ORIGINAL RESEARCH

The Effects of Grounding on Meditation Quality: Preliminary Study Report—A Case Series

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Abstract

Background: Published research shows that grounding the human body to Earth (also called "earthing") produces multiple health benefits. An earlier study documented immediate and abrupt changes in the left hemisphere of the brain upon grounding, an indication of improved brain function (Chevalier et al., 2006). The findings suggest that grounding might improve the practice of meditation, an activity that has gained widespread popularity throughout the world. **Objective:** To explore possible added benefits from meditating indoors while grounded, an experiment was set up involving 10 longtime meditators. **Methods:** Brain mapping with electroencephalographic (EEG) electrodes applied to the head was used to measure brain function during grounding vs. non-grounding periods of the meditation. The participants were monitored separately while meditating in a special conductive recliner chair. They were grounded for 40 minutes in the middle of their meditation session. Grounding was accomplished by using conductive cords to connect the chair, as well as 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, participants were disconnected, that is, not grounded. They were blind to when they were and were not grounded. **Results:** Both objectively and participatively, a deeper meditation was documented during the period of the meditation when participants were grounded compared to when they were not grounded. About half of the participants showed evidence through brain mapping of improvements in brain function. The principal characteristics of the meditation improvements during grounding were: (a) high Alpha in the frontal lobes (increased top-down control regulation and emotional control), (b) high Theta (increase in internal focus, spiritual awareness, and meditation), and (c) tendencies toward brain disorders disappeared during grounding. **Conclusion:** This small pilot project presents evidence that meditating indoors while grounded offers benefits beyond the meditation itself and replicates traditional practices in which individuals meditated while sitting on the ground. These results warrant more research with more participants and a control group.

Keywords: grounding, earthing, meditation, EEG, brain mapping, brain function improvement

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Grounding the human body to Earth (also called "earthing" or simply "grounding") is a practice that has been around for ages. For most of our evolutionary history, people were barefoot. Then they started to wear animal skins and use them to make shoes (moccasins) and later shoes with leather soles. These shoes were still grounding the person wearing them because they absorbed humidity. It is only with the invention of shoes with rubber and plastic soles that people started to live disconnected from the earth. For example, there is a correlation between the growth in the incidence of type 2 diabetes and sales of synthetic-sole shoes in the US since the 1950s (Ober et al., 2014). While this correlation does not prove causation, it is nevertheless worrisome.

How do we know if someone is grounded? The easiest way is to use a continuity tester (Earthing.com, 2022). When you touch a metallic button on this tester, it gives you a green light when you are grounded. Another way is to measure the decrease in induced body voltage. This measurement is possible when the body is in the presence of electromagnetic fields (EMFs). Since in this modern world we are constantly exposed to EMFs generated by electric power lines at 60 Hz or 50 Hz (depending on the country), this measurement is possible to perform almost everywhere. This is done using a voltmeter (or a multimeter) set to measure AC volts (Chevalier, 2020).

There are individual differences between people about grounding. For example, a person with dry skin will be less easily grounded. By humidifying or wetting the skin, the electrical resistance of the skin decreases and that person will be well grounded. That is why it is more beneficial to walk barefoot on moist dirt or grass than dry dirt or grass. That is also why if people touch a live wire when in their bath, they will be electrocuted while if they touch the same wire when dry they will experience a shock but not be electrocuted.

Published research shows that grounding the human body 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 (Chevalier et al., 2012; Ober et al., 2014; Oschman et al., 2015). A study published in 2006 documented immediate and abrupt changes in the left hemisphere of the brain at all frequencies (Beta, Alpha, Theta, and Delta) upon grounding, with changes more dramatic and obvious in the Beta and Alpha frequency bands (Chevalier et al., 2006). This research shows that the brain is dramatically affected by grounding. The finding also 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 US alone (Clarke et al., 2015). It is interesting to note that in Eastern traditions going back thousands of years, practitioners have been depicted as sitting 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.

Methods

This is a preliminary interventional non-controlled study to assess if meditating while grounded improves the meditation experience. Brain mapping with electroencephalographic (EEG) electrodes applied to the head was used to measure brain function during grounding vs. non-grounding periods of the meditation.

Participants

Ten participants over 18 years old (mean age 50.2 years; standard deviation 14.6 years) who have been meditating daily for more than one year were asked to meditate using their own meditation technique while grounded. The only requirements regarding the meditation technique were that the meditation can be done in stillness (no movements allowed) and does not involve heavy breathing techniques. The participants were not allowed to take food, caffeine, or other stimulants within two hours of the test.

Equipment

The brain mapping equipment used for this study was the WAVi Brain Assessment Platform (WAVi, https://wavimed.com/), which comprises a helmet with 19 active electrodes based on the well-established International 10–20 system of electrode placement, and a computer with specialized software.

Research Protocol and Outcome Measures

Participants were tested individually. After signing the informed consent, they were asked to fill two questionnaires: the McGill Pain Questionnaire (MPQ) to determine the level, type, and location of their pain (Melzack, 1975) and the Brief Mood Introspection Scale (BMIS), a questionnaire developed to assess actual mood at the time of taking it (Mayer & Gaschke, 1988). On completion, the person was then escorted to the experiment room and invited to sit in a comfortable reclining chair made of grounding material. A brain mapping helmet was placed on the head of the participant. In addition to being grounded through the recliner, grounding patches were placed on the palm of each hand to make certain participants were well grounded. The patches on

the hands also serve to give a relatively direct access of the electrons of the earth to the brain through the arms and neck. The recliner and the patches were connected to a system using a switch that allowed connecting or disconnecting grounding by the researcher supervising the test in a way that participants would not know when they were grounded or not grounded (participants were not told that they would be disconnected from earthing at some point in time during their meditation). The parches and the reclining chair were connected to the grounding system of the building.

Once "hooked up," participants 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 that first period, the brain mapping equipment was activated for 4 minutes to record the first brain mapping period (this was called Session 1). Without the knowledge of the participant, the researcher then flipped the switch to ground the participant for 40 minutes. Five minutes before the end of the 40-minute grounding period, another 4-minute brain mapping session was recorded (Session 2) while the participant was still grounded. At the end of the 40-minute grounding session, the researcher flipped the switch again to unground the participant. The last ungrounded period lasted for 10 minutes. Five minutes into this third period, another 4-minute brain mapping was recorded (Session 3). After all recordings were stopped, the helmet, patches, and sensors were removed and the participant was asked again to fill out the MPQ and the BMIS questionnaires. They were also asked to complete a short form to assess the quality of their meditation (Meditation Quality Assessment Form or MQAF). Thus the outcome measures are the brain mapping recordings, MPQ and BMIS scores, and the MQAF response.

Results

In the figures that follow, the perspective is 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 (Warner, 2013). 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 participant (the *z* value). The *z* value (or *z* score; see the color key on the upper right of the figure; normally +3 is in red and –3 in blue, since this paper is in black and white with shades of grey, the darker electrodes sites cannot be differentiated, however, it will be pointed out to the reader if it is an excess [+3] or deficiency [–3]) 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 participant'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 (Brain Science International, n.d.). "0" is the normal mean located within the green (white) region (Brain Science International, 2022). 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 and –3 as the minimum deficiency (Collura, 2007a).

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 (Collura, 2014; Warner, 2013).

Participant 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 five years, one to two hours a day. She indicated that at the beginning of the meditation, she felt that her heartbeat was very strong and fast, much stronger and faster than usual. Later during the meditation, she felt 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. Absolute and relative power before (Session 1), during (Session 2), and after (Session 3) are presented in the following figures, beginning with Participant 1 (see Figures 1–3).

In the case of Participant 1, Figure 1 shows that O2 is overpowering the other sites in the Beta band.

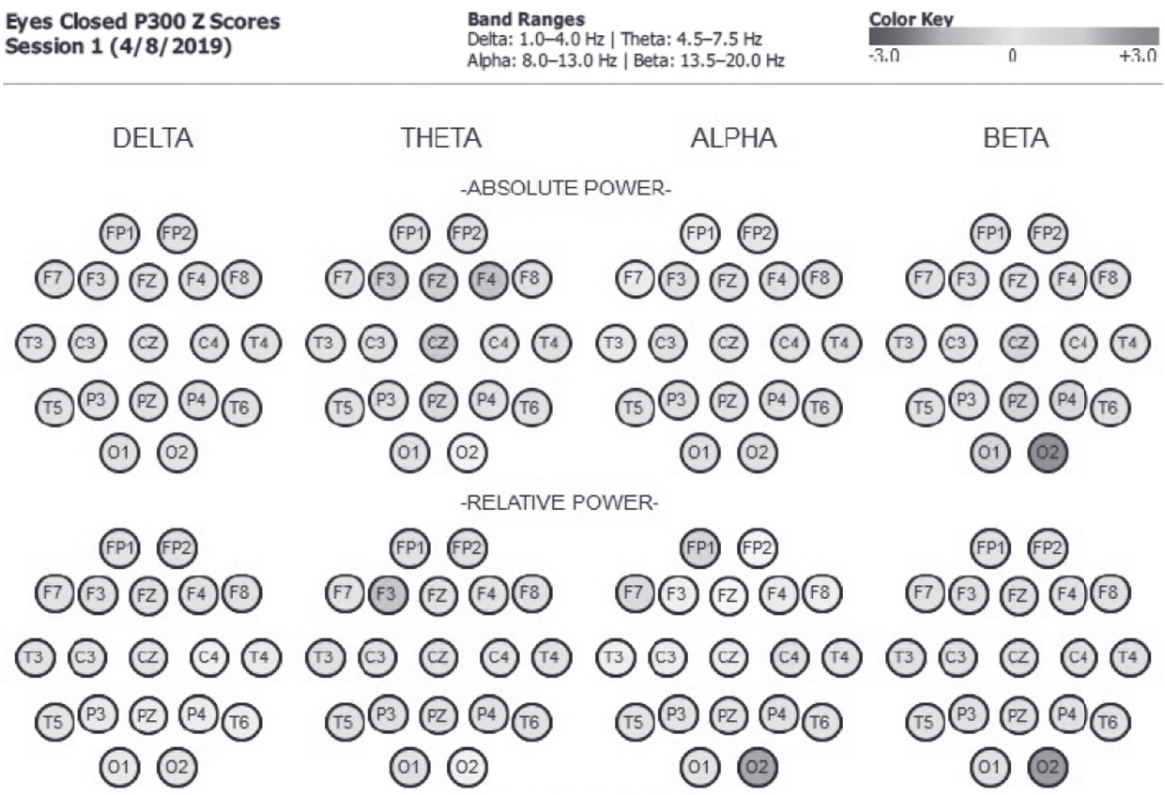

Figure 1. Brain mapping results for Participant 1 before grounding.

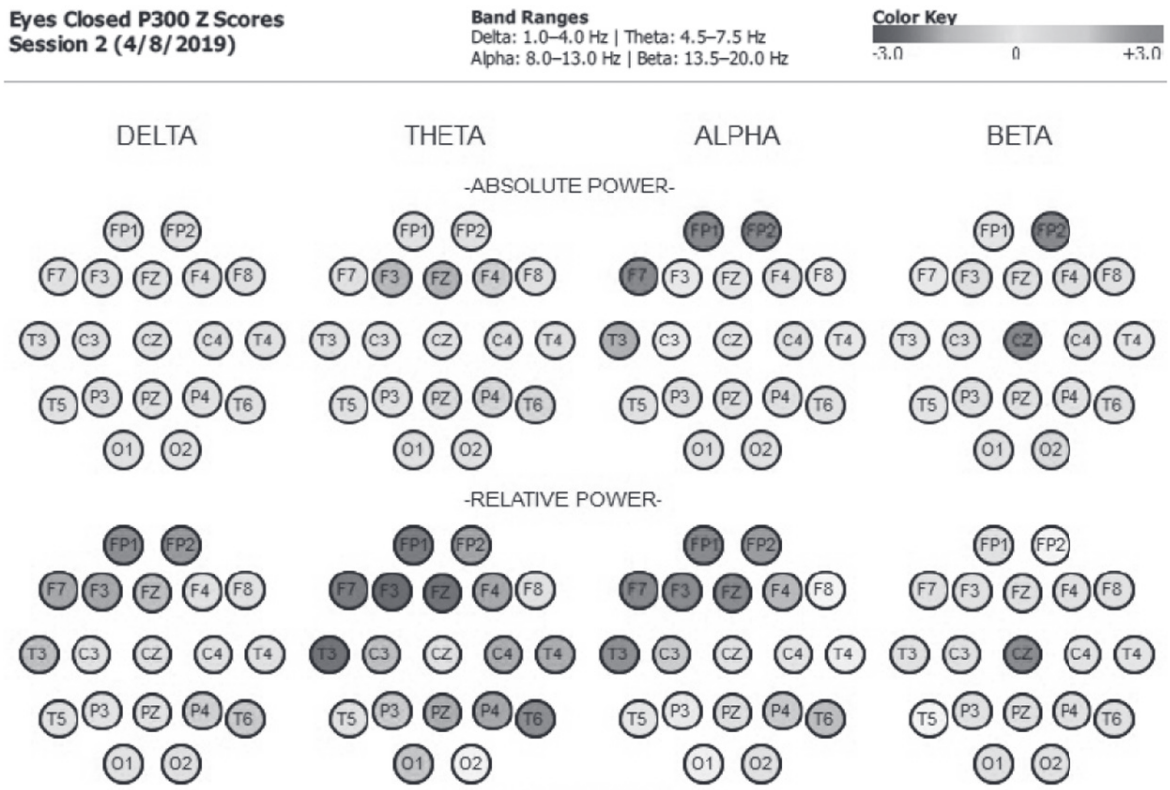

Figure 2. Brain mapping results for Participant 1 during grounding.

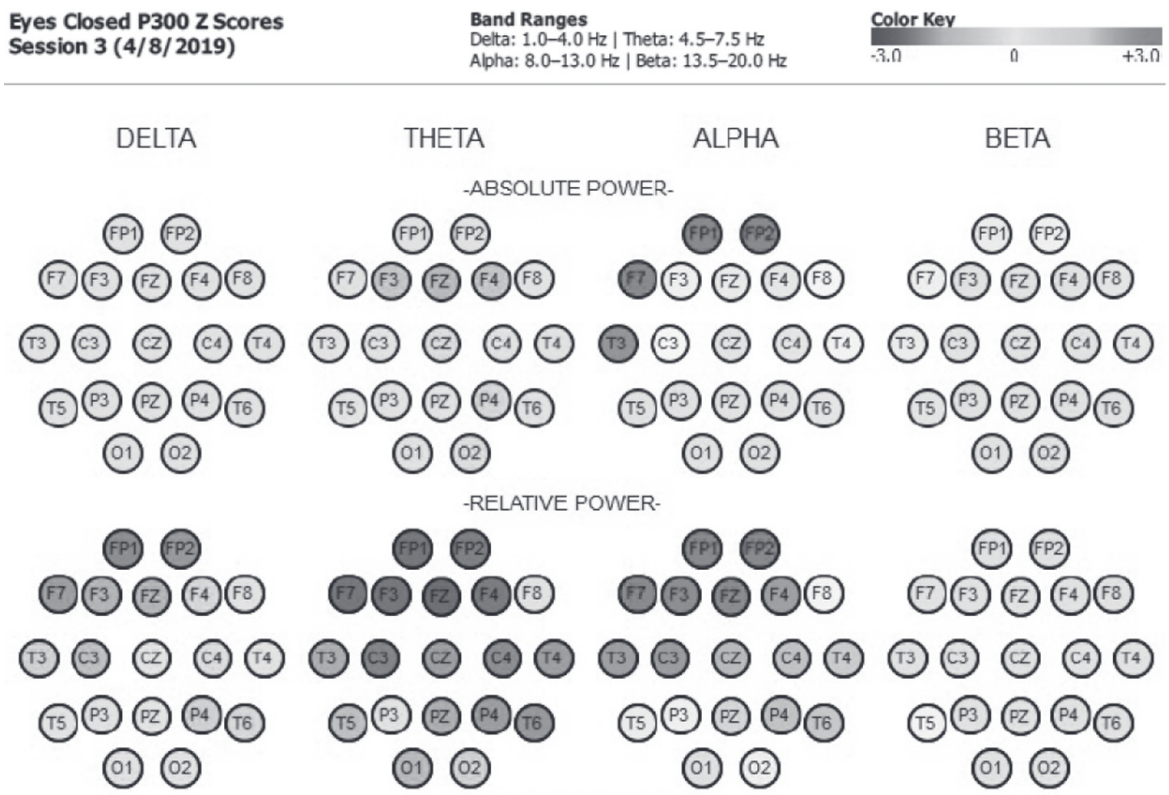

Figure 3. Brain mapping results for Participant 1 after grounding.

O2 main function is visual processing of the left half of the visual space. Other functions include pattern recognition, color perception, movement perception, black/while perception, and edge perception (Walker et al., 2008; Warner, 2013). For Participant 1, O2 overpowering the other sites in the Beta band (for both relative and absolute power) probably means that Participant 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 (Walker et al., 2008; Warner, 2013). It is interesting to note that O2 in relative power Alpha is lower than normal. This phenomenon has been observed often and the reason is that Alpha activity is inversely related to cortical activity and blood flow (Allen et al., 2004; Cook et al., 1998; Oakes et al., 2004).

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) (Walker et al., 2008; Warner, 2013). High activity in Beta at CZ is associated with relaxed attentiveness (Warner, 2013). The main function of FP2 is emotional attention with other functions including judgment, sense of self, self-control, and restraint of impulses (Cook et al., 1998). High Beta activity at FP2 may be indicative of Participant 1 internally controlling feelings and emotions (Warner, 2013). Coupled with high Alpha activity, the control of feeling and emotions is done in a calm and non-stressful manner. The principal function of FP1 is logical attention with other functions including orchestration of network interactions, planning, decision making, task completion, and working memory (Walker et al., 2008; Warner, 2013). 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 (Misselhorn et al., 2019; Warner, 2013). High Alpha in the left frontal cortex may be associated with a depressed mood state (Warner, 2013). Again, high CZ in Beta reflects relaxed attentiveness. Also, there is low activity mainly in frontal Theta. Frontal computations are related to Theta activity (Allen et al., 2004). Since Alpha activity is inversely related to cortical activity (Allen et al., 2004; Cook et al., 1998; Oakes et al., 2004), it is not surprising that high frontal Alpha suppresses Theta activity.

Similar to the during-grounding period, after grounding there is high Alpha activity at FP1, FP2, and F7 in absolute power reflecting a relaxed, peaceful alertness with emotional restrain. Also similar to during grounding, there is low activity mainly in frontal Theta in relative power. Frontal computations are related to Theta activity (Cavanagh & Frank, 2014). Since Alpha activity is inversely related to cortical activity (Allen et al., 2004; Cook et al., 1998; Oakes et al., 2004), 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, and interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (Monastra et al., 1999; Snyder & Hall, 2006; Warner, 2013). 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 (iMotions, 2017; Thibodeau et al., 2006). The table below gives the result of all three sessions for Participant 1.

	Subject #1			Ref Range
	Session 1	Session 2	Session 3	(55 yrs)
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, and 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.

Coherence results. See Figure 4.

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 (Locatelli et al., 1998). 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 (Warner, 2013). Hypercoherence is when brain sites are not functioning in efficient interdependent fashion, they have too much "cross-talk," are overly connected, or locked together. Hypocoherence is called poor inter-site interaction and is associated with diminished cognitive efficiency (Warner, 2013). In the Beta band, coherence was higher before grounding compared to during and after grounding. This could be due to test anxiety (Warner, 2013). 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 (Warner, 2013). It could also be that she went into a total unification and integration of consciousness experience as seen during Transcendental Meditation practice (Travis et al., 2017). During and after meditation, Delta and Theta coherence decreased well below normal levels, indicating that Participant 1 turned her focus inward and that her brain inhibited most of the usual functions related to control, fear, memory, and decision making (Elmer et al., 2018; Eschmann et al., 2018; Harmony, 2013; Lesting et al., 2013; Nacher et al., 2013). Alpha coherence is similar in all three sessions while Beta coherence decreased the most during grounding, an indication of less mental processing and deeper meditation.

Summary of findings for Participant 1. During grounding, Participant 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 total unification and integration of consciousness

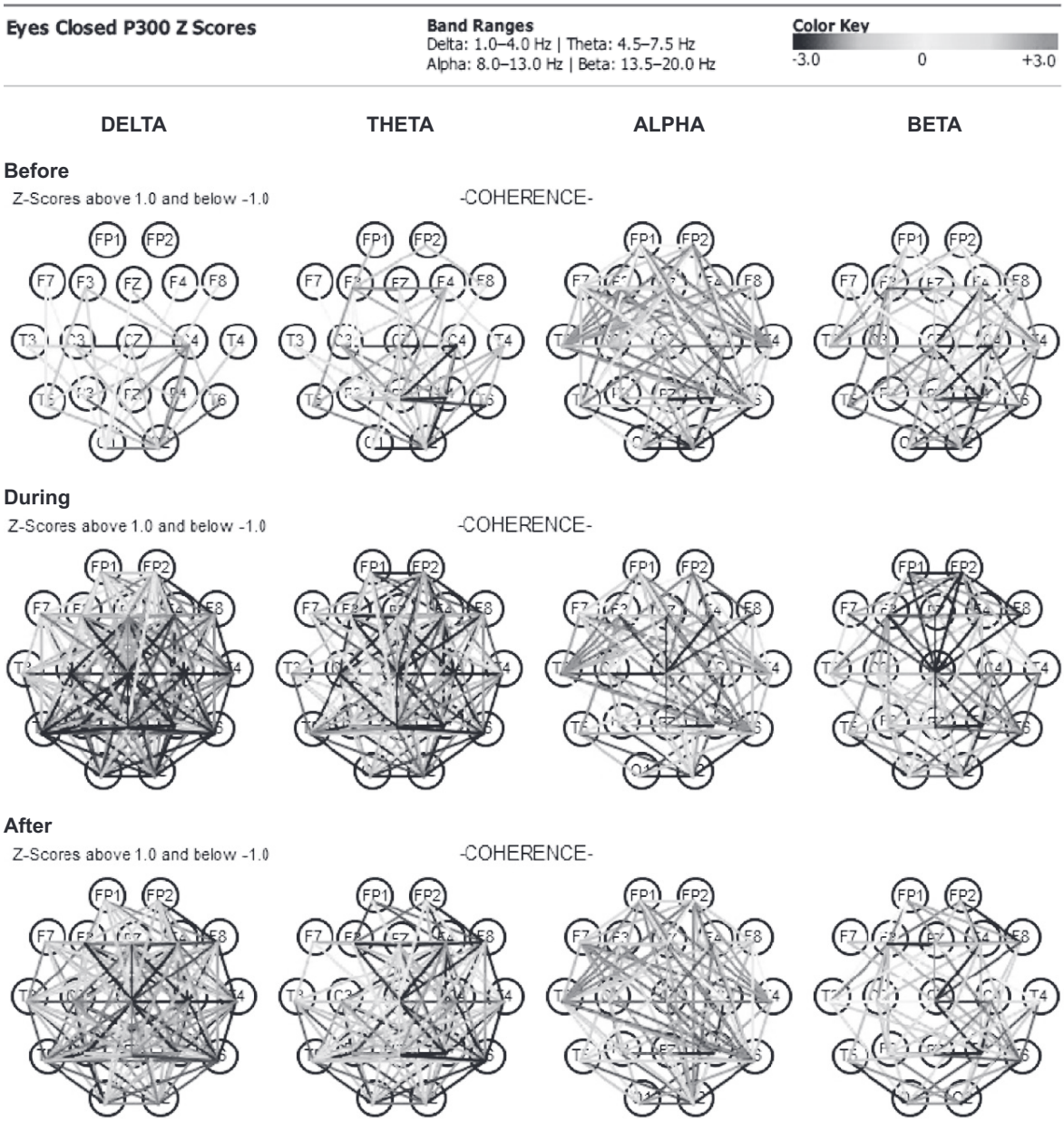

Figure 4. Coherence results for Participant 1.

similar to reported result for people practicing Transcendental Meditation, even though she was practicing a quiet type of meditation taught by Dr. Joe Dispenza (Hebert et al., 2005). Participant 1's meditation deepened when grounded and stayed deep for 15 minutes after the end of the grounding period.

Participant 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. See Figures 5–7.

Similar to Participant 1, Participant 2's O2 is overpowering the other electrode sites in the Beta band (for both relative and absolute power). However, contrary to Participant 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 Participant 2 is internally processing perception, vision, color,

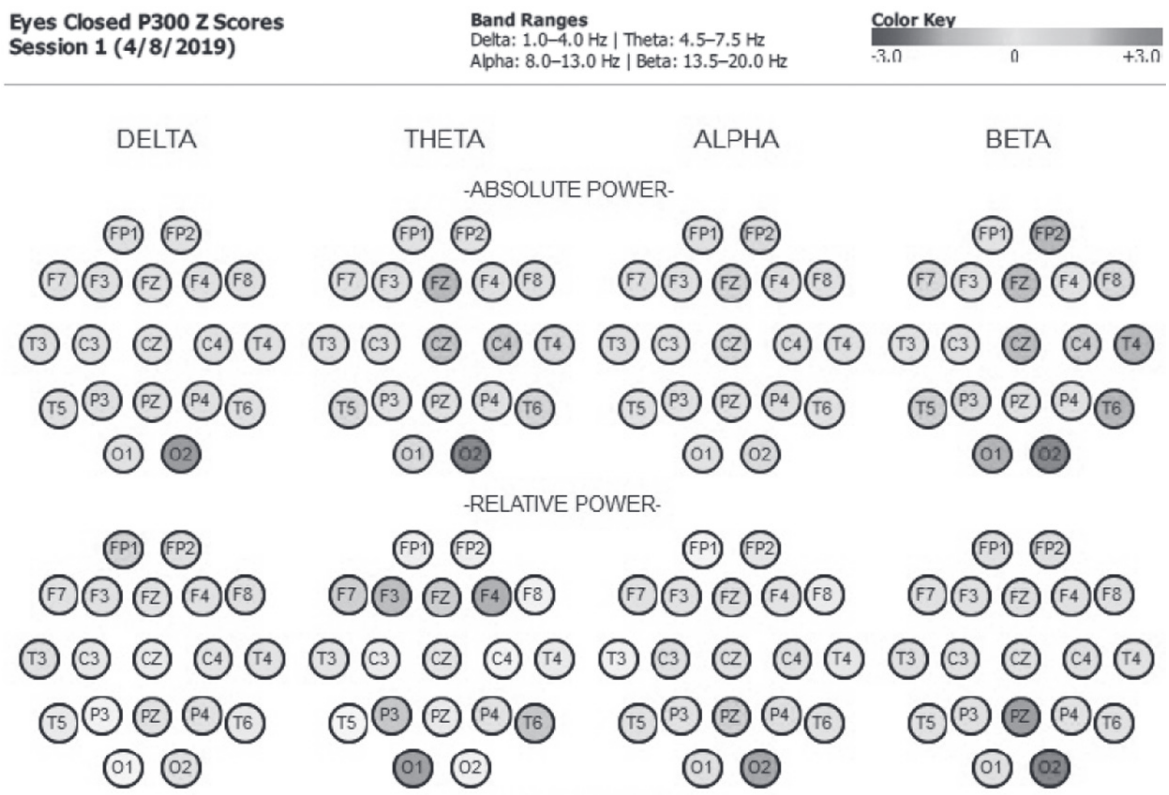

Figure 5. Brain mapping results for Participant 2 before grounding.

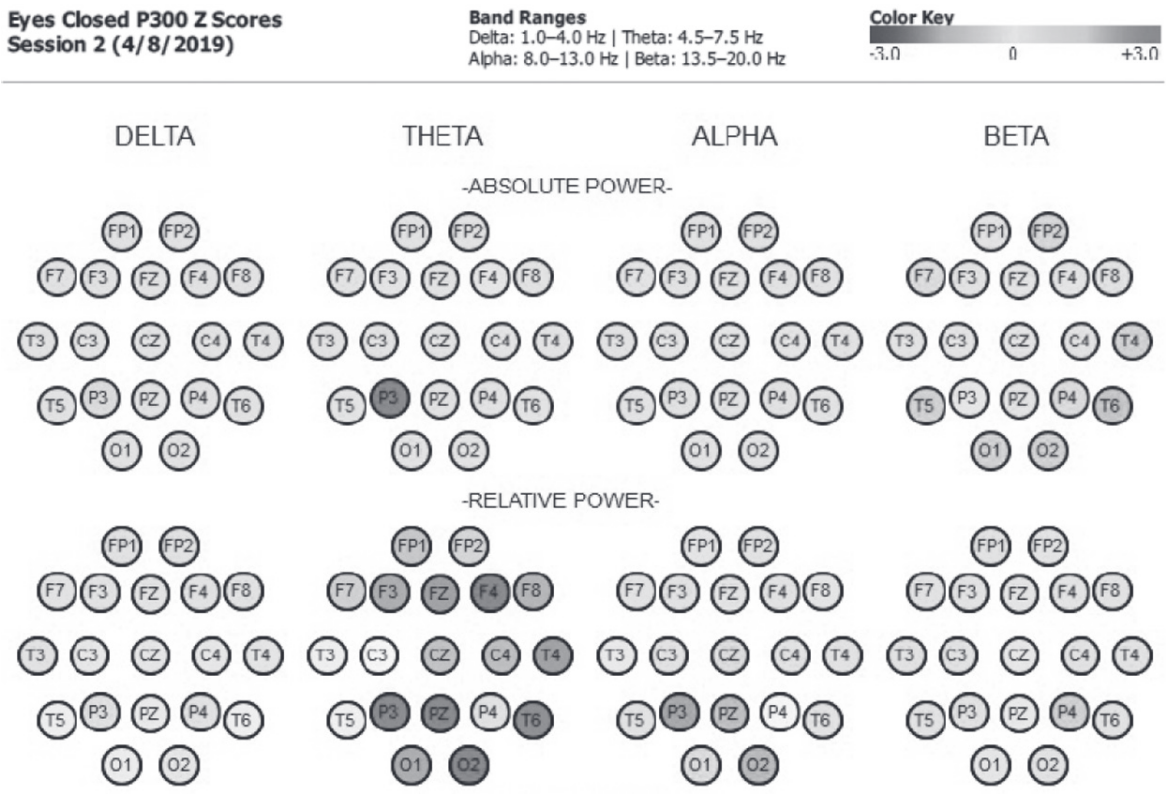

Figure 6. Brain mapping results for Participant 2 during grounding.

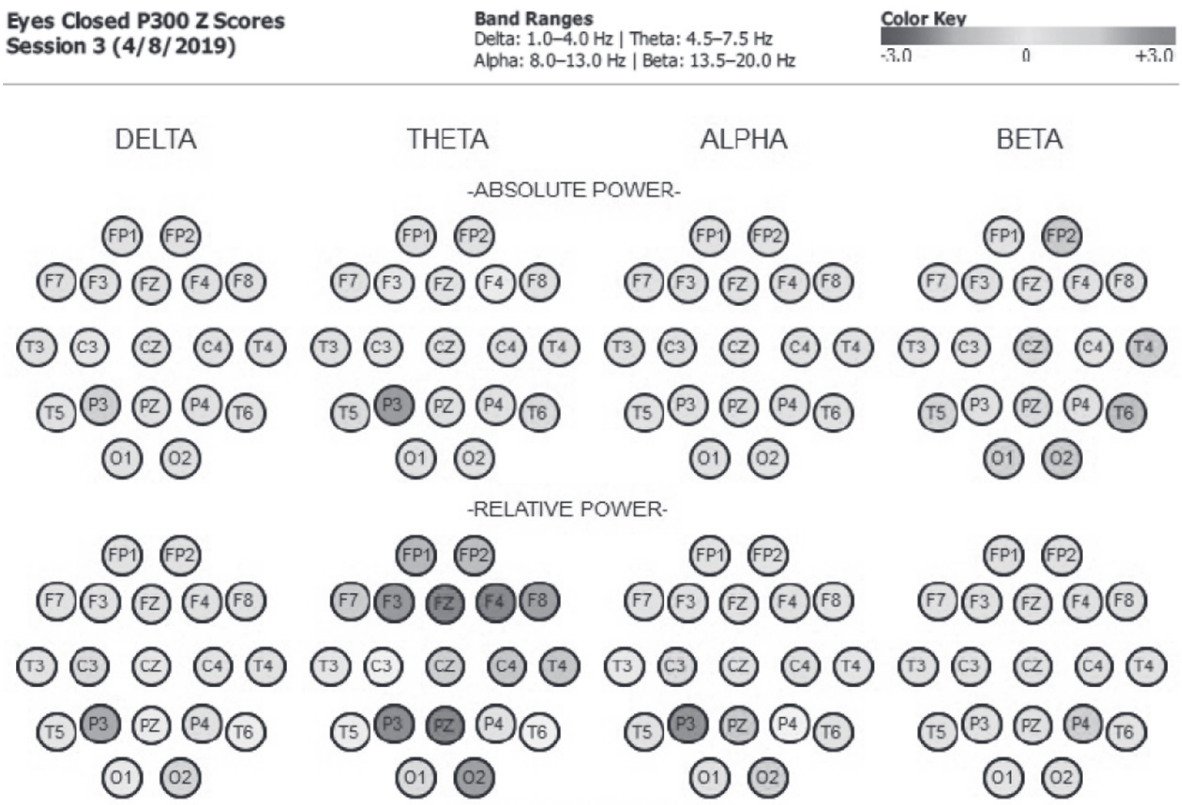

Figure 7. Brain mapping results for Participant 2 after grounding.

shape, and motion. Significant increase in Delta at O2 indicates an increase in inhibition of brain functions interfering with internal concentration for the brain functions corresponding to the location of O2, that is, internally processing perception, vision, color, shape, and motion (Harmony, 2013; Walker et al., 2008). The increase in Theta at O2 indicates a substantial increase in the need for cognitive control for related brain functions (Eschmann et al., 2018).

Looking at absolute power, during grounding, there is high activity in the Theta band for P3. The principal function of P3 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 (Walker et al., 2008; Warner, 2013). High Theta activity at P3 indicates a substantial increase in cognitive control for related brain functions during the grounding period (Eschmann et al., 2018). 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 (Warner, 2013).

Similar to the during-grounding period, the after-grounding period absolute power shows that there is high Theta activity at P3, indicating an increase in cognitive control for related brain functions during grounding (Eschmann et al., 2018). 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 indicates a decrease in cognitive control after grounding, as compared to during grounding, and lower internal focus, spiritual awareness, and quality of meditation than during grounding.

CZ Theta/Beta and F3/F4 Alpha. The table below gives the result of all three sessions for Participant 2.

	Subject #2			Ref Range
	Session 1	Session 2	Session 3	(55 yrs)
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, though 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, and interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (Monastra et al., 1999; Snyder & Hall, 2006; Warner, 2013). 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 (iMotions, 2017; Thibodeau et al., 2006).

Coherence results. See Figure 8.

During the grounding period, coherence increased a little for all frequency bands on the right hemisphere and decreased in the left hemisphere (not so apparent here but clearly visible in the color pictures, especially in the Beta band). Increased coherence for the right hemisphere means an

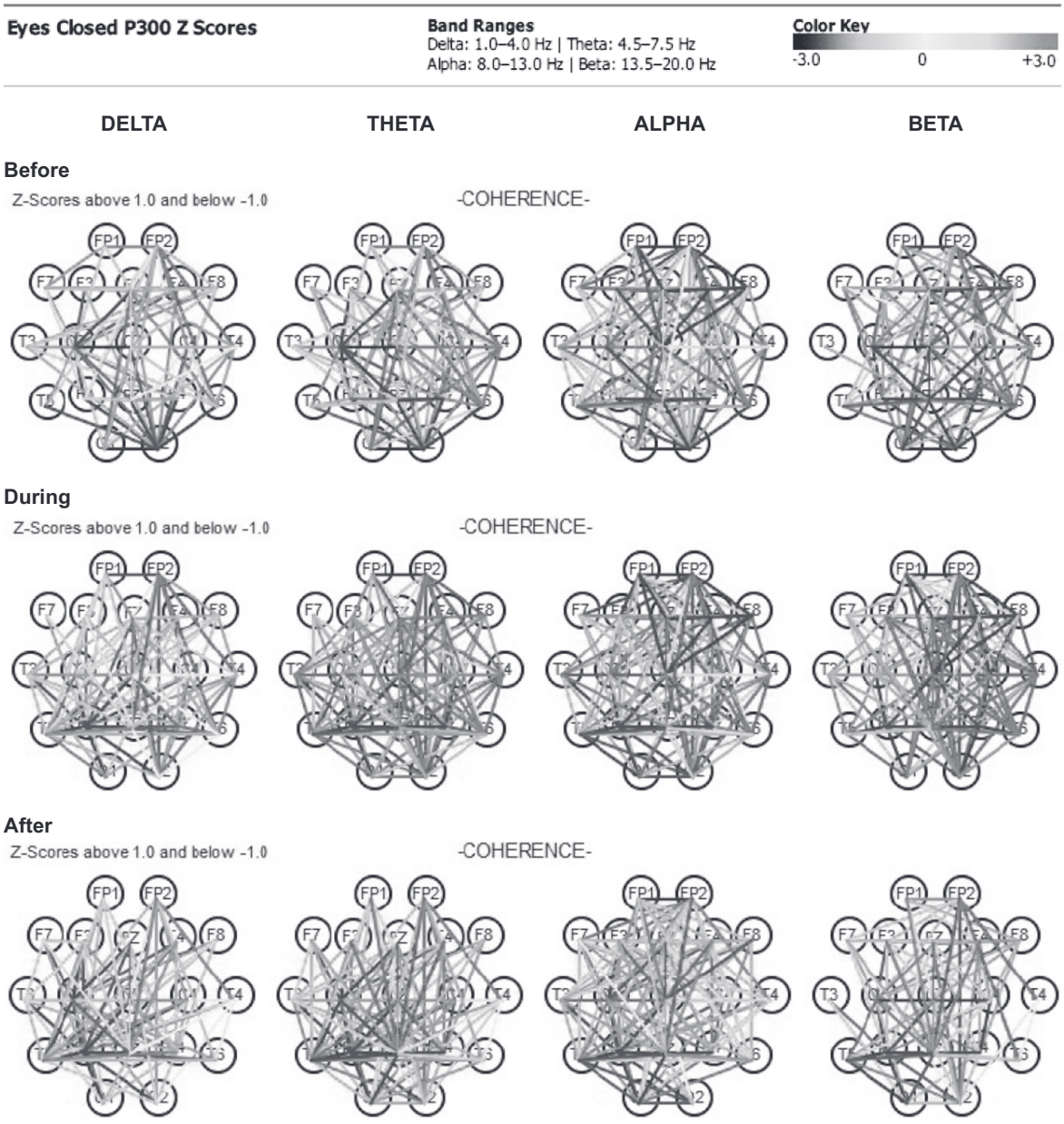

Figure 8. Coherence results for Participant 2.

increase in the functions associated with that hemisphere such as synthesis, holistic thinking, creativity, intuition, and insight 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, linguistical thinking, and reasoning. After grounding, the coherence in the right hemisphere decreased to become similar to what it was before grounding. This is an indication of deeper meditation during grounding. Coherence in the left hemisphere remained similar to the during-grounding period at all frequencies.

Summary of findings for Participant 2. During grounding, there was a substantial increase in internal focus. There was also a deepening of the meditation and an increase in spiritual awareness during grounding. After grounding, the situation with internal focus was similar to during grounding but decreased, indicating a decrease in the quality of meditation compared to during grounding. It was also apparent that grounding helped the brain function better.

Participant 3

Female, 42, energy medicine practitioner. She takes two Advils per day for one to three days during menses. Her meditation technique is sitting with opening chakras. She has been meditating for 15 years for one to two hours a day. She indicated that the first 15 minutes was usual and then it got worse. She felt nauseated and weak, broke into a 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 a friend who is a 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 participant 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 conducted.

Brain mapping results. See Figures 9 and 10.

Before grounding, Participant 3's absolute power is normal but with a tendency toward low activity. 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, hypervigilance, meditation, prayer, and spiritual awareness (Warner, 2013). 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 (Harmony, 2013). T5 is related to verbal understanding, reading comprehension, and auditory processing (Walker et al., 2008; Warner, 2013). The main function of P3 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 (Walker et al., 2008; Warner, 2013). PZ is about perception and integrating somato-sensory information with posterior visual perceptions, working memory, route finding, and praxis (Walker et al., 2008; Warner, 2013). The main function of O1 is visual processing of the right half of the visual space, including pattern recognition, color, black/white, movement and edge perception, and memory encoding while the main function of O2 is visual processing of the left half of the visual space, including pattern recognition, color, black/white movement, and edge perception (Walker et al., 2008; Warner, 2013). These results indicate a good level of internal focus and concentration.

During grounding, Participant 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 (Harmony, 2013). Remember that T5 is related to verbal understanding, reading comprehension, and auditory processing (Walker et al., 2008; Warner, 2013). There is also high activity in the Delta frequency band for P4 and T6. The main function of P4 is perception (cognitive processing) of the left half of space, image and spatial processing and memory, facial decoding, nonverbal reasoning, praxis, integration with environment, map orientation, and knowing the difference between right and left (Walker et al., 2008; Warner, 2013). The main function of T6 is emotional understanding.

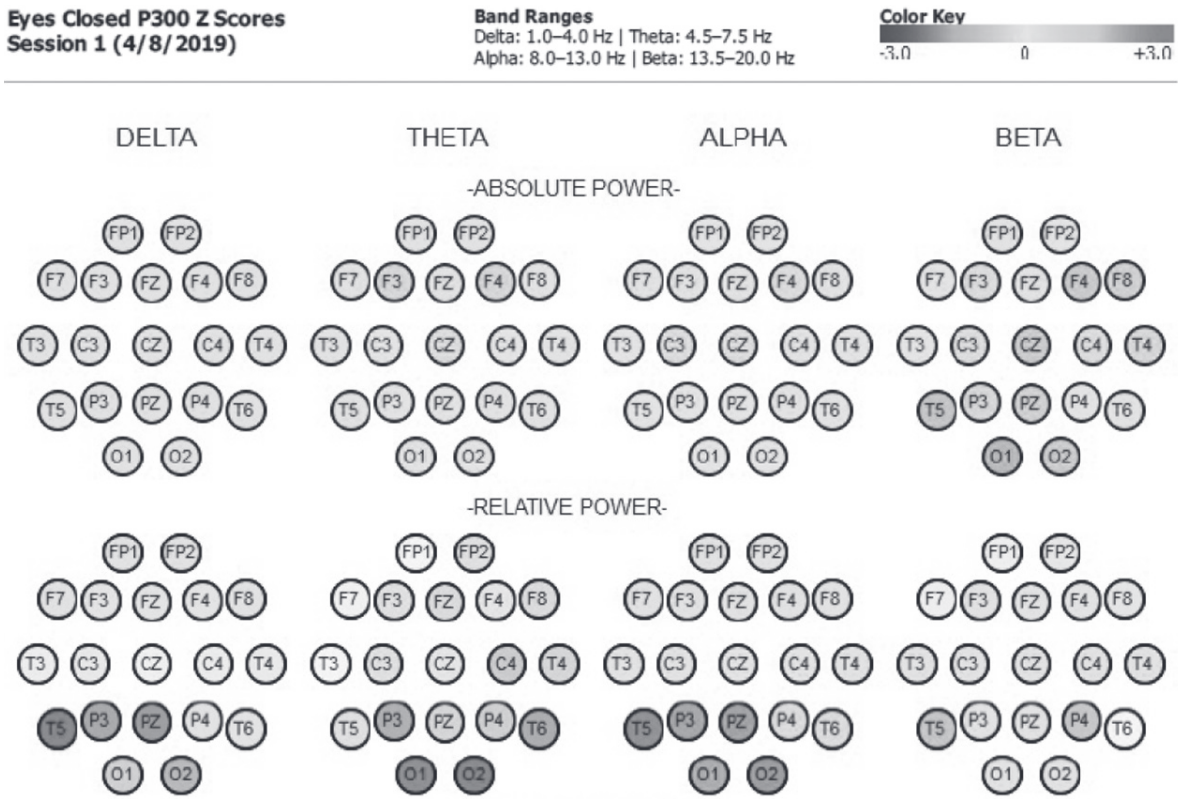

Figure 9. Brain mapping results for Participant 3 before grounding.

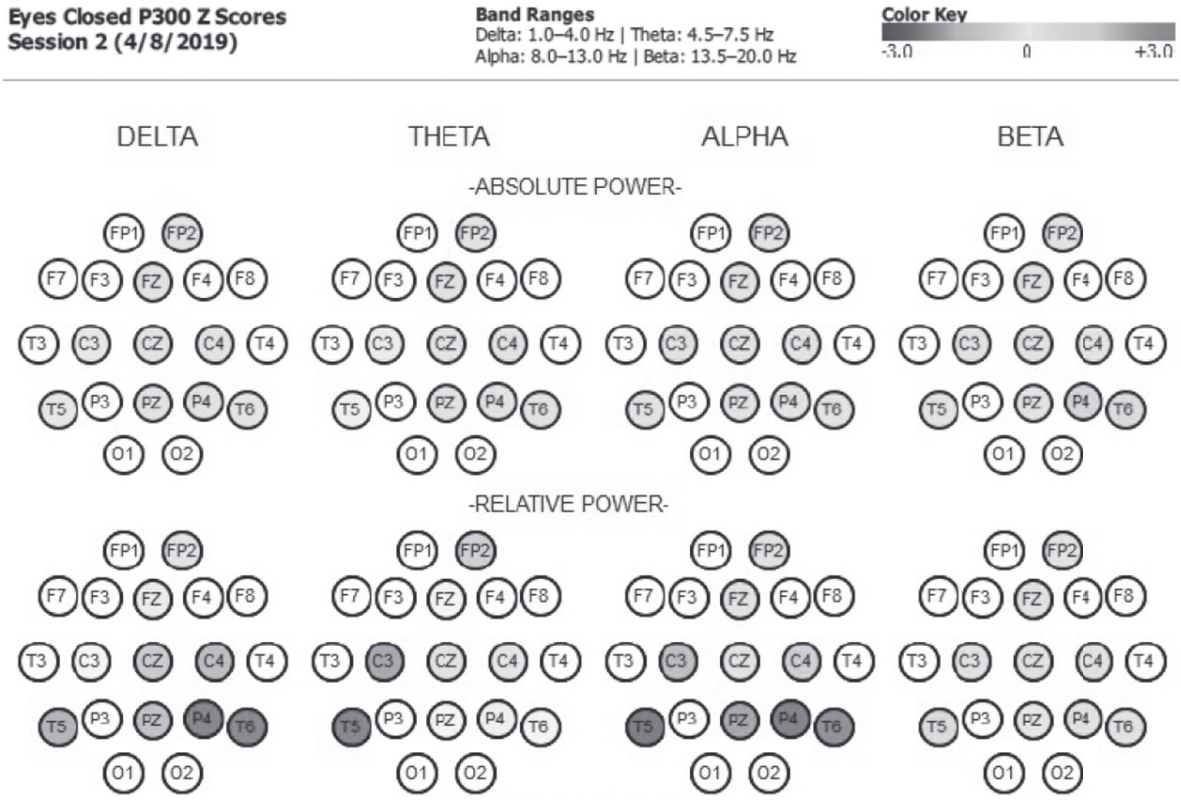

Figure 10. Brain mapping results for Participant 3 during grounding.

Other functions include facial and symbol recognition, and auditory processing (Walker et al., 2008; Warner, 2013). 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 (Harmony, 2013). At the same time, Alpha activity at P4, T5, and T6 was 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, Participant 3 was sweating profusely (cold sweat).

CZ Theta/Beta and F3/F4 Alpha. The table below gives the result for the two sessions available for Participant 3.

	Subject #3		Ref Range
	Session 1	Session 2	(40 yrs)
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, and interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (Warner, 2013). 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 (Thibodeau et al., 2006).

Coherence results. See Figure 11.

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 participant was going within and that most of the brain processes where inhibited. It also indicates a less efficient emotional memory, visual sensations, perception, and sensorimotor

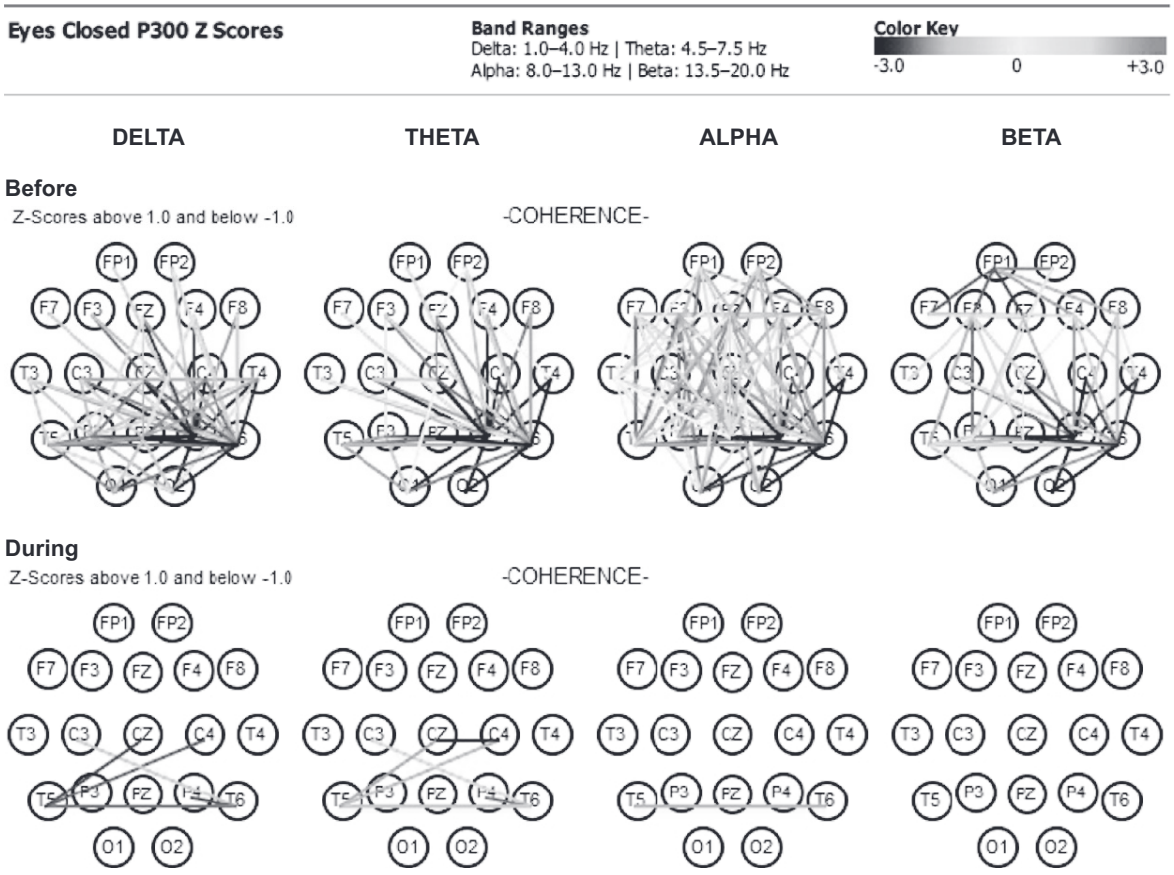

Figure 11. Coherence results for Participant 3.

integration (Walker et al., 2008). 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.) (Warner, 2013) but possibly also lack of flexibility of logical and emotional memory, perception, and sensations (Walker et al., 2008). It appears that Participant 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 participant needed to return to normal daily function in order to be aware in the present time of what was happening to her (healing crisis).

Summary of findings for Participant 3. We do not have a post-meditation brain mapping recording for this participant 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 conducted. Participant 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 bodily discomfort that increased until we had to stop the experiment after 52 minutes. Before grounding, Participant 3 went into a state of internal focus, hypervigilance, meditation, prayer, and spiritual awareness. These results indicate a good level of internal focus and concentration. During the healing crisis, which started almost immediately after the beginning of the grounding period, Participant 3 was sweating profusely (cold sweat). Participant 3 had tendencies toward ADHD and interpersonal detachment with qualitative aspects of autistic or Asperger's behavior. These tendencies disappeared during grounding. Interestingly, Participant 3 had a negative processing mode when coming to the lab that switched to a more positive processing mode during grounding.

Participant 4

Female, 29, yoga teacher and 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 felt very calm, her head hurt a little from electrode pressure, and she felt cold. Otherwise, she was very relaxed and centered. Overall, her meditation was as usual to slightly worse than usual.

Brain mapping results. See Figures 12–14.

Looking first at absolute power before grounding, Participant 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, and 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 (Warner, 2013). Activation of the frontal lobes in both Alpha and Beta frequency bands (especially Alpha) indicates high alertness and cortical processing efficiency and selectivity of the brain related to the functions just mentioned but in a calm and composed way (Berger & Davelaar, 2018; Hebert et al., 2005; Warner, 2013).

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 indicates high alertness and cortical processing efficiency of the brain related to the functions just mentioned but in a calm and composed way (Hebert et al., 2005; Warner, 2013). High Alpha activity coupled with low Theta and Delta indicates that the Alpha band is dominant, suppressing the inhibition of corresponding brains functions (Allen et al., 2004).

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 participant started to be cold and asked for a blanket, around the middle of the grounding period.

After grounding, the brain is in a very different disposition. Many electrodes stopped working because Participant 4 kept moving to change positions (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

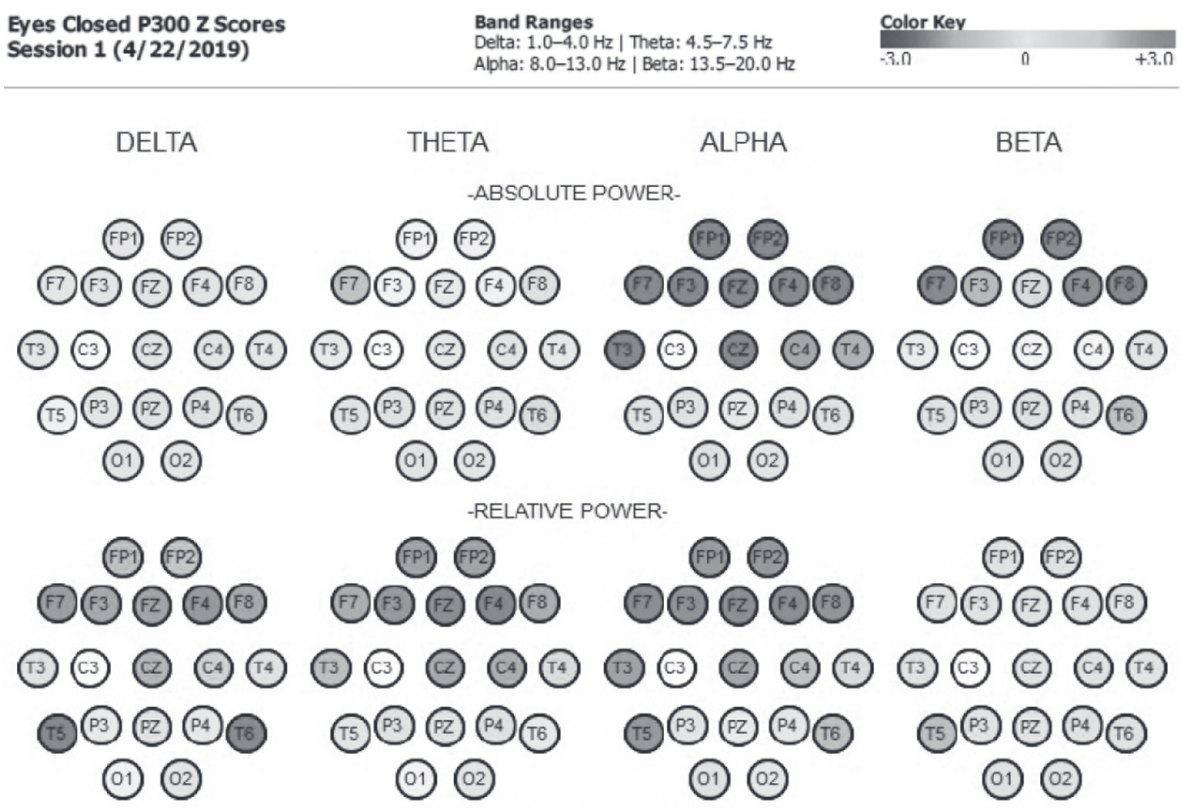

Figure 12. Brain mapping results for Participant 4 before grounding.

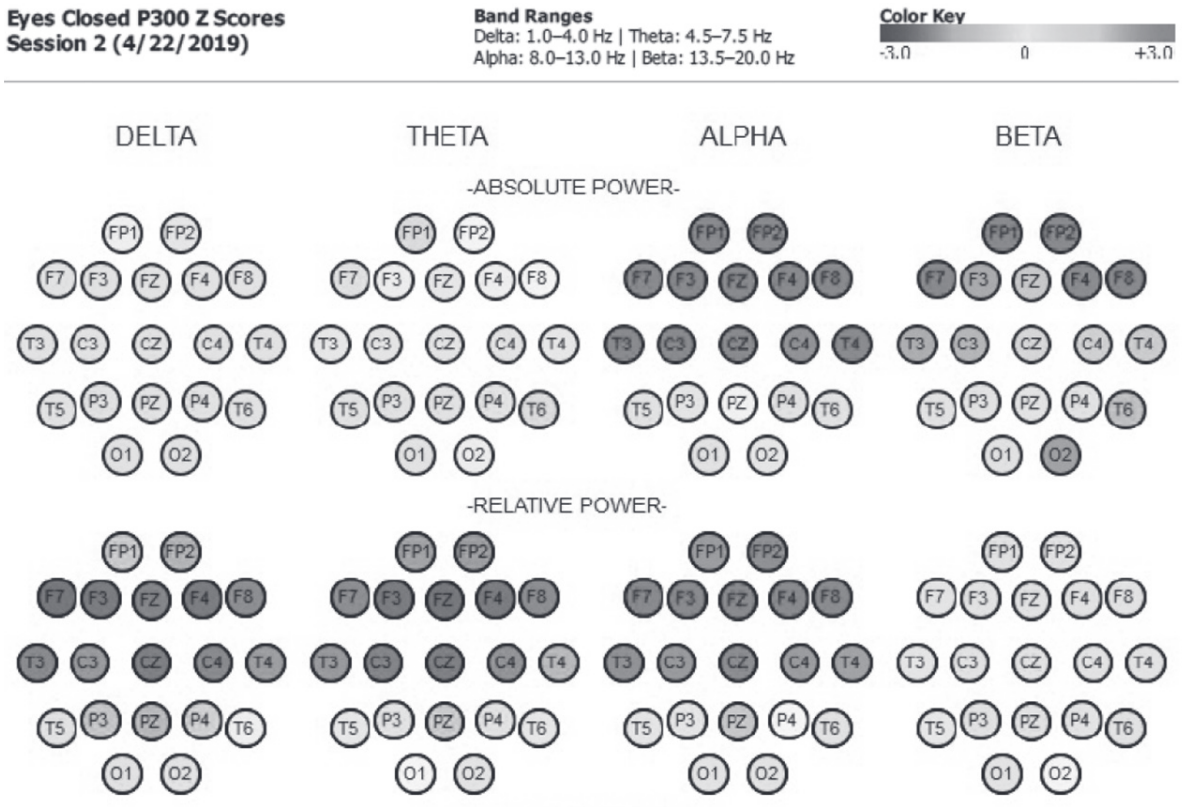

Figure 13. Brain mapping results for Participant 4 during grounding.

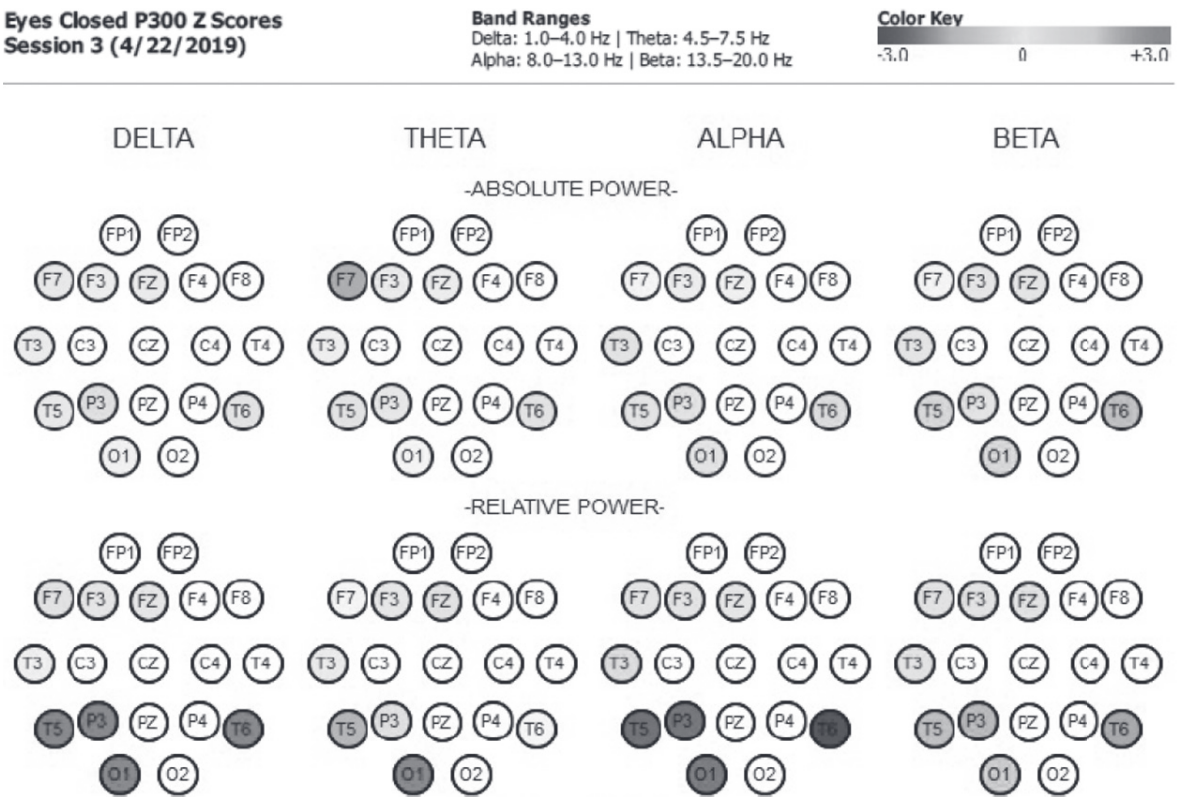

Figure 14. Brain mapping results for Participant 4 after grounding.

some attempt to suppress the activities of the normal awake brain in an attempt to continue meditation (Misselhorn et al., 2019).

CZ Theta/Beta and F3/F4 Alpha. The table below gives the result of all three sessions for Participant 4.

	Subject #4			Ref Range
	Session 1	Session 2	Session 3	(30 yrs)
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 movement in order to reposition herself. F3/F4 Alpha started in the reference range and stayed in the reference range during and after grounding.

Coherence results. See Figure 15.

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, and 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 (Warner, 2013). High Alpha coherence in the frontal lobes indicates an increase in cognitive processing and attentiveness (Basar & Güntekin, 2012; Berger & Davelaar, 2018). Delta coherence was also slightly enhanced, an indication of increase in attentional processes, mainly decision making and attentional processes (Güntekin & Basar, 2016). During the grounding period, Alpha coherence in the frontal lobes increased, being high even in the temporal and parietal areas. Temporal lobes regulate the 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 (Warner, 2013). Parietal lobe functions are: organization, integration, and synthesis of auditory and visual perception and kinesthetic inputs; orientation; cognitive processing;

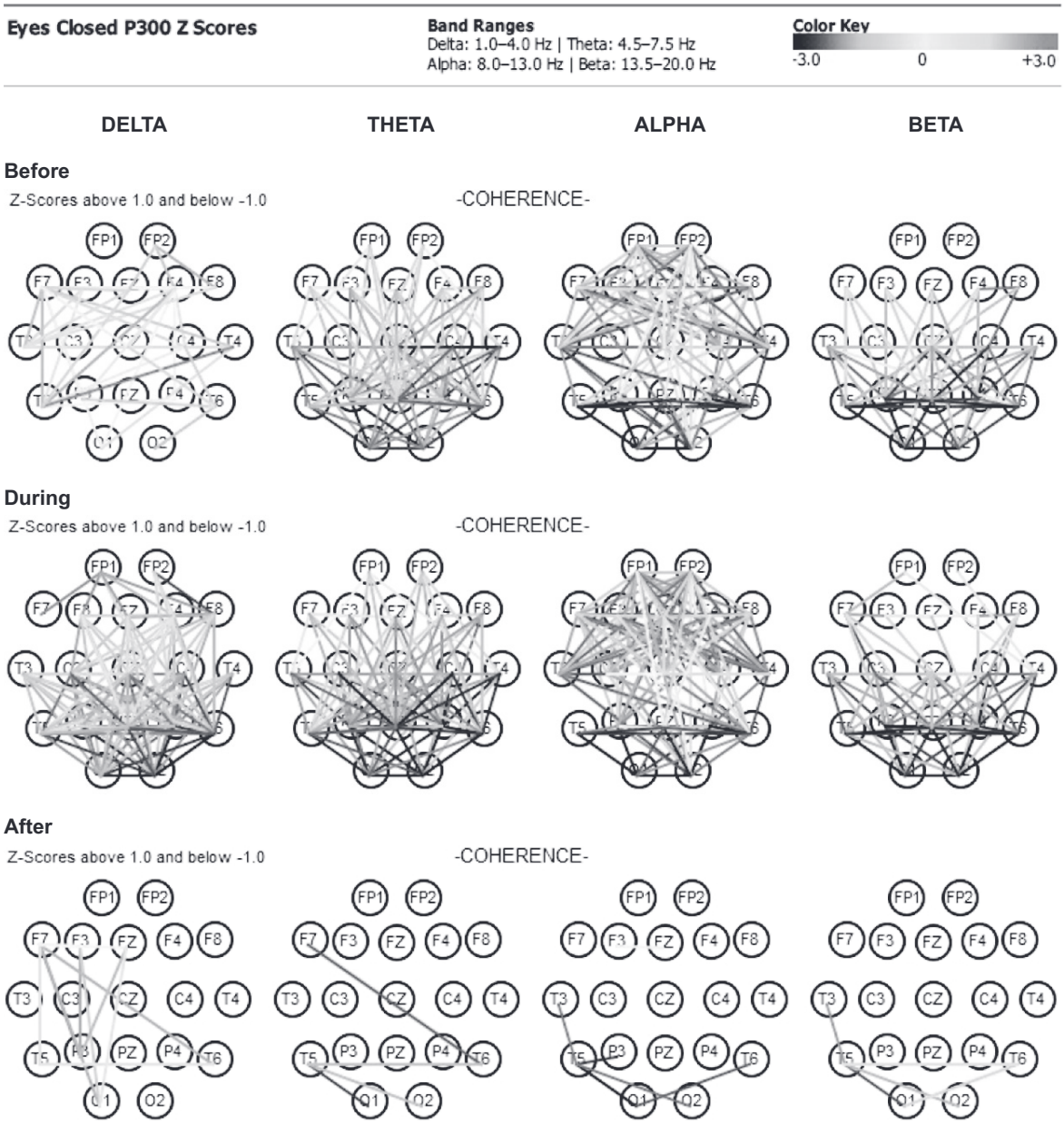

Figure 15. Coherence results for Participant 4.

and attention. The parietal lobes solve the problems that the frontal lobes conceptualize and are often labeled the "association cortex" (Warner, 2013). Coherence decreased significantly for all bands 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, indicating that the participant turned her focus inward (Eschmann et al., 2018; Harmony, 2013). Delta and Theta coherence started to increase especially 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 participant became more aware of the surroundings and more focused externally after the grounding period.

Summary of findings for Participant 4. Before grounding, Participant 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 was similar to before grounding but slightly intensified. It was about in the middle of the grounding period that the participant 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, Participant 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.

Participant 5

Female, 45, tutor. Her meditation technique is Kriya yoga as taught by the Self-Realization Fellowship. She has been meditating for 10 years for three to four 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 gave 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 pinpoint 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.

Participant 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 uses is a form of stillness meditation. He has been meditating for seven to eight years for about 30 minutes twice daily. He wrote that he felt much better after the meditation but later wrote that because of the length of the meditation—longer than his usual—he felt slightly better than usual.

Brain mapping results. See Figures 16–18.

Before grounding, Participant 6's absolute power is normal but with a tendency toward low activity. 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, hypervigilance, meditation, prayer, and spiritual awareness (Warner, 2013). Also note 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 (Allen et al., 2004; Cook et al., 1998; Oakes et al., 2004). T5 functions include logical (verbal) understanding, verbal and reading comprehension, comprehension of auditory and visual perception, and long-term memory both visual and auditory (Walker et al., 2008; Warner, 2013). The main functions of O1 and O2 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 (Walker et al., 2008; Warner, 2013). PZ is about integrating somato-sensory information with posterior visual perceptions, working memory, spatial relations, route finding, and praxis (Walker et al., 2008; Warner, 2013). These results indicate a good level of internal focus and concentration (Warner, 2013). In the Delta band, only T6 is hyperactive. T6 monitors brain functions related to emotional understanding, physical awareness (insula), and facial and symbol recognition—social cues (Walker et al., 2008; Warner, 2013). 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 (Harmony, 2013).

During grounding, absolute power is normal but again with a tendency toward low activity. Relative power shows high activity for CZ and PZ in the Theta band. 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,

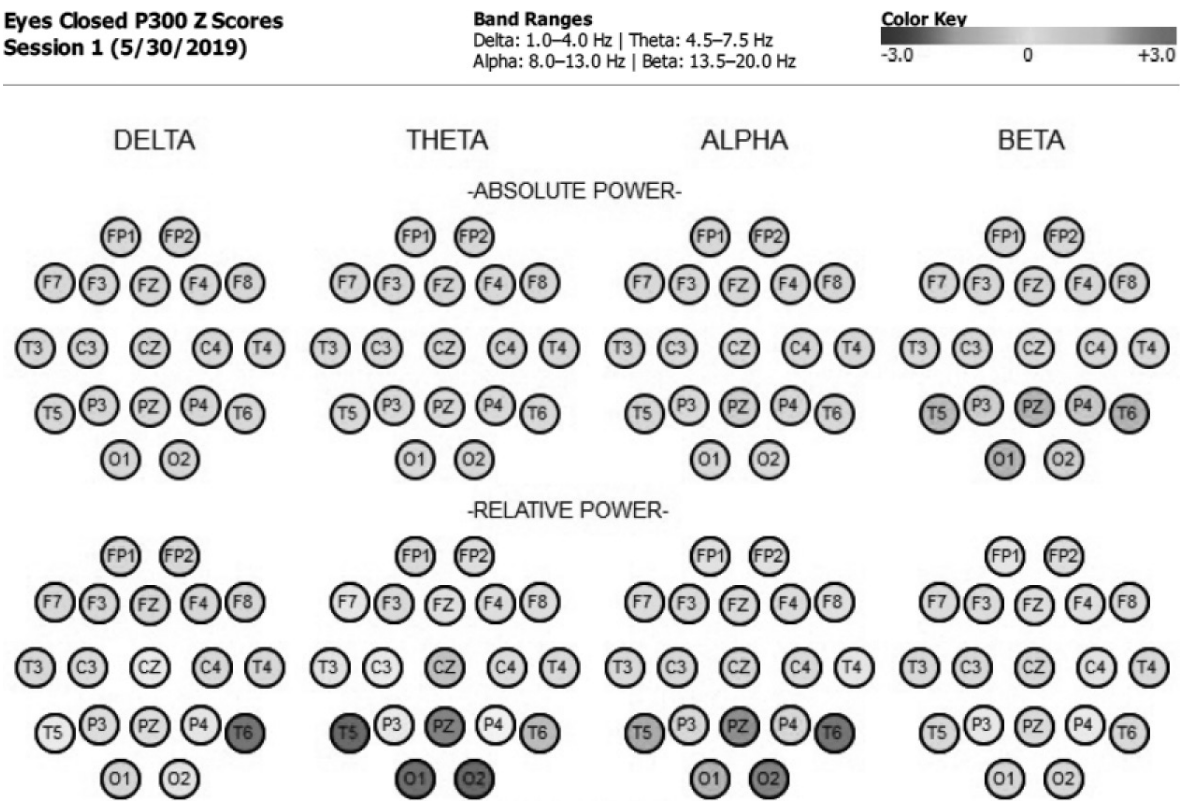

Figure 16. Brain mapping results for Participant 6 before grounding.

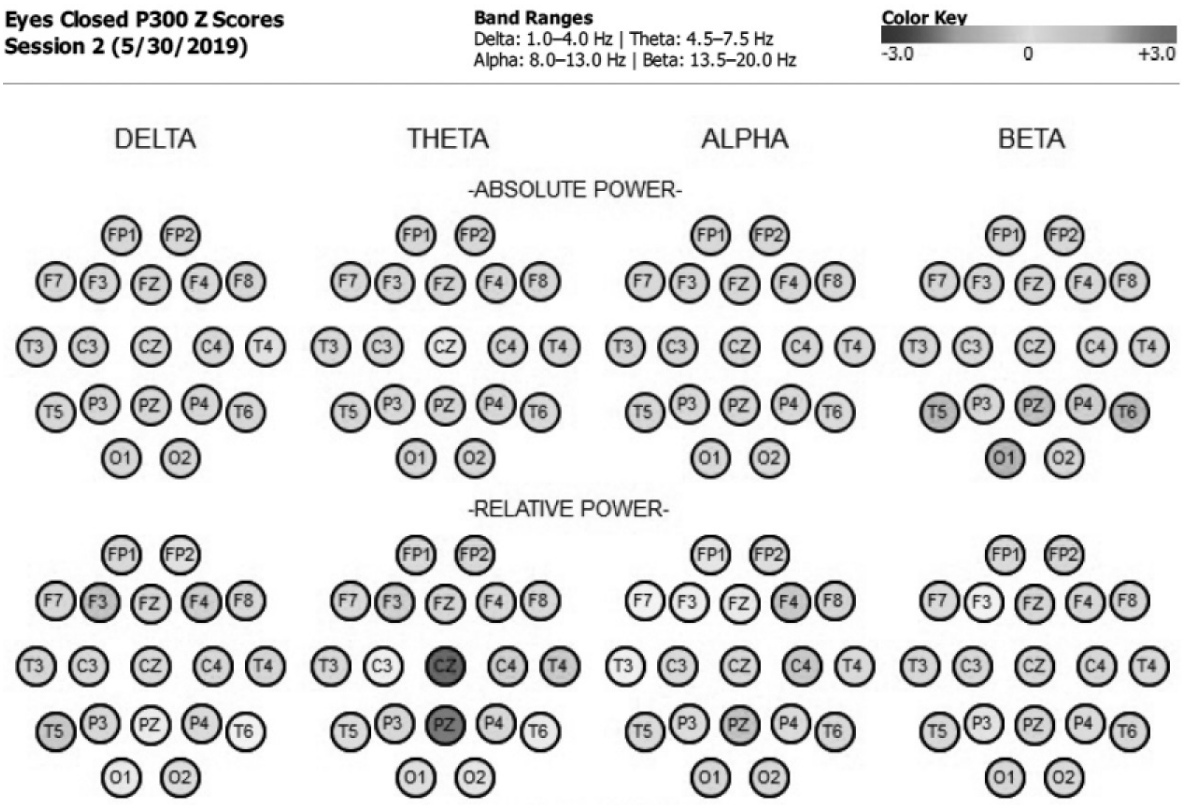

Figure 17. Brain mapping results for Participant 6 during grounding.

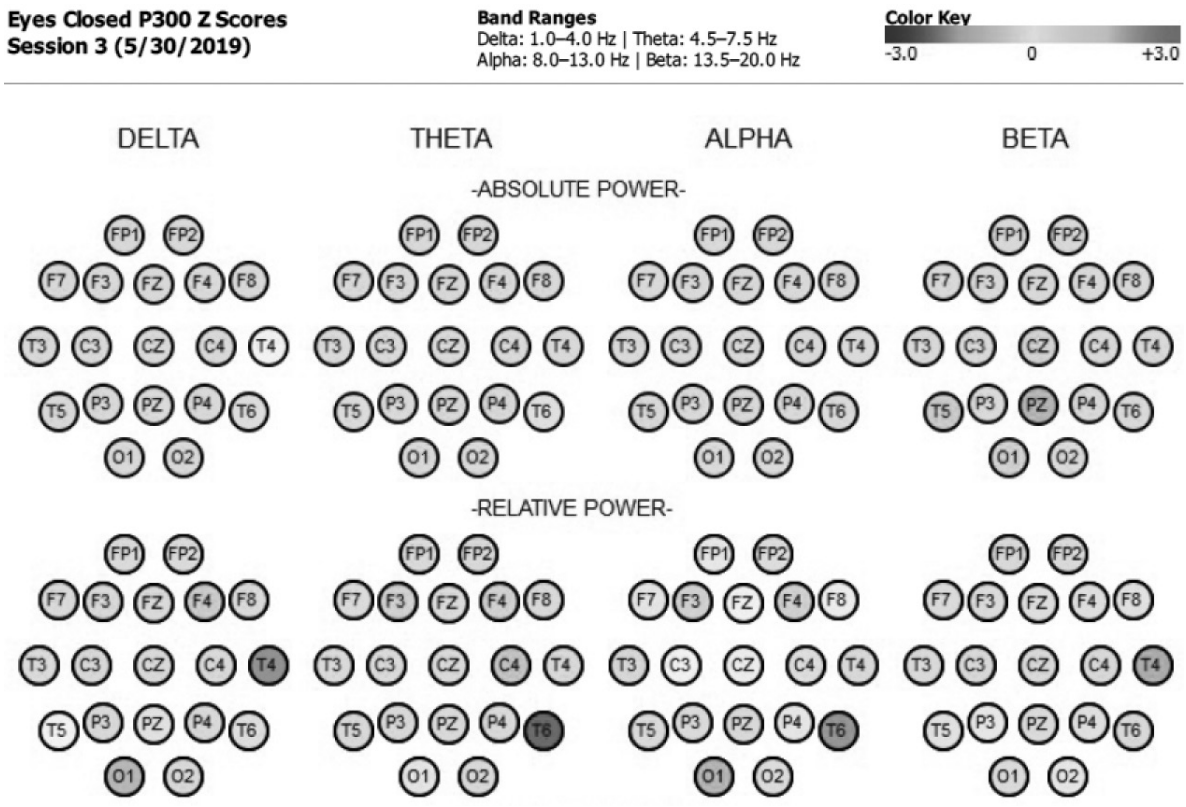

Figure 18. Brain mapping results for Participant 6 after grounding.

and fine motor movements (Walker et al., 2008; Warner, 2013). PZ is about perception, integrating somato-sensory information with posterior visual perceptions, spatial relations, route finding, and working memory (Walker et al., 2008; Warner, 2013). 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. Thus 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 two locations (Eschmann et al., 2018). There is also a small increase in Alpha mainly in the frontal area, an indication of relaxation.

After grounding, Participant 6 absolute power is still normal but again with a tendency toward low activity. Relative power shows high activity for T6 in the Theta band. T6 monitors brain functions related to emotional understanding, physical awareness (insula), and facial and symbol recognition—social cues (Walker et al., 2008; Warner, 2013). An increase in Alpha at T6 indicates an increase in alertness regarding the functions controlled by T6 (Eschmann et al., 2018). 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. The table below gives the result of all three sessions for Participant 6.

	Subject #6			Ref Range
	Session 1	Session 2	Session 3	(65 yrs)
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.

Coherence results. See Figure 19.

Before grounding, coherence was quite low for all frequency bands, with Alpha showing a

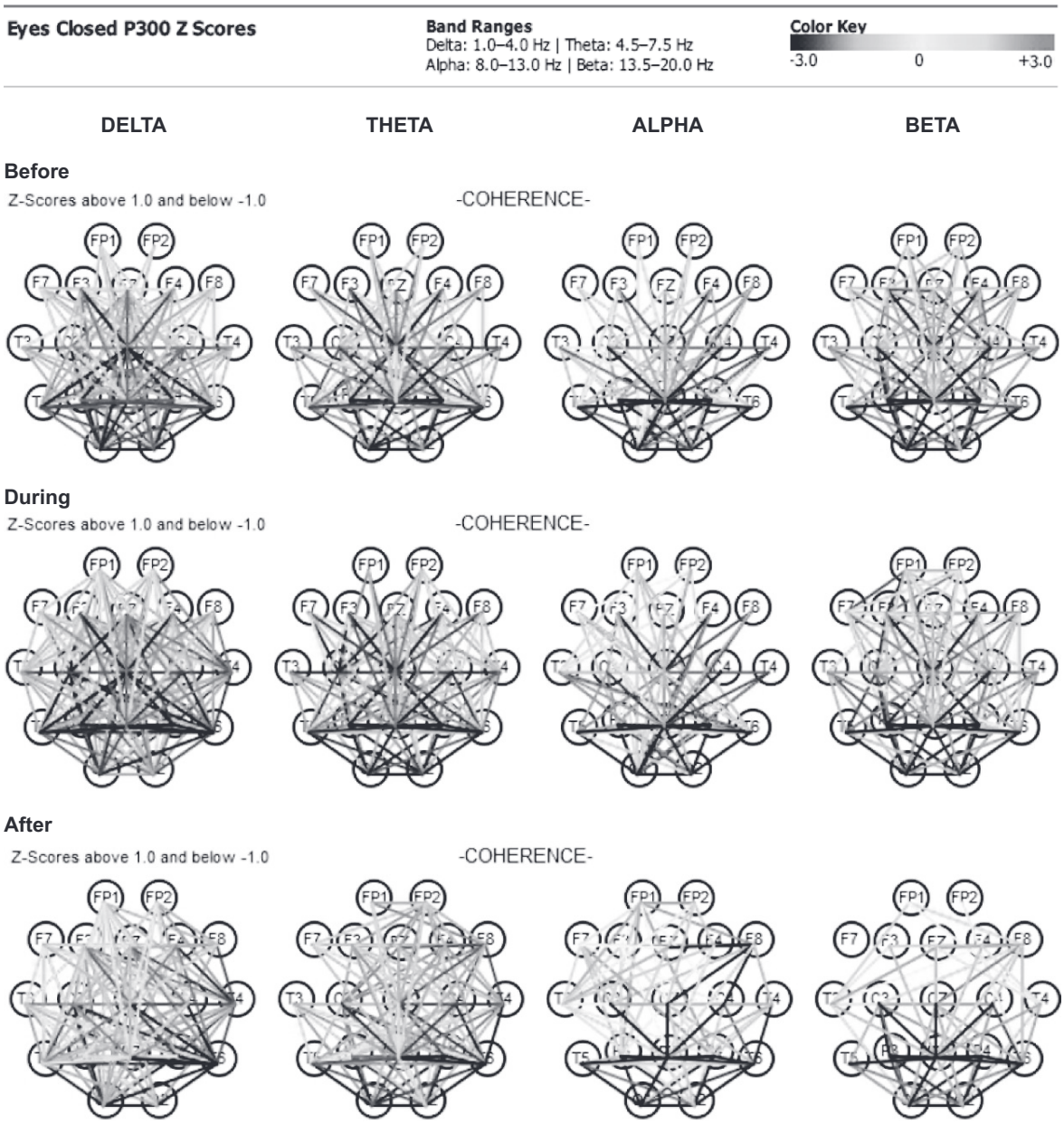

Figure 19. Coherence results for Participant 6.

few positive correlations in the left hemisphere before grounding. Low coherence is associated with diminished cognitive efficiency and functional connectivity (Walker et al., 2008; Warner, 2013). It is a sign that the brain is not able to efficiently connect cortical areas to perform specific tasks (Brain Science International, 2022). It results in decreased information transfer between cortical areas (Babiloni et al., 2016). Decreased coherence also results in less cooperation than normal, leading to reduced efficiency, longer processing time, and mistakes (Walker et al., 2008). 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 (Colgin, 2013). Low coherence in the Delta band indicates a decrease in large-scale, distant cortical network coordination related to decision making. In other words, in conditions not requiring decision making, Delta-band coherences are typically much reduced (Nacher et al., 2013). 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 (Warner, 2013). It also indicates quiet wakefulness (Goman & Machinskiĭ, 1984). 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, and 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 (Warner, 2013). An increase in frontal lobe coherence in Beta implies an increase in mental activity related to the functions coordinated by the frontal lobes (Warner, 2013).

Summary of findings for Participant 6. Before grounding, Participant 6 showed signs of good internal focus and concentration, hypervigilance, meditation, prayer, and spiritual awareness. During grounding, there was an increase in cognitive control over brain functions and better relaxation compared to before grounding. Participant 6 relaxed very well and went into a deep state of meditation during grounding. After grounding, Participant 6 continued to relax even more than during grounding going into a deep state of meditation. There was evidence of improvements in cognitive efficiency and functional connectivity due to grounding that lasted even after ungrounding.

Participant 7

Male, 34, acupuncturist. The meditation practice he uses is a form of mantra meditation. He has been meditating for 10 years for about 90 minutes per day. He indicated that he felt very calm and that his head hurt a little from electrode 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. See Figures 20–22.

Before grounding, Participant 7 absolute power is normal with a tendency toward low activity in Alpha and Beta and higher activity in Theta and Delta. 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

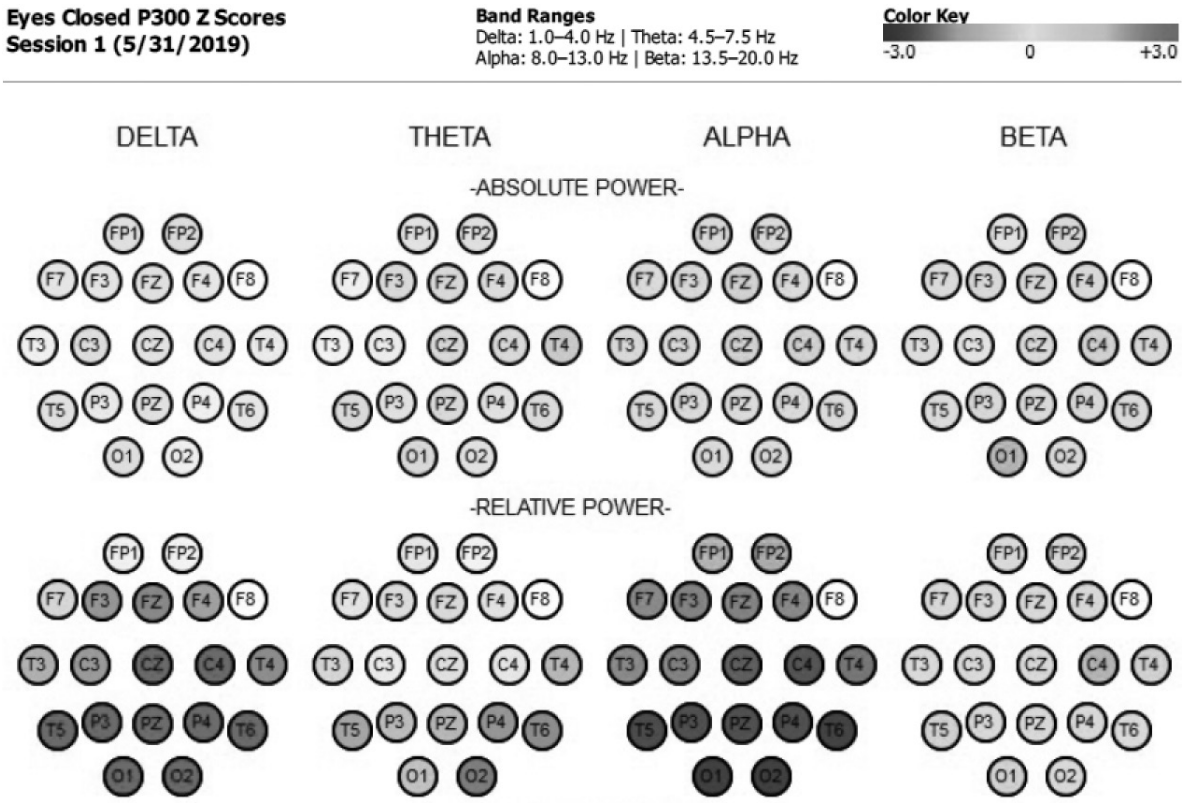

Figure 20. Brain mapping results for Participant 7 before grounding.

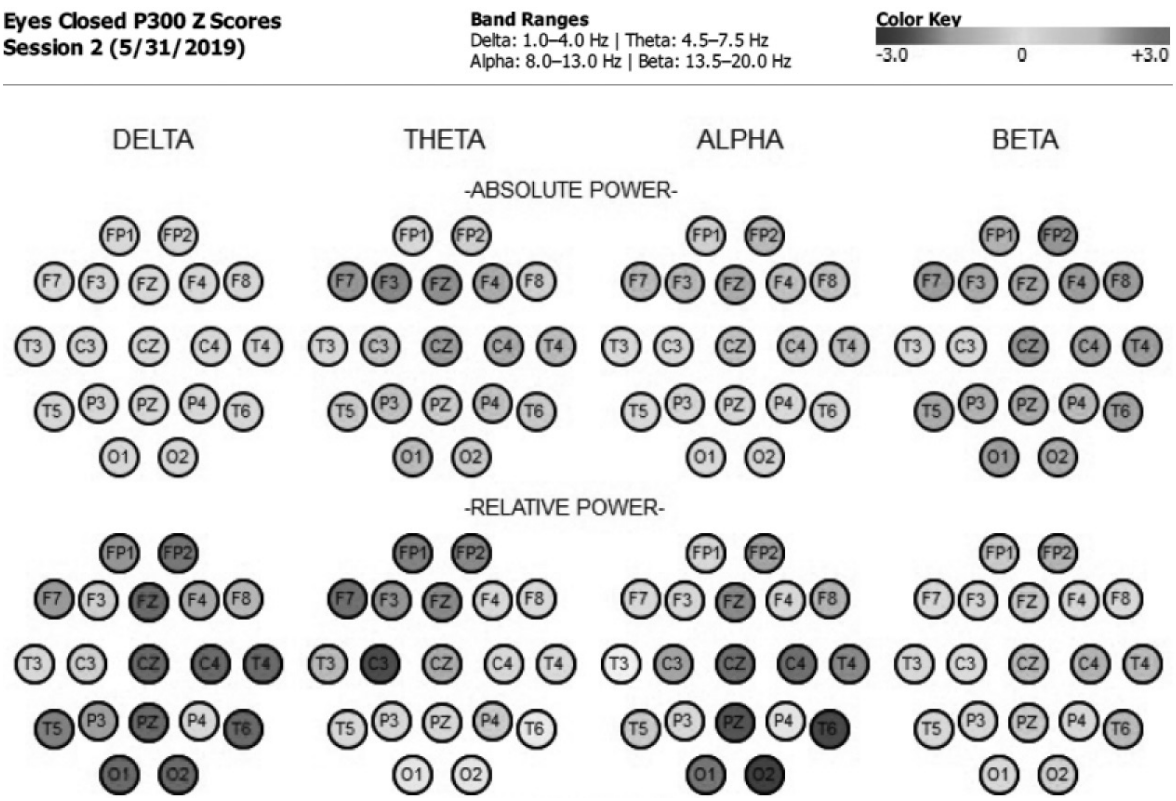

Figure 21. Brain mapping results for Participant 7 during grounding.

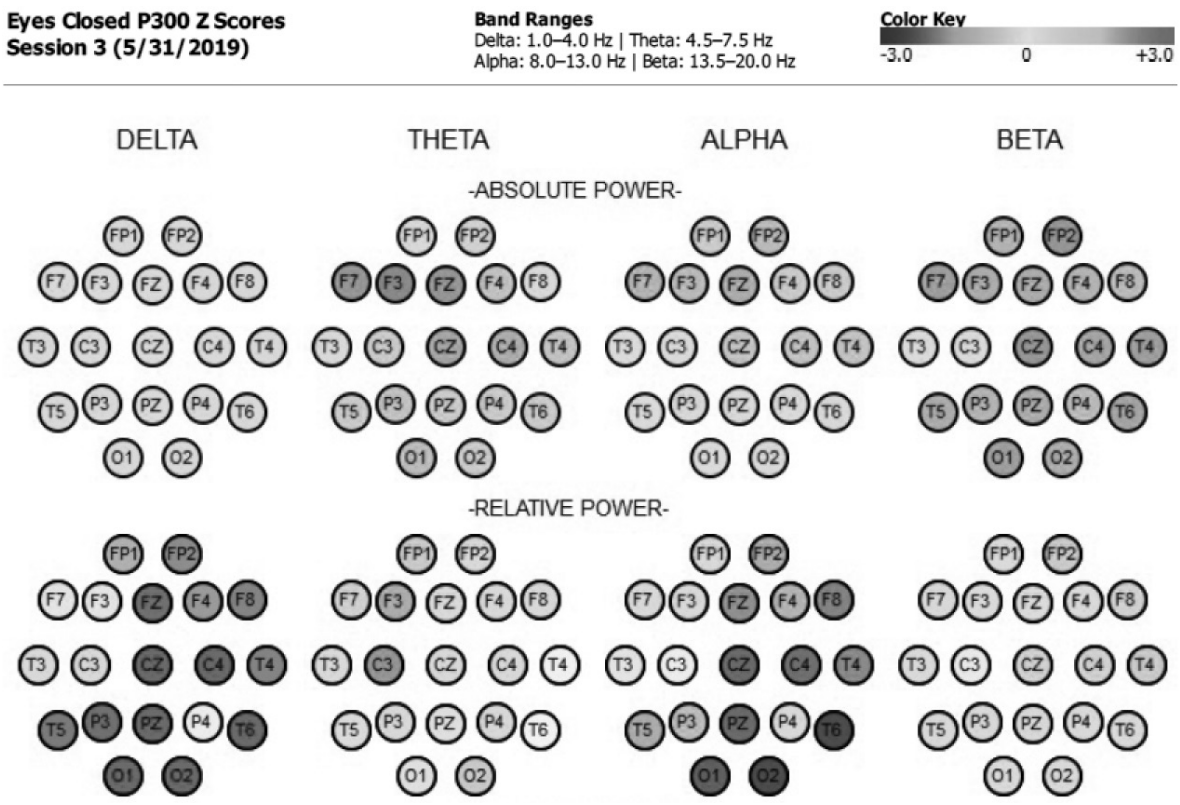

Figure 22. Brain mapping results for Participant 7 after grounding.

posterior of the brain is associated with feelings of calm and wellbeing (Warner, 2013) while elevated Delta activity is related to increase in the flow of deep unconscious information during meditation (Dissanayaka et al., 2015). Together, parietal, and occipital regions are concerned with procedural memory (Warner, 2013). The temporal lobes are the auditory association cortex, also including 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 (Warner, 2013). 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 (Warner, 2013). When Delta waves are increased, our awareness of the physical world is decreased. We also access information in our unconscious mind through Delta (Warner, 2013). 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 (Collura, 2014), both functions being antagonistic with the functions supported by Alpha brain waves, which are inversely related to cortical activity (Allen et al., 2004; Cook et al., 1998; Oakes et al., 2004).

During grounding, Participant 7 absolute power is normal with a tendency toward low activity in all 4 frequency bands. 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's main function is emotional attention with judgment, sense of self, self-control, and restraint to impulses of other functions involving this area (Walker et al., 2008). FZ's main function is motor planning of both extremities and midline. Other functions involving FZ include running, walking, and kicking (Walker et al., 2008). The principal function of CZ is sensorimotor integration of both lower extremities and midline, including ambulation as another function involving this area (Walker et al., 2008). PZ's principal function is perception with other functions involving this area including spatial relations, route finding, and praxis (Walker et al., 2008). Notice that the same electrode locations show low activity in Alpha. Delta and Alpha tend 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 (Basar & Güntekin, 2012). This high Delta activity is the sign of deep inner concentration and meditation (Allen et al., 2004) and an increase in the flow of deep subconscious information during meditation (Dissanayaka et al., 2015).

After grounding, Participant 7 absolute power is normal with a tendency toward low activity in all four frequency bands (light green to blue). Relative power shows high activity mainly 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 slightly amplified. FP2's main function is emotional attention with judgment, sense of self, self-control, and restraint to impulses of other functions involving this area (Walker et al., 2008). FZ's main function is motor planning of both extremities and midline. Other functions involving FZ include running, walking, and kicking (Walker et al., 2008). CZ's principal function is sensorimotor integration of both lower extremities and midline, including ambulation as another function involving this area (Walker et al., 2008). PZ's principal function is perception, with other functions involving this area including spatial relations, route finding, and praxis (Walker et al., 2008). Notice that the same electrode locations show low activity in Alpha. Delta and Alpha tend 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 (Basar & Güntekin, 2012). This high Delta activity is the sign of deep inner concentration and meditation (Allen et al., 2004) and an increase in the flow of deep subconscious information during meditation (Dissanayaka et al., 2015).

CZ Theta/Beta and F3/F4 Alpha. The table below gives the result of all three sessions for Participant 7.

	Subject #7			Ref Range
	Session 1	Session 2	Session 3	(35 yrs)
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, and interpersonal detachment with qualitative aspects of autistic or Asperger's behavior (Brain Science International, 2022). 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 (Thibodeau et al., 2006).

Coherence results. See Figure 23.

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) (Hagelin, n.d.). Participant 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

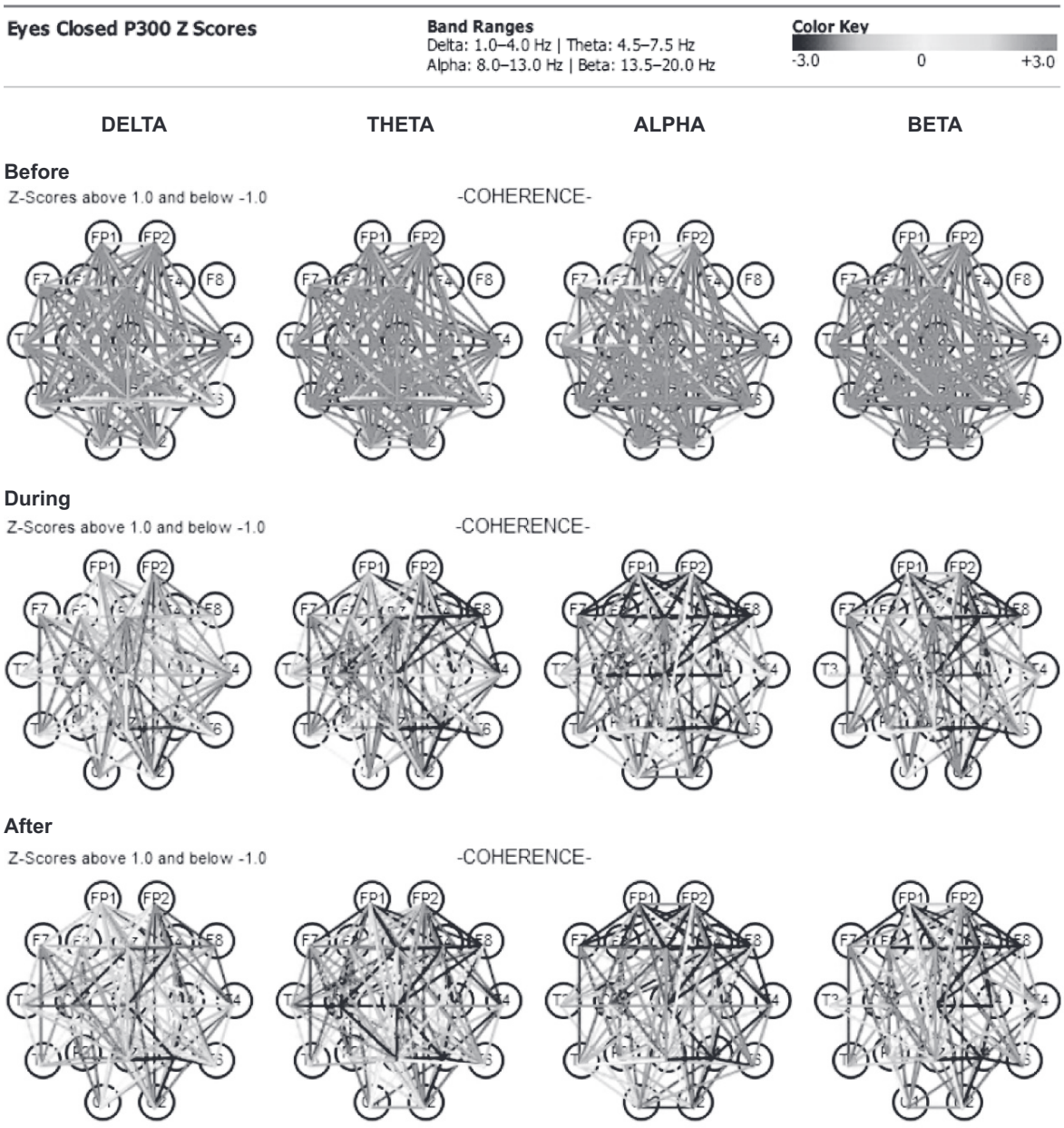

Figure 23. Coherence results for Participant 7.

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 (Warner, 2013). The result is decrease in flexibility of all brain functions (Walker et al., 2008). Beta hypercoherence may indicate anxiety, panic attacks, stress, and test anxiety (Warner, 2013). When excessive Alpha coherence is present, the brain may be locked up in Alpha and be hard to speed up or slow down (Warner, 2013). Excessive coherence may also indicate depression (Warner, 2013). 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 (Asheville TM Center, n.d.; Brandmeyer et al., 2019; Hagelin, n.d.; Hankey, 2006; Travis & Arenander, 2006). 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), the brain locked up in Alpha, and a high level of top-down control (Theta and Delta) (Cardenas et al., 2017).

Summary of findings for Participant 7. Before grounding, Participant 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 as 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 similar to during grounding, indicating a similar meditation state but slightly less deep. There are also indications that during grounding brain functioning improved.

Participant 8

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

Brain mapping results. See Figures 24–26.

Before grounding, Participant 8's absolute power is normal but with a tendency toward low activity. 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 (Deepeshwar et al., 2019). The frontal lobes are responsible for higher executive functions such as: attentional gating, decision making, problem solving, memory, social awareness, character, motivation, planning, and 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 (Warner, 2013). An excess of Alpha activity in the frontal brain is associated with emotional control (Warner, 2013). High Alpha activity coupled with low Theta and Delta indicates that the Alpha is dominant, suppressing the inhibition of corresponding brains functions (Harmony, 2013) or cognitive control related to the functions associated with the frontal lobes (Eschmann et al., 2018). O2's 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 (Walker et al., 2008; Warner, 2013). An excess Theta activity at O2 is indicative of an increase in cognitive control for related brain functions (Eschmann et al., 2018).

Similar to the before-grounding period, Participant 8's absolute power is normal during grounding but with a tendency toward low activity. 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.

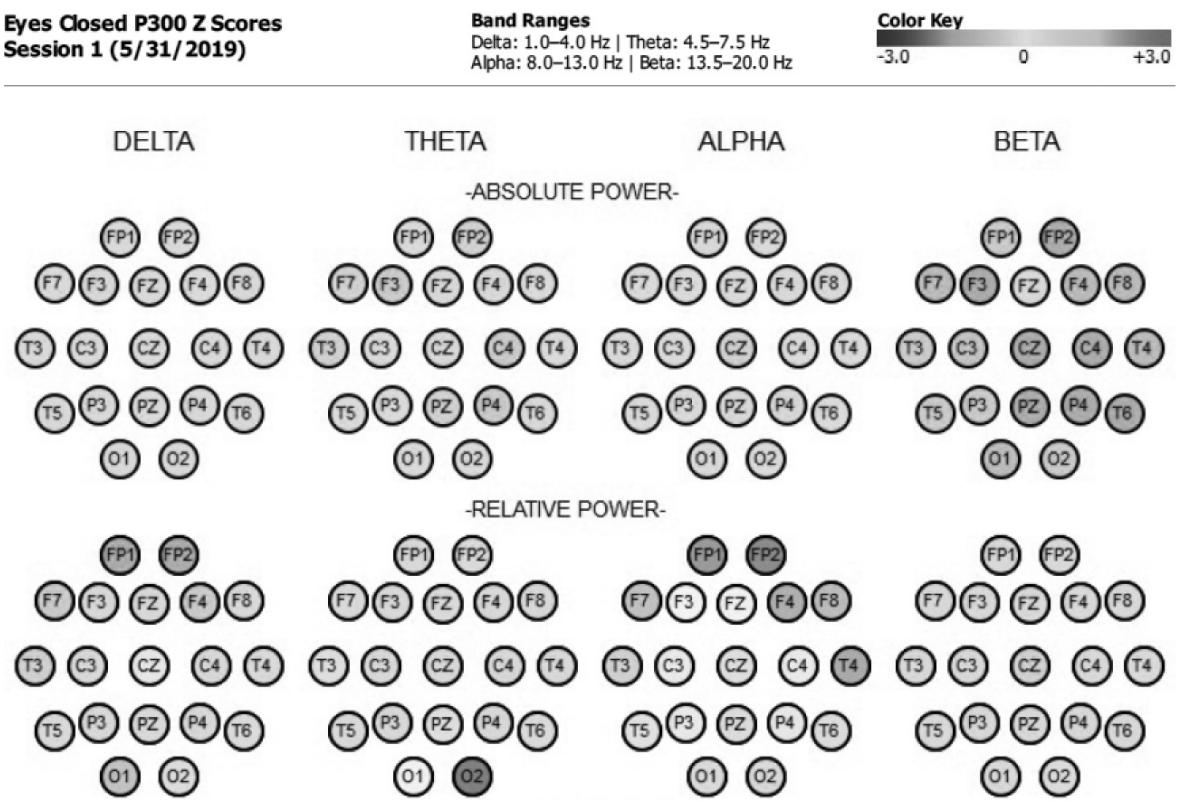

Figure 24. Brain mapping results for Participant 8 before grounding.

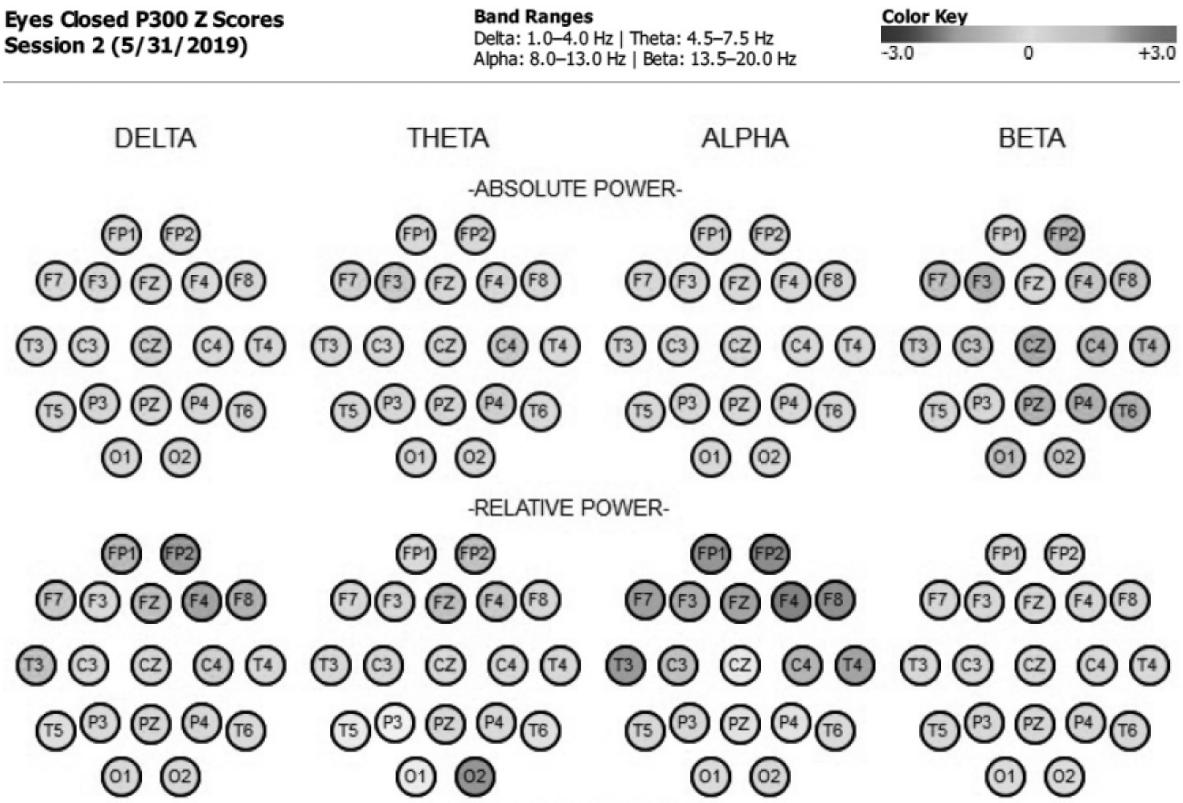

Figure 25. Brain mapping results for Participant 8 during grounding.

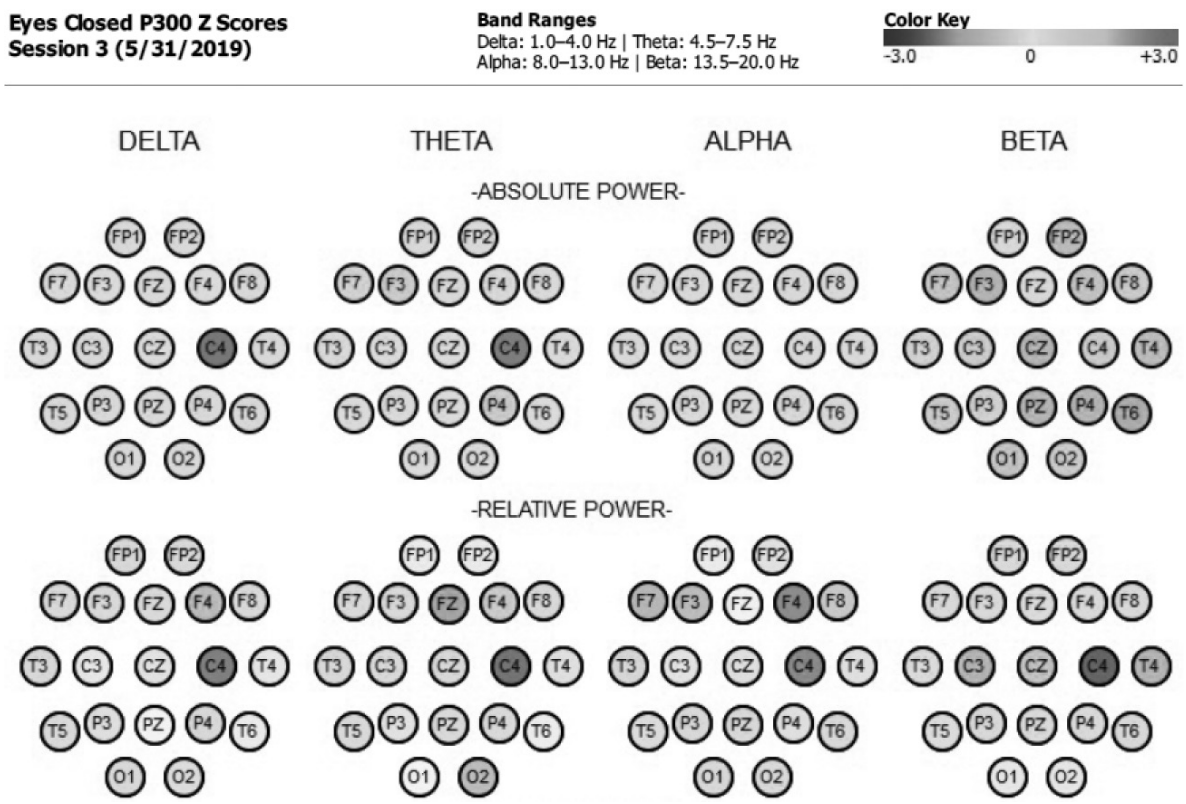

Figure 26. Brain mapping results for Participant 8 after grounding.

After the grounding meditation, absolute power remained normal, with a tendency toward low activity, except that C4 is now activated. C4's principal function is sensorimotor integration of the left upper extremity with other functions including calming, handwriting, and emotion/feeling (BioPac Systems, 2017; Walker et al., 2008; Warner, 2013). 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. The table below gives the result of all three sessions for Participant 8.

	Subject #8			Ref Range
	Session 1	Session 2	Session 3	(75 yrs)
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 (Thibodeau et al., 2006).

Coherence results. See Figure 27.

It can be seen that coherence in Delta and Theta is lower than normal during the pre-grounding phase, indicating that the participant was going inward and that most of the brain's 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, and analytical reasoning, etc.) (Warner, 2013). Frontal Alpha coherence was found to be a sensitive discriminator of the Transcendental Meditation technique (Collura, 2007b). Coherence in Alpha and Beta remained practically the same before, during, and after grounding. After grounding, coherence decreased even more for Delta and Theta, indicating more suppression of unconscious cognitive brain functions.

Summary of findings for Participant 8. Before grounding, there are indications that Participant 8 showed a mild level of cognitive control and that she was going inward. During

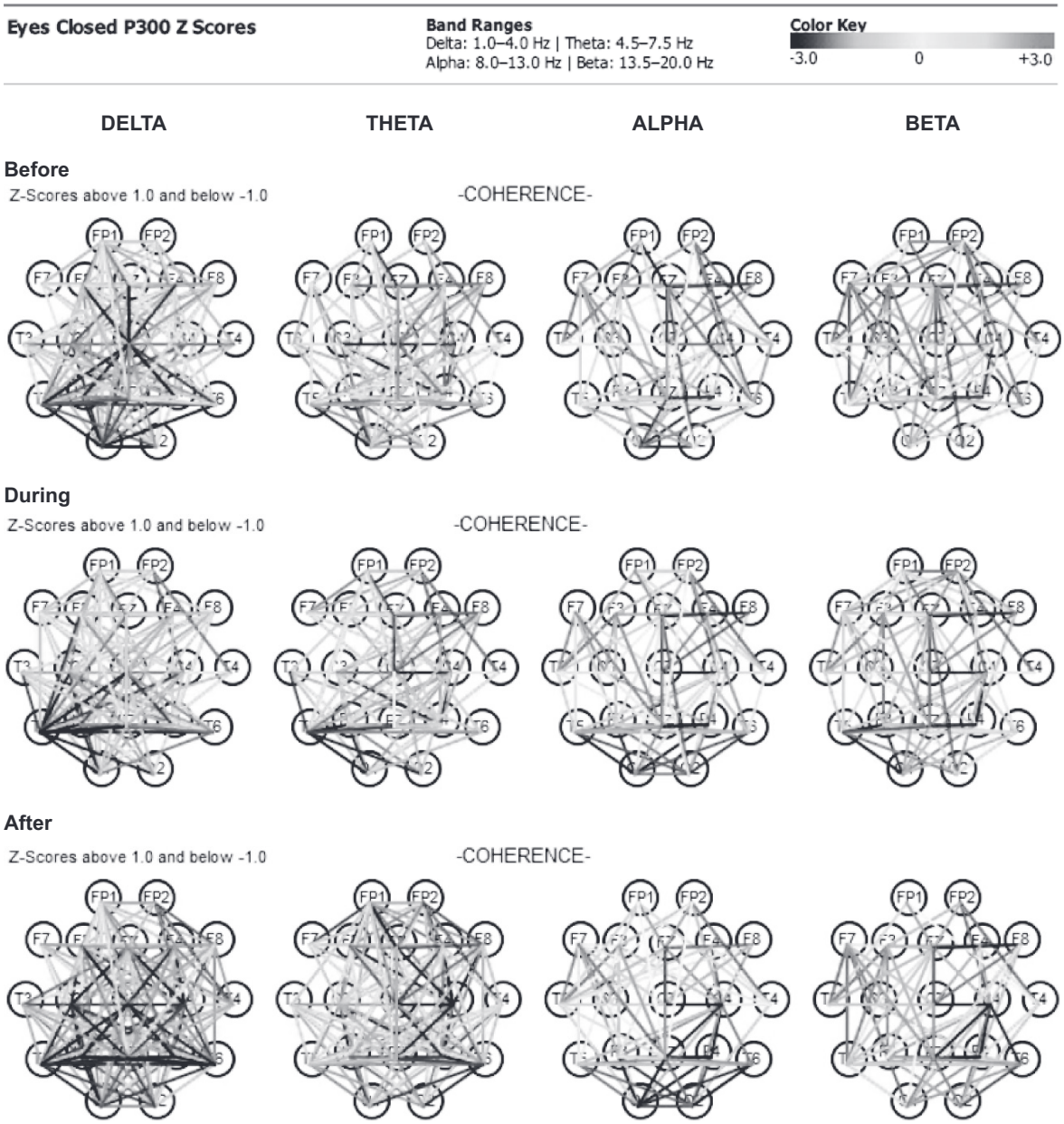

Figure 27. Coherence results for Participant 8.

grounding, cognitive control was still there but much more relaxed with a deepening of the meditation, peacefulness, and alertness. After grounding, the situation was similar but the meditation became less deep.

Participant 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 to 10 years for one 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 slightly better after the meditation.

Brain mapping results. See Figures 28–30.

Before grounding, Participant 9's absolute power is normal but with a tendency toward low activity. The P4 electrode did not provide any information. Theta and Delta relative power shows high activity for electrode sites in the whole brain but more so in the posterior region. T6 and O2 in the Theta band and O1 in the Delta band

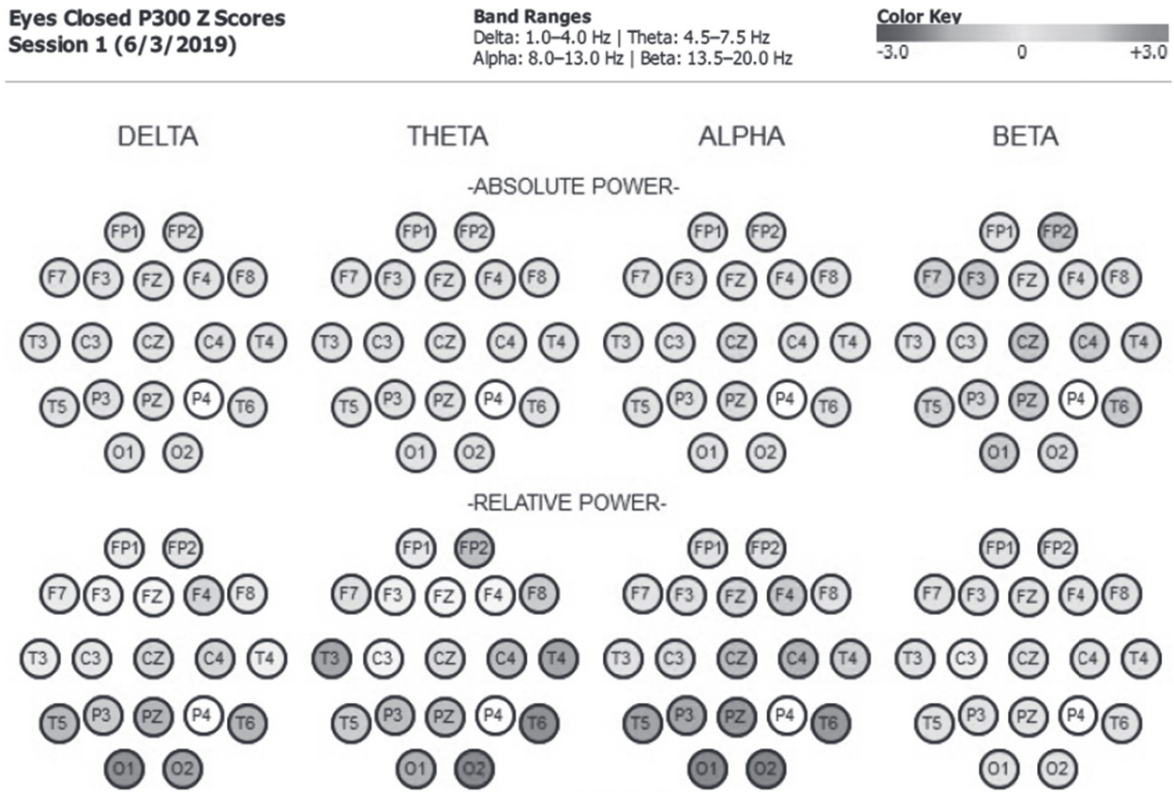

Figure 28. Brain mapping results for Participant 9 before grounding.

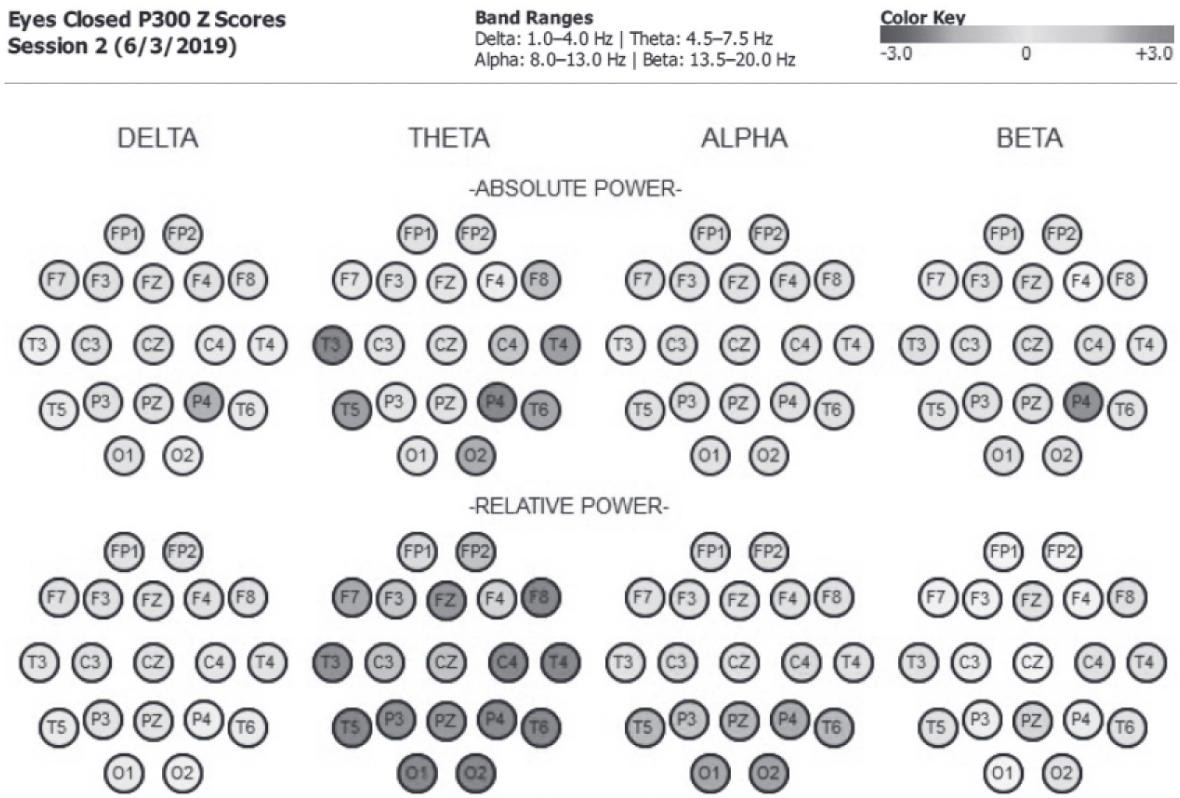

Figure 29. Brain mapping results for Participant 9 during grounding.

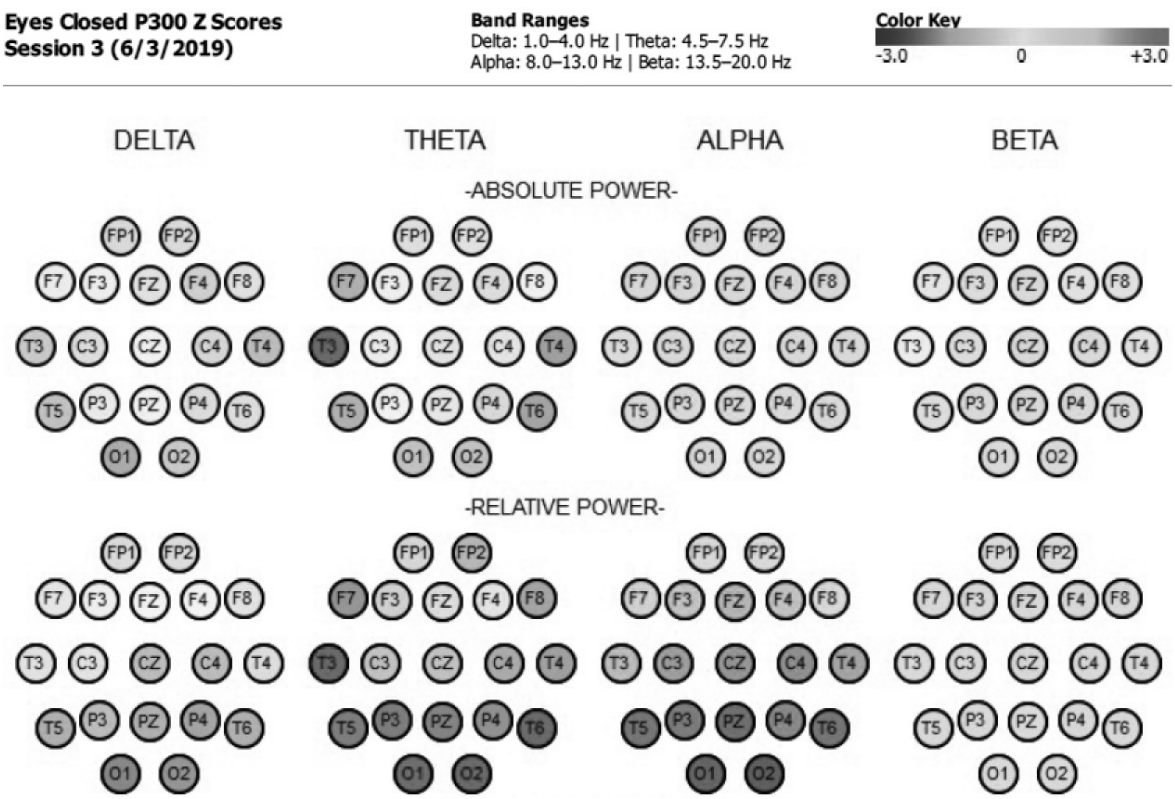

Figure 30. Brain mapping results for Participant 9 after grounding.

are particularly active regions of the brain. Strong Theta waves are associated with internal focus, hypervigilance, meditation, prayer, and spiritual awareness (Warner, 2013). Also note 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 (Allen et al., 2004; Cook et al., 1998; Oakes et al., 2004). T6's 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 (Walker et al., 2008; Warner, 2013). T6 activation in the Theta band is an indication of a substantial increase in the need for cognitive control for brain functions related to that electrode site (iMotions, 2017). O1 and O2 are primary visual areas and relate to the visual association cortex, visual processing, procedural memory, and visual perception (Warner, 2013). PZ is about integrating somato-sensory information with posterior visual perceptions and working memory (BioPac Systems, 2017; Warner, 2013).

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, hypervigilance, meditation, prayer, and spiritual awareness (Warner, 2013), indicating an increase in the depth of meditation for Participant 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 (Allen et al., 2004; Cook et al., 1998; Oakes et al., 2004).

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

CZ Theta/Beta and F3/F4 Alpha. The table below gives the result of all three sessions for Participant 9.

	Subject #9			Ref Range
	Session 1	Session 2	Session 3	(60 yrs)
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 was still low, and returned to the normal range after grounding. Right-lateralization indicated a more negative processing mode (Thibodeau et al., 2006).

Coherence results. See Figure 31.

Before the grounding period, coherence was high all over the brain and at all frequency bands. This high coherence state increased during grounding and remained at a similar level during grounding and 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) (Asheville TM Center, n.d.). 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 in the before-grounding period). The brain is too rigid and this also occurs when the brain builds new neural

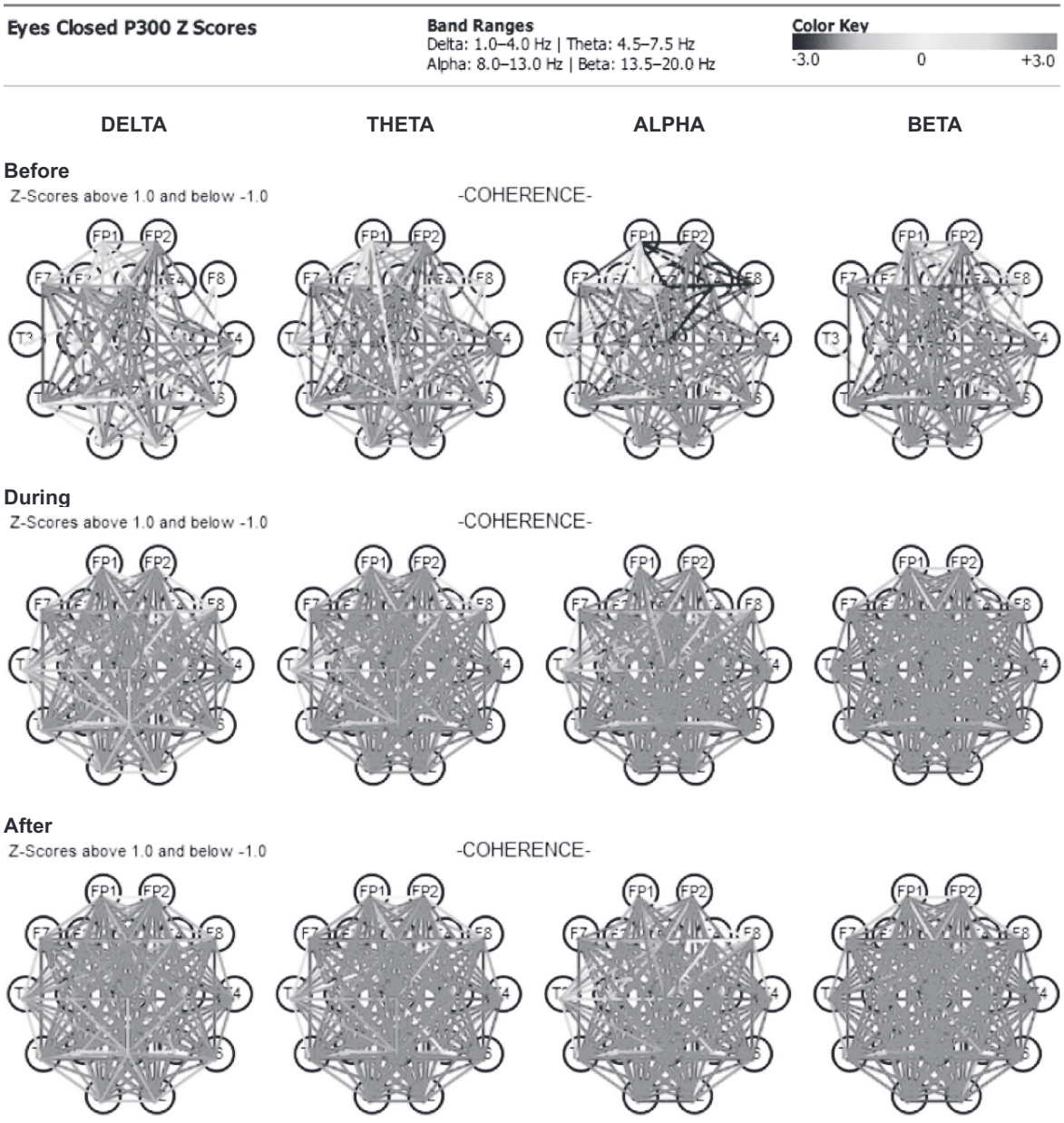

Figure 31. Coherence results for Participant 9.

connections. The brain is not efficiently processing and executing information, resulting in poor day-to-day performance (Warner, 2013). The result is decrease in flexibility of all brain functions (Walker et al., 2008). Beta hypercoherence may indicate anxiety, panic attacks, stress, and test anxiety (Warner, 2013). When excessive Alpha coherence is present, the brain may be locked up in Alpha and be hard to speed up or slow down (Warner, 2013). Excessive coherence may also indicate depression (Warner, 2013). 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 (Asheville TM Center, n.d.; Brandmeyer et al., 2019; Hagelin, n.d.; Hankey, 2006; Travis & Arenander, 2006).

Summary of findings for Participant 9. Before grounding, Participant 9's brain showed signs of internal focus, hypervigilance, meditation, prayer, and spiritual awareness. There are also signs of emotional control. During grounding, there is a deepening of internal focus, hypervigilance, meditation, prayer, and spiritual awareness, indicating a deepening of the meditation. After the grounding period, the brain, while still more in meditation than during the before-grounding period, started to revert to its condition before grounding.

Participant 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 seven years for 20 minutes daily. She said that even though the helmet hurt her head, she still was able to feel in her lower body, especially the root and sacral chakras. 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 of 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. See Figures 32 and 33.

Before grounding, Participant 10's absolute power is normal but with a tendency toward low activity. Delta relative power shows high activity for electrode sites in the posterior region of the brain. Electrode sites 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 brain waves can also occur when areas of the brain go "offline" to take up nourishment, as in deep sleep. Delta waves are also increased if a person is becoming drowsy. Increase in Delta activity also decreases our awareness of the physical environment and we access information in our unconscious mind through Delta (Warner, 2013). Elevated Delta activity in the posterior region of the brain is related to an increase in the flow of deep unconscious information during meditation (Dissanayaka et al., 2015). Also note 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, in this case, the increase in flow of information (Allen et al., 2004; Cook et al., 1998; Oakes et al., 2004).

Participant 10's 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's 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, and walking (Walker et al., 2008; Warner, 2013). Since Participant 10 was in pain during grounding, an increase in CZ in Theta and Beta is likely an indication of an increase in cognitive control over sensory-motor functions controlled by the brain regions under CZ (Eschmann et al., 2018). P3 is also highly activated in Beta. Its principal function is cognitive processing of the right half of space, with other functions including spatial relations, sensations, calculations, verbal reasoning, and praxis (Walker et al., 2008; Warner, 2013). 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 (Warner, 2013). However, neuroimaging studies have also reported meditation to enhance activity in the prefrontal

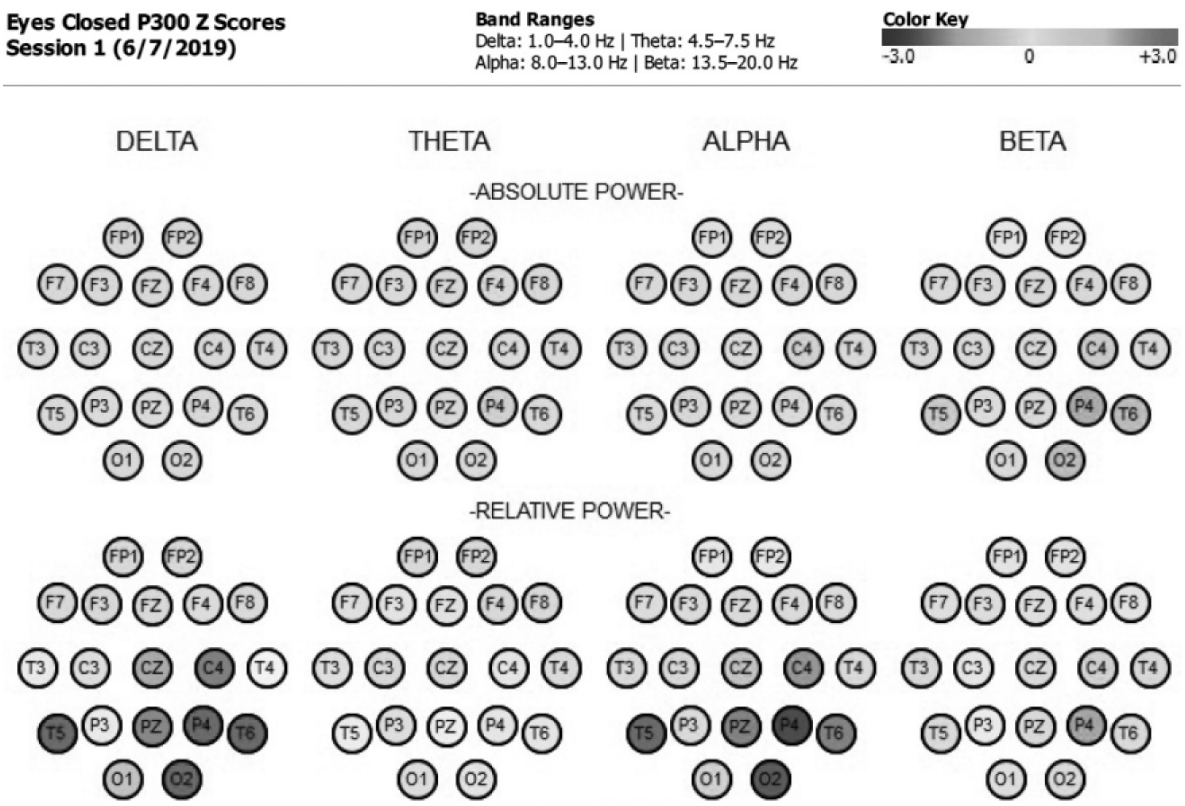

Figure 32. Brain mapping results for Participant 10 before grounding.

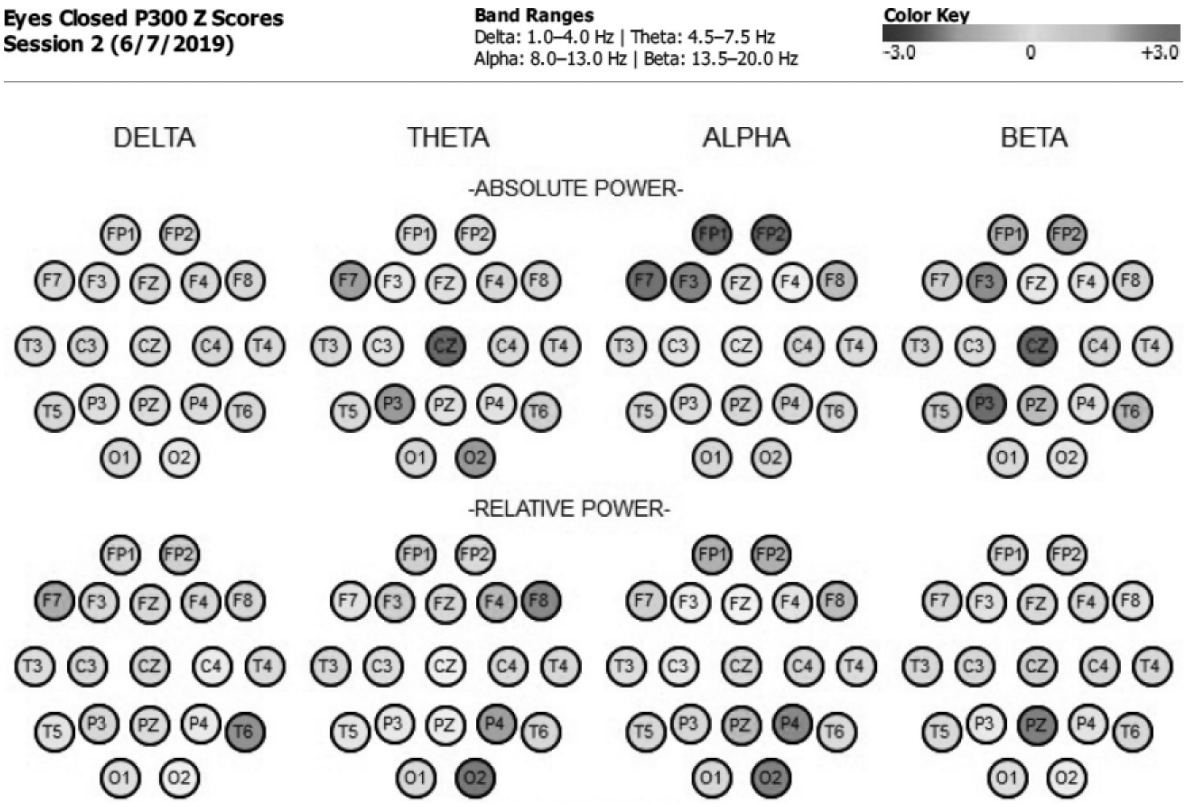

Figure 33. Brain mapping results for Participant 10 during grounding.

cortex, especially in the Alpha and Theta bands (Deepeshwar et al., 2019). The main function of the prefrontal cortex is executive operations: establishing goals, inhibiting information extraneous to the goal-directed planning process, planning, decision making, and 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) (Warner, 2013). 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. The table below gives the result for the two available sessions for Participant 10.

	Subject #10		Ref Range
	Session 1	Session 2	(40 yrs)
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 (Thibodeau et al., 2006).

Coherence results. See Figure 34.

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 (Güntekin & Basar, 2016), 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 the brain is immobilized in these frequency bands. This condition may indicate that the participant had low brain energy (Warner, 2013). It is also a sign that the brain is

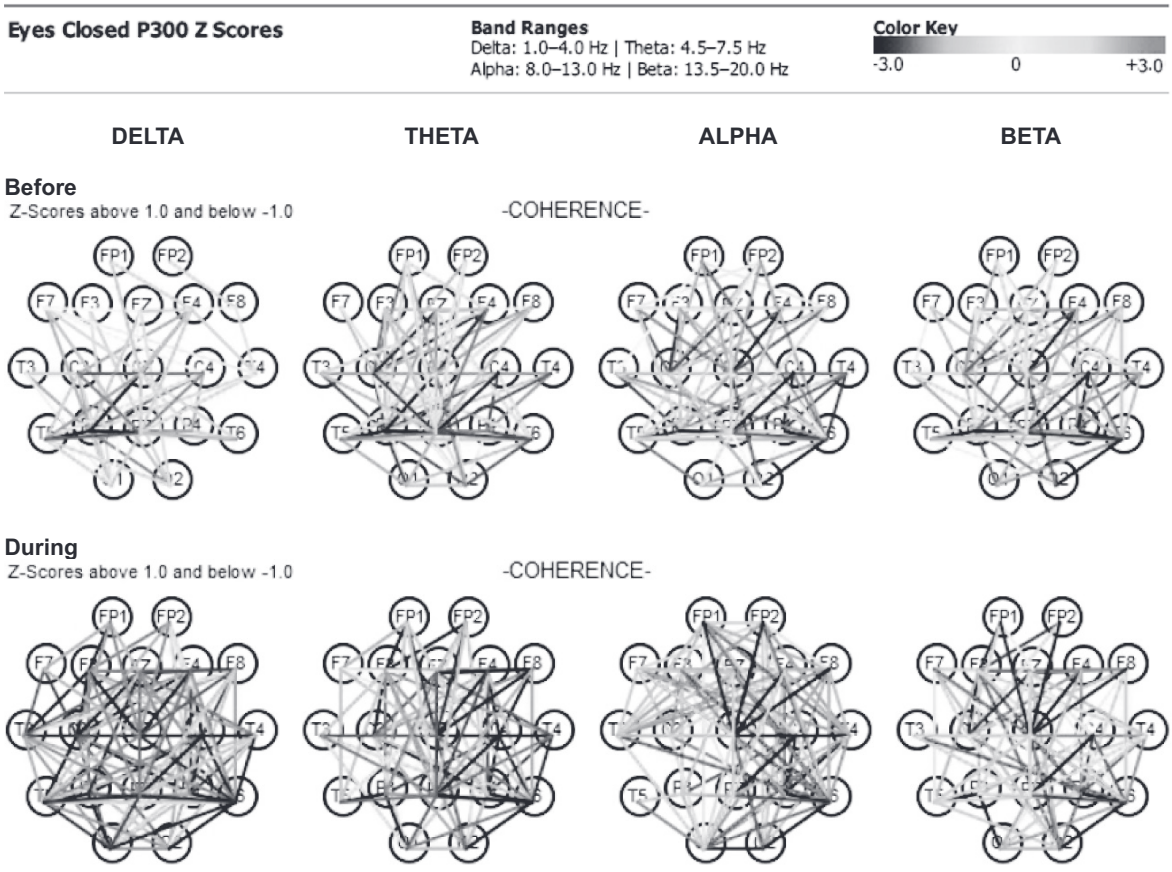

Figure 34. Coherence results for Participant 10.

not able to efficiently connect cortical areas to perform specific tasks (Warner, 2013). This results in decreased information transfer between cortical areas (Babiloni et al., 2016). Decreased coherence also results in less cooperation than normal, leading to reduced efficiency, longer processing time, and mistakes (Warner, 2013). 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 (Colgin, 2013). 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, and 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 (Warner, 2013). Activation of the frontal lobes in the Alpha frequency band indicates that those functions were activated but in a calm, objective manner (Warner, 2013). It also indicates quiet wakefulness (Goman & Machinskiĭ, 1984).

Summary of findings for Participant 10. Before grounding, Participant 10's brain showed 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, Participant 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 was consciously and calmly controlling somato-sensory information related to pain. Participant 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.

Discussion

General Conclusions

The brain mapping data of Participants 1, 2, 4, 6, 7, 8, and 9 (7 of the 7 participants for which we have good data) show evidence that their meditation deepened during grounding. For two of them (Participants 1 and 6), meditation continued to be excellent or even deepened after ungrounding. For most participants (Participants 2, 4, 7, 8, 9), that was not the case, i.e., the quality of their meditation started to decrease after ungrounding. For some participants (2, 3, 6, and 7), there is evidence that the brain functioned better during grounding.

From these results, we can infer that Participant 6 had the most positive results from meditating grounded. His meditation deepened during grounding, which continued to be excellent or deepen after grounding. Further, there is evidence that his brain functioned better during grounding. His meditation practice is a simple form of stillness meditation, seemingly similar to mindfulness but without paying attention or making any effort to be aware of the environment.

One participant (Participant 3) experienced a profound healing crisis during the experiment. This is interesting in light of this participant being an energy medicine practitioner with certainly good sensitivity to energies.

Two participants (Participants 7 and 10) complained that the frontal electrodes were giving them pain. Participant 4 said she was cold in the middle of the experiment. These situations, while difficult to predict, need to be looked at closely to prevent such occurrences in future studies.

In summary, the characteristics of the meditation improvements are:

1. High Alpha in the frontal lobes reflects top-down control regulation and emotional control in a calm, composed way. Frontal Alpha coherence was found to be a sensitive discriminator of the Transcendental Meditation technique (4 out of 7 participants with good data).
2. High 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 (3 out of 7 participants with good data).
3. Tendencies toward slow-wave disorders, ADHD, and interpersonal detachment with qualitative aspects of autistic or Asperger's behavior disappeared during meditation (3 out of 7 participants with good data).

Limitations

The resources available limited the number of participants and also forced us to do a case series and to compromise on the meditation technique by having meditators use different techniques with common characteristics such as stillness and no heavy breathing.

Recommendations

Future research could benefit from having a more standardized meditation protocol, for example, having participants practicing the same meditation such as TM or mindfulness, achieving a uniform population of meditators. A larger number of participants would allow more comparison groups such as: a group sitting 40 minutes without meditation or grounding (control); another with 40 minutes meditation without grounding; another with no meditation with grounding; and finally, a group sitting in meditation with grounding. It would also allow the possibility to use more sophisticated research designs such as crossover or step wedge.

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. These results warrant more research with more participants and a control group.

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