well as the process of change. It is taught in the Indigenous culture that for each teaching within the Medicine Wheel (caring, as identified as one of the teachings of the North Door), there is an opposite of that teaching (not caring) (McCabe, 2008; Nabigon, 2006; Nabigon, 2010). While possessing these opposites, the Medicine Wheel provides teachings on how to overcome the concept of “not caring,” or not feeling cared about, by experiencing seven natural healing practices which include: laughing, crying, sweating, yawning, shaking, talking, and yelling (Hyatt, 2013; McCabe, 2008; Nabigon, 2010; Nabigon, 2006). These methods contribute to the process of change a person can progress through on their journey from sickness to optimal health (Nabigon, 2006; Nabigon, 2010).

Primal Therapy

Moreover, although there was no literature identified regarding the QEEG measurements of the neurophysiological impact of yelling, a form of therapy that involves yelling as a component of the healing process is known as Primal therapy. Primal therapy was developed by Dr. Janov and it is the process of surfacing unconscious thoughts and emotions which stem from childhood (Brown, M., 1973; Janov, 1970). The experience is typically terminated with a scream and the patients make a subjective report involving feelings of insight and relaxation afterwards (Brown, 1973; Janov, 1970). This was supported by Karle, Corriere and Hart (1973) as they observed significant decreases in frequencies from beta to alpha activity (average of 12.5Hz pre-treatment to 8.9Hz post-treatment) after the participants underwent Primal therapy for three weeks. This decrease in frequency to alpha activity is indicative of increased relaxation (Aftanas & Golocheikine, 2001; Anand, Chhina, & Singh, 1961; Arambula, et. al, 2001; Banquet, 1973). Subjective report of the participants' mood were considered in the experiments performed on Primal therapy. The participants felt more relaxed, experienced clear feelings of insight and therefore their mood generally improved after therapy (Karle, Corriere & Hart, 1973; Janov, 1970; Brown, 1973).

Deep Breathing

Since minimal research involving yelling nor its neurophysiological impact on brain activity, using QEEG, have been found, the neurophysiological impact on brain activity as a result of deep breathing will be measured in the current study. Deep breathing was chosen for reference as it is considered a component of the process of yelling which involves deep abdominal inhalation followed by forceful exhalation of breath passing through the vocal cords to produce the yell. This component is being isolated as it may be the case that it is the breathing component of the yell that is influencing brain activity.

In a study performed by Arambula et al. (2001), the EEG measurements and breathing rates of a yoga master were recorded before, during and after meditation and it was observed that there was a significant decrease in his breathing rate with an accompanying significant increase in alpha activity during meditation. This finding of increased alpha activity and relaxation during meditation is consistent with other physiological correlates observed during meditation and yoga (Anand, Chhina & Singh, 1961; Corby, Roth, Zarcone Jr & Kopell, 1978; Delmonte, 1984; Dostalek, Faber, Krasa & Vele, 1979; Kamatsu, Okuma & Takenaka, 1957; Woolfolk, 1975). It was suggested in this article by Arambula et al. (2001) that due to the correlation between the decrease in breathing rate and increase in alpha activity, that it may be the deep breathing that was responsible for the increased alpha activity. Other studies demonstrated results of significant increases in alpha activity associated with deep breathing during vigorous activity (Travis *et al.*, 1996; Petruzzello and Tate, 1997). This is another circumstance in which deep breathing is involved in conjunction with another component (physical activity) which results in the significant production of alpha activity. Deep breathing is a common aspect between these studies and could be responsible for the alpha activity production.

Research has been completed that focused on the effects of meditation that supports coupling EEG and a Profile of Moods States (POMS) questionnaire (Xue, *et al.*, 2014; Field, *et al.* 1996; Woo, *et al.* 2009). These studies demonstrate relationships between significant changes in brain activity and significant decreases in certain subscales of the POMS (Xue, *et al.*, 2014; Field, *et al.* 1996; Woo, *et al.* 2009). This supplies the methods of the experiment with an objective as well as a subjective measurement of emotionality. This is suggesting that changes in brain activity are accompanied by corresponding subjective interpretations of mood (Xue, *et al.*, 2014). The approaches in which the current study will be pursuing similar procedures will be described in the methods section.

Present Study

Purpose of Study

The purpose of the present study is to extend the work done on EEG and/or POMS findings with regards to primal therapy and deep breathing while meditating/engaging in physical activity. It is the aim of this study to explore the possibility that the same, or similar, effects on QEEG can be produced from the treatment conditions (yelling, deep breathing) on their own without the other components of therapy or meditation/vigorous exercise. The present study proposes to analyse POMS and QEEG measures before and after the conditions (yelling, deep breathing, vocal control which will be discussed further in methods section) to discern the therapeutic impact on neurophysiology and emotional affect.

Although yelling is identified within the Indigenous culture as a healing technique (Hyatt, 2013; McCabe, 2008; Nabigon, 2010; Nabigon, 2006), there has yet to be an objective analysis of yelling using the QEEG. In this study, objective measures of the effects of yelling will be provided in order to provide objective support for this ancient Indigenous healing practice.

Furthermore, there has not been an experiment found that has looked at yelling individually, using the QEEG and POMS. This study aims to isolate the yelling component of Primal therapy by investigating whether the yelling on its own can produce a similar effect on EEG measures as was found in the study completed by Karle et al (1973). The POMS questionnaire was not mentioned in this 1973 study; however it will be an additional component to the current experiment. If yelling is the key component of primal therapy that is associated with increased alpha activity, the results of the current study should demonstrate similar findings. If yelling is not the essential component, it is expected that the results of this study would show dissimilar brain activity following yelling as compared to that of Karle et al (1973). This could suggest that other components of the therapy were responsible for the changes in frequency.

Nevertheless, it is also a focus of the current study to determine if deep breathing is the essential component of the yell that is responsible for the increased alpha activity. Additionally, this contemporary investigation aims to determine whether deep breathing on its own was responsible for the increased alpha activity found as a result of the previously mentioned studies involving meditation/vigorous exercise. If deep breathing is in fact the key component to the increase in alpha activity, the results of the present study should validate this increase found in previous studies by producing similar affective changes within the deep breathing condition (producing a significant increase in alpha activity after deep breathing). If deep breathing is not associated with increased alpha activity as was found in the previously mentioned studies the present research should demonstrate results that are not similar in comparison.

In summary, subjective measures of mood will be collected using the Profile of Mood States (POMS) questionnaire along with objective QEEG measures and these results will be correlated. This will allow for the measurement of change in emotional affect before and after each treatment condition. From this, therapeutic impact on emotion can be interpreted from each condition.

Hypotheses

In considering the literature previously described I predict that there will be a significant increase in alpha activity following the yelling condition as compared to the respective baseline measurements. I predict that there will be a significant increase in alpha activity following the deep breathing condition as compared to its baseline measures. I also predict that there will be significant differences in alpha activity produced between the post measures of the treatment conditions (yelling, deep breathing, and vocal control). Additionally, as discussed in the research completed regarding coupling EEG measures and POMS (Xue et al., 2014; Field, *et al.* 1996; Woo, *et al.* 2009), I predict that there will be a significant difference in pre/post measures of the POMS following the yelling and deep breathing conditions. Finally, I predict that there will be a relationship between POMS results and QEEG results.

Methods

Participants

The group was composed of 10 adults between the ages of 18 and 32 years old from Laurentian university.

Measures

The 19-channel QEEG will be used as an objective measure of brain activity. It functions in that an aggregate of electrical signals produced by billions of nerve cells in the brain is collected by each sensor (Xue, Tang, Tang & Posner, 2014). The sensors will be placed according to the International 10-20 System nomenclature. The signals received by the sensors are amplified by an amplifier box and an output is produced that can be viewed on a computer (Xue et al., 2014). With this output, the data can be organized into the classic frequency bands (Gamma, Beta, Alpha, Theta, and Delta) which may then be interpreted (Xue et al., 2014). For all participants, the data was recorded via winEEG software along with the mitsar box amplifier with a sampling rate of 250Hz. For all variables, an alpha level of .05 was used, and the assumptions of homogeneity of variance and normality were met.

The POMS, short form, will be used as an additional subjective measure of the participant's mood prior to and following the treatment conditions. POMS scores will be explored in order to evaluate whether the participants experienced a subjective change in their mood after taking part in each condition as compared to their pre-treatment baseline. The results from the POMS will be correlated with the QEEG measures to check for associations between the subjective results and the objective QEEG data. This is considering the fact that QEEG measurements can be used to imply brain activity involved in the emotional experience. Using results from the POMS questionnaire and the QEEG measurements, interpretations of possible emotional sensations the participants may have experienced as a result of yelling, deep breathing, or engaging in a vocal control will be considered. The POMS scale involves 30 items in which the participant is required to rate their perceived consistency between the adjective presented to them and their current emotional state on a 5-point likert scale (Husain, Thompson & Schellenberg 2002). There are six subscales and each of the scores associated with them can range from 5 to 25 (Husain, Thompson, & Schellenberg, 2002). The POMS questionnaire possesses six subscales in which the scores are organized into categories of moods (Tension, Depression, Anger, Vigour, and Confusion) (Husain, Thompson & Schellenberg 2002).

Since yelling is naturally done in response to a particular frame of mind, mood should be considered in the analysis of the data. This will be carried out by construing the potential relationship between significant changes in brain activity and scores of the POMS. An example of the thought behind this is that the total of all the POMS scores within each condition can be combined (total mood disturbance (TMD)) and correlated with significant QEEG measures in order to relate the subjective and objective measures of this study. It is important to note that mood will not be manipulated in this experiment, however, regardless of whether mood is manipulated a priori, exploring changes in mood, recorded via the POMS before and after each treatment condition may have a notable effect on understanding the significance of the results. For this reason, POMS is an appropriate measure for this study in conjunction with the QEEG as it may be used to make appropriate clarifications about the relationships as described above.

Procedure

All participants took part in all treatment conditions of the experiment as it is a within subjects design. The QEEG, an amplifier box, POMS questionnaire, a microphone, and a laptop will be used as materials. The participants began by filling out an informed consent form (see Appendix A), the QEEG was administered and they were given the POMS (see Appendix B) prior to beginning the experiment. Pre-baseline QEEG measurements were established. The participant were asked to sit with their eyes open (EO) for 90 seconds and then they were asked to close their eyes for 90 seconds while they sat as motionless as possible, breathing as they normally would, without concerning themselves with any particular blinking patterns. This will completed a total baseline measurement of 3 minutes. Once the baseline measurements had been established, while keeping eyes closed (EC), the participant was cued to begin their yell. They were instructed to maintain the yell for at least 5 seconds or for as long as possible (see Appendix D for script used to describe to participants precise instructions on how to complete each of the three treatment conditions). This 5-second condition period was repeated two additional times with approximately 20-second rest periods between each yell. During the 20-second rest periods, participants were instructed to sit with minimal movement, keeping eyes closed and breathing as they usually would. Once the condition period was completed, post-baseline QEEG measurements were gathered. The participant was measured again for 90 seconds with eyes closed and 90 seconds with eyes open. The participant was re-administered the POMS, provided with an exit questionnaire (see Appendix C) in order to gather any additional information that may not have been gathered in the POMS, and finally were given information regarding the experiment (see Appendix D). This same process will be followed for the deep breathing and vocal control conditions; however, in place of yelling for five seconds the participant was instructed, once cued, to take a deep breath in as if they were about to yell and then release the air from their lungs at a slow rate for the five second period that was spent yelling in the first condition described. In order to maintain consistency with the yelling condition, the exhale of the deep breathing condition was executed with the mouth open as the yell was performed in this manner. During the vocal control condition, when cued to begin, the participants were instructed to take a deep breath in through their mouth and to “Say ah” in a similar fashion as if they were in a doctor’s office. The vocal control condition has been included in order to rule out that it is not the fact that the participant is making a sound that is responsible for the effects of the yell. The conditions were randomly assigned to control for order effects.

Analysis

This experiment is a 3x2 within subjects design. The independent variables are condition and time. Within the condition variable, the levels are yelling, deep breathing and a vocal control. Within the time variable, the levels are pre- and post-measures. The dependent variables are the QEEG measures and the POMS scores. Data were analysed using SPSS (statistical package for the social sciences) version 20 (IBM, 2012). Effect sizes are reported as partial eta squared values.

QEEG Analysis

Firstly, it is important to note that although my experiment is a 3x2 design, through utilizing the QEEG, two other measures of hemisphere and sensor are automatically included and will therefore be considered in the analysis. In order to analyze the data from the QEEG sessions, eye blink artifacts were removed from the EEG signals. As means of beginning the analysis of the QEEG data, 30-second samples of raw spectral data, from raw EEG data, of pre and post measures were extracted and spectral analyzed using winEEG software. Tables of raw spectral data were transferred to SPSS version 20 where all variables were defined. Relative scores were computed from the raw spectral data. The relative scores were computed by dividing each value, measured in $\mu V^2/Hz$, or spectral power associated with its corresponding combination of variables [eyes closed vs. eyes open measures, treatment conditions, pre or post measures of each, sensor (Fp1 through O2, identified on the QEEG cap), and finally frequency band width] by the mean global power value. The total spectral power value was calculated from 1356 values associated with the respective combination of variables (treatment, pre/post, EO/EC, hemisphere, sensor, frequency band). This was done to control for individual differences in baseline QEEG power.

Using the relative scores, repeated measures ANOVA (only a single dependent variable, relative spectral power, is being considered in the QEEG analysis) was performed evaluating eyes open and eyes closed measures separately, across all three conditions, including pre and post measures, for every sensor within each separate frequency band (delta - gamma). Due to the abundance of combinations of variables being included into the ANOVA, a MANOVA command was implemented into the syntax. The nature of the MANOVA command accommodates for the alpha correction and therefore allows for the alpha level to remain .05. Significant results were graphed and interpreted. Appropriate significant findings are considered in the discussion section. Post hoc tests were also completed in order to identify specific aspects of the interaction that were most significant in driving the interaction. Comparisons were included into the MANOVA command. In order to avoid performing multiple t-tests and inflating the standard error, thus increasing the chance of making a type I error, instead, one variable within the interaction was isolated and repeated measures ANOVA testing was performed. The repeated measures ANOVA in this instance was considering only the variables involved in the significant findings and within each level of the variable being isolated as means of deducing the driving force more specifically. Post-hoc specifications were included in the MANOVA command T-tests were then performed only for the level of the variable being isolated that demonstrated significance.

POMS Analysis

The methods used to analyse POMS results are somewhat similar to that of the QEEG analysis. These different subscales were considered separately as well as combined into one TMD score as described above. A repeated measures ANOVA testing of raw POMS scores were calculated considering the subscales separately using the MANOVA command as a correction. A repeated measures ANOVA was calculated for the TMD of pre and post measures across all three conditions. Significant results were graphed and interpreted. T-tests were calculated when appropriate, for significant results only.

Correlations Analysis

Pearson correlations were considered and were performed to consider the relationship between the significant results of the QEEG and the POMS questionnaire. As a result, two variables from the QEEG findings were compared to two variables of the POMS which will be discussed in the results sections that follows.

Results

Separate repeated measures ANOVA tests were completed for the six classic frequency bandwidths (delta-gamma). The variables used to compute the ANOVA tests were treatment (1, 2, 3), time (pre, post), hemisphere (left, right), and sensor (Fp1 – O2). All data were included in the analysis however due to technical difficulty, two participants have missing data, one within the yelling condition, and one within the eyes open measures only of the yelling condition.

QEEG Results

The significant findings along with F-statements revealed from spectral analysis are represented in Table 1, where EO is the eyes open measure and EC is the eyes closed measure. All other main effects and interactions were not significant. The results presented encompass significant 4-way interactions within the alpha, beta 2, and gamma frequency ranges with eyes closed. The significant main effects will not be considered as they do not provide information towards the effects from any of the three conditions.

Table 1.
All significant main effects and interactions across all frequency bands (delta – gamma)

Band Width	View	Effect	F-statement
Delta	EO	Sensor (main effect)	$F_{(7,49)} = 5.87$, $p<.001$, $n^2=.456$
Delta	EC	Sensor (main effect)	$F_{(7,49)} = 14.68$, $p<.001$, $n^2=.677$
Theta	EO	Sensor (main effect)	$F_{(7,49)} = 5.27$, $p<.001$, $n^2=.429$
Theta	EC	Sensor (main effect)	$F_{(7,49)} = 9.88$, $p<.001$, $n^2=.585$
Alpha	EO	Sensor (main effect)	$F_{(7,49)} = 7.91$, $p<.001$, $n^2=.530$
Alpha	EC	Condition x time x hemisphere x sensor	$F_{(14,98)} =2.09$, $p=.019$, $n^2=.230$
Beta1	EO	Sensor (main effect)	$F_{(7,49)} =4.24$, $p=.001$, $n^2=.377$
Beta1	EC	Sensor (main effect)	$F_{(7,49)} =2.31$, $p=.041$, $n^2=.248$
Beta2	EO	Sensor (main effect)	$F_{(7,49)} =3.84$, $p=.002$, $n^2=.354$
Beta2	EC	Condition x time x hemisphere x sensor	$F_{(14,98)} =1.79$, $p=.051$, $n^2=.204$
Gamma	EC	Condition x time x hemisphere x sensor	$F_{(14,98)} =2.87$, $p=.001$, $n^2=.291$

Interaction within the Alpha Frequency Range

This graph displayed below in Figure 1 represents the dynamic activity of relative alpha power within each channel (F1 to O2) of the QEEG. It is comparing the pre and post measures of all three conditions. All of the left hemispheric sensors are displayed on the left in the x-axis and the right hemispheric sensors are displayed to the right. The significant interaction within the alpha frequency band ($F_{(14,98)} = 2.09$, p=.019, η^2=.230) was graphed and is displayed in Figure 1; however, will not be considered in the discussion section as the section with the significant effect was not informative in reference to any of the three conditions. This graph demonstrates that there is significantly more relative alpha power (more alpha activity) measured from the t5 sensor prior to the deep breathing condition. This significant finding is not associated with the effect of any condition and instead reflects baseline differences.

Figure 1.
4-way interaction within the alpha frequency band of Condition by Time by Hemisphere by Sensor (EC) that accounts for 23% of the variance

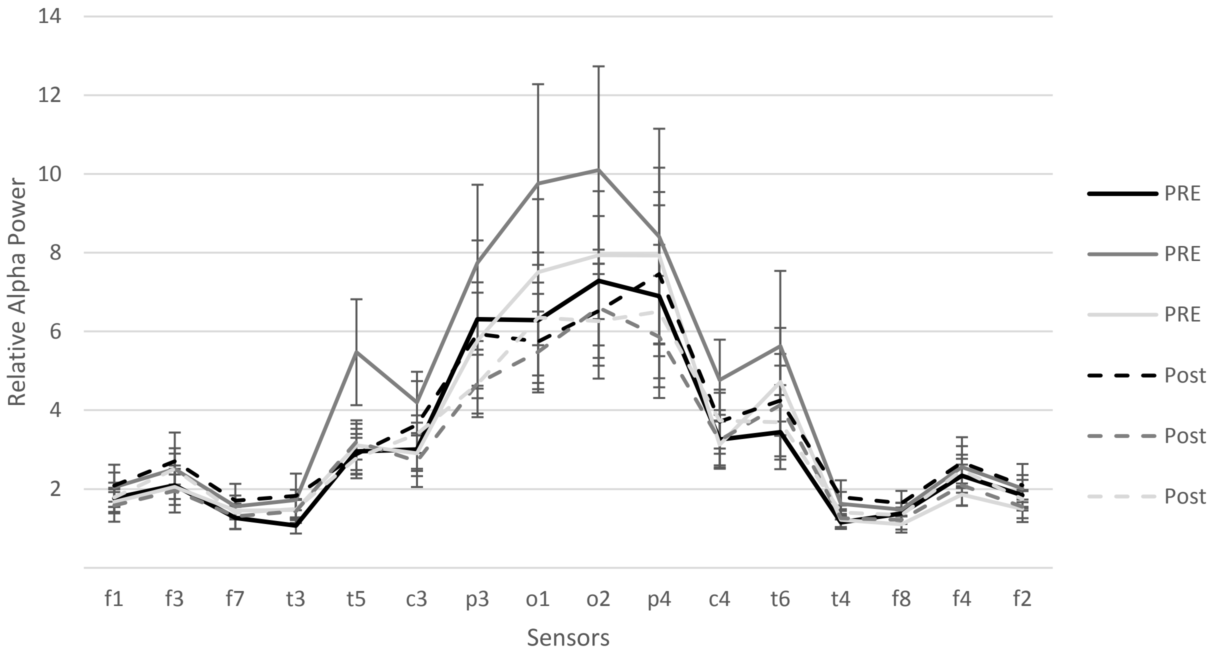

Figure 1. The sensors of the QEEG cap are represented on the x-axis and the relative gamma power is identified on the y-axis. Relative alpha power of pre and post measures of all conditions (yelling, deep breathing, and vocal control) are being compared within and across each sensor.

<u>*Interaction within the Beta2 Frequency Range*</u>

This graph displayed below in Figure 2 is considering the dynamic activity of relative beta2 power within each channel of the QEEG. It is comparing the pre and post measures of all three conditions. The significant 4-way interaction within the beta2 frequency band ($F_{(14,98)} = 1.79$, $p=.051$, $\eta^2=.204$) was graphed and is displayed in Figure 2. This graph demonstrates that there is significantly more relative beta2 power post yelling within t3 as compared to its respective pre-treatment baseline measurement as well as the pre and post measures of the vocal control condition and the post measure of the deep breathing condition. Within the t4 channel there is significantly more relative beta2 power post yelling as compared to its respective pre-treatment baseline measurement as well as the pre and post measures of the other two conditions.

Figure 2.
4-way interaction within the beta2 frequency range of Condition by Time by Hemisphere by Sensor that accounts for approximately 20% of the variance

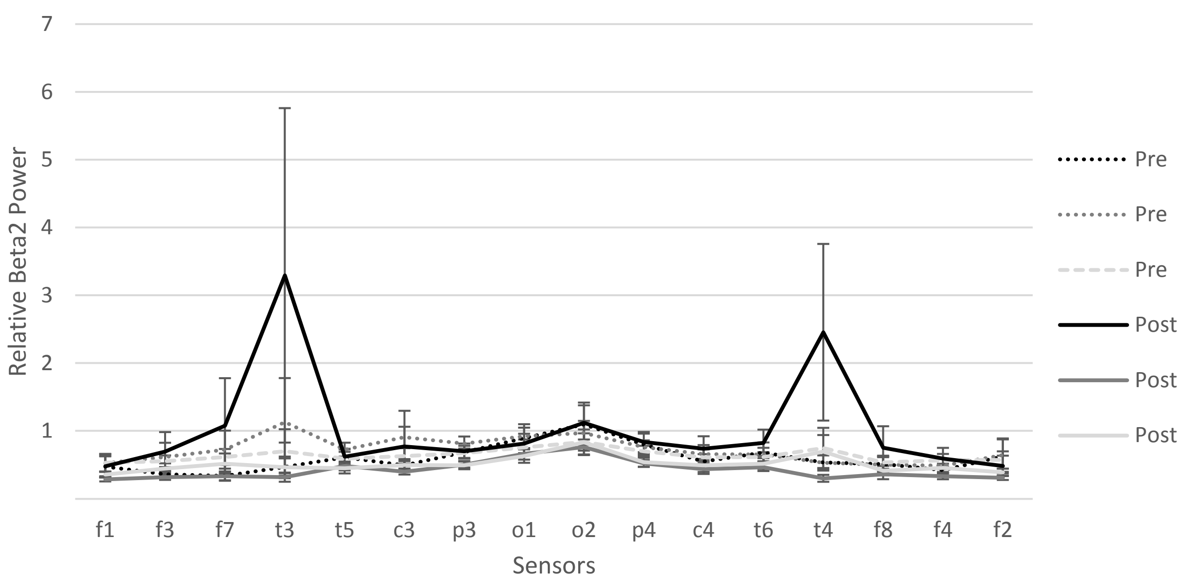

Figure 2. The sensors of the QEEG cap are represented on the x-axis and the relative beta2 power is identified on the y-axis. Relative gamma power of pre and post measures of all conditions are being compared within and across each sensor.

<u>Interaction within the Gamma Frequency Range</u>

This graph displayed below in Figure 3 represents the dynamic activity of relative gamma power within each channel of the QEEG. It is comparing the pre and post measures of all three conditions. The significant 4-way interaction within the gamma frequency band ($F_{(14,98)} = 2.87$, $p=.001$, $ŋ^2=.291$). This graph reveals that there is

Figure 3.
4-way interaction within the gamma frequency range of Condition by Time by Hemisphere by Sensor that accounts for approximately 30% of the variance

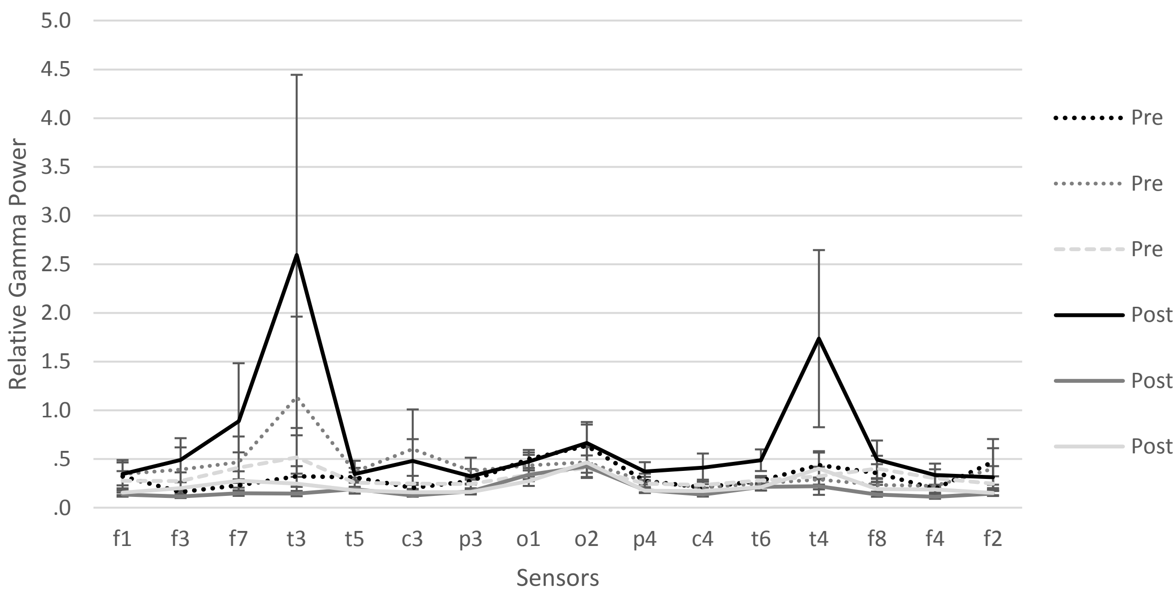

Figure 3. The sensors of the QEEG cap are represented on the x-axis and the relative gamma power is identified on the y-axis. Relative gamma power of pre and post measures of all conditions are being compared within and across each sensor.

significantly more relative gamma power post-yell within the t3 and t4 channels. This means that the impact of a condition was dependent on the hemisphere and sensor region being considered. Post-hoc analysis narrowed the driving force of the interaction to the left hemisphere ($F_{(14, 98)}$=2.41, p=.006, $ŋ^2$=.256), and therefore the measurements from the t3 sensor. The main source of the interaction could not be narrowed down further as there was no significance when comparing the pre measures ($F_{(14, 112)}$= 1.06, p=.401) to the post measure ($F_{(14. 98)}$= 1.58, p=.100) across all sensors of the left hemisphere within the yelling condition. This implies that once the significant increase in relative gamma power had been isolated to the left hemisphere, each variable (condition, time and sensor) is an equally essential components of the significant interaction. Individually, these variables are not contributing any more or less to the driving force of the interaction.

Exit Questionnaire Results

The results of the exit questionnaire were not considered in this experiment as they did not provide any additional information than was gathered from the POMS questionnaire.

POMS results

This graph below includes the comparison of raw POMS scores within each subscale (Tension, Depression, Anger, Vigour, Fatigue and Confusion). The pre and post scores of the three conditions were compared. The results from the analysis of the POMS data revealed a significant 3-way interaction of condition by time by subscale ($F_{(10,90)}$= 2.73, p=.006, $ŋ^2$=.233). This suggests that the incidence of a significant difference in pre and post measures within each condition was dependant on the subscale being considered. This interaction was graphed and displayed in Figure 4. Post-hoc analyses demonstrated that there is a significant increase in vigour post yell ($t_{(9)}$=-2.75, p=.022). Also, there is a significant decrease in fatigue scores post yell ($t_{(9)}$=4.09, p=.003). There was a significant decrease in tension as a result of the two control conditions (deep breathing and the vocal control) only (t(9)=2.61, p=.028; t(9)=2.64, p=.027, respectively).

Figure 4.
3-way interaction of raw POMS scores of Condition by Time by Subscale that accounts for approximately 23% of the variance

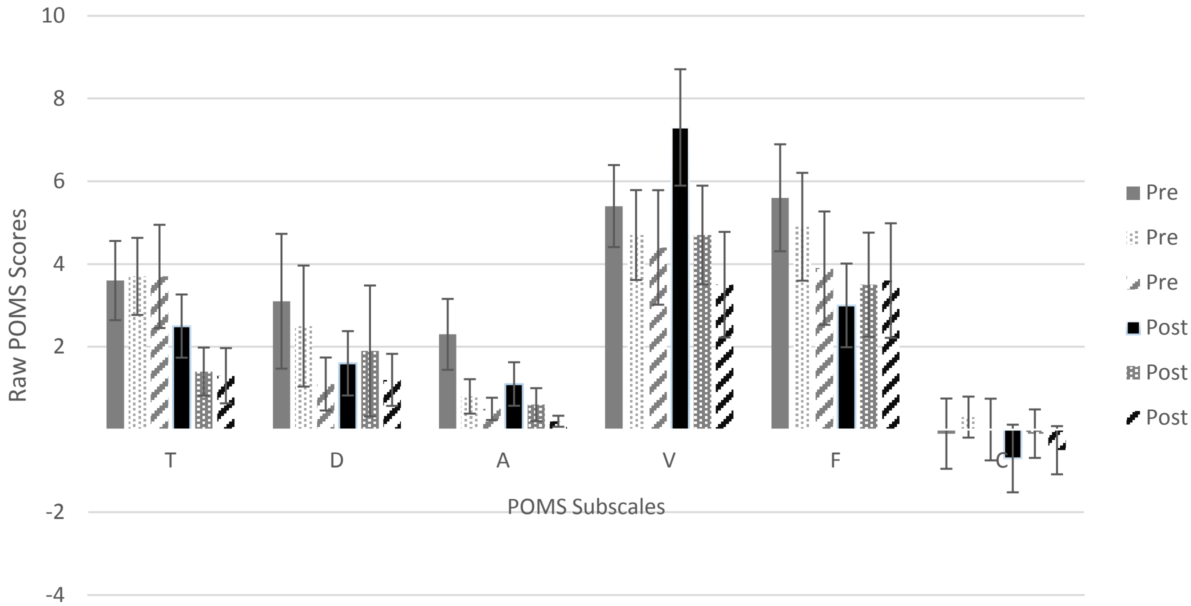

Figure 4. The six POMS subscales (Tension, Depression, Anger, Vigour, Fatigue and Confusion) are identified on the x-axis and the raw POMS scores are represented on the y-axis. Raw POMS scores of pre and post measures of all conditions are being compared within each subscale.

Total Mood Disturbance Results

The total mood disturbance (TMD) is calculated by combining all of the raw scores from the POMS questionnaire into a total value. The TMD was calculated separately for pre and post scores. As a result, there is one total value for all the scores of the POMS that were administered prior to the three treatment conditions (yelling, deep breathing and vocal control) and one total value for all the scores of the POMS that were administered following the three conditions. There was a significant decrease in TMD scores following the yelling condition only ($t_{(9)}$=3.68, p=.005) that is shown in Figure 5. Significance was not demonstrated for the total pre and post scores of the deep breathing nor vocal control conditions ($t_{(9)}$=1.77, p=.110; $t_{(9)}$=1.75, p=.115, respectively). The significance of the TMD is discussed as this will be further utilized for correlations.

Figure 5.
Difference between the pre and post TMD scores within the yelling condition

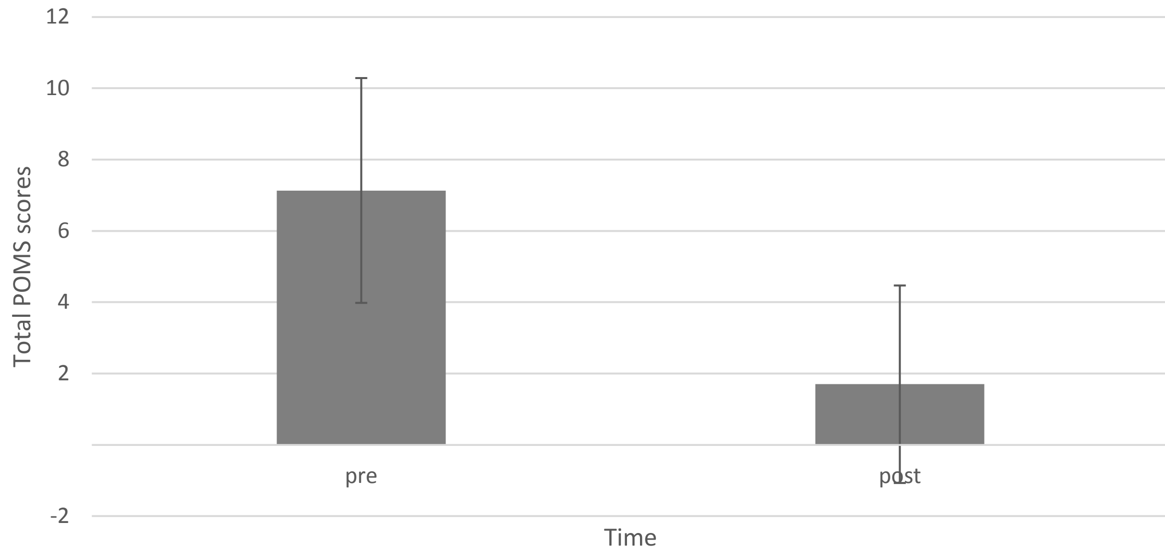

Figure 5. Time is displayed on the x-axis and total POMS scores is displayed on the y-axis. A comparison is being made between the total of the POMS scores gathered before each treatment condition and the total of the scores gathered after each condition.

Correlations Results

Pearson's R was computed to evaluate the relationship between the post-yell measures of t3 and t4 within the gamma frequency range and the pre and post POMS scores across all conditions as well as for the pre and post TMD scores. There was a significant strong positive correlation between the t3 and t4 sensors (r=.902, p=.001). There was also a significant negative correlation between the significant increase in gamma power (gamma activity) within the t3 and post TMD scores (r=-.706, p=.034). The significant increase in gamma power within t4 was also significantly negatively correlated to post TMD scores (r=-.684, p=.042); this correlation is also negative.

Discussion

The contemporary study exploring the therapeutic benefits of yelling demonstrated that there was a significant increase in relative gamma power bilaterally in the temporal lobes (t3 and t4 regions) following the yelling condition only (as evidenced within the Beta 2 4-way interaction as well). Gamma frequency is associated with attention (Tiitinen, et al., 1993), arousal (Strüber, et al., 2000), object recognition (Basar, et al., 2000; Keil, et al., 1999), language perception (Pulvermüller, et al., 1995), and auditory working memory (Christophe, et al. 2004). Gamma frequency oscillations are involved in the integration and synchronization of large amounts of information being processed by the brain (Senkowski, *et al.* 2007; Galambos, 1992; Gray, Konig, Engel, & Singer, 1989). The gamma band width is defined as 40 Hz + or 40 + cycles per second (Senkowski, *et al.* 2007; Galambos, 1992; Gray, Konig, Engel, & Singer, 1989). To break this down further, this means that every 25 milliseconds all of the information throughout the brain is being integrated and synchronized. The synchronization patterns occur from the front of the brain and proceeds towards the back (Senkowski, *et al.* 2007; Galambos, 1992; Gray, Konig, Engel, & Singer, 1989). What is interesting to note is that the significant increase in relative gamma power that was observed in this study is highly localized to the temporal regions (the t3 and t4 sensors of the QEEG cap) (view Figure 3). This could suggest that the synchronization pattern is occurring from side to side (from left to right temporal) as well, as opposed to solely the regular front to back pattern as discussed above. The left and right hemispheres are often generally referred to as separate brains (MacNeilage, *et al.* 2009; Sperry, 1975; Geschwind, & Levitsky, 1968). Therefore, it is interesting to note that the synchronization occurring between the left and right temporal lobes suggests that the two halves of the brain are communicating and working in unison after yelling. Synchronized oscillations occurring between the two hemispheres is essential for cohesive cognitive sensations (Aboitiz, López & Montiel, 2003). This great increase in gamma frequency essentially suggests a greater organization rate of thoughts within the temporal lobe regions as a result of yelling. It is also significant to note this effect persisted within the Beta2 frequency band, suggesting a synchrony bilaterally of higher frequency activity.

The findings of the studies discussed earlier that involved the results of significantly increased alpha activity following Primal therapy (Brown, 1973; Karle, Corriere & Hart, 1973; Hoffmann & Goldstein, 1981) were not consistent with those of this study. Based on the findings of the current study, it is speculated that the increase in alpha activity found in studies regarding Primal therapy was associated with another component of the therapy, or a combination of the yell and another component. Another factor that could have contributed to the inconsistency of findings between the current and past studies, is that it was noted in one study (Karle, Corriere & Hart, 1973) that EEG measures were recorded for frontal and occipital regions only. As a result of this, the inconsistency could be a result of the neglect to measure the activity of a wider variety of areas across the brain.

The findings of the present study were also not consistent with the studies involving meditation/vigorous exercise (Arambula et al., 2001; Anand, Chhina & Singh, 1961; Corby, Roth, Zarcone Jr & Kopell, 1978; Delmonte, 1984; Dostalek, Faber, Krasa & Vele, 1979; Kamatsu, Okuma & Takenaka, 1957; Woolfolk, 1975; Travis *et al.*, 1996; Petruzzello and Tate, 1997) and significant increases of alpha activity. The contemporary study did not result in significant changes in alpha power in response to deep breathing on its own. Consequently, this suggests that the significant increase in alpha activity recorded in previous experiments is associated with some other component, or combination of components of the studies. One study specified that the breathing rate during meditation significantly decreased from an average of 12 breaths/minute to 5 breaths/minute (Arambula, *et al.* 2001) implying that the individual breaths increased significantly in duration. It may be the case that the increase in duration of the breaths is responsible for the increase in alpha activity, or as mentioned earlier, the combination of this factor with another.

Significant pre and post measures across conditions were identified within specific subscales of the POMS. There was a significant increase in vigour scores following the yelling condition only. This indicates that, in general, participants had a subjective perception of increased energy after yelling. Paired with the gamma results, this suggests a perceived increased ability to attend to tasks, which is consistence with the terms of the role of gamma frequency in integrating large amounts of information. There was also a significant decrease in fatigue scores following the yelling condition. This suggests that the participants generally felt less tired following the yelling condition. Finally, there was a significant decrease in tension scores following both control conditions (deep breathing and vocal control) only. These findings coincide with studies involving deep breathing and singing (identified as the closest analog to the vocal control) being associated with increased relaxation (Arambula, *et al.* 2001; Chuang, C. *et al.* 2010; Grape, *et al.* 2002).

Significant decreases in total mood disturbance (TMD) scores of the POMS questionnaire as a result of yelling were identified. This means that participants' scores significantly improved overall. Further analysis revealed significant correlations between the t3 and t4 regions measured from the QEEG and the TMD scores of the POMS questionnaire. A negative correlation was verified between the increased gamma power and decreased mood disturbance. This means that as the relative gamma power in the t3 and t3 regions increased, the TMD decreased significantly.

Consequently, these results confirm that increased gamma relative power in the temporal lobes is related to improvements in overall mood.

In conclusion, the results of this study have led to the understanding that yelling does produce a significant impact on the brain which suggests positive affect on mood. This provides grounds for further investigation of this practice.

Implications

The present experiment provided objective measurements of the ancient Indigenous practices performed within the culture for years. By measuring QEEG prior and in response to the treatment conditions, measurement of the dynamics in emotional affect were identified. From this, the beneficial impact on emotion were interpreted with regards to each treatment. Now that objective data regarding yelling has been gathered, this Indigenous healing method has been provided with some initial support. Furthermore, yelling does not cost anything and is a natural process that can be carried out by any individual. Through this study, I have added to the initial understanding of some therapeutic benefits of yelling by measuring QEEG and POMS directly after yelling, deep breathing and the vocal control. The results of this study have provided science with an initial understanding of what begins to occur when someone engages in yelling as a healing practice.

Limitations of the Study and Potential Future Direction

The first possible limitation of the current study is the small sample size. The sample size of ten people was identified as being large enough in order to acknowledge significant effects from the treatment conditions; however, it is not large enough to generalize the effects to the population. In the future, a large sample size of 30 + participants could be used in order to increase the experiment's ability to generalize any effects found to a larger population. A second limitation to this study is that there were 30-second spectral samples taken directly following the baseline measures from each condition. This provides information regarding immediate effects, but falls short of providing information surrounding longer term benefits of yelling. In the future, research may be conducted, using QEEG and POMS, to measure effects of yelling the following day, or after a few days to identify potential longer term benefits. A third limitation to this study is that there were no spectral samples taken during any of the treatment conditions. This was not completed due to extensive muscle artifacts in the raw QEEG data as a result of the yelling condition. Perhaps through further investigation, spectral samples could be extracted from the periods of rest between each yell as means of gathering information that most closely mimics the phenomenon of the effects "during" the yell. A final limitation to the present experiment this is cultural and gender differences were not considered. Future research may accommodate for these factors as they could enhance the results by offering further details that may better explain the effects associated with yelling. Additional suggestions for future research would include perhaps the manipulation of emotion prior to yelling in order to observe whether yelling has a greater effect in response one specific emotion versus another. Furthermore, in light of the inconsistencies previously identified between the findings from previous studies and the current research, future investigation could be carried out in order to attempt to identify more specifically which constituent alone or in combination with others is/are responsible for the increases in alpha activity found as a result in research concerning Primal therapy, meditation and vigorous exercise.

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Appendix A

Consent Form

The Therapeutic Benefits of Yelling

By Sarah Pagnutti

Supervising professor is Dr. Persinger of the Psychology department at Laurentian University.

Sarah Pagnutti
Laurentian University

I, ____________________________ am invited to participate in the research study conducted by Sarah Pagnutti, fourth year student.

The purpose of this study is to evaluate the therapeutic benefits of yelling through quantitative electroencephalographic (QEEG) measures. The areas of the brain where activity is significantly altered as a result of yelling will be observed and interpreted in this experiment.

My participation will essentially consist of attending three sessions which will be approximately one hour each during which I will be asked to complete the short form version of a well-used psychology questionnaire known as the Profile of Mood States (POMS)(duration: approximately 5-10 minutes) at the beginning and end of each session. This will be accompanied by the administration of the QEEG and the request to either yell, deep breathe, or produce a musical note in a sound proof chamber, when instructed (duration: approximately 45 minutes). The sessions will be held on ________________(Date) at ___________________(Time) in room C002.

My participation in this study will entail that I yell, engage in deep breathing activities, or hold a musical note, and this may cause me to feel psychological, emotional, physical or social discomfort. I have received assurance from the researcher that every effort will be made to minimize these risks. As means of minimizing social discomfort, I will be in a sound proof chamber during the treatment period. In the case that I feel any psychological or emotional discomfort, you may contact Dr. Michael Persinger. I may experience a slight throat irritation from yelling; however, I am at no greater of a risk of this occurring if I would yell at a sports game or something of the sorts.

My participation in this study will assist to provide objective data to support the ancient Indigenous healing method of yelling. This will allow preliminary understanding of what begins to occur as a result of engaging in yelling as a healing practice. Yelling is a free and natural process that may be carried out by any individual.

I have received assurance from the researcher that the information I will share will remain strictly confidential. I understand that the contents will be used only for purposes of evaluating the effects of the treatment conditions (yelling, deep breathing, holding a musical note) and that my confidentiality will be password protected, masked by the use of an identification code, and in the case of paper copies, will be locked in a cabinet.

Your anonymity will be protected by ensuring that any personal information is kept separate from your data and an identification code will be assigned to you. Any personal information or data collected from you will be kept in a secure manner that can only be accessed by myself and the supervising professor. This information will be kept for the duration of this study.

I will receive two bonus marks in the class in which my professor has specified as my participation will take a total of 1 hour across three sessions to complete. If I choose to withdraw, I will still receive the bonus marks.

I am under no obligation to participate and if I choose to participate, I can withdraw from the study at any time and refuse to answer any questions without penalty. If I choose to withdraw, all data gathered until the time of withdrawal will be destroyed.

I, ________________________________ agree to participate in the above research study conducted by Sarah Pagnutti of the Psychology department, working under the supervision of Dr. Persinger of Laurentian University.

If I have any questions about the study, I may contact the researcher or her supervisor.

Participant's signature:________________________________
Date:___________________________

Researcher's signature:________________________________
Date:___________________________

Appendix B

Age: ___________ Sex: Male Female ID: _____________

Below is a list of words that describe feelings people have.

Please read each one carefully.

Then circle the number which best describes how you are feeling.

The numbers refer to these phrases: 0 = Not at all

1 = A little

2 = Moderately

3 = Quite a bit

4 = Extremely

1. Tense 0 1 2 4
2. Angry 0 1 2 3 4
3. Worn out 0 1 2 3 4
4. Lively 0 1 2 3 4
5. Confused 0 1 2 3 4
6. Shaky 0 1 2 3 4
7. Sad 0 1 2 3 4
8. Active 0 1 2 3 4
9. Grouchy 0 1 2 3 4
10. Energetic 0 1 2 3 4
11. Unworthy 0 1 2 3 4
12. Uneasy 0 1 2 3 4
13. Fatigued 0 1 2 3 4
14. Annoyed 0 1 2 3 4
15. Discouraged 0 1 2 3 4
16. Nervous 0 1 2 3 4
17. Lonely 0 1 2 3 4
18. Muddled 0 1 2 3 4
19. Exhausted 0 1 2 3 4
20. Anxious 0 1 2 3 4
21. Gloomy 0 1 2 3 4
22. Sluggish 0 1 2 3 4
23. Weary 0 1 2 3 4
24. Bewildered 0 1 2 3 4
25. Furious 0 1 2 3 4
26. Efficient 0 1 2 3 4
27. Full of pep 0 1 2 3 4
28. Bad-tempered 0 1 2 3 4
29. Forgetful 0 1 2 3 4
30. Vigorous 0 1 2 3 4

PLEASE MAKE SURE YOU HAVE ANSWERED EVERY QUESTION

Appendix C **Exit questionnaire**

1. Do you remember if any particular thought, emotion, or experience was elicited during your yelling bursts, deep breathing, or vocal control trials?
____
____
____
____
____

2. Did you yell as loud as you could? (Answer only for yelling condition)
____
____
____
____
____

3. Did you try and visualize anything in particular to help you yell, engage in deep breathing, or the vocal control?
____
____
____
____
____

4. Did you associate the yelling, deep breathing, or vocal control with a negative or positive experience/emotion/situation?
____
____
____
____
____

5. Is there anything that was not included in the POMS that you wish to share and elaborate on with regards to your experience?
____
____
____

****************Thank you!****************

I hope you have a less stressful rest of your day! ☺

Appendix D
Header: Contact me, Sarah Pagnutti, with any comments, feedback, or concerns.

Debriefing Form

Dear Participant,

I would like to thank you for participating in this research project.

My research examines the changes in brain activity as a result of yelling compared to the changes associated with deep breathing and making a musical note. The changes in brain activity will be related to respective emotional experiences in order to determine any correlations between these experiences and potential therapeutic benefits that result.

The present experiment provides objective measurements of the ancient Indigenous practices performed within the culture for years and provides these practices with some support. The results of this study can provide science with an initial understanding of what begins to occur when someone engages in yelling as a healing practice.

In this study, you began and terminated the experiment by filling out the short form of the Profile of Mood States (POMS) questionnaire. Moreover, a quantitative electroencephalogram (QEEG) was applied to your head. You were asked to enter a sound-proof room on your own and when instructed, you either yelled or engaged in a deep breathing, musical note exercise.

Deception was not implemented in this study.

Based on previous research, it is expected that each treatment condition (yelling, deep breathing, making a musical note) will have a significant effect on changes in brain activity as compared to the respective baseline measures. Furthermore, it is predicted that there will be a significant difference between the impact of yelling compared to that of deep breathing and making a musical note.

All information you have provided via the POMS as well as all data collected by the QEEG will remain anonymous and confidential.

If you are experiencing any unsettling feelings as a result of participating in this study, you may contact Dr. Michael Persinger to discuss any concerns. Please remember that any cost in seeking medical assistance is at your own expense.

If you are interested in reading further into aspects of this study, feel free to look at the following articles:

The physiological correlates of Kundalini Yoga Meditation: A study of a Yoga Master
By Arambula et al. (2001)

The Cree Medicine Wheel as an organizing paradigm of theories of human development
By Nabigon (2010)

The new body psychotherapies. Psychotherapy: Theory, Research & Practice
By Brown (1973)
Sarah Pagnutti, January 3, 2015

Appendix E

Script of Instructions for Participants

Are you in a comfortable position and do you feel like you can yell while staying relatively still in this position?

In a moment I'm going to close the door and at this time I would like you to sit and gaze towards the area on the wall in front of you and relax as if you were in a doctor's office waiting for an appointment. Don't worry about any specific breathing, just relax. You will be completing a baseline measure of 3 minutes with your eyes open and then I will cue you to close your eyes and at this point simply close your eyes and relax. After 3 minutes with eyes closed, I am going to cue you to yell/take a deep breath/make a musical note while keeping your eyes closed. Please keep your eyes close throughout the entire experiment until I cue you to open them again, which won't be until you finished yelling/taking a deep breath/making a musical note 3 times and have sat relaxed for another 3 minutes at the end of the experiment. I will walk you through this process through a microphone throughout your time in the chamber with the door closed. You will have a microphone beside you that you can use to communicate with me throughout the experiment; however, I will be turning the microphone down to low while you are yelling for your own comfort. I will be leaving the volume at minimum so that I can hear you slightly just so that I know when you finish yelling so I can mark it for reference later during my data analysis.

When I cue you to yell, I would like you to take a deep breath in through your mouth and then yell as loud as you can for about five seconds or for as long as you can, I will give you about a 20 second rest period between yells at which point you would sit with eyes closed and relax waiting for my cue to yell again. Throughout this process, try and stay as still as possible. Do you have any questions before we get started?

When I cue you to begin your deep breath, I would like you to take a deep breath in through your mouth and then breathe out with your mouth open for about 5 seconds or as long as you can. I will give you about a 20 second rest period between deep breaths at which point you would sit with eyes closed and relax waiting for my cue to take another deep breath. Throughout this process, try and stay as still as possible. Do you have any questions before we get started?

When I cue you to begin the vocal control, I would like you to take a deep breath in through your mouth and as you breathe out, make the sound as you would when a doctor depresses your tongue and asks you to "Say ah." After your deep breath in through your mouth, please make this sound with your mouth open for about 5 seconds or for as long as you can. I will give you about a 20 second rest period between musical notes at which point you would sit with eyes closed and relax waiting for my cue to begin the musical note again. Throughout this process, try and stay as still as possible. Do you have any questions before we get started?