

Laurentian University

QEEG Profile Changes Following Three Total Body Modification (TBM) Treatments

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Introduction

Total Body Modification (TBM) is a new, yet effective form of alternative medicine. It combines applied kinesiology and Traditional Chinese Medicine (TCM) to determine an imbalance of energy systems within the body (Millet, 2015). Once this imbalance has been determined, TBM harmonization, which is quick, rapid taps along specific body points, is performed to help correct the issue. TBM takes a more holistic approach of medicine, focusing on the body as a whole, integrated unit, rather than individual muscles or organ systems. This form of alternative medicine is based off of the concept that if one part of the circuit is disrupted, the whole circuit will be affected (Millet, 2015).

TBM uses reflex points to indicate what or where the specific weakness is. Each reflex point corresponds to a specific body system, internal organ or gland (Melnichuk, 2009). When a specific reflex point is stimulated and a person's muscle tests weak it is indicative of where the imbalance of the circuit is. From knowing this, the proper body points can then be stimulated to help with the harmonization. These body points are very similar to the acupuncture meridian system used in TCM (Melnichuk, 2009). Due to TBM being a recent development in the field of alternative medicine, there is limited amount of literature on its efficacy as a treatment.

The main research question of this study was to determine if the application of TBM would affect baseline states of QEEG activity. It was hypothesized that after completing three treatments of TBM there would be an increase of left hemispheric activity as well as an increase in mood states. This is hypothesized because depression has been shown to cause a decrease of frontal activity, specifically left hemispheric. Therefore, an increase of mood should lead to an increase of left hemispheric activity.

Acupuncture and Meridian Systems

Previous research has shown that acupuncture points are linked together in a network of meridians (Langeuint and Vandont, 2002). Meridians are energy channels that line the body, where acupuncture is the application of small needles to stimulate the circulation of energy that flows through these meridians. These meridians are distributed laterally and symmetrically along the surface of the body (Langeuint and Vandont, 2002). The meridians of the body are said to represent a Yin and Yang relationship (Tsuei, 1996). The relationship of Yin and Yang is one of the most fundamental concepts behind TCM (Perlow, 1973). It is a theory based off the concept that there are two natural complimentary and contradictory forces of our universe, and you cannot have one without the other (Tsuei, 1996). The principle of opposite polarity and duality, while both forces are opposite, they complement each other (Ulette et al, 1998). The Chinese have enforced the theory that for there to be complete harmony in the body the Qi must be undisturbed and flow freely through the body (Perlow, 1973). When the flow of Qi gets disrupted the equilibrium of the individual's meridians is thrown off, producing a disharmony in physiological and sometimes psychological states (Ulette et al, 1998). Acupuncture has demonstrated that the theory of health depends on the Yin and Yang forces circulating the meridians of the body (Perlow, 1973)

Acupuncture meridians represent channels that allow the flow of “meridian qi” (Kaptchuk, 2000). This qi is subtle energies that flow through the body (Ulette et al, 1998). Meridian qi flows in a specific routine through the 12 principle meridian systems. Primarily, these meridians connect the limbs to the head and trunk of the body (Veith 1949). There are also accessory meridians which start at principle meridians and lead to organs of the body (Veith 1949). The 12 principle meridians can be separated into 6 Yin meridians and 6 Yang meridians.

The meridian qi begins in the chest, flowing along the Yin meridians which are distributed through the chest, abdomen and inner side of the limbs. The qi then flows upwards towards the head, flowing along the Yang meridians, which are distributed along the head, face, trunk and outer side of the limbs (Tsuei 1996).

Acupoints are specific points that are located along the meridians and are considered points of access which allow for the flow of Qi through the body (Tsuei 1996). Acupuncture literally means to puncture with a needle, “acu” is Latin for “needle”. Acupuncture consists of inserting fine needles into these acupoints, which allow for there to be a change in energy flow through the meridians. This change has been shown to be beneficial towards an individual’s physiological and psychological states (Roshke et al, 2000). Similar to acupuncture, TBM harmonization works with the mechanism of applying quick rapid pressure to re-adjust the Qi channels of the body (Melnychuk, 2009).

Previous studies have demonstrated that the application of acupuncture stimulates the synthesis and release of two essential neurotransmitters, norepinephrine and serotonin (Samuels et al, 2010). Both of these transmitters can significantly influence an individual’s mood and are frequently linked with many forms of mental illness (Samuels et al, 2010). Many treatments of depression, such as antidepressants and electroconvulsive shock therapy, function to increase serotonergic neurotransmission (Owens and Nemeroff, 1994). Roshke and colleagues (2000) performed a study analyzing 70 majorly depressed patients with the effects of acupuncture. Participants were all treated with antidepressants through the study and were separated into three groups; acupuncture group, placebo group and control group. The overall results of the study were indicative that acupuncture improves depressive symptoms more than pharmacological drugs alone (Roshke et al, 2000). If norepinephrine and serotonin synthesis is stimulated by

acupuncture, which utilizes the same meridian system as TBM, then it stands to reason that synthesis may also be stimulated by TBM harmonization. This will be assessed in the current study.

Another study acupuncture study performed by Tanaka and colleagues (2000) analyzed changes in EEG bands in response to the application of acupuncture. The results showed an increase of activity within each EEG band. These EEG changes were only induced when acupuncture changes were induced, concluding that changes in EEG activity were due to the stimulation of acupuncture (Tanaka et al, 2002).

Acupuncture has also been shown to increase cortical activity in the brain, such as the insula, anterior cingulate, dorsolateral prefrontal cortex and the cerebellar cortex (Wu et al, 1998). The insula is important in mapping bodily states (Damasio et al, 2000). It is associated with emotional experiences, providing emotional context to a sensory experience (Damasio et al, 2000). An increase in insular activity after acupuncture is understandable because the function of acupuncture is to regulate the meridian qi through the body, “re-charging” the body.

Quantitative Electroencephalography (QEEG).

A quantitative electroencephalograph (QEEG) measures voltage fluctuations along the scalp of an individual (Niedermeyer & De Silva, 2005). Neurons in the brain communicate through electrical impulses, which are caused by ionic changes of neurons (Niedermeyer & De Silva, 2005). The measurement of this electrical activity is in terms of Hertz (cycles/second). A QEEG takes electroencephalography (EEG) measurements and conducts a mathematical analysis, condensing EEG data into a single page summary (Koberda et al, 2012).

A QEEG measures this activity in 5 specific wavelengths; delta, theta, alpha, beta and gamma (Corradini, 2014). Delta wave has a frequency of 0.5-4 Hz and is associated with deep sleep, 4-8 Hz is a representation of a Theta wave and is associated with a drowsy meditative state. Alpha wave frequency is between 8-13 Hz and is characterized by a relaxed and reflective state. The frequency of 13-30 Hz is associated with a Beta wave and is linked to active thought, and finally, Gamma is the highest frequency, which is anything 30 Hz and above, this is associated with integration (Whittingstall and Nikos, 2000). As you increase frequency of the wavelength you also increase cortical activity and level of alertness.

The QEEG utilizes a 10-20 system, which describes the location of scalp electrodes using a 19 electrode cap (Corradini, 2014). The 10-20 system is representative of the actual distance between adjacent electrodes and if they are either 10% or 20% of the total front-back or right-left distance of the skull. Data from a QEEG must be collected using the software system winEEG, and from here raw data can be extracted and analyzed using programs such as s-LORETA or SPSS. A QEEG is useful in determining under or over activated brain regions, as well as connections or pathways that have high or low activity. The use of electroencephalography as a diagnostic tool has been demonstrated in experimental and clinical applications, demonstrating clear correlates between brain activity and behaviour (Corradini, 2014).

Clinical Applications of a Quantitative Electroencephalography

A study performed by Koberda and colleagues in 2013 was conducted for the purpose of determining clinical applications of the QEEG. This was performed in hopes of furthering QEEG neuroimaging application in a neurology practice. In this study, 100 QEEG recordings of patients from a neurology clinic were taken over a period of 6 months. The patients were split up into groups that fit their neurological symptoms. One of the groups analyzed consisted of

participants who suffered chronic headaches (Koberda et al, 2013). Participants with chronic headaches received QEEG recordings, which indicated an increase of beta in the frontal and occipital locations (Koberda et al, 2013). Along with suffering from chronic headaches these patients were also presented with co-morbidity anxiety. This anxiety could contribute to the elevated beta band activity (Koberda et al, 2013). Post-concussion patients were also analyzed using QEEG, which indicated an increase in frontocentral beta power. 95% of the 100 QEEG readings were statistically significant. These findings are indicative of QEEG analysis performing a starting point and reference point during neurofeedback therapy (Koberda et al, 2013). This can back up the theory that QEEG has clinical applications and can be used to identify and help treat certain neurological disorders.

Corradini and Persinger (2014) performed a study to determine correlations within neuropsychological tests to quantify chronic deficits from mild closed head injuries. In this study, QEEG power was analyzed using s-LORETA. s-LORETA is short for standardized low-resolution brain electromagnetic activity (Wanger et al, 2004), and it functions by taking raw EEG data and converting it into a functional area, allowing the visualization of areas of high and low activation. The results of this study showed low-power within alpha, theta and delta bands within caudal regions of the cortex in participants who showed moderate-to-severe neuropsychological impairments. These findings can infer that there is a relationship between neuropsychological impairments. The clinical benefits of this study conclude that the QEEG can be useful when determining the area of dysfunction, and by knowing what the dysfunction is, it can potentially provide treatment for future cases (Corradini and Persinger, 2014).

To determine the effects of Chiropractic adjustment on brainwave patterns, Barwell and colleagues (2009) performed a study to analyze pre and post adjustments with the use of a QEEG.

Baseline QEEG measurements were taken pre chiropractic adjustment, and post chiropractic adjustment (Barwell et al, 2009). The results of this study displayed an increase of alpha brainwave pattern. This alpha activity was then followed by an increase in global brain activity. Chiropractic adjustments occur when a chiropractor properly cracks and re-adjusts your back to re-align it. The spine is part of the central nervous system, and has nerves that are attached to all organs of the body (Cramer and Darby, 2005). For example, the dorsal root nerve is branched from the spinal cord. This nerve is responsible for carrying signals of sensation from the body to the brain (Cramer and Darby, 2005). These spinal adjustments were proven to affect the nervous system beyond the dorsal root nerve, but to also affect the function of the brain itself (Barwell et al, 2009). The results of this study show an increase in alpha, and with alpha being related to relaxed and reflective states, this can conclude that the treatment of chiropractic care can lead to a more relaxed state when comparing pre to post treatment QEEG baselines.

Methods

Participants

A total of a fifteen participants were used to complete this experiment. Ten participants were part of the treatment group and were previously patients of Dr Brosseau, which is how they were recruited for participating in this experiment. Five participants were used as the control group and they were recruited from Laurentian University. Ages of the participants ranged from 18-65. There was a total of ten female participants and five male participants. Participants who were receiving TBM were receiving it from Dr Brosseau who is a licenced chiropractor and is certified to perform TBM, he was also performing the treatment free of charge.

Materials

The QEEG was used to measure brain activity. It functions by measuring the brains neuronal activity through a 19 electrode cap (Corradini, 2014). The electrodes of the cap utilize the international 10-20 system (Corradini, 2014). This system refers to the fact that adjacent electrodes at 10% or 20% total distance of left-right or front-back of the cap. The electrode sends signals which are amplified by the mitsar box where the output is collected on a computer using the software winEEG. The output is organized within 5 classical bandwidths; Delta, Theta, Alpha, Beta and Gamma. From here, raw data can be extracted and further analyzed using SPSS and sLORETA.

A mood questionnaire was administered pre and post each TBM treatment to each participant. Due to time restraints, the mood questionnaire consisted of only five questions and these questions were picked based off of the categories of the POMS. The categories were; fatigue, confusion, anger, depression and tension (McNair *et al*, 1971). The administration of this mood questionnaire was with a Likert scale of 0-7, where 0 was the absolute lowest and 7 was the absolute highest. The results of the mood questionnaires were then put into SPSS for further analysis. The results from the mood questionnaires and QEEG measures were correlated to analyze if there was a statistical significance between treatment of TBM and mood.

TBM is a treatment that is supposed to improve the wellbeing of an individual. With the treatment of TBM the assumption is being made that mood will also improve. Improvement in health has been correlated to an improvement in mood (Roshke *et al*, 2000).

Procedure

This experiment will take place in the Chiropractic office of Dr Micheal Brosseau. Participants of this experiment are current patients of Dr Brosseau. The dependent variables of this study are QEEG relative spectral power and the mood questionnaire. The independent variables are trials (1, 2 and 3) and pre and post treatment of TBM. Two other variables to take into account when using the QEEG apparatus is sensor and hemisphere.

To begin, participants came into the office for a brief overview of the procedure. This brief overview outlined the procedure of the experiment, explaining how the QEEG worked, why the mood questionnaire was being administered, and although participants had already been exposed to TBM and knew what it was, a brief overview of TBM was also explained. For each trial participants will receive a mood questionnaire pre and post TBM treatment (See appendix B). Prior to Trial 1 of the experiment participants were required to sign an informed consent form, outlining that they were aware of what the procedures of the experiment consisted of and that they are able to withdraw from the experiment at any given time with no penalty (See Appendix A). The participants were required to wear a 19 channel sensory cap (Mitsar EEG-201). Once the cap is on, a 90 second eyes open (EO) and 90 seconds eyes closed (EC) baseline was taken pre and post each treatment of TBM. The treatment of TBM lasted anywhere from two minutes to seven minutes. During this time, the QEEG cap stayed on. Participants were asked to come into Dr Brosseaus office for a total of three TBM treatments. After the completion of three trials participants received a thank-you letter, informing them they are welcome to the final write up of the experiment so they can see the results (See appendix C).

Analysis

This experiment was a 2X3 within subjects design. The independent variables were trial (1, 2 and 3) and time (pre and post). The dependent variables of this experiment were QEEG relative spectral power, and the mood profiles. Although, as stated above, two variables to take into consideration when using the QEEG apparatus is hemisphere (left or right) and sensory (19 sensor cap).

QEEG Analysis

QEEG analysis was performed with the program winEEG. To begin, once the data from each trial was collected, eye blink artifacts were removed from the recorded EEG signals. Thirty seconds of spectral data was then removed from each of the eyes open and eyes closed pre and post baseline measures. From here, relative scores were computed. This was performed by taking each value ($\mu\text{V}^2/\text{Hz}$), and dividing it with its corresponding combination of variables. These variables were a combination of eyes closed vs eyes open, trial 1, 2 or 3, pre or post measures, sensors (Fp1 through O2), and finally, frequency band width (delta-gamma). These values were divided by the total spectral power value. This total spectral power was calculated from a total of 1356 values.

The relative scores were then used to compute a within subjects ANOVA. This ANOVA was performed separately on eyes open and eyes closed variables, but across all conditions; trial (1, 2, or 3), pre and post, and for every sensor within each frequency band (delta-gamma).

Due to the large amount of combinations that the above command would give, a MANOVA command was used. This was done so the alpha value could remain at .05. From

here, significant results were graphed and further elaboration on them can be found within the *discussion* section. After determining and analyzing significant findings, further statistical analysis was performed to determine the source of interaction. This was done through post-hoc tests. Again, due to a high number of variables, to limit the chance of making a type I error, one variable within the interaction was isolated to determine if it was the driving force. From here, a paired t-test was then performed to conclude the significance of the isolated variable.

s-LORETA Analysis

Source localization allows us to see a functional image that is collected through winEEG. This is done by collecting six seconds of raw data from the collected winEEG data. This collection is done for eyes open and eyes closed pre and post baselines of each trial. From here, these six second increments of data are imported into s-LORETA software. From here, the data analyzed for the treatment group was eyes closed, trial, 1 pre-treatment compared to eyes closed, trial 3, post treatment. The very first baseline of eyes closed was analyzed against the very last baseline of eyes closed collected. Significant results will be further explored in the *discussion* section. To analyze the control group, only eyes closed trial one pre-treatment was analyzed from the treatment group when analyzing the control group due to the reason that the control group only received one sham treatment. Again, significant findings will be further discussed in the *discussion* section.

Mood Analysis

As stated above, due to time restraints no standardized mood questionnaire was used. A short, five question mood questionnaire was given to participant's pre and post treatment to

determine their mood at that very exact moment. This questionnaire was formulated based off of certain categories of the POMS. Moods analyzed were; Anger, fatigue, confusion, tension and depression (McNair et al, 1971). Each mood subscale was analyzed differently by running a within-subjects ANOVA. With significant findings, graphs were made and post-hoc analysis were conducted by performing a paired t-test to determine the source of interaction. Significant results will be elaborated within the *discussion* section.

Correlations

To determine if there was a difference in mood states from pre to post treatment of TBM Pearson correlations were performed on data collected from QEEG and the mood questionnaire. Significant results were then graphed, and will be further explored in the end *discussion* section.

Results

All data was recorded using winEEG software and mitsor box amplifier at 250 Hz for all participants. 30 second samples for pre and post TBM measures and spectral data was analyzed using the winEEG software. Data was then exported into SPSS version 22 for further analysis. Assumptions of normality and linearity were met for all variables. Relative scores for each individual sensor was computed. An individual repeated measures ANOVA was conducted for each of the 6 classical bandwidths (delta-gamma). The variables of performed ANOVA were sensors, trial (1, 2 and 3), eyes open, eyes closed and hemisphere.

Delta Bandwidth

To identify if there was a difference of delta wavelengths between all three trials, an individual repeated-measures ANOVA was conducted. The results of delta showed a three way interaction significance when comparing eyes open baseline of trial by hemisphere by sensor ($F_{(14,98)}=1.87, p=.039, \text{partial } n^2=.211$). Representation of this three way interaction is shown in Figure 1. Another significant three way interaction was found again within the eyes open baseline when comparing week by pre-post by hemisphere ($F_{(2,14)}=4.36, p=.034, \text{partial } n^2=.384$). This significant interaction is represented in Figure 2. From here, a post-hoc test was performed to determine the source of interaction. A significant interaction was found within sensors O1 of week 1 and week 3 with eyes open ($T(9)= -3.137, p=.014$).

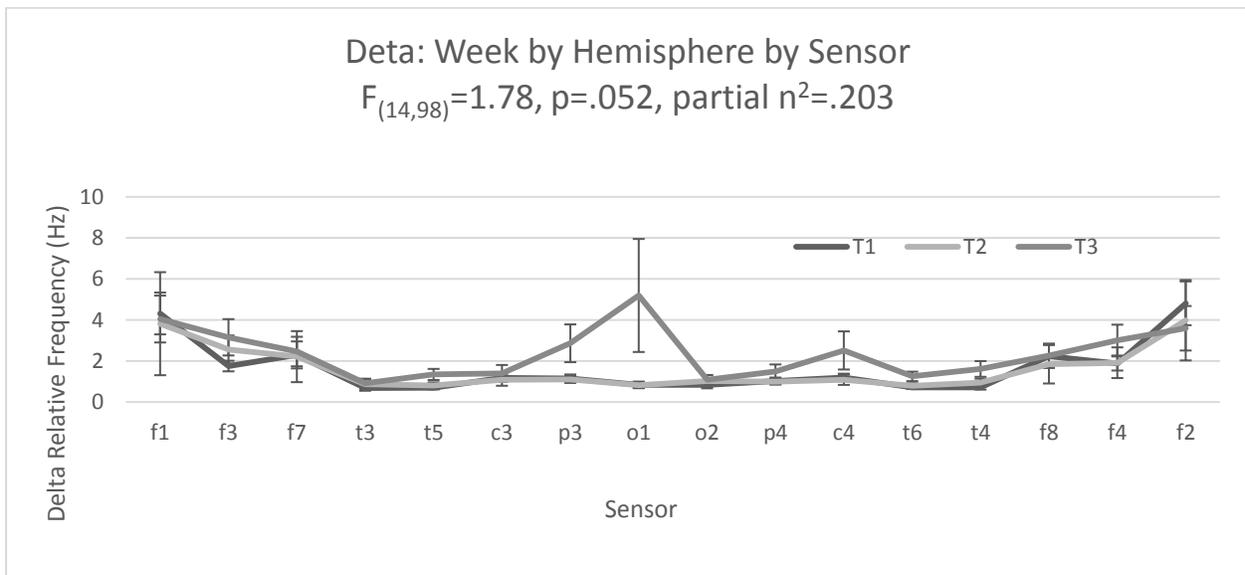


Figure 1: Representation of the three way interaction of week by hemisphere by sensor.

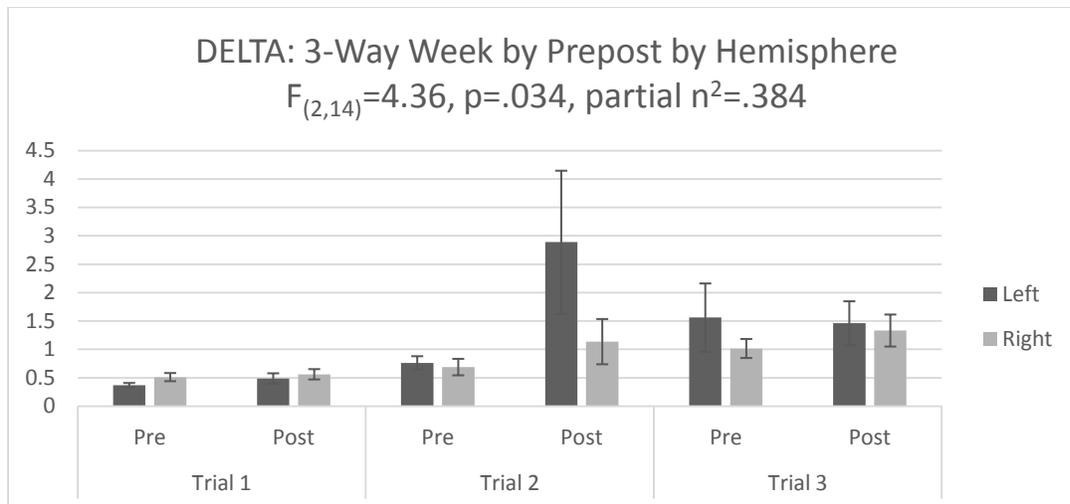


Figure 2: The representation of the 2 way interaction week by pre-post by hemisphere. The results indicate that trial 2 has a significant increase in the left hemisphere post treatment ($F_{(2,14)}=4.36, p=.034, \text{partial } n^2=.384$).

Theta Bandwidth

A within subjects ANOVA was performed to determine if there was any significant interaction within the theta bandwidth. The results indicated a significant three way interaction with eyes closed between trial by hemisphere by sensor ($F_{(14,98)}=2.27, p=.010, \text{partial } n^2=.245$). A representation of this interaction can be seen within figure 3. From here, a post hoc analysis was performed. The results from a paired t-test indicated that there was a significant effect within the left occipital sensor, O1 ($T(9)=2.338, p=.044$). A representation of this finding can be found in Figure 4.

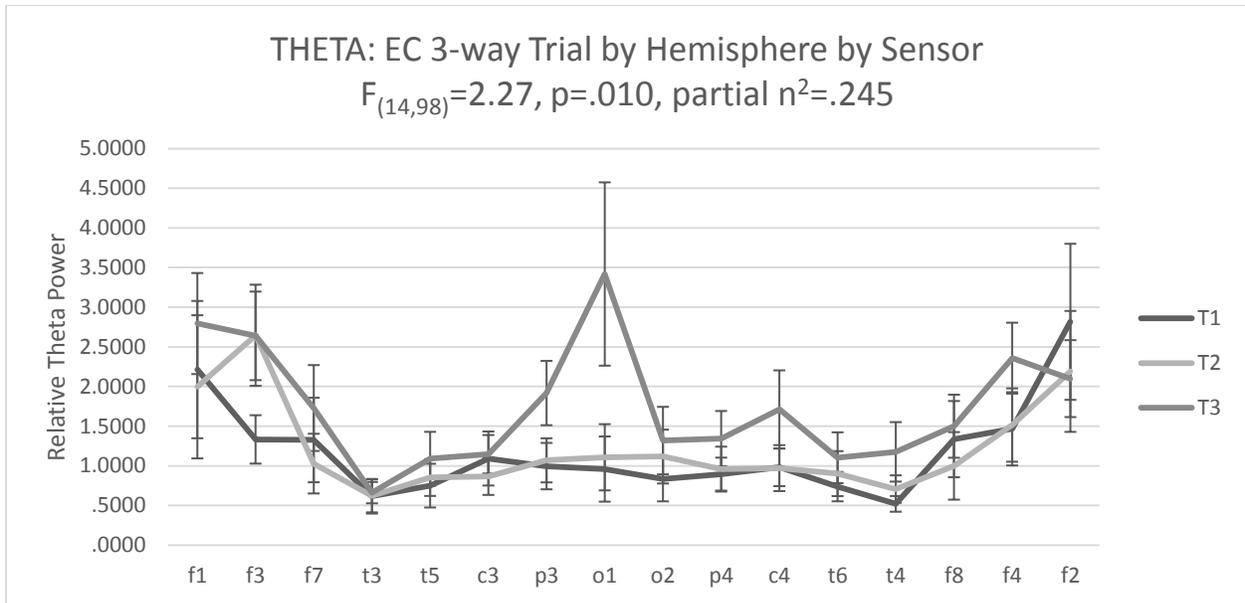


Figure 3: A representation of the three way interaction within the theta band, trial by hemisphere by sensor. (Note: Standard error of the mean was used to create error bars.)

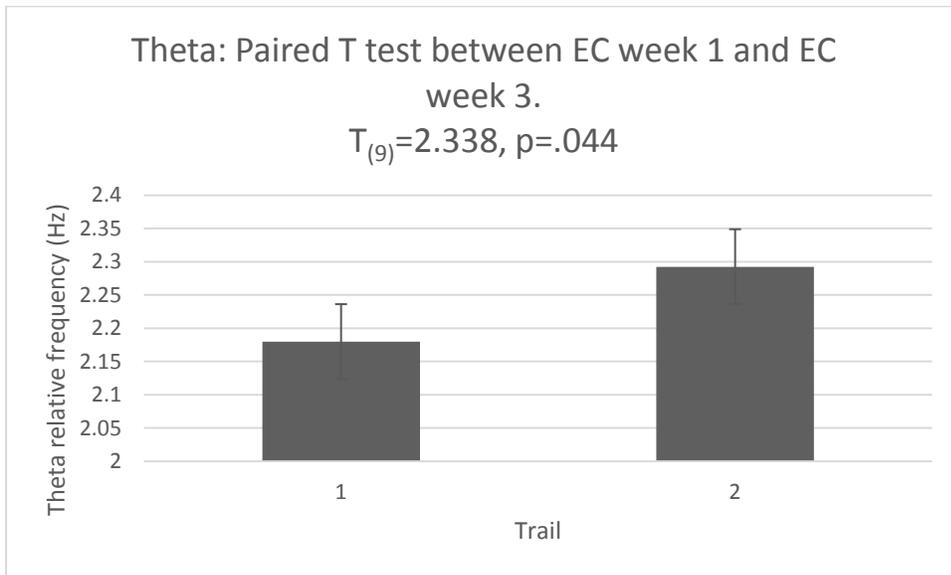


Figure 4: Representation of the post-hoc analysis performed to indicate the source of interaction between the three way interactions. This concluded there was a significant interaction within O1. (Note: Standard error of the mean was used to create error bars.)

Alpha Bandwidth

A within subjects ANOVA was used to analyze if there was any statistical significance within the alpha bandwidth. Alpha showed non-significant interactions between variables. There was a statistically significant affect when comparing the alpha relative frequency through the three trials ($F_{(2,12)}=5.34$, $p=.022$, partial $\eta^2=.471$). A representation of this can be found in Figure 5.

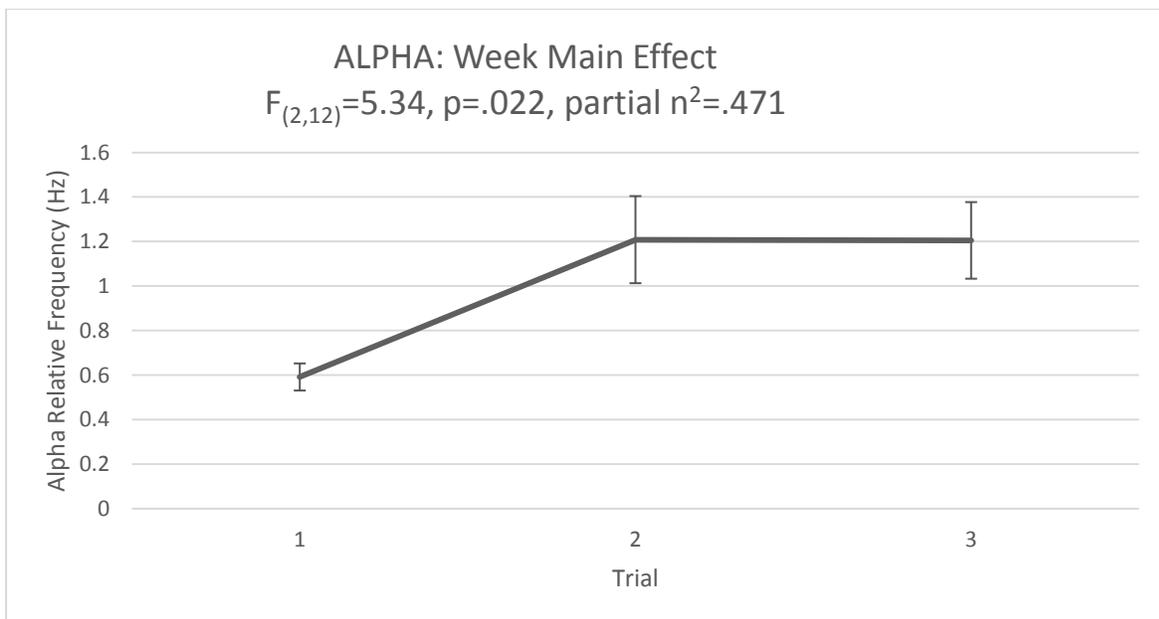


Figure 5: A representation of the Alpha relative frequency in Hertz over three treatments of TBM. The results are statistically significant, with $p < .05$.

Beta 1 Bandwidth

The Beta 1 bandwidth was analyzed using a within subjects ANOVA. This test indicated a significant difference with a three way interaction between week by hemisphere by sensor ($F_{(14,98)}=1.96, p=.029, \text{partial } n^2=.219$). These results are displayed in Figure 6.

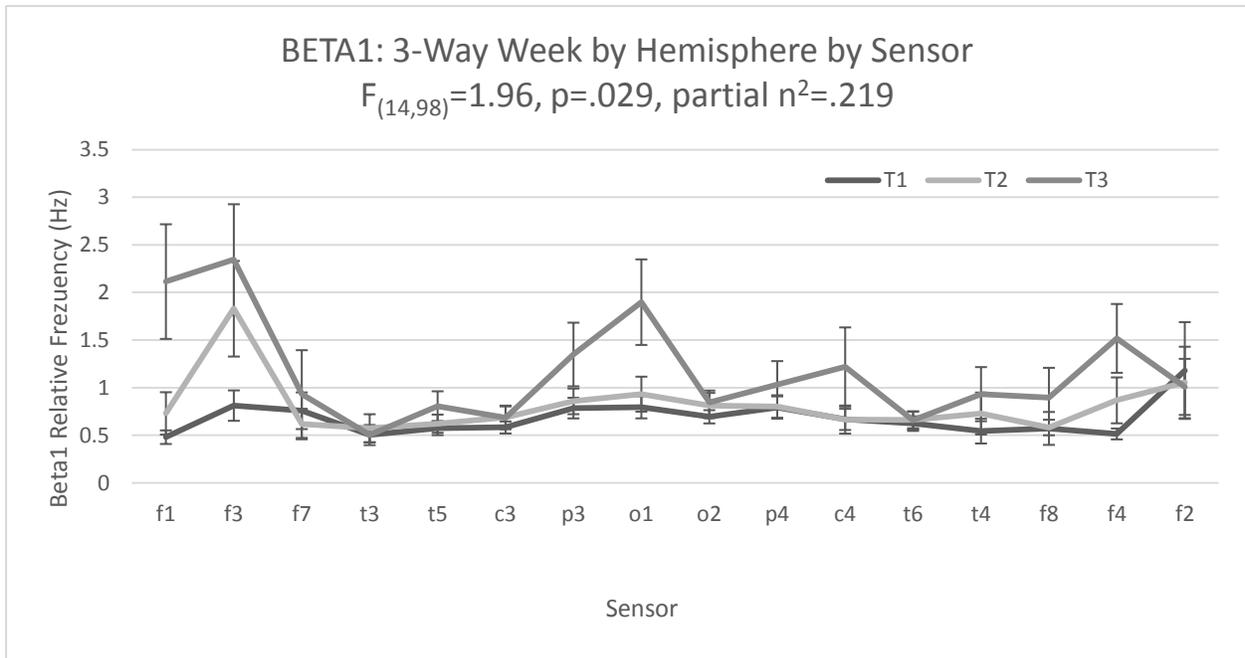


Figure 6: This figure represents the three way interaction of week by hemisphere by sensor within the Beta1 bandwidth. (Note: Standard error of the mean was used to compute error bars).

Beta 2

A within subjects ANOVA was performed to determine if there was a significant effect within the Beta2 bandwidth. The results show there was a significant three way interaction between week by hemisphere by sensor ($F_{(14,98)}=2.03, p=.022, \text{partial } n^2=.225$). Figure 7 represents this interaction. After determining there was a significant interaction, a post-hoc test was performed to determine where the source of interaction was.

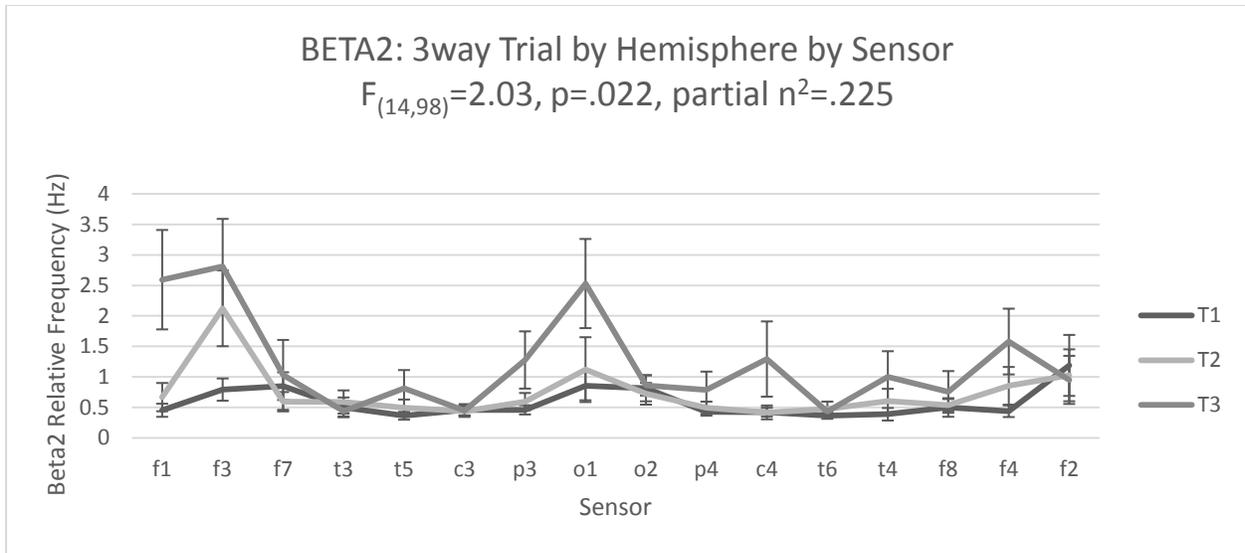


Figure 7: This figure displays the significant three way interaction of Beta2 bandwidth between trials by hemisphere by sensor. (Note: Error bars were computed by using standard error of the mean).

Gamma Bandwidth

A within subjects ANOVA was used to analyze if there was any statistical significance within the Gamma bandwidth. Gamma showed non-significant interactions between variables. There was a statistically significant affect when comparing the Gamma relative frequency through the three trials ($F_{(2,14)}=4.63, p=.029, \text{partial } n^2=.398$). A representation of this can be found in Figure 8.

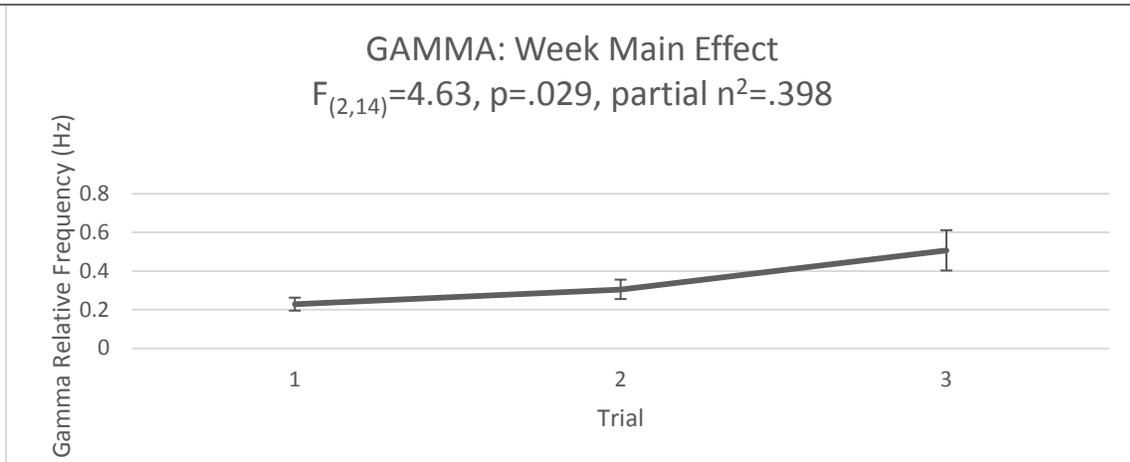


Figure 8: A representation of the Gamma relative frequency over a period of three treatments of TBM. $F_{(2,14)}=4.63$, $p=.029$, partial $n^2=.398$, concluding statistically significant results.

s-LORETA

To analyze s-LORETA data, 6 seconds of raw data was extracted from winEEG. This 6 seconds of raw data was then imported into s-LORETA software for source localization analysis. For treatment participants source localization analysis was done comparing eyes closed trial 1 pre-treatment to eyes closed trial 3 post-treatment. Table 1 shows a representation of the significant findings of the treatment group.

When analysing source localization of the treatment group and control group only trial 1 eyes closed pre-treatment was analyzed due to the control group only having one treatment, while the treatment group had three. The results of these findings are summarized in Table 2.

Table 1: Source localization analysis of eyes closed, trial 1, pre-treatment baselines compared to eyes closed, trial 3, post-treatment baselines. Only significant findings are summarized.

Thresholds	t	(p=.01) 4.56; (p=.05) 3.62	Hem
<i>delta (1.54-4Hz)</i>	4.33	BA30, posterior cingulate (L)	right
<i>theta (4.5-7Hz)</i>	4.24	BA37, inferior temporal gyrus (T)	left
<i>alpha1 (7.5-10Hz)</i>			
<i>alpha2 (10.5-13Hz)</i>	4.06	BA9,medial frontal gyrus (F)	left
<i>beta1 (13.5-20Hz)</i>	3.74	BA9,medial frontal gyrus (F)	left
	3.64	B18, cuneus (O)	right
<i>beta2 (20.5-25Hz)</i>	4.19	BA18, lingual gyrus (O)	left
<i>beta3 (25.5-30Hz)</i>	4.33	BA13, insula (sublobular)	left
<i>gamma (30.5-35Hz)</i>	3.95	BA19, cuneus (O)	right

Table 2

Table 2 summarizes the significant findings for treatment group compared the control group when comparing trial 1, eyes closed, pre-treatment baselines. Only the control group showed significance, these findings are displayed below.

Treatment > Control

Thresholds	t	(p=.01) 6.27; (p=.05) 4.88	Hem
<i>delta (1.54-4Hz)</i>			

<i>theta (4.5-7Hz)</i>			
<i>alpha1 (7.5-10Hz)</i>			
<i>alpha2 (10.5-13Hz)</i>			
<i>beta1 (13.5-20Hz)</i>	5.45	BA25, anterior cingulate (L)	right
<i>beta2 (20.5-25Hz)</i>	5.21	BA11, rectal gyrus (F)	right
<i>beta3 (25.5-30Hz)</i>	6.85	BA25, subcallosal gyrus (F)	right
	6.51	BA27, parahippocampal gyrus (L)	left
<i>gamma (30.5-35Hz)</i>			

Mood Measures

Due to time restrictions the mood questionnaire that participants had to fill out consisted of only seven questions. These questions were based off categories of the POMS (anger, confusion, depression, fatigue and tension). The questions were administered with a 0-7 Likert scale, with 0 being the absolute lowest and 7 being the absolute highest. The questionnaires were administered pre and post each TBM treatment. The values from the completed mood questionnaires for each participant was then entered into SPSS version 22 for further analysis. To begin, only the treatment group was analyzed to determine if there was a change in their mood over a series of three TBM treatments. This was analyzed by using a within-subjects ANOVA. The results of pre and post measures indicated that there was a significant difference ($F_{(4,36)}=5.67, p=.001, \text{partial } \eta^2=.387$). These results can be seen in Figure 9. From here, a post hoc analysis was performed to determine which mood showed a significant increase. The results of the post hoc analysis showed that each mood showed an increase that was statistically significant. Results from this post hoc analysis are displayed in Table 3.

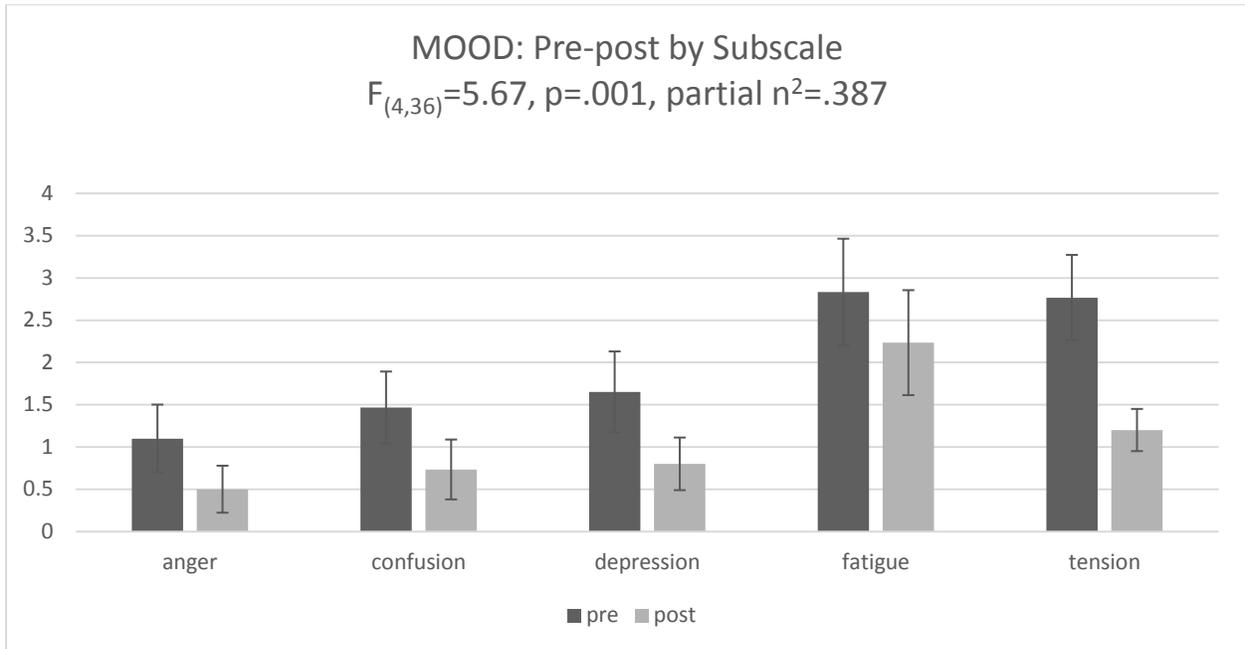


Figure 9: Displays results from the ANOVA performed to determine if there was a significant difference between pre and post measures of TBM. (Note: Error bars were created using standard error of the mean).

Table 3: This table represents the significant T statements from the post hoc performed. The analysis indicates that each mood significantly increased from pre to post treatment of TBM.

Mood	T Statement	P Value
Anger	T(9)= 2.946	p= .016
Confusion	T(9) = 3.161	p=.012
Depression	T(9)= 3.348	p= .009
Fatigue	T(9)= 2.785	p= .021
Tension	T(9)= 4.291	p= .001

Discussion

The purpose of this study was to determine if TBM affected baseline states of QEEG measurements. Research has demonstrated that meridians used in TCM acupuncture allow for subtle energies (Qi) to flow through the body, resulting in the body being in a state of balance and harmony (Langeuint and Vandont, 2002). When this harmony is disrupted it has been shown that physiological impairments occur (Langeuint and Vandont, 2002). It has also been shown that there is a correlation between mood and health, when health is positive, so is mood, and vice versa (Saki et al, 2007). With TBM focusing on the energies of the body and using meridians to help regulate this energy flow it was hypothesized that with the treatment of TBM there would be an increase in left hemispheric activity as well as an increase in mood states. Certain mood disorders, such as depression, have been shown to have a decrease in left hemispheric activity, primarily within the frontal cortex (Roshke et al, 2000). With this being said, after analyzing results it was evident that there was indeed an increase in mood treatments from pre to post treatment of TBM. Furthermore, after analyzing s-LORETA data it was also determined that there was a significant increase in left hemispheric activity.

QEEG Analysis

Delta bandwidth has a frequency anywhere between 0.5 Hz to 4 Hz and is associated with a deep sleep. After performing statistical analysis on the delta bandwidth it was apparent that there were two significant three-way interactions. The first interaction was between week (trial 1, 2, and 3) by hemisphere (left and right) by sensor (Fp1 to O2). The representations of this interaction are found in Figure 1. There is a visible increase of activity within the left occipital (O1) sensor during trial 3. Left occipital functioning is associated with visual processing and response to emotional and attentional visual processing (Magnun and Millyard, 1991). With

Delta showing an increase of activity within the treatment group it can be speculated that the participants visualizing results of the treatment. The significant increase of activity was found only within the third week of receiving TBM treatment. From this, a postulation can be hypothesised that it takes three trials of TBM to produce any significant effects. Further analysis will be necessary to determine if this hypothesis is accurate. The second significant interaction within the relative delta frequency was between week (trial 1, 2, and 3), by TBM baselines (pre or post), by hemisphere (left or right). Week 2 showed a significant increase of activity in the left hemisphere post treatment of TBM. The aim of TBM is to induce the body into a state of equilibrium, where all energy circuits are flowing equally through the body. Given that this equilibrium is associated with the most relaxed states possible, it is clear that increased delta wavelenghts can be a product of post TBM treatment. In the context of this study, after receiving a treatment of TBM to re-adjust the imbalances of the body, one could only assume an increase of delta wave activity.

Theta is represented by a frequency of 4-8 Hz. This bandwidth is represented by deep meditative or reflective state (Whittingstall and Nikos, 2000). When analyzing theta as an individual bandwidth it showed a significant three-way interaction when eyes were closed between week (trial 1, 2 and 3), by hemisphere (left or right), by sensor (Fp1 to O2). Figure 4 shows a representation of this interaction, and it is visibly significant (with no overlapping error bars), that week 3 had an increase of activity in O1, which is yet again, left hemispheric activity. This increase of activity within O2 can be indicative of an increase in psychological state. The purpose of TBM harmonization is to do exactly as it sounds, harmonize the energies of the body. When comparing each individual trial (1, 2 and 3), trial 3 shows an increase of activity within all sensors when being compared to the other two trials. This could potentially be the result of TBM

treatments requiring multiple (three in this case) administrations of TBM harmonization to stimulate a reaction. Further analysis will be necessary to conclude this hypothesis.

A frequency of 8-13 Hz is associated with an Alpha frequency. When analyzing this bandwidth there were no significant interactions, although there was a significant finding when comparing week main effects, as seen in Figure 5. There is a significant increase from trial 1 to trial 2, and a slight increase from trial 2 to trial 3. Again, trial 3 having the highest activity of relative alpha frequency (Hz), can be indicative of the postulation that multiple trials are necessary to produce a noticeable effect.

Beta frequency is associated with normal, waking consciousness. It is associated with active thought. Relative beta frequency is anywhere between 13 Hz to 30 Hz. This can be further broken down into Beta 1, Beta, and Beta 2. Beta 1 is known as low beta, and has a frequency range of 13-16 Hz, where beta has the frequency of 13.5-20 Hz, and Beta 2, known as high beta, has a frequency of 20.5-30 Hz (Corradini, 2014). When analyzing beta results there was a significant increase of activity within the relative Beta2 frequency, showing a three way interaction between the variables week (1, 2 or 3), by hemisphere (left or right), by sensor (Fp1 to O2). This can be seen in Figure 7. Again, the significant increase was within the third trial. It was fascinating to see that F1 and O1 were visibly significant compared to all other sensors, with no overlapping error bars. These sensors are located in the left hemisphere (left frontal and left occipital), which is aligned with the original hypothesis of this experiment that an increase in left hemispheric activity would be present.

Gamma is a bandwidth of high frequency, anything over 30 Hz. This bandwidth showed no significant interactions, but it did have a significant main week effect. This shows a constant increase from trial 1 to trial 3, again, with trial 3 having the most activity.

s-LORETA Analysis

Standardized low-resolution brain electromagnetic activity (s-LORETA), is a computer software that computes a functional image with imported raw data from winEEG. It shows areas of high and low activation in the cortex (Corradini, 2014). The purpose of this experiment was to determine if there was a change in baseline states of QEEG activity with the treatment of TBM. To analyze this, week one, eyes closed, pre-treatment baselines were compared with week three, eyes closed, post-treatment baselines of the treatment group. This was to determine the significant areas of activation in the brain over three treatments. The findings of this comparison can be found within Table 1 in the results section. There were eight specific structures that showed a significance in activation, where five out of these eight structures were left hemispheric.

TBM, being a recent development, has little academic literature. The concept of TBM is based off of applied kinesiology and TCM. Acupuncture is an aspect of TCM which is based off of the concept that Qi (subtle energies) flow through 12 main meridians of the body (Langeuin and Vandowin, 2002). Pariente and colleagues in 2005 performed a neuroimaging study to analyze neuronal substrates of pain when treated with acupuncture. This study tested 14 participants who suffered from osteoarthritis. These participants were exposed to acupuncture and positron emission tomography (PET) scans and results were analyzed to see areas of the cortex that showed significant activation. Their findings concluded that the left insula showed significant activation with the treatment of acupuncture (Periente et al, 2005). Interestingly, when analyzing s-LORETA data from the treatment group, the left insula showed a significant increase of activation with a p value less than .05. Past studies have proven that the insula is associated with a sense of touch and maps bodily stages associated with our emotional

experiences (Damasio 2008). It has also been shown to integrate information about states of the body. Evidently, TBM is a very physical treatment. First, it requires the practitioner to touch the patient, performing specific muscle tests, in order to determine the weakness in a circuit, and then it requires the practitioner to apply quick rapid pressure to re-align these circuits. The increase of insular activity, as found in this study and the supporting literature, is positively associated with the outcome of TBM treatments.

When analyzing the effects of TBM of the treatment group to the control group, only eyes closed, trial 1, pre TBM baselines were compared. This was due to the fact that the control group only received one sham treatment. A representation of significant findings can be seen in the *results* section under *Table 2*. Precaution must be taken when interpreting this data because it was a comparison between the control group, a perfectly healthy group of individuals, and the treatment group, which was a group of participants who were receiving treatments for different mental and physical dysfunctions. A fascinating increase of activity was found within the treatment group, but not the control group, in the left parahippocampal gyrus, with a p value less than .05. The parahippocampal gyrus is the primary input and output of the hippocampal formation, which is the area of the brain where memories are consolidated. The parahippocampal gyrus also acts as a multimodal integrator, having connections to almost everywhere in the cortex (Persinger and Scott, 2013). Persinger (1993), states that the parahippocampal region is the most likely region in the cortex for being able to extract and translate neural patterns. The parahippocampal gyrus has been implicated in detecting small, subtle energies (Scott and Persinger, 2013). One question to ponder could be, how does the practitioner able to read the dysfunctions? Could it be that the parahippocampal gyrus is picking up abnormal energies from disruptions through the circuit and sending signals through the

cortex? Subtle energies have been proven to be important in Chinese meridian systems (Languein and Vandowin, 2002), and these energies could also be important in the treatment of TBM.

Mood Analysis

The second hypothesis of this experiment was that there would be an increase in mood states when comparing pre and post TBM treatment. Figure 9 in the results section describe the results from the comparison of pre and post mood questionnaires. The five moods analyzed were extracted from categories of the POMS; anger, confusion, depression, fatigue and tension (McNair et al, 1971). It is visibly noticeable that moods did have a positive increase after receiving a treatment of TBM, whether it was trial 1, trial 2 or trial 3. Further analysis was conducted and did conclude that the increase in mood was significant for each individual mood measure. These results indicate positive subjective feelings regarding mood dimensions following TBM.

A study was performed by Kong (2007) to determine the effects of acupuncture on depression and anxiety on type 2 diabetes patients. This study consisted of one hundred type 2 diabetes patients who were randomly divided into a control group, and a treatment group. The treatment group received acupuncture along with medication for diabetes. Each group was required to fill out a depression scale (HAMD, SDS) and an anxiety scale (HAMA, SAS) to be analysed. The results of this study concluded that acupuncture improved the negative mental state of type 2 diabetes patients (Kong, 2007), which corresponds to the results found within the current study.

Limitations

This study had certain limitations. To begin, the treatment group had previously been exposed to TBM before the experiment started. This could have habituated them to the treatment. Secondly, the control group only received one sham treatment, where the treatment group received three separate TBM treatments. This could have had an effect when comparing the control group against the treatment group. Thirdly, the treatment group was being treated for different physical and/or mental health conditions. This resulted in a different TBM harmonization treatments, which could have also affected the results.

Future Applications

As mentioned earlier, TBM is just beginning to be popular within the alternative medicine field and there is little to no previous research on it. This was a clinical study to further explore the implications of TBM. This study has the benefit of exploiting the use of TBM treatments in a clinical setting, which greatly assists in developing academic literature on the subject. With this being said, the methodology of this study can be potentially used in the future for a range of clinical groups as this study validated its use in the field.

The findings presented from this study can and should be further investigated in future studies in order to explore the full benefit of TBM within various clinical settings.

Conclusion

The current study was performed to determine if TBM effected baseline QEEG measurements. There was a significant increase in activity within the left hemisphere of the brain after the third trial of TBM, with regards to delta, theta and beta waves. This further validates previous findings regarding brainwave activity and increased left hemispheric activity. Furthermore, it was hypothesised that there would be an increase in positive mood after receiving a TBM treatments. After comparing mood measures from pre and post treatment of TBM it was confirmed that there was a significant decrease in negative mood in all five categories measured; anger, fatigue, confusion, tension and depression. Overall, this study concluded that TBM does change baseline states of QEEG measures, and a significant increase of mood measures. These studies can be implicated in the field of alternative medicine, potentially providing a natural, non-pharmacological treatment.

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Appendix A: Consent to Participate

I, _____, agree voluntarily to participate in an experiment that will expose me to collecting a QEEG measurement while receiving a treatment of total body modification. I understand that the equipment generating this treatment has been performed various times through Dr Brosseau, and the QEEG measurement has been employed in other experiments by the Neuroscience Research Group over the last few years.

The measurement of the QEEG will take roughly 10-15 minutes. The QEEG is a device that measures scalp activity. It works on a 10-20 system, consisting of a cap with 19 electrodes. A gel is applied to hold each electrode to the scalp. This allows for the measurement to be taken. Once the cap is applied it is hooked up to a computer, which takes the measurement of scalp activity.

The experimenters have clearly informed me that the purpose of this experiment is to collect a measurement of brain activity before and after a treatment of total body modification. I understand I benefit from participating in this study by becoming involved in contemporary research regarding the effects of total body modification. I understand that I may withdraw from the study at any time without consequence and that my future will not in any way be affected by participating or withdrawing from the experiment. The entire session will require no longer than 1 hr. I understand that all information is confidential and will be maintained in a secure area and on a password-protected computer. Only the principal supervisors (Dr. Persinger and Dr. Brosseau) and the experimenter may access this information.

I am aware that this experiment has gone through ethics at Laurentian University and that Dr Brosseau has evaluated and approved of the methodology. I understand that I can withdraw from the experiment at any time with no penalty. I also understand that the data will be maintained in a secure location. I have also been informed that if there are any questions or unusual experiences that result from the treatment I can contact Dr Brosseau or Dr Rousseau.

Signature of Subject _____

Date _____

Signature of Witnesses _____

Appendix B: Mood Questionnaire

Rate your mood in terms of anger after the treatment of TBM

0 1 2 3 4 5 6 7

Rate your mood in terms of confusion after the treatment of TBM

0 1 2 3 4 5 6 7

Rate your mood in terms of depression after the treatment of TBM

0 1 2 3 4 5 6 7

Rate your mood in terms of fatigue after the treatment of TBM

0 1 2 3 4 5 6 7

Rate your mood in terms of tension after the treatment of TBM

0 1 2 3 4 5 6 7

Appendix C: Thank You Participation Form

Thank you for participating in this research project. My research is analyzing the changes in baseline QEEG activity before and after the treatment of Total Body Modification (TBM). Research like this can pioneer a potential method of treatment, broaden clinical studies and build the literature on the treatment of TBM.

In this study, the QEEG will be applied 5 minutes prior to treatment and a measurement will be taken 5 minutes prior to treatment, during treatment, and 5 minutes post treatment. TBM will be administered by Dr Brosseau, a licensed professional who has been properly trained in the treatment of TBM. A POMS-SF will be applied prior and post treatment of TBM. This quick questionnaire will help to analyze if the participants mood has been affected by TBM.

Some of the expected results from this research project will be an increase of alpha activity in forebrain as well as an increase in mood. Participants will be anticipated to feel more relaxed and at ease after the treatment of TBM. Explaining these results ahead of time might have influenced your answers, which is why we did not inform you of it.

All of the data collected will remain anonymous and confidential. Please do not discuss the information on this page with others, as several of the fellow patients at the office of Dr Brosseau may also be participants in the research.

If you would like to talk to someone further about the issue related to this topic, you can contact Dr Brosseau or Dr Rousseau.

If you are interested in reading more about the background of this experiment you could try the following sources.

- 1) Acupuncture: Its theory and use in general practice by Perlow, B.
- 2) The benefit from whole body acupuncture in major depression by Roshke J., Wolf Ch., Muller M.J., Wagner P., Grozinger M., and Bech S.