American Journal of Clinical Hypnosis
46:2, October 2003

The Science of Meditation and the State of Hypnosis

Jean Holroyd
University of California, Los Angeles

Two aspects of Buddhist meditation—concentration and mindfulness—are discussed in relationship to hypnosis. Mindfulness training facilitates the investigation of subjective responses to hypnosis. Concentration practice leads to altered states similar to those in hypnosis, both phenomenologically and neurologically. The similarities and differences between hypnosis and meditation are used to shed light on perennial questions: (1) Does hypnosis involve an altered state of consciousness? (2) Does a hypnotic induction increase suggestibility? I conclude that a model for hypnosis should include altered states as well as capacity for imaginative involvement and expectations.
Keywords: altered state, Buddhism, hypnosis, meditation, neurophysiology, phenomenology, suggestibility,

Questions About Altered States

There are a couple of perennial questions in the area of hypnosis: (1) Does it involve an altered state of consciousness? (2) Does an induction increase suggestibility? Review of the similarities and differences between hypnosis and meditation leads me to conclude that traditional meditation literature and contemporary meditation research can shed light on both of these questions.

An altered state of consciousness may be defined as "a qualitative alteration in the overall pattern of mental functioning such that the experiencer feels his [or her] consciousness is radically different from the 'normal' way it functions" (Tart, 1972, as cited in Pekala & Cardena, 2000, p. 95). Most psychologists surveyed in the Division of Psychological Hypnosis of the American Psychological Association agreed that hypnosis does entail an altered state (Kirsch, 1993). Yet the Division developed a definition that clearly did not rely on an altered state of consciousness. "Hypnosis is a

I would like to thank two Pali language and Buddhism scholars for their review and clarifying suggestions: Roderick S. Bucknell at the University of Queensland, Brisbane Australia, and Jason Siff at the Meditation Project, Idyllwild, California. Correspondence by e-mail may be sent to *holroyd@ucla.edu*.

procedure during which a health professional or researcher *suggests that* a client, patient, or subject experience changes in sensations, perceptions, thoughts, or behavior ..." (emphasis added; Executive Committee of the American Psychological Association Division of Psychological Hypnosis, 1993, p. 7).

Consider also the second question. When I started doing hypnosis I thought, well of course hypnosis induction increases suggestibility, but most evidence suggests otherwise. Although hypnotic induction may increase scores on hypnotizability tests, Hilgard's (1965) data showed that on average the increase was not much. An induction increases scores *significantly* for only a few people (Barber, 2000). In fact, waking suggestibility accounts for most responses to hypnotic suggestion on hypnotizability tests (Braffman & Kirsch, 1999). The scales measure suggestibility rather than hypnotizability, according to Weitzenhoffer (2002), one of the principal scales' developers.

How Meditation Can Inform About Hypnosis

Like the attentional focus procedures in hypnosis, many kinds of meditation—Buddhist, Christian, Hindu, and Jewish—emphasize concentration and letting go of thoughts. Buddhist meditation includes, in addition, mindfulness practice. While concentrative practice focuses attention and shifts it to more subtle experiences in order to let go of thoughts, mindfulness meditation trains participants to observe the rapidly shifting panorama of sensations, thoughts, emotions, etc., and to describe mental activities and states in great detail (Shear & Jevning, 1999; Wallace, 1999). Both are cultivated and work together synergistically. This article deals mostly with Buddhist meditation because both aspects can contribute to our understanding of hypnosis, and there is an extensive written record of the procedures.

Concentration, or *samadhi* in Pali (a dead language associated with ancient Buddhist texts) aims for serenity and leads to altered states of consciousness, at least one of which resembles deep hypnosis. These altered states, called the Absorptions (*jhanas*), demonstrate cognitive, emotional, and motivational changes as they increase in depth (Bucknell, 1993; Gunaratana, 1988). Mindfulness (*sati*) aims for insight (*vipassana*) through observation of one's own mental processes and altered states of consciousness. Vipassana meditation has been used in behavioral medicine and pain management programs, to teach patients to objectify their sensations and thereby become less reactive (Kabat-Zinn, 1982). Mindfulness practice is the basis for referring to the "science" of meditation in the title of this article.

Observation of one's own mental processes has been relatively neglected in hypnosis research, despite the fact that altered states usually are first identified by subjective experiences. Although we have at least two methods for assessing qualities of inner experience (the *Phenomenology of Consciousness Inventory* or PCI [Pekala, 1991; Pekala & Kumar, 2000] and the *Experience Analysis Technique* [Sheehan & McConkey, 1982]), they have been underutilized. Even these useful instruments do not address important questions about qualitative changes in hypnotic state within a session. For example, hypno-analgesia is related to depth, which varies in quantity and quality during the course of a surgical procedure.

Information about inner experience is lost to us in most hypnosis studies, because investigators stop at the point of identifying hypnotizability of the participants.

By this failure to attend to inner experience, we miss a lot of information that could help us understand what actually happens in hypnosis, including *qualitative* shifts as one goes deeper. Qualitative shifts are seen in other brain states such as sleeping and dreaming and are documented in concentrative meditation literature. This kind of information would not be picked up when a hypnotist asks, "How deep are you, on a scale of 1 to 10?"

Phenomenological descriptions of changing inner states which are subject to "temporal flux" can be buttressed by neurophysiological data (Lloyd, 2002). In consciousness studies, this has given rise to a new field called neurophenomenology (Varela, 1996). Modern neurophenomenological research on meditation, as well as the ancient Buddhist texts on concentrative practices, have the potential to advance our understanding of altered states and suggestibility in hypnosis.

This article pertains to main line or traditional Buddhist concentrative meditation practices, from the earliest Pali texts on meditation, not the later-appearing Zen or Tibetan meditation practices (although some of the neurophysiological research involves people from those traditions). After reviewing the similarities and differences between hypnosis and meditation, I will return to a consideration of whether hypnosis involves an altered state of consciousness, and whether a hypnotic induction influences suggestibility.

Similarities between Hypnosis and Concentrative Meditation

Classical hypnosis and concentrative meditation are similar in the attentional and concentration practices employed that result in altered states; in the phenomenology of those altered states; and in the neurophysiology associated with those states.

Attentional and Concentration Practices

Both hypnosis and meditation begin with attempts to relax and concentrate the mind by focusing attention. Instructions from 2000 year old texts read, "[The monk] trains thus: 'I shall breathe in tranquillising the body' (lit. bodily formation); he trains thus: 'I shall breathe out tranquillising the body' (lit. bodily formation)" (Nanamoli & Bodhi, 1995, Sutta 118). Buddhist texts list many targets (*kasinas*) for focusing the attention: things like colored disks, elements in nature, etc. (Nanamoli & Bodhi, 1995, Sutta 77). Meditators today most commonly focus on the breath. In hypnosis focusing and sustaining attention might mean staring at a spot, watching a swinging pendulum, or focusing on the suggestions themselves. (If the suggestion is that one's arm is becoming lighter and lighter, attention is focused inward to almost subliminal experience of physical movement.)

The process used to reach the state has been described in the hypnosis literature as dis-attending to competing stimuli (Crawford, 1994), or suppressing competing thoughts (David & Brown, 2002). In the meditation literature, Ayya Khema described it as letting go of thoughts and perceptions (Khema, 1997).

The Altered States

Weitzenhoffer, an early contributor to scientific hypnosis through development of the Stanford scales (Weitzenhoffer & Hilgard, 1959; Weitzenhoffer & Hilgard, 1962) recently emphasized that "hypnosis" *means* "altered state" (Weitzenhoffer, 2002). He claims that what we do—"hypnotism"—means something entirely different—it means

giving suggestions after you think a person is in the state of hypnosis. A dearth of scientific investigation of altered states in hypnosis is one motivation for examining altered states in meditation.

Buddhist texts stated that meditators should be able to use concentration to enter and *stay* in several different altered states, and should know when they were in them and when not in them. To that end, the processes for accessing them and the resulting mental characteristics were clearly described. The Buddha resorted to these Absorptions in his late life for control of pain, and at the time of his death from food poisoning, he repeatedly entered and came out of the eight successive levels.

The Absorptions reached through concentration illustrate how *qualitative* changes can be specified. Different translations of the ancient texts (*suttas*) have led to different emphases (Bucknell, 1993; Gunaratana, 1988; Khema, 1997; Nanamoli & Bodhi, 1995, Sutta 30; Thanissaro, 2002), but the progression follows the approximate (and greatly oversimplified) course indicated in Figure 1. Entering hypnotic trance is similar to moving through the first four Absorptions, both mentally and neurologically, as will be demonstrated in this article.

The movement from normal everyday mind, with thoughts prevailing, to absence of thoughts with equanimity prevailing, occurs in the first four Absorptions (Figure 1). Basically, the meditator focuses attention first on an object and then on increasingly subtle experiences, while abandoning more and more of the phenomenal field. The meditator moves through a stage of aroused positive emotion with attendant physical experience to a more peaceful happy feeling, and then to equanimity (lack of emotional reactivity). The Fourth Absorption is characterized by peaceful feelings of equanimity and a still, but very much aware, mind—much like what is found in deep hypnosis.

If one should meditate deeper and reach Absorption levels five through eight (not emphasized in most practices), one would drop more and more awareness of the environment and lose the sense of a separate self. The meditator progressively lets go of awareness of physical sense perceptions and space, psychological (or consciousness) boundaries, and eventually of awareness itself. It is in these deeper states that mystical experiences are encountered in the context of meditation (Laski, 1961; Merkur, 1999; Forman, 1999) and occasionally also in hypnosis.

Every meditator developing the Absorptions would have trained to recognize these states and be able to report on the presence or absence of mental qualities such as associative thinking, feelings of joy or rapture, feelings of equanimity, etc. Even though mindfulness is not the principal goal in concentrative meditation, it is in fact facilitated as the mind becomes quiet. This enables the meditator to observe the qualities of the trance state and report back on it, in contrast with the limited report of “deep,” or “eight on a scale of one to ten,” that may be reported by people in hypnosis. A more extensive analysis of processes in concentrative meditation, particularly from the Tibetan Buddhist tradition, may be found in Brown (1977).

Phenomenology of Hypnosis and Meditation

Focusing and sustaining attention in both hypnosis and meditation leads to similar changes in mental state. Two experiments give relevant information. High hypnotizables were studied in one experiment (Cardena, 2003); Indian Kundalini meditators in the other (Venkatesh, Raju, Shivani, Tompkins, & Meti, 1997). Both used

Figure 1: Mental Qualities of the First Four Absorbtions (*Jhanas*)

	First Absorption	Second Absorption	Third Absorption	Fourth Absorption
Meditator's Process	Focus attention on object	Let go of thought	Let go of delight, zest, bliss	Let go of happiness, well being, ease; let go of pain
	Thought[1] (*Vitakka*/*Vicara*)[2]	**Oneness of mind or concentration** (*ekodibhava*) Tranquility (*Sampasadana*)	— — — —	— — — —
	Delight, zest, bliss (*Piti*)	Delight, zest, bliss; sometimes rapture or ecstasy	**Equanimity** (*upekha*), **mindfulness** (*sati*)	— — — —
	Happiness, well being, ease (*sukkha*)	Happiness, well being, ease	Happiness, well being, ease felt with the body	**Equanimity, mindfulness**

[1]Bold type represents the prominent mental qualities at each level. Dashes indicate continuity of those qualities into a subsequent *jhana* or deeper state.

[2]Pali words are provided for principal terms, in as much as there are variations in translations and the reader may wish to compare sources in the reference list.

the Phenomenology of Consciousness Inventory (Pekala, 1991). Cardena had highly hypnotizable people do self-hypnosis in a relaxed condition or while pedaling a stationary bike. The Indian meditators were doing Kundalini meditation, which involves concentration and visualizing energy moving through the body.

The two studies cannot be directly compared because they analyzed the data differently. However, both meditation and deep self-hypnosis were associated with elevations on PCI scales reflecting alterations in state of awareness, self-awareness, time sense, perception, and meaning; with changes in imagery vividness and rationality; and both processes were accompanied by feelings of joy and love.

(The hypnosis data represents scales that changed between waking state and deep self-hypnosis state. The meditation data represents scales on which meditators scored higher than 65th percentile rank on the Pekala norms of students sitting quietly with eyes closed [Pekala, 1991]. Kundalini meditators did not have as many differences between normal state and meditating state as people in deep self-hypnosis compared

with waking state, perhaps because long term meditation had raised scores permanently on some PCI scales.)

Another way of looking at similarities in phenomenological experience is to compare the PCI results for medium and deep levels of hypnosis (Cardena, 2003), with medium and deep Absorptions (levels 1-2 vs. 3-4) described in Buddhist texts (Bucknell, 1993; Gunaratana, 1988; Khema, 1997; Nanamoli & Bodhi, 1995, Sutta 30; Thanissaro, 2002). Experience tends to be more vivid at medium levels and more equanimous at deep levels, whether it is hypnosis or meditation.

At medium levels of hypnosis Cardena's participants experienced radical changes in body sensation (sinking, dizziness, enlarged fingers, etc.), but at very deep levels a sense of disembodiment or out-of-body experiences often occurred. In meditation, body sensations may be intense and strange at mid levels but at deep levels the meditator purportedly has abandoned both pleasure and pain. Emotion was also very intense at medium levels of hypnosis, but it either disappeared at deep levels or became a mystical feeling of wonder. There is the same direction of movement in meditation, from stronger than usual positive emotion at middle levels to equanimity at deep levels.

In hypnosis attention moved from a focus on imagination at medium levels to free floating in deep self-hypnosis. Again, meditation shows similar changes, with perhaps finer distinctions made for the four different Absorption levels: attention is first focused on the target object, then on pleasure, ending with focus on stillness. In hypnosis, thought moved from increasingly imaginal and real to totally absorbed or actually disappearing. In meditation, thought moves from active, through concentration, to being still yet mindful at deep levels (and characterized by one-pointedness in some texts, Cf. Gunaratana, 1988, and Khema, 1997). While there is no thought per se in the Fourth Absorption, there is awareness in the midst of stillness, which is mindfulness.

Table 1 summarizes in parallel columns the psychological picture at profound depth for both hypnosis and meditation. There is a quiet quality, absent thought and emotion, stated in positive terms as equanimity. The person is out of touch with the body and loses sense of a separate self. These characteristics were cogently described for hypnosis in 1979 by Ronald Shor.

The last point, about experience of the self, is very important to our discussion of whether an induction increases suggestibility. According to Shor, "As [hypnotic] trance deepens there is also a progressive temporary loss of self-reflective *executive monitoring*, at least within the bounds of consciousness... [loss of the] little disembodied 'psychic self' sitting off to one side in the periphery of conscious awareness watching what is going on" (p. 123, emphasis added).

This list of phenomenological similarities may be altered by future investigations, but it is a start in the right direction of understanding the hypnotic state as quite similar to deep concentrative meditation states. There are parallel changes in neurophysiology.

The Neurophysiology of Hypnosis and Meditation

Ultimately, for a state construct to be meaningful, one should be able to specify not only the psychological characteristics but also the physiological markers. For example, the sleep state is accompanied by EEG sleep spindles, and a dream state is

Table 1: Phenomenological Experience of Deep States

	Deep (Self) Hypnosis	Fourth Absortion (Jhana)
Body Image	Disembodiment	Absence of pain or pleasure sensations
Thought	Absence of thought or very absorbed	Absence of thought, concentrated, still, and mindful
Emotion	Absence of emotion	Equanimity
Attention	Free floating attention	Attention focused on stillness
Experience of Self	Merging, becoming one with all, "void"	Unity consciousness, no observer standing outside the experience

correlated with rapid eye movement. The neurophysiology of deep hypnosis and deep meditation is similar. Furthermore, their neurological commonalities make the previous psychological correspondences more meaningful. For example, often there is cortical inhibition, as evidenced by very slow EEG theta waves. Such cortical inhibition would explain the absence of thoughts, emotion, body awareness and sense of self at deep levels.

Initially there was a problem of interpretation because EEG theta was associated with the reverie that precedes sleep. But now a distinction is drawn between low range theta (4-6 Hz) which is associated with reverie and high range theta (5-7 Hz) which, in the frontal cortex area, is associated with loss of executive control. Theta, in general, reflects massive cortical inhibition (Sterman, 1999).

Considering hypnosis research first, high band theta is related to hypnotizability, and theta power often increases as people (both high and low hypnotizables) go into hypnosis. This has been extensively reviewed and summarized by a number of authors (Crawford & Gruzelier,1992; Crawford, 2001; Graffin, Ray, & Lundy, 1995; Ray, 1997). The increased theta power is found in various cortical areas, but the far frontal area is well represented. To the extent that theta is present in the frontal area, executive and choice functions have shut down (Sterman, Kaiser, & Veigel, 1996). We have all noticed that deeply hypnotized people have little interest in taking initiative or evaluating a situation and making choices. There are other neurological findings, but the presence of theta is fairly consistent.

EEG theta waves are also prominent in deep states of meditation, where the

localization evidence is a bit clearer. (For a review of the early literature and methodological issues, see Schuman,1980.) The picture may be clearer because concentrative meditation is not complicated by suggestions, which in hypnosis lead to additional kinds of brain activity. In the early 1980s Larbig and his colleagues reported that an Indian fakir produced high amounts of theta when he was controlling pain in trance. Larbig's study was also one of the earliest to show increased theta in hypnosis with ordinary research subjects (Larbig et al., 1982).

Recently there have been sophisticated investigations of expert meditators from various concentrative practices such as Buddhism, Zen, meditative yoga, and Qi Gong. The studies have used EEG and some of the newer imaging methods like positron emission tomography, low resolution electromagnetic tomography, functional magnetic resonance imaging, and cerebral blood flow. The experienced meditators were compared with their own non-meditating condition, or with less experienced meditators, or with people doing non-concentrative meditation, or with inexperienced control subjects.

The far frontal cortex and the anterior cingulate gyrus on the midline surface of the frontal lobe are areas where theta figures prominently in meditation studies. Several investigations found increased EEG theta wave power, especially in those regions (Aftanas & Golocheikine, 2002, for Sahaja yoga; Kjaer, et al., 2002, for yoga nidra; Kubota et al., 2001, for Zen breath counting; Pan, Zhang, & Xia, 1994, for Qi Gong). Additional studies suggested cortical inhibition or gating of auditory sensation (Liu, Cui, Li, & Huang, 1990, for Qi Gong), increased orderliness of the brain or coherence (Khare & Nigam, 2000, for yoga and Transcendental Meditation [TM]) and reduced complexity (defined as number of cell assemblies activated, an indicator of complexity of neuronal computations in the brain), (Aftanas & Golocheikine, 2002, for Sahaja yoga). Reduced complexity may be due to switching off neural connections in order to reduce incoming information and thereby maintain internal attentional focus (Aftanas & Golocheikine, 2002).

The true neurophenomenological investigation would simultaneously measure subjective experience and neurophysiology for the same time period or event. Using this approach, theta was accompanied by a blissful emotional state (Aftanas & Golocheikine, 2001, for Sahaja yoga) and loss of a sense of executive control or desire for action (Kjaer et al., 2002, for yoga nidra; Lou et al., 1999, for yoga nidra). In yoga nidra, which also involves visualization, theta was accompanied by heightened sensory imagery (Kjaer et al., 2002). There was also relaxed concentration and decreased sympathetic nervous system activity during theta (Kubota et al., 2001, for Zen breath counting).

In both the meditation and hypnosis investigations, areas where theta is prominent (frontal cortex and especially anterior cingulate cortex) are also perfused with blood, which means that they are working hard. Two meditation investigations and four hypnosis investigations show increased regional blood flow to these areas (Newberg et al., 2001 [cingulate gyrus, inferior and orbital frontal cortex, dorsolateral prefrontal cortex and thalamus; Tibetan Buddhist monks]; Jevning, Anand, Biedebach, & Fernando, 1996 [frontal & occipital areas; Transcendental meditators]; Crawford, R. C. Gur, Skolnick, R. E. Gur, & Benson, 1993 [hypnosis pain control]; Faymonville et al, 2000 [hypnosis pain control]; Rainville et al. 1999 [hypnosis pain control]; Rainville, Hofbauer, Bushnell, Duncan, & Price, 2002 [hypnosis pain control]). However, one investigation of yoga nidra teachers found cerebral blood flow increased in areas

associated with imagination activity, actually decreasing in the cingulate area (Lou et al., 1999).

The cingulate cortex has been found to be active during hypnotic absorption (Rainville et al., 2002), hypnotic hallucinations (Szechtman, Woody, Bowers, & Nahmias, 1998), and hypnotic pain control (Kropotov, Crawford, & Polyakov, 1997; Rainville, Duncan, Price, Carrier, & Bushnell, 1997). This is additional evidence that the frontal midline is implicated in hypnosis.

When meditation involves activities other than just concentration, EEG patterns change over the relevant cortical sites, depending on the meditation activity. In a direct parallel, when hypnosis involves suggestions, the appropriate sensory and motor areas of the brain may be activated even more than in the non-hypnotic condition (Maquet et al., 1999).

- Mindfulness meditation was clearly distinguished from concentration meditation and relaxation conditions over all traditional EEG bandwidths (delta, theta, alpha, beta1, beta2; Dunn, Hartigan, & Mikulas, 1999).

- Qi Gong focusing on a specific object or self-regulation visualization resulted in more frontal mid-line theta rhythm, but Qi Gong directed at a peaceful calm mood, just letting go of thought, did not increase theta rhythm (Pan et al., 1994).

- A Kundalini Yoga adept had more alpha EEG during meditation but showed increase in theta activity immediately after meditating (Arambula, Peper, Kawakami, & Gibney, 2001). (The authors hypothesized that alpha increased because of the five-breaths/minute breathing pattern developed, and that post-meditation theta might reflect pleasurable feelings.) This paradoxical post-trance increase in theta was also found after hypnosis by Williams and Gruzelier (2001).

- One advanced Tibetan lama focusing on different objects of meditation activated correspondingly different areas of cortex (right posterior area for visualization; left central cortex for verbalization; and right fronto-temporal cortex during meditation on dissolution and reconstitution of the experience of the self; Lehmann et al., 2001).

- When three Tibetan monks raised or lowered their metabolism, increased beta (rather fast wave) activity and an asymmetry of alpha and beta activity between hemispheres were observed (Benson, Malhotra, Goldman, Jacobs, & Hopkins, 1990).

Pavlov postulated that hypnosis is a classically conditioned response of brain states that involves selected areas of cortical inhibition (Edmonston, 1986; Pavlov, 1941; Platonov, 1959). A number of theorists in the last half century agreed with him about cortical inhibition though it has been a minority viewpoint (Duensing, 1966, who called it a hypnotic leukotomy; Kissen, 1986; Hawkins & Le Page, 1988; Gruzelier & Warren, 1993; Crawford,1990; Crawford, 1994).

The evidence I have reviewed indicates that both hypnosis and concentrative

meditation result in inhibitory patterns, particularly in midline and frontal cortical areas associated with executive function and cognitive control. The research on meditation amplifies that which has been done on hypnosis and clarifies it, because suggestions that might activate cortex are not involved in purely concentrative meditation. The neurology supports what is reported regarding phenomenology. It seems that Pavlov was on the right track. However, we should assume that the neurological picture will be much more complex than simply frontal inhibition as we continue studies in this area.

Summary of Altered States Neurophenomenology

To summarize, both concentrative meditation and deep hypnosis result in similar psychological changes, such as diminished thought, emotional reaction, and body sensations, with consequent equanimity, peacefulness, and absorption. There is also a sense of unity with all or a sense of merging. Both hypnosis and meditation altered state experiences are accompanied by neurophysiological changes, particularly in frontal areas, with slowing and coherence in cortical areas representing choice and executive control. In meditation, the areas involved appear to be even more specifically the frontal midline, unless the meditation varies from standard deep concentration. It should be noted that most research does not take into account the changes in state over time. Variations in neurological pictures between studies may be related to different time slices associated with state changes (Schuman, 1980).

Differences between Hypnosis and Concentrative Meditation

The differences between hypnosis and meditation have to do largely with goals and expectancies, as well as their relative emphasis on suggestion (hypnosis) or mindfulness (meditation).

Goals and Practice

People seeking hypnosis are generally interested in a specific outcome such as symptom removal. Meditators are interested in long term goals having to do with serenity, insight, and spiritual liberation or enlightenment. Also, hypnosis (usually) calls for two people and meditation is a solo experience. Hypnotists usually assume that one cannot experience the more profound suggestions such as age regression in self-hypnosis. It remains to be seen how interaction with another person, the hypnotist, influences development of altered states.

Hypnosis patients rarely practice the skill. In fact, some patients express amazement if you tell them that it might require more than one hypnosis session to cure them of their lifelong affliction. But meditators expect to spend years developing their skill. They practice daily for 20 minutes to an hour, and go away for retreats where they practice 10 to 15 hours a day for weeks or months.

Expectancy

People using hypnosis expect that after entering an altered state they will be more suggestible; that is, the hypnotist will be able to give a suggestion that will profoundly change their perception and motivation: They won't feel pain, they won't want a cigarette, etc. People doing meditation don't expect suggestibility but rather expect that their "pure bright awareness" will enable them to see reality without bias of

prior conditioning or emotion. That is, they will be able to see how their perceptions change every moment and aren't reliable, how their sense of self is constructed from these ephemeral experiences, and how attempts to hold onto a fixed "reality" result in some kind of dissatisfaction and stress.

Other differences in expectancies relate to the prominence of emotion at middle levels. Some patients seeking hypnosis may fear that they will be flooded by traumatic memories and suffer extreme anxiety (and they very well may, depending on their personal histories). Some meditators expect to experience bliss and ecstacy (and they very well may, if they get into the Absorptions).

Some people expect to experience a past life. These include hypnosis patients who think they will discover the roots of their neuroses that way, or Buddhist meditators who think it will give them faith in the cycle of birth-death-rebirth. The disappearance of self-boundaries in deep states might facilitate both types of past life experiences.

Suggestion and Suggestibility

Suggestions are given in hypnosis but not in meditation. However, even when meditators do not receive suggestions, their own expectations may have the same effect. Enlightened meditators have experienced many past lives while in a deep state of Absorption. Did they experience past lives because of their expectations, coupled with more permeable or altered boundaries of the sense of self?

Also, concentration is intended to increase suggestibility in hypnosis, whereas in meditation concentration is used to achieve calmness, serenity, and a clear mind to develop deeper insight and understanding. A clear mind would imply "not suggestible."

There are similarities *and* differences related to the management of failure to achieve deep states. Neither a hypnotist nor a meditation teacher wants anyone to feel like a failure. Consequently, much hypnotherapy occurs at a light level, although depth is required for sensory hypnoanalgesia. And much of mindfulness meditation actually takes place at a light level. Regarding management of interfering mental activity, a hypnotist might use Ericksonian techniques to direct attention to whatever is in the field of awareness and gradually shape or move the attention inward (the "utilization technique"). In meditation, mental distraction provides a moving target for mindfulness meditation, which after all is simply trying to watch whatever the mind is doing. (In either case, hypnosis or meditation, a wandering mind is not seen as a liability but simply something to be worked with.)

There are also differences in attention to the pleasurable experiences that naturally emerge as a result of concentration. Hypnotists generally ignore them altogether, or say something like, "You may notice pleasurable feelings as you go deeper." (There is much more research on the possibility of adverse effects in hypnosis than on the pleasurable feelings that ensue.) A Buddhist master would instruct trainees to observe them and then let them go, and not to become too attached to the ecstatic experiences of middle Absorption levels.

Does Hypnosis Involve an Altered State of Consciousness?

Having reviewed the phenomenology, neurophysiology, similarity and differences between hypnosis and concentrative meditation, we can now return to our initial questions. One reason why we haven't defined hypnosis in terms of a state until

now is that we didn't trust self-report of subjective states, and there were no specific markers. Now we can begin to define the state by using a combination of self-report and neurological indicators. The state is suggested by a shift of brain activity *in the direction* of inhibitory processes, perhaps in frontal-midline areas, taken together with a shift in phenomenological experiences *in the direction* described by people in deep hypnosis (Cardena, 2003; Pekala & Kumar, 2000; Kumar, Pekala, & Cummings, 1996). The PCI scales that contribute to an index of that state (a "hypnoidal" score) are: Altered State, Self-Awareness, Altered Time Sense, Absorption, Volitional Control, Rationality, Internal Dialogue, Altered Experience, Memory, and Altered Body Image (Pekala, 1991).

As we refine our thinking, we must keep in mind the changeableness of an altered state. It may vary from light to profound even within one session, and have different cognitive, emotional and motivational qualities at different levels. Also, the state may not be necessary in order to pass most of the items on standard suggestibility (hypnotizablity) scales, as discussed in material that follows.

A second reason why we haven't defined hypnosis in terms of a state is that state theories lacked explanatory or predictive power. The neurophenemological approach allows us to redress that problem. Considering brain activity and subjective experience may explain old findings as well as open new lines of investigation. An altered state may be important for some hypnotic tasks and not for others. For example, we could predict:

1. Psychotherapy applications would be more effective in light to medium hypnosis and less effective in deep hypnosis, to the extent that the therapy relies on emotional expression and associative thought.
2. Intervention goals like analgesia would be more easily achieved at deep state levels with their characteristic inhibition of thought and perception. (We know that pain can be reduced by many people using hypnosis, but only a few can go deep enough to block the actual perception of pain itself.)
3. Both deep hypnosis and meditative Absorptions (*jhanas*) would be facilitated by training to produce theta in the 5-7 Hz high range, especially in frontal midline areas. There is anecdotal evidence that theta training is associated with altered states (J. Holroyd, personal communication, March 20, 2003; R. Pekala, personal communication, March 17, 2003; M. Schuman, personal communication, February 20, 2003).
4. Hypnotizability should also be increased by training to produce high band theta. We have some evidence in support of this hypothesis (Brady & Stevens, 2000), although a subsequent well controlled investigation yielded negative findings and many suggestions for methodological improvements (Stevens et al., 2003).

Does a Hypnotic Induction Increase Suggestibility?

Some people do go into a trance and do increase response to suggestions with induction. However, other people score moderately high on suggestibility (hypnotizability) scales yet do not develop evidence of an altered state (Barber, 2000). These moderately high hypnotizables seem to respond to suggestion solely on the

basis of imaginative involvement—good ability to imagine or fantasize. Pekala et al. (2003) found that vividness of imagery during a hypnotic dream was a strong determinant of how deeply hypnotized people feel.

Clarification of the nature of suggestion and suggestibility is called for here. Classically suggestion is defined as a communication that is accepted uncritically, in a process that is non-rational (Sidis, 1898, and McDougall, 1908, as cited in Schumaker, 1991). Several authors attribute that suspension of critical thought and judgment to dissociation, which is said to neutralize *executive control* and thereby enhance suggestibility (Cardena & Spiegel, 1991; Gheorghiu & Kruse, 1991; Schumaker,1991). Cardena and Spiegel (1991) hypothesized that suggestibility is facilitated when there are few competing cognitive demands and less self-reflective thought, which is exactly what happens in trance. For example, in a recent experiment, suggestibility increased following instructions to let go of competing thoughts or to become very absorbed, more than it increased with added relaxation instructions (Brown, Antonova, Langley, & Oakley, 2001).

We can reason that for people who use an induction to focus attention and deflect competing thoughts, suggestibility is increased by an induction. People who rely mostly on fantasy involvement for response to suggestions may be the ones who do not increase in suggestibility with an induction. (However, they probably also would have more difficulty with major surgery than people who can develop trance, because they can't block out perception of pain sensation.)

Pekala and Kumar (2000) referred to the two groups described as classic highs and fantasy highs (with or without dialog), though Pekala (2002) wondered if many of the classic highs weren't just asleep. Barber (2000) referred to the two groups as amnesia prone and fantasy prone. The two types of mental skills in which the two groups excel are not mutually exclusive, but it is useful to separate them conceptually.

And there is a third characteristic that determines what will happen following an induction—expectancy. People coming for hypnosis expect that they will be more suggestible after an induction, while meditators do not expect suggestibility to develop, even though the altered state may be virtually the same. Kirsch (2000) has made the case that (second to waking suggestibility) expectancy accounts for a large amount of the variance in response to suggestion (Braffman & Kirsch, 1999). This potent predictor is manifested by Barber's (2000) third type of high hypnotizables, "positively set individuals" who cooperate and have expectations that facilitate response to hypnosis.

A Model that Includes Altered States

How can we think of these three different determiners of hypnotic response? What if we formulate "hypnosis" in terms of response to suggestion, based on altered state, imagination, and expectancy, all operating synergistically? The mutuality and interdependency of these factors may readily be seen from the material we have covered. Suggestion without an altered state is just an invitation to use imagination and fantasy. An altered state without suggestion is just trance or meditation. Not only are altered state and imagination interactive contributors, but they also interact with expectancy.

So, if we translate this into patient characteristics, in the dentist's office what might we see? The patient either expects that hypnosis will prevent pain during an extraction or doesn't. She either can creatively imagine pleasant situations, or can't.

And the patient either can obtund thought processes and emotion through concentration, resulting in cortical inhibition, or can't. If she falls into the Yes category on all three, conditions are optimal. (Of course, these polar characteristics actually represent continua along which people could be rated.)

We can predict different responses to suggestion depending on how patients rate on these three variables. Consider first the predicted outcomes for people who *can* develop an altered state, as defined phenomenologically and neurologically. The patient in the dentist's office would fall into the first group in Table 2—altered state well developed, good imagination, and high expectancy that she can block pain. She could develop profound analgesia.

The second group in Table 2 is odd. They can develop an altered state and have good imagination for following suggestions, but have low expectancy that they will succeed. Sometimes people who don't expect to go into hypnosis actually do respond very well. In a study of stage hypnosis sequellae, Crawford et al. noted that when people with low expectations respond strongly they may even be upset by the apparent "loss of self control" and have a transient negative reaction (Crawford, Kitner-Triolo, Clarke, & Olesko, 1992).

The third group is also interesting. It includes patients who have told me,

Table 2: Altered State Well Developed

Patient Characteristics	Response to Suggestions
1. Good Imagination, High Expectation	Profound analgesia for sensory pain
2. Good Imagination, Low Expectation	Profound analgesia (the surprised patient)
3. Poor Imagination, High Expectation	Good analgesia if told "don't feel anything"
4. Poor Imagination, Low Expectation	Uncertain outcome; perhaps no reduced pain or suffering unless in extremely deep trance

Table 3: Altered State Not Well Developed

Patient Characteristics	Response to Suggestions
1. Good Imagination, High Expectation	Reduced suffering though not sensory pain
2. Good Imagination, Low Expectation	Probably less benefit than above
3. Poor Imagination, High Expectation	No reduced pain or suffering (the disappointed patient)
4. Poor Imagination, Low Expectation	No analgesia or reduced suffering, but didn't expect it anyway

"Don't bother to describe scenes or give creative suggestions. Just tell me to go deeper." That is, they know they can develop a blank mind—i.e., a trance—and imagery suggestions just confuse or distract them.

I am uncertain about the fourth group who develop trance but have poor imagination and no expectation that hypnosis will help them. They probably couldn't benefit much from suggestions but perhaps, if in deep enough trance, as neurologically defined, they would simply be insensate. I am reminded of naturally occurring trance phenomena, such as spontaneous analgesia when people are in shock due to trauma in a battle.

Then we have the people who are less capable of developing an altered state, at least without extensive training. Many people in the first group in Table 3 may present as high hypnotizables based on their imagination ability, which allows them to be responsive to suggestions. They are able to reduce pain significantly in a clinical setting, but it is actually the suffering they are reducing for the most part, not sensory pain. That reduced suffering seems to be sufficient for most purposes. And they may do well in psychotherapy applications of hypnosis.

I am not certain what to say about the second group, with well developed imaginative skills but less expectation that they will benefit from hypnosis and inability to develop an altered state.

The third group would include the patient who has little talent for concentration to develop an altered state *and* little imaginative skill, but high expectations for benefit from hypnosis. That person is likely to be disappointed. This group of people illustrates that more than expectancy of benefit is necessary for benefit to occur.

And the person who lacks all three skills or attributes, in the fourth and final group, did not expect benefit anyway.

The predictions in Tables 2 and 3 are derived from what is known in the extensive cognitive-behavioral literature, taking into consideration the striking similarity between the neurophysiology and the self-report of phenomenological experience in deep hypnosis and deep meditation. The predictions about hypnotic response should be viewed as a way of taking altered state into account rather than using it as a road map. The model is, however, congruent conceptually (if not in specific details) with data on types of high hypnotizable people identified by the Pekala and Kumar (2000) PCI research, and types described by T. X. Barber (2000). This approach simply recognizes that neurophenomenological processes, which are individual difference variables, contribute to the development of psychological types such as Pekala's "classic highs" and "fantasy highs" and Barber's "amnesia prone," "fantasy prone," and "positively set" individuals.

As we begin the twenty-first century, we are accumulating information on the phenomenology of hypnosis and meditation. To that we add information about the neurophysiology of those states. This neurophenomenological information can enhance the abundant knowledge that we already have about attitudes and cognitive-behavioral responses to hypnosis conditions. That integration will yield a more rounded, three dimensional picture of hypnosis. We will have brought the missing two parts of the triad back into the picture.

References

Aftanas, L., & Golocheikine, S. (2002, Sep 20). Non-linear dynamic complexity of the human EEG during meditation. *Neuroscience Letters, 330* (2), 143.

Aftanas, L.I., & Golocheikine, S.A. (2001, Sep 7). Human anterior and frontal midline theta and lower alpha reflect emotionally positive state and internalized attention: High-resolution EEG investigation of meditation. *Neuroscience Letters, 310* (1), 57-60.

Arambula, P., Peper, E., Kawakami, M., & Gibney, K.H. (2001). The physiological correlates of Kundalini Yoga meditation: A study of a yoga master. *Applied Psychophysiology and Biofeedback, 26*, (2),147-53.

Barber, T.X. (2000). A deeper understanding of hypnosis: Its secrets, its nature, its essence. *American Journal of Clinical Hypnosis, 42,* 208-272.

Benson, H., Malhotra, M.S., Goldman, R.F., Jacobs, G.D., & Hopkins, P.J. (1990). Three case reports of the metabolic and electroencephalographic changes during advanced Buddhist meditation techniques. *Behavioral Medicine, 16* (2), 90-95.

Brady, B., & Stevens, L. (2000). Binaural-beat induced theta EEG activity and hypnotic susceptibility. *American Journal of Clinical Hypnosis, 43* (1), 53-69.

Braffman, W., & Kirsch, I. (1999). Imaginative suggestibility and hypnotizability: An empirical analysis. *Journal of Personality & Social Psychology. 77* (3), 578-587.

Brown, D.P. (1977). A model for the levels of concentrative meditation. *International Journal of Clinical and Experimental Hypnosis, 25* (4), 236-273.

Brown, R.J., Antonova, E., Langley, A., & Oakley, D.A. (2001). The effects of absorption and reduced critical thought on suggestibility in an hypnotic context. *Contemporary Hypnosis. 18* (2), 62-72.

Bucknell, R. S. (1993). Reinterpreting the jhanas. *Journal of International Association of Buddhist Studies, 16* (2), 375-409.

Cardena, E. A. (2003). *The phenomenology of quiescent and physically active deep hypnosis*. Manuscript submitted for publication.

Cardena, E., & Spiegel, D. (1991). Suggestibility, absorption, and dissociation: An integrative model of hypnosis. In J. F. Schumaker (Ed.) *Human suggestibility: Advances in theory, research, and application* (pp. 93-107). New York: Routledge.

Crawford, H.J. (1990). Cognitive and psychophysiological correlates of hypnotic responsiveness and hypnosis. In M.L. Fass & D. Brown (Eds.), *Creative Mastery in Hypnosis and Hypnoanalysis: A Festschrift for Erika Fromm* (pp. 47-54). Hillsdale, NJ: Lawrence Erlbaum Associates.

Crawford, H.J. (1994). Brain dynamics and hypnosis: Attentional and disattentional processes. *International Journal of Clinical and Experimental Hypnosis, 42*, 204-232.

Crawford, H.J. (2001). Neuropsychophysiology of hypnosis: Towards an understanding of how hypnotic interventions work. In G.D. Burrows, R.O. Stanley, & P.B. Bloom, (Eds.), *International Handbook of Clinical Hypnosis* (pp. 61-84). New York: Wiley.

Crawford, H.J., & Gruzelier, J.H. (1992). A midstream view of the neuropsychophysiology of hypnosis: Recent research and future directions. In E. Fromm & M. R. Nash (Eds.), *Contemporary hypnosis research* (pp. 227-266). New York: Guilford Press.

Crawford, H.J., Gur, R.C., Skolnick, B., Gur, R.E., & Benson, D.M. (1993). Effects of hypnosis on regional cerebral blood flow during ischemic pain with and without suggested hypnotic analgesia. *International Journal of Psychophysiology, 15*, 181-195.

Crawford, H.J., Kitner-Triolo, M., Clarke, S. W., & Olesko, B. (1992). Transient positive and negative experiences accompanying stage hypnosis. *Journal of Abnormal Psychology, 101*, 663-667.

David, D., & Brown, R.J. (2002). Suggestibility and negative priming: Two replication studies. *International Journal of Clinical and Experimental Hypnosis, 50* (3), 215-228.

Duensing, F. (1966). Level of consciousness in hypnosis and pain sensitivity from a neurophysiological viewpoint. *Psychotherapy and Psychosomatics, 14,* 365-378.

Dunn, B.R., Hartigan, J.A., & Mikulas, W.L. (1999). Concentration and mindfulness meditations: Unique forms of consciousness? *Applied Psychophysiology and Biofeedback, 24* (3), 147-165.

Edmonston, W. (1986). *The induction of hypnosis.* New York: John Wiley & Sons.

Executive Committee of the American Psychological Association Division of Psychological Hypnosis (1993, Fall). *Psychological Hypnosis: A Bulletin of Division 30*, (2), 7.

Faymonville, M.E., Laureys, S., Degueldre, C., DelFiore, G., Luxen, A., Franck, G., Lamy, M., & Maquet, P. (2000). Neural mechanisms of antinociceptive effects of hypnosis. *Anesthesiology, 92* (5),1257-1267.

Forman, R. K. (1999*). Mysticism, mind, consciousness*. Albany, NY: State University of New York Press.

Gheorghiu, V.A. & Kruse, P. (1991). The psychology of suggestion: An integrative perspective. In J. F. Schumaker (Ed.) *Human suggestibility: Advances in theory, research, and application* (pp. 59–75). New York: Routledge.

Graffin, N.F., Ray, W.J., & Lundy, R. (1995). EEG concomitants of hypnosis and hypnotic susceptibility. *Journal of Abnormal Psychology, 104*, 123-131.

Gruzelier, J., & Warren, K. (1993). Neuropsychological evidence of reductions on left frontal tests with hypnosis. *Psychological Medicine, 23*, 93-101.

Gunaratana, M.H. (1988). *The jhanas in Theravada Buddhist meditation*. Kandy, Sri Lanka: Buddhist Publication Society.

Hawkins, R., & Le Page, K. (1988). Hypnotic analgesia and reflex inhibition. *Australian Journal of Clinical and Experimental Hypnosis, 16*, 133-139.

Hilgard, E.R. (1965). *Hypnotic susceptibility*. New York: Harcourt, Brace & World.

Jevning, R., Anand, R., Biedebach, M., & Fernando, G. (1996). Effects on regional cerebral blood flow of transcendental meditation. *Physiology and Behavior, 59* (3), 399-402.

Kabat-Zinn, J. (1982). An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. *General Hospital Psychiatry, 4,* 33-47.

Khare, K.C., & Nigam, S.K. (2000). A study of electroencephalogram in meditators. *Indian Journal of Physiology and Pharmacology, 44* (2), 173-178.

Khema, A. (1997). *Who is my Self? A guide to Buddhist meditation*. Boston: Wisdom Publications. [Based on Sutta 9, the States of Consciousness Sutta, in M. Walshe, Trans. (1987). *The long discourses of the Buddha.* Boston: Wisdom.]

Kirsch, I. (1993). Professional opinions about hypnosis: Results of the APA Division 30 survey. *Bulletin of Division 30, Psychological Hypnosis, APA, 2,* 4-5.

Kirsch, I. (2000). The response set theory of hypnosis. *American Journal of Clinical Hypnosis, 42,* 274-292.

Kissen, B. (1986*). Conscious and unconscious programs in the brain. Vol 2. Psychobiology of human behavior,* New York: Plenum.

Kjaer, T.W., Bertelsen, C., Piccini, P., Brooks, D., Alving, J., & Lou, H. C. (2002). Increased dopamine tone during meditation-induced change of consciousness. *Brain Research. Cognitive Brain Research, 13* (2), 255-259.

Kropotov, J.D., Crawford, H.J., & Polyakov, Y.I. (1997). Somatosensory event-related potential changes to painful stimuli during hypnotic analgesia: Anterior cingulate cortex and anterior temporal cortex intracranial recordings. *International Journal of Psychophysiology, 27* (1), 1-8.

Kubota, Y., Sato, W., Toichi, M., Murai, T., Okada, T., Hayashi, A., & Sengoku, A. (2001). Frontal midline theta rhythm is correlated with cardiac autonomic activities during the performance of an attention demanding meditation procedure. *Brain Research. Cognitive Brain Research, 11* (2), 281-287.

Kumar, V.K., Pekala, R.J., & Cummings, J. (1996). Trait factors, state effects, and hypnotizability. *Journal of Clinical and Experimental Hypnosis, 44* (3), 232-349.

Larbig, W., Elbert, T., Lutzenberger, W., Rockstroh, B., Schnerr, G., & Birbaumer, N. (1982). EEG and slow brain potentials during anticipation and control of painful stimulation. *Electroencephalography and Clinical Neurophysiology, 53,* 298-309.

Laski, M. (1961). *Ecstasy: A study of some secular and religious experiences*. Bloomington, IN: Indiana University Press.

Lehmann, D., Faber, P. L., Achermann, P., Jeanmonod, D., Gianotti, L. R., & Pizzagalli, D. (2001). Brain sources of EEG gamma frequency during volitionally meditation-induced, altered states of consciousness, and experience of the self. *Psychiatry Research, 108* (2), 111-121.

Liu, G. L., Cui, R. Q., Li, G. Z., & Huang, C. M. (1990). Changes in brainstem and cortical auditory potentials during Qi-Gong meditation. *American Journal of Chinese Medicine, 18* (3-4), 95-103.

Lloyd, D. (2002). Functional MRI and the study of human consciousness. *Journal of Cognitive Neuroscience, 14* (6), 818-831.

Lou, H. C., Kjaer, T. W., Friberg, L., Wildschiodtz, G., Holm, S., & Nowak, M. (1999). A 15O-H2O PET study of meditation and the resting state of normal consciousness. *Human Brain Mapping, 7* (2), 98-105.

Maquet, P., Faymonville, M. E., Degueldre, C., Delfiore, G., Franck, G., Luxen, A., & Lamy, M. (1999). Functional neuroanatomy of hypnotic state. *Biological Psychiatry, 45*, 327-333.

Merkur, D. (1999). Unitive experiences and the state of trance. In M. Idel & B. McGinn,

(Eds). *Mystical union in Judaism, Christianity, and Islam: An ecumenical dialogue* (pp. 125-153). New York: Macmillan.

Nanamoli, B., & Bodhi, B., Trans. (1995). Sutta 30 [The Shorter Discourse on the Simile of the Heartwood], Sutta 77 [The greater discourse to Sakuludayin], Sutta 118 [Mindfulness of Breathing], *The Middle Length Discourses of the Buddha: A new translation of the Majjhima Nikaya*. Boston: Wisdom Publications.

Newberg, A., Alavi, A., Baime, M., Pourdehnad, M., Santanna, J., & d'Aquili, E. (2001). The measurement of regional cerebral blood flow during the complex cognitive task of meditation: A preliminary SPECT study. *Psychiatry Research, 106* (2),113-122.

Pan, W., Zhang, L., & Xia, Y. (1994). The difference in EEG theta waves between concentrative and non-concentrative qigong states—a power spectrum and topographic mapping study. *Journal of Traditional Chinese Medicine, 14* (3), 212-218.

Pavlov, I.P. (1941). *Conditioned reflexes and psychiatry*. New York: International Publishers.

Pekala, R.J. (1991*). Quantifying consciousness: An empirical approach*. New York: Plenum.

Pekala, R.J., & Cardena, E. (2000). Methodological issues in the study of altered states of consciousness and anomalous experiences. In E. Cardena, S. J. Lynn,& S. Krippner (Eds.), *Varieties of anomalous experience: Examining the scientific evidence* (pp. 47-82). Washington, DC: American Psychological Association.

Pekala, R. J., & Kumar, V. K. (2000). Operationalizing "trance" I: Rationale and research using a psychophenomenological approach. *American Journal of Clinical Hypnosis, 43,*107-135.

Pekala, R.J., Kumar, V.K., Maurer, R., Elliott, N. C., Masten, E., Moon, E., & Salinger, M. (2003). *How deeply hypnotized did I get? Attributes predicting estimated hypnotic depth*. Unpublished manuscript.

Platonov, K.I. (1959). *The word as a physiological and therapeutic factor: The theory and practice of psychotherapy according to I. P. Pavlov*. Washington, DC: Library of Congress.

Rainville, P., Duncan, G.H., Price, D.D., Carrier, B., & Bushnell, M.C. (1997). Pain affect encoded in human anterior cingulate but not somatosensory cortex. *Science, 15*; 277 (5328), 968-971.

Rainville, P., Hofbauer, R. K., Bushnell, M. C., Duncan, G. H., & Price, D. D. (2002). Hypnosis modulates activity in brain structures involved in the regulation of consciousness. *Journal of Cognitive Neuroscience, 14,* 887-901.

Rainville P., Hofbauer, R. K., Paus, T., Duncan, G. H., Bushnell, M. C., & Price, D. D. (1999). Cerebral mechanisms of hypnotic induction and suggestion. *Journal of Cognitive Neuroscience, 11,* 110-125.

Ray, W.J. (1997). EEG concomitants of hypnotic susceptibility. *International Journal of Clinical and Experimental Hypnosis, 45*, 301-313.

Schumaker, J.F. (1991). Introduction. In J. F. Schumaker (Ed.) *Human suggestibility: Advances in theory, research, and application* (pp. 1-33). NewYork: Routledge.

Schuman, M. (1980). The psychophysiological model of meditation and altered states of consciousness: A critical review. In J. M. Davidson & R. J. Davidson (Eds.) *The psychobiology of consciousness* (pp. 333-378). New York: Plenum.

Shear, J., & Jevning, R. (1999). Pure consciousness: Scientific exploration of meditation techniques. [On-line]. *Journal of Consciousness Studies, 6* (2/3), pages not listed. Abstract from: Imprint Academic http://www.imprint.co.uk/.

Sheehan, P.W., & McConkey, K.M. (1982). *Hypnosis and experience: The exploration of phenomena and process.* Hillsdale, NJ: Erlbaum.

Shor, R.E. (1979). A phenomenological method for the measurement of variables important to an understanding of the nature of hypnosis. In E. Fromm & R. E. Shor (Eds.), *Hypnosis: Developments in research and new perspectives* (2nd Ed.) (pp. 105-135). New York: Aldine-Atherton.

Sterman, M.B. (1999). Functional patterns and their physiological origins in the waking EEG: Implications for event-related EEG responses. In G. Pfurtscheller & F. H. Lopes da Silva (Eds.), *Event-related desynchronization. Handbook of electroencephalography and clinical neurophysiology* (Revised Series, Vol. 6), (pp. 33-49). Amsterdam: Elsevier Science B. V.

Sterman, M.B., Kaiser, D.A., & Veigel, B. (1996). Spectral analysis of event-related EEG responses during short-term memory performance. *Brain Topography, 9* (1), 21-30.

Stevens, L., Gilbert, J., Haga, Z., Vaughan, E., Queen, B., Leach, C., Brady, B., Nockels, P., Adams, D., McManus, P. (2003). Binaural beat induced theta EEG activity and hypnotic susceptibility: Contradictory results and technical considerations. *American Journal of Clinical Hypnosis, 45*, 295-309

Szechtman, H., Woody, E., Bowers, K.S., & Nahmias, C. (1998). Where the imaginal appears real: A positron emission tomography study of auditory hallucinations. *Proceedings of the National Academy of Sciences, 95*, 1956-1960.

Tart, C.T. (1972). *Altered states of consciousness***.** Cited in E. Cardena, S. J. Lynn, & S. Krippner (Eds.), *Varieties of anomalous experience: Examining the scientific evidence* (pp. 47-82). Washington, DC: American Psychological Association.

Thanissaro, B. (Trans.) (2002). The Factors of Concentration (Samadhanga sutta), *Anguttara Nikaya V.28* [On-line]. Available http://www.accesstoinsight.org/canon/anguttara/an05_028.html

Venkatesh, S., Raju, T.R., Shivani, Y., Tompkins, G., & Meti, B.L. (1997). A study of structure of phenomenology of consciousness in meditative and non-meditative states. *Indian Journal of Physiology and Pharmacology, 41*, 149-153.

Varela, F.J. (1996). Neurophenomenology: A methodological remedy for the hard problem. *Journal of Consciousness Studies, 3,* pp. 330-349.

Wallace, B.A. (1999). The Buddhist tradition of samatha: Methods for refining and examining consciousness. *Journal of Consciousness Studies, 6,* 175-187.

Weitzenhoffer, A. (2002). Scales, scales and more scales. *American Journal of Clinical Hypnosis, 44,* 209-220.

Weitzenhoffer, A.M., & Hilgard, E.R. (1959). *The Stanford Scales of Hypnotic Susceptibility, Forms A and B.* Palo Alto, CA: Consulting Psychologists Press.

Weitzenhoffer, A.M., & Hilgard, E.R. (1962). *The Stanford Scales of Hypnotic Susceptibility, Form C.* Palo Alto, CA: Consulting Psychologists Press.

Williams, J.D., & Gruzelier, J.H. (2001). Differentiation of hypnosis and relaxation by analysis of narrow band theta and alpha frequencies. *International Journal of Clinical and Experimental Hypnosis, 49,* 185-206.