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ENHANCED HYPNOTIC SUGGESTIBILITY FOLLOWING APPLICATION OF BURST-FIRING MAGNETIC FIELDS OVER THE RIGHT TEMPOROPARIETAL LOBES: A REPLICATION

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The suggestibility of normal, young men and women was assessed by Spiegel's Hypnosis Induction Profile (HIP) before and after weak (1 microTesla), burst-firing magnetic fields were applied for 20 min over either the left or over the right temporoparietal lobe or both hemispheres; a fourth group received sham treatment. Only the group that received the stimulation over the right hemisphere exhibited a marked increase in suggestibility (eta = 0.58) following the treatment. These results replicate components of several different previous experiments and suggest that attribution of symptomatic changes following exposures to weak, extremely low frequency magnetic fields, to placebo effects may not be correct. Instead, fields whose signatures contain biorelevant information may directly affect the neurocognitive processes that are associated with hypnotizability.

Keywords: Hypnosis; burst-firing; magnetic fields; right hemisphere; brief durations; human

Direct interaction between neurocognitive activity and (externally) applied, time-varying magnetic fields has been hypothesized to require very weak energies if the information within the applied pattern is neurobiologically relevant or resonant with the functional networks of cortical organization (Jacobson, 1994; Liboff, Williams, Strong & Wistar, 1984; Schiff, Jerger, Duong, Chang, Spano & Ditto, 1994). Homogeneous application of time-varying magnetic fields within brain space should be a less than optimal procedure because many neurocognitive processes are hemispherically lateralized or probabilistically

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distributed within specific cortical regions. Field parameters that enhance the unique asymmetry of a neurocognitive activity should also enhance its effect upon both overt behaviors and subjective experiences (Persinger, 1995 a,b; Richards, Persinger & Koren, 1994).

However the types of subjective experiences and the magnitude of alterations in medical symptoms that follow brief exposures to these weak, complex, magnetic fields are also prone to placebo effects (Macklis, 1993) that are influenced by the innuendo of the context and the expectancies of the patient or subject. Although many researchers have assumed that the changes that follow brief exposures to extremely low frequency magnetic fields are due exclusively to either placebo effects or to experimenter biasing, a third possibility exists. Specific, complex patterns of weak, magnetic fields may *directly* enhance the neurocognitive processes that are strongly associated with suggestibility (Persinger, 1996; Tiller & Persinger, 1994). The subsequent elevation of hypnotizability following the application of exogenous magnetic signals within brain space would amplify the impact of subtle stimuli from the environment or experimenter (particularly within the clinical settings) upon the subject or patient. This experiment offers evidence to support this critical differentiation.

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METHOD

Subjects

A total of 48, right handed, university men and women (ages 19 through 21 years) volunteered for an experiment about relaxation; they were not familiar with the experimenter.

Procedure

Each subject was tested singly. On the day of the experiment, the subject sat in a comfortable chair that was housed within an acoustic chamber. The standardized Hypnosis Induction Profile (HIP), as described by Spiegel and Spiegel (1978), was administered by an experienced professional. The resultant score ranges from 0 to 10 and is derived from different, qualitatively conspicuous behavioral responses to instructions.

Goggles were then placed over the eyes of the subject and a modified motor cycle helmet was placed over the head. Along both sides of the helmet four small solenoids were embedded in an elliptical pattern (major axis: 7.5 cm; minor axis: 5 cm) such that the magnetic field maximally penetrated through the temporoparietal

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regions of the subject's brain. After the helmet had been placed, the experimenter left the room and closed the door. All subjects were exposed to the same burst-firing pattern (Richards, Persinger & Koren, 1993) from the same program that was presented for 1 sec every 4 sec by a personal computer, for 20 min. This particular pattern simulated one example from the class of "burst-firing" signatures that are generated by aggregates of limbic neurons. Each successive voltage point or pixel was 3 msec and there were a total of 230 successive points. The field pattern was rotated (by a commutator external to the chamber) to each of four pairs of solenoids once every 2 sec (0.5 Hz spatial rotation). Other characteristics of the equipment and the rationale for this presentation has been described previously (Richards, *et al.*, 1993).

A subject received only one of four treatments: 1) sham field (no activation of field), 2) field over the left temporoparietal region, 3) field over the right temporoparietal region, and 4) bilateral application of the field over the left and right hemispheres within this region. The different geometries were applied by activating or deactivating switches on the helmet that determined the delivery of the magnitude (but not the rate) of current to the solenoids. The field strength over the activated hemisphere was 10 to 50 mG (1 to 5 microT) while the strength over the non-stimulated side was about 1/10 this value. At the end of the exposure the goggles were removed and the HIP was readministered to each subject; the subject then left the experimental area.

The difference between the second and the first administration of the HIP as well as the proportion of change (second HIP—first HIP, quantity divided by the first HIP) served as the indicators of change. The basic design was a two way analysis of variance (4 treatments and 2 sexes). All analyses involved SPSS software on a VAX 4000 computer.

RESULTS

Two way analysis of variance demonstrated no statistically significant differences between gender [$F(1,40) < 1.00$, $p > .05$] or imminent treatment conditions [$F(3,40) < 1.00$, $p > .05$] for the first Hypnosis Induction Profile scores. The grand mean and standard deviation were 5.6 and 2.3, respectively. However, two way analysis of variance for the absolute change in the HIP score demonstrated statistically significant differences between the treatments [$F(3,40) = 7.36$, $p < .001$; eta = 0.58]; there were neither statistically significant sex differences [$F < 1.00$] nor an interaction between sex and treatment [$F < 1.00$]. Similar treatment differences were noted for the proportional change in suggestibility as a function of treatment [$F = 6.10$, $p < .01$; eta = 0.53].

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Post hoc analyses (Tukey's set $p < .05$) demonstrated that the only source of this difference was due to the marked increase in suggestibility for the subjects who received the right hemispheric stimulation relative to the groups that received either the sham field, left hemispheric application, or bilateral application; they did not different significantly from each other. Figure 1 (left panel) displays the means and standard deviations for the second HIP scores after each of the four treatments. The right panel shows the percent change in the HIP scores, relative to pretreatment HIP scores, for each of the four treatments; again, *post hoc* analysis indicated that the major source of the difference was due to the increased hypnotizability after the complex pulsed field had been applied over the right hemisphere.

DISCUSSION

The results of this study were similar to those of previous reports that employed slightly different paradigms (Tiller & Persinger, 1994). However the effect size, as predicted, was larger when wave signatures that are associated with opioid-like responses (Fleming, Persinger & Koren, 1994) were applied. The results clearly

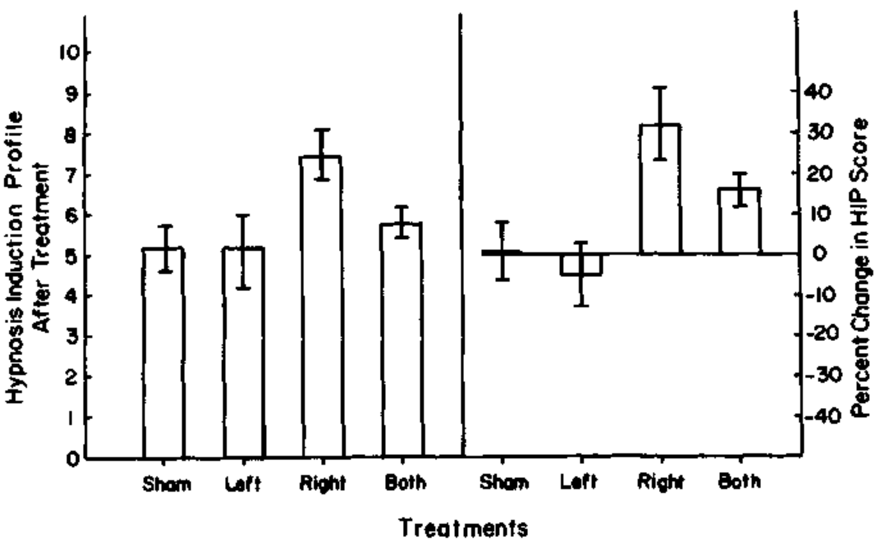

FIGURE 1 Means and standard deviations (left panel) for the Spiegel's Hypnosis Induction Profile (HIP) after 20 min exposure to burst-firing magnetic fields presented for 1 sec every 4 sec to either the left or right temporoparietal region or both hemispheres; sham-field values are also shown. The percentage change from baseline for these treatments is shown in the right panel. Vertical bars indicate S.E.M. (standard error of the mean).

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showed, even during double blind conditions, that the capacity for hypnotic induction was specifically increased when the magnetic field stimulation occurred over the right hemisphere only. That the effect was due to an artifact or placebo treatment is unlikely since the groups that had been exposed to the same pulse pattern (but over the left hemisphere only or over both hemispheres) did not differ significantly from the group that had been exposed to the sham field.

Although the specific neurocognitive mechanisms or processes by which hypnotizability occurs have not been mapped, they may predominantly involve patterns that are usually attributed to the right (nondominant) hemisphere. Traditional stimulus operations that are employed to facilitate or evaluate hypnotizability, such as tactile stimulation of the left hand or passive, left-right visual pursuit of moving objects (swinging pendulums), would also activate right hemispheric processes by either contralateral tactile input or by requirements to integrate visuospatial patterns, respectively. Individuals who exhibit intermittent cessation of the left hemispheric processes that are associated with awareness, are more likely to exhibit periods that reflect right hemispheric activation: hypervigilance and dissociation (Persinger, 1994). The results of this study indicate that typical sensory modalities can be by-passed if the stimulation contains fundamental frequencies (John, 1990) and occurs over the critical portion of brain space.

Although alternative mechanisms have been suggested (Weaver & Astumian, 1990) one general consensus among classical physicists has been that weak magnetic fields, such as the ones employed in this study are not sufficient to induce neuroelectrical alterations whose amplitudes are sufficient to be registered as subjective experiences. Consequently any medical benefit (or adverse reaction) has been attributable to the placebo reactions despite the poorly understood neurocognitive substrate of these responses. The results of this study indicate that asymmetric application of complex, burst-firing magnetic fields whose strengths vary within the 1 microT range may directly affect that neurocognitive substrate and enhance its amplitude. From this perspective the changes that have occurred after brief exposures to some types of magnetic fields would not be placebo effects per se but would be due to the fact that the field enhanced the neuroelectrical process that facilitates placebo effects.

The clinical implications of this result are significant. Our primary thrust for developing this technology is to offer a treatment option other than pharmacological invasiveness. We have assumed that complex, magnetic patterns whose sequences are resonant or congruent with theoretical or empirical correlates of affective or cognitive states, would facilitate the induction of specific neural signals that would trigger cellular changes that could serve as the substrate for more adaptive responses. The enhanced suggestibility that was noted in this study is

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sufficient in magnitude (more than one-third of the variance explained) to have clinical utility. Such enhancement of hypnotizability could easily increase the effectiveness of psychotherapeutic instructions and cognitive restructuring.

The legitimacy of employing magnetic fields in medicine and psychology has been impeded by the overinclusiveness of the label. Failure to apply the specific parameters that are congruent with a specific neurocognitive pattern of brain activity would be analogous to early protopharmacology when behavioral effects were elicited by unpurified compounds from unspecified sources and given in unmeasured dosages through any mode of ingestion. Today we would not say all drugs are due to placebo effects simply because the changes due to a small subset of drugs are confounded by this process. Contemporary theory (Jacobson, 1995; Liboff, *et. al.*, 1984; Persinger, 1995a; Sandyk, 1995) and research (Bassett, 1989; Persinger, 1995b; Sandyk, 1992; 1995) indicate that the information within the field signature must match the physicochemical characteristics of the target structure or activity within the brain.

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