EEG Event-Related Spectral Signatures associated with Psi-conducive States

Thomas F. Collura, Ph.D., P.E
BrainMaster Technologies, Inc.
Oakwood Village, OH

Norman S. Don, Ph.D.
Kairos Foundation and the The University of Illinois Chicago
Wilmette, IL

SHORT ABSTRACT

This report describes the results of an analysis of EEG recorded from a high-scoring subject on a series of tasks associated with psi states. EEG was recorded during a forced-choice, five-response task. Using offline analysis of the EEG, it was possible to identify a spectral signature that was found ($p < 0.001$) when the task was performed at an above-chance level. The details of this signature will be shown, and implications for neurofeedback training of associated states will be discussed.
Key words: EEG, Event-related potentials, Psi states

LONG ABSTRACT

This report describes the results of an analysis of EEG recorded from a high-scoring (S) subject on a series of tasks associated with psi states. EEG was recorded during a forced-choice, five-response task. Event-related EEG was recorded over an 8000 millisecond epoch prior to each response, from 5 EEG channels, one EOG channel, and one EMG channel. Using offline analysis of the EEG, it was possible to identify a spectral signature that was found ($p < 0.001$) when the task was performed at an above-chance level. Bonfonerri-corrected t tests were used to determine the frequency bands that were significantly larger for correct versus incorrect responses. Interchannel correlations were also computed, and found to higher (mean of 0.89) for correct responses than for incorrect responses (mean of –0.02). The event-related spectral signature was found to show significantly higher energy in motor strip, at the following frequencies: 13, 18, 19, 24, 32, 36, 37, 39, 43, 46, 48. All t tests were significant at the level $p < 0.001$ at these frequencies. An engineering analysis of these frequencies and their associated amplitudes suggests that when correct responses were forthcoming, the subject was producing bursts of EEG with a center frequency near 40 Hz, and at a rate of 6-7 bursts per second. This is consistent with the concept that a 40 Hz "binding" rhythm is being produced, and that this rhythm occurs in bursts at a rate near the low alpha or high theta range.

METHOD & RESULT

EEG was recorded during a forced-choice, five-response task. Event-related EEG was recorded over an 8000 millisecond epoch prior to each response, from 5 EEG channels, one EOG channel, and one EMG channel. Using offline analysis of the EEG, it was possible to identify a spectral signature that was found ($p < 0.001$) when the task was performed at an above-chance level. Bonfonerri-corrected t tests were used to determine the frequency bands that were significantly larger for correct versus incorrect responses. Interchannel correlations were also computed, and found to higher (mean of 0.89) for correct responses than for incorrect responses (mean of –0.02).

SPECTRAL SIGNATURE

The event-related spectral signature was found to show significantly higher energy in motor strip, at the following frequencies: 13, 18, 19, 24, 32, 36, 37, 39, 43, 46, 48. All t tests were significant at the level $p < 0.001$ at these frequencies. An engineering analysis of these frequencies and their associated amplitudes suggests that when correct responses were forthcoming, the subject was producing bursts of EEG with a center frequency near 40 Hz, and at a rate of 6-7 bursts per second. This is consistent with the concept that a 40 Hz "binding" rhythm is being produced, and that this rhythm occurs in bursts at a rate near the low alpha or high theta range.

SUMMARY

These findings suggest that there is a particular EEG event or process associated with successful performance of a Psi task. This state is characterized by a particular type of 40 Hz rhythm, and has a unique spectral signaturesuggesting a rate of between 6 and 7 bursts per second. This suggests the possibility of using neurofeedback to develop the ability to recognize, and produce, these states.

IMPLICATIONS FOR NEUROFEEDBACK

Under the proposed model, it might be possible to detect and feed back EEG signals associated with psi-conducive states by delivering positive (reward) feedback when the EEG exhibits a pattern of harmonic activity, for example, the presence of 7, 14, 21, 28, 35, 42, … Hz peaks in spectral power. This model provides a specific experimentally derived rationale for using this type of EEG reinforcement, for the development of psi-related abilities.
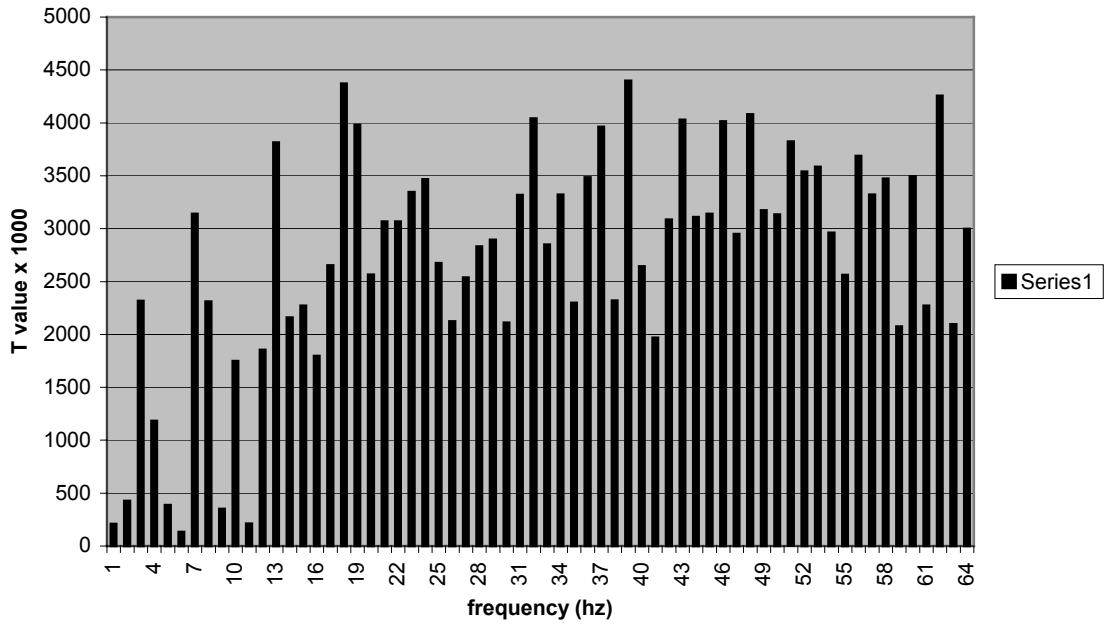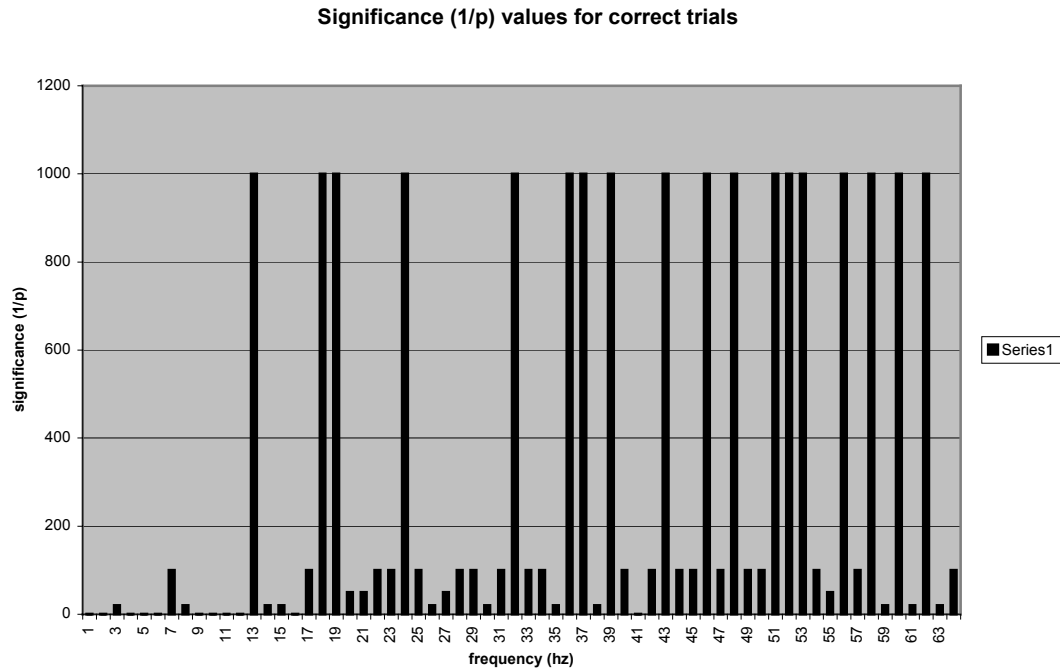
ILLUSTRATIONS

Expected frequencies from 6-7 Hz Rate Model
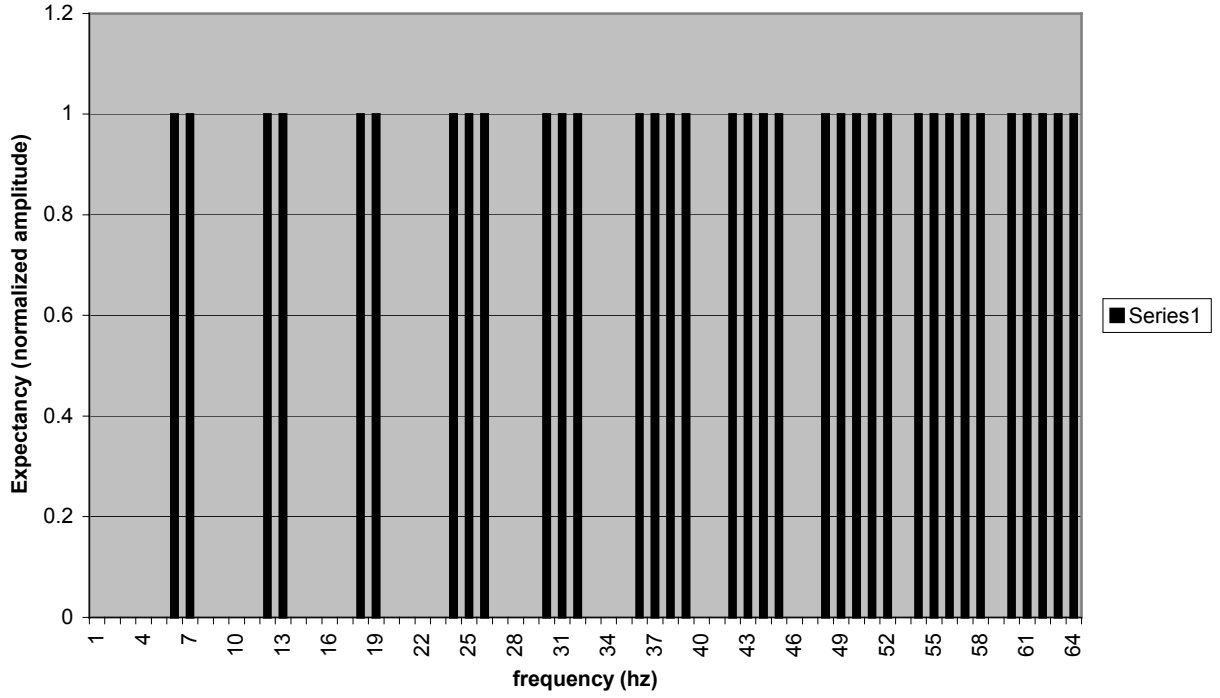
X

T values (x 1000) for correct trials

Significance (1/p) values for correct trials

REFERENCES

Collura, T.F. (1987) "A Transient-Event Model for EEG Power Spectra," Proc. 40th Ann. Conf. on Engrg. in Med. & Biol., Niagara Falls, NY., Sept., 1987, 247.

Don, N.S., Warren, C.A., McDonough, B.E., and Collura, T.F. (1987) Event-Related Brain Potentials and a Phenomenological Model of Psi-Conducive States, Research in Parapsychology, Matuchen, NJ: Scarecrow Press.

Don, N.S., Warren, C.A., McDonough, B.E., and Collura, T.F. (1988) State Specificity and Psi Testing, Proceedings of the Parapsychology Association, June, 1988