Response Expectancies, Treatment Credibility, and Hypnotic Suggestibility: Mediator and Moderator Effects in Hypnotic and Cognitive-Behavioral Pain Interventions

Leonard S. Milling, Ph.D., Jessica S. Shores, M.A., Elizabeth L. Coursen, M.A., Deanna J. Menario, M.S., and Catherine D. Farris, M.S.
Department of Psychology, University of Hartford

ABSTRACT

Background: *Several studies have shown that response expectancies are an important mechanism of popular psychological interventions for pain. However, there has been no research on whether response expectancies and treatment credibility independently mediate hypnotic and cognitive-behavioral pain interventions and whether the pattern of mediation is affected by experience with the interventions. Also, past research has indicated that hypnotic pain interventions may be moderated by hypnotic suggestibility. However, these studies have typically failed to measure the full range of suggestibility and have assessed pain reduction and suggestibility in the same experimental context, possibly inflating the association between these variables.* ***Purpose:*** *To clarify the mediator role of response expectancies and treatment credibility, and the moderator role of hypnotic suggestibility in the hypnotic and cognitive-behavioral reduction of pain.* ***Methods:*** *Approximately 300 participants were assessed for suggestibility. Then, as part of an apparently unrelated experiment, 124 of these individuals received analogue cognitive-behavioral, hypnotic, or placebo control pain interventions.* ***Results:*** *Response expectancies and credibility independently mediated treatment. The extent of mediation increased as participants gained more experience with the interventions. Suggestibility moderated treatment and was associated with relief only from the hypnotic intervention.* ***Conclusions:*** *Response expectancies and treatment credibility are unique mechanisms of hypnotic and cognitive-behavioral pain interventions. Hypnotic suggestibility predicts relief from hypnotic pain interventions and this association is not simply an artifact of measuring suggestibility and pain reduction in the same experimental context. The relationship between suggestibility and hypnotic pain reduction appears to be linear in nature.*

(**Ann Behav Med** 2007, *33*(2):167–178)

We gratefully acknowledge the many research assistants who contributed to this study, with special appreciation for Kevin Ball, Nicole Boeri, Margaret Carr, Phuong Chau, Anne McGinnis, Danielle Miller, Rebecca Neal, Dana Prechter, Annie Thode, Priscilla Thorn, Candace Toval, Jacqlyn Tumolo, Holly Walker, and Amanda Yoczik.

Reprint Address: L. S. Milling, Ph.D., University of Hartford. Department of Psychology, 200 Bloomfield Avenue, West Hartford, CT 06117. E-mail: milling@hartford.edu

INTRODUCTION

Pain exacts a heavy toll in terms of human suffering, medical expenditures, disability compensation, and lost productivity (1). It is one of the most frequent reasons for visits to doctors' offices and hospital emergency rooms (2,3). Popular psychological interventions for managing pain include hypnosis and cognitive-behavioral therapy. Indeed, a recent large scale survey showed that hypnosis and cognitive-behavioral techniques such as deep breathing, progressive relaxation, and guided imagery were each used by several million people in the U.S. during 2002 to treat pain and other medical conditions (4). Of note, there is considerable evidence that both hypnosis (5–7) and cognitive-behavioral interventions (8,9) are effective methods of alleviating pain. The purpose of this analogue treatment study is to help clarify the psychological mechanisms that explain how hypnotic and cognitive-behavioral interventions reduce pain and to elucidate which interventions may be most effective for particular groups of people.

Response Expectancies

According to Baron and Kenny (10), a *mediator* variable is a mechanism through which an independent variable (e.g., treatment) is able to influence a dependent variable (e.g., outcome). Response expectancies, or the expectancy of the occurrence of nonvolitional responses to situational cues (11), have been advanced as a mediator of hypnotic and cognitive-behavioral pain interventions (see 12), as well as placebo pain reduction (e.g., 13,14). Kirsch's (15) response expectancy theory is an extension of Rotter's (16) social learning theory (SLT). According to SLT, the probability that a behavior will occur is a function of the expectancy that the behavior will lead to reinforcement and the strength of that reinforcement. SLT predicts the occurrence of goal-directed (i.e., voluntary) behaviors. As such, the SLT conception of expectancy is said to be an *outcome expectancy*. In contrast, response expectancies predict the occurrence of involuntary behaviors, such as pain.

A growing number of studies have shown that response expectancies are an important mechanism of hypnotic and cognitive-behavioral pain interventions. Most studies demonstrate a pattern of partial mediation. For example, Montgomery, Weltz, Seltz, and Bovbjerg (17) found that response expectancies partially mediated the effect of hypnosis on breast biopsy pain. Similarly, a series of experimental pain studies by Milling and colleagues

showed that a variety of hypnotic and cognitive-behavioral pain treatments were partially mediated by response expectancies (see 12 for a review and study). However, none of these investigations examined the effect of experience with the treatments on the pattern of mediation. Conceivably, the extent of mediation might increase with greater experience using a particular intervention.

Why would mediation increase with experience? A possible answer comes from SLT. Rotter (16) distinguished between two kinds of expectancies. A *specific expectancy* is the person's expectation that the same outcome will occur in the future based on past experiences in the identical situation. A *generalized expectancy* is the person's generalization of expectancies that the same or similar outcomes will occur in the future based on past experiences in similar situations. The more experience one has in a particular situation, the more likely their behavior will be determined by specific expectancies. According to Rotter, a specific expectancy allows for a high level of prediction of behavior in a single situation, whereas a generalized expectancy permits only a modest level of prediction, but in a wider range of situations. Thus, the more experience one has with a particular pain intervention, the more fully response expectancies should mediate treatment. Hence, the first goal of this study is to evaluate the mediator function of response expectancies in hypnotic and cognitive-behavioral pain treatments and to examine whether the extent of mediation increases with greater experience using the treatments.

Credibility of Treatment Rationale

The credibility of a treatment rationale refers to how believable, logical, and convincing a treatment is perceived to be (18). Like expectancy, credibility has been theorized to be a mechanism of psychotherapy. The Devilly and Borkovec (18) scale, and its predecessor (19) have emerged as the gold standard of measures of treatment credibility. Research with these scales has shown that credibility is related to treatment outcome, although with less consistency than expectancy. Theorists and empirical researchers alike conceptualize expectancy and credibility as separate constructs. For example, Devilly and Borkovec (18) contend that credibility primarily involves logical thought processes, whereas expectancy is more related to affective processes.

Treatment credibility has been shown to predict the effectiveness of psychotherapy for a range of problems (20–23). However, there has been no research evaluating credibility as a mediator of psychological pain interventions. Accordingly, a second goal of this study is to evaluate the mediator function of credibility in hypnotic and cognitive-behavioral pain treatments. We wanted to examine whether credibility mediates these pain treatments independent from expectancy and whether mediation increases with more experience using the interventions. This is the first study to examine credibility as a mediator of hypnotic and cognitive-behavioral pain treatments and it is the first to assess whether the pattern of mediation is affected by experience with the interventions.

Hypnotic Suggestibility

Baron and Kenny (10) describe a *moderator* as a variable that affects the strength or direction of the relationship between an independent variable (e.g., treatment) and a dependent variable (e.g., outcome). *Hypnotic suggestibility* is the general tendency to respond to hypnotic suggestions (24). There is some evidence that suggestibility may moderate hypnotic pain interventions. For example, in reviews of research on hypnosis and clinical pain, Patterson and Jensen (6,7) identified nine studies in which suggestibility had been assessed. Of these, two acute pain studies (25,26) and four chronic pain studies (27–30) showed a relationship between suggestibility and pain reduction. Also, in a meta-analysis of 23 studies on the hypnotic reduction of experimental and clinical pain, Montgomery et al. (5) reported that individuals scoring in the high range of suggestibility achieved more pain reduction than those in the low range. However, of the 23 studies, 8 did not assess suggestibility and another 8 included individuals only from the high or low ranges. Because most people fall in the medium suggestibility range (31), studies incorporating only those who score very high or low on this variable tell us little about the relationship between suggestibility and hypnotic pain reduction in the general population.

Moreover, studies of the association between hypnotic suggestibility and hypnotic pain reduction have characteristically measured suggestibility and pain reduction as part of the same experiment, possibly inflating the observed relationship between these variables. Some hypnosis scholars contend that associations among hypnotic behaviors may be the result of a *context effect* (32). In a context effect, participants respond consistently across measures of hypnotic behaviors when the measures are transparent and the hypothesized association between them can be discerned.

However, when participants are not aware there is a connection between the measures, the relationship between them is weak or nonexistent. Indeed, the prolific hypnosis scholar N. Spanos has argued that "the oft-replicated relationship between suggestibility and suggested analgesia is situation-specific and will tend to break down when the two testing situations are not implicitly or explicitly defined as related to one another" (33, p. 460).

To the contrary, Milling et al. (12) recently reported that the objective dimension of a standardized measure of hypnotic suggestibility moderated the effect of several hypnotic and cognitive-behavioral pain interventions, even though suggestibility and pain reduction were measured as part of two seemingly unrelated experiments. Many measures of hypnotic suggestibility assess two or three dimensions of suggestibility. As such, a third goal of this study

is to replicate and extend Milling et al. by examining whether objective, subjective, and involuntariness dimensions of suggestibility moderate the effect of hypnotic and nonhypnotic pain interventions, when suggestibility and pain reduction are measured in separate contexts and using a sample representative of the full range of suggestibility in the general population.

The Current Study

To evaluate response expectancies and treatment credibility as mechanisms of popular psychological pain interventions, we compared analogue versions of a hypnotic treatment and a cognitive-behavioral treatment with a placebo condition in reducing finger pressure pain. We had participants rate the relief they expected to obtain from treatment and the credibility of the treatment. A placebo control condition was included to establish the effectiveness of the hypnotic and cognitive-behavioral treatments. Because participants rated treatment credibility, it was necessary for our control condition to be a treatment of some kind rather than a no-treatment control condition. We predicted that expectancy and credibility would independently mediate treatment. To examine the effect of experience on the pattern of mediation, we had participants make expectancy and credibility ratings after hearing a brief description of the treatment, again after practicing or experiencing a treatment, but without using it to reduce pain, and a third time after they had used the treatment while their finger was in pain stimulator. We predicted that ratings based on a verbal description would not mediate treatment. Consistent with past research (12), we predicted that ratings based on practice alone would partially mediate treatment. Lastly, we predicted that ratings based on actual experience using a treatment to reduce pain would fully mediate the effect of subsequent treatment. To determine whether hypnotic suggestibility moderated the effect of our treatments, we recruited a sample representative of suggestibility in the general population. We measured suggestibility and pain reduction in separate experimental contexts and tested their interaction in regression analysis. We predicted that all three dimensions tapped by our suggestibility scale would be related only to the effect of our hypnotic treatment.

METHOD

Participants

Forty-one male and 83 female introductory psychology students took part in the main study to satisfy a course requirement. The mean age of participants was 19.43 years ($SD = 3.61$, range = 18–44). Sixty-nine percent of the sample described themselves as Caucasian, 12% as African American, 4% as Asian or Pacific Islander, 2% as Hispanic, 0.8% as other, and 13% did not respond. These individuals were recruited from a group of approximately 300 introductory psychology students who earlier had been screened for hypnotic suggestibility using the Carleton University Responsiveness to Suggestion Scale (31) in the guise of an unrelated experiment.

To prevent participants from making a connection between the screenings and the main study, the two procedures were run by separate groups of experimenters. Also, the screenings were run on the central university campus and the main study was performed in a pain treatment lab located on a satellite campus. Finally, a female voice was used on the screening tape and a male voice was used on the treatment tapes to prevent participants from concluding the tapes were made by the same person. These steps were designed to reduce the possibility of a context effect, in which responding to the screenings might affect later responding to the pain treatments.

Apparatus

A Forgione-Barber strain gauge pain stimulator (34) was used to administer finger pressure pain. This device consists of a doughnut-shaped weight (900 g) attached to a bar (231 g) that pivots from a hinged support stand at the far end. The index finger is placed on top of a 5-cm stand in the middle and the other fingers rest on a platform between the finger stand and the support stand. The bar is 2 mm wide where it contacts the index finger. When the bar is lowered onto the index finger, it produces 2,041 g of force at the contact point.

Instruments

Carleton University Responsiveness to Suggestion Scale (CURSS) (31).

The CURSS consists of a hypnotic induction and seven test suggestions. It produces three indices of suggestibility. *Objective suggestibility* reflects what the participant believes an onlooker would have observed the participant do in response to each suggestion. *Subjective suggestibility* refers to the participant's inner, subjective experience of each suggestion. Finally, *involuntariness* indicates the extent to which each suggestion was experienced as happening automatically and without a feeling of effort. Test-retest reliability coefficients of .67 to .76 have been reported for the three indices (35). The validity of the CURSS has been suggested by high correlations with other suggestibility measures (36). The version of the CURSS used herein replaces goal-directed fantasies with repetition of suggestions, which yields a more normal distribution of scores (37).

Pain Intensity Rating

Pain intensity was measured on an 11-point visual analog scale ranging from 0 (*no pain at all*) to 10 (*pain as intense as one can imagine*). A placard with an 18-cm line showing the verbal anchors and eleven numbers was displayed in front of participants. These individuals placed their finger in the pain stimulator and were prompted by an audiotape

to report a number reflecting intensity every 20 sec for 1 min. The sum of these reports yielded an index of intensity ranging from 0 to 30. Cronbach's alpha coefficients were .95 for baseline intensity 1, .94 for baseline intensity 2, .94 for postintensity 1, and .94 for postintensity 2.

Pain Expectancy Rating

Expected pain was measured using the same 11-point scale used in the pain intensity ratings. Participants provided a single numerical rating ranging from 0 to 10.

Desire for Relief Rating

Desire for pain relief was measured on an 11-point visual analog scale ranging from 0 (*no desire for pain relief*) to 10 (*very strong desire for pain relief*) using a placard with an 18-cm line showing the verbal anchors and 11 numbers.

Credibility of Treatment Rationale Scale (18)

This scale is a 3-item measure of how believable, logical, and convincing a treatment is perceived to be. Each item is measured on a 9-point scale ranging from 1 (*not at all*) to 9 (*very*). A placard with an 18-cm line showing the verbal anchors for each item and the nine numbers was displayed in front of participants. The sum of these items yielded an index of credibility ranging from 3 to 27. Cronbach's alpha has been estimated to range from .81 to .86, and the validity of the scale is suggested by its ability to predict treatment outcome (18).

Analogue Treatments

The analogue treatments were adapted from published material describing each procedure and incorporated in a treatment manual. The treatments were delivered in three phases. During the familiarization phase, participants listened to a brief verbal description of the treatment. During the preparation phase, participants heard detailed information about the treatment, plus an opportunity to experience it, but without placing their finger in the stimulator. Finally, during the intervention phase, an experimenter administered the treatment while the participant placed his or her finger in the stimulator. The treatments were provided by five master's level graduate students and four advanced undergraduates who were trained and monitored by the first author.

Hypnotic Analgesia Condition

During the preparation phase, the 13 male and 29 female participants assigned to this condition listened to an audiotape presenting: (a) information from Kirsch, Lynn, and Rhue (38) designed to correct misconceptions about hypnosis and to create a positive attitude toward it; (b) the hypnotic induction from the CURSS (31); and (c) information about hypnotic analgesia and an opportunity to experience a 45-sec glove analgesia suggestion adapted from Spanos, Perlini, and Robertson (39). During the intervention phase, an experimenter working live from the treatment manual administered the glove analgesia suggestion to each hand during the third and fourth trials.

Cognitive-Behavioral Condition

This treatment was closely adapted from Stress Inoculation Training (SIT), a multicomponent cognitive-behavioral intervention for pain (40). During the preparation phase, the 13 males and 29 female participants assigned to this condition listened to an audiotape presenting: (a) information about the Melzack and Wall gate-control theory of pain perception (41); and (b) information and practice in the use of progressive muscle relaxation, guided imagery; and coping self-statements. During the intervention phase, an experimenter working live from the treatment manual helped participants to use coping self-statements, muscle relaxation and imagery during the third and fourth trials.

Placebo Control Condition

The placebo consisted of an inert solution presented as an experimental topical analgesic. The solution was composed of povo-iodine and oil of thyme, producing a brown liquid with a medicinal smell. The solution was placed in a pharmaceutical bottle labeled, "Trivaricaine: Approved for Research Purposes Only." During the preparation phase, the 14 male and 27 female participants assigned to this condition heard information about the nature of medical analgesics and had an opportunity to experience the Trivaricaine without placing their finger in the stimulator. During the intervention phase, participants made intensity ratings during the third and fourth trials with the Trivaricaine applied to each index finger.

Procedure

All individuals previously screened for suggestibility were contacted by telephone and invited to take part in a study comparing an experimental analgesic with psychological pain control techniques. No selection criteria were used in recruitment. Experimenters were blind to participants' suggestibility scores. Participants were randomly assigned in blocks to one of the three treatment conditions so that each condition had equal proportions of male and female participants, and to one of two orders, in which they alternately placed their left and right index fingers in the pain stimulator for four 1-min trials. The study, including the sample of 124 participants, was completely separate from that of an earlier investigation (12).

Participants receiving the hypnotic analgesia treatment were not told the study involved hypnosis until after the second trial to prevent a *hold-back effect* (42). In a hold-back effect, participants exaggerate the pain during baseline trials to leave room for improvement on post trials

due to the effects of hypnosis. Individuals in the cognitive-behavioral and placebo conditions were not told the experiment involved hypnosis until the debriefing to prevent them from erroneously concluding they were being hypnotized.

To further reduce the possibility that participants might mistakenly conclude they were being hypnotized unless and until they actually received the hypnotic treatment, all cues associated with hypnosis (e.g., books) were removed from the treatment room. Also, the relaxation and imagery instructions in the cognitive-behavioral treatment were delivered with a soothing voice quality, but without the unique tone and cadence associated with hypnosis. Thus, these participants had no more reason to believe they were being hypnotized than any person taking part in a study involving progressive muscle relaxation and guided imagery.

To begin the experiment, participants were again told that the purpose of the study was to compare the effectiveness of an experimental analgesic with psychological procedures for pain reduction. Participants provided written informed consent and completed a medical screening form. Eligible participants could not have a medical condition that affected the sensitivity of either index finger. Figure 1 shows a flow diagram of the experimental procedure. On the first pain trial, participants placed an index finger in the pain stimulator and made intensity ratings (i.e., baseline intensity 1), followed by expectancy ratings (i.e., baseline expectancy 1) indicating what they expected the pain would be like if they were to again place the same finger in the stimulator without intervention. On the second pain trial, participants placed their other index finger in the stimulator and made intensity ratings (i.e., baseline intensity 2), followed by expectancy ratings (i.e., baseline expectancy 2) indicating what they expected the pain would be like if they were again to place that finger in the stimulator without pain control techniques. At this point, participants rated their desire for pain reduction.

Next, during the familiarization phase, participants heard a brief verbal description of the treatment they were

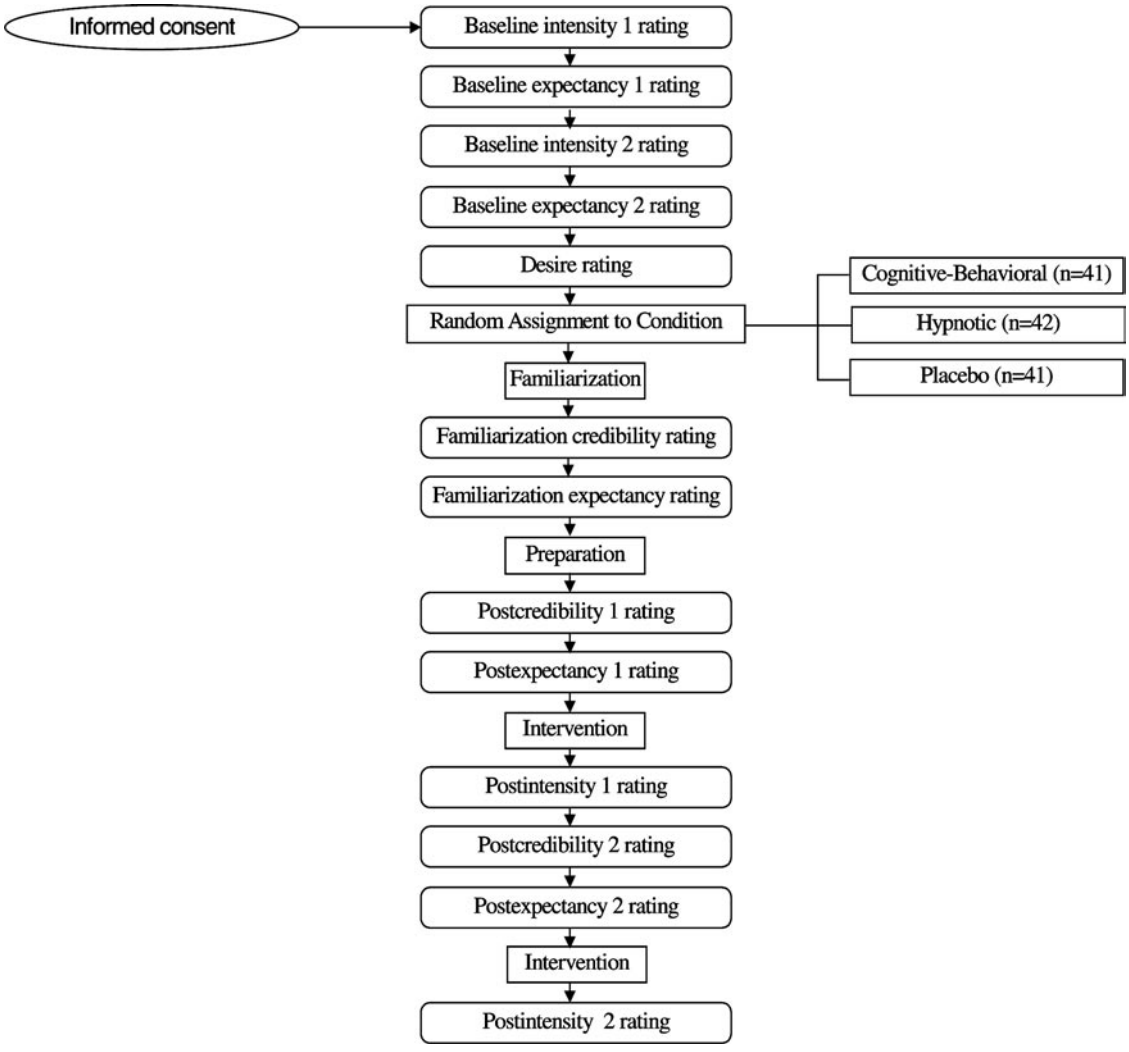

FIGURE 1 Flow diagram of experimental procedure.

about to receive. Afterward, they rated the credibility of the treatment (i.e., familiarization credibility) and how intense they expected the pain to be (i.e., familiarization expectancy) while using the treatment during the third pain trial. Then, during the preparation phase, participants heard detailed information about the treatment, plus an opportunity to practice or experience it, but without placing their finger in the stimulator. Participants then rated the credibility of the treatment (i.e., postcredibility 1) and how intense they expected the pain to be (i.e., postexpectancy 1) while using the treatment during the third pain trial.

Subsequently, the intervention phase began with the third pain trial, wherein the experimenter administered the intervention while the participant placed his or her index finger in the stimulator and made intensity ratings (i.e., postintensity 1). Participants then rated the credibility of the treatment (i.e., postcredibility 2) and how intense they expected the pain to be while using the treatment (i.e., postexpectancy 2) during the fourth pain trial. Then, during the fourth pain trial, the experimenter resumed the intervention while the participant placed his or her other index finger in the stimulator and made intensity ratings (i.e., postintensity 2).

RESULTS

Preliminary Analyses

The CURSS yielded mean scores of 2.23 ($SD = 1.96$; range = 0–7) on the objective dimension, 5.39 ($SD = 4.71$; range = 0–20) on the subjective dimension, and 4.58 ($SD = 4.83$; range = 0–18) on the involuntariness dimension. The frequency of objective scores was: 0 (21%), 1 (22%), 2 (18%), 3 (12%), 4 (14%), 5 (3%), 6 (7%), and 7 (3%). This distribution is comparable to normative information for the scale (31). Means and standard deviations for intensity, expectancy, credibility, and desire ratings by condition are shown in Table 1. A series of one-way analyses of variance (ANOVA) on suggestibility scores, as well as on baseline expectancy and intensity ratings did not yield a significant effect for condition, thus suggesting the comparability of the treatment groups on these variables. A $3 \times 4 \times 9$ (Condition × Trial × Experimenter) mixed-model ANOVA, with intensity ratings as a repeated factor, did not produce a significant main effect for experimenter or significant two-way or three-way interactions of experimenter with condition and trial, thereby suggesting the absence of experimenter effects.

Reduction of Pain Intensity

A 3×4 (Condition × Trial) mixed-model ANOVA, with intensity ratings at baseline 1, baseline 2, post 1 and post 2 as a repeated factor, failed to produce a significant main effect for condition, $F(2, 121) = 0.41$, *ns*, $\eta^2 = .01$. The within-subjects effect of trial was significant, $F(1, 121) = 14.97$, $p \leq .001$, $\eta^2 = .11$. A least significant difference test on estimated marginal means with a Bonferroni adjustment for the number of statistical comparisons revealed that participants reported more intense pain at baseline 1 ($M = 12.70$) and baseline 2 ($M = 12.81$) than they did at post 1 ($M = 10.99$) and post 2 ($M = 11.03$). The condition × trial interaction was significant, $F(2, 121) = 6.34$, $p \leq .02$, $\eta^2 = .10$. Scheffé post hoc contrasts revealed that participants in the cognitive-behavioral and hypnotic analgesia conditions reported less intense pain on post 1 and post 2 ratings than they did on baseline 1 and baseline 2 ratings, compared with participants in the placebo control condition.

TABLE 1
Means and Standard Deviations for Intensity, Expectancy, Credibility and Desire Ratings by Treatment Condition

	Treatment Condition					
	Cognitive-Behavioral[a]		*Hypnotic Analgesia*[b]		*Placebo Control*[a]	
	M	*SD*	*M*	*SD*	*M*	*SD*
Measure						
Baseline intensity 1	12.83	6.09	12.76	6.39	12.51	5.68
Baseline intensity 2	12.93	5.60	13.50	6.22	12.00	5.92
Postintensity 1	10.00	6.22	10.47	6.50	12.49	5.81
Postintensity 2	9.78	5.80	10.38	6.92	12.93	6.14
Baseline expectancy 1	5.88	2.58	5.50	2.45	5.46	2.25
Baseline expectancy 2	5.98	2.23	5.81	2.53	5.37	2.46
Familiarization expectancy	3.85	1.93	4.14	2.13	2.95	1.84
Postexpectancy 1	3.56	2.02	3.76	2.18	3.29	2.02
Postexpectancy 2	3.83	2.21	4.02	2.27	4.66	2.21
Familiarization credibility	18.83	4.13	13.60	5.56	15.71	5.13
Postcredibility 1	19.98	4.27	14.21	6.65	15.85	5.05
Postcredibility 2	20.10	5.91	14.19	7.30	10.29	5.42
Desire for pain relief	5.98	2.54	5.24	2.50	5.40	2.74

[a] $n = 41$. [b] $n = 42$.

When this analysis was repeated incorporating gender as an independent variable, the resulting 2×3×4 (Gender× Condition × Trial) mixed-model ANOVA yielded a significant main effect for gender, $F(1, 118) = 18.27$, $p \leq .001$, $\eta^2 = .13$, with male participants ($M = 9.02$) reporting significantly less pain than female ($M = 13.26$). However, the two-way and three-way interactions of gender with condition and trial were nonsignificant, suggesting the absence of gender effects in treatment.

Mediator Analysis of Response Expectancies and Treatment Credibility

We hypothesized that response expectancies and credibility would increasingly mediate our pain treatments as participants gained more experience with them. In the mediator analyses, we compared the effect of our cognitive-behavioral and hypnotic interventions with that of our placebo. In each of the three mediator analyses, four simultaneous regressions were computed, following Baron and Kenny (10). In the first and second regressions, the hypothesized mediators (expectancy and credibility) were separately regressed on the independent variable (treatment). In the third regression, the dependent variable (postintensity) was regressed on the independent variable (treatment), controlling for the covariate (baseline intensity). In the fourth regression, the dependent variable (postintensity) was regressed on the hypothesized mediators (expectancy, credibility) and the independent variable (treatment), controlling for the covariates (baseline intensity and expectancy).

In the first set of analyses, expectancy and credibility ratings provided at familiarization were evaluated as mediators of the effect of subsequent intervention during the third trial. Consistent with prediction, neither familiarization expectancy nor credibility mediated the effect of treatment. In the second set of analyses, expectancy and credibility ratings provided at post 1 were tested as mediators of the effect of subsequent intervention during the third trial. Contrary to prediction, postexpectancy 1 and postcredibility 1 ratings failed to partially mediate treatment.

Finally, in the third set of analyses, expectancy and credibility ratings provided at post 2 were evaluated as mediators of the effect of subsequent intervention during the fourth trial. Table 2 shows the results of these analyses. In the first regression, after baseline expectancy 2 was controlled, treatment significantly predicted postexpectancy 2. In the second regression, treatment significantly predicted postcredibility 2. In the third regression, after controlling for the effect of baseline intensity 2, treatment predicted postintensity 2. In the fourth regression, after controlling for baseline intensity 2 and baseline expectancy 2, postexpectancy 2 and postcredibility 2 predicted postintensity 2. Reduction of pain intensity was related to reduction of expected pain ($\beta = .54$, $p = .001$) and to higher treatment credibility ($\beta = -.17$, $p = .006$). Sobel tests revealed that the indirect effects of treatment on pain intensity at post 2 via both response expectancy ($z = 2.86$, $p = .004$) and credibility ($z = 2.46$, $p = .014$) were significant. The effect of treatment on intensity was less when entered together with response expectancy and credibility in the fourth regression ($\eta^2 = .02$) than when entered without expectancy and credibility in the third regression ($\eta^2 = .14$). Indeed, the effect of treatment on intensity was no longer significant when response expectancy and credibility were included in the fourth regression. As predicted, these results indicate that the effects of treatment on intensity at post 2 were fully mediated by response expectancy and credibility.

TABLE 2
Simultaneous Regressions Testing Mediation of Effects of Treatment on Pain Intensity by Expectancy and Credibility at Post 2

Criterion and Predictor	*F*	*p*	*Beta*	*Eta²*
Postexpectancy 2				
Baseline expectancy 2	82.39	.001	.63	.41
Treatment	9.92	.002	–.22	.08
Postcredibility 2				
Treatment	28.35	.001	.43	.19
Postintensity 2				
Baseline intensity 2	126.37	.001	.70	.51
Treatment	19.80	.001	–.28	.14
Postintensity 2				
Baseline intensity 2	20.80	.001	.45	.15
Postcredibility 2	7.70	.006	–.17	.06
Baseline expectancy 2	3.15	.079	–.16	.03
Postexpectancy 2	45.80	.001	.54	.28
Treatment	2.53	.115	–.08	.02

TABLE 3
Hierarchical Regressions Testing Interaction of Desire and Expectancy in Reduction of Pain Intensity at Post 1 and Post 2

Criterion and Predictor	*F*	*p*	*Beta*	*Eta²*
Postintensity 1				
Baseline intensity 1	192.68	.001	.74	.62
Desire (D)	0.01	.938	.01	.00
Baseline expectancy 1	0.05	.829	–.02	.00
Postexpectancy 1 (E)	19.65	.001	.34	.15
E × D	0.48	.489	–.13	.00
Treatment	16.27	.001	–.22	.12
Postintensity 2				
Baseline intensity 2	204.85	.001	.67	.64
Desire (D)	1.04	.309	.06	.01
Baseline expectancy 2	4.98	.028	–.21	.04
Postexpectancy 2 (E)	118.47	.001	.71	.51
E × D	0.01	.949	–.01	.00
Treatment	6.68	.011	–.13	.05

TABLE 4
Hierarchical Regressions Testing Moderation of Effects of Treatment by Objective, Subjective, and Involuntariness Indices of Hypnotic Suggestibility

	Criterion							
	Postintensity 1				*Postintensity 2*			
Suggestibility Index	*F*	*p*	*Beta*	Eta^2	*F*	*p*	*Beta*	Eta^2
Objective								
Baseline intensity	165.08	.001	.75	.58	114.48	.001	.68	.49
Suggestibility (S)	2.59	.110	–.09	.02	7.38	.008	–.17	.06
Treatment (T)	1.76	.187	–.08	.02	5.39	.022	–.15	.04
T × S	5.75	.018	–.23	.05	5.35	.022	–.24	.04
Subjective								
Baseline intensity	176.89	.001	.75	.60	123.50	.001	.68	.51
Suggestibility (S)	8.73	.004	–.17	.07	14.90	.001	–.24	.11
Treatment (T)	1.84	.177	–.08	.02	5.48	.021	–.14	.04
T × S	8.70	.004	–.27	.07	8.47	.004	–.29	.07
Involuntariness								
Baseline intensity	172.37	.001	.75	.59	121.49	.001	.68	.51
Suggestibility (S)	6.89	.010	–.15	.06	13.02	.001	–.22	.10
Treatment (T)	1.56	.214	–.07	.01	4.91	.029	–.14	.04
T × S	7.30	.008	–.24	.06	8.52	.004	–.28	.07

Desire for Pain Reduction

Price and Barrell (43) theorize that a combination of desire for pain relief and expectancy should more strongly predict analgesia than expectancy alone. Vase, Robinson, Verne, and Price (44) showed that a combination of desire and expectancy predicted placebo pain reduction among irritable bowel syndrome patients. However, the analyses reported in Vase et al. make it impossible to determine whether desire, or the combination of desire and expectancy explained additional variance in pain reduction beyond that accounted for solely by expectancy.

To evaluate whether desire adds to the prediction of pain reduction by expectancy, we performed hierarchical regressions in which we compared the effect of our hypnotic and cognitive-behavioral interventions with that of our placebo. The results of these regressions are shown in Table 3. In the first analysis, postintensity 1 ratings were regressed on baseline intensity 1, desire, baseline expectancy 1, postexpectancy 1, desire × postexpectancy 1, and treatment cluster. After controlling for the effects of baseline intensity and expectancy scores, postintensity 1 was predicted by postexpectancy 1 and treatment, but not by desire or the desire × postexpectancy 1 interaction.

In the second analysis, postintensity 2 ratings were regressed on baseline intensity 2 postexpectancy 2, desire × postexpectancy 2, and treatment cluster. After removing the effects of baseline intensity and expectancy, postintensity 2 was predicted by postexpectancy 2 and treatment. Once again, neither desire nor the interaction of desire and expectancy predicted pain reduction. Our results suggest the possibility that the findings reported by Vase et al. (44) may have been a function of a failure to segregate expectancy from desire.

Moderator Analysis of Hypnotic Suggestibility

We hypothesized that hypnotic suggestibility would be more strongly related to the relief produced by a hypnotic intervention than by the nonhypnotic interventions. Accordingly, we compared the effect of our hypnotic analgesia treatment with that of our two nonhypnotic treatments (cognitive-behavioral and placebo). We performed a series of hierarchical regressions and tested the interaction of suggestibility and treatment in predicting pain reduction. Separate regressions were performed on post 1 and post 2 ratings for each of the indices of suggestibility measured by the CURSS. In each analysis, we regressed postintensity on the corresponding baseline intensity rating, suggestibility, treatment, and the Suggestibility × Treatment interaction.

Table 4 presents the results of these analyses. With regard to objective suggestibility, the regression on post 1 ratings shows that after controlling for baseline intensity 1, postintensity 1 was predicted only by the interaction of objective suggestibility scores and treatment. The regression on post 2 scores shows that after removing the effect of baseline intensity 2 scores, postintensity 2 was predicted by objective suggestibility scores, treatment, and the interaction of objective suggestibility scores and treatment.

Figure 2 depicts the interaction of objective suggestibility and treatment in the two regressions according to Aiken and West (45). Residualized change scores in pain

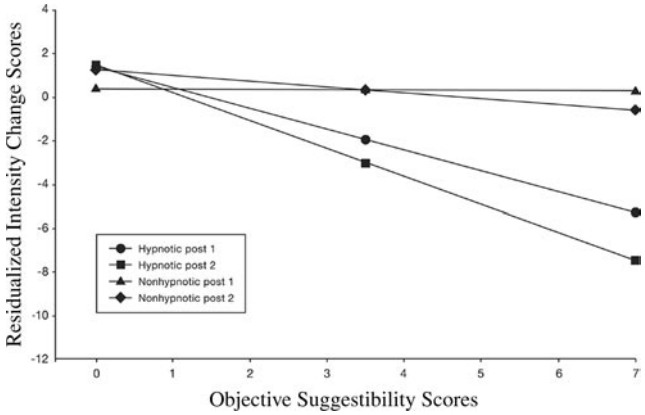

FIGURE 2 Interaction of objective suggestibility and treatment on post 1 and post 2 residualized intensity change scores.

intensity were produced by regressing postintensity on baseline intensity. A scatter plot of residualized change scores and objective suggestibility was generated, and a regression line was drawn for each of the two treatment clusters at post 1 and post 2. Figure 2 shows that higher levels of objective suggestibility were associated with more pain reduction in the hypnotic treatment, but not in the nonhypnotic treatments.

As for subjective suggestibility, Table 4 shows that after removing the effect of baseline intensity 1, postintensity 1 was predicted by subjective suggestibility scores, and the interaction of subjective suggestibility scores and treatment. The regression on post 2 ratings shows that after controlling for baseline intensity 2 scores, postintensity 2 was predicted by subjective suggestibility, treatment, and the interaction of subjective suggestibility and treatment. Figure 3 depicts the significant interaction of subjective suggestibility and treatment. Higher levels of subjective suggestibility were associated with more relief in the hypnotic treatment, but not in the nonhypnotic treatments.

Finally, with regard to the involuntariness dimension, Table 4 shows that after controlling for baseline intensity

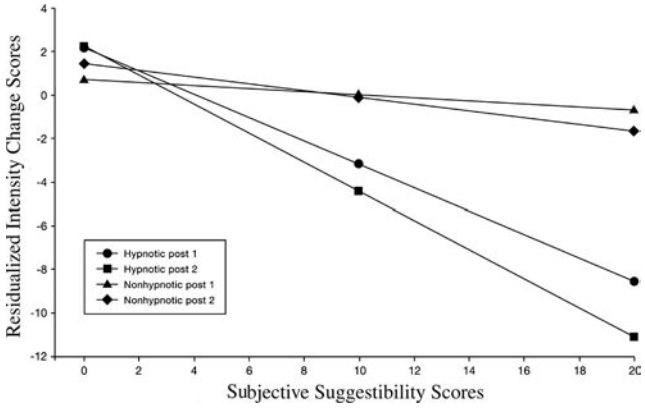

FIGURE 3 Interaction of subjective suggestibility and treatment on post 1 and post 2 residualized intensity change scores.

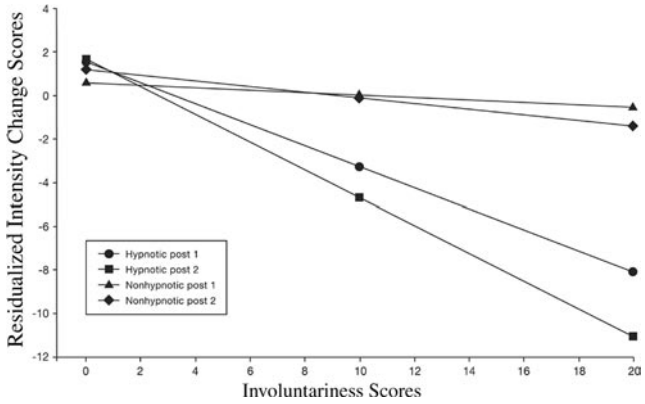

FIGURE 4 Interaction of involuntariness and treatment on post 1 and post 2 residualized intensity change scores.

1, postintensity 1 was predicted by involuntariness, and the interaction of involuntariness and treatment. The regression on post 2 ratings shows that after removing the effect of baseline intensity 2 scores, postintensity 2 was predicted by involuntariness, treatment, and the interaction of involuntariness and treatment. Figure 4 illustrates the significant interaction of involuntariness and treatment. Higher involuntariness scores were associated with more pain reduction, but only in the hypnotic treatment.

In sum, these results indicate that the effects of treatment on intensity at post 1 and post 2 were by moderated by objective, subjective, and involuntariness indices of hypnotic suggestibility.

Supplementary Analysis

To assess whether pain reduction experienced at post 1 explained variance in pain reduction experienced at post 2 beyond that accounted for by the independent and mediator variables, we computed a simultaneous regression

TABLE 5

Simultaneous Regression Predicting Reduction of Pain Intensity at Post 2 by Expectancy, Credibility, Treatment, and Reduction of Pain Intensity at Post 1

Criterion and Predictor	*F*	*p*	*Beta*	*Eta*^{2}
Postintensity 2				
Baseline intensity 1	0.21	.645	–.06	.01
Baseline intensity 2	2.48	.118	.21	.02
Baseline expectancy 1	0.15	.699	.04	.00
Baseline expectancy 2	0.40	.528	–.08	.00
Familiarization expectancy	0.16	.694	.03	.00
Postexpectancy 1	0.43	.515	.06	.00
Postexpectancy 2	0.75	.388	.08	.01
Familiarization credibility	0.06	.804	.02	.00
Postcredibility 1	0.01	.963	–.01	.00
Postcredibility 2	0.25	.618	–.05	.00
Treatment	3.30	.072	–.09	.03
Postintensity 1	42.43	.001	.65	.28

in which we compared the effect of the hypnotic and cognitive-behavioral treatments with that of the placebo. We regressed postintensity 2 on postintensity 1, the independent variable (treatment), the mediators (expectancy and credibility ratings provided at familiarization, post 1 and post 2), and the covariates (intensity and expectancy ratings provided at baseline). Table 5 shows the results of this regression. After controlling for the covariates, only postintensity 1 predicted postintensity 2. The effect of treatment approached, but failed to reach significance. None of the mediators predicted pain reduction. The results suggest that past experiences of pain reduction contribute most to later pain reduction.

DISCUSSION

The results of this study showed that our hypnotic and cognitive-behavioral treatments reduced pain more than our placebo control condition, but there was no difference between these interventions. As predicted, response expectancies and credibility of treatment rationale independently mediated the effect of our psychological interventions on pain. Also consistent with prediction, the extent of mediation increased as participants gained more experience with the treatments. Finally, as anticipated, objective, subjective, and involuntariness indices of hypnotic suggestibility moderated the effect of our hypnotic and nonhypnotic pain interventions.

A growing number of studies have found that response expectancies mediate the effect hypnotic and cognitive-behavioral pain treatments. Montgomery et al. (17) reported that response expectancies partially mediated the effect of hypnosis on breast biopsy pain. Likewise, a series of analogue treatment studies showed that response expectancies partially mediated the effect of various analogue hypnotic and cognitive-behavioral interventions on experimental pain (see 12). Noting the emergence of a pattern of partial mediation in this literature, Milling et al. (12) identified response expectancies as an important *common factor* in hypnotic and cognitive-behavioral pain treatments and posited that other common factors, or factors specific to the interventions also accounted for the effectiveness of these treatments. The results of our study are in line with this contention. Response expectancies and treatment credibility independently mediated our hypnotic and cognitive-behavioral pain interventions. These findings are consistent with influential theoretical writings (46) and empirical research (see 47) indicating that expectancy and credibility are two of the essential common factors shared by all forms of psychological treatment. Further research on the common factors shared by hypnotic and cognitive-behavioral pain interventions would seem to be a potentially fruitful area of inquiry.

We found that the extent of mediation by response expectancies and credibility increased with more experience using the treatments. As anticipated, ratings of response expectancies and credibility based on a brief description of the treatments failed to mediate subsequent intervention. Also as anticipated, ratings of response expectancies and credibility based on past experience using a treatment to reduce pain produced full mediation of subsequent intervention. However, contrary to prediction, expectancy and credibility failed to partially mediate treatment when ratings were based on an opportunity to practice or experience a pain treatment, but without actually using it to reduce pain. This is surprising considering that a series of analogue studies showed that expectancy ratings based on practice partially mediated a variety of psychological pain treatments (see 12). Perhaps assessing response expectancies and credibility based on a brief description affected later ratings based only on the opportunity to practice or experience a treatment. Conceivably, participants felt the need to maintain consistency in their ratings until they had substantial experiential evidence to the contrary. This proposition is in line with the observation that prior items on a measure can create consistency pressures in later items (48).

Using a sample representative of the full range of hypnotic suggestibility in the general population, we found that objective, subjective, and involuntariness dimensions of suggestibility moderated our pain treatments. Individuals scoring higher on all three suggestibility indices achieved more pain reduction, but only from the hypnotic treatment. Few past studies in this area have assessed the full range of suggestibility. Of these, laboratory studies point to a pattern of moderation, with individuals scoring higher on suggestibility obtaining more pain reduction only from hypnotic interventions (e.g., 13,49,50). In contrast, clinical studies, including those of labor pain (25), headaches (27,28,30), bone marrow aspirations (26), and osteoarthritis pain (30), tend to show that patients scoring higher on suggestibility achieve more relief from any legitimate treatment, regardless of whether it is hypnotic or nonhypnotic. Of note, in our study, suggestibility moderated treatment even though elaborate precautions were taken to prevent participants from recognizing there was a connection between the screenings and the pain interventions. This challenges the position that the frequently cited association between suggestibility and hypnotic pain reduction is simply an artifact of measuring both variables in the same experimental context, as some scholars have contended (33).

Consistent with past research, our results suggest a linear relationship between hypnotic suggestibility and hypnotic analgesia. In a meta-analysis of 23 studies on hypnotic pain reduction, Montgomery et al. (5) calculated 35 effect sizes assessing relationships between suggestibility and analgesia. The mean weighted effect size of $D = 1.16$ for individuals falling in the high suggestibility range was significantly larger than the mean weighted effect size of $D = –0.01$ for individuals in the low suggestibility range.

The mean weighted effect size of $D = 0.64$ for individuals in the medium range was not significantly different from that of individuals in the high or low ranges. From this pattern, one can extrapolate a linear relationship between suggestibility and pain reduction. However, Montgomery and his colleagues urged caution in interpreting differences between their suggestibility groups because of the small number of effect sizes for participants in the low and high ranges and because participants from studies in which suggestibility had not been assessed were assigned to the medium range in the meta-analysis. Our results, based on a sample representative of the full range of suggestibility in the general population, corroborate a linear relationship between suggestibility and hypnotic analgesia.

Several important limitations of this study should be noted. Our sample overrepresented young people and women relative to their presence in the general population. Also, we assessed the effect of our treatments on the sensory dimension of pain (i.e., intensity), but not the affective dimension (i.e., unpleasantness). Some pain researchers believe that interventions like hypnosis have a greater impact on the affective than the sensory dimension (51). In addition, our analogue interventions may not have been completely representative in scope and duration of how hypnosis and cognitive-behavioral therapy are actually used to treat pain in clinical situations. Finally, laboratory pain is mild in intensity, whereas clinical pain can be extremely aversive and has health implications.

However, by clarifying the processes of psychological pain interventions, analogue studies can have useful applications to the treatment of clinical pain. We showed that higher suggestibility was associated with more relief, but only from our hypnotic intervention. This argues that hypnosis may be the treatment of choice for pain patients higher on suggestibility. We also showed that response expectancies and credibility independently mediated treatment and that mediation increased with experience using the interventions. This suggests that expectancy and credibility are initially fluid and easily modified by experience. Thus, early in the treatment of clinical pain, clinicians may wish to structure their interventions so there is a high likelihood of pain reduction. This may produce therapeutic response expectancies and perceptions of credibility that can lead to even more relief later on. Future research might usefully compliment our findings by examining the interplay of response expectancies, credibility, and other mechanisms of hypnotic and cognitive-behavioral interventions in the treatment of clinical pain.

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