Effects of Repeated 11 Hertz Entrainment on the EEG

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While effects of audio-visual stimulation (AVS) on the EEG have been reported since the early 1930s, it has not been until recently that researchers have begun to investigate means of incorporating such interventions into clinical practice. Although still sparse, research efforts are beginning to show promise. As noted by Montgomery, Ashley, Bums, and Russell (1994), several case studies have demonstrated enhancement of cognitive as well as muscular systems through the use of AVS.

Purpose

The purpose of this study was to examine the effects of 11-Hertz entrainment on the EEG pattern of a normal adult. Interest was whether or not AVS at 11 Hertz would produce immediate and long term changes in the high alpha rhythm (10-12Hz), a rhythm known to be associated with relaxation.

Subject

The subject of the study was a 23-year-old, married, Caucasian female with no history of psychiatric difficulties or head injuries. She was a high school graduate with one year of post-secondary technical training. One month prior to intervention, the WAIS-R was used to assess the subjects level of intellectual functioning. Full Scale, Verbal, and Performance IQ scores were found to be within the average range.

Method

In order to obtain a baseline level of high alpha prior to initiating AVS, five separate ninety-second EEG assessments were conducted, at various times, over the course of a one week period. The subject was then administered fifty ten-minute entrainment periods over the course of two months. EEG assessment occurred after the first, tenth, twentieth, thirtieth, fortieth, and fiftieth entrainment periods. Each EEG assessment protocol consisted of a ninety second EEG recording of 45 two second epochs. At least 20 two second artifact-free epochs were selected for quantification. The EEG was assessed prior to entrainment, and at zero minutes, five minutes, ten minutes and fifteen minutes post entrainment. This design allowed the EEG to be examined immediately prior to entrainment and for 15 minutes afterwards. In order to assess the stability of the EEG in the absence of audio-visual stimulation, assessments were conducted between the twenty-fifth and twenty-sixth entrainment periods and one week subsequent to the fiftieth entrainment period All entrainment periods and assessments were conducted with eyes open. The subject was instructed to remain stiff and quiet during these sessions and asked to casually focus on a given object without exhibiting a fixed stare.

Instrumentation

Assessments were conducted using the Autogenics A620 EEG Feedback System. A monopolar technique was utilized with both earlobes serving as reference with the active located at Cz. Entrainment conditions were administered with the PolySync Pro photosonic stimulation system. Stimulation parameters were programmed as follows:

Volume:50	Intensity: 50
Tone:Single	Frequency: 11 Hertz
Phase:Focus	Duty Cycle: 5
Pitch: FSL	Time: 10 Minutes

Figure I illustrates baseline high alpha levels as well as the previously mentioned assessment periods both with and without AVS. As can be seen, high alpha is relatively constant during the baseline period, ranging from 79.81 picawatts to 119.16 picawatts. The assessment periods following AVS show consistent increases in magnitude of the high alpha bandwidth. The one exception was phase three. In this phase, high alpha magnitude was unusually greater during pre-assessment relative to other pre-assessments. Following AVS there was a decrease in high alpha magnitude. It should also be noted that during those assessment phases in which no AVS was administered, *high alpha* levels remained relatively constant. Also note that with only one exception, the magnitude of high alpha during baseline did not change from session to session. This indicates there was no long term changes in the high alpha bandwidth across the entrainment sessions.

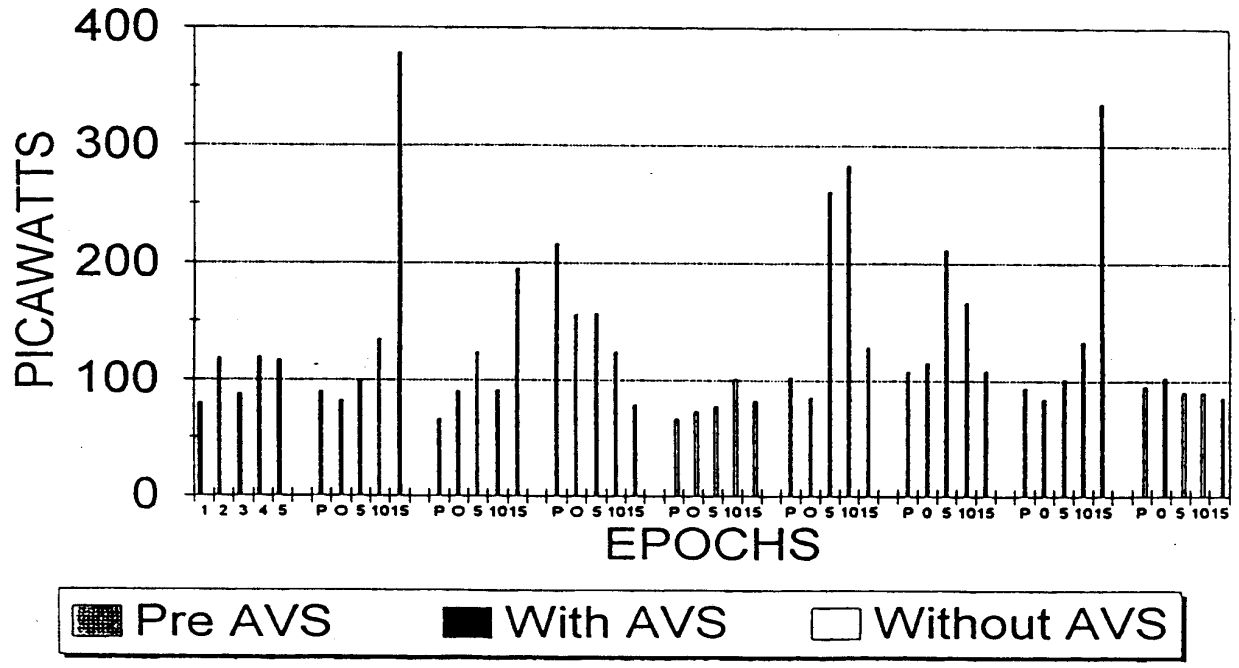

Figure 1: High Alpha Magnitude

Theta, low alpha, SMIk, and beta were also monitored for changes following AVS. As can be seen in Figure 2, the differences between pre-AVS, no AVS, and AVS are less marked and more variable in these bandwidths than in high alpha.

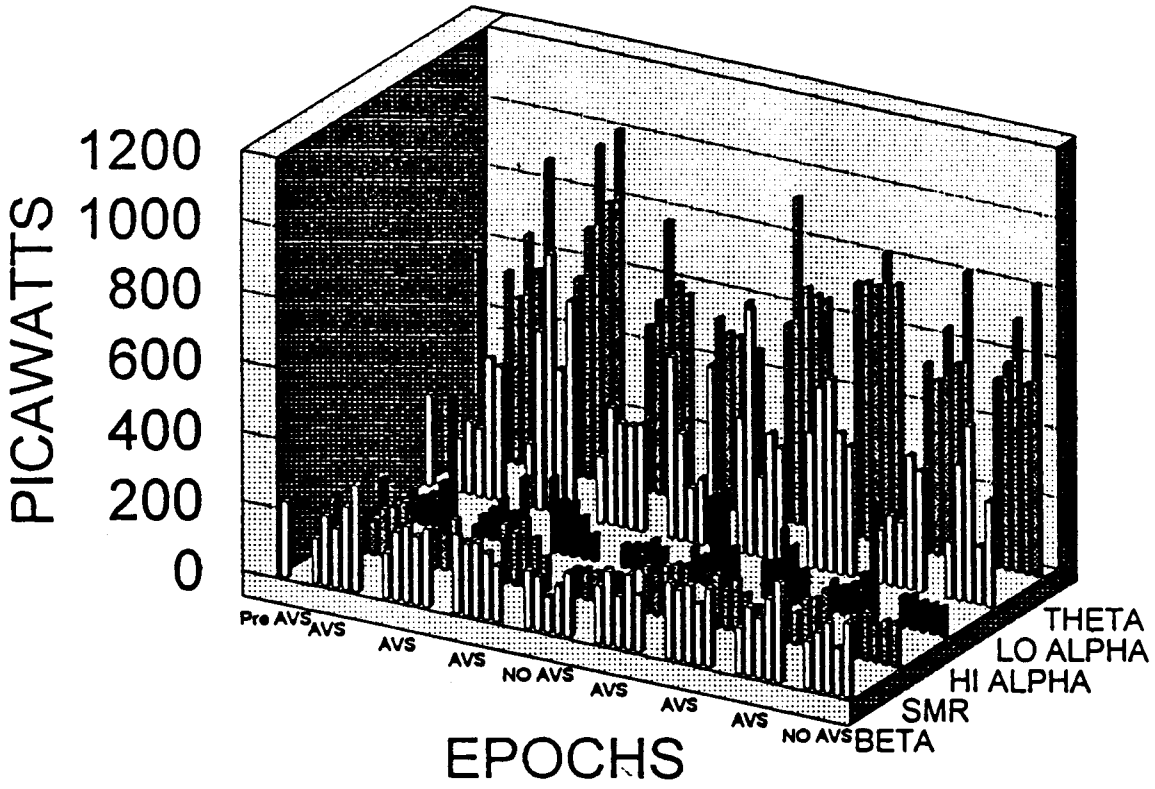

Figure 2: Magnitude of All Bandwidths

Discussion

Findings of the study clearly demonstrate immediate changes in the EEG following entrainment, especia0y in the bandwidth of the AVS frequency. It appears that lower initial levels of high alpha increase following I I hertz entrainment; whereas, greater initial levels of high alpha decrease following I I hertz entrainment. In addition, such changes do not seem to be permanent but rather temporary in nature. In nearly every case, pre-assessment high alpha was consistent with baseline levels thereby suggesting that changes in the EEG do not carry over from session to session.

Wide positive implications for the use of entrainment in the clinical setting may be taken from this study, findings are limited and must be interpreted as such. Not only was this a

single case design, but conditions were very specific in nature. For example, the subject was assessed and administered AVS under eyes-open circumstances. Findings may not generalize to conditions where experimentation is carried out under eyes-closed circumstances. In addition, entrainment was provided at a frequency of I I hertz. Results may vary dramatically at other AVS frequencies. Finally, while effects of entrainment do not appear to be permanent in nature, data suggests that some changes may last longer than fifteen minutes following the discontinuation of AVS. Specifically how long is unclear from this study. Future research will need to address these issues before conclusions can be made regarding the use of such interventions in clinical practice.

Reference

Montgomery, D. D., Ashley, E., Bums, W. J., & Russell, H. L. (1994). Clinical outcome of a single case study of EEG entrainment for closed head injury. Proc. Assoc. Applied Psychophysiology. and Biofeedback, 25, 92-83.

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