



Processes of change in psychological flexibility in an interdisciplinary group-based treatment for chronic pain based on Acceptance and Commitment Therapy

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ARTICLE INFO

Article history:

Received 10 November 2010

Received in revised form

13 January 2011

Accepted 8 February 2011

Keywords:

Chronic pain

Acceptance

Values

Mindfulness

Processes of change

Cognitive behavioral therapy

Acceptance and Commitment Therapy

ABSTRACT

There are now numerous studies of Acceptance and Commitment Therapy (ACT) for chronic pain. These studies provide growing support for the efficacy and effectiveness of ACT in this context as well as for the role of ACT-specific therapeutic processes, particularly those underlying *psychological flexibility*. The purpose of the present study was to continue to build on this work with a broader focus on these processes, including acceptance of pain, general psychological acceptance, mindfulness, and values-based action. Participants included 168 patients who completed an ACT-based treatment for chronic pain and a three-month follow-up. Following treatment and at follow-up, participants reported significantly reduced levels of depression, pain-related anxiety, physical and psychosocial disability, medical visits, and pain intensity in comparison to the start of treatment. They also showed significant increases in each of the processes of psychological flexibility. Most uncontrolled effect sizes were medium or large at the follow-up. In correlation analyses changes in the four processes measures generally were significantly related to changes in the measures of depression, anxiety, and disability. In regression analyses the combined processes were related to changes in outcomes above and beyond change in pain intensity. Although in some ways preliminary, these results specifically support the unique role of general psychological acceptance in relation to improvements achieved by treatment participants. The current study clarifies potential processes of change in treatment for chronic pain, particularly those aiming to enhance psychological flexibility.

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There is a growing body of literature to support Acceptance and Commitment Therapy (ACT) (Hayes, Strosahl, & Wilson, 1999) in the treatment of chronic pain, including treatment outcome studies in both adult (McCracken, Vowles, & Eccleston, 2005; Vowles & McCracken, 2008; Wicksell, Ahlqvist, Bring, Melin, & Olsson, 2008) and pediatric samples (Wicksell, Melin, Lekander, & Olsson, 2009). Treatment outcome studies conducted so far suggest that relatively brief ACT interventions of between three to eight weeks can produce significant benefits in the emotional, physical, and social functioning of people with chronic pain. As further support for applications of ACT to chronic pain, secondary analyses within these studies show that the processes of psychological flexibility targeted in ACT appear to account for an appreciable proportion of the benefits

observed. However, a broader focus on processes of change is important to continue to clarify the roles of the separate processes defined within this treatment approach.

Simply stated, the assumption behind the application of ACT to chronic pain is that it is not merely the severity of pain or other symptoms in isolation that influences patient functioning, but also psychological relationships between these symptoms and behavior. Accordingly, ACT is explicitly not aimed at reducing pain or distress, or at changing the frequency or content of thoughts. Instead, ACT seeks to improve functioning for people with chronic pain by modifying the impacts of pain and other symptoms through acceptance and mindfulness methods. It does this by increasing *psychological flexibility*, defined in part as the ability to act effectively in accordance with personal values and goals in the presence of potentially interfering thoughts and feelings (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). In the model underlying ACT psychological flexibility entails six interrelated therapeutic processes: acceptance, cognitive defusion, contact with the present moment, self-as-context, values, and committed action.

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Vowles and McCracken (2008) reported the effects of a three to four week intensive treatment for chronic pain based on ACT. Significant improvements in pain, depression, pain-related anxiety, disability, medical visits, work status and physical performance were found following treatment and at a 3-month follow-up. Two ACT processes were examined in this study: acceptance of pain as measured by the Chronic Pain Acceptance Questionnaire (CPAQ; McCracken, Vowles, & Eccleston, 2004) and values-based action as measured by the Chronic Pain Values Inventory (CPVI; McCracken & Yang, 2006). Changes in acceptance of pain were related to changes in pain, depression, pain-related anxiety, physical and psychosocial disability and physical performance in the pre- to post-treatment interval and changes in values-based action were significantly associated with change in pain, depression and physical and psychosocial disability in the pre-treatment to follow-up interval.

In a randomized controlled trial Wicksell and colleagues (Wicksell, Ahlqvist, et al., 2008) compared treatment as usual (TAU) to a 10-session ACT-based protocol for patients suffering from whiplash-associated disorder. At a seven-month follow-up, ACT demonstrated better results than TAU in terms of disability, life satisfaction, fear of movement, and depression. Mediation analysis showed significant indirect effects for psychological inflexibility, as measured by the Psychological Inflexibility in Pain Scale (PIPS; Wicksell, Renöfält, Olsson, Bond, & Melin, 2008), in relation to changes in disability and life satisfaction. The PIPS is regarded as a measure of avoidance and cognitive fusion.

The role of a wider range of the components of psychological flexibility in the well-being and daily functioning of people with chronic pain has been examined in studies using correlational methods, mostly done at one point in time, without experimental manipulation or application of a treatment. These studies have illustrated the significant role of processes of general psychological acceptance (McCracken & Velleman, 2010; McCracken & Zhao-O'Brien, 2010), acceptance of pain (e.g., Mason, Mathias, & Skevington, 2008; McCracken et al., 2004), mindfulness (McCracken & Velleman, 2010; McCracken, Gauntlett-Gilbert, & Vowles, 2007), value-based action (McCracken & Yang, 2006) and general flexibility itself (McCracken, Vowles, & Zhao-O'Brien, 2010). The study of these varied processes has not yet been done as comprehensively during the course of treatment.

In order to demonstrate that the wider process of psychological flexibility as currently conceptualized is useful in the treatment of chronic pain it is necessary eventually to demonstrate that each of its component processes plays a significant role in treatment outcome. So far process studies of ACT in chronic pain have been limited, mostly constrained by the availability of appropriate validated measures. One way to expand this work is to expand within the process of acceptance. Thus far only specific pain-related acceptance has been studied in this context. An existing measure of general psychological acceptance, the Acceptance and Action Questionnaire (AAQ) (Hayes et al., 2004) could be used to assess acceptance conceived more broadly. It measures acceptance of unwanted thoughts and feelings without a specific focus on pain. Another way to expand this work is to select additional processes not yet examined. Acceptance, cognitive defusion, contact with the present, and self-as-observer are also regarded as the “mindfulness” processes within ACT (McCracken & Thompson, 2009). Hence, in a situation where there are few specific measures for most of the ACT processes, a measure of mindfulness could be used to reflect these. The role of mindfulness in ACT-based treatments has been subject to less study, although recent studies show that increases in mindfulness correlate with treatment effects with ACT (Forman, Butryn, Hoffman, & Herbert, 2009; Kocovski, Fleming, & Rector, 2009).

The purpose of the present study was to investigate a range of treatment processes in ACT for chronic pain that is more comprehensive in comparison to those investigated in previous studies, a range that includes for the first time general psychological acceptance and mindfulness. The simultaneous examination of multiple specific processes is expected to improve targeting of methods to optimize outcomes and to generally aid in treatment development (Kazdin, 2007; Preacher & Hayes, 2008). The specific aims of the present study were twofold. First, we sought to perform a detailed examination of treatment outcomes following an ACT-based treatment in a sample of chronic pain patients not previously studied for this purpose. Second, we sought to conduct treatment process analysis including four treatment processes: acceptance of pain, general psychological acceptance, mindfulness, and values-based action. Consistent with the ACT model, it was expected that patients would report an increase in the four process variables over the course of therapy. It was also expected that these changes would predict outcome such that patients who improved more on these processes would experience larger improvements in emotional, social, and physical functioning. Finally, we predicted that outcome would be more closely related to changes in the components of psychological flexibility than to changes in pain intensity since the focus of treatment was not specifically on reducing pain, but rather on changing how one responds to pain.

Method

Participants

Participants were patients who attended treatment at a tertiary care pain rehabilitation unit in southwest England between September 2006 and June 2009. All participants reported persistent pain of 3 months duration or longer and significant levels of pain-related distress and disability, and agreed with the rehabilitative focus nature of treatment. Participants were excluded from treatment if they required further medical tests or procedures or had conditions sufficient to interfere with participation in a group-based treatment, such as significant cognitive impairment or overwhelming psychiatric conditions. Inclusion and exclusion were determined by assessments from a specialist physician and clinical psychologist prior to being offered treatment. These assessments are primarily pragmatic in nature, for purposes of determining the appropriateness of treatment, and not focused on deriving formal medical or psychiatric diagnoses.

This study included 168 individuals (112 women, 56 men) between the ages of 18 and 77 years ($M = 43.5$, $SD = 13.0$) who completed a three-or-four-week course of interdisciplinary treatment for chronic pain, as well as the three-month follow-up session. The sample of 168 excluded 57 individuals who completed treatment, but did not attend the follow-up. These 57 were excluded because all of the primary analyses involved an examination of outcomes at the follow-up assessment.

The larger proportion of participants was women, 66.7%, as is typically the case in specialty services for chronic pain. Mean age was 46.2 years, $SD = 10.1$. They completed a mean of 13.6 years of education, $SD = 3.6$. They were almost exclusively White European in background, 98.2%. They were mostly married or cohabitating, 58.5%, and the remainder were single, 28.3%, divorced or separated, 11.4%, or widowed 1.8%. They were mostly out of work, 72.3%, and the average time period out of work was 76.5 months, $SD = 69.3$. The largest single group of patients was not working due to pain, 47.6%, followed by retired early specifically due to pain, 21.1%, working part time because of pain, 6.6%, working full time, 6.0%, working part time, 4.2% or other, 14.5%. The median

chronicity of pain was 97.5 months and the “usual pain intensity” on a scale from zero to ten was 7.0, $SD = 1.7$. The most frequently identified primary pain site was low back, 56.6%, followed by lower extremity, 14.5%, full body, 9.4%, upper extremity, 8.8%, neck, 3.8%, or other, 7.0%. Most participants, 66.4%, reported a diagnosis of chronic unspecific pain such as “chronic pain syndrome” or “non-specific musculoskeletal pain”, followed by fibromyalgia, 18.6%, post back surgery pain, 7.2%, complex regional pain syndromes, 6.0%, or other.

Ethical approval for the study was received from the relevant institutional ethics committee and all participants provided written informed consent prior to their data being used in the study.

Measures

Participants completed a series of assessment instruments before and after treatment and at the three-month follow-up. Background characteristics were assessed with an ad hoc questionnaire that also included items about pain onset, duration, location, and so forth. Research assistants supervised the assessments to aid in completion. Missing data occurred in fewer than 5.4% of cases on any single measure.

The measures administered included measures of the primary process variables of interest in this study: acceptance of chronic pain, general psychological acceptance, mindfulness, and values-based action; and outcome measures related to physical, emotional and social functioning and healthcare use.

Chronic Pain Acceptance Questionnaire (CPAQ)

The CPAQ (McCracken et al., 2004) is a measure of pain-related acceptance widely used in people with chronic pain. The 20 items are rated on a 7-point scale and form two subscales: activity engagement, reflecting the pursuit of life activities with pain present, and pain willingness, reflecting a relative absence of attempts to avoid or control pain. The total score was used in the present study to enable analyses of acceptance of pain as a single construct. The CPAQ has repeatedly shown to have good psychometric properties (Vowles, McCracken, McLeod, & Eccleston, 2008). The Cronbach's alpha for the total scale based on the current sample was .85.

Acceptance and Action Questionnaire-II (AAQ-II)

The AAQ-II (Bond et al., submitted for publication) is a 10-item scale developed to assess the same construct as the original AAQ (Hayes et al., 2004). It is a short general measure of psychological acceptance or the willingness to experience unwanted private experiences, such as bodily sensations, emotions, thoughts, memories, in the pursuit of one's values and goals. It is sometimes referred to as a measure of psychological flexibility. Patients are asked to rate each statement on a scale from 1 (never true) to 7 (always true). Higher scores represent higher levels of general acceptance. The AAQ has been showed to have good validity and adequate internal consistency (Hayes et al., 2004). The Cronbach's alpha for the AAQ-II based on the current sample was .88.

Mindful Attention Awareness Scale (MAAS)

The MAAS (Brown & Ryan, 2003) is a 15-item measure of trait mindfulness. Each of the items reflects a relative absence of mindfulness and are rated such that higher ratings indicate less frequency of the response indicated. Hence, higher scores on the 0–6 scale (*almost always* to *almost never*) indicate higher mindfulness. Items include, “I find myself preoccupied with the future or the past” or “It seems I am running on automatic without much awareness of what I'm doing.” The MAAS was chosen as a measure of mindfulness because it is brief and well-validated. The MAAS has

been extensively validated and used in a number of previous studies (Brown & Ryan, 2003; Brown, Ryan, & Creswell, 2007). The Cronbach's alpha for the MAAS based on the current sample was .86.

Chronic Pain Values Inventory (CPVI)

The CPVI (McCracken & Yang, 2006) is a 12-item measure of values-based action for use with people with chronic pain. It asks respondents to rate the importance of the values they hold in six domains of living: family, intimate relations, friends, work, health, and growth or learning; and their success at living according to them on a scale from 0 (not at all important/successful) to 5 (extremely important/successful), respectively. Previous studies using the CPVI have focused on the mean success rating only. The success items have demonstrated adequate internal consistency and construct validity (McCracken & Yang, 2006; Vowles & McCracken, 2008) and sensitivity to change in ACT-based treatment for chronic pain (Vowles & McCracken, 2008). The Cronbach's alpha for the success scale based on the current sample was .86.

British Columbia Major Depression Inventory (BCMDI)

The BCMDI (Iverson & Remick, 2004) is a 20-item self-report measure of depression based on the Diagnostic and Statistical Manual of Mental Disorders (4th edition; DSMIV; American Psychiatric Association, 1994) criteria for major depression. The first 16 items are symptoms that are endorsed if present over the past 2 weeks and then, if present, rated on a scale from 1 (very mild problem) to 5 (very severe problem). The last 4 items measure the impact of these symptoms and problems on day-to-day life with regard to work or school, family and social life activities. These impact scores were not used in the present study. Previous studies support the reliability, validity and clinical usefulness of the test (Iverson & Remick, 2004). The Cronbach's alpha for the BCMDI based on the current sample was .81.

Pain Anxiety Symptoms Scale-20 (PASS-20)

The PASS-20 (McCracken & Dhingra, 2002) is a 20-item measure of pain-related fear and avoidance. Each item is rated on a frequency scale from 0 (never) to 5 (always). Examples of items include, “I think that if my pain gets too severe, it will never decrease,” “I avoid important activities when I hurt,” and “I worry when I am in pain”. The reliability and validity of the PASS-20 are well established (Carleton, Abrams, Asmundson, Antony, & McCabe, 2009; McCracken & Dhingra, 2002). The Cronbach's alpha for the total scale based on the current sample was .92.

Sickness impact profile (SIP)

The SIP (Bergner & Bobbitt, 1981) is a behaviorally based measure of health status. It reflects perceived health-related limitations in 12 categories of activity, such as sleep and rest, home management, social interaction, and so forth, comprising in total 136 statements. All items in the instrument are weighted and an overall score can be calculated as well as scores on the physical and psychosocial dimensions. Higher scores mean more functional disability. The SIP is widely used in healthcare settings and has repeatedly shown to have good psychometric properties (De Haan, Aaronson, Limburg, Hewer, & Van Crevel, 1993; Kalkman, Schillings, Zwartz, van Engelen, & Bleijenbergh, 2007). In the present study we used the physical and psychosocial disability component scores.

Medical visits

Pain-related medical visits over the past 6 months, including GP, specialist visits, and emergency care, were summed based on patient estimates.

Pain intensity

Average pain intensity over the past week was assessed using a 0 (no pain) to 10 (worst possible pain) numerical rating scale.

Treatment

All participants in this study received a treatment program that was a form of Acceptance and Commitment Therapy (Hayes et al., 1999) specifically designed for delivery to groups of patients, in a specialty care setting, and within a coordinated interdisciplinary team consisting of clinical psychology, physical therapy, occupational therapy, nursing, and medicine (McCracken, 2005). Treatment methods explicitly targeted the key processes of the ACT. The primary process targeted is psychological flexibility and the primary goal is improved daily functioning. Particular methods focused on enhancing acceptance of pain and other psychological experiences, contact with the present moment, self-as-observer, cognitive defusion, values, and committed action. Detailed information on treatment philosophy and content can be found in McCracken (2005) and Hayes et al. (1999) and similar methods can be found in Dahl, Wilson, Luciano, and Hayes (2005).

As noted, the duration of the active treatment phase was three to four weeks, depending on a psychological assessment of case severity and complexity. Treatment was delivered primarily in a group format during five days per week for six and one half hours each day. Each treatment day included approximately two and one quarter hours of physical conditioning, one hour of psychological methods, 30 min of mindfulness training, and one hour of activity management, with the remainder of the time devoted to other aspects of skills training and health education. All the methods used by the team of psychologists, physical therapists, occupational therapists, nurses, and physicians were designed not to target pain or other symptoms for removal, but instead to alter the patient's relationship to these experiences so that they could reduce their impact and improve functioning. The psychological sessions were designed specifically to emphasize experiential methods rather than didactic ones. This treatment generally does not include explicit cognitive restructuring or self-statement analyses exercises, strategies to increase self-efficacy, or training in relaxation or other methods aimed at controlling feelings or thoughts. While in treatment patients lived independently in apartments adjacent to the hospital. To ensure treatment integrity, treatment content and patient progress were discussed in supervision sessions, clinical teams meetings (three times per week) and once-weekly clinical seminar meetings.

Statistical analyses

The main goal of the present study was to explore the relationship between ACT processes and outcomes beyond whether the treatment produces a positive impact per se. Hence, the primary analyses focused on relations between process change during the treatment phase in relation to outcome at follow-up. Initially, *t*-tests were used to assess for potential differences among those who attended and did not attend the follow-up appointment. Next, we evaluated treatment outcomes immediately following treatment and at the follow-up. Paired-samples *t*-tests were used to examine improvements over time for all variables and within-subjects effect sizes were calculated according to Cohen (1988). Finally, we examined if the changes in outcomes were significantly related to changes in the four ACT process measures with two sets of analyses. In both analyses, to partly address the temporal order of "process" and "outcome," we

computed *pre-to-post* residualized changes for the hypothesized processes of change and *pre-to-follow-up* residualized changes for outcome measures. First, we calculated an overall correlation matrix of these change scores. Next, hierarchical multiple regression was used to assess the ability of change scores in the four measures representing psychological flexibility to account for variance in the change scores from outcome measures. These analyses also were designed to consider and statistically control the role of relevant patient background variables as well as changes in pain intensity.

Results

Preliminary analysis

From the larger database including the current sample there were no demographic differences between those who attended the follow-up and those who did not attend, except that follow-up completers had slightly more years of education, $t(280) = 1.78, p = .08$. With regard to the primary process and outcome measures, follow-up attenders and non-attenders were not different on any of the process measure or on pain-related anxiety, medical visits, or pain, as measured at pre-treatment, all $t < 1.4$, all $p > .17$. However, those who attended follow-up presented with somewhat lower scores on depression, $t(286) = -2.61, p < .05$, physical disability, $t(303) = -2.48, p < .05$, and psychosocial disability, $t(302) = -2.80, p < .01$.

Impact of treatment

Table 1 summarizes descriptive statistics for all the primary process and outcome measures at pre-, post, and 3-month follow-up. Based on *t*-tests, the patients showed significant improvements in all scores for both time periods, all $t(167) \geq 5.17$, all $p < .001$, for pre- to post assessment scores, and all $t(167) \geq 3.00$, all $p < .005$, for pre- to 3-month follow-up assessment scores.

Fig. 1 shows specific effect size magnitudes for all measures. From pre- to post assessment scores, the overall average effect across all measures was $d = 0.85$ (range: 0.47–1.61). Changes for acceptance of pain, values-based action, depression, pain-related anxiety and psychosocial disability were of a large size. The changes for the remaining variables were medium sized. From pre- to follow-up assessment scores, the Cohen's *d* values were slightly smaller, averaging $d = 0.68$ (range: 0.29–1.42). Nevertheless, improvements over this longer time frame in acceptance of pain, values-based action and pain-related anxiety were of a large size. A medium effect size was seen for psychological acceptance, mindfulness, depression, and physical and psychosocial disability. Changes across time for medical visits and pain intensity were smaller sized.

Table 1
Mean values and standard deviations for all measures over time.

	Pre-treatment		Post-treatment		3-Month follow-up	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Acceptance of pain	48.32	15.68	73.53	19.24	70.57	21.39
Values-based action	1.64	1.04	2.68	1.13	2.42	1.16
Psychological acceptance	38.01	12.53	44.86	13.30	46.09	12.89
Mindfulness	3.66	0.86	4.08	0.86	4.15	0.93
Depression	28.07	12.74	14.93	11.40	18.96	13.51
Pain-related anxiety	48.24	18.27	32.64	19.38	32.26	18.29
Physical disability	0.22	0.12	0.14	0.11	0.16	0.11
Psychosocial disability	0.31	0.16	0.16	0.14	0.20	0.16
Medical visits (past 6 months)	8.88	12.48	—	—	4.89	5.26
Pain intensity	7.02	1.54	6.29	1.77	6.58	1.94

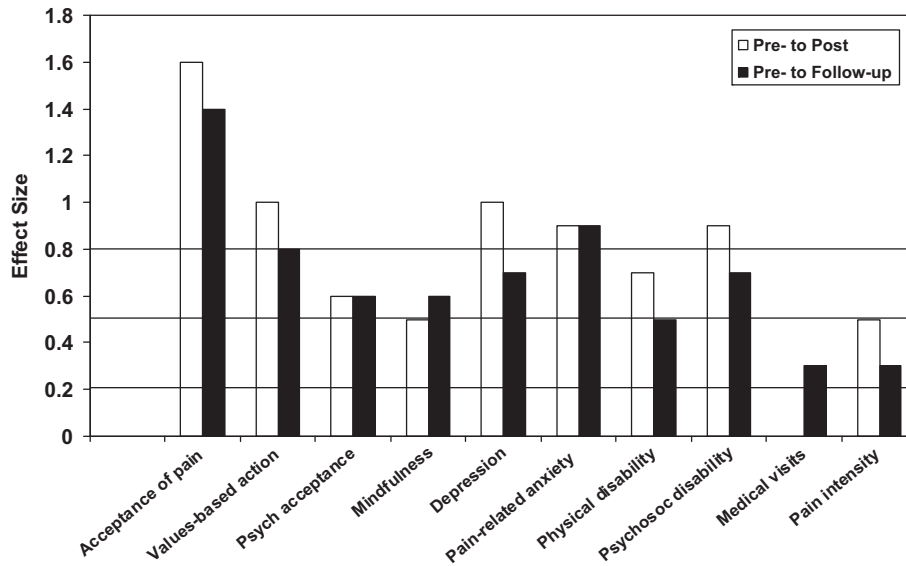


Fig. 1. Within-subject effect sizes (Cohen's d) for all measures. Horizontal reference lines in the figure represent small (0.2), medium (0.5) and large (0.8) effect sizes.

Treatment process analysis

Simple Pearson correlation coefficients between residualized changes in outcome measures and residualized changes in process measures were calculated. As Table 2 shows, there were significant relationships between change scores in the four process measures and change scores in depression, pain-related anxiety and physical and psychosocial disability. All but one of these 16 coefficients met criteria for significance at a level of $p < .01$. However, no significant relations between changes on any process variables and change on the number of medical visits were found. Finally, only changes in acceptance of pain were significantly correlated with changes in pain intensity, with the direction suggesting that greater increases in acceptance of pain were associated with greater reductions in pain intensity.

The correlation analyses also showed that none of the changes in the four process measures was correlated with another at a level that would suggest they were redundant or likely to lead to problems of multicollinearity in regression analyses. All correlations were less than .6, including correlations between change in acceptance of pain and change in mindfulness, $r = .46$, change in psychological acceptance, $r = .55$, and change in values-based action, $r = .40$; correlations between change in mindfulness and change in psychological acceptance, $r = .49$, and values-based action, $r = .33$; and between change in psychological acceptance and change in values-based action, $r = .41$; therefore all process variables were retained for the regression analyses.

We also tested correlations between age, gender, education, and duration of pain with the residualized change scores for the five primary outcome measures and the four process measures. Among these 36 correlations only one was significant at $p < .05$. Age was negatively correlated with change in acceptance of pain between

pre-treatment and follow-up, $r = -.17$, $p < .05$. Hence, older age was significantly associated with less improvement in acceptance of pain, albeit weakly so.

Next, hierarchical regression analyses are carried out to investigate the unique and combined contributions of change scores in the four process measures from pre-treatment to post-treatment in accounting for change scores in outcome measures from pre-treatment to follow-up. First, demographic variables including sex, age, education, and duration of pain were tested and retained in the equations when significant ($p < .05$ to enter, $p > .10$ to remove). Second, change in pain intensity was entered to statistically control its contribution to explained variance in outcome changes. Finally, change scores in the four process measures, acceptance of pain, values-based action, psychological acceptance and mindfulness, were entered into the equation as a block. Variance estimates (ΔR^2), standardized regression coefficients (beta) and squared semi-partial correlation coefficients (sr^2) for these analyses are displayed in Table 3.

As shown in Table 3, and as expected from the correlation analyses, none of the demographic variables accounted for a significant amount of variance in change in any of the outcome measures. Changes in pain intensity entered at Step 1 accounted for an average of 6.8% of pre- to follow-up changes in the outcome measures. Addition of the block of the four primary process variables resulted in a significant increment of the total variance explained by the equations, average total $R^2 = .25$, range 10.0% variance in the equation for medical visits to 34.0% in the equation for psychosocial disability. All the overall models were statistically significant with the exception of the prediction of change in the number of medical visits; all other $F > 5.14$, all $p < .001$. The process variables, acceptance of pain, values-based action, psychological

Table 2

Correlations among residualized change scores of process measures (acceptance of pain, values-based action, psychological acceptance and mindfulness) with residualized changes scores of outcome measures.

	Depression	Pain-related anxiety	Physical disability	Psychosocial disability	Medical visits	Pain intensity
Acceptance of pain	-.31*	-.47**	-.37**	-.31*	-.17	-.32**
Values-based action	-.27*	-.29*	-.25*	-.34**	-.03	-.07
Psych acceptance	-.44**	-.41**	-.40**	-.48**	-.15	-.06
Mindfulness	-.16	-.41**	-.28*	-.33**	-.11	-.14

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

Table 3
Summary of the hierarchical multiple regression analyses predicting pre- to follow-up change scores in outcomes measures from pre- to post-treatment change scores in process measures.

Dependent variable and step	Predictor	ΔR^2	Beta	sr^2
Depression				
Step 1		.10**		
Step 2	Pain intensity	.20***	.30**	.078
	Acceptance of pain		.01	.0001
	Values-based action		-.12	.010
	Psych acceptance		-.44***	.116
	Mindfulness		.14	.012
Total R^2		.30***		
Pain-related anxiety				
Step 1		.05*		
Step 2	Pain intensity	.25***	.11	.012
	Acceptance of pain		-.24*	.032
	Values-based action		-.05	.0025
	Psych acceptance		-.15	.014
	Mindfulness		-.19	.026
Total R^2		.30***		
Physical disability				
Step 1		.02		
Step 2	Pain intensity	.18***	.06	.0036
	Acceptance of pain		-.16	.014
	Values-based action		-.05	.0025
	Psych acceptance		-.26*	.040
	Mindfulness		-.06	.0025
Total R^2		.20***		
Psychosocial disability				
Step 1		.09**		
Step 2	Pain intensity	.25***	.28**	.073
	Acceptance of pain		.12	.0081
	Values-based action		-.17	.023
	Psych acceptance		-.42***	.102
	Mindfulness		-.09	.0049
Total R^2		.34***		
Medical visits				
Step 1		.08**		
Step 2	Pain intensity	.02	.26*	.058
	Acceptance of pain		-.03	.0004
	Values-based action		.06	.0025
	Psych acceptance		-.13	.010
	Mindfulness		-.02	.0004
Total R^2		.10		

* $p < .05$. ** $p < .01$. *** $p < .001$.

acceptance and mindfulness, explained an additional average 18.0% of the variance in outcome measures, even after controlling for change in pain intensity, with the exception of the prediction of the change on medical visits, all other $F > 5.80$, all $p < .001$. In the final equations, at least one of the process variables made the strongest unique contribution in all equations except for medical visits. Psychological acceptance made the strongest unique contribution on three occasions, for depression, physical disability and psychosocial disability, whereas acceptance of pain made a significant unique contribution to the prediction of pain-related anxiety. The beta values for mindfulness and values-based action were lower, and they did not make significant unique contributions in accounting for the changes in outcome variables.

Discussion

This study assessed the outcomes and processes of change in an ACT-based, interdisciplinary, group treatment for chronic pain.

Immediately following treatment and at 3-month follow-up, participants reported significantly lower levels of depression, pain-related anxiety, physical and psychosocial disability, medical visits and pain intensity in comparison to the start of treatment. Almost all effect sizes relative to treatment onset remained at a medium or large level at the 3-month follow-up, with the exception of pain intensity and number of medical visits, which were of a small size. These results support findings from previous studies evaluating ACT-based interventions for people with chronic pain (Dahl, Wilson, & Nilsson, 2004; Vowles & McCracken, 2008; Vowles, McCracken, & Zhao-O'Brien, 2010; Wicksell Ahlqvist, et al., 2008) and add to the overall base of evidence supporting the effectiveness of this treatment approach (Hayes et al., 2006).

The four processes of psychological flexibility included here, acceptance of pain, values-based action, psychological acceptance, and mindfulness, improved significantly over the time periods analyzed. The effect sizes for acceptance of pain and values-based action were large immediately following treatment and at follow-up. In particular, the effect sizes for acceptance of pain were the largest across all assessed variables, which is consistent with one of the explicit goals of treatment. The effect sizes for general acceptance and mindfulness were medium following treatment and at follow-up. Overall, changes in the four processes of psychological flexibility were significantly related to changes in depression, pain-related anxiety, physical and psychosocial disability in expected directions, such that increases in these processes were associated with improvements in functioning. However, no relations between changes in the process measures and the number of medical visits were found.

Across the pre- to follow-up change scores in the various measures of disability and suffering, the pre- to post-change scores in the four process measures, combined to account for much greater variance, average 18.0%, than that explained by changes in pain intensity, average 6.8%. This occurred despite the fact that pain intensity scores were entered at an earlier and statistically advantageous stage in the regression analyses. These findings provide clear support for the model underlying ACT with its primary focus on psychological flexibility (Dahl et al., 2005; McCracken, 2005).

Although this study was not designed primarily to compare the processes underlying psychological flexibility with each other, pattern of findings from the regression analyses suggests that general psychological acceptance had a significant and unique role to play in the improvements achieved by our sample of complex pain sufferers. This finding lends support to the breadth of the ACT model. It is remarkable that change in general psychological acceptance predicted improvements in outcome beyond those accounted for by acceptance of pain. This suggests that improvements following ACT in those suffering from chronic pain result from an increase in a willingness to experience many varied psychological experiences, unwanted emotional experiences, memories, thoughts, urges, other physical symptoms, and so forth. This reflects the frequent observation that the suffering and disability experienced by chronic pain patients do not emerge solely from pain and pain avoidance, but of generalized inflexible patterns of experiential avoidance (Hayes et al., 2006). Inflexible and avoidant responses to pain are presumably specific behavior patterns within a larger functional class of responses coordinated by a context of fusion and control around a wide array of negatively evaluated private experiences, such as anger, depression, fatigue, fear, frustration, guilt and shame, among others. The present data extend preliminary evidence from a cross-sectional study showing that general psychological acceptance had unique relations with the daily functioning of people with chronic pain even when included in a model with other beneficial processes, such as pain acceptance and mindfulness (McCracken & Zhao-O'Brien, 2010).

The present results provide additional support for the broad applicability of ACT and its primary process, psychological flexibility (Hayes et al., 2006). Not only do these results show impact across a range of outcome measures, which is itself remarkable, but they also add another positive result to the growing body of results across a range of conditions. These results include outcome and processes data, usually including some variant of the AAQ, for diabetes management (Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007), for epilepsy (Lundgren, Dahl, & Hayes, 2008), for anxiety and mood problems (Forman et al., 2009; Lappalainen et al., 2007), for psychological distress in the workplace (Flaxman & Bond, 2010), and smoking cessation (Gifford et al., 2004), among others.

As expected, success in valued action improved significantly over the time periods analyzed. Also, the increase in this success was consistently and significantly associated with greater reductions in emotional impacts and disability and greater improvements in functioning. Along with recent process studies examining the role of values (Hayes, Orsillo, & Roemer, 2010; Lundgren et al., 2008; Vowles & McCracken, 2008), the present results provide evidence for another component of the ACT model that has been relatively less studied. However, in the regression analyses, changes in values-based action did not contribute significantly to the measured improvements in the outcome measures. This finding contrasts with an earlier study, in which the long-term beneficial impact of an ACT-based program similar to that used in the present study was mediated by changes in values-based action (Vowles & McCracken, 2008; Vowles et al., 2010). In the previous study, values-based action made significant unique contributions to the prediction of improvements achieved at follow-up. This inconsistency may be in part due to the fact that current study included other process variables from within the same treatment model, general psychological acceptance and mindfulness. Interactions between the different processes in the ACT model over the course of the therapy and during follow-up phases deserve further research.

Patients reported higher levels of mindfulness after the intervention and at the follow-up. Changes in mindfulness were significantly related to changes in pain-related anxiety and physical and psychosocial disability in expected directions. However, the regression analyses did not lend support for mindfulness as a significant unique predictor of outcome. It is difficult to precisely understand the role of mindfulness with the methods employed here. However, a small number of studies have reported mediational results for mindfulness measures in ACT with mixed results. For example, in an open trial of ACT for social anxiety, Kocovski et al. (2009) found that changes in mindfulness were significantly correlated with changes in social anxiety, but further regression analyses did not lend further support for mindfulness as possible mediator. In another open trial of ACT for weight loss, Forman et al. (2009) found that mindfulness only emerged as a potential mediator at 6-month follow-up. More robust support for mindfulness per se as a key process within ACT awaits future studies that utilize more precise, specific, and formal, process analyses, or dismantling methodologies.

An interesting unpredicted result emerged from a set of somewhat peripheral analyses of age, gender, education, and duration of pain. With one exception none of these variables was significantly correlated with changes in outcome or process variables. The one exception was a small, significant, negative correlation between age and acceptance of pain. This pattern of results suggests that ACT as studied here is equally effective regardless of age, gender, education, or duration of pain.

Several limitations of the study should be noted. First, the absence of randomization and an appropriate control condition means that we cannot unambiguously attribute treatment effects to the ACT-based treatment. However, the combination of strong outcomes in patients with long term and intractable conditions, and the pattern of

results involving the process measures, suggest that the present findings would be unlikely except from some specific processes of treatment. Besides, previous randomized controlled trials have shown that ACT for chronic pain (Dahl et al., 2004; Wicksell, Ahlqvist et al., 2008; Wicksell, Olsson, & Hayes, 2010) yields significant improvements in outcome measures such as life satisfaction, pain, disability and healthcare use, and that increased psychological flexibility explains at least some variance in these results. A second weakness of the study was that the effect size for medical visits was somewhat modest and that the addition of the processes of psychological flexibility to the corresponding regression equation did not reliably improve the explained variance in this outcome. These results may be in part due to the large baseline standard deviation in medical visits scores, which suggests that the method used to quantify it could need more development. Further experience may lead us to refine this measure, and to better capture direct and indirect costs, as is needed in treatment cost-effectiveness research.

It should be noted that the processes of psychological flexibility examined are conceptualized as dynamic behavioral patterns and are technically complex to measure. In a sense we remain in our first generation of instruments development in this area and future improvements are practically inevitable. For many of the measures used here the ability to report on the behavior patterns included in the measures interacts with the behavior patterns assessed. For example, when a person lacks mindfulness skills they are often unaware of how “mindless” their behavior is. The reporting of acceptance and values tend to have a similar quality – in treatment one learns to be more accurate *and* to change the quality of one’s behavior at the same time. Future studies of ACT and pain also may benefit from including measures of additional aspects of the model that were not well-reflected in present study, such as cognitive defusion (Gutiérrez, Luciano, Rodríguez, & Fink, 2004; Páez-Blarrina et al., 2008). ACT process research may gain from more measurement intensive designs, from using more varied assessment methods, from collecting process data more frequently during the course of treatment and follow-up, and analyzing it in a way that will allow a detailed examination of the relations of process variables and outcome change. Shared method variance is a perennial problem in research designed as done here. Heavy reliance on retrospective self-report measures ought to be supplemented with more direct measures that are done closer in time and in situation to the behavior patterns of interest and with a mix of methods that reduce the possibility of method effects inflating observed relations. Finally, it will be important to examine the repeatability, long-term stability, and generality of these effects. Although, such an analysis of longer term (three-year) follow-up is currently being done by our research group based on a separate patient sample (Vowles et al., 2010).

Along with limitations, this study also has several methodological strengths, such as the size of the sample, chronicity of the disorder, clinical significance, measurement of key process variables, and the inclusion of follow-up assessment. These features and the data we present add some momentum to the empirical progress being made in relation to ACT in general (Gaudiano, 2009; Levin & Hayes, 2009).

Despite limitations, the current study adds to existing research into ACT-based treatments for chronic pain, particularly in the broader range of process measures used. We have shown that changes in processes of psychological flexibility appear to participate in important ways in patient outcomes, such as their level of emotional suffering and their physical and social functioning, above and beyond change in pain intensity. It seems worthwhile for clinicians to continue to improve their skills with ACT-based methods and for researchers to continue to design treatment studies more creatively, and examine treatment data more carefully, to promote this growing body of work.

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