



Citation for published version:

Crombez, G, Viane, I, Eccleston, C, Devulder, J & Goubert, L 2013, 'Attention to pain and fear of pain in patients with chronic pain', *Journal of Behavioral Medicine*, vol. 36, no. 4, pp. 371-378. <https://doi.org/10.1007/s10865-012-9433-1>

DOI:

[10.1007/s10865-012-9433-1](https://doi.org/10.1007/s10865-012-9433-1)

Publication date:

2013

Document Version

Peer reviewed version

[Link to publication](#)

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Running Head: PATTERNS OF ATTENTION AND FEAR OF PAIN IN CHRONIC PAIN

Attention to pain and fear of pain in patients with chronic pain

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This study was supported by a research grant from the Fund for Scientific Research, Flanders (Belgium).

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Abstract

Objective: to investigate how acceptance of illness affects chronic pain in terms of attention towards pain and fearful thinking of pain.

Methods: 62 participants (50 women) with chronic pain carried a palmtop computer for two weeks. Eight times each day auditory signals were delivered to cue participants to complete questions about their experience.

Results: Multilevel analyses indicated that on moments with more intense pain, more fearful thinking about pain, and less positive emotions, attention to pain was increased. Illness acceptance did not moderate the relation between pain intensity and attention to pain. Results further indicated that on moments with more intense pain, more negative emotions, and less positive emotions, fearful thinking about pain was increased. Of particular interest was the finding that the relationship between pain intensity and fearful thinking about pain was less strong for those high in acceptance.

Conclusions: Pain captures attention and elicits fearful thinking about pain. Acceptance may be a useful avenue to lower negative thinking about pain, and to increase well-being in patients with chronic illnesses.

Keywords: chronic pain, acceptance, attention, fear

Introduction

We seek a better understanding of the intriguing problem of why many people with chronic pain develop extensive disability and distress that cannot be explained by the severity of disease, illness or injury. A large number of factors may contribute to the variability in distress and disability, both between individuals presenting with similar problems, and within individuals in different situations. A promising line of investigation has been into how ‘attention’ is assigned to pain (Eccleston & Crombez, 1999; Legrain et al., 2009), and the consequences of its deployment (Moriarty et al, 2011). This study focuses on a neglected feature of attentional allocation: Specifically, attention to pain as it occurs in the natural ‘everyday’ environments in which people experience chronic pain. Within this ‘everyday’ environment we also investigate the potential role of acceptance as a moderator of attention and of the fearful experience of chronic pain.

How and when pain demands attention has been studied largely in the laboratory with student volunteers and controlled pain stimuli. Under experimental conditions, several variables have been isolated that are now known to determine the attentional demand of a pain stimulus. Using a primary task paradigm in which participants are instructed to ignore pain while performing an attention-demanding task, impairments in task performance are used as indicators of the interruption of attention by pain (Crombez et al, 1994). Using this paradigm, several pain-related variables that moderate interruption by pain have been identified, such as novelty (Crombez et al, 1996, 1997) and temporal unpredictability (Crombez et al., 1994). Also the fearful apprehension of pain is known to amplify the interruption of attention by pain (Crombez et al., 1998). Further, those with an exaggerated tendency to negatively interpret actual or anticipated pain experiences, i.e. catastrophizing, show a larger interference of attention by pain in comparison with controls (Crombez et al.,

1998; Heyneman et al., 1990; Vancleef & Peters, 2006), and, more specifically, a pronounced difficulty disengaging attention from pain, once detected (Van Damme et al., 2002, 2004).

Attentional interference has also been studied cross-sectionally in clinical pain populations. Greater pain intensity and a higher threat value of pain both facilitate attention to pain in chronic pain patients (Crombez et al., 1999; Eccleston, 1994). In addition to these laboratory studies, self-report studies further validate the importance of the threat value of pain for attention in clinical populations (Goubert et al., 2004; Roelofs et al., 2003).

The study of individual differences of how patients with chronic pain respond to repeated daily interruption by pain has also proven fruitful. In particular, patient pain management habits and beliefs as to how far to accept pain and disability have emerged as important (McCracken et al., 2004). When confronted (again) with pain and its consequences for daily living, some patients may sometimes persevere with unproductive and historically unhelpful efforts to relieve pain by avoidance, help-seeking, and a rigid focus on pain as the sole problem. The ensuing struggle to control pain, and to achieve the largely unachievable goal of pain relief, may become dominant, and for many patients life-defining (Eccleston & Crombez, 2007). The obverse to struggling to control pain is an acceptance of chronic pain involving both an ability to be in pain without struggle, and being able to engage in meaningful life activities despite pain. Such acceptance may help patients to regulate everyday life despite chronic pain (Vowles & McCracken, 2008). Patients with an accepting attitude have reported more successful adjustment to chronic pain, as measured by self-reported depression, anxiety and disability (McCracken, 1998; Viane et al., 2003), and adaptive copers showed greater acceptance of pain compared to dysfunctional patients (McCracken et al., 1999; Vowles & McCracken, 2008).

Although research into psychological processes of attention has been relatively fruitful there are significant weaknesses in the evidence base that arise largely from methodological limitations (Shiffman & Stone, 1998). First, we need translational studies to extend laboratory findings into ecological and natural settings. Second, investigations of psychological variables rely heavily on the use of retrospective self-report. Asking patients to report on their beliefs about their experience introduces the chance of incomplete and inaccurate recall (Erskine et al., 1990). Third, there has been an emphasis on the assessment of attention for a single task, or as an individual difference variable. The dynamic process of the moment by moment appraisals of pain has only rarely been investigated.

The main objective of this study is to study attention for pain and fearful thinking about pain as they occur in the daily lives of chronic pain patients, using a within subject design and diary assessment methods. A second objective is to investigate the potential moderating role of acceptance on attention to pain and fear of pain. We aimed to assess immediate experiences in the natural environment of the individual using Ecological Momentary Assessment (Shiffman & Stone, 1998; Stone & Shiffman, 1994), or Experience Sampling Method (Csikszentmihalyi & Larsen, 1987; Delespaul, 1995). We studied the relationship between daily attention for pain, pain intensity and fearful thinking of pain, and the individual differences in these within-person relationships. This investigation was in three parts. First, we assessed daily associations between attention to pain, pain intensity and fearful thinking about pain. Second, we tested whether individual differences in acceptance were associated with attention to pain and whether acceptance moderated the relationship between daily reported pain intensity and attention to pain. Third, we explored whether individual differences in acceptance were associated with fearful thinking of pain and whether acceptance moderated the relationship between daily reported pain intensity and fear.

Method

Participants

This study concerns a secondary analysis of data. Details of sampling frames and methods have been described in detail in a previous study (Viane et al., 2004) and are reviewed here briefly. Seventy-three participants were recruited in this study. However, 11 participants were excluded from the statistical analyses because of insufficiently valid diary entries, largely because of technical problems or because participants voluntarily skipped signals, leaving a final sample of 62 participants. Participants were 50 women and 12 men with chronic pain ($M_{age} = 46.11$ years, age range: 22-65 years), recruited from a self-help group of fibromyalgia patients ($N = 16$) and from a pain clinic at a university hospital ($N = 46$). All participants were Caucasian. The majority of the patients were married or cohabiting (75.8%); 24.2% had a high education level (more than twelve years of education). Forty-eight patients (77.4%) reported that their pain started gradually and 46.8% used pain medication three or more times a day. The majority of the patients reported back pain and/or lower extremity pain (40.3%) and widespread pain (33.9%). All patients gave their informed consent to participate and the study was approved by the ethics committee of the faculty.

Measures

Electronic diary assessment. For two weeks patients carried a palmtop computer. Eight times each day auditory signals (beeps) were delivered on the palmtop at randomly selected times to cue participants to complete questions about their experience of pain, medication use and mood. Diary reports were considered valid when participants responded to the beep within 15 minutes. In order to be included in the analyses, participants were instructed to respond validly to at least two-thirds of the emitted beeps. During an initial session, study aims and procedures were explained and the use of the electronic diary was

practiced. Each participant was given a guidebook and was informed that telephone assistance was available when problems arose with the palmtop computer. Each participant was paid 60 euro for completing the two-week diary. Questions were presented one at a time in a fixed order. Items were answered on a 7-point scale, labelled 'not at all' to 'very much'. The total diary took approximately 5 minutes to complete. *Pain Intensity* was assessed by means of the item 'Right now, I am in pain'. *Attention to pain* was measured by adapting one item of the Pain Vigilance and Awareness Questionnaire (PVAQ; McCracken, 1997): 'Right now, I am focussing on my pain'. This item is indicative of active vigilance, which has been found to be positively associated with pain-related anxiety (Roelofs et al., 2003; Wong et al., 2011). *Fearful thinking about pain* was measured by aggregating scores on two items: 'Right now, I have the feeling that the pain is getting too much' and 'Right now, I am afraid of the pain'¹. *Positive affect* and *negative affect* were aggregated, resulting in two variables of well-being. We examined the moods 'cheerful', 'relaxed', 'happy', 'sad', and 'fearful' based on the Larsen and Diener's (1992) mood circumplex model. We also included 'frustrated' because of its relevance to the chronic pain situation.

Self-report instruments. *Acceptance* was measured by the Illness Cognition Questionnaire (ICQ; Evers et al., 2001) at the first day of the two-week period. The ICQ is an instrument assessing cognitions that reflect different ways of re-evaluating the aversive meaning of chronic illness. Three generic illness cognitions are assessed: Helplessness (6 items, e.g., "my illness frequently makes me feel helpless"); *Acceptance* (6 items, e.g., "I have learned to accept the limitations imposed by my illness"); and Disease Benefits (6 items, e.g. "dealing with my illness has made me a stronger person"). The validity of the ICQ has been supported by positive correlations with physical and psychological health status, personality

¹ Separate analyses with each item of the fearful thinking about pain scale revealed similar effects as the analyses with the two items aggregated.

dimensions, coping and social support (Evers et al., 2001; Lauwerier et al., 2010). In this study only the acceptance subscale was used for statistical analyses.

Multilevel Analyses

Because our data have a hierarchical structure with multiple daily observations nested within one participant, we conducted multilevel regression analyses with Hierarchical Linear Modelling (Raudenbush & Bryk, 2002). In hierarchically structured data, variability in outcome measures can be constructed with a Level 1 model, representing sources of within-person variability, and a Level 2 model, representing sources of between-person variability. In our study, level 1 variables consisted of the multiple daily observations, and level 2 variables consisted of between-person variables such as gender, age, education, pain duration, and acceptance as measured by the ICQ. Level 1 variables were group mean centered to eliminate the influence on parameter estimates of individual differences in level 1 variables (Nezlek, 2001). Continuous level 2 variables were standardized and grand mean centered to allow for comparisons across patients and for clearer interpretation of coefficients. The level 2 variable gender was dummy coded and entered into the equations as uncentered (0 = females; 1 = males). Full maximum likelihood estimation was used for all models. In our analyses we followed a model building procedure (Raudenbusch & Bryk, 2002). When effects proved to be non-significant, we excluded them from further steps in model building to maximize stability and reliability of the findings (Kreft & De Leeuw, 1998). The moderator role of acceptance was investigated in the last step of model building. Models included random intercepts and random slopes. Effect sizes r were calculated according to the formula provided by Kenny et al. (2006), with $r = .10$ indicating a small effect, $r = .30$ a medium effect, and $r = .50$ a large effect (Cohen, 1988). Analyses were conducted using the HLM software package (Version 6.01).

Results

Characteristics of the diary data

The mean number of diary entries was 92.5 (range 70-112), giving a total of 5735 recorded entries. Patient compliance with the scheduled random electronic diary reports was good, over 88%. A large majority (95%) considered the 2-week period of diary recording as representative of their normal life, according to debriefing interviews. Three participants reported differences in daily routine because of loss of job, or of sickness.

Attention to pain

We investigated whether (a) momentary pain intensity, fearful thinking about pain, and positive and negative mood had an effect on attention to pain, (b) between-person variables (acceptance, age, gender, education and pain duration) affected attention to pain, and (c) the within-person association between pain intensity and attention to pain varied as a function of acceptance.

Initial analyses indicated that there was substantial variance in attention to pain between the momentary assessments within participants (variation within participants = 49%), and also between participants (variation between participants = 51%). First, we investigated whether momentary pain intensity, fear of pain, and positive and negative mood (Level 1 variables) had an effect on attention to pain. This model proved to be a better explanation of the data than a model including no variables, $\chi^2(18) = 3530.93, p < .0005$. About 35% of the variance was explained by the level 1 variables. Results indicated that on daily moments with more pain (Coefficient = .30, $t(61) = 10.26, p < .0005$), more fearful thinking about pain (Coefficient = .43, $t(61) = 12.94, p < .0005$), and less positive emotions (Coefficient = -.09, $t(61) = -3.15, p < .005$), attention to pain was increased. There was no effect of negative emotions (Coefficient = .02, $t(61) = .67, ns$). In sum, this analysis revealed that pain intensity,

fear of pain, and positive emotions had a unique value in explaining attention to pain. Because the effects of negative emotions were not significant we excluded this variable from our model.

Second, we included the between-person variables acceptance, age, gender, education, and pain duration in our model to investigate whether these between-person variables affected attention to pain. This model proved to be better than a model including only the Level 1 variables, $\chi^2(5) = 13.06, p < .05$. The Level 2 variables accounted for 20% of the between-person variance. Analyses revealed that when participants reported being more accepting (Coefficient = $-.41, t(56) = -2.57, p < .05$), they reported less attention to pain. In sum, this analysis revealed that acceptance contributed significantly in explaining attention to pain, beyond the effects of the level 1 variables, namely pain intensity, fear of pain, and positive emotions. Because the effects of age, gender, education, and pain duration were not significant, they were dropped from the final model.

Third, we entered acceptance as a cross-level moderator of the Level 1 relationship between momentary pain intensity and attention to pain. The results for this model, however, did not indicate that acceptance moderated the relationship between pain intensity and attention to pain (Coefficient = $.01, t(60) = .40, ns$). Results of the final model are summarized in Table 1.

- Insert Table 1 about here -

Fearful thinking about pain

We hypothesized that fear of pain is associated with both daily observation-level variables (momentary pain intensity, positive and negative mood) and individual level variables (age, gender, education, pain duration, and acceptance). We assessed (a) whether momentary pain intensity, positive and negative mood have an effect on momentary fearful

thinking about pain, and (b) how these within-person associations varied as a function of acceptance.

Initial analyses indicated that there was substantial variance in fearful thinking about pain between the momentary assessments within participants (variation within participants = 35%), and also between participants (variation between participants = 65%). First, we investigated whether momentary pain intensity, positive and negative mood (Level 1 variables) were associated with fear of pain. Our model explained the data better than a model including no variables, $\chi^2(12) = 3142.60, p < .0005$. About 32% of the variance was explained by the level 1 variables. Results indicated that on daily moments with more intense pain (Coefficient = .34, $t(61) = 11.16, p < .0005$), more negative emotions (Coefficient = .21, $t(61) = 7.08, p < .0005$), and less positive emotions (Coefficient = -.05, $t(61) = -2.29, p < .05$), fearful thinking about pain was increased. In sum, this analysis revealed that pain intensity, negative emotions, and positive emotions had a unique value in explaining fearful thinking about pain. Because all variables proved to be significant, none were dropped from our model.

Second, we included the between-person variables acceptance, age, gender, education, and pain duration in our model to investigate whether these between-person variables affected fear of pain. This model proved to be no better than a model including none of these predictors, $\chi^2(5) = 3.74, ns$. The Level 2 variables accounted for about 19% of the between-person variance. Level 2 variables revealed no significant effects. Because the effects of age, gender, education, and pain duration were not significant, they were excluded from the final model. However, acceptance remained in our model to allow cross-level moderation with this variable.

Third, we entered acceptance as a cross-level moderator of the Level 1 relationship between momentary pain intensity and fearful thinking about pain. This model explained the data better than the previous model without cross-level moderator, ($\chi^2(3) = 11.46, p = .01$). The results for this model revealed that acceptance moderated the relationship between pain intensity and fearful thinking about pain (Coefficient = $-.10, t(60) = -4.12, p < .0005$). The negative value for acceptance indicated that although the overall relationship within persons between pain intensity and fearful thinking about pain was positive (Coefficient = $.34, t(60) = 12.17, p < .0005$), this relationship was less strong for those high in acceptance. Results of the final model are presented in Table 2.

- Insert Table 2 about here -

Discussion

This study used a diary methodology to address within-subject relationships between attention to pain, pain intensity, fearful thinking about pain, and to provide insight into the role of acceptance on daily attention to pain and fearful thinking about pain. The objective was to replicate and extend prior research into the natural environment of patients with chronic pain.

Results are in line with the idea that pain is a strong demand for attention (Eccleston & Crombez, 1999; Legrain et al., 2009). When patients experience increases in their pain, attention to pain also increases. This finding adds to the accumulating evidence that pain is more than a sensory and affective experience. Pain has a profound impact upon our cognitive system (Moriarty et al., 2011). Pain is a biologically hard-wired signal of bodily threat, and functions effectively to capture attention. Even with repeated experience, as in the case of patients with chronic pain, the interruptive function of pain does not dissipate. Attention to pain is not solely dependent upon pain intensity. The fearful apprehension of pain also plays a

role. When patients experience more fearful thoughts about pain, they attend more to pain. There is a large body of experimental evidence illustrating that fear installs a behavioural pattern of hypervigilance (Crombez et al., 2005; Eysenck, 1992; Legrain et al., 2009). It is reasonable to assume that on occasions when cognition is dominated by fear of pain content, that attention to body and pain increases and one can become more aware of pain or pain-related information. Our data further suggest that attention to pain should not entirely be considered as a trait-like, stable disposition. Hypervigilance is often discussed as a disposition to scan the body for threatening information (Chapman, 1978; Watson & Pennebaker, 1989). However, a large part of the variance in our data is within subject: participants' experiences change throughout and between each day. Attention to pain should be considered state-like and dynamic, revealing its sensitivity to changes or challenges in the environment.

Of particular interest in this study was the role of acceptance of pain upon attention to pain. We found that acceptance lowered average levels of attention to pain. However, contrary to our expectation, acceptance did not moderate the relationship between pain intensity and attention to pain. This means that patients higher in acceptance do not necessarily pay less attention to pain when their pain is more intense. It may be that not the direction, but the content of attention is of critical importance for acceptance (Cioffi, 1991; McCracken, 1997; McCracken, 2007). Patients high in acceptance may have a more open, more permissive attention to pain, whereas patients low in acceptance may be characterized by a defensive attention to pain (Crombez et al., 2005). Accepting patients are then overall less motivated to avoid pain and are less preoccupied overall with pain. However, in daily confrontation with pain, pain may continue to demand attention and interrupt daily tasks.

A final objective was to explore patterns of fearful thinking about pain in the daily life of patients. We found that when patients experience more intense pain, they also had more

fearful thoughts about it. Intriguingly, this relationship was moderated by individual differences in acceptance, and this effect had a medium effect size. We found that for patients with higher levels of acceptance, pain intensity was less strongly related to fearful thoughts about pain. Pain seems to be less able to trigger a pattern of negative thinking about pain in those patients who accept their pain. This is in line with a contextual approach on acceptance as a willingness to experience pain in an open and non-reactive way, not trying to avoid or control pain (McCracken et al., 2004). To our knowledge only one study has reported a similar finding (Kratz et al., 2007). In this study, however, pain patients completed only weekly reports of pain severity, negative affect and positive affect. Results indicated that increases in negative affect during pain exacerbations were buffered by higher levels of pain acceptance.

A final noteworthy finding in our study concerns the role of positive affect. We found that when patients feel good, they attend less to pain. These findings add to the growing recognition of the significance of positive affect in adjustment to chronic pain (Davis et al., 2004; Hamilton et al., 2004; Zautra, et al., 2005). Our results support the idea that emotional states may influence pain through its impact on attention regulation. As yet it is unclear how positive affect decreases attention to pain in daily life. According to the broaden-and-build theory of positive emotions (Fredrickson & Joiner, 2002), positive emotions broaden the scope of attention and cognition, enabling flexibility and creative thinking. As a result when increases in positive affect are experienced, attention may be less rigidly focused upon pain, and fewer fearful thoughts about pain may be triggered. An alternative hypothesis is that activities that elicit positive emotions are powerful in maintaining attention to these activities, and, as a result, patients are less distracted by pain. Indeed, there is evidence that engagement

with pleasant pictures increase pain tolerance (de Wied & Verbaten, 2001). More research is needed to explore these different explanations.

This study has some limitations. First, it is possible that the patients who volunteered for the study may not be representative for all patient groups. Our sample was fairly homogeneous in terms of sociodemographic and pain characteristics. Further research is needed to demonstrate whether our results can be replicated with patients with other complaints, or recruited via different procedures. Second, a diary methodology may interfere with the daily routines of some participants or they may cause patients to attend to their pain more and therefore may increase awareness of pain and its consequences. Although possible, it should be noted that research on keeping diary records in pain patients found little support for reactive effects (Cruise et al., 1996; Stone et al., 2003). Third, the sample size in this study was small, predominantly due to difficulties with the recruitment of the patients into a time intensive study. Fourth, our measure of attention to pain may have been unable to distinguish between two modes of attention to pain. Attention to pain may occur in an open-minded, accepting attitude to pain, or in a narrowly focused, defensive way (Cioffi, 1991; McCracken, 2007). Fifth, acceptance in our study was measured by the Illness Cognition Questionnaire (Evers et al., 2001), but other instruments, developed from different theoretical backgrounds exist (De Vlieger et al., 2006; McCracken, 1998). Previous research has shown that acceptance measures only correlate moderately (Viane et al., 2003; De Vlieger et al., 2006). Hence, research is warranted that identifies the (dis)similarities in content of these questionnaires. Finally, this study is not experimental, and the nature of the within-subject data is cross-sectional. Therefore, one should be cautious about making causal inferences about the observed relationships.

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Table 1

Final hierarchical linear model assessing the impact of acceptance upon attention to pain

	<i>Coefficient</i>	<i>SE</i>	<i>t</i>	<i>Effect size r</i>
Intercept (γ_{00})	2.83	.13	21.60***	
Acceptance (ICQ) (γ_{01})	-.40	.15	-2.68*	.28
Pain intensity (γ_{10})	.30	.03	10.09***	.56
Positive mood (γ_{20})	-.09	.03	-3.57**	.29
Fearful thinking about pain (γ_{30})	.44	.04	11.83***	.59

Note. Regression equation: $Y_{ij} = \beta_{0j} + \beta_{1j}(\text{pain intensity}) + \beta_{2j}(\text{positive mood}) + \beta_{3j}(\text{fearful thinking about pain}) + r_{ij}$, with $\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{acceptance}) + u_{0j}$, $\beta_{1j} = \gamma_{10} + u_{1j}$, $\beta_{2j} = \gamma_{20} + u_{2j}$ and $\beta_{3j} = \gamma_{30} + u_{3j}$.

ICQ = Illness Cognition Questionnaire (Evers et al., 2001)

* $p < .05$; ** $p < .005$; *** $p < .0005$

Table 2

Final hierarchical linear model assessing the impact of acceptance upon fearful thinking about pain

	<i>Coefficient</i>	<i>SE</i>	<i>t</i>	<i>Effect size r</i>
Intercept (γ_{00})	2.28	.13	17.63***	
Acceptance (ICQ) (γ_{01})	-.45	.14	-3.27**	.35
Pain intensity (γ_{10})	.34	.03	12.17***	.50
Positive mood (γ_{20})	-.05	.02	-2.28*	.43
Negative mood (γ_{30})	.21	.03	7.17***	.17
Pain intensity x Acceptance (γ_{11})	-.10	.02	-4.12***	.40

Note. Regression equation: $Y_{ij} = \beta_{0j} + \beta_{1j}(\text{pain intensity}) + \beta_{2j}(\text{positive mood}) + \beta_{3j}(\text{negative mood}) + r_{ij}$, with $\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{acceptance}) + u_{0j}$, $\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{acceptance}) + u_{1j}$, $\beta_{2j} = \gamma_{20} + u_{2j}$ and $\beta_{3j} = \gamma_{30} + u_{3j}$.

ICQ = Illness Cognition Questionnaire (Evers et al., 2001)

* $p < .05$; ** $p < .005$; *** $p < .0005$