

The Effects of Grounding on Meditation Quality: Preliminary Study Report – Experiment Details

ABSTRACT

Published research shows that grounding the human body to Earth (also called Earthing) produces multiple health benefits. They include reductions in pain, inflammation, and stress, and improvements in energy, quality of sleep, peripheral blood flow, and indicators of osteoporosis and glucose regulation (1-3). An earlier study documented immediate and abrupt changes in the left hemisphere of the brain upon grounding, an indication of improved brain function (4). The finding suggests that grounding might improve the practice of meditation, an activity that has gained widespread popularity throughout the world. There are an estimated 18 million adherents of various meditation practices in the U.S. alone (5). It is interesting to note that in Eastern traditions going back thousands of years, practitioners have been depicted to sit on the ground while meditating and thus have been very likely grounded. In today's Western world, most practitioners do not meditate on the ground outside.

Objective: To explore possible added benefits from meditating while grounded indoors, an experiment was set up involving 10 longtime meditators.

Method: In the experiment, brain mapping with electroencephalographic electrodes (EEG) applied to the head was used to measure brain function during grounding vs. non-grounding periods of the meditation. Similarly, skin conductance, heart rate and heart rate variability, and muscle tension (EMG) measurements were taken to determine tension and relaxation effects.

The participants were monitored separately while meditating on a special conductive recliner chair. They were grounded for 40 minutes in the middle of their meditation session. Grounding was accomplished by using a conductive cord to connect the chair, as well as special patches applied to the palms of the hands, to the grounding system of the building. For the first 15 minutes of the meditation, and the last 10 minutes, the participants were disconnected, that is, not grounded.

Results: Both objectively and subjectively, a deeper meditation was documented during the period of the meditation when participants were grounded compared to not being grounded. About half of the subjects showed evidence of improvements in brain function through brain mapping. In addition, the measurements collectively revealed signs of a healing response and detoxification occurring as a result of the grounding.

Conclusion: This small pilot project presents evidence that meditating grounded indoors offers benefits beyond the meditation itself, and replicates traditional practices where individuals practiced while sitting on the ground.

EXPERIMENT DETAILS

Subjects

Ten individuals over the age of 18 (mean age 50.2 years; standard deviation 14.6 years) who have meditated daily for more than one year. Prospective subjects with any of the following criteria were omitted from the study:

- If pregnant;

- Had cardiovascular or pulmonary condition such as asthma or heart beat irregularities;
- Were taking any prescription medication (less than one month prior to participation);
- Received treatment for mental disorder or taken psychotropic medication within the past 2 years;
- Consumed alcohol within 48 hours of participation;
- Used recreational drugs, cigarettes or vaping;
- Were participation in any other research project;
- Previous used indoor grounding products;
- Going barefoot outside or be grounded more than once a week and for more than half hour a day;

The subjects were not allowed to take food, caffeine or other stimulants within 2 hours of the test.

Research Protocol and Outcome Measures

Participants were tested individually. After signing the informed consent, subjects were asked to fill the McGill Pain Questionnaire (MPQ) and the Brief Mood Introspection Scale (BMIS). On completion, the person was then escorted to the experiment room and invited to sit in a comfortable reclining chair. A brain mapping helmet was placed on the head. Electrodes to measure skin conductance, trapezius muscle tension and blood volume pulse (BVP) were also placed on each subject. Electrodes for BVP measurements (measuring heart rate and heart rate variability [HRV]) and skin conductance (SC) were connected to the fingers of the non-dominant hand. Grounding patches were placed on the trapezius muscles for electromyography (EMG) recording. Grounding patches were also placed on the palm of each subject's hands. The patches were connected to a system that allowed grounding or disconnecting by the researcher supervising the test in a way that subjects would not know when they were grounded or not grounded. The reclining chair, made of conductive material, was also a connected to the grounding system.

Once "hooked up" subjects were asked to meditate in their usual way with closed eyes. They first meditated not grounded for 15 minutes. Five minutes before the end of the initial period, the brain mapping equipment was activated and recording brain waves for 4 minutes (this was called Session 1). Without the knowledge of subjects, the researcher controlling the grounding system five minutes before the end of the 40-minute grounding period, another 4-minute brain mapping recording then activated the grounding equipment, and without any break, subjects continued meditating for 40 minutes grounded. Five minutes before the end of this period (Session 2), another 4-minute brain mapping recording was taken. The last period (Session 3), without a break, was for 10 minutes, this time the subject was ungrounded again, with brain mapping done for a duration of 4 minutes five minutes before the end.

The results for all three recordings and for each subject are presented below. After all recordings were stopped, the helmet, patches and sensors were removed and the subject was asks to fill again the MPQ and the BMIS questionnaires and also a short form to assess the quality of their meditation (Meditation Quality Assessment Form or MQAF).

Summary of Results

Brain mapping data for subjects 1, 2, 4, 6, 7, 8 and 9 provided good data and showed evidence that their meditation deepened during grounding.

For subjects 1 and 6 brain mapping data showed evidence that meditation continued to be excellent or even deepened after ungrounding,

For subjects 2, 4, 7, 8, 9 the deeper quality of the meditation seen during the grounding period decreased during the final ungrounded period.

For subjects 1, 2, 3, 6 and 7 evidence of improved brain function was recorded during the grounding period. For subjects 1 and 6 brain function continued to improve after ungrounding.

The data for subjects 1, 2, 6, 8, and 9 provided evidence from physiological parameters (skin conductance, heart rate and/or HRV parameters) of a healing response.

Subject 3 experienced a profound healing crisis during the experiment. Subjects 7 and 10 complained that the frontal electrodes were uncomfortable, and somewhat painful. Subject 4 said she was cold in the middle of the experiment and she was provided with a blanket at that moment. Subject 5 stopped the session at the beginning of the grounding period claiming that she could not tolerate the effects that grounding produced on her body and mind.

For subjects 3 and 10, only session 1 and session 2 recordings were obtained; for subject 5, only the session 1 recording.

RESULTS

Brain Mapping

The brain mapping equipment used for this study was the p3 WAVI Brain Assessment Platform (<https://www.p3baseline.com/technology>) which comprises a helmet with 19 active electrodes based on the well-established International 10-20 system of electrode placement ([https://en.wikipedia.org/wiki/10%E2%80%9320_system_\(EEG\)](https://en.wikipedia.org/wiki/10%E2%80%9320_system_(EEG))), and a computer with specialized software.

EMG, Skin Conductance and HRV Results

We use the ProComp5 Infini (<http://thoughttechnology.com/index.php/procomp5-infiniti-5-channel-biofeedback-neurofeedback-system-w-biograph-infiniti-software.html>) to measure the following parameters: electromyography (EMG), skin conductance (SC), heart rate, certain parameters derived from heart rate variability (HRV) such as low frequency (LF), high frequency (HF), their ratio (LF/HF) and the standard deviation of normal to normal heart beats (SDNN). In the graphs presented for each parameter and each subject below, the first vertical line in red (Event Marker) marks the time when the first 4-minute brain mapping recording was started. The second vertical line is the time when the subject was grounded. The third vertical line marks the time the second 4-minute brain mapping recording was started. The fourth vertical line marks the time when the subject was ungrounded. Finally, the fifth vertical line is the time when the third 4-minute brain mapping recording was started.

Subject 1

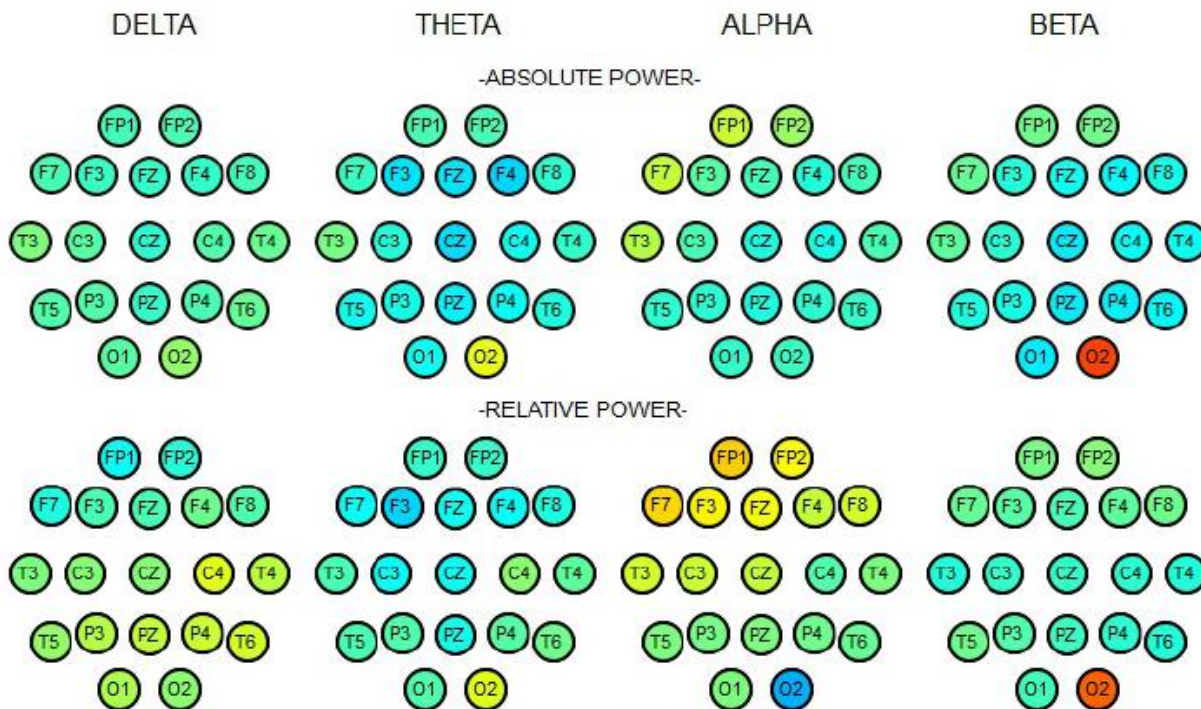
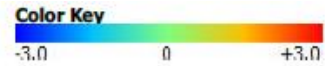
Female, 54, accountant and a Yoga teacher. Her meditation technique is a quiet type of meditation taught by Dr. Joe Dispenza. She has been meditating for 5 years, 1-2 hours a day. She indicated that at the beginning of the meditation, she felt that her heart beat was very strong and fast, much stronger and faster than usual. Later during the meditation, she felt that she could hear her heart beat strong and fast from time to time. She finally indicated that the experience of this meditation testing was very nice, slightly better than usual.

Brain Mapping Results

Before grounding

Eyes Closed P300 Z Scores
Session 1 (4/8/2019)

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

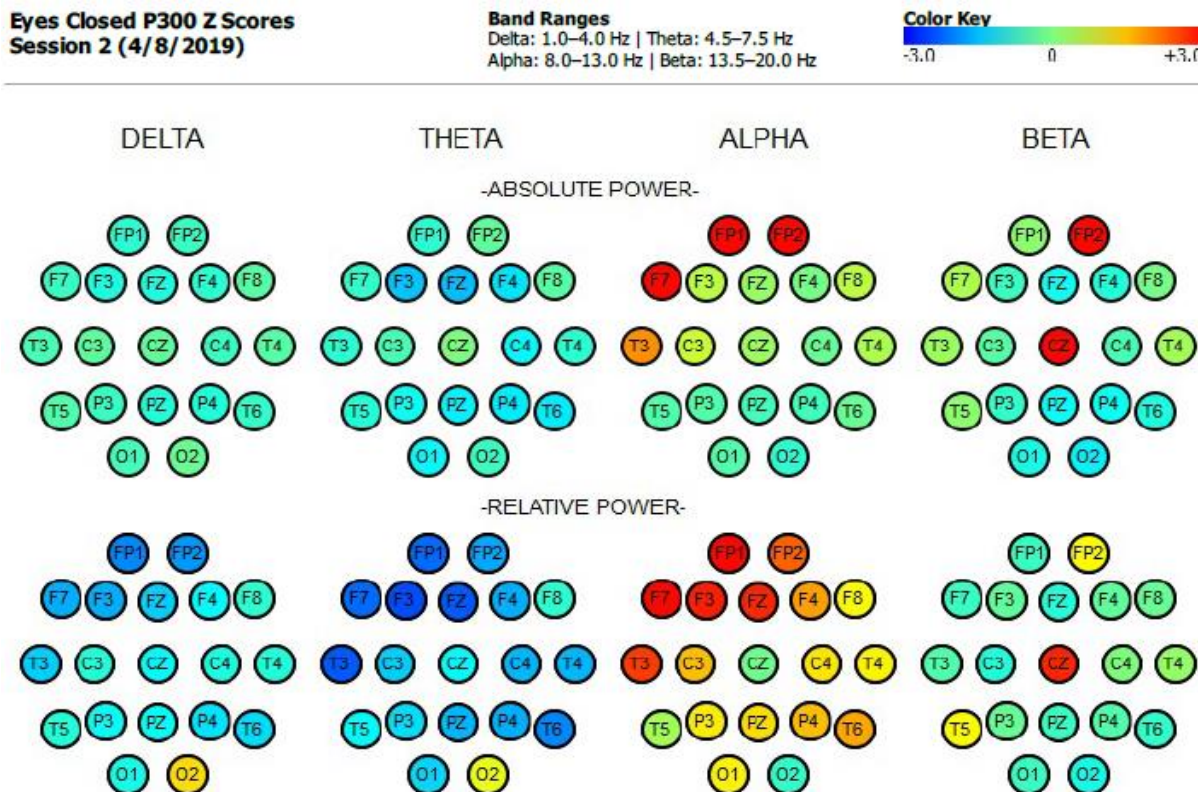


The diagrams above show a perspective where we are looking down at the top of the head from above (FP1 and FP2 are on the forehead). Absolute Power is the brainpower available within a particular frequency band at each electrode site, in other words, the strength of the frequency band (in microvolts squared) at each site (6). It is expressed as a comparison with standardized values obtained from the average of a population including thousands of people with the same age and sex as the subject (the Z value). The Z value (or Z score; see the color key on the upper right of the figure above) is expressed as the difference between the mean score of a population and the patient's individual score divided by the standard deviation of the population. It indicates how "deviant" a subject's score is from the norm. It tells us whether there is deficient or excessive activity in a given frequency band for a given electrode site (or group of electrode sites), such as excessive Beta activity at O2 (colored red in the diagrams above for Subject 1 (7)). One standard deviation (SD) above the norm is yellow, two SD above the norm is orange, and three SD is red. '0' is the normal mean located within the green region (light green). One SD below the norm is light blue, two SD below is darker blue, and three SD is darkest blue (8). It is very rare to see a Z score greater than +3 or less than -3 as 99.8% of the population Z scores are within this range. Thus, the software uses +3 as the maximum excessive value (red color in the color key) and -3 as the minimum deficiency (darkest blue color in the color key) (9).

Relative Power is the brainpower at one electrode site divided by the total power of all the other electrode sites combined. It tells us whether a particular frequency band at a particular site is overpowering other vital frequency bands at other sites. It is expressed as the percentage of total power at each site for each frequency band (6, 10). In the case of Subject 1, O2 is overpowering the other sites in the Beta band.

O2 main function is visual processing of the left half of the visual space. Other functions include pattern recognition, color perception, movement perception, black/white perception and edge perception (6, 11). For Subject 1, O2 overpowering the other sites in the Beta band (for both relative and absolute power) probably means that Subject 1 is internally processing perception, vision, color, shape and motion. There could be hyper-focus too possibly because of some anxiety related to her participation or for other reasons (6, 11). It is interesting to note that O2 in relative power Alpha is low. This phenomenon has been observed often and the reason is that Alpha activity is inversely related to cortical activity and blood flow (12, 13, 14).

During grounding

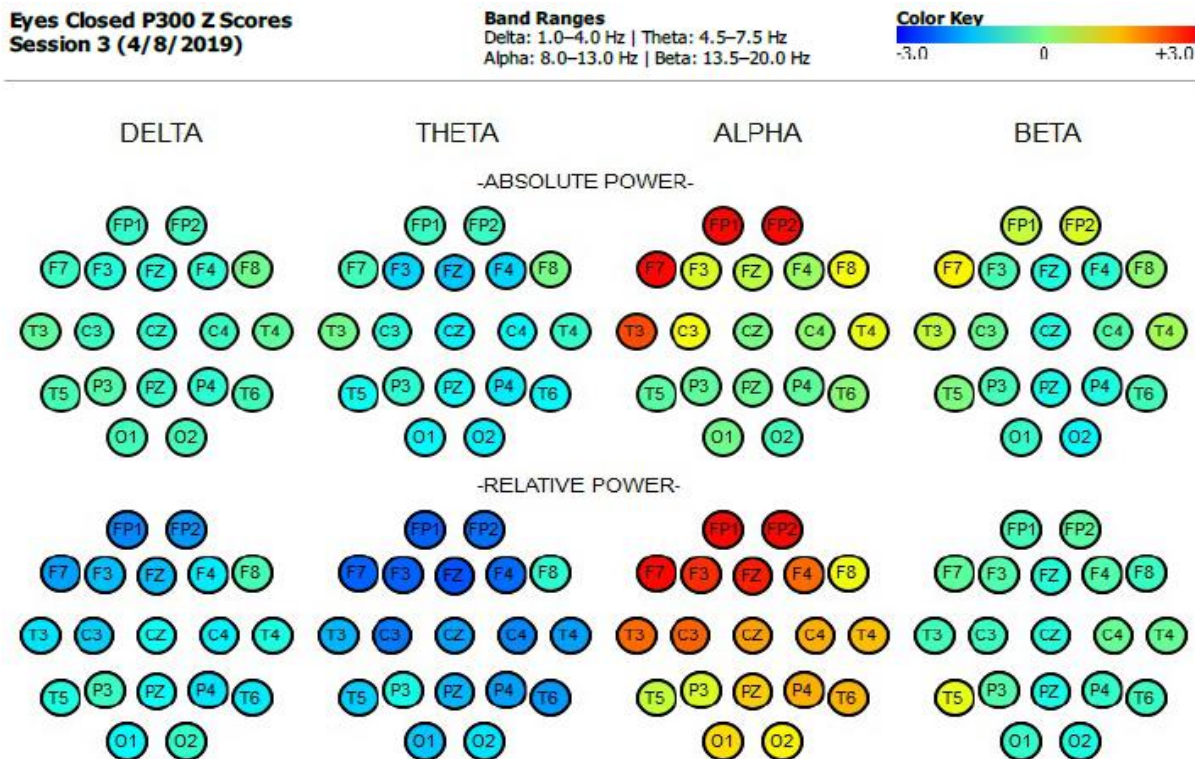


During grounding, absolute power shows high activity in the Beta band for CZ and PF2. CZ principal function is sensorimotor integration and functions of both lower extremities and midline. Another function of CZ is ambulation (awareness of body movement and position). CZ, influences three cortices simultaneously, somatosensory, motor and cingulate. The cingulate is concerned with emotion/feeling, attention and working memory. They interact so intimately that they constitute the source for the energy of both external action (movement) and internal action (thought, animation, and reasoning) (6, 11). High activity in Beta at CZ is associated with relaxed attentiveness (6). FP2 main function is emotional attention with other functions including judgment, sense of self, self-control and restraint of impulses (12). High Beta activity at FP2 may be indicative of Subject 1 internally controlling feelings and emotions (6). Coupled with high Alpha activity, the control of feeling and emotions is done in a calm and non-stressful manner. FP1 principal function is logical attention with other functions including orchestration of network interactions, planning, decision making, task completion and working memory (6, 11). High Alpha activity at FP1 is indicative of a calm decision to control emotions (because FP2 is also highly active). The ensemble of these active electrodes site in Alpha and Beta reflects a relaxed, peaceful alertness with emotional restraint.

Looking at relative power, high Alpha in the frontal lobes reflects top-down control regulation and emotional control (6, 15). High Alpha in the left frontal cortex may be associated with a depressed

mood state (6). Again, high CZ in Beta reflects relaxed attentiveness. Also, there is low activity mainly in frontal Theta. Frontal computations are related to Theta activity (16). Since Alpha activity is inversely related to cortical activity (12, 13, 14) it is not surprising that high frontal Alpha suppresses Theta activity.

After grounding



Similarly to during grounding, there is high Alpha activity at FP1, FP2 and F7 in absolute power reflecting a relaxed, peaceful alertness with emotional restraint. Also, similarly to during grounding, there is low activity mainly in frontal Theta in relative power. Frontal computations are related to Theta activity (16). Since Alpha activity is inversely related to cortical activity (12, 13, 14) it is not surprising that high frontal Alpha suppresses Theta activity. The fact that the tendencies seen during grounding increased after grounding is an indication that her meditation continued to deepen after the end of the grounding period.

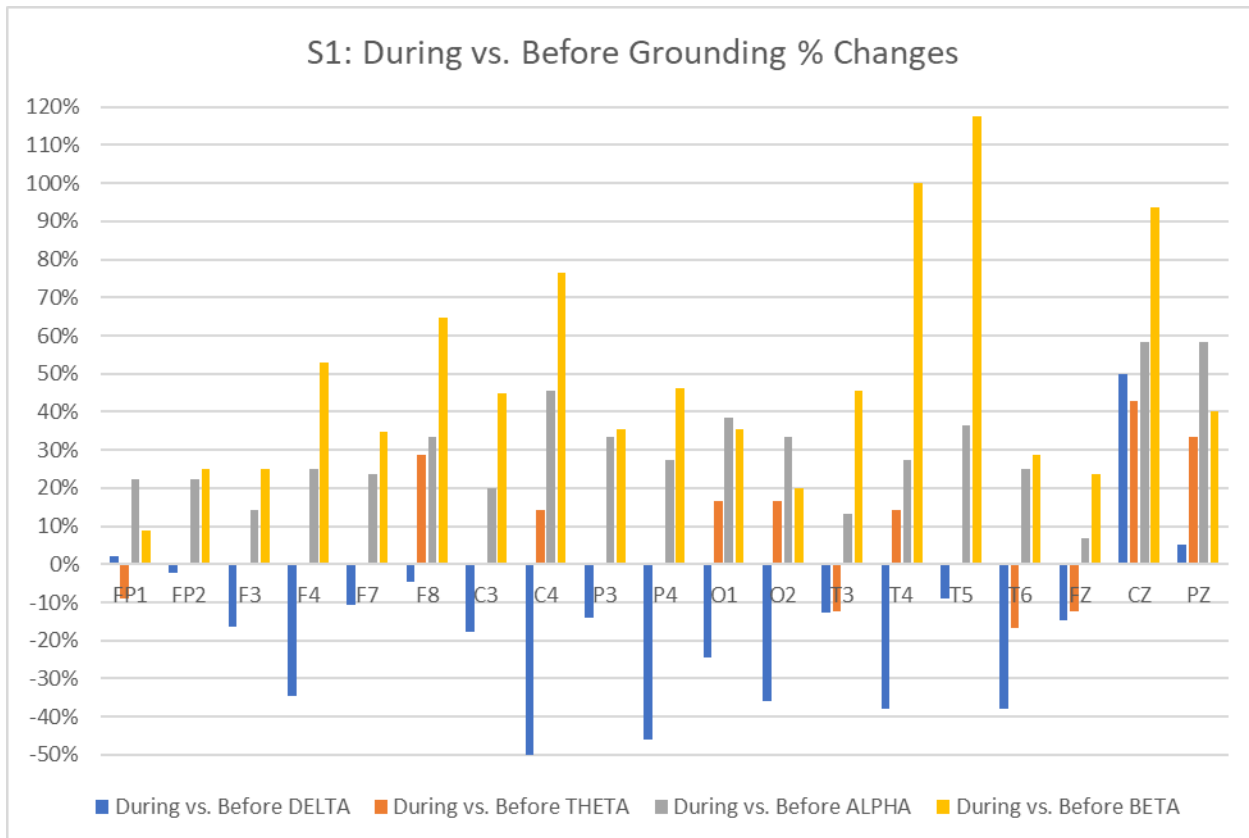
CZ Theta/Beta and F3/F4 Alpha

Researchers have shown that calculating the relative power ratio Theta/Beta at CZ can be used to determine slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (6, 17, 18). They also discovered that calculating F3/F4 relative power ratio in the Alpha band means processing information in a positive way for an increase while a decrease in the ratio indicated a more negative processing mode (19, 20). The table below give the result of all 3 sessions for Subject 1.

	Subject #1			Ref Range (55 yrs)
	Session 1	Session 2	Session 3	
CZ Theta/Beta	3.0	1.3	2.6	0.8-2.8
F3/F4 Alpha	0.9	0.8	1.0	0.8-1.2

It can be observed that CZ Theta/Beta was high compared to the normal range before the grounding phase of the experiment, indicating tendencies toward slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior. This parameter became normal during grounding and stayed normal after grounding but increased significantly compared to during grounding (by a factor of 2). This is an indication that grounding helped mitigate the previously mentioned disorders with a better mitigation happening during the grounding period. F3/F4 Alpha was in the reference (normal) range before grounding and stayed in that range during and after grounding.

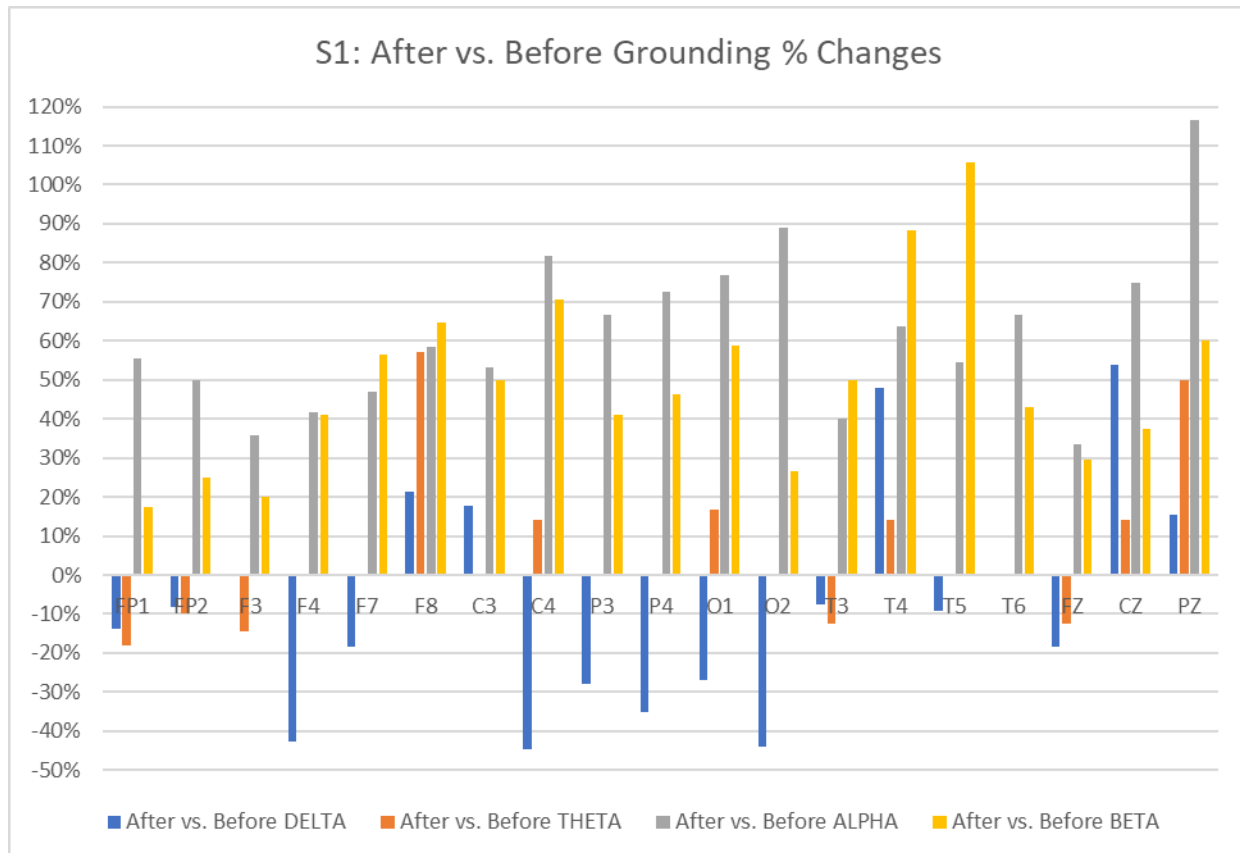
During vs. Before grounding (total peak-to-peak microvolts)



- * Beta increased significantly at all locations except FP1.
- * FP1 principal function is logical attention. Other functions involving FP1 are: orchestrate network interactions, planning, decision making, task completion and working memory (6, 11).
- * Beta increased more on the right side in general except in the back of the brain (T5-T6 and O1-O2). This could be due to test anxiety (6).
- * Alpha increased significantly at all locations except F3, T3 and FZ.
- * F3 main function is motor planning for the right upper extremity. Other associated functions are: fine motor coordination and mood elevation (11).
- * T3 and T5: Long term verbal and visual memory, linguistic and reading perception and comprehension, processing integration and perception of auditory input, visual perception of what an object is, “Inner voice”, positive mood.
- * FZ is near intentional and motivational centers.
- * Alpha increased more on the right side of the brain but the inverse happened in the back of the brain (P3-P4, O1-O2 and T5-T6).
- * Alpha CZ and PZ increased the most of all locations. Both locations are associated with sensori-motor awareness and functions.
- * Theta increased significantly at F8 and PZ only. Increase in impulse control or vigilance?

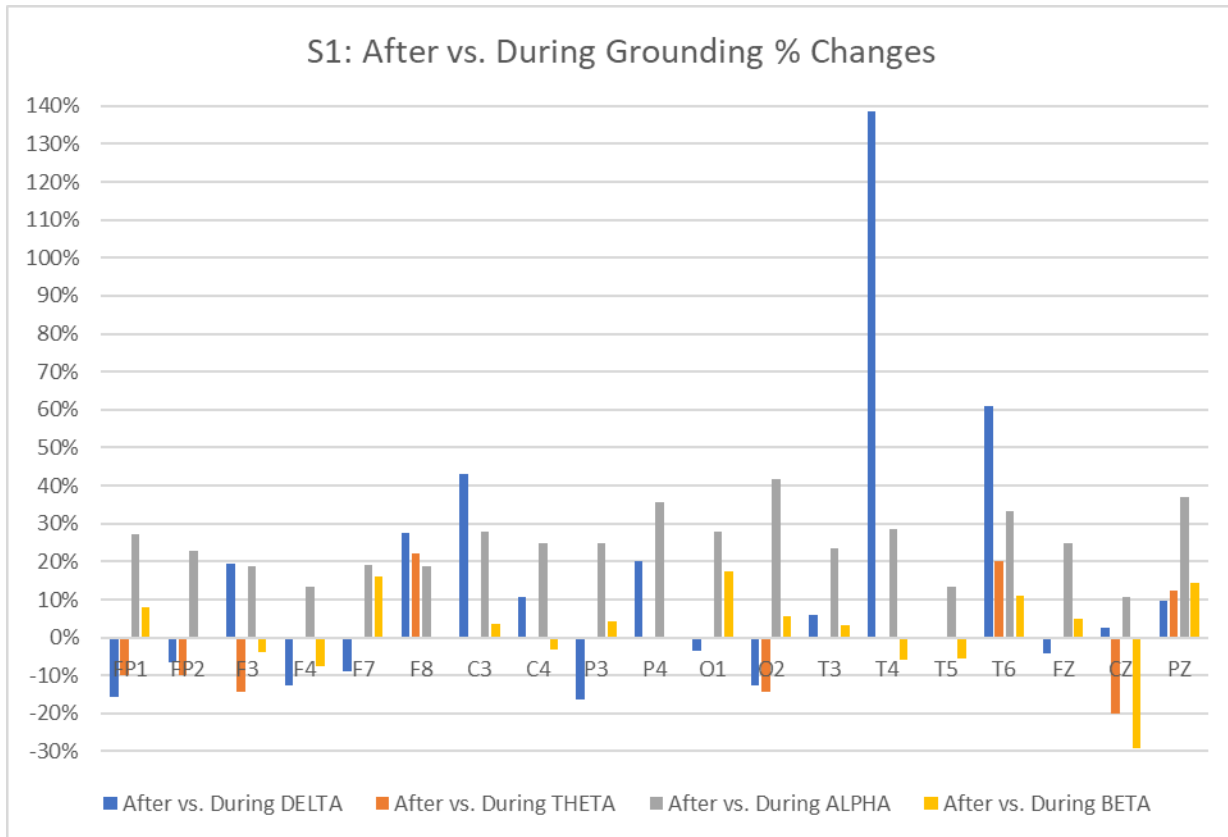
- *F8 – spatial and visual working memory, sustained attention, conscious facial emotional processing, prosody, empathy conscience, feeling sense of right and wrong, emotional gating, vigilance area.
- * PZ: Integrating somato-sensory information with posterior visual perceptions, working memory.
- * Delta decreased more on the right side except at F7-F8, indicating a decrease in inhibition of brain functions interfering with internal concentration (21).
- * Conclusion: S1 brain became more mentally active but at the same time she became more calm, peaceful and alert during grounding.

After vs. Before grounding



- * Beta remained significantly higher than before grounding at all locations except FP1. This is similar to during grounding.
- * Beta increased more on the right side of the brain but the inverse happened in the back of the brain (T5-T6 and O1-O2).
- * Alpha increased significantly at all locations, more than on during vs. before grounding.
- * Alpha increased more on the right side of the brain but the inverse happened in the front of the brain (FP1-FP2).
- * Alpha CZ and PZ increased even more than during vs. before grounding.
- * Theta increased significantly at F8 and PZ. This is similar to during grounding.
- * Delta decreased more on the right side for F3-F4, C3-C4, P3-P4, and O1-O2, but overall not as much as during grounding.
- * Delta increased more on the right side for F7-F8, T3-T4.
- * Conclusion: S1 became even more calm, peaceful and alert after grounding, probably experiencing more positive emotions. It is a continuation of the positive changes started during grounding.

After vs. During grounding



- * Changes between after and during grounded meditation are generally small except for Delta at C3, T4 and T6 which increased appreciably after grounding.
- * F8 – spatial and visual working memory, gestalt, sustained attention, conscious facial emotional processing, prosody.
- * C3: hand and digits (with F3 – handwriting and inhibit or execute action), audition, happiness, syntax.)
- * P4: Visual-spatial sketch pad, image and spatial processing, facial decoding, integration with environment, spatial memory, perhaps dysfunction effects self-concern, map orientation, knowing the difference between right and left, self in space, music, body image, physical act of dressing (left side body awareness).
- * T4, T6: conscious emotional and physical awareness (insula), sense of direction, visual memory & visualization, categorization, sound voice intonation perception, music, facial recognition, spatial and facial perception - social cues.
- * Theta showed a significant increase at F8 and a significant decrease at CZ.
- * F8 – spatial and visual working memory, gestalt, sustained attention, conscious facial emotional processing, prosody, empathy conscience, feeling sense of right and wrong, emotional gating, vigilance area.
- * CZ: sensori-motor awareness and functions.
- * Alpha increased at all locations indicating increased relaxation, peacefulness and alertness.
- * Beta did not change significantly except for a significant decrease at CZ.
- * Conclusion: S1 continued to relax, be peaceful and alert of internal sensations after grounding.

Coherence Results

Eyes Closed P300 Z Scores

Band Ranges

Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

Color Key

-3.0 0 +3.0

DELTA

THETA

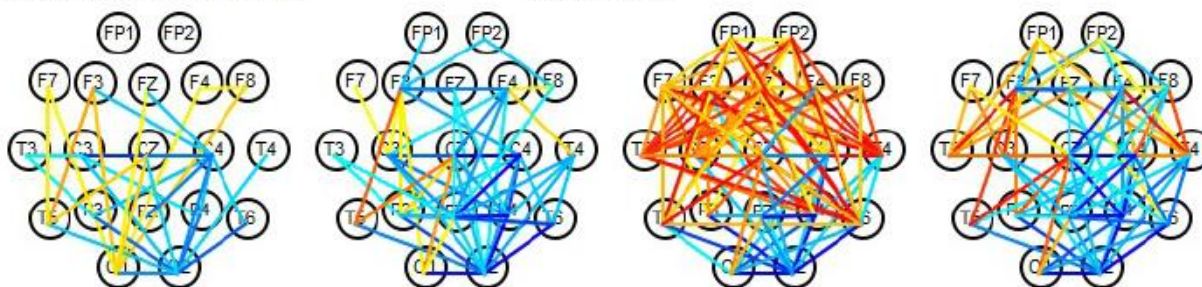
ALPHA

BETA

Before

Z-Scores above 1.0 and below -1.0

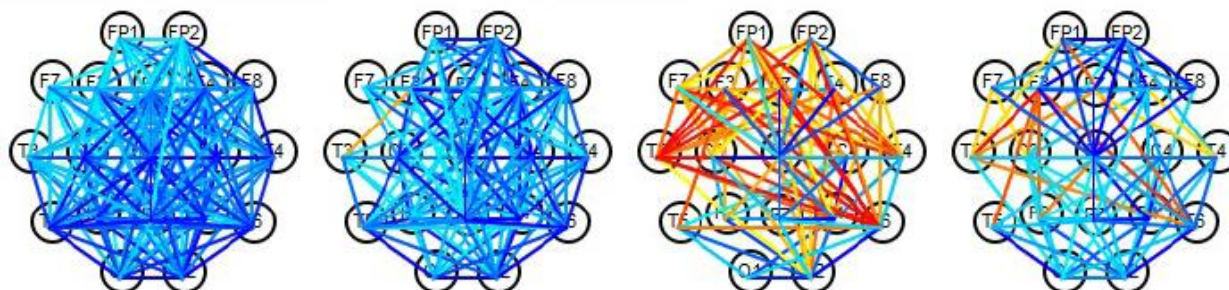
-COHERENCE-



During

Z-Scores above 1.0 and below -1.0

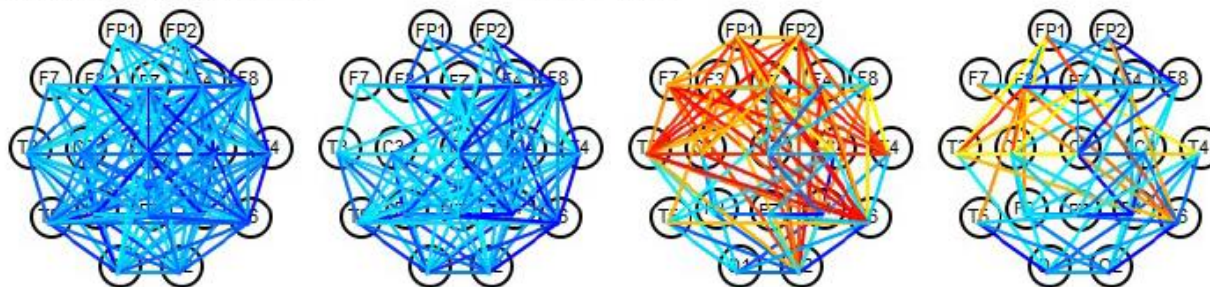
-COHERENCE-



After

Z-Scores above 1.0 and below -1.0

-COHERENCE-



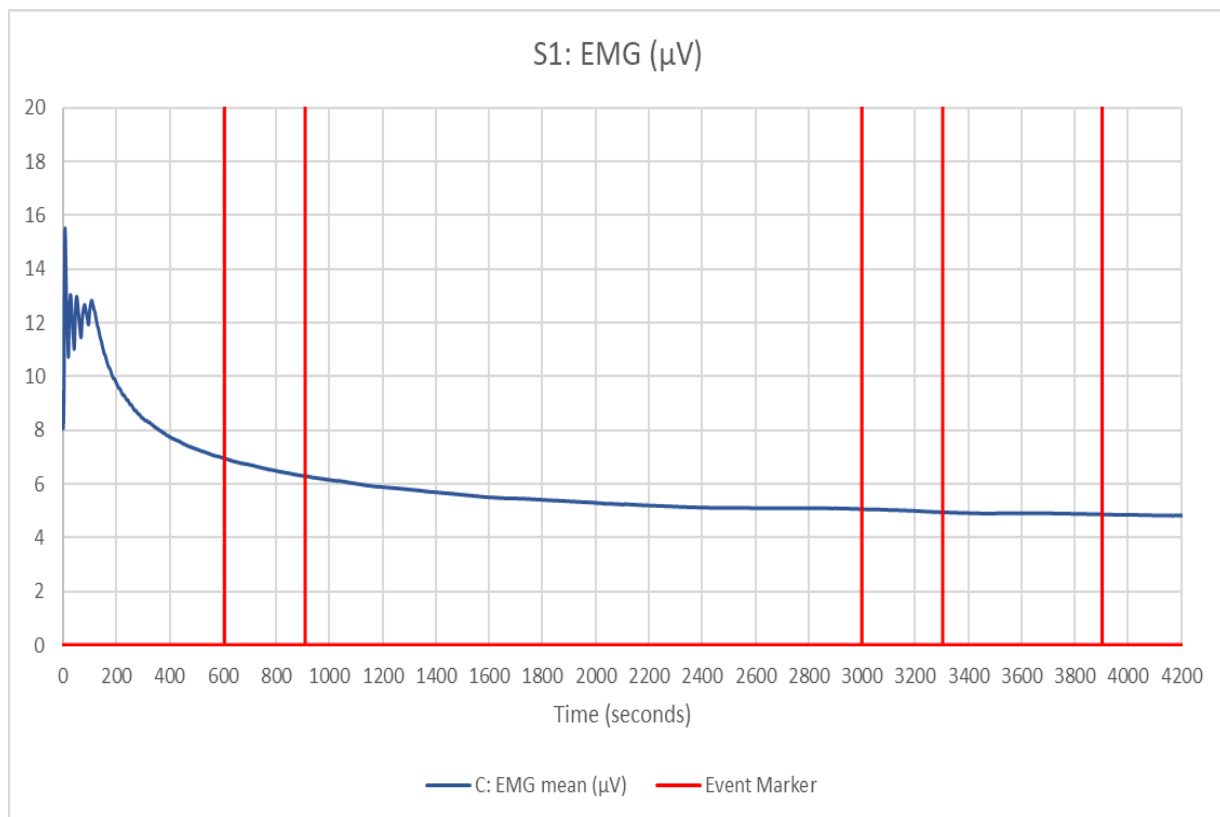
EEG coherence can be defined as the normalized cross-power spectrum per frequency of two signals recorded simultaneously at different sites of the scalp. It is a measure of the synchronization between the two signals and may be interpreted as an expression of their functional interaction (22).

Coherence reflects how stable the phase relationship is between two electrode sites. Coherence quantifies the degree of interaction or communication, shared information, between brain sites (6). Hypercoherence is when brain sites are not functioning in efficient interdependent fashion, they have too much “cross-talk”, they are overly connected or locked together. Hypocoherence is called poor inter-site interaction and is associated with diminished cognitive efficiency (6). In the Beta band, coherence was higher before grounding compared to during and after grounding. This could be due to test anxiety (6). There is a lot of Alpha coherence before, during and after grounding. This could

be excessive in which case the brain may be locked up in Alpha and be hard to speed up or slow down (6). It could also be that she went into a pure consciousness experience as seen during Transcendental Meditation practice (23). During and after meditation, Delta and Theta coherence decreased well below normal levels (as showed by the increase in the number of blue lines) indicating that Subject 1 turned her focus inward and that her brain inhibited most of the usual functions related to control, fear, memory and decision making (21, 24, 25, 26, 27). Alpha coherence is similar in all 3 sessions while Beta coherence decreased the most during grounding, an indication of less mental processing and deeper meditation.

Electromyography (EMG) Results

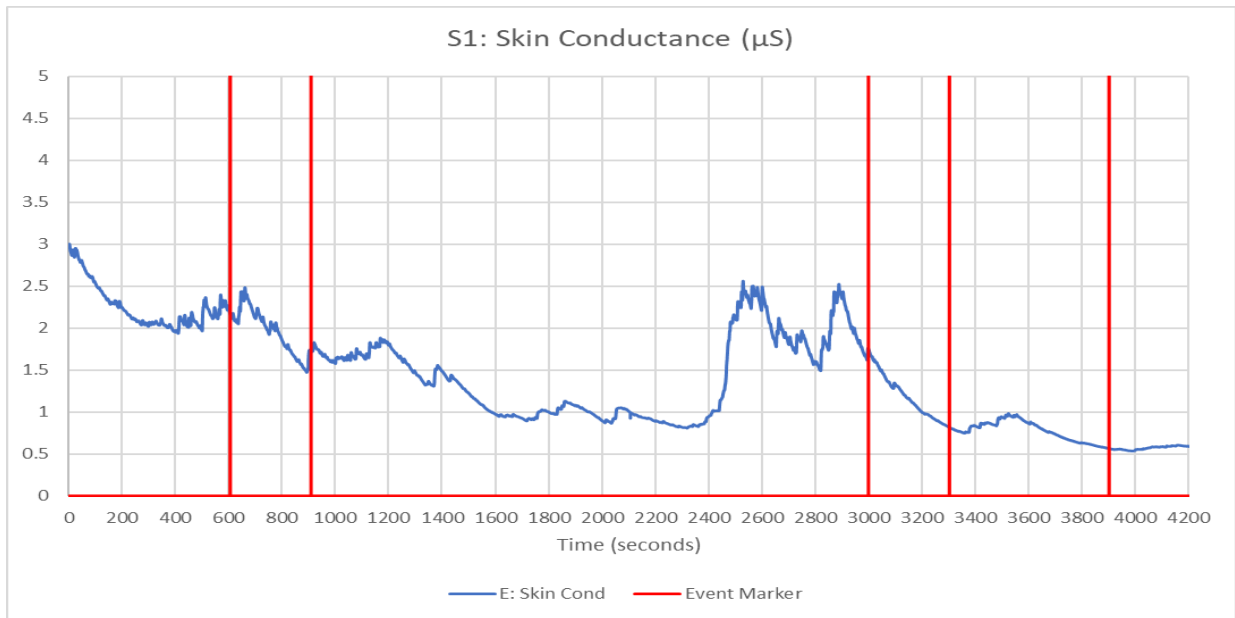
For all subjects, EMG was recorded from a configuration that allows recording of both trapezius muscles simultaneously (example: wide electrode placement, Figure 1-1b.1, page 29, reference 28).



The graph above shows progressive relaxation of the trapezius muscles.

Skin Conductance (SC) Results

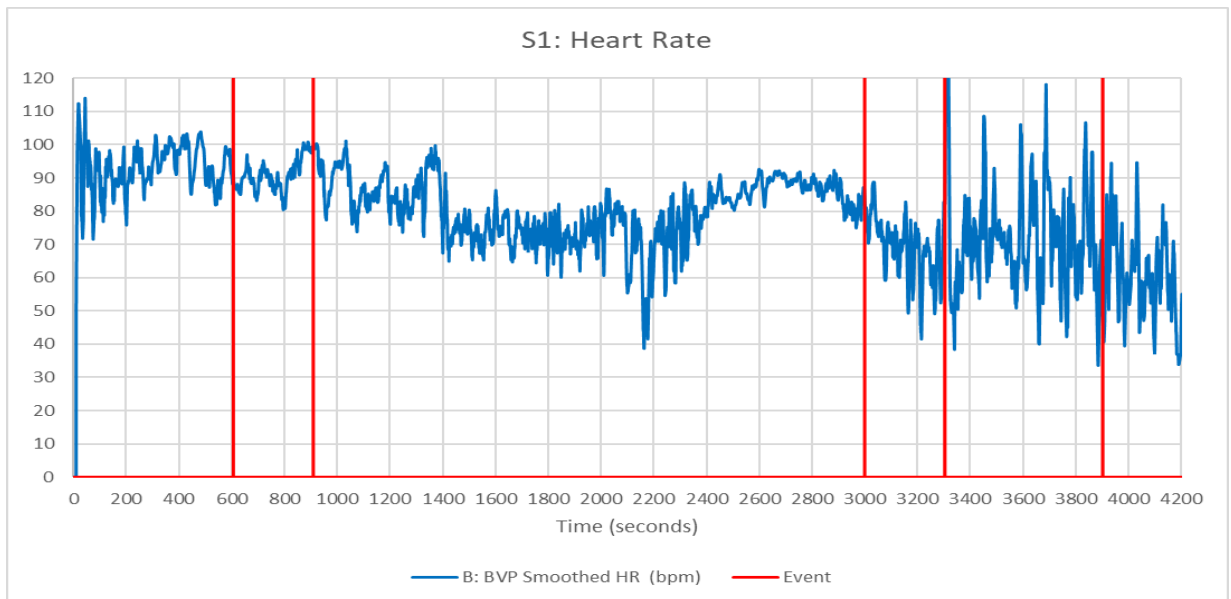
For all subjects, SC was recorded from sensors placed on the index and ring fingers of the non-dominant hand (as shown in Figure 3-1a on page 171 of reference 28).



Subject 1 skin conductance continued to decrease for about 40 minutes after the start of the session, indicating parasympathetic system activation (i.e. autonomic nervous system (ANS) relaxation). Then there is a sharp increase in skin conductance for about 7 minutes. Then skin conductance decreased for the rest of the session with a small increase just after the end of the grounding period.

Heart Rate Results

For all subjects, heart rate was recorded from a blood volume pulse (BVP) sensor placed on the middle finger of the non-dominant hand (similar to configuration for index finger shown in Figure 5-1a.1 on page 298 of reference 28).

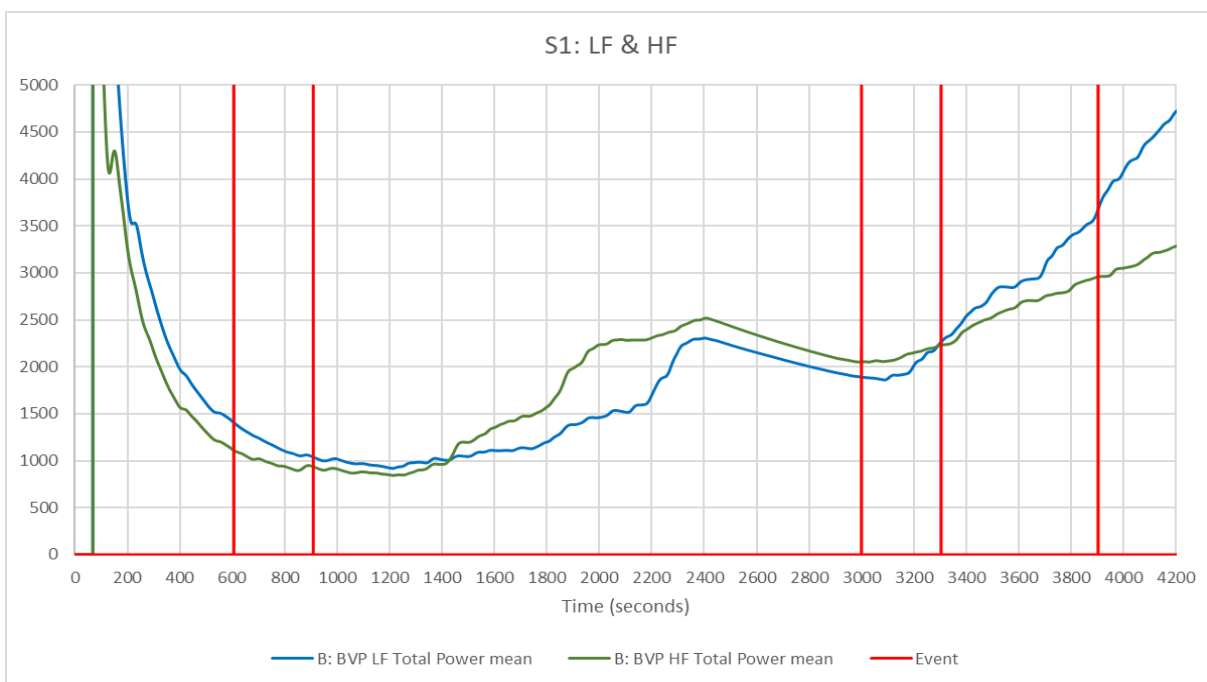


Subject 1 heart rate started at about 90 beats per minute and showed a tendency to increase for the first 8 minutes. It then decreased to about 90 beats per minute again and remained there for about 9 minutes before decreasing for about 6 minutes. It then stayed relatively stable at 72 beats per minute for about 13 minutes before increasing again for another 9 minutes going back to 90 beats per minute for a brief period (about 3 minutes). It then decreased again for about 18 minutes to about 60 beats per minute (at the end of the grounding period) and then stay more or less stable with large variability until the end of the session. The fact that her heart rate was at 90 beats per minute for the

first 16 minutes and again around 44 minutes into the session may explain why she felt that her heart was strong and fast.

Low-Frequency (LF) and High-Frequency (HF) Results

When doing short-term recordings of heart rate with a BVP sensor (as it is the case in the recordings of LF and HF and SDNN) three main spectral components are usually calculated from the variability of heart rate. These are very low frequency (VLF; ≤ 0.04 Hz), low frequency (LF; 0.04-0.15 Hz), and high frequency (HF; 0.15-0.4 Hz) (29). VLF is less well defined than the other 2 components; it is generally considered related to thermoregulatory sympathetic activity (30, 31) including peripheral vasomotor regulation (32) and the humoral systems (31). Because of its less defined physiological understanding, VLF analysis is omitted in this paper. LF is sensitive to changes in cardiac sympathetic (and presumably parasympathetic) nerve activity (31) although one group argues that LF is rather a measure of modulation of cardiac autonomic outflows by baroreflexes (33). HF is synchronized to the respiratory rhythm (in usual circumstances) and is primarily modulated by cardiac parasympathetic innervation (31).

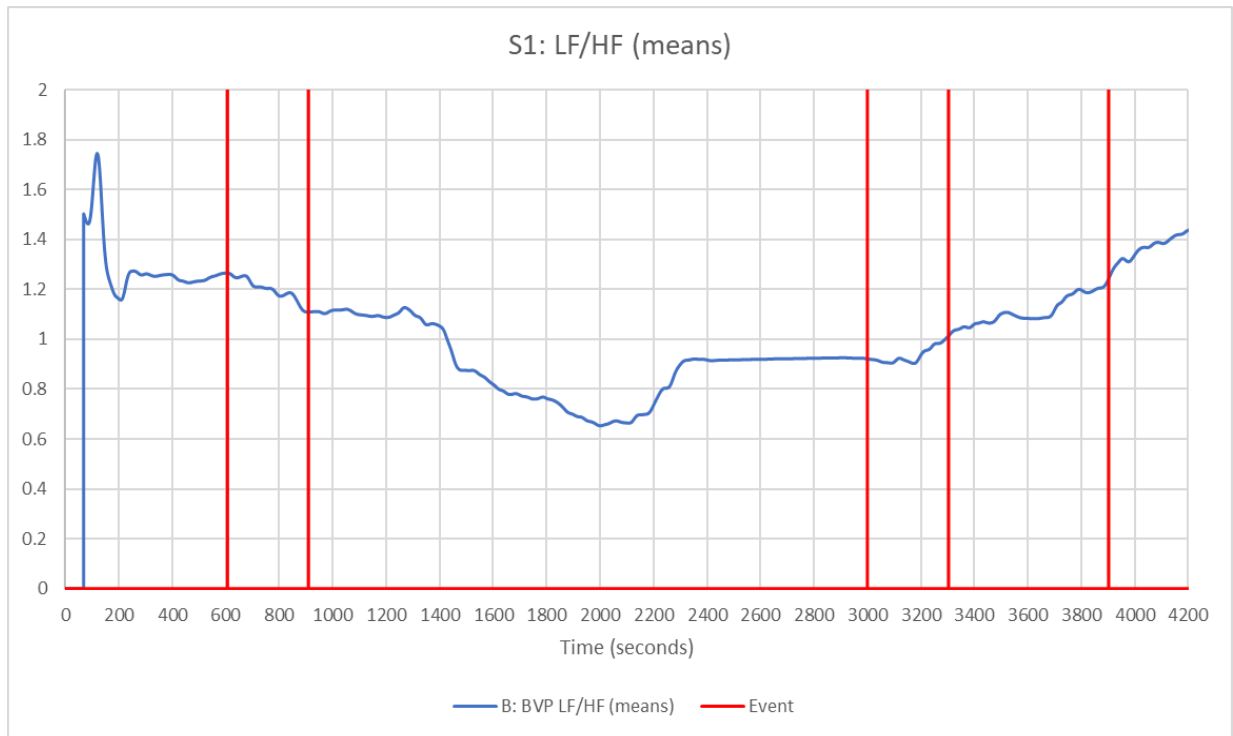


The first observation for Subject 1 is that LF and HF are close together for the entire session. The second observation is that LF started at a slightly higher value than HF but this switches after about 23 minutes into the session. Switching happened again to a higher value for LF at the ungrounding time (55 minutes after the start of the experiment). It is also interesting to note that both LF and HF decrease until the first reversal (about 23 minutes), then start to increase for about 17 minutes (40 minutes from the start of the experiment), decrease again for another 11 minutes (51 minutes after the start of the experiment) and then increase again until the end of the experiment.

LF/HF Results

The heart rate variability (HRV) parameter LF/HF (low frequency divided by high frequency) reflects the balance between the sympathetic and parasympathetic branches of the autonomic nervous system (ANS) (29). It is considered a more accurate representation of the ANS balance than LF or HF separately. The higher the value of LF/HF the more the sympathetic system dominates the

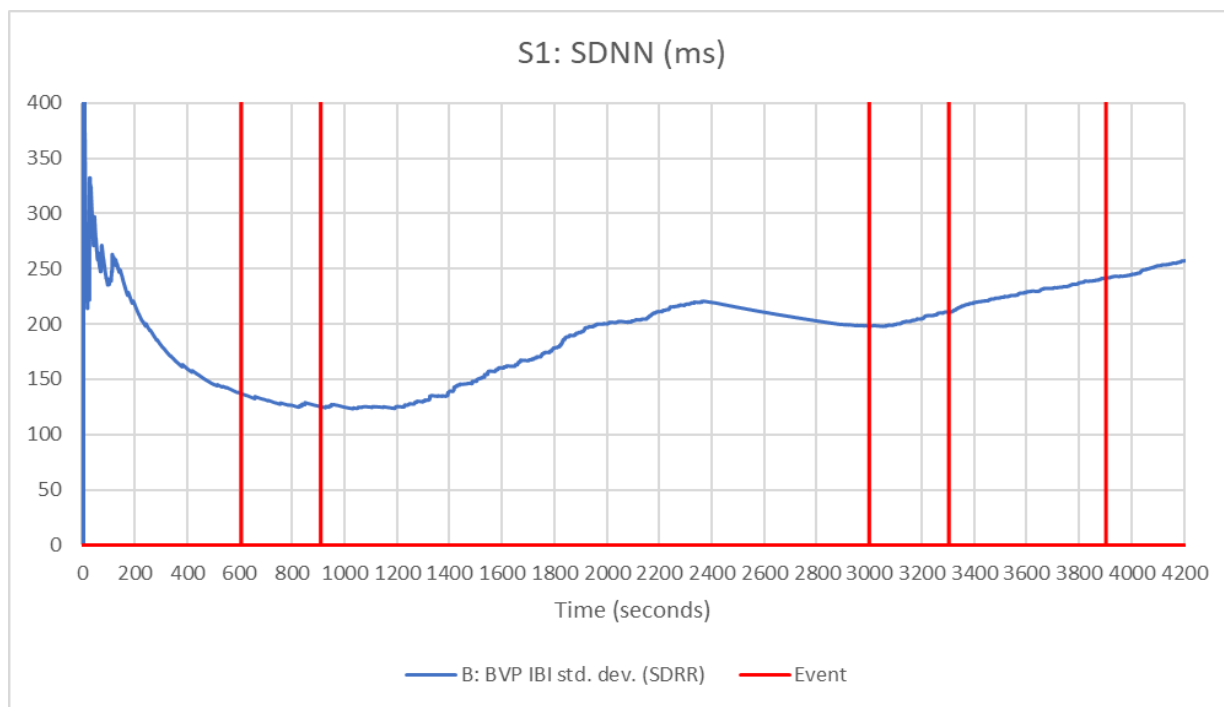
ANS response (the more stressed the body is). When the value of LF/HF goes down, this parameter reflects a relaxation response (activation of the parasympathetic system).



From the graph above it can be seen that, after an initial increase during the first 2 minutes, LF/HF progressively decreased i.e., the ANS became progressively calmer (increased parasympathetic activity) for the first 33 minutes after the start of the session. Then LF/HF increased for about 5 minutes followed by a stable period for about 14 minutes. LF/HF then continued to increase for the rest of the session.

SDNN Results

SDNN, the standard deviation of the normal to normal intervals (that is all intervals between adjacent QRS complexes resulting from node depolarization during one heart beat), reflects all the cyclic components responsible for variability in the period of recording considered (29). It is accepted that a high value of SDNN is desirable because it reflects increased variability and high variability is considered healthy for the heart. Very high SDNN is considered a sign of attentive arousal or alertness (29).



SDNN decreased until the start of the grounding period (15 minutes after the start of the session), then started to increase to reach a maximum value after 25 minutes of grounding (40 minutes after the start of the session), decreased again until 35 minutes into the grounding period (50 minutes into the session) and increased again until the end of the session.

Summary of Findings for Subject 1

Brain mapping: During grounding Subject 1's meditation became deeper than before. Her brain waves reflected an increase in internal focus and a relaxed peaceful alertness. She may have gone into an experience of pure consciousness similar to reported results for people practicing Transcendental Meditation (even though she was practicing a quiet type of meditation taught by Dr. Joe Dispenza).

Trapezius Muscles show a progressive relaxation consistent with a person relaxing and going into a meditative state.

Skin Conductance shows a decrease for about 40 minutes. Then it increases sharply 25 minutes into the grounding indicating an increase in ANS stress. This is similar to a result published previously (34). Coupled with previous research on the effect of grounding on inflammation, which indicates a decrease in inflammation as early as 30 minutes after the start of a grounding period (35), we can interpret the current SC result as an indication of a change in metabolism (respiration rate, heart rate, blood oxygenation and skin conductance) after about 20 to 30 minutes after the start of a grounding period.

Heart rate shows an increase starting 22 minutes into the grounding period. This is also similar to previously published results (34, 35), indicative of a change in metabolism due to grounding between 20 and 30 minutes after the start of the grounding period.

LF and HF were both close to each other during the entire session with LF increasing more rapidly than HF after the end of the grounding period. Also, LF and HF varied in a similar way both decreasing for the first 23 minutes, reaching a maximum 25 minutes into the grounding period, decreasing again until the end of the grounding period, and increasing again until the end of the

session. This increase in both HF and LF is indicative of an increase in the autonomic nervous system (ANS) activation which would be a normal response if the body started to heal itself as suggested by results of previous publications (34, 35).

LF/HF: From the closed values and similar changes in LF and HF, it is expected that LF/HF will stay close to 1.0, except toward the end of the session. This is exactly what we see in the graph of LF/HF. This result is consistent with other publications on grounding (1, 34, 35).

SDNN increased rapidly during grounding up to 25 minutes into the grounding period, increasing less rapidly after the end of the grounding period. This is similar to results presented in a previous publication (1).

Overall, Subject 1 meditation deepened when grounded and stayed deep for 15 minutes after the end of the grounding period. Physiological measures (SC, HR, EMG and HRV parameters) are consistent with a person physiology deeply relaxing during the grounding period and starting to heal the body.

Subject 2

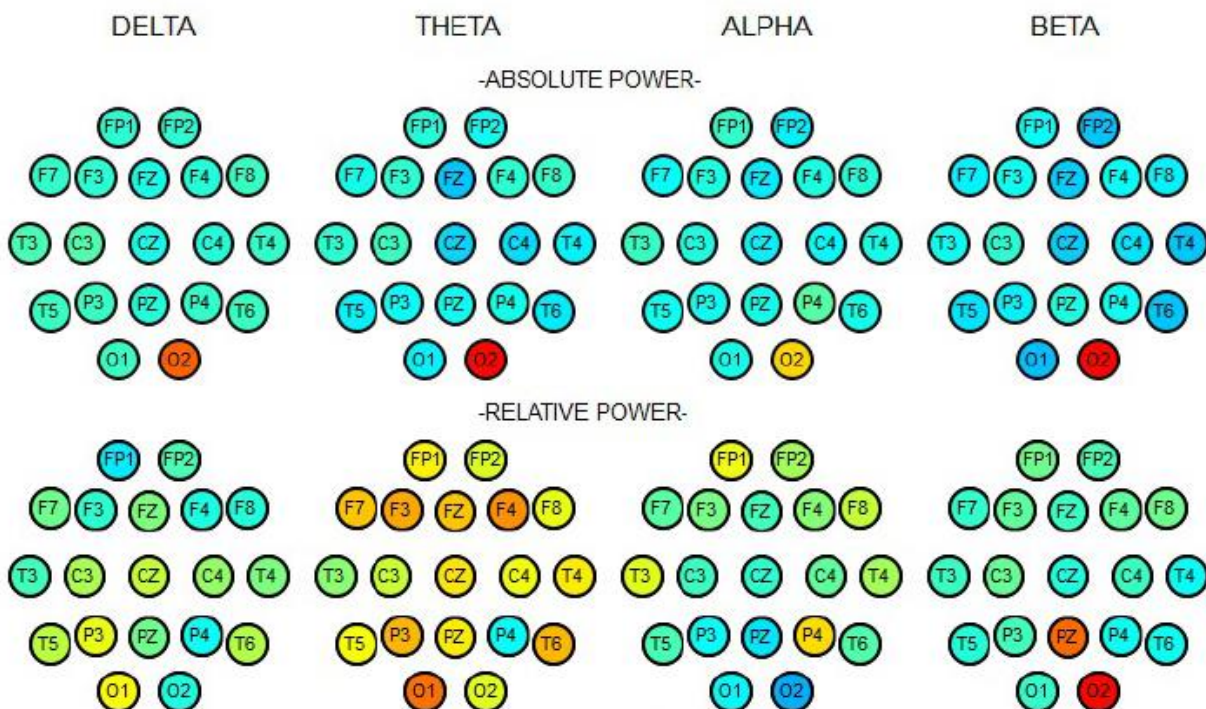
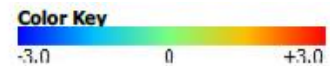
Male, 56, software engineer. Meditation practice involves picturing himself as a tree. He has been meditating for 10 years for about 30 minutes to an hour per day. He felt very good and relaxed after the meditation. He mentioned that the staff was very friendly and caring. All the testing was easy and fun. Overall the experience was slightly better than usual.

Brain Mapping Results

Before grounding

Eyes Closed P300 Z Scores
Session 1 (4/8/ 2019)

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

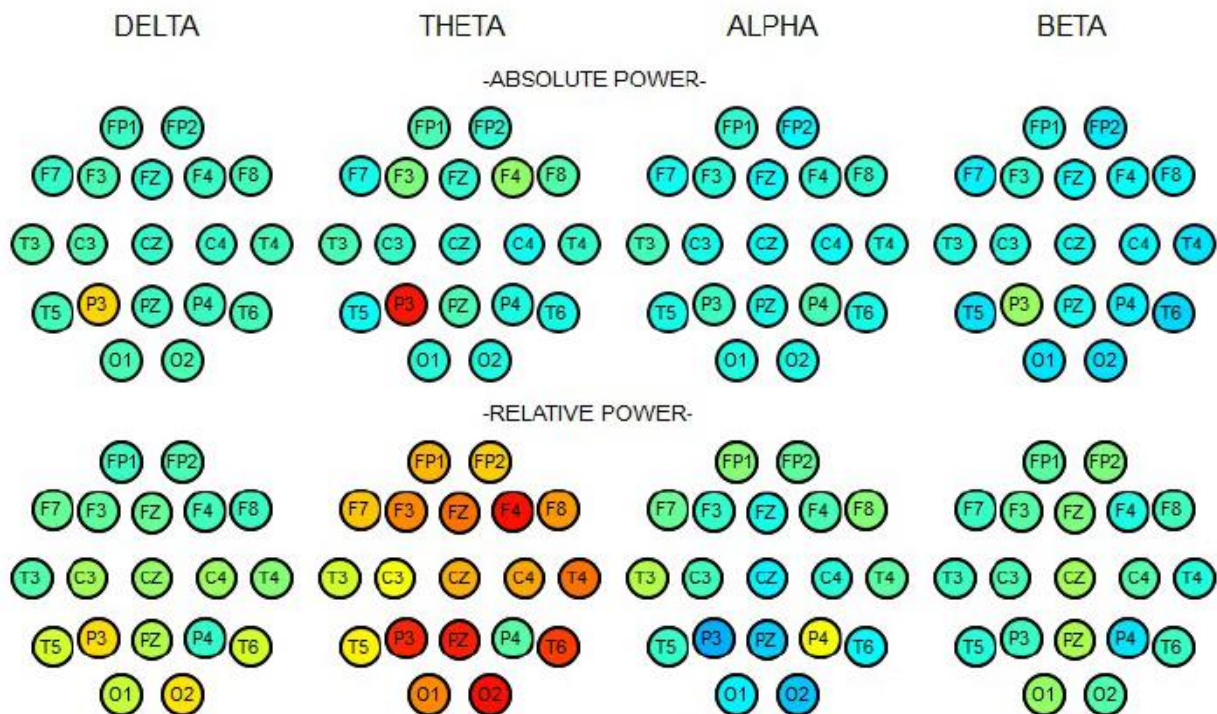


Similarly to Subject 1, Subject 2 O2 is overpowering the other electrode sites in the Beta band (for both relative and absolute power). However, contrary to Subject 1, O2 is also overpowering the other electrodes sites in the Delta and Theta bands in absolute power but not so in relative power. This result probably means that Subject 2 is internally processing perception, vision, color, shape and motion. Delta significant increase at O2 indicates an increase in inhibition of brain functions interfering with internal concentration for the brain functions corresponding to the location of O2 (internally processing perception, vision, color, shape and motion) (11, 21). Theta increase at O2 indicates a substantial increase in the need for cognitive control for related brain functions (25).

During grounding

**Eyes Closed P300 Z Scores
Session 2 (4/8/2019)**

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

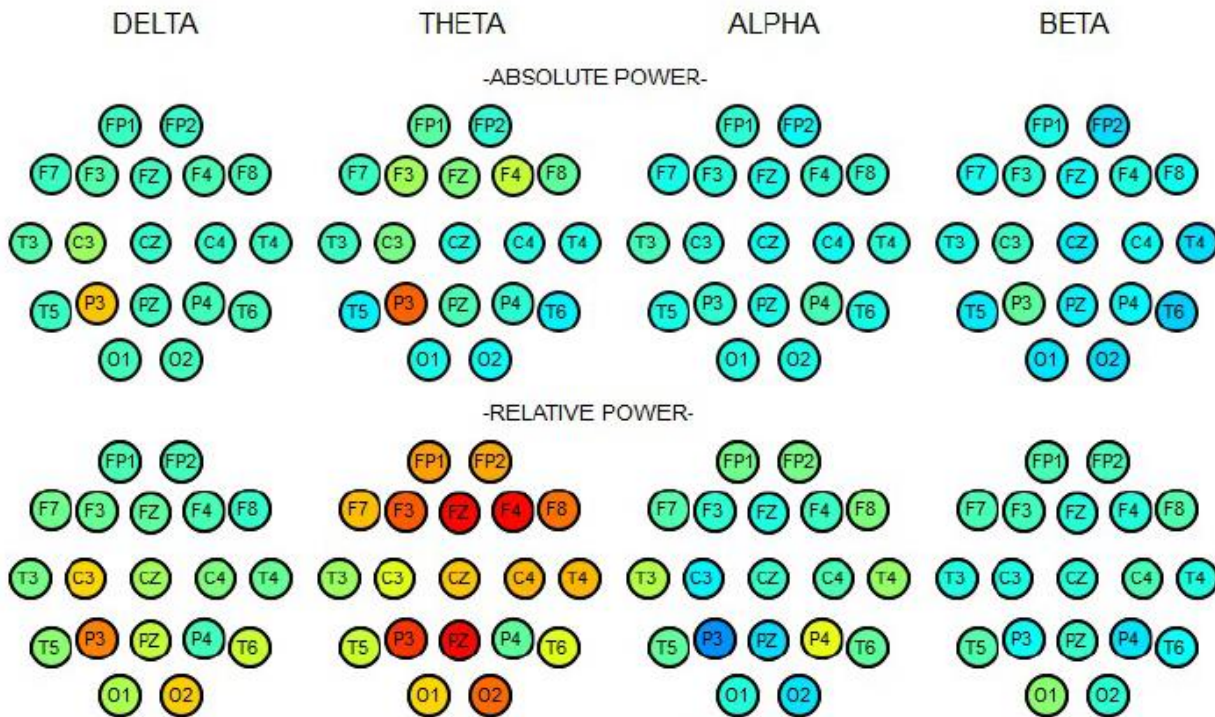


Looking at absolute power, during grounding, there is high activity in the Theta band for P3. P3 principal function is perception (cognitive processing) of the right half of the visual space. Other functions include spatial relations, sensations, math processing and calculations, praxis, verbal reasoning and language processing, logical reasoning, and complex grammar (6, 11). High Theta activity at P3 indicates a substantial increase in cognitive control for related brain functions during the grounding period (25). Relative power shows high activity of the brain at almost all sites in the Theta band indicating substantial increase in cognitive control for almost all related brain functions during the grounding period related to an increase in internal focus, spiritual awareness and meditation (6).

After grounding

**Eyes Closed P300 Z Scores
Session 3 (4/8/2019)**

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz



Similarly to during grounding, absolute power shows that there is high Theta activity at P3 indicating an increase in cognitive control for related brain functions during the grounding period (25). Relative power shows high brain activity in the Theta band at almost all electrode sites indicating substantial increase in cognitive control for almost all related brain functions after the grounding period. However, the Theta activity at P3 in absolute power and at almost all locations in relative power is not as high as during grounding. This indicate a decrease in cognitive control after grounding as compared to during grounding and lower internal focus, spiritual awareness as well as a lower quality of meditation than during grounding.

CZ Theta/Beta and F3/F4 Alpha

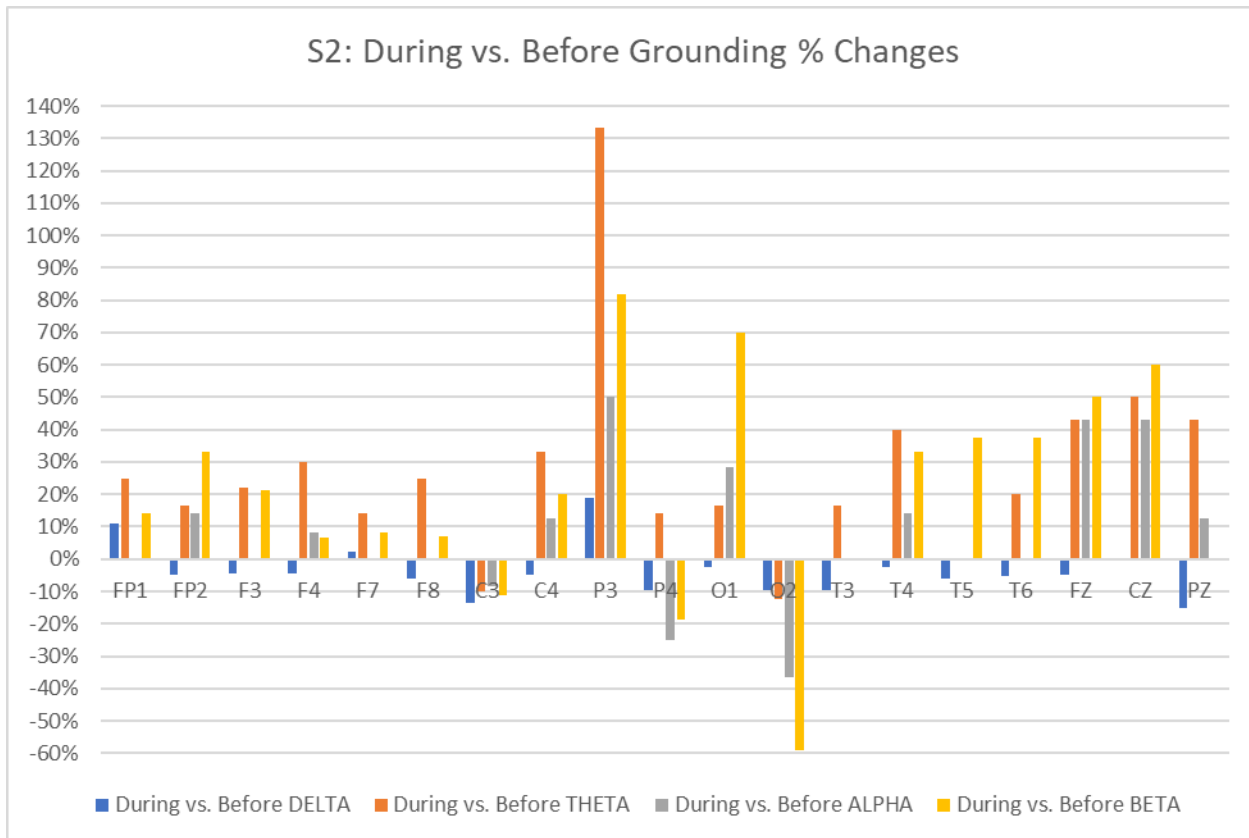
Researchers have shown that calculating the relative power ratio Theta/Beta at CZ can be used to determine slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (6, 17, 18). They also discovered that calculating F3/F4 relative power ratio in the Alpha band means processing information in a positive way for an increase while a decrease in the ratio indicated a more negative processing mode (19, 20). The table below give the result of all 3 sessions for Subject 2.

	Subject #2			Ref Range (55 yrs)
	Session 1	Session 2	Session 3	
CZ Theta/Beta	3.8	2.9	2.6	0.8-2.8
F3/F4 Alpha	0.7	0.7	0.7	0.8-1.2

It can be observed that CZ Theta/Beta was very high before grounding, decreased substantially during the grounding phase of the experiment (by 24%) and that this parameter became normal after

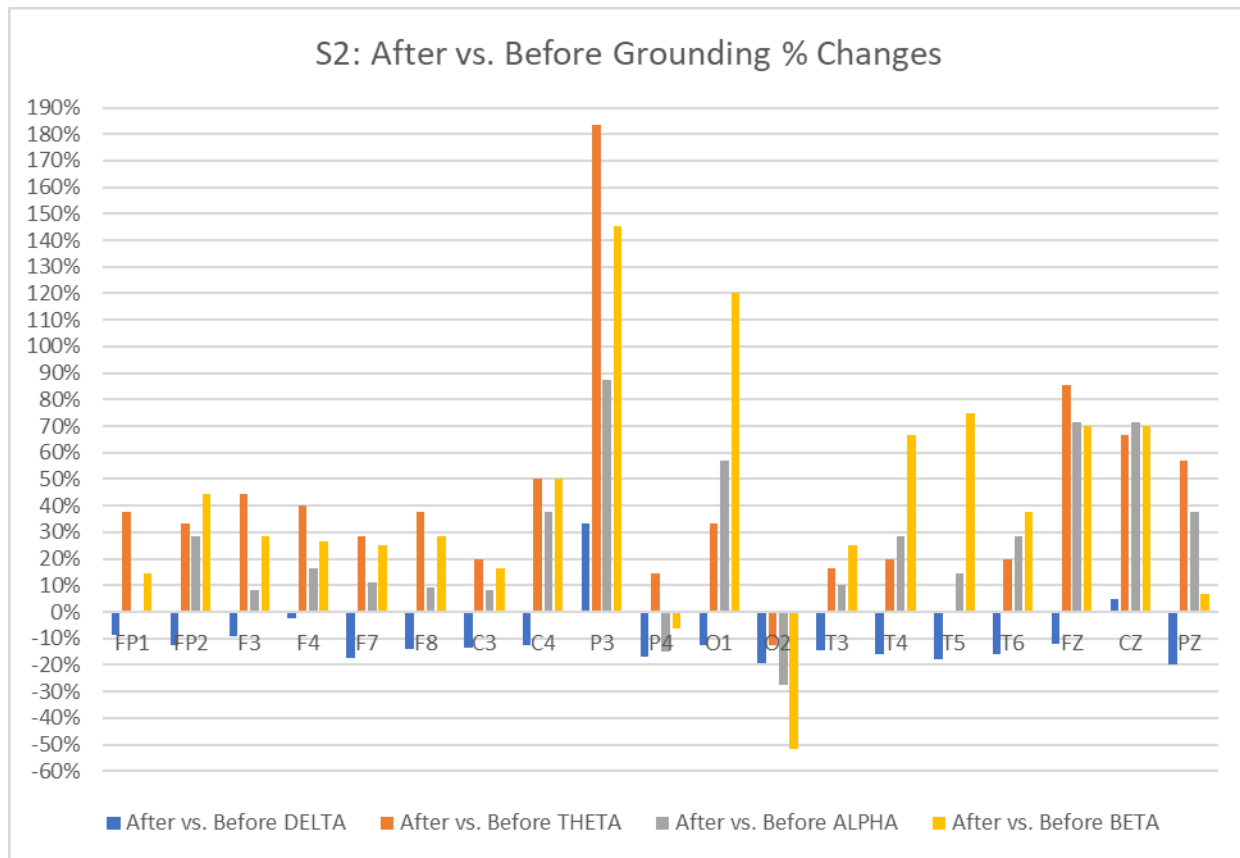
grounding, however decreasing much less than between session 1 and session 2 (11.5%). Remember that high CZ Theta/Beta indicates tendencies toward slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (6, 17, 18). It is apparent from the present results that grounding helped the brain function better. F3/F4 Alpha started just below the reference range and stayed that way during and after grounding indicating possibly a slightly negative processing mode (19, 20).

During vs. Before grounding



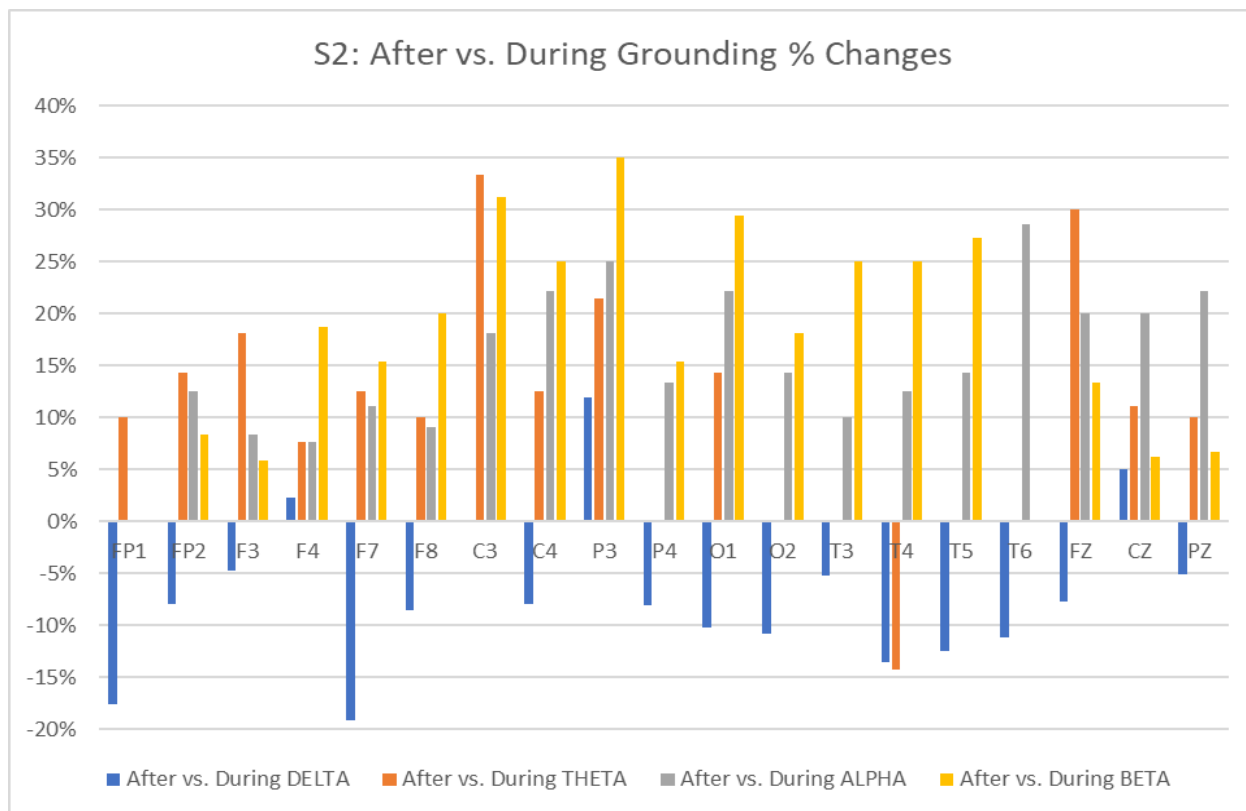
- * Beta increased for most locations and decreased significantly only at O2. This means increase in brain activity in general.
- * Beta increased the most at P3.
- * P3 increased for all frequency bands specially Theta, Alpha and Beta (P3 relates to logical reasoning, calculations and language).
- * Alpha increased significantly at P3, O1, FZ (frontal eye fields, motor, focus and action observation) and CZ (somato-sensory association cortex).
- * Theta and Beta increased for most locations with Theta increasing the most at P3 (having increased Theta and Beta is like driving with a foot on the gas pedal and the other on the brakes).
- * Huge imbalance between O1 and O2 (O1 relates to memory encoding with semantic tasks; while O2 relates to perception, vision, color).
- * C3 and O2 are the only locations with a decrease at all frequency bands (C3 relates to hand and digits (with F3 – handwriting and inhibit or environment, spatial memory)).
- * P4 decreased in Delta, Alpha and Beta. P4 relates to visual-spatial sketch pad, image and spatial processing, facial decoding, integration with the environment (6).
- * Delta did not change significantly at any electrode locations.
- * Conclusion: These results suggest that he went into a certain level of subjective, daydreaming like state during grounded meditation but with the brain/mind still able to maintain relaxation, peacefulness and alertness.

After vs. Before grounding



- * Beta increased for many locations and decreased significantly only at O2. It increased more than during grounding. This means increase in brain activity.
- * Alpha increased more than during the grounded meditation.
- * Theta also increased more than during grounding.
- * Theta and Beta increased even more than during grounding so the driving with a foot on the gas pedal and the other on the brakes is even more so after grounding (6).
- * Delta has not changed significantly except for a significant increase at P3.
- * P3 increased for all frequency bands specially Theta, Alpha and Beta (P3 relates to logical reasoning, calculations and language).
- * After grounding, the situation is similar to that during grounding except that Beta, Alpha and Theta are increasing more overall.
- * Conclusion: The internal focus is less perfect than during grounding and the mind is a little more agitated.

After vs. During grounding



- * Beta continued to increase after grounding.
- * Alpha increased significantly at C4, P3, O1, T6, FZ, CZ and PZ.
- * Theta also continued to increase after grounding.
- * Delta decreased more after grounding than during grounding indicating a decrease in inhibition of brain functions interfering with internal concentration (14).
- * **Conclusion:** S2 brain was trying to meditate while having a foot on the gas pedal and the other on the brakes is even more so after grounding (6). S2 succeeded in meditating after the grounding period ended as can be seen from the increase in Alpha after grounding.

Coherence Results

Eyes Closed P300 Z Scores

Band Ranges

Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

Color Key

-3.0 0 +3.0

DELTA

THETA

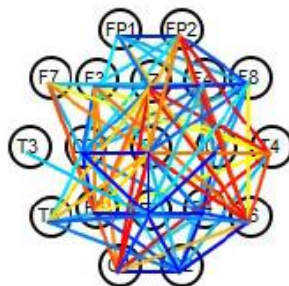
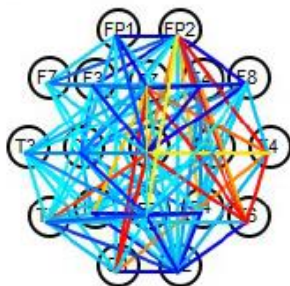
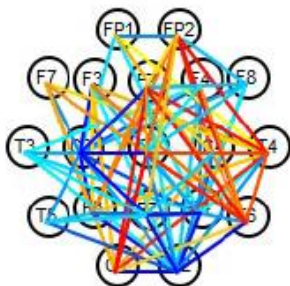
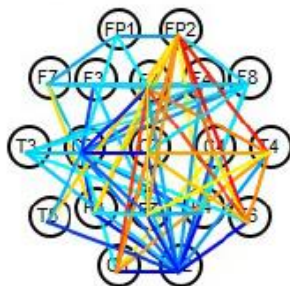
ALPHA

BETA

Before

Z-Scores above 1.0 and below -1.0

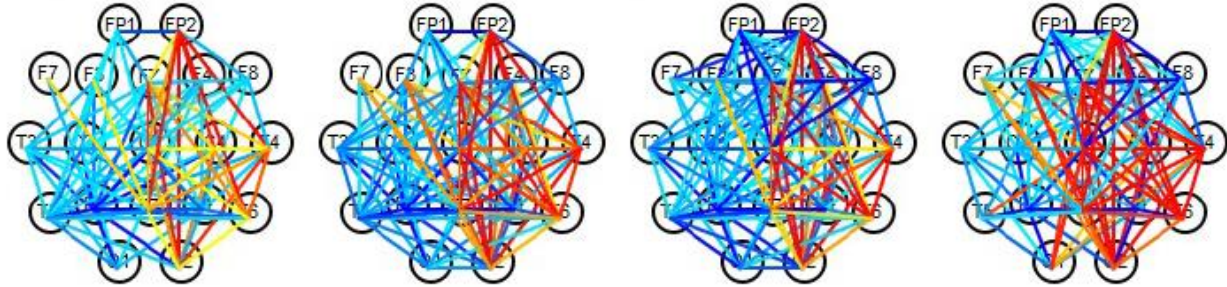
-COHERENCE-



During

Z-Scores above 1.0 and below -1.0

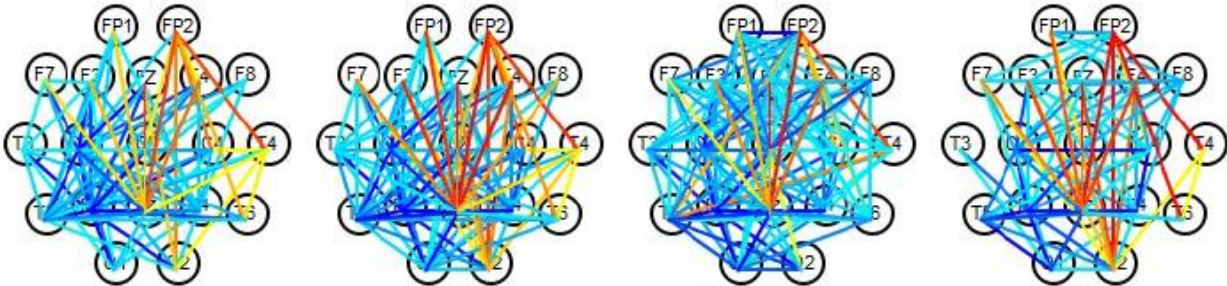
-COHERENCE-



After

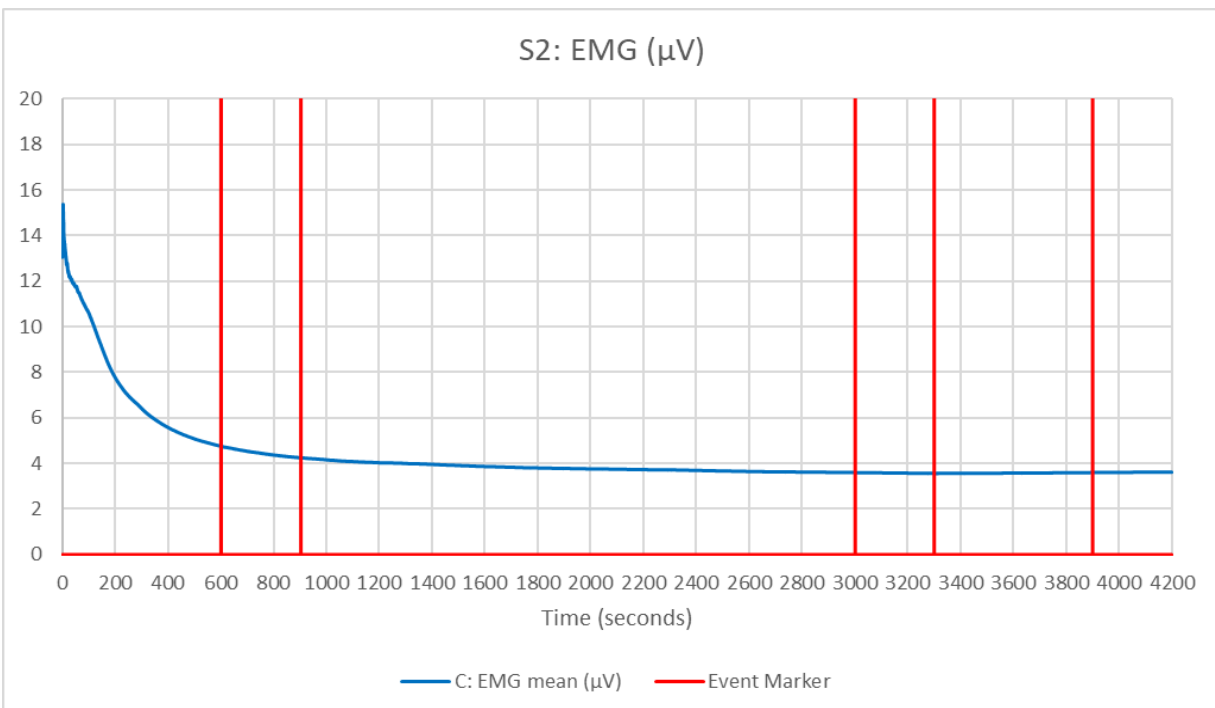
Z-Scores above 1.0 and below -1.0

-COHERENCE-



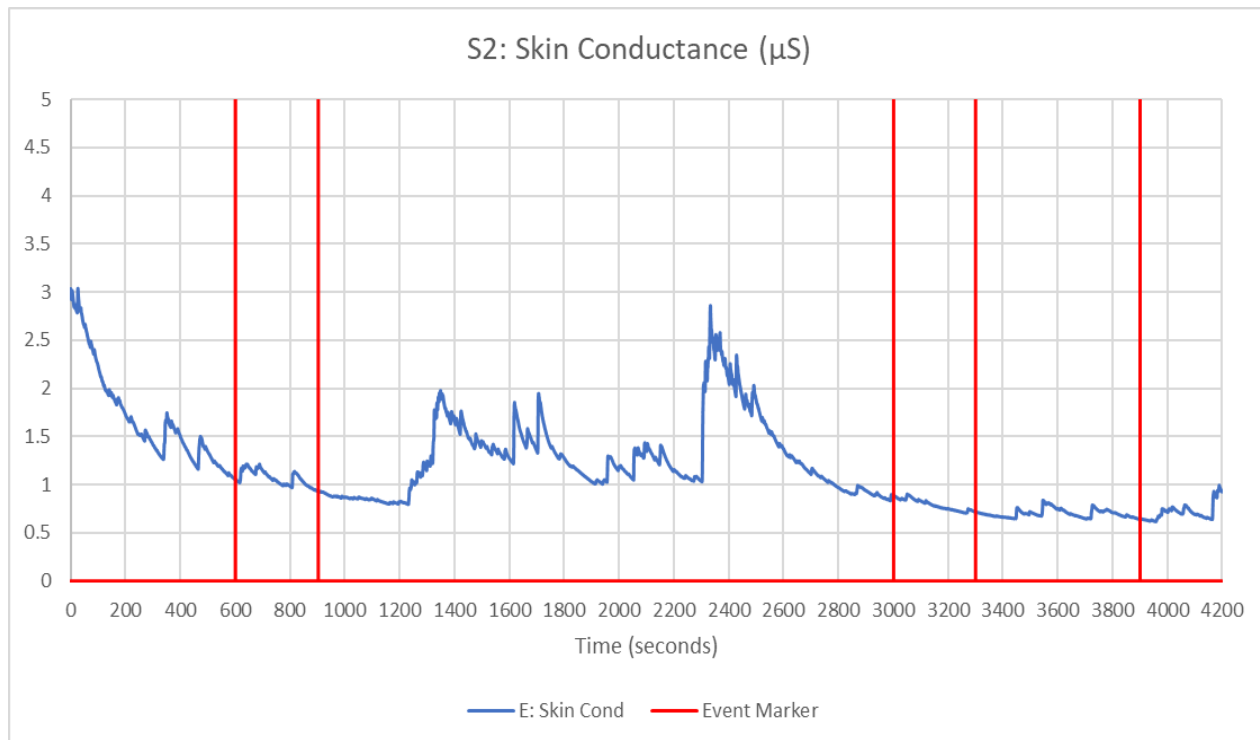
During the grounding period, coherence increased for all frequency bands (as indicated by red lines) on the right hemisphere and decreased in the left hemisphere. Increase coherence for the right hemisphere means an increase in the functions associated with that hemisphere such as synthesis, holistic thinking, creativity, intuition and insight, etc. while a decrease in coherence of the left hemisphere indicates a decrease in the functions of that hemisphere such as, analysis of details, sequential thinking, linguistic thinking, reasoning, etc. After grounding the coherence in the right hemisphere was still lower but became more similar to what it was before grounding. Coherence in the left hemisphere remained lower than before grounding at all frequencies.

Electromyography (EMG) Results



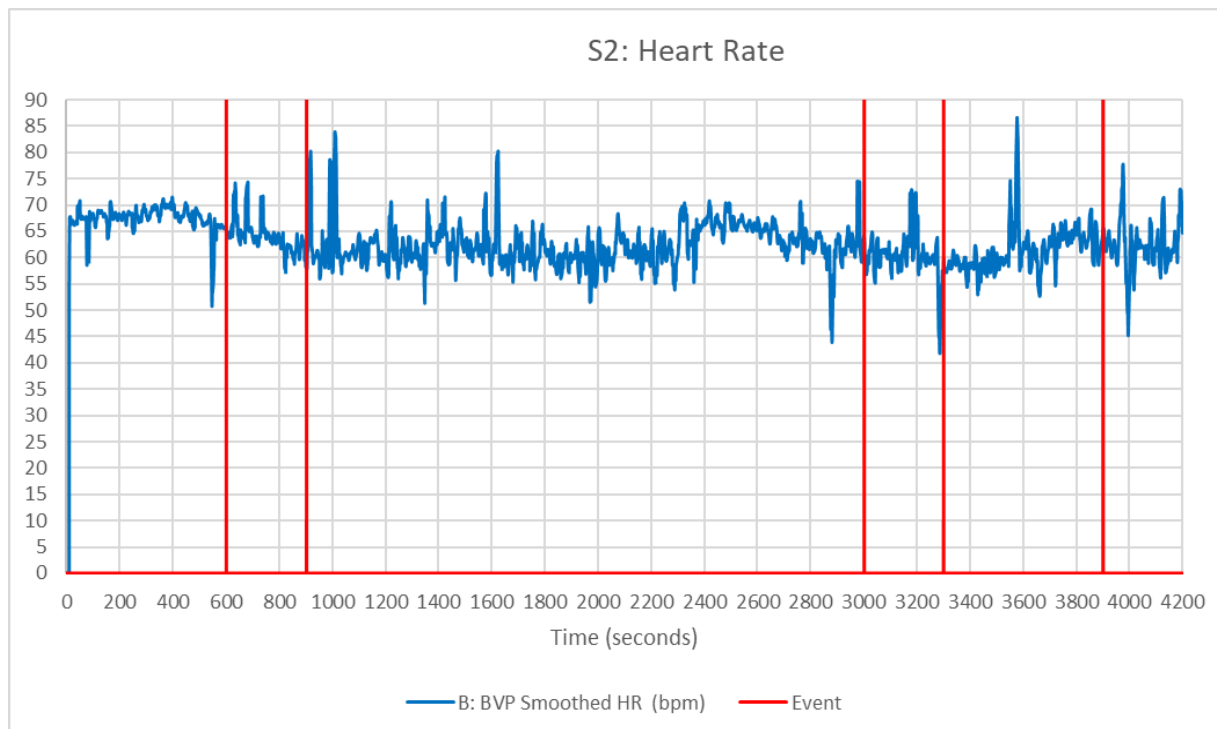
The graph above shows progressive relaxation of the trapezius muscles

Skin Conductance (SC) Results



From the beginning of the session, Subject 2 skin conductance decreased for about 20 minutes (indicating parasympathetic system activation or ANS relaxation). After that, skin conductance fluctuated quite a bit for about 18 minutes (with a large peak at about 38.5 minutes) then decreased for the rest of the session.

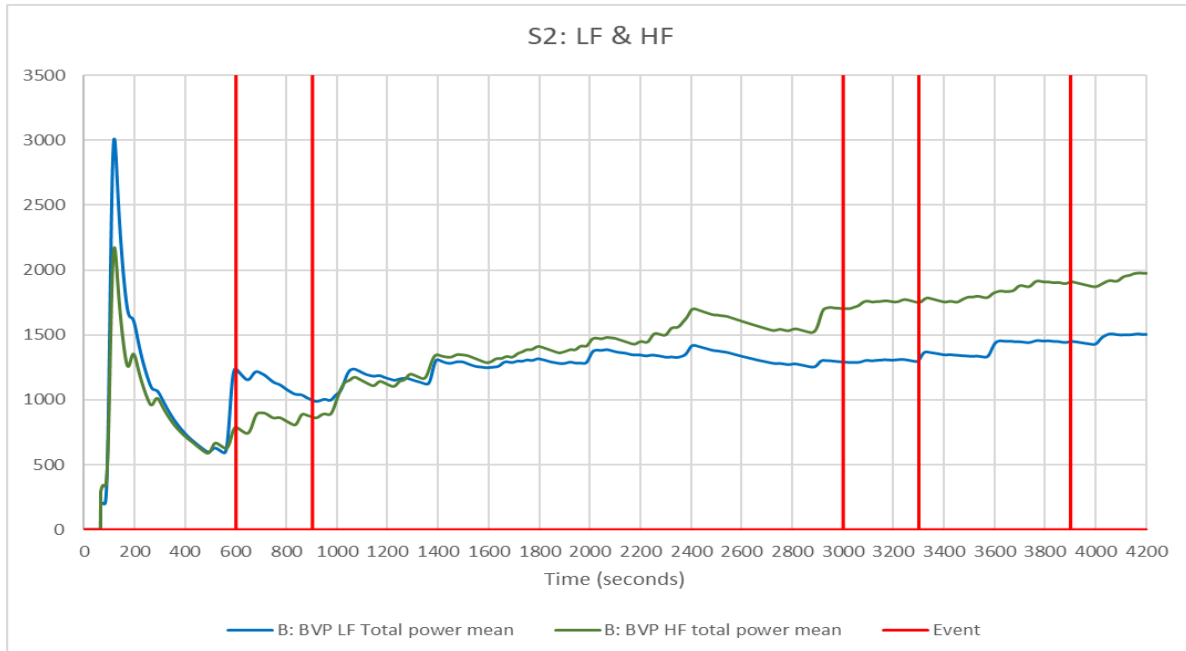
Heart Rate Results



Subject 2 heart rate started at 67 beats per minute and showed a slight tendency to increase for the first 7 minutes. It then decreased for about 10 minutes and stay relatively stable to 60 beats per

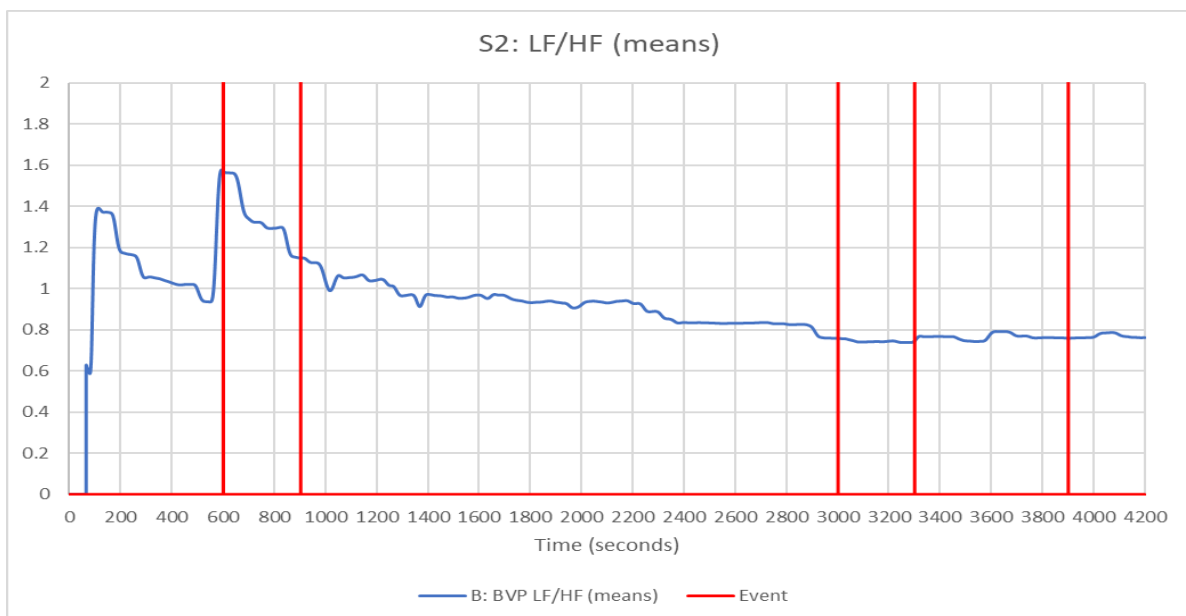
minute for about 22 minutes before increasing slightly again for about 4 minutes. It then decreased again until the end of the grounding period (55 minutes after the start of the session), started to increase again for 10 minutes and then stayed more or less stable until the end of the session, ending at about 65 beats per minute.

Low-Frequency (LF) and High-Frequency (HF) Results



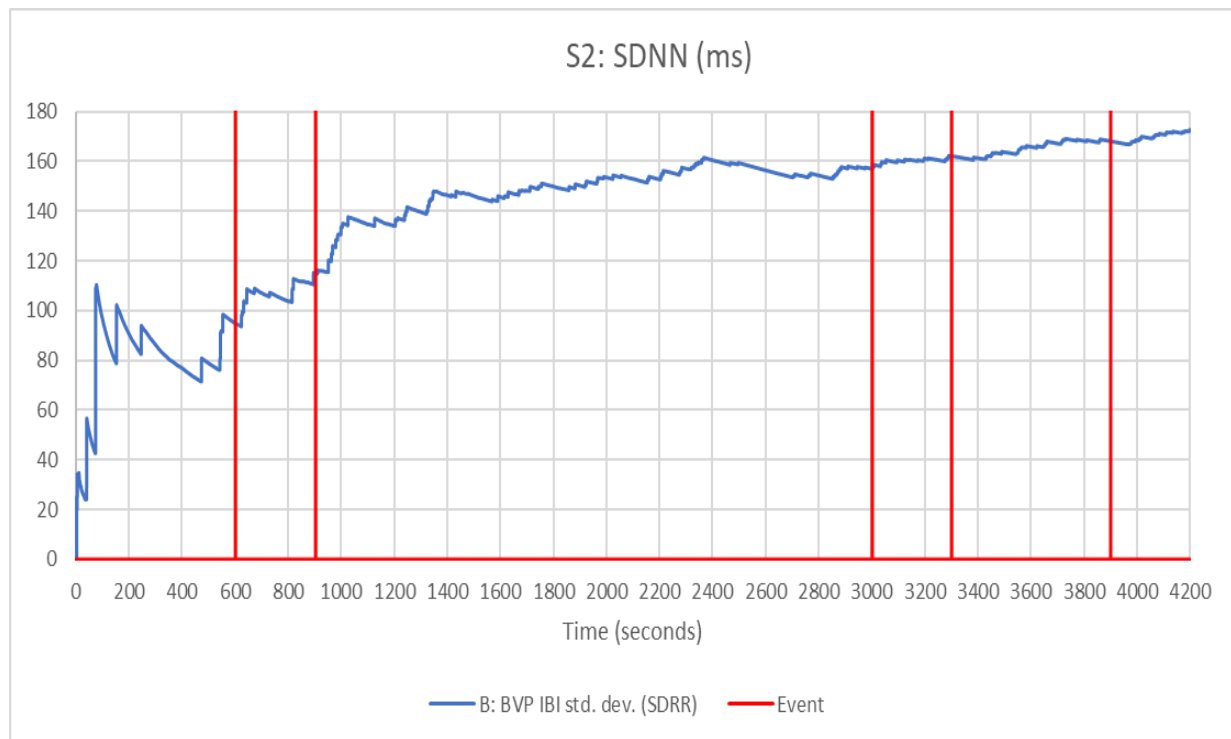
As it is the case for Subject 1, we have also for Subject 2 that LF and HF are close together in value for the entire session, diverging more during the second half of the session. The second observation is that LF and HF started quite identical in value for the first 2 minutes rising rapidly during that time with LF rising to a higher value than HF. Then LF stayed more or less higher than HF until about 21 minutes into the session. At that time, a reversal occurred where HF became slightly higher than LF, with the separation between the two frequency bands increasing over time until the end of the session.

LF/HF Results



After an initial and rapid increase for the first 2 minutes, LF/HF decreases for about 7 minutes, increased rapidly again (for about one minute) before decreasing exponentially for the rest of the session.

SDNN Results



SDNN increased rapidly initially (for about 1.5 minutes from the start of the recorded session) then decreased slowly for about 6 minutes and increased thereafter for the rest of the session.

Summary of Findings for Subject 2

Brain mapping: During grounding, there is a substantial increase in internal focus. There is also an increase in spiritual awareness and meditation. After grounding, the situation with internal focus is similar to during grounding but decreased indicating a decrease in the quality of meditation compared to during grounding. It is also apparent that grounding helped the brain function better.

Trapezius Muscles show a progressive relaxation consistent with a person relaxing and going into a meditative state.

Skin Conductance decreased for about 20 minutes (indicating parasympathetic system activation). Then it increases rapidly with ups and downs until at about 23 minutes in the grounding period. This large peak at about 23 minutes after the start of the grounding period starts at a similar time to what was observed in a previous study and it is consistent with to the body starting the healing process (34, 35).

Heart rate shows a peak at around 42 minutes after the start of the session (27 minutes into the grounding period). Again, this is a similar result to what was observed in a study published in 2010 (34).

LF and HF behave similarly in the graph of HF and HF vs. time. For the first 17 minutes LF was higher than HF which indicates some level of stress while after that period HF became bigger and

bigger with time compared to LF indicating a relaxation response all the way to the end of the session. There was a small increase in both LF and HF 40 minutes after the start of the session (25 minutes into the grounding period) which could indicate a response to grounding similar to Subject 1 but much less i.e. possibility of a healing response. This position is supported by the results of heart rate and SC (34, 35)

LF/HF: After an initial and rapid increase for the first 2 minutes, LF/HF decreases for about 7 minutes, increased rapidly again (for about one minute) before decreasing exponentially for the rest of the session. There is no indication of an effect of a healing-type response for this parameter.

SDNN: After about 8 minutes, SDNN increased for the rest of the session. There is a small bump 40 minutes after the start of the session (25 minutes after the beginning of the grounding period) that is suggestive of a potential healing effect as seen in the Chevalier and Sinatra paper (1).

Overall, Subject 2 meditation also deepened during grounding with increase in spiritual awareness. However, after the grounding period, there is a decrease in the depth of meditation but it is still better than before grounding. As it is the case with Subject 1, Subject 2 physiological measures (SC, HR, EMG and HRV parameters) are consistent with a person physiology deeply relaxing during the grounding period and starting to heal the body.

Subject 3

Female, 42, energy medicine practitioner. She takes 2 Advil per day for 1-3 days during menses. Her meditation technique is sitting with opening Chakras. She has been meditating for 15 years for 1-2 hours a day. She indicated that the first 15 minutes was usual then it got worse. She felt nauseated and weak and she broke out into cold sweat and got chilly. We had to stop the meditation after 52 minutes because she could not continue. This means we do not have brain mapping results for after grounding. A few minutes after she got time to relax, she called her friend medical intuitive. After the call, she told us that her medical intuitive friend told her that it was a healing crisis due to some form of uterine infection that she was not able to diagnose so far. She was happy that grounding could discover that problem. Even though her meditation was worse than usual, she left the lab feeling slightly better than when she arrived.

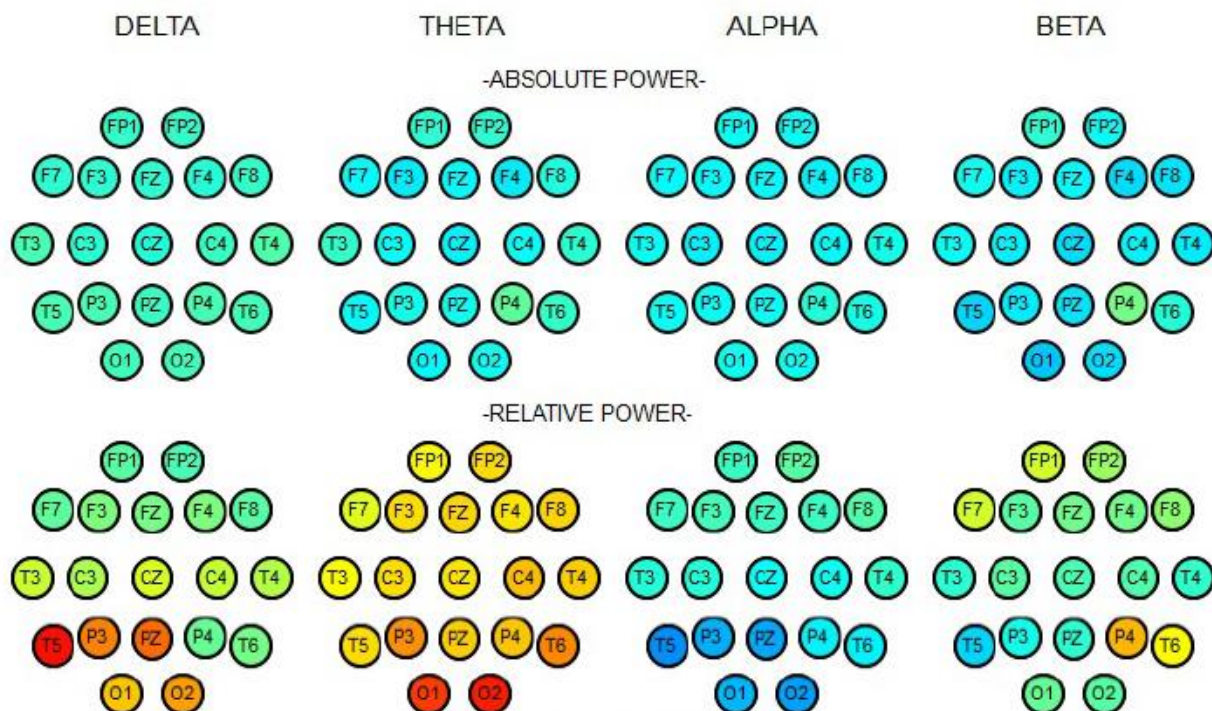
We do not have a post-meditation brain mapping recording for this subject because the profound healing crisis she experienced during the grounding period forced her to end the session before the recording of the post-grounding part of the experiment could be done.

Brain Mapping Results

Before grounding

Eyes Closed P300 Z Scores
Session 1 (4/8/2019)

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

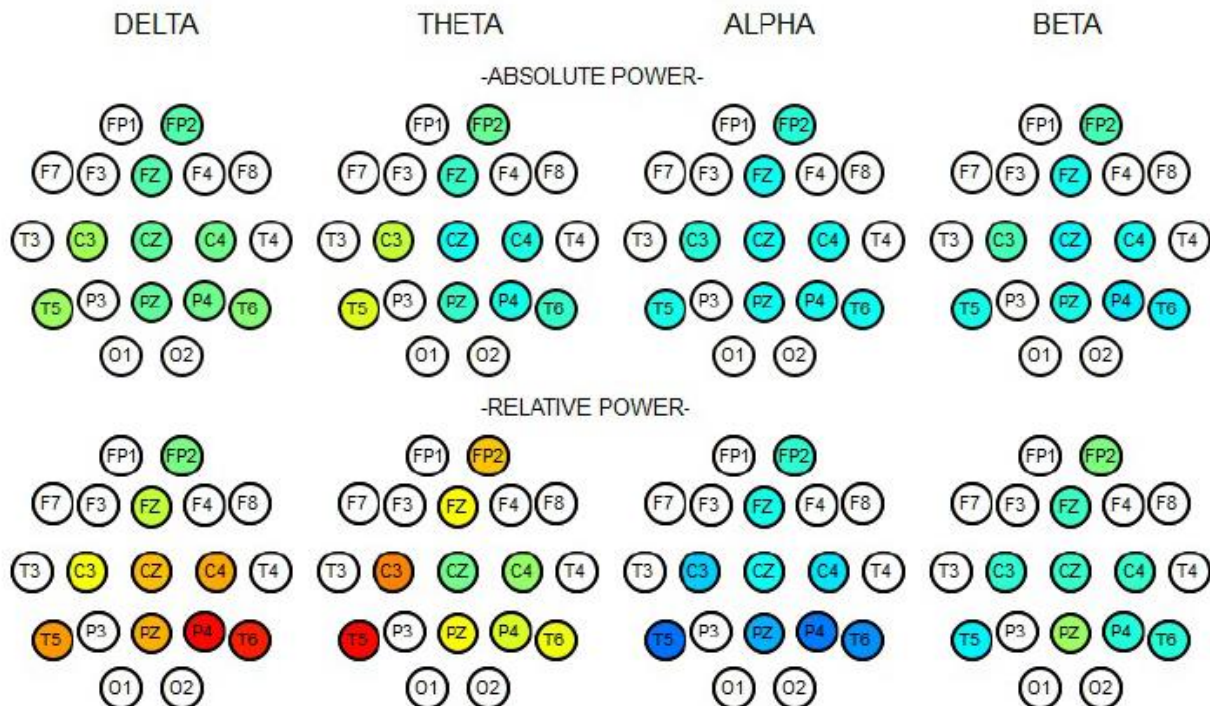
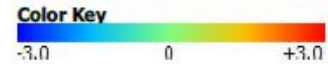


Subject 3 absolute power is normal but with a tendency toward low activity (light green to light blue). Relative power shows high activity for all electrode sites in the Theta frequency band and more so in the posterior region of the brain. This is associated with internal focus, hyper-vigilance, meditation, prayer and spiritual awareness (6). In the Delta band, the sites on the left and central regions at the back of the head are activated indicating an increase in inhibition of brain functions interfering with internal concentration related to the brain function at these locations (21). T5 is related to verbal understanding, reading comprehension and auditory processing (6, 11). P3 main function is perception (cognitive processing) of the right half of the visual space, spatial relations, verbal and logical reasoning and memory, language processing, sensations, math calculations and processing, and praxis (6, 11). PZ is about perception and integrating somato-sensory information with posterior visual perceptions, working memory, route finding and praxis (6, 11). O1 main function is visual processing of the right half of the visual space, including pattern recognition, color, black/white, movement and edge perception, memory encoding while O2 main function is visual processing of the left half of the visual space, including pattern recognition, color, black/white movement and edge perception (6, 11). These results indicate good level of internal focus and concentration.

During grounding

Eyes Closed P300 Z Scores
Session 2 (4/8/2019)

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz



During grounding, Subject 3 moved quite a bit because of her healing crisis and so all the white electrodes are not properly connected and do not give information on brain function. In the relative power section, T5 shows high activity in the Theta band indicating an increase in cognitive control of the brain function monitored at T5 during grounding (21). Remember that T5 is related to verbal understanding, reading comprehension and auditory processing (6, 11). There is also high activity in the Delta frequency band for P4 and T6. P4 main function is perception (cognitive processing) of the left half of space, image and spatial processing and memory, facial decoding, non-verbal reasoning, praxis, integration with environment, map orientation, knowing the difference between right and left (6, 11). T6 main function is emotional understanding. Other functions include facial and symbol recognition, auditory processing (6, 11). An increase in Delta at these electrode locations indicates an increase in inhibition of brain functions related to these electrode locations interfering with internal concentration (21). At the same time Alpha activity at P4, T5 and T6 were decreased. These are the same locations where Delta and Theta are increased indicating that the high Delta and Theta at these locations is suppressing the cognitive functions of the corresponding brain functions. During the healing crisis and before the end of the experiment, Subject 3 was sweating profusely (cold sweat).

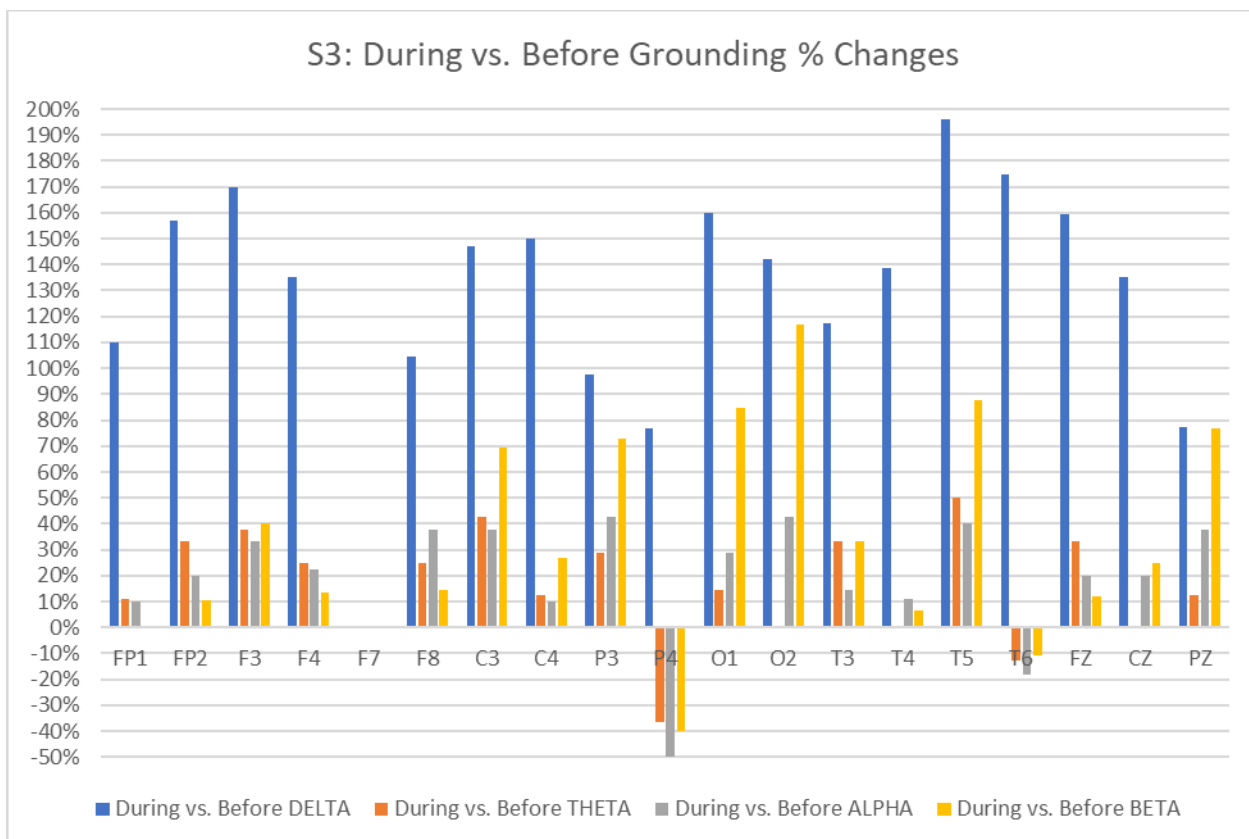
CZ Theta/Beta and F3/F4 Alpha

Researchers have shown that calculating the relative power ratio Theta/Beta at CZ can be used to determine slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior. (6, 17, 18) They also discovered that calculating F3/F4 relative power ratio in the Alpha band means processing information in a positive way for an increase while a decrease in the ratio indicated a more negative processing mode (19, 20). The table below give the result for the two sessions available for Subject 3.

	Subject #3		Ref Range (40 yrs)
	Session 1	Session 2	
CZ Theta/Beta	3.6	1.6	0.8-2.8
F3/F4 Alpha	0.6	1.5	0.8-1.2

It can be observed that CZ Theta/Beta was high before grounding and decreased very significantly during grounding (by 56%), ending in the reference range. Remember that high CZ Theta/Beta indicates tendencies toward slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (6). F3/F4 Alpha started below the reference range and went above the reference range during grounding indicating possibly starting with a negative processing mode switching to a more positive processing mode during grounding (19).

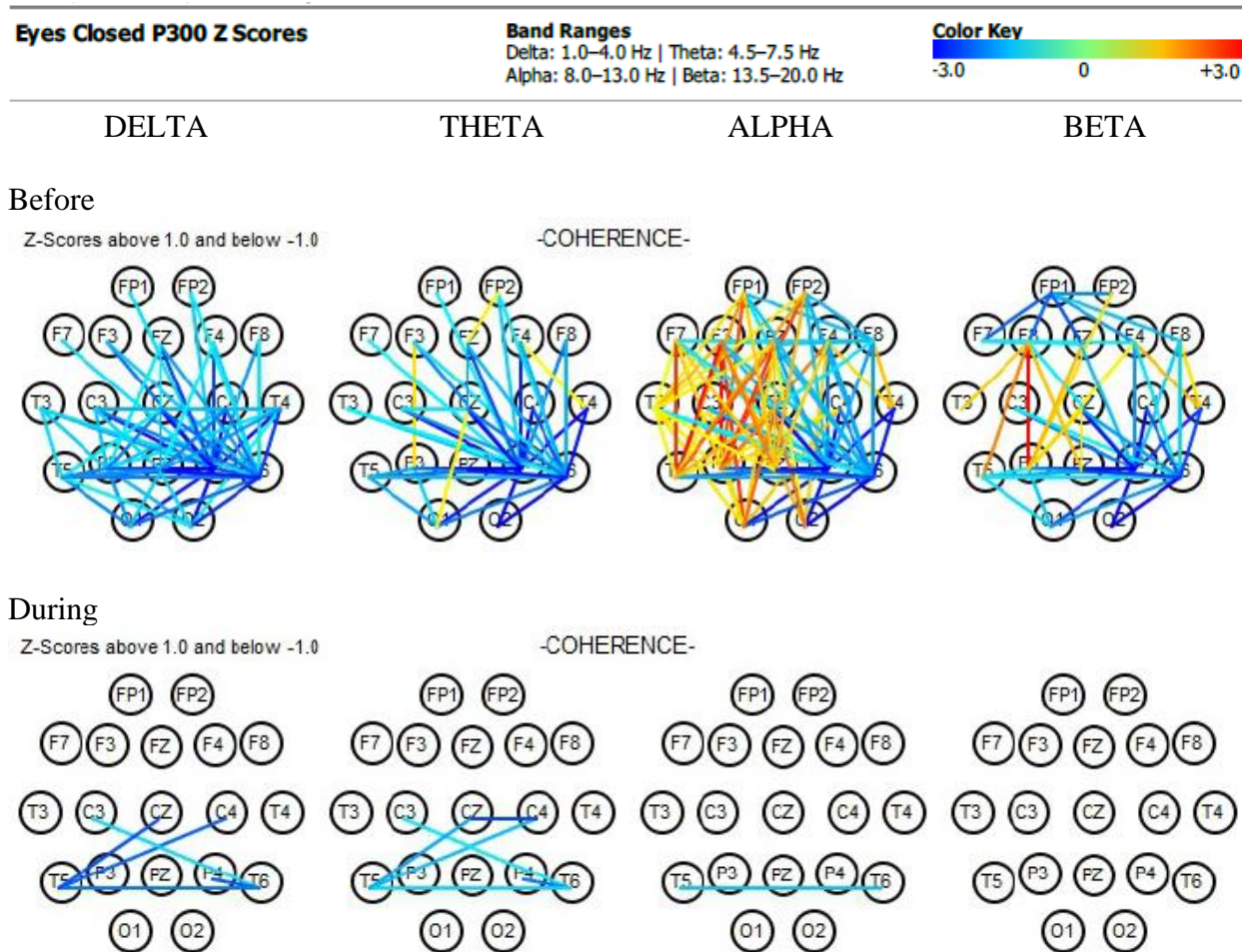
During vs. Before grounding



- * In general, all frequency bands increased significantly during grounding indicating a significant activation of the brain.
- * The exceptions are P4 and T6 which decreased significantly for Theta, Alpha and Beta.
- * P4 relates to visual-spatial sketch pad, image and spatial processing, facial decoding, integration with environment, spatial memory (6).
- * T6 relates to conscious emotional and physical awareness (insula), sense of direction, visual memory and visualization, categorization, sound voice intonation perception, music facial recognition, spatial and facial perception - social cues (6).
- * Delta increased very significantly at all locations, more than any other frequency band, indicating an increase in inhibition of brain functions interfering with internal concentration (14). She became very internally focused during the grounding period.
- * Theta increased significantly for Fp2, F3, F4, F8, C3, P3, T3, T5 and FZ, indicating an increase in cognitive control at these electrode locations (15).

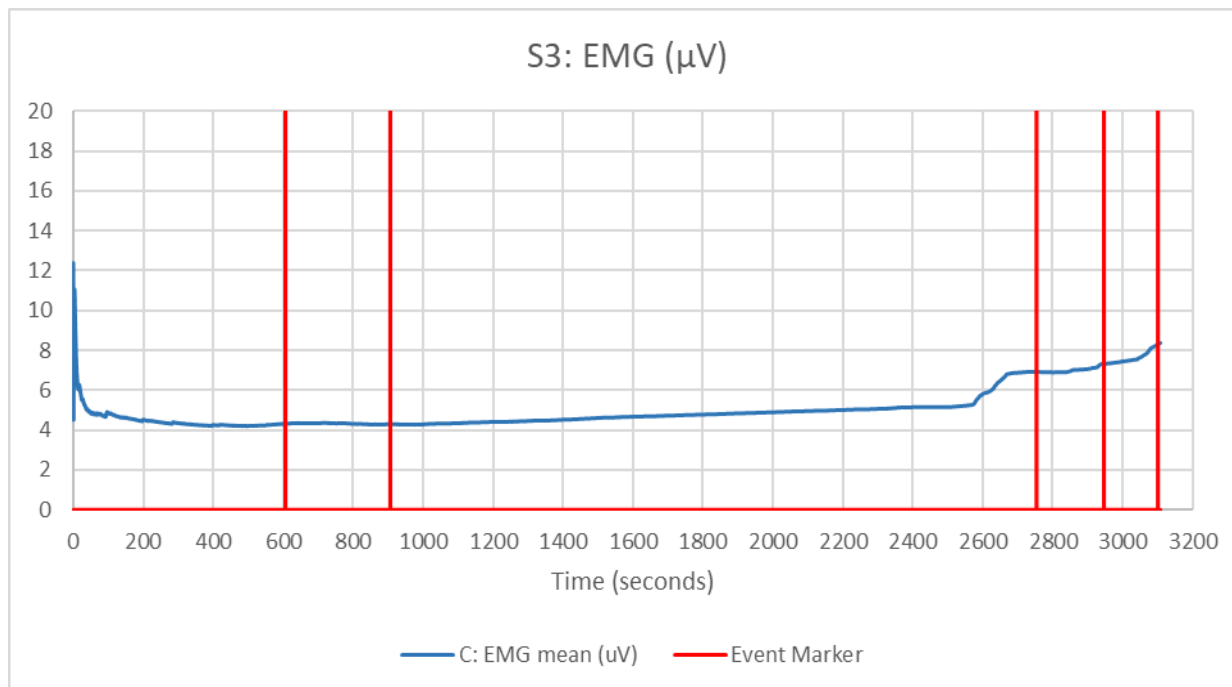
- * Alpha increased significantly at 12 electrode locations and overall (averaging the % changes at all locations). This was probably due mainly to an increase in alertness.
- * Beta also increased very significantly indicating an increase in mental processing.
- * Having large increases in Beta and Theta is like driving with the brakes on (the brain does not run smoothly) (6).
- * **Conclusion:** S3 became very introverted with activated mental processing. It is like most areas of the brain went “off line” to take care of the current healing crisis by integrating as much information as possible about the situation. This is similar to brain waves in growing infants.

Coherence Results



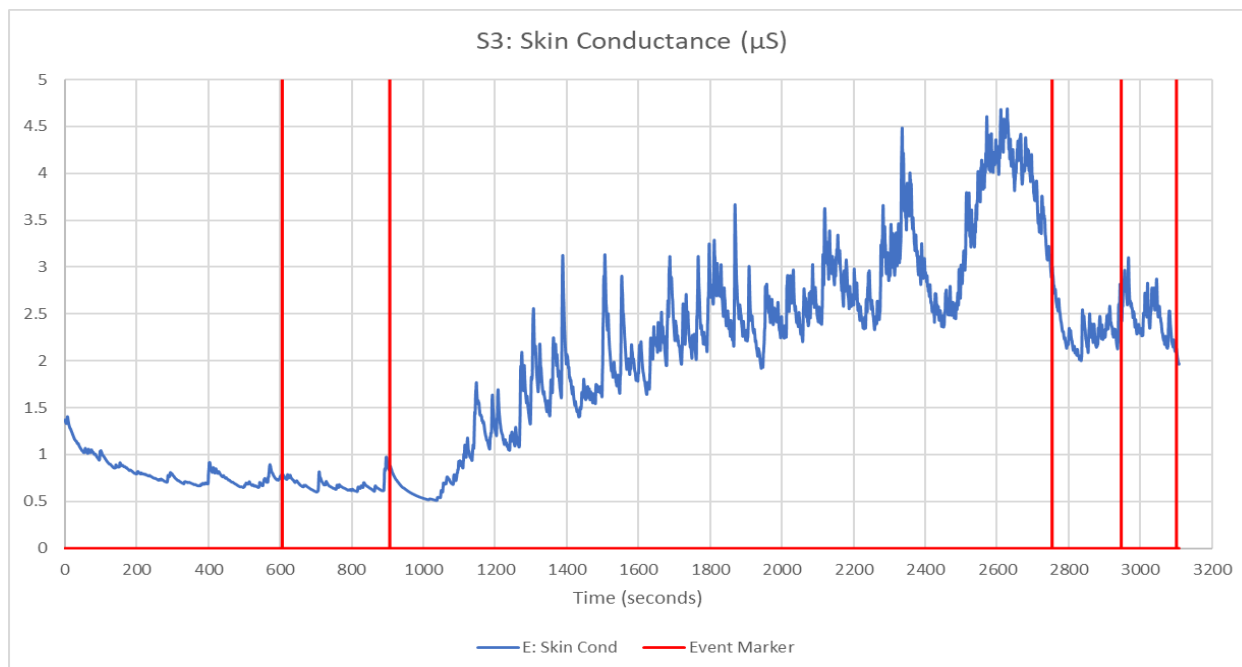
It can be seen that coherence in the Delta, Theta and Beta bands was lower than normal during the pre-grounding phase indicating that the subject was going inside and that most of the brain processes were inhibited. It also indicates a less efficient emotional memory, visual sensations, perception and sensorimotor integration (11). There was high Alpha coherence in the brain functions of the left indicating activity of the functions related to that hemisphere (detailed analysis, sequential and linguistic thinking, logic, analytical reasoning, etc.) (6) but possibly also lack of flexibility of logical and emotional memory, perception and sensations (11). It appears that Subject 3 was intensely internally focused with a highly cognitively active and attentive brain. During meditation and the healing crisis, coherence returned to normal levels because the subject needed to return to normal daily function in order to be aware in the present time of what was happening to her (healing crisis).

Electromyography (EMG) Results



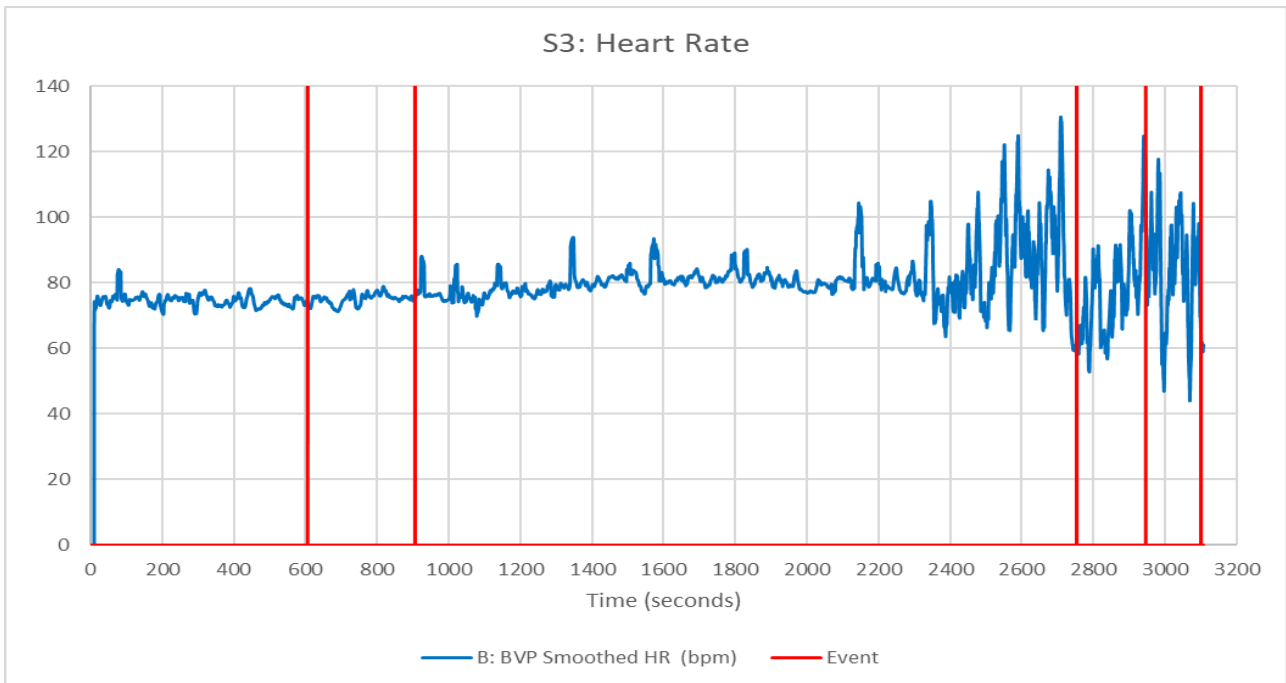
After a brief relaxation period lasting about 8.5 minutes, the graph above shows progressive tensing of the trapezius muscles starting just after grounding. Muscle tension increased markedly 43 minutes after the start of the experiment (28 minutes into the grounding period). Note that the third brain mapping recording was started but was not completed due to the subject experiencing a profound healing crisis.

Skin Conductance (SC) Results



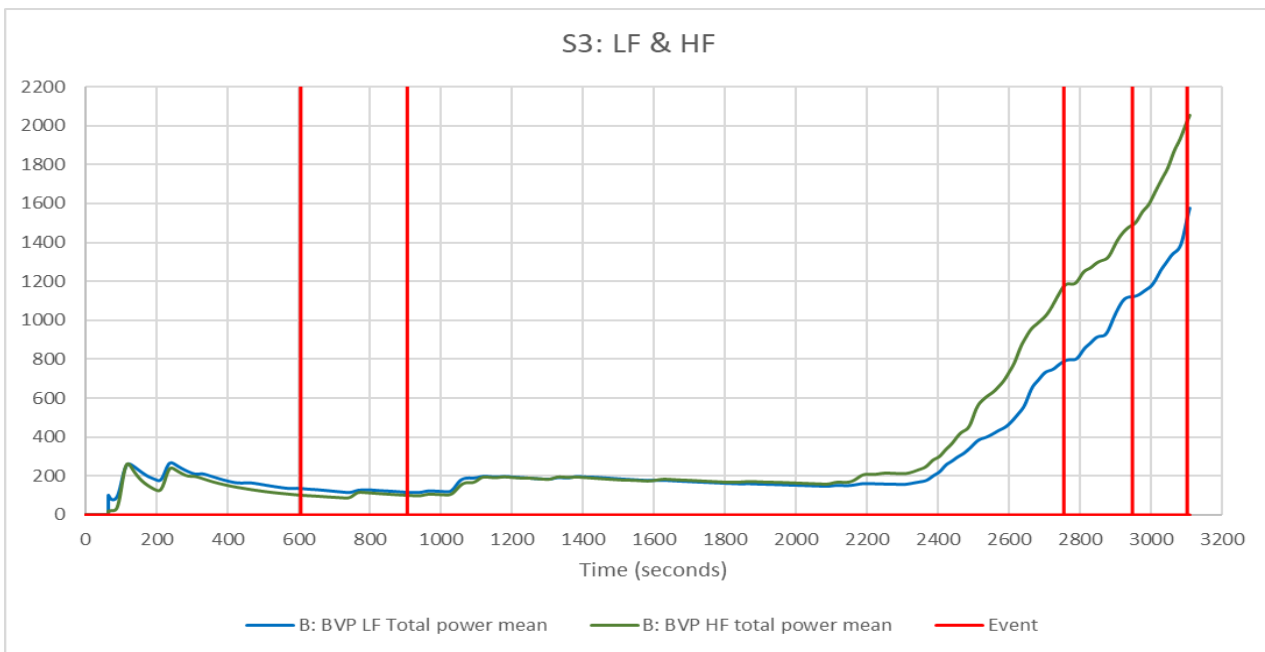
From the start, Subject 3 skin conductance (SC) continued to decrease for up to about 17 minutes after the start of the session indicating parasympathetic system activation (i.e. ANS relaxation). Then there was a large increase with high peaks until about 44 minutes into the session. At around the time the second brain mapping recording was started (about 46 minutes into the session), there was a large decrease in SC that then stayed the same until the rest of the session.

Heart Rate Results



Subject 3 heart rate remained quite stable at about 75 beats per minute for about 18 minutes after the start of the grounding period. Then heart rate started to increase slowly stabilizing to around 80 beats per minutes until about 39 minutes into the session. It then became very chaotic for the rest of the session. It can be observed from the graph above that the heart rate started to increase at about 3.5 minutes after the start of the grounding period and became unstable about 25 minutes after the start of the grounding period.

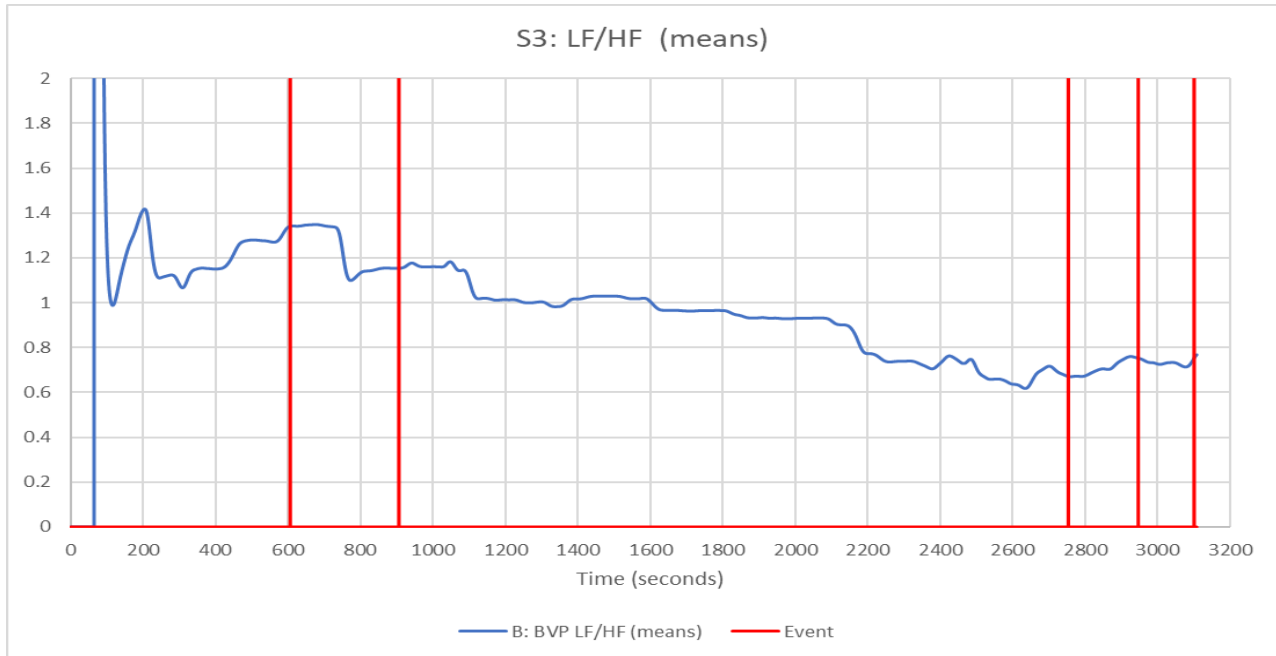
Low-Frequency (LF) and High-Frequency (HF) Results



As it is case for Subject 2, we have also for Subject 3 that LF and HF are close together in value for the entire session, starting to diverge during the last portion of the session. In the case of Subject 3, LF and HF are really close in value (around 200) until the 36th minute into the session. Then both LF

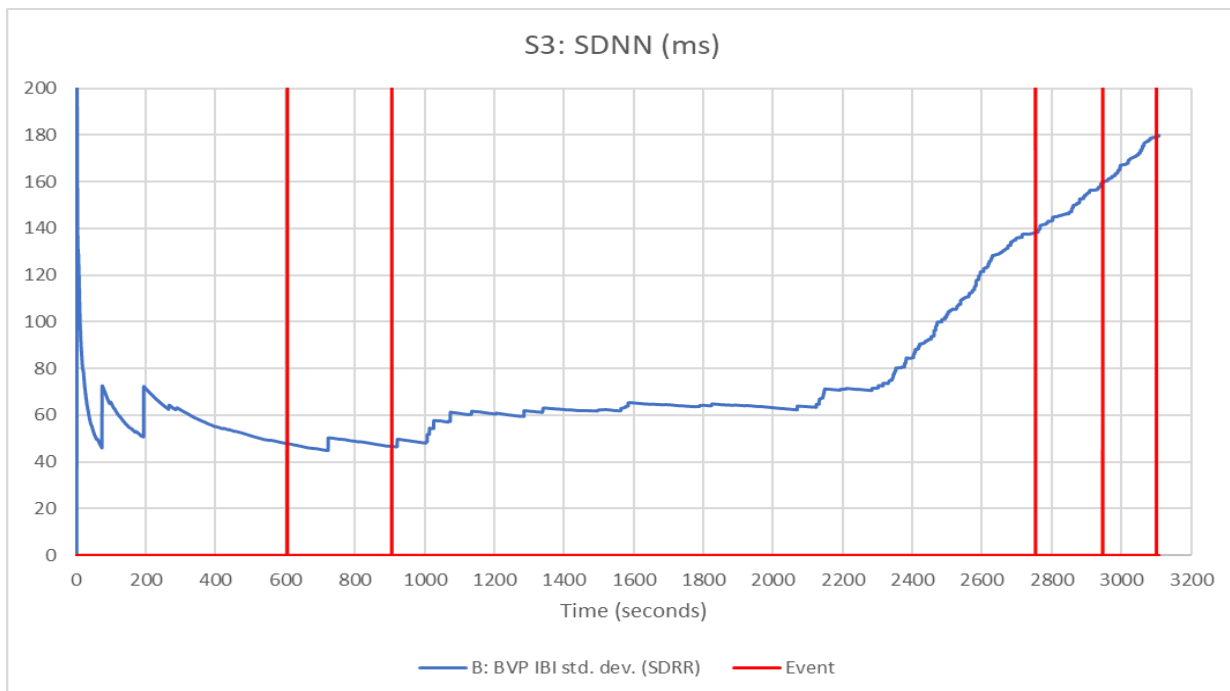
and HF increase more or less linearly with HF becoming larger than LF and the gap between the two increasing over time.

LF/HF Results



At 1.5 minute after the start of the session, LF/HF raised rapidly to produce a large peak that lasts only for 30 seconds (the peak goes up to 5 on the vertical scale, probably an artifact due to the stress the subject experienced to get ready) then there is a slow decrease for the rest of the session with higher variability for the first 19 minutes followed by a more constant decrease until about the 44th minute unto the session. After that LF/HF is more or less constant until the end of the session.

SDNN Results



SDNN decreased initially up to about 12 minutes from the start of the recorded session. It then stabilized for about 5 minutes, experienced a rapid but small increase for about a minute and stabilized again for about 17.5 minutes. After that SDNN increase slowly at first but then linearly until the end of the session.

Summary of Findings for Subject 3

We do not have a post-meditation brain mapping recording for this subject because the profound healing crisis she experienced during the grounding period forced her to end the session before the recording of the post-grounding part of the experiment could be done. Subject 3 explained after the session that about 15 minutes into the session (close to the time the grounding period started) she started to feel some discomfort inside her body that increased till the time when we had to stop the experiment after 52 minutes.

Brain mapping: Before grounding Subject 3 went into a state of internal focus, hyper-vigilance, meditation, prayer and spiritual awareness. These results indicate good level of internal focus and concentration. During the healing crisis, which started almost immediately after the beginning of the grounding period, Subject 3 was sweating profusely (cold sweat). Subject 3 had tendencies toward ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior. These tendencies disappeared during grounding. Surprisingly, Subject 3 had a negative processing mode when coming to the lab that switched to a more positive processing mode during grounding.

Trapezius Muscles: Subject 3 experienced progressive tensing of the trapezius muscles starting just after the beginning of the grounding period. Muscle tension increased markedly 43 minutes after the start of the experiment (28 minutes into the grounding period). At that time, she became quite distressed. The third brain mapping recording was started but was not completed due to the subject experiencing a profound healing crisis.

Skin Conductance Two minutes after the start of the grounding period, SC started to increase with large fluctuations until about 44 minutes into the session and stayed quite large for the rest of the session. This indicates progressive increase in sympathetic system (stress).

Heart rate increased slowly starting about 3 minutes into the grounding period corresponding to the time when Subject 3 experienced the beginning of her healing crisis. The heart rate stabilized to around 80 beats per minutes about 39 minutes into the session (24 minutes into the grounding period). It then became very chaotic for the rest of the session.

LF and HF were very close to each other for about 36 minutes (21 minutes into the grounding period). Then both LF and HF increase more or less linearly with HF becoming larger than LF and the gap between the two increasing over time. This may seem curious since Subject 3 was experiencing a deep healing crisis. However, healing can only happen when the ANS balance is more toward parasympathetic activation which is what we observe in her case. Note that this result is very different from SC which is also purported to represent the activity of the ANS. The difference is that LF and HF and LF/HF are related to the function of the vagus nerve which control the function of internal organs and the healing response while SC is more about peripheral autonomic and brain responses. So, while the body was going through a healing crisis internally (as seen by LF and HF) SC shows an increase in stress i.e., activation of the sweat glands producing cold sweat.

LF/HF: After an initial period of fluctuating stability that lasted about 12 minutes LF/HF started a slow decrease until about the 44th minute into the session (29 minutes after the start of the grounding period). After that LF/HF is more or less constant until the end of the session. This data shows

Subject 3 ANS relaxing (going into parasympathetic mode activation). This is of course consistent with the results obtained with LF and HF showing that she went into a healing crisis (i.e. into vagus nerve activation).

SDNN was quite stable for the first 21 minutes into the grounding period. It then increased more or less linearly for the rest of the session. This linear increase is no doubt a sign of attentive arousal and alertness.

Subject 4

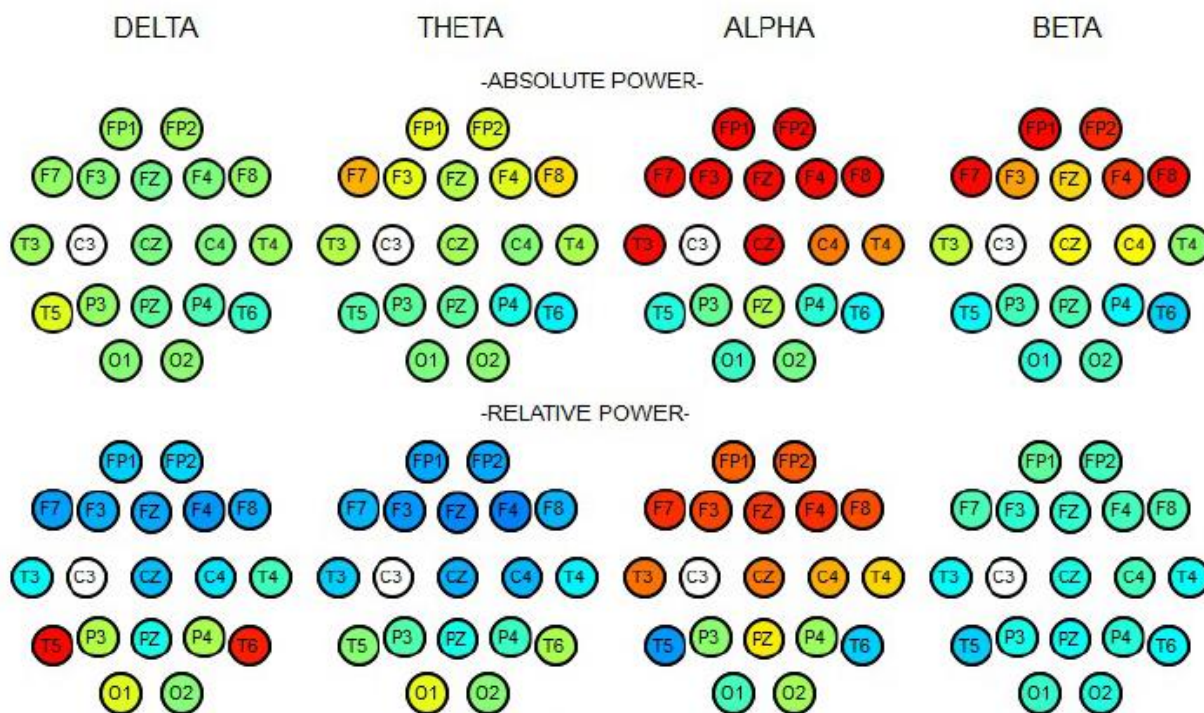
Female, 29, Yoga teacher, trainer, fitness and nutrient specialist. Her meditation technique is a seated silent meditation. She has been meditating for 11 years for about 30 minutes to an hour daily. She indicated that she feels very calm and that the head hurts a little from electrodes pressure and that she felt cold. Otherwise, she was very relaxed and centered. Overall her meditation was as usual to slightly worse than usual.

Brain Mapping Results

Before grounding

Eyes Closed P300 Z Scores
Session 1 (4/22/2019)

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz



Looking first at absolute power, Subject 4's brain displays high activity in the frontal lobes in the Alpha and Beta bands. The frontal lobes are responsible for higher executive functions such as: attentional gating, decision making, problem solving, memory, social awareness, character, motivation, planning, judgment. The frontal lobes are also responsible for immediate and sustained attention, social skills, emotions, empathy, time management, working memory, moral fiber or character, executive planning and initiative. They identify problems and may send them to other parts of the brain for resolution (6). Activation of the frontal lobes in both Alpha and Beta frequency

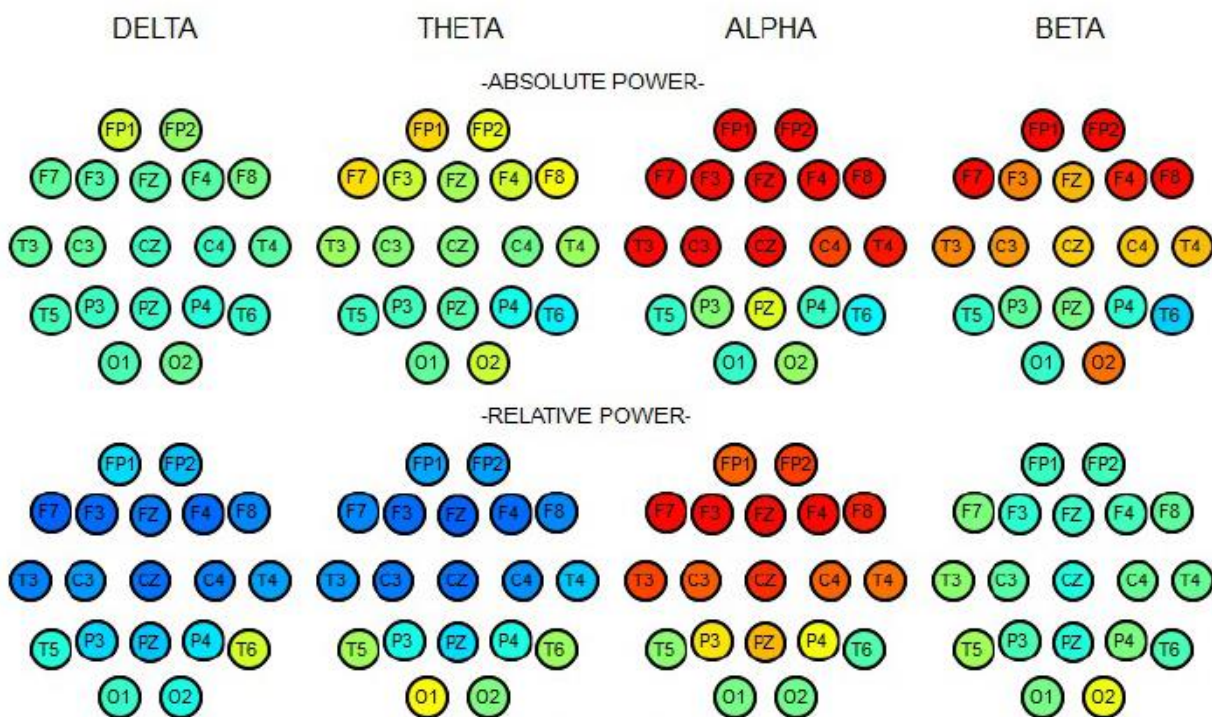
bands (especially Alpha) indicate high alertness and cortical processing efficiency and selectivity of the brain related to the functions just mentioned but, in a calm, and composed way (6, 36, 37).

Relative power gives a slightly different picture by showing high activity in the frontal lobes in the Alpha band only with low activity in the Delta and Theta bands. Alpha activity in the frontal brain is associated with emotional control and indicate high alertness and cortical processing efficiency of the brain related to the functions just mentioned but, in a calm, and composed way (6, 36). High Alpha activity coupled with low Theta and Delta indicates that the Alpha band is dominant suppressing the inhibition of corresponding brains functions (14).

During grounding

**Eyes Closed P300 Z Scores
Session 2 (4/22/2019)**

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

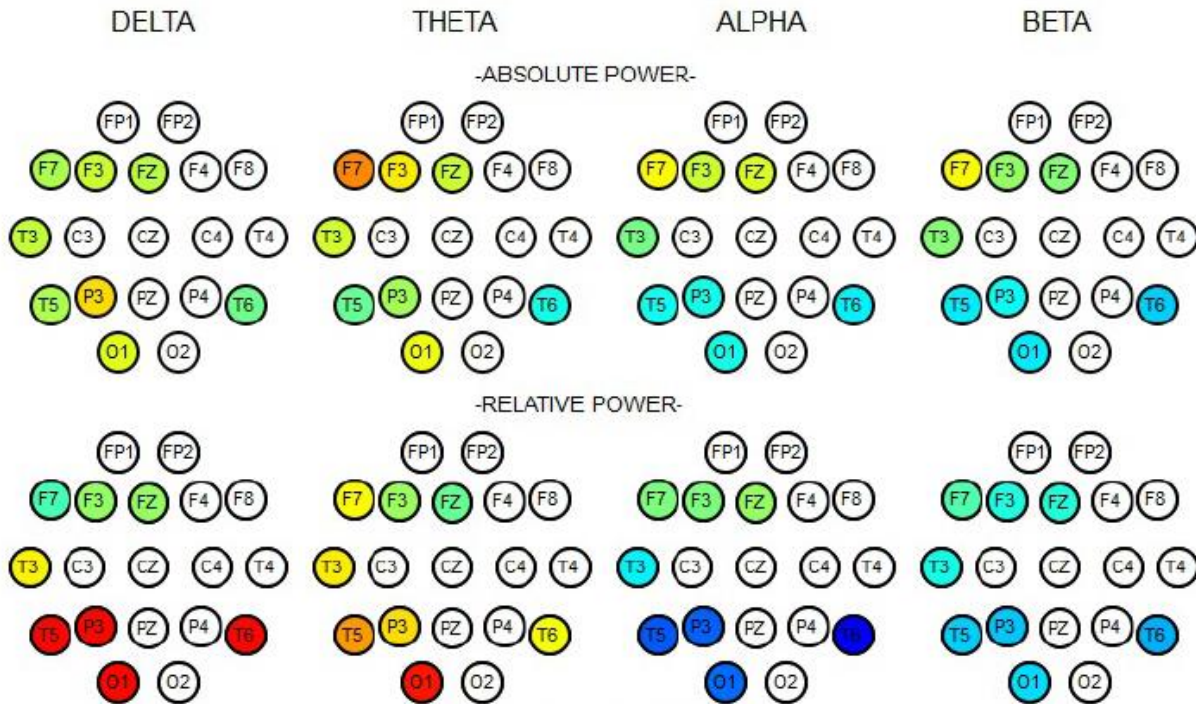
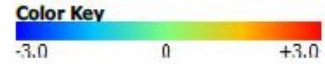


During grounding, the situation is similar to before grounding but slightly intensified, including the central strip and parts of the temporal lobes. It is the period when the subject started to be cold and asked for a blanket around the middle of the grounding period.

After grounding

**Eyes Closed P300 Z Scores
Session 3 (4/22/2019)**

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz



After grounding, the brain is in a very different disposition. Many electrodes stopped working because Subject 4 kept moving to change position (her initial position was sitting erect not touching the back of the grounding chair but after about 45 minutes she needed to change position). Looking at relative power, we now see high activity in the Delta occipital region indicating some attempt to suppress the activities of the normal awake brain in an attempt to continue meditation (15).

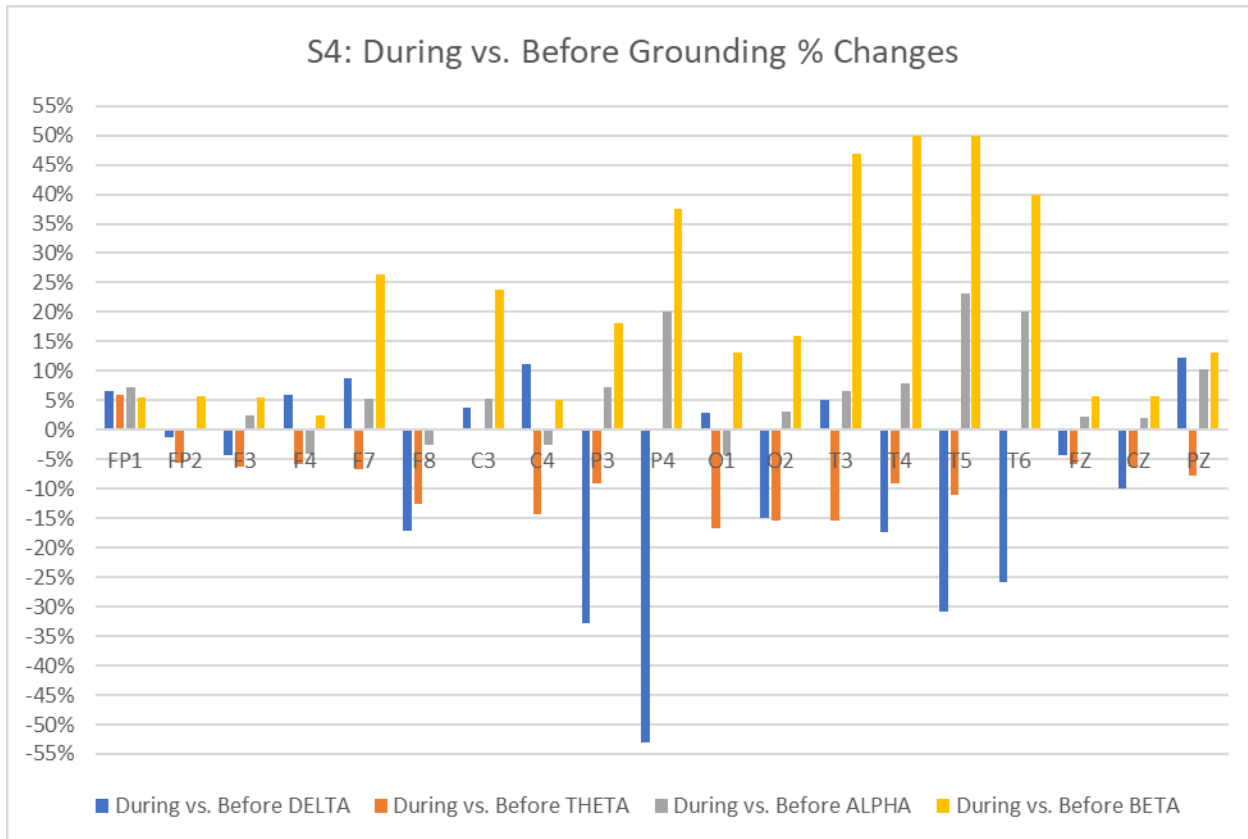
CZ Theta/Beta and F3/F4 Alpha

Researchers have shown that calculating the relative power ratio Theta/Beta at CZ can be used to determine slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (6, 17, 18). They also discovered that calculating F3/F4 relative power ratio in the Alpha band means processing information in a positive way for an increase while a decrease in the ratio indicated a more negative processing mode (19, 20). The table below give the result of all 3 sessions for Subject 4.

	Subject #4			Ref Range (30 yrs)
	Session 1	Session 2	Session 3	
CZ Theta/Beta	1.1	1.0	3.7	0.8-2.8
F3/F4 Alpha	0.8	0.9	0.8	0.8-1.2

It can be observed that CZ Theta/Beta was in the reference range before and during grounding and became much higher after grounding. This is probably due to several minutes of movements in order to reposition herself. F3/F4 Alpha started in the reference range and stayed in the reference range during and after grounding.

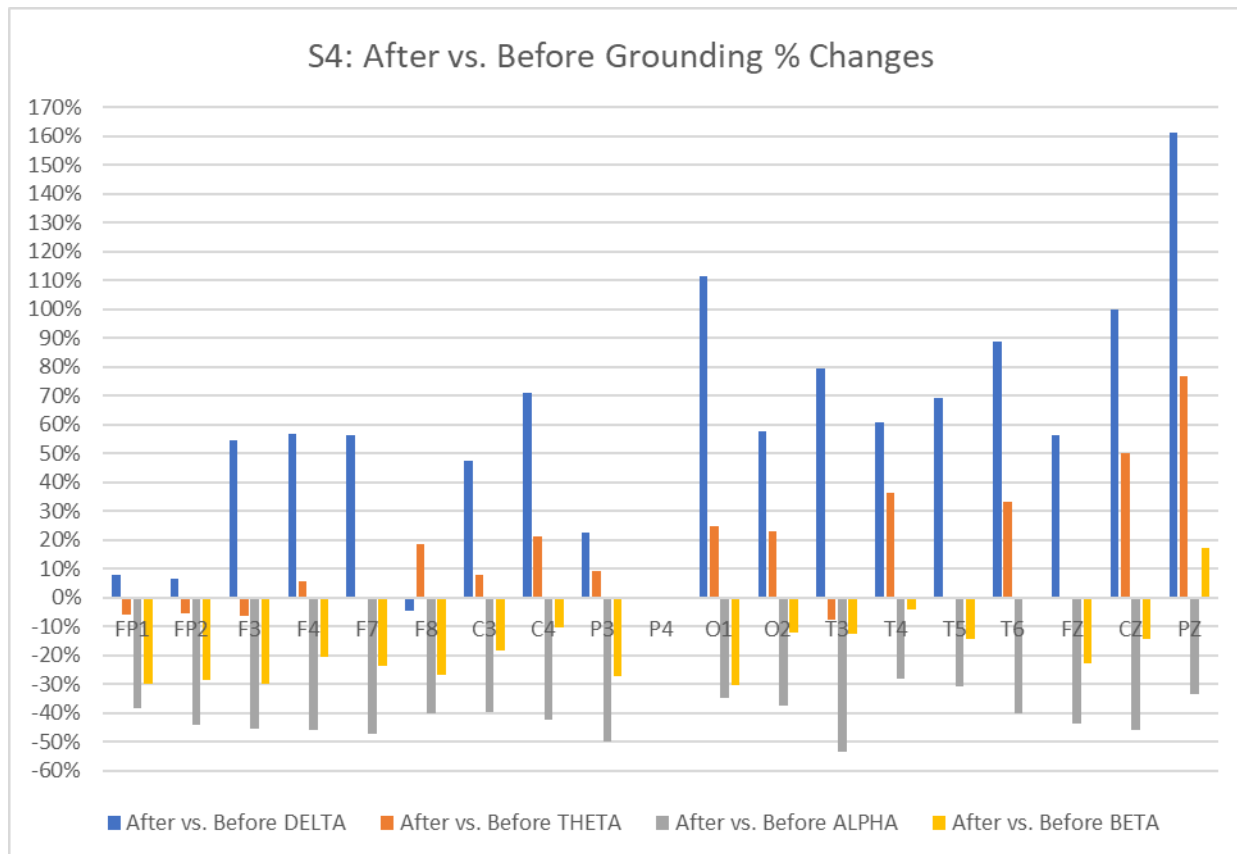
During vs. Before grounding



- * Significant decreases (> 20%) in Delta for P3, P4, T5 and T6 with no significant increases, indicating a decrease in inhibition of brain functions interfering with the brain functions measured by those electrode sites (21).
- * P3 relates to language processing, integration of self, logical reasoning and memory, imagination, spelling and short-term memory, internal concentration related math calculations, naming objects, complex grammar, sentence construction and math processing (6).
- * P4 relates to visual-spatial sketch pad, image and spatial processing, facial decoding, integration with environment, spatial memory (6).
- * T3 & T5 relates to comprehension both verbal and reading, visual perception of what an object is, processing integration and perception of auditory input, comprehension of auditory and visual perception (6).
- * T6 relates to conscious emotional and physical awareness (insula), sense of direction, visual memory and visualization, categorization, sound voice, intonation perception, music facial recognition, spatial and facial perception - social cues (6).
- * T4 & T6: conscious emotional and physical awareness (insula), sense of direction, visual memory & visualization, categorization, sound voice, intonation perception, music, facial recognition, spatial and facial perception - social cues (6).
- * There were no significant changes in Theta.
- * There were significant increases in Alpha for P4, T5 and T6.
- * There were significant increases in Beta for F7, C3, P4, T3, T4, T5 and T6.
- * F7 relates to approach behavior, engagement, interest, mood regulation, processing of positive emotional input, conscious awareness (6).
- * F7 is near centers for rational activities (38).
- * C3 relates to hand and digits (with F3 – handwriting and inhibit or execute action}, audition, happiness, syntax.

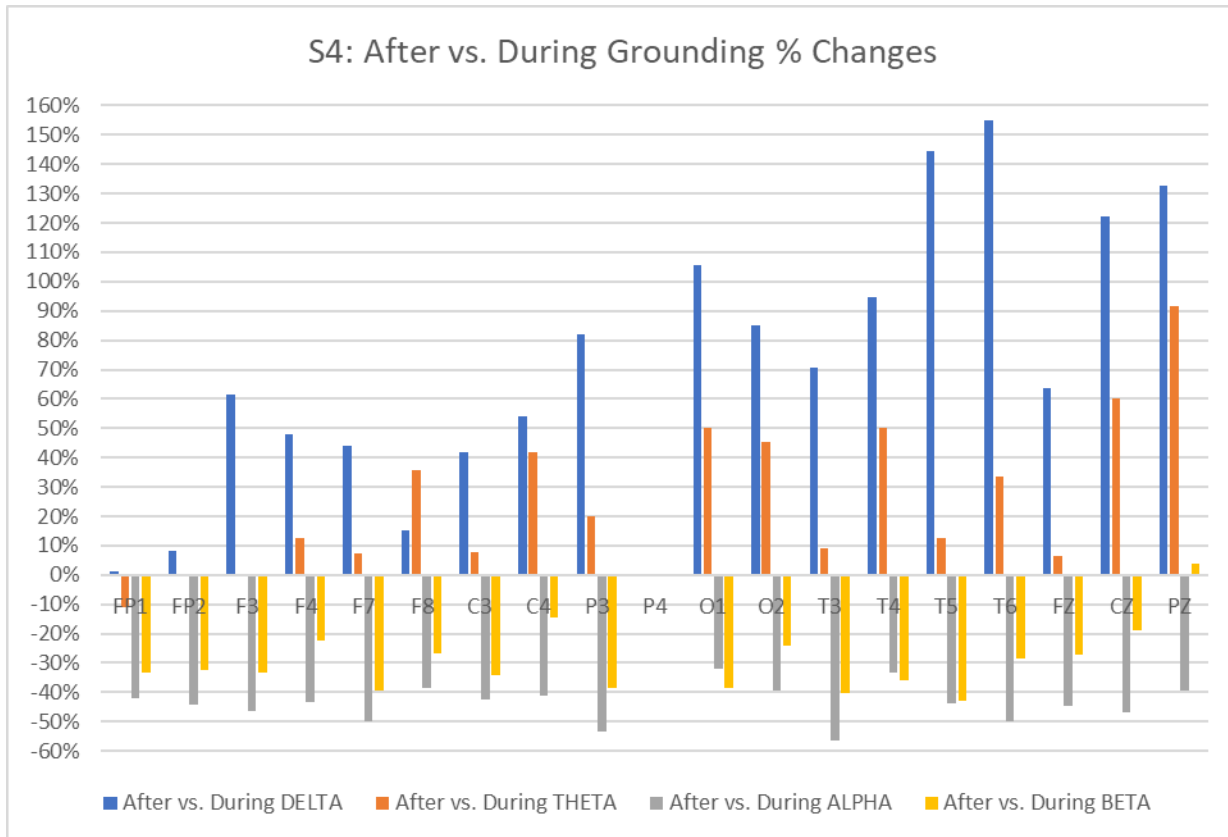
* Conclusion: Her brain became more receptive (decrease in Delta), more calm, peaceful and alert (increase in Alpha), but also with increasing mental activity and possibly some anxiety (increase in Beta; due to being cold?).

After vs. Before grounding



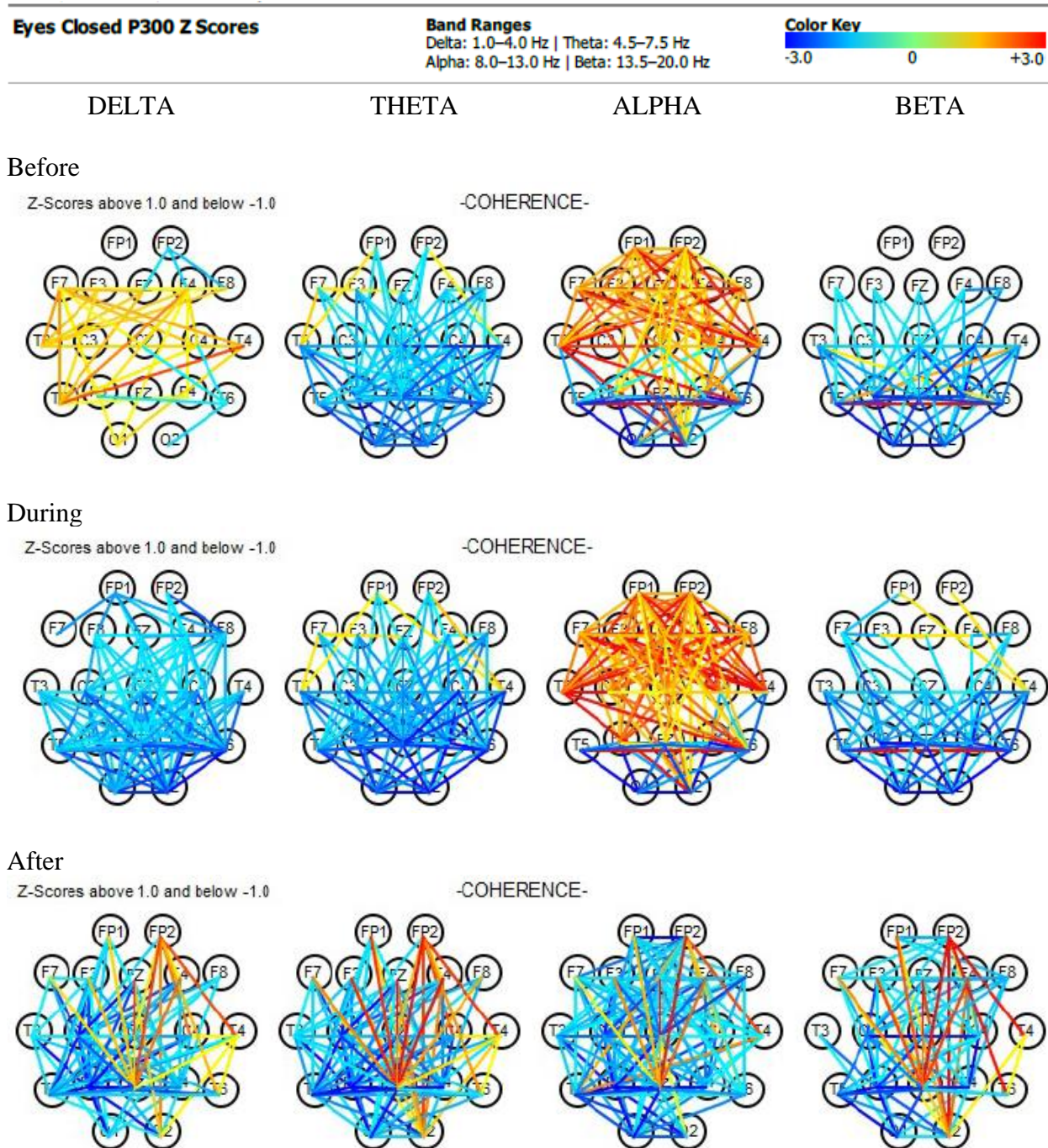
- * Delta increased very significantly at almost all electrode locations, indicating an increase in inhibition of brain functions interfering with internal concentration (21).
- * Theta increased significantly at C4, O1, O2, T4, T6, CZ and PZ, indicating an increase in cognitive control for brain functions related to these electrode locations (25).
- * C3, C4 and CZ deal with sensory and motor functions (6).
- * O1 and O2 are located under primary visual areas (6).
- * PZ: Integrating somato-sensory information with posterior visual perceptions, working memory (6).
- * The decrease in Alpha may be indicative of anxiety, PTSD, or short-term memory impairment. Low alpha increases cortisol in the brain, which affects the hippocampus and thus short-term memory (6).
- * Beta brainwaves are associated with a state of thinking, mental, intellectual activity and outwardly focused sustained concentration. A decrease in Beta thus reflects a decrease in these brain activities.
- * Conclusion: After grounding, S4 experienced an increase in anxiety (Alpha), an increase in cognitive control (Theta) and an increase in internal concentration (Delta).

After vs. During grounding



- * Delta increased very significantly at almost all electrode locations, more so than during grounding, indicating an extra-increase in inhibition of brain functions interfering with internal concentration (21).
- * Theta increased significantly at F8, C4, P3, O1, O2, T4, T6, CZ and PZ, indicating a further increase from during the grounding period in cognitive control for brain functions related to these electrode locations (25).
- * F8 is close to the source of emotional impulses (38).
- * The significant decrease in Alpha at all electrode sites may be indicative of an increase compared to during grounding of anxiety, PTSD, or short-term memory impairment. Low alpha increases cortisol in the brain, which affects the hippocampus and thus short-term memory.
- * Beta brainwaves are associated with a state of thinking, mental, intellectual activity and outwardly focused sustained concentration. A decrease in Beta thus reflects a decrease in these brain activities.
- * Conclusion: The brain condition comparing after vs. during grounding is experiencing an increase in anxiety, an increase in internal concentration and an increase in cognitive control above what was experienced during grounding.

Coherence Results

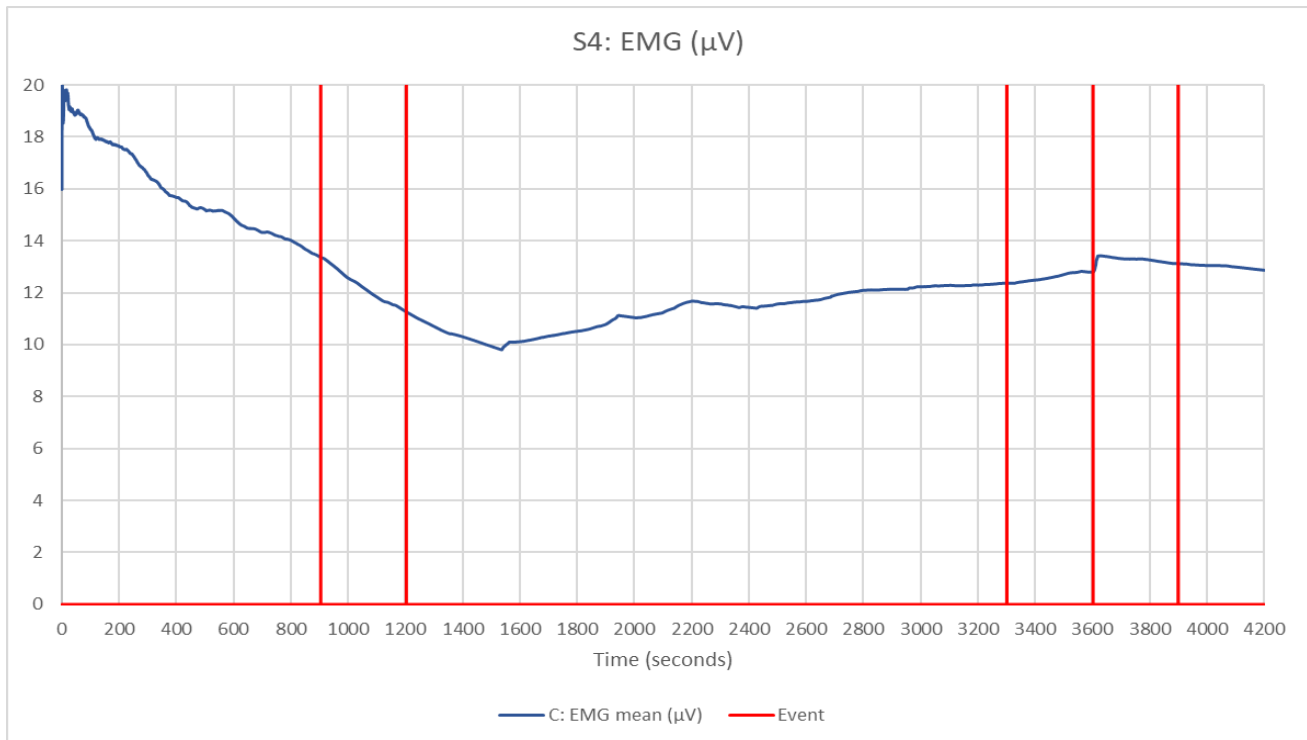


Before grounding, coherence was very high in the Alpha band for the frontal lobes. The frontal lobes coordinate higher executive functions such as attentional gating, decision making, problem solving, memory, social awareness, character, motivation, planning, judgment. The frontal lobes are responsible for immediate and sustained attention, social skills, emotions, empathy, time management, working memory, moral fiber or character, executive planning and initiative. They identify problems and may send them to other parts of the brain for resolution (6). High Alpha coherence in the frontal lobes indicates an increase in cognitive processing and attentiveness (36, 39). Delta coherence was also slightly enhanced an indication of increase in attentional processes, mainly decision making and attentional processes (40). During the grounding period, Alpha coherence in the frontal lobes increased, being high even in the temporal and parietal areas.

Temporal lobes regulate auditory association cortex; phonetics, letters to sound, grasping the whole picture vs. sensing everything in fragments, episodic memory, emotional valence and regulation of temper (emotions) (6). Parietal lobes functions are: organization, integration, and synthesis of auditory, visual perception, and kinesthetic inputs, orientation, cognitive processing and attention. The parietal lobes solve the problems that the frontal lobes conceptualize. It is often labeled the “association cortex” (6). Coherence decreased significantly in the alpha band after the grounding period, an indication of a decrease in the need of higher level of attentiveness and cognition after grounding possibly due to the resolution of her being cold by giving her a blanket.

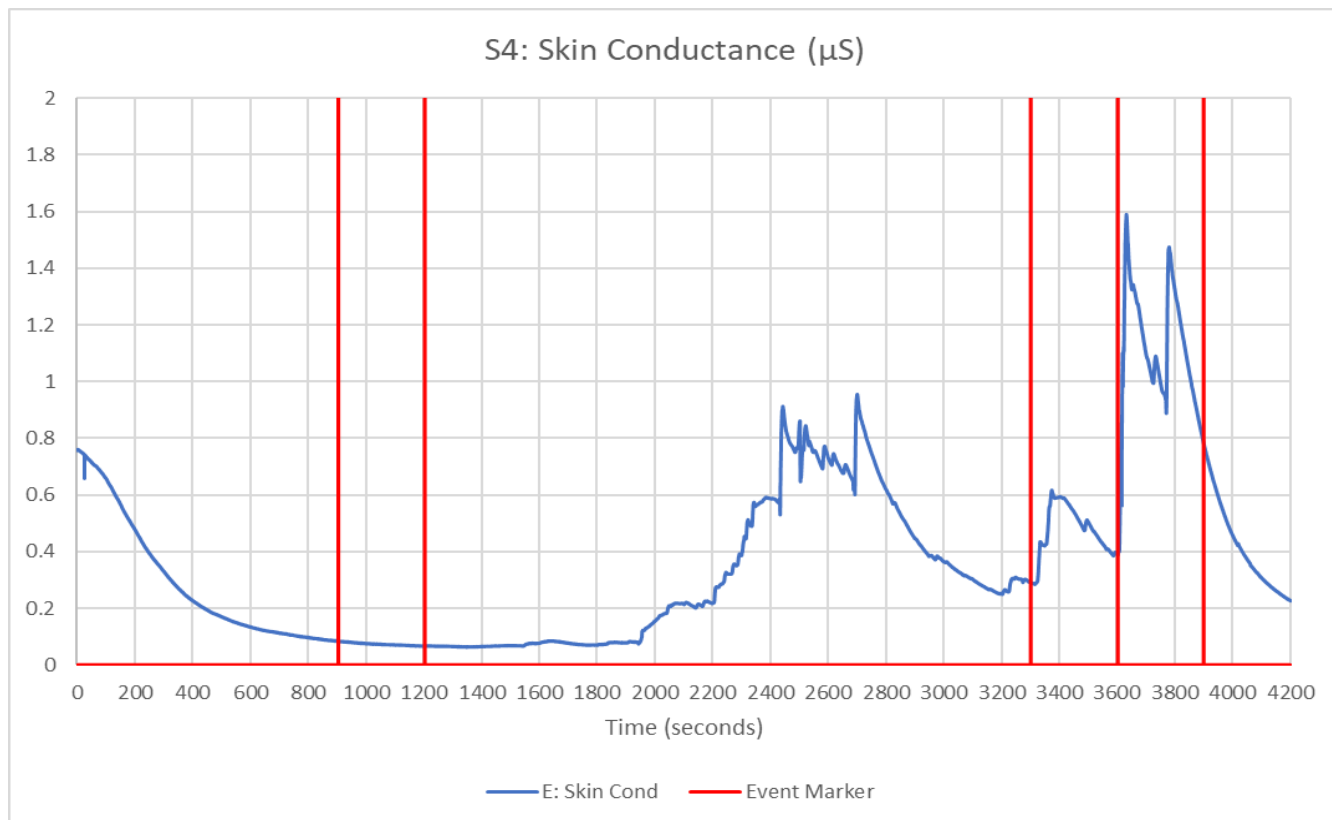
Also note that during the grounding period, Delta and Theta coherence decreased (as showed by the increase in the number of blue lines) indicating that the subject turned her focus inward (21, 25). Delta and Theta coherence started to increase specially on the right hemisphere after grounding indicating an increase in internal processing of information related to imagination and other functions of the right hemisphere. Beta coherence remained similar before and during grounding but increased after grounding, especially on the right hemisphere, indicating that the subject became more aware of the surroundings and more focused externally after the grounding period.

Electromyography (EMG) Results



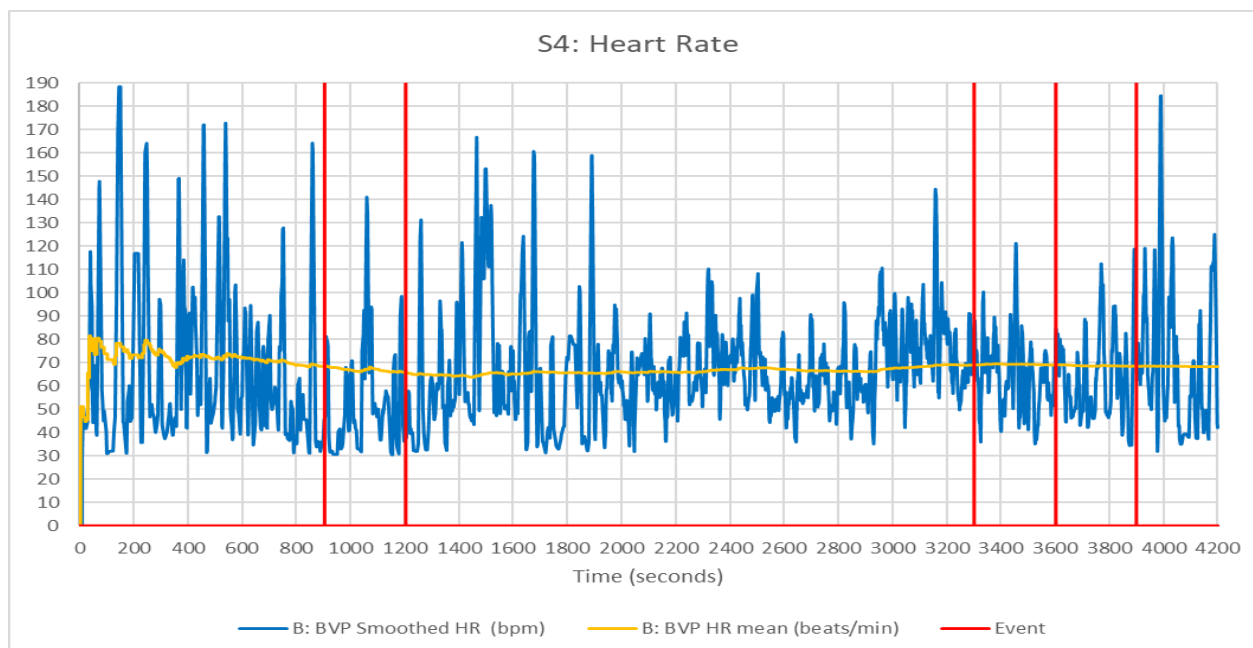
The graph above shows Subject 4 relaxing her trapezius muscles up to about 5.5 minutes in the grounding period. Then the muscles started to tense. Note the sharp increase in muscle tension just at the time of ungrounding (at the 4th vertical line).

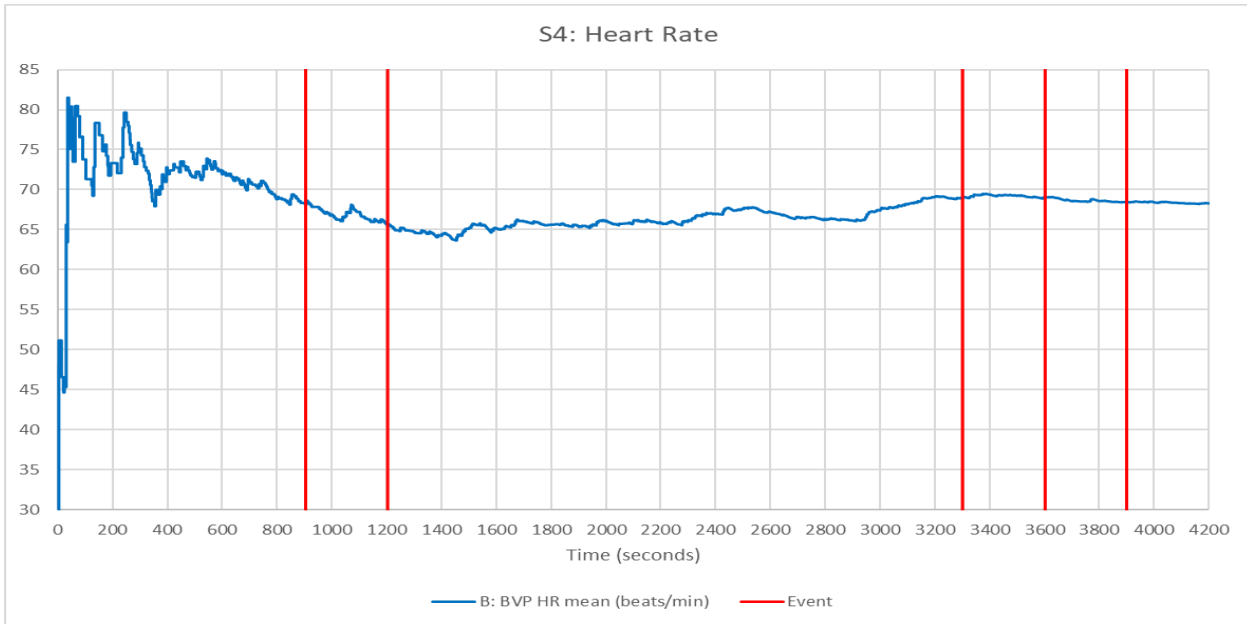
Skin Conductance (SC) Results



Subject 4 skin conductance decreased for about 33 minutes after the start of the session indicating parasympathetic system activation (i.e. ANS relaxation). Then skin conductance increased substantially for about 8 minutes, stabilizing (with sharp peaks going up and down) for about 4 minutes before decreasing again for another 8 minutes. There is a very large and sharp increase right at the grounding time (60 minutes after the start of the session) indicating sympathetic system activation (i.e. ANS excitation). After 3 minutes skin conductance decreases again until the end of the session.

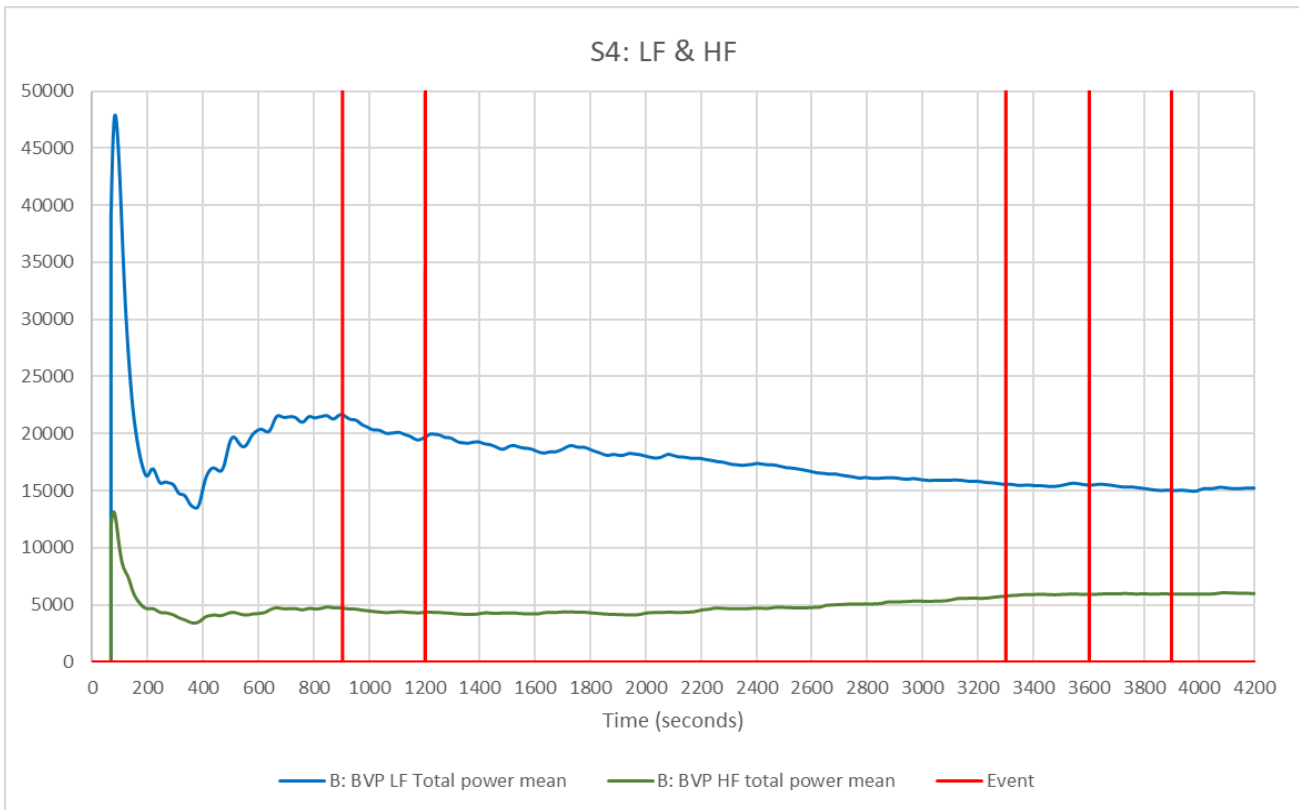
Heart Rate Results





Subject 4 heart rate has a large variability as can be seen from the values of BVP Smoothed HR (blue line, top graph). It can be observed from the lower graph (reproducing the yellow line of the upper graph) that the average heart rate started at 77 beats per min and that it decreased for about 24 minutes to 64 beats per minute. After that it started to increase very slowly for the next 19 minutes to a maximum of 69 beats per minute before staying essentially stable for the rest of the session.

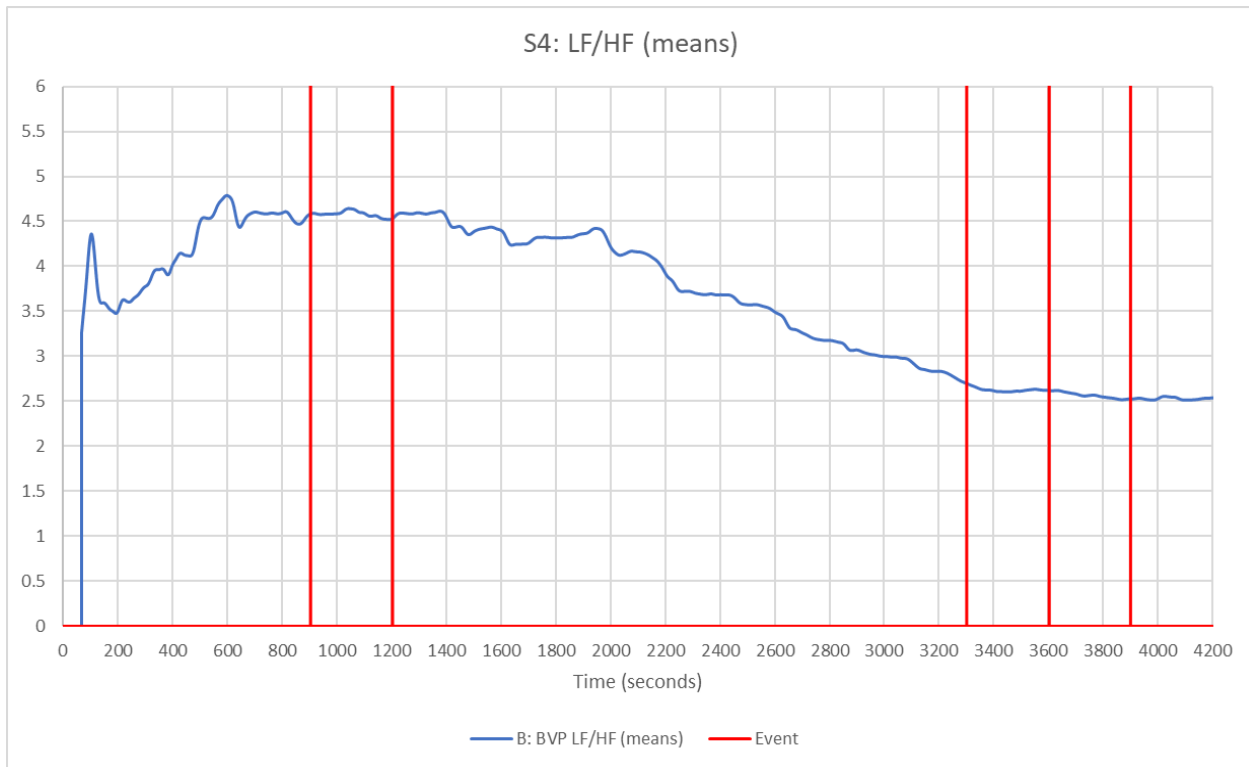
Low-Frequency (LF) and High-Frequency (HF) Results



The first observation for Subject 4 is that LF stayed much higher than HF for the entire session. This indicates activation of the sympathetic nervous system (high level of stress) for the entire session. About 1.5 minutes after the start of the session both LF and HF increased rapidly with LF increasing to a much higher value than HF, producing a high peak. This is followed by a rapid decrease for

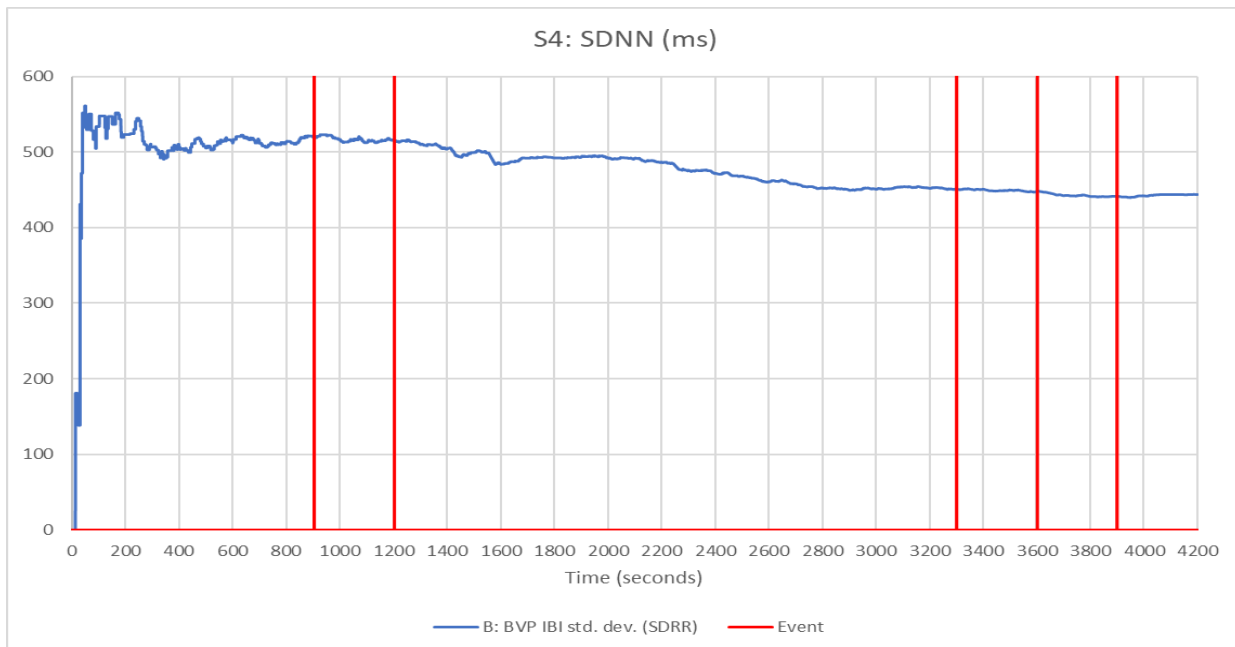
about 5 minutes. There is then another, less rapid increase for about 5 minutes followed by a slow decrease for the rest of the session for LF while HF stayed more or less stable for 21 minutes before increasing slowly again for the rest of the session.

LF/HF Results



About 1.5 minutes after the start of the session, there is a small peak in LF/HF that lasts only for one minute. Then there is an increase for about 7 minutes, followed by a stable period lasting for about 13 minutes. After that there is a slow decrease for the rest of the session. Note that, contrary to the first 3 subjects, Subject 4's LF/HF is much higher than 1.0 for the entire session, an indication of stress.

SDNN Results



After a rapid increase for about one minute, SDNN decreased slowly during the entire session. Note that Subject 4's SDNN is much higher than that of the previous subjects. It is accepted that high value of SDNN is desirable because it reflects increased variability and high variability is considered healthy for the heart. Subject 4's SDNN is high enough to be considered a sign of attentive arousal or alertness.

Summary of Findings for Subject 4

Brain mapping: Before grounding, Subject 4's frontal lobes were very active which indicates high alertness, emotional control and cortical processing efficiency and selectivity of the brain related to executive planning and attention but in a calm and composed way. During grounding, the situation is similar to before grounding but slightly intensified. It is about in the middle of the grounding period that the subject started to be cold and asked for a blanket. Despite this situation, her brain became more receptive, more calm, peaceful and alert than before grounding. After grounding, Subject 4 kept moving to change position (her initial position was sitting erect not touching the back of the grounding chair but after about 45 minutes she needed to change position). The brain was working to suppress the activities of the normal awake brain in an attempt to continue meditation. There was evidence of an increase in anxiety, an increase in internal concentration and an increase in cognitive control above what was experienced during grounding.

Trapezius Muscles: Subject 4 experienced progressive relaxing of the trapezius muscles up to about 5.5 minutes after the start of the grounding period. Then the muscles started to tense possibly because of the discomfort of being cold. However, the use of the term "relaxing" here is relative as the tension in her trapezius muscles was much larger than for the previous 3 subjects. Note the sharp increase in muscle tension just at the time of ungrounding (4th vertical line).

Skin Conductance: Initially, Subject 4's skin conductance decreased for about 33 minutes (13 minutes into the grounding period) indicating parasympathetic system activation (i.e. nervous system relaxation). Then SC start to increase and reach its highest value 45 minutes after the start of the session (25 minutes after the beginning of the grounding period). This result is in agreement with the results published by Chevalier 2010 (34). Note the very large increase in SC at the ungrounding time (60 minutes after the start of the session).

Heart rate: Subject 4 heart rate has a large variability. The average heart rate started at about 77 beats per min and decreased for about 24 minutes to 64 beats per minute. After that it started to increase very slowly for the next 19 minutes before staying essentially stable for the rest of the session. Note the increase in heart rate reaching a maximum at about 23 minutes into the grounding session. This is again in agreement with the heart rate increase result published by Chevalier 2010 (34).

LF and HF: For the entire session, LF was much higher than HF indicating sympathetic system activation (stress).

LF/HF is clearly way above 1.0 indicating sympathetic system activation (stress). The stress reached its maximum about 10 minutes into the session, stay about the same for 13 minutes and decreases for the rest of the session. At its lowest value LF/HF is still at 2.5. So, it seems that grounding helped her destress a little.

SDNN was much larger than for the previous three subjects, indicating arousal and vigilance for the entire session with a little decreased in arousal after the start of the grounding period.

Overall: Before grounding, Subject 4's frontal lobes were very active which indicates high alertness, emotional control and cortical processing efficiency and selectivity of the brain related to executive planning and attention but in a calm and composed way. During grounding, the situation is similar to before grounding but slightly intensified. Despite being cold, her brain became more receptive, more calm, peaceful and alert than before grounding. After grounding, Subject 4 kept moving to change position. There was evidence of an increase in anxiety, an increase in internal concentration and an increase in cognitive control above what was experienced during grounding. Trapezius muscle tension was higher than for other subjects, probably a feature of this subject. Skin conductance and heart rate are suggestive of a healing response. However, such indications of a healing response were not seen in the HRV parameters.

Subject 5

Female, 45, tutor. Her meditation technique is Kriya Yoga as taught by Self Realization Fellowship. She has been meditating for 10 years 3 to 4 hours daily. She asked for the experiment to be stopped about 10 to 15 minutes into the grounding period claiming that her grounding experience was very unpleasant. In the Meditation Quality Assessment form, she gives a long description of what happened during her meditation: "Switching on affected silent inward prayer. I was recalling the Gurus of my lineage. It altered my thinking and I lost my place, I dropped back 2 Gurus in the sequence. I lost the pin point focus at the spiritual eye. It was as though an energy came up my body and there was a man of light at my right eye with an uncomfortable parure(?)... Internally my body started experiencing heat. I would describe it as very unpleasant. I asked for the study to stop. The relief was not immediate. It felt as though the energy was draining from my body."

Because of her early withdrawal, we have no usable data, having only the brain mapping recording before the start of the grounding period.

Subject 6

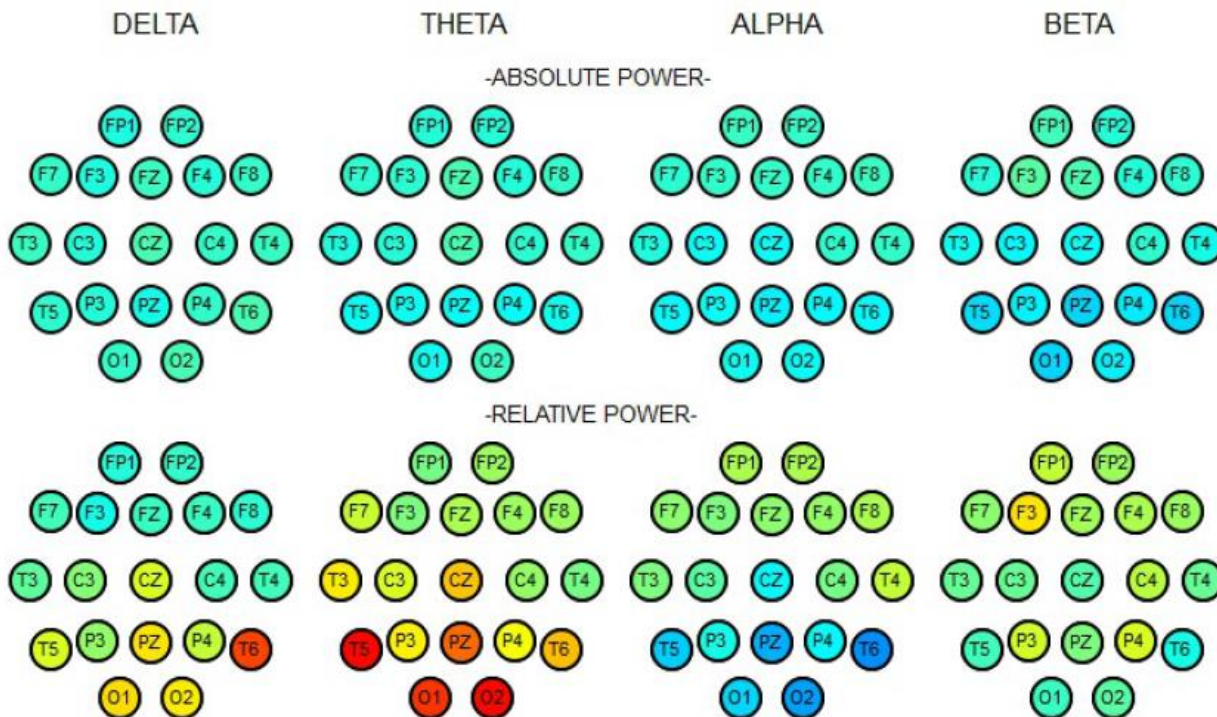
Male, 63, Realtor. He experiences shortness of breath with mild or light exertion. He takes Ventolin once or twice a week. The meditation practice he used is a form of stillness meditation. He has been meditating for 7-8 years for about 30 minutes twice daily. He wrote that he felt much better after the meditation but later he wrote that because of the length of the meditation – longer than his usual – that he feels slightly better than usual.

Brain Mapping Results

Before grounding

Eyes Closed P300 Z Scores
Session 1 (5/30/2019)

Band Ranges
Delta: 1.0-4.0 Hz | Theta: 4.5-7.5 Hz
Alpha: 8.0-13.0 Hz | Beta: 13.5-20.0 Hz

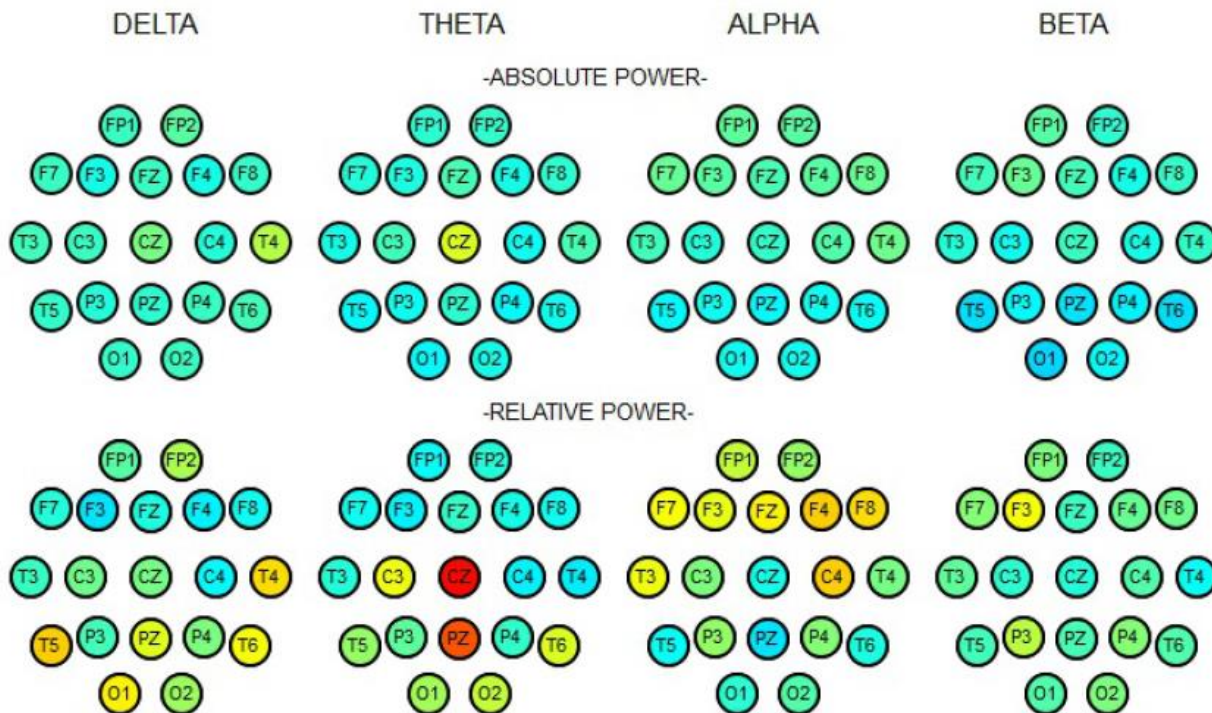


Subject 6 absolute power is normal but with a tendency toward low activity (light green to light blue). Relative power shows high activity in Theta for electrode sites in the posterior region of the brain, mainly T5, O1, O2 and, to a lesser extent PZ. This is associated with internal focus, hyper-vigilance, meditation, prayer and spiritual awareness (6). Note also the low activity in the Alpha band for the same region of the brain which is due to Alpha being inversely related to cortical activity (12, 13, 14). T5 functions include logical (verbal) understanding, verbal and reading comprehension, comprehension of auditory and visual perception, long term memory both visual and auditory (6, 11). O1 and O2 main functions are visual processing (right half of visual space for O1 and left half for O2) with other functions such as visual association cortex, procedural memory and visual perception (6, 11). PZ is about integrating somato-sensory information with posterior visual perceptions, working memory, spatial relations, route finding and praxis (6, 11). These results indicate good level of internal focus and concentration (6). In the Delta band only T6 is hyper-active. T6 monitors brain functions related to emotional understanding, physical awareness (insula), facial and symbol recognition - social cues (6, 11). T6 activation in the Delta band is an indication of an increase in inhibition of brain functions interfering with internal concentration related to T6 brain functions (21).

During grounding

Eyes Closed P300 Z Scores
Session 2 (5/30/2019)

Band Ranges
 Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
 Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

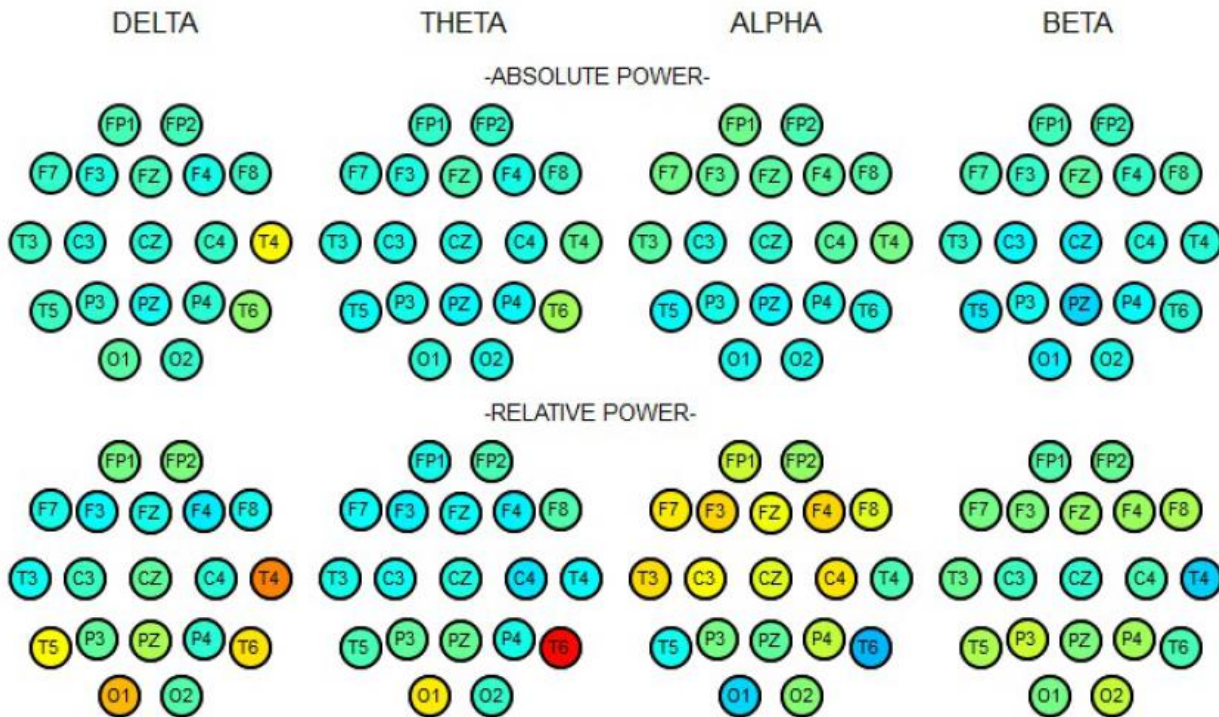


During grounding, absolute power is normal but again with a tendency toward low activity (light green to light blue). Relative power shows high activity for CZ and PZ. CZ records sensory-motor functions and integration of both lower extremities and midline, short term memory, awareness of body, body position, body movement, coordination of sensory input with motor output, gross motor activity, walking, throwing a ball, fine motor movements (6, 11). PZ is about perception, integrating somato-sensory information with posterior visual perceptions, spatial relations, route finding and working memory (6, 11). Both sites are about spatial discrimination and the ability to identify where bodily functions originate. They are also responsible for both the external senses of touch, temperature, pain and the internal senses of joint position, visceral state and pain. So, an increase in activity at CZ and PZ in the Theta band indicates an increase in cognitive control over the brain functions related to those 2 locations (25). There is also a small increase in Alpha mainly in the frontal area, an indication of relaxation.

After grounding

**Eyes Closed P300 Z Scores
Session 3 (5/30/2019)**

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz



After grounding, Subject 6 absolute power is still normal but again with a tendency toward low activity (light green to light blue). Relative power shows high activity for T6 in the Theta band. T6 monitors brain functions related to emotional understanding, physical awareness (insula), facial and symbol recognition - social cues (6, 11). An increase in Delta at T6 indicates an increase in inhibition of brain functions interfering with internal concentration related to brain functions recorded at T6 and more so than during the grounding period (25). Relatively high Alpha activity in the frontal cortex reflects a relaxed, peaceful alertness (Alpha activation exhibits an inverse correlation with cognitive performance so it is not surprising to find that high activation at T6 in the Theta band correlates with low Alpha activity at the same electrode site).

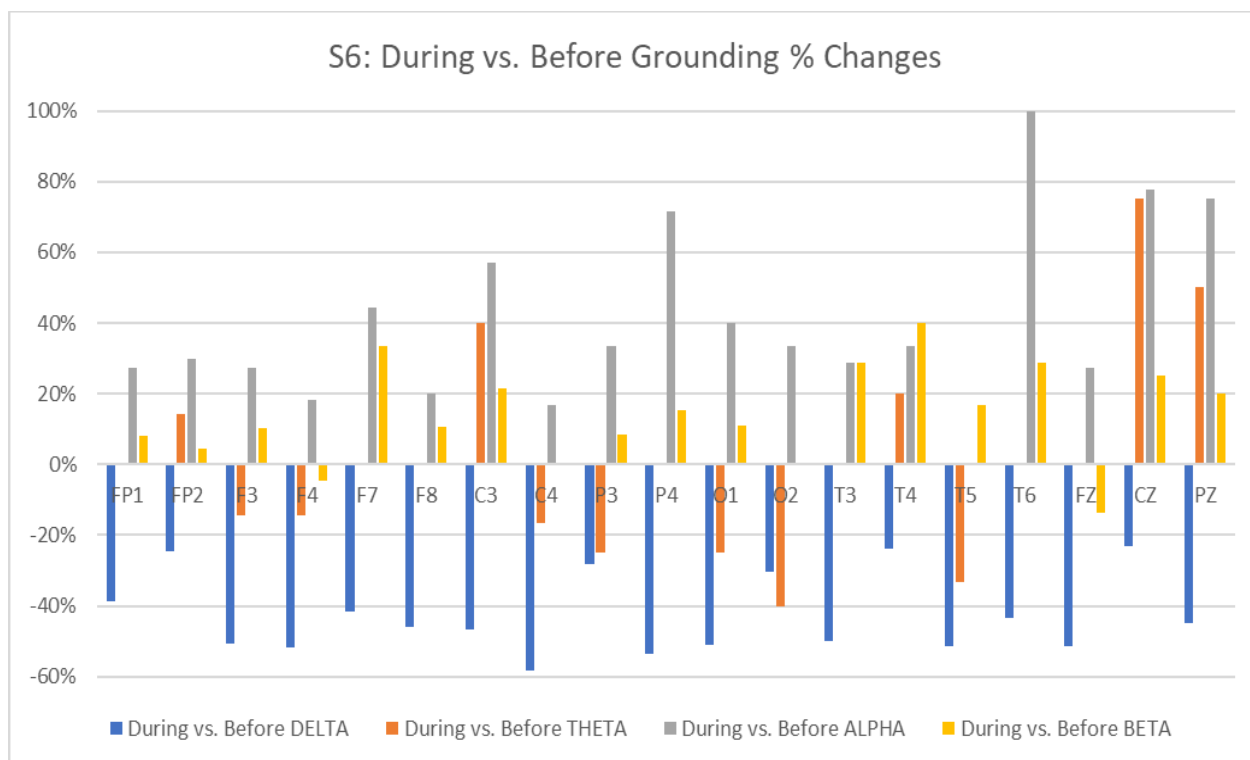
CZ Theta/Beta and F3/F4 Alpha

Researchers have shown that calculating the relative power ratio Theta/Beta at CZ can be used to determine slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (6, 17, 18). They also discovered that calculating F3/F4 relative power ratio in the Alpha band means processing information in a positive way for an increase while a decrease in the ratio indicated a more negative processing mode (19, 20). The table below give the result of all 3 sessions for Subject 6.

	Subject #6			Ref Range (65 yrs)
	Session 1	Session 2	Session 3	
CZ Theta/Beta	2.0	2.2	0.8	0.8-2.8
F3/F4 Alpha	1.1	1.1	1.1	0.8-1.2

It can be observed that both CZ Theta/Beta and F3/F4 Alpha started in the normal range and stayed in the normal range during and after grounding.

During vs. Before grounding



* Delta decreased significantly at all locations indicating a decrease in inhibition of brain functions interfering with internal concentration (19), i.e. the brain is going into a receptivity mode.

* Very significant increases in Theta for C3, CZ and PZ, indicating an increase in brain functions interfering with internal concentration related to the functions related to these brain function.

* C3: hand and digits (with F3 – handwriting and inhibit or execute action), audition, happiness, syntax.

* CZ records the functions of the somato-sensory association cortex (6).

* PZ is about integrating somato-sensory information with posterior visual perceptions, working memory. Posterior parietal cortex - sense of direction, parietal and occipital – procedural memory. Posterior PZ may involve long term memory, sensory integration and some quick decisions in crisis situation (6).

*Theta decreased significantly for P3, O1, O2, and T5, indicating a release from control for these locations. (25)

* P3: Language processing, integration of self, logical reasoning and memory, imagination, spelling and short-term memory, math calculations, naming objects, complex grammar, sentence construction and math processing (right side body awareness) (6).

* O1: memory encoding with semantic tasks (6).

* O2: perception, vision, color (somewhat shape and motion) (6).

* T3 and T5: Long term verbal and visual memory, linguistic and reading perception and comprehension, processing integration and perception of auditory input, visual perception of what an object is, “Inner voice”, positive mood. (6)

* Alpha increased significantly at all locations, except F4, C4, and T5. This is associated with a state of relaxation, peacefulness and alertness.

* Beta increased significantly for F7, C3, T3, T4, T6, and CZ and PZ.

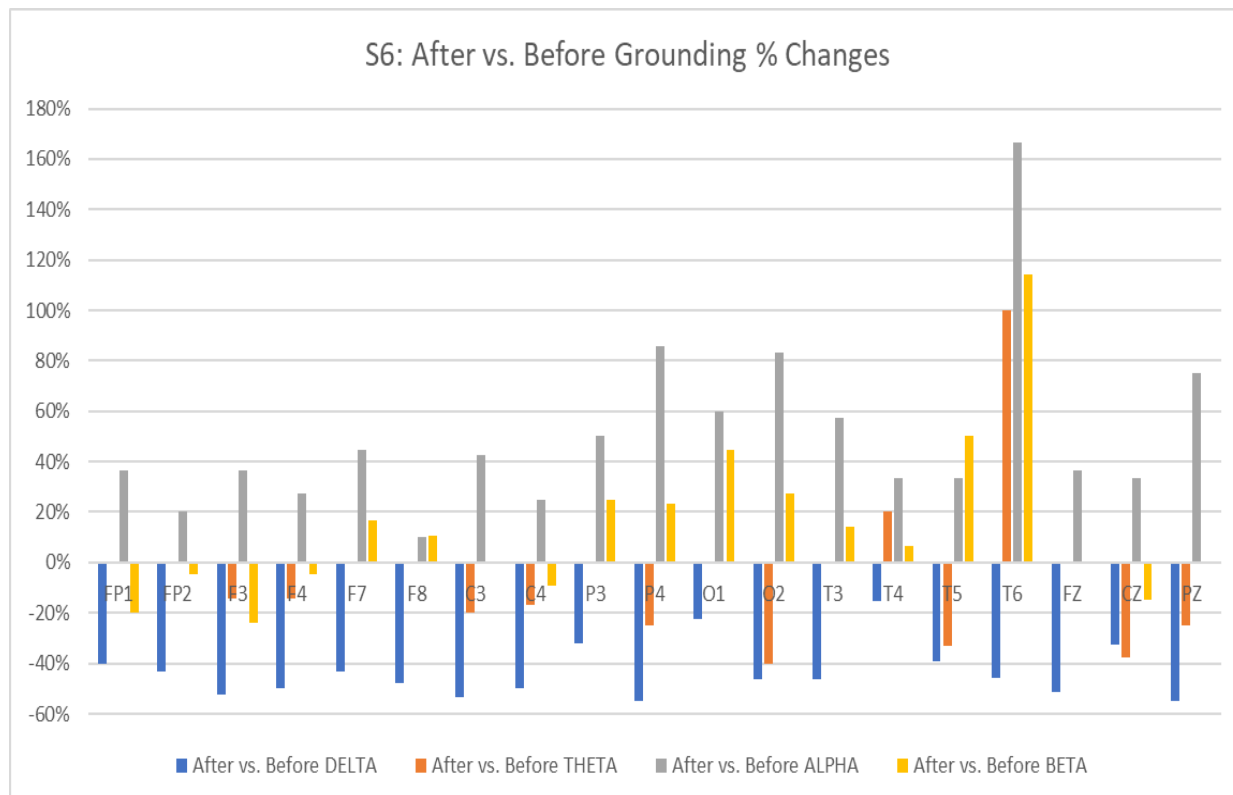
* F7: Creates and controls output of spoken and written language, visual and auditory working memory, selective attention, Broca's area (word retrieval, semantics, verbal understanding, speech), divided and selective attention. (6)

* F7 is near centers for rational activities (38).

* T4 and T6: conscious emotional and physical awareness (insula), sense of direction visual memory & visualization, categorization, facial recognition, sound voice intonation perception, music, spatial and facial perception - social cues. (6)

* Conclusion: Subject 6 relaxed very well and went into a deep state of meditation (Alpha state) during grounding.

After vs. Before grounding



* Delta decreased significantly at almost all locations (except T4) indicating a decrease in inhibitory oscillations (21), i.e. the brain continued to be in a receptivity mode during grounding.

* Significant increases in Theta for T4 and specially T6.

* T4 and T6: conscious emotional and physical awareness (insula), sense of direction visual memory & visualization, categorization, facial recognition, sound voice, intonation perception, music, spatial and facial perception - social cues. (6)

* Theta decreased significantly for C3, P4, O2, T5, and CZ and PZ, indicating a release from control for these locations. (25)

* P4: Visual-spatial sketch pad, image and spatial processing, facial decoding, integration with environment, spatial memory, perhaps dysfunction effects self-concern, map orientation, knowing the difference between right and left, self in space, music, body image, physical act of dressing (left side body awareness) (6).

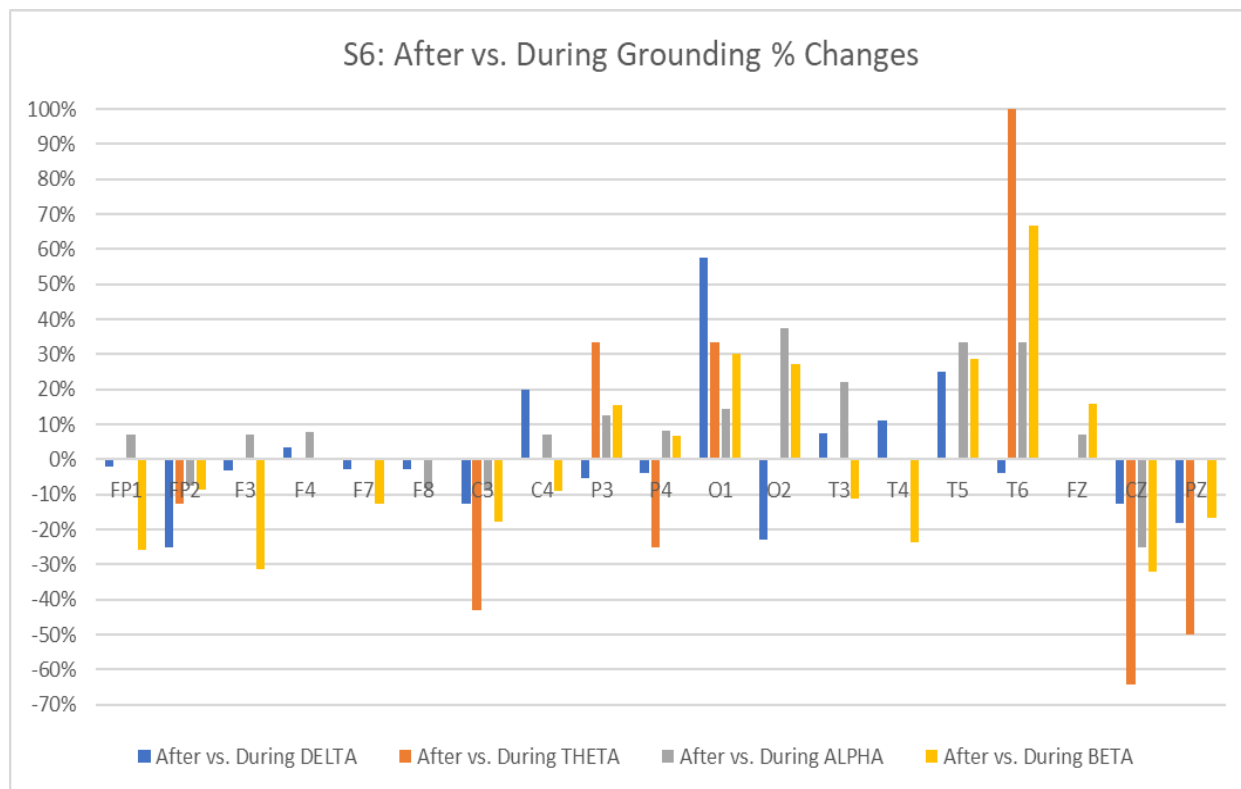
* Alpha increased significantly at all locations, except F8, even more than during grounding. This indicate the continuation of a state of relaxation, peacefulness and alertness.

* Beta increased significantly for P3, P4, O1, O2, and specially T5 and T6, indicating mental activity increase in these locations.

* Beta decreased significantly for Fp1 and F3.

- * Fp1: verbal retrieval, visual working memory, verbal analytical and approach behaviors (6).
- * F3: Judgment, planning, sustain attention, inhibition of responses, verbal episodic memory retrieval, problem solving, sequencing, deducing facts to conclusions (6).
- * Conclusion: Subject 6 continued to relax even more than during grounding going into a deep state of meditation (Alpha state).

After vs. During grounding

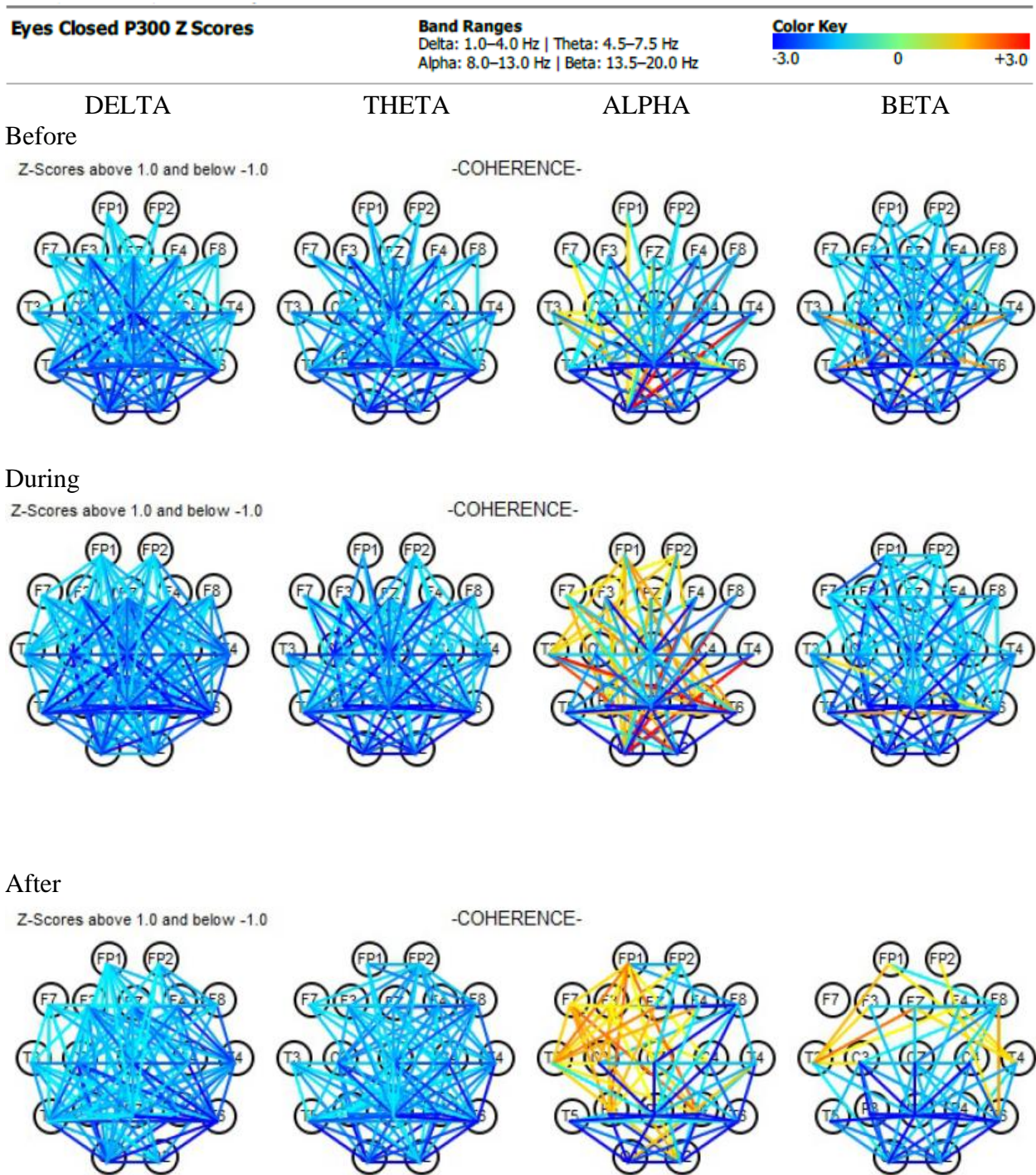


- * Delta increased significantly at C4, O1, and T5, indicating an increase in inhibition of brain functions interfering with internal concentration at these locations after grounding more than during grounding (21).
- * Delta decreased significantly at Fp2 (emotional/contextual attention) and O2, indicating a decrease in inhibition of brain functions interfering with internal concentration at these locations (21).
- * Theta increased significantly at P3, O1 and specially at T6, indicating an increase in cognitive control over those locations (25).
- * Theta decreased significantly at C3, P4, CZ and PZ, indicating a decrease from cognitive control in these locations.
- * Alpha increased significantly at O2, T3, T5 and T6.
- * T3 and T5: comprehension both verbal and reading, visual perception of what an object is, processing integration and perception of auditory input, comprehension of auditory and visual perception (reading and word recognition), long term memory – auditory (verbal) and visual, linguistic perception and comprehension, “Inner voice”, positive mood (6).
- * T4 and T6: conscious emotional and physical awareness (insula), sense of direction, visual memory and visualization, categorization, facial recognition, sound voice intonation perception, music, spatial and facial perception - social cues (6).
- * Alpha decreased significantly only at CZ.
- * Beta increased significantly at O1, O2, T5 and specially T6.
- * Beta decreased significantly at Fp1, F3, T4 and CZ.

* However, on average all 4 frequency bands did not change significantly, indicating changes in local areas only.

* **Conclusion:** There are small differences between after and during grounding except at T6, indicating a controlled arousal of emotional and physical awareness related to visual memory and visualization.

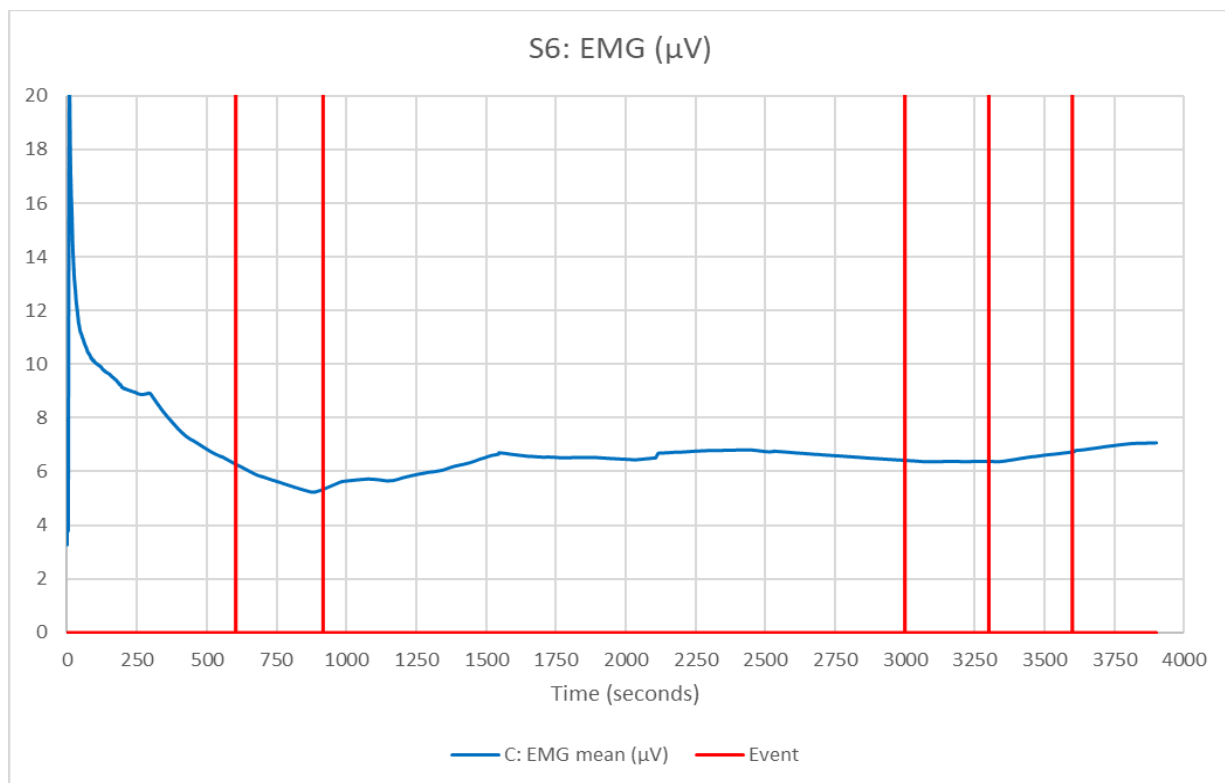
Coherence Results



Before grounding, coherence was quite low for all frequency bands with Alpha showing a few positive correlations in the left hemisphere before grounding. Low coherence is associated with diminished cognitive efficiency and functional connectivity (6, 11). It is a sign that the brain is not able to efficiently connect cortical areas to perform specific tasks (6). It results in decreased

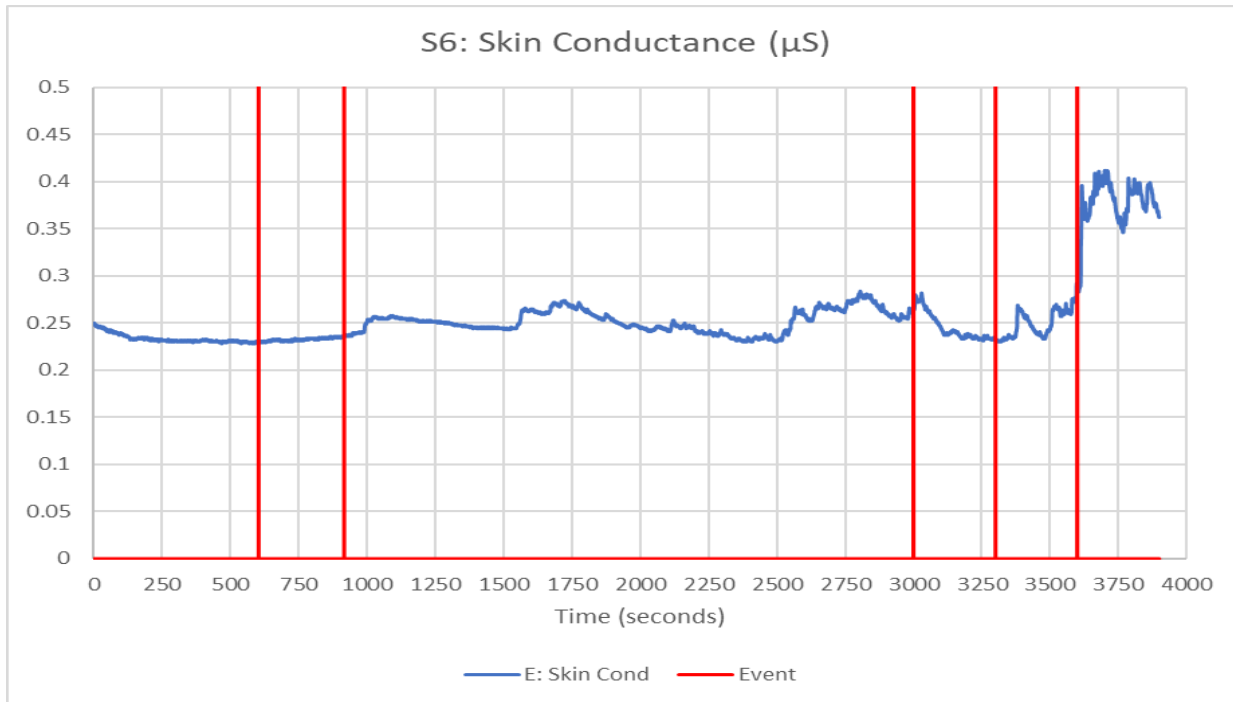
information transfer between cortical areas (41). Decreased coherence also results in less cooperation than normal, leading to reduced efficiency, longer processing time, and mistakes (11). Low coherence in the theta band is an indicator of lower functioning memory, visual short-term memory, behavioral deficits and impairment in other cognitive operations (42). Low coherence in the delta band indicate a decrease in large-scale, distant cortical networks coordination related to decision making. In other words, in conditions not requiring decision making, delta-band coherences are typically much reduced (24). Coherence increased in the Alpha band during grounding and even more so after grounding indicating intercommunication activity of the functions related to that hemisphere (detailed analysis, sequential and linguistic thinking, logic, analytical reasoning, etc.) but in a calm, objective manner (6). It also indicates quiet wakefulness (43). Coherence increased in the frontal lobes for the Beta band after grounding. The frontal lobes coordinate higher executive functions such as attentional gating, decision making, problem solving, memory, social awareness, character, motivation, planning, judgment. The frontal lobes are responsible for immediate and sustained attention, social skills, emotions, empathy, time management, working memory, moral fiber or character, executive planning and initiative. They identify problems and may send them to other parts of the brain for resolution (6). An increase in frontal lobes coherence in Beta implies an increase mental activity related to the functions coordinated by the frontal lobes (6).

Electromyography (EMG) Results



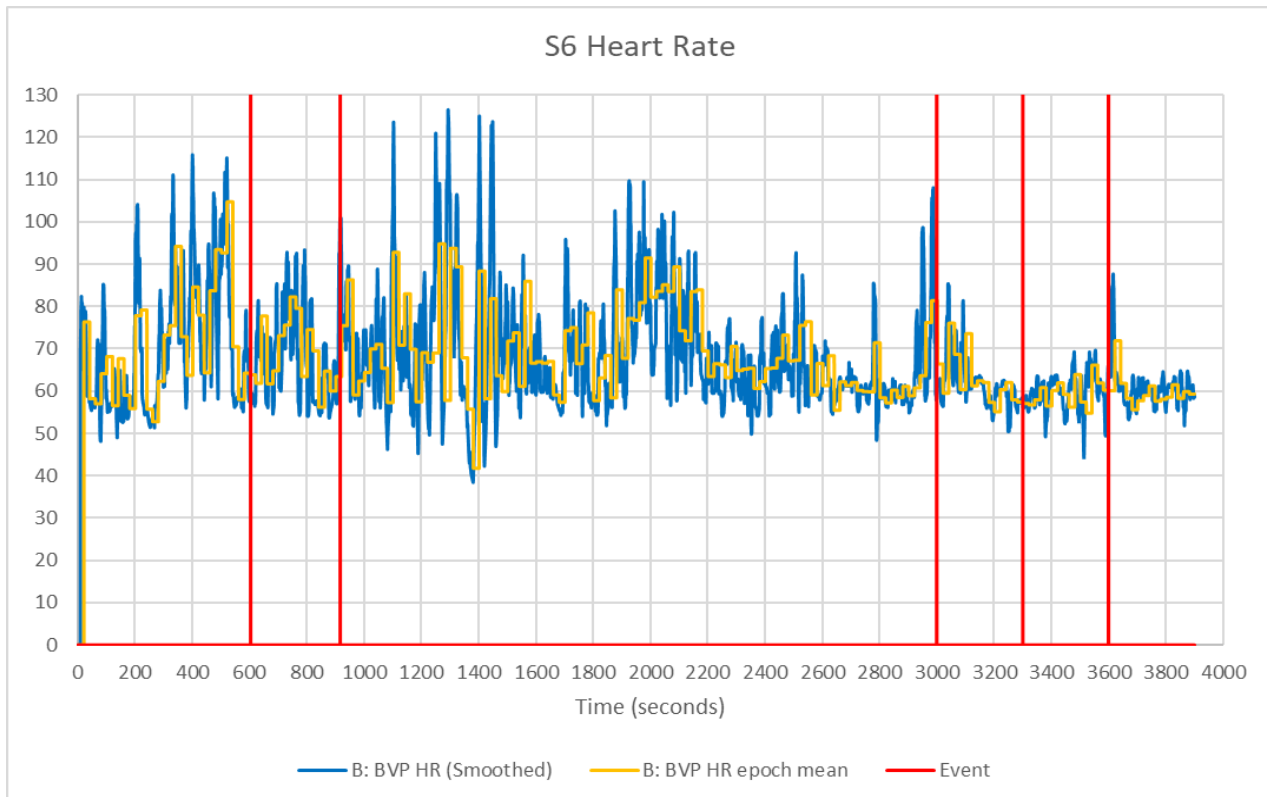
The graph above shows Subject 6 relaxing his trapezius muscles up to about the start of grounding period 15 minutes from the start of the session. Then the muscles tensed a little until about 11 minutes in the grounding period and remained at about the same level of tension for the rest of the experiment.

Skin Conductance (SC) Results



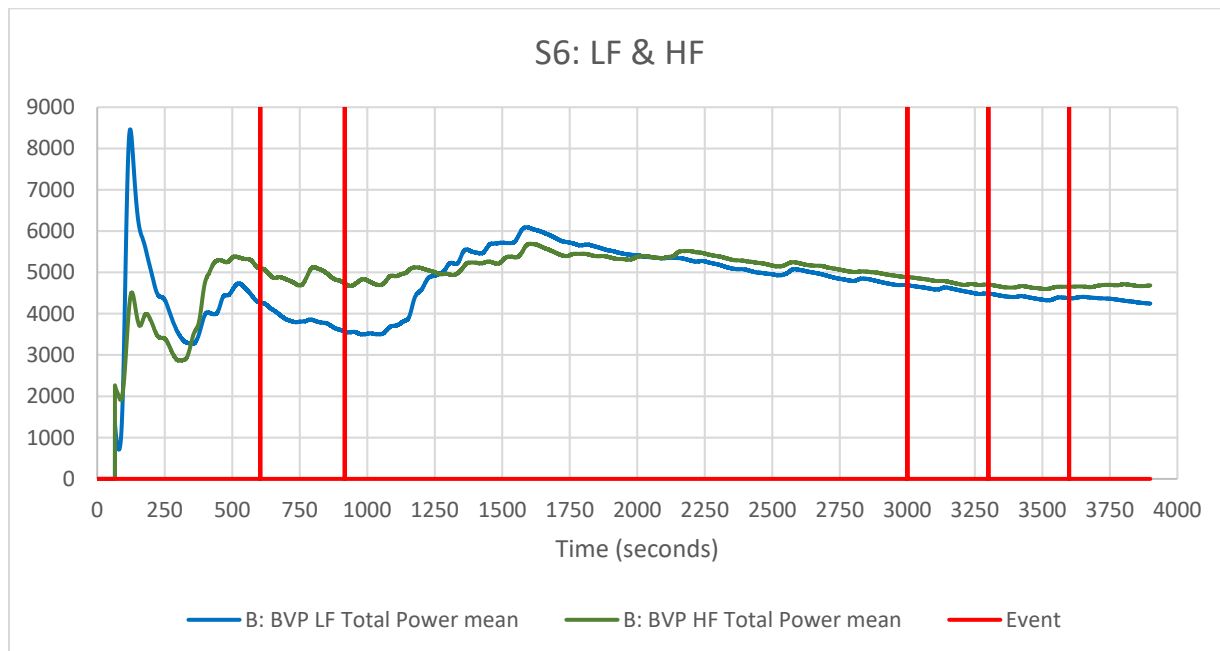
After a small decrease initially (for about 8 minutes) Subject 6 skin conductance remained quite stable for most of the session, increasing sharply at the beginning of the second brain mapping recording (60 minutes after the start of the session; 5 minutes after the end of the grounding period), remaining high for the rest of the session.

Heart Rate Results



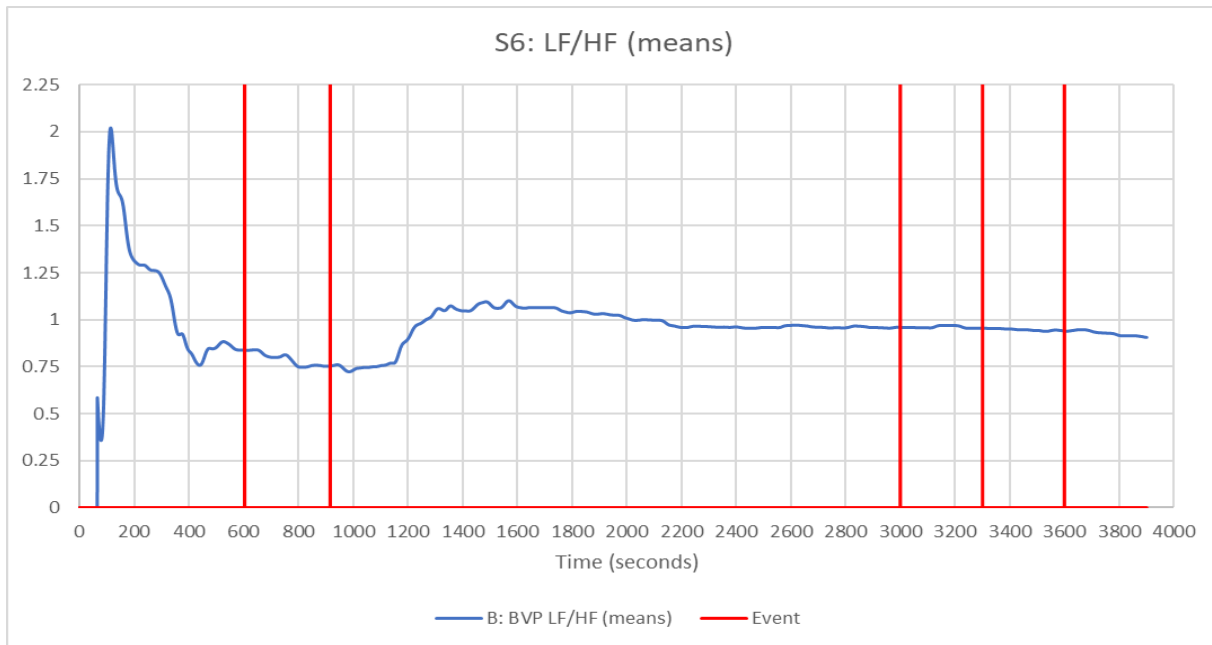
Subject 6 heart rate had a large variability up to about 37 minutes into the session (22 minutes into the grounding period). Despite the large variability, it can be observed that the average heart rate started at round 60 beats per minute then increased to around 100 beats per minute 9 minutes after the start of the session. It then decreased to between 60 and 70 beats per minutes (with large variability) until about 31 minutes into the session, reaching a maximum of about 90 beats per minute about 35 minutes into the session (20 minutes into the grounding period). It finally decreased slowly to come down to about 60 beats per minute at the end of the session. Note again that the increase in heart beat in the middle of the grounding session is in agreement with the results obtained in Chevalier 2010 and consistent with a healing response.

Low-Frequency (LF) and High-Frequency (HF) Results



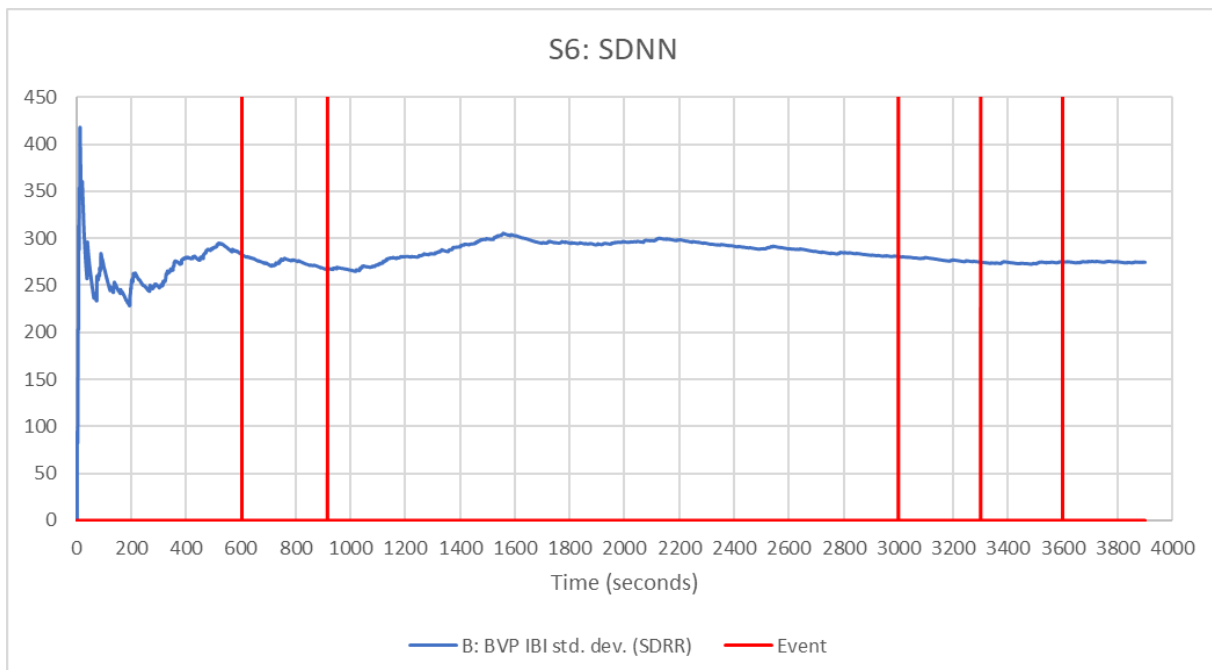
As it is the case for Subject 1, 2 and 3, the first observation is that LF and HF remained close together in value for the entire session, with the largest divergence starting 6.5 minutes after the start of the session and lasting for about 14 minutes. The second observation is that LF and HF increased rapidly for the first 2 minutes. During that time LF raised to a much higher value than HF, producing a large peak. This large peak is probably an artifact due to calculations onset and/or subject initial stress of getting ready for the session. Then there is a switch and HF became higher than HF for about 14 minutes, stayed more or less higher than HF until about 21 minutes into the session. At that time, a reversal occurred again and HF became slightly higher than HF for about 12.5 minutes (33.5 minutes into the session, 18.5 minutes into the grounding period), time at which a final reversal occurred where HF became higher than LF until the end of the session, indicating an improvement in relaxation. The reversal to a higher HF in the middle of the grounded period is consistent with a healing response.

LF/HF Results



After one minute and a half, LF/HF increased rapidly resulting in a large peak that then decreased for about 5.5 minutes (probably an artifact due to the stress the subject experienced to get ready). This is followed by a stable period lasting for 13 minutes (from 7 to 20 minutes into the session). This is the period where LF/HF is the lowest during the entire session (< 1.0), indicating that this is the period when the subject was most relaxed. Then there was a rapid increase in LF/HF for 6 minutes (corresponding to an increase in stress) followed by a very slow decrease for the rest of the session. The decrease became very slow (almost flat) around 36 minutes after the start of the session (21 minutes after the start of the grounding period) until the end of the grounding period. It is also the time when LH/HF went below 1.0 again for the rest of the session.

SDNN Results



After an initial decrease for about 5 minutes from the start of the session, SDNN increased slowly for 4 minutes then decrease for about 8 minutes (less than 2 minutes after the start of the grounding

period). SDNN then increased slowly for another 8.5 minutes before decreasing slowly for the rest of the session (about 39 minutes).

Summary of Findings for Subject 6

Brain mapping: Before grounding, Subject 6 shows signs of good internal focus and concentration, hyper-vigilance, meditation, prayer and spiritual awareness. During grounding, there was an increase in cognitive control over brain functions and better relaxation compared to before grounding. Subject 6 relaxed very well and went into a deep state of meditation during grounding. After grounding, Subject 6 continued to relax even more than during grounding going into a deep state of meditation. There is evidence of improvements in cognitive efficiency and functional connectivity due to grounding that lasted even after ungrounding.

Trapezius Muscles: Subject 6 experienced a progressive relaxation of the trapezius muscles during the first 15 minutes (up to the time of grounding) then a slight increase in muscle tension for 11 minutes which stayed about the same for the rest of the grounding period. Note that the trapezius muscles' relaxation was not as complete as for the first 3 subjects even though much better than for Subject 4.

Skin Conductance stayed quite constant with small bumps 2 minutes after grounding, 11 minutes after grounding and 26 minutes after grounding (the largest of the 3 bumps), suggestive of a possible healing response (34, 35). Note the very large and fast increase 60 minutes after the start of the session (when the third recording was started).

Heart rate had large variations for about 37 minutes into the session (22 minutes into the grounding period). However, it can be observed that 31 minutes into the session (16 minutes into the grounding period) Subject 6's heart rate increased progressively, reaching a maximum of 90 beats per minute around 20 minutes after the start of the grounding period. This has some similarity with the heart rate change during grounding reported by a study published in 2010 (34) and it is indicative of a potential healing effect of grounding.

LF and HF remained close together in value for the entire session with LF being slightly higher most of the time except for the first 6 minutes and between the 21st and the 35th minutes into the session (6th and 20th minutes after the start of the grounding period). There is indication of deep relaxation and the reversal to a higher HF in the middle of the grounded period is consistent with a healing response.

LF/HF increased rapidly initially resulting in a large peak that is probably an artifact. This is followed by a stable period lasting for 13 minutes (from 7 to 19 minutes into the session). This is the period when LF/HF is the lowest during the entire session, indicating that this period was the period when the subject was the most relaxed. Then there was a rapid increase in LF/HF for 6 minutes (corresponding to an increase in stress) followed by a very slow decrease for the rest of the session. The decrease became very slow (almost constant) around 36 minutes after the start of the session (21 minutes after the start of the grounding period) until the end of the grounding period. It is also the time when LH/HF went below 1.0 for the second time, staying below 1.0 for the rest of the session. Coupled with the results for SC, heart rate and LF and HF, this result is consistent with a healing response (34, 35).

SDNN was fairly constant for the entire session (staying mainly between 250 and 300). SDNN maximum is reached about 26 minutes after the start of the session (11 minutes after the start of the

grounding period). This corresponds to the time when Subject 6 experienced the maximum arousal of the session.

Overall: Before grounding, Subject 6 brain shows signs of good internal focus and concentration, hyper-vigilance, meditation, prayer and spiritual awareness. Subject 6 relaxed very well and went into a deep state of meditation during grounding. After grounding, Subject 6 continued to relax even more than during grounding going into a deep state of meditation. There is evidence of improvements in cognitive efficiency and functional connectivity due to grounding that lasted even after ungrounding. Skin Conductance, heart rate and HRV parameters shows sign of a possible healing effect (34, 35).

Subject 7

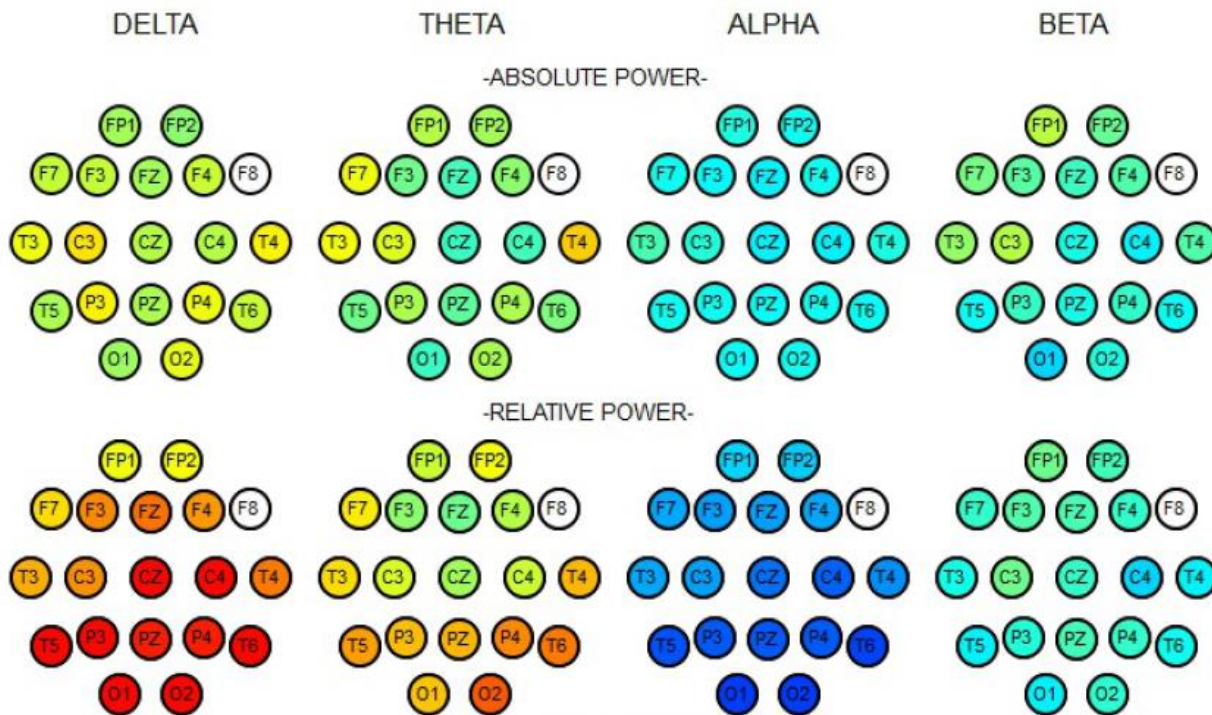
Male, 34, acupuncturist. The meditation practice he used is a form of mantra meditation. He has been meditating for 10 years for about 90 minutes per day. He indicated that he feels very calm and that the head hurts a little from electrodes pressure. However, he said that he was able to put that aside mentally and have a good meditation. Overall, he rated how he felt as much better than when he arrived.

Brain Mapping Results

Before grounding

Eyes Closed P300 Z Scores
Session 1 (5/31/2019)

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz



Before grounding, Subject 7 absolute power is normal with a tendency toward low activity in Alpha and Beta (light green to light blue) and higher activity in Theta and Delta (light green to yellow). There is no data for F8. Relative power shows high activity for electrode sites in the posterior region of the brain mainly in the Delta band and also in the Theta band. Elevated Theta in the posterior of the brain is associated with feelings of calm and well-being (6) while elevated Delta activity is related to increase in the flow of deep unconscious information during meditation (44). Together,

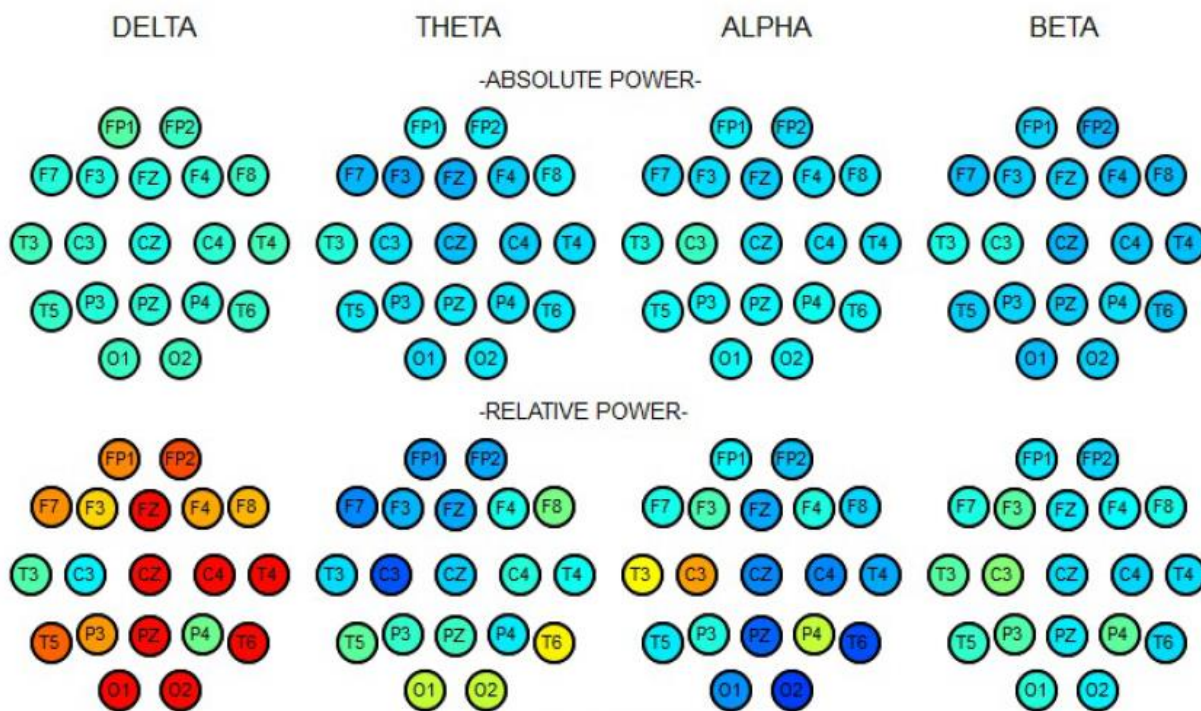
parietal and occipital regions are concerned with procedural memory (6). The temporal lobes are the auditory association cortex, including also phonetics, letters to sound, grasping the whole picture vs. sensing everything in fragments (may be dysfunctional in autism), episodic memory, emotional valence and regulation such as temper (6). Excessive Theta and Delta waves have a slowing effect and the brain is underactive. Lack of blood flow to the brain increases Theta and Delta waves (6). When Delta waves are increased, our awareness of the physical world is decreased. We also access information in our unconscious mind through Delta (6). There is also low Alpha activity in the posterior of the brain. That is because an increase in Theta indicates an increase in cognitive control over those locations (10), both functions being antagonistic with the functions supported by Alpha brain waves which are inversely related to cortical activity (12, 13, 14).

During grounding

**Eyes Closed P300 Z Scores
Session 2 (5/31/2019)**

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

Color Key
-3.0 0 +3.0



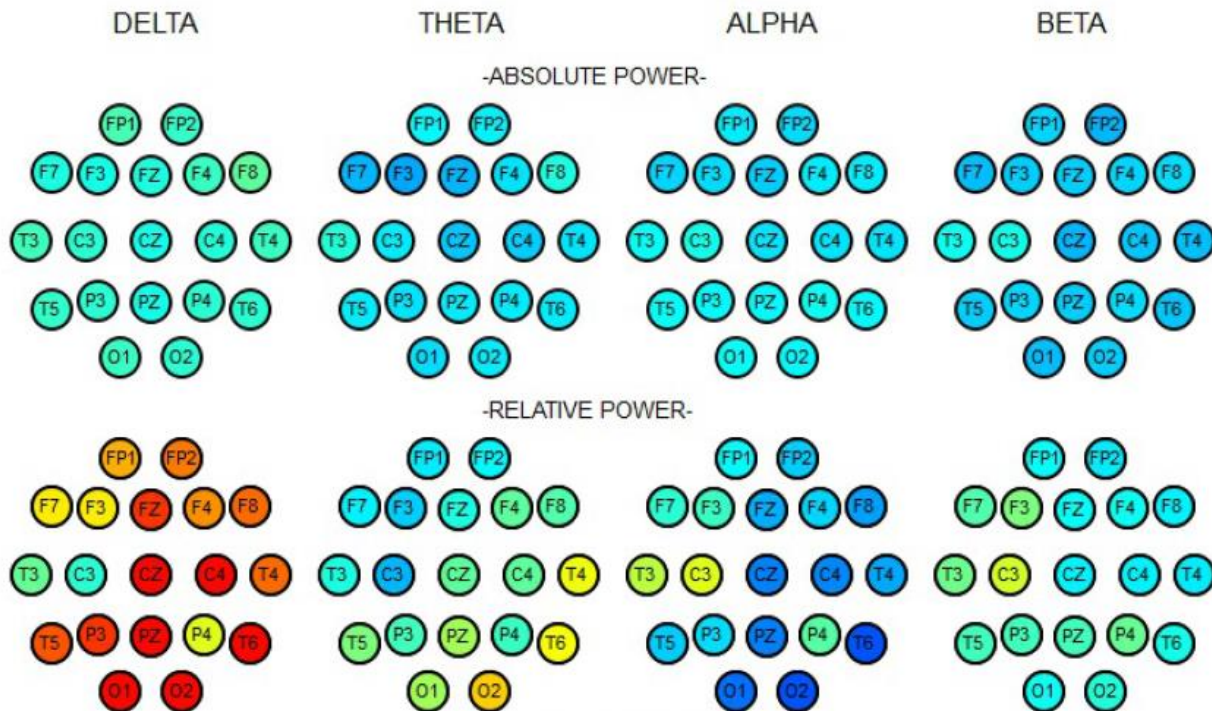
During grounding, Subject 7 absolute power is normal with a tendency toward low activity in all 4 frequency bands (light green to blue). Relative power shows high activity for electrode sites at the posterior region in the Delta band, but also in the central strip (FZ, CZ and PZ) and Fp2. This is a similar situation compared to before grounding but amplified. Fp2 main function is emotional attention with judgment, sense of self, self-control and restraint to impulses of other functions involving this area (11). FZ main function is motor planning of both extremities and midline. Other functions involving FZ include running, walking and kicking (11). CZ principal function is sensorimotor integration of both lower extremities and midline, including ambulation as another function involving this area (11). PZ principal function is perception with other functions involving this area including spatial relations, route finding and praxis (11). Noticed that the same electrode locations show low activity in Alpha. Delta and Alpha have a tendency to be antagonistic (and so is Theta) since elevated Delta activity in meditation is related to an increase in the flow of information during meditation (39). This high Delta activity is the sign of deep inner concentration and meditation (14) and an increase in the flow of deep subconscious information during meditation (44).

After grounding

Eyes Closed P300 Z Scores
Session 3 (5/31/2019)

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

Color Key
-3.0 0 +3.0



After grounding, the brain functions are very similar to during grounding, indicating a similar meditation state but slightly less deep.

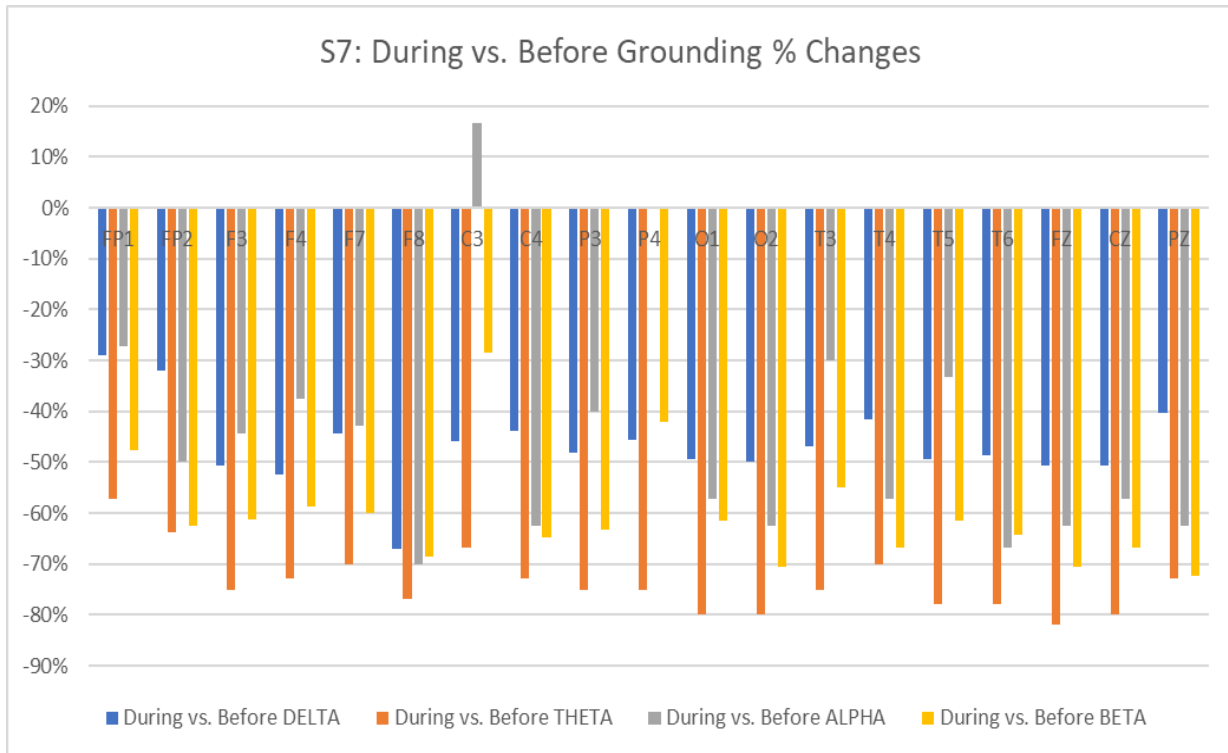
CZ Theta/Beta and F3/F4 Alpha

Researchers have shown that calculating the relative power ratio Theta/Beta at CZ can be used to determine slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (6, 17, 18). They also discovered that calculating F3/F4 relative power ratio in the Alpha band means processing information in a positive way for an increase while a decrease in the ratio indicated a more negative processing mode (19, 20). The table below give the result of all 3 sessions for Subject 7.

	Subject #7			Ref Range (35 yrs)
	Session 1	Session 2	Session 3	
CZ Theta/Beta	3.2	2.0	2.5	0.8-2.8
F3/F4 Alpha	0.8	1.0	0.4	0.8-1.2

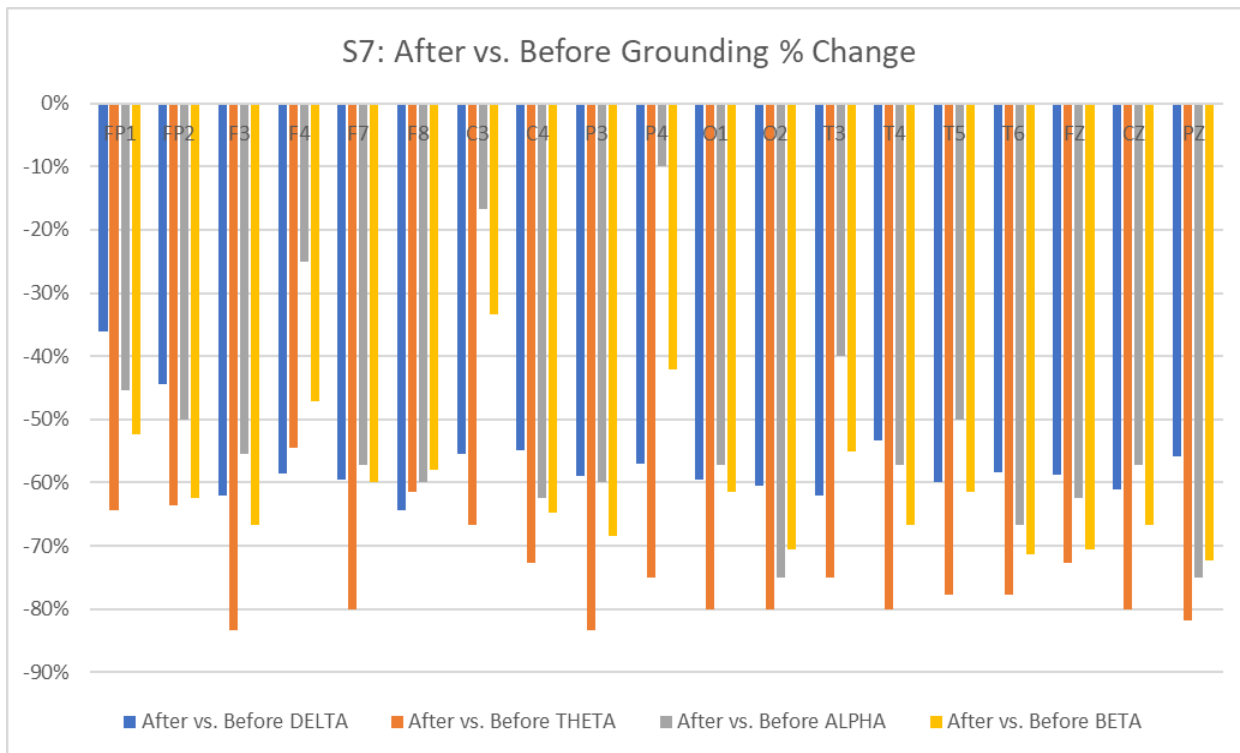
It can be observed that CZ Theta/Beta was high before grounding and decreased substantially during the grounding phase of the experiment (by 37.5%) to end in the normal range. It started to increase again after grounding but remained in the normal range. Remember that high CZ Theta/Beta indicates tendencies toward slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (6). It is apparent from the present results that grounding helped the brain function better. F3/F4 Alpha started normal, stayed normal during grounding and went below the normal range after grounding. Right-lateralization indicated a more negative processing mode (19).

During vs. Before grounding



- * All 4 frequency bands decreased significantly at all locations (except for C3 and P4 in the Alpha band).
- * Delta decreased significantly at all locations indicating a decrease in inhibition of brain functions interfering with internal concentration compared to during grounding (21). This means a decrease in internal mental concentration but also it means an increase in receptivity.
- * Theta decreased significantly at all locations indicating a decrease in the need for cognitive control for brain functions related to all electrode locations (25).
- * Alpha decreased at all electrode locations, except C3 and P4. Low alpha may be indicative of anxiety, PTSD, or short-term memory impairment (6).
- * Low alpha increases cortisol in the brain, which affects the hippocampus and thus short-term memory (6).
- * Beta decreased at all locations. If beta is deficient, either all over or in small areas, the brain may have insufficient energy to perform tasks at peer group standards.
- * Conclusion: S7 seems to have a brain lacking energy, tired, but in a deep meditation state.

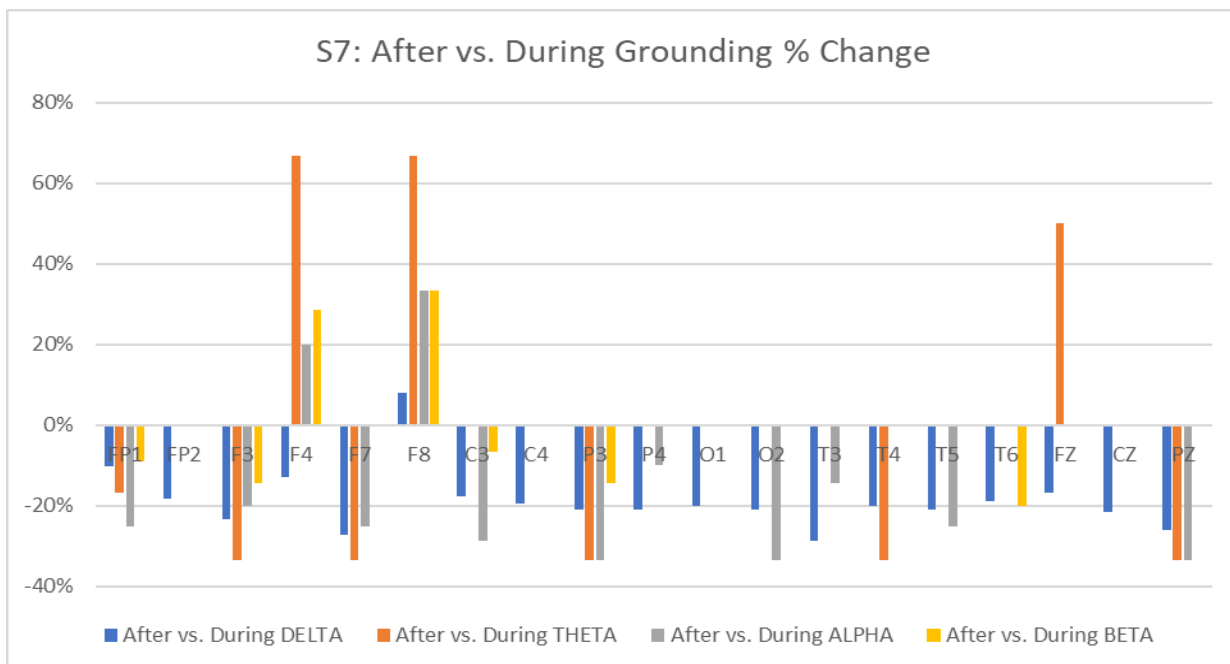
After vs. Before grounding



* All 4 frequency bands decreased significantly at all locations.

* Conclusion: Subject 7 seems to have a brain lacking energy, tired, receptive state but in a deep meditation state.

After vs. During grounding

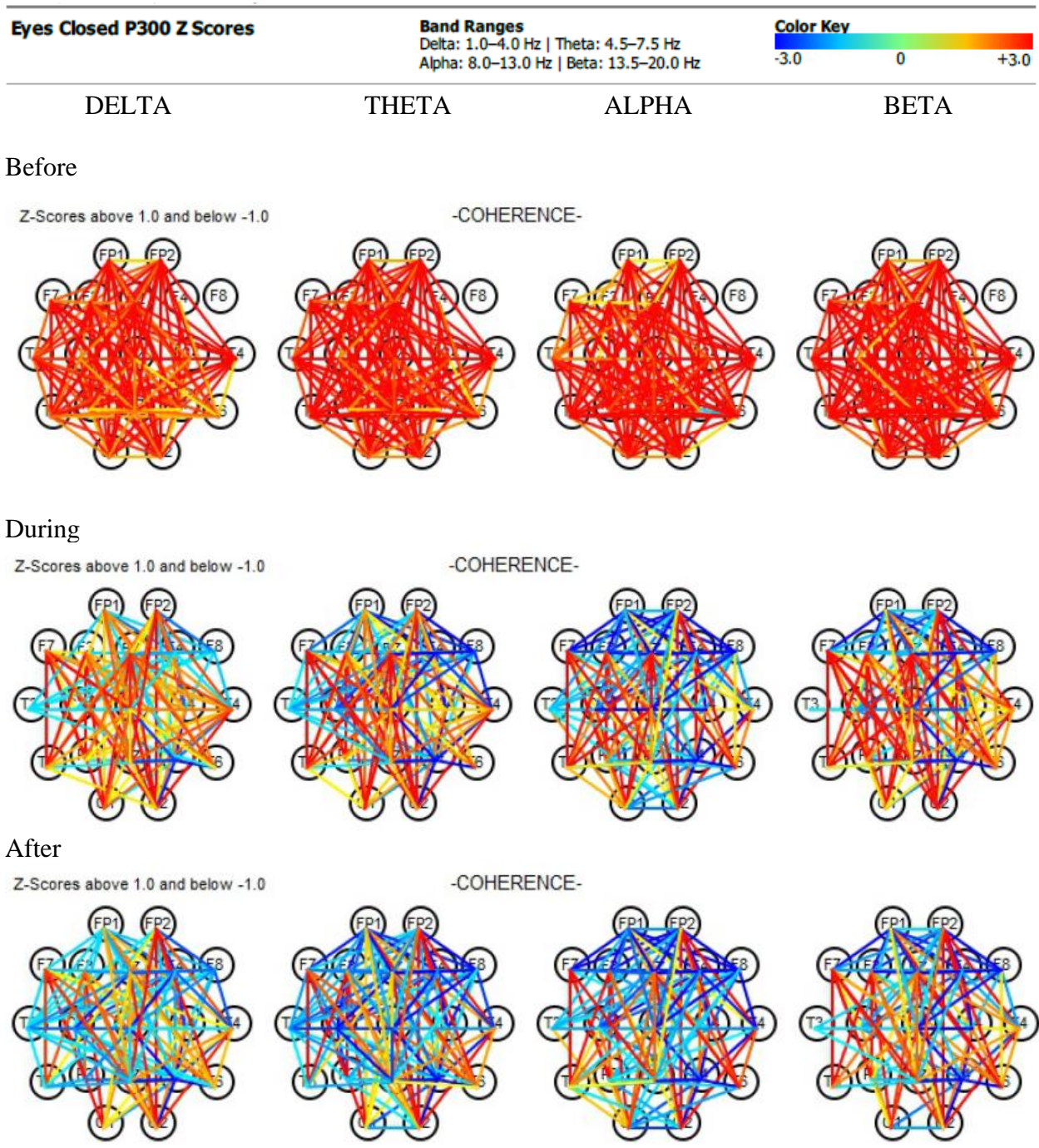


* Theta changed most and most significantly at F4, F8 and FZ after grounding compared to during grounding.

* F4 & F8 - Avoidance behavior, withdrawal, impulse control (important links to the amygdala). Emotional tone variations (motor aprosodia) (6).

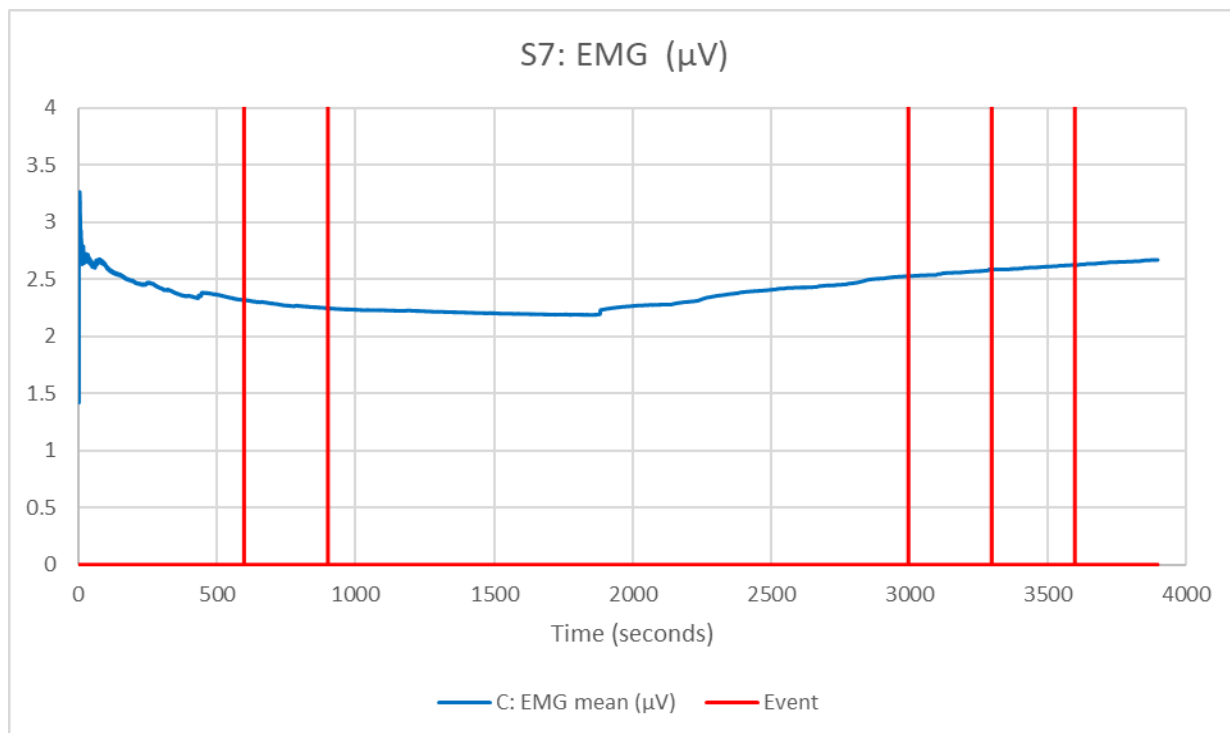
- * F4 – inductive creative, inductive emotional, metaphorical thinking, short-term retrieval of spatial-object memory, vigilance, selective and sustained attention (6).
- * F8 – spatial and visual working memory, gestalt, sustained attention, conscious facial emotional processing, prosody, empathy conscience, feeling sense of right and wrong, emotional gating. Vigilance area. Apprehension, disinterest, sustained and selective attention. Processing of anger, rage, anxiety, fear. Regulation of aggressive and sexual impulses. (6)
- * F8 is close to source of emotional impulses (38).
- * FZ is near intentional and motivational centers (38).
- * Conclusion: Subject 7 impulse control increased after grounding. Grounding seemed to help with impulse control i.e. making it easier.

Coherence Results



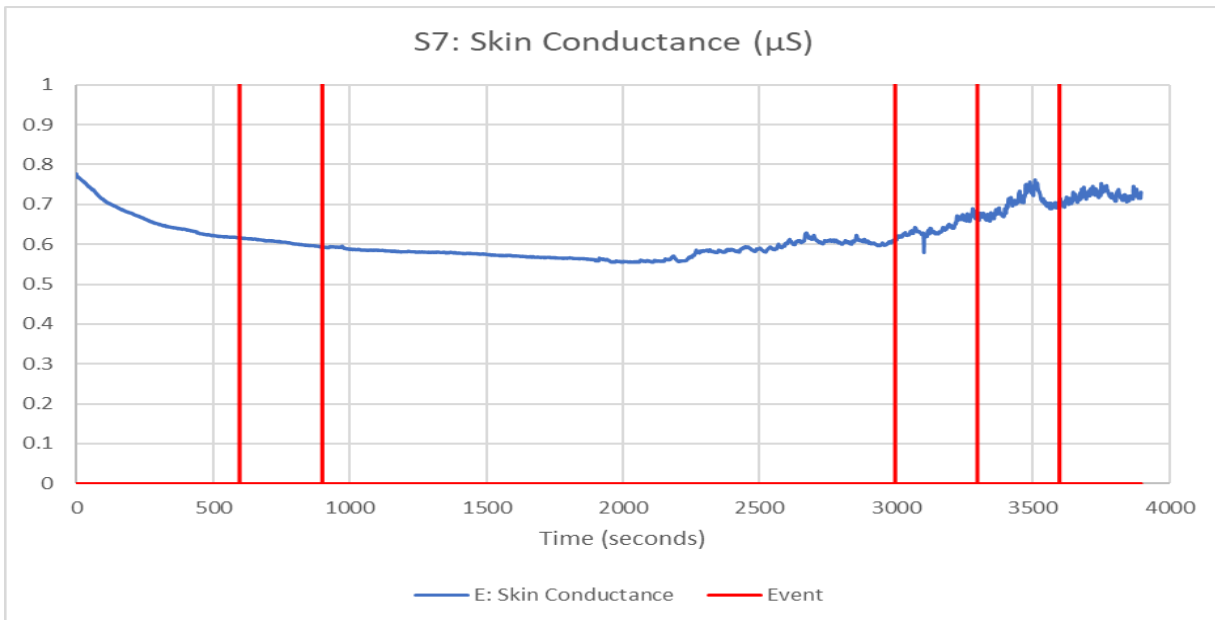
Before the grounding period, coherence was high all over the brain and at all frequencies. Coherence is the most common measure used to determine if different areas of the brain are generating signals that are significantly correlated (coherent) or not significantly correlated (not coherent) (45). Subject 7's brain is in hypercoherence all over and at all frequency bands. Hypercoherence happens when brain sites are not functioning in efficient interdependent fashion, but rather have too much “cross-talk”. Excessive coherence tends to indicate two or more areas of the brain being overly connected or locked together (this is the situation here for almost all brain sites except for F8 which did not provide data before grounding). The brain is too rigid, and this also occurs when the brain builds new neural connections. The brain is not efficiently processing and executing information resulting in poor day-to-day performance (6). The result is decrease in flexibility of all brain functions (11). Beta hyper-coherence may indicate anxiety, panic attacks, stress and test anxiety (6). When excessive Alpha coherence is present, the brain may be locked up in Alpha and be hard to speed up or slow down (6). Excessive coherence may also indicate depression (6). However, brain researchers have found that long-term and advanced meditation practitioners have a brain that is more coherent and integrated, and that this heightened efficiency of brain functioning grows over time through practice — even outside of meditation — improving mental performance and overall health. Higher coherence is associated with more integrated and effective thinking and behavior, including greater intelligence, creativity, learning ability, emotional stability, ethical and moral reasoning, self-confidence, and reduced anxiety (45-49). However, since brain coherence decreased and became more normal during and after the grounding period, before grounding results suggest that the excessive coherence level at all frequency bands before grounding is rather due to abnormal patterns such as anxiety and stress (Beta), brain locked up in Alpha and high level of top-down control (Theta and Delta) (50).

Electromyography (EMG) Results



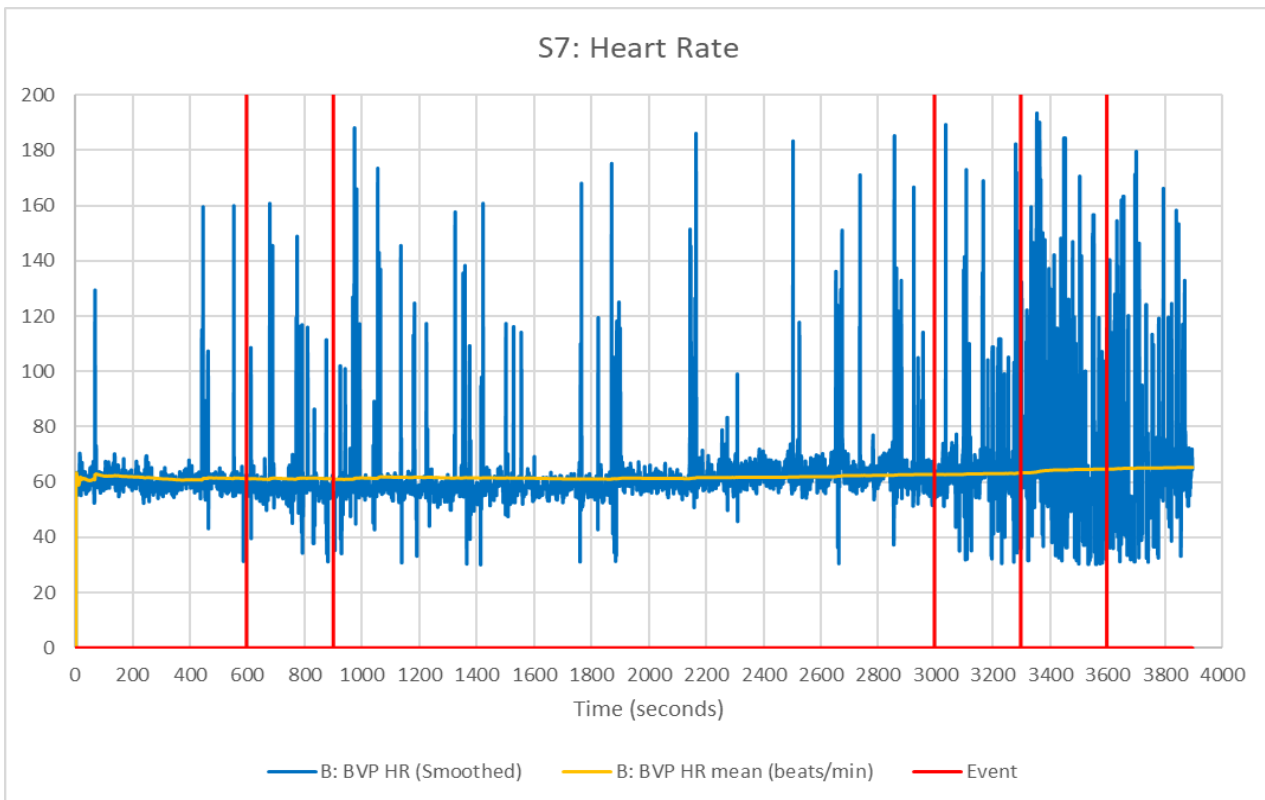
The graph above shows Subject 7 relaxing his trapezius muscles up to about 16 minutes into the grounding period. Then the muscles started to tense slowly until the end of the session.

Skin Conductance (SC) Results

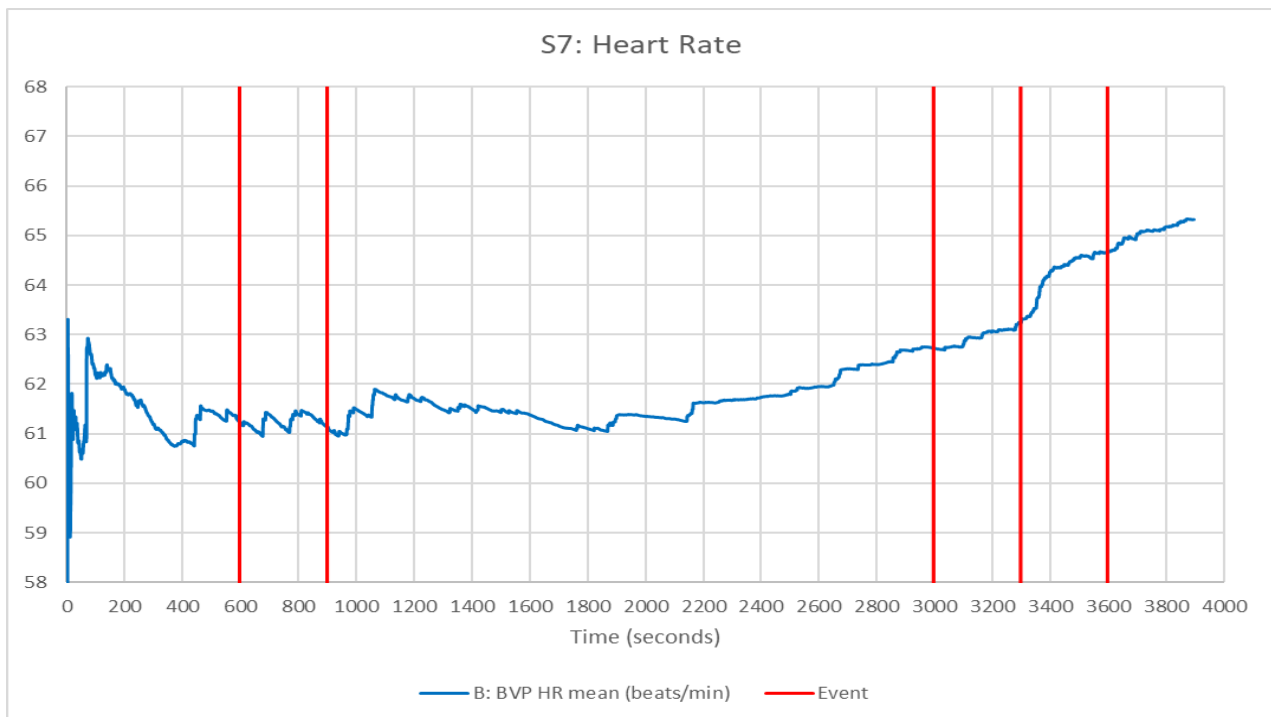


Subject 7 skin conductance decreased for about 36 minutes after the start of the session indicating parasympathetic system activation (i.e. ANS relaxation). Then skin conductance increased slowly for the rest of the session indicating sympathetic activation (increased in stress).

Heart Rate Results

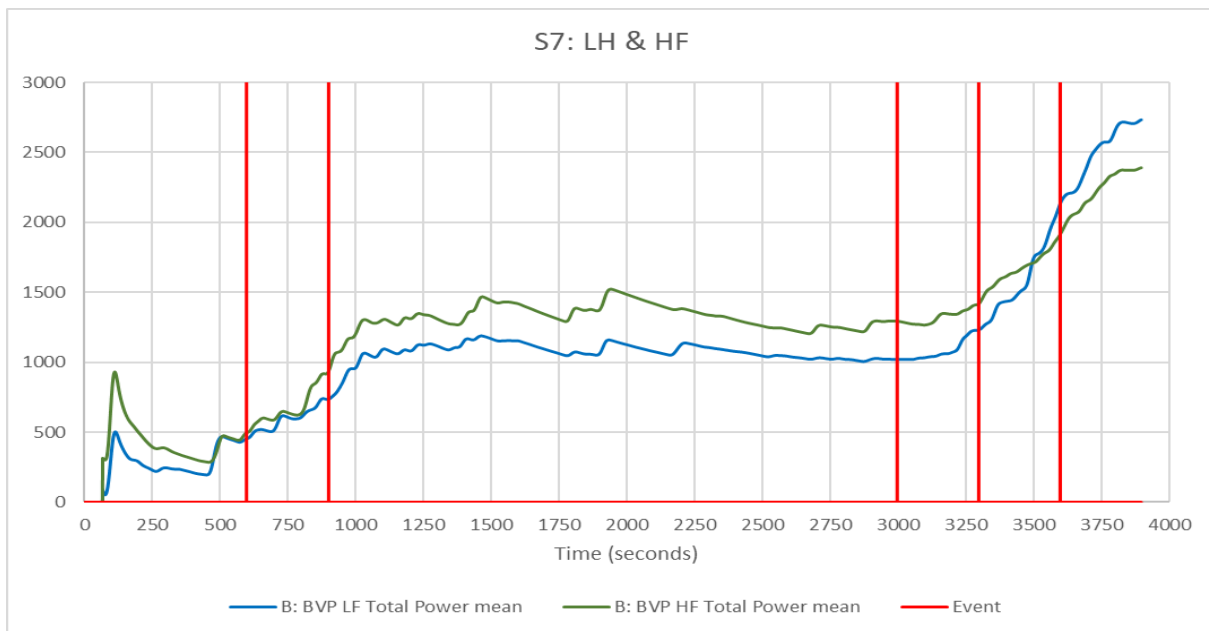


Subject 7 heart rate has a large variability as can be seen from the values of BVP HR (Smoothed) (blue line). Nevertheless, it can be observed from BVP HR mean (yellow line) that the average heart rate was quite constant, starting around 60 bpm, with a very slight increase toward the end of the session to about 65 bpm.



Enlarging the preceding graph (graph before the graph above) using only HR mean (graph just above) to enlarge the changes in heart rate, it can be observed that the heart rate was fairly constant until about 36 minutes into the session (21 minutes into the grounding period), time at which heart rate increase started and accelerated. Heart rate started at 61 beats per minute then fluctuate for about 36 minutes (21 minutes into the grounding period) before increasing constantly until the end of the session to about 65 beats per minute. Notice a rapid increase in heart rate just after ungrounding.

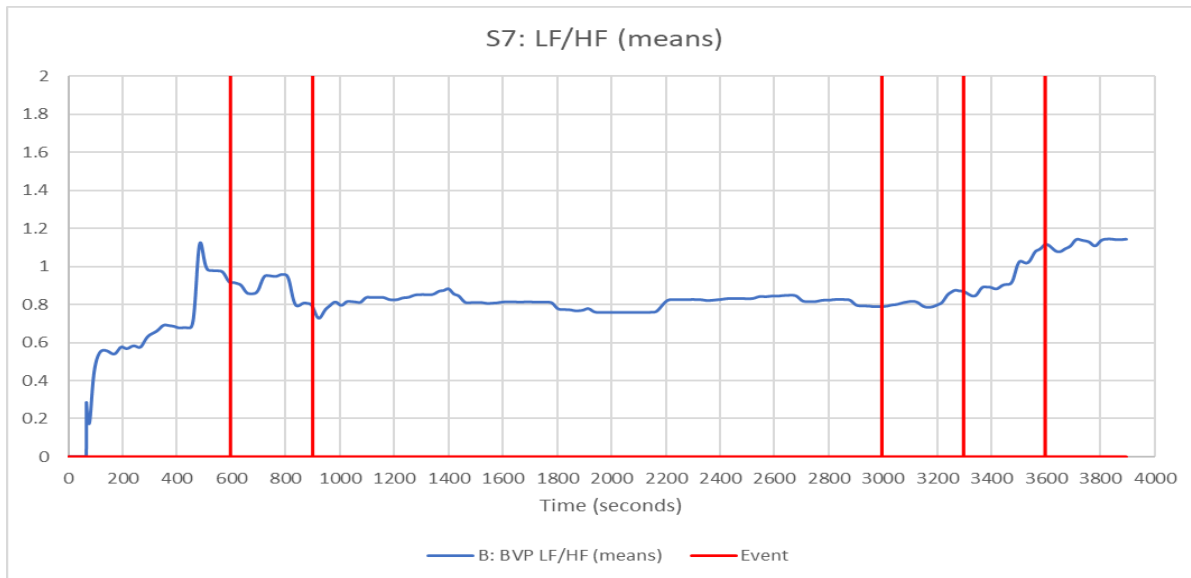
Low-Frequency (LF) and High-Frequency (HF) Results



As it is the case for Subjects 1, 2, 3 and 6, Subject 7's LF and HF remained close together for the entire session, with the largest divergence in the middle of the session. Similarly to these other subjects, LF and HF raised rapidly for the first 2 minutes with HF raising to about twice the peak value of LF. They then both decrease for about 8 minutes with HF remaining larger than LF. Then both LF and HF increased for about 17 minutes with HF increasing more than LF. This is followed by a plateau where both LF and HF remained relatively stable for approximately 28 minutes (close

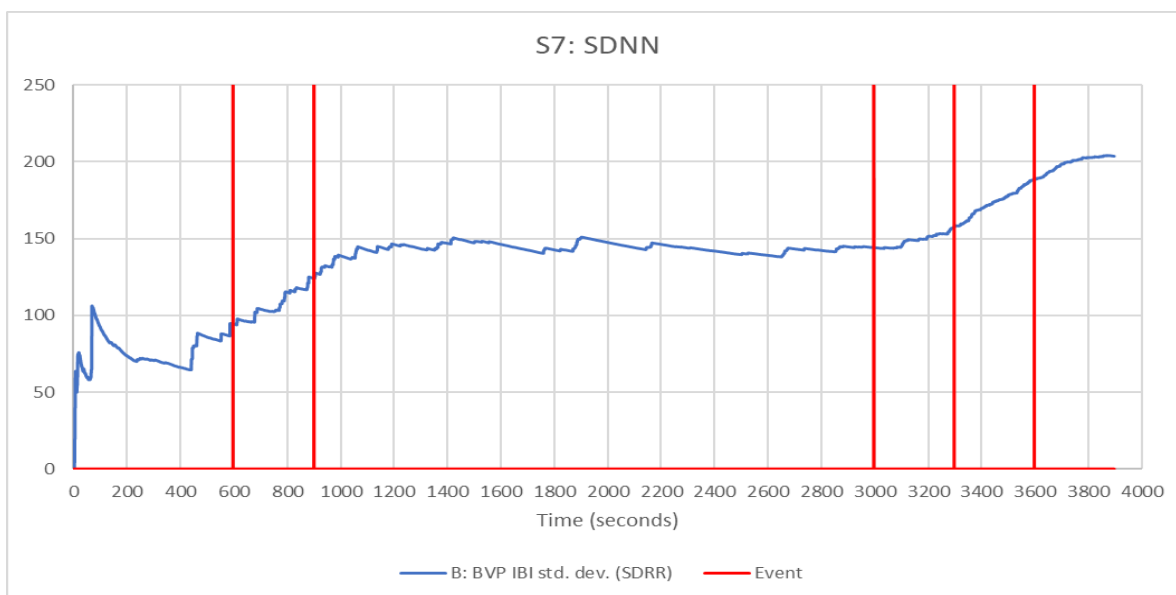
to the end of the grounding session). Then both LF and HF increased but there is a switch 58 minutes after the start of the session (3 minutes after the end of the grounding period) and LF became higher than HF until the end of the session.

LF/HF Results



After one minute, there is a rapid increase in LF/HF for another minute, followed by a slower increase for 5 minutes. Then there is a rapid increase again for less than a minute followed by a slow decrease for 7 minutes. Then there is a stable period lasting for about 40 minutes (from the start to the end of the grounding period). After that LF/HF increases again for about 7 minutes before stabilizing for the rest of the session. Except for the first 7 minutes of the session, note that LF/HF is the lowest during the grounding period (and very stable too).

SDNN Results



Subject 7 SDNN increased rapidly for the first 1.5 minutes then decreased for 6 minutes approximately. It then increased for about 13 minutes, stayed stable for the next 31.5 minutes (close to the end of the grounding period) before starting to increase again until the end of the session.

Summary of Findings for Subject 7

Brain mapping: Before grounding, Subject 7 experienced feelings of calm and well-being with increase in the flow of deep unconscious information during meditation. During grounding, the situation was similar than before grounding but amplified. There were signs of deep inner concentration and meditation and an increase in the flow of deep subconscious information. After grounding, the brain functions were very similar to during grounding, indicating a similar meditation state but slightly less deep. There are also indications that during grounding brain functioning improved.

Trapezius Muscles: Subject 7's trapezius muscles were relaxing up to about 16 minutes into the grounding period (31 minutes from the start of the session). Then the muscles started to tense slowly until the end of the session. This is probably the time when he started feeling some level of pain in the frontal EEG electrodes.

Skin Conductance decreased for about 37 minutes after the start of the session (22 minutes into to grounding period) indicating parasympathetic system activation (i.e. nervous system relaxation). Then SC increased slowly for the rest of the session indicating sympathetic activation (increased in stress). This is likely due to Subject 7 feeling some level of pain at the frontal EEG electrodes (as he described after the end of the session).

Heart rate had a large variability nevertheless it was fairly constant until about 36 minutes into the session (21 minutes into the grounding period), time at which heart rate increased until the end of the session. This heart rate increase about in the middle of the grounding period is possibly due to Subject 7 starting to feel some level of pain at the frontal EEG electrodes (as he described after the end of the session). Notice a rapid increase in heart rate just after ungrounding.

LF and HF: HF became larger than LF just before the start of the grounding period and stayed larger for the entire grounding period, with a reversal happening about 3 minutes after the grounding period when LF became larger than HF. This result indicates that Subject 7 was able to relax during the grounding period even though he felt some level of pain due to the frontal EEG electrodes (Subject 7 confirmed that he was able to ignore the pain during his meditation).

LF/HF stayed stable and the lowest (below 1.0) from the beginning of the grounding period to the end of the grounding period (40 minutes) and started to increase after ungrounding. This result suggest that grounding helped him to relax despite feeling some pain from the frontal EEG electrodes.

SDNN also stayed quite stable from the beginning to the end of the grounding period (40 minutes) and started to increase after ungrounding. SDNN seems about average compared to the other subjects.

Overall: Before grounding, Subject 7 experienced feelings of calm and well-being with increase in the flow of deep unconscious information. During grounding, the situation was similar than before grounding but amplified. There were signs of deep inner concentration and meditation and an increase in the flow of deep subconscious information. After grounding, the brain functions are very similar to during grounding, indicating a similar meditation state but slightly less deep. There are indications of improvement in brain function during the grounding period of his meditation. Subject 7 was able to maintain a good level of meditation despite feeling some pain from the frontal EEG electrodes.

Subject 8

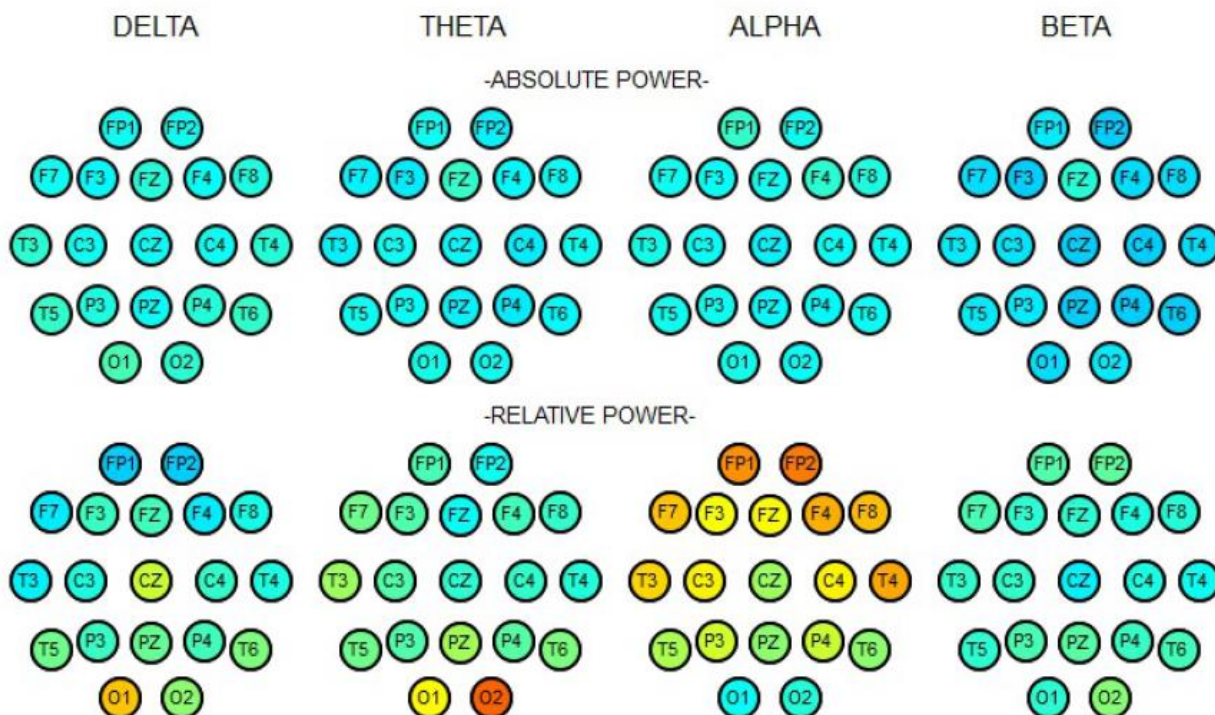
Female, 76, Yoga instructor. Her meditation technique was the Hansa meditation as taught by Self Realization Fellowship. She has been meditating for 55 years for 1 hour in the morning and 1 hour at night daily. She indicated that there were times that the meditation felt better and at other times a challenge. Overall though she indicated that she felt a lot better after the meditation.

Brain Mapping Results

Before grounding

Eyes Closed P300 Z Scores
Session 1 (5/31/2019)

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

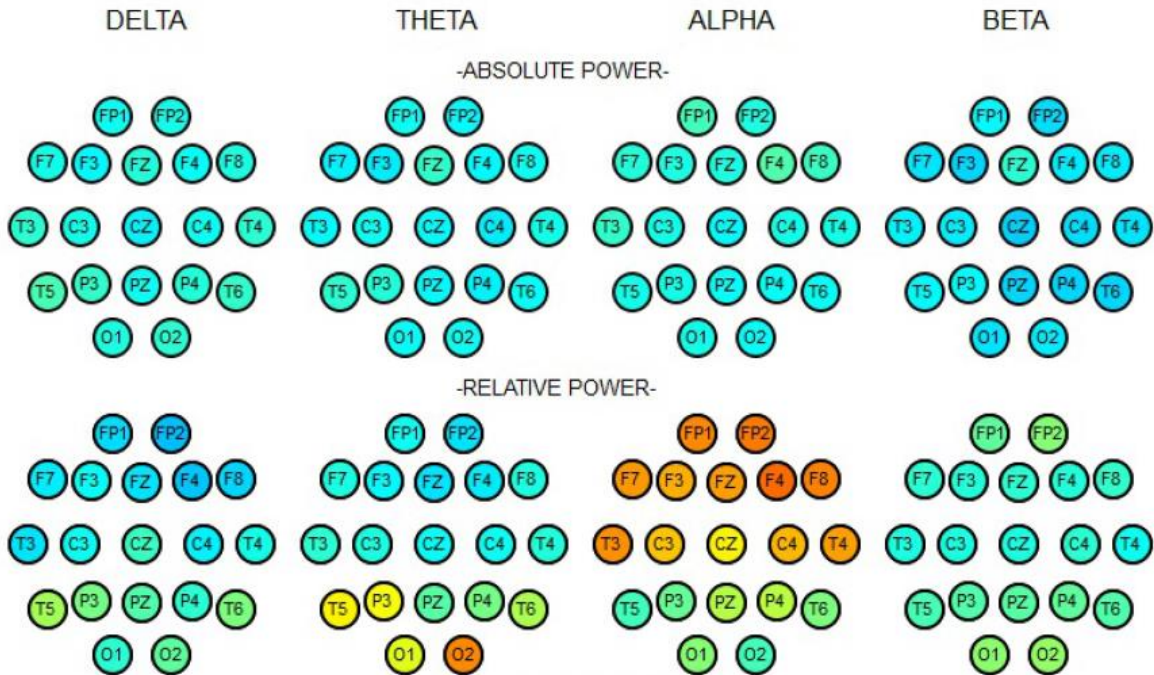


Subject 8 absolute power is normal but with a tendency toward low activity (light green to light blue). Relative power shows relatively high activity in the frontal area for Alpha and in O2 for Theta. Neuroimaging studies have reported meditation to enhance activity in the prefrontal cortex, especially in the Alpha and Theta bands (51). The frontal lobes are responsible for higher executive functions such as: attentional gating, decision making, problem solving, memory, social awareness, character, motivation, planning, judgment. The frontal lobes are also responsible for immediate and sustained attention, social skills, emotions, empathy, time management, working memory, moral fiber or character, executive planning and initiative. They identify problems and may send them to other parts of the brain for resolution (6). An excess of Alpha activity in the frontal brain is associated with emotional control (6). High Alpha activity coupled with low Theta and Delta indicates that the Alpha is dominant suppressing the inhibition of corresponding brains functions (21) or cognitive control related to the functions associated with the frontal lobes (25). O2 main function is visual processing of the left half of the visual space. Other functions where O2 is involved include: pattern recognition, color, movement, edge and black/white perception, vision, color and to some extent motion (6, 11). An excess theta activity at O2 is indicative of an increase in cognitive control for related brain functions (25).

During grounding

**Eyes Closed P300 Z Scores
Session 2 (5/31/2019)**

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

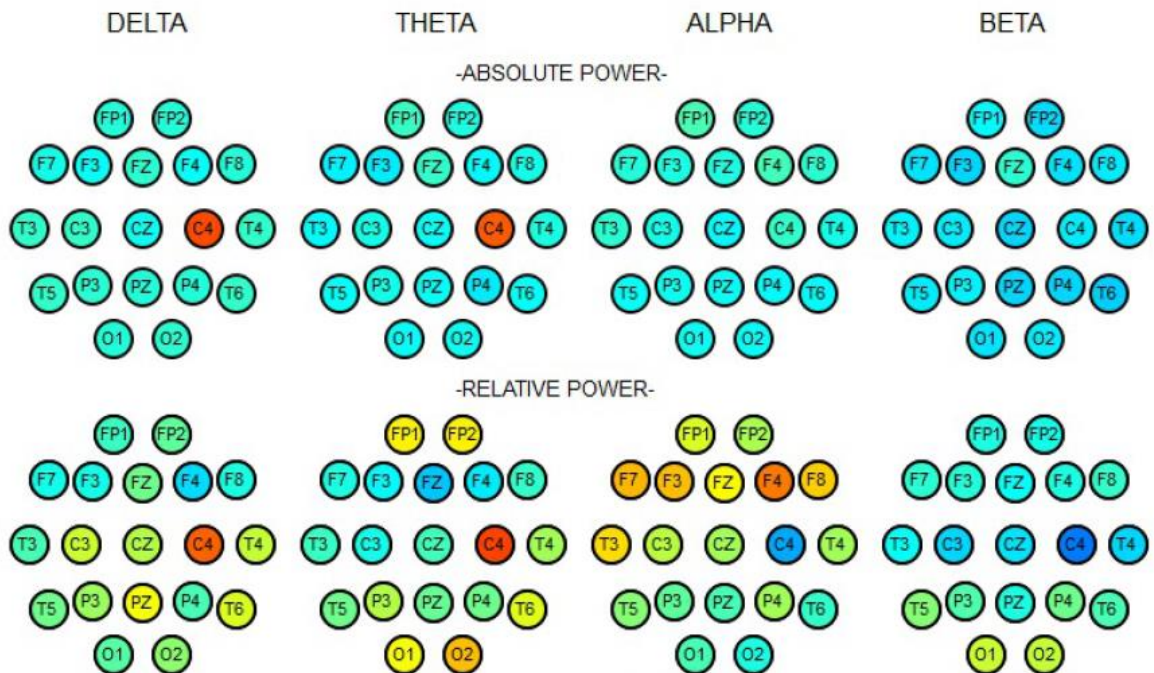


Similarly to before grounding, during the grounding period Subject 8 absolute power is normal but with a tendency toward low activity (light green to light blue). Relative power shows relatively high activity in the frontal area for Alpha and in O2 for Theta. The activity in Alpha at the frontal lobes is increased from the before grounding period, indicating a deepening of the meditation.

After grounding

**Eyes Closed P300 Z Scores
Session 3 (5/31/2019)**

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz



After the grounding meditation, absolute power remained normal with a tendency toward low activity (light green to light blue) except that C4 is now activated. C4 principal function is sensorimotor integration of the left upper extremity with other functions including calming, handwriting, and emotional/feeling (6, 11, 38). Relative power remained a bit high in the frontal part of the brain in Alpha but much decreased compared to during the grounding part of the meditation indicating that the meditation became less deep.

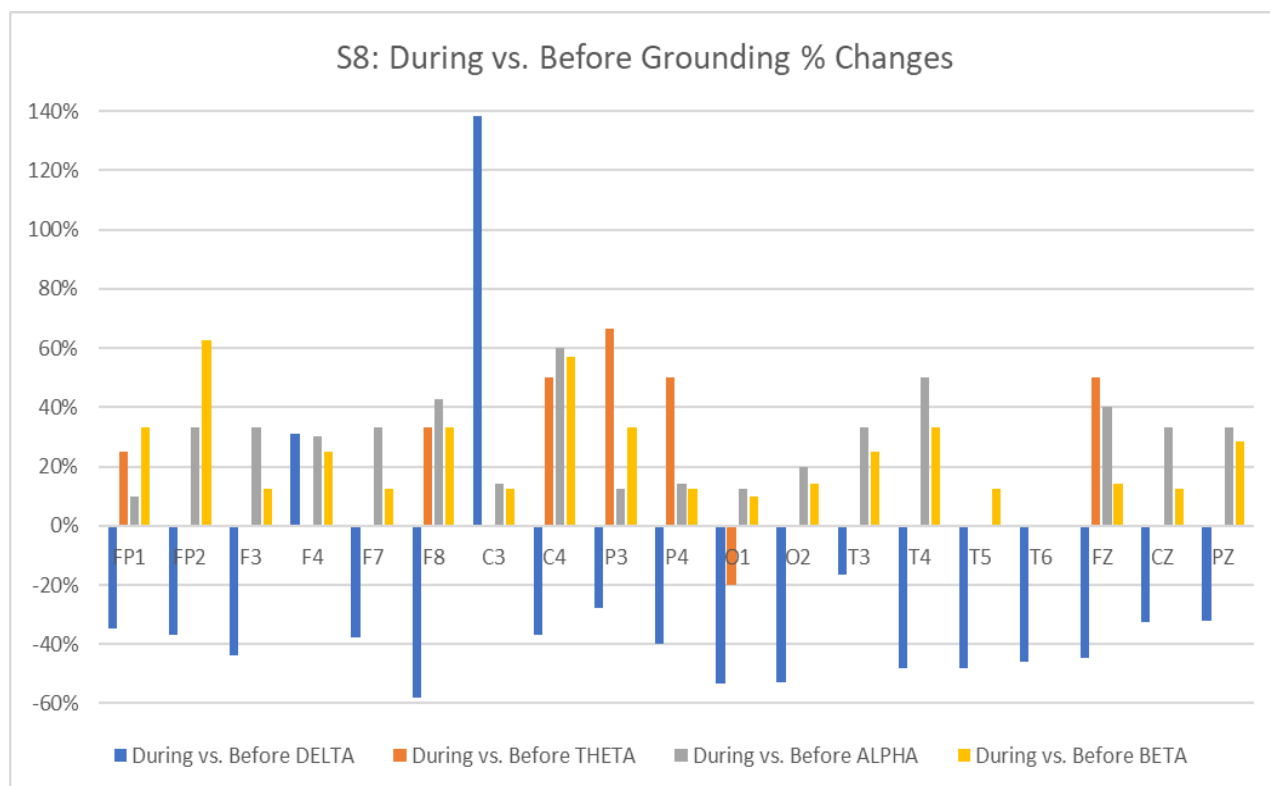
CZ Theta/Beta and F3/F4 Alpha

Researchers have shown that calculating the relative power ratio Theta/Beta at CZ can be used to determine slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (6, 17, 18). They also discovered that calculating F3/F4 relative power ratio in the Alpha band means processing information in a positive way for an increase while a decrease in the ratio indicated a more negative processing mode (19, 20). The table below give the result of all 3 sessions for Subject 8.

	Subject #8			Ref Range (75 yrs)
	Session 1	Session 2	Session 3	
CZ Theta/Beta	1.3	1.1	1.6	0.8-2.8
F3/F4 Alpha	0.4	0.4	0.5	0.8-1.2

CZ Theta/Beta was normal before grounding and remained normal during and after grounding. F3/F4 Alpha started low and stayed low during and after grounding. Right-lateralization indicated a more negative processing mode (19).

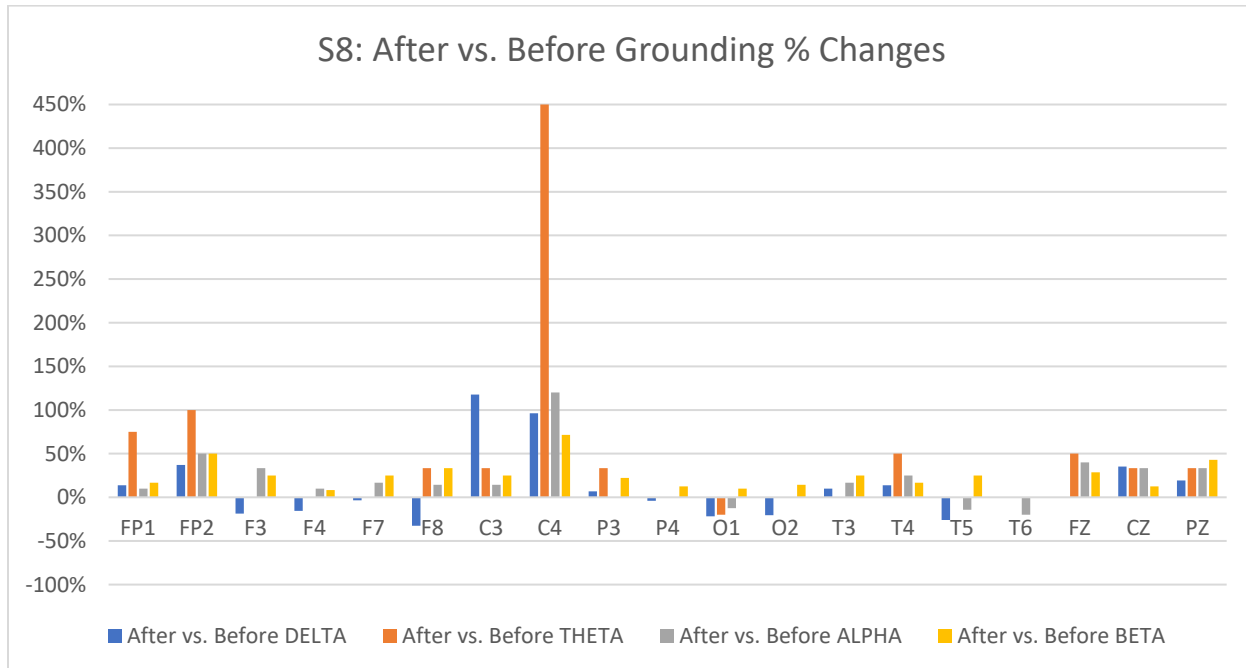
During vs. Before grounding



* Delta decreased significantly at all locations except C3 and T3, indicating a decrease in inhibition of brain functions interfering with internal concentration (25).

- *Delta increased very significantly at C3, indicating an increase in inhibition of brain functions interfering with internal concentration for the corresponding brain functions (21).
- * C3: hand and digits (with F3 – handwriting and inhibit or execute action), audition, happiness, syntax (6).
- * C3, C4 and CZ deal with sensory and motor functions and integration (38, 52).
- * Theta increased significantly at Fp1, F8, C4, P3, P4 and FZ, indicating an increase in cognitive control for brain functions related to the brain regions under those electrode locations (25).
- * Fp1: Verbal retrieval, visual working memory, verbal analytical and approach behaviors (6). Logical attention, orchestrate network interactions, planning, decision, making, task completion, working memory (52).
- * F8: Spatial and visual working memory, gestalt, sustained attention, conscious facial emotional processing, prosody. Empathy conscience, feeling sense of right and wrong, emotional gating, vigilance area, apprehension, disinterest, sustained and selective attention, processing of anger, rage, anxiety, fear. Regulation of aggressive and sexual impulses. (6)
- * F8 is close to source of emotional impulses (38). Emotional expression, drawing (right hand), cognitive mood regulation (52).
- * C4: Cognition of music, reasoning/decision making and emotional/feeling, and in addition, disrupts the process of basic body signaling, happiness & sadness (6).
- * P3: Language processing, integration of self, logical reasoning and memory, imagination, spelling and short-term memory, math calculations, naming objects, complex grammar, sentence construction and math processing (right side body awareness) (6). Perception (cognitive processing) right half of space, spatial relations, multimodal sensations, calculations, praxis, verbal reasoning (52).
- * P4: Visual-spatial sketch pad, image and spatial processing, facial decoding, integration with environment, spatial memory, self-concern, map orientation, knowing the difference between right and left, self in space, music, body image, physical act of dressing (left side body awareness) (6). Perception (cognitive processing) left half of space, spatial relations, multimodal sensations, praxis, non-verbal reasoning (52).
- * FZ is near intentional and motivational centers (38). Frontal eye fields, focus and action observation (6). Motor planning of both lower extremities and midline, running, walking and kicking (52).
- * Alpha increased significantly at many locations, with no decreases, indicating of an increased in relaxation, peacefulness and alertness.
- * Beta increased significantly at many locations, but not as much as Alpha, indicating some mental activity increase compared to before grounding.
- * Conclusion: Subject 8 went in to a deep release of inhibition of brain functions accompanied with release of control of many brain functions, relaxation, peacefulness and alertness.

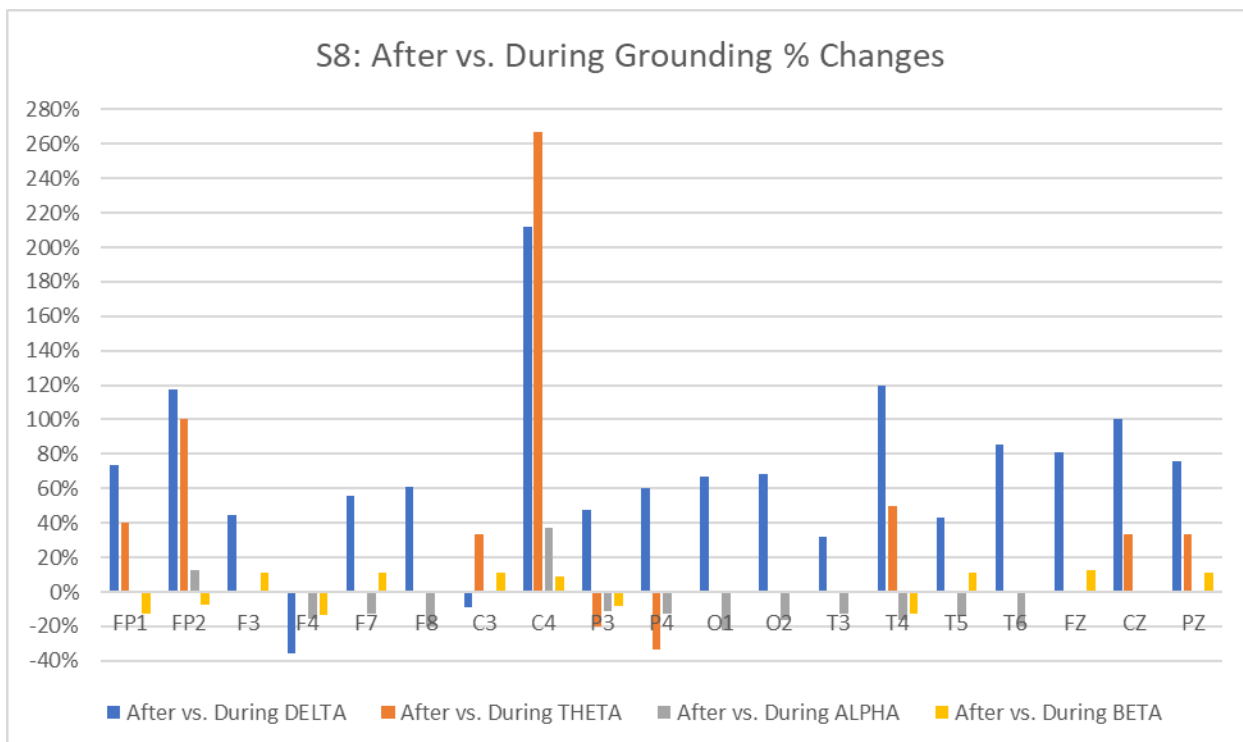
After vs. Before grounding



- * Delta increased significantly for Fp2, C3, C4 and CZ (most significantly at C3 and C4), indicating an increase in inhibition of brain functions interfering with internal concentration for the corresponding brain functions (25).
- * C3, C4 and CZ deal with sensori-motor functions and integration (38, 52).
- * Fp2: Face and object processing, gestalt and context, episodic memory (when overactive may correlate with irritability, impulsivity, tactless, manic and panic behavior) (6). Emotional attention, judgement, sense of self, self-control, restraint of impulses (52).
- * Delta decreased significantly for F8, O1, O2 and T5, indicating a decrease in inhibition of brain functions interfering with internal concentration for the corresponding brain functions (25).
- * F8: Spatial and visual working memory, gestalt, sustained attention, conscious facial emotional processing, prosody. Empathy conscience, feeling sense of right and wrong, emotional gating, vigilance area, apprehension, disinterest, sustained and selective attention, processing of anger, rage, anxiety, fear. Regulation of aggressive and sexual impulses. (6)
- * O1 and O2: primary visual areas (25). Visual association cortex, visual processing, procedural memory, dreaming, visual perception (6, 52).
- * T3 and T5: Long term verbal and visual memory, linguistic and reading perception and comprehension, processing integration and perception of auditory input, visual perception of what an object is, "Inner voice", positive mood (6).
- * T5 and T6: certain memory functions (38).
- * T5: Logical (verbal) understanding, word recognition, auditory processing (52).
- * Theta increased tremendously at C4, probably being the dominant factor driving the function of Theta, indicating a substantial increase in cognitive control for related brain functions (25).
- * C4: Cognition of music, reasoning/decision making, emotional/feeling, and disrupts the process of basic body signaling, happiness and sadness (6).
- * C3, C4 and CZ deal with sensori-motor functions (38).
- * C3: Sensorimotor integration right upper extremity, alerting responses, handwriting (right hand) (52).
- * Alpha increased the most at C4 and significantly at Fp2, F3, T4, FZ, CZ and PZ, indicating of an increased in relaxation and alertness of the brain functions related to these electrode sites.
- * FZ: Frontal eye fields, motor, focus and action observation (6).

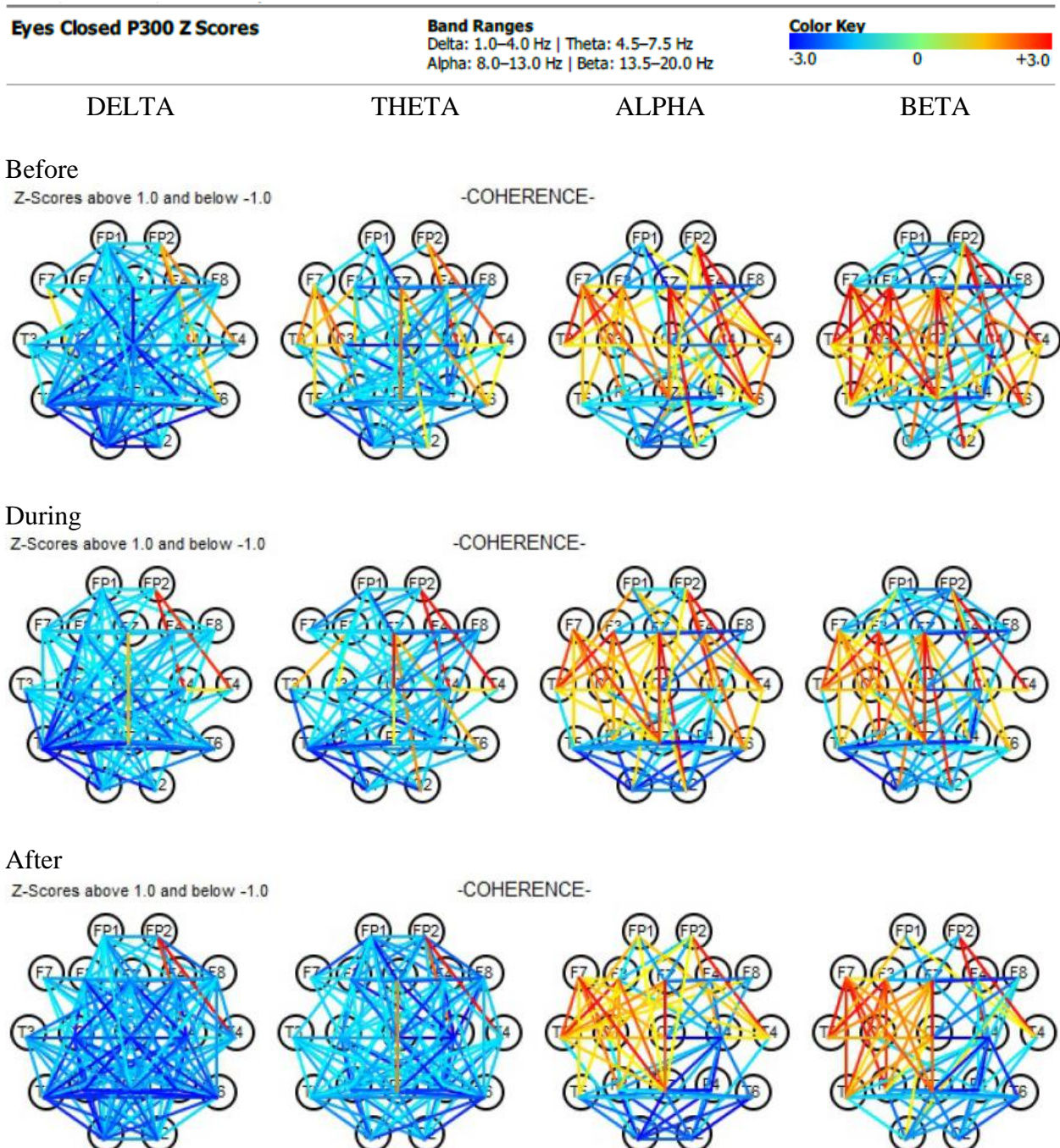
- * FZ is near intentional and motivational centers (38).
- * FZ: Motor planning of both lower extremities and midline, running walking and kicking (52).
- * PZ: Integrating somato-sensory information with posterior visual perceptions, working memory. Posterior parietal cortex - sense of direction, Balint's syndrome...the client cannot attend to multiple objects simultaneously, can't shift attention from one location to another, or perhaps one sensory modality to another. Parietal and Occipital – procedural memory. Posterior PZ may involve long term memory, sensory integration and some quick decisions in crisis situations. (6)
- * PZ: logical attention, orchestrate network interactions planning, decision making, task completion and working memory (52).
- * Beta increased significantly for Fp2, F3, F7, F8, C3, C4, P3, T3, T5, FZ, and PZ, indicating increased mental activity at the brain centers near those electrodes.
- * F3: Judgment, planning, sustain attention, inhibition of responses, verbal episodic memory retrieval, problem solving, sequencing, deducing facts to conclusions (6).
- * F3: Motor planning right upper extremity, fine motor coordination, mood elevation (52).
- * F7: Creates and controls output of spoken and written language, visual and auditory working memory, selective attention Broca's area (word retrieval, semantics, verbal understanding, speech), divided and selective attention (6). Near centers for rational activities (38).
- * F7: Verbal expression, speech fluency, cognitive mood regulation (52).
- * P3: Language processing, integration of self, logical reasoning and memory, imagination, spelling and short-term memory, math calculations, naming objects, complex grammar, sentence construction and math processing, right side body awareness (6). Perception (cognitive processing), right half of space, spatial relations, multimodal sensations, calculations, praxis, verbal reasoning (52).
- * Conclusion: Relaxation and release of functions related to sensory motor and emotions and feelings of happiness vs. sadness with some increase in mental functions and some inhibition of sensori-motor functions.

After vs. During grounding



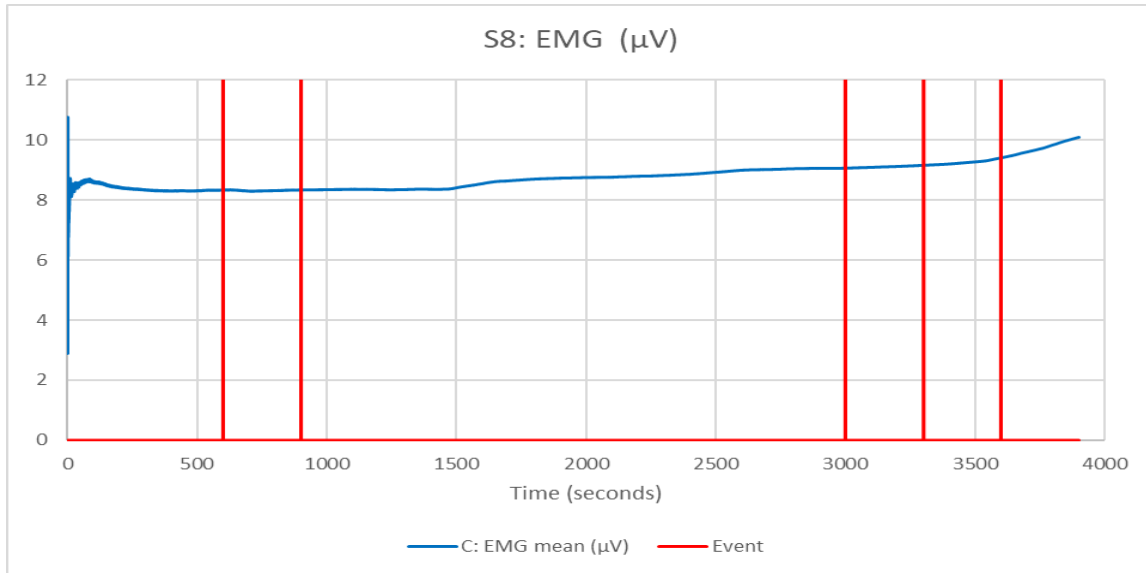
- * Delta increased significantly at almost all electrode locations, indicating an increase in inhibition of brain functions interfering with internal concentration for the corresponding brain functions (21).
- * Theta increased significantly for Fp1, Fp2, C3, C4, T4, CZ and Pz (most significantly at C4), indicating a substantial increase in cognitive control for related brain functions even after grounding stopped (25).
- * Theta decrease significantly for P3 and P4, indicating a substantial decrease in cognitive control for related brain functions even after grounding stopped (25).
- * Alpha increased significantly at C4 and decreased significantly at F8, O1 and T6.
- * Beta did not show any significant change.
- * Conclusion: Subject 8 continued to have a good meditation even after being ungrounded.

Coherence Results



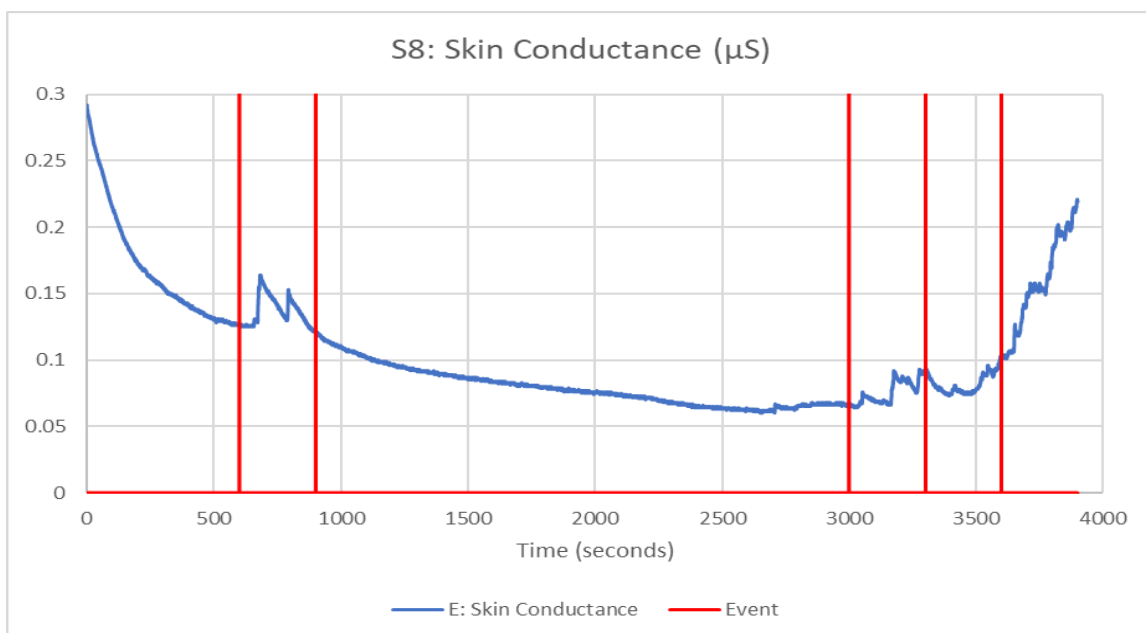
It can be seen that coherence in Delta and Theta is lower than normal during the pre-grounding phase indicating that the subject was going inside and that most of the brain unconscious cognitive processes were inhibited. In Beta, there is high coherence in the brain functions of the left hemisphere indicating activity of the functions related to that hemisphere (detailed analysis, sequential and linguistic thinking, logic, analytical reasoning, etc.) (6). Frontal Alpha coherence was found to be a sensitive discriminator of the Transcendental Meditation technique (52). Coherence in Alpha and Beta remained practically the same before, during and after the grounding period. After grounding, coherence decreased even more for Delta and Theta indicating more suppression of unconscious cognitive brain functions.

Electromyography (EMG) Results



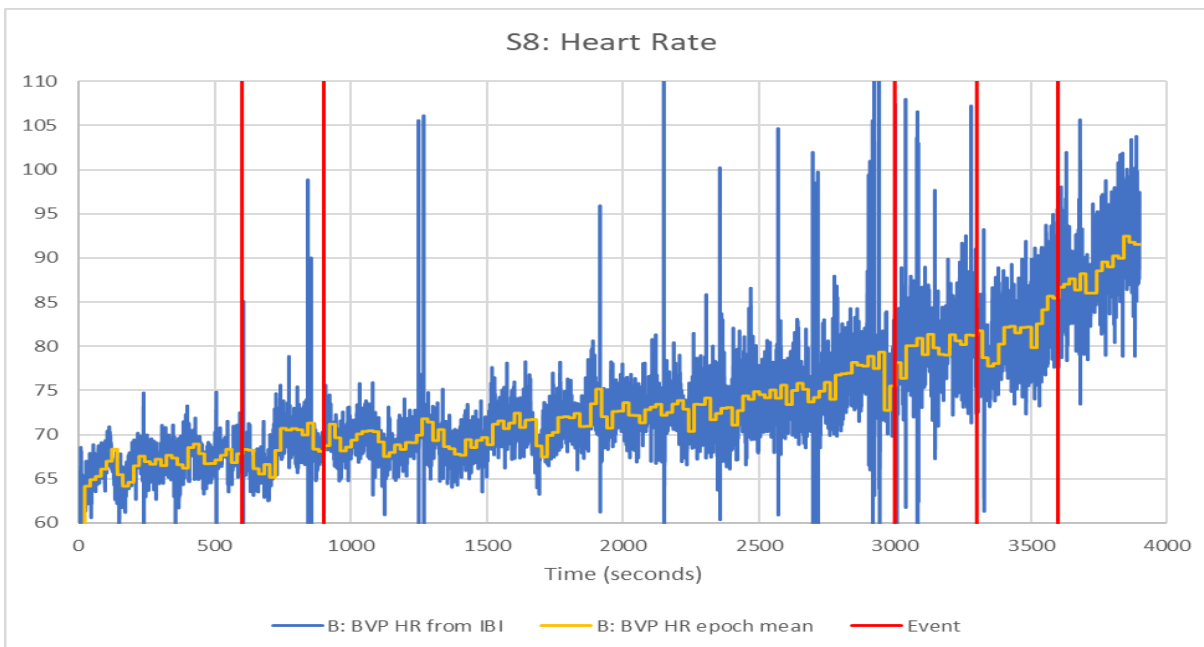
The graph above shows Subject 8 trapezius muscles initially getting more tense for about a minute (initial period of adjustment). Then her trapezius muscles relaxed until about 8 minutes into the session. Then muscle tension stayed about the same for another 17 minutes (10 minutes into the grounded period). Then her muscles started to tense slowly until the end of the session.

Skin Conductance (SC) Results



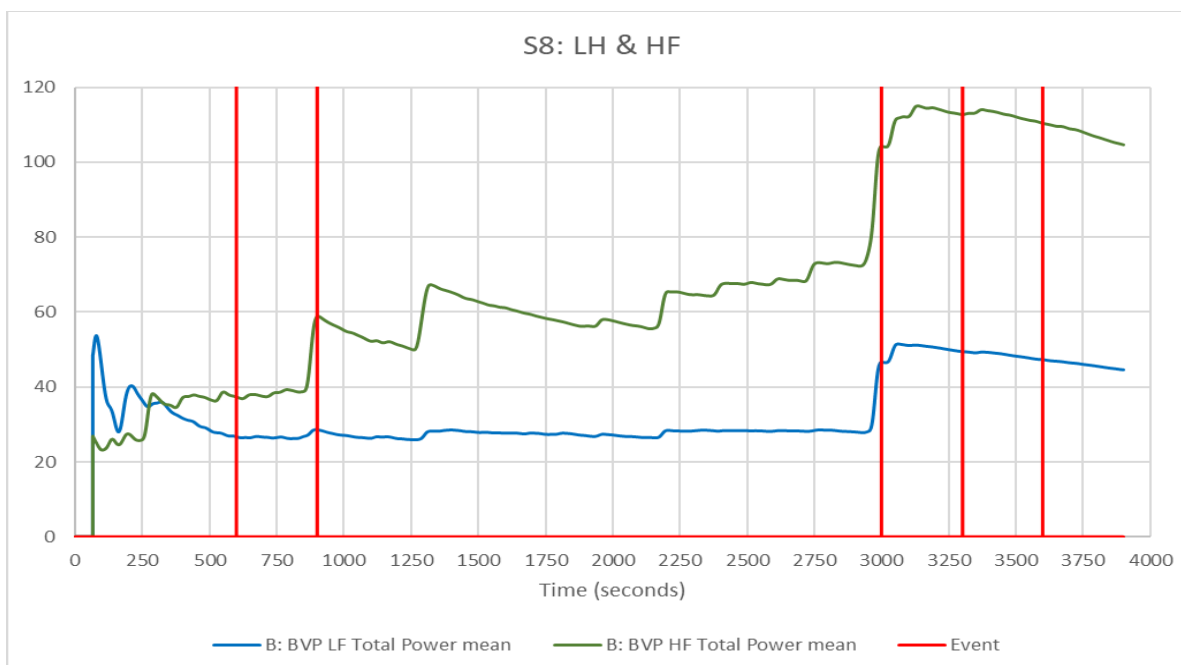
Subject 8 skin conductance decreased for most of the duration of the session (until about 45 minutes after the start of the session) indicating parasympathetic system activation (i.e. ANS relaxation). Then skin conductance remained relatively stable for another 13.5 minutes before increasing sharply for the rest of the session indicating sympathetic activation (increased in stress).

Heart Rate Results



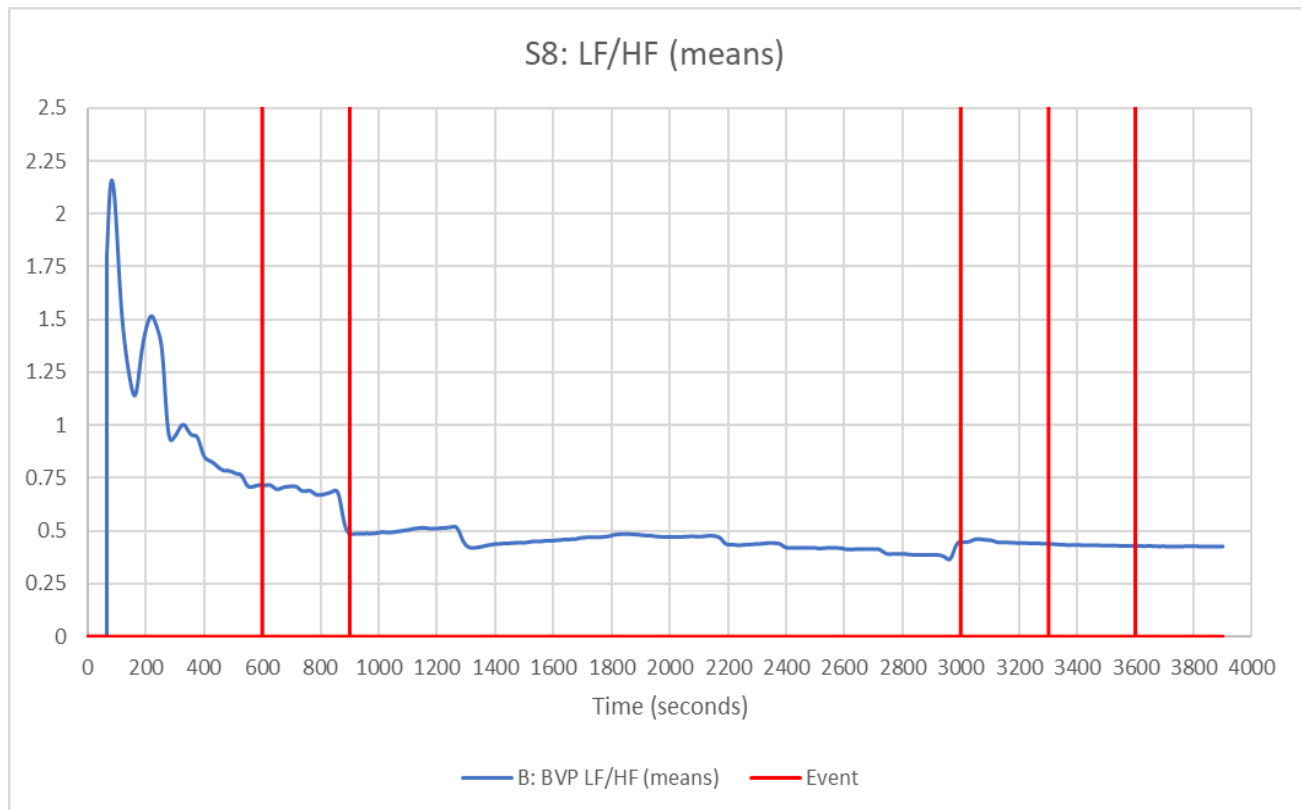
Starting at about 65 beats per minute (this is more clearly seen in the yellow line representing heart rate epoch means, each epoch being the mean of 20 seconds of data), Subject 8 heart rate increased slowly during the entire session but more rapidly after the end of grounding period, 55 minutes after the start of the experiment, ending at about 92 beats per minute. Notice a sharp decrease in heart rate just after ungrounding for about 2 minutes (starting at 81 decreasing to 78 beats per minute) before increasing rapidly until the end of the session.

Low-Frequency (LF) and High-Frequency (HF) Results



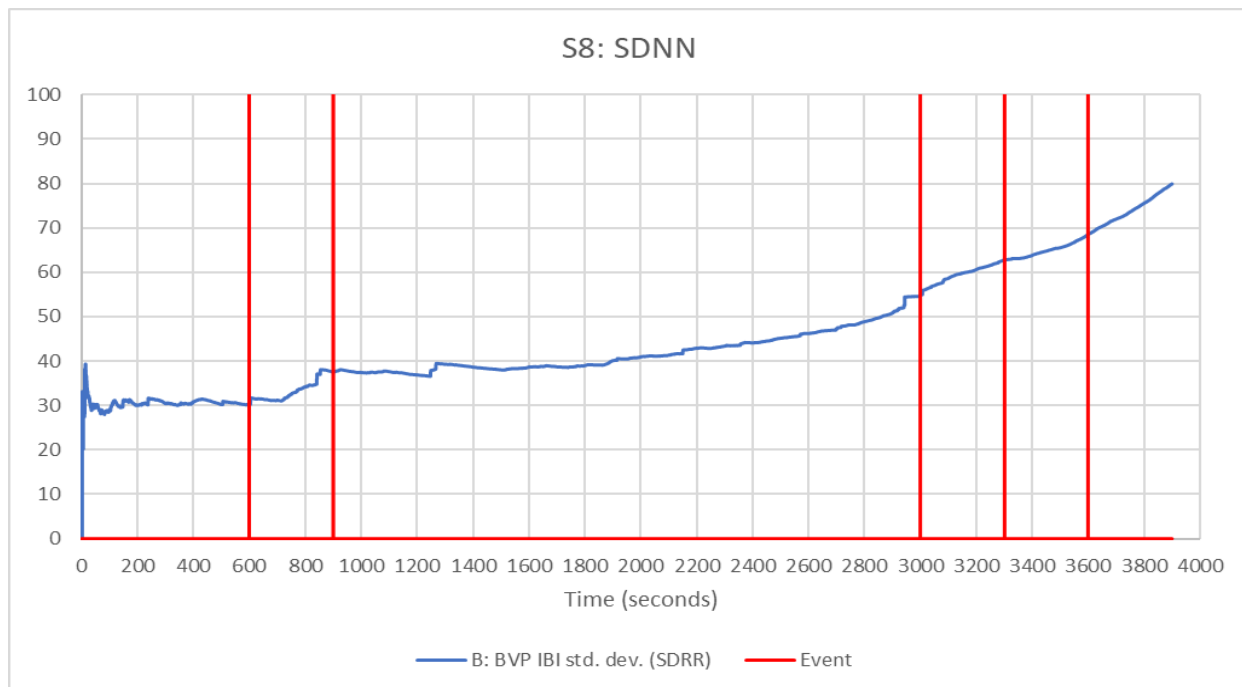
After one minute, there is a peak in LF that lasted for 2 minutes then there is a decrease until 10 minutes into the session followed by a stable period lasting for 39 minutes before a last jump followed by a slow decrease until the end of the session. During the same time period, HF increased slowly for 3 minutes initially, followed by a rapid increase for one minute and then a slow increase for 10 minutes, then another rapid increase for a minute then a decrease for 6 minutes then another increase for one minute followed by another decrease for about 14 minutes. There is next a slow increase for about 13 minutes followed by a rapid increase lasting about 4 minutes and a final slow decrease until the end of the session. Notice that about 4 minutes after the start of the session, HF crossed over to become larger than LF and stayed that way until the end of the session, increasingly distancing itself from LF during the entire session.

LF/HF Results



One minute and half into the session, there is an initial large peak in LF/HF that lasted about 1.5 minutes (again this peak is probably an artifact due to the stress the subject experienced to get ready). This is followed by a slow decrease for the rest of the session (although very close to be stable up to about 50 minutes into the session with a little increase at that time). Notice an abrupt decrease in LF/HF at about the time of the start of the grounding period. LF/HF became the lowest during most of the grounding period (< 0.5).

SDNN Results



Subject 8's SDNN stayed stable for the first 12.5 minutes. It then increased relatively quickly for about 2 minutes, stayed stable for about 6 minutes before increasing first slowly and then more rapidly for the rest of the session (in an exponential-like fashion). Note the Subject 8's SDNN is the smallest of all the subjects in this study.

Summary of Findings for Subject 8

Brain mapping: Before grounding, there are indications that Subject 8 showed a mild level of cognitive control and that she was going inside. During grounding cognitive control is still there but much more relaxed with a deepening of the meditation, peacefulness and alertness. After grounding, the situation is similar but the meditation became less deep.

Trapezius Muscles tension decreased until about 8 minutes into the session. It then stayed about the same until 25 minutes into the session or 10 minutes after the start of the grounding period. Then her trapezius muscles started to tense very slowly until the end of the session.

Skin Conductance decreased for most of the duration of the session (until about 45 minutes after the start of the session, 30 minutes into the grounding period) indicating ANS relaxation. Then skin conductance remained relatively stable (with some variability) for another 13.5 minutes (about 3.5 minutes after the end of the grounding period) before increasing sharply for the rest of the session indicating increased ANS stress. Despite the small and slow increase in trapezius muscle tension during the grounding period, this decrease in ANS activation is a sign a good relaxation.

Heart rate, starting around 65 beats per minutes, increased slowly during the entire session but more rapidly after the end of grounding period, 55 minutes after the start of the experiment, ending at about 92 beats per minute.

LF and HF: After the first 6 minutes, Subject 8's HF component of HRV became much larger and stayed much larger than LF for the rest of the session. This situation indicates a good relaxation of

the ANS during the entire session except at the beginning (which could be due to the initial adjustment time). Despite the increase in heart rate, this is consistent with a good meditation.

LF/HF: After an initial high peak (probably due to the initial period of getting into a comfortable position), 5 minutes into the session LF/HF decreased below 1.0 for the rest of the session, indicating that HF became larger than LF at that moment (as can be confirmed by looking at the LF & HF graph).

Subject 9

Female, 62, Pranic healer. Her meditation technique is the Arhartic Yoga meditation as taught by Master Choa Kok Sui. She has been meditating for 8-10 years for 1 hour to 1.5 hours daily. She indicated that the pain in her left hip was gone after meditation. Overall, she indicated that she felt a slightly better after the meditation.

Brain Mapping Results

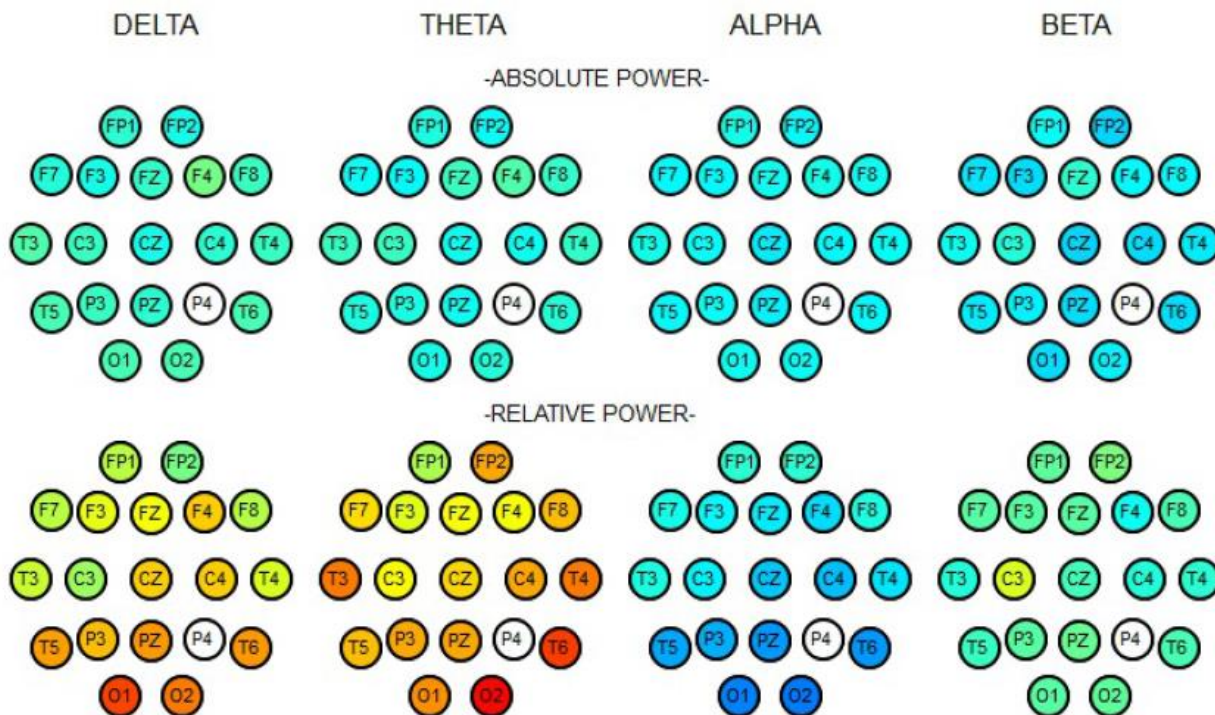
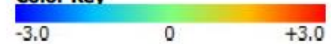
Before grounding

Eyes Closed P300 Z Scores
Session 1 (6/3/2019)

Band Ranges

Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

Color Key



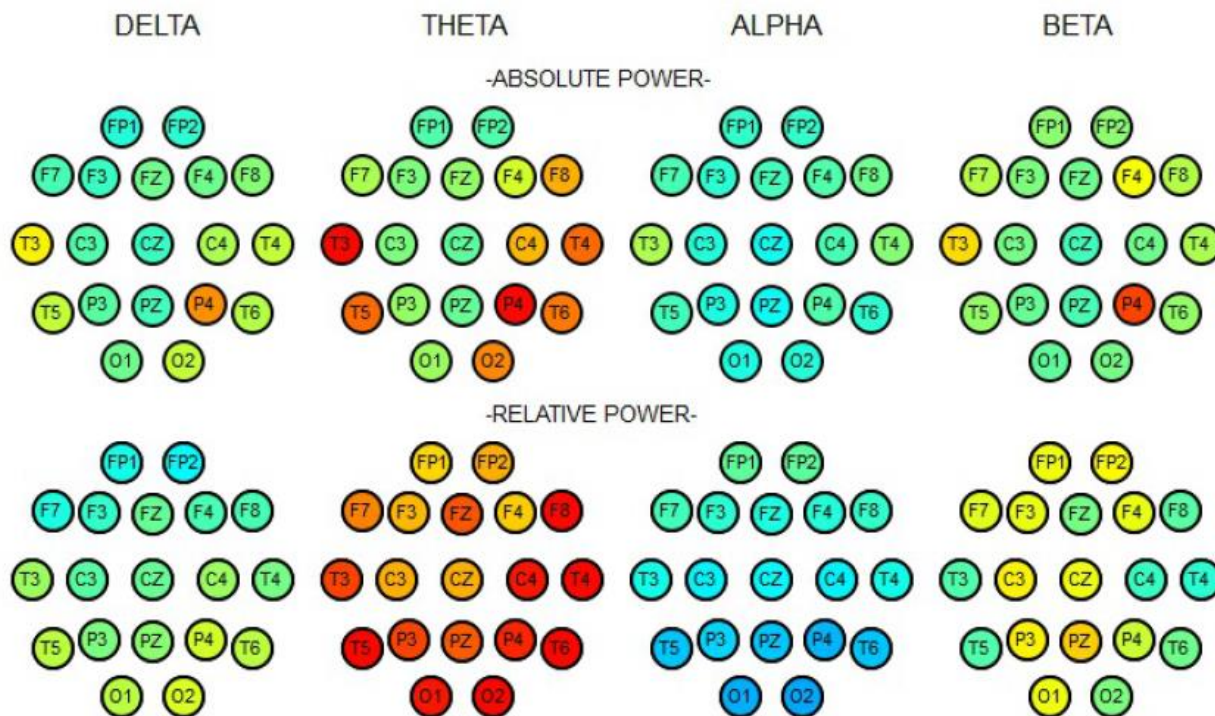
Subject 9 absolute power is normal but with a tendency toward low activity (light green to light blue). The P4 electrode did not provide any information. Theta and Delta relative power shows high activity for electrode sites in the hole brain but more so in the posterior region of the brain. T6 and O2 in the Theta band and O1 in the Delta band are particularly active regions of the brain. Strong Theta waves are associated with internal focus, hyper-vigilance, meditation, prayer and spiritual awareness (6). Note also the low activity in the Alpha band for the same region of the brain which is due to Alpha being inversely related to cortical activity (12, 13, 14). T6 main function is emotional understanding with other functions involving this area being facial recognition, symbol recognition, auditory processing, sense of direction, visual memory and visualization, categorization, sound voice

intonation perception, music, and social cues (6, 11). T6 activation in the Theta band is an indication of a substantial increase in the need for cognitive control for related brain functions related to that electrode site (20). O1 and O2 are primary visual areas and are relate to visual association cortex, visual processing, procedural memory and visual perception (6). PZ is about integrating somato-sensory information with posterior visual perceptions, working memory (6, 38).

During grounding

**Eyes Closed P300 Z Scores
Session 2 (6/3/2019)**

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

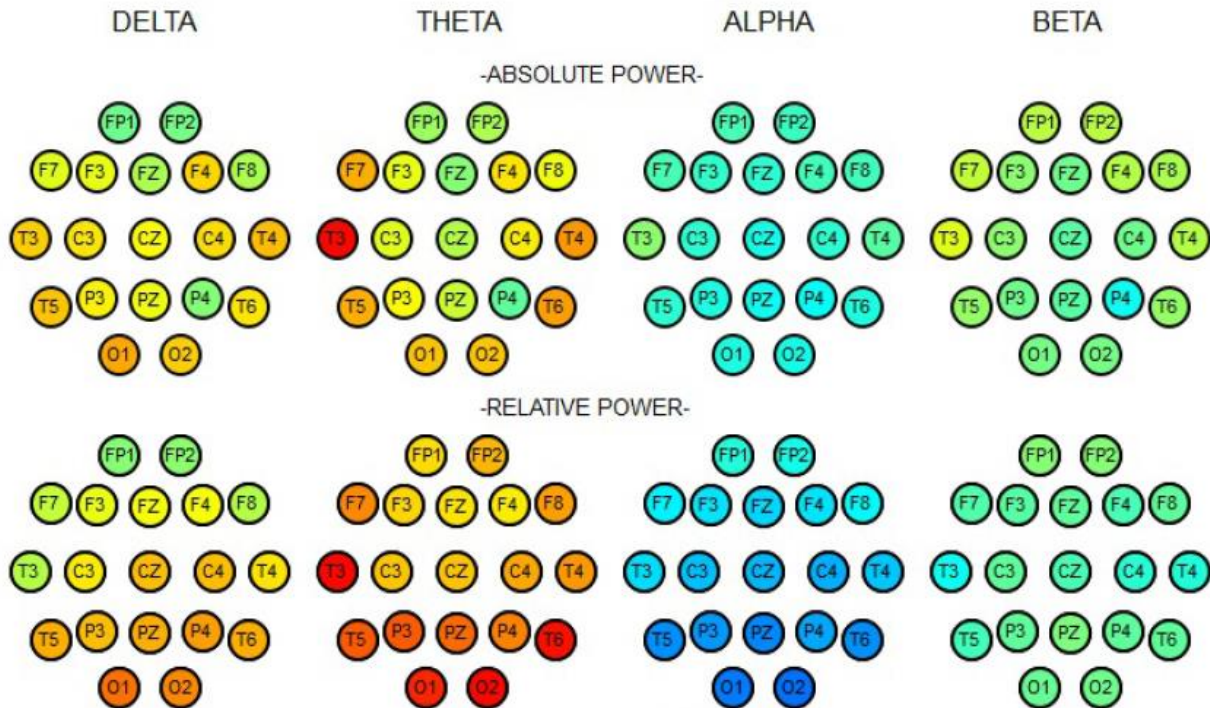


During grounding, both absolute power and relative power show a significant increase in Theta band activity at many electrode sites (this is more prevalent in relative power where all electrode sites are activated). Strong Theta waves are associated with internal focus, hyper-vigilance, meditation, prayer and spiritual awareness (6), indicating an increase in the dept of meditation for Subject 9 during the grounding period. Note again the low activity in the Alpha band for the same region of the brain which is due to Alpha being inversely related to cortical activity (12, 13, 14).

After grounding

**Eyes Closed P300 Z Scores
Session 3 (6/3/2019)**

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz



After the grounding period, the brain, while still more in meditation than before grounding, started to revert to the condition it was before grounding.

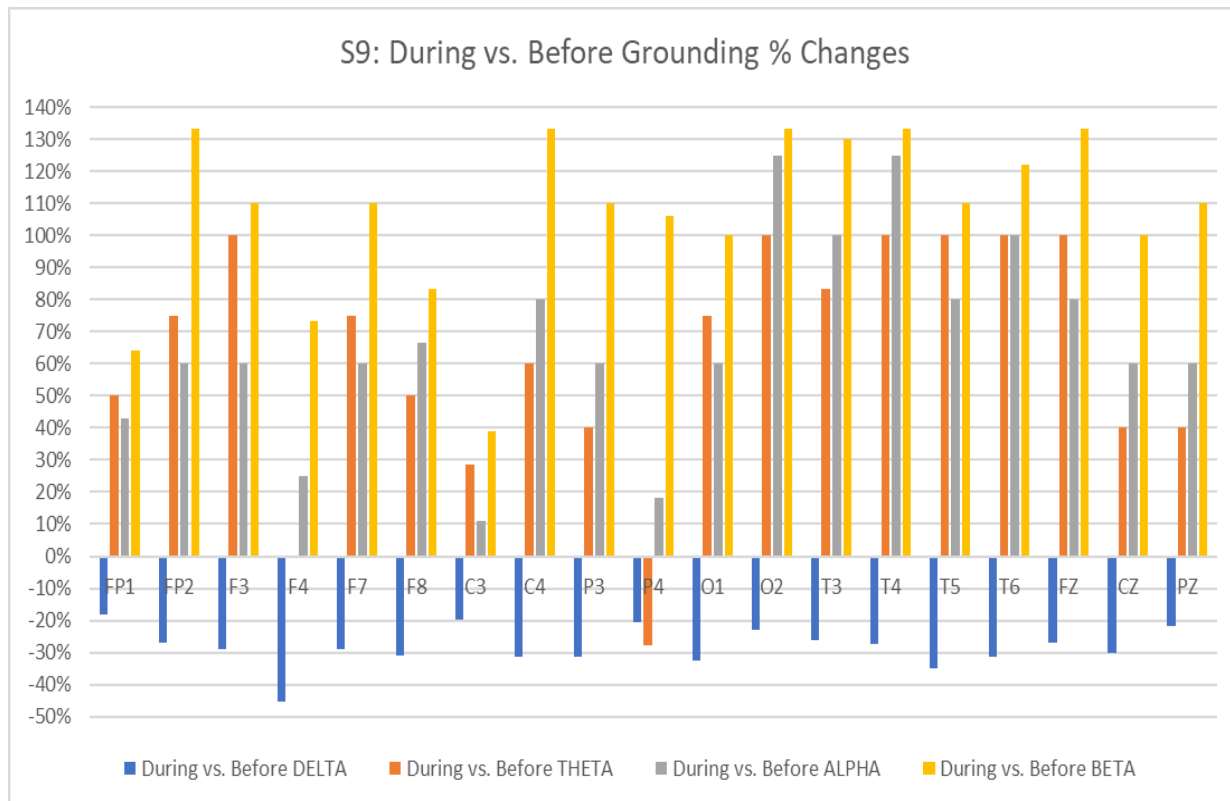
CZ Theta/Beta and F3/F4 Alpha

Researchers have shown that calculating the relative power ratio Theta/Beta at CZ can be used to determine slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (6, 17, 18). They also discovered that calculating F3/F4 relative power ratio in the Alpha band means processing information in a positive way for an increase while a decrease in the ratio indicated a more negative processing mode (19, 20). The table below give the result of all 3 sessions for Subject 9.

	Subject #9			Ref Range (60 yrs)
	Session 1	Session 2	Session 3	
CZ Theta/Beta	1.8	1.1	1.9	0.8-2.8
F3/F4 Alpha	0.4	0.7	1.2	0.8-1.2

CZ Theta/Beta was in the normal range before grounding and remained in the normal range during and after grounding. F3/F4 Alpha started quite low, improved during grounding but still low, and returned to the normal range after grounding. Right-lateralization indicated a more negative processing mode (19).

During vs. Before grounding



* Delta decreased significantly at almost all locations indicating a decreased in inhibition of brain functions interfering with internal concentration for the corresponding brain Functions (21).

* Theta increased significantly at all locations, except 2: F4 = 0% and P4 with a significant decrease, indicating a substantial increase in the need for cognitive control for related brain functions and a substantial decrease in the need for cognitive control for brain functions related to P4 (25).

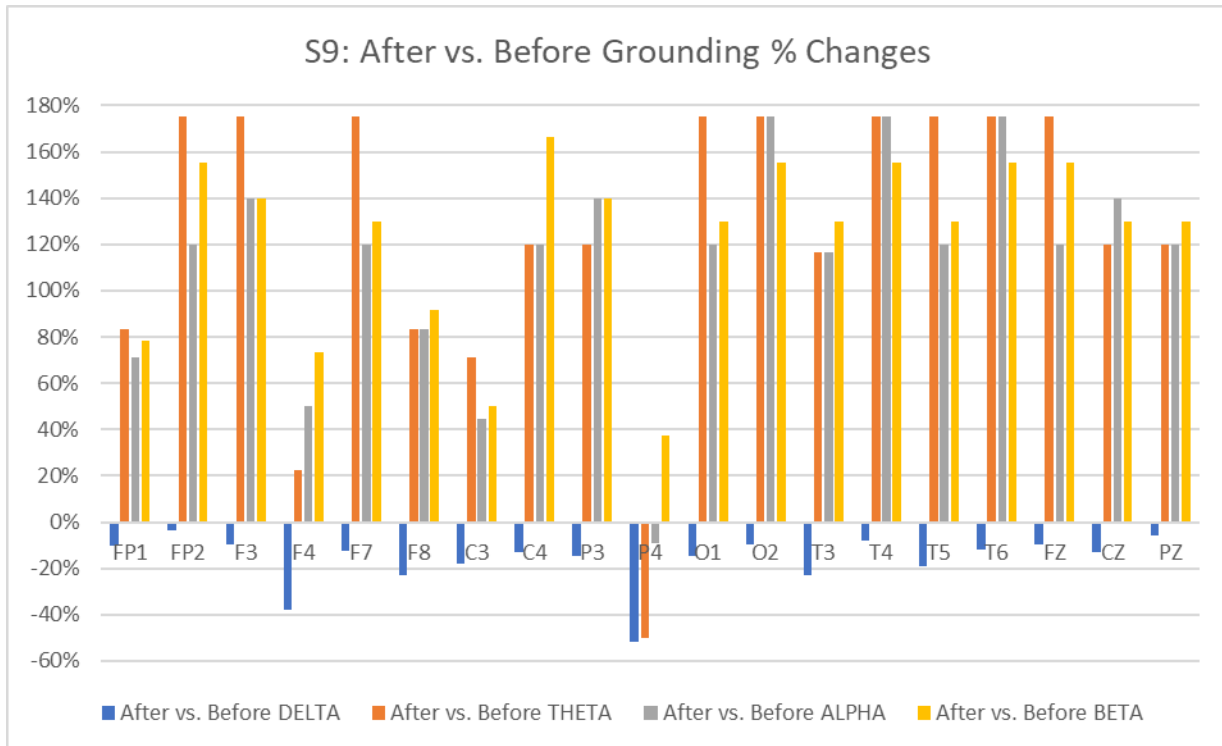
* P4: Visual-spatial sketch pad, image and spatial processing, facial decoding, integration with environment, spatial memory, self-concern, map orientation, knowing the difference between right and left, self in space, music, body image, physical act of dressing (left side body awareness) (6).

* Alpha increased at all locations and significantly so except at 2 locations: C3 and P4. This indicates an increase in relaxation, peacefulness and alertness (6).

* Beta increased significantly at all locations indicating an increase in alertness and mental activity.

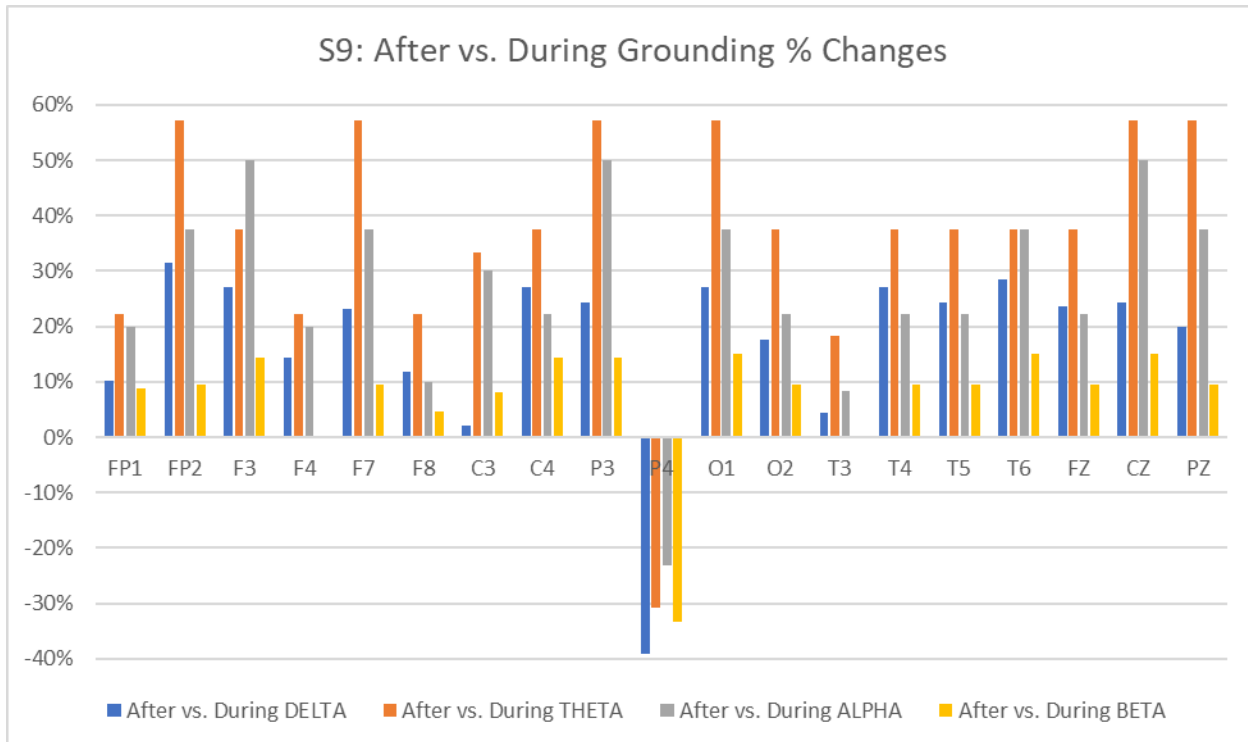
* Conclusion: Subject 9 experienced a decrease in inhibition of brain functions interfering with internal concentration, i.e. higher level of receptivity. Subject 9 also became more relaxed, peaceful and alert but mental activity also increased.

After vs. Before grounding



- * Delta decreased at all locations but significantly so at F4, F8, P4, and T3, indicating a decrease in inhibition of brain functions interfering with internal concentration for the corresponding brain functions (25).
- * F4 & F8 - Avoidance behavior, withdrawal, impulse control (important links to the amygdala), emotional tone variations (motor aprosodia) (6).
- * F4 – inductive creative, inductive emotional, metaphorical thinking, short-term retrieval of spatial-object memory, vigilance, selective and sustained attention (6).
- * F8 – spatial and visual working memory, gestalt, sustained attention, conscious facial emotional processing, prosody, empathy conscience, feeling sense of right and wrong, emotional gating, vigilance area, apprehension, disinterest, sustained and selective attention, processing of anger, rage, anxiety, fear, regulation of aggressive and sexual impulses (6).
- * F8 is close to source of emotional impulses (38).
- * T3 and T5: Long term verbal and visual memory, linguistic and reading perception and comprehension, processing integration and perception of auditory input, visual perception of what an object is, “Inner voice”, positive mood (6).
- * Theta increased significantly at all locations except for a significant decrease at P4, indicating a substantial increase in the need for cognitive control for related brain functions and a substantial decrease in the need for cognitive control for brain functions related to P4 (25).
- * Alpha increased at all locations and significantly so except at P4. This indicates an increase in relaxation, peacefulness and alertness continuing after grounding stopped.
- * Beta increased significantly at all locations indicating an increase in alertness and mental activity.
- * Conclusion: After the end of the grounding period, Subject 9 level of receptivity decreased but she continued to be more relaxed, peaceful and alert.

After vs. During grounding



- * Delta increased at almost all locations, except for non-significant increases at Fp1, F4, F8, C3, O2, and T3, with a significant decrease at P4, indicating an increase in inhibition of brain functions interfering with internal concentration for all the locations except P4 (21).
- * Theta increased significantly at almost all locations except for a significant decrease at P4, indicating a substantial increase in the need for cognitive control for related brain functions (25).
- * Alpha increased at all locations and significantly so except for 3 locations: F8, P4 and T3. This indicates the continuation of an increase in relaxation, peacefulness and alertness even after the grounding period ended.
- * Beta did not change significantly except for a significant decrease at P4. There is a significant decrease at P4 for all frequency bands.
- * P4: Visual-spatial sketch pad, image and spatial processing, facial decoding, integration with environment, spatial memory, perhaps dysfunction effects, self-concern, map orientation, knowing the difference between right and left, self in space, music, body image, physical act of dressing (left side body awareness) (6).
- * Conclusion: After the end of the grounding period, Subject 9 experienced a decrease in receptivity, an increase in the need for cognitive control for almost all electrode locations and increase in internal concentration, relaxation and alertness compared to during the grounding period.

Coherence Results

Eyes Closed P300 Z Scores

Band Ranges
 Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
 Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz



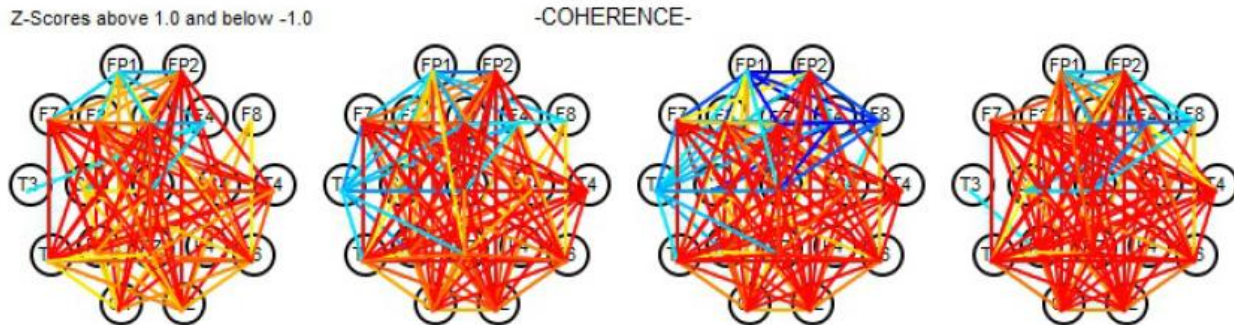
DELTA

THETA

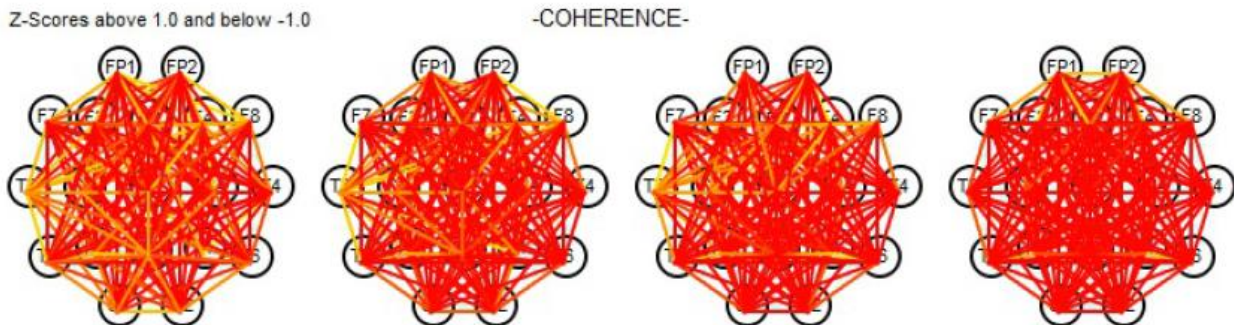
ALPHA

BETA

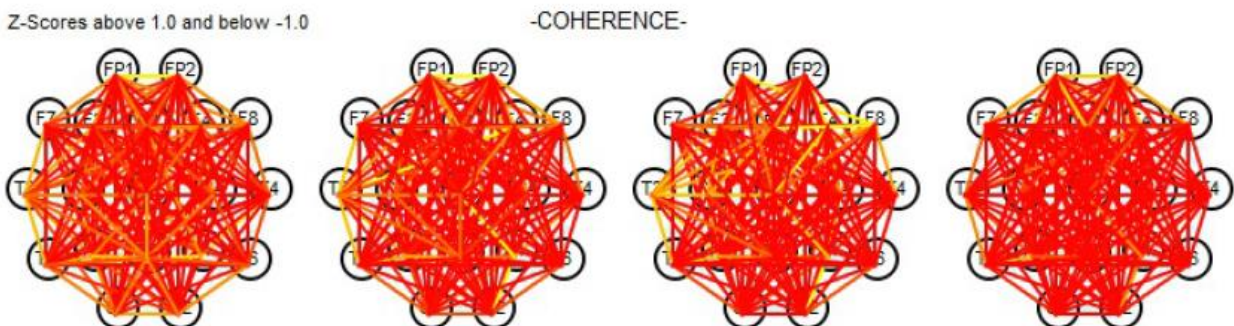
Before



During



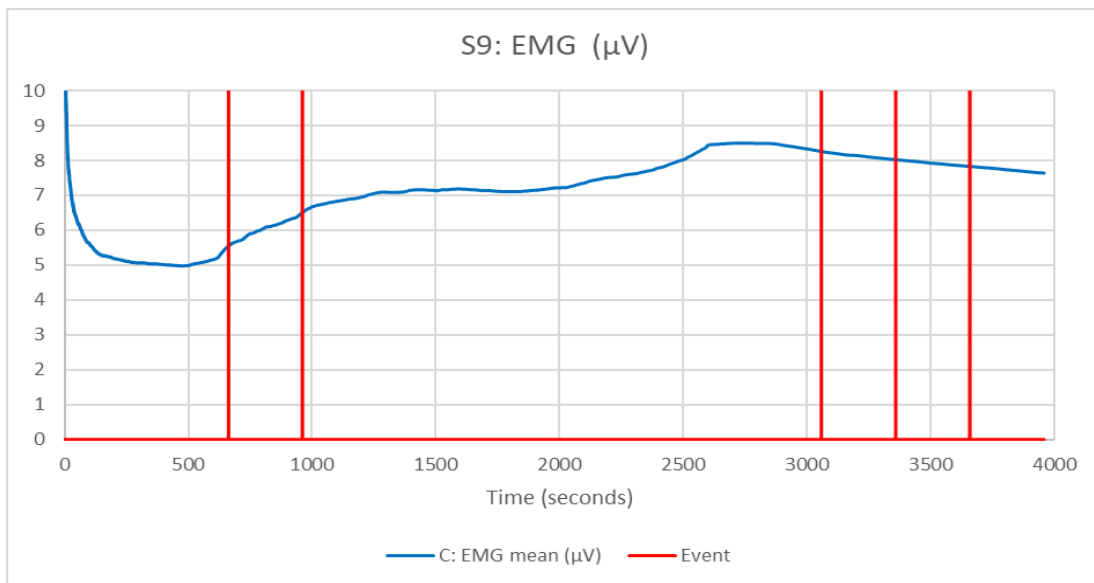
After



Before the grounding period coherence was high all over the brain and at all frequency bands and this high coherence state increased during grounding and remained at a similar level as during grounding after grounding. Coherence is the most common measure used to determine if different areas of the brain are generating signals that are significantly correlated (coherent) or not significantly correlated (not coherent) (47). Hypercoherence happens when brain sites are not functioning in efficient interdependent fashion, but rather have too much “cross-talk”. Excessive coherence tends to indicate two or more areas of the brain being overly connected or locked together (this is the situation here for almost all brain sites except for F8 which did not provide data before grounding). The brain is too rigid, and this also occurs when the brain builds new neural

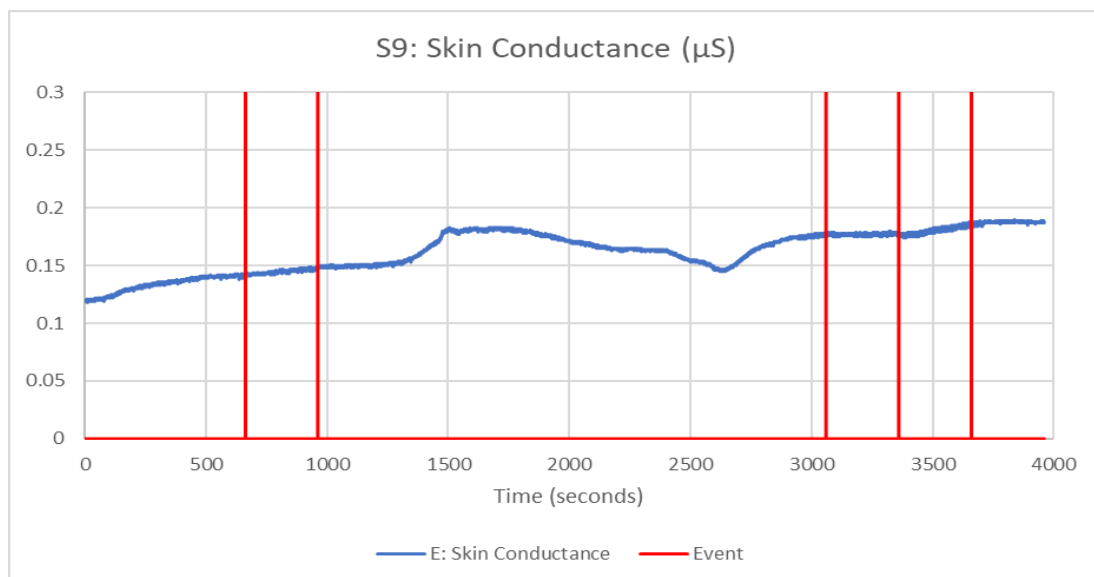
connections. The brain is not efficiently processing and executing information resulting in poor day-to-day performance (6). The result is decrease in flexibility of all brain functions (11). Beta hyper-coherence may indicate anxiety, panic attacks, stress and test anxiety (6). When excessive Alpha coherence is present, the brain may be locked up in Alpha and be hard to speed up or slow down (6). Excessive coherence may also indicate depression (6). However, brain researchers have found that long-term and advanced meditation practitioners have a brain that is more coherent and integrated, and that this heightened efficiency of brain functioning grows over time through practice — even outside of meditation — improving mental performance and overall health. Higher coherence is associated with more integrated and effective thinking and behavior, including greater intelligence, creativity, learning ability, emotional stability, ethical and moral reasoning, self-confidence, and reduced anxiety (45-49).

Electromyography (EMG) Results



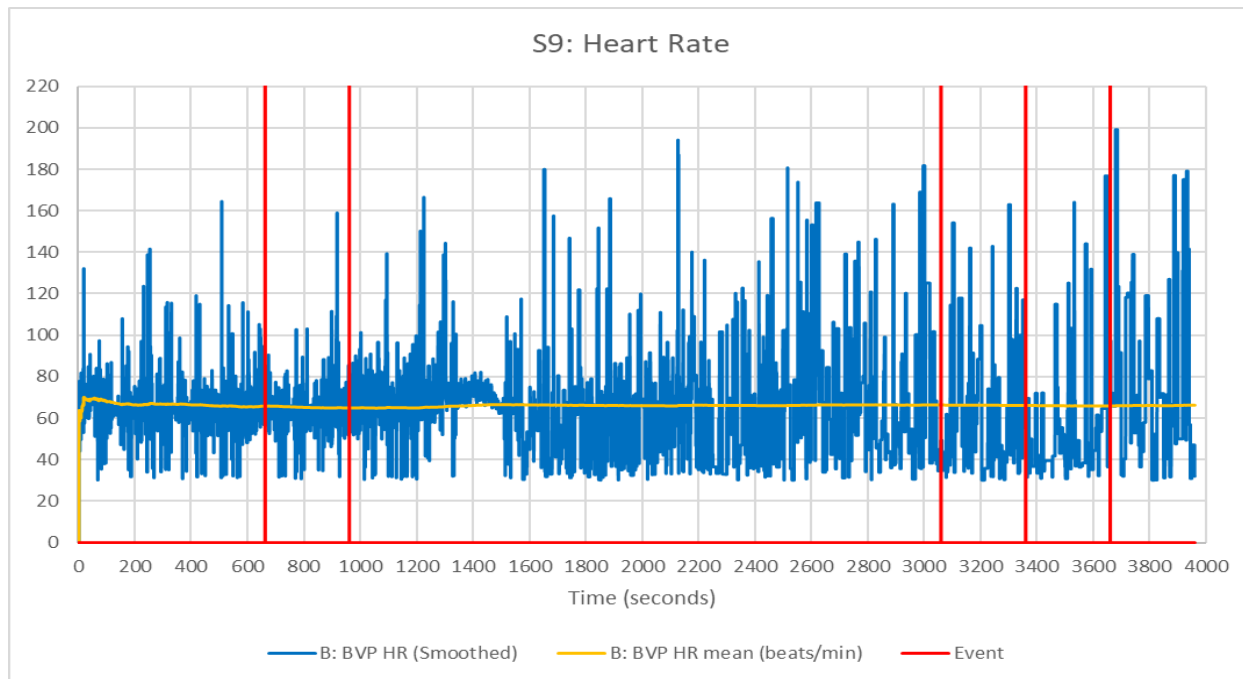
The graph above shows Subject 9 relaxing her trapezius muscles for about 8.5 minutes into the initial ungrounded period. After that, trapezius muscles tension increased first relatively fast then slower and then faster again until about 44 minutes into the session. After that muscle tension decreased slowly until the end of the session.

Skin Conductance (SC) Results

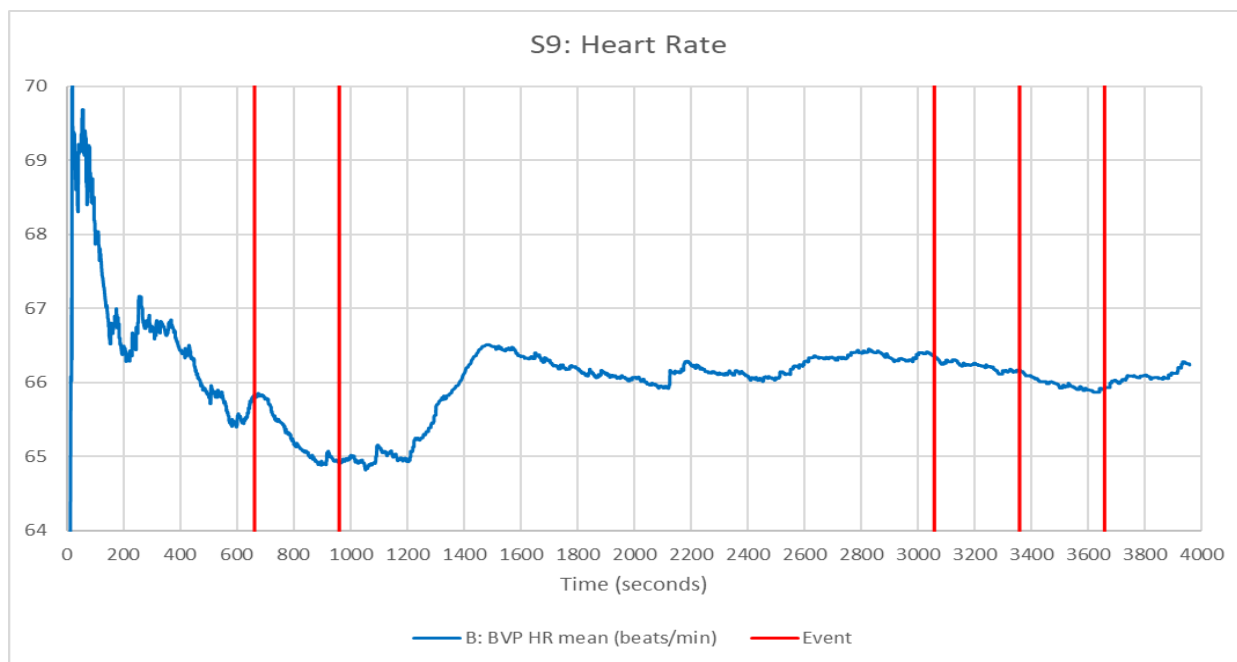


Subject 9 skin conductance increased slowly for the first 25 minutes after the start of the session indicating sympathetic system activation (i.e. slight increase in stress). Then skin conductance decreased slowly for 19 minutes (indicating ANS relaxation) before starting to increase again slowly for the rest of the session, indicating again sympathetic activation (increased in stress).

Heart Rate Results



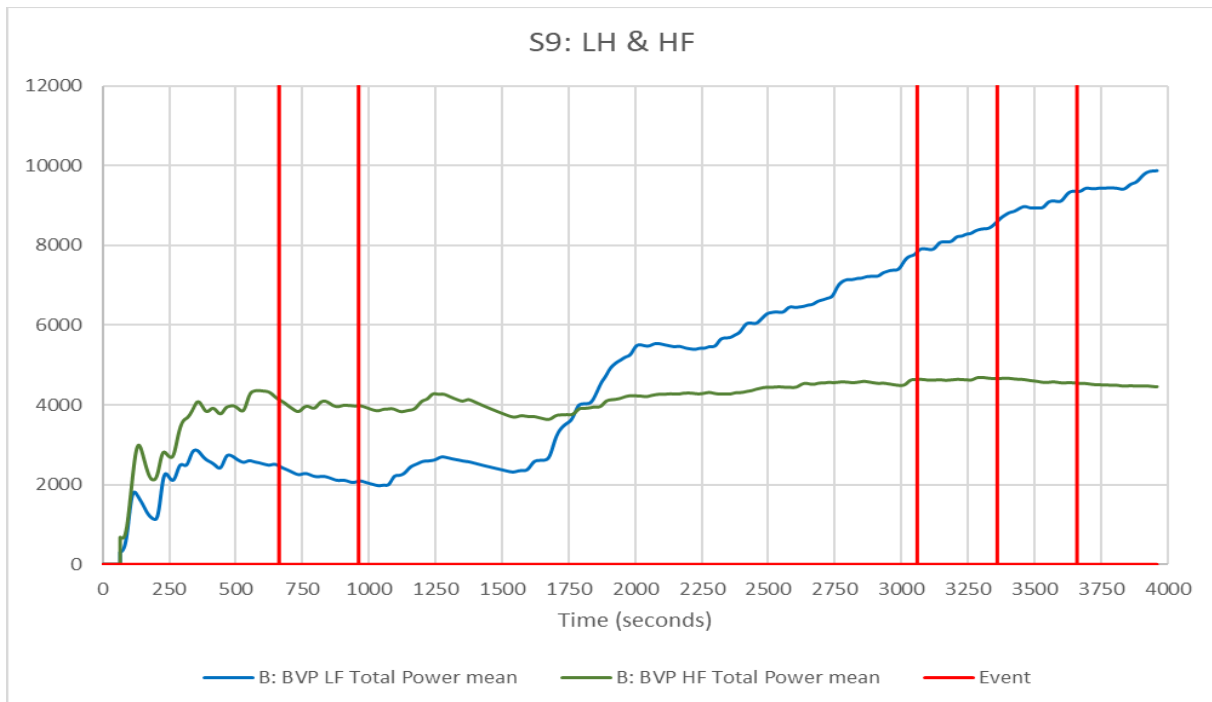
Subject 9 heart rate has a large variability as can be seen from the values of BVP HR (Smoothed) (blue line). Nevertheless, it can be observed from BVP HR mean (yellow line) that the average heart rate was quite constant (around 65 bpm).



Looking at the average heart rate (HR mean) in an expanded scale, it can be seen that heart rate was fairly constant, starting at a maximum of 69 beats per minute, going down to a minimum of 65 beats

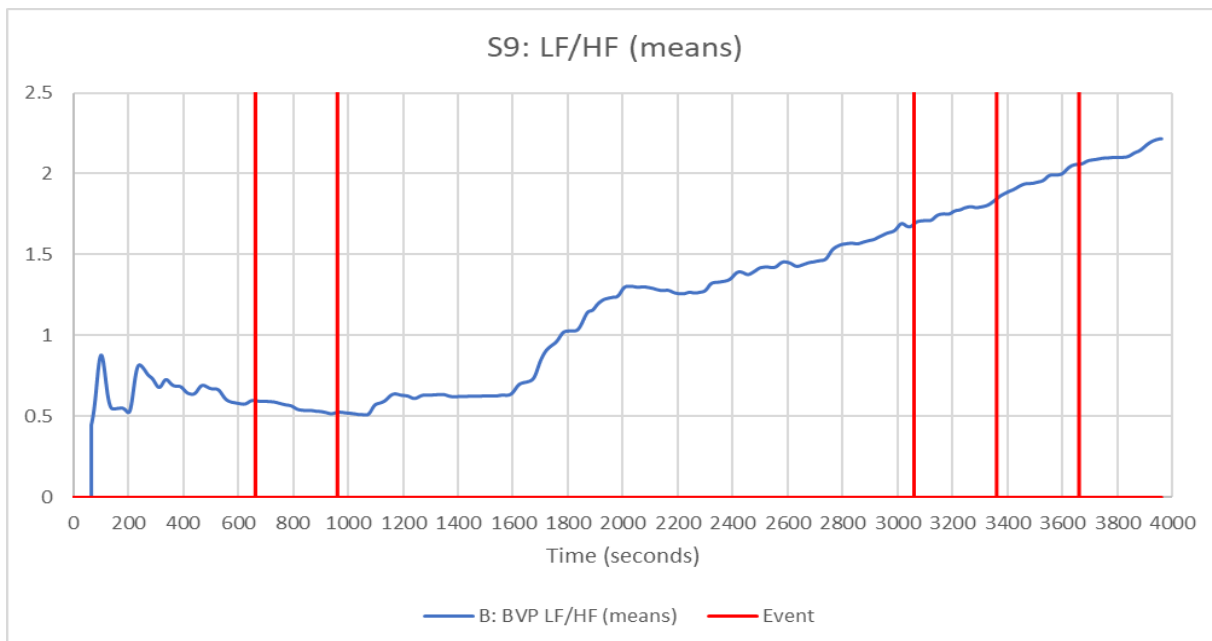
per minute around the start of the grounding period. It then increased to 66 beats per minute 9 minutes after the start of the grounding period and stayed there for the rest of the session.

Low-Frequency (LF) and High-Frequency (HF) Results



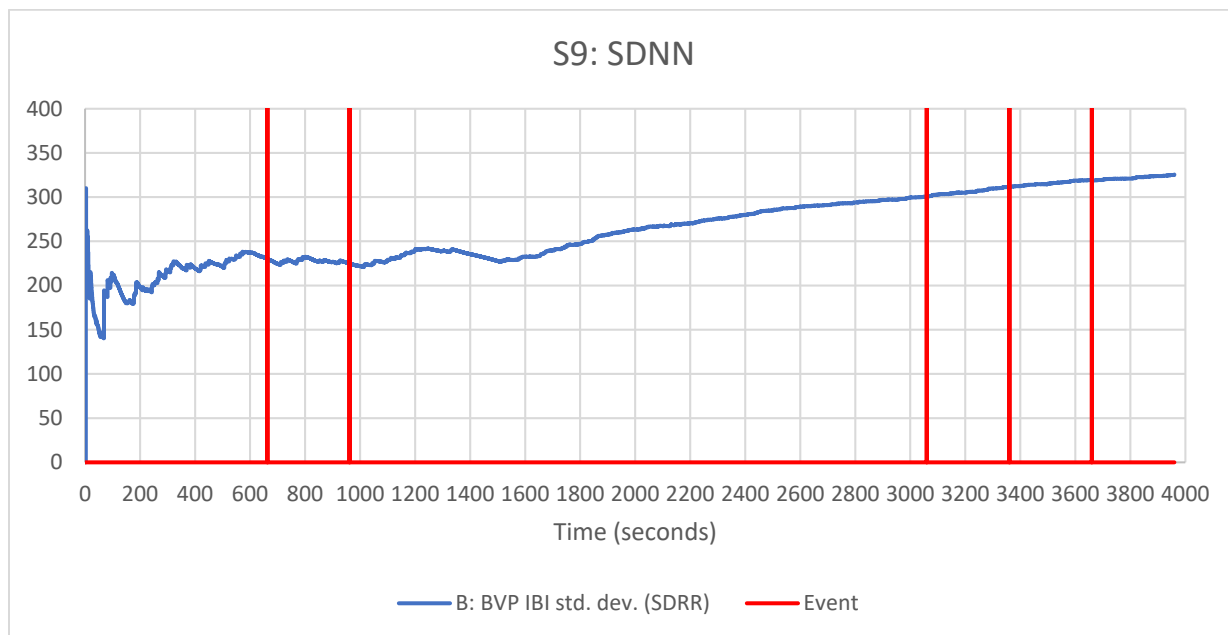
For Subject 9, LF and HF started by rising rapidly between the first and second minutes from the start of the session ending in a peak at about 2 minutes with HF peak rising to about twice the peak value of the LF peak. HF remained higher than LF until about 30 minutes into the session. After the initial peak, both LF and HF increase for about 3 minutes. While HF stayed stable after that for the rest of the session, LF stable period lasted about 20 minutes. After that period LF started rising until the end of the session crossing over and surpassing LF at about 30 minutes into the session.

LF/HF Results



Despite a small peak about 2 minutes after the start of the session, LF/HF stayed low (less than 1.0) for the first 30 minutes. It then increased almost linearly for the rest of the session (for the next 36 minutes).

SDNN Results



Subject 9 SDNN decreased rapidly during the first minute then increase for about 9 minutes before stabilizing for another 15 minutes. It then increased slowly for the rest of the session (40 minutes).

Summary of Findings for Subject 9

Brain mapping: Before grounding, Subject 9's brain shows signs of internal focus, hyper-vigilance, meditation, prayer and spiritual awareness. There are also signs of emotional control. During grounding, there is a deepening of internal focus, hyper-vigilance, meditation, prayer and spiritual awareness, indicating a deepening of the meditation. After the grounding period, the brain, while still more in meditation than before grounding, started to revert to the condition it was before grounding.

Trapezius Muscles: Subject 9 was relaxing her trapezius muscles for about 8.5 minutes into the initial ungrounded period. After that trapezius muscles tension increased first relatively fast then slower until about 44 minutes into the session (that is 28 minutes into the grounding period). After that trapezius muscles tension decreased slowly until the end of the session.

Skin Conductance increased slowly for the first 25 minutes after the start of the session (9 minutes into the grounding period) indicating sympathetic system activation (i.e. slight increase in stress). Next, then skin conductance decreased slowly for 19 minutes (indicating nervous system relaxation) before starting to increase again slowly for the rest of the session, indicating again sympathetic activation (increased in stress). The change in SC between the highest and lowest values is about 40%. It seems that grounding did induce relaxation for 19 minutes into the grounding period (from the 9th minute to the 28th minute into the grounding period). Then, 28 minutes into the grounding period, SC started to increase again. This increase could be seen as consistent with the result obtained by a study published in 2010 (34). Also note that the maximum tension in the trapezius muscles happened 28 minutes into the grounding period, about the same time as the start of the increase in SC (34, 35).

Heart rate is fairly constant with a maximum of 69 beats per minute (at the beginning of the session) and a minimum of 65 just around the start of the grounding period. Note that the highest heart rate value after the start of the grounding period happens about 9 minutes and again 31 minutes after the start of the grounding period (66.5 beats per minute). Heart rate decreased after that. The increase in heart rate 31 minutes after the start of the grounding period coupled with the increase in SC at about the same time could be seen as consistent with the result obtained previously indicating possible healing effects of grounding (34, 35).

LF and HF: HF remained higher than LF until about 30 minutes into the session (14 minutes into the grounding period). While HF stayed stable for the rest of the session, 10 minutes into the grounding period, LF increased almost linearly for the rest of the session surpassing HF at about 30 minutes into the session (14 minutes into the grounding period). This means that after about 14 minutes of grounding the stress in the body (more precisely in the ANS), increased for the rest of the session.

LF/HF stayed low for the first 27 minutes (11 minutes into the grounding period). It then increased almost linearly for the rest of the session. Notice that for the first 30 minutes LF/HF was below 1.0, in agreement with the LF and HF graph results.

SDNN increased for about 9 minutes (at the 10th minute into the session) before stabilizing for 15 minutes (up to 9 minutes into the grounding period). It then increased slowly for the rest of the session. This is in agreement with the results of the LF & HF graph where LF started increasing at around 10 minutes into the grounding period while HF stayed stable until the end of the session. An increasing value of SDNN is desirable because it reflects increased variability and high variability is considered healthy for the heart.

Overall: Before grounding, Subject 9's brain shows signs of internal focus, hyper-vigilance, meditation, prayer and spiritual awareness. During grounding, there is a deepening of internal focus, hyper-vigilance, meditation, prayer and spiritual awareness, indicating a deepening of the meditation. After the grounding period, the brain, while still more in meditation than before grounding, started to revert to the condition it was before grounding. Physiological indicators give a mixed picture. While SC was showing a decrease in the middle of the grounding period (suggesting relaxation), LF became higher than HF (i.e. LF/HF > 1.0) 14 minutes into the grounding period (an indicator of ANS stress), in the middle of the time when SC was decreasing. An increasing value of SDNN is desirable because it reflects increased variability and high variability is considered healthy for the heart. The conclusion is that Subject 9, being a long-term meditator, was able to have a good meditation despite not having optimum relaxation. There are also suggestive healing effects observed for some parameters (SC and heart rate).

Subject 10

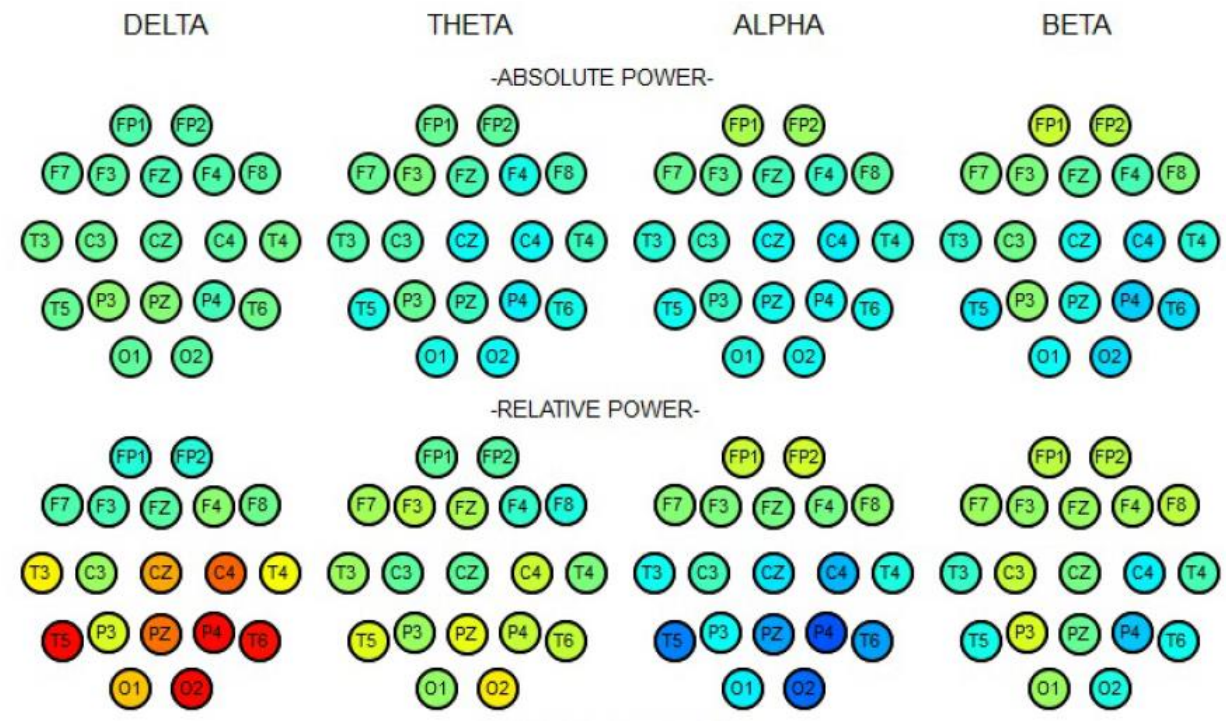
Female, 41, voice, piano and Yoga teacher. Her meditation technique is the I AM meditation as taught by Mata Armritanandamayi, also known as Amma (the "hugging saint"). She has been meditating for 7 years 20 minutes daily. She said that even though the helmet has hurt her head, she still was able to feel in her lower body, specially root and sacral chakra. She felt grounded! She asked for the experiment to be stopped at the end of the grounding period because of the discomfort due to the pressure by the EEG electrodes located in the forehead region. Consequently, we have only data before and during grounding for her. Overall, she rated how she felt after meditation slight better than usual.

Brain Mapping Results

Before grounding

Eyes Closed P300 Z Scores
Session 1 (6/7/2019)

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz



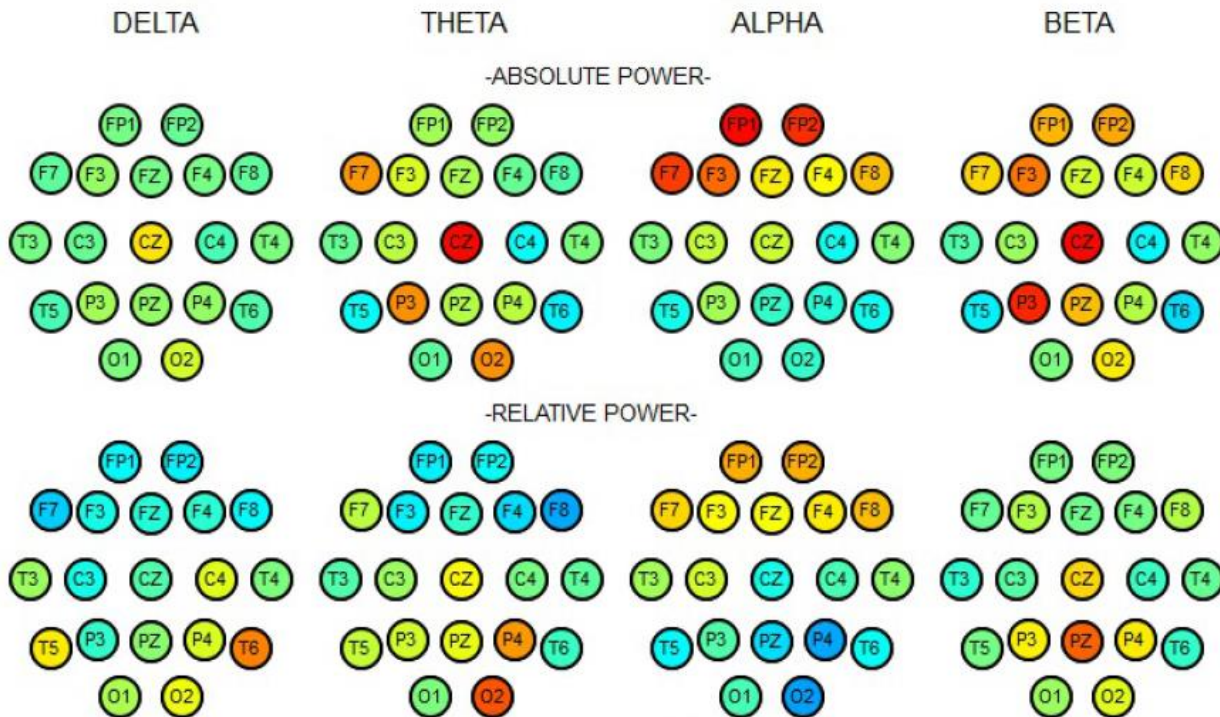
Subject 10 absolute power is normal but with a tendency toward low activity (light green to light blue). Delta relative power shows high activity for electrode sites in the posterior region of the brain. Electrode site showing high activity in Delta are CZ, PZ, C4, P4, T5, T6 and O2. Strong Delta waves have a slowing effect and the brain is underactive. Delta brainwaves can also occur when areas of the brain go “off line” to take up nourishment, as in deep sleep. Delta waves are also increased if a person is becoming drowsy. Increase in Delta activity also decrease our awareness of the physical environment and we access information in our unconscious mind through Delta (6). Elevated Delta activity in the posterior region of the brain is related to an increase in the flow of deep unconscious information during meditation (44). Note also the low activity in the Alpha band for the same regions of the brain that are highly activated in Delta which is due to Alpha being inversely related to cortical activity (i.e. increase flow of information in this case) (12, 13, 14).

During grounding

Eyes Closed P300 Z Scores
Session 2 (6/7/2019)

Band Ranges
Delta: 1.0–4.0 Hz | Theta: 4.5–7.5 Hz
Alpha: 8.0–13.0 Hz | Beta: 13.5–20.0 Hz

Color Key
-3.0 0 +3.0



Subject 10 absolute power is normal in Delta but there are many electrode sites that became very active during grounding, especially in frontal Alpha and Beta. In Theta the most active electrode site is CZ. CZ main function is sensorimotor integration of both lower extremities. Other functions involving this area are ambulation, short term memory, awareness of body, body position, body movement, walking (6, 11). Since Subject 10 was in pain during grounding, an increase in CZ in Theta and Beta is likely an indication of an increase in cognitive control related sensory-motor functions controlled by the brain regions under CZ (25). P3 is also highly activated in Beta. P3 principal function is cognitive processing of the right half of space with other functions including spatial relations, sensations, calculations, verbal reasoning and praxis (6, 11). This is consistent with someone thinking about controlling her reactions to pain. High Alpha in the frontal region of the brain could be due to an excess of inefficient Alpha activity associated with emotional control (6). However, neuroimaging studies have also reported meditation to enhance activity in the prefrontal cortex, especially in the Alpha and Theta bands (51). The prefrontal cortex main function is executive functioning – establishes goals, inhibits information extraneous to the goal directed planning process, plan and make decisions, working memory. Prefrontal lobes have connections to the amygdala, self-regulation, initiation, social-emotional behavior in social context, recognition and production of expression of language (prosody) (6). High activation of the prefrontal cortex in the Alpha band is further indication that the brain is consciously and calmly controlling somato-sensory information in this case related to the control of pain.

CZ Theta/Beta and F3/F4 Alpha

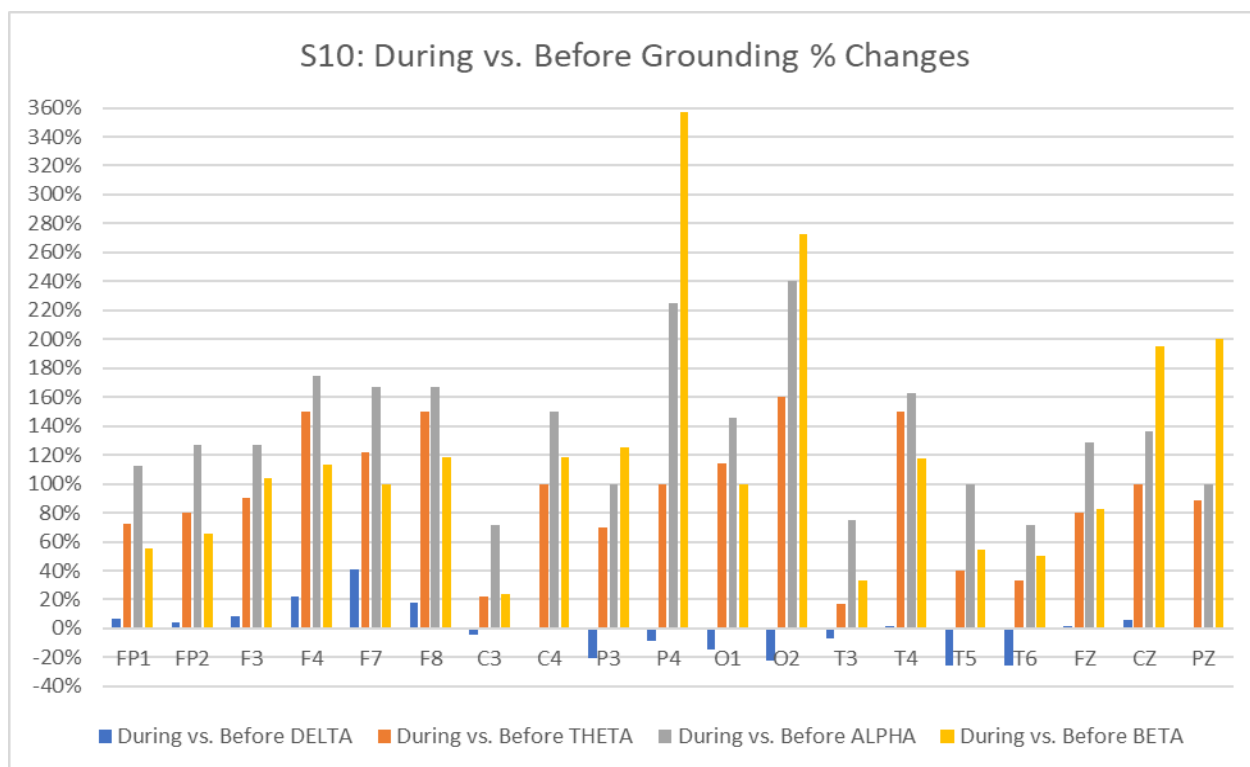
Researchers have shown that calculating the relative power ratio Theta/Beta at CZ can be used to determine slow-wave disorders, ADHD, interpersonal detachment with qualitative aspects of autistic

or Asperger's behavior (6, 17, 18). They also discovered that calculating F3/F4 relative power ratio in the Alpha band means processing information in a positive way for an increase while a decrease in the ratio indicated a more negative processing mode (19, 20). The table below give the result for the 2 available sessions for Subject 10.

	Subject #10		Ref Range (40 yrs)
	Session 1	Session 2	
CZ Theta/Beta	1.7	0.8	0.8-2.8
F3/F4 Alpha	1.6	0.5	0.8-1.2

CZ Theta/Beta was in the normal range before grounding and remained in the normal range during grounding. F3/F4 Alpha started rather high but became low during the grounding period (a significant decrease by 69%). Right-lateralization indicated a more negative processing mode (19).

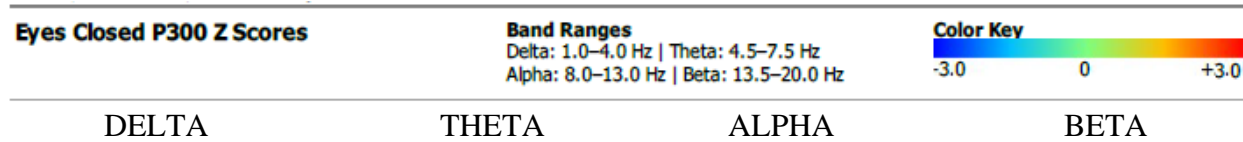
During vs. Before grounding



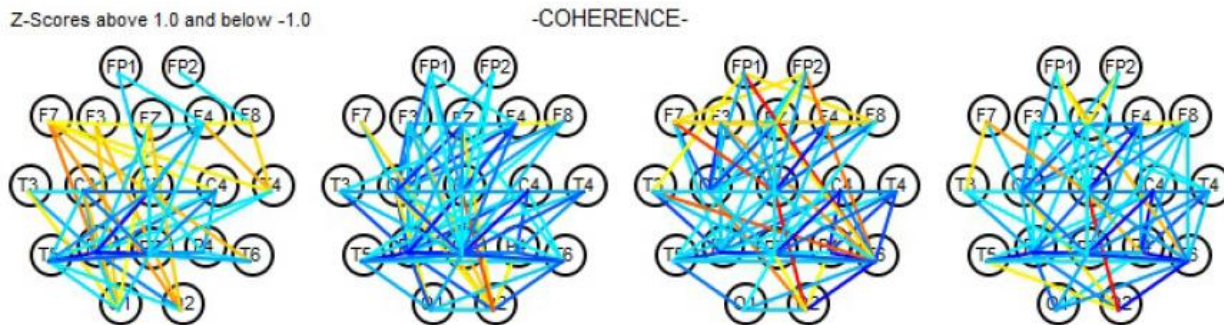
- * Delta increased significantly only at F4 and F7, indicating an increase in inhibition of brain functions interfering with internal concentration for brain functions related to the location of these electrodes.
- * F4: Inductive creative, inductive emotional, metaphorical thinking, short-term retrieval of spatial-object memory, vigilance, selective and sustained attention (6).
- * F7: Creates and controls output of spoken and written language, visual and auditory working memory, selective attention Broca's area (word retrieval, semantics, verbal understanding, speech), divided and selective attention (6). Near centers for rational activities (38).
- * Theta increased significantly at almost all electrode locations (except for a non-significant increase at T3), indicating an increase in cognitive control related almost all brain functions (25).
- * Alpha increased significantly at all electrode locations, indicating an increase in relaxation, peacefulness and alertness.
- * Beta increased significantly at all locations indicating an increase in alertness and mental activity.

* Conclusion: Subject 10 increased her control of rational activities and emotional thinking during grounding. This was in conjunction with an increase in alertness and mental activity. Nevertheless Subject 10 was able to experience some relaxation and peacefulness during the grounding period.

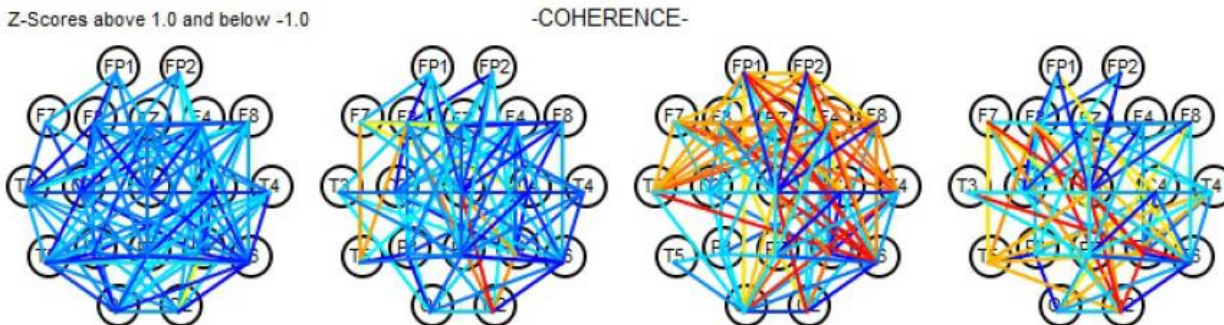
Coherence Results



Before



During

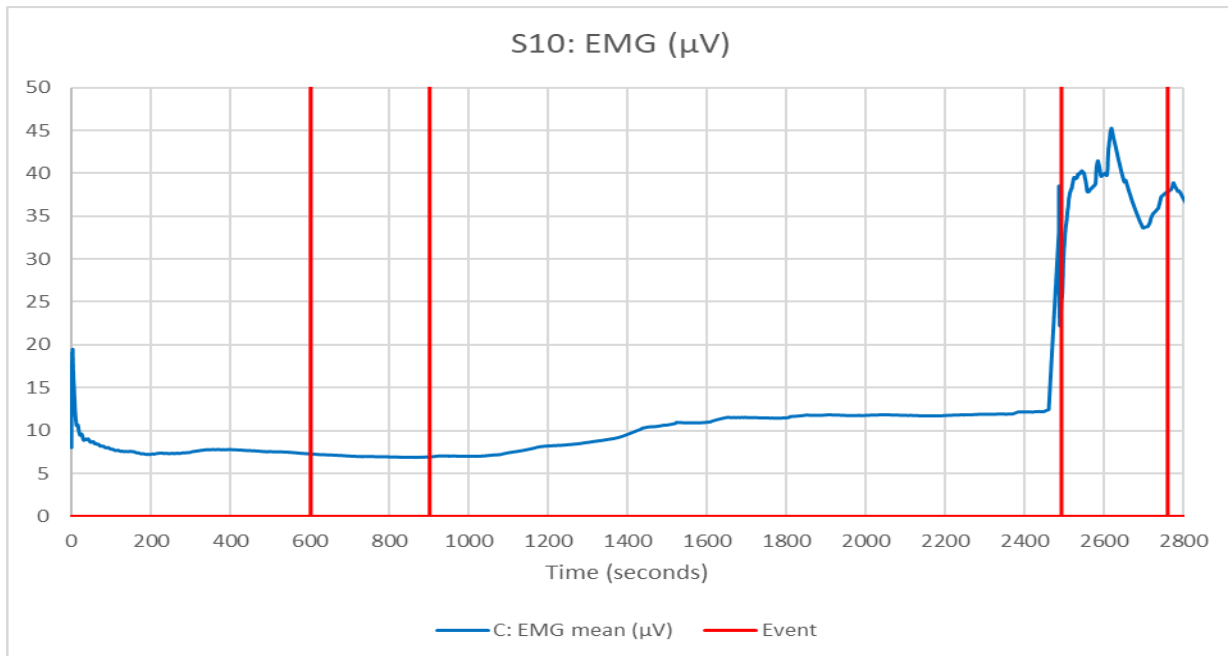


Before grounding, coherence was rather low for all frequency bands except at the frontal left side of the brain in the Delta band. The left frontal lobe is involved in controlling language related movement (42), indicating that this region of the brain was communicating normally in the Delta band (i.e. subconscious communications). During grounding, coherence decreased all over the brain in Delta and Theta, while increasing in Beta but even more in Alpha. Low coherence in Delta and Theta is an indication that inter-site communication is low and that the brain is immobilized in these frequency bands. This condition may indicate that the subject had low brain energy (6). It is also a sign that the brain is not able to efficiently connect cortical areas to perform specific tasks (6). It results in decreased information transfer between cortical areas (41). Decreased coherence also results in less cooperation than normal, leading to reduced efficiency, longer processing time, and mistakes (6). Low coherence in the Theta band is an indicator of lower functioning memory, visual short-term memory, behavioral deficits and impairment in other cognitive operations (42). Coherence increased mainly in the frontal lobes of the Alpha band during grounding indicating increased intercommunication activity of the functions related to the frontal lobes which coordinate higher executive functions such as attentional gating, decision making, problem solving, memory, social awareness, character, motivation, planning, judgment. The frontal lobes are responsible for

immediate and sustained attention, social skills, emotions, empathy, time management, working memory, moral fiber or character, executive planning and initiative. They identify problems and may send them to other parts of the brain for resolution (6). Activation of the frontal lobes in the Alpha frequency band indicates that those functions were activated but, in a calm, objective manner (6). It also indicates quiet wakefulness (43).

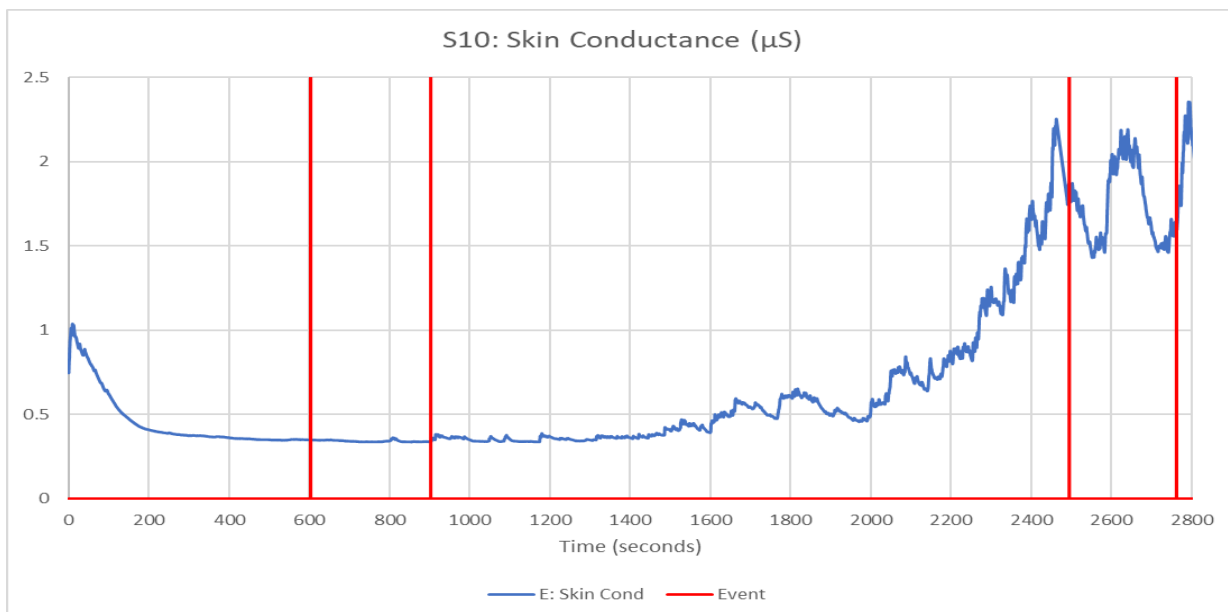
Electromyography (EMG) Results

Subject 10:



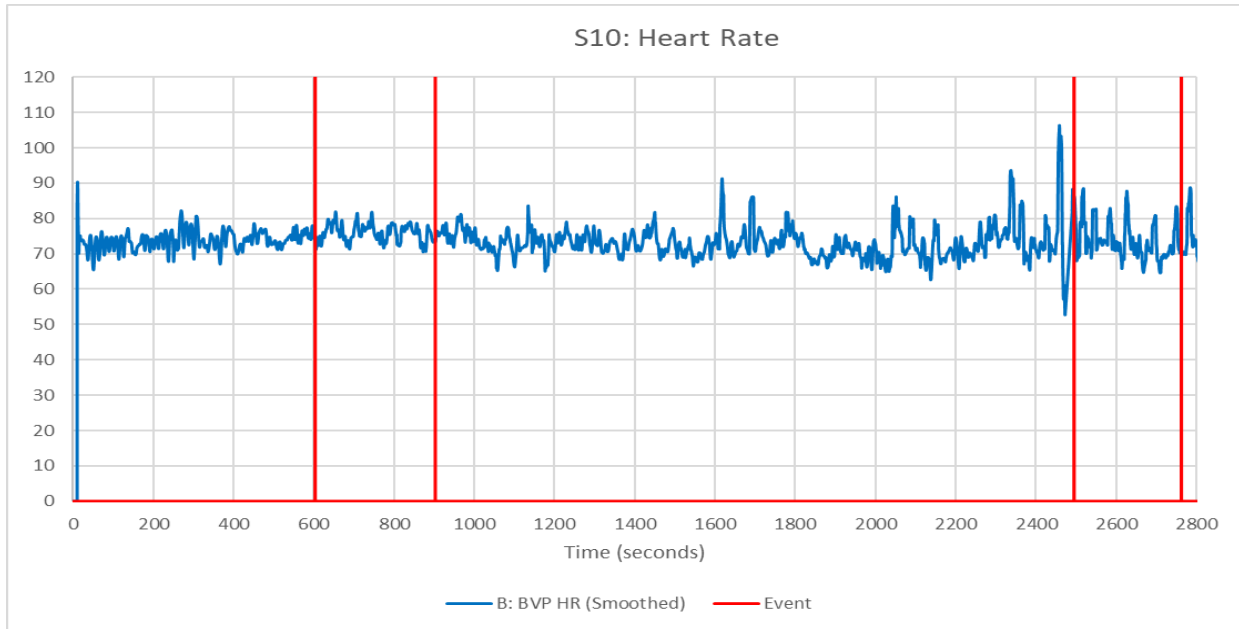
The graph above shows Subject 10 relaxing her trapezius muscles for the first 4 minutes. Then muscle tension stayed about the same for another 14 minutes, followed by the muscles starting to tense slowly for another 10 minutes and stabilizing for about 13 minutes after that. Finally, muscle tension raised tremendously and rapidly for about 2 minutes and stayed high for the rest of the session.

Skin Conductance (SC) Results



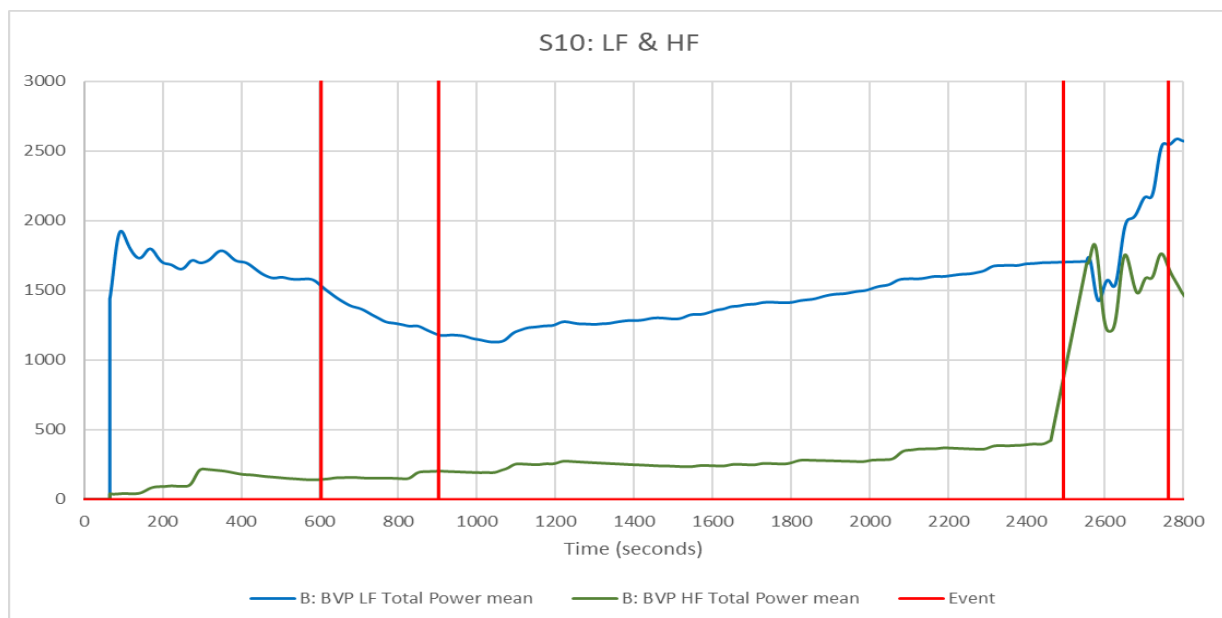
Subject 10 skin conductance decreased rapidly at first and then slowly for the first 15 minutes after the start of the session (just at the beginning of the grounding period) indicating parasympathetic system activation (i.e. ANS relaxation) and stayed relatively stable for another 10 minutes (at the 25th minute into the meditation or 10th minute into the grounding period). Then skin conductance increased slowly for 8 minutes before increasing sharply for another 8 minutes, staying high for the rest of the session indicating sympathetic activation (increased in stress).

Heart Rate Results



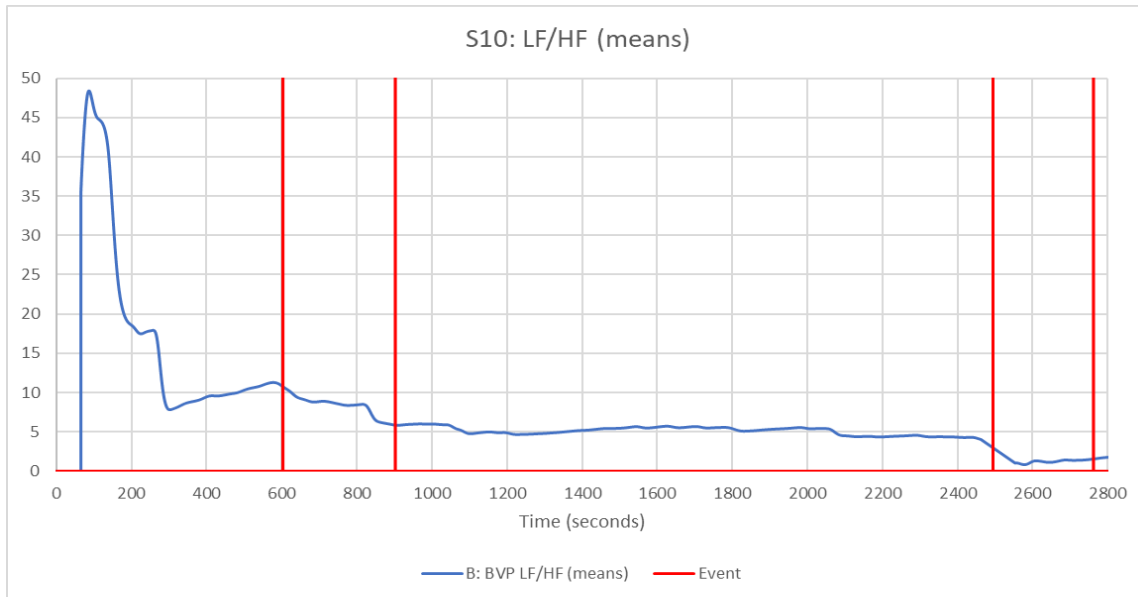
Subject 10 heart rate was very stable, changing by less than 10 beats per minute for the entire session (between 70 to 78). Subject 10 heart rate started at about 73 beats per minute and increased for the first 10 minutes. It then stabilizes to about 78 beats per minutes for about 7 minutes before going down slowly for about 13 minutes, staying at around 70 beats per minutes for 4 minutes. It then increased to about 73 beats per minutes and stayed at that rhythm (with large variations) for the rest of the session.

Low-Frequency (LF) and High-Frequency (HF) Results



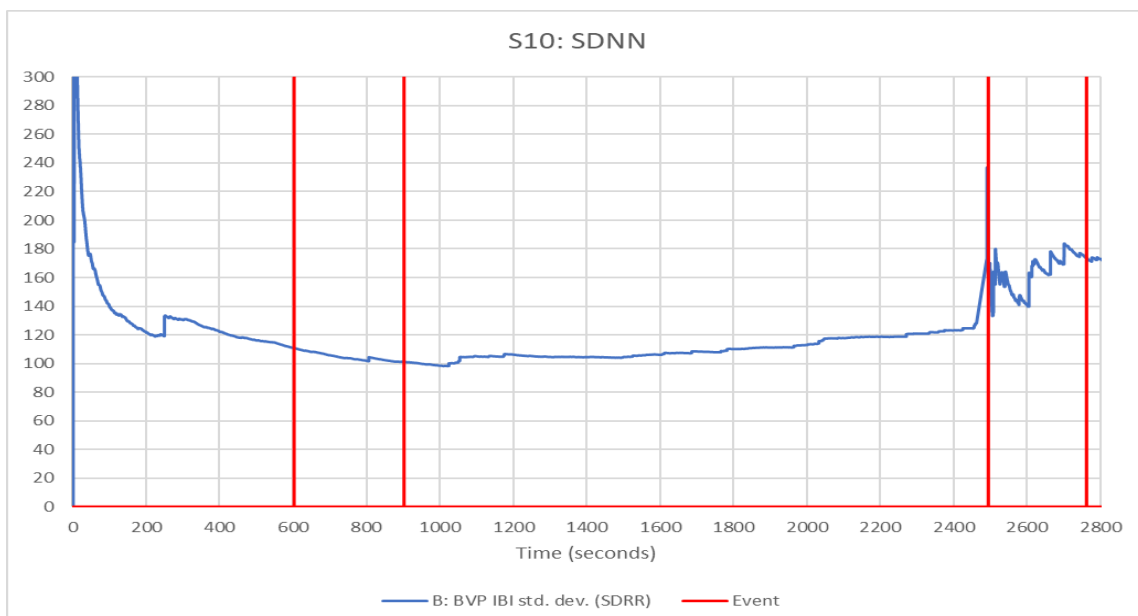
The first observation for Subject 10 is that LF is much larger than HF for almost all the duration of the session except for the last 4 minutes indicating high stress for most of the session. After one minute from the beginning of the session, LF increased rapidly for less than a minute, then decreased slowly for 16 minutes (up to 2.5 minutes into the grounding period), then increased slowly for 25 minutes and then down and up again until the end of the session. In the case of HF, one minute after the start of the session, HF increased slowly for about 41 minutes then it increased rapidly for 2 minutes and then stayed at the same level but with large ups and downs for the last 4 minutes.

LF/HF Results



One minute after the start of the session, LF/HF increased rapidly producing a huge peak at about 1.5 minutes after the start of the experiment (again this peak is probably an artifact due to the stress the subject experienced to get ready). Then LH/HF decreased rapidly for 3.5 minutes and started to increase slowly for approximately 5 minutes. It then decreased slowly for about 9 minutes before stabilizing for about 22 minutes and decreasing again relatively rapidly again for about 2 minutes, stabilizing for the rest of the session (about 4 minutes).

SDNN Results



Subject 10's SDNN decreased rapidly for the first 4 minutes then more slowly for another 13 minutes. It then increased slowly for the rest of the session except for a rapid increase at about 41 minutes into the session followed by a slower increase with oscillations until the end of the session (about 6 minutes).

Summary of Findings for Subject 10

Brain mapping: Before grounding, Subject 10's brain shows indications of slowing down and becoming underactive, possibly becoming drowsy. There could have been an increase in the flow of deep unconscious information. Toward the end of the grounding period, Subject 10 complained of pain at the frontal electrode sites so it is not surprising to find an increase in cognitive control related sensory-motor functions during grounding. There are indications that her brain is consciously and calmly controlling somato-sensory information related to pain. Subject 10 started with a positive processing mode becoming a negative processing mode during the grounding period. This is most likely due to the pain she felt at the frontal electrode sites.

Trapezius Muscles tension relaxed for the first 4 minutes of the session and then stayed about the same for another 14 minutes. This was followed by an increase in tension slowly for another 10 minutes, stabilizing after that for about 13 minutes. At about 41 minutes into the session, trapezius muscles tension raised rapidly for about 2 minutes and stayed high for the rest of the session. The rapid increase in tension at 41 minutes happened at the time Subject 10 told us that she is in pain from the pressure caused by the EEG electrodes on her forehead.

Skin Conductance decreased rapidly at first and then slowly for the first 15 minutes after the start of the session (until the beginning of the grounding period) indicating parasympathetic system activation (i.e. relaxation) and stayed relatively stable for another 10 minutes. Then skin conductance increased slowly for 8 minutes (that is 33 minutes into the session and 18 minutes into the grounding period) before increasing sharply for another 8 minutes, staying high for the rest of the session indicating high sympathetic activation (huge increased in stress). Comparing SC with EMG, one finds that SC responded to the stress due to EEG frontal electrode pain about the same time EMG did.

Heart rate was very stable, changing by less than 10 beats per minute for the entire session (between 70 and 75). About 39 minutes after the start of the session (24 minutes after the start of the grounding period) Subject 10's heart rate started to show larger variations for the rest of the session.

LF and HF: LF is much larger than HF for almost all the duration of the session except for the last 4 minutes. This indicates a high activation of the sympathetic branch of the ANS for most of the session (high ANS stress) except for the last 4 minutes, after the subject was told that we will stop the experiment in a few minutes just to finish our second brain mapping recording.

LF/HF is much larger than 1.0 except for the last 4 minutes. This results also indicates a high activation of the sympathetic branch of the ANS (high ANS stress) for most of the session, in agreement with the results of LF & HF.

SDNN decreased rapidly for the first 4 minutes then more slowly for another 13 minutes (about 2 minutes after the start of the grounding period). It then increased slowly for the rest of the session except for a rapid increase at about 41 minutes into the session followed by a slow increase with oscillations until the end of the session (for about 6 minutes). This last high increase in SDNN is probably a sign of attentive arousal or alertness from Subject 10 due to the knowledge that the session will end soon.

Overall: Before grounding, Subject 10's brain shows indications of slowing down and becoming underactive, possibly becoming drowsy. There could have been an increase in the flow of deep unconscious information. Toward the end of the grounding period, Subject 10 complained of pain at the frontal electrode sites so it is not surprising to find an increase in cognitive control related sensory-motor functions during grounding. This is consistent with someone thinking about controlling her reactions to pain. She was able to do this calmly. Subject 10 started with a positive processing mode becoming more negative during the grounding period. This is most likely due to the pain she felt at the frontal electrode sites. EMG and SC show an increase in stress after the start of the grounding period while LF & HF as well as LF/HF show high level of ANS stress from the start of the session. At 41 minutes, at the time she tells us that she has pain at her frontal electrodes, for the last 4 minutes (after she is told that the session will end soon) ANS stress decreases.

Summary

Subjects 1, 2, 4, 6, 7, 8 and 9 (7 of the 7 subjects for which we have good data) brain mapping data show evidence that their meditation deepened during grounding. For some of them (Subjects 1 and 6) meditation continued to be excellent or even deepened after ungrounding, however for most subjects (Subjects 2, 4, 7, 8, 9) that was not the case i.e. the quality of their meditation started to decrease after ungrounding.

For some subjects there is evidence that the brain functioned better during grounding. These are Subjects 2, 3, 6 and 7.

For some subjects (Subjects 1, 2, 6, 8, 9) there is some evidence from physiological parameters (skin conductance, heart rate and/or HRV parameters) of a healing response.

One subject (Subject 3) experienced a profound healing crisis during the experiment. Two subjects (Subjects 7 and 10) complained that the frontal electrodes were giving them pain. Subject 4 said she was cold in the middle of the experiment and Subject 5 stopped the session at the beginning of the grounding period claiming that she could not stand the effects that grounding produced on her body and mind.

Conclusion

Experienced meditators who meditated grounded for 40 minutes experienced a deeper meditation than when meditating not grounded. About half of them show evidence of improvements in brain function and a majority of them show signs of a healing response. One subject experienced a profound healing crisis that started a few minutes after the onset of the grounding period. This small pilot project presents evidence that meditating grounded has many benefits beyond the meditation itself.

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