HYPNOSIS and HYPNOTHERAPY

EEG Markers of Alert Hypnosis: The Induction Makes a Difference

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Rather than attempt to uncover some simplistic unidimensional EEG "signature" of the hypnotic state, this study obtained EEG Event Related Potentials (ERPs) in response to suggestion only and an alert hypnotic induction plus the identical suggestion conditions. The suggestion asked the ten subjects to hallucinate having earplugs in their ears to attenuate a series of computer generated tone pips. Hypnotizability testing was completely separated in both time (6-9 months prior) and context from this research. Alert hypnosis (Barabasz, 1985; Barabasz & Barabasz, 1996) was used to preclude effects that might be wrought by relaxation. Only the hypnotizable but not the non hypnotizable subjects showed statistically significant attenuation of their EEG ERPs in response to the hypnotic induction plus suggestion condition in contrast to the identical suggestion alone. An independent post-experimental inquiry revealed that the one highly hypnotizable subject who responded in an equivalent manner to both conditions did spontaneously enter hypnosis in an effort to respond to the essence of the instructions. Consistent with previous research (Barabasz, Barabasz, Jensen, Calvin, Trevisan, & Warner, 1999; Barabasz & Lonsdale, 1983; Spiegel, Cutcomb, Ren, & Pribram, 1985), the data reveal that when responses are time locked to events, robust physiological markers of hypnosis emerge that reflect alterations in consciousness that correspond to subjects' subjective experiences of perceptual alteration. These effects were not produced by suggestion alone but only by hypnosis in hypnotizable subjects. (Sleep and Hypnosis 2000;4:164-169)

Key words: *alert hypnosis, EEG/ERPs, trance, psychophysiology of hypnosis, suggestibility*

INTRODUCTION

The issue of hypnosis as a trance state versus a nontrance "sociopsychological phenomenon" continues to divide the field (1). The controversy persists despite a now substantial body of evidence showing specific physiological effects of hypnosis which cannot be accounted for by suggestion or relaxation alone (2).

The later components electroencephalographic cortical event-related potentials (ERPs) are affected by information processing strategies such as task relevance and surprise (3). This psychophysiological approach to the study of attentional processes seems especially appropriate for the study of hypnotically produced alterations in perception which involve attentive focused concentration with a constriction in peripheral awareness (2,4-6). Indeed, hypnotized individuals demonstrate extraordinary ability to alter pain perception (7,8), substitute trance for sedative drug use (9), modify the immune system (10), reduce blood loss in surgery (11), produce hallucinations (4), and change motor function so that it seems involuntary (12). Because these alterations involve an apparent psychological influence on somatic function, an understanding of the mechanism for such profound effects requires the demonstration of some brain function alterations that can be separated from

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the general context of, for example mood, by time locking the EEG data to specific events.

The point is not to attempt to uncover some simplistic unidimensional EEG "signature" of the hypnotic state, per se, but rather to determine whether or not hypnotizable individuals exposed to a hypnotic induction, involving hypnotic depth sufficient for the demands of the specific task, can show ERP changes that correspond to their subjective experience that can be differentiated from the effects of suggestion alone.

Recently, this author (2) culminated 20 years of his event-related EEG hypnosis research by dispelling the myth of non-replication (13,14) of physiological markers of hypnosis. The effects of positive obstructive and negative obliterating instructions on visual and auditory P300 ERPs were tested. Twenty subjects were stringently selected for hypnotizability using both the Harvard Group Scale of Hypnotic Susceptibility (HGSHS) (15) and the Stanford Hypnotic Susceptibility Scale: Form C (SHSS:C). Attempts to maximize or plateau subjects' hypnotizability before individualized testing and between hypnotizability testing sessions were made using repeated hypnosis. All high hypnotizables (scoring 9-12) passed the auditory and visual hallucination items of the SHSS:C while none of the low (scoring 0-3) hypnotizables did so. Both the highs and lows were requested to perform identical tasks during waking and alert hypnosis (16-18). An alert hypnotic induction was chosen in contrast to a traditional relaxation induction to preclude EEG effects that might be attributed to relaxation alone. Orne's (19) famous "Real Simulator Design" was used to assess effects for the hypnotizable participants attributable to hypnotic responsiveness rather than those that are merely artifacts of the experimental socio-psychological context, situational variables or to expectancies on the part of both subjects and experimenters. High hypnotizables showed greater ERP amplitude while experiencing negative hallucinations and lower ERP amplitudes while experiencing positive obstructive hallucinations in contrast to the low hypnotizables (who were trying to mimic hypnotic responses to the suggestions) and their own waking imagination-only conditions. The data clearly revealed that when responses are time locked to events, rather robust physiological markers of hypnosis emerge. Rather than a simplistic unidimensional "signature" of the hypnotic state, these bi-directional ERPs varied consistently by type of suggestion after a hypnotic induction to reflect alternative alterations in consciousness that corresponded closely to subjects' subjective experiences of perceptual alterations. These effects were not produced by the low hypnotizables by social influence (trying to mimic responses to the suggestions) or by the highs in a waking condition. These findings have been replicated independently (20,21). This study showed that accounting for suggestion type after a hypnotic induction reveals remarkable consistency of findings among dozens of researchers worldwide.

The present pilot study was intended to bring even further stringency to the Barabasz et al. (2) design by 1) completely separating the hypnotizability testing from the experiment; 2) testing ERP responses to the suggestions both with and without a hypnotic induction, and 3) attempting to account for spontaneous hypnosis (where hypnotizable subjects engage in their hypnotic abilities as their mode of replying to suggestions in the absence of a formal induction), or alternate hypnotic responding (responding in a manner other than that suggested by the experimenter) by means of independent post experimental inquiries.

METHODS

Subjects

As in the Barabasz et al. (2) experiment, right-handed volunteers were selected from a large rural university pool of nearly 300 individuals. All were initially introduced to hypnosis and screened in groups of 7 to 12 using the Harvard Group Scale of Hypnotic Susceptibility (HGSHS) (15). Those scoring from 9 to 12 or 0 to 3 were further oriented to hypnosis using standardized procedures (22) for 2 to 3 hours, during which time attempts were made to maximize hypnotizability by repeated hypnosis, both individually and in groups. Participants were then tested individually using the 12- point SHSS:C (23). High hypnotizable (N=5; 3 females, 2 males) participants in this study scored from 9 to 12 (M=11.1). All highs passed both the auditory and visual hallucination items. Lows (N=5; 2 males, 3 females) passed only motoric items and scored from 0 to 3 (M= 1.4).

Measures

Auditory ERPs of the EEG were recorded from referential monopolar leads at Fz, Cz, and Pz according to the International 10/20 system. To assist in the detection of eye movement artifacts, an electroculogram (EOG) was recorded as a bipolar channel, using two Beckman silver/silver chloride electrodes attached by double-sided adhesive washers to the lower orbital ridge and the outer canthus of the

left eye.

A Lexicor Medical Technology (Boulder, CO) Neurosearch 24 (NRS-24) System was used to record EEG. Resistance was kept below 3000 ohms (m=2.2K) with a maximum of 500 ohms difference among sites. EEG was amplified by the NRS-24 32,000 times, 0.5-64 HZ with a 60 Hz notch filter (AC electrical in the USA is 60 Hz rather than the worldwide 50 Hz). EEG was digitized on-line at 256 samples per second with a 0.1 microvolt amplitude resolution for 70 ms proceeding through 970 ms following the onset of each stimulus. The standard P300 ERP component was measured as peak-to-peak amplitude within the selected latency range (250-450ms). EOG was amplified 5,000 times with a flat gain (to within – 4dB) between 2 Hz and 100 Hz. All 1-second epochs were examined for artifact rejection by excluding from data analysis any ERPs that were a) EOG/muscle artifact contaminated, b) alpha-rhythm bursts (particularly in the eyes closed, auditory conditions) and c) analog to digital conversion outliers.

P300 standard ERP components were defined by a process essentially consistent with Spiegel, Bierre, and Rootenberg (24) and our previous study (2) rather than the less sophisticated procedures characteristic of an earlier ERP hypnotic hallucination study (25). Briefly, the process was a) maximal and minimal amplitudes were identified, b) the half amplitude between neighboring peaks was established, c) the point in ms (time) on the abscissa of the identified half amplitude was used as the dividing boundary between N200 and P300, and d) within each latency window, a maximum/minimum finder (tracing the cursor over the sine curve that produced a continuous 0.1 microvolts resolution digital readout) was used to locate the amplitude for the P300 ERP for each participant for each experimental condition at all recording sites. The process, which allowed inspection of individual mean ERP responses to each condition, was intended to facilitate the qualitative evaluation of the participants' responses to the alternative conditions as discussed by Spiegel and Barabasz (26) and Barabasz et al. (2).

Procedure

Unlike the Barabasz et al. (2) study, the participation in the hypnosis testing procedure was separated completely from the present study of "EEG and attentional processes." Hypnotizability data for the participants in the present study was collected 6 to 9 months prior to this study as part of the screening process for another study. None of these participants were involved in previous hypnosis research. There is no evidence (as supported by the post-experimental inquiry) that any participants were aware of the hypnosis component until they were given the informed consent for the second condition which involved an alert hypnotic induction. The signage for my laboratory had changed 8 years prior to the present experiment from "Laboratory of Hypnosis and REST Research" to read "Attentional Processes Lab." Furthermore, it is known that about an even number of hypnosis and non-hypnosis experiments are conducted yearly in the lab. In the present experiment, all suggestion only conditions were conducted prior to testing the hypnosis condition.

The auditory stimuli required to elicit the ERPs consisted of 25 tone pips (at 2000 Hz and 70 dB) presented at 1 second intervals using Lexicor V4.1E software modified from its alternative "odd ball paradigm" random differential tone presentation. All suggestion only data were collected from subjects before introducing the alert hypnotic induction plus suggestion condition.

In the suggestion only condition both high and low hypnotizable participants were given the following suggestion "OK, now while remaining as deeply hypnotized as you are, imagine that you are putting foam earplugs in your ears. The earplugs are expanding and they reduce what you can hear by about 30-35 decibels, just like the regular ones available, reducing what you can hear." The 25 tone repetitions were then administered while EEG data were collected. Then, "OK, you're taking the earplugs out, they're out and you can hear just as you did before."

Only after data from the suggestion only condition had been collected were the low hypnotizables instructed as to their next role in the experiment. As in previous experiments (2,10,25,27), low hypnotizable participants served as a quasi-control group and were asked to simulate hypnosis according to Orne's (19) guidelines. The simulators were told to behave just as they believed an excellent hypnotic participant would behave. They were told to mimic the responses to the suggestion as if they were hypnosis. These participants were likely further motivated by the instruction that the experimenter would stop the experiment if it was determined that they were simulating but that intelligent participants have previously been successful at fooling experimenters (22,28). Orne's (19) design was specifically developed to account for responses that could be evoked by social influence rather than hypnosis. The investigator did not detect simulators during his contact with any participant.

Once suggestion only data were collected, subjects were exposed to alert hypnosis using established

procedures (see 17,29). The procedure increases heart rate and alertness (16) and cannot be considered a relaxation producing induction. Each participant was asked to roll his or her eyes up while being led to this position by focusing on the investigator's thumb. The thumb was moved slowly from 10 to 16 cm in front of the participant's nose to the approximate center of the forehead. Speed of movement was coordinated with the participant's ability to follow without swimming of the eyes or obvious loss of focus. An eyes-closed catalepsy test was then administered. Then, instructions for increased hypnotic depth were given during a count from 1 to 10. To aid hypnotic depth, participants were asked to assign a number on an open-ended scale (2,25, E.R. Hilgard, personal communication, August 12, 1979). They were then asked to double this level and to indicate when they had reached this deeper level "While becoming even more alert, focused, concentrated" by raising a finger on their left hand (all complied) (all Ss were right hand dominant). Consistent with common clinical uses of hypnosis, it is generally critical to produce a level of hypnotic depth sufficient to achieve hypnotic responsiveness to difficult suggestions. The identical suggestion as was used in the suggestion only condition was then administered. The 25 tone repetitions were then given while EEG data were collected. Then, "OK, you're taking the earplugs out, they're out and you can hear just as you did before."

After all data were collected and the experiment was clearly completed, an independent post experimental inquiry was conducted to determine strategies employed by participants in response to the alternative conditions. The inquiry was open ended to encourage any other comments about the experiment.

RESULTS

A within group contrast approach for the two treatment conditions (suggestion only versus suggestion plus hypnosis) was chosen as this is the most appropriate manner to deal with the high within group variability of responses characteristic of those who are highly hypnotizable (22). The variability problem may be further increased by high hypnotizables' capacity to enter self-hypnosis and their tendency to do so contrary to the experimenters' intentions. In one experiment (reviewed by 22) an independent post experimental inquiry found that 5 highs out of a total of 14 admitted using self-hypnosis during the supposedly "waking" condition. Because of the occurrence of spontaneous hypnosis or the practice of self-hypnosis by high hypnotizables under noninduction conditions, production of statistical significance in group comparisons is left to those few subjects who make dramatic gains between waking and hypnosis induction conditions. As E.R. Hilgard and Tart (30) explained, overall between groups comparisons that fail to account for spontaneous hypnosis responses will understate the changes that take place for some subjects as a direct result of entering a hypnotic state. The risk of failing to statistically identify such real changes wrought by hypnosis are especially high for studies limited to a small number of subjects. Given the small N available for this investigation and the bi-modal rather than normal distribution of the data for the highly hypnotizable subjects the non parametric distribution free Wilcoxon Signed Ranks Test was chosen for data analysis.

The results of the Wilcoxon test for all three sites for the low hypnotizable subjects show no significant differences ($p > .05$) in effect for the hypnotic induction plus suggestion condition compared with the suggestion only condition [Fz (Ns – R = 4, T = 1, $p > .05$, suggestion only M = 6.96, SD = 2.41, suggestion plus hypnosis M = 7.34, SD = 2.01), Cz (Ns – R = 5, T = 2, $P > .05$ suggestion only M =6.7, SD = 2.81; suggestion plus hypnosis M = 5.94, SD = 3.21) and Pz (Ns – R = 4, T = 2, $p > .05$, suggestion only M =7.08, SD = 3.40; suggestion plus hypnosis M = 7.06 SD = 2.30)].

In sharp contrast to the findings produced by the low hypnotizables, the comparisons between the two conditions for the high hypnotizables were significant ($p < .01$) for each of the three sites showing a significant attenuation of the P300 as a result of the hypnotic induction plus suggestion condition versus the suggestion only condition [Fz (Ns – R = 5, T = 0, $p < .01$, suggestion only M = 7.44, SD = 3.23, suggestion plus hypnosis M = 3.02 SD = .91), CZ (Ns – R = 5, T = 0, $p < .01$, suggestion only M = 6.15, SD = 1.07; suggestion plus hypnosis M = 2.94 SD = 3.35) and Pz (Ns – R = 5, T = 0, $p < .01$, suggestion only M = 6.26, SD = 2.15; suggestion plus hypnosis M = 2.98, SD = 1.34)].

Data for each subject was also inspected for directionality of change. One high hypnotizable subject demonstrated virtually identical ERPs between the two conditions at each site (Fz suggestion only average ERP = 2.7 microvolts, hypnosis plus suggestion average ERP = 2.7 microvolts, Cz suggestion only average ERP 1.7 microvolts, hypnosis plus suggestion ERP = 1.7 microvolts and Pz suggestion only average ERP 4.9 microvolts, hypnosis plus suggestion average ERP = 5.3 microvolts) while all of the other highs showed attenuation of their average ERPs in the hypnosis condition of at least 50% in contrast to the suggestion only condition.

Qualitative findings obtained from the

independent post experimental interview are revealed in the Discussion below.

DISCUSSION

Despite the modest number of subjects (N = 10) available for this study, the findings showing that only hypnotizables but not non-hypnotizables are able to attenuate their EEG ERPs in response to a hypnotic induction plus suggestion are completely consistent with previous research (for example 2;31-34).

The present study addressed the issue of completely separating the hypnotizabilty testing (completed 6 – 9 months earlier) from the context of the present experiment. How could the high hypnotizables be "holding back" their best efforts in the suggestion condition when they had no knowledge that this was a hypnosis experiment nor that hypnosis was to be used until after the suggestion only data were collected?

The data clearly show that the hypnotic induction, with efforts to assure adequate hypnotic depth, made it possible for the high but not the low hypnotizables to show significant attenuation of their ERPs across all three sites in response to the hypnotic induction plus suggestion condition in contrast to the identical suggestion alone. Furthermore, the use of alert hypnosis means that the findings cannot be attributed to relaxation effects.

While it would seem that adequate hypnotic depth should be produced before expecting a subject to complete a difficult task under hypnosis, consistent with previous work (22,30), one highly hypnotizable subject produced almost identical responses to the two conditions. The post experimental inquiry was unremarkable in that no subject saw themselves as taking part in a hypnosis experiment until the second informed consent was obtained which described the hypnotic induction. However, for the highly hypnotizable subject who produced similar ERPs to both conditions, the inquiry was revealing. He noted "When I got the instruction to make like there were ear plugs in my ears, I just did what I learned to do when I was a kid." "Tell me more" replied the independent post-experimental inquirer. "Well when I'd get spanked by my Dad for something, I could turn off the pain like just going to another place so that's what I did with the suggestion too – same as the hypnosis part too." This response appears to be a classic example of spontaneous hypnosis with apparent dissociation. Clinicians who use hypnosis regularly with difficult cases frequently observe that hypnotizable patients spontaneously use the hypnotic state in their own idiosyncratic way rather than slavishly responding to the practitioners' instructions. This highly hypnotizable subject responded to both the suggestion and hypnosis plus suggestion conditions by entering self hypnosis through prior dissociative experience to attenuate the stimuli rather than imagine the use of earplugs. As Kihlstrom (1) observed, persistent individual differences can go beyond the effects of experimental manipulation. This example of spontaneous self hypnosis by no means should be taken as evidence that clinicians need not attempt to gain adequate hypnotic depth for many patients before attempting difficult suggestions.

The findings reveal that suggestion alone is insufficient to produce a difficult response without the use of a hypnotic induction. Only those who had demonstrated their ability to become hypnotized were able to produce such changes showing robust physiological markers of hypnosis that reflect alterations in consciousness that correspond to subjects' subjective experiences of perceptual alteration.

The data do not contradict the notion that social influence, expectancy and context may be important to maximizing treatment outcomes with patients. The point is simply that hypnosis per se can make certain responses possible that go beyond those that might be wrought by social variables. Hypnosis in treatment will probably always involve a complex interplay of both domains.

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