

Frequency domain EEG source locations during arm levitation under hypnosis: a pilot study.

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Introduction

Hypnosis, an altered state of consciousness, may involve a variety of brain mechanisms depending on the used suggestion (Gruzelier 1996, Rainville et al. 1999). The present pilot study assessed differences in brain electric activity between willful and hypnotically induced motor activity. We investigated the difference of brain electric activity during a simple task, i.e., while an arm was voluntarily raised and while the same arm was levitated (involuntarily) under hypnotic suggestion. An EEG source localization approach was used for data analysis.

Method

P.W. (a psychiatrist with extended experience in hypnotherapy) used hypnotic suggestions on 4 right-handed subjects (1 male, 3 females) to induce a left arm levitation. Before and after hypnosis, the subjects were asked to raise their left arm willfully (control condition). 27-channel EEG was continuously recorded from the following scalp locations (10-20 System): Fp1/2, Fpz, F7/8, F3/4, Fz, Fc1/2, T7/8, C3/4, Cz, Cp1/2, P7/8, P3/4, Pz, Po3/4, O1/2, Oz.

Artifact-free 2-second epochs were identified off-line (81 ± 19.2 epochs per subject). The intracerebral 3-dimensional gravity centers of brain electric activity (source localization in the frequency domain) were computed for 7 independent frequency bands (cf. Table 1) via FFT dipole approximation (single phase modeling, Lehmann & Michel, 1990) and subsequent, conventional dipole fitting (single source modeling), yielding the coordinates of the intracerebral locations of the brain electric gravity centers (sources of EEG frequency bands) on the inferior-superior, anterior-posterior and left-right brain axes of a standard head. For each frequency band, two-tailed paired t-tests ($N=4$ subjects) were computed between the hypnosis and the control condition.

Results

The t-tests revealed significant differences between the hypnosis condition and the control condition for the delta, alpha1, beta1 and beta2 frequency band source gravity centers. Under hypnosis, the source gravity center was more posterior for the delta band ($p<.038$), more left for the alpha1 band ($p<.029$), more anterior for the beta1 band ($p<.013$) and more right for the beta2 band ($p<.029$). In addition, there was a tendency ($p<.065$) for the gravity center under hypnosis to be more posterior for the theta band.

Conclusions

The results indicate that hypnotically induced arm levitation as compared with willed arm raising is associated with a shift of the gravity center of inhibitory brain activity (generators of delta EEG frequency) to more posterior areas (supporting Rainville et al. 1999), and a shift of excitatory brain activity (generators of beta-1 EEG frequency) to more anterior areas. Thus, movements under hypnosis appear to involve anterior brain regions more than normal movements, and to disengage posterior regions. Other hypnotic suggestions might well engage other areas, as a function of the suggested action (e.g. Gruzelier 1996, Rainville et al. 1999). Unfortunately the present data could not be used to review the putative hemispheric differences of hypnotic states because only left arm movement data were available.

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References

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Table 1: The EEG frequency bands

delta	: 1.5 - 6 Hz
theta	: 6.5 - 8 Hz
alpha1	: 8.5 - 10 Hz
alpha2	: 10.5 - 12 Hz
beta1	: 12.5 - 18 Hz
beta2	: 18.5 - 21 Hz
beta3	: 21.5 - 30 Hz

Source Location of the EEG Frequency Bands

