The relation between catastrophizing and the communication of pain experience

M.J.L. Sullivan a,*, M.O. Martel a, D. Tripp b, A. Savard a, G. Crombez c

a Department of Psychology, University of Montreal, Canada
b Department of Psychology, Queen's University, Canada
c Department of Experimental-Clinical and Health Psychology, Ghent University, Belgium

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Abstract

The Communal Coping Model of pain catastrophizing proposes that pain catastrophizers enact pain behaviors in order to solicit support or empathy from their social environment. By this account, pain catastrophizers might be expected to engage in behavior aimed at maximizing the probability that their pain will be perceived by others in their social environment. To test this prediction, 40 undergraduates were videotaped during a cold pressor procedure. A separate sample of 20 (10 men, 10 women) undergraduates were asked to view the video sequences and infer the pain ratings of the cold pressor participants. Correlational analyses revealed that higher levels of pain catastrophizing of the cold pressor participants were associated with observer inferences of more intense pain, \( r = .39, p < .01 \). The relation between cold pressor participants’ level of pain catastrophizing and observer inferences of pain intensity was mediated by the cold pressor participants’ pain behavior. Although pain catastrophizing was associated with observers’ inferences of more intense pain, cold pressor participants’ level of pain catastrophizing was not associated with observers’ accuracy in inferring self-reported pain. Implications of the findings for theory and clinical practice are addressed.

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Keywords: Catastrophizing; Pain communication; Pain behavior; Perceiving others’ pain; Observing pain; Communal coping; Accuracy of pain inferences

1. Introduction

Research has demonstrated that the tendency to catastrophize in response to pain contributes to negative emotional and physical outcomes (Sullivan et al., 2001). Pain catastrophizing has been associated with several pain-related outcomes including more intense pain (Sullivan et al., 1995), heightened pain behavior (Keefe et al., 2000; Sullivan et al., 2000), greater analgesic consumption (Jacobsen and Butler, 1996; Bédard et al., 1997), reduced involvement in daily activities (Keefe et al., 1989), and occupational disability (Burton et al., 1995; Sullivan et al., 1998; Sullivan and Stanish, 2003).

It has been suggested that the expressive features of pain catastrophizing might reflect a communal approach to coping with pain (Sullivan et al., 2000, 2001). Within this framework, it is assumed that individuals differ in the degree to which they adopt interpersonal goals in their efforts to cope with stress (Coyne and Fiske, 1992; Lyons et al., 1998; Sullivan et al., 2000). Sullivan et al. (2001) suggested that pain catastrophizers might engage in exaggerated pain expression in order to maximize proximity, or to solicit assistance or empathic responses from others in their social environment. By
this account, pain catastrophizers might be expected to engage in behavior aimed at maximizing the probability that their pain, emotional distress, and disability will be perceived by others in their social environment. Craig and his colleagues (Craig, 1998; Prkachin and Craig, 1995; Hadjistavropoulos and Craig, 2002) have proposed that the communication of pain occurs as a function of characteristics of the sender, the perceiver, and the situation. The pain behavior of the sender is one means by which pain is communicated to others. Pain behaviors are the various actions or facial and postural displays that are enacted during the experience of pain. These might include facial expressions, vocalizations, protective or evasive movements (Williams, 2002; Prkachin et al., 2004). Pain catastrophizing has been associated with the display of more varied and prolonged pain behavior, particularly when in the presence of another person (Keefe et al., 2000; Sullivan et al., 2000, 2004).

Research has yet to systematically address the relation between pain catastrophizing and pain communication. It is possible that the pain behavior of pain catastrophizers might lead observers to infer more intense pain. It is also possible that observers may discount pain behaviors if they judge these to be exaggerated, and in turn, make inferences of less intense pain. Elucidation of the determinants of the relation between pain catastrophizing and pain communication might increase our understanding of the processes that link pain catastrophizing to negative pain-related outcomes.

The primary aim of the present research was to test the hypothesis that pain catastrophizing would be associated with the communication of more intense pain. A second hypothesis was that the relation between pain catastrophizing and observers’ inferences of more intense pain would be mediated by pain behavior. To test these hypotheses, participants were videotaped while taking part in a cold pressor procedure. A separate sample of participants viewed the videotapes and were asked to infer the level of pain of the cold pressor participants.

2. Methods

2.1. Participants

Forty (22 men, 18 women) students enrolled in undergraduate psychology courses at Dalhousie University volunteered to participate in a study involving the exposure to a painful stimulus. The mean age of the sample was 22.6 years (SD = 4.2) with a range of 19–42 years. A second sample of 20 psychology undergraduates (10 men, 10 women) from the University of Montreal volunteered to participate in a study concerning the perception of others’ pain. The mean age of the second sample was 21.8 years (SD = 3.7) with a range of 20–28 years.

2.2. Apparatus

A cold pressor apparatus was used consisting of a refrigerated container, measuring 30 cm × 40 cm × 30 cm. Water was constantly circulated by an internal pump and temperature was maintained at 2–4 °C. Participants were videotaped during the procedure using a Hitachi VM-2300A VHS video camera positioned behind a one-way mirror.

2.3. Measures

2.3.1. Catastrophizing

The Pain Catastrophizing Scale (PCS; Sullivan et al., 1995) was used as a measure of catastrophic thinking associated with pain. The PCS instructions ask participants to reflect on past painful experiences, and to indicate the degree to which they experienced each of 13 thoughts or feelings when experiencing pain, on 5-point scales with the end points (0) not at all and (4) all the time. The PCS yields a total score and three subscale scores assessing rumination, magnification, and helplessness. The PCS has been shown to have high internal consistency (coefficient zs: total PCS = .87, rumination = .87, magnification = .66, and helplessness = .78; Sullivan et al., 1995). For the present study, coefficient zs were as follows: total = .86, rumination = .90, magnification = .78, and helplessness = .84.

2.3.2. Pain

A 11-point numerical rating scale was positioned on the wall directly in front of the participants. Participants gave verbal reports of their current pain by choosing numbers between (0) no pain and (10) extreme pain.

2.4. Procedure: cold pressor participants

Individuals responded to a web-based advertisement for volunteers to take part in a study involving exposure to a painful stimulus. Prior to consent, an assistant described the cold pressor apparatus and procedure to prospective participants. Participants were told that the study was concerned with the relation between thoughts and physical discomfort and they were assured that the procedure would not result in physical injury. Individuals who were suffering from a medical condition associated with persistent pain such as migraine headache or back pain, or from other conditions that might be adversely affected by the pain procedure (e.g., cardiovascular problems, previous experience of frostbite) were not considered for participation. There were no cases of participant withdrawal. All participants were tested by a female experimenter who was present in the testing room throughout the procedure.

Prior to the cold pressor procedure, participants completed the PCS. To regulate arm temperature, participants immersed their dominant arm in a container of room temperature water for 5 min. Participants were then instructed to place their arm on the moveable armrest of the cold pressor apparatus, to lower their arm into the cold water, and to keep their arm immersed for a period of one minute. They were signalled, by a voice on a tape recording, to give 3 verbal ratings of their current level of pain at 20 s intervals during the water immersion. At the end of 1 min, they were signalled to remove their arm from the ice water. Participants were aware that they...
were being videotaped but they could not see the video camera. For the purposes of the present study, only the 5-s videotape segment immediately prior to the first pain report was used. In other words, observers viewed participants as they experienced 5 s of cold pressor immersion, starting at 15 s point and ending at 20 s point of the immersion period. Previous research has shown that pain behavior is to some degree reactive, decreasing in intensity over the course of exposure to a painful stimulus (Craig and Patrick, 1985). The 15–20 s period of immersion was chosen as a period where pain behaviors would be most likely to occur but removed sufficiently from initial moment of immersion to reduce potential confounding by startle reactions.

2.4.1. Assessment of pain behavior

Two trained coders independently coded each video sequence for instances of pain behavior according to a procedure described by Sullivan et al. (2004). The pain behavior coding procedure was similar to that described by Keefe and Block (1982) but adapted for a cold pressor paradigm. Judges were trained to competency following a manualized approach to coding pain behavior previously developed in our laboratory (Sullivan et al., 2000, 2004). Coders recorded the frequency and duration of the following pain behaviors: (1) facial expressions such as grimacing or wincing, (2) verbal and paraverbal pain expressions such as phrases, grunts, sighs, and moans, and (3) bodily movements such as arching of the neck, bending forward, rocking, hand clenching, and shaking of the arm or legs. For each video sequence, coders determined the duration and intensity of each category of pain behavior. Intensity was rated on a three-point scale with the following anchors: (1) mild, (2) moderate, and (3) intense. Percentage agreement for the classification of different pain behaviors was 88%, 89%, and 97%, for facial expressions, verbal/paraverbal expressions, and bodily movements, respectively. Discrepancies were resolved through discussion. Percentage agreement for the ratings of pain behavior intensity was 84%, 86%, and 89% for facial expressions, verbal/paraverbal expression, and bodily movements, respectively. Correlations between the two coders’ ratings of pain behavior duration were .93, .94, and .94 for facial expressions, verbal/paraverbal expressions, and bodily movements, respectively. For pain behavior intensity ratings and pain behavior duration ratings, the mean of the two coders’ ratings was used in analyses. Indices of pain behavior were computed for each sequence by multiplying the duration of pain behavior by the intensity of the pain behavior (Prkachin et al., 2004).

2.4.2. Procedure: observers

Observers were told that the research was concerned with the accuracy with which others’ pain could be inferred. Observers were tested individually and were asked to watch 40 5-s video sequences that were presented on a projector screen (4 ft × 5 ft). The video sequences were presented in the same random order for all participants. The experimenter explained that the individuals in the video sequences had participated in a previous experiment examining responses to painful stimulation. Observers were asked to watch each video segment carefully and to infer to the best of their ability the degree of pain experienced by the cold pressor participant. Observers were provided with a rating form on which to inscribe their inferred pain. Observers rated cold pressor participants’ pain on 11-point scales with the endpoints (0) no pain and (10) extreme pain.

2.5. Data reduction and data analytic approach

Since the majority of verbal/paraverbal expressions co-occurred with facial grimaces (89%), facial grimaces and verbal/paraverbal expressions were combined into one category. Indices of pain behavior (i.e., duration × intensity) were computed separately for facial/(para)verbal expression and bodily movements.

To address the relation between catastrophizing and the communication of pain experience, correlations were computed between cold pressor participants’ PCS scores and observers’ inferred pain ratings. Regression analyses were used to examine the role of pain behavior in mediating the relation between cold pressor participants’ PCS scores and observers’ inferred pain ratings. Communication accuracy was assessed by computing the absolute difference between cold pressor participants’ pain ratings and the observers’ inferred pain ratings.

3. Results

3.1. Sample characteristics: cold pressor participants

Participants’ catastrophizing scores, pain ratings, and pain behavior indices are presented in Table 1. The mean PCS score for the entire sample (M = 20.1, SD = 6.8) was comparable to that which has been reported in previous research (Sullivan et al., 2000). There were no significant sex differences for PCS scores, t(38) = −.42, p > .67, the facial/(para)verbal pain behavior index, t(38) = −.96, p > .34, or the bodily movement pain behavior index, t(38) = −.16, p > .87. There was a marginally significant sex difference for pain ratings, t(38) = −1.8, p = .07, where women reported higher levels of pain than men.

Correlations between the different subscales of the PCS (ruminating, magnification, and helplessness), pain, and pain behavior indices are presented in Table 2. Consistent with previous research (Sullivan et al., 1995), all subscales of the PCS were significantly

Table 1
Sample characteristics: catastrophizing scores, pain ratings, and pain behavior indices

<table>
<thead>
<tr>
<th></th>
<th>Sex of cold pressor participant</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>PCS</td>
<td>20.0 (7.1)</td>
<td>19.0 (6.5)</td>
</tr>
<tr>
<td>Pain</td>
<td>6.3 (2.7)</td>
<td>4.9 (2.3)</td>
</tr>
<tr>
<td>Pain behavior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facial/verbal</td>
<td>2.9 (3.5)</td>
<td>2.0 (2.6)</td>
</tr>
<tr>
<td>Bodily movement</td>
<td>2.1 (2.7)</td>
<td>2.0 (2.0)</td>
</tr>
</tbody>
</table>

Note. Pain ratings were made on a 0–10 scale. Pain behavior index was computed by multiplying the duration of pain behavior by the intensity of the pain behavior. Values in parentheses are standard deviations. ns = not significant.
correlated with pain ratings, all $p < .05$. Participants with higher PCS total scores also obtained higher scores on both pain behavior indices. The PCS subscale scores were significantly correlated with the bodily movement pain behavior index but not with the facial/(para)verbal pain behavior index.

3.2. Observers’ pain inferences

A two-way (sex of cold pressor participant × sex of observer) mixed ANOVA was used to examine sex differences in inferred pain. Analyses revealed significant main effects for sex of observer, $F(1,38) = 32.5$, $p < .0001$, and a sex of cold pressor participant × sex of observer interaction, $F(1,38) = 5.6$, $p < .02$. As shown in Table 3, there was an overall tendency to underestimate participants’ pain. Consistent with previous research (Robinson and Wise, 2003), simple effects tests revealed that male observers underestimated pain to a greater extent than female observers, and male observers’ tendency to underestimate pain was most pronounced when estimating the pain of women, $p < .05$.

3.3. Catastrophizing and pain communication

The relation between pain catastrophizing and pain communication was addressed by examining the correlation between cold pressor participants’ PCS scores and observers’ inferred pain ratings. As predicted, higher PCS scores were associated with higher inferred pain ratings for both male, $r = .36$, $p < .02$, and female, $r = .40$, $p < .01$, observers.

Table 3

<table>
<thead>
<tr>
<th>Observer sex</th>
<th>Sex of cold pressor participant</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Sex of cold pressor participant</td>
<td>−1.9 (2.4)</td>
<td>−1.5 (2.5)</td>
</tr>
<tr>
<td>Male</td>
<td>Sex of cold pressor participant</td>
<td>−3.1 (2.2)</td>
<td>−2.0 (2.3)</td>
</tr>
</tbody>
</table>

Note. Actual and inferred pain ratings were made on a 0–10 scale. Values in parentheses are standard deviations.

A hierarchical multiple regression analysis was conducted to examine the role of pain behavior in mediating the relation between cold pressor participants’ PCS scores and observers’ inferred pain ratings (Table 4). Mediation would be supported if the relation between PCS scores and observers’ inferred pain ratings was no longer significant when controlling for pain behavior indices. For this analysis, a single observer-inferred pain rating was derived by averaging the inferred pain ratings of male and female observers, and was used as the dependent variable. In the first step of the analysis, the two pain behavior indices were entered, accounting for 44% of the variance in inferred pain ratings, $F_{\text{change}}(2,37) = 14.6$, $p < .001$. The total PCS score was entered in the second step of the analysis but did not contribute significantly to the prediction of observer pain ratings, $F_{\text{change}}(1,36) = 1.4$, $p > .24$. Examination of the $\beta$ weights from the final regression equation revealed that only the facial/(para)verbal pain behavior index contributed significant unique variance to the prediction of observer’s inferred pain ratings. The Sobel test ($z = 1.97$, $p < .05$) indicated significant mediation (Sobel, 1988).

3.4. Accuracy of inferred pain ratings

The accuracy of inferred pain ratings was computed as the absolute difference between cold pressor participants’ self-reported pain ratings and observers’ inferred pain ratings (higher values reflect greater discrepancy between self-reported and inferred pain ratings). Analyses revealed that higher PCS scores were not associated with more accurate pain inferences by male, $r = .23$, $p > .15$, or female observers, $r = .17$, $p > .27$. Although not significant, the direction of the correlations suggested that higher PCS scores were associated with less as opposed to more accurate inferred pain ratings.
4. Discussion

Prior to the development of Communal Coping Model, pain catastrophizing was construed primarily as a maladaptive cognitive style that contributed to emotional distress and heightened pain (Keefe et al., 1989; Jensen et al., 1991; Turner and Aaron, 2001). The processes invoked to explain the relation between pain catastrophizing and negative pain-related outcomes were similar to those that had been invoked to explain the relation between negative thinking and depression (Turner and Aaron, 2001). The Communal Coping Model represented a marked departure from traditional cognitive frameworks in positing that the coping efforts of individuals experiencing pain are not necessarily directed toward the management of pain. Rather, it was suggested that for pain catastrophizers, the experience of pain might provide the stage for the pursuit of interpersonal goals.

In past research, support for the communal coping model has come primarily from studies showing that the pain experience or pain expression of pain catastrophizers is sensitive to social context (Giardino et al., 2003; Sullivan et al., 2004). The relation between pain catastrophizing and pain is higher when pain patients are living with a spouse or caregiver (Giardino et al., 2003), higher levels of pain catastrophizing are associated with higher levels of short-term spousal support (Cano, 2004), and pain catastrophizers are more expressive when experiencing pain in the company of another person than alone (Sullivan et al., 2004). Pain catastrophizing has also been associated with negative interpersonal outcomes (Keefe et al., 2003; Boothby et al., 2004; Lackner and Gurtman, 2004).

According to the Communal Coping Model, pain catastrophizers will show a preference for dealing with pain and distress in a social context (Sullivan et al., 2001). It has been suggested that high pain catastrophizers might use expressions of distress or disability as strategies for soliciting assistance or support from their social environment. Consistent with this prediction, the results of the present study showed that higher levels of pain catastrophizing in cold pressor participants accounted for 15% of the variance in observers' inferred pain ratings.

Albeit consistent with the predictions of the communal coping model of pain catastrophizing, the results of the present study do not provide direct evidence that pain catastrophizers enact pain behaviors specifically to attain certain interpersonal goals. The attainment of interpersonal goals remains a speculative process that might underlie the relation between catastrophizing, pain experience, and pain expression. Alternate explanations must also be considered. For example, it has been suggested that appraisals of threat and helplessness might be sufficient to account for the relation between pain catastrophizing and pain outcomes (Severeijns et al., 2004). Although the latter explanation cannot be ruled out on the basis of the present findings, research to date does not support the view that pain catastrophizers are less well equipped to deal with pain situations. Previous research has shown no relation between catastrophizing and the repertoire of coping strategies (Sullivan et al., 1995), and pain catastrophizers employ fewer coping strategies only when in the presence of others (Sullivan et al., 2004).

Communication models of pain (Prkachin and Craig, 1995; Hadjistavropoulos and Craig, 2002) have discussed the operation of central motor programs responsible for the activation of motor programs for the expression of pain. The latter explanation would suggest that the heightened pain behavior of catastrophizers might reflect the operation of automatic processes and not the intentional display of distress to attain interpersonal goals. Questions concerning the relative automaticity or intentionality of the pain behavior displays of high catastrophizers will need to be addressed in future research.

Pain catastrophizing is typically assessed by self-report measure where individuals indicate the frequency with which they experience different pain-related thoughts and feelings. In order for pain catastrophizing to influence others’ pain inferences, pain catastrophizing must be associated with the display of overt signals that will be used by observers to infer pain ratings (Hadjistavropoulos and Craig, 2002; Thorn et al., 2003). The overt display of distress (grimacing, vocalizations) during pain experience conveys information to observers about the internal experience of the individual who is experiencing pain (Prkachin, 1986; Hadjistavropoulos and Craig, 2002). Pain behavior has been discussed as the vehicle through which pain catastrophizers might elicit proximity, support or assistance from others (Keefe et al., 2000; Sullivan et al., 2000, 2001).

In the present study, two indices of pain behavior were derived from coding of the different pain behaviors displayed by the cold pressor participants; one reflecting the degree to which participants displayed facial grimaces or vocalizations, and one reflecting the display of other bodily movements. Pain catastrophizing was associated with higher scores on both pain behavior indices, but the stronger relation was between pain catastrophizing and the bodily movement pain behavior index.

A regression analysis was conducted to determine whether the relation between pain catastrophizing and observers' pain inferences could be accounted for by
pain catastrophizers’ higher levels of pain behavior. The results suggested that catastrophizers’ facial/(para)verbal displays mediated the relation between catastrophizing and observers’ inferred pain ratings. Even though the zero-order correlation between pain catastrophizing and the bodily movement pain behavior index was of greater magnitude, observers appeared to rely primarily on facial/(para)verbal cues to infer pain ratings.

The diagnostic value of facial expressions of pain has been reported in previous investigations. Prkachin et al. (1983) reported that observers ranked facial actions as more important indicators of pain experience than bodily movements. It is possible that facial pain behaviors may be more specific indicators of pain experience and, as such, considered by observers to be more reliable indicators of pain than other forms of pain behavior (Prkachin, 1986; Williams, 2002). Alternately, as a function of experience, observers might develop an intuitive understanding that facial displays are under less volitional control than other forms of pain behavior and consequently will weigh facial information more heavily than information about other bodily movements in drawing inferences about others’ pain (Rinn, 1984).

Although pain catastrophizers communicated more intense pain to observers, observers were not more accurate in inferring catastrophizers’ pain. It is possible that although pain catastrophizers might emit more pain behaviors, observers might discount the information value of catastrophizers’ pain behavior as a reliable index of actual pain experience. If pain catastrophizers are using pain displays to achieve interpersonal goals, they might be emitting signals that cause observers to question whether the participants’ behavior reflects veridical pain experience (Prkachin, 2005). It is also possible that pain catastrophizers’ propensity to express their pain through channels, such as bodily movements, that observers do not consider diagnostic of pain experience might lead observers to underestimate pain (Prkachin et al., 1983; Prkachin, 1992; Hadjistavropoulos et al., 1996).

A certain degree of caution needs to be exercised in the interpretation of the present findings. First, findings based on the research using experimental pain induction procedures on samples of undergraduate students might not generalize to pain experiences associated with injury or illness. In addition, the use of video recording might have influenced the manner in which participants behaved during the cold pressor procedure. Another important limitation is the decontextualized nature of the pain situation. In naturally occurring pain, the mechanism of injury (e.g., falling), and the social context are likely to influence the manner in which pain is expressed and inferred. In the present study, observers were not part of the context in which the pain was being experienced and the cold pressor participants knew that there was no one (other than the research assistant) currently observing their pain experience. Previous research has shown that pain reports and pain displays can be influenced to a significant degree by awareness of the composition of the audience (Kleck et al., 1976; Block et al., 1980).

In spite of these limitations, the results of this study provide preliminary evidence that pain catastrophizers emit a variety of behavioral signals during the experience of pain that lead others to infer more intense pain experience. It is interesting to speculate that by leading observers to infer more intense pain, catastrophizers might also be eliciting specific behavioral responses from observers (Cano, 2004). Observers’ empathic or support responses might reinforce and maintain the pain behavior displays of catastrophizers, independent of catastrophizers’ actual level of pain (Goubert et al., 2005). However, the absence of a relation between pain catastrophizing and accuracy of observers’ inferences suggests that adequate clinical management of pain catastrophizers’ pain might sometimes be compromised. Future research will need to examine whether the relations observed in this study can be replicated under more ecologically valid conditions. Advance in this area will also depend on the ability to devise experimental paradigms that allow for the exploration of real time dynamic interchange between observers and the individual experiencing pain.

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References


