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An electronic diary assessment of the effects of distraction and attentional focusing on pain intensity in chronic low back pain patients

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Objective. The present study examined the effects of a manipulation of attention to pain (i.e. attentional focusing vs. distraction) on pain intensity in daily life of patients with chronic low back pain. It was hypothesized that attentional focusing would lead to decreased pain intensity in high pain fearful individuals, whereas distraction from pain would be associated with decreased pain intensity in low pain fearful individuals.

Design. An experience sampling methodology was used to examine the effects of a manipulation of attention to pain on pain intensity in daily life of pain patients.

Methods. A total number of 38 patients with chronic low back pain participated in this study and carried a palmtop computer for 2 weeks. During this period, patients were 'beeped' 8 times a day to complete diary questions. On certain days, instructions to either attend to or distract from pain were given.

Results. Multi-level analyses showed that attentional focusing was not associated with decreased pain intensity in high pain fearful individuals and that distraction did not lead to decreased pain intensity in low pain fearful individuals. The manipulations in isolation neither influenced pain intensity. The manipulation check was generally weak.

Conclusion. A manipulation of attention to pain in daily life of patients with chronic low back pain proved difficult to accomplish. As the manipulation check was generally unsuccessful, no clear inferences about the underlying theory can be made. Future research within the field of pain treatments (e.g. *in vivo* exposure) might benefit greatly from electronic diary assessments studies.

The 'fear-avoidance model of exaggerated pain perception' has been postulated as a biopsychosocial model to explain how and why some individuals with an acute pain state develop a chronic pain syndrome (Lethem, Slade, Troup, & Bentley, 1983).

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The central concept in this model is avoidance of movement or activities as a result of pain-related fear. Philips (1987) has stressed the importance of cognitions influencing avoidance behaviour. Based on the work of Lethem *et al.* and Philips, the 'fear-avoidance' model has lately been refined into a cognitively oriented model of pain-related fear in chronic musculoskeletal pain. A behavioural mechanism is posited whereby fear of movement and (re)injury might contribute to the maintenance of chronic pain (Asmundson, Vlaeyen, & Crombez, 2004; Vlaeyen, Kole-Snijders, Boeren, & Van Eek, 1995; Vlaeyen, Kole-Snijders, Rotteveel, Ruesink, & Heuts, 1995; Vlaeyen & Linton, 2000). According to this model, if individuals catastrophize about their pain, pain-related fear may evolve. This leads to increased attention (hypervigilance) to bodily sensations and pain, and avoidance behaviours. Subsequently, a chronic pattern of disability, depression and disuse is maintained. Depression and disuse are known to be associated with decreasing pain tolerance and may promote the painful experience. The pain experiences fuel the cycle of increasing fear and avoidance, creating a vicious circle. In contrast, non-catastrophizing patients do not become fearful, and are more likely to confront daily activities, leading to (fast) recovery.

The relation between fear of pain, attention to pain and pain perception

According to the cognitive theory of anxiety put forward by Eysenck (1992), the most important function of anxiety is facilitating the early detection of potentially dangerous stimuli. Anxiety represents a shift into a mode of hypervigilance (increased attention), such that the person scans the environment for threatening stimuli. In the case of chronic pain, one may expect that high fearful individuals are hypervigilant towards pain and other somato-sensory signals. One may also expect that the pain experience is more intense in individuals having high levels of hypervigilance. Unravelling the relations between pain-related fear, hypervigilance and pain intensity has been challenging for many pain researchers. Several experimental studies conducted in chronic low back pain patients and fibromyalgia patients have produced mixed results with respect to the associations between pain-related fear and hypervigilance, and between hypervigilance and pain report as measured with various self-report measures (Crombez, Vervaet, Lysens, Baeyens, & Eelen, 1998; Ferguson & Ahles, 1998; Peters, Vlaeyen, & Kunnen, 2002; Peters, Vlaeyen, & Van Drunen, 2000; Roelofs, Peters, & Vlaeyen, 2002; Roelofs, Peters, & Vlaeyen, 2003). Some experimental studies have examined the effect of a manipulation of attention to pain (i.e. distraction and attentional focusing) on the pain perception. Studies examining the effects of distraction on the pain experience have produced mixed results (e.g. McCaul, Monson, & Maki, 1992). It has been suggested that the effect of distraction on reducing the pain experience may depend on the level of pain-related fear. That is, distraction may only be beneficial for low pain fearful individuals (e.g. Hadjistavropoulos, Hadjistavropoulos, & Quine, 2000; Heyneman, Fremouw, Gano, Kirkland, & Heiden, 1990; Roelofs, Peters, Van der Zijden, & Vlaeyen, 2004). With respect to attentional focusing, Leventhal and Everharts's parallel processing model postulates that focusing on sensory aspects of the pain stimuli is beneficial as it prevents the distress schemata from activation. Attention is directed away from the emotional schema and is refocused on a more neutral schema (Leventhal, 1982, 1990, 1992; Leventhal, Brown, Shacham, & Engquist, 1979; Leventhal & Everhart, 1979). Previous research has suggested that especially high pain fearful individuals may profit from attentional focusing on pain (see Roelofs *et al.*, 2004). Taken together, there is some evidence to suggest that pain-related fear moderates the relation between attention to pain and pain perception.

The use of diary studies in examining the relation between fear of pain, attention to pain and the pain perception in daily life

Despite the numerous methodological strengths of experimental studies, a potential drawback is that the measurement of pain intensity is based on self-report measures that are completed by individuals at a single moment in time. These measures rely on people's ability to accurately recall pain over a considerable number of days. There are two limitations of recall-based pain questionnaires. First, recall is an active reconstruction process likely to distort past experiences. Second, retrospective assessments do not provide information about the variability of the pain constructs. These two limitations are the major reasons for the growth in the popularity of pain diaries. Momentary sampling strategies such as Ecological Momentary Assessment (EMA; Hufford, Shiffman, Paty, & Stone, 2001; Shiffman & Stone, 1998; Stone & Shiffman, 1994) and the Experience Sampling Method (ESM; Csikszentmihalyi & Larsen, 1987; Delespaul, 1995; De Vries, 1992; Larson & Csikszentmihalyi, 1983) have been developed. In these methods, chronic pain patients are asked to report on their immediate pain at several times throughout the day. Signal-contingent recording involves respondents recording their experiences whenever signalled by the observer. Typically, the interest is with what the respondent is experiencing the precise moment they are signalled. ESM has important advantages over cross-sectional measures. First, the problem of retrospective recall can be avoided (cf. Eich, Reeves, Jaeger, & Graff-Radford, 1985; Erskine, Morley, & Pearce, 1990; Jamison, Sbrocco, & Parris, 1989; Stone *et al.*, 2003). Second, daily fluctuations of different pain constructs can be examined. Third, an individual response bias such as exaggeration can be avoided since participants are used as their own controls (i.e. responses of the same person are compared and analysed). Finally, temporal precedence to strengthen causal inferences can be established.

To date, one study examined the effects of a manipulation of attention to pain on self-reported pain intensity by means of a diary study in fibromyalgia patients who were randomized over three conditions (Fors, Sexton, & Götestam, 2002). Patients in all conditions rated their pain intensity on a visual analogue scale daily for 28 days. In the distraction condition, patients were given a 'pleasant guided imagery' audiotape, and were instructed to visualize beautiful natural settings on nice summer days. In the attentional focusing condition, patients were given an audiotape that described how endorphins and inhibitory neurons limited the pain, and were instructed to visualize their own pain-alleviating systems. Relaxation training was also given in both experimental groups. In the control condition, treatment as usual was given and no further instructions were given with respect to the focus of attention. Distraction reduced pain ratings of patients during the 28-day study period, but the effects of attentional focusing did not differ from pain ratings in the control group. As relaxation training was also given in both experimental conditions, it may be difficult to determine the pure effects of the distraction and attentional focusing manipulations on pain intensity. A further limitation of the Fors *et al.* study is that guided pleasant imagery qualifies as more than distraction and could be effective via a variety of possible cognitive and emotional processes, which are not well described as distraction.

The current study

The present study offers a first attempt to examine the influence of a manipulation of attention to pain (distraction versus attentional focusing) on pain intensity in chronic low back pain patients. We investigated whether pain-related fear as a trait characteristic, measured with the Tampa scale for Kinesiophobia (TSK; Miller, Kori, & Todd, 1991), moderated the effects of distraction and attentional focusing on pain intensity. Drawing on Leventhal and Everhart's parallel processing model, we hypothesized that attentional focusing would lead to decreased pain intensity particularly in high pain fearful individuals. Further, in line with previous experimental studies (Hadjistavropoulos *et al.*, 2000; Heyneman *et al.*, 1990; Roelofs *et al.*, 2004), we hypothesized that a distraction from pain manipulation would be associated with decreased pain intensity in low pain fearful individuals, but that individuals high in pain-related fear would not benefit from distraction.

Method

Participants

A total number of 38 chronic non-specific low back pain patients (57.9% female), who were referred to the pain clinic of the Maastricht University Hospital (The Netherlands), were recruited for participation. Patients received a letter in which their participation was requested. A consent form was enclosed with this letter, which was sent back by mail. Inclusion criteria were (a) experiencing low back pain for at least 6 months and (b) age between 18 and 65. Exclusion criteria were (a) serious visual deficit and deafness; (b) being non-fluent in Dutch; (c) having difficulty holding a pen or writing; (d) serious psychiatric diseases; (e) alcohol and/or drug problems; and (f) having participated in a previous ESM study. Mean age of the sample was 46.4 years ($SD = 9.8$, range 30–64) and mean pain duration was 145.1 months ($SD = 117.0$, range 6–444). Interference with daily activities was measured with the Quebec back pain disability scale (Kopec *et al.*, 1995). Mean score on this measure was 56.4 ($SD = 15.3$, range 30–84), indicating that the sample was substantially disabled. Further, 100% were Caucasian, 23.7% were working full- or part-time, 89.5% were married or living with a partner and 84.2% had one or more children. All patients were informed about the purpose of the study and signed a written consent. Patients were paid €25 for participation. The Ethics Committee of the University Hospital of Maastricht approved the study protocol.

Electronic diary and assessment

Each patient carried a palmtop computer (type m100) in a protective case for 3 weeks. During the first week, associations between spontaneous fluctuations in pain intensity, attention and fear of pain were assessed, which are reported elsewhere (Roelofs, Peters, Patijn, Schouten, & Vlaeyen, 2004). In the second and third weeks, attention to pain was manipulated (see manipulation). Diary questions were presented on-screen for completion via a touch screen (50×50 mm) and entries were time- and date-stamped. PEAS software was used on the palm top (see acknowledgements for more information about the software), which was programmed to 'beep' eight times a day between 8:00 h (weekend 9:00 h) and 22:00 h over at least 7 consecutive days. In most cases, the experiment started on a Monday or Wednesday and lasted for 2 weeks. The beeps were presented in a random time schedule. Data captured from the palm was transferred to a PC where software turned data into SPSS. Before the start of the experiment, all participants were carefully instructed and trained in completing the diary.

Current pain intensity was assessed by means of the item, 'Right now, I am in pain'. To assess the effectiveness of the manipulation check (see statistical analyses), we measured attention to pain by means the item, 'Right now, I am focusing on my pain', which was drawn from the Pain Vigilance and Awareness Questionnaire (PVAQ; McCracken, 1997; Dutch version: Roelofs, Peters, McCracken, & Vlaeyen, 2003). As this item reflects an active scanning process, we also added an item that captures attention to pain as a more passive process, 'Right now, I find it easy to ignore my pain'. All items were rated on a 7-point Likert scale type with anchors labelled *very much* and *not at all*. A number of additional questions were also included in each momentary assessment. However, since these data are not considered below, a detailed presentation of these questions is omitted.

Manipulation

Each manipulation (i.e. distraction and attentional focusing) occurred two times in 2 weeks time with the constraint that within a week, a distraction manipulation was always followed by an attentional focusing manipulation and vice versa. Further, the time between two manipulations was at least 2 days. The palmtop computer generated instructions for both manipulations. For the attentional focusing manipulation, a brief message was displayed on the palmtop computer (i.e. 'pay close attention to your pain and other sensations today') at 9:00 h, 10:00 h, 13.30 h and 18.30 h. Moreover, patients were prompted by the palmtop computer to complete a 'pain booklet' three times that day at random times. In this booklet, patients were instructed to write down all pain sensations and other somato-sensory sensations they had experienced since waking up or since the previous time they completed the booklet. The pain booklet also included an illustration of the human body accompanied by sensory and affective words derived from the McGill Pain Questionnaire (MPQ; Melzack, 1975). Patients were instructed to encircle words that represented their pain most accurately and had to indicate by means of an arrow from the word to the place on the body for which that word was representative of the pain felt. It took approximately 5 to 10 minutes to complete each assignment.

For the distraction from pain manipulation, a brief message was displayed on the palmtop computer (i.e. 'pay close attention to positive things in your environment') at 9:00 h, 10:00 h, 13.30 h and 18.30 h. Moreover, patients were given a camera and were signalled by the palmtop computer to take pictures that day of positive things that they experienced in their environment. Patients were instructed to complete a 'photo booklet' three times a day at random times in which they were requested to write down the objects or persons from which they made pictures. They also had to indicate why this picture was positive for them. Patients also had to scan six pictures and indicate what picture they liked most and why they liked that picture most.

The attentional focusing manipulation and the distraction from pain manipulation were similar with respect to form. That is, both manipulations were initiated by the palmtop computer and a booklet was used to write down pain sensations (attentional focusing manipulation) or positively charged pictures (distraction condition). In addition, a scanning task was part of both manipulations; that is, scanning the body in the attentional focusing manipulation and scanning pictures in distraction manipulation. The self-reported effectiveness of each manipulation was measured when patients completed their participation. Patients were requested to provide a percentage reflecting the extent to which they were able to either pay attention to or to distract from pain and bodily sensations and to complete the assignments that was part of the manipulation. This percentage was anchored by 0 (*not effective at all*) to 100 (*most effective*).

Procedure

After informed consent was obtained, patients completed the TSK (Miller *et al.*, 1991) and the Quebec Back Pain Disability Scale (Kopec *et al.*, 1995). In addition, demographic details were also obtained. Patients were explained that the interest of the study was to investigate how pain was experienced during the day and what factors influence pain. They were also told that they would receive instructions to either attend to or distract from pain on different days. They were told that an audible alarm would go off eight times a day at randomly selected moments during the morning, afternoon and evening for at least 7 consecutive days. Patients could delay answering a prompt for a maximum of 20 minutes when engaged in an activity that could not be interrupted. Patients were then trained to fill in questions on a palmtop demonstration version by choosing the fixed response options of each question and then pressing the 'next' button. Patients visited the research centre at Maastricht University twice (after the first two manipulations had occurred and after the last two manipulations had occurred). Data were transferred from the palmtop computer to the researchers' computer, and after the first visit, a new protocol was implemented on the palmtop computer. This was necessary because patients had to be unaware of the days at which manipulations occurred. Stand-by assistance during the experiment was available.

Statistical analyses

Data obtained in the present study requires a multi-level modelling strategy (see Hox, 1995). In multi-level modelling, the repeated observations (replies to the 'beeps') are called *Level 1 units*. These observations are organized within *Level 2 units*, which constitute days. Days are organized within *Level 3 units*, which constitute persons. A critical feature of a multi-level model is that responses from the Level 1 observations are likely to be non-independent from each Level 2 unit and that Level 2 observations are non-independent from each Level 3 unit. This dependency can be described by an intra-class correlation. The effect of daily observations on another (Level 1) is estimated while Level 2 (days) and Level 3 (persons) effects may 'modify' the strength and direction of the relation that is modelled. In the present study, a random intercept model was used. The procedure for analysis was as follows.

First, temporal fluctuations of pain intensity (dependent variable) within days as a linear and quadratic trends were examined, as pain intensity may show a gradual increase as the day goes on but decrease at the end of the day (cf. Peters *et al.*, 2000b). In the case of a significant linear and/or quadratic time trend, it was controlled for in subsequent analyses. Further, differences between pain intensity during the weekdays and the weekend were examined by means of a dummy variable (weekdays versus weekend).

Second, we examined the effect of the manipulation on pain intensity and whether this effect was moderated by pain-related fear as well as by the sequence of the manipulation. The manipulations were coded as two dummies representing the attentional focusing manipulation and distraction from pain manipulation, which were both compared with the first week (baseline reference) in which no manipulation took place (see electronic diary and assessment section). Moderation by pain-related fear (TSK) and the sequence effect were examined by computing interaction terms between both dummies representing the manipulations, TSK and sequence. It is important to examine the effect of sequence as the second distraction manipulation could work differently when the first distraction manipulation has occurred. Similarly, the second attentional focusing manipulation could have different effects on the pain intensity when the first attentional focusing manipulation has taken place. The analyses were conducted according to the top-down procedure, which involved starting with a full model including all interaction terms and main effects. We started the model with pain intensity as the dependent variable and the three-way interaction between all predictors (i.e. manipulation, TSK scores and sequence of the manipulation). In the absence of a statistically significant three-way interaction effect between the predictors, the two-way interaction between sequence and manipulation was examined. In a further step, the critical interaction between manipulation and TSK on pain intensity was examined. In a final step, the main effect of the manipulation (coded as two dummies) was examined. Statistical significance of an interaction term or main effect in a model was estimated by comparing the log likelihood ratio chi-square statistics (-2LL) between the model with and the model without this term. The -2LL is itself chi-squared distributed with degrees of freedom equal to the number of constraints (terms) differentiating both models.

Multi-level analysis was also used for the manipulation check. The effectiveness of the attentional focusing and distraction manipulations was examined by regressing the manipulation (dummy) on the items, 'I am focusing on my pain now' and, 'I find it easy to ignore my pain now'. The model with the manipulation is compared with the model without manipulation and the -2LL was used to test whether the manipulation check was successful. All analyses were conducted with MLWin version 1.1.

Results

The linear time trend was analysed as a random effect as the variability of slopes among patients was significant. The quadratic trend did not differ between patients and was analysed as a fixed effect. Thus, for analyses in which pain intensity was the dependent variable, time as a linear and quadratic trend was entered in the multi-level regression analyses. No differences between pain intensity during the weekdays and the weekend were found. Compliance with the monitoring procedure was adequate. Participants answered 72.7% of the prompts, of which 13.2% accounted for missing data on days in which no response was given to any beep and 19.4% for missing data on days in which no or only one beep was answered. Importantly, patients verbally reported that missing beeps were not caused by the severity of their back pain but rather by performing activities in which they were not able to complete the beeps, such as visiting with family or going out for a day.

Effect of manipulation on pain intensity

To examine the effect of the attentional focusing and distraction manipulations in interaction with the TSK on pain intensity, a model with two three-way interactions (both manipulations coded as dummies in interaction with sequence and TSK) was estimated first. Compared with the model without the three-way interactions, the three-way interactions were not significant ($\Delta - 2\text{LL} = 1.22$, $df = 2$, $p = .543$). The two-way interaction between sequence and TSK was not significant ($\Delta - 2\text{LL} = 1.08$, $df = 1$, $p = .299$). Two-way interactions between sequence and attentional focusing manipulation and between sequence and distraction from pain were not significant ($\Delta - 2\text{LL} = 3.06$, $df = 2$, $p = .217$). Thus, no sequence effect was found indicating that the second manipulation was not affected by the precedence of a similar manipulation. The critical interactions between manipulation and TSK did not reach statistical significance ($\Delta - 2\text{LL} = 3.58$, $df = 2$, $p = .167$). Standardized beta weights of these interaction terms are presented in the upper part of Table 1 (Model 1). TSK in isolation did not predict pain intensity ($\Delta - 2LL = 0.39$, $df = 1$, $p = .532$). Both manipulations in isolation did not significantly influence pain intensity ($\Delta - 2LL = 0.98$, $df = 2$, $p = .613$). Standardized beta weights of main effects of manipulation are also presented in the upper part of Table 1 (Model 1). One may argue that the failure to find the hypothesized effects may be due to insufficient spread in the dependent variable (e.g. pain intensity). Pain intensity ratings during the baseline week were normally distributed (mean = 4.54 and $SD = 1.43$). During the attentional focusing manipulation (day level), mean pain intensity ratings were 4.61 ($SD = 1.56$), and during distraction from pain manipulation, mean pain intensity ratings were 4.50 ($SD = 1.49$). Although these mean scores do not take the diurnal cycle of pain into account, it does indicate sufficient spread in the dependent variable.

Table 1. Standardized beta weights of the manipulation in isolation and in interaction with TSK and manipulation check

	Attention to pain × TSK		Distraction × TSK		Attention to pain		Distraction	
	Beta	*SE* (Beta)	Beta	*SE* (Beta)	Beta	*SE* (Beta)	Beta	*SE* (Beta)
Manipulation								
Model 1	0.18	0.10	0.01	0.10	0.02	0.02	0.01	0.02
Model 2	0.18	0.11	0.03	0.09	0.02	0.02	− 0.01	0.02
Model 3	0.19	0.09	0.01	0.08	0.03	0.02	0.01	0.02
Manipulation check					Beta	*SE* (Beta)	Beta	*SE* (Beta)
Model 1	Item: 'Right now, I am focusing on my pain'				0.02	0.02	0.01	0.02
	Item: 'Right now, I find it easy to ignore my pain'				− 0.03	0.02	0.01	0.02
Model 2	Item: 'Right now, I am focusing on my pain'				0.02	0.02	0.02	0.02
	Item: 'Right now, I find it easy to ignore my pain'				− 0.03	0.02	0.03	0.02
Model 3	Item: 'Right now, I am focusing on my pain'				0.02	0.02	0.02	0.02
	Item: 'Right now, I find it easy to ignore my pain'				− 0.04	0.02	0.03	0.02

Note. Model 1: effect of manipulation examined at level of day of manipulation; Model 2: effect of manipulation examined at the level of day of manipulation and self-reported effectiveness above 50%; Model 3: effect of manipulation on following 'beep' moment and with self-reported effectiveness above 50%. Attention to pain and distraction were coded as dummy variables.

Post hoc analyses

Analyses were repeated for manipulations of which the self-reported effectiveness was above 50% (Model 2). The critical interactions between manipulation and TSK did not reach statistical significance ($\Delta - 2LL = 2.88$, $df = 2$, $p = .237$) and no significant main effects for the manipulations were found ($\Delta - 2LL = 1.87$, $df = 2$, $p = .393$). In the next series of *post hoc* analyses, only the beep immediately following the manipulation (i.e. completing either the pain booklet or the photo booklet) and self-reported effectiveness above 50% were analysed (Model 3). The critical interactions between manipulation and TSK did not reach statistical significance ($\Delta - 2LL = 4.76$, $df = 2$, $p = .093$). In addition, no significant main effects for the manipulations were found ($\Delta - 2LL = 4.00$, $df = 2$, $p = .135$). The standardized beta weights of the critical interactions between manipulation and TSK as well as the main effects of both manipulations for both series of analyses are depicted in Table 1 (upper part).

Manipulation check

For nearly all manipulations, patients adhered very well to the protocols and completed the pain booklets, photo booklets and took pictures. The effectiveness of the manipulation was examined by regressing the manipulation (coded as two dummies) on two attention to pain items. The lower part of Table 1 presents the standardized beta weights for the manipulations. The manipulation check proved unsuccessful with respect to the item, 'I am focusing on my pain now' for Model 1 ($\Delta - 2LL = 1.10$, $df = 2$, $p = .577$), Model 2 ($\Delta - 2LL = 1.83$, $df = 2$, $p = .401$) and Model 3 ($\Delta - 2LL = 2.11$, $df = 2$, $p = .348$), and for the item, 'I find it easy to ignore my pain now', the manipulation check proved successful only for Model 3 ($\Delta - 2LL = 7.15$, $df = 2$, $p = .028$), but not for Model 1 ($\Delta - 2LL = 2.08$, $df = 2$, $p = .353$) and Model 2 ($\Delta - 2LL = 4.19$, $df = 2$, $p = .123$).

Discussion

This study examined whether a manipulation of attention to pain influenced pain intensity measured in daily life of chronic low back pain patients. It was expected that the attentional focusing would lead to decreased pain intensity in high pain fearful individuals, whereas distraction from pain would lead to decreased pain intensity in low pain fearful individuals. In contrast to our expectations, no substantial and statistically significant effects of the manipulations in isolation or in interaction with scores on the TSK were found. The failure to find evidence for pain diminishing effects of attentional focusing in high pain fearful pain patients may at first glance be at odds with Leventhal and Everharts's parallel processing theory, which assumes that focusing on sensory aspects of the pain experience may be beneficial for high fearful patients as it directs attention away from the emotional schema (Leventhal, 1982, 1990, 1992; Leventhal *et al.*, 1979; Leventhal & Everhart, 1979). However, we cannot exclude the possibility that our attentional focusing manipulation, which took place in daily life of pain patients, may have also activated emotional schemata, thereby preventing the expected pain diminishing effects of attentional focusing from occurring. The failure to demonstrate pain-decreasing effects of distraction in low pain fearful individuals is in contrast to findings from several experimental studies (e.g. Hadjistavropoulos *et al.*, 2000; Heyneman *et al.* 1990; Roelofs *et al.*, 2004). It should be kept in mind that although major efforts were undertaken to manipulate attention to pain (e.g. assignments by means of booklets, repeated recalls to either pay attention to or distract from pain, the use of positive stimuli for the distraction manipulation), the manipulation check showed that it was difficult to accomplish a manipulation of attention to pain in daily life in patients with chronic low back pain. As such, no inferences can be made about the underlying theory that was investigated.

Another issue that needs addressing is the percentage of missing data. We used a signal-contingent method, which is more intrusive than other methods since respondents have no control over when they will complete the records. As such, they may be signalled at times when it is inconvenient to fill out the data form (see also Aaron, Mancl, Turner, Sawchuk, & Klein, 2004). However, the percentage of missing data is comparable to other studies. For example, Larson (1979) reported that one third of the signals were missed. Other studies have reported a rate of missed signals between 15% and 20% (e.g. Csikszentmihalyi & Graef, 1980: Larson & Lampman-Petraitis, 1989). We did not give incentives when individuals did not have any missing data on a day or the complete week of sampling. Incentives could have improved compliance in the present study. One may further argue that the ability of respondents to tolerate the intrusiveness of these methods would decrease as the level of disorganization and stress in their lives increased. However, there are some indications that seriously ill patients are able to complete their pain diary for a long period of time (De Wit *et al.*, 1999). A potential drawback of the use of pain diaries is that they cause patients to attend to their pain perhaps more than they otherwise would. Increased attention to pain might consequently change a person's experience of it. Such changes are referred to as reactive effects. However, little support for reactive effects in sampling patients with electronic diaries has been reported (Cruise, Broderick, Porter, Kaell, & Stone, 1996; Stone *et al.*, 2003). One further limitation with respect to the distraction manipulation should be mentioned. A difficulty with assessing the influence of a distraction manipulation on the pain perception is that individuals are inquired about the experience of pain and are thus asked to attend to and think about their pain. This may limit the effectiveness of the distraction manipulation (Johnson & Petrie, 1997; Leventhal, 1992).

Taken together, although it is a well-known fact from experimental studies that attention (Arntz, Dreessen, & Merckelbach, 1991) and (emotional positive) distraction (McCaul *et al.*, 1992) regulate the experience of pain (Vendrig & Lousberg, 1997), the present study showed that a manipulation of attention to pain is difficult to accomplish in daily life of patients with chronic low back pain. Consequently, no clear inferences can be made as to the underlying theory that was investigated. An interesting field for future research, in which electronic diary assessments might be particularly valuable, is within the context of treatment. For example, the mechanism behind the effectiveness of *in vivo* exposure could be further elucidated by analysing how attention to pain, fear of pain and pain intensity change over the course of the treatment, and to examine how these pain constructs are related to the return of back pain episodes.

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