Article

Magnetic Stimulation of the Temporal Cortex: A Partial "God Helmet" Replication Study

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Abstract

The effects of magnetic stimulation of the brain in comparison with suggestibility and expectation are studied. Eight magnetic coils were embedded in a helmet, placing four over the temporal lobes on each side of the head. These produced 0.0001 Tesla (10 mG) magnetic fields (MF). "Spiritual experiences" were reported by some of the 20 volunteers who received magnetic stimulation of the temporal lobes. These "spiritual experiences" included sensing the presence of "spiritual beings." Stimulation durations and field strengths were within the limits used by Dr. M. A. Persinger in similar ("God Helmet") experiments (20 minutes, 10 mG). Questionnaires were applied before, during, and after the experimental sessions. Analysis of the subjects' verbal reports, using Whissel's Dictionary of Affect in Language, revealed significant differences between subjects and controls, as well as less robust effects for suggestion and expectation.

Keywords: God Helmet, magnetic stimulation, temporal cortex, Michael Persinger, spiritual experience.

Introduction

Neurotheology or spiritual neuroscience is the study of the neural bases for spirituality and religion. The goal of neurotheology is to discover the cognitive processes that produce spiritual and religious experiences and their accompanying affect and relate them to patterns of brain activity, how they evolved, and the effect of these experiences on personality.

In our research, we used an apparatus (Figure 1) not unlike the Koren Helmet, often called the "God Helmet." The Koren Helmet is an instrument created by Dr. Persinger and colleagues to perform experiments in the field of neurotheology (Persinger, 2001). These experiments have elicited a wide range of visitor experiences (Persinger, 1989) (angels, ghosts, demons, deities, spirits, etc.), including the *sensed presence*. Several scientists from various fields have reported mystic experiences in Persinger's lab, as well as mystics, psychics, and atheists. The helmet used in this research was built in our laboratory by J. P .L. Ortiz, an electronics technician, working under the guidance of the primary author.

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Figure 1

The God Helmet (Koren Helmet) stimulates the temporal neo-cortex and mesio-basal portions of the temporal lobes with complex magnetic fields. The God Helmet places four magnetic coils on each side of the head, above the temporal lobes. Some subjects exposed to these fields reported having "spiritual experiences" during our tests. These subjects included atheists, as well as religious believers. In one media interview (BBC, 2003), Persinger stated that 80% of the subjects reported the "presence" of "nonphysical beings" in the room where the experiments were conducted, including the "presence of God" in a small number of subjects.

Antecedent Studies

Other researchers have explored the effects of magnetic fields on the human brain, including Sandyk (1997, 1999), who reported therapeutic effects from the magnetic field on patients with Parkinson's disease and multiple sclerosis. Hirata et al. (2011) reported eliciting phosphenes using weak magnetic fields. Martiny K, Lunde M, Beach P (2010) reported antidepressant effects from low-intensity magnetic fields. Robertson (2010) reported changes in pain processing following low-intensity magnetic pulses.

Mystic experiences have been reported from all countries throughout history. Mystic experiences have been defined as "altered states of consciousness accompanied by positive affect" (Murphy, 2011). Dr. Andrew Newberg (2001) has shown that religious experiences affect the temporal lobes of those who experience them. Dr. Persinger (2010) has demonstrated that when the temporal lobes are activated in specific ways, the subjects have religious experiences. These two lines of research both implicate the temporal lobes as crucial in mystic experiences.

M. A. Persinger (2001) has reported religious and mystic experiences in laboratory settings using low-intensity magnetic signals, most notably the elicitation of the "sensed presence" experience and (much more rarely) visions of God. Persinger and colleagues have suggested that specific classes of subjective experiences are related to subtle changes in brain activity, influenced by fluctuations in global geomagnetic activity (Persinger, 1988). Persinger AM,Roll WG, Tiller SG,Koren SA,Cook CM (2002) reported neurophysiological correlates of experiences reported by Sean Harribance, a remote viewer. Low-intensity complex magnetic signals were applied over his right parietal-temporal lobe, causing him to sense presences on his left side. These results suggest that the paranormal phenomenon Harribance reported was quantitatively correlated with morphological and functional abnormalities involved in the right pario-temporal cortex and the hippocampal formation (Persinger,MA,Roll,WG,Tiller,SG,Koren SA,Cook CM 2002). Beuregard and Paquette (2006) did an experiment with Carmelite nuns who reported moments of union with God. Magnetic resonance images (fMRI) were taken from them while they were in this state. Their experiences were found to correlate with changes in the medial orbitofrontal cortex, inferior and superior parietal lobes, medial pre-frontal cortex, left anterior cingulate cortex, and left insula. The results suggest that mystical experiences are mediated by several brain regions and systems. These include the temporal lobes, the region we focus on in the present study.

Objective

The research objective was to replicate aspects of the experiments reported by Dr. Michael Persinger. These include (a) magnetic stimulation of the temporal lobes, (b) low-intensity magnetic fields, and (c) movement of the magnetic fields. A further objective was to explicate the effects of suggestion on the outcome of the experiment by including subjects who had heard of the "God Helmet" and informing them that they were going to receive a session with that apparatus, explicitly "planting" a suggestion.

Hypothesis to Be Tested

With these tests, the researcher intended to repeat the experimental results of Michael A. Persinger and colleagues, in which the God Helmet turned on, could induce mystical experiences on the volunteers. Therefore if can be said that the hypothesis to be tested was: "It is possible to repeat the results of Michael A. Persinger and colleagues, using a God Helmet built in Brazil, without having any orientation of them regarding the tests and the construction of a God Helmet?" It is also expected that the twenty volunteers chosen by the criteria specified below don't be harmed by the research, in other words, that they don't suffer any sort of damage, neither physical, nor emotional, and, at the end of the tests, they feel very well and willing to repeat the tests, in another occasion.

Methods

The methodology applied on the research that is the subject of this project is the following:

a) Participants

1 - The choice of twenty volunteers and how would they be tested:

- Through interview, in which they were informed about all the methodology to be used on the tests;
- All the twenty would be tested, one at a time.
- Before and after the tests, a doctor (Dr. Elson de Araújo Montagno), would measure their blood pressure and heartbeats of each patient. That wouldn't be made during the tests to not alter the results.
- Each patient would be blindfolded during each test;
- Would be considered excluded from the tests, the volunteers with physical problems, psychological and psychiatric problems, according to the doctor's opinion.

b) Criteria of Inclusion of Volunteers on the Research

Would be included on the research volunteers that:

- Wished to participate;
- Were selected in the interviews (judged by the responsible for the tests, Carlos Alberto Tinoco);
- Had signed the Consent Form;
- Had been considered apt by the doctor.

c) Criteria for Exclusion of the Research Subjects

Would be considered excluded from the research, subjects that:

- After being selected, gave up participating on the tests;
- Even willing to participate, the medical and psychological exams indicate as inapt;
- Refuse to sign the Consent Form.

d) Equipment Used on the Construction of the God Helmet

1- Construction of the God Helmet, according to specifications of Dr. Persinger and colleagues (see internet "God Helmet"):

- Construction of cictuit a), which is an oscillator (see Appendix 2);

- Construction of cictuit b), which is known as "Johnson-DJ's Decade", that is a counter of electric pulses, from 1 to 10 (see Appendix 2);
- Construction of a current amplifier, which must be coupled to each solenoid, because the DJ does not supply sufficient current (see Appendix 3);
- Cut the helmet with holes approximately eight centimeters in diameter at the height of the temporal lobes for placing the eight solenoids, four at each side of the skull;
- Acquisition of copper wire (26 AWG) endcapped with varnish, with 50.0 meters in length;
- Preparation of eight solenoids, each with five hundred turns;
- Manufacture of four wooden wheels (simple wood), each with a diameter > 8.00 cm, to provide support to the eight solenoids (two pairs with two wheels each);
- Acquisition of eight ferrite rods (d=1/4", length= 3") to be placed into each of eight solenoids;
- Acquisition of 8 cables of 24 AWG, with two meters long each, to be connected to the eight solenoids, which will bring information to the responsible researcher (plastic wrapping with four different colors);
- Wrap the copper wire of each solenoid with pharmacist tape, for proper protection;
- Experimental Measurement of the value of electric current in each solenoid, so that we can know the value of the magnetic field generated in each solenoid (not to exceed the critical value, between 10 nanotesla and 1 microtesla, according to Raul Marino, Jr., informed by Dr. Newberg (Marinho Jr, 2005). This value was measured = 0.000165 amperes, which corresponds to a magnetic field of B = 0.001 microtesla within the security value. The value of the magnetic fields is measured with a multimeter (precision voltmeter), which possesses scale for micro and milli volts.

e) Printed Material

- Preparation of printed material to be used after each experiment (see Appendix 4).

f) Time for the Conduction of the Research

-Twenty-minutes for each patient, seven of them on the first day, seven in the second and six in the third. On the first day, the time for conducting the tests was six hours and twenty five minutes; on the second day it was used approximately the same time of the first test, and in the third day it was spent about five hours and thirty minutes. The average time spent in each test was one hour and 20 minutes, approximately.

g) Procedure

- The whole experience would be held in three days, and could be carried part in the morning and part in the afternoon;
- Before each test, the researcher in charge would apply on each patient the appropriate questionnaire (see Appendix);

- During the tests, the researcher in charge would apply the questionnaire for each patient (see Appendix);
- After the tests, the researcher in charge would apply the appropriate questionnaire (see Appendix);
- The God Helmet would be placed on the head of each of the eight volunteers, each in turn, when the magnetic fields would be activated for twenty minutes;
- Each volunteer patient had to sign a consent form, sparing the Spiritist Integrated Schools – "FIES" of any damage that he may suffer as a result of the tests, although all possible precautions were taken in advance;
- The principal investigator would inform patients, before testing, the values of the magnetic field that would be used, and the maximum value that could be used without damage being caused to the patient;
- The mentioned doctor, that would measure the blood pressure, temperature and heartbeats of each patient before and after the tests, would inform that they do not pose a risk to patients;
- After the completion of the research, an Act would be written, which should be signed by the head of research, by Seu Dante, builder of the CD, by the doctor, and all twenty volunteers. Only then may the research be considered finished.

h) General Information

- Individual interviews with volunteers, made by the head of research. On this occasion, they would be informed of all procedures and methods that would be used during the tests;
- Each of them would be examined by a doctor and, if he states that the volunteer is fit, he may be accepted;
- If they agree to be patient on the tests, they still must sign the Consent Form. Only then, applicants would be accepted, definitely;
- A psychologist would examine the volunteers before and after the tests, to assess problems arising from contact with the "unknown".

Ten subjects were given 20-minute magnetic stimulation sessions using 100 Hz magnetic pulses produced by a locally assembled Johnson Decade Counter and applied through an array of magnetic coils located above the temporal-parietal region of the head.

The magnetic coils used in the experiment were made with 500 turns of 26-gauge copper wire around disk-shaped flux concentrators, output magnetic fields calculated to have RMS peaks of 0.000001 Tesla (10 mG) when connected to an active Johnson Decade Counter.

We used "simple" pulses, which Persinger (2010) reported are among the least effective patterns for magnetic field neural stimulation, as the brain habituates to these in short periods of time. However, we maintained movement of the magnetic fields, coil placement over the temporal-parietal region, and field strengths on the order of 10 mG. Our simple signals were used in the absence of any source for the "Chirp" pattern or amygdalar burst-firing pattern used in Persinger's experiments and provided an opportunity to test the effects of magnetic fields moving above the temporal lobes, as well as weak (10 mG) magnetic fields, although without

complex patterns. According to Persinger and Koren (2005a), the Koren Helmet requires exposures of at least 20 minutes for mystic and/or altered-state experiences to appear under its influence. This was used as the duration of our experimental sessions. A blindfold was used to achieve partial sensory deprivation.

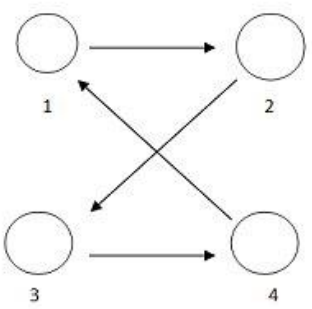

Figure 2

One pair of coils at a time actively put out magnetic fields. The active coil was changed every 250 msec, changing from the posterior to anterior superior temporal lobes, and then from the posterior to anterior inferior temporal lobes (Figure 2), in a pattern not unlike a figure eight. The same configuration was used above both temporal lobes. The coils were "yoked" so that each pair of coils designated with a number was active at the same time as its contralateral counterpart. One such sequence required 1000 msec.

The position of the coils was cross-shaped, with their arms, one vertical and the other horizontal. The dorsal and ventral pairs were thus each active for 500 msec. Our equipment differed from Persinger's helmet, which rotated the signals between the four coils. However, like Persinger's (2001, 2010) arrangement, ours included time frames for the movement of the magnetic fields such that the dorsal and ventral portions of the temporal lobe each received 500 msec exposures in succession.

The experimental sessions were carried out on three days: September 27, October 13, and October 18, 2010, between 14:00 and 18:00, local time (Brazilia Time Zone = GMT -3).

Global geomagnetic values (K indices) during the times of the experiments were 0 to 2 (09/27/10), one (10/13/10), and one (10/18/10) (NOAA archives, 2011).

The control group consisted of an additional 10 subjects who were treated with a zero-amplitude (sham) field.

Biomedical measures from all subjects were taken before each test and found to be within normal limits. The mean arterial pressure fell approx. 12 x 7, the average body temperature was between 37 and 36.5 degrees Celsius and the average heartbeat rate was around 74 per minute. After the first evaluation, our magnetic helmet was placed on the head of each of the subjects and actively run for 20 minutes or left off for control subjects. All volunteers sat in a comfortable chair during the tests. The helmet was fitted with a blindfold.
Pre-session questionnaires were applied regarding each subject's emotional state, expectations, and prior knowledge of the God Helmet before experimental sessions. In the last two minutes of the sessions, subjects were queried regarding any sights, sounds, tactile sensations, smells, and tastes that they might be experiencing. After the sessions, subjects were asked about their overall state. Descriptions of subjective states and experiences were also collected from each subject during and after the experimental sessions.

Subjects were told that they were participating in a God Helmet experiment, deliberately planting a suggestion that would actively encourage expectation. Not all subjects (n=10) had prior knowledge of the apparatus. Nevertheless, the phrase "God Helmet" strongly connotes an exotic experience, planting a similar suggestion for all subjects, regardless of whether they had prior knowledge of the God Helmet.

Expectation is the subjective correlate of suggestion and suggestibility. Our subjects were asked what they would expect during a "God Helmet" session. Only a small number (n=5) reported no expectations. Prior to the experimental sessions, the majority of subjects reported expectations of altered states, calmness, and unusual sensations.

Analysis of the subjects' responses was accomplished using *Whissel's Dictionary of Affect in Language* (Whissel, 2009), an instrument that quantifies the affective dimension of spoken language, including pleasantness, activation, concreteness, and abstractness, as well as performing word counts.

All words were scored with the *Dictionary of Affect* by matching words to the *Dictionary* and importing scores for three variables: pleasantness, activation, and imagery. These scores represent previous ratings of how pleasant a word seemed, how active it seemed, and how easy it was to form "a picture in your mind" of the word. A total of 537 words were produced by participants; 496 of these (92.4%) were matched by the *Dictionary*. Data included a count of the number of words used by each person during and after the God Helmet session.

The analysis was a repeated-measures analysis of variance for pleasantness, activation, and imagery; number of words with field; and expectation as between-subjects factors (2x2x2). Post-hoc tests were t-tests, which assessed whether the means of two groups were statistically significantly different from each other. The methods employed for post-hoc analysis were unknown to the translator at the time of the translation, preventing translator bias.

We used measurements of verbal behavior during and after experimental sessions to explicate the relative roles of magnetic field stimulation and suggestion. We recorded answers to queries about what subjects expected the session would be like prior to the experimental sessions. These answers are included in the detailed results at Table 1. Analysis of verbal behaviors in expressing expectations provided a way to analyze the effects of suggestion directly.

Table 1. Detailed results for the 20 subjects

Subjects with no expectations before experimental session:

Subject number	Field on or off Knew about God Helmet or didn't know	Religion	Expectations before experimental session	Experiences during experimental session	Experiences after experimental session
1	NO FIELD - KNEW ABOUT GOD HELMET	No specific religious beliefs (spiritualistic)	No expectations	Felt sleepy	Felt well
6	FIELD ON - KNEW ABOUT	Spiritualist	No expectations	Felt muscle spasms in arms	Felt very well

	GOD HELMET Had seen a lecture about God Helmet.			and legs. Felt perineal sensations including 'energy' explosions. Right side more relaxed. Memories of Childhood. Saw himself in his father's workplace. Felt relaxed.	
7	NO FIELD - KNEW ABOUT GOD HELMET	Catholic	No expectations	Heard sound water, smell of roses, stomach growling. Saw sheep on green grass. Saw light shaped like stars and grey color.	Felt very well
11	FIELD OFF - NO KNOWLEDGE OF GOD HELMET	Atheist	No expectations	Felt nothing. Saw dots of light.	Felt well
12	FIELD ON - NO KNOWLEDGE OF GOD HELMET	Spiritualist; experienced meditator	No expectations. "Didn't know what it was about."	Arms growing, like when relaxed or meditating. Saw a skinny black dog running from the left to the right.	Felt good, in a meditative state. If had more time, would have entered in an altered state of consciousness.
17	FIELD OFF - NO KNOWLEDGE OF GOD HELMET	No specific religious beliefs; spiritualistic	No expectations	Felt sleepy	Felt well

Subjects with expectations before experimental session:

Subject number	**Field on or off** **Knew about God Helmet or didn't know**	**Religion**	**Expectations before experimental session**	**Experiences during experimental session**	**Experiences after experimental session**
2	FIELD ON - KNEW ABOUT GOD HELMET	Catholic	Expected "mind-altering" experience	Pressure on the right side of head; something physical; right ear throbbing slightly; light fatigue	Continued to feel the pulse

3	NO FIELD - KNEW ABOUT GOD HELMET	Catholic	Expected "something good"	Something moving in the right cheek; saw a metallic cylindrical tube go from him and leave tassels of yellow flowers	Felt well and light; thinks had a mild religious experience
4	FIELD ON - KNEW ABOUT GOD HELMET	Spiritualist	Expected an altered state of consciousness	'Someone' touched hands. Peace, Tranquility. Numbness in the body. Felt 'everything vanish'. Did not feel body, or time passing. Felt presence of a man standing on the right side.	Felt very well. Feeling peace, tranquility. If it took more time, would leave the body.
5	NO FIELD - KNEW ABOUT GOD HELMET	Tendency to spiritualism	Expected to be more relaxed	Heard noise like an aircraft twice. Felt a touch on both shoulders. Felt fear when hearing the sound.	Felt well, balanced, relaxed
8	FIELD ON - KNEW ABOUT GOD HELMET	Catholic. (priest)	Feared not reaching the objective he expected, which was leaving his body	Smell of perfume like talc. Saw colors black, grey and dark blue. Saw people dressed in white and grey. Saw black dogs and a chair.	Felt like he came back to earth; felt very well. Seemed like a dream.
9	NO FIELD - KNEW ABOUT GOD HELMET	No specific religious beliefs	Expected to leave the test feeling calm	Saw an ancient battle, armor, horses, swords, etc. Saw girl come from behind her. Saw her hair. Someone was threatening her. She ran, laughs, something real. Feeling afraid for her. Thought it was an actor. Felt it was something real. Involuntary muscle contractions.	Felt well

10	FIELD ON - KNEW ABOUT GOD HELMET	Catholic	Feared being disturbed by seeing something unknown	Smelled talcum. Tightness in the head. Saw man riding a bike falling; saw the side of a male face, ear very clear. Felt side, saw something moving from right to left. Felt afraid to see the man on bike. Heavy leg. Muddled thinking.	Felt calm
13	FIELD OFF - NO KNOWLEDGE OF GOD HELMET	No specific religious beliefs. Spiritualistic.	Having different sensations	Feeling like an electric current raging his body three times. Felt a pulse at the top of the head.	Felt well
14	FIELD ON - NO KNOWLEDGE OF GOD HELMET	Nonpracticing Catholic. Spiritualistic.	Feared feeling sick	Sweet flavor in the mouth, taste of fruits. Tingling in the scalp and running down to the face. Smell of sweet incense.	Felt more relaxed than when sitting in the armchair
15	FIELD OFF - NO KNOWLEDGE OF GOD HELMET	No specific religious beliefs; spiritualistic	Expected to have a different experience	Buzz in both ears. Smell of incense. Heavy hands. Mind pulsing in the rhythm of the heart. Forgot the reality.	Felt very well
16	FIELD ON - NO KNOWLEDGE OF GOD HELMET	No specific religious beliefs; spiritualistic	Expected something interesting	No specific flavor. Felt the head involved in energy. A little anxious for being blindfolded and not knowing what was happening.	Felt well; imagined that there would be another step in the test
18	FIELD ON - KNEW ABOUT GOD HELMET	Buddhist	Feared having a shock. Felt anxiety.	Relaxed quickly, felt claustrophobic, got some sleep	Felt well
19	FIELD OFF - NO KNOWLEDGE OF GOD HELMET	Atheist	Expected to be relaxed	Only felt the weight of the GH; almost slept	Very calm
20	FIELD ON - NO KNOWLEDGE OF GOD HELMET	Lutheran	Expected to feel better than before experimental session	Felt the body relaxing. Increase of the heartbeats. Anxiety. Heartbeats increased on entering in a	Felt well

				different state of consciousness. Reacted against and avoided the experience.	

Analysis

Subjects were grouped according to field (control or field on) and according to their expectations (no, n=6; yes, n=14). Both of these divisions proved fruitful. P<.10 was employed as the p value. All results given in the table (see Appendix 5) are significant at this level. One unit of measurement was the words spoken by the participants. There were 396 during the helmet administration and 141 after. The words used during the time that the helmet was connected, comprises two groups of persons: 1 - without expectations (6 persons) and 2 – with expectations (14 persons).

Effects of expectation on comments *during* the experimental sessions

	Subjects who reported expectations:
used words with lower concreteness	1.82 versus 1.99
used more common words	freq of 2588 versus 1550
used more abstract words	30.2% versus 20.6%
used words of a generally unpleasant emotional type	14.8 versus 7.4%
used a disproportionately high number of words	78% of the words, when only 70% of the participants belonged to this group

Effects of expectation on comments *after* the experimental sessions

	Subjects who reported expectations:
used more emotionally cheerful words	5.6% versus 0
used more emotionally nasty words	4.7 versus 0
used more passive words	31.8% versus 16.7%
used more concrete words	6.5% versus 0
used a disproportionately high number of words	80% when only 70% of the participants belonged to this group

Comparison of subjects with controls

Comments *after* the administration of the helmet

Predictably, in view of our use of 100 Hz pulses instead of complex magnetic signals, there were no statistically significant differences between the comments of those who received the field and those who did not during administration of the helmet. Differences between subjects and controls emerged in analysis of post-session comments. This is consistent with Dr. Persinger's findings and methods, which have emphasized post-session narratives (accompanied by a brief questionnaire), recognizing the tendency of subjects to dislike talk during the sessions. We questioned our subjects in the last two minutes of their sessions, when the tendency for subjects receiving a field to find verbal interruptions irritating (Freeman J,Persinger AM, 1996) would be at its maximum, but also when responses would have been most clear.

Those who received a field (Fields On)

used more common words	freq=2153 versus 666
used shorter words	4.35 versus 5.19 letters
used fewer passive words	21.8% versus 37.3%
used more abstract words	39.7% versus 21.8%
used fewer emotionally unpleasant words	3.9% versus 15.2%
used a disproportionately high number of words	60% when only 40% of the participants were in this group

The results reported here are significant at $p<.05$ with two exceptions of interest. The more trivial results are mentioned first.

Differences between the during-session and after-session conditions

Overall, people's language was more "pleasant" after the administration of the helmet than during it (2.02 versus 1.90). It should be mentioned that the language was generally "pleasant" in tone. The average pleasantness score for everyday English is 1.84.

Overall, people's language was more active during the administration of the helmet than after it (1.74 versus 1.56); it should be mentioned that the language was generally active in tone during the helmet session and generally less so afterwards. The average activation score for everyday English is 1.67.

Overall, people's language was more concrete (higher imagery) during the administration of the helmet than after it (1.75 versus 1.68), but also more concrete throughout, as the average imagery for everyday English is 1.53.

Overall, people said more during the administration of the helmet than afterwards (19.8 words per person versus 5.75).

Differences associated with field versus controls

Overall, people who were exposed to a field had more to say than controls (15.9 words per subject; 9.65 per control).

For words used after the helmet administration, those exposed to the field used fewer pleasant words (2.07) than did the controls (2.25). For words used during the administration, the two groups were equal (1.90; 1.92). Both groups used more pleasant words after the helmet administration, but the group not exposed to a field showed a greater increase in verbal pleasantness.

For those not expecting a result, language during the session was more abstract (lower imagery) under the field (1.69) than it was for controls (1.94). For those expecting a result, it was similar under field (1.74) and no field (1.75).

For those not expecting a result, concreteness (imagery) was higher during helmet administration (2.06) than after (1.66). Concreteness was similar for those expecting a result (1.79; 1.70).

Expectation by subjects was associated with some differences. The administration of a field led to (a) participants' talking more, and to (b) their using fewer pleasant words to describe their feelings after the administration, and to (c) their using more abstract language.

There were two effects for knowledge of the helmet (n=11) versus experimental naïveté (n=9) in combination with the field/no-field condition that differed from those of expectation. Those who knew about the helmet used more active language (1.679 versus 1.625) and more concrete language (1.829 versus 1.723) throughout than those who did not know about the helmet.

A small additional significant effect

The 4 subjects who mentioned some "fear" or "concern" in their expectations, the 6 cases with no expectation, and the 10 cases who expected positive or mind-expanding results constituted three additional subdivisions of our experimental cohort. This last group (positive expectations) used more abstract language than the other two groups (imagery of 1.693 versus 1.860 and 1.883).

Summary

For comments *during* the administration of the field, the language of those expecting an effect was less emotionally pleasant and more abstract (i.e., talking about feelings rather than things) than those who reported no expectations before the experimental session. For comments *after* the field, the language of those expecting an effect was more emotionally loaded and more concrete.

The language *during* the session did not differ significantly between those receiving the field stimulation and controls. The language of those receiving a field, collected *after* the experimental sessions, involved simpler, more common, and less passive words, with less negative emotional content than controls.

If we can interpret the results described above causally, the administration of a field caused participants to say more after their sessions and to become more abstract and less overtly pleasant in what they were saying.

Both expectation and field administration were associated with differences in verbal responses. "Field on" and control subjects' verbal responses collected after the experimental session differed significantly.

Both the field and expectation increased the number of words produced by participants in comparison to controls and those without expectations, respectively.

Table 2: Average (mean) number of words used before and after the session

Group	People	Words per person after	Words per person during
Control, no expectation	4	2.25	7.75
Control, expectation	6	8.33	21.5
Fields on, no expectation	2	11.00	23.5
Fields on, expectation	8	7.50	23.63

In Table 1, one can observe the effects of expectation, as well as the results for control subjects, on the number of words used by subjects in four different experimental conditions:

(1) Both the administration of the field and the subjects' expectations made them more verbose. In the absence of both of these, they had significantly less to say.

(2) Those expecting an effect displayed more abstract language during the administration phase and more concrete language after it. Their language retained an emotionally negative character.

(3) Those receiving a field used emotionally less negative language and simpler language to describe their experiences after their sessions.

(4) The differences in post-session verbal behavior between subjects and controls, as well as between those with expectations (which we consider the subjective correlate of suggestion) and those without, tends to support Persinger's conclusion that the effects of temporal lobe stimulation with moving weak magnetic fields cannot be attributed to suggestibility (St. Pierre, 2006).

Geomagnetic Factors

The experiments were conducted in Curitiba, Brazil, close to the center of the South Atlantic Anomaly (SAA), a region with significantly lower mean geomagnetic H values. However, geomagnetic storms and particle precipitation in the South Atlantic anomaly are stronger than those at respective middle and moderate latitudes of the northern hemisphere (Danilov, 2001). Global geomagnetic field strengths average from 30,000 (equatorial) to 60,000 (polar) nT. In contrast, geomagnetic field values in the SAA rarely exceed 20,000 nT. Further, this region is

subject to geomagnetic micropulsations (Macmillan, 2009), possibly arising from electron precipitation from the terminus of the Van Allan Belt, directly above the SAA (Trivedi, 2005). The amplitudes of one kind of geomagnetic turbulence, preliminary reverse impulses (PRI), within the SAA are about three times higher than those happening at tropical latitudes. PRI in the SAA have anomalously frequent occurrences and amplitudes in the SAA, "caused by the significant enhancement of ionospheric conductivity due to the weakness of the ambient magnetic field intensity in the SAA region" (Shinburi et al., 2010). Saboia and Marques (2005) found a further source of geomagnetic turbulence in the SAA's strong toroidal and poloidal geomagnetic salients, strong magnetic oscillations, and transitory reversed magnetic polarities in the area. They also noted magnetic torsional eddies and vortices, creating frequent transitory changes in local geomagnetic field strength.

The geomagnetic field within the SAA is about 1/3 weaker than the global geomagnetic field, allowing greater fluctuations in response to solar events, the ultimate source for variation in geomagnetic field strength. Persinger (1995) hypothesized that specific patterns of information appearing within the variable portion of the geomagnetic field that appear during times of elevated geomagnetic activity are responsible for these effects and not the field strength itself. In one study, Persinger (1995) found that elevated levels for the geomagnetic field that correlated with his recorded effects had occurred 12 hours before the subjects received complex magnetic field stimulation. The probability of such variations in the local geomagnetic field prior to our experimental sessions was very high. The neural processes generating the sense of self in those with enhanced temporal lobe lability can be disrupted by variations in magnitude of the geomagnetic field on the order of 1%. Within the normal population, the same can be expected from variations on the order of 3%. Within the SAA, these variations can be expected at rates exceeding once per day, as the region experiences its constant, low-intensity geomagnetic storms. Thus, our present experiments, carried out under conditions of global geomagnetic quiet, display phenomena expected during periods of elevated global geomagnetic activity. These results can be accommodated through Persinger's hypothesis that there is some particular frequency or pattern of information probabilistically associated with a narrow range of variation in intensity global geomagnetic activity (Persinger, 1995b), and the neural effects of global turbulence are approximated by the local turbulence within the SAA.

The variable portion of the earth's magnetic field constitutes about 10% of its total field strength. The enhanced geomagnetic activity that Persinger found to amplify certain effects of complex magnetic field occurs within this "amplitude band." Persinger (1998, 2004) has found that elevated geomagnetic activity, as distinct from higher field strengths, correlates with several phenomena that our subjects reported. These include the sensed presence (Booth, 2005) and decreased pleasantness of neural stimulation with complex magnetic fields (Persinger, 1998, 2004). The latter result agrees with our finding of less pleasant language from subjects than controls.

Discussion

The results of the tests specified herein are in agreement with the literature indicated in the initial topic entitled Antecedent Studies, on this article.

The application of the God Helmet can provoke the appearance of phosphenes, and it is possible that some of the images perceived by volunteers or participants resulted from iconicity.

Another aspect that should be noted is that while the number of volunteers under the effect of the magnetic field on the action referred to the perception of odors of perfume, talc, incense, roses etc., at least one of the volunteers with the magnetic field off felt something similar. The author of this article failed to ascertain the causes of this difference.

Granqvist et al. (2005), failing to replicate the results of Persinger's research, claimed that the latter's results were due to suggestibility and not magnetic fields. Persinger (2005a) replied that Granqvist's magnetic fields were distorted, preventing adequate replication. Persinger's re-analysis (St. Pierre, 2006) of 407 of his experimental subjects and results obtained showed that the specific configuration of the field patterns ("signals"), and not their suggestibility, predicted the subject's responses.

Our efforts tend to support the hypotheses that magnetic signals that are too weak to elicit neural activity through current induction can have marked effects on subjective experiences correlating with brain activity. This in turn supports Persinger's conclusion (2010) that weak, patterned, magnetic fields do not influence brain activity through current induction, but are instead attributable to interactions between fields from the Koren Helmet and endogenous magnetic fields within the brain ("field-to-field" interactions).

Persinger's pre-session suggestion (to maintain blind experimental conditions) is that subjects are about to participate in a relaxation experiment. Granqvist's et al. (2005) subjects "were informed that the project was about the influence of complex, weak magnetic fields on experiences and feeling states." This suggestion prevented blind conditions. However, no studies of low-intensity complex magnetic neural stimulation have been done without any suggestions to the subjects at all, and the present study is no exception. What we have done here is deliberately facilitate suggestion (expectation) by informing the subjects they were going to receive a session with the "God Helmet." This would allow its effects to dominate results from all control subjects if it were a determinative factor. Our results display a greater association between verbal reports and application of our magnetic fields than with suggestion and expectation (Table 2).

Conclusions

Our results were not as phenomenal as those reported by Persinger (2010). This can explained by our use of a 100 Hz signal instead of the complex magnetic signals used in his experiments, as well as our forgoing the use of a Faraday cage and acoustic chamber, as used in his studies (Persinger, 2001). Our results suggest that the stimulation has effects without them, although our effects appeared in observations made after, and not during, the experimental sessions. Our results have a precedent in Baker-Price's studies, which found a reduction in depression in head-injury patients (Baker-Price et al., 1996, 2003) with complex magnetic signal neural stimulation.

These studies included six-week follow-up of the subjects, and their reported effects did not include responses gathered during the stimulation.

Telling subjects that they were going to receive sessions with a God Helmet prior to the experimental sessions allowed us to test whether suggestibility determined the outcome of the experiment. Allowing subjects to know about the God Helmet constituted a deliberate suggestion, not attributable to *inadvertent* experimenter bias (none of Persinger's subjects, outside those whose experiences were published as case histories, had any knowledge of the God Helmet).

We obtained quantitative measures for the effects of suggestibility and expectation, as well as for subjects and controls. The present study, partially replicating Persinger's procedures and results, supports the contention that our results and those reported in Persinger's research publications are attributable to the fields and their configurations, not to suggestibility (see Table 2). Suggestibility played a role, but not enough to account for our results. We look forward to further experiments in this field.

The author believes that the tests he performed replied, in a way, those performed by Michel A. Persinger and colleagues. Another point that must be highlighted is that, by all indications, the tests performed by the author indicate the direction of the influence of expectations of volunteers in the results of the tests.

Therefore, the author believes that their results point, in fact, in two directions: 1- tests indicate, in part, a replication of the researches of Persinger and colleagues; 2- tests described here also point to the influence of expectation of the volunteers on the test results. Thus, the conclusion that can be taken is that more researches, more testing, with a larger number of volunteers, should be made.

The research was conducted in Curitiba, Brazil, in the Integrated Center for Experimental Research-CIPE (Centro Integrado de Pesqisas Experimentais). The design for this research was approved by the Ethics Committee from Group Uninter, according to the statement 172/2010, dated 06 August 2010. The authors wish to express our thanks to Dr. Cynthia Whissel for her contributions to the analysis of our data. Reprint requests should be directed to: Carlos Alberto Tinoco, Centro Integrado de Pesqisas Experimentais, Rua Tobias de Macedo Jr. 246. Santo Inácio,Curitiba-Pr, Brazil ZP:82010-340

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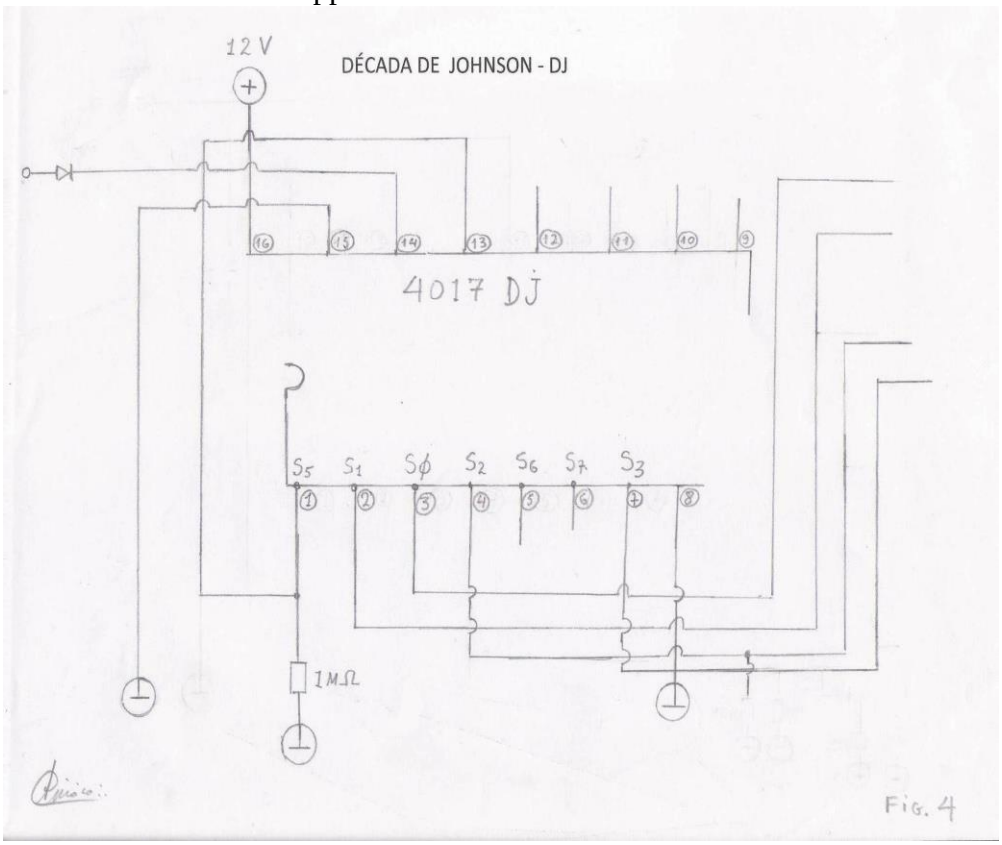
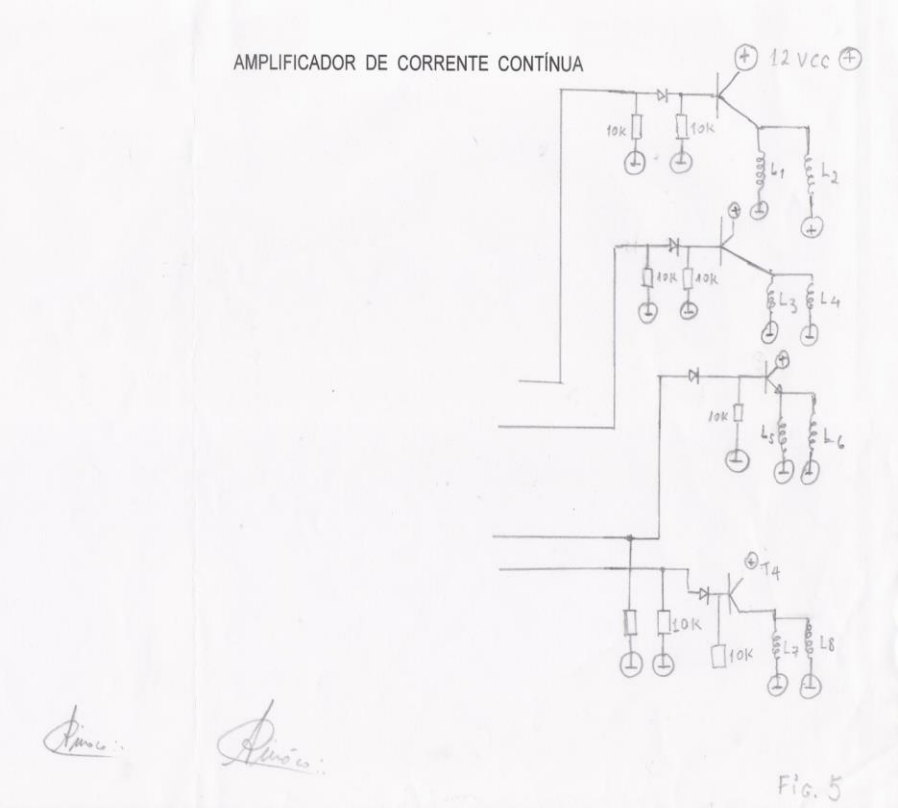
Appendices

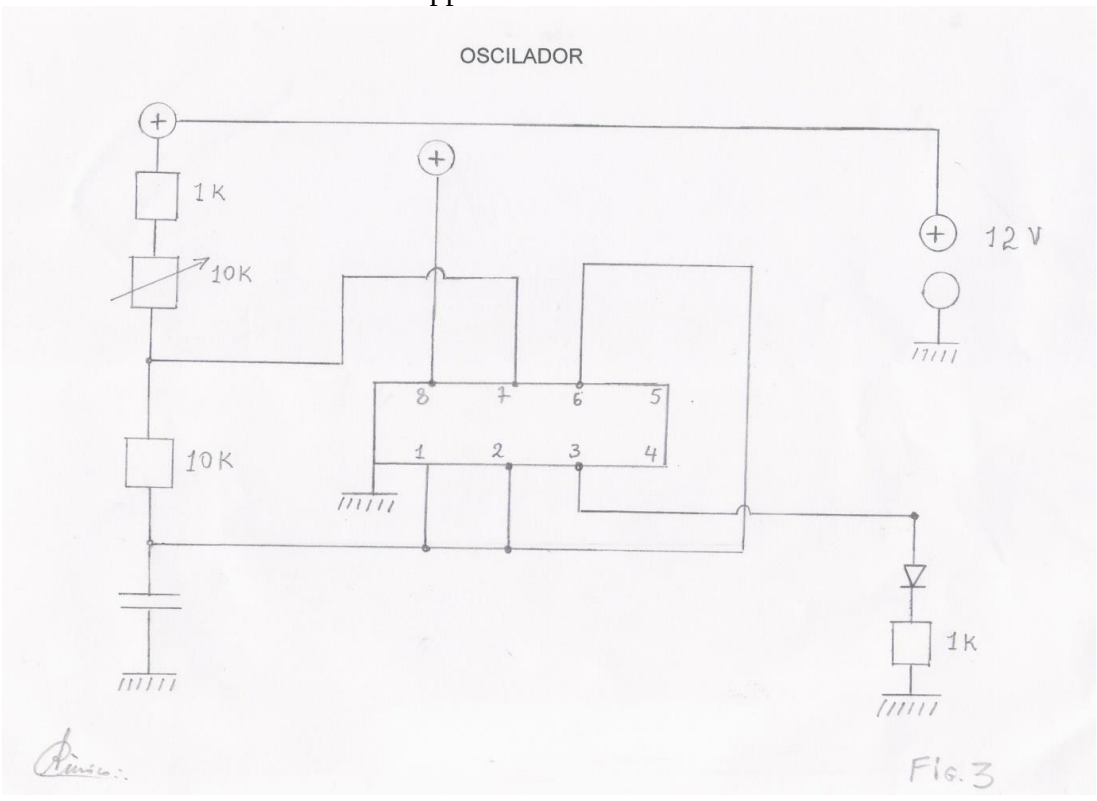
Appendix 1: Jonhson-DJ Decade



Appendix 2: Current Amplifier



Appendix 3: Oscilator



Appendix 4 (Questionnaires)

1-Questionnaries:

a) Model of questionnaire to be applied by the responsible researcher, on the twenty volunteers, before the research (sign with an X):
1-Are you anxious? Yes….. No….. Indifferent…..
2-If anxious, on which degree?
Very anxious….. Anxious….. A little anxious….. No anxiety…..
3-What do you expect to happen to you during the Research? (Describe):
4-If you fear something, what is it? (Describe):
5-What do your relatives – siblings, parents, uncles, etc. – think about the Research? (Describe):
6-What is your greatest fear? (Describe):
7-What is your positive expectation? (Describe):
8-Do you trust on the person responsible for this Research? (Sign with an X):
Yes….. No….. Indifferent…..
9-If yes, on which degree? (Sign with an X):
Very much….. Much….. Normal….. Little….. Very little….. Any…..
10-In case your expectancy is little, very little or any, do you still want to proceed with the Research?

b) Model of questionnaire to be applied on the twenty patients, one at a time, during the research:
1-How are you feeling now? (Sigh with an X):
Excellent….. Very good….. Well….. Regular….. Bad….. Terrible…..
2-Do you hear something? (Ask to describe, from which side, what king of sound, etc.):
3-Do you feel any flavor? (Ask to describe):
4-Do you feel any kind of odor? (Ask to describe):
5-Do you feel any kind of touch? (Ask to describe, where and how):
6-Are you seeing anything? (Ask to describe, from which side, the color, etc.):
7-Are you feeling some kind of emotion? (Ask to describe):

c) Model of questionnaire to be applied by the responsible for the research, on the twenty volunteers, after the tests:
1-How are you feeling now? (Describe):
2-In case positive, on which degree? (Sign with an X):
Great….. Very Well….. Well….. Regular…..
3-In case negative, on which degree? (Sign with an X):
Tolerable….. Bad….. Terrible…..
4-Would you undergo another test, after this one? (Sign with an X):
No….. Yes….. Indifferent…..
5-Did you have some kind of religious experience? (Describe):
6-Was it an important experience?
Yes….. No….. Indifferent…..
7-In case positive on which degree? (Sign with an X):
Amazing….. Very important….. Important….. Indifferent…..
8-In case negative, on which degree? (Sign with an X):

Terrible….. Very bad….. Bad….. Tolerable….. Indifferent…..
9-Describe, briefly, how was the test for you. (Describe):