

Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience

Reflexology and Its Effect on the EEG

J. A. Putman ^{a a} & M. Sunde ^b

^a EEG Spectrum , Los Angeles, USA

^b Touch Therapy Institute , Encino, California, USA

Published online: 20 Oct 2008.

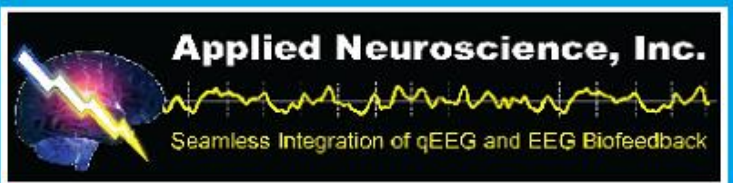
To cite this article: J. A. Putman & M. Sunde (1999) Reflexology and Its Effect on the EEG, Journal of Neurotherapy: Investigations in Neuromodulation, Neurofeedback and Applied Neuroscience, 3:2, 36-41, DOI: [10.1300/J184v03n02_05](https://doi.org/10.1300/J184v03n02_05)

To link to this article: http://dx.doi.org/10.1300/J184v03n02_05

PLEASE SCROLL DOWN FOR ARTICLE

© International Society for Neurofeedback and Research (ISNR), all rights reserved. This article (the "Article") may be accessed online from ISNR at no charge. The Article may be viewed online, stored in electronic or physical form, or archived for research, teaching, and private study purposes. The Article may be archived in public libraries or university libraries at the direction of said public library or university library. Any other reproduction of the Article for redistribution, sale, resale, loan, sublicensing, systematic supply, or other distribution, including both physical and electronic reproduction for such purposes, is expressly forbidden. Preparing or reproducing derivative works of this article is expressly forbidden. ISNR makes no representation or warranty as to the accuracy or completeness of any content in the Article. From 1995 to 2013 the *Journal of Neurotherapy* was the official publication of ISNR (www.isnr.org); on April 27, 2016 ISNR acquired the journal from Taylor & Francis Group, LLC. In 2014, ISNR established its official open-access journal *NeuroRegulation* (ISSN: 2373-0587; www.neuroregulation.org).

THIS OPEN-ACCESS CONTENT MADE POSSIBLE BY THESE GENEROUS SPONSORS



Reflexology and Its Effect on the EEG

J.A. Putman and M. Sunde

The authors gratefully acknowledge Siegfried Othmer and EEG Spectrum for their generous support in carrying out this project and their unwavering determination in bringing the field of neurofeedback onto the forefront of mainstream healthcare.

Introduction

Reflexology is an ancient wholistic healing technique that has been practiced for centuries by many diverse cultures around the world although there is some controversy as to where and when it originated. The oldest documentation depicting the practice of reflexology was discovered in Egypt. A pictograph showing two men working on the feet of two other men was discovered around 2500-2330 BC in the tomb of an Egyptian physician, Ankmahor. Another theory holds that foot reflexology was passed down to the American Indians by the Incas. One American Indian tribe- the Cherokee Indians of North Carolina- can attest that they have, for centuries, acknowledged the importance of feet in maintaining physical, mental and spiritual balance. (Dougans, 1991) And although there is no conclusive proof, the prevailing view is that reflexology originated in China and came into existence about the same time as acupuncture around 5000 years ago. (Wagner, 1987)

Reflexology's basic premise is that specific reflex points on the feet, hands and ears correspond to the glands, organs and systems of the body and when stimulated, the body's natural healing capabilities are engaged. All the organs, glands and other parts of the body are laid out in the same arrangement on the feet as 'reflections/ reflexes' of the parts of the body. A reflex is an involuntary or unconscious response to a stimulus. In reflexology, when the reflexes on the feet are stimulated, an involuntary response is elicited in organs and glands

connected by energy pathways to these specific reflexes. (Dougans, 1991)

When pressure is applied to certain points on the feet, electrochemical nerve impulses are activated, forming a 'message'. This message passes through 'afferent neurons' to a ganglion (a collection of nerve cells and fibers which form an independent nerve center outside the spinal cord and the brain). The message then passes from the ganglion via 'efferent neurons' to the specific organ, which will then respond. The nerve impulses initiated by pressing reflex areas on the feet might then link into the autonomic nervous system, which is primarily concerned with the involuntary action of internal organs, muscles and glands. The goal of reflexology is to trigger a return to homeostasis by inducing deep states of relaxation. To quote Avi Grinberg in "Holistic Reflexology": "The truly successful treatment is not the one that saves the person from a condition that is in its advanced stage, but one that prevents its development into a serious or chronic condition." When the body is relaxed, circulation can flow unimpeded and supply necessary nutrients and oxygen to the cells leading to organ healing and a return to a normal state of functioning. Eunice Ingham, one of the first and most famous practitioners of reflexology stated that, "Circulation is life. Stagnation is death."

Reflexology takes the importance of circulation a step further. The concept of energy channels is the central point around which the practices of reflexology and acupuncture are based. Both hold to

the belief that vital energy is channelled along various lines throughout the body. In acupuncture, the lines are referred to as meridians; in reflexology they are often called zones. Both assert that disease is caused by blockages in these lines of energy and so treatment involves restoring a state of energy flow through the stimulation of various points for the purpose of clearing any obstructions. In acupuncture, points all over the body are stimulated by the use of needles. Reflexology concentrates only on the reflex areas and sections of meridians found on the feet which are stimulated by a specific massage and finger pressure technique. When congestions are cleared, energy is able to flow unimpeded and a state of healthy balance is restored. The energy that flows through these lines is known as "ch'i" or life-force. The Chinese were the originators of the concept of ch'i believing that it circulates in the body in much the same way blood or lymph does. This vital life-force controls the workings of the main organs and systems of the body. For each organ to maintain a perfect state of health, the ch'i energy must be able to flow freely along the meridians. Iona Marsaa-Teergurden describes meridians as containing "a free-flowing, colourless, noncellular liquid which may be partly actuated by the heart."

Persons who have been treated with reflexology describe it as having profound mood altering effects. (The authors have both experienced this directly.) In addition, there is often a reported increase in a person's overall energy and level of arousal when treated with reflexology as well as with other "hands-on" therapies, such as massage. The descriptions from persons who have undergone reflexology sound very similar to the experience of alpha or SMR training. This lead to speculation about how these reported changes in mood and arousal brought about by this hands-on technique would manifest in the EEG, particularly, over the somatosensory cortex.

There appears to be a topographical relationship between pressure and touch receptors

on the body and the location of corresponding sensory neurons in the thalamus and the somatosensory cortex. The more sensitive to touch a particular part of the body is, the more densely packed the cortical area devoted to coding the stimuli originating from that surface receptor area. (Schneider & Tarshis, 1980) In humans a disproportionate amount of the cortex is devoted to sensory input from the lips, tongue, hands and feet. Although the impulses from the touch and pressure receptors are projected onto the surface of the cortex, the cells that encode these sensations are mostly below the surface. Pressure felt in the foot is encoded not only at the surface of the cortex but also in a column of cells extending down into the cortex. (The cortical "surface" area for the foot is actually located inside the fissure between the left and right hemispheres). Since sensory input is projected onto both cortical and thalamic regions, it would seem probable that there would be some record or manifestation of pressure and touch in the EEG.

In addition to the mechanics of touch, there is also the "intent" - a loving caress vs. an accidental brush, for example, where the former would tend to bring the limbic system into the transaction and the latter would not.

Since neurofeedback and reflexology appear to bring about some similar changes in mood and arousal, it is possible that there may be some common mechanisms of regulation and control that are being engaged by both techniques. This leads to further speculation (by Siegfried Othmer and the authors) as to the possible synergistic effect of using reflexology as an adjunct to neurofeedback. This issue will not be addressed in this small scale pilot study however. The scope of this paper will be limited to exploring what changes occur over the cortex at C3 and C4 during the course of a single reflexology session for the purpose of suggesting possible directions for future research into developing more inclusive treatment regimens that take advantage of existing alternative treatment techniques.

Method

Subjects

The subjects were 13 adults, male and female, aged 23-63. This was not a random sample but rather a sample of convenience composed of colleagues and friends who had at least some familiarity with biofeedback and meditation. 12 of the subjects had never experienced a reflexology session.

Physiological Measures

EEG Spectrum in Los Angeles provided the EEG biofeedback equipment: the Biointegrator, an 8 channel multi-modality biofeedback system manufactured by the Bio Research Institute. The system uses a battery operated encoder (4 AA 1.5 volt nickel-cadmium batteries) with a fiber optic cable for data stream transmission (The ProComp from Thought Technology). Note that although we were using biofeedback equipment, it was used strictly for measurement purposes. The EEG sampling rate was set at 200 per second. The raw signal was fed through a sliding window with EEG analysis performed using fast Fourier transforms. The EEG measures observed were amplitude, power, relative power and percent synchrony. Percent synchrony is defined as the percentage of time the phasing of two independent generators is within 45 degrees of one another. Note that according to this definition, an increase in % synchrony doesn't necessarily imply anything about coherence although they are certainly related since they both involve neural timing. For example: 2 generators might be locked in phase with a phase difference that is greater than 45 degrees in which case % synchrony would be 0 even though the signals would be coherent. Conversely, the phase relationship could be changing in any manner and % synchrony would be 100 as long as the phasing of the two signals is within 45 degrees. Each frequency band is comprised of frequency bins that are .78 Hz wide. % synchrony is represented by the highest value frequency bin for that band, as opposed to an

average of all bins. This holds for the amplitude measure as well. Bandwidth examined were theta (3.5-7.4 Hz) alpha (7.5-12.1 Hz) and Beta (12.2-42Hz) with subsequent band redefinition for the purpose of examining trends in narrower bands.

Non-EEG measures were temperature, skin conductance, heart rate and EMG. The purpose of including these additional measurements was to obtain a more comprehensive picture of how the person was responding physiologically. The EEG does not give a clear indication of sympathetic nervous system activity where temperature, skin conductance and (to a lesser extent) EMG do. These measurements were used primarily to determine the level of discomfort experienced by the subject. The severity of discomfort would determine the degree of change observed in the physiological substrates of the fight-flight response- specifically, increases in SCR and decreases in peripheral temperature (EMG had to be eliminated early on because it was too cumbersome for the reflexologist to navigate around all of the sensor wires.) EEG artifacts were observed in the amplitude measure. Artifact clipping was not used in this case as we were not doing actual biofeedback and therefore the subject was not being rewarded for anything false. Silver/silver chloride electrodes were used. The electrode hookup was 2 channel with placement at C3 and C4 since this is the region where sensory input is registered. Ground and reference (common) were placed on the ears. Temperature probes were placed on left and right index fingers, SCR placed on second and third fingers of the left hand and the heart rate photosensor was placed on any one of the remaining fingers. Five or more minutes of baseline activity was recorded with eyes closed.

Reflexology Procedures

The reflexologist (M.S.) began the session with gentle massaging of the foot and lower leg with the actual reflexology portion following shortly after. The hands were used in a complimentary fashion where one provided support and braced

while the other performed the manipulations. Pressure was applied primarily by the thumb on the sole of the foot with the index and third fingers providing leverage. The reflex areas of both left and right feet were alternately massaged from toes to heel. Although the reflexologist followed a certain basic pattern (moving from the left foot-lower leg to the right and back again), she was strongly guided by her perception of the needs of the individual subject with respect to their level of discomfort. The average duration of the session was 45 minutes.

Results

Of the 13 persons who participated, 11 had useable data. Of these 11, 10 showed significant increases (>20%), over the course of the entire "hands on" portion of the session in one or more of the following measures: % alpha synchrony, alpha amplitude, % theta synchrony and theta amplitude. (3 subjects had increases in one measure, 5 had increases in two, 1 had an increase in three and 1 had an increase in four). Only one person had no increases (see table 1). However, there didn't appear to be any compelling differences between the post session baseline and the initial baseline.(There was a rather precipitous drop in these measures at the start of the reflexology after which all measures would begin a slow climb back up to baseline). All increases in amplitude were bilateral and those persons who experienced the least amount of pain had the smoothest increasing trends in alpha and theta amplitude. In all but one subject, alpha at C3 was slightly and consistently higher than alpha at C4. Additionally, holding or gentle massage of a part of the foot or leg (as opposed to painful manipulation) was sometimes followed by a temporary increase in the % alpha synchrony. But these changes were not consistent from one person to another. This response occurred approximately 50 percent of the time when the reflexologist would begin working on a new area. At first it was thought that this inconsistency was due to the subjective experience of each individual in that what was experienced as pleasureable by one person was

subtly distressing to another. A decision was made to examine the corresponding changes in temperature and SCR, figuring that this would aid in separating out "unpleasant touches" from the "pleasant" ones. Unfortunately, this only made the results more contradictory and confusing.

However, one of the most interesting findings involved changes immediately following baseline when the reflexologist would begin with gentle touching and massage. Of the nine subjects who were artifact free during the 5 minute baseline, seven showed a moderate to sharp drop in amplitude and/ or % synchrony in both alpha and theta shortly after the hands on portion of the session began (figure 1). This was not a grounding problem either as any surplus charge passing from the reflexologist through the subject's body would have caused a transient spike in potential. This response has been reported by other clinicians as well, where physical contact by the therapist can sometimes cause a desynchronizing of the slow wave activity. High amounts of theta and alpha activity are certainly expected when the eyes are closed and the mind is adrift and unfocused. So when touch is initiated, attention becomes narrowed and focused upon the sensory input coming in from the surface receptors. And since we were measuring at C3 and C4, where sensory input is registered, we would expect to see a desynchronization of the slow wave activity in that region.

Discussion

Probably the most interesting result of this descriptive study that explores instrumentation in assessing the effect of alternative therapy, is the fairly consistent drop observed in alpha-theta amplitude, and to a lesser extent % synchrony, following the initiation of gentle touch. It is generally accepted that physical affection plays some kind of vital role in stimulating the brain in such a way that it creates a medium conducive to healthy neural development. Perhaps healing touch creates an atmosphere of cortical stimulation that

exercises mechanisms involved in future cognitive development by causing them to regularly desynchronize the EEG at the low end of the spectrum. Children (as well as adults) are compelled to attend to sensory input coming in from their touch sensors. This may help lay the groundwork for attending to other forms of stimuli. These very preliminary findings may suggest that one of the ways in which healing touch improves functioning is through sensory activation of the mechanisms (involving projections from the reticular formation onto the thalamic nuclei perhaps) that deal with desynchronizing alpha and theta brain wave activity in the cortex.

Additionally, the fact that there was such a very tight correlation in the changes observed at both EEG sites would seem to imply activation of subcortical loops, as there are no cortical connections across the midline. The sites C3 and C4 were chosen more for historical reasons than anything else and so for all intents and purposes in this context, the choice was arbitrary. (i.e. We were not doing biofeedback which by definition involves rewarding for desired activity produced at a particular site whether through thalamic loops, cortical loops or local recruitment.) Thus, the changes observed were likely taking place globally. (Although it certainly would have been nice to have used a 19 channel instrument to verify this through a QEEG.)

Although an overall pleasant and energizing experience, reflexology is not without its discomfort. Sometimes pressure applied to areas of myofascial injury may cause pain which can range from mild discomfort to extreme pain. In some

persons it takes a great deal of manipulation and pressure to cause pain where as in others, mild touching is as all that is required to cause excruciating pain. This being so, a particularly sensitive person may have a mild to pronounced increase in their sympathetic nervous system activity upon being touched in a vulnerable area. Although all of the volunteers had their own unique responses to different aspects of the reflexology treatment itself, they all reported feeling deeply relaxed and clear headed following the treatment. This collective response illuminates the central flaw in this study: persons do not generally undergo these treatments solely for the purpose of having their trigger points or energy meridians manipulated (which may be pleasureable or painful), but rather to achieve a higher more efficient level of psychophysiological integration. These physically manipulative treatments serve to break up blocked or congealed energies allowing the reorganization processes involved in healing to take place afterwards without effort. Perhaps a better way of conducting a study such as this would be to examine the EEG over the course of several reflexology sessions with instrumentation that could provide multiple site monitoring and track long term trends in coherence and phase - generally thought to be more important measures of neural communication than amplitude. Also, data collection following a reflexology session would avoid the sometimes colossal difficulties inherent in combining a hands-on technique with delicate measurements involving many wires.

Please see the table on the next page for an overall review of the results.

Table 1

Subject	Alpha amplitude	Alpha % synch	Theta amplitude	Theta % synch
1	+	0	+	0
2	0	0	+	+
* 3	+	+	+	+
** 4a,b	0,+	0,0	0,0	+,0
5	0	+	0	0
6	+	0	+	0
7	0	0	+	0
8	+	0	0	0
9	+	+	+	0
10	0	0	0	-
11	+	+	0	0

* subj 3 fell asleep at midpoint
 ** subj 4 (a- without thyroid hormone, b- with thyroid hormone)

References

Chan, P. (1975). *Finger Acupressure*. Ballantine Books. Toronto, Canada.

Dougans, I. (1991). *Reflexology: Foot Massage for Total Health*. Element Books Inc., Rockport, MA.

Grinberg, A. (1989). *Holistic Reflexology*. Thorsons.

Ingham, E. (1951). *Stories the Feet Have Told Through Reflexology*. Ingham Publishing.

Maraa-Teegurden, I. (1981). *Handbook of Acupressure II*. Ginseng du Foundation.

Schneider, A.M. and Tarshis, B. (1980). *Physiological Psychology: Somesthetic Senses*. Random House Inc. NY, NY.

Wagner, F. (1987) *Reflex Zone Massage*. Thorsons.

John Putman is a licensed psychotherapist and certified biofeedback therapist affiliated with EEG Spectrum in Los Angeles. His educational background includes an M.A. in Clinical Psychology, a B.A. in Mathematics and an M.S. in Electromedical Science. Mr Putman has consulted widely with other professionals on computerized biofeedback systems.

Merle Sunde began her professional career in reflexology over two decades ago. She is a Certified Reflexologist and is currently an instructor at the Touch Therapy Institute in Encino, California. Ms Sunde's knowledge and understanding include other 'mind-body' therapies such as acupressure, color therapy, aromatherapy, Reiki and visualization.

Address all correspondence to: John Putman 1710 N. Fuller Ave #507 Hollywood, CA 90046 or e-mail to JPutman905@aol.com.