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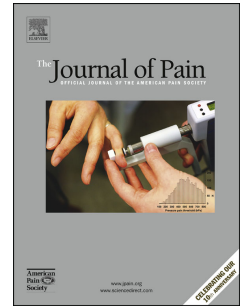
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# Accepted Manuscript

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Title: The Mediating Role of Acceptance in Multidisciplinary Cognitive Behavioral Therapy for Chronic Pain

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**Abstract**

Cognitive Behavioral Therapy (CBT) is the most frequently delivered psychological intervention for adults with chronic pain. The treatment yields modest effect sizes and the mechanisms of action remain understudied and unclear. Efforts are needed to identify treatment mediators that could be used to refine CBT and improve outcomes. The primary aim of this study is to investigate whether pain-related acceptance, from the psychological flexibility model, mediates changes in outcome over time in a CBT-based treatment program. This includes comparing how this variable relates to three other variables posited as potential mediators in standard CBT: life-control, affective distress, and social support. Participants attended a five-week outpatient multidisciplinary program with self-report data collected at assessment, post-treatment, and at 12-month follow-up. Multilevel structural equation modeling was used to test for mediation in relation to three outcomes: pain interference, pain intensity, and depression. Results indicate that effect sizes for the treatment were within the ranges reported in the CBT for pain literature. Pain-related acceptance was not related to pain intensity, which is in line with past empirical evidence and the treatment objectives in Acceptance and Commitment Therapy (ACT). Otherwise, pain-related acceptance was the strongest mediator across the different indices of outcome. Accumulating results like these suggest that acceptance of pain may be a general mechanism by which CBT-based treatments achieve improvements in functioning. More specific targeting of pain-related acceptance in treatment may lead to further improvements in outcome.

**Perspective**

Potential mediators of outcome in a CBT-based treatment for adult chronic pain were investigated using multilevel structural equation modeling. The results highlight the role of

pain-related acceptance as an important treatment process even when not explicitly targeted during treatment. These data may help clinicians and researchers better understand processes of change and improve the choice and development of treatment methods.

**Key words:**

Acceptance and Commitment Therapy (ACT), acceptance, Cognitive Behavioral Therapy (CBT), chronic pain, mediator, multilevel structural equation modeling (SEM)

## Introduction

At present Cognitive Behavioral Therapy (CBT) is the most widely used psychological treatment for adults with chronic pain and is considered a *standard* treatment.<sup>54</sup> CBT-based treatments for chronic pain are multi-component in nature, including methods to: 1) increase knowledge about pain; 2) address beliefs that may interfere with engagement in activities; 3) improve patients' skills and change their behavior; and 4) improve physical and social activity. Many different interventions are employed under the same general rubric of CBT for chronic pain.<sup>10, 14, 15, 48</sup> One example is multidisciplinary treatment for chronic pain which often is based on a cognitive behavioral framework. This format for delivery of treatment for chronic pain is frequently employed around the world, especially in North America and Europe, and has established benefits.<sup>14, 15, 35</sup>

While superior in comparison to no treatment or treatment as usual, CBT produces only small to medium effect sizes for pain and related disability.<sup>54</sup> The modest effects for CBT for chronic pain have drawn increasing attention to the theoretical models that underpin CBT and multidisciplinary approaches that involve CBT more broadly.<sup>34, 54</sup> Greater efforts are needed to identify "process variables" or mediators that could be used to refine CBT and improve outcomes.<sup>56, 50, 54</sup>

A large number of psychological variables have been identified as potential CBT process variables, including pain beliefs and perceived control over pain,<sup>19, 20, 50</sup> social support,<sup>42, 43</sup> coping,<sup>19, 20</sup> self-efficacy,<sup>50</sup> helplessness,<sup>4-6</sup> affective distress, and catastrophizing.<sup>4, 6, 45, 46, 50,</sup>  
<sup>52</sup> CBT-based treatments have typically taken a broad focus on processes for change and incorporated diverse packages of methods. So far evidence from studies of these treatments has not revealed which processes and methods are most effective or necessary in determining

outcome.<sup>54, 56</sup> In fact, relatively few treatment outcome studies have undertaken to measure and analyse possible mediators<sup>50, 51, 57</sup> or changes processes<sup>4-6, 19, 20, 45, 46</sup> in chronic pain trials.

The process of “acceptance” first appeared in a study of chronic pain more than 20 years ago (Geiser, 1992) though it is not currently a predominant focus within treatment development. It can be defined as the conscious embrace of psychological experiences when to otherwise attempt to avoid them negatively impacts on overall functioning. It is sometimes referred to as willingness or openness. Acceptance is a component of *psychological flexibility*, the core therapeutic focus of Acceptance and Commitment Therapy (ACT).<sup>17</sup> Components of psychological flexibility have been identified as mediators in trials of ACT for chronic pain.<sup>51, 57</sup> Also, pain-related acceptance appears to underlie improvement in outcomes for chronic pain where acceptance is specifically targeted, as in ACT,<sup>32, 33</sup> and where it is not targeted, as in traditional CBT approaches.<sup>1, 56</sup> It has been argued that psychological flexibility is a fundamental aspect of health.<sup>21</sup> Here we focus on pain-related acceptance as similarly “fundamental” to outcome for chronic pain. Further, in previous studies of pain treatment pain-related acceptance has not been compared with other potential mediators so that their relative contribution could be examined.

The primary aim of this study is to investigate whether pain-related acceptance mediates changes in outcome over time in a CBT-based multidisciplinary pain treatment program. This includes comparing how acceptance, which was not explicitly targeted, relates to three other potential mediators that are intended targets in broad CBT-based treatment packages and the examined treatment program, life-control,<sup>14, 15, 34</sup> affective distress,<sup>52</sup> and social support.<sup>41, 42</sup>

Two hypotheses were tested in the present study. Firstly, improvements on measures of pain

interference, pain intensity and depression at post-treatment and 12-month follow-up would be observed and the level of improvements would be consistent with previously published efficacy studies of CBT-based treatments for adults with chronic pain. Secondly, pain-related acceptance would demonstrate significant and unique mediating effects in relation to changes in outcome measures during treatment even when other potential mediators are taken in to account.

## **Methods**

### ***Participants***

Participants were 409 consecutive referrals between 2009 and 2012 admitted to a five-week, outpatient, CBT-based multidisciplinary program at the Pain Rehabilitation Unit at Skåne University Hospital. The unit is a government supported, regional specialist center that also offers other treatment options and assessments. Patients are admitted to the five-week program if they meet the following criteria: 1) are between 18 and 65 years of age; 2) speak Swedish fluently; 3) have symptoms of chronic pain that impact significantly on everyday life; 4) have undergone a full medical examination and received appropriate medical treatment where indicated; and 5) are able to function in a group setting and participate in a five-week program involving five to seven hours per day two to four days a week. Patients are not admitted to the program if they have acute or severe psychiatric disorders or symptoms, are actively abusing analgesic medications (including narcotics), alcohol or other drugs, or have already undergone similar treatment. Patients are offered transportation to the clinic or provided with accommodation if they require it.

The participating patients were 342 women and 67 men between the ages of 18 and 61 years ( $M=41.7$ ,  $SD=10$ ). The majority (82.2%) were born in Sweden or another Nordic country. Most (55.2 %) had upper secondary school as their highest education level while 11.2 %



completed secondary school and 27.9 % studied at university level. Approximately half of the participants (51.3%) were currently working or studying to some degree. The mean number of pain locations in the body was 15.9 with an average duration of pain of 7.3 years. The mean self-reported usual pain intensity over the past week (rated on 0-10 scale) was 7.2 (SD=1.6). The most commonly identified diagnoses were fibromyalgia (25.2 %) followed by cervicocranial syndrome (15.9 %), cervicobrachial syndrome (15.9%), low back pain (5.6%), and myalgia (4.6 %). All participants gave written informed consent prior to their data being used in the study and the Regional Ethical Review Board in Lund, Sweden (2013/381) gave ethical approval for the study.

### ***Treatment***

Three multidisciplinary teams with training in CBT and extensive experience of pain rehabilitation delivered the treatment based on cognitive behavioral principles. The teams included an occupational therapist, a clinical psychologist, a physician, a physiotherapist, and a social worker. Team members met each patient for assessment and attended meetings with the patient to clarify their personal goals and to formulate an individual rehabilitation plan. Patients participated in group-based sessions delivered by the team members on bio-psychological explanations about pain and pain medications (physician); work-related and national insurance issues (social worker); and ergonomics, time-use adaptations and problem solving strategies (occupational therapist). Patients also participated in practical group activities concentrated on physical exercises, body awareness, and relaxation (physiotherapist) as well as everyday occupational performance (occupational therapist). Group sessions focused on thoughts and emotions, communication training, behavioral home tasks, and stress-management skills were held by a psychologist. The main psychological interventions used were psychoeducation, cognitive restructuring, and behavioral activation in accordance with personal goals of patients. A core feature of the program was the CBT

framework used to guide all interventions. For example, emphasis was placed on challenging behavior patterns and beliefs systematically during the practical group activities. Likewise, relevant knowledge was provided during all group-based sessions to facilitate stepwise behavior change in line with identified goals. Treatment integrity was upheld by frequent team meetings. Furthermore, team members co-led group sessions to enhance co-operation and consistency and further integrate delivery around a cognitive behavioral framework. Significant others were invited for a half-day to participate in education and discussions about chronic pain and pain rehabilitation. The overall goals of the treatment program were to help patients improve their strategies for managing chronic pain and its consequences, to improve their perceived quality of life, to improve their ability to participate in everyday activities, to reduce their pain experience, and to increase the knowledge of significant others regarding pain and its consequences by inviting them to participate in the rehabilitation. The treatment components were generally not based on an acceptance-oriented philosophy.

Patients were enrolled in a day treatment program lasting 25 contiguous days. Patients attended the pain clinic five to seven hours per day, two to four days per week (18 active treatment days) with the rest of the weekdays being used for home practice. The patient was then discharged to a “homework phase” that lasted two months wherein patients worked on achieving their long term goals as identified in their individual rehabilitation plan. At the end of the homework phase the patient underwent a two-day follow-up assessment (the post-treatment assessment) where progress, difficulties, and future goals were discussed. Twelve months after discharge from the day treatment program, patients were mailed a number of questionnaires and asked to complete and return (the 12-month follow-up assessment).

### ***Measures of treatment outcome***

Self-report data were collected at an initial assessment, after treatment (two months after discharge at the two-day follow-up assessment), and 12 months after treatment. From these, we selected three different outcome measures that have been previously identified as core outcome domains in trials of patients with chronic pain: pain interference, pain intensity, and depression.<sup>8, 49</sup>

*Pain interference* was measured using the Multidimensional Pain Inventory (MPI) version 2. The MPI has satisfactory psychometric properties.<sup>23</sup> A Swedish version was used.<sup>39</sup> The MPI version 2 consists of three parts and 61 items where each item is rated on a 7-point scale (0 = *never*; 6 = *very often*). Only Part 1, which consists of 28 items and asks about the perception of pain and pain-related consequences, was included in this study. Pain interference was measured with the specific subscale of the same name from Part 1. The 11 item-subscale measures pain-related life interference, including interference with family and marital functioning, work and work-related activities, and social-recreational activities.<sup>39, 44</sup> The mean score was calculated for the scale.

*Pain intensity* was measured using the Numerical Rating Scale (NRS). This is a single item scale where the patient is asked to rate pain intensity over the past week on a scale ranging from 0 (*no pain*) to 10 (*worst possible pain*). The NRS is commonly used and has been shown to be a valid and sensitive measure when assessing changes in pain intensity.<sup>13</sup>

*Depression* was measured with the Hospital Anxiety and Depression Scale (HADS).<sup>58</sup> The HADS is designed to detect symptoms of anxiety and depression amongst patients in a medical setting. The *Anxiety* and *Depression* subscales each contain seven items rated on a 4-point scale (0-3). Both the English original and the translated Swedish version have

acceptable validity and reliability.<sup>24, 58</sup>

### ***Measures of proposed mediators***

*Pain-related acceptance* was measured with the Chronic Pain Acceptance Questionnaire (CPAQ)<sup>33</sup> The CPAQ is comprised of 20 items rated on a 7-point scale (0 = *never true*; 6 = *always true*) and includes two subscales: *Activity Engagement* and *Pain Willingness*. Only the total score was used in the current study to allow analysis of acceptance of pain as a single construct.<sup>31, 36</sup> The CPAQ has satisfactory psychometric properties.<sup>37, 55</sup> The Swedish version of the CPAQ used in this study has similar psychometric properties as the English original.<sup>53</sup>

*Life control*, *affective distress* and *social support* were measured using the respectively named subscales from part 1 of the MPI (version 2), where each item is rated on a 7-point scale (0 = *never*; 6 = *very often*). The mean score was calculated for each subscale. The *Life Control* subscale consists of four items which focuses on the perceived ability to solve problems and feelings of personal mastery and competence. The *Social Support* subscale consists of three items measuring appraisal of support received from spouse, family, and significant others. The *Affective Distress* subscale consists of three items measuring low mood, irritability, and tension.<sup>39, 44</sup>

### ***Statistical analyses***

A series of t-tests were performed to examine potential differences between participants who provided complete and incomplete data. Descriptive statistics were produced to present demographic and clinical characteristics at pre-treatment and outcome at post-treatment and 12-month follow-up. Effect sizes were calculated for each outcome measure over the observed time intervals (pre to post-treatment and pre-treatment to follow-up). To correct for

correlated data within-subjects effect sizes (Cohen's  $d$ ) were calculated using the formula described by Dunlap et al.<sup>7</sup> Controlled effect sizes for CBT for chronic pain patients usually fall in the small ( $d=0.2$ ) to moderate range ( $d=0.5$ ).<sup>54</sup> Taking a conservative approach and assuming that the current treatment achieves outcomes in the low end of this range, power analyses suggested that a sample size of 400 was sufficient to detect a pre-to-post/ follow up treatment effect size of  $d = 0.2$  with 80 % power and  $p = 0.05$ .

Multilevel structural equation modeling (SEM) was used to evaluate change in treatment outcome measures across the assessment points and to investigate the indirect effects of the proposed mediators. The mediating or indirect effect refers to processes through which changes take place.<sup>27</sup> Mediation analyses investigate the influence of a mediating variable (M) on a relationship between an independent (X) and a dependent (Y) variable. A mediating variable partly or fully accounts for the treatment effect. Complete mediation refers to an absence of treatment effect when the mediator has been controlled. Partial mediation occurs when the treatment effect is reduced by a non-trivial amount when the mediator has been controlled.<sup>2</sup>

We note that we apply the term mediator here specifically to the observed within group or over time effect in single treatment cohort. This is to distinguish it from the more common use of the term in between group designs. A single treatment condition can contribute to an understanding of mediation processes but yields weaker evidence than studies with a control group and random assignment.<sup>28</sup> Nevertheless, and in accordance with recommendations on the analysis of mediation,<sup>22,29</sup> this study tested a model of mediation developed prior to undertaking the data analyses, attempted to address possible concerns about temporality by assessing change with a longitudinal design, utilized an adequate sample size, and examined

multiple mediators simultaneously. By considering several mediators at the same time we were able to evaluate the relative contribution of each mediator to outcome although all mediators may be active and working in parallel.

A detailed description of Multilevel SEM is beyond the scope of this article (see<sup>40</sup> for a detailed description). An advantage of Multilevel SEM is that it permits grouping of data hierarchically at different levels. These “nested” groups can have independent or additive effects on results. For example, data can be grouped by time (Level 1) (e.g., pre and post-treatment/follow-up) across all participants to investigate if change occurred across time. Data can also be nested at the between person level (Level 2) to determine whether change differed across time between individuals. Multilevel SEM is suited to complex models and among other things allows one to simultaneously investigate the importance of two or more mediators.

In the present study, multilevel models were used to investigate if changes in pain interference, pain intensity, and depression (outcome measures) over time were mediated by changes in pain-related acceptance, life control, affective distress, and social support (mediators). Time was used as a proxy for treatment. Data were nested on three levels: time, between-person, and group with approximately 10 patients in each treatment group. We did not have an a priori hypothesis regarding group effects because it was assumed that treatment delivery was essentially uniform and any group difference were assumed to be small. Thus, we used a two level- modeling approach, stratifying data using the group variable. A similar analytical approach was employed by Vowles et al.<sup>57</sup> in their study of mediation in adult chronic pain patients treated with ACT.

Version 7 of Mplus<sup>38</sup> was used to test a lower level mediation model, a so-called 1-1-1 design as recommended by Preacher et al.<sup>40</sup>. In this approach the independent variable (time), mediators (e.g., pain-related acceptance), and outcome (e.g., depression) were assessed on Level 1 with random intercepts and random slopes on Level 2 (between person). This type of estimation model permits structural coefficients to vary randomly across clusters. In other words, the analysis takes random factors, which are part of the dataset, into account and therefore produces robust and realistic findings. The significance of the indirect effect was estimated using the product of coefficients and 95% confidence estimates.<sup>12</sup> This method directly assesses the significance of the indirect, or mediating effects.<sup>26</sup> Age, education and gender were grand-mean centered and included as Level 2 (between person) covariates in all multilevel models.<sup>11</sup> All mediators were examined separately to test for individual mediating effects. Thereafter, all significant individual mediators were examined simultaneously to investigate the importance (variance accounted for) of each mediator in these parallel processes and to see if there was any overlap between them.

## **Results**

### ***Descriptive and attrition analyses***

Based on the results of the power analysis 409 patients were recruited to the study. A total of eight dropped out of treatment due to medical or personal reasons. The remaining patients completed treatment but had some missing data points owing either to the patient failing to complete a particular measure or staff failing to administer a particular measure or to record the information in the electronic journal for that patient. Of the 409 patients enrolled in the study, 321 (78.5 %) had complete data (all items/all measures) at pre-assessment; 289 (70.7 %) had complete data at post-treatment, and 264 (64.5 %) had complete data at the 12-month follow-up. No differences were found between those who provided complete data (all

items/all measures) at all three time points (N=171, 41.8%) and those who did not (N=238, 58.2 %) on any of the outcome or process measures, or in relation to gender, country of birth, education level, work status, or pain duration (all  $p$  values  $\geq 0.072$ ). Thus data appeared to be missing at random. In attempting to deal with missing data we adhered to recommended statistical procedures.<sup>9,25</sup> Table 1 presents the means, standard deviations, and within-subjects effect sizes (Cohen's  $d$ ) for the outcome and mediator variables for participants with complete data at all three time points (N = 171). The findings did not differ from those obtained when using all available data for each outcome and mediator variable, i.e., where cases were excluded analysis by analysis (maximum N = 409). To further investigate the possible influence of missing data on results, sensitivity analyses were undertaken using multilevel SEM. Specifically, four different missing data patterns were identified in the dataset, dummy coded and then analyzed: intermittent missing values at one assessment point; intermittent missing values at two assessment points; complete data; and one or more missing values at all assessment points. These patterns of missing data were unrelated to treatment outcome, and as such we use all available data from the 409 participants in the subsequent multilevel SEM analyses. Cases were excluded analysis by analysis if they had missing values on the time variable, the covariates, or if they had missing values on all variables except the time variable and the covariates.

Visual inspection of histograms, normal Q-Q plots and boxplots indicated that scores on all measures were approximately normally distributed. Outliers were identified by computing standardized scores and using absolute  $Z$  values larger than 3 as a cut off (N = 15). Findings were consistent whether the analyses were conducted with or without outliers. Hence, the small number of outliers (N = 15) were included in all subsequent analyses.



Table 1  
Means and within-subjects effect sizes for treatment participants

	Pre- Treatment M (SD)	Post- Treatment M (SD)	12-Month Follow-up M (SD)	Pre-to-Post Treatment Cohen's <i>d</i>	Pre-to-Fup Treatment Cohen's <i>d</i>
<b>Outcome</b>					
Pain interference	4.6 (0.9)	4.5 (0.9)	4.2 (1.1)	0.15	0.35
Pain intensity	7.3 (1.4)	6.4 (2.1)	6.4 (2.1)	0.48	0.48
Depression	8.9 (4.1)	7.1 (4.4)	7.0 (4.6)	0.43	0.43
<b>Mediator</b>					
Pain acceptance	43.1 (16.5)	50.4 (15.2)	55.0 (16.0)	-0.47	-0.73
Life control	2.6 (1.1)	3.3 (1.2)	3.4 (1.2)	-0.67	-0.70
Affective distress	3.7 (1.0)	3.2 (1.2)	3.1 (1.3)	0.50	0.54
Social support	4.4 (1.4)	4.3 (1.2)	4.1 (1.4)	0.09	0.21

Notes: Pain-related acceptance was measured with the Chronic Pain Acceptance Questionnaire, pain intensity with the Numerical Rating Scale, depression with the Hospital Anxiety and Depression Scale. Pain interference, life control, affective distress and social support were assessed with the Multidimensional Pain Inventory. N=171

### ***Multilevel SEM of Treatment Effect***

Using all data available, a significant effect of time was observed on all outcomes at each assessment point in the multilevel SEM models. Specifically, decreases were observed in pain interference (N = 232) (B[SE] = -0.156 [0.031],  $p < .001$ ), pain intensity (N = 231) (B[SE] = -0.453[0.059],  $p < .001$ ), and depression (N = 233) (B[SE] = -0.804[0.115],  $p < .001$ ). No cross-level interaction between Level 1 and 2 was observed for any of the analyses. Thus age, gender, and years of education (the Level 2 covariates) had no significant impact on outcome in the present sample.

### ***Multilevel Mediation***

All mediators were analyzed using all available data. Multilevel models were used to investigate if significant changes in pain interference, pain intensity, and depression (outcome variables) over time were mediated by changes in pain-related acceptance, life control, affective distress, and social support (proposed mediators). The multilevel analyses for the mediating effects (univariate) on each outcome variable are presented in Table 2.

The  $a$ -path represents the effect of time on the mediator and the  $b$ -path the effect of the mediator on the outcome controlling for time. The  $c$ -path represents the total effect of time on outcome and the  $c'$ -path represents the direct effect of time on outcome when controlling for the mediator. The mediating or indirect effect refers to the effect of the mediator on the relationship between time (a proxy for treatment) and changes on the outcome variables. The cross-product  $a*b$  directly assesses the significance of this effect. Confidence intervals are derived from the obtained distribution of  $a*b$  scores. If lower and upper bounds do not contain zero, the indirect effect is significant at the level specified in the analysis. The cross product  $a*b$  is equivalent to the difference between the total effect of time (treatment) on outcome and the direct effect of time (treatment) on outcome when adjusting for the mediators ( $c-c'$ ). As can be seen in Table 2, changes in pain interference during treatment were mediated (separately) by changes in each of the proposed mediators. However changes in pain intensity and depression were mediated only by changes in pain-related acceptance, life control, and affective distress. All significant mediators were partial mediators since they reduced the effect of time on outcomes by a non-trivial amount.

Table 2  
Results of univariate mediator analyses

Outcome	N	Mediator	Indirect Effects		Results for Indirect Effects $a*b$		
			Path	Point-estimate (SE)	Point-estimate (SE)	95% CI	
						Lower	Upper
Pain interference	233	Pain acceptance	a	0.331* (0.030)	-0.153* (0.024)	-0.214	-0.114
			b	-0.462* (0.050)			
	235	Life control	a	0.372* (0.039)	-0.095* (0.017)	-0.139	-0.068
			b	-0.256* (0.034)			
	235	Affective distress	a	-1.381* (0.211)	-0.079* (0.016)	-0.120	-0.053
			b	0.057* (0.006)			
	235	Social support	a	-0.744* (0.167)	-0.019* (0.008)	-0.039	-0.007
			b	0.026* (0.008)			
Pain intensity	237	Pain acceptance	a	0.337* (0.031)	-0.167*(0.040)	-0.270	-0.101
			b	-0.495* (0.112)			
	238	Life control	a	0.374* (0.038)	-0.239* (0.037)	-0.334	-0.178
			b	-0.638* (0.070)			
	238	Affective distress	a	-0.279* (0.042)	-0.143* (0.029)	-0.217	-0.095
			b	0.511* (0.065)			
	238	Social support	a	-0.150* (0.033)	-0.014 (0.012)	-0.043	0.005
			b	0.091 (0.072)			
Depression	235	Pain acceptance	a	0.326* (0.031)	-0.556* (0.080)	-0.761	-0.425
			b	-1.704* (0.193)			
	236	Life control	a	0.371* (0.038)	-0.537* (0.0729)	-0.722	-0.418
			b	-1.447* (0.126)			
	236	Affective distress	a	-0.272* (0.042)	-0.097* (0.017)	-0.140	-0.069
			b	0.355* (0.028)			
	236	Social support	a	-0.148* (0.033)	0.018 (0.024)	-0.044	0.058
			b				

Notes: The indirect effect is statistically significant if the confidence interval does not include zero. A 95 % confidence interval (CI) is equivalent to a value of  $p \leq .05$ . Asterisks (\*) indicate a statistically significant effect.

Next mediators found to be significant on the univariate level were examined in a multivariate fashion in relation to each outcome measure (see Table 3). All direct effects ( $c'$ ) were non-significant when controlling for the combined effect of the mediators included in the analyses. Thus the effect of time (treatment) on outcome was completely mediated by the combined effect of the proposed mediators included in the analyses. Specifically, changes in pain-related acceptance, life control, affective distress, and social support all mediated change in pain interference during treatment, but pain-related acceptance had the strongest indirect effect. For outcome as indexed by pain intensity only changes in life control and affective

distress were simultaneous and significant mediators. For depression changes in pain-related acceptance, life control, and affective distress all significantly and simultaneously mediated changes in depression. However pain-related acceptance was the strongest mediator.

Table 3  
Results of multivariate mediator analyses

Outcome	Mediator	Path	Total, Direct, and Indirect effects		Results for Indirect Effects $a*b$			
			Point-estimate (SE)	Point-estimate (SE)	95% CI		Proportion of effect mediated (a*b)/c	
Pain interference N=228		Total c	-0.156* (0.031)					
		Direct c'	0.040 (0.036)					
	Pain acceptance	a	0.322 (0.029)	-0.113* (0.019)	-0.163	-0.081	0.72	
		b	-0.352* (0.044)					
	Life control	a	0.368* (0.038)	-0.024* (0.012)	-0.054	-0.005	0.15	
		b	-0.066 (0.031)					
	Affective distress	a	-0.286* (0.041)	-0.020* (0.007)	-0.038	-0.009	0.13	
		b	0.168* (0.032)					
	Social support	a	-0.153* (0.034)	-0.048* (0.012)	-0.079	-0.029	0.31	
		b	0.132* (0.034)					
Pain intensity N=231		Total c	0.453* (0.059)					
		Direct c'	-0.117 (0.082)					
	Pain acceptance	a	0.324* (0.030)	-0.057 (0.036)	-0.150	0.003	na	
		b	-0.174 (0.112)					
	Life control	a	0.372* (0.037)	-0.168* (0.038)	-0.266	-0.105	0.37	
		b	-0.452* (0.090)					
	Affective distress	a	-0.290* (0.041)	-0.064* (0.025)	-0.128	-0.023	0.14	
		b	0.222* (0.078)					
	Depression N=229		Total c	-0.804* (0.115)				
			Direct c'	-0.036 (0.129)				
Pain acceptance		a	0.322* (0.030)	-0.296* (0.070)	-0.476	-0.181	0.37	
		b	-0.918* (0.194)					
Life control		a	0.368* (0.037)	-0.261* (0.055)	-0.403	-0.171	0.32	
		b	-0.709* (0.135)					
Affective distress		a	-0.286* (0.041)	-0.240* (0.048)	-0.364	-0.160	0.30	
		b	0.839* (0.122)					

Notes: The indirect effect is statistically significant if the confidence interval does not include zero. A 95 % confidence interval (CI) is equivalent to a value of  $p \leq .05$ . Asterisks (\*) indicate a statistically significant effect.

## Discussion

Consistent with the treatment outcome literature, a multidisciplinary, five-week, CBT-based treatment delivered in a specialist pain unit in southern Sweden produced significant improvements in overall functioning for adults with chronic pain. In line with published trials, the improvements at 12-month follow-up were modest with uncontrolled effects sizes of 0.35 for pain interference, 0.48 for pain intensity, and 0.43 for depression. Although not the primary aim of this study, the present findings contribute to a larger body of evidence indicating that CBT-based approaches are empirically supported for chronic pain but could be improved.

We undertook multilevel structural equation modeling to assess both the individual and simultaneous effects of change in four proposed mediators of treatment outcome. Life control, affective distress, and social support are considered legitimate potential processes of change in treatments such as the one studied here. Although pain-related acceptance was not explicitly targeted, it was our prediction that it would demonstrate a mediating role nonetheless. Consistent with our hypotheses, changes in pain-related acceptance during treatment, on its own, significantly partially mediated changes in pain interference, pain intensity, and depression. Changes in life control and affective distress during treatment also significantly partially mediated outcomes on all measures. Changes in social support were found to significantly partially mediate pain interference but not pain intensity or depression. Once again, our use of the term “mediate” here applies to a within group effect over time in a treated sample and not to a between group effect between a treatment and control group.

When examining the mediators in a multivariate fashion the relative importance of the potential mediators appears more clearly. First, pain-related acceptance remained a significant

independent contributor to changes in outcome as measured by pain interference and depression, over and above the effects of changes in life control, affective distress, and social support during treatment. When considering outcome as indexed by pain interference, a primary outcome measure across treatment trials, pain-related acceptance was the strongest of the mediators evaluated (0.72 for pain-related acceptance versus 0.15 for life control, 0.13 for affective distress, and 0.31 for social support).

Pain-related acceptance, in contrast to the other proposed mediators, was not related to pain intensity in the multivariate analyses. The univariate analyses suggested that pain-related acceptance was only weakly related to change in pain intensity. These results are compatible with past empirical evidence<sup>30, 32</sup> and with the explicit treatment objectives of ACT, which seeks to improve functioning by increasing psychological flexibility rather than reductions in pain or distress.<sup>16, 17</sup>

The current findings suggest that, as process variables, changes in life control and affective distress were most important to treatment outcome as indexed by pain intensity and depression – and not as indexed by pain interference. In contrast, changes in social support appeared to have little relation to changes in pain interference, pain intensity, or depression. The theoretical model underpinning CBT as it is usually applied certainly includes a role for life control, affective distress, and social support. Out of this range of theoretically consistent mediators, which were specifically targeted during the program, life control stood out as an important mediator. These findings may be sample or measure specific and the role (and measurement) of these variables warrants further investigation. However, these findings draw attention to the need to either increase the potency of interventions that are directed at the weaker mediators or to reconsider the relative value of interventions that target these

mediators in multi-component treatment packages. Certainly future studies are needed with designs that allow treatment components to be targeted to address mediator or process variables that are relevant to particular patients.

Previous investigations examining potential process variables in CBT approaches for chronic pain have focused largely on pain beliefs and perceived control over pain,<sup>19, 20, 50</sup> social support,<sup>42, 43</sup> coping,<sup>19, 20</sup> self-efficacy,<sup>50</sup> helplessness,<sup>4-6</sup> affective distress, and catastrophizing.<sup>4, 6, 45, 46, 50, 52</sup> These process variables have been investigated because they reflect typical targets of traditional multi-component CBT packages and evidence suggests that changes in these variables indeed are associated with the treatment outcomes observed. Findings from the present study and those of Vowles et al.<sup>56</sup> and Baranoff et al.<sup>1</sup>, suggest that changes in an additional process variable that is not considered a target of traditional CBT, namely pain-related acceptance, may also play an important role in the outcomes achieved within the approach. We were constrained here by the available data and did not analyze pain beliefs, catastrophizing, coping, self-efficacy, and helplessness. We, therefore, cannot comment on the relative importance of these process variables in relation to pain-related acceptance nor on potential interactions between them. Further studies are needed that examine a wide range of theoretically-driven process variables, involving large sample sizes, control groups, and more frequent monitoring of process variables.

Findings from the present study must be viewed within the context of certain statistical and design limitations. According to Maric et al.<sup>29</sup> mediation studies can be viewed as falling on a continuum or ladder of evidence. As the current study involved a single treatment condition it falls at the lower end of this ladder. Studies at every level can help us understand mediation processes but the strongest evidence is found in studies with a control group and random

assignment.<sup>29</sup> Mediation findings from a study involving a single treatment condition, such as the present study, must be interpreted with caution as time effects are not necessarily due to the effects of treatment. Nevertheless, as Maric argues, a single group design can still contribute to an understanding of mediation processes, and this is evidenced by several recent investigations of mediation in single treatment groups.<sup>28, 47, 57</sup>

The statistical approach employed here (in the absence of a control group) uses time as a proxy for treatment. While inferences must be drawn cautiously when using such a design we note that participants in this study reported, a mean number of pain locations in the body of 15.9, with an average duration of pain of 7.3 years. It seems unlikely that the current patients would have significantly improved during the investigated time period without treatment. Furthermore, process variables were measured at the same time as the outcome variables at pre-, post-treatment and follow-up. More frequent measurement of the process and outcome variables may have permitted a more detailed analysis of temporality, where change in the mediator is shown to precede change in the outcome variable.

To use the available data to maximum advantage, and to insure that the studied sample would be representative of patients admitted to treatment at a specialist pain treatment center, we included patients in our analyses who had missing data on one or more of the studied variables at one or more of the assessments. While it cannot be completely ruled out, attrition and sensitivity analyses strongly suggested that the presence of missing data did not bias our findings for either outcome or mediation. Missing data appears to reflect failures in data collection as only eight patients dropped out of treatment. Other limitations include the exclusive reliance upon self-report measures and that treatment was not delivered according to a manualized protocol. Generalizability of the findings may also be limited as 83.6% of



the-participants were women and 27.9 % studied at university level. This demographic make-up is somewhat unusual in comparison to epidemiological studies of pain in Sweden<sup>3, 18</sup> but similar to patients seen at other tertiary pain clinics, as described in the 2013 report from the Swedish Quality Registry for Pain Rehabilitation (76% women and 24% studied at university level).<sup>41</sup>

Finally, a limitation of this study and multi-disciplinary delivered, multi-component CBT treatment programs in general is the difficulty pin-pointing the interventions that carry the largest impact on treatment processes and/or outcomes. To be clear, this study was not designed to isolate the impact upon acceptance of any individual treatment component. We cannot specify whether an individual or combination of interventions impacted on this process. Nonetheless it would seem reasonable to think that staff modelling of acceptance or interventions such as behavioral activation, goal setting, and physical exercise that help to coordinate greater activity without requiring reduction in pain or psychological discomfort to happen first are likely key ingredients in treatment. If improved outcomes are to be achieved in multidisciplinary, multi-component CBT programs, further studies are needed to identify specific components that are “active” in relation to pain acceptance, other relevant mediators, and outcome.

In summary, these data from clinical practice highlight the role of pain-related acceptance as a potential key therapeutic process in a treatment not specifically designed to target acceptance, a treatment based on a traditional CBT model. Acceptance of pain is a part of the psychological flexibility model that underpins ACT. The psychological flexibility model includes processes that encourage the individual to act in accordance with their personal values, in the presence of potentially interfering thoughts and feelings, and with a greater

appreciation of what the current situation or context allows.<sup>16,17</sup> The model is explicit about its core scientific strategy and philosophical assumptions. A major strength of the model is also that it can be considered integrative, since it specifies six key processes that seem able to organize wide ranging treatment-related variables into a smaller number of functional dimensions.<sup>34</sup> As a result this model may support a degree of theoretical integration, a clear focus on treatment process, and may hasten progress in the field of pain management.<sup>33</sup> We propose that more precise targeting of acceptance and other facets of psychological flexibility may increase the effectiveness of multidisciplinary treatments based broadly within CBT, and this proposal remains to be further investigated.

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