HHS Public Access

Author manuscript

Clin J Pain. Author manuscript; available in PMC 2017 June 01.

Published in final edited form as:

Clin J Pain. 2016 June ; 32(6): 506–512. doi:10.1097/AJP.0000000000000294.

The Associations Between Pain-Related Beliefs, Pain Intensity, and Patient Functioning: Hypnotizability as a Moderator

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Abstract

Objectives—Based on the idea that thoughts held about pain may represent "self-suggestions" and evidence indicating that people with higher levels of trait hypnotizability are more responsive to suggestions, the current study evaluated hypothesized moderating effects of hypnotizability on the associations between pain-related thoughts and both pain intensity and pain interference.

Methods—Eighty-five individuals with chronic pain were given measures of hypnotizability, pain intensity, pain interference, and pain-related thoughts (control beliefs, catastrophizing).

Results—Analyses supported a moderating role of hypnotizability on the association between control beliefs and pain interference. Specifically, the negative association between pain control beliefs and pain interference were stronger among those with higher trait hypnotizability than between those with lower trait hypnotizability.

Discussion—The study findings, if replicated in additional samples of individuals with chronic pain, have important clinical and theoretical implications. For example, if trait hypnotizability is found to predict an individual's response to a particular technique of cognitive therapy – such as focusing on and repeating pain control belief self-statements – measures of hypnotizability could be used to identify individuals who might be most responsive to this technique. The current findings indicate that research to further examine this possibility is warranted.

Keywords

Chronic pain; Catastrophizing; Control beliefs; Hypnotizability; Pain intensity

Chronic pain is a significant problem worldwide that has complex biopsychosocial causes and impacts.[1–3] The beliefs that individuals have about pain are hypothesized to play an important role in their experience of and response to pain.[4–6] Two belief domains that have been consistently shown to be associated with pain and its impact are control beliefs (i.e., beliefs about one's ability to control pain) and catastrophizing (i.e., very negative self-statements about pain and its implications for one's well-being) [4,7–10]. However, the

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All of the other authors declare no conflicts of interest related to this study.

magnitude of the associations between measures of these beliefs and measures of pain and pain interference is not always strong, consistent with the possibility that there may be factors that moderate these associations; that is, it is possible that these beliefs play a larger role in functioning for some individuals than others.

Knowledge regarding the factors that moderate the impact of pain-related beliefs on functioning would have a number of practical implications.[11] First, this knowledge could potentially inform better patient-treatment matching; patients for whom pain beliefs play a larger role in functioning may benefit more from cognitive therapy that targets changes in these beliefs. Second, greater knowledge in this area could provide information that may be useful for enhancing treatment efficacy. For example, if a moderating factor was modifiable, outcomes could be enhanced by better preparing patients for pain treatment using interventions that target the moderating variable (e.g., Motivational Interviewing to enhance motivation for treatment engagement [12–14] or hypnosis to enhance response to cognitive behavioral therapy [15–16]).

To the extent that pain-related beliefs and attributions can be viewed as "self-suggestions," and given evidence indicating that individuals who score higher on measures of general hypnotizability are more responsive to suggestions than individuals who score lower on measures of hypnotizability,[17–19] we have hypothesized that people with more trait hypnotizability might evidence stronger associations between thoughts – including catastrophizing thoughts and pain control beliefs – and outcomes that are influenced by those beliefs.[20] In short, higher levels of trait hypnotizability may make individuals with chronic pain more vulnerable to the negative effects of catastrophizing and more responsive to the positive effects of control beliefs. Preliminary support for this possibility comes from research showing that, relative to individuals with lower hypnotizability scores, individuals with higher hypnotizability scores (1) demonstrate stronger affective responses to violent films,[21] (2) are more likely to believe that a hypnotically suggested event had actually occurred,[22–23] and (3) can find it more difficult to shift from negative to positive moods when moods are induced by negative images.[24]

Given these considerations, the aim of this study was to test a hypothesized moderating effect of hypnotizability on the associations between measures of pain-related beliefs and measures of pain intensity and patient functioning. Specifically, we hypothesized that hypnotizability would moderate the associations between measures of pain-related catastrophizing and control beliefs and measures of pain intensity and pain interference, such that individuals with higher hypnotizability scores would evidence stronger associations between measures of these variables than individuals with lower hypnotizability scores; that is, hypnotizability would amplify the negative effects of catastrophizing and the positive effects of control beliefs.

METHODS

Study participants

The subjects who provided data for this study are individuals with disabilities (multiple sclerosis [MS], n = 54; spinal cord injury [SCI], n = 15; muscular dystrophy [MD], n = 15;

acquired amputation [AMP], n = 1) who are participating in an ongoing clinical trial examining the efficacy and mechanisms of three psychological treatments for chronic pain, relative to an education control condition. However, all of the data reported here were collected at pre-treatment, prior to randomization. In order to participate in the study, individuals must: (1) be 18 years of age or older; (2) have a disability diagnosis as verified by either (a) a review of the individual's University of Washington Medical or Harborview Medical Center medical records, or (b) verification confirmed by the participant's physician; (3) have a significant chronic pain problem that has lasted 6 months or more that started or became worse since the onset of their disability; (4) have average pain intensity rating of ≥4 on a 0–10 NRS of pain intensity in the last week; (5) report experiencing pain at least half of the days in the past four weeks; and (6) be able to read, speak, and understand English.

Study exclusion criteria include: (1) having severe cognitive impairment defined as two or more errors on a 6-item cognitive screener;[25] (2) having severe psychiatric condition or psychiatric symptoms that would interfere with participation, specifically active suicidal ideation with intent to harm oneself or active delusional or psychotic thinking; (3) having a history of receiving psychological treatment for pain in the past, as reflected by either/or (a) having attended more than three treatment sessions in outpatient setting that focused on treatment of pain and (b) having received inpatient comprehensive pain treatment where learning pain management was the primary reason for treatment; (5) currently receiving any psychological treatment for pain; (6) having participated in any previous research study or currently participating in a research study conducted by investigators in the Department of Rehabilitation Medicine that involved pain management via psychological treatments; (7) having a significant skull defect; (8) history of a seizure condition within the last year; (9) having permanent braiding, dreadlocks, or a hair piece; and (10) skull contains metal plates or screws, or if the skull beneath the scalp has missing sections or holes. The latter four exclusion criteria are included because the parent study involves assessment of brain activity before and after treatment using electroencephalogram, and these factors could potentially interfere with the interpretation of the electroencephalogram data.

Measures

Although a number of variables are assessed at baseline in the ongoing parent study, the variables needed to describe the sample and test the hypothesis here include measures of (1) demographic and diagnosis-related variables, (2) pain-related beliefs (catastrophizing and control beliefs), (3) average pain intensity, (4) pain interference, and (5) hypnotizability.

Demographic and diagnosis-related variables—All study participants were asked to respond to questions asking them about their age, sex, ethnicity, employment status, and diagnosis (i.e., SCI, MS, MD, or AMP). In addition, the participants were asked to provide information regarding the duration of their disability (e.g., time since SCI onset, or amputation, or onset of first MS or MD symptoms).

Pain-related beliefs—We assessed two pain-related beliefs in this study: catastrophizing and control beliefs. Catastrophizing beliefs were assessed using the 13-item Pain Catastrophizing Scale (PCS [26]). The PCS is the most commonly used measure of

catastrophizing in pain research, and a great deal of evidence supports its reliability and validity as a measure of pain-related catastrophizing.[26,27] The PCS items can be scored to create three subscales (assessing three components of catastrophizing: rumination, magnification, and helplessness) or to create a single total score.[26] The total scale score is most often used in research in this area (e.g., [28–30]) because of evidence that all of the items load onto a single global factor (i.e., the subscale scores are strongly associated with one another), the total score (but not the individual scales) can be used as an interval-level scale.[31] Moreover, performing analyses with all three subscales separately would triple the analyses needed, decreasing power. For these reasons, we used the total score in the current study. The internal consistency (Cronbach's alpha) of the PCS in the current sample was 0.91, indicating excellent reliability.

Control beliefs were assessed using the 10-item Control scale from the Survey of Pain Attitudes (SOPA [32]). The SOPA Control scale assesses the extent to which the respondent believes that he or she can control the experience of pain. Respondents indicate the extent to which each of the statements regarding pain control beliefs is true for them on a 0 ("*This is untrue for me*") to 4 ("*This is very true for me*") scale. The Control scale has evidenced good test-retest stability over a 2-week period (r = .79) and good internal consistency (Cronbach's alphas range from .78 to .84).[32] Its validity is supported by its negative associations with key pain-related variables including pain intensity and pain interference.[33–35] The internal consistency (Cronbach's alpha) of the SOPA Control scale was 0.69, indicating adequate reliability in the current sample.

Average pain intensity—Average pain intensity was measured using a composite score (average) of four 0–10 Numerical Rating Scale (NRS) ratings of 24-hour recalled average pain, assessed within a 7-day window by telephone interview by a research staff member. For each of the individual ratings, participants were asked to rate their "average pain over the past 24 hours on a 0–10 scale, where 0 is '*No pain*' and 10 is '*Pain as bad as you can imagine*.' NRSs are recommended over other pain intensity ratings scales because of their relative strengths, including (1) a great deal of evidence supporting their reliability and validity, (2) understandability and ease of use, and (3) ease of administration and scoring.[36,37] The use of composite scores has been recommended over individual ratings as a way to increase the reliability and precision of measurement, and evidence supports this approach.[38] The internal consistency (Cronbach's alpha) of the composite pain intensity score was 0.89, indicating good reliability for this measure in our sample.

Pain interference—Pain interference with activities was assessed using the 7-item Pain Interference scale of the Brief Pain Inventory [39]. This measure assesses the extent to which pain interferes with seven activity domains. Participants indicate level of interference with activity in each domain on 0 ("Does not interfere") to 10 ("Completely interferes") scales. The BPI Pain Interference scale is commonly used in pain research, and has evidenced reliability and validity across a wide variety of pain populations, including individuals with SCI [40] and MS.[41] The internal consistency (Cronbach's alpha) of the BPI Pain Interference scale in the current sample was 0.87, indicating good reliability.

Hypnotizability—Hypnotizability was assessed using the Stanford Hypnotic Clinical Scale (SHCS; [42]) by research staff members who were trained and supervised by a licensed clinical psychologist (MPJ) highly experienced with this measure. The measure begins with a standard hypnotic induction, which is followed by five suggestions (for hand movement, age regression, experiencing a dream, a posthypnotic suggestion, and posthypnotic amnesia). Participant responses to each suggestion are coded as a "0" or "1", depending on whether they meet criteria for responding to the suggestion. The responses are then summed to create the total score, which can range from 0 to 5. The SHCS has demonstrated validity through its strong correlation with other measures of hypnotizability.[43]

Procedures

Research staff conducted an informed consent process with all prospective participants who were deemed eligible to participate and expressed interest in participating in the study. Following enrollment, research staff members administered the Stanford Hypnotic Clinical Scale (SHCS [42]) in person with all enrolled participants. Research staff then collected basic demographic and diagnosis-related information from the participants either in person or via telephone.

Shortly before the treatment phase of the study, research staff completed a telephone assessment period with all participants. Each assessment period consisted of four telephone assessments during a 7-day period with a minimum of 24 hours between each assessment. During each of the four telephone assessments participants reported their average pain intensity in the past 24 hours using a 0–10 Numerical Rating Scale (NRS) as described above. In addition, sometime during the telephone assessment period research staff collected from participants self-report data regarding pain-related beliefs and pain interference. Participants were compensated $30 for completing the assessment period described above. All study procedures were approved by an Institutional Review Board (IRB) Committee at the University of Washington prior to initiation of the study.

Data analysis

We first computed descriptive statistics for the demographic and diagnosis-related variables to describe the sample, and computed means and standard deviations of the study variables, as well as their zero-order correlations. We then performed a series of four hierarchical regression analyses to test the hypothesized moderating effect of hypnotizability on the associations between the measures of pain-related beliefs (catastrophizing and control beliefs) and the criterion variables (average pain intensity and pain interference). In these analyses, all of the predictor variables were first centered in order to minimize the effects of multicolinearity on the unreliability of beta weights when testing the interaction effects.[44] In the first step of the two analyses predicting pain interference, we entered the measure of average pain intensity to control for the effects of pain intensity on interference. In step 2 of the analyses predicting pain interference, we entered either the measure of catastrophizing or control beliefs. For the regression analyses predicting pain intensity, we entered the belief measures in the first step. We then entered the 6-point measure of hypnotizability, followed by a term representing their interaction. Support for a moderating effect of hypnotizability would require that the interaction term contribute a significant amount of variance to the

prediction of the criterion variable.[44] To help understand the potential moderating effects of hypnotizability on the associations between the belief measures and the criterion variables, we then computed zero-order correlations between the pain belief measures (measuring catastrophizing and control beliefs) and the criterion variables, separately for participants with high (above the median) and low (below the median) trait hypnotizability. We used an alpha level of .05 to determine that an effect was statistically significant.

RESULTS

Description of the study participants and study variables

Eighty-five individuals provided data for the analyses presented here. Table 1 presents the descriptive data for these study participants. Table 2 presents the means and standard deviations of the study variables and their correlations.

Tests of the moderating effects of hypnotizability

A statistically significant moderating effect of hypnotizability was found in one of the four regression analyses, as indicated by a significant interaction effect. Specifically, hypnotizability demonstrated a significant moderating effect on the association between control beliefs and pain interference (see Table 3).

The correlation coefficients computed to explain the moderating effects found are presented in Table 4. Consistent with the study hypothesis, the association between control beliefs and pain interference was stronger among those with higher hypnotizability scores than those with lower hypnotizability scores. Moreover, a similar (albeit non-significant) pattern indicating larger associations between beliefs and the criterion variables with higher hypnotizability scores emerged for each of the pairs of variables. That is, the correlation coefficients between the belief measure and both of the criterion variables evidenced a larger absolute value for individuals with higher trait hypnotizability than those with lower hypnotizability.

DISCUSSION

The current findings provide limited support for the hypothesis that the strength of the relationships between pain beliefs (in this case, catastrophizing and pain control beliefs) and pain-related outcome/functioning domains (in this case, pain intensity and pain interference) are moderated by hypnotizability. The predicted pattern was statistically significant for one of the four relationships examined (hypnotizability as moderating the association between control beliefs and pain interference). However, the pattern (i.e., a pattern of stronger positive associations between catastrophizing and both pain intensity and pain interference and of stronger negative associations between control beliefs and both pain intensity and pain interference) emerged in all of the analyses.

Differences in the effect size of the moderating influence of hypnotizability on the associations between belief measures and outcomes could emerge under at least two conditions. First, such findings would occur if there is variability in the causal impact of pain beliefs on outcomes. That is, a model hypothesizing that higher hypnotizability enhances the

effects of self-suggestions on outcomes would predict a stronger moderating effect of hypnotizability *for those beliefs/self-suggestions that have larger causal effects on the outcome variable in question*. Thus, the present findings are consistent with (but do not prove) control beliefs as having a causal impact on decreasing pain interference, where these beliefs are "self-suggestions" which impact interference more strongly for those with higher hypnotizability. Weaker (and non-significant) findings regarding the moderating role of hypnotizability on the associations between catastrophizing and pain interference and between both beliefs and pain intensity would occur if *either* (1) these beliefs have a minimal causal influence on outcomes or (2) higher hypnotizability does not enhance the extent to which these beliefs seem "real" to patients.

Differences in the effect sizes of a linear moderating effect of hypnotizability on the associations between beliefs and important outcomes could also occur if some of the effects are not linear. For example, it is possible that it only takes certain minimal level of hypnotizability for one's thoughts to influence outcomes; very high levels of hypnotizability may not make an individual any more responsive to self-suggestions than medium levels of hypnotizability. Some preliminary support for this possibility came from the descriptive analyses examining the strengths of the associations between beliefs and the criterion variables for participants with low, medium, and high hypnotizability. Specifically, there was always an increase – and sometimes a substantial increase – in the strength of the associations from the low to medium hypnotizability participants. However, there was not a continued increase in the strength of the association between pain beliefs and the criterion variables as hypnotizability scores increased from medium to high levels. Future research is needed to determine if the linear associations (for hypnotizability moderating the effects of control beliefs on pain interference) and non-linear associations (for hypnotizability moderating effects on the other associations) suggested here replicate in other samples.

If the findings reported here do replicate, however, they would have important clinical implications. Specifically, the findings raise the possibility that having at least a moderate level of trait hypnotizability might be considered both a strength (i.e., something that facilitates being more open and responsive to beneficial self-suggestions and adaptive clinical suggestions) and a vulnerability factor (i.e., something that facilitates being more responsive to maladaptive self-suggestions or the negative suggestions of others) in individuals with chronic pain. Thus, for example, individuals with at least medium levels of trait hypnotizability may potentially be more responsive to cognitive therapy exercises that include ongoing reminders of positive self-suggestions (also known as "coping self-statements"), for example by writing these statements down, putting them on cards, and displaying the cards throughout the house in prominent locations [5]. If so, then assessing and knowing a patient's hypnotizability level,[43,45] could help guide treatment and help identify the specific exercises that patients may be more likely to benefit from.

The findings also have important theoretical implications. First, they identify a factor (hypnotizability) that has the potential to explain some of the discrepant findings regarding the importance of beliefs to patient functioning; for example, findings that show variability in the associations between catastrophizing and measures of patient functioning.[46] The study findings are also interesting to consider in light of the increasing focus of researchers on

cognitive process (i.e., what people do with their thoughts) as being distinct from cognitive content (i.e., the content of thoughts) in the pain literature.[47,48] For example, one of the key components of the psychological flexibility model of chronic pain [49,50] – cognitive defusion – has been defined as "…the ability to experience a distinction between thoughts and the things they described…".[49] A recently developed measure of cognitive fusion, which is the opposite of cognitive defusion, includes items such as "My thoughts cause me distress or emotional pain" and "I struggle with my thoughts." [51] It is possible that people with high levels of cognitive fusion may be those who also score higher on trait measures of hypnotizability – self-hypnosis may be an important underlying process by which people can become fused to their thoughts. On the other hand, it is possible that individuals with at least medium levels of trait hypnotizability may be more able to use self-hypnosis to "de-fuse" from cognitive content. Thus, the current findings suggest avenues for future research to help understand the processes that may impact how individuals adjust to pain and to more effectively match patients to specific treatments.

As mentioned previously, it is possible that some thoughts or categories of thoughts may have larger effects on some domains of patient function than others. For example, research has found stronger associations between negative/maladaptive beliefs and coping responses and measures of pain interference than between positive/adaptive beliefs and coping responses and measures of pain interference.[52] The current findings suggest that the negative belief domain of catastrophizing might evidence stronger effects on pain intensity and interference among those with at least medium levels of hypnotizability than the positive belief domain of pain control. It would be interesting to see if this potentially larger moderating effect on negative beliefs replicates in additional samples using different measures of beliefs.

Although all studies have limitations, three key limitations of the current study stand out. First, with a relatively small sample size of 85 participants, it is possible that some significant effects went undetected. For example, 3% and 4% of additional variance in pain intensity was explained by the interactions predicting pain intensity (Table 2). These effect sizes, if reliable, would have emerged as statistically significant in a larger sample. Second, the data for this study are cross-sectional. This means that we cannot make causal conclusions regarding any effects of the beliefs – that catastrophizing or control beliefs "cause" more pain intensity or interference (e.g., especially among participants with medium or higher levels of hypnotizability). Such conclusions could only be made in experimental studies in which individuals with high versus low hypnotizability were trained or encouraged to alter their beliefs and self-statements, and then any improvements in pain intensity or interference following this training were found to be larger among those with higher trait hypnotizability. However, the current findings suggest that research examining these possible causal relationships is warranted. Finally, to our knowledge this study represents the first time that the moderating influence of hypnotizability on the associations between measures of pain beliefs and pain-related outcomes have been examined. Future research is needed to determine the extent to which the current findings replicate in other samples of individuals with chronic pain.

Despite the study's limitations, the current findings identified a factor that may moderate the impact of pain-related beliefs and cognitive content on important outcomes in individuals with chronic pain. These findings, if replicated, could have important clinical and theoretical implications. First, if future research indicates that hypnotizability influences a patient's response to a particular technique of cognitive therapy, measures of hypnotizability could potentially be used to identify patients who could be particularly responsive to this specific treatment approach. Moreover, given evidence that hypnotizability can be modified, at least to some degree,[53–56] the current findings suggest the possibility that outcomes from treatments which are influenced by hypnotizability might be enhanced by procedures to increase hypnotizability prior to starting those treatments. Third, the construct of hypnotizability may provide a useful framework for understanding how simple "words" said to oneself or others can impact outcomes – for example, how individuals might become "de-fused" to their beliefs with treatment [49,51]. It is well known that words said by clinicians can heal as well as hurt.[57,58] The current findings suggest that the words we tell ourselves may have similar effects.

Acknowledgments

The ongoing study that provided the data for this paper is supported by Award Number R01 HD070973 from the National Institutes of health, National Institute of Child Health and Human Development, National Center for Medical Rehabilitation Research. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health, National Institute of Child Health and Human Development, or National Center for Medical Rehabilitation Research. Mark P. Jensen is the author of two books related to the topic of this paper (*Hypnosis for chronic pain management: Therapist guide* and *Hypnosis for chronic pain management: Workbook).* He receives royalties for the sale of these books, but has no other conflicts of interested related to this study.

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Table 1

Description of the 85 study participants

Variable	Mean (SD)	N (%)
Age in years	52.34 (13.27)	
Sex		
Men		37 (43.5%)
Women		48 (56.5%)
Race/Ethnicity		
American Indian/Alaskan Native		1 (1.2%)
Asian		2 (2.4%)
Black or African American		3 (3.5%)
Caucasian		75 (88.2%)
More than one race		2 (2.4%)
Other		1 (1.2%)
Unknown/Refused		1 (1.2%)
Employment status		
Employed Full Time		10 (11.8%)
Employed Part Time		13 (15.3%)
Homemaker		6 (7.1%)
Retired		27 (31.8%)
School Full Time		3 (3.5%)
School Part-time		1 (1.2%)
Unemployed due to disability		38 (44.7%)
Unemployed due to pain		3 (3.5%)
Unemployed other reasons		5 (5.9%)
Diagnosis		
Acquired amputation (AMP)		1 (1.2%)
Muscular dystrophy (MD)		15 (17.6%)
Multiple sclerosis (MS)		54 (63.5%)
Spinal cord injury (SCI)		15 (17.6%)
Among participants with AMP		
Time since procedure in years	2.00 (0.00)	
Among participants with MD		
Time since symptom onset in years	22.67 (13.46)	
Among participants with MS		
Time since symptom onset in years	21.85 (12.47)	
Among participants with SCI		
Duration of SCI in years	11.07 (8.73)	

Table 2

Means and standard deviations of the study variables, and their zero-order correlations.

		Zero-order correlation coefficients with				
Variable	**Mean (SD)**	**Catastrophizing**	**Pain Control Beliefs**	**Average Pain Intensity**	**Pain Interference**	**Hypntizability**
Catastrophizing (PCS)	19.03 (10.96)	-----				
Pain control beliefs (SOPA Pain Control scale)	2.26 (0.59)	−0.50***	-----			
Average Pain Intensity	4.46 (1.63)	0.35**	−0.11	-----		
Pain Interference (BPI)	4.52 (1.98)	0.56***	−0.25*	0.41***	-----	
Hypnotizability (SHCS)	2.84 (1.14)	0.19	0.02	0.04	0.10	-----

* p < .05,

** p < .01,

*** p < .001

Note: PCS = Pain Catastrophizing Scale; SOPA = Survey of Pain Attitudes; ; Average Pain Intensity = Composite score of four 24-hour recall ratings of average pain; BPI = Brief Pain Inventory; SHCS = Stanford Hypnotic Clinical Scale.

Table 3

Results of the hierarchical regression analysis testing for a moderating effect hypnotizability on the association between control beliefs pain interference.

Step and variable	Total R^2	R^2 Δ	F - R^2 Δ	B to enter
Criterion variable: Pain interference				
Step 1: Average Pain Intensity	.17	.17	16.77***	.41
Step 2: Control beliefs	.21	.04	4.45*	−.21*
Step 3: Hypnotizability	.22	.01	.76	.09
Step 4: Control Beliefs X Hypnotizability	.26	.04	4.09*	−.20*

† p < .10,

* p < .05,

** p < .01,

*** p < .001

Note: The predictor variables were centered prior to entering them into the regression equation.

Table 4

Zero-order correlations between pain beliefs and criterion measures for participants with low (1–2, n = 34), and high (3–5, n = 51) hypnotizability scores

	Hypnotizability	
Correlations between…	**Low**	**High**
Catastrophizing and pain intensity	0.16	0.50***
Catastrophizing and pain interference	0.47**	0.60***
Control beliefs and pain intensity	−0.05	−0.19
Control beliefs and pain interference	−0.03	−0.43**

** p < .01,

*** p < .001