EFFECTS OF A HYPNOTIC INDUCTION AND AN UNPLEASANTNESS-FOCUSED ANALGESIA SUGGESTION ON PAIN CATASTROPHIZING TO AN EXPERIMENTAL HEAT STIMULUS: A Preliminary Study

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Abstract: Pain catastrophizing is associated with greater levels of pain. While many studies support the efficacy of hypnosis for pain, the effect on pain catastrophizing remains unclear. The present study evaluated the effect of hypnosis on pain catastrophizing using experimental heat stimulation. Twenty-two pain patients engaged in 3 conditions: baseline (no suggestion), hypnotic induction, and hypnotic induction plus analgesia suggestion. Participants with higher baseline pain showed a significant reduction in rumination following hypnotic induction plus analgesia suggestion and significant reductions in pain due to both the hypnotic induction alone and the hypnotic induction plus analgesia suggestion. The findings suggest that unpleasantness-focused hypnotic analgesia reduces pain via its effect on the rumination component of pain catastrophizing.

Pain catastrophizing is one of the primary psychological factors that influences the experience of pain (Keefe, Rumble, Scipio, Giordano, & Perri, 2004; Linton, 2000). It has been defined as “an exaggerated negative mental set brought to bear during actual or anticipated pain experience” (Sullivan et al., 2001, p. 53) and has been consistently and
significantly associated with more pain, more psychological dysfunction, and more physical dysfunction across a wide variety of pain populations (e.g., Leung, 2012; Quartana, Campbell, & Edwards, 2009). Significant associations between pain catastrophizing and pain have also been found in laboratory situations (e.g., Gilliam et al., 2010; Roelofs, Peters, van der Zijden, & Vlaeyen, 2004; Sullivan, Thorn, Rodgers, & Ward, 2004).

Although a wide variety of theoretical models of pain catastrophizing have been proposed, including the appraisal model, the attentional model, the communal coping model, and the schema-activation model (Leung, 2012; Quartana et al., 2009; Sullivan et al., 2001), Flink, Boersma, and Linton (2013) have recently proposed viewing pain catastrophizing as a type of repetitive negative thinking. This view is consistent with the idea of catastrophizing as a type of repetitive thought process that is intrusive and from which it is difficult to disengage (Ehring et al., 2011). In this model, pain catastrophizing may be viewed as consisting of two dimensions, that is, both a style of thinking as well as the content of thoughts. Indeed, the three subscales of the Pain Catastrophizing Scale (PCS; Sullivan, Bishop, & Pivik, 1995)—the most commonly used self-report scale for measuring pain catastrophizing—appear to fall into one of these two dimensions (Flink et al., 2013). The Rumination subscale (“I keep thinking about how much it hurts”) can be viewed as a style of thinking, while both the Helplessness subscale (“There’s nothing I can do to reduce the intensity of the pain”) and the Magnification subscale (“I become afraid that the pain will get worse”) can be viewed as assessing the content of thought. Distinguishing these two dimensions provides an alternative framework for evaluating the effect of specific treatment strategies on catastrophizing, as well as for examining the influence of these catastrophizing domains on other pain-related factors.

Although cognitive restructuring (Ehde & Jensen, 2004; Richter et al., 1986; Thorn, Boothby, & Sullivan, 2002) is probably the most common therapeutic strategy for reducing pain-related catastrophizing, researchers have begun to examine the effects of both hypnotic analgesia (Pukall, Kandyba, Amsel, Khalife, & Binik, 2007) and hypnotic cognitive therapy (Ehde & Jensen, 2007; Jensen et al., 2011) on catastrophizing. Pukall and colleagues conducted a preliminary clinical trial of hypnosis for 8 females suffering from vulvar vestibulitis syndrome (VVS). Their hypnotic treatment consisted of six sessions with suggestions related to relaxation, hypnotic analgesia, and sexual pleasure. An example of a hypnotic analgesia suggestion is “imagine the pain as a bright red ball, and then reducing the pain by dulling the color” (Pukall et al., 2007, p. 421). The researchers used the PCS to measure participants’ catastrophizing with respect to VVS pain. As a result of the hypnotic treatment, catastrophizing of VVS
pain decreased significantly between pretreatment and 1-month, and 6-month follow-ups. Jensen and his colleagues also conducted a preliminary clinical trial investigating the effects of hypnotic cognitive therapy in 15 multiple sclerosis patients with chronic pain. Participants were given 16 sessions of the treatment that included four sessions each of four different treatment modules: an education control, self-hypnosis training, cognitive restructuring, and a combined hypnosis-cognitive restructuring intervention. Representative suggestions used in the self-hypnosis training module consisted of decreased unpleasantness, increased pain acceptance, decreased awareness of uncomfortable sensations, imagined anesthesia, and increased awareness of comfort and comfortable sensations. The combined intervention module used the following suggestions: increased comfort with ambiguity about conclusions regarding pain and its impact, focused attention to alter pain-related catastrophizing into more reassuring and realistic cognitions and to ponder these types of more adaptive cognitions, and age progression to increase the participants’ sense of control over pain and its impact on their lives. In the educational control module, participants were given information about the effect of pain on individuals with multiple sclerosis, the neurophysiology of pain, sleep hygiene, and activity management. Therapists were instructed not to teach any specific pain-coping skills such as a relaxation, self-hypnosis, or cognitive restructuring skills during the session. The cognitive restructuring module consisted of the following four primary components: education about the role of cognition in pain, cognitive coping skills acquisition, rehearsal of cognitive coping skills, and encouragement of maintenance and generalization of skills. Participants were taught a method of recording and evaluating catastrophic pain thoughts. Examination of core beliefs about chronic pain and instructions relating to thought-stopping skills were also provided. Catastrophizing cognition was measured using the PCS. Results of their study showed that lower levels of catastrophizing occurred after the self-hypnosis training module, the cognitive restructuring module, and the combined intervention module as compared with the pretreatment status. The level of catastrophizing after the combined intervention module was lowest among all four treatment modules.

Moreover, a large number of studies support the efficacy of hypnosis for both acute (Landolt & Milling, 2011; Montgomery, DuHamel, & Redd, 2000; Patterson & Jensen, 2003; Tomé-Pires & Miró, 2012) and chronic pain (Adachi, Fujino, Nakae, Mashimo, & Sasaki, 2014; Elkins, Jensen, & Patterson, 2007; Jensen, 2009; Jensen & Patterson, 2006; Montgomery et al., 2000; Patterson & Jensen, 2003; Tomé-Pires & Miró, 2012). Evidence also shows that hypnotic pain treatments can result in a large number of beneficial “side effects,” such as an increase
in perceived control over pain, stress reduction, and enhanced well-being (Jensen et al., 2006). These studies support the use of hypnosis for treating chronic pain in general and perhaps specifically for pain catastrophizing.

However, it is not yet clear how hypnosis reduces pain catastrophizing. Two possible mediating mechanisms are via mindfulness and one’s style of thinking. It has been pointed out that hypnosis shares some similarities with mindfulness-based treatments such as promoting acceptance and focusing attention (Lynn, Das, Hallquist, & Williams, 2006), and that mindfulness-based treatments appear to be similar to the induction phase of hypnosis (Jensen, 2011). For example, both a mindfulness-based approach and a hypnotic induction instruct a participant to focus his or her attention on a single sensory experience, such as that of breathing. It has also been reported that mindfulness-based treatments can reduce maladaptive styles of thought in a variety of conditions. For example, Querstret and Cropley (2013) identified 19 studies that demonstrated the efficacy of mindfulness for reducing rumination and worry. In these studies, mindfulness-based treatments were effective for reducing rumination in patients with cancer (Campbell, Labelle, Bacon, Faris, & Carlson, 2012), depression (Van Aalderen et al., 2012), and otherwise healthy university students (Jain et al., 2007; Shapiro, Oman, Thoresen, Plante, & Flinders, 2008). From this research, it seems reasonable to hypothesize that a hypnotic induction alone could reduce the thought style dimension of pain catastrophizing (that is, scores on the Rumination subscale) via its influence on general mindfulness.

Several factors could potentially moderate the effects of hypnosis, including both baseline pain intensity and the specific content of hypnotic suggestions. For example, Patterson and colleagues found that individuals with burns who report higher baseline levels of pain intensity (5 or greater on a scale of 1 = no pain to 10 = worst possible pain) experience significant pain reductions following a hypnotic intervention, as compared to their pretreatment status and in comparison with pain in a control group (Patterson, Everett, Burns, & Marvin, 1992; Patterson & Ptacek, 1997). The hypnotic intervention in their studies used a modified version of the Rapid Induction Analgesia procedure (Barber, 1977) for burn wound debridement (Patterson, Questad, & de Lateur, 1989). The suggestions included deepening the hypnotic experience by using imagery of 20 staircases, feelings of comfort and relaxation, a suggestion of amnesia, and an analgesia suggestion that the body part undergoing debridement would become heavy and numb. A posthypnotic suggestion of comfort and relaxation during a subsequent dressing change was also provided. In the control group, the patient was told that they received a hypnotic intervention and that it would be useful to close one’s eyes, count to 20, and imagine oneself
in a relaxing place prior to burn debridement. With respect to the importance of hypnotic suggestions, De Pascalis and colleagues have shown that a hypnotic induction plus a glove anesthesia suggestion produced greater reduction of pain intensity than a hypnotic induction alone (De Pascalis, Cacace, & Massicotte, 2004, 2008).

The current study sought to understand better the effects of hypnotic analgesia on pain catastrophizing in a sample of patients with chronic pain, using an induced noxious heat stimulation model. Based on the available research, we hypothesized the following: (a) Individuals with higher baseline pain intensity would report significant reductions in both pain intensity and the thought style dimension of pain catastrophizing (as assessed by the Rumination subscale of the PCS) following a hypnotic induction alone and a hypnotic induction plus analgesia suggestion, when compared to a no-hypnotic suggestion condition; and (b) among individuals with higher baseline pain intensity, reductions in pain intensity and the thought style of pain catastrophizing following hypnotic induction plus analgesia suggestion would be greater following hypnotic induction alone. If the two hypnosis conditions reduced the thought style of pain catastrophizing, we also anticipated that they would reduce pain via the effects of hypnosis on the thought style.

**Method**

**Participants**

The study participants consisted of a convenience sample of outpatients at a university hospital pain clinic. Study inclusion criteria were the following: (a) attending the pain clinic with pain as the primary presenting problem; (b) age 16 years or older; (c) ability to read and write Japanese; and (d) willingness to participate in the present study. Participants were classified as high baseline pain intensity (HBP) or low baseline pain intensity (LBP), based on pain-intensity ratings using a Visual Analogue Scale anchored with 0 = No pain and 10 = Worst possible pain. The participants with scores greater than or equal to 5.0 in the baseline condition were assigned to the HBP group and the remaining participants with scores less than 5.0 were assigned to the LBP group. The study was approved by the Institutional Review Board for Clinical Research at Osaka University Hospital, and written informed consent was obtained from all participants prior to participation.

**Materials**

*Pain catastrophizing: The Pain Catastrophizing Scale (PCS).* The Pain Catastrophizing Scale (PCS) is a 13-item self-report questionnaire that measures maladaptive thoughts regarding pain (Sullivan et al., 1995). Each item is rated on a 5-point Likert-type scale. The PCS is
scored on three subscales assessing helplessness, magnification, and rumination. The Japanese version of the PCS used in this study has been shown to have excellent reliability for the Helplessness (Cronbach’s alpha = .81) and Rumination (Cronbach’s alpha = .80) scales, and marginal reliability for the Magnification scale (Cronbach’s alpha = .65; Matsuoka & Sakano, 2007). In the Japanese version of the PCS, Item 1, which is usually scored as a part of the Helplessness scale when administered to English-speaking individuals, is scored as a part of the Rumination scale.

**Pain intensity: Visual Analogue Scale (VAS).** The Visual Analogue Scale (VAS) for measuring pain intensity consisted of a 10-centimeter line anchored by two extremes of pain intensity, namely 0 = No pain and 10 = Worst possible pain. The participants were asked to make a mark on the line that best represented their recalled level of pain intensity after completion of one condition. The scale was scored by measuring the distance from the No pain end of the line to participant’s mark. A large body of evidence supports the validity of the VAS for assessing pain intensity (Jensen, Karoly, & Braver, 1986; Price, McGrath, Rafii, & Buckingham, 1983; Rainville, Carrier, Hofbauer, Bushnell, & Duncan, 1999).

**Procedure**

The participants were asked to engage in all three experimental conditions using a within-participants design (see Figure 1). The three experimental conditions were baseline (B), hypnotic induction (HI), and hypnotic induction plus analgesia suggestion (HI+AS). A shortened version of the B condition was also carried out as a practice trial in order to accustom participants to an experimental task before starting the three conditions. Details of the experimental task are described later in the section explaining the heat stimulation. All participants received the B condition first to control for the residual effect of hypnosis (Hofbauer, Rainville, Duncan, & Bushnell, 2001; Rainville et al., 1999; Rainville, Duncan, Price, Carrier, & Bushnell, 1997). After the B condition, half of the participants received the HI condition followed by the HI + AS condition. The other half of the participants received the HI + AS condition followed by the HI condition. The two orders of conditions (B→HI→HI+AS and B→HI+AS →HI) were counterbalanced.

**Experimental Conditions**

Details of each condition’s procedures are described below. Hypnotic suggestions and instructions regarding each experimental task were recorded in advance and provided to the participants during each condition via headphones.
Baseline condition. The participants were asked to sit on a comfortable, reclining chair with armrests. Before receiving heat stimulation, participants were instructed (a) to detect and count target heat stimuli without speaking or taking any action and (b) to look at a mark (silver magnet) placed on the upper part of a wall in front of them and to keep their eyes open during the heat stimulation as much as they could. No hypnotic suggestions were provided in the B condition. Once the heat stimulation was over, the participants were asked to get up from the chair and to rate their catastrophizing and pain intensity during the heat stimulation of the B condition, using the PCS and the VAS.

Hypnotic-induction condition. First, a hypnotic induction was applied to the participants, who were seated as in the B condition (sitting on a comfortable, reclining chair). We used the eye closure and hand-lowering items of the Japanese version of the Stanford Hypnotic Susceptibility Scale, Form A (SHSS:A; Saitoh, 2004; approximately
20–25 minutes) as suggestions for hypnotic induction. The participants were instructed to look at the mark on the wall during the initial phase of a hypnotic induction, and then the eye closure suggestion was followed by the hand-lowering suggestion. After completion of the two hypnotic induction suggestions, the participants were instructed to count the target heat stimuli without speaking or taking any specific actions when they would receive the heat stimulation. Then, they were asked to open their eyes and to keep them open. At the same time, it was suggested to the participants that they would continue to feel relaxed, calm, and comfortable when they opened their eyes. Subsequently, the heat stimuli were delivered without an analgesia suggestion. After receipt of the heat stimuli, the participants were asked to close their eyes again and to relax. Then, a dehypnotization procedure was conducted using the dehypnotization procedure of the SHSS:A. In the dehypnotization procedure, an experimenter (audiotape in the present experiment) counted back from 20 to 1 and suggested that the participants would feel refreshed when the count reached one. After completion of the dehypnotization procedure, the participants were asked to complete the PCS and the VAS.

_Hypnotic induction plus analgesia suggestion condition._ After providing the same hypnotic induction procedure and instructions as the HI condition regarding counting the heat stimuli, a suggestion of decreased pain unpleasantness was given. As in the analgesia suggestion, the participants received the suggestion that a sensation of comfort and well-being would sweep through their arm and spread to their whole body. They were also given the suggestion that they could feel the intensity and quality of the heat stimulation while it was provided, but they would primarily feel comfortable with a sense of well-being. The suggestion used in this study was based on that of Rainville et al. (1999). The first author (TA) translated the suggestion into Japanese and added minor changes to fit the experimental situation (e.g., changing “the stimulation” in the original suggestion into “heat”). We chose the unpleasantness-focused analgesia suggestion because pain catastrophizing is particularly associated with the activity of brain regions involved in processing pain unpleasantness (Gracely et al., 2004; Rainville, 2002). After providing the analgesia suggestion, the participants were asked to open their eyes and to keep them open. They were also provided with the suggestion that feelings of relaxation, calmness, and comfort would continue when they opened their eyes. As in the HI condition, the heat stimulation was followed by the instructions to the participants to reclose their eyes and relax. Immediately thereafter, the same dehypnotization procedure as in the HI condition was conducted, after which the participants completed the PCS and the VAS.
Heat Stimulation

Heat stimuli were delivered using a computerized thermal contact stimulator (Contact-Heat Evoked Potential Stimulator [CHEPS]; Medoc Advanced Medical Systems Ltd., Ramat Yishai, Israel). The CHEPS generates a rapid temperature change (heating rate of 70°C/sec and cooling rate of 40°C/sec) via a combination of a heating foil (27 mm in diameter) and a Peltier element for active back-cooling. The probe was attached to the left forearm with a strap and heat stimuli were delivered to that location, except for 1 participant who had clinical pain in the left forearm. This participant received heat stimuli to the right forearm. In each experimental condition, heat stimuli were applied using an oddball task (De Pascalis, Magurano, & Bellusci, 1999; Duncan-Johnson & Donchin, 1977). The participants completed a block of 70 heat stimuli for each experimental condition and a block of 27 stimuli for a practice trial. Two types of heat stimuli were delivered. Infrequent (16% of stimuli) 54°C noxious heat stimuli (target stimuli) were interspersed among frequently occurring (84% of stimuli) 44°C nonnoxious heat stimuli (standard stimuli) in a block of heat stimuli. Target stimulus presentation order was pseudorandomized with the criterion that two target stimuli could not be presented in succession. The interstimulus interval was set at a constant 3 seconds. The baseline temperature of the probe was 30°C. Before the heat stimulation was delivered, participants were instructed that they were to count silently the number of target heat stimuli delivered and to keep their eyes open during heat stimulation in all conditions.

Somatosensory Event-Related Potential (SERP) data in response to heat stimulation and hypnosis were recorded additionally, but these data are not reported here.

Statistical Analyses

The statistical analyses were conducted using the Statistical Package for the Social Sciences 21.0 (IBM Corp, 2012). The dependent variables (rumination, helplessness, magnification, and pain intensity) were analyzed using four separate two-way repeated-measures analyses of variance (ANOVAs) to examine their changes according to the experimental manipulations. Post hoc comparisons were performed using the Holm-Bonferroni method (Holm, 1979), which sets a \( p \) value of .05 as significant. A \( t \) test was used to assess differences in age between the HBP and LBP groups.
RESULTS

Demographic Characteristics of Participants

Twenty-four participants began the present study, but 2 declined to continue the study after the practice trial. The mean age of the remaining 22 participants was 69.00 years ($SD = 10.54$, Range = 46–84). A total of 55% of participants ($n = 12$) were female, 50% ($n = 11$) belonged to the HBP group, and 23% ($n = 5$) had previous experience of hypnosis. Pain duration among the 22 participants was as follows: 6 months or less ($n = 2; 9\%$), from 6 months to 1 year ($n = 0; 0\%$), from 1 year to 3 years ($n = 7; 32\%$), from 3 years to 5 years ($n = 8; 36\%$), and over 5 years ($n = 5; 23\%$). Most participants had chronic pain lasting over 6 months. Pain types included leg pain ($n = 6; 27\%$), low back pain ($n = 5; 23\%$), postherpetic neuralgia ($n = 4; 18\%$), and other types of pain including rheumatoid arthritis and pain in a group of muscles ($n = 7; 32\%$). The mean level of pain intensity among all participants as assessed by the VAS in the B condition was 4.97 ($SD = 2.55$). No significant differences in ages was present between the HBP and LBP participants (HBP: $M = 65.91$, $SD = 10.76$; LBP: $M = 72.09$, $SD = 9.83$), $t (20) = 1.41$, $p = .175$, $d = 0.60$.

Comparison of Experimental Conditions and Baseline Pain Intensity.

Means and standard deviations of all dependent measures are presented in Table 1. Repeated-measures ANOVAs revealed significant interactions between the experimental condition and baseline pain intensity for rumination, $F(2, 40) = 5.97$, $p = .005$, $\eta^2 = .22$, and magnification, $F(2, 40) = 6.21$, $p = .004$, $\eta^2 = .23$. Post hoc analysis using the Holm-Bonferroni method revealed a significant reduction of rumination in the HI+AS condition ($p = .014$, $d = 0.79$) and a marginally significant reduction in the HI condition ($p = .037$, $d = 0.62$) as compared to the B condition among HBP participants. No significant difference was found in rumination between the HI and HI+AS conditions among the HBP participants ($p = .464$, $d = 0.14$). The post hoc analysis also revealed that the HBP participants reported significantly greater rumination ($p = .008$, $d = 1.26$) and magnification ($p = .015$, $d = 1.14$) than the LBP participants in the B condition. There were no significant interactions, $F(2, 40) = 2.39$, $p = .105$, $\eta^2 = 0.10$, or main effects: experimental condition, $F(2, 40) = 0.58$, $p = .566$, $\eta^2 = .03$; baseline pain intensity, $F(1, 20) = 1.31$, $p = .267$, $\eta^2 = .06$, for helplessness.

For pain intensity, repeated-measures ANOVAs revealed a significant interaction between experimental condition and baseline pain intensity, $F(2, 40) = 5.14$, $p = .010$, $\eta^2 = .17$, and a main effect of experimental condition, $F(2, 40) = 4.71$, $p = .015$, $\eta^2 = 0.16$, and baseline pain intensity, $F(1, 20) = 18.97$, $p = .000$, $\eta^2 = .49$. Post hoc analyses using the Holm-Bonferroni method revealed reductions in pain intensity in
Table 1
Means and Standard Deviations of Dependent Variables (N = 22)

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Baseline Pain Intensity</th>
<th>Baseline Mean</th>
<th>SD</th>
<th>Hypnotic Induction Mean</th>
<th>SD</th>
<th>Hypnotic Induction + Analgesia Suggestion Mean</th>
<th>SD</th>
<th>Condition Effect F (df)</th>
<th>Condition × Baseline Pain Intensity Effect F (df)</th>
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</thead>
<tbody>
<tr>
<td>Rumination</td>
<td>High</td>
<td>11.18&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.26</td>
<td>7.36&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>6.15</td>
<td>6.55&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>5.43</td>
<td>0.86 (2, 40)</td>
<td>5.97&lt;sup&gt;**&lt;/sup&gt; (2, 40)</td>
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<td></td>
<td>Low</td>
<td>4.09&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.91</td>
<td>6.82&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>5.91&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.14</td>
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<tr>
<td>Helplessness</td>
<td>High</td>
<td>6.18&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.53</td>
<td>5.45&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>4.81</td>
<td>0.58 (2, 40)</td>
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<td></td>
<td>Low</td>
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<td>3.47</td>
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<tr>
<td>Magnification</td>
<td>High</td>
<td>3.55&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.42</td>
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<td>2.50</td>
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<td>2.87</td>
<td>0.48 (2, 40)</td>
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<tr>
<td></td>
<td>Low</td>
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<td>2.09&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>Pain Intensity</td>
<td>High</td>
<td>7.09&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.47</td>
<td>5.13&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.06</td>
<td>5.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.72</td>
<td>4.71&lt;sup&gt;*&lt;/sup&gt; (2, 40)</td>
<td>5.14&lt;sup&gt;*&lt;/sup&gt; (2, 40)</td>
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<tr>
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<td>Low</td>
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<td>3.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.47</td>
<td>2.76&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.73</td>
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*Note.* Means with different subscripts are significantly different (p < .05) from one another for experimental condition effects. 
*<sup>p</sup> < .05. **<sup>p</sup> < .01.
the HI ($p = .003, d = 1.10$) and HI+AS conditions ($p = .002, d = 0.91$), relative to the B condition among the HBP participants only. No significant difference was found between the HI and HI+AS conditions among the HBP participants ($p = .961, d = 0.01$). Post hoc analyses also revealed that the HBP participants displayed significantly greater pain intensity than the LBP participants in all three experimental conditions (B: $p = .000, d = 3.12$; HI: $p = .012, d = 1.18$; HI+AS: $p = .025, d = 1.03$).

**Discussion**

The present study sought to better understand the effects of a hypnotic induction alone and hypnotic analgesia on pain catastrophizing using an experimental pain model. As predicted, participants with higher baseline pain intensity evidenced a significant reduction in rumination in the hypnotic induction plus analgesia suggestion condition as compared to the baseline condition. Inconsistent with our hypothesis, the hypnotic induction condition did not produce a significant reduction in rumination. However, the effect of the hypnotic induction condition on rumination approached significance and there was a medium-to-large effect size for the reduction in rumination ($d = 0.62$), and sample size in the current study was relatively small. Therefore, we can assume that the hypnotic induction reduced the rumination component of pain catastrophizing. With respect to pain intensity, the participants with higher baseline pain intensity evidenced significant reductions in both the hypnotic induction and the hypnotic induction plus analgesia suggestion conditions as compared to the baseline condition. However, no differences were found in rumination and pain intensity between the two hypnotic conditions.

The findings indicate that hypnotic analgesia suggestions that target the affective component of pain (unpleasantness) have their primary effects on rumination (thought style) and less profound effects on helplessness and magnification (thought content), and that these effects are limited to individuals with relatively higher baseline levels of pain intensity. Rumination is a particularly important component of pain catastrophizing, given its strong associations with pain intensity (Sullivan & Neish, 1998) and disability (Sullivan, Stanish, Waite, Sullivan, & Tripp, 1998). In the attentional model of pain catastrophizing, Sullivan and colleagues have pointed out that catastrophizers ruminate more about their pain, and their attentional performance is disrupted by anticipation of pain stimulus onset (Sullivan et al., 2001). Thus, attentional focus on pain has a close association
with pain catastrophizing, especially rumination. In fact, several neuroimaging studies have illustrated that an increase in activity in brain areas responsible for attention is associated with an increase in pain catastrophizing. Gracely and his colleagues (Gracely et al., 2004) conducted a functional magnetic resonance imaging (fMRI) study with 29 fibromyalgia patients to examine the association between pain catastrophizing, as measured by the Coping Strategy Questionnaire (CSQ; Rosenstiel & Keefe, 1983), and the brain response to pressure pain stimuli. Results showed that pain-catastrophizing scores, after controlling for self-reported depressive symptoms, were significantly associated with increased activity in brain areas related to anticipation of pain (medial frontal cortex, cerebellum), attention to pain (dorsal anterior cingulate gyrus, dorsolateral prefrontal cortex), emotional aspects of pain (claustrum), and motor control (premotor cortex, lentiform nucleus). Seminowicz and Davis (2006) also conducted an fMRI study with 22 healthy volunteers to investigate the effect of pain catastrophizing as measured by the PCS on brain activity to two levels of electric nerve stimulation (mild and moderate pain). In completing the PCS, participants were instructed to consider their reactions to pain experiences in general and not to focus on one specific event. Results showed that pain catastrophizing was associated with activity in cortical regions related to affective (insula, rostral anterior cingulate cortex), attentional (dorsolateral prefrontal cortex), and motor aspects (premotor cortices) of pain during mild pain. During moderate pain, pain catastrophizing was negatively correlated with activity in the dorsolateral prefrontal cortex, which is implicated in the top-down modulation of pain intensity. This small engagement of the dorsolateral prefrontal cortex was interpreted as the lack of control during more intense pain. Interestingly, some areas of the brain, which are impacted by hypnotic analgesia, overlap with brain areas responsible for attentional mechanism such as anterior cingulate and prefrontal cortices (Faymonville et al., 2000; Hofbauer et al., 2001; Rainville et al., 1997; Wik, Fischer, Bragé, Finer, & Fredrikson, 1999). This overlap is consistent with the present results, suggesting that hypnotic suggestions focusing on the unpleasantness dimension of pain may act on the thought style dimension of pain catastrophizing via its impact on the attentional function of pain information processing.

Given the potential overlap between hypnosis and mindfulness, as suggested by a number of scientists (Holroyd, 2003; Jensen, 2011; Lynn et al., 2006), a hypnotic induction, namely so-called general hypnosis, may enhance a type of “decentering” from pain experience. Consistent with this idea, we found a significant reduction in rumination in the hypnotic induction plus analgesia suggestion condition and a marginally significant reduction in the hypnotic induction condition.
Mindfulness-based treatments have been shown to be effective treatments for reducing pain in a number of studies (Cramer, Haller, Lauche, & Dobos, 2012; Lakhan & Schofield, 2013). These considerations suggest that “decentering” may mediate at least some of the beneficial effects of both hypnosis and mindfulness-based treatments. Decentering is the ability to observe one’s thoughts and feelings as temporary, objective events in the mind, as opposed to reflections of self that are necessarily true (Fresco et al., 2007). It is regarded as one of the fundamental therapeutic mechanisms among mindfulness-based treatments (Allen, Bromley, Kuyken, & Sonnenberg, 2009; Bieling et al., 2012; Carmody, Baer, Lykins, & Olendzki, 2009; Teasdale et al., 2002). An individual engaged in decentering can observe one’s experience in a detached manner, and then excessive engagement in a repetitive negative thought style (e.g., rumination) may reduce. McCracken, Gutiérrez-Martínez, and Smyth (2013) reported that decentering, as measured with an 11-item subscale of the Experiences Questionnaire (EQ; Fresco et al., 2007), is significantly associated with the quality of functioning in the chronic pain population. Further investigations are needed to empirically examine the extent to which hypnosis impacts decentering as measured by the EQ, associations between decentering and specific hypnotic processes (e.g., absorption and dissociation), and whether the effect of hypnosis on decentering results in pain reduction.

As predicted, people with higher baseline pain levels displayed significant alleviation of rumination and pain intensity in the two hypnotic conditions. The present results are consistent with Patterson and colleagues (Patterson et al., 1992; Patterson & Ptacek, 1997). Patterson, Adcock, and Bombardier (1997) suggested that people who have higher baseline levels of clinical burn pain may show greater pain reduction because of higher motivation to disengage from the pain experience and a greater willingness to benefit from hypnotic analgesia. This motivational factor among individuals who have higher baseline levels of pain might underlie the decrease in rumination and pain intensity in the present study.

Generally, lower experimental baseline pain sensitivity consistently predicts a greater reduction of chronic pain after therapeutic interventions. For example, higher baseline heat pain thresholds were associated with a greater reduction of postherpetic neuralgia pain following an opioid treatment (Edwards, Haythornthwaite, Tella, Max, & Raja, 2006). Among female nonmalignant chronic pain patients, higher baseline ischemic pain tolerance was associated with a greater improvement in pain due to a 4-week multidisciplinary treatment program including a cognitive behavior therapy, graded exercise training, medication management, and physical therapy (Edwards, Doleys, Lowery, & Fillingim, 2003). Lower baseline heat pain intensity also predicted improvements in pain in the vulvar vestibulitis syndrome following a variety of
treatments such as a biofeedback, cognitive behavior therapy, application of a hypoallergenic agent, and surgery (Granot, Zimmer, Friedman, Lowenstein, & Yarnitsky, 2004). It is reasonable that nonreactivity to a temporal painful stimulation predicts an improvement in distressing chronic pain responses because more extreme behavioral, cognitive, and emotional responses to acute pain can exacerbate and maintain chronic pain symptoms (Flor & Turk, 2011). However, the participants with lower baseline pain levels for experimental heat stimulation showed no significant reduction in catastrophizing and pain intensity for the same experimental heat stimulation in the two hypnotic conditions. It would be interesting to replicate the present study focusing on clinical pain, rather than experimental pain. For patients with clinical pain, experimental pain in the current investigation might have been more tolerable because they could understand the source and duration of their experimental pain. They were unlikely to have appraised that pain as dangerous. If we considered the participants’ clinical pain as a dependent variable, significant reductions in catastrophizing and pain might be observed due to hypnosis among participants with lower experimental pain levels.

We found pain-intensity reductions in response to a hypnotic induction alone, as well as a hypnotic induction plus an analgesia suggestion, at least among those with higher baseline pain intensity. The effect of the hypnotic induction condition on rumination approached significance and there was a robust effect size for the reduction in rumination, and the sample size in the present study was relatively small. Therefore, a hypnotic induction may reduce pain intensity via its effect on the rumination component of pain catastrophizing. Further research is needed with larger samples to examine whether a hypnotic induction itself has a direct effect on pain intensity or an indirect effect via its effect on rumination.

As another explanation, it is possible that the relaxation suggestion that was present in the hypnotic induction had an analgesic effect, given previous research showing that a hypnotic induction with relaxation suggestions can reduce the pain intensity evoked by an experimental electric stimulus (Sharav & Tal, 2004) and the pain intensity of fibromyalgia patients (Castel, Pérez, Sala, Padrol, & Rull, 2007). Further research is needed to clarify the specific analgesic effects of relaxation suggestions.

The present study had several limitations. First, the present results may be attributable to a regression to the mean effect due to grouping participants based on their baseline pain intensity. Participants with higher baseline pain might become habituated to subsequent heat stimulation, and participants with lower baseline pain might produce lower pain ratings to the stimulation in the baseline condition. To rule out this effect, it would be necessary to conduct another study.
with a control group, in which participants take part in the baseline condition repetitively. Second, we used retrospective reporting methods to show changes in pain catastrophizing. Retrospective reporting may reflect recalled experience rather than the actual extent of pain catastrophizing and pain intensity during each condition. A third limitation was that the analgesia suggestion focused only on reductions in pain unpleasantness. Different effects might have occurred if we also included suggestions for pain-intensity reductions, an increased ability to ignore pain, or dissociation from pain sensations. Given that the response to hypnosis depends largely on the wording of the specific suggestions (Crawford & Gruzelier, 1992; Kihlstrom, 2013; Oakley & Halligan, 2010), further research is needed to determine how different suggestions influence the different components of pain catastrophizing. A fourth limitation was the intensity of the experimental stimuli in the present study. It is possible that the participants considered the heat stimulation relatively tolerable because it was not painful enough. The mean level of pain intensity in the baseline condition among all participants was 4.97. Maruo and his colleagues reported that mean clinical pain VAS scores in Japanese chronic neuropathic and non-neuropathic pain patients were lower than the value of the present study (neuropathic pain: mean VAS = 3.8; nonneuropathic pain: mean VAS = 3.6; Maruo et al., 2014). Therefore, we can regard the heat stimulation in the present study as sufficiently painful because the mean VAS score in the baseline condition was higher than the score of Japanese patients attending a hospital due to their difficulties with chronic pain. A fifth limitation was the lack of assessment of participants’ hypnotizability. Hypnotizability is one of the most influential factors in hypnosis and significantly correlates with hypnotic modulation of pain intensity as induced by experimental heat stimulation (Rainville et al., 1999). However, a meta-analysis by Montgomery and colleagues reported that hypnotizability only accounts for 6% of the variance in responsiveness to hypnotic interventions for clinical problems, including medical procedural pain and headache (Montgomery, Schnur, & David, 2011). It is possible that effects of hypnotizability on catastrophizing and pain intensity in the present study were relatively small because of the participants’ actual chronic pain.

In summary, our findings indicate that a hypnotic induction plus an unpleasantness-focused analgesia suggestion has a primary influence on the rumination component of pain catastrophizing, but only among those patients with relative high baseline levels of pain intensity. Further research is needed to determine if these findings apply to other pain models and when other analgesia suggestions are used, as well as to determine the mechanisms of these effects.
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**Effekte einer hypnotischen Induktion und eine Unannehmlichkeits-fokussierte Analgesie-Suggestion bezogen auf die Katastrophisierung von Schmerzen infolge eines experimentellen Hitzereizes: Eine vorläufige Studie**

Tomonori Adachi, Aya Nakae und Jun Sasaki


**Stephanie Reigel, MD**
Effets d’une suggestion d’analgésie axée sur le malaise et d’une induction hypnotique sur la dramatisation de la douleur à la suite d’un stimulus thermique expérimental: une étude préliminaire

Tomonori Adachi, Aya Nakae et Jun Sasaki


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Efectos de una inducción hipnótica y una sugerencia de analgesia enfocada hacia lo desagradable en la catastrofización del dolor ante un estimulo experimental de calor: Un estudio preliminar.

Tomonori Adachi, Aya Nakae y Jun Sasaki

Resumen: Catastrofizar el dolor está asociado con mayores niveles de dolor. Mientras muchos estudios sustentan la eficacia de la hipnosis para el dolor, el efecto sobre la catastrofización del dolor permanece incierto. El presente estudio evaluó el efecto de la hipnosis en la catastrofización del dolor usando una estimulación experimental de calor. Veintidós pacientes participaron en tres condiciones: línea basal (sin sugerencias), inducción hipnótica, e inducción hipnótica más sugerencias de analgesia. Los participantes con una línea basal de dolor más alta mostraron una reducción significativa en rumiación después de la inducción hipnótica más sugerencias de analgesia y reducciones significativas de dolor debido tanto a la inducción hipnótica por sí sola y la inducción hipnótica más sugerencias de analgesia. Estos hallazgos sugieren que la analgesia hipnótica enfocada a lo desagradable reduce el dolor a través de sus efectos en el componente de rumiación en la catastrofización del dolor.

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