RECENT DEVELOPMENTS IN THE STUDY OF HYPNOTIC PAIN REDUCTION: A NEW GOLDEN ERA OF RESEARCH?

Leonard S. Milling

University of Hartford, West Hartford, Connecticut, USA

Abstract

This article presents a selective review of recent developments in research on hypnotic pain reduction. A profusion of well-controlled studies of hypnotic analgesia in children suggests that hypnosis ranks among the more effective psychological tools for managing the distress experienced by youngsters undergoing invasive medical procedures. This literature also draws attention to the importance of matching interventions to natural pain coping strategies. Virtual reality hypnosis shows much promise as a treatment and may offer hope to people who might otherwise be unable to experience hypnotic analgesia. Response expectancies appear to be a key psychological mechanism of hypnotic pain reduction. Neuroimaging studies point to activity in the midcingulate cortex as a possible biological mechanism of hypnotic analgesia. More generally, based upon the findings of a sound empirical literature, important meta-analytic and qualitative reviews have concluded that hypnosis is effective for reducing both experimental and clinical pain. Indeed, the study of hypnotic pain reduction is vigorous, innovative, and may well have entered a golden era of research. Copyright © 2008 British Society of Experimental & Clinical Hypnosis. Published by John Wiley & Sons, Ltd.

Key words: children, hypnosis, neuroimaging, pain reduction, response expectancies, virtual reality

Introduction

Prominent hypnosis scholars, representing diverse theoretical viewpoints, agree on the remarkable power of hypnosis to relieve pain. ‘Arguably, the property of hypnosis that has the greatest potential for social good resides in the ability of participants to radically reduce, or in some cases eliminate, both chronic and acute pain’ (Lynn, Kirsch, Barabasz, Cardena and Patterson, 2000: 241). Classically, hypnotic analgesia involves making direct suggestions for symptom reduction in which it is suggested that the affected body part is numb, insensitive, or lacks feeling (see Chaves, 1993). However, other approaches to hypnotic analgesia place less emphasis on making direct suggestions for pain reduction and instead highlight the utility of delivering established cognitive-behavioural techniques in a hypnotic context (see Kirsch, Montgomery and Sapirstein, 1995).

Empirical evidence of the potency of hypnosis for reducing pain is strikingly robust. For example, in their seminal meta-analysis of research on hypnotic analgesia, Montgomery, DuHamel and Redd (2000) reported a moderate to large effect size (D = 0.67) for hypnosis. These investigators determined that the average participant treated with hypnosis obtained more pain relief than 75% of those in no-treatment and standard
treatment control conditions. Furthermore, important qualitative reviews of the use of hypnosis with clinical pain have concluded that hypnosis is an effective tool for managing both acute and chronic pain (e.g. Patterson and Jensen, 2003).

This article offers a selective review of recent developments in research on hypnotic pain reduction. Four topics were identified for consideration: (a) hypnotic pain reduction in children; (b) virtual reality pain reduction and hypnosis; (c) response expectancies as a psychological mechanism of hypnotic pain reduction; and (d) brain imaging studies of hypnotic pain reduction. The review is not intended to be comprehensive and undoubtedly there are other promising developments in the field of hypnotic analgesia. The topics reviewed herein were selected because of the recent increase in empirical research on them and/or their potential interest to the field.

**Hypnotic pain reduction in children**

During the last seven years, there has been an explosion of research on the use of hypnosis for reducing pain in children and adolescents. The number of controlled studies in this area has practically doubled. In some ways, this growth is not surprising. Children and adolescents are known to be more responsive to hypnosis than adults. Normative research has shown that hypnotic suggestibility begins to increase starting as early as age 3, peaks between the ages of 8 and 12, declines somewhat through the age of 16, and then remains relatively stable throughout the adult years (London, 1965; Morgan and Hilgard, 1978/1979). Children and adolescents are more likely than adults to pass the same test suggestions on equivalent standardized measures of hypnotic suggestibility (London, 1962). Hypnosis has been well established as a technique for reducing pain in adults (Montgomery et al., 2000). Because children and adolescents are more responsive to hypnosis than adults, it follows that youngsters might be able to use hypnosis to reduce pain even more effectively than adults.

The first controlled studies of hypnosis for reducing children’s pain were conducted during the 1980s and 1990s. This research featured comparisons of hypnosis with distraction to reduce the discomfort experienced by youngsters undergoing invasive medical procedures, such as bone marrow aspirations and lumbar punctures. Typical distraction techniques included diversion of attention to interesting objects in the examination room (e.g. toys, pop-up books) or to deep breathing. These investigations demonstrated that hypnosis was more effective than distraction in reducing children’s distress (Zeltzer and LeBaron, 1982), particularly if the patients were younger (Kuttner, Bowman and Teasdale, 1988), or scored in the high range of hypnotic suggestibility (Smith, Barabasz and Barabasz, 1996). However, not all of the early studies showed that hypnosis was superior to distraction (Wall and Womack, 1989) or to nondirective play therapy (Katz, Kellerman and Ellenberg, 1987).

Recent clinical pain studies have focused on comparisons of hypnosis with multi-component cognitive-behavioural interventions, as well as evaluations of the relative effectiveness of different kinds of hypnotic analgesia suggestions. For example, Liossi and Hatira (1999) examined the effectiveness of hypnosis and cognitive-behavioural therapy in alleviating the discomfort experienced by youngsters undergoing bone marrow aspirations. Participants were 30 pediatric patients, age 5 to 15, suffering from leukemia. The patients were randomly assigned to hypnosis, cognitive-behavioural or no-treatment control conditions. The hypnosis intervention consisted of three 30-minute sessions in which children experienced an induction, plus suggestions for relaxation, pleasant imagery and comfort, as well as direct suggestions for pain reduction.
The cognitive-behavioural intervention consisted of progressive-muscle and autogenic relaxation, breathing, and coping self-statements.

Hypnosis and cognitive-behavioural therapy were found to be more effective than the no-treatment control condition in reducing children’s pain and distress. There was no difference between the two active treatments in alleviating self-reported pain, but hypnosis was more effective than cognitive-behavioural therapy in alleviating observer-rated distress. These findings are interesting because they raise the possibility that hypnosis may be superior to certain multi-component cognitive-behavioural interventions in reducing some aspects of discomfort associated with invasive medical procedures. More research in this area is needed comparing hypnosis with other cognitive-behavioural techniques. For example, imagery is often a key element of multi-component cognitive-behavioural pain treatment packages (Turk, Meichenbaum and Genest, 1983).

As for comparisons of different kinds of hypnotic analgesia suggestions, Hawkins, Liossi, Ewart, Hatira and Kosmidis (1998) evaluated the relative effectiveness of direct and indirect hypnotic suggestions in reducing the pain associated with lumbar punctures. Participants were 30 children, age 6 to 16, with leukemia and non-Hodgkin’s lymphoma. The youngsters were randomly assigned to direct or indirect analgesia suggestion conditions. The direct suggestion condition featured many of the analgesia suggestions described in the classic book on child hypnosis by Gardner and Olness (1981), such as suggestions for numbness (e.g. allow your back to go to sleep), topical anesthesia (e.g. paint numb medicine on back), local anesthesia (e.g. inject anesthetic), glove anesthesia (e.g. let numb feeling transfer from hand to affected body part), and the ‘switchbox’, in which the child is asked to image turning off switches in the brain that control pain sensations in various parts of the body. The indirect suggestion condition included a relaxing setting sun image, as well as imagery of adjusting to spicy Mexican food.

Children assigned to both treatment conditions showed significant pre to post reductions in pain. However, there was no difference between treatments. Unfortunately, the absence of a control condition in this investigation makes it difficult to interpret the findings. This limitation was addressed in a follow-up study by Liossi and Hatira (2003). Participants were 80 children, age 6 to 16, with leukemia and non-Hodgkin’s lymphoma. These youngsters were randomly assigned to the same direct or indirect suggestion conditions used in Hawkins et al. (1998), or to one of two control conditions (i.e. attention control or standard medical care) to manage the pain associated with lumbar punctures.

The direct and indirect suggestion conditions were more effective than the control conditions in reducing child-reports of pain and observer ratings of distress. However, there was no difference in effectiveness between the two kinds of suggestions. Thus, the direct and indirect suggestions evaluated in these studies may not represent a useful distinction. However, both kinds of suggestions did provide relief from the lumbar punctures. Moreover, consistent with Smith et al. (1996), the three studies by Liossi and her colleagues (Hawkins et al., 1998; Liossi and Hatira, 1999; Liossi and Hatira, 2003) showed that hypnotic suggestibility was associated with greater response to the hypnotic interventions. Thus, hypnotic suggestibility may be a particularly useful variable for predicting which children benefit from hypnotic interventions. Consistent with the recommendation of Lynn and Schindler (2002), researchers who study hypnotic pain reduction in youngsters and clinical hypnotists who work with pediatric pain patients may be well advised to assess hypnotic suggestibility as a standard part of their work.

In experimental pain studies, the efficacy of hypnosis can be examined under rigorous laboratory conditions that permit greater standardization of the pain stimulus and
treatments than is usually possible in a hospital or clinic. In one of the first studies of this kind with children, Zeltzer, Fanurik and LeBaron (1989) evaluated the efficacy of hypnosis for relieving cold pressor pain. Twenty-nine healthy children, age 6 to 12, were assigned to hypnosis or no-treatment control conditions. The hypnosis intervention consisted of suggestions to think about something pleasant, exciting, or fun. The experimenter asked questions during the cold pressor to help the children become intensely involved in the images. Hypnosis was shown to be more effective than no treatment in reducing pain.

Later, several of the same investigators evaluated the relationship between coping style and response to two different interventions for reducing cold pressor pain. Fanurik, Zeltzer, Roberts and Blount (1993) classified 60 healthy children, aged 8 to 10, as attenders or distractors based on their coping style during a baseline immersion in the cold pressor. Attenders coped by directing attention towards sensations or emotions resulting from the pressor. Distractors directed attention away from sensations or emotions resulting from the immersion. Children were then randomly assigned to one of three treatment conditions. In the sensory focusing condition, the children were instructed to attend to non-painful sensations of the pressor. In the imagery condition, the children were helped to divert attention from the pressor by focusing on imagery of something fun, exciting or pleasant. In the control condition, the children were engaged in a discussion of family, social or school activities. Results indicated an interaction between coping style and intervention, with distracters in the imagery condition showing greater pain tolerance than attenders using imagery. Among distracters, those using imagery showed the largest decrease in pain intensity ratings, whereas those using sensory focusing actually showed an increase in intensity ratings. These findings suggest that interventions which match natural coping methods are likely to produce the most relief. Although this was not a study of hypnosis per se, the imagery condition utilized in this investigation was very similar to the hypnosis condition used in Zeltzer et al. (1989). Certainly, the findings suggest how hypnotic suggestions might be structured to match a child’s natural coping style.

Chaves was one of the first to observe that people have their own preferred natural coping strategies for dealing with pain (Chaves and Barber, 1974; Chaves and Brown, 1987). Two very recent studies highlight the importance of designing pain interventions to match children’s natural coping style. Jaaniste, Hayes and von Baeyer (2007) evaluated the effect of imagery and sensory information on cold pressor pain administered to 78 healthy children, aged 7 to 12. In the imagery condition, participants were helped to imagine playing ball with other children in a park or walking home with other children. In the sensory preparation condition, information was provided about the sensations that would be experienced when the arm was placed in the cold pressor. The Pain Coping Questionnaire was used to measure the extent to which children used distraction as a coping style. There was a significant interaction between intervention and coping style on pain tolerance. Children with a high distraction coping style who received imagery or a low distraction coping style who did not receive imagery showed more pain tolerance than youngsters with a low distraction coping style who received imagery or a high distraction coping style who did not receive imagery.

A second study by the same investigative team (Piira, Hayes, Goodenough and von Baeyer, 2006) compared the effectiveness of imagery and sensory focusing interventions for reducing cold pressor pain. One hundred and twenty healthy children, aged 7 to 14, were classified as having a high or low distraction coping style based on their Pain Coping Questionnaire scores. They were then randomly assigned to either the same
imagery condition used in Jaaniste et al. (2007), to a sensory focusing condition in which they envisaged themselves testing the temperature of the water in a cold lake or washing paint off their arm with cold water, or to a control condition. For children with a low distraction coping style, the sensory focusing condition produced greater pain tolerance than the other treatment conditions. Thus, youngsters who characteristically cope by attending to painful stimuli responded best to an intervention where their attention was directed towards rather than away from the sensations produced by the cold pressor. Once again, this highlights the importance of designing pain interventions to match coping style. Although the interventions used in this study and in Jaaniste et al. (2007) were not hypnotic, the imagery could be characterized as hypnotic-like in nature. Indeed, a hypnotic intervention could be structured to distract a youngster from pain sensations, or to help them focus on the sensations in the same way that Piira et al. (2006) helped their participants to focus on and reframe the pain sensations associated with the cold pressor.

In sum, research on hypnotic pain reduction in children suggests that hypnosis is effective for managing the discomfort associated with a variety of invasive procedures. Early research generally showed that hypnosis was more effective than distraction in reducing children’s clinical pain. Recent research has raised the possibility that hypnosis may be as effective, or possibly more effective than some multi-component cognitive-behavioural pain interventions. This may be especially true for children who score higher on hypnotic suggestibility. The distinction between direct and indirect hypnotic suggestions for analgesia has not been shown to be especially meaningful. However, recent experimental pain studies with children have highlighted the importance of matching interventions to pain coping styles. Consequently, youngsters who have a coping style in which they prefer to direct attention away from sensations or emotions associated with the pain may respond best to suggestions that involve images and experiences that are pleasant and exciting. In contrast, children who have a coping style in which they prefer to direct attention towards the pain may respond best to suggestions in which they are invited to attend to non-painful aspects of an invasive procedure.

Virtual reality pain reduction and hypnosis

Virtual reality (VR) is a technology that enables a person to interact with a computer-simulated, three-dimensional environment. Advanced VR technology provides visual, auditory, and tactile information that enables users to become fully immersed in a simulated world. A user wears a head-mounted display, which is a helmet that presents a stereo visual image of the simulated world. The stereo image provides a sense of space and depth. A motion tracker in the helmet measures the position of the user’s head and adjusts the visual image accordingly. Consequently, users feel as though they can look around and move through the simulated world. Headphones deliver sounds that further help the individual become fully immersed in the virtual environment. Input devices such as joy sticks, hand-held wands, and data gloves enable the person to move through the simulated environment and to interact with simulated objects.

During the past ten years, VR has attracted attention as a technique for managing the pain and discomfort associated with invasive medical procedures. In some ways, VR and hypnotic pain reduction are similar in that both can encourage an individual to divert attention away from an unpleasant medical procedure and towards created events that are intended to be experienced as if they were real. Recently, Patterson and his associates conducted some innovative research combining VR and hypnotic pain reduction techniques.
In a series of case reports, Patterson and colleagues employed a VR environment called SnowWorld to help burn patients experience VR-induced hypnosis (Patterson, Tininenko, Schmidt and Sharar, 2004; Patterson, Wiechman, Jensen and Sharar, 2006a). In the SnowWorld virtual environment, patients begin at the top of an icy 3-D canyon and float to the bottom. As they drift downward, they are given suggestions that they are becoming more and more relaxed. This is very similar to a hypnotic induction. After reaching the bottom of the canyon, the patients illustrated in the case reports were given posthypnotic suggestions for pain relief and relaxation during subsequent wound care.

Based on the promising results described in these case reports, Patterson, Hoffman, Palacios and Jensen (2006b) carried out a controlled study in which they evaluated the individual and combined effects of VR distraction and posthypnotic analgesia suggestions on experimental pain. One hundred and three undergraduate volunteers were randomly assigned to one of four treatment conditions. Participants in the hypnosis condition listened to an audiotape in which they heard a hypnotic induction that included imagery of traversing a snowy canyon. Then, the tape presented post hypnotic suggestions for comfort and pain reduction. Afterwards, they received a thermal pain stimulus. In the VR condition, patients descended the virtual 3-D canyon of SnowWorld as they experienced the pain stimulus. Patients in the hypnosis plus VR condition heard the same audio tape used in the hypnosis condition (including the post-hypnotic analgesia suggestions) and thereafter went down the SnowWorld canyon while undergoing the pain stimulus. Finally, patients in the no-treatment condition listened to an audio tape called ‘Relaxing Sounds from Nature’ and thereafter were given the pain stimulus.

Participants treated with VR reduced worst pain intensity more than those who did not receive VR. Hypnotic suggestibility moderated the effect of the post hypnotic analgesia suggestions, but not VR analgesia. That is, all participants receiving VR reduced pain more than those who did not receive VR, regardless of suggestibility level. However, only participants who scored in the high range of suggestibility reduced pain using the post hypnotic suggestions.

The Patterson et al. (2006b) study is fascinating and suggests many interesting possibilities for combining VR and hypnotic analgesia. For example, Patterson et al. utilized post-hypnotic analgesia suggestions. It is interesting to speculate about the results that might have been obtained if the hypnotic analgesia suggestions had been delivered continuously while participants were actually experiencing the pain stimulus. Also, Patterson et al. essentially used VR to induce and amplify hypnosis. It might also be possible to use hypnosis to amplify the effects of VR by having a patient enter hypnosis and then giving suggestions that the person will become more and more immersed in the experiences of the VR world. The study of VR hypnosis is in its infancy and there appear to be many exciting avenues for future research.

Response expectancies as a mechanism of hypnotic pain reduction

Recently, response expectancies have been a focal point of research on the psychological mechanisms of hypnotic pain reduction. Response expectancies are the expectancy of the occurrence of one’s own nonvolitional responses to situational cues (Kirsch, 1990). According to Kirsch (1985), ‘nonvolitional responses are responses that are experienced as occurring automatically, that is, without volitional effort… They include emotional reactions (e.g., fear, sadness, elation), sexual arousal, conversion symptoms, pain, and so forth’ (p. 1189). The pain that one would expect to experience as a result of having a cavity drilled by a dentist would be an example of a pain response expectancy.
Kirsch (1990) has hypothesized that response expectancies are a mechanism through which psychotherapy generates behaviour change. As such, response expectancies are not simply a correlate of treatment outcomes, but rather are a cause of change in psychotherapy. In the case of hypnotic pain reduction, response expectancies are thought to produce relief by establishing a cognitive set in which the person anticipates pain reduction to occur in response to hypnotic analgesia suggestions.

In one of the first studies of hypnosis and pain response expectancies, Montgomery, Weltz, Seltz and Bovbjerg (2002) evaluated the effect of a brief hypnotic intervention for reducing the discomfort associated with breast biopsy surgery. Participants were 20 women, aged 30 to 81 years, who underwent excisional breast biopsy in a large metropolitan hospital. The patients were randomly assigned to either a 10-minute hypnotic intervention delivered just before the breast biopsy or to a standard medical care condition. The hypnosis intervention consisted of a standardized hypnotic induction followed by suggestions for control, muscle relaxation, peace, comfort, and pain reduction. Additionally, patients were instructed on how they could use hypnosis on their own (i.e. self-hypnosis). Patients were told that the effects of hypnosis would occur before, during, and after the surgery.

Prior to the biopsy (and after the 10-minute intervention for those in the hypnosis group), patients were asked how much pain they expected to feel following the biopsy. Actual levels of pain were assessed after the biopsy was completed. Patients in the hypnosis group reported less postsurgical pain than those in the standard medical care condition. Moreover, patients’ expectations for pain reduction partially mediated the effect of hypnosis on their reports of postsurgical pain. That is, expectations for relief generated by the hypnosis intervention partly accounted for the amount of pain reduction that hypnosis actually produced. These findings are consistent with the position that response expectancies are a mechanism of hypnotic analgesia.

A recent series of experimental pain studies also have highlighted the role of response expectancies as a mechanism of hypnotic pain reduction. In the first of these studies, Milling, Kirsch, Meunier and Levine (2002) evaluated the individual and joint effects of hypnosis and a multi-component cognitive-behavioural intervention for reducing laboratory pain. Undergraduate volunteers placed their index finger in a finger pressure device for one minute and made baseline pain ratings. Thereafter, participants were asked to indicate what they expected the pain to be like if they were again to place the same finger in the pain stimulator.

Participants were then randomly assigned to hypnotic analgesia, cognitive-behavioural, combined, or no-treatment control conditions. These analogue interventions were delivered in two phases. During the preparation phase, participants listened to an audi-tape that presented information about pain management and provided an opportunity to practise specific pain reduction techniques without placing their finger in the stimulator. Then, participants made an expectancy rating reflecting what they expected the pain to be like if they used the pain reduction techniques they had just experienced while placing their finger in the stimulator. Thereafter, during the intervention phase, an experimenter administered the pain reduction techniques live while participants placed their finger in the stimulator and made post pain ratings.

The hypnotic analgesia intervention consisted of information designed to correct misconceptions about hypnosis and to foster a positive attitude towards it, a hypnotic induction, information about hypnotic analgesia, and an opportunity to experience a classic glove analgesia suggestion. The cognitive-behavioural intervention was closely adapted from Stress Inoculation Training (Turk, Meichenbaum and Genest, 1983) and
consisted of information about the gate-control theory of pain, as well as information and practice in the use of progressive muscle relaxation, guided imagery and coping self-statements. The combined treatment incorporated all of the elements of the hypnotic analgesia and cognitive-behavioural interventions, with each of the techniques framed as hypnotic in nature. Each of the analogue interventions reduced pain more than the control condition. Also, the effect of the two hypnosis interventions on pain intensity was partially mediated by expectancy. That is, baseline to post changes in ratings of pain intensity were partially accounted for by baseline to post changes in expected pain produced by the hypnotic interventions.

In a study using the same basic paradigm, Milling, Reardon and Carosella (2006) compared the effectiveness of distraction, cognitive-behavioural, hypnotic cognitive-behavioural, and hypnotic analgesia interventions with placebo and no-treatment control conditions in reducing finger pressure pain. The hypnotic analgesia and cognitive-behavioural interventions were the same ones used in Milling et al. (2002). The hypnotic cognitive-behavioural intervention was identical to the cognitive-behavioural treatment except that it was presented entirely in a hypnotic context. That is, it was delivered while participants were in hypnosis and each of the techniques was framed as being hypnotic in nature. Finally, the distraction intervention featured a word shadowing task designed to divert attention from pain to an external stimulus.

The hypnotic analgesia intervention was more effective in reducing pain than the no-treatment control condition, and the cognitive-behavioural and hypnotic cognitive-behavioural interventions were more effective than both the placebo and no-treatment conditions. Moreover, using Baron and Kenny’s (1986) classic approach to testing mediation, expected pain partially mediated the effect of the interventions on pain intensity. That is, changes in expected pain produced by the four analogue treatments partially accounted for changes in ratings of actual pain intensity.

In a third study in this series, Milling, Shores, Coursen, Menario and Farris (2007) evaluated the mediator function of response expectancy and treatment credibility in the pain reduction produced by the hypnotic analgesia, cognitive-behavioural and placebo control interventions described earlier. The credibility of a treatment rationale refers to how believable, logical, and convincing an intervention is perceived to be. The hypnosis and cognitive-behavioural interventions produced more pain reduction than the placebo control condition. In addition, using the Baron and Kenny (1986) method of evaluating mediation, after participants had had an opportunity to use the interventions to reduce the discomfort of the finger pressure device, credibility and changes in expected pain together fully mediated actual pain reduction.

The findings of Montgomery et al. (2002) on using hypnosis to alleviate clinical pain, along with those of Milling and colleagues in reducing experimental pain (2002, 2006, 2007) show that expectations for pain reduction generated by hypnosis partially account for the amount of relief that hypnosis actually produces. The striking uniformity of these findings argues that response expectancies are an important psychological mechanism of hypnotic pain reduction. Of note, the reviewed studies reveal a pattern of partial rather than full mediation by response expectancies. Thus, other mechanisms (e.g. credibility of treatment rationale, therapeutic alliance) may also partly explain how hypnosis works to reduce pain. Therefore, response expectancies do not appear to be the final common pathway through which hypnotic analgesia works. However, response expectancies do clearly seem to be one important pathway to relief.
Brain imaging studies of hypnotic pain reduction

One of the most exciting areas of research to emerge in recent years involves the use powerful neuroimaging techniques, such as positron emission tomography and functional magnetic resonance imaging, to describe the neurobiology of hypnosis. Several teams of investigators have conducted some very innovative research using these neuroimaging techniques to better understand the brain processes involved in hypnotic pain reduction.

Rainville and his associates utilized positron emission tomography (PET) to assess the effects of different kinds of hypnotic suggestions for pain reduction on cerebral activity. A PET scan shows changes in blood flow to different areas of the brain, making it possible to determine which areas are more active and which areas are less active during a particular task. Rainville, Duncan, Price, Carrier and Bushnell (1997) utilized PET scanning to evaluate the effect of hypnotic suggestions for changes in pain unpleasantness on brain activity. PET scans were conducted prior to hypnosis, during the hypnotic induction, and during suggestions for increased and decreased pain unpleasantness while participants immersed a hand in hot water. The suggestions affected ratings of pain unpleasantness, but not pain intensity, and also activated the anterior cingulate cortex, but not the somatosensory cortex. The anterior cingulate cortex is responsible for regulating complex interactions between sensations, cognitions, emotions, and motor behavior. The suggestions also produced increased blood flow to the frontal cortices, as well as the medial and lateral posterior parietal cortices (Rainville, Hofbauer, Paus, Duncan, Bushnell and Price, 1999).

In another study using the same basic paradigm, Hofbauer, Rainville, Duncan and Bushnell (2001) investigated the effect of hypnotic suggestions for changes in pain intensity on brain function. Suggestions for changes in pain intensity produced changes in activity in the primary somatosensory cortex, but not in the anterior cingulate cortex. The somatosensory cortex is responsible for processing information related to somatic sensations such as pressure, temperature and pain. As a group, the findings of these three studies suggest that the hypnotic reduction of the sensory dimension of pain is modulated primarily in the somatosensory cortex, whereas the hypnotic reduction of the affective dimension of pain is modulated primarily in the anterior cingulate cortex.

Faymonville and her colleagues also used PET scanning to study brain activity during hypnotic pain reduction. In Faymonville, Laureys, Degueldre, Del Fiore, Luxen, Franck, Lamy and Maquet (2000), highly suggestible participants underwent PET scans while experiencing thermal stimulation. During the scans, participants either remained in a resting state, imagined pleasant imagery from their past or imagined pleasant imagery from their past while in hypnosis. Results showed that hypnosis reduced both the intensity and unpleasantness of the pain, and was modulated by activity in a region of the anterior cingulate cortex called the midcingulate cortex.

More recently, Boly and her colleagues (see Boly, Faymonville, Vogt, Maquet and Laureys, 2007) used functional magnetic resonance imaging (fMRI) to corroborate the involvement of the midcingulate cortex in hypnotic pain reduction. An fMRI measures changes in magnetic fields in the brain that indicate increased blood flow, and hence activation of particular brain regions. An advantage of fMRI is that its temporal and spatial resolution is superior to PET. Faymonville, Boly and Laureys (2006) theorize that anatomically, the midcingulate cortex is in an ideal location to receive pain-related sensory information from the somatosensory cortex and insula, as well as pain-related affective information from the amygdaloid complexes and pregenual anterior cingulate
cortex. Together, the studies by Faymonville and Rainville point to activity in the midcingulate cortex as a key biological mechanism of hypnotic pain reduction.

Conclusions

Recently, there have been some exciting developments in research on hypnotic pain reduction. A proliferation of well-controlled investigations has shown that hypnosis ranks among the more effective psychological tools for relieving the distress experienced by children undergoing invasive medical procedures. Moreover, several recent investigations with children have suggested the importance of designing hypnotic pain interventions to match natural pain coping style. Also, virtual reality may be an effective way of helping people to experience hypnotic analgesia, possibly including those who score in the low range of hypnotic suggestibility and who might otherwise be poor candidates for hypnosis. Additionally, response expectancies appear to be a key psychological mechanism of hypnotic pain reduction. Finally, neuroimaging studies suggest that activity in the midcingulate cortex modulates hypnotic pain reduction, and may represent a biological mechanism of hypnotic analgesia.

The potential cross-pollination of these four research areas introduces some intriguing questions. For example, could neuroimaging studies reveal something unique about the developing brains of children that make them particularly responsive to hypnosis, and presumably to hypnotic pain interventions? Additionally, because play is a natural mode of interaction and communication for children, would the game-like quality of virtual reality hypnosis make it an especially useful pain intervention for them? Also, what role do response expectancies play in mediating the relief produced by virtual reality hypnosis? Finally, neuroimaging studies have shown that the anticipation of placebo analgesia is modulated by activity in the prefrontal cortex (Wager, Rilling, Smith, Sokolik, Casey, Davidson, Kosslyn, Rose and Cohen, 2004). What could neuroimaging studies reveal about the biological substrates of expecting hypnotic pain reduction? These are just some of the interesting questions potentially spawned by a fusion of the four research areas.

Almost fifteen years ago, Chaves (1994) reviewed what were then recent advances in the application of hypnosis to pain management. Chaves commented that the previous 30 years of research in clinical and experimental hypnosis had represented ‘something of a golden era’ (p. 125), but within that context, studies of hypnotic pain management were somewhat of a disappointment. He noted that clinical research on hypnotic analgesia was largely anecdotal or suffered from a failure to specify interventions and outcome measures. Also, many studies had failed to assess relationships between hypnotic suggestibility or preexisting pain coping strategies and treatment outcome. Finally, the existing literature did not take into account participants’ attitudes, expectancies, and beliefs about hypnosis in predicting pain reduction.

Research on hypnotic analgesia has made important strides relative to the limitations noted by Chaves (1994). Thanks to a plethora of well-controlled outcome studies, hypnotically suggested analgesia has been identified as a ‘well-established’ treatment for pain (Montgomery et al., 2000), and important qualitative reviews of its clinical effectiveness have appeared in the most prestigious of psychology journals (e.g. Patterson and Jensen, 2003). As illustrated by the research reviewed herein, studies of hypnotic analgesia now frequently assess suggestibility, as well as variables such as expectancies and patient coping styles. Hypnosis researchers are addressing new and important issues such as the biological substrates of hypnotic analgesia and virtual reality hypnosis.
these are these are exciting times for the field and the study of hypnotic pain reduction may well have entered a golden era of research.

References


Address for correspondence:
Leonard S. Milling, PhD
University of Hartford
Department of Psychology
200 Bloomfield Avenue
West Hartford, CT 06117 USA
Email: milling@hartford.edu
tel: (860) 768-4546
fax: (860) 768-5292