**THE USE OF HYPNOSIS IN MEDICINE: FROM NEUROSCIENCE TO CLINICAL PRACTICE**

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**Abstract**

Hypnosis as a neurophenomenon has occupied curious minds since the dawn of time. While some still approach the topic with suspicion, hypnosis traces its roots back to ancient civilizations. Recorded history provides us with insight into religious use of hypnosis, whilst modern neuroscience shows an interest to elucidate its neurobiological background. Throughout the years, the idea of hypnotic practice hasn’t been abandoned but has gradually proved its clinical utility in multiple health conditions. The use of modern research techniques like fMRI and the discovery of several functional brain networks (executive control network, salience network, and default-mode network) enabled scientists to define hypnosis as a different state of consciousness. This article gathers the most relevant findings in neurophysiology of hypnosis and highlights hypnosis as a possible supplement therapy in pain alleviation. Recent findings suggest that a hypnotic state alters both perceived pain intensity and expected pain unpleasantness based upon our memory of a painful experience. Altogether, these findings introduced the clinical implementation of hypnosis as a pain-alleviating tool in various medical conditions, some of them described in this article. Furthermore, while being in a hypnotic state, people could successfully stop smoking or resolve their phobias. Finally, this article gives an overview of forensic use of hypnosis when the witness or victim experienced a trauma which distorted his or her memory of the event.

**KEYWORDS:** fMRI, hypnosis, neuroscience, pain management

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**WHAT IS HYPNOSIS?**

The British Society of Clinical and Academic Hypnosis and the American Psychological Association accept a few different definitions of hypnosis, mostly containing the following: “a procedure during which a health professional or researcher suggests that a patient or subject experience changes in sensations, perceptions, thoughts, or behavior.” Hypnosis induces a state which includes the following three subjective components: absorption, dissociation and suggestibility. Absorption refers to the ability of one’s mind to highly focus on the present moment. In other words, a person has a tendency to be fully involved in a current experience. Dissociation manifests itself when a person unintentionally separates sensations that take place in the moment. Absorption together with dissociation enables high concentration on a particular item and therefore, the mind doesn’t wander nor interfere with peripheral awareness. Suggestibility is concisely defined as an individual’s ability to respond to hypnotic suggestions and enter the hypnotic state.

There is still an ongoing debate whether hypnosis induces an altered state of consciousness or is it just a placebo effect and the product of expectations. In a series of studies participants who experienced hypnotic states reported higher degrees of mental ease and automaticity (a reduction in spontaneity), as well as decreased self-orientation and perception of time compared to non-hypnotic state. Hypnosis can also alter an individual’s sensory experience, motor and emotional control, causing changes in an individual’s mental structure.
Numerous experimental and clinical studies have tried to explain the neural pathways and mechanisms underlying hypnosis. Due to its complex nature, hypnosis still remains an enigma. However, some relevant findings have been reported in the last few decades. Researchers who have measured changes in brain activity among healthy volunteers during hypnosis found an increase in left-sided occipital, parietal, precentral, premotor, ventrolateral, and prefrontal cortices, right-sided occipital and anterior cingulate cortices, while a decrease of activity was observed in precuneus, bilateral temporal, medial prefrontal, and right premotor cortices. In fact, increased brain activity is related to the metabolic boost of these particular areas. The boost is an outcome of a 16% increase in supplementary regional cerebral blood flow (rCBF), especially in frontal and right temporal regions. Moreover, decreased rCBF in the brainstem may suggest that attenuated activity of cholinergic nuclei within the brainstem also plays a role in hypnosis.

The literature indicates that individuals differ in their ability to respond to hypnotic suggestions and enter a hypnotic state – highly hypnotizable subjects (HHS) and low hypnotizable subjects (LHS). HHS present with four different states during hypnosis: relaxation-induction-suggestion-waking up. Moreover, experts claim that it is simple to predict suggestibility of an individual – one that is more responsive to suggestions outside hypnosis will also be the one easily induced in hypnosis. Furthermore, structural MRI studies revealed a difference in size of the anterior part of corpus callosum, named rostrum, comparing HHS to LHS. HHS demonstrate a 32% larger rostrum and, consequently, better connection between prefrontal cortices. As far as EEG is concerned, studies have shown predominance of alpha activity in the left hemisphere, and over anterior regions of cortex in HHS. In addition, studies suggested that HHS have more labile fronto-parietal networks and are thereby more responsive to hypnotic induction due to lower fronto-parietal alpha synchronization during hypnosis. Regarding other EEG rhythms, it seems that HHS are characterized by lower beta and delta activity, while theta power is increased during hypnosis in general, implying amplification of attention.

The latest publication from Oxford University regarding the SN is conceived to examine functional connectivity among three brain networks that might engage in mechanisms underlying hypnosis. Those three networks are the most important in maintaining resting-state brain activity and include: the executive control network (ECN), salience network (SN), and default mode network (DMN). The ECN comprises the dorsolateral prefrontal cortex (DLPFC) and superior parietal cortex which activate during attention-related as well as working-memory tasks. Similarly, the SN plays a crucial role in distinguishing a spectrum of endogenous and external stimuli in order to keep attention only on the relevant ones. It typically activates when one is in danger or anxious, which shows us its evident evolutionary significance. Notable regions of the SN are the anterior insula (AI) and dorsal anterior cingulate cortex (dACC), together with several subcortical structures (e.g. amygdala). The DMN is a recently discovered brain system that plays a great role in self-related cognition and activates when “individuals are engaged in internally focused tasks including autobiographical memory retrieval and envisioning the future.” The DMN consists of a set of midline brain structures and the preeminent posterior cingulate cortex (PCC). Based on previous scientific speculations, this particular research has hypothesized that HHS when hypnotized would show: decreased activity in the dACC (as the central node of the SN); increased connectivity between ECN regions and SN attentional control regions; decreased connectivity in the DMN. Indeed, the Oxford study using fMRI has confirmed that under hypnosis highly hypnotizable individuals display reduced dACC activity and enhanced linkage between the ECN and SN (insula portion). It has also showed higher overall variability in connections between the ECN, SN and DMN among highly hypnotizable individuals. Reduced dACC activity manifests as higher suggestibility, while enhanced linkage between the ECN and SN, especially the dopamine-rich DLPFC and dACC may modify our attention and emotional perception towards external or endogenous stimuli. This intensified relation could have been predicted due to the increased levels of homovanillic acid (a dopamine metabolite) found in cerebrospinal fluid among highly hypnotizable subjects in earlier studies. Furthermore, outcomes suggest a negative correlation between hypnotic state and ECN-DMN connectivity, which is displayed as reduced self-reflection during hypnosis. Although prior works have stressed thamentioned self-identification during hypnosis appears...
The use of hypnosis in medicine: from neuroscience to clinical practice. pp. 207 – 215

HYPNOANALGESIA

As announced in the introduction, in this article we focus on the possibility of lessening a wide spectrum of different types of pain with hypnosis as an adjunct therapy.

Pain is an unpleasant somatic and emotional sensation that is hard to measure due to its subjective component. Even when a person thinks of experiencing pain or feels under threat of pain, the sympathetic nervous system activates as a defence mechanism. Studies have proved that the same physical stimulus evokes different sensations and responses among different individuals. Affective perception of pain reflects differences in pain threshold, mediated mainly by the medial thalamic nuclei, prefrontal cortex and limbic system through spinoreticular, spinohypothalamic, and spinopontoamygdaloid pathways. Those variations can be seen in fMRI as divergences in cortex activation (primary somatosensory cortex; anterior cingulate cortex and prefrontal cortex) (Figure 2). If, when suffering from pain, the subject is exposed to hypnotic suggestion (to either increase or decrease pain unpleasantness), it significantly changes the subject’s sensation of pain. The phenomenon is noticed as an alteration in anterior cingulate cortex (ACC) activity and it varies upon hypnotic suggestions. The ACC serves as an input modulator which merges perceptions of pain from the somatosensory (pain intensity) and prefrontal (memory, long-term pain effects) cortices. If hypnotic suggestions propound to increase or decrease pain intensity, alterations are seen in the somatosensory cortex. Those observations lead us to the impressive conclusion that hypnotic suggestions alter pain unpleasantness as well as pain intensity and can change the activity of both the ACC and the somatosensory cortex (Table 1). However, experts disagree when it comes to the possibility of individuals under induced hypnoanalgesia to discriminate between those two pain dimensions (pain unpleasantness and pain intensity). Nevertheless, it is doubtless that an induced hypnotic state without hypnotic suggestions doesn’t cause hypnoanalgesic effect (Figure 3). 9

HYPNOSIS IN MEDICAL PRACTICE

Even though hypnosis as a neurophenomenon is often compared to meditation and other modified states of consciousness, it never occurs voluntarily or as a spontaneous (patho)physiological phenomenon. It is a product of hypnotic suggestions and can be induced quickly and painlessly. Hypnotic suggestions have been used in medical practice since its earliest days. It is interesting how one of the first publications on using hypnosis for pain relief in clinical practice was authored by the famous Santiago Ramón y Cajal. Numerous studies have highlighted beneficial effects of hypnosis in various clinical situations, such as treatment of pain, childbirth, gastrointestinal disorders, skin conditions,

post-surgical recovery, treatment of phobia, depression, anxiety, psychosomatic, post-traumatic, and dissociative disorders. Considering its limits, it is important to emphasize that hypnosis may not be useful for all medical conditions. Moreover, experts have agreed that clinical hypnosis is neither a type of psychotherapy nor a cure itself, but a therapeutic method that can facilitate the main type of treatment if conducted by properly educated professionals.

### HYPNOSIS FOR SMOKING CESSATION

Cigarette smoking is a leading preventable cause of disease and a leading cause of premature death. It blights nearly every organ of the body and is a leading risk factor for chronic obstructive pulmonary disease, cancer and vascular disease and increases risk for pregnancy complications.10 Most smokers are aware of the negative sides of smoking and many of them express a desire to stop this bad habit but they can rarely achieve it independently (Figure 4). There have been several approaches in helping people to stop smoking: using pharmacologic substances such as nicotine patches or non-pharmacologic counseling, acupuncture and more recently hypnosis.

Nowadays, hypnosis is becoming a more widely used, adaptive method for smoking cessation. Treatment procedures last 5–8 sessions from 60 to 90 minutes. It starts with inducing a light state of trance by directing the patient’s attention to his breathing. As the state deepens the hypnotherapist uses suggestions to provide dissociation between smoking and nonsmoking. For instance, one arm is light weighted, symbolizing freedom while the other arm feels heavy and represents a burden. Furthermore, patients consider good and bad sides of smoking and are led into imagining a smokeless future while stimulating their self-confidence.
and the sense of independence. They are instructed to do self-hypnosis and relaxation whenever the situation is stressful or difficult for them.11,12

A lot of studies have been conducted about the potential effectiveness of hypnotherapy. One of the earliest studies from 1975 carried out a trial of three approaches: hypnosis and counseling, hypnosis alone, and counseling alone. The combination of hypnosis and counseling provided most promising results with an abstinence rate of 50% after 10 months. In other studies hypnosis alone varies from 12–19% of success. Some scientists proposed the idea of group treatment suggesting that this approach will give even better results. Surprisingly, no major statistical difference was found between group and individual treatment.11 Based on the overall results, hypnotherapy has provided benefit to some smokers but most of the studies had their limitations thus further research using controlled trials is necessary.12

HYPNOTHERAPY OF MULTIPLE SCLEROSIS

As a chronic condition that has no definitive and successful therapy, multiple sclerosis continues to be a very difficult disease to live with. Furthermore, over 50% of patients suffer from chronic pain, which is linked with depression, functional impairment, and fatigue. Studies have shown that a different approach, in which hypnotic suggestions were used, could lessen progressive MS symptoms and improve patients’ quality of life. A case study by Sutcher was one of the first studies that attempted to objectivize the improvement of physical symptoms in patients, which include drooling, inability to move an extremity, balance loss, speech impairment, spasticity, and pain.13 In conclusion, it was shown that hypnotic suggestions improved both psychological and physical symptoms in subjects with progressive MS. As a classic hypnosis session with a qualified therapist has some limitations, patients are encouraged to train and practice self-hypnosis outside of sessions. Additional studies explored the concept of using self-hypnosis as opposed to progressive muscle relaxation (a treatment in which the participant progressively tightens and relaxes different muscle groups in the body).14 Patients with multiple sclerosis were divided into controlled groups to research the additional benefits that this type of treatment could bring. Current pain intensity rating was reviewed both before and after the treatment, along with daily pain intensity which was assessed between the treatments and during the 3-months follow-up. The results indicated that both self-hypnosis and progressive muscle relaxation result in pain reduction, while patients who received hypnotic analgesia showed an increase in hours of pain relief. As the results of these studies show, hypnotic analgesia has multiple benefits for people that suffer from chronic pain, including those with MS, so researchers sought to further enhance the effect on pain intensity. Therefore, it was investigated if some other techniques combined with hypnosis could improve pain reduction. Some techniques that have been proven to amplify the effect of hypnotic analgesia are EEG neurofeedback and cognitive restructuring.15,16 The use of neurofeedback training increased the number of participants who benefited from self-hypnosis and gave more people an opportunity to overcome their chronic pain for a longer period of time.16 In contrast, cognitive reconstructing technique allowed the patients to come to terms with their disease and pain while also declining the level of catastrophizing (the tendency to focus on pain and evaluate it in an unrealistic and thoroughly negative light).16

HYPNOTHERAPY OF PHOBIA

A phobia is an excessive and irrational fear reaction. It is a type of anxiety disorder due to a constant fear of an object or situation. The diagnostic criteria claim that the fear is present for more than six months and causes significant life imbalance in an attempt to avoid certain situations or objects.17 Often phobia emerges as a panic attack with features such as tachycardia, dyspnea, inability to speak, gastrointestinal distress, chest tightness (Figure 5). Treatment for phobias comprises pharmacologic measures for severe pathologies or, more commonly, a nonpharmacologic behavioral approach.

In recent years, a new approach for treating phobias came into focus which integrated cognitive, behavioral and hypnotic techniques also known as cognitive-behavioral hypnotherapy.

Figure 5. While being in a hypnotic state, people can successfully resolve their phobias. Source: Photo “scream” by Clara Jordan on Flickr. Available under the CC-BY-SA 2.0 Generic license (https://creativecommons.org/licenses/by-sa/2.0/).

Studies have shown that this integration provides a more productive treatment than any approach alone. The first step is to manage resistance to treatment and develop a personalized relationship which includes support and ego recruitment. Thereafter, the therapist induces hypnosis for relaxing and enhancing concentration. In the state of trance, the patient is encouraged to develop a sense of mastery over the problem which is accompanied by physical relaxation. This way, the therapist constructs hypnotic suggestions which help the patient not to ignore or avoid the problem, but how to cope with it from a new point of view. Subsequently, after few sessions, the patient is exposed to specific phobia in vivo. The key to the treatment is to undergo imagined and real-life exposure because in many cases the therapy alone was insufficient without such exposure. Lately, some studies have demonstrated equal or even better efficacy with a combination of computer-based virtual reality exposure therapy and hypnotherapy.

Currently, there are too many variables which affect research such as patient’s expectations about hypnosis, his hypnotic receptiveness and imaginative skills. Clinical guidelines have to be established in order to provide standardized and effective treatments. In conclusion, therapy of phobia continues to be a work in progress.

VIRTUAL REALITY AND HYPNOSIS

While the use of virtual reality (VR) as a therapeutic tool is relatively new in the scientific field, it has been proven in recent findings that its usage has a wide range in the medical domain. Although hypnosis as a pain management treatment is not broadly used due to several limitations, scientists aspire to integrate VR and hypnosis in the hope of creating a therapy that would affect all patients, regardless of their susceptibility to hypnosis. Virtual reality hypnosis could compensate the lack of imaginative absorption (a term used for subjects with low capacity to create mental imagery) while also providing the subject with vivid visual and audio stimuli. The virtual reality technology in recent studies mostly uses the Snow World environment, where participants immerse in exploring the virtual snow canyon while throwing snowballs and meeting icemen, penguins, and mammoths on the way. This type of VR distractions is combined with hypnotic suggestions in hope of boosting the effect of hypnotic analgesia. (Figure 6). The study conducted by Askar, Patterson and Sharar in the treatment of acute pain in patients situated in the burn unit showed a drop in the time patients spent thinking about their pain, with decreases in worst pain and anxiety scores. In addition, there was a 50% reduction in the amount of opioids required for the treatment, which proved the combination of VR and hypnosis has a certain amount of analgesic effect on the subjects. Further studies were carried out in controlled groups of volunteers that were assigned to four groups; the first group had received only VR distraction, the second only hypnotic treatment, the third both VR and hypnosis, while the fourth group was control and received neither. The parameters that were observed were cortisol level, changes in sleep patterns, mood, and pain reduction. The studies have shown that VR, whether in combination
with hypnosis or not, reduced the pain in participants regardless of their level of hypnotisability. Furthermore, it has been proven that the virtual reality technology could help individuals who have trouble with visualization. In conclusion, while VR hypnosis has the potential to be used in acute pain management and mood disorders, subsequent studies should be conducted to examine its effect on chronic pain management.

HYPNOSIS IN FORENSICS

Can hypnosis improve memory recall? According to the latest studies, the effect of hypnotic therapy on the academic performance of students is not very promising, it even showed that the group who received no intervention had better results. However, successful use of hypnosis in forensic purposes in investigation processes has been recorded. Hypnosis in the field of law enforcement is used only in certain limited cases (murder, kidnapping, bombings) (Figure 7). In the 19th century, the first legal cases which included posthypnotic testimonies were reported and just in 1976 the FBI developed a training program for using forensic hypnosis.

The hypnotic interview is recorded in both audio and video format. The witness or victim signs an informed consent, while the mental health professional conducts the hypnotic induction: relaxation, deep breathing, pleasant imagery not related to the incident. Furthermore, the crucial aspect is how the questions are asked with minimal influence on an interviewee’s memory. Asking “open ended questions” simply encourages the witness or victim to explain what happened in their own words. Forthright questions for details are avoided. The health professional deepens compliancy during hypnosis if needed and confronts the interviewee with emotional reactions. Hypnotic deepens compliancy during hypnosis if needed and confronts the interviewee with emotional reactions. Hypnotic interviews are not the standard everyday procedure for gaining information about a crime scene, rather they are the last attempt if nothing before succeeds. Extra precautions must be taken if the victim or witness was a subject to traumatic event. In addition, hypnosis can even distort memory consequently misleading the investigation. The information obtained from forensic hypnosis can be considered accurate and reliable if they are consistent with previously gathered evidence.

Despite memory imperfection and general public skepticism about hypnosis, more often than not it provided a valuable contribution to investigations helping the witness or victim refresh their memory. Nevertheless, the procedure must be done impeccably, following the guidelines set by experts.

CONCLUSION

The disclosure of neurobiological background of hypnosis provides us with insight into unrealized potential of hypnotic therapy in medical practice. Clinical studies have shown increased efficacy in standard therapy of various cases when combined with hypnotherapy as a complementary therapy, especially when it comes to chronic pain treatment. Whether positive clinical outcome is just a placebo-linked effect or it specifically originates from hypnosis, is still open to question. Nevertheless, modern medicine is reopening its doors to one of the most intriguing neurophenomena of human history.
References:


HIPNOZA U MEDICINI – OD NEUROZNASTVENIH TEORIJA DO KLINIČKE PRAKSE

Sažetak

Hipnoza je, s neuropsihijatrijskog gledišta, zaokupljala znatiželjne umove još od davnina. Unatoč tome što mnogi skeptično govore o hipnozi, ona se prakticirala još u drevnim civilizacijama. Povijesni dokumenti daju nam uvid u upotrebu hipnoze u religiozne svrhe, dok moderna neuroznanost nastoji otkriti njezine neurobiološke temelje. Ideja o korištenju hipnoze u medicinske svrhe nije s godinama napuštena, već je polagano potvrdila svoju kliničku vrijednost u brojnim zdravstvenim problemima. Suvremene istraživačke metode poput funkcionalne magnetske rezonancije i otkrića funkcionalnih neuronskih mreža važnih za izvršne funkcije i usmjeravanje pažnje pomogle su znanstvenicima definirati hipnozu kao sredstvo za umanjenje bolja u različitim stanjima od kojih su neka opisana u ovom radu. Osim toga, hipnoza bi mogla pomoći ljudima koji žele prestati pušiti u ostvarenju njihovog cilja, jednako kao što bi ljudima s fobijama pomogla riješiti se straha. Konačno, ovaj rad obrađuje i upotrebu hipnoze u forensici kada se nastoji pomoći žrtvi ili svjedoku da točnije rekonstruira traumatični događaj važan za istragu.

KLJUČNE RIJEČI: fMRI, hipnoza, neuroznanost, zbrinjavanje boli

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FIND OUT MORE:

Further reading about one of the pioneers exploring benefits of hypnosis in clinical practice, especially pain relief – Santiago Ramón y Cajal
Mlinarić I. Santiago Ramón y Cajal. Gyrus. 2015;2(3):XVI.
Available from:

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