EEG P300 Event-Related Markers of Hypnosis

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Barabasz, Barabasz, Jensen, Calvin, Trevisan, and Warner (1999) showed that, when subjects are stringently selected for hypnotizability and responses are time locked to events, robust markers of hypnotic responding emerge that reflect alterations in consciousness that correspond to subjects’ subjective experiences of perceptual alteration. To further test the Barabasz et al. (1999) hypothesis, we obtained EEG visual P300 event-related potentials (ERPs) from 20 high- and low-hypnotizable subjects. The effects of positive obstructive and negative obliterating instructions were tested during waking and alert hypnotic conditions. High-hypnotizables showed greater ERP amplitudes in response to the negative hallucination condition and lower ERP amplitudes in response to the positive obstructive hallucination when compared to the low-hypnotizables. Contrary to socio-psychological or role play conceptualizations, the hypnotic induction resulted in specific psychophysiological responses which could not be produced by waking imagination or by the lows who were trying to mimic hypnotic responding.

Understanding the physiological effects of hypnosis is important for therapy implementation as well as clarifying the theoretical basis of hypnotic responsiveness. This study sought to shed light on physiological effects of alternative hypnotic suggestions and nonhypnotic conditions by studying EEG visual event-related potentials (ERPs).

According to Hilgard (1977), hypnosis involves focused attention and dissociation that occur when attention is directed at a particular stimulus. The hypnotized individual is said to be absorbed in the stimulus. Although multiple stimuli can be presented at a time, a hypnotized individual can focus on a specific stimulus to the point of overlooking other environmental cues or stimuli. People have different
hypnotic abilities and different inherent levels of hypnotizability, which influence their responses to hypnotic suggestions.

Attentional processes have been measured by event-related potentials (ERPs) that are electrical potentials specifically time related to precise external stimuli acting on the organism. Testing hypnotic attentional processes by use of this EEG measure has been one of the most illuminating approaches to determining psychophysiological effects of hypnosis because, unlike EEG measures devoted to an attempt to assign specific general wave forms (alpha, beta, theta) to hypnotic responding, ERP’s are distinct from contextual influences such as happy or sad mood states (DePascalis, 1999).

ERPs are recorded as a series of epochs on the EEG and can be broken down into different components based on the latency time from stimulus presentation. Hypnosis involves concentration, cognitive flexibility, and information processing strategies (Hilgard, 1965). These can now be measured by the later components of EEG event related potentials. Thus we have a rationale for the use of this measure to elucidate specifics of hypnotic responses and to help differentiate them from those that can be wrought by extraneous variables such as expectancy and context.

Early methodologically and technologically unsophisticated studies produced results that are difficult to interpret. Clynes, Kohn, and Lifshitz, (1964), Galbraith, Cooper, and London, (1972), Guerrero-Figueroa and Heath, (1964), and Wilson, (1968), showed that ERPs decrease in response to hypnotic suggestions when the stimulus is attenuated. Conversely, Amadeo and Yanovski, (1975), Andreassi, Balinsky, Gallichio, De Simone, and Mellers, (1976), Beck and Barolin, (1965), Serafetinides, (1968), and Zakrzewski and Szelenber, (1981) were unable to determine a difference between hypnotized and non-hypnotized participants’ ERPs. There were several methodological problems with these studies such as the lack of sophisticated equipment to measure ERPs, the use of hypnotic susceptibility measures with poor psychometric properties, inadequate sample sizes, and lack of proper controls for effects of experimental demand characteristics, context, or expectancies.

Two recent, experimentally more sophisticated, studies used comprehensive experimental controls and more modern EEG data acquisition. David Spiegel’s Stanford University lab (Spiegel, Cutcomb, Ren, & Pribram, 1985) recorded visual event-related responses (VER) from 6 high and 6 low hypnotizable participants in three conditions: stimulus enhancement, stimulus diminution, and stimulus elimination (obstructive hallucination) while focusing on a cathode ray tube (CRT) display. All participants were given the suggestion, while in hypnosis, that a cardboard box blocked their view of the monitor and prevented them from seeing the flashes. This hypnotic suggestion to produce a positive hallucination resulted in a significant suppression of the later components of the VERs among highly hypnotizable participants but not the lows, thus indicating a difference in information processing.

The first fully controlled ERP hypnosis study was completed by Barabasz and Lonsdale (1983). The findings demonstrated significantly differing results when they tested four high- and five low-hypnotizable participants’ olfactory-event-related potential amplitudes in response to laboratory grade odors. Participants were stringently selected for high and low hypnotizability using the Stanford Hypnotic Susceptibility Scale: Form C (SHSS:C) (Weitzenhoffer & Hilgard, 1962). Experimental demand characteristics, including experimenter expectancies, were controlled by using Orne’s
The real-simulator procedure where the lows were instructed to mimic hypnotic responding. All participants were given the hypnotic suggestions by the first author who remained masked to participants’ hypnotizability level. These consisted of the standardized instructions for anosmia to all odors from Item 9 on the SHSS:C. The instructions suggested that the participants would not smell anything while different strengths of an odor of eugenol were presented in a low by-pass olfactorium. High-hypnotizable participants showed significant amplitude increases of the P300 for weak and strong odors while hypnotized but not during the waking state. No amplitude increases were found for the low-hypnotizable participants. This demonstrated that hypnosis might produce a psychophysiological response that can be detected by the EEG P300 that could not be produced with identical instructions and suggestions during waking conditions. The later Spiegel, Cutcomb, Ren, and Pribram (1985) study confirmed that EEG event-related potentials could serve as a marker of the hypnotic state, but the amplitude findings appeared to be in the opposite direction of the Barabasz and Lonsdale (1983) study.

Later, Spiegel and Barabasz (1988) theorized that the apparent differences in the directions of the amplitude findings might be due to the differences in the hypnotic instructions in the two experiments. The Spiegel et al. (1985) study employed a positive hallucination, which was intended to lead the participants into absorption in the hallucinated obstruction. The perception of the stimulus was reduced and, therefore, event related potentials were suppressed. However, the Barabasz and Lonsdale (1983) study employed the standardized negative suggestion from the Stanford Form C item 9 (“You will not smell anything at all”). Therefore, the participants were likely to be surprised when they smelled anything at all. This would result in the increased P300 response. Spiegel and Barabasz (1990) hypothesized that hypnotic attention to a stimulus would be likely to enhance the amplitude of the P300 event-related response wave because participants would be surprised that they smelled anything at all, whereas, hallucinating an obstructing object would likely decrease the amplitude of this later component of cortical response because participants would have reduced perception of the computer-generated stimulus.

Barabasz and Spiegel’s explanation for their findings was explored in a preliminary pilot study (Barabasz, Barabasz, Barabasz, Warner, 1995) but not thoroughly tested experimentally because only seven total participants were used. This pilot study, which included three low-hypnotizable and four high-hypnotizable participants, showed that the obstructive hallucination for highly hypnotizable individuals resulted in attenuation of the P300. The negative hallucination results demonstrated an early exaggerated response followed by attenuation. On the other hand, the low-hypnotizable participants had similar responses, which included elevated P300 after stimulus presentation, for all three conditions.

Only one ERP study (Perlini, Lorimer, Campbell, & Spanos, 1992) has come from those who embrace the socio-cognitive theory of hypnosis (Spanos, 1986). Rather than accounting for hypnotic behavior through dissociation, the socio-cognitive position maintains that participants “delude” themselves into believing their intentional acts are involuntary (Kirsch & Lynn, 1995). Perlini et al. (1992) employed obstructive, transparent, negative and semantic hypnotic hallucinations in their ERP study. They included nine participants who scored 5-7 on the Carleton University Responsiveness to Suggestion Scale (CURSS) (Spanos, Flynn, & Gabora, 1989), which they considered...
to be highly suggestible. The participants viewed letter strings, which included both nouns and non-words. They pressed a button that was labeled “yes” if the string of letters formed a word and “no” if they were a non-word.

Considering the several major flaws in the Perlini et al. (1992) study, it is not surprising that no significant findings were produced. In contrast to the Barabasz and Lonsdale (1983) and the Spiegel et al. (1985) studies, there was no control for demand characteristics, which may have resulted in the participants’ responding as they believed the experimenter would have them respond. The CURSS measure of simple suggestibility has poor psychometric properties and cannot be considered to be an acceptable measure for stringently testing levels of hypnotic capacity. Therefore, whether the “high-hypnotizable” participants were, indeed, highly hypnotizable is questionable. Perhaps most problematic is that the researchers did nothing to determine whether or not any of the participants were capable of producing hallucinations but then used a protocol specifically requiring this rare ability. The failure to include any low- or non-hypnotizable participants precluded the possibility of determining which responses might be due to hypnosis versus those due to simple suggestion. Finally, when analyzing the data, the researchers excluded any trial where the participants did not respond to the cognitive discrimination task. Since the task was to have participants hallucinate obstructions so that they could not see the presenting stimuli, excluding these trials would completely confound the results. As might be expected, these variables precluded any overall significant ANOVA results. However, posthoc analysis showed that the obstructive hallucination elicited a suppression of the P3 over the parietal area. This finding, from the only socio-cognitive lab to explore a physiological substrate of hypnosis, is entirely consistent with the dissociative (state theory) hypothesis of Spiegel and Barabasz (1988).

DePascalis (1994) also attempted to account for the differences in the Spiegel et al. (1985) and Barabasz and Lonsdale (1983) studies. DePascalis (1994) employed seven high- and nine low- hypnotizable participants in two experimental conditions, stimulus enhancement and obstructive hallucination. ANOVA results indicated consistently smaller P3 amplitudes for an obstructive hallucination than for the stimulus enhancement condition. High-hypnotizable participants also had longer P3 latencies in the right hemisphere during stimulus enhancement and greater P3 peak amplitudes in the left hemisphere than the low- hypnotizable participants did. Although DePascalis (1994) tested the participants to assure that all of the high-hypnotizable participants were capable of hallucinations, demand characteristics were not accounted for and the quality of the data was constrained by the limitations of the equipment then available in the lab at La Sapienza, Italy. Furthermore, the fact that low-hypnotizable participants were not instructed to simulate (mimic) hypnotic responding, an important control used in the Barabasz and Lonsdale (1983) study, may have resulted in the experimenter treating these participants differently from the highs. The lack of a real-simulator design for this study makes data interpretation difficult. The most recent work from DePascalis (1999) addresses a number of the earlier difficulties. The 1999 findings are entirely consistent with the earlier Barabasz, Barabasz, Jensen, Calvin, Trevisan, and Warner (1999) research.

Barabasz et al. (1999) tested the effects of positive obstructive and negative obliterating instructions on visual and auditory EEG P300 ERPs. Considering issues raised by Spiegel and Barabasz (1988), 20 participants stringently selected for
hypnotizability, were requested to perform identical tasks during waking and alert hypnotic conditions. High-hypnotizables showed significantly greater mean ERP amplitudes while experiencing negative hallucinations (i.e. a suggestion not to perceive the stimuli) and significantly lower mean ERP amplitudes while experiencing positive obstructive hallucinations (i.e. a suggestion to perceive competing stimuli instead of the presented ones) in contrast to low-hypnotizables and their own waking conditions. The findings clearly show that accounting for suggestion type reveals remarkable consistency of findings among dozens of researchers. The study revealed that when participants are very stringently selected for hypnotizability and responses are time locked to events, robust physiological markers of hypnosis can emerge that reflect alterations in consciousness that correspond to participants’ subjective experiences of perceptual alteration.

Despite the fact that the Barabasz et al. (1999) study demonstrated remarkable consistency of ERP findings among several labs, going back as far as the classic Barabasz and Lonsdale (1983) study and more recently including even the one study from a socio-cognitive laboratory, the theoretical and practical importance of the findings necessitated a replication and extension of this research. Indeed, as recently as 1995, Kirsch and Lynn sought to converge state-based and socio-cognitive theories of hypnosis. The Barabasz et al. (1999) findings failed to support Dixon and Laurence’s (1992) assertion that the literature is fraught with non-replication of physiological markers of hypnotic responses. Despite disproving Dixon and Laurence (1992) and the lack of any new data supporting their position, this myth again surfaced in a presentation at the annual scientific meeting of the Society for Clinical and Experimental Hypnosis (Kirsch, 1999). The present research sought to further test the effects of alternative instructions on EEG P300 visual event-related potentials in a full scale experimentally controlled replication/extension of the previous Barabasz et al. (1999) study. Significant results indicating a change in event-related potentials during hypnosis provide a greater understanding of the relation of hypnosis to cerebral activity which indicates physiological markers for hypnotic responses exist while shedding further light on the criticality of the wording of hypnotic instructions for patients. Our findings, therefore, are of major potential relevance to the application of hypnosis in clinical situations.

**Method**

**Participants**

The Harvard Group Scale of Hypnotic Susceptibility Form: A (HGSHS:A) (Shor & Orne, 1962) was administered to approximately 200 university and community volunteers after they received an informative 45-55 minute presentation on hypnosis. During this time, myths about hypnosis were debunked and volunteers had the opportunity to ask questions and voice concerns before being hypnotized. An attempt was made to maximize participants’ hypnotizability by their experiences with repeated hypnosis and observations of hypnotic induction demonstrations. Participants scoring 3 or below or 9 or above on the Harvard Group Scale of Hypnotic Susceptibility Form: A (HGSHS:A) (Shor & Orne, 1962) were invited to participate in the plateauing (hypnotizability maximizing) which involved additional repeated hypnosis sessions. Then the Stanford Hypnotic Susceptibility Scale Form: C (SHSS:C) (Weitzenhoffer &
Hilgard, 1962) was individually administered. Ten high-hypnotizables (SHSS:C scores 10 and above) and 10 low-hypnotizables (SHSS:C scores 2 and below) participated in the experiment. All high-hypnotizable participants passed the negative hallucination item from the SHSS:C, which includes presenting three colored boxes with a suggestion that the participant will only see two boxes. The mean for the high-hypnotizable group was 10.9 and the low-hypnotizable group mean was 1.8. None of the lows passed the negative hallucination item. The participants included 7 males and 13 females ranging in age from 19 to 52 years old with the mean age of 28.2 years old. Of the twenty participants, sixteen were Caucasian, three were Hispanic and one was Native American. All participants indicated that they were free from known vision problems (other than the use of corrective lenses).

**Measures**

Hypnotizability was determined by using the Harvard Group Scale of Hypnotic Susceptibility: Form A (HGSHS:A) (Shor & Orne, 1962) and the Stanford Hypnotic Susceptibility Scale: Form C (SHSS:C) (Weitzenhoffer & Hilgard, 1962). Both scales have 12 items, which indicate characteristics of hypnotized individuals. The HGSHS:A was standardized on undergraduate students and has a reliability of $r = 0.80$ and a validity of $r = 0.74$ (Shor & Orne, 1963). The SHSS:C was also standardized on undergraduate students and has a test-retest reliability of $r = 0.83$. The SHSS:C is the most widely used and most highly regarded measure of hypnotizability (see Barabasz & Barabasz, 1992).

The electroencephalogram (EEG) was recorded from monopolar leads at O1, O2, Fz, Cz, and Pz using a Neurosearch-24 System. The software was “Evoked Potential Version 4.1E” modified in accordance with specifications from the second author for enhanced resolution by Lexicor Medical Technology, Boulder, CO. Active electrode to ear reference resistance was kept below 3000 ohms (Mean 2.43K) with a maximum of 400 ohms difference among sites. EEG was amplified by the NRS-24 32,000 times, 0.5-64Hz with a 60 Hz notch filter. 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 peak-to-peak amplitudes within the selected latency range (250-450 ms). After affixing the electrode cap and establishing the quality of the EEG record, the participants completed the three counterbalanced experimental conditions. Eye movement was monitored by electrodes using the electrooculogram (EOG) with silver/silver chloride hat electrodes affixed by double sided adhesive washers in a bipolar arrangement, superior orbit referenced to the outer canthus of the right eye. EOG was amplified 5,000 times with a flat gain (to within -4dB) between 2 Hz and 100 Hz. Prior to analysis, visual event related potentials (VEPs) that were contaminated by eye muscle movement (EOG) were excluded. Artifactation of all data was accomplished by examination of each 1 second of raw data by the second author (AB). Artifactual data was independently cross-checked by the third author (MB) who was masked with respect to hypnotizability, experimental condition and the second author’s artifactation decisions. Agreement between the two raters was near unity. As in Barabasz et al. (1999) 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, and c) analog to digital conversion outliers.
Procedure

Orne’s “Real-Simulator design” (1979) was used for this experiment following the same procedures as the Barabasz et al. (1999) study. Consistent with Barabasz and Lonsdale (1983) and Barabasz and Barabasz (1992), low-susceptibility participants served as a quasicontrol group. These participants were asked to simulate hypnosis, which included the expectancy that they would be successful in doing so. The reversing checkerboard stimulus was presented in the waking condition while participants were instructed to observe the computer screen. All participants received the hypnotic induction, which was completed by an experimenter who was masked with regard to participants’ hypnotizability. The hypnotic induction, which is explained in further detail below, was followed by the obstructive and negative hallucinations in counterbalanced order. High- and low-hypnotizable participants were exposed to the identical hypnotic induction procedures. Barabasz’ alert induction was used (Barabasz & Barabasz, 1995, 1996; Barabasz et al., 1999) to preclude responses that might be produced by the relaxation effects of the more frequently used eyes closed hypnotic induction.

Experimental Conditions

The visual event-related potentials of the high- and low-hypnotizable participants were compared in three conditions: (a) awake with stimulus presented but no hypnotic induction, (b) hypnotized with negative hallucination suggestion (Barabasz, Barabasz, & Jensen, 1995, 1996; Barabasz & Lonsdale, 1983) and (c) hypnotized with a positive hallucination (Spiegel, Cutcomb, Ren, & Pribram, 1985). After Barabasz’s (1995; 1996) alert hypnosis induction technique the two hypnotic hallucinations were presented in counterbalanced order. The obstructive hallucination condition included instructing the participants “OK, now, while remaining as deeply hypnotized as you are, imagine a cardboard box blocking the computer screen, a cardboard box blocking your view of the screen.” The alternating checkerboard pattern stimulus was presented within a 20-cm X 25-cm square area on a computer screen for 50 stimulus repetitions 1-meter in front of the participant. The stimuli consisted of a checkerboard-reversing pattern where black squares turn white and white squares turn black. The 50 stimulus alterations were presented over a 30-second period with each stimulus being presented for approximately half a second. The positive hallucination suggestion was removed. The negative visual hallucination condition included instructions that stated “OK, now while remaining as deeply hypnotized as you are, imagine you are traveling through outer space and you are entering a dark nebula, the dark nebula envelops you completely and for now you can see nothing, nothing at all.” The reversing checkerboard stimulus was then again initiated on the computer screen for a 30-second period following which the negative hallucination was removed.

To assure fixation of each participant’s eyes on the computer screen, participants were visually monitored continuously by use of a close focus closed circuit TV camera and monitor. This procedure was also intended to minimize potential cues from the experimenter.

Results

P300 amplitude was determined from the positive going peak within the range of 250-450 milliseconds (ms). The amplitude data were analyzed by a 2 x 3 analysis
of variance (ANOVA) using the multivariate analysis of variance (MANOVA) \textit{Systat Version 5.2 Edition} (SYSTAT, 1992). The factors were hypnotizability (low, high) and conditions (awake, negative hallucination, positive obstructive hallucination) effects on the Cz, Pz, Fz, O1, and O2. An LSD post hoc test was performed only when overall significance was found.

Main effects for condition were significant at Pz, F(2,54) = 3.55, \(p < .05\); O1, F(2,54) = 4.94, \(p < .05\); and O2, F(2,54) = 4.59, \(p < .05\). No significant main effect differences for condition or hypnotizability were found at Cz and Fz. However, interaction effects were significant for the means of condition and hypnotizability for four sites; Cz, F(2,54) = 5.49, \(p < .01\); Pz, F(2,54) = 6.05, \(p < .01\); O1, F(2,54) = 6.78, \(p < .005\); and O2, F(2,54) = 5.09, \(p < .01\).

High-hypnotizable participants’ P300 amplitudes in response to the repeated visual stimulus were measured during a negative suggestion and contrasted to low hypnotizable participants in the same condition. In the negative hallucination condition, post hoc analyses of cell means using the LSD test showed that the mean P300 amplitude of the high-hypnotizable participants at Cz (m = 10.56, SD = 8.47), at Pz (m = 12.80, SD = 7.07), at O1 (m = 14.84, SD = 8.60) and at O2 was significantly higher (Cz \(p < .01\), Pz, O1 \(p < .005\)) than the low hypnotizable negative hallucination group at Cz (m= 5.16, SD = 1.86), Pz (m = 6.39, SD = 5.15), O1 (m = 7.61, SD = 5.24) and O2 (m = 8.31, SD = 4.74). There were no significant differences found between condition and hypnotizability at the Fz site. High-hypnotizable participants’ mean P300s were significantly higher than the low-hypnotizable participants during the negative hallucination condition at Cz, Pz, O1 and O2.

High-hypnotizable participants were given an obstructive suggestion during a repeated visual stimulus and contrasted to low-hypnotizable participants. Supporting the hypothesis, post hoc analysis of cell means using the LSD test showed the high-hypnotizable obstructive group had significantly lower (\(p < .05\)) mean P300 amplitudes at O1 (m = 4.90, SD = 1.42), and O2 (m = 3.24, SD = 2.19) than the low-hypnotizable obstructive hallucination group at O1 (m = 8.57, SD = 6.53), O2 (m = 8.58, SD = 3.91). The high-hypnotizable obstructive group had significantly lower (\(p < .10\)) mean P300 amplitudes at the Pz (m = 3.97, SD = 2.91) and Cz (m = 3.86, SD = 2.83) than the low-hypnotizable obstructive hallucination group at Pz (m = 7.60, SD = 4.70) and Cz (m = 7.34, SD = 4.18).

High-hypnotizable participants’ P300 amplitudes in response to the repeated visual stimulus were measured during a negative suggestion and contrasted to an obstructive suggestion. The high-hypnotizable participants in the negative hallucination condition at Cz (m = 10.56, SD = 8.47), Pz (m = 12.80, SD = 7.07), O1 (m = 14.84, SD = 8.60) and O2 (m = 13.74, SD = 8.38) had significantly higher (\(p < .001\)) mean P300 amplitudes than in the high-hypnotizable obstructive condition at Cz (m = 3.86, SD = 2.83), Pz (m = 3.97, SD = 2.91), O1 (m = 2.88, SD = 1.42) and O2 (m = 3.24, SD = 2.19). There were no significant differences found among conditions at the Fz site. The hypothesis was supported in that high-hypnotizable participants’ mean P300s in the negative hallucination condition were significantly higher than those of the high-hypnotizables in the obstructive condition at the Cz, Pz, O1 and O2 sites (see Figure 1).
Low-hypnotizable participants’ P300 amplitudes were measured in response to the repeated visual stimulus when they were instructed to simulate obstructive and negative hallucinations that was then contrasted to the waking condition. The low-hypnotizable participants had no significant difference ($p < .05$) in the mean P300 amplitude across the three conditions, which is consistent with the hypothesis. Under waking (no hypnotic induction) conditions there were no significant differences ($p < .05$) at any of the five sites between high- and low-hypnotizable participants’ mean P300 response to the stimuli.

**Discussion**

Our findings replicate Barabasz et al. (1999) and support the hypothesis that the high-hypnotizable participants exposed to hypnosis with an obstructive suggestion would show significantly lower P300 amplitudes in response to a reverse checkerboard visual stimulus in contrast to low-hypnotizable participants. Responses to a negative obliterating suggestion for the high-hypnotizables showed increased amplitudes. Hypnosis does appear to be a process involving both focused attention and dissociation (Hilgard, 1992). Giving a suggestion, which focuses attention away from a presented stimulus, decreases the perception of that stimulus.

Our study shows that at the O1 and O2 sites, the P300 amplitude was suppressed in high-hypnotizable participants compared to low hypnotizable participants when given the obstructive suggestion of the cardboard box blocking the view of the computer screen. There was also a suppression of P300 amplitude at Cz and Pz in high-hypnotizable participants, although not at the same level of significance. Different results from different EEG sites are likely to have resulted from the type of stimulus employed. Because the stimulus was a reversing checkerboard pattern viewed on the computer screen, the O1 and O2 sites were likely to be more activated because this is the area in control of vision and most likely to respond to a visual stimulus.
At these same sites, Cz, Pz, O₁, and O₂, the P300 amplitude was enhanced in the high-hypnotizable participants when given the negative suggestion that they were in a dark nebula and would see nothing at all. This supports the hypothesis, which stated that high-hypnotizable participants given a negative suggestion would show significantly higher P300 amplitudes in response to a reverse checkerboard visual stimulus in contrast to low-hypnotizable participants. When given a negative hallucination suggestion such as “you will see nothing at all,” the focus is still upon the stimulus. The participant is asked to remove any presentation of the stimulus and, therefore, the increased P300 is likely to be a result of surprise at seeing anything at all. This is precisely what occurred in the Barabasz and Gregson (1979) olfactory event related potential study conducted in Antarctica where a suggested odor accompanied by a no odor stimulus produced an enhanced P300 amplitude.

Our findings reveal that, as was hypothesized, the high-hypnotizable participants demonstrated an increase in P300 amplitude in response to the negative hallucination suggestion and a decreased P300 amplitude in response to the positive hallucination suggestion. The high-hypnotizable group may have been surprised if they saw something at all during the negative hallucination suggestion because they were instructed that they would not see anything at all. The positive obstructive hallucination suggestion, on the other hand, allowed an incomplete or partial obstruction of the stimulus generator which apparently led to a decreased P300 amplitude. This indicates that suggestions that are meant to remove or completely eliminate a stimulus, such as in clinical pain, can actually attenuate the effect of the suggestion, whereas a suggestion aimed at blocking the stimulus or dissociating attention away from the stimulus should work to help decrease the perception of the stimulus.

The hypothesis, that low-hypnotizable participants instructed to mimic hypnotic responding by simulating both the obstructive and negative hallucinations in response to the suggestions would show no significant alteration in visual event-related potentials as compared to the awake condition, was also confirmed. This indicates that the low-hypnotizable participants indeed could not produce hypnotic responses. They did not experience the hallucinations despite their expectations and the efforts to do so. These results, along with the experimenter’s (AB) inability to identify the low-hypnotizable participants who were instructed to simulate (mimic) hypnotic responses, also support the idea that the findings are the effects of hypnosis per se, rather than experimental demands, situational variables, or expectancies. As in the Barabasz et al. (1999) study, hypnosis produced psychophysiological responses that can be detected by the EEG P300 which can be clearly separated from responses produced by non-hypnotizable simulators who were trying to respond to the identical suggestions and from the EEG P300s of the hypnotized participants elicited without the hypnotic induction.

In this study, we attempted to determine the effects of alternative instructions on EEG P300 visual event related potentials. There was not only a significant difference between the high- and low-hypnotizable participants in the obstructive and negative hallucination conditions but also between the high-hypnotizable participants in the negative hallucination and obstructive hallucination conditions. This indicates that participants who are capable and willing to enter a hypnotic state can perform different kinds of mental tasks when they attempt to block out a stimulus by removing it rather than blocking it out by focusing on something altogether different. These differences
show a physiological difference that occurs only in hypnotizable participants only after a hypnotic induction. However, as elucidated by the Barabasz et al. (1999) experiment, individual differences in P300 can and do occur which are consistent with participants’ interpretations of the suggestions following an hypnotic induction. Two participants reported completely blocking out the stimulus with the negative suggestion and both attenuated rather than exaggerated the P300s. Interestingly, one of these two hypnotic virtuosos showed only minimal attenuation of the P300 with the cardboard box blocking hallucination noting she “could still see the changing lights (flashes from the alternating checkerboard stimulus) around the edges of the box.”

As Spiegel and Barabasz (1988) indicated, these results are of substantial applied significance because they suggest that clinicians should use care in the construction of hypnotic suggestions for their patients. In addition to providing a marker of the hypnotic state, which contradicts socio-cognitive or role play conceptualizations of hypnotic responding, these results are important because they facilitate effective construction of hypnotic suggestions. For example, suggestions that are meant to remove a stimulus still have the participants focus their attention on that stimulus in the first place, whereas focusing the participants’ attention on an alternative blocking stimulus allows the participants to be absorbed in the alternate stimulus. This is consistent with Hilgard’s theory (1977), which describes hypnosis as being involved in focused attention and dissociation which occur when attention is directed at a particular stimulus. The hypnotized individual is absorbed in the stimulus and although multiple stimuli can be presented at a time, a hypnotized individual can focus on a specific stimulus to the point of overlooking other environmental cues or stimuli.

Further research with clinical populations is now needed to help determine the generalizability of our findings to those involved in treatment of medical or psychological conditions. It will be helpful to know which alternative suggestions are more effective with actual patients. Hypnosis has been shown to be an effective adjunct in the treatment of a wide range of disorders. However, this study, consistent with clinical lore, shows that some suggestions may actually perpetuate the problem. Since the data obtained in very recent controlled experiment (Barabasz, 2000) clearly show that the hypnotic induction can produce effects that can not be produced by hypnotic suggestion alone, more research about the effectiveness of alternative hypnotic inductions and alternative hypnotic suggestions is recommended.

References


