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Hypnotic Analgesia and Stress Inoculation Training: Individual and Combined Effects in Analog Treatment of Experimental Pain

Leonard S. Milling,[1,4] **Irving Kirsch,**[2] **Suzanne A. Meunier,**[3] **and Michelle R. Levine**[2]

The individual and combined effects of hypnotic analgesia and a multicomponent cognitive–behavioral intervention were compared in the analog treatment of experimental pain. Eighty-three participants previously assessed for hypnotic suggestibility were randomly assigned to hypnotic analgesia, Stress Inoculation Training, combined (analgesia plus Stress Inoculation procedures delivered in a hypnotic context), or control conditions. Participants in the 3 treatment conditions reported more reduction of finger pressure pain than did control participants. However, there was no difference among the 3 treatments in pain reduction. More pain reduction was associated with greater suggestibility. Decreases in pain were correlated with expected pain reduction in the hypnotic analgesia and combined conditions, but not in the cognitive–behavioral condition. Therefore, response expectancies may play a larger mediational role in hypnotic treatments for experimental pain than in cognitive–behavioral interventions.

KEY WORDS: pain; analog treatment; hypnosis; cognitive–behavioral interventions; Stress Inoculation Training.

Pain is perhaps the most common of all medical complaints. When disease, injury, and invasive medical procedures produce pain that cannot be satisfactorily alleviated through standard medical treatment, psychological methods such as hypnosis and cognitive–behavioral interventions are often called upon to provide relief. Pain reduction via hypnosis classically involves hypnotic analgesia, in which it is suggested that the affected body part is numb and lacks feeling (reviewed in Chaves, 1993). Cognitive–behavioral interventions typically seek to alter appraisals of the pain and to divert attention away from pain sensations (reviewed in Turk, Meichenbaum, & Genest, 1983). Individual cognitive–behavioral techniques are sometimes integrated

[1]Department of Psychology, University of Hartford, West Hartford, Connecticut.
[2]Department of Psychology, University of Connecticut, Storrs, Connecticut.
[3]Department of Psychology, University of Arkansas, Fayetteville, Arkansas.
[4]Correspondence should be directed to Dr Leonard S. Milling, Department of Psychology, University of Hartford, 200 Bloomfield Avenue, West Hartford, Connecticut 06117; e-mail: milling@mail.hartford.edu.

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into sophisticated intervention packages such as Stress Inoculation Training (SIT; Turk et al., 1983), a multicomponent treatment that combines progressive muscle relaxation, attention diversion through imagery and deep breathing, as well as coping self-statements. The purpose of this treatment analog study was to evaluate the individual and joint effects of hypnosis and a multicomponent cognitive–behavioral intervention in reducing experimental pain.

Generally, empirical evaluations of hypnosis and cognitive–behavioral methods for reducing pain have yielded encouraging results. Most evidence of the utility of hypnosis comes from a sizeable experimental pain literature (reviewed in Spanos, 1989). Although the induced pain employed this research is quite different from clinical pain in intensity and emotional aversiveness, the methodological rigor made possible by an experimental pain paradigm provides unique supporting evidence of the potential of hypnosis for alleviating clinical pain. Moreover, a growing number of controlled studies of clinical pain have shown that hypnosis is effective in reducing the discomfort associated with burn debridement (Patterson, Everett, Burns, & Marvin, 1992; Wakemen & Kaplan, 1978), chronic headaches (ter Kuile et al., 1994), temporo–mandibular joint dysfunction (Stam, McGrath, & Brooke, 1984), refractory fibromyalgia (Haanen et al., 1991), child birth (Harmon, Hynan, & Tyre, 1990), oral mucositis in bone marrow transplant patients (Syrjala, Cummings, & Donaldson, 1992), as well as pediatric lumbar punctures and bone marrow aspirations (Kuttner, Bowman, & Teasdale, 1988; Smith, Barabasz, & Barabasz, 1996; Zeltzer & LeBaron, 1982).

There have been few studies of the effectiveness of cognitive–behavioral procedures for reducing experimental pain. However, an extensive literature illustrates the merit of these techniques for alleviating clinical pain (reviewed in Turk et al., 1983). In particular, multicomponent cognitive–behavioral treatments such as SIT have been shown to be effective in reducing the discomfort of arthritis (O'Leary, Shoor, Lorig, & Holman, 1988), headaches (Newton & Barbaree, 1987), dental procedures (Getka & Glass, 1992), oral mucositis (Syrjala, Donaldson, Davis, Kippes, & Carr, 1995), arthroscopic surgery (Ross & Berger, 1996), chronic low back pain (cf. Newton-John, Spence, & Schotte, 1995; Nicholas, Wilson, & Goyen, 1991), as well as pediatric bone marrow aspirations and lumbar punctures (Jay, Elliott, Katz, & Siegel, 1987).

In view of the utility of hypnosis and cognitive–behavioral interventions for reducing pain, there has been surprisingly little research comparing these two types of treatments. The few studies contrasting hypnosis against simple distraction from a pain stimulus have produced contradictory findings (Smith et al., 1996; Spanos, McNeil, Gwynn, & Stam, 1984; Tenenbaum, Kurtz, & Bienias, 1990; Zeltzer & LeBaron, 1982). Likewise, the few studies comparing hypnosis against multicomponent cognitive–behavioral interventions have yielded conflicting results (Miller & Bowers, 1986, 1993; Spanos, Ollerhead, & Gwynn, 1985/1986). Overall, this literature is small and leaves unanswered many questions about the relative effectiveness of these interventions for reducing experimental and clinical pain.

The absence of a substantial literature comparing these psychological treatments is especially poignant in view of recent meta-analyses showing that adding hypnosis

can significantly enhance the effectiveness of cognitive–behavioral procedures for a variety of problems, including obesity, insomnia, hypertension, and anxiety (Allison & Faith, 1996; Kirsch, 1996; Kirsch, Montgomery, & Sapirstein, 1995). The findings of these meta-analyses would seem to argue that a combination of hypnosis and cognitive–behavioral interventions might be more effective in reducing pain than either treatment by itself. A primary focus of the current investigation was to address this hypothesis.

Indeed, this treatment analog study examined four questions about the effectiveness of hypnosis and cognitive–behavioral interventions for reducing experimental pain. First, are hypnosis and cognitive–behavioral procedures equally effective in reducing the discomfort of an experimental pain stimulus or is one technique more effective than the other? To answer this question, we compared the effects of an analog hypnotic analgesia intervention to an analog of the multicomponent SIT cognitive–behavioral program in reducing finger pressure pain.

Second, does adding hypnosis to a cognitive–behavioral intervention produce a combination that is more effective than either procedure by itself? On the basis of recent meta-analytic findings (Allison & Faith, 1996; Kirsch, 1996; Kirsch et al., 1995), we conjectured that a joint treatment would provide more relief than either procedure alone. To address this issue, we incorporated a condition that combined all of the elements of our hypnotic analgesia and SIT interventions (i.e., educational information, suggestions for analgesia, progressive muscle relaxation, attention diversion through imagery, and coping self-statements) and framed the resulting analog treatment entirely within a hypnotic context. That is, relaxation was described as "hypnotic relaxation," attention diversion was said to be accomplished through "hypnotic imagery," and coping self-statements were characterized as "coping self-suggestions." For comparison purposes, a no-treatment-control condition was incorporated into the study.

A third question asked whether individuals higher in hypnotic suggestibility would benefit more from the two hypnosis analog interventions and those lower in suggestibility would obtain more relief from the cognitive–behavioral analog intervention. Several studies have suggested that pain reduction is produced by an interaction between suggestibility level and whether an intervention is presented in a hypnotic or a nonhypnotic context (Miller & Bowers, 1986; Smith et al., 1996; Spanos, Kennedy, & Gwynn, 1984; Spanos, McNeil, et al., 1984). To address this question, we employed an unselected sample of participants whose level of hypnotic suggestibility previously had been assessed in a separate experimental context and tested the interaction between suggestibility and treatment condition on pain reduction.

Finally, we wanted to know whether the expected effects of the analog interventions would be associated with the amount of pain reduction actually obtained. Response expectancies, defined as the anticipation of one's own automatic, nonvolitional reactions to events (Kirsch, 1985), have been shown to mediate pain reduction from placebos (reviewed in Kirsch, 1997) and perceptions of a pain stimulus (Baker & Kirsch, 1991). However, the role of response expectancies generated by specific treatments for pain, such as hypnosis and cognitive–behavioral procedures, has not been

well studied. To examine this issue, we measured changes in participants' pain expectancies as a result of undergoing training in hypnosis and the cognitive–behavioral procedures and then tested whether these changes in response expectancy were associated with treatment outcome.

METHOD

Participants

Fifty-six female and 27 male undergraduate introductory psychology students volunteered to take part in this study in exchange for credits needed to satisfy a course requirement. Participants were recruited by telephone from a group of approximately 300 introductory psychology students previously screened for hypnotic suggestibility using the Carleton University Responsiveness to Suggestion Scale (CURSS; Spanos, Radtke, Hodgins, Stam, & Bertrand, 1983) in a separate experimental context. Specifically, the CURSS was administered by an independent group of research assistants in a different location on campus as part of an apparently unrelated study.

The CURSS consists of a hypnotic induction and seven test suggestions. Self-reported objective scores on the CURSS are obtained by having participants complete a questionnaire in which they indicate whether they had made the response called for by the suggestion (0 = *no* and 1 = *yes*). Hypnotic suggestibility is measured as the sum of the scores for the seven suggestions. A test–retest reliability of .67 has been reported for CURSS objective scores (Spanos, Radtke, Hodgins, Bertrand, Stam, & Dubreuil, 1983). Validity has been suggested by large correlations with other measures of suggestibility (Spanos, Radtke, Hodgins, Bertrand, Stam, & Moretti, 1983). In this study, a modified version of the CURSS was employed in which instructions for goal-directed fantasies are replaced by repetition of suggestions (Comey & Kirsch, 1999). This modification results in a more normal distribution of response scores.

Apparatus

The pain stimulus was administered using the Forgione–Barber Strain Gauge Pain Stimulator (Forgione & Barber, 1971). This device consists of a doughnut-shaped weight (900 g) attached to the end of a moveable bar (231 g) that pivots from a support stand at the far end. The participant's finger is positioned atop a 2-in. stand in the middle of the stimulator, and the bar is lowered onto the finger. The other fingers rest on a platform between the finger stand and the support stand. The moveable bar is about 2-mm wide where it contacts the finger and delivers about 2,041 g of force. This device is an accepted method of inducing experimental pain that has been commonly employed in studies evaluating hypnotic, nonhypnotic, and placebo pain reduction (e.g., Hargadon, Bowers, & Woody, 1995; Montgomery & Kirsch, 1996; Spanos, Perlini, Patrick, Bell, & Gwynn, 1990; Spanos, Perlini, & Robertson, 1989).

Instruments

Pain Intensity Report

The intensity of the pain stimulus was measured on an 11-point Visual Analogue Scale (VAS) anchored at *no pain at all* (0) and *pain as intense as one can imagine* (10). An 18-cm visual analogue line depicting the verbal anchors and 11 numbers was affixed to the wall in front of participants. These individuals placed their left index finger in the pain stimulator and an audiotape prompted them to report a number reflecting pain intensity every 20 s for 60 s. These three reports were totaled to produce an index of overall pain intensity ranging from 0 to 30. Baseline pain intensity reports were obtained prior to treatment, and post pain intensity reports were obtained, whereas participants utilized the pain reduction techniques that they had learned as part of treatment. No participants withdrew their finger from the stimulator during the baseline or post trials. Cronbach's alpha was .95 for baseline scores and .97 for post scores.

Pain Expectancy Report

The expected intensity of the pain stimulus was measured using the same 11-point VAS employed in the pain intensity report. Participants provided a single numerical rating ranging from 0 to 10. The baseline pain expectancy report was obtained immediately after the baseline pain intensity report and reflected what participants expected the pain would be like if they were to again place their finger in the stimulator for 1 min. The post pain expectancy report was obtained immediately after training in the analog treatments and indicated what participants expected the pain would be like if they were to place their finger in the stimulator for 1 min while using the pain reduction techniques they had just learned and practiced.

Analog Treatments

Each of the three analog treatments was delivered in two phases. During the training phase, participants listened to an audiotape that presented information about pain management and provided an opportunity to practice specific pain reduction techniques (without placing their finger in the pain stimulator). Thereafter, during the intervention phase, experimenters worked live from a script contained in a treatment manual to administer the pain reduction techniques to participants, while their finger was placed in the stimulator and post pain ratings were obtained. The experimenters consisted of seven advanced female undergraduate students who were trained by the senior author and monitored by him during the course of the experiment.

Hypnotic Analgesia Condition

During the training phase of this analog treatment, the 22 participants in this condition listened to an audiotape providing instruction and practice in hypnotic analgesia. The audiotape began by presenting information adapted from Kirsch,

Lynn, and Rhue (1993) and intended to correct misconceptions about hypnosis and to facilitate a positive attitude towards it (e.g., hypnotized people do not lose control of themselves and cannot be made to do or say whatever the hypnotist wants). Thereafter, participants listened to the hypnotic induction from the CURSS (Spanos, Radtke, Hodgins, Stam, et al., 1983). After experiencing the induction and entering hypnosis, participants heard some educational information about hypnotic analgesia, followed by a 45-s glove analgesia suggestion adapted from Spanos et al. (1989) in which it was suggested to participants that their left hand was insensitive and numb, as if they were wearing a thick glove. The training tape ended with cancellation of the glove analgesia suggestion, but participants were instructed to sit with their eyes closed and to remain in hypnosis. At this point, the experimenter prompted participants to make post pain expectancy ratings.

Thereafter, during the intervention phase, the experimenter made suggestions for the participant to go deeper into hypnosis and then administered the glove analgesia suggestion. While continuing this suggestion, the experimenter guided the participant's finger into the pain stimulator, and post pain ratings were obtained. The glove analgesia suggestion was continued throughout the time the participant's finger was in the pain stimulator. After the third post pain rating was made, participants withdrew their finger from the stimulator, the analgesia suggestion was cancelled, and participants were brought out of hypnosis. The complete hypnotic analgesia analog treatment, including training and intervention phases, lasted approximately 22 min.

Cognitive–Behavioral Condition

This analog treatment was adapted from SIT, a state-of-the-art cognitive–behavioral intervention for pain developed by Turk et al. (1983). With a few minor exceptions, the text and organization of this experimental treatment was drawn verbatim from Turk et al. (1983). During the training phase, the 23 participants in this condition listened to an audiotape providing instruction and practice in SIT. The tape began by describing the Melzack and Wall gate-control theory of pain perception. Thereafter, participants heard information about progressive muscle relaxation drawn from Turk et al. (1983) and experienced Jacobsonian muscle relaxation as detailed in Goldfried and Davison (1976) in which they were instructed to tense and relax all of the muscle groups in their body (e.g., shoulders, thighs) one group at a time. Then, participants listened to information about distraction through imagery and underwent guided imagery in which they imagined themselves at a lake on a warm summer's day, both drawn from Turk et al. (1983). Finally, participants were instructed in the use of coping self-statements (e.g., "I'll control the pain using the techniques I have learned."), also drawn from Turk et al. (1983). When the training tape ended, participants were told to sit with their eyes closed and to remain relaxed. Then, the experimenter prompted participants to make post pain expectancy ratings.

Thereafter, during the intervention phase, the experimenter told the participant to become even more relaxed and to generate a coping self-statement that he or she could use during the post pain assessment. Then, the experimenter provided instructions for progressive muscle relaxation and guided imagery identical to those

practiced during training. After undergoing the relaxation and while engaged in the imagery, the participant's left index finger was guided into the stimulator, and post pain ratings were obtained. The experimenter continued the imagery instructions throughout the time the participant's finger was in the stimulator. Thereafter, the participant's finger was removed from the stimulator, and the imagery was concluded. The cognitive–behavioral treatment lasted approximately 62 min.

Combined Condition

This condition incorporated all of the elements of the hypnotic analgesia and cognitive–behavioral interventions, with each of the techniques framed as hypnotic in nature. During the training phase, the 20 participants in this condition listened to an audiotape providing instruction and practice in the all of the techniques. The tape began by presenting information designed to produce a positive attitude towards hypnosis, followed by the hypnotic induction from the CURSS. After entering hypnosis, participants listened to information about the Melzack and Wall gate-control theory, progressive muscle relaxation (labeled hypnotic relaxation), hypnotic analgesia, distraction through imagery (labeled hypnotic imagery), and coping self-statements (labeled hypnotic self-suggestions; e.g., "The techniques I have experienced can control the pain more and more . . ."). After information about each specific technique (e.g., imagery) was presented, the audiotape provided an opportunity for participants to practice that technique. The training tape ended with the conclusion of the imagery and cancellation of the glove analgesia suggestion, but participants were instructed to remain in hypnosis and to sit with their eyes closed. Then, participants made post pain expectancy ratings.

Thereafter, during the intervention phase, the experimenter made suggestions for the participant to go deeper into hypnosis and to generate a coping self-suggestion. Then, the experimenter made suggestions for hypnotic relaxation, glove analgesia, and hypnotic imagery identical to those practiced during training. While each participant's left hand was "numb" from the glove analgesia suggestion and while he or she was engaged in the imagery, the experimenter guided the participant's finger into the stimulator and post pain ratings were obtained. Imagery suggestions were continued during the time each participant's finger was in the stimulator. After the third pain rating was obtained, the participant's finger was removed from the stimulator, the imagery was concluded, the glove analgesia suggestion was cancelled, and the participant was brought out of hypnosis. The combined treatment lasted approximately 76 min.

Procedure

Participants were contacted by telephone to participate in a study of pain management. No mention was made of hypnosis to participants in the hypnotic analgesia and combined treatment conditions until after the baseline pain assessment to prevent a "holdback" effect (Zamansky, Scharf, & Brightbill, 1964). It has been suggested that some participants might hold back their responses in nonhypnotic situations (e.g., baseline pain assessment) if they believe such responses will be compared

to the same performance during hypnosis (e.g., post pain assessment of hypnotic treatments). Participants were randomly assigned to one of the four treatment conditions in blocks, so that groups were matched for suggestibility and had comparable proportions of males and females.

Individuals in the cognitive–behavioral and control conditions were not aware that this experiment investigated hypnosis. To diminish the possibility that participants in the cognitive–behavioral condition might erroneously conclude they were being hypnotized, all cues associated with hypnosis were minimized (while maintaining the integrity of the cognitive–behavioral techniques). No mention was made of hypnosis to these individuals. Experimenters delivered the relaxation and imagery instructions with an appropriately soothing voice tone, but without the unique rhythm and long pauses often associated with hypnosis. There were no materials (e.g., books, journals) present in the treatment rooms that might cause these participants to incorrectly infer that the cognitive–behavioral condition might be hypnotic in nature.

Experimenters were blind to participants' hypnotic suggestibility scores. Before starting the experiment, participants provided informed consent and completed a medical screening form. Each participant was run through the procedure individually.

Baseline Pain Assessment Phase

At the outset, an experimenter administered the baseline pain assessment in which participants placed their left index finger in the pain stimulator and provided pain intensity reports every 20 s for 60 s. Next, participants provided a pain expectancy rating in which they indicated what they would expect the pain to be like if they were again to place their finger in the stimulator for 1 min (i.e., expected pain *without* pain reduction techniques).

Training Phase

At this point, the training phase commenced. Participants in the combined treatment condition began by listening to a training audiotape, whereas participants in the other conditions completed filler questionnaires and read magazines to equalize the amount of time spent in the study. Specifically, participants in the cognitive–behavioral condition waited 10 min before beginning training and those in the hypnotic analgesia condition waited 50 min. Consequently, despite differences in the length of the treatments, all participants participated in the experiment for the same total amount of time.

In each of the three active treatment conditions, the training tape presented information about pain reduction and provided an opportunity to practice specific techniques. Participants in the hypnotic analgesia and combined conditions experienced a hypnotic induction as part of their training tape, and these individuals remained in hypnosis throughout the rest of the experiment. At the end of the hypnotic analgesia and combined training tapes, the glove analgesia suggestion was cancelled, but these individuals were instructed to remain in hypnosis and to sit with their eyes closed. At the end of the cognitive–behavioral training tape, participants were instructed to remain relaxed and to sit with their eyes closed.

At this point, participants in the active treatment conditions made a second pain expectancy rating indicating what they would expect the pain to be like if they were to again place their finger in the stimulator for 1 min, this time while using the techniques they had just learned and practiced (i.e., expected pain *with* pain reduction techniques).

Intervention Phase and Post Pain Assessment

Thereafter, during the intervention phase, experimenters worked live from the treatment manual script to administer the pain reduction techniques to participants before and during the time their left index finger was placed in the stimulator, and post pain intensity ratings were obtained. More specifically, participants in the cognitive–behavioral condition were first coached to generate a coping self-statement. Then, they were administered progressive muscle relaxation and imagery by the experimenter. While experiencing the imagery, participants were helped to place their left index finger in the stimulator and made post pain ratings. Thereafter, these participants were instructed to open their eyes and were debriefed.

Participants in the combined condition, already in hypnosis, were instructed to generate a coping self-suggestion. Then, the experimenter made suggestions for relaxation, glove analgesia, and imagery. With their hand "numb" and while experiencing the imagery, these participants put their finger in the stimulator and provided post pain ratings. Thereafter, the glove analgesia and hypnosis were cancelled, and the participants were debriefed.

Individuals in the hypnotic analgesia condition, also already in hypnosis, were given suggestions for glove analgesia. Then, they placed their finger in the stimulator and made post pain ratings. After the third pain rating was obtained, the glove analgesia suggestion and hypnosis were cancelled. This was followed by debriefing.

Participants in the control condition waited 60 min after providing the baseline pain intensity report and the baseline pain expectancy report. During this time, they completed filler questionnaires and read magazines. Then, control participants were asked to provide a second pain expectancy rating indicating what they thought the pain would be like if they placed their finger in the stimulator. Thereafter, these participants put their finger in the stimulator and made post intensity ratings. Finally, control participants were debriefed.

RESULTS

Preliminary Analyses

On the CURSS, mean objective scores were 2.09 ($SD = 2.00$) for the hypnotic analgesia condition, 2.26 ($SD = 1.96$) for the cognitive–behavioral condition, 1.95 ($SD = 1.76$) for the combined condition, and 2.22 ($SD = 2.21$) for the control condition. A one-way analysis of variance (ANOVA) on CURSS objective scores failed to show a significant main effect for condition, thereby suggesting the comparability of the treatment groups on suggestibility.

Table I. Means and Standard Deviations (in Parenthesis) for Baseline and Post Pain Intensity and Expectancy Ratings by Condition

Condition	Pain intensity		Pain expectancy	
	Baseline	Post	Baseline	Post
Hypnosis	12.50 (7.63)	8.73 (7.21)	4.64 (3.05)	2.73 (2.23)
Cognitive–behavioral	9.61 (4.55)	6.52 (3.88)	3.74 (2.05)	2.09 (1.51)
Combined	11.55 (5.79)	8.10 (5.52)	4.70 (2.25)	3.00 (1.80)
Control	12.61 (6.23)	14.83 (7.40)	4.83 (2.53)	4.72 (2.30)

Means and standard deviations for baseline and post measures of pain intensity and pain expectancy are presented in Table I. As expected, a one-way ANOVA on baseline ratings failed to show a significant main effect for treatment condition on either pain intensity or pain expectancy ratings. Differences among the seven experimenters were assessed using a 4×7 (Condition $\times$ Experimenter) analysis of covariance (ANCOVA) on post ratings of pain intensity and expectancy, with the corresponding baseline scores as the covariate. These analyses failed to yield a main effect for experimenter or a significant interaction between experimenter and treatment condition for either pain intensity or expectancy.

Within condition, paired-comparisons of baseline and post ratings indicated that baseline to post changes in pain intensity scores were significantly different from 0 for all four conditions, with significant decreases in reported intensity for the hypnotic analgesia ($t_{21} = 3.34$, $p < .01$), cognitive–behavioral ($t_{22} = 4.89$, $p < .001$), and combined treatments ($t_{19} = 4.18$, $p < .001$), as well as a significant increase in reported intensity for the control condition ($t_{17} = -2.57$, $p < .05$). Baseline to post decreases in pain expectancy scores were significantly different from 0 for the hypnotic analgesia ($t_{21} = 4.78$, $p < .001$), cognitive–behavioral ($t_{22} = 5.57$, $p < .001$), and combined conditions ($t_{19} = 4.59$, $p < .001$). However, for the control condition, baseline to post changes in pain expectancy were not significantly different from 0 ($t_{17} = .38$, *ns*).

Main Analyses

A one-way ANCOVA on post expectancy scores, with baseline expectancy scores as the covariate, revealed a significant main effect for treatment condition, $F(3, 81) = 10.33$, $p < .001$. A Tukey's HSD test ($p < .05$) revealed that participants in the control condition expected more pain (adjusted mean = 4.50) than did those in the hypnotic analgesia (adjusted mean = 2.63), cognitive–behavioral (adjusted mean = 2.49), or combined (adjusted mean = 2.86) conditions. There was no significant difference between the three treatment conditions in expected pain.

A one-way ANCOVA on post intensity scores, with baseline intensity scores as the covariate, yielded a significant main effect for treatment condition, $F(3, 82) = 11.42$, $p < .001$. A Tukey's HSD test ($p < .05$) revealed that participants in the control condition reported more intense pain (adjusted mean = 13.96) than did those in the hypnotic analgesia (adjusted mean = 7.94), cognitive–behavioral (adjusted mean = 7.99), and combined (adjusted mean = 8.06) treatment conditions. However, there was no significant difference between the three treatment conditions in reported pain intensity.

Table II. Hierarchical Regression of Post Treatment Pain Intensity on Baseline Intensity, Residualized Pain Expectancy Change Scores, Suggestibility, and Treatment Condition

Variable	F	$p <$
Baseline pain (BP)	192.42	.001
Changes in expected pain (EP)	61.74	.001
Hypnotic suggestibility (HS)	5.99	.02
Treatment condition (TC)	3.95	.01
EP × HS	0.48	.49
EP × TC	1.73	.17
HS × TC	0.19	.91
EP × HS × TC	0.33	.80

Suggestibility, Expected Pain, and Pain Intensity

Residualized change scores in pain expectancy were generated by regressing post pain expectancy scores on baseline pain expectancy scores. Table II presents the results of a hierarchical regression of post pain intensity on baseline pain intensity, residualized pain expectancy change scores, suggestibility, treatment condition, and all possible two-way and three-way interactions of the independent variables. The regression revealed that changes in expected pain, suggestibility, and treatment condition (but none of the interaction terms) added significantly to the prediction of post pain intensity after the effect of baseline pain scores had been removed.

In the regression, changes in pain intensity were significantly predicted by hypnotic suggestibility. Residualized change scores in pain intensity were produced by regressing post intensity scores on baseline intensity scores. These residualized pain intensity change scores were significantly correlated with hypnotic suggestibility ($r = -.25$, $p < .05$), thereby indicating that individuals higher in suggestibility achieved greater pain reduction.

Although the interaction between treatment condition and expectancy as predictors of changes in pain intensity did not approach significance, this is a notoriously low power test. Pedhazur (1982), for example, recommends using an alpha of .10 and examining differences in correlations even with p levels as high as .25. In our data, changes in expected pain were significantly correlated with changes in pain intensity for participants in the hypnotic analgesia ($r = .56$, $p < .01$), combined ($r = .70$, $p < .001$), and control ($r = .53$, $p < .05$) conditions, but not for those in the cognitive–behavioral ($r = -.02$, *ns*) condition.

DISCUSSION

Four main findings were evident in the results of this study. First, our hypnosis and cognitive–behavioral analog treatments were equally effective in alleviating finger pressure pain. This finding is similar to those of studies comparing hypnotic analgesia against distraction (Spanos, McNeil, et al., 1984; Tenenbaum et al., 1990) and SIT (Miller & Bowers, 1993; Spanos et al., 1985/1986) in reducing cold pressor pain. On the other hand, hypnosis has been shown to be more effective than distraction in relieving the pain experienced by children undergoing bone marrow aspirations

and lumbar punctures (Zeltzer & LeBaron, 1982). Thus, had our participants been children, thought to be more hypnotically suggestible than adults (see Olness & Kohen, 1996), or had our participants been exposed to the extreme pain associated with highly invasive medical procedures, it is unclear whether our treatments would have had an equivalent effect.

A second main finding showed that combining a cognitive–behavioral intervention with hypnosis was no more effective in reducing finger pressure pain than either analog intervention by itself. This result was somewhat unexpected based on recent meta-analyses indicating that cognitive–behavioral treatments can be significantly enhanced by adding hypnosis (Allison & Faith, 1996; Kirsch, 1996; Kirsch et al., 1995). For example, in a review of 18 studies, Kirsch et al. (1995) found that the average patient receiving cognitive–behavioral therapy supplemented by hypnosis showed greater improvement than at least 70% of individuals receiving the same treatment without hypnosis.

However, only one of the 18 studies included in the Kirsch et al. (1995) review addressed pain reduction. Edelson and Fitzpatrick (1989) reported that a multicomponent cognitive–behavioral intervention for chronic pain produced as much relief as the same treatment preceded by a hypnotic induction. Relatedly, experimental pain studies comparing hypnotic and nonhypnotic suggestions for analgesia generally have failed to show that adding an induction to an analgesia suggestion yields greater relief than the analgesia suggestion alone (Houle, McGrath, Moran, & Garrett, 1988; Spanos, Radtke-Bodorik, Ferguson, & Jones, 1979; Van Gorp, Meyer, & Dunbar, 1985). Overall, these investigations of experimental and clinical pain, in combination with our own findings, raise the possibility that unlike treatments for other problems, cognitive–behavioral interventions designed to reduce pain may not be enhanced by adding hypnosis.

A third main finding indicated that more pain reduction was associated with higher levels of hypnotic suggestibility. Relief was not a function of an interaction between suggestibility and whether an intervention was provided in a hypnotic versus a nonhypnotic context. On one hand, some studies have reported a suggestibility by context interaction in which the greatest relief was obtained by highs receiving hypnosis (Miller & Bowers, 1986; Smith et al., 1996) or by lows receiving nonhypnotic interventions (Spanos, Kennedy, et al., 1984; Spanos, McNeil, et al., 1984). Such a pattern of findings would have important theoretical implications and might argue for treatment matching based on level of suggestibility wherein highs would be prescribed hypnosis and lows would be referred for cognitive–behavioral interventions. On the other hand, an even larger number of studies have failed to confirm this interaction and instead show that higher suggestibility is associated with greater pain reduction from hypnotic and nonhypnotic treatments alike (Houle et al., 1988; Miller & Bowers, 1993; Spanos et al., 1979; Tenenbaum et al., 1990; Van Gorp et al., 1985).

Thus, the findings of these latter investigations, along with our own results, challenge two predominant models of psychological pain reduction. Hilgard's neodissociation model contends that hypnotic analgesia involves two processes (Hilgard, 1977, 1979). First, a small amount of pain reduction is thought to be produced through

attention diversion and relaxation and is available to everybody. Second, a large amount of relief can be obtained through the dissociation of pain from awareness behind an amnesia-like barrier and is available only to those high in suggestibility. Hilgard's model predicts a significant interaction between suggestibility and treatment context with the greatest pain reduction experienced by highs receiving hypnosis.

A second influential perspective is offered by Spanos (1986). According to his sociocognitive model, all pain reduction, hypnotic and nonhypnotic, can be understood as resulting from attention diversion and reinterpretation of pain stimuli as less distressing. Spanos contends that both highs and lows are capable of substantial pain reduction. "However, low suggestibles come to see themselves as unable or unwilling to respond maximally to the types of suggestions associated with hypnosis; they consequently report little or no pain reduction when given analgesia suggestions" (Spanos, 1986, p. 460). Spanos's model also predicts a significant suggestibility by context interaction with the greatest amount of pain reduction achieved by highs receiving hypnosis and lows receiving cognitive–behavioral procedures. However, our findings, as well as the results of the majority of studies addressing this issue, contradict the Hilgard and Spanos models. High suggestibles appear to experience greater relief, regardless of treatment context. Consequently, alternative theoretical models of psychological pain reduction would seem to be needed.

Finally, our findings indicated a powerful association between changes in ratings of expected pain following training and later changes in ratings of pain intensity during intervention. However, the relationship between expected and actual pain reduction was not uniform across condition. Decreases in pain intensity were significantly correlated with expected pain reduction from the hypnotic analgesia and combined interventions, but not from the cognitive–behavioral intervention. This finding raises the possibility that hypnotic treatments for pain may be more substantially mediated by response expectancies than is SIT. Response expectancies may play a larger role in hypnosis than SIT because of differences in how these treatments are typically presented. Participants in our analog hypnosis conditions were directed during training to take the traditional, passive role of the hypnotic participant (e.g "Today, you have *experienced* a great many ways that hypnosis can control pain. You have had an *opportunity to experience* hypnotic relaxation, hypnotic analgesia, distraction through hypnotic imagery and hypnotic coping self-suggestions."), thereby making pain reduction less volitional, and in turn, emphasizing the role of response expectancies. In our analog cognitive–behavioral condition, SIT was (accurately) presented to participants as a skill that can be learned and employed to reduce pain (e.g., "Today, you have *learned* a great many things about using cognitive–behavioral techniques to control pain. You have been *shown how to use* progressive muscle relaxation, distraction though imagery, and coping self-statements."), thereby making pain reduction more volitional, and in turn, reducing the role of response expectancies. Without doubt, this pattern of findings is in need of replication. However, it would appear that although our three treatments produced similar amounts of relief, the mechanisms by which the hypnotic and cognitive–behavioral interventions achieved their effect may have been quite different.

This study employed an experimental pain stimulus to evaluate the effectiveness of analog versions of two interventions commonly used to treat clinical pain. Several limitations of this approach should be highlighted. First, experimental pain and clinical pain are substantially different phenomena. Clinical pain, whether acute or chronic, is usually intense, unavoidable, and unpredictable. In contrast, experimental pain is typically mild in intensity and brief in duration. Individuals who take part in studies of experimental pain are aware that they are unlikely to suffer tissue damage and that they can withdraw from participation at any time (Edens & Gil, 1995).

Second, the analog treatments utilized in this study may have been different in some important ways compared with the actual interventions from which they were derived. For example, clinical hypnotists typically do not limit themselves to a single "glove analgesia" type of suggestion when using hypnosis to help patients manage clinical pain. Similarly, our version of SIT may not have been fully representative of how it is used in clinical situations. SIT patients are usually encouraged to take a more active and autonomous role in the pain coping process than our highly standardized treatment protocol allowed. Furthermore, SIT commonly incorporates multiple practice sessions provided across a span of weeks to help patients master key pain management skills while confronting gradually increasing levels of the stressor. On one hand, our 60-min SIT session may have been more representative of the length of the original treatment than the single 20-min tape-recorded session utilized by Spanos et al. (1986) or the single 30-min session employed by Miller and Bowers (1986, 1993). On the other hand, it is unclear whether the results of our evaluation of analog versions of SIT and hypnotic analgesia in reducing finger pressure pain would generalize to a comparison of these treatments as they actually used in clinical situations to alleviate the kind of pain associated with, for example, a bone marrow aspiration, a burn injury, or chronic low back pain.

Acknowledging these limitations, it is also worth noting that the control inherent in an experimental pain paradigm affords an opportunity to evaluate with great precision the effectiveness of a standardized set of clinically relevant interventions for reducing a standardized pain stimulus (Edens & Gil, 1995). Our results, obtained under carefully controlled conditions, suggest the equivalence of analog versions of hypnotic analgesia and SIT in reducing experimental pain. Furthermore, a combination of the two analog interventions appears to be no more effective in reducing discomfort than either procedure alone. The full implications of these findings would be best revealed by considering them in tandem with the results of parallel studies of clinical pain. Therefore, future research may usefully compare the individual and combined effects of hypnosis and cognitive–behavioral treatments as they are actually used in clinical settings to alleviate a range of acute and chronic pain problems.

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