Path Model of Psychological Antecedents to Pain Experience

Experimental and Clinical Findings

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Objectives: Two studies are described addressing how anxiety, fear of pain, and catastrophizing impact on pain experience.

Methods: In study 1, 66 undergraduates (34 men, 32 women) completed measures of state and trait anxiety, fear of pain, and catastrophizing prior to participating in a cold pressor procedure. In study 2, 60 undergraduates (30 men, 30 women) completed the same measures and participated in dental hygiene treatment and rated the pain they experienced during a scaling procedure (removing deposits from the tooth surface).

Results: In both studies, fear of pain and catastrophizing were significantly correlated with pain intensity ratings, and fear of pain and catastrophizing were correlated with each other. Trait anxiety was correlated with catastrophizing but not with fear of pain or pain. Path analyses revealed significant paths from trait anxiety to state anxiety, from trait anxiety to catastrophizing, and from catastrophizing to pain intensity ratings.

Discussion: The findings suggest that although fear of pain and catastrophizing are related constructs, catastrophizing provides unique predictive ability for pain ratings, while fear of pain does not. Clinical and theoretical implications of these findings are discussed.

Key Words: pain, catastrophizing, fear of pain, dental pain, dental fear

construed as an emotional variable. Fear of pain has been defined as a “highly specific negative emotional reaction to pain eliciting stimuli involving a high degree of mobilization for escape/avoidance behavior.” Catastrophizing has been defined as “an exaggerated negative mental set brought to bear during actual or anticipated painful experience.”

There is considerable research to support a strong association between fear of pain (and pain-related fears) and various pain-related outcomes. Clinical and experimental research continues to accumulate showing that fear of pain influences the experience of pain, and pain-related disability. Individuals who score high on measures of fear of pain report more intense pain, are less active, and have reduced range of motion. Fear of pain has also been associated with a tendency to discontinue or avoid activity that may be associated with pain. Catastrophizing has been shown to be associated with emotional distress states such as anxiety and depression, analgesic intake, duration of hospitalization, and occupational disability.

**RELATIONS BETWEEN CATASTROPHIZING AND ANXIETY/FEAR OF PAIN**

Vlaeyen and Linton have suggested that catastrophizing may be a cognitive precursor to fear of pain. Specifically, Vlaeyen and Linton propose that catastrophic thinking following injury may lead to the development of fear of pain, contributing in turn to activity avoidance or escape behavior. Similarly, Sullivan and Neish have suggested that catastrophic thinking may play a role in the development of dental fears and avoidance of dental care. The view that catastrophizing might contribute to the development of fear of pain is consistent with cognitive theories of emotion that suggest that cognitive factors precede and determine the nature of emotional reactions to emotion-relevant stimuli.

Although research supports the view that fear of pain and catastrophizing are related constructs, the precise nature of this relation remains unclear. Questions remain concerning the manner in which these variables summate or interact to influence pain experience. The issue of construct distinctiveness is also of concern in this area of research. Although pain catastrophizing and fear of pain have been discussed as partially independent constructs, it is possible that they may simply reflect subcomponents of larger order factors such as trait anxiety or negative affectivity. Some models have addressed the possibility that variables such as trait anxiety might function as precursors to the development or expression of catastrophic thinking and pain-related fears. Still other models have addressed the possibility that catastrophic thinking may best be conceptualized under the general rubric of emotional disorders such as anxiety and depression.

The importance of delineating more clearly the interrelations between catastrophizing and fear of pain is not restricted to theoretical concerns but has implications for clinical practice as well. Clinically, the greatest impact would be expected from an intervention targeting the construct most predictive of pain. If a pattern of findings emerged supporting the view that catastrophizing is uniquely predictive of pain, albeit related to fear of pain, then cognitive interventions aimed at correcting or modifying maladaptive thinking may yield the most positive outcome. Alternately, if findings suggested that fear of pain is uniquely predictive of pain, then behavioral interventions using graded exposure techniques may yield most positive outcome. Of course, both hypothetical relationships could be found to exist, suggesting the need for both types of interventions.

**PRESENT RESEARCH**

Two studies were conducted to examine how fear of pain and catastrophizing influence pain experience and how trait anxiety and state anxiety are related to these 2 constructs. In study 1, undergraduate students completed measures of catastrophizing, fear of pain, and anxiety prior to participating in a cold pressor procedure. In study 2, undergraduate students completed measures of these constructs prior to undergoing a dental hygiene procedure. Two broad questions were addressed by these studies. One addressed the relations that best characterize how fear of pain and catastrophizing affect pain experience, and the other addressed the extent to which these constructs are explained by anxiety. The inter-relationships among these constructs were examined through path analyses.

**STUDY 1**

A path model was constructed that incorporated a number of hypotheses about the relationships among the pain variables and anxiety. The path model also included several assumptions as to causal priority. Sex (SEX) was taken as antecedent to all variables and was the only purely exogenous variable. Because no unequivocal hypotheses regarding sex could be adduced from prior research, paths linking sex to reported pain (PAIN), trait anxiety (ANXT), fear of pain (FOP), and catastrophizing (CAT) were specified for the purposes of evaluating those connections. It was assumed that any sex differences in state anxiety (ANXS) would be explainable (mediated) by sex differences in ANXT, so that no direct path from SEX to ANXS was hypothesized. ANXT was entered as an explanatory antecedent to ANXS. Because both FOP and CAT have a conceptual link to a more general anxiety construct, ANXT was specified as a causal antecedent to both constructs. Paths from FOP to PAIN and from CAT to PAIN were hypothesized. It was further hypothesized that ANXS would not af-
fect FOP or CAT in addition to any effects that ANXT might have. That is, it was assumed that any variations in state anxiety from usual (trait) levels would not affect FOP and CAT. Finally, we assumed that any relationship that general anxiety (ANXT) might have to PAIN would be mediated through FOP and CAT. Therefore, separate paths from ANXT to PAIN and from ANXS to PAIN were not included in the model.

MATERIALS AND METHODS

Participants
Sixty-six undergraduates (34 men, 32 women) participated in the research in exchange for course credit. Participants ranged in age from 18 to 41 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 (eg, cardiovascular problems, previous experience of frostbite) were not considered for participation.

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 cm × 40 cm × 30 cm. The insulated container was equipped with a moveable armrest used to immerse a participant’s arm in the ice water. Water temperature was maintained at 2–4°C.

Measures
Anxiety
State and trait anxiety were measured with the respective indices of the STAI. Using a 4-point scale (ranging from “not at all” to “very much so”), subjects were asked to respond to 20 items describing how they felt at that moment (state anxiety) and to 20 items describing how they generally feel (trait anxiety). The summary scores for trait and state anxiety were derived by summing all endorsements for each scale respectively.

Fear of Pain
The Fear of Pain Questionnaire-III (FPQ-III; 38) is a 30-item instrument that describes different painful situations. Respondents rate the amount of fear they anticipate would be associated with the experience of each painful situation. Ratings are made on 5-point scales with the endpoints “1” (not at all) and “5” (extreme). Although the FPQ yields three subscale scores for minor, severe, and medical pain, only the total score was used in this study (Cronbach’s α = 0.92). A number of investigations have supported the reliability and validity of the FPQ.

Catastrophizing
The Pain Catastrophizing Scale (PCS; 5) 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). Although the PCS yields three subscale scores assessing rumination, magnification, and helplessness, only the total score was used in this study (Cronbach’s α = 0.87).

Pain
An 11-point Likert-type rating scale was positioned on the wall directly in front of the cold pressor apparatus. Participants gave verbal reports of their current pain by choosing numbers between “0” (no pain) and “10” (extreme pain).

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 1 of 2 female experimenters.

Upon arrival at the laboratory, participants were asked to complete the FPQ-III and the PCS. To regulate arm temperature, participants immersed their dominant arm in a container of room temperature water for 5 minutes prior to the cold pressor procedure. 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 for 1 minute. They were signaled, by a voice on a tape recording, to give 3 verbal ratings of their pain at 20-second intervals, and then were instructed to remove their arm from the ice water. There were no cases of arm withdrawal prior to the end of the 1-minute immersion. Pain ratings were highly correlated (0.68–0.87) and were averaged to yield a composite index of pain intensity.

STATISTICAL ANALYSIS
The path analysis was accomplished through application of LISREL 8.52 to the covariance matrix for the included variables. LISREL simultaneously estimates the values for the paths and other parameters in the model and provides tests of statistical significance of the parameters based on standard errors for the unstandardized parameters. In accordance with usual path analytic procedures, standardized parameter values from the analyses were reported in this research, but statistical significance was determined from the analyses of the unstandardized data. LISREL also calculates a goodness-of-fit test for the hypothesized model. A significant χ² implies that the covariance matrix estimated from the model deviates significantly from the actual covariance matrix. Therefore, a nonsignificant χ² is desirable, but the power of the χ² test is greatly dependent upon the sample size. Consequently, goodness-of-fit measures are often employed to evaluate model fit. In the present research, the standardized root-mean-square residual
(SRMR\textsuperscript{40}), the root mean square error of approximation (RMSEA\textsuperscript{40}), the comparative fit index (CFI\textsuperscript{40}), and the goodness of fit index (GFI\textsuperscript{40}) are reported in addition to the $\chi^2$ goodness-of-fit test. The SRMR is the average of the squared residuals that are obtained by comparing the estimated and actual covariance matrices when variables are standardized.\textsuperscript{40} The RMSEA is based on the population discrepancy function and is a measure of the discrepancy in the fit of the hypothesized model in relation to its degrees of freedom.\textsuperscript{40} For the SRMR and RMSEA, smaller values indicate better fit, and Hu and Bentler\textsuperscript{41} suggest that a well-fitting model will have a SRMR of 0.08 or less and an RMSEA of 0.06 or less. The GFI compares the fit of the hypothesized model to the fit of no model at all,\textsuperscript{40} and the CFI compares the fit of the hypothesized model to the baseline independence model.\textsuperscript{40} Larger values of the GFI and CFI indicate better fit, and the maximum value for each is 1.00. GFIs and CFIs of 0.90 and greater are usually considered to indicate adequate fit.

In addition to the a priori specifications of paths that were described previously, correlated errors (disturbances) for FOP and CAT were specified. The specification of correlated errors for these 2 variables indicates a hypothesized covariance that is not due to any confoundings with SEX or ANXT. Thus, it was hypothesized that FOP and CAT would have common variance unrelated to other variables in the model, because they share a common conceptual relationship to pain.

**RESULTS**

**Descriptive Statistics**

Means and standard deviations from the FPQ, PCS, and pain ratings are presented in Table 1. Analysis of sex differences revealed significant effects for CAT, $t(64) = 2.08, P < 0.05$, and PAIN, $t(64) = 2.09, P < 0.05$. Women reported higher levels of CAT and PAIN than men.

Correlations are presented in Table 1. Consistent with previous findings, FOP and CAT were significantly correlated with PAIN, and FOP and CAT were well correlated with each other. ANXT was well correlated with CAT but not with FOP or PAIN.

**Path Analysis**

Path coefficients for the hypothesized model are shown in Table 2. The only significant paths were ANXT to ANXS, ANXT to CAT, and CAT to PAIN. The other unspecified paths in the causal hierarchy were tested individually, and none was found to be significant ($P > 0.05$). The correlated errors for FOP and CAT were highly significant ($P < 0.001$). The fit of the model was good (SRMR = 0.030, RMSEA = 0.00; CFI = 1.00; GFI = 0.98), and the covariance matrix predicted by the model did not differ significantly from the actual covariance matrix, $\chi^2(5, n = 66) = 3.19, P > 0.50$.

**DISCUSSION**

The primary aim of study 1 was to examine the relations that might best characterize how anxiety/negative affectivity, fear of pain, and catastrophizing impact on pain experience. Consistent with previous research, fear of pain and catastrophizing were significantly correlated with pain experience. However, when catastrophizing and fear of pain were included in a path analysis, only catastrophizing contributed significant unique variance to the prediction of pain.

A limitation of the present study is that pain was induced under controlled laboratory conditions that differ in significant ways from the naturalistic conditions under which pain is typically experienced. Experimental pain procedures have the advantage of allowing for standardization of stimulation, but experimental control is gained at the cost of tenuous ecological relevance. Cold pressor pain is not associated with the same degree of threat, uncertainty, and life disruption that accompanies the pain of injury or the pain associated with clinical procedures. In addition, participants in study 1 were re-assured that no harm would ensue from exposure to the cold water, and they were aware that they could terminate exposure to pain by removing their arm from the water at any time. The safety and

<table>
<thead>
<tr>
<th>Variables</th>
<th>SEX</th>
<th>ANXT</th>
<th>ANXS</th>
<th>FOP</th>
<th>CAT</th>
<th>Mean</th>
<th>SD</th>
</tr>
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<tr>
<td>Trait anxiety (ANXT)</td>
<td>0.20</td>
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<td>35.4</td>
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<td>State anxiety (ANXS)</td>
<td>0.23</td>
<td>0.68**</td>
<td></td>
<td></td>
<td></td>
<td>30.8</td>
<td>7.7</td>
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<td>0.17</td>
<td>0.14</td>
<td>0.06</td>
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<td></td>
<td>78.0</td>
<td>13.4</td>
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<tr>
<td>Catastrophizing (CAT)</td>
<td>0.25*</td>
<td>0.42**</td>
<td>0.22</td>
<td>0.51**</td>
<td></td>
<td>16.8</td>
<td>7.5</td>
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<tr>
<td>Expressed pain (PAIN)</td>
<td>0.25*</td>
<td>0.12</td>
<td>0.13</td>
<td>0.29*</td>
<td>0.44**</td>
<td></td>
<td>6.6</td>
</tr>
</tbody>
</table>

Note: *$P < 0.05$; **$P < 0.01$. 

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control over aversive stimulation associated with cold pressor procedures may not be characteristic of many painful clinical situations.

To evaluate the reliability of the findings of study 1, it was necessary to examine the tenability of the emergent model of the relation between fear of pain and catastrophizing under more ecologically relevant conditions.

**STUDY 2**

Anxiety and fear about dental treatment remain widespread. Population studies indicate that approximately 50% of adults report some degree of fear of dental treatment.42,43 It has also been reported that 5–20% of adults are sufficiently fearful of dental procedures that they consult dentists only when symptomatic or avoid dental care altogether.44–46 High levels of anxiety and fear have been observed even in response to non-invasive and ostensibly non-threatening dental hygiene procedures such as probing and scaling.47,48 In individuals with high levels of dental fear, fear of pain is considered to be the primary determinant of avoidance of dental treatment.48–50

Numerous investigations have shown that anxiety and fear are significant predictors of pain during dental treatment.48,51 Investigations have also shown that catastrophizing is a significant predictor of pain during dental treatment.30,48,52 As such, the dental setting may provide a suitable context for an ecologically-grounded test of possible relations among anxiety, fear of pain, and catastrophizing.

In study 2, undergraduate students completed measures of fear of pain, catastrophizing, and anxiety 1 week prior to participating in a dental hygiene procedure. The dental hygiene treatment included a “scaling” procedure where hard and soft deposits are removed from the tooth surface with a metal instrument. The procedure is performed without anesthetic and can be associated with significant discomfort.48 Discomfort and pain during scaling can result from contact from the metal instrument with the gingiva (e.g., when removing deposits below the gum line), or with the dentogingival junction.

The same path model was applied to the data in study 2. Thus, the same hypotheses are tested for dental pain as were evaluated in study 1 for experimentally induced pain.

**MATERIALS AND METHODS**

**Participants**

Sixty undergraduate students (30 men, 30 women) volunteered to participate in exchange for course credit and free dental hygiene treatment. The mean age of the sample was 20.2 years (SD = 3.7) with a range of 18–40 years. All participants were enrolled in Introductory Psychology at Dalhousie University. Students were only considered for participation if they had not received dental treatment within the last 6 months.

**Measures**

**Anxiety**

The State-Trait Anxiety Questionnaire37 is described in study 1.

**Fear of pain**

The Fear of Pain Questionnaire—III (FPQ-III; 38) is described in study 1.

**Catastrophizing**

The Pain Catastrophizing Scale (PCS; 5) is described in study 1.

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**TABLE 2. Path Coefficients for Studies 1 and 2**

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>SEX</th>
<th>ANXT</th>
<th>ANXS</th>
<th>FOP</th>
<th>CAT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cold pressor task (study 1)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trait anxiety (ANXT)</td>
<td></td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State anxiety (ANXS)</td>
<td></td>
<td></td>
<td>0.68***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear of pain (FOP)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catastrophizing (CAT)</td>
<td></td>
<td></td>
<td></td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Expressed pain (PAIN)</td>
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<td></td>
<td></td>
<td></td>
<td>0.08</td>
</tr>
<tr>
<td><strong>Dental procedures (Study 2)</strong></td>
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<td></td>
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<tr>
<td>Trial anxiety (ANXT)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>State anxiety (ANXS)</td>
<td></td>
<td></td>
<td>0.60***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear of pain (FOP)</td>
<td></td>
<td></td>
<td></td>
<td>0.45***</td>
<td>18</td>
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<tr>
<td>Catastrophizing</td>
<td></td>
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<td>0.30*</td>
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<tr>
<td>Expressed pain (PAIN)</td>
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<td></td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.14</td>
<td>0.35**</td>
<td></td>
</tr>
</tbody>
</table>

*Note: *P < 0.05; **P < 0.01; ***P < 0.001.*
Pain

Participants were asked to rate the degree of pain they experienced during the scaling procedure on an 11-point scale with the end points “0” (no pain) and “10” (extreme pain).

Procedure

Upon initial arrival at the Dalhousie University Dental Clinic, participants completed a consent form, the FPQ-III, and the PCS. The dental hygienist then collected information relevant to the participant’s health history and performed a comprehensive oral examination. Approximately 1 week later, participants returned to the Dental Clinic for treatment. The scaling procedure was performed by 1 of 30 senior dental hygiene students. All treatment was supervised by Clinical Faculty. At the termination of treatment, participants were asked to rate the pain they experienced during the scaling procedure.

RESULTS

Descriptive Statistics

Descriptive statistics on study measures are presented in Table 3. Sex differences were found only for FOP, \( t(58) = 4.01, P < 0.001 \). There were no significant differences between women and men on PAIN or CAT.

Table 3 gives the correlations among the variables. Consistent with the findings of study 1, FOP and CAT were significantly correlated with PAIN, and CAT was significantly correlated with FOP. ANXT was correlated with CAT but not with FOP, and ANXT had a small correlation with PAIN.

Path Analysis

The path coefficients and statistical significance are indicated in Table 2. As in study 1, path coefficients for ANXT to ANXS, ANXT to CAT, and CAT to PAIN were significant. In addition, the path from SEX to FOP was significant. The unspecified paths in the causal hierarchy were tested, and none was found to be significant (\( P > 0.05 \)). The correlated errors for FOP and CAT were significant (\( P < 0.05 \)). The fit of model was again found to be quite good (SRMR = 0.038; RMSEA = 0.00; CFI = 1.00; GFI = 0.98), and the predicted covariance matrix did not differ significantly from the actual covariance matrix, \( \chi^2(5, n = 60) = 4.00, P > 0.50 \).

The data sets from studies 1 and 2 were combined for an analysis of the same path model that was investigated in those studies. Scores on the pain ratings (PAIN) were standardized separately for the 2 samples. Prior to combination, it was observed in a multi-sample analysis that the model parameters did not differ significantly between the 2 groups, \( \chi^2(25, N = 126) = 24.38, P > 0.40 \). This omnibus test is not as powerful as individual tests of parameters between groups, but there were no a priori grounds for testing particular parameters for between groups differences.

The model parameters were also tested for differences between the men and women of the combined samples. SEX, of course, was eliminated from the model in this multi-sample analysis, because each group consisted only of men or women. The results indicated no significant overall differences, \( \chi^2(18, n = 126) = 27.43, P > 0.05 \).

A path diagram (standardized solution) for the combined data sets is shown in Figure 1. For the purposes of illustration, parameters were left in the model that were not significant in either study, and the non-significant parameters are designated by the lighter color of the values. As indicated by Figure 1, the same parameters were significant as in study 2. The fit of this model to the combined sample of 126 participants was excellent (SRMR = 0.021; RMSEA = 0.00; CFI = 1.00; GFI = 0.99), \( \chi^2(5, n = 126) = 2.43, P > 0.50 \).

DISCUSSION

Consistent with previous research, the findings of study 2 showed that fear of pain and catastrophizing are significantly correlated with self-reports of pain intensity during dental treatment. As in study 1, when catastrophizing and fear of pain were included in a path analysis, only catastrophizing contributed significant unique variance to the prediction of pain.

The consistency between the findings of studies 1 and 2 lends support to a model proposing that catastrophizing is a

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**TABLE 3. Correlations Among Measures: Dental Procedure**

<table>
<thead>
<tr>
<th>Variables</th>
<th>SEX</th>
<th>ANXT</th>
<th>ANXS</th>
<th>FOP</th>
<th>CAT</th>
<th>Mean</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>Trait anxiety (ANXT)</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>State anxiety (ANXS)</td>
<td>0.12</td>
<td>0.60**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear of pain (FOP)</td>
<td>0.47**</td>
<td>0.23</td>
<td>0.12</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Catastrophizing (CAT)</td>
<td>0.07</td>
<td>0.31*</td>
<td>0.29*</td>
<td>0.39**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expressed pain (PAIN)</td>
<td>0.12</td>
<td>0.26*</td>
<td>0.13</td>
<td>0.29*</td>
<td>0.40**</td>
<td>3.3</td>
<td>2.3</td>
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</table>

Note: *P < 0.05; **P < 0.01.
related, but separate, construct from fear of pain. Moreover, our results suggest that catastrophizing is predictive of pain over and above fear of pain. Finally, catastrophizing and fear of pain were measured prior to exposure to a painful stimulus, thus supporting their antecedent status as predictors of pain experience.

As in previous research, the present findings indicate that catastrophizing and fear of pain are highly correlated. Several models of cognitive-affective functioning afford antecedent or causal status to cognitive factors in the development of emotional dysfunction. Vlaeyen and Linton have adopted a cognitive framework to account for pain-related disability, suggesting that catastrophizing might represent the cognitive precursor of pain-related behavioral avoidance. The design of the present studies does not allow for tests of temporal hypotheses suggested by cognitive models of pain-related outcomes. Nevertheless, the relations observed in the present study help clarify how catastrophizing and fear of pain may influence pain-related outcomes. The results of the path analyses suggest that while catastrophizing might contribute to fear of pain, fear of pain is not the mechanism through which catastrophizing influences pain. A direct path was found between catastrophizing and pain. However, there was no direct path between fear of pain and pain. The relation between fear of pain and pain was fully accounted for by catastrophizing.

It is interesting to note that in these experiments, trait anxiety was related to state anxiety and catastrophizing, but not to fear of pain. Crombez et al have suggested that trait anxiety may be a general trait measure of negative affectivity, and they cite studies which support a relation between catastrophizing and negative affectivity. It is important to note that Crombez et al also found that catastrophizing contributed to attentional interference in response to pain, independent of negative affectivity. This finding again suggests that although constructs such as negative affectivity and anxiety are related to catastrophizing, it is catastrophizing per se that seems to be the more predictive construct when it comes to pain-related outcomes.

Fear has been described as a complex construct with behavioral, cognitive, and physiological components. It is possible that fear of pain may have direct influence on pain-related outcomes other than pain experience. As suggested by Vlaeyen and Linton, fear of pain may be particularly associated with behavioral avoidance. This possibility could not be examined in the present study given that behavioral measures were not included.

It is of interest to consider that there may be a reciprocal relation between catastrophizing and fear of pain. Although it has been suggested that catastrophizing may contribute to the development of fear of pain, fear of pain may also contribute to catastrophic thinking. Recent evolutionary perspectives on emotion have discussed the functional organization of cognition and behavior associated with fear. The premise is that discrete emotions, such as fear, function as organized physiological–cognitive–behavioral systems that maximize survival under different environmental conditions. It has been suggested that fear may lead to the automatic initiation of cognitive mechanisms that give rise to selective attention to threat-related stimuli, or the preferential processing of fear-relevant information. Although these models acknowledge that some degree of cognitive processing is required to elicit emo-

**FIGURE 1.** A path model of psychological antecedents to pain experience.
tion, they posit that the emotion itself initiates a style of information processing that is designed to enhance survival.

The alarmist and hypervigilant characteristics of pain catastrophizing share features with the cognitive style associated with other fears and phobias. Indeed, one of the functions of pain catastrophizing might be to promote the preferential processing to both stimulus and sensation-related information. Under threat conditions (eg, bodily injury), a catastrophic cognitive style may yield survival advantage by increasing attention to and care of injury, or avoidance of future injury. As with other domains of fear, it is only when the frequency of elicitation or the intensity of experience exceeds some critical value that a catastrophic cognitive style becomes maladaptive. Even though catastrophizing has been discussed within theoretical models of depression and anxiety, emotional disorders may represent only a subset of several domains where catastrophic thinking may be observed. To insist on discussing catastrophizing primarily within the context of emotional disorders may be unnecessarily restrictive. The pathologizing of catastrophizing in this manner may deter efforts to explore the social, interpersonal and communicative functions of catastrophizing that might be central to understanding the basis of catastrophizing, yet only tangentially related to emotional disorders.

As noted earlier, the findings of the present research may have clinical implications. There are significant consequences to fear of pain that go beyond the subjective experience of pain. With respect to dental care, fear of pain can lead to avoidance and impact negatively on oral health. Individuals with high levels of dental fear have more missing teeth, they are more likely to require prosthodontic treatment, and in later years, they are more likely to be edentulous. With respect to injury, high levels of fear of pain have been associated with greater likelihood of occupational disability. Our findings also fit within a diathesis–stress model of chronic pain proposed by Turk. In this model it is suggested that certain predisposing individual variables (eg, anxiety sensitivity/trait anxiety) may increase the likelihood of a fear reaction and other interpretive cognitive processes (eg, catastrophizing) following injury, thus increasing the likelihood of disability.

Different clinical approaches have been advocated to effect decreases in fear of pain and catastrophizing. Graded exposure to feared activities can yield reductions in the intensity of fear. Graded exposure interventions have been discussed as the preferred intervention to decrease avoidance and escape behaviors associated with pain. It has been suggested that exposure provides individuals with the opportunity to “correct” expectancies for negative outcomes, thus facilitating approach behaviors to feared activities or situations. These factors and clinical meaningful reductions in pain and pain-related outcomes. Intervention techniques that involve cognitive restructuring, re-framing, self-instruction, and re-appraisal have been discussed as a useful means of changing catastrophic cognitions.

Interpretation of the present findings has proceeded from the assumption that the tools used to measure catastrophizing and fear of pain are relatively “pure” measures of these constructs. To the extent that the measures might be contaminated by items that are not construct-specific, then the true relations between these constructs may be obscured or distorted. An additional assumption underlying the use of the FPQ is that high scores reflect a “generalized” tendency to experience fear in pain-producing situations. McNeil et al reported that the FPQ was significantly correlated with dental pain in orofacial pain patients, thus providing evidence that it is appropriate to use when measuring fear of dental pain. Although “cold pressor” pain is not included in the item content of the FPQ, the internal reliability of the FPQ has been shown to be high (α values from 0.90 to 0.97). The magnitude of coefficients of internal consistency indicates that there is a high degree of shared variance among items, and lends support to the assumption that “specific” fears of pain are highly interrelated.

Some of the limitations of the present research have implications for the generalizability of findings. Participants in both studies were undergraduate students who were not suffering from a pain-related health condition. The applicability of the present findings to individuals suffering from pain-related conditions is thus uncertain. With regard to study 2, it is also important to consider that participants were not suffering from debilitating levels of fear of pain. Given that participants volunteered for participation in a study that would involve dental treatment, highly fearful individuals may have declined the opportunity to participate. Replication with a clinical sample of dental patients, perhaps undergoing treatment of neglect- or avoidance-related dental problems, will be necessary to increase confidence in the generalizability of findings.

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