Research

ELECTROPHYSIOLOGICAL PROPERTIES OF HUMAN OCULAR EXTRAMISSION

by Colin A. Ross, M.D.

ABSTRACT

The author presents evidence supporting the hypothesis that human ocular extramission, the emission of brain waves through the eye, can be detected using qEEG equipment or two-channel neurofeedback equipment. A high-impedance electrode housed inside electromagnetically insulated goggles was employed that makes no physical contact with the body and is about two centimeters in front of the pupil. Readings were taken with two-channel biofeedback equipment and with a qEEG The waveform of ocular extramission is physiologically active compared to the reading from a control electrode suspended in space in front of the goggles: it is similar to the waveform of frontal leads in overall structure and in the appearance of eye blink and muscle artifact in the tracing, combined with an absence of heart artifact. The waveform for a control electrode showed only consistent high-frequency, low amplitude background and heart beat artifact. It may be possible to study a variety of disease states by recording ocular extramission, using a high-impedance non-contact electrode.

Keywords: Ocular extramission; non-contact electrode; remote detection of EEG

INTRODUCTION

It has been accepted in western science at least since John Locke published his *Essay Concerning Human Understanding* in 1690, that human visual perception is a passive process: photons enter the eye, but no energy of any kind is sent out through the eye.[1] In a series of papers, Winer and colleagues differentiate two theories of vision: *intromission,* which is endorsed by western science, and *extramission,* which is rejected by western science.[2-4] Winer and colleagues are dismayed that a substantial number of college students believe in the extramission theory, and they call for better science education in an effort to correct this erroneous belief. There are three elements to extramission theory, all of which are rejected by Winer: 1) there is an emission of some kind from the eyes 2) the emission interacts with objects in the outside world, and 3) this emission plays a role in visual perception.

Maloney, Schrodinger and Toulmin agree with Winer that no energy beam of any kind emerges from the eyes.[5-7] Toulmin states that:

> *If we prefer, we can think of the phenomenon of sight as the Greeks did, regarding the eye not as a kind of sensitive plate, but as the source of antennae or tentacles which stretch out and seize on the properties of the object it surveys.*
>
> *For to say "light travels" reflects the nature of reality, in a way which "his eyes swept the horizon" does not, is to point to the fact that the latter remains at best a metaphor. The optical theory from which it came is dead. Questions like "What sort of brooms do eyes sweep with?" and, "What are the antennae made of?" can be asked only frivolously. The former does more: it can both take its place at the heart of a fruitful theory and suggest to us further questions, many of which can be given sense in a way which the questions suggested by "His eyes swept the horizon" never can.*

I hypothesized that there is partial validity to the extramission theory of vision: extramission and intromission need not be mutually exclusive models.[8] I hypothesized that human ocular extramission is composed of electromagnetic radiation in the same frequency ranges as the general field that emerges through the skull. Recent developments in sensor and amplifier technology have made it possible to detect the electrocardiogram remotely at a distance of one meter, and the electroencephalogram at a distance of two millimeters.[9-13] Since the electromagnetic field of the brain emerges through the skull and is detectable remotely, I predicted that human ocular extramission can likewise be detected remotely.

Because ocular extramission does not have to pass through the skull, I predicted that it has greater amplitude than the general field emerging through the skull. The amplitude might also be increased by the geometry of the skull, the presence of the optic nerve terminal at the retina, and conscious focusing and attention. The question of whether ocular extramission has any physiological function is a separate question from whether a detectable signal emerges through the eyes. Any hypothesized functions of ocular extramission cannot be investigated until a measurable, objective extramission signal has been detected.

METHODS

TWO-CHANNEL NEUROFEEDBACK EQUIPMENT

In order to test the hypothesis that a detectable EEG signal is emitted through the eyes in a manner that could be replicated by investigators with neurofeedback equipment, I used an Atlantis II biofeedback unit and its accompanying software purchased from www.brainmaster.com. I used standard gold-plated Ag/AgCl electrodes purchased from the same site, except for the high-impedance electrode used to detect ocular extramission

The high-impedance electrode consisted of a planar array fabricated using custom silicon-based printed circuit techniques. The multi-electrode array had a single 235 um shank, 15 um thick, with 64 sites arranged on the shank. The multi-electrode array was then bonded to a printed circuit board with a Samtec connecter. The 64 sites on the Samtec connector were then shorted with solder and attached to custom EEG cables, effectively making the multi-electrode array one single electrode of 64 distinct contacts with a collective site size of (64 x 177 μm^2) = 11,328 μm^2. Impedance of the electrode in physiological saline was 30 kiloohms. Impedance of the electrode in air was not taken, but is assumed to be in the giga-ohm range.

The high-impedance electrode was placed on the inside of the right lens of a pair of goggles: the electrode was mounted such that it was about two centimeters in front of the right iris of the test subject, a 59-year old Caucasian male. In order to obtain sufficient electromagnetic insulation to be able to detect a signal, the right front lens of the goggles was covered with multiple layers of aluminum foil and copper wire mesh. A ground electrode was placed on the left mastoid: for Channel 1, a reference electrode clip was placed on the right ear lobe and the active electrode was inside the goggles. For Channel 2, a reference electrode clip was attached to the left earlobe and the active electrode was placed above the right eyebrow at Fp2. Nine 3-second readings were taken from both channels with eyes closed, and nine 3-second readings from both channels with eyes open. During all readings the participant's facial musculature was still. Significance was set at $p < .05$.

qEEG Equipment

Data was collected utilizing 21 channels of a Deymed Truscan 32 channel clinical EEG system. An Electro-Cap, Lexicor surgical style cap was used for collection of 19 channels in a 10/20 electrode placement with a linked ears reference. The additional two channels, also with linked ears reference, were used for the goggle electrode and a free hanging electrode placed approximately two centimeters in front of the goggles. The goggle electrode was located in front of the right eye below FP2. The free hanging electrode was held in place by two cotton tip applicators that had been taped together and then taped to the top of the goggles, extending the electrode forward and hanging freely in front of the goggles. Data was collected for approximately 7.5 minutes in both eyes closed and eyes open, resting states. The goggle electrode is labeled POz and the free hanging electrode Fpz.

Results

The results of the recordings using neurofeedback equipment are reported in greater detail elsewhere.[9] At Fp2, in delta, the amplitude was 4.23 µV (SD 1.02) with eyes open and 3.82 µV (SD 0.64) with eyes closed, which was not significant. At Fp2, in alpha, the amplitude was 4.01 µV (SD 1.49) with eyes open and 6.63 µV (SD 2.03) with eyes closed, $t(16)= 3.12$, $p <.007$. In the ocular extramission, in delta, the amplitude was 8.46 µV (SD 4.89) with eyes open and 3.73 µV (SD 1.65) with eyes closed, $t(16)=2.75$, $p <.02$. In the ocular extramission, in alpha, the amplitude was 5.48 µV (SD 3.16) with eyes open and 3.32 µV (SD 1.78) with eyes closed, which was not significant. Amplitude was greater with eyes open in the ocular extramission than at Fp2 in all frequency ranges sampled (1-42 Hz).

In the qEEG, the waveforms of ocular extramission (POz), the control electrode (Fpz) and the standard scalp locations are shown in Figures 1 and 2. The EEG recording samples reveal that the goggle electrode (POz) is showing the same EEG patterns as Fp2 with what appears to be a slight difference in amplitude. In addition, the EEG artifact and eye blinks seen at Fp2 do not appear to register as strongly in the goggle electrode labeled POz. The free hanging electrode shows what appears to be cardiac activity either from the earlobes or the chest and artifact noise from the surroundings. There is an absence of the signal that is seen in either the goggle electrode (POz) or Fp2. This allows the conclusion that the goggle is recording a true EEG signal.

Discussion

The results of the recordings demonstrate that an electromagnetic signal emerges from the eyes, that it has greater amplitude than the field emerging through

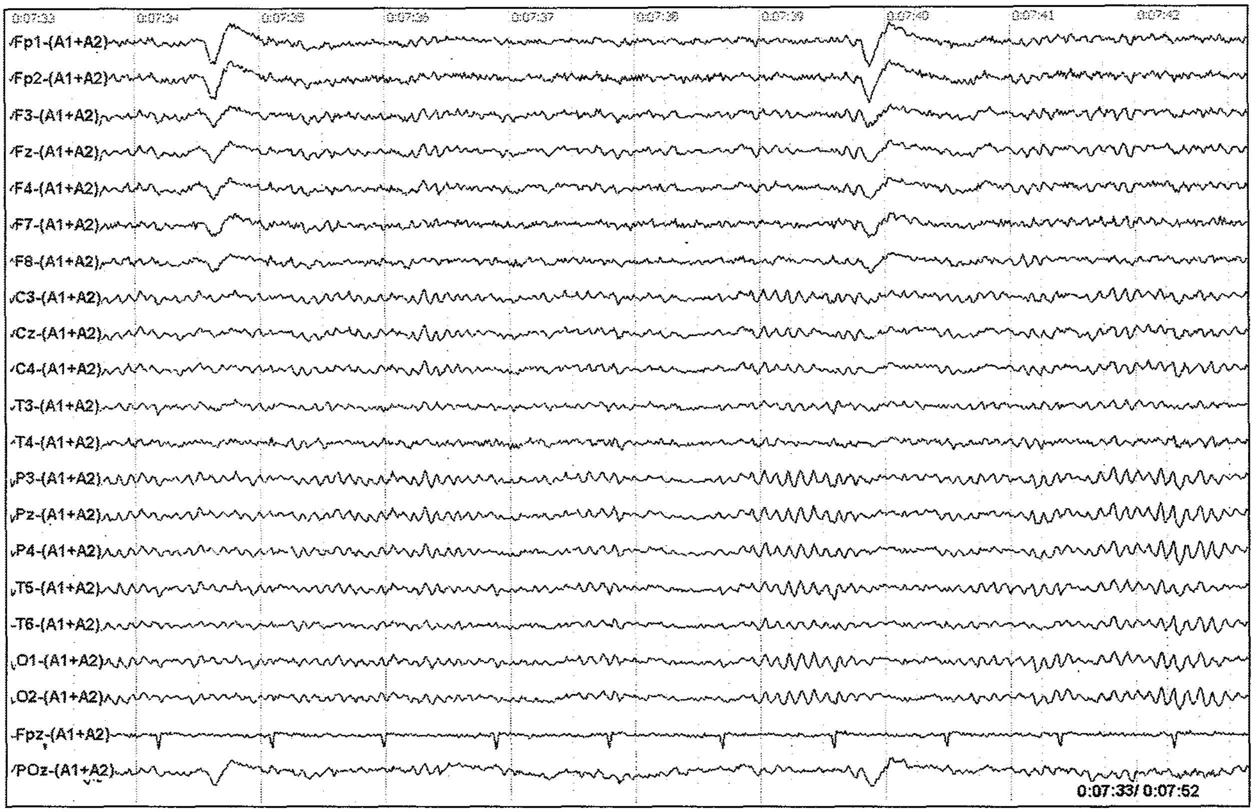

Figure 1. A Sample Epoch with Standard qEEG Electrodes A Non-Contact Ocular Extramission Electrode (POz) and a Control Electrode (Fpz)

the skull, and that it has distinct electrophysiological properties compared to the signal read by an electrode at Fp2. The ocular extramission demonstrates reversed blocking in delta, for instance, and no alpha blocking, while conventional alpha blocking and no delta blocking are observed at Fp2. Alpha blocking is well recognized in the neurofeedback literature and can be detected remotely using high impedance electrodes that make no physical contact with the person.[10-13] The waveform of human ocular extramission resembles that of other frontal leads and is distinctly different from the signal detected by a control electrode suspended in space in front of the electromagnetically insulated goggles.

Taken together, these findings demonstrate that a physiological EEG signal can be detected at two centimeters in front of the eye using a high-impedance electrode that makes no physical contact with the body. Since the electromagnetic field of the brain can be sensed remotely, and since ocular extramission has greater amplitude and distinct electrophysiological properties from the signal at Fp2, it might be possible to capture ocular extramission and use it as the target in neurofeedback protocols.[14] It might also be possible to study the characteristics of the extramission signal in a variety of disease states. For instance, it would be of interest to know the characteristics of ocular extramission in macular degeneration, multiple sclerosis, blindness, individuals with enucleation of an eye, epilepsy, various psychiatric disorders including conversion blindness, tumors of the occipital cortex, and coma. It would be of interest to know whether auditory and visual evoked potentials can be captured in the extramission signal.

One might think that ocular extramission could not be detected at more than a very short distance due to

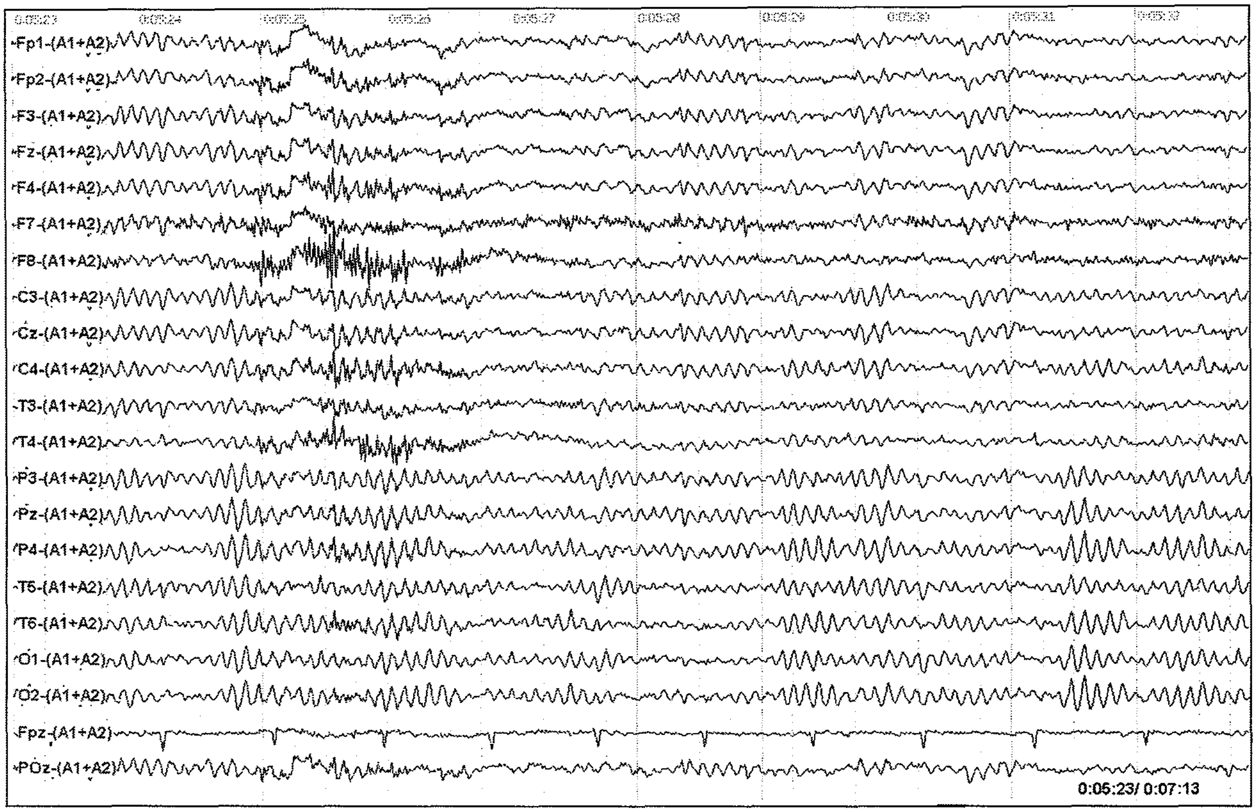

Figure 2. A Second Sample Epoch with Standard qEEG Electrodes A Non-Contact Ocular Extramission Electrode (POz) and a Control Electrode (Fpz)

the inverse square law, according to which the power density of any electromagnetic signal decreases with the square of the distance. However, this does not apply to extra-low frequency radiation in the range sampled by neurofeedback equipment. Barr, Jones and Rodger state that, "In the lower ELF field, the attenuation suffered by globally propagating electromagnetic waves is extraordinarily small.[15] It amounts to only 0.3 dB/1000 km at 10 Hz, increasing with frequency to 1 dB/1000 km at 60 Hz." Decibels (dB) is the unit for attenuation. For all practical purposes, the attenuation of ocular extramission at ecologically relevant distances is negligible.

One might also consider the possibility that the signal being detected is not really coming from the brain, but either from the retina or the eyeball. Conventionally, electroretinography involves stimulating the retina with light in order to trigger release of photons by the retinal tissues:[16] since the ocular extramission in the present study is detected in complete darkness inside goggles, the mechanism of conventional electroretinography cannot be contributing to the signal. Even if there is a small contribution from the retina, however, that would not alter the fact that there is an extramission signal.

Additionally, one might argue that since EEG equipment detects an electrical potential difference between an active electrode and a neutral reference electrode, the eye electrode is not detecting an actual emission through the eyes. This cannot be true because if there was no signal then the eye electrode could not detect a varying potential difference and the software could not generate a waveform. The fact that the extramission signal is transduced and registered as an electrical potential difference between two points does not imply that there is no electromagnetic field emitted into external space by the brain.

In general, it could be useful to be able to gather a screening EEG waveform with a single non-contact electrode that did not require contact paste or an EEG technician. Garguilo et al. have recently demonstrated that a passive dry electrode system can yield a waveform similar to standard contact electrodes.[17] It appears that an equally good waveform can be detected without any direct contact by the active electrode. Such a recording could be made by nursing or other staff and stored in a flash drive or transmitted to a computer through a secure wireless connection for later analysis by a physician.

Ultimately, it may be possible to take a full scalp EEG with non-contact electrodes housed in a standard cap or helmet, or even a hand-held device, thus dispensing with the need for paste and difficulties obtaining low enough impedance readings at individual electrodes. Based on the results reported here, such technology could be as sensitive as current contact electrodes. Other potential applications of ocular extramission detection technology are described in Ross and in the patent for an electromagnetic beam detection device on the US Patent Office web page.[8,18]

Additionally, electromagnetic ocular extramission provides a potential mechanism for the sense of being stared at.[19-22] Human skin can capture photons and use them to activate physiological processes such as melanin production and vitamin D synthesis; the retina can capture photons and transduce them into electrical signals in the optic nerve; and plants can capture photons in order to synthesize chlorophyll. Therefore it is possible that there are receptors in the skin that can detect human ocular extramission. Now that a potential signal has been identified, further studies can investigate the hypothesis that ocular extramission provides a mechanism for detection of staring.

The theory of human energy fields proposes that detection of electromagnetic ocular extramission was selected for during evolution in predator-prey interactions.[8] An animal that could detect a predator's stare, even if only subliminally, could take evasive action and increase its chances of survival. The prey's sense of danger, impending death and general malaise may have been culturally transformed into evil eye beliefs according to which a sorceress or witch doctor can cast evil spells by staring at a target with malevolent intent.[9] These hypotheses can now be investigated scientifically because a measurable mechanism is available for future study.

Conclusion

It is possible to detect human ocular extramission at a distance of about two centimeters in front of the eye using a high-impedance non-contact electrode housed inside electromagnetically insulated goggles. The waveform of the extramission signal closely resembles that at Fp1 and Fp2 using qEEG equipment and has distinct properties from the signal at Fp2 using a two-channel biofeedback system. The extramission waveform is distinctly different from that of a control electrode suspended in space in front of the goggles. It will be of interest to study the properties of ocular extramission in a variety of disease states, and also potential roles it may play in evil eye beliefs and other anthropological phenomena.

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