



## Catastrophizing, depression and expectancies for pain and emotional distress

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### Abstract

The present research addressed the relation between catastrophizing, depression and response expectancies in anticipation of an experimental pain procedure. One hundred and twenty undergraduates (48 men, 72 women) participated in exchange for course credit. Prior to immersing one arm in a container of ice water, participants were asked to complete measures of catastrophizing and depression, and to estimate the degree of pain and emotional distress they expected to experience. After a 1-min immersion, participants rated their actual experience. Pain expectancies partially mediated the relation between catastrophizing and pain experience. Pain expectancies also mediated the relation between depression and pain experience. Catastrophizing, but not depression, was associated with a tendency to underestimate pain and emotional distress. The implications of these findings for the conceptual distinctiveness of catastrophizing and depression are discussed. Discussion also examines the potential implications of the present findings for pain management interventions. © 2001 International Association for the Study of Pain. Published by Elsevier Science B.V. All rights reserved.

*Keywords:* Catastrophizing; Pain expectancies; Emotional distress

### 1. Introduction

Psychological variables hold a prominent place in current theorizing on mechanisms of pain perception (e.g. Melzack and Wall, 1965; Melzack, 1990, 1993, 1999). Considerable research has shown that a number of cognitive and affective variables impact significantly on pain experience (Romano and Turner, 1985; Jensen et al., 1987; Turk and Rudy, 1992; Sullivan et al., 1995). Two variables that have received considerable attention in the last decade are catastrophizing and depression. Catastrophizing has been discussed as a significant cognitive determinant of pain experience, and depression has been discussed as a significant emotional determinant of pain experience (Spanos et al., 1979; Romano and Turner, 1985; Chaves and Brown, 1987; Jensen et al., 1987; Sullivan et al., 1992, 1995). To date, the processes by which catastrophizing and depression impact on pain experience remain largely unknown. The present study examined the degree to which *pain expectancies* underlie the relations among catastrophizing, depression, and pain.

#### 1.1. Pain expectancies

Predictions about non-volitional responses to a particular stimulus are referred to as 'response expectancies'. Examples of non-volitional responses include emotional reactions, sexual arousal, and pain. Although non-volitional responses are considered to occur automatically, the expectation of their occurrence can have a strong impact on experience and behavior (Kirsch, 1985). Considerable research has shown that there is a high degree of concordance between response expectancies and actual experience (Rachman and Lopatka, 1988; Baker and Kirsch, 1991).

Response expectancies for pain have been discussed as a significant determinant of actual pain experience (Kirsch, 1985). For example, it has been shown that manipulations of pain expectancies through hypnosis can lead to significant increases or decreases in pain perception (Spanos, 1986). The powerful analgesic effects of placebos have also been discussed in terms of expectancy manipulations (Montgomery and Kirsch, 1996; Kirsch, 1997; Price et al., 1999). It has been suggested that many psychological interventions for pain management may exert their effects, at least in part, through their influence on pain expectancies (Baker and Kirsch, 1991).

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Kirsch (1985) has suggested that the relation between response expectancies and experience is unmediated. In other words, he suggests that response expectancies may represent one of the most basic of psychological variables. This position has significant implications for explicating the underlying basis of several psychological determinants of pain experience. Response expectancies may represent the final common pathway of several psychological influences on pain perception. A central focus of the present research was to examine whether catastrophizing and depression exerted their impact on pain through their association with pain expectancies.

### *1.2. Catastrophizing, depression and pain expectancies*

Catastrophizing is currently viewed as a multidimensional construct comprising elements of rumination ('I can't stop thinking about how much it hurts'), magnification ('I'm afraid something serious may happen'), and helplessness ('There is nothing I can do to reduce the intensity of the pain') (Sullivan et al., 1995). In the past two decades, catastrophizing has emerged as one of the most robust, and reliable psychological predictors of pain experience (Turk and Rudy, 1992; Geisser et al., 1999; Keefe et al., 1999). To date, a relation between catastrophizing and pain has been observed in several different populations, including individuals undergoing aversive diagnostic procedures (Sullivan et al., 1995), chronic pain patients (Spinhoven et al., 1989), arthritis patients (Keefe et al., 1989; Martin et al., 1996), dental patients (Sullivan and Neish, 1998), post-surgical patients (Keefe et al., 1987), and students undergoing experimental pain procedures (Heyneman et al., 1990). The relation between catastrophizing and pain has been demonstrated in prospective studies, and catastrophizing has been shown to account for pain-related outcomes better than medical status variables (Keefe et al., 1989; Martin et al., 1996; Sullivan and Neish, 1998).

As a function of their history of heightened pain experience, across several domains of pain-eliciting situations, individuals who catastrophize may develop expectancies of future heightened pain experiences. Alternately, individuals who catastrophize may develop beliefs about the high degree of aversiveness associated with pain eliciting situations, even ones for which they have no prior experience (Turk and Rudy, 1992; Sullivan et al., 1995). Thus, whether on the basis of prior painful experience, or associated beliefs about pain-eliciting situations, individuals who catastrophize may come to expect that future pain eliciting situations will be associated with a high degree of pain. The first hypothesis of the present research was that pain expectancies will mediate the relation between catastrophizing and pain experience.

Depression has also been associated with heightened pain experience (Romano and Turner, 1985). Clinical research has shown that depressive symptoms are correlated with ratings of pain intensity and that the prevalence of depres-

sive disorders is unusually high in individuals suffering from chronic pain (Dworkin and Gitlin, 1991; Sullivan et al., 1992; Banks and Kerns, 1996). A relation between depression and pain has been demonstrated in several populations of persistent pain sufferers including patients with chronic low back pain (Haythornthwaite et al., 1991; Gaskin et al., 1992; Geisser et al., 1995), osteoarthritis (Keefe et al., 1987), rheumatoid arthritis (Brown et al., 1989), and fibromyalgia (Martin et al., 1996). A relation between depression and pain has also been observed in undergraduate students participating in experimental pain procedures (Sullivan et al., 1997; Walsh et al., 1998).

There is also research to show that depression is associated with expectancies for negative outcomes (for a review Haaga et al., 1991). Depressed individuals, compared to non-depressed individuals, rate future negative events as more likely and expect to perform worse on social and cognitive tasks (Lewinsohn et al., 1982; Johnson and Tversky, 1983). It has been suggested that factors such as increased accessibility of mood-congruent memories, or selective attention to mood-congruent information may account for the relation between depression and pessimistic thinking (Lewinsohn et al., 1982; Ingram, 1984). This line of reasoning suggests that depression will be associated with expectancies for heightened pain experience. The second hypothesis of the present research was that pain expectancies will mediate the relation between depression and heightened pain experience.

### *1.3. Catastrophizing, depression and expectancies for emotional distress*

A relation between catastrophizing and emotional distress has been reported by several investigators (Chaves and Brown, 1987; Rosenstiel and Keefe, 1983; Sullivan et al., 1995). Similarly, depression has been associated with various indices of pain-related emotional distress (Rama Krishnan et al., 1985; Wade et al., 1990; Kerns et al., 1994). Through processes similar to those discussed for pain expectancies, catastrophizing and depression may be associated with expectancies for heightened emotional distress in anticipation of potentially painful situations. In other words, it can be hypothesized that expectancies for emotional distress will mediate the relation between catastrophizing and actual emotional distress, and between depression and actual emotional distress.

It is possible that emotional distress reactions to a painful situation may arise as a function of inaccurate pain expectancies. This hypothesis derives from research showing that underestimates of pain are associated with heightened emotional distress following aversive stimulation (e.g. Arntz et al., 1991). For example, Wallace (1985) found that patients who underpredicted their post-surgical pain were more distressed than those who made accurate predictions. Similarly, Arntz et al. (1990) found that underestimates of pain stimuli resulted in greater fear of the pain stimulus and greater anxiety. Thus, underprediction of

pain as opposed to expectancies for emotional distress may contribute to heightened emotional distress in individuals who catastrophize or individuals who are depressed.

#### 1.4. The present research

In the present research, male and female undergraduates were invited to participate in a cold pressor procedure. In this procedure, participants immerse one arm in ice water for one minute and provide ratings of their pain experience. In order to examine the relations among catastrophizing, depression and expectancies, participants were asked to rate how much pain and emotional distress they expected to experience during the ice water immersion.

Five experimental hypotheses can be summarized as follows.

1. *Catastrophizing and pain*: Pain expectancies will mediate the relation between catastrophizing and the experience of heightened pain.
2. *Depression and pain*: Pain expectancies will mediate the relation between depression and the experience of heightened pain.
3. *Catastrophizing and emotional distress*: Expected emotional distress will mediate the relation between catastrophizing and experienced emotional distress.
4. *Depression and emotional distress*: Expected emotional distress will mediate the relation between depression and experienced emotional distress.
5. *Underestimation hypothesis*: Catastrophizing and depression will be associated with underestimates of pain experience, and the degree of underestimation will predict emotional distress responses.

## 2. Method

### 2.1. Participants

One hundred and twenty undergraduates (47 men, 73 women) participated in the research in exchange for course credit. Participants ranged in age from 18 to 32 years (mean = 20.0; SD = 3.4). Individuals who were suffering from a medical condition associated with persistent pain such as migraine headache or back pain, or from other conditions that may be adversely affected by the pain procedure (e.g. cardiovascular problems, previous experience of frostbite) were not considered for participation.

### 2.2. Apparatus

A cold pressor apparatus was used to induce pain. The apparatus consisted of a refrigeration unit that cooled constantly circulating water in an insulated container measuring 30 × 40 × 30 cm. The insulated container was equipped with a moveable armrest used to immerse a parti-

cipant's arm in the ice water. Water temperature was maintained at 2–4°C.

### 2.3. Measures

#### 2.3.1. Catastrophizing

The Pain Catastrophizing Scale (PCS; Sullivan et al., 1995) is a 13-item measure of catastrophic thinking associated with pain. Participants rate how frequently they experience each of 13 thoughts or feelings when they are in pain. Ratings are made on 5-point scales with the end points (0) *not at all* and (4) *all the time*. The PCS has been shown to have high internal consistency (Cronbach (1951) alpha = 0.87; Sullivan et al., 1995).

#### 2.3.2. Depression

The Beck Depression Inventory (BDI; Beck et al., 1961) was used as a self-report measure of depression. The BDI consists of 21 items describing various symptoms of depression. Participants' responses were summed to yield an overall index of severity of depressive symptoms. Numerous studies have shown the BDI to be a reliable and valid measure of depressive symptomatology (Beck et al., 1988).

#### 2.3.3. Expected pain and emotional distress

Participants were asked to rate the pain they expected to experience during the cold pressor by choosing a number between (0) *no pain* and (10) *extreme pain*. Participants also completed a brief measure of expected mood consisting of nine adjectives drawn from the Profile of Mood States (POMS; McNair et al., 1971). Participants rated the intensity of different moods they expected to experience on a 11-point scale with the endpoints (0) *not at all* and (10) *extremely*. Adjectives were chosen to represent three different mood categories: (1) sadness (sad, discouraged, hopeless); (2) anger (angry, hostile, irritable); and (3) anxiety (anxious, tense, worried). A composite score for negative mood was computed by summing all nine items of the mood scale. The reliability coefficient for the total scale was 0.81.

#### 2.3.4. Experienced pain and emotional distress

An 11-point Likert-type rating scale was positioned on the wall directly in front of the cold pressor apparatus. Participants provided verbal reports of the pain they experienced by choosing numbers between (0) *no pain* and (10) *extreme pain*. The mood adjectives and the rating scale used to assess experienced emotional distress during the cold pressor were the same as those described for expected emotional distress.

### 2.4. Procedure

Participants were told that the study was concerned with the correlates of physical discomfort. They were informed that the cold pressor procedure would not result in physical injury and were told they would receive course credit even if

they withdrew from the study. Participants were tested by one of two female experimenters.

Upon arrival to the laboratory, participants were asked to complete the PCS, and BDI. Participants were seated in the testing room where they were shown the cold pressor apparatus. Participants then rated their expected pain and emotional distress. They were then instructed to place their arm on the moveable armrest of the cold pressor apparatus, to lower their arm into the water, and to keep their arm immersed until asked to remove their arm from the ice water. They were signaled, by a voice on a tape recording, to give three verbal ratings of their pain at 20-s intervals. Correlations among the three pain ratings were high (0.59–0.89) and were therefore averaged to produce a composite index of pain experience.

### 3. Results

Mediation is established when the independent variable (e.g. catastrophizing) is associated with both the dependent variable (e.g. pain experience) and the hypothesized mediator (e.g. pain expectancies) (Baron and Kenny, 1986). Complete mediation is established when the relation between the independent and dependent variables is no longer significant, after variance associated with the mediator has been controlled.

#### 3.1. The mediating role of pain expectancies

Correlations among measures are presented in Table 1. Catastrophizing was significantly correlated with both pain expectancy ( $r = 0.23$ ,  $P < 0.02$ ) and pain experience ( $r = 0.44$ ,  $P < 0.001$ ). Pain expectancy and pain experience were also correlated ( $r = 0.28$ ,  $P < 0.002$ ).

Two regression analyses were performed to examine whether pain expectancies mediated the relation between catastrophizing and pain experience. As shown in Table 2 (Regression 1), catastrophizing accounted for 20% of the variance in pain experience when it was entered alone in the regression analysis. In Regression 2, expected pain was entered in step 1 of the analysis, contributing 8% of the variance in pain ratings. Catastrophizing was entered next, contributing an additional 15% of variance to the prediction

Table 1  
Correlations among measures<sup>a</sup>

	BDI	PainExp	MoodExp	Mood	Pain
PCS	0.24**	0.23**	0.43**	0.59**	0.44**
BDI		0.13	0.32**	0.32**	0.18*
PainExp			0.22**	0.12	0.27**
MoodExp				0.67**	0.44**
Mood					0.50**

<sup>a</sup>  $n = 120$ . PCS, Pain Catastrophizing Scale; BDI, Beck Depression Inventory; PainExp, expected pain; MoodExp, expected emotional distress; Mood, experienced emotional distress; Pain, experienced pain. \* $P < 0.05$ , \*\* $P < 0.01$ .

Table 2

Regression analysis examining the mediating role of expectancies for the relation between catastrophizing and pain<sup>a</sup>

Variable	Beta	$r^2$ (change)	$F$ (change)	$P$
<i>Regression 1: Catastrophizing predicting pain</i>				
Catastrophizing	0.44**	0.20	29.0	0.000
<i>Regression 2: Catastrophizing predicting pain controlling for expectancies</i>				
Expected pain	0.18*	0.08	9.9	0.002
Catastrophizing	0.40**	0.15	23.1	0.000

<sup>a</sup>  $n = 120$ . In Regression 2, beta weights are from the final regression equation. \* $P < 0.05$ , \*\* $P < 0.01$ .

of pain. Examination of the beta weights in the final regression equation revealed that pain expectancies and catastrophizing each contributed significant unique variance to the prediction of pain. The results of this analysis indicate that pain expectancies partially mediate the relation between catastrophizing and pain.

Depression was significantly associated with pain experience ( $r = 0.18$ ,  $P < 0.05$ ) but was not significantly associated with pain expectancies ( $r = 0.13$ , not significant). Table 3 presents the results of regression analyses examining the mediating role of pain expectancies in the relation between depression and pain experience. In Regression 1, depression accounted for 3% of the variance in pain ratings when it was entered alone. In Regression 2, depression was entered in step 2, after controlling for pain expectancies. Examination of the beta weights revealed that pain expectancies contributed significant unique variance to the prediction of pain but depression did not. The results of this analysis provide mixed support for the hypothesis that pain expectancies mediate the relation between depression and pain.

#### 3.2. The mediating role of expected emotional distress

Catastrophizing was significantly correlated with expectancies for emotional distress ( $r = 0.44$ ,  $P < 0.01$ ) and experienced emotional distress ( $r = 0.59$ ,  $P < 0.001$ ). Expectancies for emotional distress and experienced emotional distress were also correlated ( $r = 0.67$ ,  $P < 0.001$ ).

Table 3

Regression analysis examining the mediating role of expectancies for the relation between depression and pain<sup>a</sup>

Variable	Beta	$r^2$ (change)	$F$ (change)	$P$
<i>Regression 1: Depression predicting pain</i>				
Depression	0.18	0.03	3.9	0.05
<i>Regression 2: Depression predicting pain controlling for expectancies</i>				
Expected pain	0.26*	0.08	9.9	0.002
Depression	0.14	0.02	2.6	0.10

<sup>a</sup>  $n = 120$ . In Regression 2, beta weights are from the final regression equation. \* $P < 0.05$ .

Table 4  
Regression analysis examining the mediating role of expectancies for the relation between catastrophizing and emotional distress<sup>a</sup>

Variable	Beta	r <sup>2</sup> (change)	F (change)	P
<i>Regression 1: Catastrophizing predicting emotional distress</i>				
Catastrophizing	0.58**	0.34	62.2	0.000
<i>Regression 2: Catastrophizing predicting emotional distress controlling for expectancies</i>				
Expected emotional distress	0.51**	0.45	96.5	0.002
Catastrophizing	0.36**	0.11	29.1	0.000

<sup>a</sup> *n* = 120. In Regression 2, beta weights are from the final regression equation. \*\**P* < 0.01.

Table 4 shows the results of regression analyses testing the mediating role of expected emotional distress in the relation between catastrophizing and experienced emotional distress. Regression 1 revealed that catastrophizing accounted for 34% of the variance in experienced emotional distress when it was entered alone. In Regression 2, expected emotional distress was entered in step 1 of the analysis, accounting for 45% of the variance in experienced emotional distress. Catastrophizing was entered in step 2 and contributed an additional 11% of variance. Beta weights revealed that expected emotional distress and catastrophizing each contributed significant unique variance to the prediction of experienced emotional distress. The results suggest that expectancies for emotional distress partially mediate the relation between catastrophizing and experience emotional distress.

Depression was also significantly correlated with expectancies for emotional distress ( $r = 0.32$ ,  $P < 0.01$ ) and experienced emotional distress ( $r = 0.32$ ,  $P < 0.01$ ). In Table 5, the results of a regression analyses suggest that the relation between depression and experienced emotional distress is completely mediated by expectancies for emotional distress. Specifically, although depression accounted for significant variance in experienced emotional distress when it was entered alone, it did not contribute to the prediction of experienced emotional distress beyond the variance accounted for by expected emotional distress.

Table 5  
Regression analysis examining the mediating role of expectancies for the relation between depression and emotional distress<sup>a</sup>

Variable	Beta	r <sup>2</sup> (change)	F (change)	P
<i>Regression 1: Depression predicting emotional distress</i>				
Depression	0.32**	0.10	13.6	0.000
<i>Regression 2: Depression predicting emotional distress controlling for expectancies</i>				
Expected emotional distress	0.63**	0.45	96.5	0.000
Depression	0.11	0.01	2.7	0.10

<sup>a</sup> *n* = 120. In Regression 2, beta weights are from the final regression equation. \*\**P* < 0.01.

### 3.3. Underestimation of pain and experienced emotional distress

Error scores were computed by subtracting expected pain ratings from experienced pain ratings (prediction error = experienced pain – expected pain). Scores of 0 reflect perfect prediction, positive scores reflect underprediction and negative scores reflect overprediction. Catastrophizing scores were associated with a tendency to underpredict pain ( $r = 0.27$ ,  $P < 0.01$ ) and emotional distress ( $r = 0.29$ ,  $P < 0.01$ ). However, depression was unrelated to prediction accuracy, either for pain ( $r = 0.08$ , not significant) or emotional distress ( $r = 0.06$ , not significant).

As in previous research (Wallace, 1985; Arntz et al., 1991), underprediction of pain was associated with higher ratings of experienced emotional distress ( $r = 0.39$ ,  $P < 0.01$ ). However, this correlation was no longer significant when experienced pain was statistically controlled ( $r = 0.02$ , not significant). Furthermore, emotional distress was highly correlated with experienced pain ( $r = 0.50$ ,  $P < 0.001$ ), but not with expected pain ( $r = 0.12$ , not significant). Taken together, these findings suggest that the relation of emotional distress to differences between expected and experienced pain are not really due to the underprediction of pain (i.e. to relatively low pain expectancies). Instead, they are due to the impact of experienced pain on emotional distress.

## 4. Discussion

The present findings are consistent with previous research showing that catastrophizing is associated with the experience of heightened pain and emotional distress in response to painful stimulation (Heyneman et al., 1990; Sullivan et al., 1995, 1997). The findings are also consistent with previous research showing that depression is associated with the experience of heightened pain and emotional distress in response to painful stimulation (Romano and Turner 1985; Haythornthwaite et al., 1991; Geisser et al., 1993; Walsh et al., 1998).

A central objective of this research was to address whether expectancies mediated physical and emotional distress responses associated with catastrophizing and depression. Results of regression analyses revealed that pain expectancies partially mediated the relations between catastrophizing and pain, and catastrophizing and emotional distress. The magnitude of the relations between catastrophizing and pain, and catastrophizing and emotional distress was reduced when expectancies were included in the regression analyses. Yet, when examined simultaneously in a regression analysis, both expectancies and catastrophizing contributed to unique variance to the prediction of pain and emotional distress.

The hypotheses concerning the mediating role of response expectancies in the relations between depression

and pain, and depression and emotional distress received mixed support. In support of a mediation hypothesis, the correlation between depression and pain experience was no longer significant after controlling for pain expectancies. However, the association between depression and pain expectancies was not significant, thus precluding an adequate test of a mediational hypothesis. Regression analyses revealed that expectancies for emotional distress completely mediated the relation between depression and experienced emotional distress. The latter finding suggests that response expectancies are the mechanism through which depression exerts its effects on pain-related emotional distress.

The findings also suggest that catastrophizing and depression differ in the ways in which they impact on pain-related outcomes. There have been several previous discussions on the degree of overlap between catastrophizing and depression (Sullivan and D'Eon, 1990; Jensen et al., 1987; Haaga, 1992; Haaga et al., 1991). It has even been suggested that the degree of overlap may be sufficient to consider the two constructs redundant (Sullivan and D'Eon, 1990). The view that emerges from the present findings is that the two constructs may influence pain and emotional distress in qualitatively different ways. Specifically, when response expectancy is controlled, the relation between depression and pain-related outcomes is no longer significant. In contrast, the data indicate that the relation between catastrophizing and pain-related outcomes is at least partially independent of expectancy.

The data in this study shed light on the relation between emotional distress and what has been termed 'underprediction' of pain (Wallace, 1985; Arntz et al., 1991). Underprediction has typically been measured as the difference between expected pain and experienced pain. The present data indicate that the relation between underprediction and emotional distress may be due to variance in pain perception, rather than variance in what people predict their pain will be; in which case, underprediction is a misnomer. In the data reported here, emotional distress was highly correlated with reported pain, but not with expected pain. When reported pain was statistically controlled, the association with underprediction (i.e. the difference between expected and experienced pain) vanished. These data suggest that increased emotional distress is not produced by underprediction, but rather by greater pain, independent of pain prediction. In other words, the observed relation between underprediction of pain and experienced emotional distress may be an artifact of the manner in which underprediction is operationalized. Individuals who experience high levels of pain may react with heightened emotional distress, regardless of the degree of pain they expected to experience.

The relation between catastrophizing and underprediction of pain is of interest. Catastrophizers' previous experiences with pain-eliciting situations should inform them that future pain-eliciting situations will be associated with heightened pain. Yet, the correlation between catastrophizing and pain

expectancies was modest compared to the correlation between catastrophizing and pain experience. One possibility is that catastrophizers' underprediction of pain may serve as a means of minimizing their anticipatory distress. The underprediction of pain may allow catastrophizers' to approach potentially pain eliciting situations with less anxiety or fear than if their pain expectancies were accurate. A potential drawback of such a strategy would be that underprediction of pain may also preclude the mobilization of preparatory coping efforts (cf. Chaves and Brown, 1987).

It is interesting to speculate that catastrophizers' underprediction of pain may account for their excessive focus on pain sensations. Several investigations have shown that excessive focus on pain sensations is a central feature of catastrophizing (Spanos et al., 1979; Crombez et al., 1997; Sullivan and Neish, 1998; Sullivan et al., 2000). It has also been shown that unexpected events are likely to receive greater attention, and promote more extensive processing, particularly when the experience is negative (Pyszczynski and Greenberg, 1981; Pratto and John, 1991; Taylor, 1991). For catastrophizers, the unexpected intensity of their pain experience may draw their attention to their pain sensations or the pain stimulus.

There are interesting clinical implications to the pattern of findings observed in the present study. First, the findings suggest that interventions that incorporate expectancy manipulations may have beneficial effects on pain and emotional distress. In light of the magnitude of the relation between response expectancies and pain-related outcomes, expectancy interventions may have modest impact on pain experience, but marked impact on emotional distress responses to pain. The present findings also suggest that interventions specifically targeting catastrophic thinking have the potential for leading to sizeable decreases in pain and emotional distress.

It is necessary to consider limitations of the present study. First, participants' lack of previous experience with cold pressor pain may have implications for the generalizability of findings. It is possible that a different pattern of findings might have emerged with a pain stimulus with which participants had prior experience. Relatedly, the use of an experimental pain stimulus limits generalizability to painful clinical procedures. The use of a student sample with minimal levels of depression may not have permitted an adequate test of relations among depression, pain expectancies and pain-related outcomes. Future research will need to explore the relation between catastrophizing and pain expectancies in more ecologically and clinically relevant settings. It will also be important to examine further the degree to which catastrophizing influences the manner in which individuals retrieve and make use of previous information related to painful experiences in forming expectancies for future pain experiences. Additionally, it will be of interest to examine how catastrophizing influences how individuals make use of current pain experience to correct inaccurate pain predictions.

In summary, the findings of the present research provide interesting insight into the differential mechanisms by which catastrophizing and depression may impact on pain-related outcomes. The findings also highlight how some individuals may adopt strategies for managing pain eliciting situations that may have short-term advantages but long-term disadvantages. If replicated under more clinically relevant conditions, the findings may contribute to a better understanding of the components of interventions that are central to therapeutic improvement, and may ultimately provide means for preventing the perpetuation a maladaptive interplay between cognitive and affective processes contributing to heightened physical and emotional distress.

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