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Focused analgesia in waking and hypnosis: Effects on pain, memory, and somatosensory event-related potentials

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Abstract

Somatosensory event-related potentials (SERPs) to painful electric standard stimuli under an odd-ball paradigm were analyzed in 12 high hypnotizable (HH), 12 medium hypnotizable (MH), and 12 low hypnotizable (LH) subjects during waking, hypnosis, and a cued eyes-open posthypnotic condition. In each of these conditions subjects were suggested to produce an obstructive imagery of stimulus perception as a treatment for pain reduction. A No-Analgesia treatment served as a control in waking and hypnosis conditions. The subjects were required to count the number of delivered target stimuli. HH subjects experienced significant pain and distress reductions during posthypnotic analgesia as compared to hypnotic analgesia and between these two analgesic conditions as compared to the two control conditions. Outside of hypnosis, these subjects remembered less pain and distress levels than they reported during hypnotic and posthypnotic analgesia treatments. In contrast, for waking-analgesia treatment, HH subjects remembered similar pain and distress levels to those they reported concurrently with the stimulation. HH subjects, during hypnotic and posthypnotic analgesia treatments, detected a smaller number of target stimuli and displayed a significant amplitude reduction of the midline frontal and central N140 and P200 SERP components. No significant SERP differences were observed for these subjects between treatments in waking condition and between hypnotic and posthypnotic analgesic treatments. For the MH and LH subjects no significant N140 and P200 amplitude changes were observed among analgesic conditions as compared to control conditions. These amplitude findings are seen as indicating that hypnotic analgesia can affect earlier and later stages of stimulus processing.

Keywords: Pain; Hypnosis; Analgesia; Pain sensation; Pain memory; Somatosensory event-related potentials; N140; P200

1. Introduction

Previous findings have shown that obstructive hallucinations of noxious stimulation in hypnosis reduce pain sensation (for reviews see, [8,30]) and the amplitude of a later P300 component of the SERPs [14,15,48], indicating that the locus of hypnotic influence is not in the initial sensory experience itself, but rather in the cognitive-emotional component of the information processing. However, more recent EEG findings have also evidenced that focused analgesia, in hypnosis, may reduce a stimulus-locked 40 Hz-EEG synchronization response [12] that is believed to reflect perceptual aspects of stimulation [1]. Therefore, the main aim of the present study was to further evaluate the modulatory effect of hypnotic analgesia on both the earlier N140 and later P300 component of the SERPs, the former believed to be more stimulus orientated and the latter expression of the ongoing cognitive-emotional processing (e.g., [26]). The study was devoted to address a very important and controversial question concerning the impact of hypnosis on the response to suggestions (see [38]). This was carried out by comparing the effects of an analgesia suggestion, administered during a non-hypnotic waking

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condition, with those obtained delivering the same suggestion just after the induction of hypnosis and, later, after a cued posthypnotic condition that is believed to produce a deeper hypnosis [2].

A typical characteristic of the deeply hypnotized individual is the appearance, spontaneously upon emerging from hypnosis, of an apparent amnesia for that which had occurred while in the hypnotic state (posthypnotic amnesia). There seems to be a general agreement that posthypnotic amnesia is not the same as simple forgetting [27,44], and that it is a product of hypnotic suggestion, direct or implicit [32–34,37,52], and also a product of dissociation [21,60]. No reports are known to us evaluating the effect of spontaneous posthypnotic distortion of pain memory. Thus, a further purpose of the present study was to evaluate, upon emergence from hypnosis, the degree in which retrospective pain and distress ratings are spontaneously distorted, and whether these distortions are modulated by individual differences in hypnotizability. The rationale for this evaluation is based on results of previous studies showing that memory distortion of pretreatment pain contributes to an exaggeration of self reports of pain relief [13,22,29,39,40].

Further aim of the present investigation was to evaluate whether: (1) in HH individuals, the analgesic suggestions are more effective following a formal hypnotic induction (hypnotic and posthypnotic conditions) than in the waking condition; (2) pain reduction during hypnotic and posthypnotic analgesia conditions is accompanied by an attenuation of the N140 and P200 peaks of the SERPs.

2. Methods

2.1. Subjects

Thirty-six right-handed undergraduate students (18 women and 18 men; age range 19–28 yr) were selected for high ($N = 12$; 6 women and 6 men), medium ($N = 12$; 6 women and 6 men), and low ($N = 12$; 6 women and 6 men) levels of hypnotic susceptibility. The subjects were tested using the Italian translation by [57] of the Stanford Hypnotic Susceptibility Scale, Form C (SHSS:C; [16,59]). They were categorized as being HH subjects ($N = 12$, $M = 10.5$, $SD = 0.7$) or LH ones ($N = 12$, $M = 2.9$, $SD = 1.5$) when their scores on SHSS:C were, respectively, 1 SD above or below the group mean of a larger group of subjects ($N = 105$, $M = 6.8$, $SD = 3.9$; 65 women and 40 men). The moderately hypnotizable group was formed with subjects who showed hypnotizability scores 1 SD within the group mean ($N = 12$, $M = 6.3$, $SD = 0.8$). Two female hypnotists carried out the assessment of hypnotic susceptibility about 20 days prior to the EEG recording session. In this session, hypnosis was induced again by one of the two hypnotists who did not know the hypnotizability level of the subject. Subjects were admitted to participate in the experiment only if they reported an absence of medication use or medical conditions that might interfere with pain sensitivity (e.g., diabetes mellitus, high blood pressure, heart diseases, asthma, post trauma to hands, frostbite, arthritis, Raynaud's syndrome). Subjects were not informed of their hypnotic ability and of the relevance of hypnotic ability in the experiment. Women who were in a menstrual period were invited for EEG recordings in another occasion.

2.2. Procedure

The selected subjects were individually invited in the EEG lab and upon arrival they were informed about the nature of the painful electric stimulation. In accordance with the ethical norms of the Italian Association of Psychology (AIP), a written consent was obtained if they agreed to participate in the experiment. In this session, hypnosis was induced for the second time using an Italian translation of the original American protocol of the Stanford Hypnotic Clinical Scale (SHSC; [42]). The subjects were not informed about their hypnotizability level during the EEG recording session and were all naïve volunteers.

2.3. Pain treatments

During waking and hypnosis conditions, the following five pain treatments were administered to each subject: (1) Waking-Pain (No-Treatment: W-Pain). Subject was required to detect target painful stimuli (eyes-open) without giving suggestions to reduce pain. (2) Waking-Analgesia (W-Analgesia). Suggestion to produce an obstructive imagery of stimulus perception by imagining a glove that was covering the finger and the hand and focusing on sensation in the finger and hand and experiencing that all sensations of the stimulated finger will be attenuated (eyes-open). (3) Hypnosis-Pain (No-Treatment: Hy-Pain). At the end of hypnotic induction and hypnotic testing, painful stimuli were delivered without suggestions to reduce pain (eyes-closed). (4) Hypnosis-Analgesia (Hy-Analgesia). In hypnosis condition was given an analgesia suggestion as in (2) (eyes-closed). (5) Post Hypnosis-Analgesia (P.Hy-Analgesia). Just before getting out from hypnosis, the subject was suggested that he/she will tend to sink deeper and deeper into involvement in the hypnotic state with open eyes, after that the experimenter will have knocked two times on the wall of the sound proof box ('fractionation technique', see Barabasz and Watkins, 2005; p. 193). When the subject was just out from hypnosis, the experimenter knocked two times and suggested to the subject that he/she was going into a deeper hypnosis state and the above-reported analgesia suggestion was administered. At the end of P.Hy-Analgesia treatment, the subject was waked up from hypnosis. Both waking and hypnosis conditions were counterbalanced across subjects in order to avoid possible order effects or habituation. Within each waking or hypnosis condition, the order of the treatments was not varied to prevent for a proactive effect of suggestion. Between waking and hypnosis conditions, a resting period of 12 min was given. In each condition, the subject was asked to count the number of delivered target stimuli.

Each treatment condition lasted about 5 min. Painful stimuli were applied to the subjects middle finger of the right hand and, at the end of each condition, they were asked to rate any