Guided Internet-Based Cognitive Behaviour Therapy for Chronic Pain

MONICA BUHRMAN
Abstract

Chronic pain is one of the most common causes of disability and sick leave. Psychological factors play a central role in the experience of pain and are important in the management of pain. However, for many people with chronic pain CBT is not available. There is a need to develop alternative ways to deliver treatments that reach more individuals with chronic pain. Internet-based treatments have been shown to be effective for several disorders and recent research suggests that internet-based CBT for chronic pain can be effective. The present thesis included four randomized controlled studies with the aim of evaluating whether guided internet-based treatments based on CBT can help individuals with chronic pain regarding psychological variables.

Study I investigated the effects of an internet-based CBT intervention with telephone support for chronic back pain. The study showed reductions in some variables assessed.

Study II investigated the effects of an internet-based CBT intervention for chronic back pain without telephone support and with a live structured interview before inclusion. It was found that the treatment can reduce some of the distress associated with chronic pain.

Study III investigated the effects of a guided internet-delivered CBT as a secondary intervention. Participants were patients who had previously completed multidisciplinary treatment at a pain management unit. Results showed that the internet-based treatment can be a feasible option for persons with residual problems after completed pain rehabilitation. Effects remained at six-month follow-up.

Study IV focused on the effect of a guided internet-delivered acceptance and commitment therapy (ACT) for persons with chronic pain. Results suggest that an internet-delivered ACT treatment can help persons with chronic pain. Effects remained at six-month follow-up.

In conclusion, guided internet-based CBT can decrease distress associated with chronic pain.

Keywords: Chronic pain, Cognitive Behaviour Therapy, Internet, Acceptance and Commitment Therapy, Guided self-help, Secondary intervention

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To my Bo and our wonderful daughters Graciela, Alicia and Isabel.
This thesis is based on the following papers, which are referred to in the text by their Roman numerals.


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### Abbreviations

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<tr>
<td>ACT</td>
<td>Acceptance and Commitment Therapy</td>
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<tr>
<td>ANCOVA</td>
<td>Analysis of covariance</td>
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<td>ANOVA</td>
<td>Analysis of variance</td>
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<td>CBT</td>
<td>Cognitive Behaviour Therapy</td>
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<td>CSQ</td>
<td>Coping Strategies Questionnaire</td>
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<td>CPAQ</td>
<td>Chronic Pain Acceptance Questionnaire</td>
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<td>FAM</td>
<td>Fear avoidance model</td>
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<td>GCT</td>
<td>The gate control theory</td>
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<td>HADS</td>
<td>Hospital Anxiety and Depression Scale</td>
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<td>iCBT</td>
<td>Internet-based Cognitive Behaviour Therapy</td>
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<td>IASP</td>
<td>International Association for the Study of Pain</td>
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<td>ITT</td>
<td>Intent-to-treat</td>
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<td>MADRS</td>
<td>Montgomery Åsberg Depression Rating Scale</td>
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<td>MANOVA</td>
<td>Multivariate analyses of variance</td>
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<td>MPI</td>
<td>Multidimensional Pain Inventory</td>
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<td>NS</td>
<td>Neutral Stimulus</td>
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<tr>
<td>RCI</td>
<td>Jacobson's reliable change index</td>
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<tr>
<td>SSL</td>
<td>Secure Sockets Layers</td>
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<tr>
<td>US</td>
<td>Unconditioned Stimulus</td>
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<td>PAIRS</td>
<td>Pain and Impairment Relationship Scale</td>
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<td>QOLI</td>
<td>Quality of Life Inventory</td>
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Introduction

Pain is a frequent sensation experienced by all human beings, and it has an important protective function that is necessary for survival. Pain enables the individual to either escape or protect the injured body and thus enhances survival. However, when pain becomes chronic, it becomes maladaptive, causes physical and emotional suffering and often leads to significant health care use and expenditures.

Definition and classification of pain

The International Association for the Study of Pain (IASP) has defined pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” (IASP, 1994). Pain can be classified in terms of its intensity (mild, moderate, or severe), duration (acute or chronic); pathophysiology (nociceptive, neuropathic, or mixed), or according to type or syndrome (cancer, fibromyalgia, migraine etc.). Acute pain is associated with strains, fractures, surgery, or trauma. It has a short time course and gradually diminishes as healing occurs. Chronic pain or persistent pain can be continuous or intermittent and last longer than 3-6 months (IASP, 1994). From a pathophysiological view pain is divided into two broad categories: nociceptive pain and neuropathic pain. Nociceptive pain is divided into two types; somatic and visceral pain. Somatic pain is caused by activation of pain receptors on the surface of the body such as the skin or tissues that lies deeper such as the muscles. Visceral pain is diffuse and is caused by activation of pain receptors from compression, extension, stretching or inflammation. Neuropathic pain is a neurological disorder from damage to nerves that carry information about pain (IASP, 1994). Pain is a subjective and conscious experience that results from brain activity in response to a noxious stimulus and engages the sensory, emotional, and cognitive processes of the brain (Willis, 2007). Functional imaging techniques have focused on defining the network of brain structures involved in physiological pain and in chronic pain (Tracey, 2005; Moisset, & Bouhas-sira, 2007). Imaging studies show that pain involves activity in several cerebral regions which are in line with the sensory, emotional, and cognitive aspects of the experience of pain (Ladabaum, Minoshima, & Owyang, 2000; Apkarian, Bushnell, Treede, & Zubieta, 2005). There are studies that suggest
that chronic pain is accompanied by significant atrophy in certain brain regions such as 5-11% less neocortical grey matter volume (Apkarian, Sosa, Sonty, Levy., et. al., 2004; May, 2008).

Chronic pain

Prevalence and economic aspects of chronic pain

Several studies have investigated the prevalence of chronic pain among adults. Results show that the global prevalence of chronic pain is currently at 20 per cent, i.e. one in five persons is likely to suffer from chronic pain. The estimated prevalence in Europe ranges from 19-53 per cent (Elliot, Smith, Penny, Smith & Chambers, 1999; Breivik, Collet, Ventafridda, Cohen & Gallacher, 2006; Gerdle, Björk, Cöster, Henriksson, Henriksson, & Bengtsson, 2008). However published prevalence reports may have different methodologies. Most reports focus on chronic pain but some studies do not discriminate between chronic pain and current pain. Furthermore, these reports survey different types of population samples. The more specified the population and the type of pain, the lower the population estimate tends to be. Another often-cited prevalence report for Europe is that more than 100 million people are living with chronic pain due to a musculoskeletal condition (Breivik et al., 2006; Gerdle et al., 2008). Breivik et al. reported that 18 per cent suffer from chronic pain in Sweden (Breivik et al., 2006).

Considering all sources of expenditures, chronic pain has a large financial impact on society. The costs related to chronic pain in Europe and the United States are estimated at 14% of the country’s gross domestic product (Waddell & Nordlund, 2000). The direct and indirect costs are estimated in a recent study at SEK 87 billion per year in Sweden. The direct cost associated with health care use and medicines amounted to SEK 7 billion. The indirect costs accounted for the largest sum, SEK 80 billion. The indirect costs include lost productive time from workers due to sick leave (Swedish Council on Health Technology Assessment (SBU), 2006)

Psychological aspects of chronic pain

Chronic pain is a demoralizing situation that compromises all aspects of the person’s life. Living with chronic pain requires major emotional resources as it depletes emotional reserves. The continuing effort for relief from pain and limitations of carrying out daily activities due to pain, often lead to feelings of demoralization, helplessness, hopelessness and to depression and disability (Ericsson, Poston, Linder, Taylor, Haddock, & Foreyt, 2002; Keogh, McCracken, Eccleston, 2006; Crombez, Eccleston, van Hamme, & Vlieger, 2008). In a review chronic pain has been found to be associated with mood,
anxiety, somatoform, substance use, and personality disorders (Dersh, Polatin, & Gatchel, 2002).

The prevalence of major depressive disorder in chronic pain patients has been reported to range between 30 and 54 per cent (Dersh et al., 2002). Depression has been found to be associated with poor pain related outcomes such as functional limitations (McWilliams, Cox, & Enns, 2003). Persons with chronic pain and depression report greater disability and interference with daily activities, although the nature of this relationship is not completely clear (Keogh et al., 2006). An important aspect could be that depressive symptoms may contribute to lack of motivation, which results in less activity, and negative cognitions that in turn leads to pain beliefs that inhibit optimal function (Geisser, Roth, Theisen, Robinson, Riley, 2000). Depression has also been reported to be a predictor for the onset of disabling pain (Vlaeyen & Linton, 2000; Carroll, Cassidy, & Côté, 2004; Jarvik, Hollingworth, Heagerty, Haynor, Boyko, & Deyo, 2005).

As mentioned earlier, anxiety has also been documented to coexist with chronic pain (Dersh et al., 2002). Furthermore, anxiety has been shown to be related to the experience and adjustment to pain (e.g. McCracken, Zayfert, & Gross, 1992; Vlayen et al., 2000; Asmundson, 2001). Threat of pain can lead to constant vigilance and monitoring of harmful stimulations, which leads to fear and avoidance. Regardless of pain severity, patients with high anxiety scores respond with fear and avoidance to a number of stimuli such as different physical activities (Asmundson & Taylor, 1996). Fear and avoidance have been emphasized in early studies to be important components in maintaining chronic pain (e.g., Fordyce, Shelton, & Dundore, 1982; Philips, 1987). In more recent years, the fear-avoidance model has been developed, which relates to fear and pain to behaviour through avoidance learning (Vlaeyen et al., 2000).

Models

Different models have contributed to the understanding of the complexity of chronic pain and the development of effective treatments. Below follows a review of some important models regarding chronic pain.

The gate control theory of pain

There is no question that physical perturbations contribute to pain symptoms; nor is there any controversy anymore that psychological factors play an important part in the symptoms reported by individuals with chronic pain. The traditional biomedical model of medicine viewed pain as a dichotomy; it was either of physiological origin or due to psychological factors (Engels, 1977). One early attempt to integrate physiological and psychological factors
in a model of chronic pain was the gate control theory (GCT) (Melzack & Wall, 1965; Melzack & Casey, 1968). According to the GCT, peripheral stimuli interact with cortical variables, such as mood and anxiety, in the perception of pain. Both physiological and psychological components have either potentiating or moderating effects (Melzack & Wall, 1965). Overall, however this theory has given rise to new clinical treatments and (e.g. Fordyce, Roberts, & Sternbach, 1985) and pain is no longer explained exclusively in terms of physiological factors.

The biopsychosocial perspective

The dualistic models viewpoint conceptualized the mind and body as functioning separately and independently. To be able to account for psychosocial factors the biopsychosocial model was developed. It focuses on both “disease” and “illness”, in the complex interaction of biological, psychological and social variables (Gatchel, 1996; Schultz, Crook, Fraser, & Joy, 2000). Disease is often conceptualized as a disruption of specific body structures or organ systems caused by pathological, anatomical or physiological changes. Illness on the other hand is referred to the physical discomfort, emotional distress, behavioural limitations, and psychosocial disruption associated with symptoms and disability (Engel, 1977). The distinction between disease and illness is analogous to the distinction that can be made between nociception and pain. Nociception involves the stimulation of nerves that transfer information about potential tissue damage to the brain. Pain, on the other hand, is the subjective perception that results from the interpretation, and modulation of sensory information (Gatchel, Peng, Peters, Fuchs, & Turk, 2007). From this perspective the person’s perception and respond to illness is a result of a complex interaction of biological, psychological and social variables. Chronic conditions are viewed from a longitudinal perspective. During the evolution of a disease or impairment, the relative weighting of physical, psychological, and social factors may shift. During the initial phase, following tissue injury, trauma, and inflammation treatment is centred on pain relief and identification. Psychological and social factors play relatively limited role in this phase. For patients in whom pain persists, however, psychological and social factors play a more significant role in the overall pain experience (Turk & Gatchel, 2002). The biopsychosocial model, accounts for the likelihood that’s patients’ lives are affected significantly in a variety of ways by the persistent pain, thus requiring a comprehensive treatment approach designed to address all aspects of required care (Engel, 1980; Gatchel et al., 2007). A number of studies have showed how social and behavioural factors influence health, and illness (for a review see Gatchel et al., 2007).
The fear-avoidance model – a cognitive behavioural approach

The fear-avoidance model (FAM) of chronic pain was first developed by Lethem and colleagues (1983) to explain why some musculoskeletal injuries can lead to longstanding pain, depression, and disability. The model was elaborated by Vlaeyen and collaborators (1995), and they suggested that fear of movement/(re)injury represents a response to pain that is influenced by catastrophizing. Pain-related fear and avoidance behaviours contribute to disuse, depression, and disability. Vlaeyen and Linton (2000) published a state-of-the-art review of the fear-avoidance literature, and the researchers present a comprehensive fear-avoidance model of chronic musculoskeletal pain. This model can be summarized as follows (see Figure 1). Following a pain provoking injury, one of two competing responses may occur. The pain experience is appraised as non-threatening and is dealt with in an adaptive manner i.e. initial rest of the affected area followed by gradual increased activity level, which allows the person to proceed to recovery. On the other hand, pain is experienced as a threat; the person may view the pain as dangerous and may catastrophize about its harmful consequences. As a consequence the person becomes mired in a vicious cycle that promotes increased fear of pain, avoidance of pain, and, as a consequence, disuse, depression, and disability. A great advantage with this model is that it explains the development and maintenance of chronic pain.

The empirical support for the separate elements of the fear-avoidance model is considerable. Cook and colleagues (2006) employed structural modelling techniques and presented support for the causal influence of fear of pain on self-reported avoidance behaviour in a sample of chronic musculoskeletal pain patient. Furthermore, research has shown that pain-related fears are more strongly related to functional disability in chronic pain patients than pain severity (for review Vlaeyen et al., 2000). However, several studies have shown that pain intensity contributes in explaining disability (for review Leew, Goosens, Linton, Crombez, Boersma & Vlaeyen, 2007). The fear-avoidance model proposes that persons with chronic pain avoid activities that are assumed to increase pain or (re)injury. Several studies have demonstrated that pain-related fear is associated with avoidance behaviours (see reviews Vlaeyen et al., 2000 & Leew et al., 2007). Studies have further demonstrated that fear of movement and (re)injury are better predictors of functional limitations than biomedical parameters (McCracken, Gross, Sorg, & Edmands, 1993).

Fear and anxiety are often used interchangeably with regard to pain. The distinction between fear and anxiety is that fear is defined as an emotional state characterized by autonomic nervous system activation, including physiological changes characteristic of increased sympathetic outflow and parasympathetic withdrawal, to prepare the organism for action. Fear is elicited in response to an actual or perceived threat and motivates escape or active
avoidance behaviour. Anxiety, on the other hand, is defined as a more gradual building mood state and involves more cognitive processing. It gives less autonomic arousal or autonomic suppression and more passive avoidance behaviour (Barlow, 2004). The distinction is more difficult to make in a clinical context, especially when the threatening stimulus (pain) is constantly present, as in the case of chronic pain (Leew et al., 2007). Asmundson and collaborators (2004) presented an updated fear-anxiety-avoidance model where the direct link between fear and avoidance behaviour, because by definition a person cannot avoid a threat that is already present. Anxiety is added as a pathway in the anticipation of pain to the fear pathway in the presence of pain, see Fig 2. It is not yet evident whether this updated model added any value to the original one (Leew et al., 2007).

Figure 1 The fear-avoidance model (Vlaeyen & Linton, 2000). Reproduced with the permission from the International Association for the Study of Pain (IASP).
Figure 2 The fear-avoidance model, based on the fear-avoidance model of Vlaeyen and Linton (2000) and the fear-anxiety-avoidance model of Asmundson et al., (2004).

**Pain catastrophizing**

As previously mentioned, pain catastrophizing is seen as an important component in the development of chronic pain as described by the fear-avoidance model (Vlaeyen & Linton, 2000). Pain catastrophizing, can be defined as “an exaggerated negative mental set brought to bear during actual or anticipated pain experience” (Sullivan et al., 2001). Catastrophizing is often seen as a cognitive coping measure and has often been assessed using the Coping Strategies Questionnaire (Rosenthiel & Keefe, 1983). Results show that catastrophizing is associated with increased pain, physical and psychosocial dysfunction in patients with various chronic pain problems (Sullivan et al., 2001; for review see Keefe, Rumble, Scipio, Giordano, & Perri, 2004; Linton & Bergbom, 2011; Nieto, Raichle, Jensen, Miró, 2012). In addition, individuals prone to catastrophizing demonstrate higher rates of analgesic usage as well as greater healthcare utilization (Gil, Thompson, Keith, Tota-Faucette, Noll, & Kinney, 1993; Jacobsen & Butler, 1996). Studies suggest that catastrophizing and heightened depressed mood have an additive and adverse effect on the impact of pain (Arnow et al., 2011; Linton et al., 2011). This give support to earlier findings (Geisser, Robinson, & Henson, 1994; Sullivan, Bishop, & Pivik, 1995; Leeuw et al., 2007) that depression and catastrophizing are two separate entities. Linton and Bergbom (2011) emphasizes that clinics should focus on addressing both depressed mood and catastrophizing.
Interdisciplinary treatments

The biopsychosocial approach to pain challenges clinicians to think about integrated care. Interdisciplinary pain rehabilitation programmes are the embodiment of the biopsychosocial model. The interdisciplinary programme requires the collaborative expertise from multiple disciplines because of the medical and psychological complexities. The professional staff may vary from one clinical setting to another but the treatment team usually includes a physician, psychologists, physical therapists, occupational therapists, social workers, and nurses (Sanders, Harden, & Vicente, 2005). In interdisciplinary rehabilitation for chronic pain the patients are encouraged to be active and involved in their treatment goals, treatment plan development, and reviewing progress of their goals. The disciplines forming the treatment team lend their expertise toward the common goal of maximizing the patient’s functioning. Each discipline contributes to the treatment planning, implementation, progress assessment, and follow-up care for every patient throughout the course of treatment (Towsend, Bruce, Hooten, & Rome, 2006). Interdisciplinary treatment goals include improvement in physical functioning (e.g., improved range of motion, standing, walking and postural exercises), general functional status (e.g., increased activities of daily living, social, leisure and domestic responsibilities), increase in self-management of the chronic pain condition, improvement of vocational/disability status (e.g., return to work, job training), reduction/discontinuation of medications, and improvement in pain severity (Sanders et al., 2005; Towsend, et al., 2006). The essential components of CBT for chronic pain are described separately.

Research supports the efficacy of interdisciplinary treatments for chronic pain (see review, Flor, Fydrich, & Turk, 1992). The evidence-based clinical practice guidelines for chronic non-malignant pain, recommend interdisciplinary rehabilitation that is goal-directed, time-limited, and based on cognitive-behavioural therapy (Sanders et al., 2005; SBU, 2006). Patients seen at interdisciplinary treatment centres are often individuals who have complex problems, have been seen by several physicians, and experience high levels of emotional distress (Clark, 2000). Interdisciplinary programmes for chronic pain are time consuming and costly, but are more cost-effective than conventional medical treatments (Turk & Okifuji, 1998; Clark, 2000). However, there are studies that suggest that individuals who have undergone a multidisciplinary rehabilitation programme not seldom have residual problems one year after rehabilitation and difficulty returning to their daily activities (Maruta, Swanson, & McHardy, 1990; Maruta, Malinchoc, Offord, & Colli gan, 1998). It is not uncommon for patients to revisit the rehabilitation clinic and go through the rehabilitation programme for a second time leading to increased costs (Jensen, Bergström, Ljungquist, & Bodin, 2005).
Cognitive behavioural therapy (CBT)

The first reported trial of behavioural treatment for chronic pain was published in the late 1960s by Fordyce, Fowler, Lehman, and de Lateur (1968). Since then, there is a significant database regarding the efficacy of cognitive-behavioural treatments (see reviews Morley et al., 1999; McCracken, & Turk, 2002; Hoffman, Papas, Chatkoff, & Kerns, 2007). A distinction has been made between the cognitive-behavioural perspective and cognitive and behavioural techniques (Turk, 2003; Kerns, Sellinger, & Goodin, 2011). A description of the different perspectives in CBT is presented below. A common factor for the psychologically oriented interventions for chronic pain is that the focus is on the consequences that pain has on one’s life, rather than on pain intensity, as a way of directly addressing adaptive behavioural change (Turk, 2003; Kerns et al., 2011).

The behavioural approach to chronic pain

In the behavioural approach pain is understood in terms of behaviour by which it is manifested. Moreover, the behaviour is subject to laws of learning and conditioning. A differentiation is made between respondent and operant conditioning (Turk, 2003).

Respondent conditioning

Respondent conditioning occurs when a neutral stimulus (NS) is presented with an unconditioned stimulus (UCS) in close temporal proximity. Through repeated pairing with the unconditioned stimulus, the neutral stimulus becomes capable of eliciting a conditioned response. This is also referred as classical or Pavlovian conditioning (Sundel & Sundel, 1999). In chronic pain this could occur if a nociceptive stimulus is repeatedly paired with a NS in close temporal proximity, the NS will elicit a pain response, i.e. certain activities are related to anxiety and fear about pain, than to an actual pain-activity relationship (e.g. Linton, 1985). Thus, many neutral or pleasurable activities may elicit or exacerbate pain. A number of activities (stimulus) may be expected to elicit pain or exacerbate pain and will be avoided (i.e. stimulus generalization). Anticipatory fear can elicit physiological reactivity that may aggravate pain. Thus, conditioning may directly increase nociceptive stimulation and pain (Turk, 2003). From this perspective treatment of chronic pain focuses on exposure to behaviours that produce progressively less pain than was predicted, which is expected to reduce anticipatory fear and anxiety associated with the activity.

Operant conditioning

We communicate through behaviours, and a behaviour can elicit a response from the observer. This learning process of behaviour is explained by the
operant conditioning model that was delineated by B.F. Skinner. Operant behaviours, like respondent behaviours, can be elicited by specific stimuli but are also influenced by factors occurring during and after the presence of the stimulus. The premise underlying operant conditioning is that when behaviour is followed systematically by either a reward (reinforcement) or a punishment, the result is an increase or decrease, respectively, in frequency of the behaviour in the future (Sundel & Sundel, 1999). In chronic pain the behaviours that are targeted through behavioural strategies are referred to as pain behaviours. Pain behaviours can include facial expressions, excessive verbalization about pain, guarded movements, or restriction of movements (Turk, 2003). There is a modest correlation between intensity of pain and pain behaviours (Fordyce, Lansky, Calsyn, Shelton, Stolov, & Rock, 1984). Positive reinforcement, such as receiving sympathetic attention from others, and negative reinforcement such as avoiding bothersome household chores, could contribute to the maintenance of pain behaviours. Adaptive behaviours, such as activity, often decrease in individuals with chronic pain. This can be explained by operant processes, that is, the well behaviours have not been adequately reinforced (Romano, & Turner, 1995). Pain behaviours are identified, as are their controlling antecedents and consequent reinforcement or punishment (Novy, 2004). Operant approaches focus on the extinction of pain behaviours and the increase and maintenance of desired behaviours. Patients with chronic pain are expected to set up goals and follow through with recommendations, see Table 1.

The efficacy of treatments in accordance with operant principles has been demonstrated in several studies with persons with various chronic pain disorders (see reviews Morley et al., 1999; Van Tulder, Ostelo, Vlaeyen, Linton, Morley, & Assendelfelt, 2000). Operant behavioural therapy has also been found to be a cost-effective method for reducing disability and improving quality of life (Smeets, Severens, Beelen, Vlaeyen, & Knottnerus, 2009).

Table 1. Summary of characteristics of operant conditioning approach to chronic pain

- Pain behaviours are reduced through extinction
- General activity level is gradually increased using an initial baseline. This is done in a collaborative manner with the patient.
- Operant conditioning methods (e.g. shaping, reinforcement, response prevention) are used to achieve behaviour change.
- Operant methods are applied across as many different environmental conditions and people as possible to maximize generalization.
Cognitive behavioural approach to chronic pain

The operant approaches were not able to adequately account for human cognition and language (covert behaviours). Hence, the next phase of developments in psychological approaches to chronic pain accentuated the role of private experiences, thoughts, beliefs, and feelings. This was added to the earlier focus on overt behaviours (i.e., behaviours that can be observed by others). Four key components of CBT have been described: “education”, “skills acquisition”, “skills consolidation”, and “generalization and maintenance” (Turk, 2003). The “education” component focuses on helping individuals challenge their negative perceptions regarding their abilities, and to manage pain by making them aware of the role that thoughts and emotions play in potentiating and maintaining stress and physical symptoms – cognitive restructuring. Cognitive restructuring includes the identification of negative automatic thoughts and replacement of these maladaptive thoughts with adaptive, beneficial ones. The crucial element is bringing about a shift in the patient’s repertoire from well-established, habitual, and automatic but ineffective responses toward systematic problem-solving and planning, control of affect, behavioural persistence, or disengagement from self-defeating situations when appropriate (Turk, 2003; Kerns et al., 2011). The aim of the “skills acquisition” and “consolidation” component is to help persons, besides learning to practice new coping skills, to incorporate a wide variety of cognitive and behavioural pain-coping strategies, including relaxation, problem solving, distraction methods, activity pacing, and communication skills. The goal of the coping strategies is to maximize individuals’ functionality and quality of life. Therapists use education, didactic instruction, Socratic questioning, and role-playing techniques among others. The last component “generalization and maintenance” focus on solidifying coping skills and preventing relapse. Individuals are encouraged to apply their coping skills to a progressively wider range of daily activities. Table 2 summarizes the basic characteristic of the CBT approach to chronic pain. They are taught to develop problem-solving skills to enable them to analyse and develop plans for dealing with pain flares, anticipate future difficulties, and other challenging situations (Turk, 2003; Novy, 2004; Kerns et al., 2011).

Empirical support for CBT for pain management has been found for a variety of chronic pain problems compared to wait-list controls and alternative active treatment (Morley et al., 1999; Eccleston, Morley, Williams, Yorke, Mastroyannopoulou, 2002; Weydert, Ball, & Davis, 2002).
Table 2. Summary of characteristics of cognitive behavioural approach to chronic pain

- Problem-oriented.
- Educational (about self-management, problem solving, coping, and communication skills).
- Collaborative (patient and health care provider work together).
- Addresses the relationship among thoughts, feelings, behaviour, and physiology.
- Anticipate setbacks and relapse and teaches patients how to deal with these.

Acceptance and commitment therapy (ACT)

Acceptance and commitment therapy (ACT) is an acceptance and mindfulness-based psychotherapeutic intervention that can be applied to different disorders (Hayes, Strosahl, & Wilson, 1999). It is based on relational frame theory, RFT, a theory of language and cognition that attempts to further develop previous operant and cognitive models. RFT provides a more sophisticated understanding of human language and cognition than previous behavioural conceptualizations, particularly regarding the arbitrary nature of language-based processes and the effects these processes can have on people’s lives (Hayes, 2004). ACT emphasizes functional analysis over description of behaviour and work to identify basic processes that are common across settings and syndromes. A central aim in ACT is to adequately understand human suffering and focus treatment on decreasing suffering, as well as increasing effective and meaningful functioning (Hayes et al., 1999; Hayes, Luoma, Bond, Masuda, & Lillis, 2006). The primary goal of ACT is psychological flexibility. This is defined as direct and open contact with present experiences on a moment-to-moment basis in a way that permits behaviour to continue and evolve according to one’s goals and values. Psychological flexibility is composed of six interrelated processes: acceptance, cognitive defusion, self as context, values, committed action, and contact with the present moment.

Acceptance involves openly contacting negatively evaluated experiences, hence permitting the presence of experiences that are unwanted, such as feelings, physical sensations, memories, and urges. It permits these experiences to be present and does not give them a controlling role over behaviour. Cognitive defusion is about altering function, which means an awareness of the process of thinking and not just the content of thinking. This process involves realizing the distinction between our actual selves and actual events and the thoughts we have about ourselves and events. Cognitive defusion is the experience of a reduction in the dominating impact our thinking may
have in our life. Self as context is the ability to recognize the distinction between experiences and who is having the experiences. It is about not becoming overly attached to our experiences, our beliefs, or our stories about ourselves, i.e. not be defined by verbal descriptions or evaluations about oneself. Values are life directions that are in accord with what a person holds to be important and desirable. Values are never completely reached, in contrast to goals, and they provide a guide for action. Committed action usually starts within a values domain and includes setting goals and taking the steps to achieve them. It is about choosing particular directions in life and building these into larger patterns of behaviour and integrating them into daily life. Committed action is also letting go of a particular goal in a situation if needed, and keeping the action going in the chosen direction. Contact with the present moment is the ability to track fluidly with the on-going moment-to-moment experience of our environment. Furthermore, contact with the present moment enables persons to be flexible, responsive, and aware of the possibilities and learning opportunities afforded by the current situation. This is achieved through observation and awareness skills, which in turn are obtained by including mindfulness exercises (Hayes et al., 1999). Mindfulness can be defined in different ways. One common definition is “the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally, to the unfolding of experience moment by moment” (Kabat-Zinn, 2003, p 145). Mindfulness has its roots in ancient Asian religious traditions and focus is on fully experiencing the phenomenon in the present, without reference to the past or future (Kabat-Zinn, 2003). A review showed that mindfulness could be helpful for individuals with a variety of health conditions, including chronic pain (Grossman, Niemann, Schmidt, & Walach, 2004). The ACT model of psychopathology, psychological inflexibility, is argued to emerge from the opposite of the six interrelated processes: experiential avoidance, cognitive entanglement, attachment of a conceptualized self, loss of contact with the present moment, and the failure to act in accordance with core values (Hayes et al., 2006).

The idea of acceptance is not new with regard to chronic pain (Fordyce, 1976). The ACT model is much broader and more complex than the idea that treatment is about acceptance of chronic pain. In ACT, acceptance, as mentioned earlier, is about psychological flexibility. ACT-based treatments aim to enable individuals to flexibly respond to pain, distress, and related experiences. Individuals are encouraged to give up ineffective struggling with experiences that cause suffer and commit to behaviours that are in accordance with the person’s goals and values (McCracken, & Yang, 2006). In chronic pain the efforts to reduce or eliminate pain are often unsuccessful. Therefore, continuing attempts to control pain may be maladaptive, and prevent the person from participation in valued activities (McCracken, Vowles, & Eccleston, 2004). Patients who find their pain unacceptable attempt to avoid it and seek available interventions to reduce or eliminate it. These efforts may
lead to missed opportunities and reduction in productive functioning (McCracken, 1998). Hence, pain is seen in ACT as an inevitable part of living that can be accepted, whereas struggling to avoid inescapable pain causes more suffering. Two primary aspects of pain have been found to be important: willingness to experience pain and engagement in valued life activities despite the pain experience (McCracken et al., 2004).

A review examined the effects of acceptance-based interventions (ACT and mindfulness-based stress reduction (MBSR)) for chronic pain, and results showed that acceptance-based treatments are effective as an alternative but not superior to traditional CBT (Veehof, Oskam, Schreurs & Bohlmeijer, 2011). Research examining acceptance of pain has shown that greater acceptance of pain is associated with reports of lower pain intensity, less pain-related anxiety and avoidance, less depression, less physical and psychosocial disability, greater physical and social ability, and better work status (McCracken, 1998; Vowles & McCracken, 2008; McCracken & Velleman, 2010; McCracken & Zhao-O’Brien, 2010). Several studies of persons with chronic pain provide support for various components of psychological flexibility in their well-being and daily functioning, including the processes of acceptance (Nicholas & Asghari, 2006), mindfulness (McCracken, Gauntlett-Gilbert, & Vowles, 2007), value-based action (McCracken & Yang, 2006), and general psychological flexibility itself (McCracken & Vowles, 2007; McCracken & Gauntlett-Gilbert, 2011; McCracken & Gutiérrez-Martinez, 2011). In addition, ACT has been listed as an empirically supported treatment for chronic pain and depression (APA, 2006/2011).

### Table 3. Summary of characteristics of acceptance and commitment therapy approach to chronic pain

- Raise awareness of failure from strategies aimed at pain control and reduction
- Exposure to thoughts and feelings related to the experience of pain and general awareness training for emotional circumstances
- Mindfulness exercises
- Body awareness
- Exercises to show the possibility of activity and enjoyment with pain present
- Exercises to raise awareness of the social effects of over pain displays

### Internet-based treatments for chronic pain

The Internet is regarded as an indispensable communication tool throughout the world. The increase in use of the internet and mobile devices worldwide has made internet-based interventions increasingly common (e.g. Ritterband, GonderFrederick, Cox, Clifton, West, & Borowitz, 2003). However, the
Internet is not the only way to deliver psychological and behavioural treatments as an alternative to face-to-face treatments. Bibliotherapy was one of the first attempts to help patients through books and other written material (Glasgow & Rosén, 1978; Marrs, 1995). Several studies have investigated the effects of CBT delivered through bibliotherapy for different disorders such as depression (e.g. Scogin, Jamison, & Gochneaur, 1989), insomnia (Mimeault, & Morin, 1999), sexual dysfunctions (van Lankveld, 1998), and migraine (Fritsche, et.al., 2010). Beside text-based treatments, other self-help formats, such as audiotapes and telephone delivery systems, have been used to evaluate the effects for different physical and mental health conditions (e.g. Mohr, Vella, Harts, Heckman, Simon, 2008). Self-help refers to treatments that are delivered with minimal input from a clinician. Internet-based treatments often use structured self-help material, presented via the internet and, when the treatment is guided, a therapist provides support and encouragement online (Andersson, 2009). For the last decade researchers across the world have investigated the power of the internet to create internet-based prevention and treatment programmes (see reviews, Andersson et al., 2008; Barak, Hen, Boniel-Nissim & Shapira, 2008).

Definitions of internet-based treatments

Various terms have been used to describe the interventions conducted via the internet for different health purposes. Examples of the different terms are web-based therapy, e-therapy, cybertherapy, eHealth, computer-mediated interventions, online therapy, computerized self-help, and internet therapy. There are several factors that differentiate the different treatments conducted by means of the internet. Clarity and consistency of terms are needed (Ritterband, Andersson, Christensen, Carlbring, & Cuijpers, 2006; Barak, Klein, & Proudfoot, 2009). Common factors are that, generally internet interventions are referred to systematic treatment/prevention programmes, addressing determinants of health, delivered largely via the internet, and interfacing with an end user (Ritterband, et al., 2003; Abbot, Klein, & Ciechomski, 2008; Bennett & Glasgow, 2009). On behalf of the International Society for Research on Internet Intervention, Ritterband and colleagues (2006) defined internet interventions:

“Internet interventions are treatments, typically behaviourally based, that are operationalized and transformed for delivery via the internet. Usually, they are highly structured; self-guided or partly self-guided; based on effective face-to-face interventions; personalized to the user; interactive enhanced by graphic, animations, audio, and videos; and tailored to provide follow-up and feedback.”

Barak and colleagues (2009) used four categories, based on their prime approaches, to define internet-based therapeutic interventions. This categoriza-
tion is not based on an accepted empirical model or on a theoretical conceptualization but on a practical basis. In the first category the researchers propose that education interventions; self-guided web-based therapeutic interventions; and human supported web-based therapeutic interventions are named web-based intervention. The second category, online counselling and therapy, refers to the various options that exist for interpersonal communication through the internet. Internet-operated therapeutic software is the third category in their definition of internet-based interventions. Other online activities are the fourth category of internet interventions and consist of online activities such as participation in support groups via chat, audio or webcam communication channels, the use of online assessments and accessing health-related information via information sites, and podcasts.

Content
The programme content is an essential component of the web-based intervention. The programme content can be intended to educate (e.g. education about a particular problem area) or to accomplish a therapeutic change (e.g. CBT for different diagnoses) (Abbot, Klein, & Ciechomski, 2008). Here, the focus is on internet-delivered CBT, iCBT. Another important component in web-based interventions is the use of multimedia. These interventions often use text to disseminate programme content, however variability exists and other multimedia options include pictures/graphics, animations, audio, and video (Barak et al., 2009). Including a greater variety of multimedia formats could be advantageous (Ritterband, et al., 2006).

Guidance
An important aspect of web-based interventions is how interactive they are, i.e. how much the patient participates within the programme, e.g. uses self-assessment and self-monitoring tools. More interactive online activities probably enhance patients’ understanding of programme content (Abbot et al., 2008). All web-based treatments require that patients act by themselves but the type and degree of feedback offered varies. The degree of feedback differs from self-guided programmes that do not offer supportive feedback or provide automated supported feedback to human-supported, guided programmes that offer tailored feedback, and more tailored feedback often means more therapist time (Barak, et al., 2009; Marks, Cuijpers, Cavanagh, van Straten, Gega, & Andersson, 2009). A meta-analysis reported that guided internet-based treatments for depression showed higher effect sizes than unguided treatments (Andersson & Cuijpers, 2009).

Communication
The different possible communication modalities include: individual or group contact and asynchronous, i.e. time-delayed, or synchronous, i.e. simultaneous, communication mode. The online communication for therapeutic
purposes is similar to other internet-based communication, i.e. e-mail, instant messaging or chat (Barak et al., 2009). However, communication for therapeutic purposes should be bound to certain guidelines and rules in order to maintain the patients’ privacy and prevent unauthorized individuals from accessing patient information (Midkiff, & Wyatt, 2008). Messages may be misunderstood, as there is a lack of nonverbal communication cues, body language and voice qualities, and therefore it is essential to probe and ask for clarifications in the communication (Barak et. al., 2009). As mentioned earlier, internet treatment can either be individual or a group treatment. It seems, however, that the online group format is more applicable to providing emotional support than individual therapy (Barak, Boniel-Nissim, & Suler, 2008).

**Software**

Different therapeutic software solutions are used, such as: robotic simulation of therapists providing dialog based therapy with patients (Tantam, 2006), rule-based systems for assessment, treatment selection, and progress monitoring (Squires, & Hester, 2004). For children and youths gaming and three-dimensional virtual environments have been developed and used for therapeutic purpose (Goh, Ang, & Chern Tan, 2008). Furthermore, the contribution of mobile applications such as smart phone applications is being studied in the health care system (Krishna, Boren, & Balas, 2009; Rosser, & Eccleston, 2011).

**Therapeutic alliance**

Internet-based treatments have been criticized, for instance for the lack of face-to-face visibility, which prevents the transmission and detection of a client’s nonverbal communication cues, and the use of a therapist’s body language. These are considered to be essential parts of the therapeutic alliance (Rochlen, Zack, & Speyer, 2004). The therapist contact in guided iCBT treatments, measured in time, is much less than in face-to-face treatments, about 1/10 of the time (Andersson et al., 2012). However, Cook and Doyle (2002) showed in a study that clients rated alliance higher when in online therapy compared to face-to-face therapy clients. Reynolds’ and colleagues’ (2006) found similar results, i.e. online clients rated session impact and therapeutic alliance as similar to the face-to-face clients. Furthermore, their preliminary results showed that online therapists evaluated the depth, smoothness, and positivity aspects of session impact and the confidence aspect of the therapeutic alliance higher than face-to-face therapist. The research discussed that this could be explained from the asynchronous form of communication, which allows online therapists to have a “zone of reflection”. The studies mentioned investigated alliance in small samples, N=15 and N=17 respectively and without a control group. In a recent study, Andersson and colleagues (2012) investigated alliance ratings in guided iCBT in three sepa-
rate samples. One sample with depression (n=49), one with generalized anxiety disorder (n=35) and the third sample with social anxiety disorder (n=90). Results showed that alliance ratings were high in all three samples and in line with face-to-face treatments. These results suggest that it is possible to establish a good therapeutic relationship despite the lack of face-to-face visibility in internet-based treatments.

Considerations

There are several important issues to consider regarding internet-based treatments. They are all delivered in a unique way, which requires that the therapist and the client/patient are suitable for this kind of treatment (Abbot, et al., 2008; Andersson, et al., 2008). Various considerations are mentioned below. However, a thorough review of the different issues is beyond the scope of this thesis.

The online therapist

General therapeutic competence is not automatically translated to e-therapy competence. The clinician in a guided internet-based treatment should be able to express himself/herself in writing. It is also important that the online therapist, besides possessing knowledge of the practice of psychotherapy, should have some skills in computer technology and be familiar with the internet and its tools (Midkiff et al., 2008; Andersson, 2009). The online therapist should also be able to assess if the client/patient is suitable for the type of treatment in terms of technical and writing skills, lack of extreme pathology, and the nature of the problem (Suler, 2001; Abbot et al., 2008). There is data suggesting that experienced therapists may require less time to support patients than inexperienced ones. However, the outcomes for the patients did not differ in the study mentioned that examined iCBT for social anxiety disorder (Andersson, Carlbring, Furmark, & Sofie 6 research group, 2012). Considering the above it is desirable that online therapist receive training covering all the unique characteristics of internet-based therapy (Abbott et al., 2008; Barak et al., 2009).

The potential consumer for internet-based treatment

There is limited knowledge about predictors of outcome in internet-based treatments, which makes it difficult to state for whom internet treatments are unsuitable (Andersson, 2009). Individuals with psychiatric disorders that experience distortions of reality, suicidal ideation, or comorbid psychiatric disturbance may not be suitable for an internet-based intervention since it may be difficult to assess and quickly give help to the person through the internet (Abbot et al., 2008). Furthermore, the potential consumer should have internet access, some computer and writing skills and be fluent in the language that is used in the treatment (Suler, 2001; Abbot et al., 2008; An-
dersson, 2009). Hence, thorough and rigorous assessments are required to decide if an internet-based treatment suits the individual (Suler, 2001; Abbot et al., 2008).

**Attrition**

Dropout rates in internet-based trials vary significantly. In a review they were reported to range from 2 to 83% (Melville, Casey, & Kavanagh, 2010). A common approach classifies dropout based on non-completion of one or more assessment or treatment components (i.e. pre-treatment assessments, treatment sessions, post-treatment assessments) (Melville et al., 2010). Attrition can be a big problem, so it is important to engage and involve the user in the treatment which can motivate the person to learn and progress through the programme (Ritterband, Thorndike, Cox, Kovatchev, & Gonder-Frederick, 2009). It seems that attrition is a bigger problem in unguided internet-based treatments than guided ones (Marks et al., 2009). Different trials have used different methods to prevent dropouts, telephone support (e.g. Study I), personalized reminders instead of impersonal automatic reminders (e.g. Clarke et al., 2005; Stevens et al., 2008), and financial cost to the patient (Chan et al., 2010). A recent study investigated whether non-completers dropped out because of lack of efficacy; whether adding choice, reminders and financial cost were factors; and whether contact with the clinician could improve adherence. Results showed that non-completers still benefit from each successive part completed in the treatment to a similar degree as patients who completed the whole treatment. Improving adherence to the treatment enhanced the benefit derived by the patients. Furthermore, the results showed that clinician contact improved adherence and financial cost also prevented dropouts (Hilvert-Bruce, Rossouw, Wong, Sunderland, & Andrews, 2012).

**Cost-effectiveness**

Cost-effectiveness is usually mentioned as one of the primary advantages of internet-based treatments. Economic analyses have become more important as internet interventions have moved from efficacy studies (i.e. aimed at examining whether a treatment works under ideal circumstances for a specified group of patients) to effectiveness trials (i.e. examines whether a treatment works in real world settings and in situations that clinicians encounter in their daily routine practice) (Andersson, Carlbring, & Cuijpers, 2009). A review (Tate, Finkelstein, Khavjou, & Gustafson, 2009) that included eight studies investigated the cost-effectiveness of internet-based interventions. They concluded that there was a lack of detailed and comprehensive analyses in the cost-effectiveness studies included. One of the studies (Southard, Southard, & Nuckolls, 2003) included a more comprehensive analysis, and the study reported benefits associated with the internet-based intervention. A more recent study investigated the economic impact of iCBT compared to
CBT group therapy for social anxiety disorder. The study had a societal perspective and both direct (e.g. health care consumption) and indirect costs (e.g. loss of work productivity, time spent in self-help groups) were included in the analyses. Results showed that both CBT group therapy and iCBT were economically beneficial within a year but iCBT was more cost-effective due to lower intervention costs (Hedman, Andersson, Ljótsson, Andersson, Rück, & Lindefors, 2011). Two studies have shown that iCBT for irritable bowel syndrome (IBS) can be cost-effective. In both trials the analysis included direct and indirect costs (Andersson, et al., 2011; Ljótsson, et al., 2011). Participants were recruited through self-referral from the general adult population in Sweden in one of the trials (Andersson, et al., 2011) while the recruitment in the other study was from a clinical setting (Ljótsson, et al., 2011). Another interesting difference was that the dropout rate was much lower in the self-referral trial (Andersson, et al., 2011). A recent study showed that iCBT can be a cost-effective alternative for severe health anxiety. Direct and indirect costs were included in the analysis and a societal cost reduction of £1,244 was demonstrated (Hedman, Andersson, Lindefors, Andersson, Rück, & Ljótsson, in press). These results indicate that internet-based CBT may be cost-effective treatments for different disorders.

Ethical issues

Confidentiality and security are important concerns regarding internet-based interventions. It is essential that information be transmitted in a secure way. Security can be provided by incorporating secure sockets layers (SSL) which are also used for payment transaction on the internet i.e. authentication in different levels is required. Encryption technologies, i.e. information is converting plain text to cipher text, combined with SSL maintains the security and integrity of the user (Abbot et al., 2008; Midkiff et al., 2008). Several problems can arise related to internet-based treatments, such as users’ ability to conceal their true identity, the problem of providing emergency assistance if needed, a reliance on technology, and difficulties with billing and fee collection (Barak et al., 2009). Several of the mentioned difficulties are encountered e.g. through assessments before inclusion, but it is clear that there is a need for ethical, legal and general guidelines for internet-based interventions (Abbot et al., 2008; Midkiff et al., 2008; Barak et al., 2009; Andersson, 2010). Professional associations have developed specific ethical guidelines such as the American Psychological Association, International Society for Mental Health Online (Abbot et al., 2008; Midkiff et al., 2008; Barak et al., 2009).

Internet-based treatments for health problems

Internet-based psychotherapeutic interventions have been found to be effective for several disorders (see review Barak et al., 2008). Several psychiatric
disorders have been studied with iCBT and results have been equivalent to face-to-face therapies, e.g. panic disorder (Carlbring et al., 2005; Kiropoulos et al., 2008; Bergström et al., 2010); social anxiety disorder (Andrews, Davies, & Titov, 2011; Hedman, et al., 2011), and subthreshold depression (Spek et al., 2007). Effective results have also been found for depression and anxiety (Spek et al., 2007; Andersson, & Cuijpers, 2009; Cuijpers, Donker, van Straten, Li, & Andersson, 2010) and posttraumatic stress (PTSD) (e.g. Lange, Rietdijk, Hudecovicova, van de Ven, Schrieken, & Emmelkamp, 2003; Litz, William, Bryant, & Papa, 2007; Klein et al., 2009). The internet treatments for the psychiatric disorders will not be further reviewed, since it is beyond the aim of the present thesis.

Behavioural medicine interventions have also been proved effective when delivered through the internet (see reviews Cuijpers, van Straten, & Andersson, 2008; Andersson, Ljótsson, & Weise, 2011). Internet-based interventions have been evaluated for several health problem such as weight loss (Tate, Wing, & O’Donell, 2001), diabetes management (McKay, Glasgow, Feil, Boles, & Barrera, 2002); smoking cessation (Stoddard, et al., 2005) physical activity (Napolitano et al., 2003); insomnia (see review Cheng, & Dizon, 2012); Irritable bowel syndrome (IBS) (Ljótsson, Hedman, et al., 2011; Ljótsson, Andersson, et al., 2011); tinnitus (Kaldo, Levin, Widarsson, Buhrman, Larsen & Andersson, 2008; Hesser, et al., 2012), headache (Ström, Pettersson, & Andersson, 2000), and chronic pain (see reviews Bender, Radhakrishnan, Diorio, Englesakis, & Jadad, 2011; Rini, Williams, Broderick, & Keefe, 2012). It is worth mentioning that Kaldo and colleagues (2008) compared iCBT to a traditional CBT group treatment for tinnitus and found no significant difference between the treatment formats.

A systematic review (Cuijpers et al., 2008) investigated iCBT for health problems. Twelve randomized controlled or comparative studies were included. The included studies focused on chronic pain (3 studies), headache (3 studies), and six other health problems (tinnitus, chronic diseases, breast cancer, paediatric brain injury, and insomnia). The interventions in the included trials differed from each other. Five interventions were guided while two consisted of self-help material without supporting contact from a clinician and the remaining studies intervention consisted of online contact between the clinician and the patients. Results showed that iCBT for health problems were effective even though the effects were slightly below the effect sizes found for iCBT for anxiety and depression (Spek et al., 2007). Since the publication of the mentioned review the number of trials investigating internet-based intervention for health problems has increased. An updated review (Andersson, Ljótsson, & Weise, 2011) examined 18 studies focusing on diabetes, cancer, pain conditions, obesity, IBS, stress management, hypertension, metabolic syndrome, cerebral palsy, infertility, HIV infection, and fruit/vegetable consumption. In the review studies on children and non-CBT trials were included (e.g. online peer interactions, physical
activity). Results were in line with the previous studies i.e. guided internet-based treatments are effective but the effects of online peer support are less clear. Furthermore, the researchers conclude that internet interventions for children and adolescents need further investigation. Hence, it seems as internet-based treatments, in particular guided iCBT, hold a promising addition and complement to existing treatments in several areas of behavioural medicine.

Internet-based treatments for chronic pain

As mentioned earlier it has become fairly well established that CBT input is a necessary component of interdisciplinary treatment for chronic pain. However, for many people suffering with chronic pain, CBT is not available, or access to this treatment modality is limited (Turk & Okifuji, 2002). Other barriers such as geographic and economic ones can hinder individuals with chronic pain to obtain evidence-based treatments (Buenaver, McGuire, & Haythornwaite, 2006). Internet-based treatment is rapidly evolving as a means for overcoming many of the mentioned barriers (Williams, 2011). The internet-based studies have focused on different chronic pain syndromes including headache, back pain, musculoskeletal pain abdominal pain and fibromyalgia. The majority of the interventions evaluated is based on CBT and are guided treatments (Bender, Radhakrishnan, Diorio, Englesakis, & Jadad, 2011). The target group in most of the studies is adults (Bender, et al., 2011) but there are some studies involving children and adolescents with chronic pain (Hicks, von Baeyer, & McGrath, 2006; Trautman, & Kroner-Herwig, 2008; Palermo, Wilson, Peters, Lewanowski, & Somhegyi, 2009; Trautmann, & Kroner-Herwig, 2010). Different technologies have been used to deliver internet-based treatments for chronic pain, i.e. e-mail discussion groups (peer support); guided internet-based treatments, unguided treatments and mobile applications. Below, a selection of studies is presented that represent the different types of internet-based treatments.

**E-mail discussion groups** consist of closed-group discussions i.e. only consented participants are included. In an early internet study (Lorig, Laurent, Deyo, Marnell, Minor, & Ritter, 2002) 580 individuals with back pain were randomized to a treatment or to a control group. The intervention group consisted of a moderated discussion group, access to a book and videotape about pain management. The control group received usual care and a subscription to a magazine of their choice however not a health magazine. Results show at one year, that the e-mail discussion group improved regarding pain intensity, disability, role function, and health distress. The treatment group also demonstrated fewer visits to physicians during the last six months of the study. The same sample was later investigated in a study where the patients’ consumption of complementary and alternative treatment modalities (e.g. acupuncture, chiropractic manipulation) were analysed. No signifi-
cant results were found, i.e. the patients’ health behaviour was not affected by the participation in the interactive discussion group (Bruce, Lorig, Laurent, & Ritter, 2005). The same research group evaluated an internet-based programme for arthritis led by two peer moderators. Results showed improvements in health status measures and self-efficacy (Lorig, Ritter, Laurent, & Plant, 2008). Peer support interventions have yielded mixed results for chronic diseases. More information is needed regarding the details of peer activities and there is a need to generalize the results to other populations (Funnell, 2010).

**Guided internet-based interventions** for chronic pain use technology in conjunction with therapist contact to support the patient. As mentioned earlier, guided internet-based programmes provide instructions for behavioural change while being monitored by a therapist. Several reviews have reported the effects of this type of treatment specifically for chronic pain, see below (Macea, Gajos, Calil, & Fregni, 2010; Bender et al., 2011). An interesting study investigated whether an iCBT intervention would help children and adolescents with chronic pain. The intervention programme consisted of different modules designed for children and their parents. The content of the modules covered different CBT topics such as education about pain, cognitive skills, relaxation, and relapse prevention. The site for the parents contained similar topics but also included training in behavioural change and communication strategies. After every module the users submitted their assignments for review by an online therapist who replied to the participants. Results showed that the individuals randomized to the iCBT group improved significantly in pain intensity and functional status compared to the wait-list control. Benefits were maintained into the follow-up period (Palermo et al., 2009).

**Unguided internet-based interventions** are, as mentioned above, websites that are fully automated. A recent study (Ruehlman, Karoly, & Enders, 2012), not included in the reviews, evaluated an internet-based multielement programme based on CBT and interpersonal and self-management approaches. 305 individuals with chronic pain were randomized to the internet-based treatment and to a wait-list control group. Participation was fully self-directed and self-paced. Participants were not contacted or managed by the research team, except when they were prompted to complete the assessments. The participants were paid for completion of the assessments, but not for participation in the programme. Results showed significant decreases, albeit modest effects, in pain, severity, pain-related interference and emotional burden, perceived disability, catastrophizing, and pain induced fear. Depression, anxiety and stress declined and the experimental group showed an increase in pain knowledge after programme exposure. A similar study (Carpenter, Stoner, Mundt, & Stoelb, 2012), evaluated the efficacy of a pilot version of a web-based CBT self-help intervention for individuals with chronic lower back pain. Individuals (N=141) were randomized to an inter-
vention group or wait-list control. The treatment consisted of a mind/body treatment rationale, pain education, and CBT techniques. The internet intervention was an interactive programme with a variety of instructional modalities (e.g. reflective and interactive exercises). Participants were prompted to complete measures after three and six weeks. They were offered financial compensation for completing the assessments. Results suggested that the internet-based programme had positive effects on participants’ ability to conceptualize, self-manage, and react to their pain.

*Mobile applications* deliver health-related tools and resources through wireless devices such as smart phones and tablet computers. There are a great number of apps (downloadable programmes designed to run on the smart phone) relating to pain, but there is no regulatory body evaluating and approving the release of health-care apps (Rosser & Eccleston, 2011). A pre-trial study, conducted on a convenience sample, investigated the use of an internet intervention delivered by a smartphone. Participants, women with chronic widespread pain, met a clinician once and received written exercises (based on CBT) and a CD with relaxation and mindfulness exercises. They were asked to complete three diary entries per day using borrowed mobile phones. The diaries included 19-32 questions. Participants received feedback that was available on a web site. Results showed that the participants experienced the intervention as supportive, meaningful and user-friendly, but the sample consisted of only six women (Kritjánsdóttir et al., 2011).

Internet-based treatments for chronic pain are relatively untested for effectiveness (Rosser et al., 2011). In the review conducted by Macea and colleagues (2010), 11 studies were assessed to quantify the efficacy of internet-based CBT for chronic pain, including study I in this thesis. The studies included evaluated the effects of iCBT for chronic pain and were randomized controlled trials. The total number of subjects was 2953 and the majority were women (67.5%). The studies varied in the type of assessments used, the study population, the aetiology of chronic pain, and time of intervention. The main outcome used in the meta-analysis is pain scale, and results showed small reductions in pain compared to waiting-list control groups. High dropout rates were reported with an average of 26%, which is higher than in traditional CBT interventions (14%). The researchers conclude that despite the modest effects internet-based interventions have the potential of expanding treatment options for many patients because of the benefits of decreased costs and the absence of side effects are. In a more recent review (Bender et al., 2011) 17 articles that evaluated CBT for chronic pain were included. The total sample analysed consisted of 2,503 individuals with different chronic pain syndromes including headache, back pain, musculoskeletal pain, abdominal pain and fibromyalgia. Results showed that iCBT was associated with improvements in pain, activity limitation, and costs associated with treatment. The effects on depression and anxiety were less consistent. The researchers found that the effects of internet-based CBT were
comparable to the effects of face-to-face treatments for chronic pain, even though the conclusions are not definite.

**The advantages and disadvantages of internet-based interventions**

Internet-based interventions are not intended to replace traditional treatments but allow a broadening of the scope and diversity of opportunities for different method of interventions, ways of approaching and reaching different clientele, and possibilities of treating diverse problems and distress areas. Below follows a summary of advantages and disadvantages of internet-based treatments.

**Advantages**

- Availability of therapists or educators
- Reduction of traditional face-to-face treatment barriers such as, inconvenience of scheduling, appointments, missing work/school, traveling, increased adherence and reduction in treatment time and costs. Furthermore, individuals that live in remote areas, persons that are socially withdrawn, physically disabled, or concerned about treatment-related stigma. (Ritterband et al., 2003; Tate et al., 2009).
- Individuals can use the internet programmes at their own pace with access unlimited by time, day, and location.
- Evidenced-based treatments can be delivered in a consisted but personalized form.
- Cost-effective use of health resources.
- Possibility of implementing evidence-based interventions (e.g., CBT) to pain practices.

**Disadvantages**

- Not suitable for all patients.
- Risks of diminished security and personal integrity.
- Risk of discontinuation of treatment due the responsibility and demands involved in self-help treatments.
- Misunderstandings and loss of information due to lack of non-verbal or visual cues.
- Risk of missing acute crises that can occur during the treatment due to fragmented communication.
Summary and concluding comments

Pain is a personal experience influenced by attention, meaning of the situation, and prior learning history as well as physical pathology. The first influential model to integrate physiological and psychological aspects in a model of chronic pain was the gate control theory (Melzack & Wall, 1968) and paved the way for the biopsychosocial perspective. The integrative biopsychosocial model incorporates the mutual interrelationships among physical, psychological, and social factors and is the basis of interdisciplinary pain rehabilitation. Developments in clinical psychology have been adapted for use within chronic pain settings. CBT, operant techniques combined with cognitive techniques, has been shown work well for chronic pain (e.g., Morley et al., 1999; Hoffman et al., 2007). Several concepts related to chronic pain have emerged from CBT and have been shown to be related to functioning. These include constructs such as catastrophizing and anxiety sensitivity among others (Gatchel et al., 2007). The fear-avoidance model explains how psychological factors such as fear and catastrophizing contribute to the development of chronic pain and maintenance of disability associated with chronic pain. The fear-avoidance model highlights important psychological factors to consider in development of chronic pain and its assessment and treatment, i.e. catastrophizing, pain-related fear and avoidance (Vlaeyen & Linton, 2000). Interdisciplinary treatments are often based on CBT (e.g., Sanders et al., 2005). Unfortunately the availability to interdisciplinary treatments and CBT for chronic pain is poor for many individuals suffering from chronic pain. This is a problem, given that the global prevalence of chronic pain is estimated to be at 20 per cent, which means enormous human suffering and societal costs (Breivik et al., 2006). It is essential to increase the accessibility of evidence-based treatments such as CBT to chronic pain suffers. Internet has been proven to be an effective channel to deliver CBT for different disorders (see reviews, Andersson et al., 2008; Barak et al., 2008). In addition to the benefits of being accessible and cost-effective, the internet can meet patients at different phases. It is not uncommon that patients that have undergone an interdisciplinary rehabilitation programme relapse or have residual discomfort and repeat the interdisciplinary treatment, which is very costly; here an internet-based intervention could be an alternative. The present thesis investigates whether CBT interventions based on the presented models can be delivered through the internet with positive outcome for individuals suffering from chronic pain. Furthermore, to see if ACT, that has been shown effective for chronic pain, can be delivered through the internet.
The Empirical Studies

Aims

General aims

The present thesis includes four studies with the aim to evaluate whether guided internet-based treatments based on cognitive behavioural therapy (iCBT) can help individuals with chronic pain regarding biopsychosocial variables.

Specific aims of the studies

*Study I - Controlled trial of Internet-based treatment with telephone support for chronic back pain*

The aim of this study was to investigate the effects of an iCBT intervention with telephone support for individuals with chronic back pain compared with a waiting-list control group.

*Study II - Guided internet-based cognitive behavioural treatment for chronic back pain reduces pain catastrophizing: A randomized controlled trial*

The aim of this randomized controlled trial was to replicate the results in study I, but with some adjustments, such as removing the telephone support. Another adjustment made was to include a live structured interview before inclusion.

*Study III - Guided internet-delivered cognitive-behavioural therapy for former patients with chronic pain: randomized controlled trial*

The aim of study III was to investigate the effect of an iCBT intervention for persons who had completed multidisciplinary treatment at a pain management unit but had residual problems. The internet-based CBT was investigated as a secondary intervention. The control condition consisted of a moderated online discussion forum. A second aim was to investigate effects at sixth months following end of treatment.
Study IV Guided internet-delivered acceptance and commitment therapy for chronic pain patients: randomized controlled trial

The aim of study IV was to investigate whether an internet based ACT treatment would help chronic pain patients. Participants were recruited from a clinical setting. The active treatment group was compared to a moderated online discussion forum.

Methods
Design and procedure

Study I
In study I participants were recruited through advertisement and filled in the inclusion form on a web site that contained questions about the person’s pain, factors that affect their pain, other treatments they might have been through and other possible diagnoses, and the form Hospital Anxiety and Depression Scale (HADS) (Zigmond, & Snaith, 1983). Informed consent was obtained electronically. The participants were assessed and randomly assigned to a pain management programme (iCBT) or a waiting-list control. The participants were given a password and an unidentifiable username that gave them access to the treatment programme and forms. Data were collected at pre- and post-treatment and were analysed in a mixed design with one between group factor (iCBT and a waiting-list control) and one within group factor (pre- and post-measurements). Follow-up data were collected 3 months after completion of the programme. Data were obtained from 47 participants (92%), who all had received the programme at that stage.

Study II
In study II participants were recruited by means of newspaper articles in national and regional papers as well as through a web page on the Internet. In several aspects the procedure was the same as in study I but with some important differences. The web page included an outline of the study, and an application form including questions partly derived from the Philips and Rachman’s manual (1996). The Hospital Anxiety and Depression Scale (HADS) (Zigmond, & Snaith, 1983) was also included, to screen for depression and anxiety. Those who completed the form were called for a structured live interview. The structured interview was carried out by two clinical psychologists. The interview covered pain symptoms, other medical and psychological conditions, previous and on-going treatments, and information about the study. During the interview the participant filled out an informed
consent form permitting the study coordinator to contact his or her physician if necessary. The participants were asked to fill out Montgomery Åsberg Depression Rating Scale (MADRS-self rated) (Svanborg, & Åsberg, 2001), which was used only for screening purposes and was not administered at post-treatment. If levels of depression were high (>20 on the MADRS-S) the participant was not included. Following the live structured interview and informed consent the participants were randomly assigned to the pain management programme (iCBT) or to a waiting list. The participants were given a password and an unidentifiable username that gave them access to the treatment programme, and forms. All participants (N=54) were asked to fill out online questionnaire measures at pre- and post-treatment.

Study III
In study III information about the study was sent to former patients at the pain centre at Uppsala University Hospital in Uppsala, Sweden. The participants had previously undergone a multidisciplinary CBT-based rehabilitation programme with focus on behaviour change through the use of different strategies such as applied relaxation, cognitive techniques, physiotherapy exercises, pacing and education about ergonomics. The patients were contacted by letter and telephone, and were asked to register on a webpage if they were interested in participating in the study. Persons who fulfilled the initial inclusion criteria underwent a structured telephone interview. The telephone interview was done in order to screen the participants for possible complications and suitability for the study (including having residual problems with pain). Participants were asked to sign an informed consent. They were screened with the Primary Care Evaluation of Mental Disorders (Prime-MD) to be able to exclude participants with on-going severe psychiatric disturbance (Spitzer et al., 1994). The screening interview also included questions on perceived discomfort level, pain intensity and information about the study. Following the telephone screening the participants were randomized to either treatment (iCBT) or to a control group. The control group participated in a moderated asynchronous online discussion forum (Lorig et al., 2002), with weekly discussion topics presented (for example “How is it for you to live with pain?”). This was intended as an active control. The discussion forum was monitored by the study coordinator but without intervening or reminding participants to go in and post messages to the forum. The participants were given a password and an unidentifiable username that gave them access to the treatment programme, forms and therapist guidance. Measures were obtained pre- and post-intervention (immediately after the treatment period), and at six months follow-up after treatment completion. Self-report measures were administered via the Internet. The control group was offered the treatment after post-measurements.
Study IV

In study IV, all participants were recruited from the Pain Centre at Uppsala University Hospital in Sweden. The patients had undergone a medical examination but had not received any multidisciplinary rehabilitation. Information about the present study was sent to patients from the patient register. The patients were contacted by telephone in order to find out if they were interested in participating in the study and if they were able to schedule a time for a screening interview. They were also asked to sign an informed consent form. The screening interview was structured, conducted by telephone and lasted for about 30 minutes. The telephone interview was done in order to screen the participants for possible complications and suitability for the study. The screening interview included questions on perceived discomfort level, pain intensity, pain duration, previous contact with the health care system, psychiatric and other physiological disorders and information about the study. After the telephone interview, the remaining individuals were randomized to either the treatment group (internet-based ACT) or to the control group. The control group participated in a moderated online discussion forum (Lorig et al., 2002) where weekly discussion topics were presented and discussion encouraged. As in the previous trial, the participants were given a password and an unidentifiable username which gave them access to the questionnaires, the treatment programme and therapist guidance. Participants were asked to complete a battery of assessments online. Participants received two phone calls, one when they had completed section three (of seven sections) and the other seven weeks into the treatment regardless which section the participant was in. The phone calls were structured and aimed to motivate and encourage the participants but also to give them opportunity to ask questions about the programme. The phone calls lasted less than 30 minutes. After seven weeks, all participants were prompted to log in to the study website to complete the study outcome measures. Measures were obtained pre- and post-intervention and administered via the internet. Follow-up data at six months was obtained for the treatment group.

Participants

As mentioned above, in study I and II participants were recruited via advertisements in regional papers and on a webpage. The participants in study III and IV were recruited from a clinical setting, the Pain Centre at Uppsala University Hospital. Table 1 summarizes descriptive statistics on demographic and other relevant characteristics of the participants who completed the programme and of the dropouts for all the studies.
Inclusion and exclusion criteria

Common inclusion and exclusion criteria for all the studies were:

- Have regular access to the internet.
- Be fluent with the Swedish language since all material in the treatment programmes is in Swedish.
- Have chronic pain (i.e. pain longer than 3 months) and have functional impairment caused by chronic pain.
- Have been medically investigated during the last 12 months.
- Have not planned any surgical treatment or on-going medical investigation that could impede participation in the study.
- Not suffering from acute physical or psychological conditions.

Additional inclusion and exclusion criteria in the different studies

- Not be bound to a wheel chair (Study I - III)
- Be between 18 and 65 years of age (Study I & II)
- Have back pain (i.e. lumbar, thoracic and/or cervical area) (Study I & II)
- Not suffer from pain that can increase as a consequence of activity (e.g., spinal stenosis) (Study I & II)
- Not suffer from heart and vascular diseases (Study I & II)
- Have current employment or on short-term sick leave (not longer than 6 months) (Study II).
- Have completed the multidisciplinary pain rehabilitation programme (Study III).
- Have residual symptoms after the rehabilitation treatment (defined as functional impairment caused by their pain as described in a self-report and later on in the telephone interview) (Study III).

In study I, 100 individuals showed an interest in the study, and 67 fulfilled the inclusion criteria. A physician was consulted to exclude persons in accordance with criteria “suffer of pain that can increase as a consequence of activity”. Of the 67 eligible who met inclusion criteria, 56 were interested in participating. Of these 56 participants, 5 (8%) eventually dropped out at various stages without providing post-treatment data, leaving a final sample of 51 participants, 22 in the treatment condition and 29 in the control condition.

In study II 80 individuals showed an interest in the study. Out of them 60 were eligible participants who met all the inclusion criteria. 54 showed interest in participating in the study. Of these 54, 26 were randomly assigned to the treatment condition and 28 to the control condition. Four dropped out (three in the control group and one in the treatment group) without providing post-treatment data.
In study III, 256 former patients, at the pain centre at Uppsala University Hospital in Sweden, were informed about the study by letter. 163 were excluded since 51 could not be reached and 112 declined participation, leaving 93 individuals. Eight of these were excluded since they could not be reached for the telephone interview. An additional seven individuals were excluded because they did not complete the inclusion forms. Of the remaining 78 persons that completed the inclusion forms, five were excluded (four were bound to a wheelchair, one had planned surgery and one individual did not meet inclusion criteria). Finally, 72 individuals were randomized to the treatment group and the waiting-list group. After randomization, six were excluded (four in the treatment group and two in the control group) and ten were lost to follow-up (six in the treatment group and four in the control group) leaving 56 completers (30 in the control condition and 26 in the treatment group). However, all the randomized participants (n=72) were included in the intention-to-treat analysis (ITT). Only the completers in the treatment group were followed up six months after treatment (23 participants completed follow-up forms).

In study IV information about the study was sent to 273 patients from the patient register at the Pain Centre, Uppsala University Hospital in Uppsala, Sweden. 73 individuals were excluded, 62 declined participation and 11 fulfilled exclusion criteria. 200 persons were assessed for eligibility but 115 were excluded because they could not be reached leaving 85 persons to be interviewed by telephone. After the telephone interview, 76 persons remained (nine were excluded, four did not meet inclusion criteria, one had planned surgery and four did not complete all the inclusion forms) and were randomized to either the treatment (n=38) or to the control group (n=38). Three participants in the treatment group were excluded after randomization because they declined participation, and 12 (six in the treatment group and six in the control condition) were lost to follow-up. All randomized participants were included in the ITT analysis. Only the completers in the treatment group were asked to complete follow-up forms six months after the treatment (n=29).
Table 1. *Demographic data for the total samples in all the studies*

<table>
<thead>
<tr>
<th>Study</th>
<th>Age M (SD)</th>
<th>Pain duration in years M (SD)</th>
<th>Gender per cent (number)</th>
<th>Education level Per cent (number)</th>
<th>Sick leave. Per cent (number)</th>
<th>Pain location Per cent (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study I (N=56)</td>
<td>44.6 (10.4)</td>
<td>10.1 (9.2)</td>
<td>Men 37.5 (21)</td>
<td>Nine-year compulsory school 17.9 (10)</td>
<td>Yes 32.1 (18)</td>
<td>Back 100.0 (56) primary area, target group in the study was back pain</td>
</tr>
<tr>
<td>Study II (N=54)</td>
<td>43.2 (9.8)</td>
<td>12.1 (8.5)</td>
<td>Women 62.5 (35)</td>
<td>Upper secondary school 25.0 (14)</td>
<td>No 67.9 (38)</td>
<td>Neck, head Not applicable</td>
</tr>
<tr>
<td>Study III (N=72)</td>
<td>40.1 (8.94)</td>
<td>6.2 (2.07)</td>
<td></td>
<td>University education 57.1 (32)</td>
<td>No 67.9 (38)</td>
<td>Shoulders, arms Not applicable</td>
</tr>
<tr>
<td>Study IV (N=76)</td>
<td>49.1 (10.34)</td>
<td>15.3 (11.65)</td>
<td></td>
<td></td>
<td>No 67.9 (38)</td>
<td>Hips, legs, feet Not applicable</td>
</tr>
</tbody>
</table>

Measurements

The selection of outcome measures was based on previous studies on CBT for chronic pain. Several measures were common for all studies, such as HADS (Zigmond et al., 1983), the Coping Strategies Questionnaire (CSQ) (Rosensthiel & Keefe, 1983), Multidimensional Pain Inventory (MPI) (Kerns, Turk & Rudy, 1985), the Pain and Impairment Relationship Scale (PAIRS) (Riley, Ahern & Follick, 1988), and Quality of Life Inventory.
(QOLI) (Frisch, Cornell, Villanueva & Retzlaff, 1992). In study I and II a pain diary was included as an outcome measure but in study II it was not analysed or presented due to missing values. In study III and IV the Chronic Pain Acceptance Questionnaire (CPAQ) (McCracken et al., 2004) was part of the measurement distributed to the participants. Measures were obtained pre- and post-intervention and administered via the internet. Self-report questionnaires generally show the same psychometric properties as paper-and-pencil administration (Buchanan, 2003).

Primary outcome measure for study I-III was CSQ (Rosensthiel et al., 1983) with a focus on the catastrophizing scale, while in study IV the primary outcome was CPAQ (McCracken et al., 2004).

Primary outcomes

The Coping Strategies Questionnaire (CSQ)-primary outcome in studies I-III

The CSQ contains 50 items divided into eight scales measuring different cognitive and behavioural coping strategies and has been widely used by chronic pain patients. The coping strategies scales are: diverting attention, re-interpreting pain sensations, coping self-statements, ignoring sensations, praying and hoping, catastrophizing and increased behavioural activities (Rosensthiel et al., 1983). The scale pain behaviour has low internal consistency and is excluded from the Swedish version. The Swedish version has high internal consistency: $\alpha = .7 - .8$, and the test-retest reliabilities ranges between $r = .4 - .9$ (Jensen & Linton, 1993).

Chronic Pain Acceptance Questionnaire (CPAQ)- primary outcome in study IV

CPAQ consists of 20 items divided into two subscales: activity engagement and pain willingness. Items are rated on a scale from 0 (never true) to 6 (always true). Higher scores denote greater activity engagement and pain willingness. Studies show acceptable reliability ($\alpha=.72 – .92$). The questionnaire correlates with measures of avoidance, distress and daily functioning. Factor analyses provide support for the two-factor structure of the scale (Vowles, McCracken, Eccleston, & Mcleod, 2008; Wicksell, Melin, Lekander, & Ols-son, 2009). CPAQ has further been validated in an internet sample with similar psychometric properties to those reported involving paper and pencil administration (Fish, McGuire, Hoga, Morrison & Stewart, 2010).
Secondary outcomes

*Hospital and Anxiety Depression Scale (HADS)*

HADS contains 14 items and evaluates severity of depression and anxiety without contamination of scores of physical symptomatology. The scale was designed for use in medical outpatient clinics (Zigmond & Snaith, 1983). The internal consistency for the anxiety scale is $\alpha = .80 - .93$ and for the depression scale $\alpha = .81 - .90$. Test-retest reliability after two weeks was $r = .80$ (Lisspers, Nygren & Söderman, 1997). Administration of the HADS in an internet sample has also been shown to provide meaningful and valid data (Andersson, Kaldo-Sandström, Ström & Strömgren, 2003).

*Multidimensional Pain Inventory, MPI*

MPI intends to measure psychosocial and behavioural consequences of chronic pain (Kerns, Turk & Rudy, 1985). The questionnaire consists of 52 items that generate 13 scales across three sections. The Swedish version of MPI (MPI-S) consists of 34 items divided into 8 subscales (Bergström, Jensen, Bodin, Linton, Nygren, & Carlsson, 1998). The first section addresses: Pain Severity, Interference, Life Control, Affective Distress and Support. The second section addresses the patient’s perception of how significantly others respond to their displays of pain: Punishing Responses, Solicitous Responses and Distracting Responses. The third section forms a general activity scale and has been excluded from the analysis since the scale structure could not be verified. The first section of MPI-S has an internal consistency of $\alpha = .80$, the second section $\alpha = .76 - .86$ and for section three is $\alpha = .67 - .81$. The test-retest coefficients for the MPI-S are $r = .73 - .89$. The discriminant validity for sections one and two, after excluding four statements, indicates that MPI-S has the same scale structure as the MPI (Bergström et al., 1998).

*The Pain and Impairment Relationship Scale (PAIRS)*

PAIRS assess beliefs and attitudes associated with the experience of chronic pain and one’s ability to function despite pain. It consists of 15 personal statements that reflect thoughts, attitudes and opinions about pain. Each statement is accompanied by a 7-point Likert rating scale for the patient to identify to what degree he/she agrees or disagrees with the given statement. Higher scores denote greater tendency to equate pain with impairment and to restrict functioning. PAIRS has an internal consistency of $\alpha = .82$ and test-retest reliability of $r = .66$ (Riley, et al., 1988).

*Quality of Life Inventory (QOLI)*

QOLI consists of 32 items for assessing life satisfaction (Frisch, et al., 1992). The assessment yields an overall score and profile in 16 areas of life;
health, self-esteem, goals and values, money, work, play, learning, creativity, helping, love, friends, children, relatives, home, neighbourhood, and community. Each item is rated in terms of importance (0=not at all important to 2=extremely important) and satisfaction (-3=very dissatisfied to 3=very satisfied). QOLI has been found to show adequate stability over time with test-retest coefficients ranging between $r = .80 - .91$. The internal consistency coefficients ranged from $\alpha = .77 - .89$ across 3 clinical and 3 nonclinical samples (Frisch et al., 1992). QOLI has further been validated in an internet sample with similar psychometric properties to those reported involving paper and pencil administration (Carlbring et al., 2007)

**Pain diary - only in study I**

The participants made daily assessments of their pain intensity for one week before and one after the treatment group went through the treatment, in study I. The participants assessed their pain intensity on a scale from 0 (no pain at all) to 100 (extreme pain) three times every day (morning, noon and evening). A pain index was worked out (the sum of the assessed pain intensity divided with the number of recordings every week). When data was analysed the highest rated pain intensity for each day was also taken into consideration and used to calculate the mean peak intensity (e.g., the sum of the peak pain intensity ratings divided by the number of peaks for the whole week.

**Treatment credibility**

In study I a measure of treatment credibility was administered, a 5-item, 10-point scale adapted from Borkovec and Nau (1972). This was done at the end of the first treatment module, after the participant had received a full description of the intervention.

**Treatment**

The interventions in study I-III were based on a CBT model for chronic pain and were derived from the CBT literature on chronic pain with some physiotherapy components. Generally, the participants were instructed to test and practice different coping strategies like relaxation, cognitive skills, stress management as well as stretching and physical exercise techniques on an individualized graded activity basis with structured instructions, see Table 2. The treatment in study IV was based on ACT and consequently the content differed from the previous studies, and it is presented separately, see Table 3. There are some differences between the treatment programmes in the different studies. This was done to adapt the content of the treatments
to the different target groups in the different studies. Moreover, in study IV a different approach was used, based on ACT.

Study I
• Guided iCBT treatment with additional weekly structured telephone calls. The participants were also offered a CD with the instructions to applied relaxation. Contact with the participants, besides the telephone calls, was e-mail based. The treatment was divided into six modules intended for six weeks of treatment.

Study II
• Guided iCBT treatment based on the intervention in study I. The treatment was slightly modified; an introduction to mindfulness was presented, the text was updated and divided into eight modules. The participants in the treatment group were contacted once by telephone by one therapist in the trial, but not the one who was their therapist. The purpose of the telephone call was to give the participants the opportunity to ask questions and to receive information about how the treatment was proceeding, mainly from a technical point of view. The phone conversation was structured and was made after two weeks of treatment. The intervention lasted for eight weeks.

Study III
• Guided iCBT based on the previous interventions, i.e. study I and II. Since the participants were previous patients from the Pain Centre at University Hospital in Uppsala, the treatment programme was consistent with the multidisciplinary clinical treatment programme. The treatment programme was divided into eight modules.

Study IV
• Guided iCBT intervention consisting of seven sections and based on ACT (Hayes, Strosahl & Wilson, 1999). To maximize participant engagement and experiential learning, most exercises (e.g. mindfulness and metaphors) could be downloaded as MP3 recordings which could be played on a computer or an MP3 player. Participants could also read examples of how individuals with chronic pain behaved in different contexts. The programme followed the procedures recommended by Hayes et al. (1999).
Treatment components

The treatment programmes were composed of an information part, rationale, and a more practical part including assignments. See Table 2, for an overview of the components in the treatment programme, studies I-III.
<table>
<thead>
<tr>
<th>Treatment Phase</th>
<th>Information, rationale</th>
<th>Assignments and coping strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week 1</strong></td>
<td>Information about pain, an introduction to CBT and the biopsychosocial perspective on pain</td>
<td>Applied Relaxation, was presented as a coping strategy and consisted of different steps, moving from deep relaxation to rapid at the end of the treatment. It was a component throughout the treatment. In addition to the written instruction a CD was offered in study I. In study II and III the instructions could be downloaded as MP3 files. Body scanning and diaphragmatic breathing (study II). Formulation of goals and risksituations. The participant formulated goals with the treatment, which were formulated in concrete and behavioural terms.</td>
</tr>
<tr>
<td><strong>Week 2</strong></td>
<td>Information about physical exercise and posture. Information developed with the collaboration with a physiotherapist specialized in chronic pain.</td>
<td>Formulation of an exercise plan. Stabilizations and warm-up exercise, presented with pictures. The exercises in study III were adapted to the exercises from the rehabilitation programme.</td>
</tr>
<tr>
<td><strong>Week 2 (study I), Week 3 (II and III)</strong></td>
<td>Information about activity planning, and the importance of scheduling activities in accordance with the participants’ goals.</td>
<td>Activity planning with the help of coping strategies such as pacing, and pausing. A component through the rest of the programme.</td>
</tr>
<tr>
<td><strong>Week 3 (study I and II) week 4 (study III)</strong></td>
<td>Information cognitive reconstruction. Introduce the concept of automatic thoughts and the relationship between thoughts, emotions, and pain.</td>
<td>Thought record, participants are asked to work with their dysfunctional cognitions.</td>
</tr>
<tr>
<td><strong>Week 4 (Study II and III)</strong></td>
<td>Information about and a short introduction to mindfulness</td>
<td>Mindfulness exercise</td>
</tr>
<tr>
<td><strong>Week 5 (study I and II), Week 6 (study III)</strong></td>
<td>Information about stress and stress management. The “fight-or-flight” response is presented and the relationship between stress and pain.</td>
<td>Thought record related to stress.</td>
</tr>
<tr>
<td><strong>Week 5 (study I and II), Week 7 (study III)</strong></td>
<td>Information about sleep problems and pain. Sleep hygiene and stimulus control is presented.</td>
<td>To continue with the activity plan related to the participants goals.</td>
</tr>
<tr>
<td><strong>Week 6-7 (study II)</strong></td>
<td>Information about communication skills and conflict resolution methods. Information about problem-solving.</td>
<td></td>
</tr>
<tr>
<td><strong>Week 6 (study I), Week 8 (study II and III)</strong></td>
<td>Information about maintaining coping strategies and flare-up planning. Summary of the treatment programme.</td>
<td>Formulation of maintenance programme and plan for pain flare-ups.</td>
</tr>
<tr>
<td>Treatment phase</td>
<td>Information</td>
<td>Assignments</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Section 1</td>
<td>Information about the programme and about pain and its consequences in life. Introduction to mindfulness.</td>
<td>Practise and register mindfulness. Participants were asked to write down everything they have done to reduce/manage their pain and register for a week their behaviours and sensations during increased pain situations (functional analysis).</td>
</tr>
<tr>
<td>Section 2</td>
<td>Information about control and willingness. Introduction to primary and secondary suffering, short- and long-term consequences.</td>
<td>To practise and register mindfulness. To register primary and secondary pain (to distinguish physiological and psychological consequences of pain). To continue to register their behaviours and sensations associated with pain. A willingness record was introduced.</td>
</tr>
<tr>
<td>Section 3</td>
<td>The term acceptance is introduced. Information about thoughts and emotions and goal setting.</td>
<td>To practise and register mindfulness. Different defusion exercises. To formulate goals.</td>
</tr>
<tr>
<td>Section 4</td>
<td>Information about self as context. To live a good life despite pain.</td>
<td>To practise and register mindfulness. Values assessment.</td>
</tr>
<tr>
<td>Section 5</td>
<td>Information values and committed action.</td>
<td>To practise and register mindfulness. Values compass.</td>
</tr>
<tr>
<td>Section 6</td>
<td>More about willingness, committed action and living according to one’s values.</td>
<td>To practise and register mindfulness. Different willingness exercise.</td>
</tr>
<tr>
<td>Section 7</td>
<td>Summary of the programme and information about maintenance.</td>
<td>Maintenance plan. Evaluation of goals.</td>
</tr>
</tbody>
</table>
Therapist guidance

In all studies the participants had regular contact with their therapists. The participants were asked to work with one module per week and were encouraged to send in their homework registrations to their therapist on a weekly basis. They received feedback from the therapists within 24 hours with the exception of weekends. Feedback consisted of written text and took approximately 10-15 minutes per week to complete for each individual participant. The content of the feedback was mainly encouragement regarding exercise completion, advice, non-specific support such as showing empathy, and responding to questions asked by the participants. Therapists also sent reminders to the participants. In study IV text messages were sent to the participant’s mobile phones. In the text message the participant was encouraged to log into the web portal. In study I and II all contact was through e-mail. In study III and IV all correspondence concerning treatment was held through a web portal. The system handled security issues with two-factor authentication.

The therapists were graduate students in their last term of a five-year clinical psychology programme, and were trained in CBT including supervision of therapeutic work. They received weekly supervision by a clinical psychologist. One exception was study II, where all the therapists were licensed clinical psychologists.

Telephone contact

In study I the participants spoke on the phone with one of the therapists once a week. The telephone calls were structured, and every call consisted of reviewing the previous week’s assignments, questions the participant might have and possible reminders and motivation. The telephone conversations did not exceed 10 minutes, except for the first call, which could last 15 minutes. In study II the participants received a telephone call after two weeks of treatment. They were contacted by one therapist in the trial, but not the one who was their therapist. The purpose of the telephone call was to give the participants the opportunity to ask questions and to hear how the treatment was proceeding, mainly from a technical point of view. The phone conversation was structured. In study IV participants received two telephone calls, one when the participants had gone through three weeks of treatment. The other telephone call was made during the seventh week of the research project regardless of the participants’ location in the treatment programme. The calls were structured and aimed to motivate, encourage and give the participants an opportunity to ask questions about the programme.
Data analyses

Study I

In study I data were analysed on a per-protocol basis i.e. not ITT. For the inventories comprising subscales multivariate analyses of variance (MANOVA) was conducted on the change scores between pre- and post-measurements. Significant between group effects were followed by univariate ANOVAs. The first set comprised the nine subscales of the CSQ and the second set the eight scales of the MPI, the third set included mean scores of the HADS scales (anxiety and depression), PAIRS, and diary ratings of pain intensity and highest pain intensity. For the three-month follow-up repeated measures ANOVA were used for the whole group, as all had received treatment at that point. Furthermore, odds ratio, and numbers needed to treat (NNT) analyses were conducted. Jacobson's reliable change index, RCI, for each individual based on the pre-treatment score, the post-treatment score and the standard error of the difference, \([X_{post}-X_{pre}]/S\, \text{diff}\), was calculated (Jacobson & Truax, 1991).

Study II

Data were analysed using the ITT principle with all available data regardless of completion of the actual treatment. Missing data (n=5) was replaced according to the principle of last observation carried forward. Given the few dropouts, we regarded this as a defensible procedure instead of modelling the lost observations using bootstrap methodology or mixed models approaches. Power was estimated from previous iCBT effect sizes (Cuijpers, et al., 2008). A conservative estimation yielded an expected standardized mean difference of \(d=0.50\) (Moreley, et al., 1999). With conventional levels of confidence (\(p<.05\)) a sample size of 64 would be required, which we also aimed for. This was based on the assumption that the catastrophizing subscale of the CSQ could be used as a proxy for the outcome since it was a sensitive measure of treatment effects in our previous trial (Study I). We used analysis of variance (Anova and Manova) to detect interaction effects in the 2 x 2 design for the continuous measures, and \(\chi^2\) for categorical variables. Data from the self-report measures were checked for normality assumptions and found suitable for parametric analyses. A post-hoc test on the pre- to post-change scores confirmed a difference between the groups at post-test, Bonferroni corrected. For the categorical outcomes we calculated Jacobson's RCI, for each individual based on the pre-treatment score, the post treatment score and the standard error of the difference \([X_{post}-X_{pre}]/S\, \text{diff}\) (Jacobson, et al., 1991).
Study III and study IV

In study III and IV data were also analysed using the ITT principle. ITT analyses were conducted with PASW Missing Value Analysis (SPSS Inc., USA) to impute all missing data on the continuous measures with the expectation-maximization method. This method computes missing values based on maximum likelihood estimates with observed data in an iterative process (Blankers, Koeter, & Schipper, 2010). The total percentage of missing data at post-intervention was 22.2% and 19.7% respectively in study III and IV. These missing values at post-intervention were imputed, and there were no missing values at baseline in any of the studies. A comparison of results based on the imputed intention-to-treat sample versus the observed data revealed similar outcomes in both studies. Therefore, only the results from the intention-to-treat analyses were reported. Comparisons were two-tailed and interpreted with a significance of $p<.05$. Analysis of covariance (ANCOVA) was used to analyse data, the method adjust for pre-test scores. $\chi^2$ was used for categorical variables. Data from the self-report measures were checked for normality assumptions and found suitable for parametric analyses. Cohen’s $d$ was used to calculate the between group effect sizes at post-intervention (effect size of 0.2-0.5 was considered small, 0.5-0.8 as moderate, and $\geq 0.8$ as large) (Cohen, 1988). Follow-up data at six months was obtained for the treatment group and was analysed with paired samples $t$-test. Power was estimated from previous iCBT effect sizes for health problems (Cuijpers et al., 2008), and we assumed a between group effect size of $d=0.50$ which would require 64 individuals to establish an effect at $p<.05$ (Cohen, 1988). In study III, as a categorical outcome on the CSQ- catastrophizing scale, we calculated Jacobson's RCI for each individual based on the pre-treatment score, the post-treatment score and the standard error of the difference $[X_{post}-X_{pre}]/S_{diff}$ (Jacobson, et al., 1991).

Results

For an overview of the means for the significant measures for all the studies, see Tables 3 and 4.

Study I – Internet-based treatment with telephone support for chronic back pain

Statistically significant interaction effects were found in the CSQ scales: catastrophizing [$F(1,49) = 7.28, p<0.01$], control over pain [$F(1,49) = 12.20, p<0.001$] and ability to decrease pain [$F(1,49) = 4.61, p<0.05$]. A significant effect for time was found in PAIRS [$F(1,49) = 7.23, p<0.01$], that is, both groups experienced a reduction in functional impairment and beliefs and
attitudes regarding pain improved regardless of group allocation. Clinically significant improvement is described in terms of Jacobson’s RCI, which was calculated for the CSQ variable catastrophizing for which a significant effect was found and which has adequate reliability (Stewart et al., 2001). PAIRS was also analysed in terms of proportion reaching the reliable change criterion. For the catastrophizing scale 39% (n=10) showed a reliable improvement, and in the control group 14% (n=4), a difference that was statistically significant \( \chi^2(1)=4.4, p<0.05 \). For the PAIRS 27% (n=7) showed a reliable improvement in the treatment group, and 10% (N=3) in the control group. However, this difference did not reach statistical significance \( \chi^2(1)=2.53, p=0.11 \).

Associations were examined between the treatment group’s scores on the treatment credibility scale (M=36.8, SD=5.5) and their changes on the subscales, and significant interactions were found (e.g., catastrophizing, control over pain and ability to decrease pain). The participants preceding impression of the treatment programme did not have any relation with the treatment’s outcome since no significant correlations were found between treatment credibility and change scores on each respective subscale.

At the three-month follow-up all participants had received the treatment and were therefore treated as one group in the analysis. Repeated measures ANOVA showed that there were significant decreases in scores from pre-treatment to follow-up for the CSQ scales: Praying and hoping \([F(1,46)=4.9, p=0.032]\), catastrophizing \([F(1,46)=14.0, p=0.005]\), control of pain \([F(1,46)=37.3, p<0.001]\), and ability to decrease pain \([F(1,47)=21.7, p<0.0001]\). For the MPI a significant improvement over time was found for Life control \([F(1,46)=15.7, p<0.001]\), and a decrease of punishing responses \([F(1,46)=4.38, p<0.05]\). Results on the PAIRS showed a significant reduction \([F(1,46)=10.8, p<0.01]\) and on the HADS-depression scale a significant decrease was found \([F(1,47)=11.6, p<0.001]\).

Study II – Guided internet-based CBT for chronic back pain reduces pain catastrophizing

A significant interaction was obtained for the outcome measure catastrophizing \([F(1,48 = 11.9, p=0.0001]\). A post hoc test on the pre- to post-change scores confirmed a difference between the groups at post-test (Bonferroni corrected). Results showed also a significant interaction between group and time in QOLI \([F(1,48) = 10.8, p=0.0002]\), and this was explained by a decrease in the control group and an increase of QOLI scores in the treatment group. A Bonferroni corrected post hoc test on the pre- to post-change scores confirmed a difference between the groups at post-test. For a comparison with the previous trial RCI was calculated for catastrophizing in the CSQ. For this scale 58% (15/26) of the treated participants showed a reliable im-
improvement, and in the control group 18% (5/28). This difference was statistically significant: $\chi^2 (1)=8.6, p=0.003$). Significant effects for time were found for PAIRS $[F(1,48) = 3.9, p=0.05]$ and HADS anxiety. There was a main effect of time for HADS anxiety $[F(1,48) = 4.1, p=0.05]$, that is, a total improvement was found regardless of group allocation.

Study III – Guided Internet-delivered CBT for chronic pain patients who have residual symptoms after rehabilitation treatment

All analyses were calculated on an ITT basis with ANCOVA. After controlling for pre-test scores, there was a significant treatment effect on the CSQ-diverting attention subscale, in favour of the treatment group, $F(1,69)=4.07, p=.047$. A large between group effect size was found Cohen’s $d = 1.13$. On the CSQ- catastrophizing subscale the ANCOVA showed a significant between group effect, $F(1,69)= 4.85, p=.03$. A moderate effect size was found Cohen’s $d=0.70$. RCI on the CSQ- catastrophizing scale did not result in any significant between group difference, with 47.2% (17/36) improving in the treatment group and 30.6% (11/36) in the active control group, $\chi^2 (1)=2.1, p=.15$ (Study I and Study II). In the secondary outcome measures, a significant effect was found on the HADS anxiety scale, in favour of the treatment group, $F(1,69)=7.01, p=.01$. A small effect size was found Cohen’s $d=0.45$. There was also a significant between group effect on the HADS depression scale, $F(1,69)=4.22, p=.04$. A small effect size was found Cohen’s $d=0.32$.

Regarding MPI, significant effects were found on the MPI life control scale $F(1,69)=5.90, p = .018$, affective distress scale $F(1,69)=18.85 p<.001$, and on the punishing responses scale $F(1,69)=4.07, p=.048$, all in favour of the treatment group. The corresponding effects sizes were small to large at Cohen’s $d=0.40$, $d=0.80$ and $d=0.53$ respectively. Furthermore, ANCOVA showed a significant between group effect in PAIRS, $F(1,69)=8.40, p=.005$. A moderate to large effect size was found Cohen’s $d=0.76$.

Follow-up analysis for the completers showed that the results persisted after six months, in all the mentioned scales.

Study IV – Guided Internet-delivered ACT for chronic pain patients

All analyses were calculated on an ITT basis with ANCOVA. On the primary outcome measure, CPAQ, ANCOVA showed significant effects between groups on the CPAQ activity engagement scale $[F(1,73)=4.36, p=.04]$, CPAQ- pain willingness scale $[F(1,73)=6.69, p=.012]$, and on the total scale on CPAQ $[F(1,73)=6.0, p=.017]$, all in favour for the treatment group. The corresponding effects sizes were medium to small at Cohen’s $d=0.60$, $d=0.49$.
and \(d=0.41\) respectively. On the secondary measures significant results were found on the HADS anxiety scale, \(F(1,73)=5.88, p=0.018\) and on the HADS depression scale, \(F(1,73)=6.87, p=0.011\). The corresponding effect sizes were small: Cohen’s \(d=0.18\) and \(d=0.44\). There was a significant treatment effect on the CSQ catastrophizing subscale, \(F(1,73)=6.10, p=0.016\). A medium between group effect size was found Cohen’s \(d=0.51\). There were also a significant treatment effect on the CSQ praying and hoping subscale, \(F(1,73)=9.46, p=0.003\), in favour for the treatment group. A small effect size was found, Cohen’s \(d=0.28\). Furthermore, there was a significant treatment effect on the MPI interfering subscale, \(F(1,73)=9.49, p=0.003\) and in the MPI affective distress subscale, \(F(1,73)=5.08, p=0.027\). A medium between group effect size was found for the MPI interfering scale, Cohen’s \(d=0.56\) and a small effect size was found, Cohen’s \(d=0.30\) for the MPI affective distress.

Follow-up analyses for the completers, six months past treatment, did not show any deterioration or improvement in the mentioned scales with the exception of the MPI interfering subscale, where improvement was detected, \(t(28)=3.22, p=0.003\), Cohen’s \(d=0.32\) showed a small effect size.

Table 4. Overview of Means (SD) for the significant results in studies I and II.

<table>
<thead>
<tr>
<th>Significant interaction effects at post-treatment and follow up</th>
<th>Study I</th>
<th>Study II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSQ scales: catastrophizing*</td>
<td></td>
<td></td>
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<tr>
<td>Group Pre Post FU-3 month</td>
<td></td>
<td></td>
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<tr>
<td>Study I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment 13.6(7.7) 8.6(5.2) 9.3(5.2)</td>
<td></td>
<td></td>
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<tr>
<td>Control 13.7(6.9) 12.3(7.2) 11.8(6.9)</td>
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<tr>
<td>control over pain*#</td>
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<td>Treatment 2.8(1.0) 3.9(0.7) 3.6(1.1)</td>
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</tr>
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<td>Control 2.9(1.1) 2.9(1.1) 3.7(1.4)</td>
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<tr>
<td>ability to decrease pain*#</td>
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<tr>
<td>Treatment 3.0(0.8) 3.9(0.9) 3.7(0.9)</td>
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<tr>
<td>Control 2.6(1.0) 2.9(1.0) 3.4(0.9)</td>
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<tr>
<td>Praying or hoping#</td>
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<tr>
<td>Treatment 12.0(6.9) 9.8(5.1) 10.5(7.1)</td>
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<tr>
<td>Control 10.4(6.7) 8.5(6.0) 9.9(7.1)</td>
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<tr>
<td>MPI scales: Life control*</td>
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<tr>
<td>Group Pre Post</td>
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<tr>
<td>Study I</td>
<td></td>
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<tr>
<td>Treatment 3.1(1.1) 3.9(1.0) 3.6(1.1)</td>
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<tr>
<td>Control 2.7(0.9) 3.1(0.9) 3.8(1.4)</td>
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<tr>
<td>Punishing responses*</td>
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<tr>
<td>Treatment 1.0(1.4) 0.7(1.1) 0.7(1.0)</td>
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<tr>
<td>Control 1.5(1.4) 1.2(1.3) 1.3(1.3)</td>
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<tr>
<td>PAIRS#</td>
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<tr>
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</tr>
<tr>
<td>Control 56.3(10.8) 53.0(11.6) 50.9(13.8)</td>
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<tr>
<td>HADS: Depression*</td>
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<td>Group Pre Post</td>
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<tr>
<td>Study I</td>
<td></td>
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<tr>
<td>Treatment 6.9(4.8) 6.0(4.7) 5.3(3.2)</td>
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<tr>
<td>Control 6.6(4.1) 5.4(4.0) 4.8(3.4)</td>
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<td>Study II</td>
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<tr>
<td>Measures</td>
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<td>CSQ scales: catastrophizing*</td>
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<tr>
<td>Group Pre Post</td>
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<tr>
<td>Treatment 14.3(6.1) 9.5(5.5)</td>
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<tr>
<td>Control 12.0(8.2) 11.6(8.2)</td>
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<tr>
<td>QOLI</td>
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<tr>
<td>Group Pre Post</td>
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<tr>
<td>Treatment 1.2(1.4) 1.7(1.4)</td>
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<tr>
<td>Control 1.8(1.5) 1.1(1.6)</td>
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</table>

\*=significant effects at post-treatment; \#=significant effects at follow-up
### Table 5. Overview of Means (SD) for the significant results in studies III and IV

<table>
<thead>
<tr>
<th>Study III Measures</th>
<th>Group</th>
<th>Pre (N=72)</th>
<th>Post (N=72)</th>
<th>FU-6months (N=23)</th>
<th>Attrition</th>
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<tr>
<td>CSQ scales:</td>
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<td></td>
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<td></td>
<td></td>
<td>22% (n=16)</td>
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<tr>
<td>catastrophizing</td>
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<tr>
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<td>9.56 (7.06)</td>
<td>8.78 (7.33)</td>
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<tr>
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<td>14.06(9.08)</td>
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<tr>
<td>Diverting attention</td>
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<td>Treatment</td>
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<td>13.84(8.52)</td>
<td>10.74(5.94)</td>
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<tr>
<td>Control</td>
<td>12.0(8.2)</td>
<td>11.6(8.2)</td>
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<tr>
<td>HADS:</td>
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<tr>
<td>Anxiety</td>
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<td>8.53 (4.51)</td>
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<td>Depression</td>
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<td>MPI scales:</td>
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<tr>
<td>Life control</td>
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</tr>
<tr>
<td>Treatment</td>
<td>2.88 (1.03)</td>
<td>3.36 (1.27)</td>
<td>3.57 (1.10)</td>
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<td>Affective distress</td>
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<td>3.28 (1.31)</td>
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<td>Punishing responses</td>
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<td>1.10 (1.24)</td>
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<td>1.23 (1.24)</td>
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</tr>
<tr>
<td>Control</td>
<td>1.24 (1.35)</td>
<td>1.49 (1.49)</td>
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<td>PAIRS</td>
<td></td>
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<td>Treatment</td>
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<td>45.82(12.39)</td>
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<tr>
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<table>
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<tr>
<th>Study IV Measures</th>
<th>Group</th>
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<th>Post (N=76)</th>
<th>FU-6month (N=29)</th>
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<td>19.7% (n=15)</td>
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<td>engagement</td>
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<td>22.84(11.02)</td>
<td>28.62(11.15)</td>
<td>27.51(11.60)</td>
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<td>Pain willingness</td>
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<tr>
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<tr>
<td>Control</td>
<td>20.61 (8.68)</td>
<td>21.53 (7.94)</td>
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</tr>
<tr>
<td>Total</td>
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<td>Treatment</td>
<td>40.97(16.61)</td>
<td>50.84(18.23)</td>
<td>51.12(18.29)</td>
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<td>CSQ scales:</td>
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<tr>
<td>Praying and hoping</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>12.00 (7.42)</td>
<td>11.93 (7.96)</td>
<td>11.94 (6.98)</td>
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<td></td>
</tr>
<tr>
<td>Control</td>
<td>11.34(6.73)</td>
<td>13.96 (6.33)</td>
<td>-</td>
<td></td>
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</tr>
<tr>
<td>MPI scales:</td>
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<tr>
<td>Interference</td>
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<tr>
<td>Treatment</td>
<td>4.76 (0.88)</td>
<td>4.37 (1.09)</td>
<td>3.99 (1.25)</td>
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<tr>
<td>Control</td>
<td>4.85 (0.89)</td>
<td>4.94 (0.93)</td>
<td>-</td>
<td></td>
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<tr>
<td>Affective distress</td>
<td></td>
<td></td>
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<tr>
<td>Treatment</td>
<td>3.32 (0.78)</td>
<td>3.08 (0.74)</td>
<td>2.77 (0.80)</td>
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<td></td>
</tr>
<tr>
<td>Control</td>
<td>3.14 (0.73)</td>
<td>3.31 (0.64)</td>
<td>-</td>
<td></td>
<td></td>
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<tr>
<td>HADS:</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Anxiety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>9.89 (4.19)</td>
<td>8.97 (4.33)</td>
<td>9.21 (4.99)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>9.13 (4.26)</td>
<td>9.67 (3.50)</td>
<td>-</td>
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<tr>
<td>Depression</td>
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<tr>
<td>Treatment</td>
<td>9.58 (4.57)</td>
<td>8.85 (4.40)</td>
<td>10.15 (5.19)</td>
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<tr>
<td>Control</td>
<td>9.63 (4.04)</td>
<td>10.52 (3.77)</td>
<td>-</td>
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</table>
Discussion

Study I
The treatment in study I was based on CBT with multidisciplinary components and administered through the internet with guidance from CBT trained graduate students. Telephone support was added as a way to increase the participants’ motivation and compliance since this has been a problem in previous internet-based treatments (Ström et al., 2000). As a result the dropout rate was very low in this trial, suggesting that telephone support may have improved adherence and reduced dropout. The results showed significant results for persons with chronic low back pain on several of the subscales on CSQ, i.e., the catastrophizing, control over pain and ability to decrease pain subscale. Catastrophizing has been found to be important to target in the treatment of chronic pain (Turner et al., 2000). The findings of the present study are comparable with the effects of CBT in general for chronic pain (Morley et al., 1999). For some measures improvements could also be observed in the control group, which could be explained by the anticipation of treatment. The three-month follow-up results suggest that the treatment had beneficial effects. Unfortunately no control group data was available at follow-up due to the crossover design used in the trial.

One important aspect to consider is the use of telephone calls, which could be argued to restrict the cost-effectiveness of the treatment and also could explain some of the treatment effects. A limitation is that participant recruitment was through newspapers and the internet which could entail that the participants were a self-selected group. The representativeness of the participants can be discussed, in comparison to clinically recruited samples. Some differences were observed in this trial, i.e., a majority of the participants were not on sick leave, which is not usually the case in clinical settings. However, the disability scores in this study did not differ from those reported in pain studies.

In spite of the mentioned limitations, this study I showed that internet-based treatment could be a feasible approach for treating distress associated with chronic pain.
Study II

In this trial iCBT for chronic back pain had an effect on catastrophizing and quality of life. The reduction in catastrophizing was in line with study I. The quality of life result is difficult to interpret, as the decrease in the control group was larger than the increase in the treatment group. Some important differences from the previous study are that all participants went through a live structured interview and the intervention did not include telephone calls, with the exception of one to ensure that the technical aspects were in order. Furthermore, a measure of quality of life was not included in the previous trial.

A limitation of study II was that participants, as in study I, were self-recruited by means of newspapers and a website. In this trial, as observed in the previous one, the majority of the participants were not on sick leave, which clinical samples often are. However, as in study I the scores on the instruments used in both trials did not differ from other pain studies. The lack of follow-up data and the small sample size are considerable limitations.

In conclusion, the results suggest that iCBT can help people with chronic pain to decrease catastrophizing and increase quality of life.

Study III

The purpose of study III was to investigate if iCBT could help chronic pain patients who had previously received a multidisciplinary treatment and yet continued to have residual problems. The results showed that the patients benefited from the treatment and the results were maintained at a six months follow-up. Significant results were found on catastrophizing, which was one of the primary outcomes and of special interest because it is associated with disability and psychological suffering (Arnow et al., 2011). This result is consistent with the previous two studies (Study I & II). However, the proportion showing reliable change on the catastrophizing did not differ between the groups. Significant effects were also found on other outcome measures. There were significant effects on the CSQ scale of diverting attention, and reductions of anxiety and depression as assessed by the HADS, in favour of the treatment group. The results also showed that the treatment group improved on the MPI scales of life control, affective distress, and punishing responses. In addition, there was a significant effect on the PAIRS, suggesting that the beliefs and attitudes related to their functioning were influenced in a positive direction.

An important difference between this study and the two previous studies was that the participants were former patients from a pain rehabilitation clinic and the treatment was given as a secondary intervention. Furthermore, an active control group is used in the form of a moderated discussion forum.
This form of control has been found in some studies to yield positive outcomes (Lorig et al., 2002). In addition, this trial was different from both our previous studies in that neither a live interview nor telephone support was included. On the other hand, participants were all known as they were previous patients at the clinic. Dropout rates were lower in the previous trials suggesting that either a live interview or telephone support may be important for reducing dropout.

Limitations to consider in this trial are that even though participants were recruited from a clinical setting they are still self-selected. It is possible that patients that declined participation because they did not feel comfortable with the internet. Furthermore, we lacked data on initial response to their previous rehabilitation, and it is possible that our sample included both non-responders and persons who had relapsed in relation to the first treatment. However, the Clinical Global Impression-Improvement scale (CGI-I) was used to rate the patient’s overall improvement from the initial rehabilitation programme (Guy, 1976). An active control group was used in the form of a moderated online discussion forum, but we did not record and analyse the activity in the forum even though it was monitored.

Overall, the results suggest that iCBT could be a feasible option for persons with chronic pain as a follow-up intervention and may be used as a complement to other multidisciplinary interventions.

Study IV

The aim of study IV was to investigate whether an internet-based treatment based on ACT could help persons with chronic pain. The participants, as in study III, were recruited from a clinical setting, but they had not received any psychological intervention for their pain. They had an average pain duration of 15 years, the majority were on sick leave and half of the participants had concurrent psychiatric problems. The primary outcome was the CPAQ, and results showed significant effects on both acceptance subscales (activity engagement and pain willingness). These subscales predict depression, pain-related anxiety and psychosocial disability in pain patients (McCracken et al., 2004). There was also a significant effect on the total score of the CPAQ. Moreover, the results on the anxiety and depression scales on the HADS were statistically significant, even though the effect sizes were small. Significant results on the CSQ catastrophizing scale were also found to be in line with the previous trials. An acceptance approach to catastrophizing thoughts would entail awareness of thoughts and feelings and still engaging in activity, rather than trying to change inner events (Hayes et al., 1999). Significant results were also found on the CSQ praying and hoping scale in favour of the treatment group. On the MPI interfering
scale the treatment group improved significantly in relation to the active control group, and follow-up data showed that the treatment group improved further six months after treatment. The treatment group also improved significantly on the MPI affective distress scale.

Study IV differs from other studies on ACT interventions for chronic pain in several ways. First, the delivery format, i.e., the internet was different. Second, several ACT interventions have been offered as part of an interdisciplinary integrated pain rehabilitation programme (McCracken, Vowles & Eccleston, 2005; Vowles et al., 2008; Wicksell, Ahlqvist, Bring, Melin & Olsson, 2008; Wicksell, Melin, Lekander & Olsson, 2009), rather than stand-alone treatments as was the case here.

This study has some limitations as well. Even though the participants were recruited from a clinical setting, they were still self-recruited. The online discussion forum was not monitored for activity and was not presented as an active treatment even though participants were encouraged to be active. However, this trial shows that internet-based ACT treatment has some promise as a viable treatment option in the management of chronic pain.
General discussion

Treatment effects

The main purpose of the present thesis was to evaluate the effects of iCBT for persons with chronic pain. To investigate whether iCBT could be helpful regarding psychological and physical variables, the treatments in the studies are based on established models of chronic pain. The biopsychosocial approach accounts for the physical, psychological and social factors in chronic pain. Interdisciplinary pain rehabilitation programmes embody the biopsychosocial model and are the treatment of choice (Flor et al., 1992). The psychological component in interdisciplinary treatments is often based on CBT and focuses on the negative impact pain has on a person’s daily life. All studies in this thesis are based on CBT with varying interdisciplinary components. The results in study I showed that persons with chronic low back pain may benefit from iCBT, especially regarding catastrophizing. Catastrophizing has been found to be an important aspect to assess and address since it is associated with several negative consequences in a person’s life such as psychosocial dysfunction and greater healthcare utilization (e.g. Jacobsen et al., 1996; Linton et al., 2011), as described earlier in the present thesis. The fear-avoidance model illustrates from a CBT perspective how different psychological components, such as catastrophizing, contribute to the development of chronic pain and maintenance of the negative consequences related to chronic pain (Vlaeyen & Linton, 2000). All studies have shown that iCBT can have a positive effect on catastrophizing, which was the primary outcome in all studies with the exception of study IV. In study II quality of life was measured with QOLI, and the treatment group showed some improvement.

In studies III and IV there were reductions in other measures of pain-related distress, anxiety and depressive symptoms. While study I-III evaluated a more traditional CBT approach for chronic pain, study IV investigated internet-based ACT for this problem. Study IV differed in several aspects, obviously the treatment content, but also in the fact that the treatment had only psychological content and no physical components as in the previous trials; moreover the participants were from a clinical setting, although they had not received any psychological or interdisciplinary treatment for chronic pain. Study IV also showed, besides the above-mentioned results, significant results on both subscales in the primary outcome CPAQ. CPAQ subscales
predict depression, pain-related anxiety and psychosocial disability in pain patients (McCracken et al., 2004).

The studies in the present thesis differed in several ways, as mentioned above; studies I-III evaluated traditional CBT with interdisciplinary components, while study IV did not include any physical or other multidisciplinary components than psychological. The treatment results from study IV suggests that chronic pain patients can experience positive effects from purely psychological content based on ACT. Another difference between the studies was that the participants in study I and II are recruited through newspapers and web sites, which can make it difficult to generalize the results to chronic pain patients from clinical settings. From this perspective the results from study III and IV are interesting, since the participants were recruited from a clinical setting rather than media advertisements (Study I; Study II; Carpenter et al., 2012, Ruehlman et al., 2012). Study III stands out in relation to previous internet studies, as it focused on former patients with residual pain problems whom we offered a secondary intervention via the internet. Former patients may have been included in other trials, but in study III we have some information about their rehabilitation history, and the treatment is tailored to them, i.e., the group and not the individuals. The findings in this study suggest that patients who have undergone a rehabilitation period can be helped by iCBT. The frequency and type of contact with the participants differed between the studies. The participants in study I received weekly telephone calls, while the rest of the studies did not include telephone support to that extent. The treatment results did not appear to have been affected by the removal of telephone contact. In addition, another difference between the studies was the way the treatment was delivered through the internet. The treatment programme in study IV was less text-based than the intervention in studies I-III. The intervention in study IV consisted largely of audio files.

Thus, results from these trials show that iCBT holds promise as effective treatment for chronic pain, even though the effect sizes varied from small to large. These results are comparable with clinical trials (Eccleston et al., 2009; Morley et al., 1999).

A problem in internet-based treatments can be the dropout rates (Melville et al., 2010). In study I and II they were quite low (8% and 7.4%) while the attrition rates in study III and IV were larger (22% and 19.7%). What this difference is due to is difficult to explain. One possibility could be that a live interview before inclusion (study II) motivates participants to stay in treatment, or that making telephone calls lowers attrition (study I). Another reason could be a sample effect, since the participants in study I and II were recruited through newspaper advertisement, while the recruitment in study III and IV was from a clinical setting. Recent studies (Ruehlman et al., 2012; Carpenter et al., 2012) also found promising results for internet-based treatments for chronic pain and showed lower dropout rates. In both of these
studies participants were paid to complete the assessment, which is not common in Sweden.

Clinical implications

All studies in this thesis showed a significant decrease in catastrophizing measured with CSQ. Catastrophizing and chronic pain have been studied by various researchers for a considerable period of time and has been repeatedly associated with negative consequences e.g. disability and psychological suffering (see reviews Sullivan et al., 2001; Keefe et al., 2004; Arnow et al., 2011). There is data that suggests that changes in pain catastrophizing mediate the reduction of disability, main complaints, and pain intensity (Smeets, Vlaeyen, Kester, & Knottnerus, 2006). Interestingly, the treatment group in study IV also improved in catastrophizing. An acceptance approach to catastrophizing thoughts would entail awareness of thoughts and feelings yet still engaging in activity, rather than trying to change inner events (Hayes et al., 1999). The participants in the studies improved in other scales suggesting that the discomfort in their lives decreased. These results were interesting especially given that CBT for chronic pain is not available for all chronic pain sufferers; these studies present a cost-effective and easily available form to deliver CBT. Other advantages would be reducing waiting lists for treatment and making it possible for patients to work at their own pace (Rini, Williams, Broderick, Francis, & Keefe, 2012). As mentioned previously, in Sweden a high percentage of the population has regular internet access (www.internetworldstats.com). Internet-based CBT could be useful as a secondary intervention as shown in study III, given the risk of relapse following pain rehabilitation and returning to pain rehabilitation clinics, entailing increased costs. This has important clinical implications. An interesting aspect of study III is that the sample is former patients, and there are no previous similar randomized internet studies in the field of chronic pain.

Limitations

Numerous measures were included in the different trials in this thesis but only a few have shown to be significant. This could be due to the lack of sensitivity of the measures used. In study I participants were asked to report their satisfaction with the treatment following the intervention, and overall the comments were very positive and did not reflect the more modest effects in the study (Study I). None of the studies investigated mediators and moderators of treatment outcome (Turner, Holtzman, & Mancl, 2007), which makes it difficult to draw any conclusions regarding the specificity of the treatment. Descriptions of CBT provide excellent general descriptions of the
assumptions but do not give specific predictions about which particular processes and treatment components are associated with which specific changes (Turk, 2002). It is difficult to explicitly map all the changes a priori onto specific outcomes, and it is likely that different treatment components may have a common effect on a given outcome. This would lead to the use of a large number of questionnaires to assess different cognitive processes, coping strategies and other consequences of chronic pain.

Another limitation is that the treatments are compared to waiting list controls (study I and II) or active control groups in the form of a moderated online discussion forum (study III and IV). This could mean it is difficult to exclude other plausible hypotheses that may account for the data. On the other hand, this is a reality in other CBT studies for chronic pain (Morley et al., 1999).

Furthermore, the selection of participants may be biased, since they are self-recruited. This is especially the case in studies I and II where advertisements were used. In studies III and IV the participants come from a clinical setting, but they are still self-recruited, which may mean that some individuals declined participation because of unfamiliarity with the internet. However, a high percentage of the Swedish population has regular internet access (www.internetworldstatus.com) which makes it less likely to be the cause of non-participation.

Another limitation is that even though studies I-III had interdisciplinary components, they cannot be regarded as truly multidisciplinary treatments since no professional categories other than psychologists/graduate students in clinical psychology had direct contact with the participants. On the other hand, the therapist had the opportunity to consult the physiotherapists and occupational therapists that helped develop the treatment programmes.

Socioeconomic factors make important contributions to adjustment and disability; unfortunately, socioeconomic data such as returning to work was not gathered in the studies.

The more specific limitations for each study have been discussed previously in the thesis.

Future research

The studies in this thesis are compared to waiting list control and moderated online discussion forums, which has its disadvantages, as discussed above. Future studies should compare internet-based treatment to other credible effective treatments. This could also be helpful in finding which components are helpful for the treatment of chronic pain. Furthermore, future studies should explore methods to enhance the effect not only of CBT treatment for chronic pain but also of the internet-based treatment format, since the observed treatment effects leave room for improvement. Future studies should also compare different technical modalities in the treatment of chronic pain.
Studies I-III differed from study IV in that the treatment in study IV was less text-based, and more audio files were used. This kind of differences should be studied in a structured way to see if they have any implications for treatment outcomes. It would also be helpful to investigate who benefits from this kind of intervention. It is clear that it is not suitable for all patients with chronic pain. This information would make assessments of internet-based treatment more effective and may lead to fewer problems with attrition. Furthermore, there is also a need to study the costs and cost-savings of this type of treatment for chronic pain since long-term sick leave is a common consequence of chronic pain. In addition, it would be interesting to include independent assessments in future studies, i.e. other than subjective self-rated questionnaires, such as behavioural observations. Effectiveness studies are also needed, i.e. internet-based CBT in a clinical setting as a regular intervention alternative.

Conclusions
Guided internet-based CBT can alleviate distress associated with catastrophizing chronic pain. The effects seem to persist at three- and six-month follow-ups. It seems to be a time-effective alternative for some persons with chronic pain. Other barriers can also be overcome with internet-based treatments, such as travel and the availability of evidence-based treatments. It may also be a feasible option for some patients that have undergone rehabilitation but have residual problems, although it is necessary to further develop this kind of treatment, since the results presented in this thesis leave room for improvement. Furthermore, it seems as ACT can be delivered through the internet for chronic pain patients. This is important since ACT has been shown to be effective for chronic pain patients. Given that chronic pain rehabilitation is a costly measure, internet-based treatments could be a valuable complement to multidisciplinary treatments.
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Monica Buhrman
References


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