Stuck in Mind
This dissertation is dedicated
to my parents,
and to Johan & Joar
Stuck in Mind
The role of Catastrophizing in Pain
**Abstract**


Pain catastrophizing emerges in the literature as one of the most important psychological determinants of both pain itself and the negative outcomes commonly associated with it. However, despite decades of research confirming the impact of catastrophizing, there are still areas that remain unexplored or in which the surface has only been scratched. The overall aim of this dissertation was to expand existing knowledge about catastrophizing and to advance the theoretical framework around the concept.

The role of catastrophizing was explored in three distinct areas: during pain in childbirth, in exposure treatment for back pain patients, and in a problem solving context. The findings from the three studies confirmed the vital role of catastrophizing in these areas. Firstly, catastrophizing played a critical role in pain in childbirth; women who catastrophized reported labor pain as more intense and the subsequent recovery period as longer than women who did not catastrophize. Secondly, catastrophizing was identified as a moderator of treatment effect in exposure in vivo for back pain patients with pain-related fear; patients who catastrophized were not helped by the exposure. Thirdly, catastrophizing played a role in a problem solving context; although this is in line with contemporary models such as the misdirected problem solving model, the results suggested a somewhat different pathway to this previous model. Taken together, these findings underscore the instrumental role of catastrophizing in diverse areas and imply a need for catastrophizing to be assessed and addressed in clinical contexts. In addition, the findings highlight a need for further development of the theoretical framework around catastrophizing as well as treatment interventions that directly target catastrophizing.

Based on these needs, a new model of catastrophizing was proposed – a model of catastrophizing from a process perspective. In this model, the proposed function of catastrophizing is to down-regulate negative affect, as a form of internal avoidance. The model is a complement to existing theoretical models and provides a framework for developing treatment interventions that directly target catastrophizing, for example by problem solving skills training. Successful interventions for people who catastrophize would lead to several gains – for the individual in less suffering and increased ability to handle pain problems, and for society as a whole in reduced costs for health care for these individuals.

*Keywords*: catastrophizing; pain; fear avoidance; problem solving.
Acknowledgements

This dissertation would have been difficult, if not impossible, to produce without the support and encouragement of a number of people who I sincerely want to thank.

First and foremost, I want to thank Steven J Linton for being the best supervisor and mentor that I could have ever wished for. During the last year at the psychology program, I discovered that writing a thesis was the most enjoyable part of my whole education. By then I had decided to enter research “at some point throughout my career”. However, I did not expect it to be so soon. Thank you Steven for believing in me, encouraging me, and opening up a new world to me! And thank you for continually bringing me into projects that I would never ever think of on my own. You are a true source of inspiration. I have learnt a lot from you and I hope to continue learning – about work and life.

I also sincerely want to thank my second supervisor, Maria Tillfors, for providing unlimited encouragement and support. You have helped me to “hålla styrfart framåt”, and not get lost on the track. You are always there whenever I need guidance, and you are a spiritizing source of energy.

My third mentor, and my informal supervisor, has been Katja Boersma. Thank you Katja for your generosity and honesty – you have been so important for me during these years! I have learned a lot through our collaborations and I always appreciate your feedback. I often get the feeling that you understand what I mean, even when I am not really sure of it myself. I truly enjoy working with you, as well as confabbing about life in general.

Another highly important person that I want to thank is Sofia Bergbom. You are a truly sincere colleague and friend. Without our discussions and without your emotional support, these years would have been so much harder - and much more boring. I am addicted to you!

I also genuinely want to thank Markus Jansson-Fröjmark, Thomas Overmeer, Shane MacDonald, Sara Larsson, and the other members in CHAMP. A research group is nothing without its members. I enjoy our discussions and collaborations and I am grateful for working in such an open-minded and inspiring group.

I would also like to thank the staff at the Psychology program, for deepening my interest in psychology, and for teaching me to be open-minded and curious: Bengt Eriksson, Anders Agrell, Håkan Stattin, and Britt Eriksson-Helleryd, to mention only a few.

There are other colleagues that also have inspired me and that I would like to thank. Thank you Madelon Peters, for carefully reading my disser-
tation, and for providing helpful comments that indeed improved it. Thank you Michael Sullivan, for the amount of interesting research about the concept of catastrophizing and for collaborating with us in Study I. Thank you Magdalena Mroczek, for sharing the experience of writing a (damn good) thesis. And thank you to all other researchers that I have had the honor to meet, to discuss with, and to collaborate with during the years as a doctoral student.

I would also like to thank the participants in my studies. Without you, these studies would not have been realized, and your experiences are what matters.

Last but not least, I want to thank the most important persons in my life: my family. Tack mamma för att du är du och för du alltid finns där för mig. Du ÄR ”the Queen of Fuckin’ Everything”. Tack pappa för att du är, och för att du har lärt mig att älska skrivandet – genom det blir livet mer verkligt. Tack mina syskon för allt vi har delat och fortfarande delar.


Örebro, September 2011
List of publications

This dissertation is based on the following studies, which will be referred to in the text by their Roman numerals:


The studies have been reprinted with permission from the copyright holders.
# Table of contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>13</td>
</tr>
<tr>
<td>Overview</td>
<td>13</td>
</tr>
<tr>
<td>Definitions</td>
<td>14</td>
</tr>
<tr>
<td>Pain</td>
<td>14</td>
</tr>
<tr>
<td>Pain catastrophizing</td>
<td>15</td>
</tr>
<tr>
<td>Historical overview</td>
<td>16</td>
</tr>
<tr>
<td>Assessment of catastrophizing</td>
<td>16</td>
</tr>
<tr>
<td>Relation to pain and overt behavior</td>
<td>18</td>
</tr>
<tr>
<td>Consequences of catastrophizing</td>
<td>18</td>
</tr>
<tr>
<td>Relation to other concepts</td>
<td>19</td>
</tr>
<tr>
<td>Theoretical models</td>
<td>20</td>
</tr>
<tr>
<td>Schema-activation model</td>
<td>20</td>
</tr>
<tr>
<td>Fear-avoidance models</td>
<td>21</td>
</tr>
<tr>
<td>Appraisal model</td>
<td>23</td>
</tr>
<tr>
<td>Communal coping model</td>
<td>23</td>
</tr>
<tr>
<td>Misdirected problem solving model</td>
<td>24</td>
</tr>
<tr>
<td>Catastrophizing from a process perspective</td>
<td>25</td>
</tr>
<tr>
<td>Catastrophizing in treatment</td>
<td>26</td>
</tr>
<tr>
<td>Summary</td>
<td>28</td>
</tr>
<tr>
<td>Aim of the dissertation</td>
<td>29</td>
</tr>
<tr>
<td>Specific aims and research questions</td>
<td>29</td>
</tr>
<tr>
<td>SHORT DESCRIPTION OF THE STUDIES</td>
<td>30</td>
</tr>
<tr>
<td>STUDY I</td>
<td>30</td>
</tr>
<tr>
<td>Introduction</td>
<td>30</td>
</tr>
<tr>
<td>Aim</td>
<td>30</td>
</tr>
<tr>
<td>Overview of the design</td>
<td>30</td>
</tr>
<tr>
<td>Participants</td>
<td>30</td>
</tr>
<tr>
<td>Measurements</td>
<td>31</td>
</tr>
<tr>
<td><em>Pain</em> catastrophizing</td>
<td>31</td>
</tr>
<tr>
<td><em>Pain</em></td>
<td>31</td>
</tr>
<tr>
<td><em>Physical recovery in Activities of Daily Living (ADL)</em></td>
<td>31</td>
</tr>
<tr>
<td>Statistical analysis</td>
<td>31</td>
</tr>
<tr>
<td>Results</td>
<td>31</td>
</tr>
<tr>
<td><em>Pain</em></td>
<td>32</td>
</tr>
<tr>
<td><em>Physical recovery in ADL</em></td>
<td>32</td>
</tr>
<tr>
<td>Conclusions</td>
<td>32</td>
</tr>
<tr>
<td>STUDY II</td>
<td>34</td>
</tr>
<tr>
<td>Introduction</td>
<td>34</td>
</tr>
</tbody>
</table>
Introduction

Overview
As long as human beings have existed, different types of bodily pain have caused a huge amount of suffering all over the world. Over time, our view of pain has gone through remarkable changes. In the 17th century, Descartes achieved a major revolution by describing the human body as a machine, and proposed that pain was a direct function of the degree of tissue damage (Descartes, 1989). According to this view, the experience of pain was equivalent with peripheral injury and there was no room for psychological contributions such as interpretations or the individual’s ability to handle the situation. Although Descartes’s theory dominated for centuries, research from the last decades has resulted in a total shift away from this mechanistic view of pain. It is now well known and accepted that psychological factors are important determinants for how people experience and handle pain.

Pain catastrophizing emerges in the literature as one of the most important psychological determinants of pain and pain-related disability (Keefe, Rumble, Scipio, Giordano, & Perri, 2004; Severeijns, Vlaeyen, van den Hout, & Weber, 2001; Sullivan, et al., 2002; Vlaeyen & Linton, 2000). Broadly speaking, catastrophizing refers to an exaggerated negative pattern of thinking that some people report when confronting pain. “I keep thinking about how much it hurts”, “It is terrible and I think it’s never going to get any better” and “I wonder whether something serious may happen” are some examples of catastrophic thoughts (Sullivan, Bishop, & Pivik, 1995). Catastrophizing has repeatedly been associated with heightened pain and disability across different populations with both acute and chronic pain (for a review, see Sullivan, et al., 2001). However, despite years of research about catastrophizing and its negative impact on pain, there are still areas where the role of catastrophizing remains unexplored or where the surface has only been scratched.

The overall aim of this dissertation is to expand our knowledge about pain catastrophizing and to advance the theoretical framework around the concept. The role of catastrophizing will be explored in three new areas. Firstly, pain in childbirth is a unique, acute pain situation where the role of catastrophizing has not been studied. While childbirth induces pain that is often very intense, the situation is also unique because the pain is generally not a signal of harm and brings manifest positive associations, and it is not known what impact catastrophizing might have in this context. Secondly, there are some gaps in our knowledge about how catastrophizing influ-
ences treatment. More specifically, it is not known how high levels of catastrophizing are related to the effect of exposure in vivo, a novel treatment approach in the pain field which was developed specifically for back pain patients with the high levels of pain-related fear which are often linked to high levels of catastrophizing. The third and final area concerns the role of catastrophizing in a problem solving context. In contemporary models, catastrophizing is linked to how pain patients frame and deal with their problem in terms of coping or problem solving. However, there is sparse empirical research supporting these links, which are of interest for the theoretical framework around the concept.

The introductory section will cover definitions and an historical overview of the concept. A review of the literature about catastrophizing will then be presented, focusing on how catastrophizing is assessed and its relation to pain, overt behavior and other concepts such as depressed mood and pain-related fear. Subsequently, theoretical models that have emerged to explain the concept will be summarized. Thereafter, research about the impact of catastrophizing in treatment will be reviewed in brief. Finally the aims and research questions will be presented.

**Definitions**

**Pain**

This dissertation deals with pain of two types: pain in childbirth and long-lasting spinal pain. Pain is usually defined as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” (IASP, 1994). Already in the definition, three features that are relevant for this dissertation appear. First, pain is a subjective experience. Second, unpleasant emotions are involved. Third, it is associated with damage or potential damage which means that it involves an interpretation of the experience. This definition makes clear that psychological features today are viewed as integrated parts of the pain experience.

One categorization of pain is based on the temporal aspect. Pain that resolves quickly is generally referred to as acute, and pain that lasts for a longer period is called chronic or persistent. The distinction between acute and persistent pain is traditionally based on an arbitrary interval of time from onset, usually 3 or 6 months (Turk & Okifuji, 2001). Sometimes the terms subacute and subchronic are used to describe the period of transition from acute to persistent pain (Main, Sullivan, & Watson, 2007). An alternative definition of persistent pain which does not depend on a set time
interval is "pain that extends beyond the expected period of healing" (Turk & Okifuji, 2001). According to these definitions, Study I in this dissertation will focus on acute pain whereas Study II and III concerns persistent pain.

Study I deals with pain in childbirth. This refers to pain during labor, which begins with contractions and ends with the birth of a baby (Melzack, 1993). The pain is usually very intense although there is large variability among women; women who are giving birth for the first time generally report the pain as more intense (Ibid.). Since earlier labor experiences might influence pain ratings as well as the expectations of childbirth, only women who were giving birth for the first time were included in study I.

Study II and III deal with persistent musculoskeletal pain in the spinal region and the terms back pain, spinal pain and musculoskeletal pain will be used interchangeably. In most cases of spinal pain (90-95%), the pain is non-specific, which means that there is no known underlying pathology such as degenerative conditions, inflammatory conditions or infective causes (Krismer & Van Tulder, 2007). Typical signs or symptoms that may indicate underlying pathology are commonly referred to as red flags (Waddell, 2004), and may indicate that further medical examination is needed. In Study II and III, people with manifest red flags were excluded.

**Pain catastrophizing**

A commonly used definition of pain catastrophizing is “an exaggerated negative mental set brought to bear during actual or anticipated pain experience” (Sullivan, et al., 2001). This is a broad definition which basically remarks that catastrophizing involves (1) a fixed pattern of thinking (“mental set”) which is (2) disproportionate in regard to the circumstances (“exaggerated”), (3) focused on unpleasant aspects (“negative”) and (4) activated when the individual confronts imaginary or actual pain (“brought to bear”).

There are some remarks to make regarding this definition. Firstly, it does not include any standpoint about what type of phenomena catastrophizing really is; if it for instance should be viewed as a thought process, an interaction between thoughts, feelings and overt behavior, or if it is more related to what some researchers call a cognitive schema, which refers to a mental structure which organizes our knowledge and determines how we interpret and process information (e.g., Cohen & Ebbesen, 1979). There is no general consensus around what type of phenomena catastrophizing is, which presumably explains why the definition fully omits it. Secondly, the definition does not explain whether the fixed pattern of thinking, the emotional component or the exaggeration of the experience is the primary
component. Thirdly, the definition does not express how catastrophizing is related to other constructs such as pain-related fear or depressed mood. Taken together, even though the above definition of catastrophizing is widely used, it does not provide a comprehensive theoretical and conceptual framework for catastrophizing.

**Historical overview**

The term catastrophizing has been used in the psychological literature for decades. The term was introduced as early as 1962 by Albert Ellis, the founder of rational-emotional therapy (Ellis, 1962), and was later adapted by Aaron Beck (Beck, 1976). In this early work, the term catastrophizing was used to describe a maladaptive cognitive style among patients with depressive and anxiety disorders and was considered as a tendency to magnify or exaggerate possible negative aspects of future events.

In the pain field, Chaves and Brown observed similar tendencies to magnify or exaggerate the negative aspects of pain in patients who went through a painful dental procedure (Chaves & Brown, 1987). In this study, catastrophizing was framed as a spontaneous cognitive strategy to minimize stress or pain, the most frequently reported by the patients. Spanos and colleagues (1979) continued to view catastrophizing as a cognitive strategy, but emphasized the impact of pain-related worry, perceived inability to cope and difficulties in diverting attention away from pain (Spanos, Radtke-Bodorik, Ferguson, & Jones, 1979). Rosentiel and Keefe also underscored the inability to cope and linked this to feelings of helplessness when elaborating on the concept (Rosenstiel & Keefe, 1983). Taken together, the term catastrophizing has been used in the pain field for several years and researchers have differed in what aspects they view as primary. Despite notable differences in the conceptualization, recurrent features involve attention to negative aspects, persistent negative thinking, and perceived inability to handle the situation.

**Assessment of catastrophizing**

Catastrophizing is usually assessed by self-report inventories. The Coping Strategies Questionnaire (CSQ) (Rosenstiel & Keefe, 1983) was an early attempt to capture catastrophizing by framing it as one of seven coping strategies used by people with back pain problems. The Catastrophizing subscale of the CSQ consists of six items reflecting helplessness and negative self-statements which might arise when confronting pain (e.g. “I worry all the time whether it will end”, “It’s awful and it overwhelms me”). To cover more dimensions of the construct, the six items from the CSQ were
complemented by other examples of catastrophic ideation when Sullivan and his colleagues developed the Pain Catastrophizing Scale (PCS) a decade later (Sullivan, et al., 1995).

The PCS consists of 13 statements reflecting thoughts and feelings that might arise when people confront pain. Respondents rate on a 5-point scale the extent to which they agree with the statement when experiencing pain. Factor analytic work on the PCS yielded three separate second-order factors, namely magnification (e.g. “I wonder whether something serious may happen”), rumination (e.g. “I can’t seem to keep it out of my mind”) and helplessness (e.g. “There is nothing I can do to reduce the intensity of the pain”) (Ibid.). This factor structure has been replicated and the scale validated in pain-free populations (e.g., Osman, et al., 2000; Osman, et al., 1997), in people with persistent pain (Osman, et al., 2000), in different age-groups (Lu, Tsao, Myers, Kim, & Zeltzer, 2007), and in diverse cultures and languages (e.g., Lu, et al., 2007; Meyer, Sprott, & Mannion, 2008; Miró, Nieto, & Huguet, 2008; Yap, et al., 2008). The PCS is hence a robust and widely used tool for assessing self-reported pain catastrophizing.

Self-report inventories like the CSQ or the PCS do not, however, assess overt behavior and might well be influenced by several sources of bias like the momentary emotional state of the respondent or individual differences in interpretation of the questions (for a discussion about bias, see e.g., Atkinson, Zibin, & Chuang, 1997). A critical review of pain catastrophizing recently pointed out that there is a need for a tool to systematically assess overt behavioral dimensions of the catastrophizing construct (Quartana, Campbell, & Edwards, 2009).

The CSQ and the PCS are generally used to assess catastrophizing as a stable tendency across situations. There is a continuing debate about whether catastrophizing really is a dispositional, trait-like tendency or if it might fluctuate across situations (see e.g., Turner & Aaron, 2001). On the one hand, ratings of catastrophizing have shown a fair amount of stability over time (Keefe, Brown, Wallston, & Caldwell, 1989; Sullivan, et al., 1995). Furthermore, catastrophizing has shown high correlation with measures of relatively stable, dispositional concepts like neuroticism (e.g., Drossman, et al., 2000). On the other hand, intensive cognitive-behavioral therapy (CBT) has led to notable reductions in catastrophizing (for a review, see Lohnberg, 2007), which indicates that contextual factors might well influence it. Moreover, it has been argued that situational demands are needed to activate the assumed dispositional components of catastrophizing (e.g., Campbell, et al., 2010). There are indeed recent studies that have assessed catastrophizing as a state-like, situational tendency by adapt-
ing the PCS for patients to fill out in direct connection to a pain-stimuli (Campbell, et al., 2010; Dixon, Thorn, & Ward, 2004; Edwards, Campbell, & Fillingim, 2005; Edwards, Smith, Stonerock, & Haythornthwaite, 2006). According to the debate about dispositional versus situational catastrophizing, a feasible interpretation based on existing knowledge is that everyone has more or less of this tendency, but that contextual factors influence whether the catastrophizing becomes salient.

**Relation to pain and overt behavior**

One of the most robust findings around catastrophizing is the link to ratings of pain intensity. This relation has been observed in a wide range of situations involving both acute and persistent pain, and in healthy individuals in addition to patients who suffer from chronic conditions (for a review, see Sullivan, et al., 2001). Although there is large variability between studies, catastrophizing accounts for up to 31% of the variance in pain ratings, and years of research have consistently confirmed the link between catastrophizing and pain (Ibid.).

Catastrophizing is also related to how people behave when confronting pain. For example, catastrophizing has been associated with so-called pain behavior (Nicassio, Schoenfeld-Smith, Radojevic, & Schuman, 1995). This refers to motor and verbal responses that some people express when confronting pain, e.g. rubbing the pain area, frowning, or complaining about how much it hurts. Catastrophizing has also been linked to a heightened use of health care (e.g., Gil, et al., 1993) and medication (Bedard, Reid, McGrath, & Chambers, 1997). These findings indicate two things. First, people who catastrophize when experiencing pain seem to have an urgent need of expressing it to others. Second, they engage in activities they think might help to solve the pain problem such as seeking medical care. Thus, catastrophizing is closely linked to overt behavior which might be used to cope with a difficult situation.

**Consequences of catastrophizing**

Catastrophizing has been linked to a number of negative consequences, cross-sectionally as well as prospectively (for reviews, see Sullivan, et al., 2001; Keefe, et al., 2004). For example, catastrophizing has repeatedly been associated with higher levels of disability. The link between catastrophizing and heightened disability has been found in patients with acute pain (e.g., Swinkels-Meewisse, Roelofs, Oostendorp, Verbeek, & Vlaeyen, 2006) as well as in patients with chronic conditions (e.g., Peters, Vlaeyen, & Weber, 2005; Severeijns, Vlaeyen, van den Hout, & Weber, 2001a;
Turner, Jensen, Warms, & Cardenas, 2002). To summarize, there is consistent evidence that people who catastrophize report the pain as being more intense, express more worries and suffer more adverse consequences of it than people who do not catastrophize.

However, the role of catastrophizing has mainly been studied in persistent and pathological pain situations and less is known about its impact in situations with more positive associations such as childbirth. Childbirth infers a remarkably intense pain. Although there are large individual differences, 60% of women who are giving birth for the first time rate their pain as severe or extremely severe (Melzack, 1993). The anticipation of this intense pain, which has been compared to the amputation of a finger without analgesia (Ibid.), might well be associated with psychological reactions such as fear and catastrophizing. On the other hand, childbirth is a unique experience and differs considerably from other situations involving pain. Labor pain is not a signal of harm but is rather an indication that the labor is proceeding. Furthermore, labor is usually restricted to a short period of time, and brings consequences that are generally viewed in a positive light: namely the birth of a child. Therefore, it is not self-evident which role catastrophizing might play in this context.

**Relation to other concepts**

Catastrophizing is closely related to negative emotionality. It has repeatedly been associated with broad negative emotional responses such as depressed mood and anxiety (for a review, see Keogh & Asmundson, 2004) and there is a debate about whether catastrophizing really is a unique construct separate from these more general emotional constructs. Measures of catastrophizing overlap to a large extent with measures of negative emotionality and there is evidence that after controlling for the broad measures, catastrophizing contributes minimally to the prediction of pain (Hirsh, George, Riley, & Robinson, 2007). There is, however, conflicting evidence indicating that catastrophizing is indeed a unique construct (Sullivan, et al., 2001). For example, a recent clinical study showed that some pain patients presented either catastrophizing or depressed mood, whereas others presented both (Linton, et al., 2011). These findings indicate that it is relevant to separate catastrophizing from other reflections of negative emotionality in a clinical context.

Catastrophizing is also associated with specific negative emotional responses to pain such as pain-related fear. In the fear-avoidance model of pain (Vlaeyen & Linton, 2000), catastrophizing is postulated as a precursor of pain-related fear and subsequent avoidance. There is some evidence supporting this sequential order of the model (Cook, Brawer, & Vowles,
2006; Leeuw, et al., 2007), but there are also contradictory findings (Wideman, Adams, & Sullivan, 2009). One interpretation of the conflicting results is that it is difficult to separate these constructs because of the large overlap between them.

Conceptually, there are recognized differences between catastrophizing and fear. Fear is commonly referred to as a basic survival mechanism occurring in response to a specific stimulus, such as pain or the threat of danger (Ohman, 2000). According to this definition, fear does not involve the fixed pattern of thinking which is salient in catastrophizing. Pain catastrophizing has broadly been referred to as “the cognitive element” of the fear network (Leeuw, et al., 2007). To narrow down catastrophizing to a purely cognitive element might, however, be an oversimplification since catastrophizing involves emotional aspects as well and is closely linked to overt behavior (e.g. pain behavior and health care seeking).

Taken together, catastrophizing is strongly related to negative emotionality in a broader sense, but also to more specific negative responses to pain, such as pain-related fear or anxiety although existing research indicates that catastrophizing is something over and above these other constructs.

Theoretical models
There is no clear consensus of how catastrophizing might be understood from a theoretical point of view. Even though most studies about catastrophizing have focused more on its relation to pain and negative outcomes than on the theoretical understanding, there have been a few attempts to integrate catastrophizing in a theoretical framework. The main attempts will be summarized below.

Schema-activation model
Before the term catastrophizing was introduced in the pain area, it was most frequently discussed in the cognitive literature about emotional disorders. Catastrophizing was proposed as a maladaptive pattern of thinking, commonly occurring among people with depressive and anxiety problems (Beck, 1976). Beck (1979) described how negative life events might activate depressive schemas and how such schemas might fuel different types of cognitive distortions whereof catastrophizing was one (Beck, 1979). From this perspective, catastrophizing was viewed as a pure cognitive concept which was a determinant for the development and perpetuation of emotional problems. Later on, the concept was transferred to the pain field and other theoretical frameworks emerged to explain specifically pain-related catastrophizing.
Fear-avoidance models

The fear-avoidance model of pain (Vlaeyen & Linton, 2000) is perhaps the most commonly used framework when theorizing around pain catastrophizing. As shown in figure 1, the model illuminates how some patients develop persistent pain problems through fearful responses to pain and subsequent avoidance of pain-related movements. Implicitly, the model infers that catastrophizing is a cognitive precursor of fear and avoidance. As noted above, the sequential order in the model has been questioned and discussed (Nicholas, 2009; Wideman, et al., 2009; Vlaeyen, Crombez, & Linton, 2009). It has been underscored that the organization of the model is not a final, empirically based “truth” but rather a theory-based heuristic (Vlaeyen, et al., 2009). Regardless of whether these reactions follow from each other or occur simultaneously, the model implies that catastrophizing is a separate construct, as distinguished from fear, negative emotions (e.g. depressed mood), vigilance, and overt behavioral avoidance.

![Figure 1](image_url)

**FIGURE 1.** The fear-avoidance model of pain (Vlaeyen & Linton, 2000)

*Note.* This figure has been reproduced with the permission of the International Association for the Study of Pain® (IASP®). The figure may not be reproduced for any other purpose without permission.

In order to refine the fear-avoidance model conceptually, Asmundson et al. (2004) presented an extended variation (Asmundson, Norton, & Vlaeyen, 2004). As shown in figure 2, this fear-anxiety-avoidance model is more
complicated than the original one and suggest in more elaborate detail how the different concepts such as anxiety, fear of pain and catastrophizing might be interrelated.

Since this model is intended to be more conceptually clear, it has been proposed as a sound basis for testing the relationship between variables (Boersma, 2005). One modification from the original model is that fear of pain has been separated from pain-related anxiety; with fear described as the response to a *present* threat whereas anxiety is the response to an *anticipated* threat (Asmundson, et al., 2004). Furthermore, the cues for anxiety are often vague or uncertain; in contrast to cues for fear that are more immediate (Barlow, 2004). Another modification is that *pain beliefs*, i.e. beliefs about pain being equivalent with harm, now have an articulated place in the model. This model infers that pain beliefs drive catastrophizing. In other words, if patients hold strong beliefs that pain signifies something is medically wrong, catastrophic thoughts are likely to emerge. However, this assumption still lacks empirical support.
**Appraisal model**

The *appraisal model* is another framework which has been used to explain pain catastrophizing (Severeijns, Vlaeyen, & van den Hout, 2006). This model is similar to the fear-anxiety-avoidance model in that it emphasizes the link between pain beliefs and catastrophizing. Based on the transactional model of stress and coping (Lazarus & Folkman, 1984), catastrophizing is described as a result of underlying beliefs (i.e. pain beliefs), *primary appraisal* (i.e. evaluation of the situation), and *secondary appraisal* (i.e. evaluation of ability to cope with the situation). To give an example, if a patient who suffers from low back pain holds beliefs that something is medically wrong in the back (pain beliefs), evaluates the situation as threatful (primary appraisal) and estimates that he or she cannot handle it (secondary appraisal), catastrophic thoughts are likely to occur. The appraisal model positions catastrophizing in a coping framework stressing the cognitive aspects of the concept.

**Communal coping model**

A model that also frames catastrophizing within a coping perspective, but from a different angle, is the *communal coping model* (CCM) (Sullivan, et al., 2001; Thorn, Ward, Sullivan, & Boothby, 2003). This model takes a step away from the cognitive conceptualization of catastrophizing by emphasizing the importance of the social context. According to the CCM, people who catastrophize might exaggerate their expressions of pain as a way to maximize social support from people around them. Catastrophizing is here seen as a form of communication and support seeking. Even though a number of studies have provided preliminary support for the CCM in confirming the link between catastrophizing and the social environment (Giardino, Jensen, Turner, Ehde, & Cardenas, 2003; Keefe, et al., 2003; Lackner & Gurtman, 2004; Sullivan, Adams, & Sullivan, 2004), the model has also received substantial criticism (Severeijns, et al., 2006). One argument is that the CCM focuses on the consequences of catastrophizing rather than on the origin. It is argued that it is feasible that people seek social support because they catastrophize, not that they catastrophize because they elicit social support as the CCM implies. Furthermore, the CCM only focuses on one way to cope with pain and worrisome thoughts, namely through the support of others, although there may be additional ways of coping. Nevertheless, even though the CCM does not provide an absolute explanation of why people catastrophize, this theory has contributed to an enhanced understanding of the context in which catastrophizing occur.
Misdirected problem solving model

A recent model that has advanced the coping framework around catastrophizing is the *misdirected problem solving model* (figure 3, Eccleston & Crombez, 2007). Coping is here conceptualized as an active attempt to solve a problem. This model builds on observations from the fear-avoidance model as well as the CCM and reframes them within a problem solving perspective. The misdirected problem solving model proposes that worry motivates pain patients to actively search for relief or a cure. These efforts, which are specifically directed at curing and getting rid of pain, have been described as *assimilative coping* (Crombez, Eccleston, van Hamme, & de Vlieger, 2008). In patients who frame the pain problem in purely biomedical terms (i.e. pain is equal to harm or injury), the attempts at problem solving might become “misdirected” if no medical solution exists, which is often the case in patients with long-term back pain. As the problem remains unsolved, the worry increases. When the worry progressively intensifies and the outcome is perceived as getting worse and worse, it has been defined as *catastrophic worry* (Davey & Levy, 1998), as captured by the concept catastrophizing. The model illustrates how a perseverance loop of catastrophic worry and misdirected problem solving develops. In this model, catastrophizing is thus part of an unsuccessful problem solving strategy which involves repeated fruitless efforts at finding a cure for pain.

In relation to the above, earlier studies support an association between repeated efforts at finding a cure and higher levels of catastrophizing, greater disability and heightened attention to pain in patients with pain problems (Crombez, et al., 2008; de Vlieger, Bussche, Eccleston, & Crombez, 2006). However, neither the way in which problem framing is linked to catastrophizing and overt problem solving behavior or the sequential order of the concepts involved have been investigated. Indeed, earlier research has stressed the importance of specifically examining how catastrophizing is related to overt problem solving behavior (Crombez, et al., 2008).

This model is similar to the fear-anxiety-avoidance model in emphasizing the link between catastrophizing and the view patients have of their problem. In the fear-anxiety-avoidance model this view is called pain beliefs, whereas in the misdirected problem solving model the term *biomedical problem framing* is used. Both terms basically capture the same tendency - to strongly believe that pain is equal to harm or serious injury.
Catastrophizing from a process perspective

As opposed to some of the aforementioned models that argue around how different concepts are related to each other, an alternative perspective is to view catastrophizing as a process where thoughts, emotions and overt behavior are intertwined. From a process perspective, catastrophizing might be conceptualized as a form of repetitive negative thinking, similar to worry or rumination. Rumination was recently defined as “passive focus on one’s symptoms of distress and the possible causes and consequences of these symptoms. The individual repeatedly goes over problems and his or her feelings about the problems, without moving into [constructive, auth. note] problem solving” (Nolen-Hoeksema, 2005). This definition might also serve for catastrophizing. In fact, one of the subscales in the PCS is labeled rumination, which might indicate that these processes indeed are
interrelated, and may both be included in the overall term repetitive negative thinking. It has been argued that repetitive negative thinking is an avoidant coping strategy (Stroebe, et al., 2007); the patient gets stuck in passive, abstract, catastrophic thinking, instead of really dealing with the problem by moving into constructive, concrete problem solving. From this perspective, focus is on the function of catastrophizing - to down-regulate negative emotions, the same function as overt behavioral avoidance. According to this view, patients with high levels of pain-related fear and anxiety might engage in catastrophizing as a way of reducing the intensity of the aversive physiological and psychological aspects of the fear response. Outside of the pain field, catastrophizing has indeed been described as a perseverative iterative style which has been linked to worry and poor problem-solving confidence (Davey & Levy, 1998). This perspective is in line with the misdirected problem solving model (Eccleston & Crombez, 2007) in that catastrophizing obstructs constructive problem solving. Taken together, the process perspective of catastrophizing provides an alternative way to look at catastrophizing as a form of covert avoidance and unconstructive problem solving.

In sum, pain catastrophizing has been described within quite diverse theoretical frameworks. It is noteworthy that these frameworks do not always contradict each other and might also be seen as complementary. Moreover, there are some recurring aspects. One such aspect is the view of catastrophizing as a form of coping, or an attempt to handle a difficult situation. In fact, in the majority of the frameworks, catastrophizing is in one way or another related to coping. Another recurring aspect is the link between catastrophizing and beliefs the person holds about pain, or in other words problem framing. However, these models are to a large extent based on theoretical assumptions and empirical support is still needed to refine the theoretical framework around catastrophizing.

**Catastrophizing in treatment**

As catastrophizing is an important factor in how people experience and handle pain problems, it might well influence how patients respond to treatment. In the treatment of chronic back pain, different approaches have been developed, and cognitive behavioral therapy (CBT) has made a noteworthy contribution to the field (for reviews, see e.g., Butler, Chapman, Forman, & Beck, 2006; McCracken & Turk, 2002; Eccleston, Williams, & Morley, 2009). CBT is generally quite effective for reducing the negative outcomes of a pain problem such as depressed mood, catastrophizing and disability. However, the effect sizes for CBT for pain are fairly modest and there are large individual differences in how well patients respond to
When scrutinizing why some patients are not helped by general CBT programs, catastrophizing has emerged as one important factor. More specifically, high levels of catastrophizing have been associated with poor outcome (McCracken & Turk, 2002; Turner, Holzman, & Mancl, 2007). Thus, patients who catastrophize do not benefit to the same extent as others from CBT programs for pain, but these programs are usually not specifically developed to target catastrophizing.

**Exposure in vivo** is a novel treatment approach within CBT for pain that is specifically developed for patients with high levels of pain-related fear. Several studies have indeed shown that exposure is effective for reducing fear, catastrophizing, disability and pain (Boersma, et al., 2004; de Jong, et al., 2005; Vlaeyen, de Jong, Geilen, Heuts, & van Breukelen, 2001; Leeuw, et al., 2008; Linton, et al., 2008; Woods & Asmundson, 2008). In addition, recent reviews have highlighted exposure as the treatment of choice for patients with high levels of fear and catastrophizing (Bailey, Carleton, Vlaeyen, & Asmundson, 2010; Lohnberg, 2007). Even though exposure is a promising treatment for this group of patients, there are two complicating issues. The first is that in some studies the effect sizes are quite modest (e.g., George, et al., 2008; Leeuw, et al., 2008). Secondly, it has been noted that there are large individual differences in how well the patients respond to the treatment (Linton, et al., 2008). Consequently, exposure in vivo is an effective treatment for some, but not all, patients with high levels of fear.

This raises the question of possible *moderators* of the treatment effect. A moderator is traditionally defined as “a third variable that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable” (Baron & Kenny, 1986). In other words, a third variable might suppress the treatment effect and since high levels of catastrophizing have been related to poor outcomes in other CBT treatments, they might also be of importance here. Taken together, CBT is a rather effective treatment for problems with chronic pain but high levels of catastrophizing have been linked to a reduction in the effect of the treatment. Whether this is also true of exposure in vivo, which is specifically developed for patients with high levels of fear, is still to be explored.
Summary

Psychological factors are today viewed as integrated features of the pain experience. Pain catastrophizing has been identified as one of the most important psychological determinants for pain and pain-related disability. Links between catastrophizing, pain, and negative outcomes have been found in people with acute pain as well as in patients suffering from chronic conditions. Moreover, catastrophizing has been related to poor treatment outcome. This means that pain patients who catastrophize apparently do worse in treatment. To help pain patients who catastrophize, refined methods that directly target catastrophizing might be needed. To develop such methods, it is crucial to have a clear theoretical framework. Several frameworks have emerged to explain catastrophizing from a theoretical point of view, but there is still sparse empirical support for some of the proposed links.

One question that emerges is whether the link between catastrophizing, pain, and negative outcomes is true regardless of the circumstances. Would a situation where pain clearly is not harmful, and in fact brings consequences that are generally viewed as positive, also provoke catastrophizing? Although childbirth contains these features, it also involves extremely intense pain, and the role of catastrophizing in this context remains unclear. A second question that arises is how high catastrophizing influences the effect of exposure in vivo, a treatment that was specifically developed for patients with pain-related fear, a condition which often goes hand in hand with catastrophizing. One possibility is that patients who catastrophize are indeed helped by exposure, since the treatment was developed for fearful patients who often have salient catastrophic thoughts. Another possibility is that the same tendency as in other CBT treatments is applicable to exposure; that patients with too high levels of catastrophizing actually do worse. A third question concerns the theoretical understanding of catastrophizing. A recurrent feature in existing theoretical frameworks is the link to beliefs that patients hold about their pain. More specifically, catastrophizing has been linked to strong beliefs that back pain is purely caused by medical factors. The misdirected problem solving model is one contemporary model which emphasizes this link, where catastrophizing is framed within a problem solving perspective. As this model is fairly new, empirical studies supporting the proposed links are sparse. In particular, the links between problem framing, catastrophizing, and overt problem solving behavior have not been scrutinized. To find out whether catastrophizing might be framed within a problem solving perspective is relevant not only in terms of theoretical understanding, but also to provide appro-
appropriate help for pain patients stuck in a vicious circle of catastrophizing and misdirected attempts to handle the situation.

**Aim of the dissertation**

This dissertation aims to expand our current knowledge about pain catastrophizing and to advance the theoretical framework around the concept. More specifically, the role of catastrophizing was explored in three areas. Firstly, it was investigated how catastrophizing was related to *pain in childbirth*, a pain situation which might be considered as unique because of its positive associations. Secondly, catastrophizing was scrutinized in the context of psychological treatment for problems with back pain. More specifically, the question posed was how high levels of catastrophizing were related to outcome in *exposure in vivo*. Thirdly, the role catastrophizing might play in a *problem solving context* was explored by linking the concept to problem framing and overt problem solving behavior.

**Specific aims and research questions**

I. Study I is a prospective study where the objective was to study the role of catastrophizing in pain in childbirth. The central question was whether the reported pain in childbirth and functioning postnatally differed between women who catastrophized about labor pain and non-catastrophizers.

II. Study II is a secondary analysis of an RCT on the effectiveness of exposure in vivo for back pain patients with pain-related fear. The main aim was to study possible moderators of outcome in exposure; catastrophizing, anxiety and depressed mood were proposed as possible moderators.

III. Study III is a prospective study where pain catastrophizing was explored from a problem solving perspective. The aim was to study the links between catastrophizing, problem framing and overt problem solving behavior through two possible models of mediation as inferred by two contemporary and complementary theoretical models, the misdirected problem solving model (Eckleston & Crombez, 2007) and the fear-anxiety-avoidance model (Asmundson, et al., 2004).
Short description of the studies

STUDY I

PAIN IN CHILDBIRTH AND POSTPARTUM RECOVERY -THE ROLE OF CATASTROPHIZING

Introduction
Pain in childbirth is one of the most intense pains that women experience in their lives. Consequently, it might well be associated with psychological reactions such as pain catastrophizing. However, childbirth differs from other pain provoking situations because of its positive associations, namely the birth of a child. Also, labor pain is normally expected to be restricted in time, which is different from many situations involving pain. Furthermore, labor pain is an important signal to the mother that the labor is proceeding and hence the pain might have a lower threat value than in other situations. Thus, there is a reason to study the relation between catastrophizing, pain and lower levels of functioning in the context of childbirth.

Aim
The aim was to investigate whether the reported pain during childbirth and functioning postnatally differed between women who catastrophize about labor pain (hereafter called “catastrophizers”) and non-catastrophizers. We hypothesized that catastrophizers would anticipate and experience more pain during childbirth than non-catastrophizers. We also hypothesized that recovery, in terms of level of functioning in activities of daily living (ADL), would take longer for catastrophizers than for non-catastrophizers.

Overview of the design
In this prospective study, the data collection was made on two occasions: after 34–41 weeks of pregnancy and 2–4 weeks following the birth. Participants were classified as catastrophizers (n = 38) and non-catastrophizers (n = 44) based on their scores on the Pain Catastrophizing Scale (PCS). Catastrophizers and non-catastrophizers were compared on ratings of anticipated and experienced labor pain and on ratings of functioning in ADL at three and seven days after the delivery.

Participants
Pregnant women (N = 82) who were giving birth for the first time were recruited through maternal health services. To participate, the women had
to be at least 34 weeks of gestation and planning to give birth vaginally. Only women answering both questionnaires (93%) were included in the analyses. The mean age was 30; range 20-42.

**Measurements**

**Pain catastrophizing**
Catastrophizing about labor pain was assessed through the Pain Catastrophizing Scale (PCS) (Sullivan, et al., 1995). In this study, the instructions of the PCS were changed slightly, so that the women were asked to focus specifically on the thoughts they had about labor pain. The PCS has been used in similar ways to assess catastrophizing about genital pain (Pukall, Binik, Khalifé, Amsel, & Abbott, 2002).

**Pain**
Anticipated and experienced labor pain was assessed by the Present Pain Intensity scale, a part of the McGill Pain Questionnaire (Melzack, 1975). Pain ratings were made on two occasions: before (anticipated) and after (experienced) childbirth.

**Physical recovery in Activities of Daily Living (ADL)**
To assess recovery in ADL, the women rated to what degree they were able to do the following, at three and seven days after the delivery, as compared to before the pregnancy: Household chores (e.g. cleaning and cooking), personal care (e.g. hygiene and getting dressed), and physical activities (e.g. taking walks, climbing the stairs, and light exercising). To obtain one score for physical recovery, the average score for the three questions was calculated.

**Statistical analysis**
To explore differences between catastrophizers and non-catastrophizers, independent t-tests were employed for anticipated labor pain, experienced labor pain, and physical recovery at three and seven days after the delivery. Since four t-tests were employed, a Bonferroni correction for multiple tests was made, requiring \( p < .0125 \) for statistical significance.

**Results**
The median-split at 20 on the PCS resulted in two distinct groups: women who catastrophized (\( M = 27.9; SD = 5.6 \)) and non-catastrophizers (\( M = 12.4; SD = 5.2 \)).
Pain
Catastrophizing women rated both anticipated and experienced labor pain as significantly higher than non-catastrophizers, as shown in table 1.

Table 1
Comparison of pain intensity (scale 0-5) in catastrophizing and non-catastrophizing women.

<table>
<thead>
<tr>
<th></th>
<th>PC (n = 38)</th>
<th>NPC (n = 44)</th>
<th>t (df)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M(SD)</td>
<td>M(SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipated pain</td>
<td>3.79 (0.59)</td>
<td>3.06 (0.65)</td>
<td>-5.32* (80)</td>
</tr>
<tr>
<td>Experienced pain</td>
<td>3.68 (0.73)</td>
<td>3.09 (0.88)</td>
<td>-3.33* (80)</td>
</tr>
</tbody>
</table>

M = mean; SD = standard deviation; df = degrees of freedom; PC = Pain Catastrophizers; NPC = Non Pain Catastrophizers. *p < .0125

Note. The groups have different n because the participants that rated on the median at 20 were treated as non-catastrophizers.

Physical recovery in ADL
Catastrophizing women rated their level of functioning in ADL as significantly lower than non-catastrophizers at three days and at seven days after giving birth, as illustrated in figure 4.

FIGURE 4. Recovery in level of functioning in activities of daily living (ADL; scale 1-6) in catastrophizing and non-catastrophizing women.

Conclusions
The results from this study demonstrate that catastrophizing does indeed play a role in pain in childbirth. Both proposed hypotheses were supported:
firstly, women who catastrophized about labor pain anticipated and experienced more intense pain in childbirth than non-catastrophizers. Secondly, women who catastrophized reported lower levels of functioning than non-catastrophizers up to a week after the delivery.

These findings replicate and expand findings from earlier studies, mostly carried out in populations with chronic and pathological pain, where catastrophizing has been associated with heightened pain and reduced involvement in daily activities (for a review, see Sullivan, et al., 2001). In this study, we found the same associations for pain associated with childbirth. Thus, despite the manifest positive facets of childbirth, the relation between catastrophizing and pain outcomes was comparable with other pain situations.

The results from this study show that catastrophizing is indeed associated with negative outcomes despite circumstances where the pain might be framed as “natural” or “harmless”. However, since the framing of the pain was not assessed, it might well be that women who catastrophized framed the pain as harmful or were afraid that something had gone medically wrong. To find out how catastrophizing is related to medical framing of pain, further research on this topic is needed; this will be the focus of study III.

These findings imply possibilities for identifying pregnant women with high levels of catastrophizing during the third trimester, for instance by using screening questionnaires. The next challenge is to develop adequate interventions. In other populations, cognitive-behavioral therapy (CBT) is a successful method which encourages better adjustment to pain. One potential path is to investigate if CBT-techniques (e.g. imaginary exposure) could be adapted as early interventions for women who catastrophize about labor pain. However, there is evidence that high levels of catastrophing might hinder the treatment effect of CBT (McCracken & Turk, 2002; Turner, et al., 2007) and there is a need to determine whether this also applies to different types of exposure before these treatments are adapted to suit pregnant women who catastrophize. Exploration of factors that might hinder the treatment effect, which is the research question in study II, will provide valuable information to the development of appropriate interventions for women who catastrophize and are at risk of experiencing childbirth as a negative event.
STUDY II

CATASTROPHIZING MODERATES THE EFFECT OF EXPOSURE IN VIVO FOR BACK PAIN PATIENTS WITH PAIN-RELATED FEAR

Introduction

*Exposure in vivo* is a novel treatment approach in the pain field which has been shown to be effective for back pain patients with high levels of pain-related fear. However, the effects differ notably between studies and one issue raised is that some patients seem to respond better to exposure than others (Linton, et al., 2008). Consequently, the effect of exposure might be suppressed by moderating factors. In other CBT treatments for pain, high levels of catastrophizing, anxiety, and depressed mood have been linked to poor outcome (e.g., McCracken & Turk, 2002; Turner, et al., 2007). How these factors are related to outcome in exposure has not yet been studied.

Aim

The main aim was to study possible moderators of outcome in exposure in vivo. Catastrophizing, anxiety, and depression were explored as possible moderators of the treatment effect. The secondary aim was to study changes in psychological variables (depression, anxiety, catastrophizing, and fear-avoidance beliefs) during treatment for patients who improved in terms of function as compared to those who did not improve, to get an indication of what helped or hindered the treatment effect.

Overview of the design

This study is based on data from a randomized-controlled trial for patients with non-specific spinal pain (Linton, et al., 2008). Figure 5 presents an overview of the design. After randomization, all participants filled out pretest 1. Thereafter, the exposure group \( n = 13 \) received exposure treatment and the waiting-list group \( n = 21 \) continued with the usual treatment. After a median of 14 weeks, the waiting-list participants completed pretest 2 and subsequently received exposure. All participants completed the posttest immediately after treatment and the follow-up three months later.
Participants
Participants were recruited via primary care facilities, advertisements in local newspapers, and National Insurance Authority offices. The participants had disabling spinal pain, ongoing or recent sick leave, and substantial levels of pain-related fear (TSK > 35). The mean age was 46 in the exposure group and 49 in the waiting-list group.

Measurements

Background and pain
Background questions (age, gender, and sick leave) and pain characteristics (intensity, location, and duration) were taken from the Örebro Musculoskeletal Pain Screening Questionnaire (ÖMSPQ) (Linton & Halldén, 1998).

Disability
Level of functioning in daily activities (e.g. walking or getting dressed) was measured with the Quebec Back Pain Disability Scale (QBPDS) (Kopec, et al., 1995).

Anxiety and depression
Anxiety and depression were assessed through the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983).

Pain catastrophizing
Catastrophizing was measured with the Pain Catastrophizing Scale (PCS) (Sullivan, et al., 1995).
Fear-avoidance beliefs
Fear-avoidance beliefs were assessed through the Tampa Scale of Kinesiophobia (TSK) (Kori, Miller, & Todd, 1990).

Statistical analysis
In order to address the main aim, data from both the exposure group (n = 13) and the waiting-list group (n = 21) were used in the analyses. Three multiple regression analyses were employed for catastrophizing, anxiety, and depression respectively, according to recommendations for the investigation of moderational effects (Baron & Kenny, 1986; Holmbeck, 2002). To test whether pretreatment levels of the psychological variables moderated the effect of treatment on disability, the interaction between the group and the psychological variable was added to the main variables. If the interaction turned out to be significant while the main variables were included in the model, this would indicate moderation. Subsequently, the nature of the significant interactions was explored with simple regressions, for participants with high and low levels of the psychological variable separately.

In order to tackle the secondary aim, only data from participants who completed the exposure was used (n = 26). The participants were divided into two groups based on a median-split on the percentage change in disability from pretest to posttest (median = -18%). To compare these groups, descriptive statistics were calculated for pretest, posttest, follow-up, and percentage change from pretest to posttest. Because of the small number of participants, it was not tested whether the differences were statistically significant.

Results
As can be seen in table 2, of the interaction terms that were entered, only the interaction between catastrophizing and group turned out to be significant over and above the main effects. This implies that the effect of exposure was significantly different depending on the patients’ levels of catastrophizing, whereas in the waiting-list group catastrophizing was not a predictor of outcome. In other words, catastrophizing was a moderator of treatment outcome in exposure.

In the analysis that investigated anxiety as a possible moderator, only the main effect was significant, meaning that anxiety was a general predictor of outcome in both the exposure group and the waiting list group. Depression was not significantly related to outcome.
Table 2
Multiple regression analyses explaining the treatment effect in reduction on disability depending on pretreatment levels of catastrophizing, anxiety, and depression.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Beta</th>
<th>p value</th>
<th>$R^2$</th>
<th>$R^2$ adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(standarized)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>.270</td>
<td>Ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catastrophizing</td>
<td>-.083</td>
<td>Ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>.187</td>
<td>Ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catastrophizing</td>
<td>.604</td>
<td>.048*</td>
<td>.27</td>
<td>.20</td>
</tr>
<tr>
<td>Group*catastrophizing</td>
<td>-.809</td>
<td>.009**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>.430</td>
<td>.014*</td>
<td>.28</td>
<td>.23</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.498</td>
<td>.005**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>.435</td>
<td>.014*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>.643</td>
<td>.008**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group*anxiety</td>
<td>-.204</td>
<td>Ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>.307</td>
<td>Ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>.163</td>
<td>Ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>.307</td>
<td>Ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>.246</td>
<td>Ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group*depression</td>
<td>-.127</td>
<td>Ns</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. *p < .05, **p < .01

To explore the nature of the significant interaction, the participants were divided into high and low catastrophizers based on a median-split (at score 26) on the PCS. Simple regression analyses for these two groups separately showed that in low catastrophizers, there was a significant effect of group
on treatment outcome, whereas in high catastrophizers, there was no such significant effect. This pattern is shown in figure 6.

*High catastrophizers only*

![Graph showing ratings of disability in the exposure group and the waiting-list group for high catastrophizers.]

*Low catastrophizers only*

![Graph showing ratings of disability in the exposure group and the waiting-list group for low catastrophizers.]

**FIGURE 6. Ratings of disability in the exposure group and the waiting-list group for low catastrophizers and high catastrophizers respectively.**

*a Note. These graphs are based on ANOVA’s.

*b Note. The large difference between the high catastrophizing groups at assessment 1 was only found when dividing the participants into high and low catastrophizers. There was no such difference between the whole exposure and waiting-list group.*

In relation to the secondary aim, the descriptive data displayed in table 3 showed that both low change participants (LCP) and high change participants (HCP) scored somewhat lower on anxiety, catastrophizing, and fear-avoidance beliefs after treatment, although these improvements were markedly higher in the HCP group. In depression, the scorings were slightly worse after treatment in the LCP group, whereas HCP also showed improvement on this variable.
Table 3
Ratings of disability and psychological variables in low change participants and high change participants at pretest, posttest and follow-up, and percentage change from pretest to posttest.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measure</th>
<th>Time point</th>
<th>Low change participants (n = 12) M(SD)</th>
<th>High change participants (n = 13) M(SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disabilitya</td>
<td>QBPDS</td>
<td>Pretest</td>
<td>49.8 (14.8)</td>
<td>46.6 (11.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posttest</td>
<td>48.8 (13.0)</td>
<td>22.1 (11.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Follow-up</td>
<td>48.1 (16.1)</td>
<td>22.9 (16.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change from pretest to posttest</td>
<td>-2%</td>
<td>-53%</td>
</tr>
<tr>
<td>Depression</td>
<td>HADS</td>
<td>Pretest</td>
<td>6.8 (4.4)</td>
<td>5.5 (4.2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posttest</td>
<td>7.2 (4.2)</td>
<td>3.4 (3.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Follow-up</td>
<td>8.1 (4.8)</td>
<td>3.8 (3.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change from pretest to posttest</td>
<td>+6%</td>
<td>-38%</td>
</tr>
<tr>
<td>Anxiety</td>
<td>HADS</td>
<td>Pretest</td>
<td>7.8 (3.1)</td>
<td>4.5 (2.8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posttest</td>
<td>6.7 (3.0)</td>
<td>3.4 (2.2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Follow-up</td>
<td>7.4 (3.7)</td>
<td>2.5 (1.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change from pretest to posttest</td>
<td>-14%</td>
<td>-32%</td>
</tr>
<tr>
<td>Catastrophizing</td>
<td>PCS</td>
<td>Pretest</td>
<td>25.7 (6.4)</td>
<td>18.7 (10.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posttest</td>
<td>21.2 (8.9)</td>
<td>9.5 (6.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Follow-up</td>
<td>21.5 (10.0)</td>
<td>11.2 (8.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change from pretest to posttest</td>
<td>-18%</td>
<td>-49%</td>
</tr>
<tr>
<td>Fear-avoidance beliefs</td>
<td>TSK</td>
<td>Pretest</td>
<td>40.8 (8.0)</td>
<td>38.6 (8.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posttest</td>
<td>35.0 (5.0)</td>
<td>26.9 (5.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Follow-up</td>
<td>35.5 (7.3)</td>
<td>28.9 (6.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change from pretest to posttest</td>
<td>-14%</td>
<td>-30%</td>
</tr>
</tbody>
</table>

*Note. The groups (LCP/HCP) were based on the posttest ratings on this measure.*
Conclusions
In conclusion, catastrophizing moderated the effect of exposure in vivo in this sample. More specifically, high catastrophizing patients were not helped by the treatment whereas low catastrophizers showed marked improvements. In addition, patients who were high on anxiety tended to have a poor outcome in general, both in the treatment group and in the waiting-list group. Depression was not significantly related to outcome. However, the descriptive data indicated that depressed mood might be related to outcome nevertheless as the high change group did indeed seem to improve on ratings of depressed mood whereas the low change group did not change at all.

This study is the first one to identify catastrophizing as a moderator of treatment outcome in exposure. This is in line with findings from earlier research about moderating factors in other CBT programs for pain (McCracken & Turk, 2002; Turner, et al., 2007). However, it contradicts the hypothesis that exposure would work best for patients with high levels of fear (Leeuw, et al., 2008), which in general is closely linked to catastrophizing. Instead, our findings point in the opposite direction, as the treatment was only effective for patients with low or moderate levels of catastrophizing (<26). One possibility is that too high levels of catastrophizing might work as a safety behavior, i.e. a subtle strategy that patients use to “protect” themselves during exposure, which hinders the patient’s ability to fully benefit from exposure (Vlaeyen, de Jong, Leeuw, & Crombez, 2004).

These findings may have clinical implications. First and foremost, assessment of patients with spinal pain and pain-related fear should involve catastrophizing. Depressed mood and anxiety should preferably be examined as well, since these variables also seem to play a role for the treatment process and outcome. Presumably treatment success is helped or hindered by other reflections of negative emotionality rather than pure levels of fear-avoidance beliefs, which implies a need to further develop exposure in vivo to benefit all patients with pain-related fear.

Even though the results from this study are informative for improving exposure, the contribution to the conceptual understanding of catastrophizing is limited. While the results denote that catastrophizing is closely linked to overt behavioral avoidance, they tell us little about how catastrophizing is related to other factors such as the framing of the pain. It might be that patients who catastrophize frame their pain as being strictly due to medical factors and search for medical explanations and cures for it. This would make them more resistant to psychological treatments in general, and to exposure in particular, as this treatment requires that the patient
engages in several fear-provoking activities that may be interpreted as harmful. If catastrophizing is related to problem framing, it might be important that the clinician identifies and addresses catastrophizing during the exposure. More research about possible links between problem framing, catastrophizing, and overt behavior, which is the topic in study III, will therefore be informative for the further development of treatments for patients with pain-related fear.
STUDY III

UNDERSTANDING CATASTROPHIZING
FROM A MISDIRECTED PROBLEM SOLVING PERSPECTIVE

Introduction
The misdirected problem solving model has been presented as a framework to explain how worry and catastrophizing might lead to rigid, medically oriented problem solving behaviors in patients with chronic pain (Eccleston & Crombez, 2007). This model underscores that the beliefs patients have about their pain, the problem framing in other words, is closely linked to worry. When the worry progressively intensifies and the outcome is perceived as getting worse and worse, it has been defined as catastrophic worry (Davey & Levy, 1998), as captured by the concept catastrophizing. The misdirected problem solving model implies that, in cases where no medical solution exists, patients who catastrophize and have a strict biomedical problem framing might end up in repeated “misdirected” efforts at finding a solution, or cure, for pain.

The expanded fear-anxiety-avoidance model also underscores the potential maladaptiveness in framing persistent pain in strict biomedical terms, here captured by pain beliefs such as “pain equals damage or serious injury” (Asmundson, et al., 2004). In this model, biomedical problem framing is proposed to trigger catastrophizing, which in turn enhances the perception of threat and the motivation to find a solution, or cure, for the pain.

In sum, both of the aforementioned models imply that back pain patients who catastrophize are likely to view the problem as primarily biomedical and, as a result, attempt to find medical solutions which often prove unsuccessful. The models might be seen as complementary rather than competing. However, the models do imply somewhat different pathways. In the formation of the misdirected problem solving model, a biomedical problem frame mediates the relation between catastrophic worry and problem solving behavior, while the fear-anxiety-avoidance model implies that it is the other way around, and that catastrophizing is the mediator. These links have not been examined empirically.

Aim
The aim was to explore if and how catastrophizing was linked to biomedical problem framing and medically oriented problem solving. We examined two possible models of mediation as inferred by the aforementioned theoretical models. The goal was to increase our understanding of catastrophizing from a problem solving perspective.
Overview of the design
This study is based on data from a prospective study about psychological processes in the development of chronic pain problems (Boersma & Linton, 2005). Participants answered questionnaires on two occasions. On the first occasion (timepoint 1, t1), catastrophizing and biomedical problem framing were assessed. On the second occasion (timepoint 2, t2), seven months later, medically oriented problem solving was assessed.

Participants
Participants (N = 173) were recruited via advertisements in local newspapers. The participants had spinal pain and at least one day of sick-leave the previous year because of the pain problem. The mean age was 57.

Measurements

Background, pain, and sick leave
Background variables (age, gender, and nationality), pain characteristics (intensity, location, and duration), and sick leave were assessed with questions taken from the Örebro Musculoskeletal Pain Screening Questionnaire (ÖMSPQ) (Linton & Halldén, 1998).

Catastrophizing
Catastrophizing was measured with the Catastrophizing subscale from the Coping Strategies Questionnaire (CSQ) (Rosenstiel & Keefe, 1983).

Biomedical problem framing
The Somatic Focus subscale from the Tampa Scale for Kinesiophobia (TSK) (Kori, et al., 1990) was used as a proxy for biomedical problem framing. Even though the TSK was originally developed to assess fear of movement and (re) injury, the Somatic Focus subscale focuses specifically on beliefs about pain signaling underlying serious medical problems. Therefore, this subscale fits well with the concept of biomedical problem framing.

Medically oriented problem solving behavior
Health care utilization was used as a proxy for medically oriented problem solving behavior, and was assessed with questions from the Outcome Evaluation Questionnaire (Keefe, Linton, & Lefebvre, 1992).
Function
Function was assessed with five questions from the Örebro Musculoskeletal Pain Screening Questionnaire (ÖMSPQ) (Linton & Halldén, 1998).

Statistical analysis
Two possible models of mediation were explored. In the first model (Alternative 1), which is in line with the misdirected problem solving model, biomedical problem framing was proposed as a mediator of the relation between catastrophizing and medically oriented problem solving behavior (see figure 7). In the second model (Alternative 2), which is in line with the fear-anxiety-avoidance model, catastrophizing was proposed as a mediator of the relation between biomedical problem framing and medically oriented problem solving behavior (see figure 8).

We used two different approaches to explore whether the data supported any of these possible models of mediation. First, multiple regressions were used to investigate whether the prerequisites of mediation effects were met, using the traditional recommendations by Baron & Kenny (1986). Second, the significance of the indirect effects were assessed with a bootstrapping
method \((n = 1000\) bootstrap resamples\) (see, Preacher & Hayes, 2008). Bootstrapping is a nonparametric resampling procedure that generates an approximation of the sampling distribution from the available data set. The bootstrapping distribution is generated by taking a sample (with replacement) of size \(n\) from the full data set. The indirect effects are then calculated in the resamples which results in point estimates and 95\% confidence intervals are estimated for the indirect effects. We considered point estimates of indirect effects to be significant if zero was not contained in the confidence interval.

**Results**

In the multiple regression analyses, the data best matched Alternative 2 (the fear-anxiety-avoidance model), as the effect of somatic focus (proxy for biomedical problem framing) on health care utilization was reduced to a non-significant level (and not the other way around) when both catastrophizing and somatic focus were used as predictors in the regression. These results are displayed in table 4.
Table 4
Multiple regression analyses exploring two possible models of mediation.

<table>
<thead>
<tr>
<th>Model</th>
<th>Step 1</th>
<th>Step 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Constant (.90, .19)</td>
<td>Constant (.57, .32)</td>
</tr>
<tr>
<td>Alternative 1: Misdirected problem solving model</td>
<td>Catastrophizing (.05, .01, .31**)</td>
<td>Catastrophizing (.04, .01, .26**)</td>
</tr>
<tr>
<td></td>
<td>Somatic focus (.04, .03, .11Ns)</td>
<td>Somatic focus (.04, .03, .11Ns)</td>
</tr>
<tr>
<td>Alternative 2: Fear-anxiety-avoidance model</td>
<td>Constant (.62, .33)</td>
<td>Constant (.57, .32)</td>
</tr>
<tr>
<td></td>
<td>Somatic focus (.08, .03, .24**)</td>
<td>Somatic focus (.04, .03, .11Ns)</td>
</tr>
<tr>
<td></td>
<td>Catastrophizing (.04, .01, .26**)</td>
<td>** Note. Alternative 1 R2 = .10 for Step 1; Δ R2 = .01 for Step 2 (Ns).**</td>
</tr>
</tbody>
</table>

Subsequently, a bootstrapping method was used to explore the significance of the indirect effects in both possible models of mediation. The analyses showed that in Alternative 1, the indirect effect of catastrophizing on health care utilization through somatic focus as a mediator was not significant (point estimate = .009; CI = -.005 -.024; p = .20) In Alternative 2, however, the indirect effect of somatic focus on health care utilization...
through catastrophizing as a mediator was significant (point estimate = .042; CI = .015 - .078); $p < .01$).

Taken together, in both approaches of mediation analyses, the data supported Alternative 2 (the fear-anxiety-avoidance model) where catastrophizing was proposed as a mediator of the relation between somatic focus and health care utilization.

**Conclusions**

This study provided support for framing pain catastrophizing within a problem solving perspective. The results confirmed the concepts involved in the misdirected problem solving model. However, the direction of the relations was somewhat different than the model proposes.

The mediation analyses supported catastrophizing as a mediator between biomedical problem framing and medically oriented problem solving. In other words, if a patient holds strong beliefs that the pain is due solely to medical factors, this might trigger catastrophizing and the patient is repeatedly seeking medical care in the hope of finding a “cure” or pain relief. This sequential order is *not* in line with the misdirected problem solving model, but is rather congruent with the expanded fear-anxiety-avoidance model. The latter model implies that pain beliefs, such as “pain means harm or serious injury”, or in other words biomedical problem framing, precedes catastrophizing and medically oriented problem solving.

This study provides support for one theoretical framework around catastrophizing, which posits that it is a “misdirected” attempt to solve a problem. The findings have implications theoretically as well as clinically. Theoretically, the concepts in the misdirected problem solving model were confirmed, but the directions were somewhat different than the model implies. This has important implications for further development of the theoretical models around catastrophizing. Clinically, this brings up the importance of examining how patients with spinal pain view their problem. If the pain is regarded as a definite signal of something medically wrong it is vital for the clinician to assess and possibly also address catastrophic worry.
General discussion

Catastrophizing plays a key role in how pain is experienced and dealt with, not only in persistent pain but also in labor pain, during exposure treatment, and in a problem solving context. This dissertation underscores the vital role of catastrophizing in these new areas, giving rise to clinical as well as conceptual issues.

Catastrophizing plays a noteworthy role during childbirth – this was the main finding from study I. Childbirth is a unique situation which generally involves extremely intense acute pain where the role of catastrophizing has practically been unexplored. Research in this area has mainly focused on the broader construct of fear of childbirth, which embraces a woman’s fear for her own or the baby’s health, fear of losing control as well as fear of pain, where the latter is one of the most commonly reported reasons (Eriksson, Westman, & Hamberg, 2006; Geissbuehler & Eberhard, 2002; Sjögren, 1997). Fear of childbirth has been related to a lower pain threshold (Saisto, Kaaja, Ylikorkala, & Halesmäki, 2001). The results from study I are in line with these findings but expand them by specifically pointing to pain catastrophizing as a critical component which presumably is related to these other, broader fear constructs.

Catastrophizing is also critical for the outcome of exposure treatment – this was the main finding from study II. Exposure in vivo is a psychological treatment for back pain patients with pain-related fear where the exact impact of catastrophizing has not been known. Earlier studies have hypothesized that exposure would be most effective for patients with high levels of fear (George, et al., 2008; Leeuw, et al., 2008). However, the empirical data has not supported this hypothesis. Our data from study II rather points in the opposite direction; exposure was not effective for patients with high levels of catastrophizing which is often related to high fear. Our results are in line with findings from studies of other CBT treatments for pain problems, where catastrophizing has indeed been linked to poor outcome (McCracken & Turk, 2002; Turner, et al., 2007). We found this was also the case in exposure. This is informative for the application and further development of exposure as it points to a need for the refinement of treatment methods. It is also informative for the conceptual understanding of catastrophizing as it implies that it is closely linked to overt behavioral avoidance.

Catastrophizing might be framed in a problem solving perspective – this was the main finding from study III. The misdirected problem solving model is a recent attempt to integrate worry, and thereby even catastrophizing, within a problem solving framework. However, empirical data
about the proposed links has been sparse. Earlier research has specifically stressed the importance of examining in what way catastrophizing is linked to overt problem solving behavior (Crombez, et al., 2008). The findings from study III add to this literature by providing preliminary support for placing catastrophizing within a problem solving framework. However, our data suggested a somewhat different pathway than the model proposes, which was more in line with the fear-anxiety-avoidance model. This implies that the theoretical models of catastrophizing are still far from complete. To summarize, on the one hand these findings denote that catastrophizing might be framed in a problem solving perspective. On the other hand, they imply that there is still room for improvement in existing theoretical frameworks.

There is a need for further development in the theoretical framework around catastrophizing because of two main reasons. First, the findings from study III highlight a need to refine the links proposed by the misdirected problem solving model. Second, existing theoretical models concerning catastrophizing do not highlight the function of catastrophizing. Exploring the function would give valuable information about why people catastrophize – in other words, the role of catastrophizing within the individual.

**How are these findings related to theoretical frameworks around catastrophizing?**

The findings from study I might be explained by the fear-avoidance model (Vlaeyen & Linton, 2000). This model was originally developed to describe the interaction between cognitive and behavioral factors in the development of problems with persistent back pain. Recent research has shown that the components in this model are also relevant and might signal enhanced risk in acute pain conditions (for a review, see Leeuw, et al., 2007) as well as in pain-free individuals (Buer & Linton, 2002). Our results replicate and extend these findings to pain in childbirth, as one interpretation is that women with fear-avoidant beliefs interpret labor pain as threatening, which in turn evokes catastrophizing. Consequently, they apparently become tense and more vigilant to pain signals, which might explain their higher ratings of pain. After childbirth, catastrophizing women had lower ratings of physical recovery suggesting avoidance of physical activities. This expands on findings from an earlier study, where catastrophizing was related to tendencies to avoid pain during the delivery (Van den Bussche, Crombez, Eccleston, & Sullivan, 2007). Our findings denote that this tendency continues after childbirth.
The fear-avoidance model might also be used to explain the findings from study II. Apparently, patients with too high levels of catastrophizing were not helped by exposure in vivo. This treatment is partly based on the Pavlovian extinction of fear paradigm (Bouton, 1988) and partly on the notion that many patients with non-specific back pain harbor irrational beliefs about pain and movements as harmful (Vlaeyen, de Jong, Geilen, Heuts, & van Breukelen, 2001). The basic idea is that patients will become less fearful by gradual confrontation to fear-provoking movements. The fear will decrease partly through habituation, and partly through disconformation of beliefs. Consequently, they will recover in terms of functioning. This did not happen in high catastrophizing patients. One explanation is that too high levels of catastrophizing might work as a safety behavior, which refers to subtle avoidant strategies that patients use to “protect” themselves from fear-provoking stimulus (Vlaeyen, et al., 2004). Catastrophizing would then be a form of subtle covert avoidance.

This fits well with the process perspective, where catastrophizing is indeed viewed as a form of avoidance (Stroebe, et al., 2007). According to this perspective, catastrophic thinking is proposed to serve the same function as other forms of avoidance, namely to down-regulate negative affect; the patient engages in passive, abstract catastrophizing as a way of reducing the intensity of the fear response. Applied to study II, this would mean that patients with high levels of catastrophizing were stuck in these abstract, passive patterns of thinking instead of engaging in the exposure treatment, which might have hindered them from getting in contact with the present moment contingencies. Consequently, the habituation did not occur and the treatment effect was never achieved. Hence, the findings from study II might be explained by a process perspective on catastrophizing.

The descriptive data of changes in psychological variables during treatment in study II might also be viewed in the light of a process perspective. Low change participants did not improve at all on ratings of depressed mood. Instead, their ratings on the posttest were above the cut-off for “possible cases of depression” (HADS subscale depression > 7) (Herrmann, 1997). Consequently, patients who did not improve by the exposure had substantial levels of both depressed mood and catastrophizing, which suggests commonalities between the two. According to the process perspective, catastrophizing is a form of passive repetitive thinking with negative content. Similar patterns of recurrent negative thinking about self and others are well-known and salient features of depressed mood (Lyubomirsky & Nolen-Hoeksema, 1995). Applied to the results of study II, this means that patients who were dwelling on their pain complaints were possibly dwell-
ing on other negative aspects of life as well, and this repetitive negative thinking hindered them from fully participating in and benefiting from the exposure treatment.

The process perspective matches the misdirected problem solving model in that catastrophizing is linked to unconstructive problem solving. From this perspective, inflexible repetitive negative thinking is closely related to inflexibility in overt behavior. In study III, catastrophizing was indeed linked to repeated efforts at finding a medical solution for the pain problem which, in cases where no medical solution actually exists, might be considered as inflexible “misdirected” problem solving behavior. Hence, these findings might be interpreted as additional support for the process perspective.

The results from study III confirmed the variables included in the misdirected problem solving model. However, the direction of the results was somewhat different than the model proposes, although this finding needs to be interpreted with caution because of methodological weaknesses (i.e. problem framing and catastrophizing were examined at the same time point). The analyses supported catastrophizing as a mediator between problem framing and medically oriented problem solving behavior. This pattern is in line with the fear-anxiety-avoidance model, where catastrophizing is proposed to mediate the relation between pain beliefs and defensive motivation, which leads to escape or defensive behavior. Pain beliefs are in essence similar to biomedical problem framing; both terms refer to patients’ assumptions that pain is equivalent with harm or injury. In other words, patients who strongly believe that the pain is strictly due to medical factors such as serious injury are more likely to catastrophize than others. This finding also fits well with the appraisal model which views catastrophizing as a result of underlying beliefs about pain, and perceived (in)capability to cope with the situation. Hence, study III suggest that biomedical problem framing sets the context for catastrophizing instead of the other way around, which is informative for further development of the theoretical framework around catastrophizing. This finding is elaborated in the model below.

Taken together, the findings from the three studies are to a certain extent explained by existing theoretical frameworks around catastrophizing. As discussed above, the results from study II and study III might further be viewed in light of a process perspective. To date, this perspective applied specifically to pain catastrophizing has only recently begun to be developed (Boersma, Flink, & Linton, 2011). The model below is elaborated in collaboration with this work and is to be viewed as an initial attempt to integrate pain catastrophizing in a process perspective.
This model is proposed as an addition and complement to already existing models, in particular to the fear-anxiety-avoidance model and the misdirected problem solving model. Indeed, some parts of this model overlap with the misdirected problem solving model. However, what is different and central to this new model is the framing of catastrophizing as repetitive negative thinking, comparable to rumination or worry. This is inspired by the growing research about repetitive negative thinking as a transdiagnostic phenomenon.
construct, identified across disorders (for a review, see Watkins, 2008). In the proposed model, catastrophizing is captured by the concept of catastrophic worry, emphasizing that catastrophizing and worry are indistinguishable from a process perspective. From this perspective, focus is on the function of catastrophizing rather than on the content.

According to this model, internal and external contexts set the stage for these processes. External context refers to the current situation around the individual, for example circumstances at work or at home, whereas key elements of the internal context are the individual’s learning history, state of mood, and more stable dispositional traits (for a review, see Watkins, 2008). One example of an internal context is biomedical problem framing, which refers to a strong belief that pain is due strictly to medical causes. This problem framing might have developed as a result of earlier experiences, for example through implicit or explicit messages from the health care system. This affects how the person interprets pain; pain signals might be interpreted as threatening and evoke thoughts about something being seriously wrong in the body (i.e. catastrophic worry), which in turn motivate the person to seek medical help to deal with the problem. This is in line with the findings from study III, and is one example of how internal and external contexts are important determinants for how the pain is subsequently dealt with.

The model displays how pain might trigger negative affect. When experiencing pain, a natural reaction, in fact, is to become distressed (“negative affect”) and to become concerned about what causes and consequences the pain might have (“motivational worry”). A certain amount of worry is vital to prepare and motivate the person to deal with threats (Mathews, 1990). In the model, this is called motivational worry and is displayed in the left pathway. Several problem definitions are considered and solutions are generated and tested out in overt behavior. Finding a medical solution to get rid of pain might be one option, but when there is little chance of success, as is often the case in persistent back pain, it might be more adaptive to change the problem formulation and consider other options where pain relief is not the main goal. This is in line with the motivational perspective on coping (Van Damme, Crombez, & Eccleston, 2008). This perspective has put forward that the most adaptive coping style when suffering from persisting disabling pain is in fact to be flexible and shift between different goals. Furthermore, the considered options ought to be concrete. It has been suggested that, in general, repetitive thinking with a concrete content is constructive whereas repetitive thinking with an abstract content is unconstructive (Watkins, 2008). A concrete content implies that the person formulates several alternatives for dealing with the pain problem,
and is willing to shift between these even if it involves confrontation with fears or a reformulation of the problem and goals.

However, depending on the internal and external context, the negative affect might also end up in a more intense *catastrophic worry* and a “mis-directed” problem solving pattern, as illustrated in the right pathway in the model. Here, the person gets stuck in repetitive negative thinking with an abstract content. This involves an inflexible goal-formulation such as “getting rid of pain”. Indeed, catastrophizing has been related to directed efforts at curing pain in cases where the pain problem was insoluble (de Vlieger, et al., 2006). The proposed function of this repetitive negative thinking is to down-regulate, or avoid, negative affect. This is in line with the proposed function of maladaptive worry, namely to avoid the somatic element of the fear response (Borkovec, Alcaine, & Behar, 2004). This fits well with the aforementioned explanation of our results from study II; that patients who catastrophized did not make full contact with the fear response, which hampered the exposure.

According to a process perspective, it makes little sense to separate different forms of repetitive negative thinking such as catastrophizing, (mal-adaptive) worry or rumination because they may all serve the same function, namely to avoid or down-regulate negative affect. The term catastrophic worry is therefore used as an overall label for this inflexible abstract repetitive negative thinking.

The catastrophic worry goes hand in hand with overt behavior which is also inflexible and repetitive. This might involve repeated unsuccessful visits to health care providers, as in study III, or persistence in avoiding movements, as in study II. These behaviors are naturally adaptive in some circumstances, for example when experiencing acute pain. However, if the person inflexibly persists in the same problem solving behavior without any success, it might be considered as a “misdirected” problem solving behavior.

This model is developed with the results from study III in mind. The data implied that catastrophizing mediated the relation between problem framing and medically oriented problem solving behavior. As can be seen in this new model, internal context such as problem framing is proposed to set the stage for catastrophic worry and inflexible problem solving behavior, which is in line with the findings from study III.
Clinical implications and directions for future research

The three studies have several clinical implications and set directions for future research. The findings from study I are important information for maternal health services and imply a need to identify catastrophizing women during their pregnancy, possibly by employing screening questionnaires. These findings may be viewed in relation to the large number of women suffering from fear of childbirth, about 6-11% in the industrialized countries (for a review, see Saisto & Halmesmäki, 2003). Women with fear of childbirth often report fear of pain (Eriksson, et al., 2006; Geissbuehler & Eberhard, 2002; Sjögren, 1997). Since pain-related fear and catastrophizing are closely related this implies a need to assess whether women who seek help because of fear of childbirth also catastrophize. The next step is to develop appropriate interventions for these groups. Treatments for women with fear of childbirth traditionally consist of individual support given by an obstetrician or a midwife (Saisto, 2001). However, the findings from study I indicate that psychological processes are highly involved, which might well require psychological methods to be addressed. To develop psychological interventions that directly target fear of pain and catastrophizing in pregnant women are missions for future research.

The findings from study II imply a need to identify patients with high levels of catastrophizing before initiating exposure in vivo and to monitor their treatment process carefully. Possibly, these patients may need additional interventions that directly target catastrophizing. There have been some attempts to develop treatments specifically targeting catastrophizing (Rodero, García, Casanueva, & Sobradiel, 2008; Thorn, Boothby, & Sullivan, 2002). However, these interventions have mainly been cognitively oriented, focusing on examining and altering the content of the catastrophic thinking.

The proposed model of catastrophizing from a process perspective entails new and different ways of addressing catastrophizing. If catastrophizing is conceptualized as a form of covert avoidance, a functional treatment approach might be considered (for a description of a functional approach, see e.g., Luoma, Hayes, & Walser, 2007). Instead of altering the content, the intervention would then focus on contextual and functional aspects; to examine when and where catastrophizing occurs, and what it hinders the patient from doing. The explicit aim is not to reduce the repetitive thinking itself, but to reduce its impact on overt behavior. The ultimate aim is that the patient engages in overt behavior that is in line with long-term goals. It is, in theory, well possible to intertwine this approach within the exposure treatment, but the effects need to be empirically examined.
A complementary intervention is to work on altering the abstract content of the catastrophic worry into a more concrete content (i.e. motivational worry). The clinician might assist the patient in formulating and facing unwanted thoughts and feelings. This might be described as a form of interoceptive exposure (McNally, 2007). Interoceptive exposure has shown preliminary but promising results, including on measures of catastrophizing (Flink, Nicholas, Boersma, & Linton, 2009), though the exposure in that study mainly focused on the pain sensations. An alternative would be to encourage the patient to formulate the catastrophizing in concrete terms and to focus on these, in order to break the internal avoidance.

Another intervention which also has the potential to increase flexibility in thinking and overt behavior is problem solving skills training. This is a traditional approach within CBT, which has successfully been used with a range of psychological and health-related problems (for a review, see Malouff, Thorsteinsson, & Schutte, 2007). For example, it has shown good results for people with depression (Unützer, et al., 2002), a condition where repetitive negative thinking is a salient feature. In problem solving skills training, the patient works with increasing flexibility in several ways: in the problem definition, in generating solutions, and in overt behavior through testing out solutions in real life. Consequently, problem solving skills training has the potential to help patients who become stuck in the inflexible “misdirected” problem solving path, although the effects on repetitive negative thinking need to be empirically tested.

Although the results from study III primarily entail theoretical contributions, there are some clinical implications as well. In particular, the link between biomedical problem framing and catastrophizing is informative for clinicians who meet patients with back pain problems. Asking patients what they believe is the reason for their pain might be the first step to identify catastrophizing. For back pain patients who strongly believe that the pain is strictly due to medical causes, despite indications or direct evidence to the contrary, it is important that the clinician addresses catastrophizing. Most clinicians do this by reassuring the patients that nothing is medically wrong with their back. However, there is surprisingly little evidence that reassurance is effective for calming patients (for a review, see Linton, McCracken, & Vlaeyen, 2008). Furthermore, a recent study found that patients who catastrophized were more often dissatisfied with their medical examination than others (Overmeer & Boersma, 2011). Medical examinations and general information are possibly needed, although they might not be enough for patients with high levels of catastrophizing. Another important aspect in this context is validation - to express acceptance of the patient’s behavior, feelings, and situation as true (Fruzzetti, 2006). Presuma-
ably, a combination of reassurance in the form of concrete, specific information and a validating response from the clinician is needed, but further research needs to find out the best way to do this.

The last issue for future research is to empirically scrutinize the proposed model of catastrophizing. Indeed, study III preliminary supported some of the proposed links but these findings need to be replicated to strengthen the conclusions. Another area to examine empirically is the difference between motivational worry and catastrophic worry. In the model, one proposed difference between these concepts is the level of flexibility and concreteness, an assumption which is based on earlier research about repetitive negative thinking. However, whether this is the case specifically in pain catastrophizing has not been explored empirically. Moreover, the assumption that catastrophizing is a form of covert avoidance which serves the function of down-regulating negative affect also needs to be empirically tested, preferably in experimental studies. The last question which needs to be addressed empirically is whether pain catastrophizing really is comparable to other forms of repetitive negative thinking such as rumination and (maladaptive) worry. Taken together, the proposed model of catastrophizing from a process perspective is to a certain extent based on earlier research about repetitive negative thinking as a transdiagnostic concept, but the model needs to be empirically tested.

**Methodological limitations**

There are some methodological shortcomings which might limit the conclusions that may be drawn from these studies.

First, all findings rely on subjective self-report inventories. This might be a threat to the internal validity because of possible response biases (Kazdin, 2003). However, all three studies rely on data from two or more assessment points that are separated in time, thereby strengthening the conclusions. Furthermore, the majority of the measures utilized are well-known and accepted inventories which earlier research has found to be psychometrically sound and reliable tools for assessing the variables of interest. Moreover, most of the concepts of interest in these studies are by definition subjective. For example, catastrophizing and pain are generally assessed through self-reports because they are highly subjective and personal phenomenon.

A second limitation concerns the small sample in study II which restricted the statistical power and possibly also the reliability of the results. Even though more studies are needed to replicate the findings, the sample size ought to be viewed in light of the fact that exposure in vivo is quite a new intervention in the pain field and only a few randomized controlled
trials have been published. Yet, despite low power we did find significant effects indicating that these are indeed salient. Moreover, our findings fit well with both theory and research in other areas where catastrophizing has been linked to poor treatment outcome.

A third limitation concerns the recruitment of participants. In all three studies, the participants were volunteers and there might have been some self-selection. The main question here is whether it is possible to generalize the findings to clinical settings. However, there are no obvious indications that our participants differ either from pain patients at a clinic or from patients in other studies in levels of pain, disability, and background features (see e.g., Leeuw, et al., 2008; Woods & Asmundson, 2008). Consequently, there are reasons to assume that our findings might well be applicable to patients in a clinical setting.

What is to be underscored as one of the main strengths is that all three studies were prospective with at least two points of assessment. Prospective data strengthens the conclusions, especially when investigating possible moderators, as in study II, and mediators, as in study III. Furthermore, psychometrically sound measures have been used and the procedures have followed general recommendations for this type of research (Kazdin, 2003).

Summary and concluding remarks
This dissertation has demonstrated that catastrophizing plays a critical role in pain in childbirth, during exposure in vivo, and in a problem solving context. Firstly, catastrophizing mattered for the experience of pain in childbirth, which implies a need to identify catastrophizing women during their pregnancy and provide support, preferably at maternal health services. Secondly, catastrophizing played the role of moderator of the treatment effect during exposure in vivo for back pain patients with pain-related fear. This is important information for the application and further development of this treatment. Moreover, it denotes that catastrophizing is closely linked to overt behavioral avoidance. Thirdly, catastrophizing played a role in a problem solving context. Although this is in line with contemporary models such as the misdirected problem solving model, our findings suggested a somewhat different pathway than that proposed by this model. This implies a need for the further development of the theoretical framework around catastrophizing.

Based partly on the findings from the three studies and partly on existing theoretical frameworks, a somewhat different conceptualization of catastrophizing has been proposed – a model of catastrophizing from a process perspective. This model is suggested as an addition and complement to
already existing theoretical models. What is new is the focus on the function of catastrophizing rather than on the content. In this model, catastrophizing is conceptualized as repetitive negative thinking. This repetitive negative thinking is viewed as a form of covert avoidance, with the proposed function to down-regulate negative affect.

Conclusions

- Catastrophizing plays a vital role in pain perception during childbirth, in the outcome of exposure treatment, and in a problem solving context
- It is critical to assess and directly address catastrophizing in clinical contexts
- **In childbirth:**
  - Maternal health services might benefit from assessing whether women who seek help due to fear of childbirth also catastrophize
  - Preventative interventions which target catastrophizing in pregnant women need to be developed and tested
- **In exposure treatment:**
  - Catastrophizing should be specifically addressed during exposure in vivo
  - Back pain patients who catastrophize possibly need additional interventions to benefit from exposure
- **In a problem solving context:**
  - Clinicians should explore what patients themselves think are the causes of their back pain
  - If the patient strongly believes that back pain is always due to injury or harm, they might have a tendency to catastrophize
- Clear instructions for how clinicians should address catastrophizing need to be developed
- Catastrophizing might be conceptualized as repetitive negative thinking which serves the function to down-regulate negative affect
- The process perspective opens new avenues for developing interventions which directly target catastrophizing:
  - by examining when and where the catastrophizing arises, and what it hinders the patient from doing
  - by reducing its impact on overt behavior through encouraging the patient to act in line with long-term goals
  - by problem solving skills training
- by interoceptive exposure

- Successful interventions for people who catastrophize would lead to several gains – for the individual in less suffering and an increased ability to handle pain problems, and for the society in reduced costs for health care for these individuals.
References


de Jong, J. R., Vlaeyen, J. W. S., Onghena, P., Goossens, M. E. J. B.,
chronic low back pain: education or exposure in vivo as mediator to

ing a solution to the problem of pain: Conceptual formulation and the
development of the Pain Solutions Questionnaire (PaSol). Pain, 123(3),
285-293.


differences in psychological and physiological responses to experiment-

Drossman, D. A., Leserman, J., Li, Z., Keefe, F., Hu, Y. J. B., & Toomey,
T. C. (2000). Effects of coping on health outcome among women with


for the management of chronic pain (excluding headache) in adults.
Cochrane database of systematic reviews (Online)(2), CD007407.

ing and experimental pain sensitivity: only in vivo reports of catastro-
phic cognitions correlate with pain responses. The Journal of Pain, 6(5),
338-339.

Edwards, R. R., Smith, M. T., Stonerock, G., & Haythornthwaite, J. A.
(2006). Pain-related catastrophizing in healthy women is associated
with greater temporal summation of and reduced habituation to ther-


related fear in Swedish women and men—Analysis of an open ended
question. The Journal of Midwifery & Women’s Health, 51(2), 112-
118.

the threat value of chronic pain: A preliminary replicated single-case


Although there is great variability, about 60% of the women who experience childbirth for the first time describe their pain as severe or extremely severe (Melzack, 1993). Consequently, anticipation of giving birth for the first time may signal to the mother that labor is proceeding. Furthermore, childbirth is often characterized by intense pain, which tends to overwhelm the individual. Melzack (1993) claimed that childbirth provides an excellent model of acute pain with a clear beginning, progress and ending. However, labor pain is different from pathological pain, both in physiological (Catheline et al., 2006) and psychological processes. Thus, although catastrophizing repeatedly has been associated with heightened pain due to injuries, there is good reason to extend the association between catastrophizing and pain, to pain and recovery in childbirth and provide support for the fear-avoidance model. It is concluded that pain catastrophizing plays a role in the experience of pain in childbirth and postpartum recovery. Further research is needed to identify appropriate interventions for catastrophizing women during the latter part of pregnancy.
Pain in childbirth and postpartum recovery – The role of catastrophizing

Ida K. Flink a,⁎, Magdalena Z. Mroczek b, Michael J.L. Sullivan c, Steven J. Linton a

a Center for Health and Medical Psychology, Department of Behavioural, Social and Legal Sciences – Psychology, Örebro University, Sweden
b Occupational and Environmental Health, Stockholm Centre for Public Health, Stockholm County Council, Sweden
c Departments of Psychology, Medicine and Neuroscience, McGill University, Montreal, Canada

A R T I C L E  I N F O
Article history:
Received 29 November 2007
Received in revised form 26 March 2008
Accepted 17 April 2008
Available online 2 June 2008

Keywords:
Catastrophizing
Pain
PCS
Childbirth
Physical recovery

A B S T R A C T
This prospective study investigated how pain catastrophizing was related to labor pain intensity and physical recovery after childbirth. Eighty-eight women giving birth for the first time completed the first questionnaire before delivery. Eighty-two of those returned the second questionnaire after delivery. Participants were classified as catastrophizers (n = 38) or non-catastrophizers (n = 44) based on their scores on the Pain Catastrophizing Scale. Comparison of the groups showed that catastrophizers anticipated and experienced more intense pain (p < .0125) and had poorer physical recovery (p < .0125), measured as the level of self-reported functioning in activities of daily living, than non-catastrophizers. These results extend the association between catastrophizing and pain, to pain and recovery in childbirth and provide support for the fear-avoidance model. It is concluded that pain catastrophizing plays a role in the experience of pain in childbirth and postpartum recovery. Further research is needed to identify appropriate interventions for catastrophizing women during the latter part of pregnancy.

© 2008 European Federation of Chapters of the International Association for the Study of Pain. Published by Elsevier Ltd. All rights reserved.

1. Introduction

Pain during childbirth is one of the most excruciating pain experiences that women encounter in their lives (Melzack, 1993). Although there is great variability, about 60% of the women who give birth for the first time describe their pain as severe or extremely severe (Melzack, 1993). Consequently, anticipation of the remarkably intense pain of childbirth may be associated with psychological reactions, such as pain catastrophizing.

Catastrophizing emerges in the literature as one of the most potent predictors of pain in general (Vlaeyen and Linton, 2000; Keefe et al., 2004; Sullivan et al., 2002; Severijns et al., 2001). It has been associated with heightened pain across several pain populations, and accounts for 7–31% of the variance in pain ratings (Sullivan et al., 1995, 2001). Catastrophizing has also been associated with a number of pain-related outcomes, including reduced involvement in daily activities (Keefe et al., 1989) and activity intolerance (Sullivan et al., 2002). Moreover, in the fear-avoidance model, catastrophizing is described as a cognitive precursor to pain-related fear and tendencies to avoid pain, which may enhance pain intensity and hinder resumption of physical activity (Vlaeyen and Linton, 2000). The role of catastrophizing has mainly been studied in chronic and pathological pain conditions and its influences on childbirth remains unclear.

Melzack (1993) claimed that childbirth provides an excellent model of acute pain with a clear beginning, progress and ending. However, labor pain is different from pathological pain, both in the physiological (Catheline et al., 2006) and the psychological process (Olofsson, 2003). Usually pain is a signal of a potential threat, which should be diminished or eliminated. In contrast, labor pain is a signal to the mother that labor is proceeding. Furthermore, childbirth differs from other types of pain with respect to its positive outgrowths; a child is born. Most other pain conditions (e.g. injury, illness) that have been studied do not have these positive associations. Thus, although catastrophizing repeatedly has been associated with heightened pain due to injuries, there is good reason to query if childbirth might represent a unique case where catastrophizing does not predict adverse pain outcomes.

Up to now, only one study has investigated catastrophizing specifically in relation to labor pain (Van den Bussche et al., 2007). Catastrophizing was positively associated with fear of being overwhelmed by pain and tendencies to avoid pain during delivery. However, the relation between catastrophizing and labor pain intensity was not studied, nor whether the tendencies to avoid pain persisted after childbirth.

This study was designed to assess whether the reported pain of childbirth and functioning postnatally differs between women who catastrophize about labor pain, catastrophizers, and non-catastrophizers. We hypothesized that catastrophizers will anticipate and experience more pain during childbirth than non-catastrophizers.

⁎ Corresponding author. Tel.: +46 19 303 740.
E-mail address: ida.flink@hkr.oru.se (I.K. Flink).

1090-3801/© 2008 European Federation of Chapters of the International Association for the Study of Pain. Published by Elsevier Ltd. All rights reserved.
We also hypothesized that recovery, in terms of level of functioning in activities of daily living, would take longer for catastrophizers than for non-catastrophizers.

2. Method

2.1. Design

In this prospective study, the data collection was made on two occasions: 34–41 weeks of pregnancy and 2–4 weeks following birth, as shown in Fig. 1.

2.2. Participants

Pregnant women were recruited through maternal health services in the county of Örebro in Sweden. To participate, the women had to be carrying their first child and be at least at 34 weeks gestation. Women who planned to give birth by caesarean section were excluded from the study but those who had an acute caesarean section in advanced labor were included. Participants were consecutively recruited by their midwife and informed consents were obtained. Eighty-eight women answered the first questionnaire and eighty-two of those returned the second questionnaire (response rate 93%).

Eighty-eight women were admitted to the study but those who had an acute caesarean section or had an acute planned caesarean section in advanced labor were included. Participants were consecutively recruited by their midwife and informed consents were obtained. Eighty-eight women answered the first questionnaire and eighty-two of those returned the second questionnaire (response rate 93%). Only participants answering both questionnaires (n = 82) were included in the analysis. The mean age of the sample was 29.6; range 20–42.

The study was conducted according to current ethical principles for clinical research stated in the Declaration of Helsinki (World Medical Association, 1997) and was approved by the maternal health care board in the county of Örebro.

2.3. Measures

Participants answered two questionnaires; one before and one after delivery. Items from several standardized self-report inventories were included in the questionnaires. Background variables included age, estimated and actual date of delivery, planned and actual use of analgesics. The reliability and internal consistency of the scales and items was assessed by calculating Cronbach’s alpha coefficient. Questionnaires were endorsed by midwives in maternity care and tested in a pilot study (N = 2). The women in the pilot study provided comments on how to improve the questionnaires and were not included in the data analysis.

Pain catastrophizing: Pain catastrophizing was measured with the Pain Catastrophizing Scale (PCS) (Sullivan et al., 1995), designed to assess various dimensions of catastrophizing about pain. The PCS consists of 13 statements describing various thoughts and feelings that people may experience when they are in pain (e.g., “I keep thinking how badly I want the pain to stop”, “There is nothing I can do to stop the intensity of the pain”). Respondents were asked to rank each statement on a five-point scale, with respect to the degree to which they have these thoughts and feelings when they are in pain (0 = not at all; 4 = all the time). In our study, the women were asked to focus specifically on the thoughts they had about labor pain. The PCS has been used in similar ways to measure catastrophizing about genital pain (Pukall et al., 2002). In the present study the PCS had good internal consistency (α = 0.925). Catastrophizing about labor pain was measured before delivery.

Pain: The Present Pain Intensity scale, a part of McGill Pain Questionnaire (MPQ) (Melzack, 1975), was used to assess anticipated and experienced labor pain. It is a six-point numerical scale used for rating pain intensity (0 = none, 1 = mild, 2 = discomforting, 3 = distressing, 4 = horrible, 5 = excruciating). The MPQ is the most commonly used measure of labor pain (Stockman and Altmair, 2001).

Pain ratings were measured on two occasions; before (anticipated pain) and after delivery (experienced pain). On each occasion, the women were asked to rate both the average and the maximum pain during labor. Labor pain has been measured in similar ways in earlier research (Lang et al., 2005). The average score of the two items (average/maximum) was calculated for both occasions (anticipated/experienced), respectively. The internal consistency of the two items was good (α = 0.791 for anticipated pain and α = 0.825 for experienced pain).

Physical recovery in ADL: To measure physical recovery after delivery we assessed the level of functioning in Activities of Daily Living (ADL). Most standardized instruments for measuring ADL have been developed for chronic conditions, such as stroke or chronic back pain (Buer and Linton, 2002). In our study the level of functioning in ADL was defined as the degree to which the woman estimated being able to do activities within the following, three and seven days after delivery, compared to their level before the pregnancy: Household chores (e.g., cleaning, cooking), personal care (e.g., hygiene, getting dressed) and physical activities (e.g., taking walks, climbing the stairs, light exercising). Responses were given on an index between 1 and 6 (1 = a lot worse than before pregnancy, 6 = as good as, or better than, before pregnancy).

To obtain one score for physical recovery the average score for the three questions was calculated for the two occasions respectively. Cronbach’s alpha coefficients indicated good internal consistency and high reliability for the items three days (α = 0.881) and seven days (α = 0.894) after delivery.

Use of analgesics: To explore the planned and actual use of analgesics during labor, two items were employed: “Do you plan to use analgesics?” before delivery and “Did you use analgesics during delivery?” after delivery. For both items the answers “yes” or “no” were given. Participants were also asked to write down the type of analgesics planned and actually used.

2.4. Procedure

Midwives in maternal health services provided the participants with information about the study, a consent form, the first questionnaire and a pre-paid envelope to return the questionnaire. The follow-up questionnaire was mailed one week after the date.

![Fig. 1](image-url) Overview of the design of the study. M1 = first measurement, 1–8 weeks before expected delivery; M2 = second measurement, 2–4 weeks after expected delivery; R = reminder, if needed.
of estimated delivery (see Fig. 1). Women completed the first questionnaire some time between the 34th and 41st week of their pregnancy, and the second 2–4 weeks after delivery. If no response was obtained within 2 weeks, a reminder phone-call was made.

Based on their PCS scores, a median-split divided the participants into two groups; catastrophizers and non-catastrophizers. PCS has been used similarly in previous studies (Sullivan et al., 1997; Sullivan and Neish, 1999).

2.5. Data analysis

To evaluate the data, descriptive statistics were calculated and distributions checked. To explore the differences between groups, comparisons of the means were made with independent t-tests for the variables anticipated labor pain, experienced labor pain and physical recovery at three and seven days after delivery. Since four t-tests were employed, a Bonferroni correction for multiple tests was made, requiring \( p < .0125 \) for statistical significance.

Statistical analyses were performed with SPSS 14.0. Missing values were estimated by calculating the mean score for the scale used.

3. Results

3.1. Pain catastrophizing

Table 1 displays mean and median scores for the PCS. The median for the whole group (20) was used to classify the participants as catastrophizers or non-catastrophizers.

Of the drop-outs (i.e. the six women who did not return the second questionnaire), five scored above the median on the PCS (catastrophizers), and one scored below the median (non-catastrophizer).

3.2. Group characteristics

As shown in Table 2, there were no marked differences between catastrophizing and non-catastrophizing women regarding age, number of women giving birth by acute caesarean sections or use of analgesics during the delivery.

3.3. Pain

Table 3 displays anticipated and experienced pain intensity for pain catastrophizers and non-catastrophizers (0 = none, 5 = excruciating). As can be seen, catastrophizing women rated their pain as significantly higher than non-catastrophizers on both occasions. The magnitude of the differences is large in anticipated pain (Cohens’ \( d = 1.17 \)) and moderate in experienced pain (Cohens’ \( d = .74 \)).

3.4. Physical recovery after delivery

Fig. 2 displays recovery in terms of level of functioning in activities of daily living (ADL) after childbirth for pain catastrophizers and non-catastrophizers (1 = a lot worse than before the pregnancy, 6 = as good as, or better than, before the pregnancy).

As illustrated in Fig. 2, non-catastrophizers rated their ADL function significantly higher than catastrophizers at three days [M = 2.53, SD = 1.13; M = 3.59, SD = 1.38; t(80) = 3.76, p = .000] and at seven days [M = 3.58, SD = 1.21; M = 4.71, SD = 1.07; t(80) = 4.49, p = .000] after delivery. The magnitude of the differences in recovery is large after three days (Cohens’ \( d = .83 \)) as well as after seven days (Cohens’ \( d = .99 \)).

4. Discussion

This study was designed to investigate how pain catastrophizing is associated with labor pain and physical recovery after childbirth. We found that women who catastrophized about labor pain anticipated and experienced more pain than non-catastrophizers, supporting our first hypothesis. The second hypothesis was also
supported; non-catastrophizers rated their recovery after childbirth better than catastrophizers.

These findings replicate and expand findings from earlier studies, mostly carried out in populations with chronic and pathological pain, where catastrophizing has been associated with heightened pain (Sullivan et al., 2001, 1995) and reduced involvement in daily activities (Keefe et al., 1989). In this study, we found the same associations for pain associated with childbirth. Thus, despite the positive facets of childbirth (e.g. a new life), the relation between catastrophizing and pain outcomes was comparable with other pain situations.

Furthermore, our study provided an opportunity to observe catastrophizing women over time, as catastrophizing was measured when the women were pregnant and outcomes were measured a number of weeks later, after the child was born. In this way, the present study contributes to the growing amount of prospective research that has emerged recently within the area (Picavet et al., 2002; Severeijns et al., 2005).

The results may be explained by the fear-avoidance model of pain. According to this model, pain experience is influenced by a range of emotional, cognitive, biological and behavioural factors (Vlaeyen and Linton, 2000). The central idea is that some individuals tend to interpret pain stimuli as threatening, which generates catastrophic thoughts, tension, vigilance, fear of pain and attempts to avoid the pain. The model was elaborated to describe the development of chronic pain but there is also some evidence that some pain-free individuals may have a tendency to harbour fear-avoidance beliefs, which become activated when they approach pain (Vlaeyen and Linton, 2002). Applied to the present study, women with this tendency may interpret labor pain as menacing, which evokes catastrophizing thoughts. They may then focus their attention on the pain, leading to an overestimation of its intensity (i.e. they anticipate more pain) and an underestimation of their own coping abilities. In the model, this vigilance is associated with increased muscle tension which may also increase pain intensity, and induce attempts to avoid the pain. Catastrophizing has indeed been positively associated with tendencies to avoid pain during delivery (Van den Bussche et al., 2007). In our study, the women also seemed to show a tendency to avoid certain movements after childbirth, resulting in a slower resumption of daily activities; i.e. walking, cooking and personal hygiene. Thus, our results indicate that the fear-avoidance model may also be relevant to the pain of childbirth.

Our findings may be viewed in relation to the increasing number of women requiring caesarean sections because of fear of childbirth (Wax et al., 2004). About 6–11% of the pregnant women in the industrialized countries suffer from this fear (Saisto and Halmesmaki, 2003; Waldenstrom et al., 2006). Fear of pain during delivery is one of the most common reasons for fear of childbirth (Eriksson et al., 2006; Sjogren, 1997; Geissbuehler and Eberhard, 2002). Also, fear of childbirth has been found to be related to a lower pain threshold (Saisto et al., 2001). Our findings provide a possible explanation for these relationships. Although fear was not measured in the present study, it is conceivable that catastrophizing women also have fear of pain. However, while catastrophizing and fear of pain are overlapping constructs, catastrophizing has been found to provide a unique predictor for pain, beyond fear per se (Sullivan et al., 2004). Therefore, catastrophizing may act as a mediator, explaining fear of childbirth and a lower pain threshold among these women.

Both groups of women in this study managed to predict the level of pain they later experienced during delivery. This contradicts earlier findings, where women who were giving birth for the first time underestimated the actual pain experienced during childbirth (Fridh and Gaston-Johansson, 1990; Paech, 1991; Waldenstrom, 1999). On the other hand, catastrophizers have been found to exaggerate the menace of pain, while understating their own capacity to handle the situation (Sullivan et al., 2001). Hence, even if the present study both catastrophizers and non-catastrophizers had a fairly realistic picture of how intense their pain would actually be.

Catastrophizing may be an important indicator for identifying mothers who may have difficulties with labor and recovery after delivery. This coincides with earlier studies, where catastrophizing has been found to predict heightened pain intensity and activity intolerance in pain-free individuals (Sullivan et al., 2002). However, even though catastrophizing preceded childbirth in our study, this does not necessarily infer a causal relationship between catastrophizing and outcomes.

The limitations of this study need to be considered. First, although the response rate was high in comparison with other studies about related topics (Van den Bussche et al., 2007), a substantial proportion of women giving birth in the county during this period were unable to participate because the questionnaires were only accessible in Swedish. This leads to a possible selection bias which might have influenced our results, as immigrant women make up about 10% of the women living in the county. Second, all measures used were subjective self-report inventories. A more objective measurement for rating physical recovery would have been appropriate, since the identified differences may be due to reporting differences rather than physical, i.e. the catastrophizers only rate their level of functioning as lower than the non-catastrophizers. One factor that may have influenced the rating is changes in cognition and mood that many women experience during late pregnancy and shortly after childbirth (Russell et al., 2001). Third, because there are large individual differences in labor pain, other factors may be influencing our results. One major determinant is prior births (Melzack, 1993). To minimize the impact of earlier experiences, possibly affecting both catastrophizing and pain, only women giving birth for the first time participated in the study. Another influencing factor is use of methods to relieve the pain. However, there were no marked differences between catastrophizing and non-catastrophizing women in use of analgesics. This replicates earlier findings where no difference was found between catastrophizers and non-catastrophizers in use of epidural analgesia (Van den Bussche et al., 2007), one of the most widespread and effective methods for relief of labor pain (Capogna et al., 1996).

Other medical factors (e.g. use of oxytocin/syntocinon) are important in relation to childbirth and postpartum recovery and may have influenced our results. However, since the main focus of this study was women’s experiences, we focused on their self-reports on standardized questionnaires. Fourth, among the women who did not answer the second questionnaire, five out of six were catastrophizers, and we do not know how this might have influenced the results. Fifth, the distinction between statistical and clinical significance should be addressed. The differences identified in this study have moderate to large effect sizes. Further studies are required to understand the impact of the findings in a clinical setting.

In this first study, pain catastrophizing was clearly associated with a heightened labor pain experience and a lower level of resumption of activities after childbirth. These findings suggest possibilities for identifying pregnant women with high levels of catastrophizing during the third trimester, for instance by using screening questionnaires. If further research confirms the role of catastrophizing in this group the next challenge will be to develop adequate interventions. In other populations, cognitive-behavioural therapy (CBT) is a successful method of treating catastrophizing and encourages better adjustment to pain (Keefe et al., 1990; Sullivan et al., 2001). One potential path is to investigate if CBT-techniques (e.g. imaginary exposure, cognitive restructuring) could be adapted as an early intervention for women who catastrophize about their labor pain. Hopefully, appropriate interventions

STUDY I

developed in collaboration with midwives may reduce women's pain perception during labor and hasten their recovery postpartum.

Acknowledgement

The authors want to thank Carina Westergren and the midwives in Örebro lans landsting for their help with the recruitment of the participants.

References


Catastrophizing moderates the effect of exposure in vivo for back pain patients with pain-related fear

Ida K. Flink*, Katja Boersma, Steven J. Linton

Center for Health and Medical Psychology (CHAMP), School of Law, Psychology and Social Work, 701 82 Örebro, Sweden

Abstract

This investigation was an initial attempt to explore psychological factors that might help or hinder the effect of exposure in vivo for patients with musculoskeletal pain and pain-related fear. The study was based on data from a randomized-controlled trial for patients with non-specific spinal pain (Linton et al., 2008).

First, catastrophizing, anxiety, and depression were studied as possible treatment moderators. We found evidence that catastrophizing was a moderator of treatment outcome in exposure. When further exploring the nature of the relationship between catastrophizing and outcome, the results showed that the exposure was effective only for patients with low or moderate levels of catastrophizing. High catastrophizers did not improve from the treatment. On the other hand, anxiety was a general predictor of poor outcome, and not a specific moderator of outcome in exposure. In contrast, depression was not significantly related to outcome.

Next, patients were divided into high change participants and low change participants based on their improvement in disability after treatment in order to investigate the change in psychological variables during treatment. Descriptive data indicated that high change participants had large improvements across treatment on depression, anxiety, catastrophizing, and fear-avoidance beliefs whereas low change participants virtually did not change at all on these variables across treatment.

These findings denote that catastrophizing is a moderator of treatment outcome in exposure whereas several psychological variables might be important for the treatment process.

1. Introduction

Exposure in vivo is a novel treatment approach for patients with musculoskeletal pain (MSP) and high levels of pain-related fear. Fear and subsequent avoidance of activities are key factors that may perpetuate pain and dysfunction in a subgroup of patients, as proposed in the fear-avoidance model (Vlaeyen and Linton, 2000). Several studies have indeed shown that exposure is effective for reducing fear, catastrophic thoughts, disability and pain in these patients (Vlaeyen et al., 2001; Boersma et al., 2004; de Jong et al., 2005; Leeuw et al., 2008; Linton et al., 2008; Woods and Asmundson, 2008). A recent review concluded that exposure is the treatment of choice for patients with pain-related fear (Lohnberg, 2007). This conclusion was based on the first studies of exposure which showed promising effects in replicated single-case experimental studies (Vlaeyen et al., 2001, 2002a, 2002b; Linton et al., 2002; Boersma et al., 2004; de Jong et al., 2005). However, one of these studies noted substantial individual differences in how well the patients responded to the treatment (Boersma et al., 2004).

Recently, four RCTs further examined the effect of exposure in vivo for patients with MSP, and the effects were not as impressive as those reported in earlier studies (George et al., 2008; Leeuw et al., 2008; Linton et al., 2008; Woods and Asmundson, 2008). Exposure resulted in moderate to large effect sizes for reducing pain-related fear, catastrophizing, disability, and pain. But when compared to other commonly used treatments, the effects were more modest (George et al., 2008; Leeuw et al., 2008; Woods and Asmundson, 2008). While the unclear results may partly due to a lack of power due to small samples, a more compelling explanation, which indeed has been noticed (Linton et al., 2008), is that some patients respond better to exposure than others. Consequently, the effect of exposure might be suppressed by moderating factors (Baron and Kenny, 1986; Vlaeyen and Morley, 2005).

One hypothesis has been that patients with high levels of pain-related fear would benefit most from exposure, but data have failed to support this (George et al., 2008; Leeuw et al., 2008). In cognitive behavioral treatment packages for MSP, where exposure is not included, high catastrophizing, anxiety, and depression have
The exposure has not yet been studied. However, how these factors relate to outcome in exposure has not yet been studied. This secondary analysis of an RCT on the effectiveness of exposure treatment has two aims. The main aim is to study possible moderators of outcome in exposure vivo. Catastrophizing, anxiety, and depression will be explored as possible moderators of the treatment effect. Pain-related fear will not be included, as only fearful patients participated. The secondary aim, which has a more exploratory character, is to study changes in psychological variables during treatment for patients who improve in disability after treatment as compared to those who do not improve, to get an indication of what helps or hinders treatment success.

2. Method

2.1. Overview of the design

This study is based on data from a randomized-controlled trial for patients with non-specific spinal pain (Linton et al., 2008). The purpose was to study the effects of exposure in vivo for pain patients with pain-related fear and disability as an addition to their usual medical treatment. Fig. 1 presents an overview of the design of the study. After randomization, all participants fulfilled posttest 1. The exposure group then received exposure treatment and the waiting-list continued usual treatment. After a median of 14 weeks, the waiting-list participants completed pretest 2 and subsequently received exposure. All participants completed the posttest immediately after treatment and the follow-up three months later. The study was approved by the Örebro University Hospital’s Board of Research Ethics.

2.2. Participants

Participants were recruited through local primary care facilities and via advertisements in local newspapers and National Insurance Authority offices. The inclusion criteria were: (1) 18–60 years old, (2) disabling spinal pain, (3) current or previous (within the last 3 months) sick leave, (4) substantial levels of pain-related fear (TSK > 35), and (5) no red flags, e.g. fractures or infections (Nachenison and Jonsson, 2000). Two hundred and twenty three people fulfilled the initial criteria and were mailed a baseline questionnaire. Forty six returned the questionnaire within the limit of 3 weeks, fulfilled the inclusion criteria, and were randomized to exposure (N = 21) or to the waiting list (N = 25). Four of the waiting-list participants did not complete the second pretest (pretest 2). In addition, 16 participants did not complete the posttest (exposure group, N = 8; waiting list, N = 8), and three did not answer the follow-up. Analyses showed that non-completers and completers did not significantly differ on background variables (age, gender, nationaliy, and work status), pain characteristics (intensity, duration, and location), disability, and psychological variables (pain-related fear and catastrophizing). For a description of reasons for non-completion, see the original study (Linton et al., 2008).

2.3. Treatment

The treatment was based on the exposure protocol developed by Vlaeyen and colleagues (Vlaeyen et al., 2004). Four clinical psychologists, with support from a physiotherapist, administered the treatment which consisted of 13–15 individual sessions including assessment, psychoeducation, and graded exposure training in vivo. Goals were developed, consisting of activities that usually are carried out in daily life, e.g. playing with the children or carrying bags from the store. During the exposure, the patients gradually confronted feared movements, e.g. lifting, bending, and twisting, in order to decrease fear and to reach the patients’ goals. Between the sessions, the patients completed homework that incorporated the movements into activities at home or at work. For a detailed description of the treatment, see the original study (Linton et al., 2008).

2.4. Measures

Swedish versions of all questionnaires were used.

2.4.1. Background variables and pain characteristics

Questions from the Örebro Musculoskeletal Pain Screening Questionnaire (OMPSQ) (Linton and Boersma, 2003) were used to assess background variables (age, gender, and sick leave) and pain characteristics (intensity, location, and duration).

2.4.2. Disability

The Quebec Back Pain Disability Scale (QBPDS) (Kopec et al., 1995) was used to assess level of functioning in daily activities (e.g. walking, get dressed). In the QBPDS, the responders are asked how difficult it is to perform 20 different activities with their current pain (e.g. climb stairs, walk 300–400 m, carry two bags of food). The answers are given on a six-point scale (0 = not difficult at all; 5 = impossible to do). The QBPDS have shown sufficient validity and reliability (Kopec et al., 1995).

2.4.3. Anxiety and depression

The Hospital Anxiety and Depression Scale (HADS) (Zigmond and Snaith, 1983) was used to assess anxiety and depression. The HADS consists of 14 statements reflecting common symptoms of anxiety (e.g. “I feel tense or ‘wound up’”) and depression (e.g. “I have lost interest in my appearance”). The responders rate to what degree they agree with the statements on a four-point scale (0 = not at all; 3 = very much indeed). The HADS has sound
psychometric properties, including the Swedish version (Herrmann, 1997; Lisspers et al., 1997; Bjelland et al., 2002).

2.4.4. Pain catastrophizing

The pain catastrophizing scale (PCS) (Sullivan et al., 1995) was used to assess pain-related catastrophic thoughts. The PCS reflects 13 thoughts and feelings that may arise when people have pain (e.g. “I keep thinking about how much it hurts”; “There is nothing I can do to reduce the intensity of the pain”). The answers are given on a five-point scale, where the respondents rate to what extent they have these thoughts and feelings when experiencing pain (0 = not at all; 4 = all the time). The PCS has been shown to have good psychometric properties (Sullivan et al., 1995).

2.4.5. Fear-avoidance beliefs

The Tampa Scale of Kinesiophobia (TSK) (Kori et al., 1990) was used to assess fear-avoidance beliefs. The TSK consists of 17 statements (e.g. “Simply being careful that I do not make anything worse is the safest thing I can do to prevent my pain from worsening”). The respondents are asked to what extent they agree with the statement on a four-point scale (1 = strongly disagree; 4 = strongly agree). The questionnaire has shown good validity and reliability, including the Swedish version (Vlaeyen et al., 1995; Goubert et al., 2004; Lundberg et al., 2004; Roelofs et al., 2004).

2.5. Statistical analyses

In order to address the question of possible treatment moderators, data from both the exposure group and the waiting-list group were used in the analyses (exposure group, N = 13, pretest 1 and posttest; waiting-list group, N = 13, pretest 1 and posttest). Three multiple regression analyses were conducted for catastrophizing, anxiety, and depression, respectively, according to recommendations for investigation of moderating effects (Baron and Kenny, 1986; Holmbeck, 2002). To test whether pretreatment levels of the psychological variables moderated the effect of treatment on disability, an interaction term was created for each psychological variable (group × psychological variable). The interaction term was added to the main variables, and if it turned out to be significant while the main variables were included in the model, this would indicate moderation. Subsequently, the nature of the significant interactions was explored with simple regressions, for participants with high and low levels of the psychological variable separately.

To reduce multicollinearity between the independent variable and the interaction variable, the variables were centered prior to the analyses.

In order to tackle the second aim, i.e. to explore changes during treatment for patients who improved on disability as compared to those who did not, only data from the participants that completed the exposure treatment were used (exposure group, N = 13, pretest 1 and posttest; waiting-list group, N = 13, pretest 1 and posttest). In these analyses, all participants were treated as one group and no distinction was made between the exposure group and the waiting list. Data was missing for one participant on the posttest ratings of disability. Consequently, this participant was not included in the analyses. The participants were divided into two groups (high change participants, HCP and low change participants, LCP), based on a median-split on the percentage disability change from pretest to posttest. The median change was an improvement of 18%. Those who scored above the median (disability decreased more than 18%) were classified as HCP, and those who scored below the median (disability decreased less than 18%) were classified as LCP. To study changes in psychological variables during treatment for HCP and LCP, descriptive statistics were calculated for posttest and follow-up on disability, depression, anxiety, catastrophizing, and fear-avoidance beliefs, and percentage change in these variables from pretest to posttest. Because of the small number of participants, it was not tested whether the differences were statistically significant.

Statistical analyses were performed with SPSS 16.0. Missing values were estimated by calculating the mean score for the scale.

3. Results

3.1. Group characteristics

As shown in Table 1, there were no marked differences between participants in the exposure group and the waiting-list group on background variables. The groups were similar regarding age, nationality and gender. They were also similar on pain characteristics. There was a significant difference between the groups on sick listing, where the exposure group had more days of sick listing than the waiting-list group ($\chi^2 = 4.2; df = 1; p = .04$).

3.2. Treatment moderators

Multiple regression analyses were performed to investigate whether improvement on disability was moderated by pretreatment levels of catastrophizing, anxiety, and depression respectively. As can be seen in Table 2, of the interaction terms that were entered, the interaction between catastrophizing and group was the only one that turned out to be significant over and above the main effects. This implies that the effect of exposure was significantly different depending on the patients’ levels of catastrophizing, whereas in the waiting-list group catastrophizing was not a predictor of outcome. In other words, catastrophizing was a moderator of treatment outcome in the exposure group. In the analysis that investigated anxiety as a possible moderator, only the main effects were significant, meaning that in this sample anxiety was a general predictor of poor outcome for both the exposure group and the waiting-list group. In the analysis that investigated depression as a possible moderator, neither main effects nor the interaction effect was significant, suggesting that depression was not significantly related to outcome.

To further explore the nature of the significant interaction, the participants were divided into high and low catastrophizers based

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Background variables for participants in the exposure group and the waiting-list group.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Exposure group (n = 13)</td>
</tr>
<tr>
<td>Age, M (SD)</td>
<td>46 (9.9)</td>
</tr>
<tr>
<td>Pain intensity, M (SD)</td>
<td>6.5 (1.1)</td>
</tr>
<tr>
<td>Gender, women/men (%)</td>
<td>62/38</td>
</tr>
<tr>
<td>Pain location (more than one location possible)</td>
<td>77</td>
</tr>
<tr>
<td>Neck (%)</td>
<td>77</td>
</tr>
<tr>
<td>Shoulder (%)</td>
<td>62</td>
</tr>
<tr>
<td>Upper back (%)</td>
<td>54</td>
</tr>
<tr>
<td>Lower back (%)</td>
<td>77</td>
</tr>
<tr>
<td>Pain duration</td>
<td>180–365 days (%)</td>
</tr>
<tr>
<td>&lt;3 months (Acute) (%)</td>
<td>0</td>
</tr>
<tr>
<td>3–12 months (Subacute) (%)</td>
<td>17</td>
</tr>
<tr>
<td>&gt;12 months (Chronic) (%)</td>
<td>83</td>
</tr>
<tr>
<td>Sick listing last 12 months*</td>
<td>1–180 days (%)</td>
</tr>
<tr>
<td>1–180 days (%)</td>
<td>31</td>
</tr>
<tr>
<td>180–365 days (%)</td>
<td>69</td>
</tr>
</tbody>
</table>

* Note: There was a significant difference between the exposure group and the waiting-list group on sick listing.
on a median-split (at score 26) on the Pain Catastrophizing Scale. Simple regression analyses for these two groups separately showed that for low catastrophizers (n = 17) there was a significant effect of group on treatment outcome (β = .488; p = .047). For high catastrophizers (n = 17) there was no significant effect of group on treatment outcome (β = −.136; p = .616). These results imply that the exposure was more effective than waiting in reducing disability for patients who were low on catastrophizing. For patients who were high on catastrophizing there was no difference in outcome between those who received exposure and those who were in the waiting-list group. Fig. 2 displays the results visually.

3.3. Description of changes in disability and psychological variables

To describe changes during treatment for patients who improved and those who did not, all patients that received exposure were included in the analyses and no distinction was made between when they received the exposure (i.e. exposure group or after the waiting period for the waiting-list group). The patients were divided into low change participants (LCP) and high change participants (HCP) based on a median-split on reduction in disability. Table 3 displays scorings on disability and psychological variables at pretest, posttest, and follow-up for LCP and HCP, as well as percentage change during treatment. On the disability measure, which was used to create the groups (LCP/HCP), LCP scored almost the same at pretest and posttest (−2%), whereas HCP decreased their scorings markedly (53%). From posttest to follow-up, the disability scorings remained stable for both groups. As can be seen in Table 3, LCP scored somewhat higher on depression at posttest than at pretest (+6%), whereas HCP decreased their scorings (−38%). LCP decreased their scorings of anxiety from pretest to posttest (−14%), but at follow-up their ratings had increased and were almost back at the pretest level. Also HCP scored lower on anxiety at posttest than at pretest (−32%), and their ratings were even lower on the follow-up. LCP decreased their ratings of

---

**Table 2**

Multiple regression analyses explaining the treatment effect in reduction on disability depending on pretreatment levels of catastrophizing, anxiety, and depression.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Beta (standardized)</th>
<th>p Value</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block 1 Group</td>
<td>.270</td>
<td>Ns</td>
<td></td>
</tr>
<tr>
<td>Catastrophizing</td>
<td>−.083</td>
<td>Ns</td>
<td></td>
</tr>
<tr>
<td>Block 2 Group</td>
<td>.187</td>
<td>Ns</td>
<td></td>
</tr>
<tr>
<td>Catastrophizing</td>
<td>.604</td>
<td>.049b</td>
<td>.27</td>
</tr>
<tr>
<td>Group + catastrophizing</td>
<td>−.809</td>
<td>.009b</td>
<td></td>
</tr>
<tr>
<td>Block 1 Group</td>
<td>.430</td>
<td>.014b</td>
<td>.28</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.498</td>
<td>.005b</td>
<td></td>
</tr>
<tr>
<td>Block 2 Group</td>
<td>.435</td>
<td>.014b</td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>.643</td>
<td>.008b</td>
<td></td>
</tr>
<tr>
<td>Group + anxiety</td>
<td>−.204</td>
<td>Ns</td>
<td></td>
</tr>
<tr>
<td>Block 1 Group</td>
<td>.307</td>
<td>Ns</td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>.163</td>
<td>Ns</td>
<td></td>
</tr>
<tr>
<td>Block 2 Group</td>
<td>.307</td>
<td>Ns</td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>.246</td>
<td>Ns</td>
<td></td>
</tr>
<tr>
<td>Group + depression</td>
<td>−.127</td>
<td>Ns</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

*p < .01.

**Table 3**

Ratings of disability and psychological variables in low change participants and high change participants at pretest, posttest and follow-up, and percentage change from pretest to posttest.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measure</th>
<th>Timepoint</th>
<th>Low change participants (n = 12)</th>
<th>High change participants (n = 13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disability</td>
<td>QBPDS</td>
<td>Pretest</td>
<td>49.8 (14.8)</td>
<td>46.6 (11.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posttest</td>
<td>48.8 (13.0)</td>
<td>22.1 (11.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Follow-up</td>
<td>48.1 (16.1)</td>
<td>22.9 (16.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change</td>
<td>−2%</td>
<td>−53%</td>
</tr>
<tr>
<td>Depression</td>
<td>HADS</td>
<td>Pretest</td>
<td>6.8 (4.4)</td>
<td>5.5 (4.2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posttest</td>
<td>7.2 (4.2)</td>
<td>3.4 (3.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Follow-up</td>
<td>8.1 (4.8)</td>
<td>3.8 (3.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change</td>
<td>+6%</td>
<td>−38%</td>
</tr>
<tr>
<td>Anxiety</td>
<td>HADS</td>
<td>Pretest</td>
<td>7.8 (3.1)</td>
<td>4.5 (2.8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posttest</td>
<td>6.7 (3.0)</td>
<td>3.4 (2.2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Follow-up</td>
<td>7.4 (3.7)</td>
<td>2.5 (1.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change</td>
<td>−14%</td>
<td>−32%</td>
</tr>
<tr>
<td>Catastrophizing</td>
<td>PCS</td>
<td>Pretest</td>
<td>25.7 (6.4)</td>
<td>18.7 (10.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Posttest</td>
<td>21.2 (8.9)</td>
<td>9.5 (6.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Follow-up</td>
<td>21.5 (10.0)</td>
<td>11.2 (8.6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change</td>
<td>−18%</td>
<td>−49%</td>
</tr>
<tr>
<td>Fear-avoidance</td>
<td>TSK</td>
<td>Pretest</td>
<td>40.8 (8.0)</td>
<td>38.6 (8.1)</td>
</tr>
<tr>
<td>beliefs</td>
<td></td>
<td>Posttest</td>
<td>35.0 (5.0)</td>
<td>26.9 (5.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Follow-up</td>
<td>35.5 (7.3)</td>
<td>28.9 (6.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change</td>
<td>−14%</td>
<td>−30%</td>
</tr>
</tbody>
</table>

* Note: The groups (LCP/HCP) were based on the posttest ratings on this measure.
catastrophizing from pretest to posttest (−18%), but the decrease was more than twice as large for HCP (−49%). The same pattern is seen on fear-avoidance beliefs, where LCP decreased their scorings from pretest to posttest (−14%), and HCP decreased twice as much (−30%). In sum, these data indicate that LCP and HCP scored lower on anxiety, catastrophizing, and fear-avoidance beliefs after treatment, but the improvements were markedly higher in the HCP group. In depression, the scorings in the LCP group were slightly worse after treatment, whereas HCP improved also on this variable.

4. Discussion

This investigation is an initial attempt to explore psychological factors that might help or hinder the effect of exposure in vivo for patients with MSP and pain-related fear.

We found evidence that catastrophizing was a moderator of treatment outcome in exposure. Indeed, the effect of exposure was dependent on the patients’ pretreatment levels of catastrophizing, whereas in the waiting-list group catastrophizing was not a predictor of outcome. When further exploring the nature of the relation between catastrophizing and outcome, the results showed that the exposure was effective only for patients with low and moderate levels of catastrophizing. For high catastrophizers, there was no difference in outcome for patients who received exposure and those who did not.

On the other hand, anxiety was a predictor of poor outcome both in the exposure group and in the waiting-list group suggesting that it is a general predictor of poor outcome, and not a specific moderator of outcome in exposure. However, depression was not significantly related to outcome.

Patients were divided into high change participants and low change participants based on their improvement in disability after treatment in order to investigate the change in psychological variables during treatment. Descriptive data were employed. The results indicated that high change participants had large improvements across treatment on depression, anxiety, catastrophizing, and fear-avoidance beliefs whereas low change participants virtually did not change at all on these variables across treatment. This denotes that several psychological variables might be important for the treatment process in exposure in vivo for pain-related fear.

The finding that catastrophizing moderated the treatment effect is in line with findings from earlier research. In other cognitive behavioral therapies (CBT) for patients with MSP, high catastrophizing has been a predictor of poor outcome (McCracken and Turk, 2002; Turner et al., 2007). Furthermore, reductions in catastrophizing during CBT have been related to treatment success (Jensen et al., 2001; Smeets et al., 2006; Vowles et al., 2007). One study of exposure in vivo found that reductions in catastrophizing mediated treatment outcome (Leeuw et al., 2008), but this has not been replicated (George et al., 2008). The current study is the first one to identify catastrophizing as a moderator of treatment outcome in exposure.

One hypothesis has been that patients with high levels of pain-related fear would benefit most from exposure, but the data have not supported this hypothesis (George et al., 2008; Leeuw et al., 2008). Our findings rather point in the opposite direction, as the treatment in the current study was helpful only for patients with low or moderate levels of catastrophizing (−26). Even though catastrophizing and pain-related fear have been considered to be theoretically different constructs (Sullivan et al., 2001), there is high overlap between them (Sullivan et al., 1995) and it is thus contradictory to the earlier hypothesis that high catastrophizers did not improve at all from the exposure. As only patients with a documented high level of pain-related fear (TSK > 35) were included, fear was not included in the analyses as a possible moderator. However, it is noteworthy that there were no salient pretreatment differences on the TSK between patients who improved and those who did not improve.

Catastrophizing might not only be a moderator of the treatment effect in exposure but is possibly also a mediator, as data from an earlier study have suggested (Leeuw et al., 2008). Our data goes in line with this, as the descriptive data indicate that catastrophizing decreased markedly in high change participants (−49% from pre- to posttest), whereas it did not decrease as much in the low change group (−18%). Clear reductions of catastrophizing during treatment might thus be crucial for improvement on disability. One possibility is that too high levels of catastrophizing trigger safety behaviors, i.e. subtle strategies that patients use to “protect” themselves, which hinders the patient to fully benefit from the exposure (Vlaeyen et al., 2004).

Anxiety was found to be a general predictor of poor outcome. Participants who scored high on anxiety tended to have a poor outcome, irregardless of receiving treatment or not. The descriptive data showed that before the treatment started, low change participants scored on average above the cut-off (>7) for “possible cases of anxiety” (Herrmann, 1997). The initial average ratings on depression were somewhat lower, but after the exposure it had increased to the level of “possible cases of depression” (HADS subscale depression > 7) for the low change participants, and at follow-up it had increased even more. Despite that initial scorings on depression were unrelated to outcome, this implies that depression might be related to outcome anyway. However, the results do not illuminate whether low mood hinders treatment success, or if it is a result of treatment failure. In light of the fear-avoidance model (Vlaeyen and Linton, 2000), which provides a theoretical basis for exposure, one would predict that depression and low mood will be related to treatment failure.

One limitation in this study is the small sample which restricts its statistical power. As all other RCTs on the effects of exposure for musculoskeletal pain (George et al., 2008; Leeuw et al., 2008; Linton et al., 2008; Woods and Asmundson, 2008), this investigation has a limited N. Consequently, the results should be interpreted with caution. One result of the small N might be the surprisingly large difference between high catastrophizers in the exposure group and the waiting-list group which can be noted in Fig. 2. Despite the potential problem with power, the moderation analyses revealed significant effects. This indicates that the identified relations indeed are important. The limited power might however withhold effects that are not that obvious but nevertheless important or restrict generalization of the findings. More research is thus needed to replicate the results.

Only descriptive data is provided to answer the second aim because of the limited N, and the findings should therefore be deemed preliminary. Nevertheless, the results provide important indications to investigate in future research. Another potential limitation concerning the second aim is the division of participants into groups of high change and low change based on a median-split on disability change. A division of groups based on a clinical relevant change on disability would presumably have resulted in more reliable groups. But as no normative data are available for the Quebec scale, we found the current procedure defensible. This was supported by the data as the procedure resulted in two clear groups of participants; those who improved on the main outcome variable “disability” during treatment and those who did not.

The results do not tell anything about the process of change, nor about the interaction between variables. The data indicated that there were several pretreatment differences between high change participants and low change participants, and these differences were even larger after treatment. But this does not clarify which variables during treatment the differences increased, i.e. when did the high
change group get better? Possibly one element changed first which brought a change in the others, but the changes may also have occurred at the same time. To reveal the process of change and the interaction between variables, further analyses would preferably include weekly measures during treatment. This would assist both in extending the theoretical framework for exposure for pain-related fear, and in developing more effective treatments.

In conclusion, catastrophizing moderated the effect of exposure in vivo in this sample. High catastrophizing patients were not helped by the treatment. In addition, patients who were high on anxiety tended to have a poor outcome in general, both in the treatment group and in the waiting-list group. The descriptive data indicated that depression also played an important role for outcome, even though it was not significantly related to outcome in the moderation analyses. These findings may have clinical implications. Assessment of patients with MSP should include these variables. Presumably treatment success is helped or hindered by catastrophizing and other reflections of emotional distress rather than levels of mere fear-avoidance beliefs, which implies a need to further develop exposure in vivo to benefit all MSP patients with pain-related fear.

References


Catastrophizing moderates the effect of exposure in vivo for back pain patients with pain-related fear

Ida K. Flink*, Katja Boersma, Steven J. Linton

Center for Health and Medical Psychology (CHAMP), School of Law, Psychology and Social Work, 701 82 Örebro, Sweden

Article info

Article history:
Received 3 July 2009
Received in revised form 20 January 2010
Accepted 2 February 2010
Available online 9 March 2010

Keywords:
Exposure in vivo
Back pain
Fear-avoidance
Randomized-controlled trial
Catastrophizing

Abstract

This investigation was an initial attempt to explore psychological factors that might help or hinder the effect of exposure in vivo for patients with musculoskeletal pain and pain-related fear. The study was based on data from a randomized-controlled trial for patients with non-specific spinal pain (Linton et al., 2008).

First, catastrophizing, anxiety, and depression were studied as possible treatment moderators. We found evidence that catastrophizing was a moderator of treatment outcome in exposure. When further exploring the nature of the relationship between catastrophizing and outcome, the results showed that the exposure was effective only for patients with low or moderate levels of catastrophizing. High catastrophizers did not improve from the treatment. On the other hand, anxiety was a general predictor of poor outcome, and not a specific moderator of outcome in exposure. In contrast, depression was not significantly related to outcome.

Next, patients were divided into high change participants and low change participants based on their improvement in disability after treatment in order to investigate the change in psychological variables during treatment. Descriptive data indicated that high change participants had large improvements across treatment on depression, anxiety, catastrophizing, and fear-avoidance beliefs whereas low change participants virtually did not change at all on these variables across treatment.

These findings denote that catastrophizing is a moderator of treatment outcome in exposure whereas several psychological variables might be important for the treatment process.

©2010 European Federation of International Association for the Study of Pain Chapters. Published by Elsevier Ltd. All rights reserved.

1. Introduction

Exposure in vivo is a novel treatment approach for patients with musculoskeletal pain (MSP) and high levels of pain-related fear. Fear and subsequent avoidance of activities are key factors that may perpetuate pain and dysfunction in a subgroup of patients, as proposed in the fear-avoidance model (Vlaeyen and Linton, 2000). Several studies have indeed shown that exposure is effective for reducing fear, catastrophic thoughts, disability and pain in these patients (Vlaeyen et al., 2001; Boersma et al., 2004; de Jong et al., 2005; Leeuw et al., 2008; Linton et al., 2008; Woods and Asmundson, 2008). A recent review concluded that exposure is the treatment of choice for patients with pain-related fear (Lohnberg, 2007). This conclusion was based on the first studies of exposure which showed promising effects in replicated single-case experimental studies (Vlaeyen et al., 2001, 2002a, 2002b; Linton et al., 2002; Boersma et al., 2004; de Jong et al., 2005). However, one of these studies noted substantial individual differences in how well the patients responded to the treatment (Boersma et al., 2004).

Recently, four RCTs further examined the effect of exposure in vivo for patients with MSP, and the effects were not as impressive as those reported in earlier studies (George et al., 2008; Leeuw et al., 2008; Linton et al., 2008; Woods and Asmundson, 2008). Exposure resulted in moderate to large effect sizes for reducing pain-related fear, catastrophizing, disability, and pain. But when compared to other commonly used treatments, the effects were more modest (George et al., 2008; Leeuw et al., 2008; Woods and Asmundson, 2008). While the unclear results may partly due to a lack of power due to small samples, a more compelling explanation, which indeed has been noticed (Linton et al., 2008), is that some patients respond better to exposure than others. Consequently, the effect of exposure might be suppressed by moderating factors (Baron and Kenny, 1986; Vlaeyen and Morley, 2005).

One hypothesis has been that patients with high levels of pain-related fear would benefit most from exposure, but data have failed to support this (George et al., 2008; Leeuw et al., 2008). In cognitive behavioral treatment packages for MSP, where exposure is not included, high catastrophizing, anxiety, and depression have...
Understanding catastrophizing from a misdirected problem-solving perspective

Ida K. Flink*, Katja Boersma, Shane MacDonald and Steven J. Linton
Center for Health and Medical Psychology (CHAMP), School of Law, Psychology and Social Work, Örebro University, Sweden

Objectives. The aim is to explore pain catastrophizing from a problem-solving perspective. The links between catastrophizing, problem framing, and problem-solving behaviour are examined through two possible models of mediation as inferred by two contemporary and complementary theoretical models, the misdirected problem solving model (Eccleston & Crombez, 2007) and the fear-anxiety-avoidance model (Asmundson, Norton, & Vlaeyen, 2004).

Design. In this prospective study, a general population sample (n = 173) with perceived problems with spinal pain filled out questionnaires twice; catastrophizing and problem framing were assessed on the first occasion and health care seeking (as a proxy for medically oriented problem solving) was assessed 7 months later.

Methods. Two different approaches were used to explore whether the data supported any of the proposed models of mediation. First, multiple regressions were used according to traditional recommendations for mediation analyses. Second, a bootstrapping method (n = 1000 bootstrap resamples) was used to explore the significance of the indirect effects in both possible models of mediation.

Results. The results verified the concepts included in the misdirected problem solving model. However, the direction of the relations was more in line with the fear-anxiety-avoidance model. More specifically, the mediation analyses provided support for viewing catastrophizing as a mediator of the relation between biomedical problem framing and medically oriented problem-solving behaviour.

Conclusion. These findings provide support for viewing catastrophizing from a problem-solving perspective and imply a need to examine and address problem framing and catastrophizing in back pain patients.

Disabling spinal pain is a common problem in Western societies. It affects about 85% of workers at some point in their working years, and for about 10% it develops into a long-term condition (Nachemson, Waddell, & Norlund, 2000; Waddell, Aylward, & Sawney,

*Correspondence should be addressed to Ida K. Flink, Center for Health and Medical Psychology (CHAMP), School of Law, Psychology and Social work, 701 82 Örebro, Sweden (e-mail: ida.flink@oru.se).

DOI:10.1111/j.2044-8287.2011.02044.x
2002). When suffering from disabling pain, a natural reaction is to worry about the causes and how to solve the problem. A certain amount of worry is adaptive in preparing us for future threats, but only if it does not get too intense (Mathews, 1990). When the worry progressively intensifies and the outcome is perceived as getting worse and worse, it has been defined as catastrophic worry (Davey & Levy, 1998), as captured by the concept catastrophizing. Catastrophizing is widely studied in the area of musculoskeletal pain, and has been identified as one of the most important psychological variables predicting long-term disability (Sullivan et al., 2001). Thus, while worry might fill an important motivational function initially, in the long run it may aggravate problems, especially when it takes the form of catastrophizing.

The misdirected problem solving model [see Figure 1 (Eccleston & Crombez, 2007)] was recently presented as an attempt to provide a framework to explain how worry and catastrophizing might lead to rigid, medically oriented problem-solving behaviours. According to this model, a patient who catastrophizes is likely to frame the pain as a biomedical problem which, in the case that no medical solution actually exists, results in the patient repeatedly seeking medical care without getting better. In the case of spinal pain, many times there is no medical solution of the problem. Thus, to keep on searching for a cure will unlikely solve the problem and in this sense an individual’s efforts become ‘misdirected’. As the problem remains unsolved, the catastrophic worry increases, which in turn results in further biomedical problem framing. Consequently, the misdirected problem solving model poses that catastrophizing is part of an unsuccessful problem-solving behaviour, involving repeated fruitless efforts that are directed towards curing or getting rid of pain.

This model was developed in relation and addition to the expanded fear-anxiety-avoidance model [see Figure 2 (Asmundson, Norton, & Vlaeyen, 2004)]. This model also underscores the potential maladaptiveness in framing a long-term pain problem in biomedical terms, here captured by pain beliefs such as ‘pain equals damage or serious injury’. In this model, a biomedical problem framing is proposed to set the stage

![Figure 1](https://example.com/figure1.png)

**Figure 1.** A stylized version of the misdirected problem solving model, focusing on the perseverance loop (Eccleston & Crombez, 2007).

**Note.** This figure has been reproduced with permission of the International Association for the Study of Pain (IASP). The figure may not be reproduced for any other purpose without permission.
for catastrophizing which in turn enhances the perception of threat and thereby the motivation to find a medical solution, or cure, for the pain.

In summary, both of the aforementioned models suggest that pain patients who catastrophize are likely to view the problem as primarily biomedical and try to find medical solutions for it, which in the case of spinal pain often prove unsuccessful. The models might be seen as complementary rather than competing, because they both focus on the emotions, cognitions, and overt behaviour involved in solving the problem of long-term pain. However, the models do imply somewhat different pathways. In the formation of the misdirected problem solving model, a biomedical problem frame mediates the relation between catastrophic worry and problem-solving behaviour while the fear-anxiety-avoidance model implies that it is the other way around. In this model, catastrophizing mediates the relation between a biomedical problem frame (i.e., pain beliefs) and problem-solving behaviour (i.e., defence motivation/defensive behaviour). Neither of the paths has, however, been empirically tested, and earlier research has stressed the importance of examining in what way catastrophizing is linked to overt problem-solving behaviour (Crombez, Eccleston, Van Hamme, & De Vlieger, 2008). Even though the sequential order of the fear-avoidance model has been scrutinized (e.g., Leeuw et al., 2007; Wideman, Adams & Sullivan, 2009), the specific link between pain beliefs and catastrophizing has not been investigated empirically, and nor has the sequential order of the misdirected problem solving model. Thus, these complementary models implicitly suggest somewhat different pathways to explain the links between problem framing, catastrophizing, and problem-solving behaviour but these have not been examined empirically.

The current study aims to explore if and how catastrophizing is linked to biomedical problem framing and medically oriented problem solving. We will do this using mediation
analyses where catastrophizing and a proxy for biomedical problem framing will be assessed at the first occasion, and a proxy for medically oriented problem solving will be assessed 7 months later. In this way, we will examine two possible models of mediation as implied by aforementioned theoretical models. The goal is to increase our understanding of catastrophizing from a problem-solving perspective.

**Methods**

**Design**

This study is based on data from a prospective study about psychological processes in the development of chronic pain problems (Boersma & Linton, 2005). Participants answered questionnaires on two occasions. On the first occasion the questions addressed background variables, pain characteristics, sick leave, and psychological processes. On the second occasion, 7 months later, the questions focused on function and health care utilization which was used as a proxy for medically oriented problem solving. Only participants who answered both questionnaires were included in the study (n = 173). The study was approved by the Örebro University Hospital’s Board on Research Ethics.

**Participants**

Participants were recruited via advertisements in local newspapers in three counties in middle Sweden. The inclusion criteria were (1) 20–60 years old, (2) perceived problems with spinal pain, and (3) at least 1 day of sick leave the previous year because of the pain problem. The questionnaires were sent to the participants via mail. For details concerning recruitment and dropouts, see the original study (Boersma & Linton, 2005). Table 1 displays background variables (age, gender, and nationality), pain characteristics (intensity, location, and duration), and sick leave for the participants.

**Measures**

Swedish versions of all questionnaires were used.

**Table 1. Background variables, pain characteristics, and sick leave for the participants**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, M (SD)</td>
<td>57 (9.1)</td>
</tr>
<tr>
<td>Gender, women/men</td>
<td>69%/31%</td>
</tr>
<tr>
<td>Nationality, born in Sweden</td>
<td>90%</td>
</tr>
<tr>
<td>Pain intensity, M (SD)</td>
<td>5.6 (2.3)</td>
</tr>
<tr>
<td>Pain location (more than one location possible)</td>
<td></td>
</tr>
<tr>
<td>Neck</td>
<td>73%</td>
</tr>
<tr>
<td>Shoulder</td>
<td>68%</td>
</tr>
<tr>
<td>Upper back</td>
<td>52%</td>
</tr>
<tr>
<td>Lower back</td>
<td>74%</td>
</tr>
<tr>
<td>Pain duration</td>
<td></td>
</tr>
<tr>
<td>&lt;3 months (acute)</td>
<td>7%</td>
</tr>
<tr>
<td>3–12 months (subacute)</td>
<td>17%</td>
</tr>
<tr>
<td>&gt;12 months (chronic)</td>
<td>75%</td>
</tr>
<tr>
<td>Sick leave last 12 months</td>
<td></td>
</tr>
<tr>
<td>1–14 days</td>
<td>35%</td>
</tr>
<tr>
<td>14–180 days</td>
<td>28%</td>
</tr>
<tr>
<td>&gt;180 days</td>
<td>34%</td>
</tr>
</tbody>
</table>
Background variables, sick leave, and pain characteristics
Questions from the Örebro Musculoskeletal Pain Screening Questionnaire (ÖMPSQ; Linton & Halldén, 1998) were used to assess background variables (age, gender, and nationality), sick leave (‘How many days of work have you missed because of pain during the past 12 months?’), and pain characteristics (intensity, location, and duration). The ratings of pain intensity (‘How would you rate the pain that you have had during the past week?’) were made on an 11-point scale (0 = no pain; 10 = pain as bad as it could be). The information about pain location (‘Where do you have pain?’) was given by checking the appropriate sites (neck, shoulder, upper back, and/or lower back). The information about pain duration was given by checking the appropriate site by 10 possible options, ranging from 0 to 1 week to >52 weeks. The ÖMPSQ has shown to be a reliable and valid instrument for assessing psychosocial factors in people with musculoskeletal pain and disability (Linton & Bersma, 2003; Westman, Linton, Öhrvik, Wahlén, & Leppert, 2008).

Catastrophizing
The catastrophizing subscale from the Coping Strategies Questionnaire (CSQ; Rosentiel, 1983) was used to assess pain-related catastrophic thoughts. This subscale consists of six items reflecting thoughts and feelings that might arise when people experience pain (e.g., ‘I worry all the time whether it will end’, ‘It’s awful and I feel that it overwhelms me’). The answers are given on a seven-point scale, where the respondents rate to what extent they have these thoughts and feelings when they experience pain (0 = never; 6 = always). The catastrophizing scale has shown appropriate construct validity (Stewart, Harvey, & Evans, 2001), and the Swedish version has shown good internal consistency (alpha range .7–.8) but somewhat less satisfactory test-retest reliability (correlations range .4–.9) (Jensen & Linton, 1993).

Biomedical problem framing
The somatic focus subscale from the Tampa Scale for Kinesiophobia (TSK) (Kori, Miller, & Todd, 1990) was used as a proxy for biomedical problem framing. The TSK was originally developed to assess fear of movement and (re)injury. However, several investigations of the factor structure of the TSK have confirmed a two-factor solution with two distinct subscales: somatic focus and activity avoidance (Goubert et al., 2004; Roelofs et al., 2007; Roelofs, Goubert, Peters, Vlaeyen, & Crombez, 2004). The construct validity of the somatic focus subscale has been supported by showing that it differs from the activity avoidance subscale in correlations with self-report measures of pain-related fear, pain catastrophizing, and disability (Roelofs et al., 2004). While the activity avoidance subscale focuses on beliefs that pain-provoking activities should be avoided, the somatic focus subscale focuses on beliefs about pain signalling underlying serious medical problems. Therefore, this subscale fits well with the concept of biomedical problem framing. Specifically, the somatic focus subscale consists of five items: ‘My body is telling me I have something dangerously wrong’, ‘I wouldn’t have this much pain if there weren’t something potentially dangerous going on in my body’, ‘My accident has put my body at risk for the rest of my life’, ‘Pain always mean I have injured my body’, and ‘People aren’t taking my medical condition seriously enough’. The answers are given on a four-point scale (0 = strongly disagree; 4 = strongly agree). The questionnaire has shown good psychometric properties (Goubert et al., 2004; Roelofs et al., 2004; Vlaeyen et al., 1995).
Catastrophizing

Biomedical problem framing (t1)

Catastrophizing (t1)

Medically oriented problem solving behaviour (t2)

Figure 3. Possible model of mediation with biomedical problem framing as a proposed mediator.

The Swedish version has shown good reliability including stability over time and internal consistency (alpha .81) (Lundberg, Stymf, & Carlsson, 2004).

Medically oriented problem-solving behaviour
Health care utilization was used as a proxy for medically oriented problem-solving behaviour, and was assessed with questions from the Outcome Evaluation Questionnaire (Keefe, Linton, & Lefebvre, 1992). The participants were asked which of the following health care providers they had visited because of their pain problem during the last 7 months (i.e., since the first questionnaire): medical doctor, physiotherapist, specialist care, or other (e.g., chiropractic or acupuncture). The total number of health care providers one had visited was used as an index of health care utilization.

Function
Function was assessed with five questions from the ÖMPSQ (Linton & Halldén, 1998). The respondents are asked to what degree they are able to participate in certain daily activities (e.g., 'I can do ordinary household chores', 'I can do the weekly shopping'). Ratings are made on an 11-point scale (0 = cannot do it because of pain; 10 = can do it without pain being a problem). The questions have shown high reliability and validity (Boersma & Linton, 2005; Linton, 1990).

Statistical analysis
First, the data were summarized and inspected through descriptive and correlational statistics.

Next, we explored two possible models of mediation. In the first model, which is in line with the misdirected problem solving model, biomedical problem framing was proposed as a mediator of the relation between catastrophizing and medically oriented problem-solving behaviour (see Figure 3). In the second model, which is in line with the fear-anxiety-avoidance model, catastrophizing was proposed as a mediator of the relation between biomedical problem framing and medically oriented problem-solving behaviour (see Figure 4).

Figure 4. Possible model of mediation with catastrophizing as a proposed mediator.
We used two different approaches to explore whether the data supported any of these possible models of mediation. First, multiple regressions were used to investigate whether the prerequisites of mediation effects were met, using the traditional recommendations by Baron & Kenny (1986). Second, the significance of the indirect effects were assessed with a bootstrapping method \((n = 1000\) bootstrap resamples) (see Preacher & Hayes, 2008). Bootstrapping is a non-parametric resampling procedure that generates an approximation of the sampling distribution from the available data set. More specifically, the bootstrapping distribution is generated by taking a sample (with replacement) of size \(n\) from the full data set. The indirect effects are then calculated in the resamples that results in point estimates and 95% confidence intervals are estimated for the indirect effects. We considered point estimates of indirect effects to be significant if zero was not contained in the confidence interval.

Statistical analyses were performed with SPSS 18.0. Missing values were estimated by calculating the mean score for the scale.

**Results**

**Descriptive and correlational statistics**

Table 2 displays means, standard deviations, and Pearson’s product moment correlations between the primary variables in the study. Somatic focus was used as a proxy for biomedical problem framing and health care utilization was used as a proxy for medically oriented problem-solving behaviour. The participants had moderate levels of both catastrophizing, with a mean rating of 14.0 \((SD = 7.5)\), and somatic focus, with a mean rating of 12.6 \((SD = 3.7)\). The participants were also moderately disabled, with a mean rating of 28.8 \((SD = 14.0)\) on function. The mean ratings of health care utilization was 1.6 \((SD = 1.2)\), which gives the mean number of health care providers that the participants had visited between timepoint 1 and 2.

As can be seen in Table 2, all primary variables in the study were correlated with coefficients varying between .24 and .50. The most pronounced correlations were found between catastrophizing and somatic focus, and between somatic focus and function. The latter correlation coefficient was negative, which means that a higher level of somatic focus at timepoint 1 indicated lower levels of function at timepoint 2.

**Table 2.** Means \((M)\), standard deviations \((SD)\), and correlations of the primary variables in the study \((n = 173)\)

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>(M) (SD)</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Catastrophizing (CSQ)</td>
<td>0–36</td>
<td>14.0 (7.5)</td>
<td>.50**</td>
<td>-.39**</td>
<td>.31**</td>
</tr>
<tr>
<td>2. Somatic focus (TSK)</td>
<td>0–20</td>
<td>12.6 (3.7)</td>
<td>-</td>
<td>-.46**</td>
<td>.24**</td>
</tr>
<tr>
<td>3. Function (OMSPQ)*</td>
<td>0–50</td>
<td>28.8 (14.0)</td>
<td>-</td>
<td></td>
<td>-.36**</td>
</tr>
<tr>
<td>4. Health care utilization (OEQ)*</td>
<td>0–4</td>
<td>1.6 (1.2)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes. CSQ, coping strategies questionnaire; TSK, Tampa Scale of Kinesiophobia; OEQ, outcome evaluation questionnaire; OMSPQ, Orebro musculoskeletal pain screening questionnaire.

*These scorings are based on ratings at timepoint 2.

**\(*p < .01**
Mediation analyses

Multiple regression analyses were performed to investigate whether the traditional prerequisites of mediation effects were met in the two possible models of mediation described in the statistical analysis section. In both models, health care utilization was used as the dependent variable as a proxy for medically oriented problem-solving behaviour. In the first model (Alternative 1: Misdirected problem solving model), somatic focus was a proposed mediator between catastrophizing and health care utilization, and in the second model (Alternative 2: Fear-anxiety-avoidance model) catastrophizing was a proposed mediator between somatic focus and health care utilization. As can be seen in Table 3, the data best matched Alternative 2 as the effect of somatic focus on health care utilization was reduced to a non-significant level (β = .11 Ns) (and not the other way around) when both catastrophizing and somatic focus were used as predictors in the regression.

Subsequently, a bootstrapping method (n = 1000 bootstrap resamples) was used to explore the significance of the indirect effects in both possible models of mediation. The analyses showed that in Alternative 1, the indirect effect of catastrophizing on health care utilization through somatic focus as a mediator was not significant (point estimate = .009; CI [−.005, −.024], p = .20). In Alternative 2, however, the indirect effect of somatic focus on health care utilization through catastrophizing as a mediator was significant (point estimate = .042; CI [.015, −.078], p < .01).

In sum, in both approaches of mediation analyses, the data supported Alternative 2 where catastrophizing was proposed as a mediator of the relation between somatic focus and health care utilization.

---

Table 3. Multiple regression analyses exploring two possible models of mediation

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alternative 1: Misdirected problem solving model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>.90</td>
<td>.19</td>
<td>.31**</td>
</tr>
<tr>
<td>Catastrophizing</td>
<td>.05</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>.57</td>
<td>.32</td>
<td></td>
</tr>
<tr>
<td>Catastrophizing</td>
<td>.04</td>
<td>.01</td>
<td>.26**</td>
</tr>
<tr>
<td>Somatic focus</td>
<td>.04</td>
<td>.03</td>
<td>.11 Ns</td>
</tr>
<tr>
<td><strong>Alternative 2: Fear-anxiety-avoidance model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>.62</td>
<td>.33</td>
<td></td>
</tr>
<tr>
<td>Somatic focus</td>
<td>.08</td>
<td>.03</td>
<td>.24**</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>.57</td>
<td>.32</td>
<td></td>
</tr>
<tr>
<td>Somatic focus</td>
<td>.04</td>
<td>.03</td>
<td>.11 Ns</td>
</tr>
<tr>
<td>Catastrophizing</td>
<td>.04</td>
<td>.01</td>
<td>.26**</td>
</tr>
</tbody>
</table>

Notes.

*Alternative 1 R² = .10 for Step 1; ΔR² = .01 for Step 2 (Ns).

*Alternative 2 R² = .06 for Step 1; ΔR² = .05 for Step 2 (p < .01).

Health care utilization was used as the criterion variable in the analyses.

**p < .01.
Discussion

The current study is an attempt to empirically investigate the links between problem framing, catastrophizing, and problem-solving behaviour. On basis of two complementary theoretical models which differ somewhat in their implicit suggestions of what drives what, we examined possible mediators using proxies for biomedical problem framing and medically oriented problem-solving behaviour. The goal was to explore whether catastrophizing might be understood from a problem-solving perspective.

We found evidence that biomedical problem framing, catastrophizing, and medically oriented problem-solving behaviour were related. This partially supports the misdirected problem solving model (Eccleston & Crombez, 2007), which proposes that these concepts are related and interact to worsen the pain problem. The model implies that if an individual who experiences pain worries extensively and frames the problem in biomedical terms, this often results in medically oriented problem-solving behaviours, that is the individual relies on medical solutions and seeks health care to cure the pain. Our data indeed support the link between these concepts but the direction of the relations was somewhat different than the model proposes.

Our results indicate that the way people view their pain problem set the stage for catastrophic worry. The mediation analyses supported catastrophizing as a mediator between biomedical problem framing and medically oriented problem solving. This is not in line with the sequential order of the misdirected problem solving model, which implies that it is the other way around; that biomedical problem framing mediates the relation between catastrophizing and problem-solving behaviour. The current findings are rather congruent with the expanded fear-anxiety-avoidance model (Asmundson et al., 2004), which implies that pain beliefs, such as ‘pain means harm or serious injury’, or in other words biomedical problem framing, might set the stage for catastrophizing and medically oriented problem-solving behaviours. In other words, the current findings indicate that if patients view their pain as primarily a medically problem, then catastrophic thoughts about what is wrong might arise. In turn, the patients may seek medical health services as an attempt to solve the problem.

It is important to note that efforts at finding medical solutions for the pain are not adaptive or maladaptive per se. To try to find a solution for pain is generally related to better functioning (Keefe, Rumble, Scipio, Giordano, & Perri, 2004) but when it is difficult to find a medical solution, such as in the case of spinal pain, a more adaptive reaction is to engage in other goals (Eccleston & Crombez, 2007). Based on our data, we cannot draw any conclusions about whether the repeated efforts for finding medical solutions for the pain problem were adaptive or not. There is, however, a relation between health care visits and poor function at the second assessment. On the one hand, this could be a sign that the efforts for finding medical solutions have not been successful. On the other hand, it might also be that the patients seek more health care because of their poor function. A third possibility is that the contact with the health care provider in fact has increased the patients’ feelings of helplessness, which in turn lead to further health care visits.

A related issue when trying to understand catastrophizing from a problem-solving perspective is that we cannot tell whether catastrophizing is a precursor or also a consequence of medically oriented problem-solving behaviour. The question of causality is a well-known issue when examining bidirectional models; since they are circular it is difficult to tease out what drives what. To clarify that, experimental studies that manipulate these concepts are needed. The current design indeed has limitations when
examining mediating factors since both the independent factor and the mediator were measured at the same timepoint. Further, it would have been of large interest to follow these people from their very first pain episode to get more information about how the proposed feedback loops develop. Another option which would have strengthened our conclusions would be to control for health care visits at baseline. However, as there is still sparse empirical support for these models, the current findings are informative as a first step and serve to set a direction for future research.

Another methodological limitation is that our findings rely solely on self-report data. An addition of an objective measure of health care visits could have verified the reliability of these self-reports, and therewith strengthened the results. To check the stability of our data, however, we repeated the same analyses with the total number of health care visits (as opposed to the number of different providers visited) as the outcome variable, and the results remained the same. A reservation should also be made concerning the use of TSK to assess biomedical problem framing. There have been conflicting findings concerning its factor structure (see e.g., Lundberg et al., 2004; Vlaeyen et al., 1995) and the measure might therefore not be considered as stable. However, to our knowledge there are no established measures for assessing problem framing and when scrutinizing the somatic focus subscale in the TSK, the questions have high face validity and were, therefore, considered as the best available proxy for biomedical problem framing.

The prospective design of this study is indeed one of the strengths. The time span of 7 months allowed analyses of how these components interacted over time. Another strength is that, apart from a relatively high mean age of 57, the sample appeared to be representative of patients suffering from spinal pain problems, with moderate levels of catastrophizing and disability. The level of somatic focus was also comparable with other samples suffering from pain problems (Roelofs et al., 2004). This denotes that the findings might be generalizable to other patients with spinal pain problems.

The findings from the present study have implications theoretically as well as clinically. Theoretically, the link between the concepts included in the misdirected problem solving model was confirmed, but the data suggests that the directions are somewhat different than the model implies. This might be important for refinement of this model. The findings also provide a framework for catastrophizing, and suggest one possible path that links catastrophizing to poor outcome in patients, namely as a mediator between problem framing and problem-solving behaviour. Clinically, this brings up the importance of examining how patients with spinal pain view their problem. If pain is regarded as a definite signal of something medically wrong, it is vital for the clinician to address catastrophic worry. Most clinicians do this by reassuring the patients that nothing is medically wrong in their back. However, there is surprisingly little evidence that reassurance is effective for calming patients (for a review, see Linton, McCracken, & Vlaeyen, 2008). General information is possibly needed, but it might not be enough for patients with high levels of catastrophizing. Another important aspect in this context is validation; to express acceptance of the patient’s behaviour, feelings, and situation as true (Fruzzetti, 2006). Presumably, a combination of reassurance in the form of concrete, specific information and a validating response from the clinician is needed, but further research needs to find out the best way to do this.

This study has contributed to the understanding of catastrophizing from a problem-solving perspective. In conclusion, catastrophizing was linked to how the pain problem was framed and dealt with. More specifically, the data indicated that catastrophic worry mediates the relation between biomedical problem framing and medically oriented
problem-solving behaviour. Future studies would preferably examine the long-term consequences of this problem-solving behaviour.

Acknowledgements

The authors sincerely want to thank Maarten Van Zalk for helpful comments about the statistical analyses.

References


Received 29 March 2011; revised version received 3 June 2011
Publications in the series
Örebro Studies in Psychology


10. Persson, Andreas, Leisure in Adolescence: Youth’s activity choices and why they are linked to problems for some and not others. 2006.


12. Larsson, Mats, Human Iris Characteristics as Biomarkers for Personality. 2007.

* Finns sedan tidigare utgiven i serien "Örebro Studies".


