

Pain catastrophizing, activity engagement and pain willingness as predictors of the benefits of multidisciplinary cognitive behaviorally-based chronic pain treatment

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Abstract Pain catastrophizing and pain acceptance have been shown to be associated with improvements after participation in cognitive behaviorally-based treatment (CBT) for chronic pain. However, it is not yet clear how important each of these factors is relative to the other. Furthermore, it is also not clear if multidisciplinary pain treatment has the same impact on the two primary dimensions of pain acceptance (activity engagement and pain willingness), and whether their role in explaining treatment outcome differs as a function of the outcomes under study. The aim of this study was to examine the relative importance of changes in pain catastrophizing, activity engagement and pain willingness as predictors of the benefits of a multidisciplinary CBT for chronic pain. 186 adults with chronic pain participated. Pain catastrophizing and activity engagement, but not pain willingness, were significantly associated with treatment outcome. Moreover, each one evidenced different patterns of asso-

ciations with outcomes. Specifically, while changes in both were associated with improvements in depressive symptoms, only catastrophizing was associated with improvements in pain intensity and only activity engagement was associated with improvements in pain-related disability.

Keywords Pain catastrophizing · Activity engagement · Pain willingness · Pain acceptance · Chronic pain treatment

Introduction

A large and growing body of evidence demonstrates that psychosocial treatments can improve patient function and overall adjustment to chronic pain (Jensen & Turk, 2014). However, it remains unclear for whom and under what circumstances different treatments are most efficacious (Ehde et al., 2014). In order to identify the best available options for patients with chronic pain, and inform the development of new and more effective treatments, it is important to understand the variables and processes that account for the positive effects of pain treatments (Cederberg et al., 2016; Ehde et al., 2014).

Cognitive-behavioral therapy (CBT) is a psychosocial treatment that has been extensively used in the treatment of individuals with disabling chronic pain. It is not a single therapy but an intervention encompassing multiple components (Jensen, 2011), although almost all versions of CBT include cognitive restructuring, which attempts to reduce maladaptive and increase adaptive cognitions as a way to improve behavior and mood. With cognitive therapy, the objective is to teach patients identify their thoughts, evaluate them to determine if they are helpful or unhelpful, and replace any unhelpful thoughts with thoughts that are more beneficial.

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Pain catastrophizing, which can be defined as a negative cognitive and affective pattern characterized by rumination, magnification, and helplessness towards pain (Sullivan et al., 1995), is a key variable that has been hypothesized to explain the benefits of CBT and cognitive restructuring. In support of this idea, catastrophic thinking about pain has been found to be associated with increased pain intensity, pain interference and disability in different chronic pain samples (Huguet et al., 2008; Nieto et al., 2011; Racine et al., 2016). Moreover, some evidence, albeit limited, has shown that the effects of multidisciplinary CBT-based treatments for individuals with chronic pain are mediated, at least in part, by the effects of treatment on catastrophizing. For example, Nieto and colleagues (Nieto et al., 2012) have shown that pre- to post-multidisciplinary pain treatment decreases in catastrophizing are associated with pre- to post-treatment improvements in function, as defined by decreases on self-reported disability, depressive symptomatology, and pain intensity in a sample of individuals with neuromuscular dystrophy. Similarly, Burns and colleagues found that early treatment decreases in catastrophizing predicted later treatment improvements in pain severity and function (Burns et al., 2003a, b), but not vice versa.

Acceptance-based treatments, such as Acceptance and Commitment Therapy (ACT), is a form of CBT that focuses less on teaching patients to change the content of thoughts, and more on teaching patients to change their relationship to their thoughts (McCracken, 2005). In addition, ACT encourages patients to focus in increasing behaviors that are consistent with their values and goals, despite pain, rather than on strategies that will specifically reduce pain. This *pain acceptance approach* (i.e., engaging in activities related to goals and values, despite pain, and refraining from attempts at avoidance or control of pain), has also been reported to be associated with positive outcomes. For example, Vowles and colleagues (Vowles et al., 2007) reported that treatment-related increases in pain acceptance accounted for significant variance in treatment-related improvements in physical and psychological function.

Pain acceptance is not a unitary concept. At least, as measured by the most commonly used measure of this domain, the Chronic Pain Acceptance Questionnaire or CPAQ (McCracken et al., 2004); it has two components: activity engagement (i.e., being engaged in valued life activities despite pain) and pain willingness (i.e., a willingness to refrain from attempting to control pain).

Research has yet to determine if these two acceptance domains contribute equality to explaining treatment outcomes, as the majority of studies have used the CPAQ total score. We were only able to identify two studies that examined the subscales separately. In one, Day and Thorn

(Day & Thorn, 2016) found in a sample of 24 patients completing a mindfulness-based program for headache that changes in activity engagement, but not pain willingness, was associated with improvements in pain interference after treatment. A second study only examined pain willingness (Richardson et al., 2010), and found that pain willingness had a stronger effect than catastrophizing with respect to pain interference during a laboratory-based pain task.

Based on these findings, it would be reasonable to hypothesize that pain catastrophizing and pain acceptance would make unique contributions to the prediction of improvements after chronic pain treatment. However, it is not yet clear how important each of the two components of pain acceptance are relative to the other, and whether the potential role of these three variables differ as a function of the outcomes under study.

Given these considerations, the aim of this work was to examine (1) the associations among pain catastrophizing, pain willingness, and activity engagement, and (2) the importance of changes in pain catastrophizing, pain willingness, and activity engagement as predictors of the benefits of a multidisciplinary chronic pain CBT-based treatment. Based on previous research, we hypothesized that pain willingness and activity engagement would be positively correlated, whereas pain catastrophizing would be negatively correlated with pain willingness and activity engagement. We also hypothesized that pre- to post-treatment changes in pain catastrophizing would show a significant and positive univariate association with changes in depressive symptoms and pain interference, while changes in pain willingness and activity engagement would evidence significant negative associations with changes in both criterion variables. Finally, we hypothesized that treatment-related decreases in pain catastrophizing and increases in activity engagement would contribute unique variance to improvements (i.e., decreases) in pain intensity, pain interference, and depressive symptomatology in a sample of adults who completed a CBT multidisciplinary chronic pain program. Given that there is limited data with respect to the role of pain willingness has in pain treatment, we considered analyses to evaluate the associations between pain willingness and treatment outcome to be exploratory.

Methods

Participants

Individuals for this study (N = 186) came from a group of adults living in Canada with chronic pain that were referred to and participated in a multidisciplinary cognitive-be-

Table 1 Description of the study sample (N = 186)

Variable	Percent (%)	N	Mean (SD)	Range
Age, years		186	50.30 (11.18)	22.6–78.5
Sex				
Men	36	66		
Women	64	120		
Marital status ^a				
Married/common-law	47	87		
Divorced/separated	14	26		
Widowed	3	6		
Never married	8	16		
Highest level of education ^a				
Primary school	3	5		
Secondary school	25	47		
College or university	42	78		
Current work status ^a				
Working	9	16		
Volunteer	1	1		
Homemaker	3	5		
Unemployed	5	10		
On disability	33	62		
Retired	14	27		
Student	1	2		
Other	6	12		

^aMissing information for “Marital status” in 51 cases, education in 56, and work status in 51 of the cases

havioral based chronic pain program. The average age of the participants was 50.30 years (SD = 11.17; range 22–78) and the majority were women (64%). The majority reported that they were experiencing pain at three or more pain sites (75%). Of those that reported pain in one site, the lower back was the most frequently reported site (13%). Participants tended to be married (64%) and well educated (58% reported having finished college or a university degree). Although a few of them were working either full- or part-time (12%), most were on disability compensation (46%). Additional descriptive information about this sample of participants is provided in Tables 1 and 2.

Measures

Pain catastrophizing

We used the 13-item Pain Catastrophizing Scale (PCS; Sullivan et al., 1995) to assess pain catastrophic thinking. The PCS requires respondents to indicate the frequency

Table 2 Means (M) and standard deviations (SD), and Pearson correlations between pre- and post-treatment changes of the variables in the study

Variable	M (SD)	BDI	PI	AE	PW	PDI
PCS	4.41 (8.11)	.33*	.25*	.32*	.40*	.16
BDI	4.61 (6.95)		.14	– .31*	– .28*	.09
PI	0.41 (0.94)			– .22*	– .05	.23*
AE	– 4.02 (8.24)				.27*	– .42*
PW	– 1.81 (6.60)					– .25*

PCS Pain catastrophizing Scale, BDI Beck Depression Inventory, PI pain intensity composite score, AE activity engagement, PW pain willingness, PDI Pain Disability Index

* $p < .001$

with which they have catastrophic thoughts when they are in pain on a 0 (“Not at all”) to 4 (“All the time”) scale. The PCS assesses three catastrophizing domains: rumination (i.e. “I cannot keep it out of my mind”), magnification (i.e. “I am afraid that pain will get worse”) and helplessness (i.e. “There is nothing I can do to reduce pain”), although the subscale scores are strongly associated with one another and are usually combined into a single total catastrophizing score, as was done in the current analyses. Higher scores indicate more frequent catastrophic pain beliefs (scores can range from 0 to 52). The PCS has proved to provide reliable and valid reports when used in different chronic pain samples (Miró et al., 2008; Van Damme et al., 2002). In the current sample, the internal consistency coefficient (Cronbach’s alpha = 0.94) indicated excellent reliability.

Activity engagement and pain willingness

We used the revised 20-item version of the Chronic Pain Acceptance Questionnaire (CPAQ-R; McCracken et al., 2004) to measure the degree to which participating patients engaged in life activities regardless of present pain (“Activity Engagement”) and their beliefs about the need to control pain (or refraining from avoidance; items assessing pain control are reverse scored to assess “Pain Willingness”). In the CPAQ-R, respondents are asked to rate how true each of the items is on a Likert scale from 0 (“Never true”) to 6 (“Always true”). Higher scores indicate greater activity engagement and pain willingness. All of the Pain Willingness items assess a perceived need to control pain (e.g., “My thoughts and feelings about pain must change before I can take important steps in my life”). Therefore, they are reverse-scored to reflect a willingness to give up efforts to control pain or a recognition that it is not necessary to control pain in order to be active or achieve valued goals. The CPAQ-R has been shown to provide

valid and reliable scores in different samples of patients and in different languages (Reneman et al., 2010). In the current sample, the internal consistency coefficient (Cronbach's alpha) was good for the Activity Engagement scale (Cronbach's alpha = 0.85) and adequate for the Pain Willingness scale (Cronbach's alpha = 0.76).

Pain intensity

We used a 0–10 Numerical Rating Scale (NRS-11) to measure pain intensity. The NRS-11 has been found to provide reliable and valid reports of pain intensity with adults experiencing chronic pain (Jensen & Karoly, 2011). Respondents were asked to rate their current, least and worst pain intensity in the past week by providing a number that best represented their pain intensity, between 0 (“No pain”) to 10 (“Worst pain imaginable”). We combined these three pain intensity scores into a single measure of “characteristic pain,” given that composite pain intensity scores have been shown to be more reliable than individual ratings (Jensen et al., 2015a, b; Stone et al., 2014). To create the pre- to post-treatment characteristic pain change scores, we subtracted the post-treatment from the pre-treatment composite score; thus, a higher (positive) change score indicates a greater decrease in pre- to post-treatment characteristic pain, and negative scores indicate a pre- to post-treatment increase in characteristic pain. The internal consistency coefficient of this measure (Cronbach's alpha = .72) was found to be acceptable in the current sample.

Pain interference

We used the Pain Disability Index (PDI; Tait et al., 1987) to measure the degree to which the participants perceived that their daily lives were disrupted by chronic pain. This questionnaire includes 7 items related to different activity domains (Family/Home responsibilities; Recreation; Social activity; Occupation; Sexual behavior; Self-care; Life-support activity). Respondents are asked to indicate the level to which their pain prevents them from doing what they would normally do in these domains on a Likert scale from 0 (“No disability”) to 10 (“Total disability”). Higher scores indicate greater pain interference. The PDI has been shown to provide reliable and valid measures of pain interference in samples of individuals with chronic pain (Tait et al., 1990). Change scores were computed such that positive scores indicate a decrease in perceived pain interference, whereas negative scores indicate an increase in pre- to post-treatment perceived pain interference. In the current sample, the internal consistency coefficient of the PDI (Cronbach's alpha = 0.83) was found to be good.

Depressive symptoms

We used the Beck Depression Inventory (BDI) to assess depressive symptoms (Beck et al., 1961). The BDI scores have demonstrated excellent psychometric properties when used with chronic pain samples (Benzon et al., 2013). The internal consistency coefficient (Cronbach's alpha = 0.90) indicated excellent internal consistency reliability for this scale in the current sample. As with the other measures, change scores were computed, with positive scores indicating a pre- to post-treatment decrease in depressive symptoms and negative scores indicating an increase in pre- to post-treatment depressive symptoms.

Procedure

The treatment program comprised three group sessions per week of 3 h of duration each. In these treatment sessions, participants (1) received education about the physiology of pain, sleep hygiene, and communication with others; (2) learnt to set relevant and realistic goals; and (3) were trained in relaxation, activity pacing and taught in management strategies. An interdisciplinary team comprised by psychologists, physiotherapists, and occupational therapists was responsible of the treatment program. Patients were expected to practice at home and to include the new skills in their daily routines. Inclusion criteria included: (a) having chronic pain and (b) a willingness to attend to the 4-week treatment program. Potential participants were excluded if they were significantly cognitively impaired, or actively suicidal, or did not possess the physical tolerance required to attend the program. A full description of this program has been provided by Cane and colleagues (Cane et al., 2016).

All measures were administered on the first day and during the last week of the 4-week treatment program. The study procedures were approved by the Ethics Institutional Review Board. Patients also provided written informed consent for the use of their data for research purposes.

Statistical analyses

We first computed descriptive statistics for the demographic and study variables to describe the sample, means and standard deviations for continuous variables, and number and percentages for categorical variables. Then, we computed Pearson correlation coefficients between pre- to post-treatment changes in the study variables to describe their zero order associations. Next, we examined the suitability of the data to ensure that they met the assumptions for the planned regression analyses by examining the skewness and kurtosis of the distributions of the predictor variables, and by computing the variance inflation factors

(VIF) for the study predictors. Finally, and in order to address the objective of this study, we performed three linear multiple regression analyses—one for each of the criterion variables of pre- to post-treatment changes in average pain intensity, pain interference, and depressive symptoms—to determine if pain catastrophizing, pain willingness, and activity engagement explained unique variance in the criterion variables.

For the analysis with pain intensity as the criterion variable, we entered age and sex to control for their potential effects in step 1. Then, in step 2, we entered change scores representing pre- to post-treatment changes in pain catastrophizing, pain willingness, and activity engagement. For the other two regression analysis (with pain interference, and depressive symptomatology as the criterion variables) we also controlled for potential effects of the changes in pain intensity. Thus, in step 1 we entered age and sex, and in step 2 we entered pre- to post-treatment changes in pain intensity to control for their potential effects on both the primary predictor and criterion variables. In step 3 we entered the change scores in pain catastrophizing, activity engagement and pain willingness as a block.

Due to the large number of planned analyses in this study it was necessary to lower the alpha level required for significance in order to control for Type I error and increase the confidence that any significant findings would be reliable. However, a highly conservative approach, such as the *Bonferroni* strategy, would result in a *p* value so low that it would substantially increase the risk of Type II errors. Thus, we elected to balance the need to control for both types of errors by using a *p* value of 0.01 for determining that a finding was statistically significant.

Results

Assumptions testing

As shown by skewness and kurtosis statistics, the distributions of the study variables were adequately normal for the planned regression analyses (skewness range – 0.70 to 1.07; kurtosis range – 0.64 to 1.32). Furthermore, all of the variance inflation factor values were below the standard cutoff value of 10 (ranging from 1.01 to 1.67), indicating that multicollinearity would not bias the findings (Tabachnick & Fidell, 1996).

Correlations among the pre- to post-treatment changes in the study variables

Zero order Pearson correlations between pre- to post-treatment changes in the study variables were performed.

Table 2 provides the results of these analyses, along with means and standard deviations of the change values. Consistent with expectations, changes in Activity Engagement and Pain Willingness scale scores were positively correlated ($r = .27, p < .01$). Similarly, as hypothesized, changes in the Pain Catastrophizing Scale scores were significantly negatively correlated with changes in the Activity Engagement ($r = -.32, p < .01$) and changes in the Pain Willingness ($r = -.40, p < .01$) scale scores. Although the pattern of associations among the change scores in the Activity Engagement, Pain Willingness, and Pain Catastrophizing Scale scores were as expected, they were weak enough to suggest that they might be independent domains.

In addition, and as hypothesized, changes in the Beck Depression Inventory scores demonstrated significant ($p < .01$) univariate associations with changes in the measures of catastrophizing (positive association), activity engagement, and pain willingness (both negative associations). However, only changes in pain willingness and activity engagement were significantly associated with changes in pain interference, and only changes in catastrophizing and activity engagement were associated with changes in pain intensity (see Table 2).

Regression analyses predicting changes in pain intensity

The results of the regression analyses predicting changes in pain intensity are presented in Table 3. Only the block of predictors including changes in pain catastrophizing, activity engagement and pain willingness made a significant contribution, explaining 10% of the variance in pre- to post-treatment changes in pain intensity. An examination of the beta weights indicated that only changes in pain catastrophizing contributed unique variance to this effect ($\beta = 0.25, p < 0.01$). Consistent with the study hypotheses, a decrease in pain catastrophizing was associated with a decrease in pain intensity.

Regression analyses predicting changes in pain interference

As can be seen in Table 4, changes in pain intensity contributed significantly to the prediction of the changes in pain interference ($\beta = 0.16, p < 0.01$), accounting for a 5% of the variance. The block of predictors including changes in pain catastrophizing, activity engagement and pain willingness also made a significant additional contribution of 16% of the variance in the criterion variable. An examination of the beta weights indicated that only changes in activity engagement contributed uniquely to this effect ($\beta = 0.37, p < 0.001$). The direction of the beta

Table 3 Predicting changes in pain intensity

Step and variable	Total R^2	R^2 change	F change	β to enter
1. Sociodemographic variables	.01	.01	0.23	
2. Predictors	.11	.10	5.99*	
Change in activity engagement				– .15
Change in pain willingness				.09
Change in catastrophizing				.25*

* $p < .005$ **Table 4** Predicting changes in pain interference

Step and variable	Total R^2	R^2 change	F change	β to enter
1. Sociodemographic variables	.05	.05	3.97	
2. Average pain intensity	.10	.05	8.19*	.16*
3. Predictors	.26	.16	10.15**	
Change in activity engagement				– .37**
Change in pain willingness				– .14
Change in catastrophizing				– .08

* $p < .01$, ** $p < .001$

weight indicated that an increase in activity engagement was associated with a greater decrease in pain interference.

Regression analyses predicting changes in depressive symptoms

The results of the regression analyses predicting depressive symptoms are presented in Table 5. As can be seen, only the block of predictors (changes in activity engagement, in pain willingness and pain catastrophic thinking) as a group made a statistically significant contribution to the prediction of the criterion (16% of the variance). However, and inconsistent with the study hypotheses, none of the change scores made statistically significant independent contributions to the prediction of changes in depressive symptoms.

Discussion

The primary aim of this study was to evaluate the roles that changes in pain catastrophizing and the two components of pain acceptance, pain willingness and activity engagement, play in explaining the benefits of multidisciplinary cognitive behaviorally (CBT)-based chronic pain treatment. Two key findings emerged. First, although the pattern of univariate associations were generally consistent with the study hypotheses, only pain catastrophizing and activity engagement emerged as significant unique predictors of any treatment outcome; pain willingness was not found to be a significant unique predictor of either outcome vari-

able, when catastrophizing and activity engagement were controlled. This negative finding in relation to pain willingness is similar to results observed in previous studies of this construct (e.g., Day & Thorn, 2016). Second, changes in catastrophizing and activity engagement showed somewhat different patterns of unique (i.e., when controlling for the other study variables) associations with outcomes, with decreases in catastrophizing being associated with improvements in pain intensity and depressive symptoms, and increases in activity engagement predicting improvements in pain interference.

These findings are consistent with previous studies showing that pain catastrophizing is an important and unique predictor of treatment outcomes in chronic pain management (Moore et al., 2016; Quartana et al., 2009). Moreover, the results are consistent with a previous study comparing activity engagement and pain willingness as predictors of chronic pain treatment outcomes, showing that activity engagement, but not pain willingness, mediated improvements in pain interference after completing a mindfulness-based program (Day & Thorn, 2016). Our results confirm and extend these preliminary findings to a wider heterogeneous sample of patients with chronic pain participating in a different (CBT-based) treatment.

Pain catastrophizing has been shown to play a central role in CBT-based treatments for individuals with chronic pain (Elvery et al., 2016; Quartana et al., 2009). However, as shown in this study, other process variables may also have a role in explaining improvements. Importantly, pain acceptance, which is a key process variable in Acceptance

Table 5 Predicting changes in depressive symptomatology

Step and variable	Total R^2	R^2 change	F change	β to enter
1. Sociodemographic variables	.01	.01	.92	.02
2. Average pain intensity	.03	.02	3.52	.06
3. Predictors	.19	.16	9.04*	
Change in activity engagement				– .19
Change in pain willingness				– .15
Change in catastrophizing				.20

* $p < .01$

and Commitment Therapy has been found to play also a role in the outcomes after participating in a multidisciplinary CBT-based treatment for chronic pain, for example, on pain intensity, disability or depressive symptoms (Åkerblom et al., 2015). Although we used a different study design, this finding was also observed in the current study. However, we found that activity engagement (but not pain willingness), may be the key acceptance factor relating to improvement.

Although both variables (i.e., pain catastrophizing and activity engagement) are central to two allegedly different therapeutic models (McCracken, 2005), encouraging pain acceptance is also consistent with classic cognitive therapy as it has been applied to chronic pain treatment. For example, when, as described by Jensen (Jensen, 2011), a therapist facilitates an understanding that some thoughts about pain (e.g., “My pain is a sign of physical damage”) are not necessarily true and can be maladaptive in and of themselves.

Thus, in chronic pain management it may not only be important to address the cognitive content, that is, *what* the patient thinks about pain (e.g., to reduce the occurrence of catastrophizing thoughts), but also to address cognitive processes, that is, *how* the patient thinks about pain (e.g., to improve willingness to engage in valued activities despite pain), in order to respond to pain in a more effective and adaptive manner (Day et al., 2014; Jensen, 2011). If future research finds that the correlations found here reflect causal processes—that both catastrophizing and activity engagement have *causal* influences on outcomes—it would be important to target both in treatment.

This study has a number of limitations that should be considered when interpreting the results. First, although the number of participants was appropriate for the analyses which were conducted, the sample size was relatively small. Additional research, ideally with larger sample sizes, would be needed to establish the reliability of findings. Second, although the study design allowed for the evaluation of concurrent associations among the change scores for the study variables, the study remains a correlational study; we were not able to test for causal associations, and

attribute specific changes to the particular characteristics of the intervention. Thus, additional studies, such as clinical trials in which activity engagement and pain willingness are specifically targeted for change in treatment conditions (versus a control condition where these process variables are not specifically targeted for change), are needed to evaluate the causal influence of each of these factors on treatment outcomes. Finally, in this study we collected information at pre- and post-treatment, but did not collect information at different stages during treatment. Future studies would profit from including some more finer-grained assessments (i.e., daily or weekly measures of both mechanism and outcome measures during treatment), which would enable a more detailed analysis of potential underlying mechanisms of treatment change.

Despite the study’s limitations, the findings provide important additional information on the relative importance of two specific treatment process variables: pain catastrophizing and activity engagement. The findings are consistent with the possibility that chronic pain treatments which help to both reduce pain catastrophizing and increase activity engagement may be more beneficial than treatments that target only one of these factors for change. The current findings indicate that research to address this question is warranted.

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Compliance with ethical standards

Conflict of interest Jordi Miró, Elena Castarlenas, Rocío de la Vega, Santiago Galán, Elisabet Sánchez-Rodríguez, Mark P. Jensen, Douglas Cane declare that they have no conflict of interest.

Human and animal rights and Informed consent All procedures were in accordance with the ethical standards of the institutional

research committees and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

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