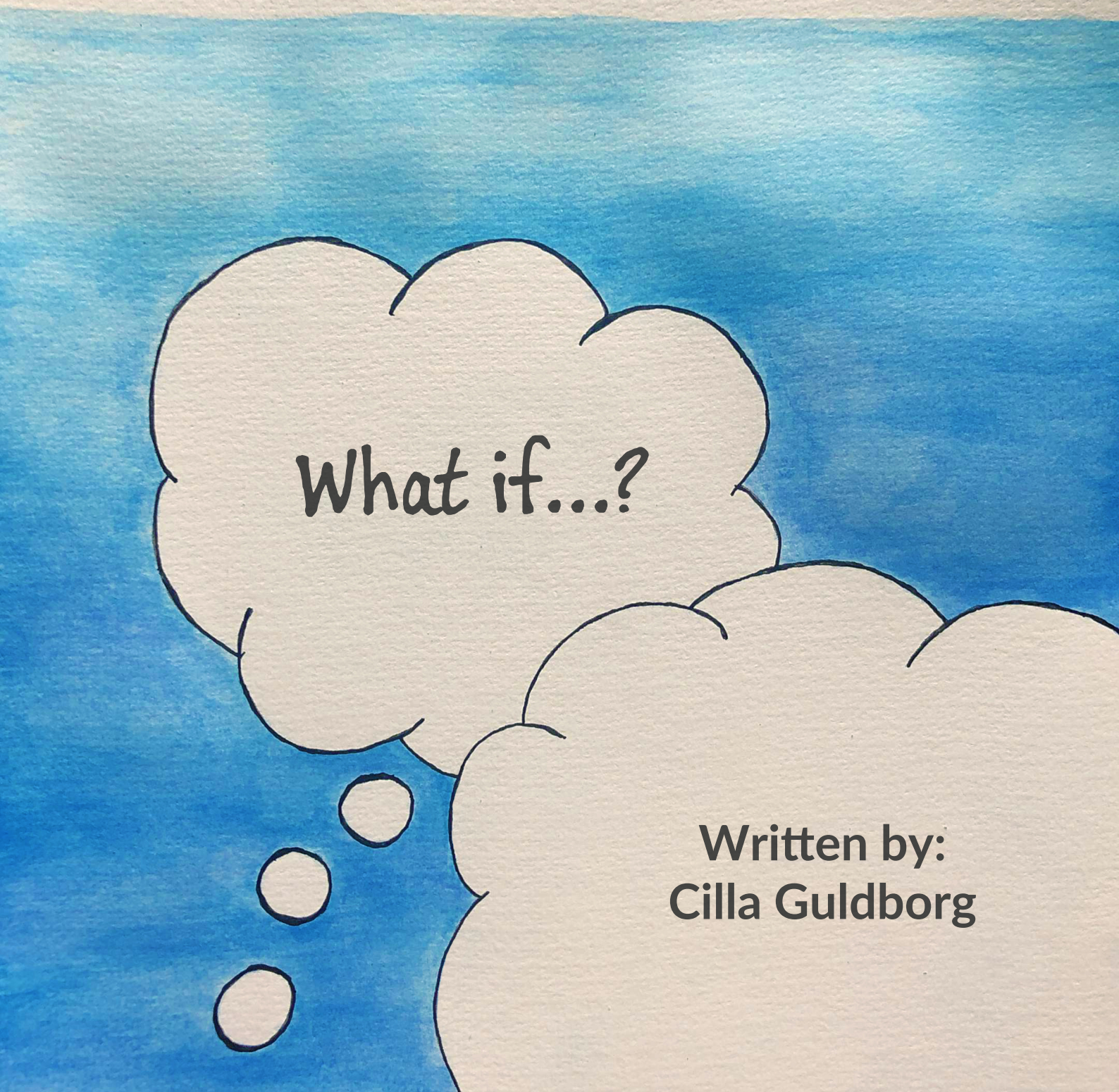
An Explorative Study of Pain Catastrophizing: Is Catastrophic Worry an Overlooked Aspect?



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I would like to extend my thanks to my supervisor

Laura Petrini for her continuous advice

Abstract

Purpose: Chronic pain is a burden for many people in Western Society (Breivik et al., 2006, p. 309f). Reviewing the functions influencing chronic pain, hereunder pain catastrophizing, is therefore pivotal. Pain catastrophizing is considered to be an important psychological factor in relation to chronic pain, and there is a notable quantity of empirical research that supports this notion (Keefe et al., 2004; Sullivan et al 2001). Conversely, the theoretical underpinnings of the construct have been less disputed. Recently, there has been renewed interest in exploring the concept in the light of contemporary psychological literature. Leading to Flink and colleagues (2013) introducing the term catastrophic worry, which they argued is an integrated aspect of a pain catastrophizing process. However, to my knowledge, there has been no empirical exploration of this concept in the pain area. The central aim of this study became to investigate if pain catastrophizing and catastrophic worry are related concepts. Additionally, the theory proposes that pain catastrophizing is a process and therefore might be capable of manipulation. The second aim of this study became to investigate this aspect.

Method: The research data in this thesis are drawn from four main sources: the catastrophizing interview, a cold pressor task, the situational pain catastrophizing scale and the standard pain catastrophizing scale. Firstly, Vasey and Borkovec's (1992) pain catastrophizing interview has been conducted to investigate the catastrophic worrying process, by making healthy participants generate a number of catastrophizing steps in relation to pain. The catastrophizing process was followed by a cold pressor task where the participants' pain tolerance threshold (PTT) was measured and lastly, the precipitants completed the situational pain catastrophizing scale (PCSs). Six weeks after the experiment the participants completed the standard pain catastrophizing scale (PCS). In addition, a thematic analysis of the catastrophizing steps was performed to investigate the cognitive content of the catastrophic worrying process.

Key findings: It was not confirmed that the number of steps produced in the catastrophizing interview correlated with pain tolerance (r=.246 n=20 p=.148) or the situational pain catastrophizing scale (r=.022, n=20, p=.463). Thereby the results are inconclusive regarding the relation between catastrophizing worry and pain catastrophizing. Conversely, the result did imply that the pain catastrophizing may be cable of manipulation, as an increase of the situational-PCS (M=24.50, SD=10.51) as compared with the standard-PCS (M=20.70 SD=10.69) was found (t(19)=1.390, p=.09). However, the finding is not significant. Carefully interpreted, the catastrophizing interview might have invoked catastrophic worry, which can have affected pain catastrophizing. Suggesting that catastrophic worry might be an integrated aspect of a pain catastrophizing process.

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Introduction

Around 19% of European adults report persistent pain of moderate to severe intensity (Breivik et al., 2006, p. 309), which can have an extensive impact on quality of life. Complaints about sleeping, sexual relations, feelings of helplessness and maintaining an independent lifestyle are common, and depression is a frequent condition (ibid., p. 309f). Certainly, chronic pain is a costly burden for many people and for Western Society. Understanding the functions that contribute to and maintain chronic pain is therefore of continuing importance.

In the last decade, the influence of psychological factors in relation to pain has become more and more apparent (Flink et al., 2013, p. 215). *Pain catastrophizing* has been the subject of much systematic investigation and has become recognized as one of the most influential psychological factors in relation to pain and pain disability (Keefe et al., 2004; Sullivan et al., 2001). Understanding the complexity of pain catastrophizing is therefore of vital importance for assessing and treating chronic pain. Conversely, the theoretical underpinnings of the construct have been less researched, and viewing the construct merely as the content of the pain catastrophizing scale is, unfortunately, a tendency (Flink et al., 2013, p. 218; Tuner & Aaron, 2000, p. 66).

The current study is an explorative investigation of pain catastrophizing. Inspiration has been drawn from Flink and colleagues' (2013) term catastrophic worry. The concept provides a useful context for exploring pain catastrophizing, as it is based on contemporary findings and theories from the psychology literature, which are applied in the pain area (Flink et al., 2013, p. 216). It has been attempted to study the relation between catastrophizing worry and pain catastrophizing, by use of Vasey and Borkovec's (1992) catastrophizing interview.

Furthermore, most of the studies that have established that pain catastrophizing and pain experience are related, are correlational studies, limiting the interpretations regarding causation (Bialosky et al., 2008, p. 35; Severeijns et al., 2005, p. 257f). This shortcoming is problematic as chronic pain might also inflict pain catastrophizing

(Severeijns et al., 2005. p. 258). However, the limited studies that have attempted to manipulate pain catastrophizing (e.g. Bialosky et al., 2008, p. 35; Jackson et al. 2005; Roditi, et al., 2009; Ruscheweyh et al, 2013; Severeijns et al., 2005) have not been very successful. The causal relation between pain catastrophizing and pain, consequently, needs further investigation. The present study attempts to contribute to this debate.

The current study begins by establishing the theoretical foundations of pain catastrophizing and catastrophic worry. Followed by a review of studies applying the catastrophizing interview and studies attempting to manipulate pain catastrophizing. After the theory, the purpose and several hypotheses will be presented.

The definition of pain

The aim of the first section of this chapter is to introduce the biopsychosocial model of pain. The model is the theoretical framework for the pain catastrophizing theories that will be introduced. The second section highlights the distinction between chronic pain and experimental pain. It is important to be aware of the differences between the to types of pain in this study, since experimental pain have been applied, in an effort to understand pain better in general.

The biopsychosocial model of pain

The International Association of the Study of Pain has defined pain in the following terms: *"An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage"* (International Association of the Study of Pain, 2014). Pain is thereby defined as a complex phenomenon consisting of both sensory and emotional accepts. Usually, pain is an adaptive function, since it can initiate behaviours such as seeking help or avoidance. Furthermore, it can promote rest that contributes to a healing process (Millar, 2002, pp., 266, 279; Ogden, 2004, p. 286).

The early conceptions of pain were based on a simple understanding in terms of stimulus and response (Gatchel et al., 2007, p. 583; Ogden, 2004, p. 286). It was be-

lieved that pain was merely a result of the severity of the injury, and the psychological reaction was considered a by-product (Ogden, 2004, p. 286). This conception was a product of the biomedical philosophy, where the body and mind was divided (Gatchel et al., 2007, p. 582). This conviction changed with Ronald Melzack and Patrick D. Walls publication of the *Gate Control Theory of pain (GCT),* where the psychological aspect was included in the understanding of pain perception (ibid., p. 583; Millar, 2002, p. 271). In briefly terms the theory suggested that a gateway controlled by physical, behavioural and emotional factors could intensify or lessen the pain experience (Ogden, 2004, p. 288f). Thereby the understanding of pain became more complex consisting of several interacting aspects, and the individual became an active agent in the perception of pain (ibid., pp. 287f). However, this theory has been criticised for still framing pain as a stimulus-response reaction. Therefore the theory cannot interpret pain that consists without apparent physical explanation (ibid., p. 289f).

Today pain is most commonly understood in a biopsychosocial perspective, where pain perception is understood as an interaction between biological, psychological, social and cultural aspects (Gatchel et al., 2007, p. 581f; Jones & Zachariae, 2009, p. 129). *Nociception* is a term for the physiological element of pain, defined as a process where sensory information about potential or actual tissue damage is conveyed to the brain (Breedlove & Watson, 2013, pp. 242-246; Gatchel et al., 2007, p. 582; Jensen et al., 2004, p. 24). For example, outer stimulation such as temperature alterations of the skin activates receptors call free never endings that send electrical signals to the brain (Bolanowski, 2002, p. 237).

The term *pain perception* refers to the conscious experience of pain and can be defined as a result of complex perceptual and cognitive processes in the brain, where sensory information is combined with cognitions and emotions (Gatchel et al., 2007, p. 582; Jones & Zachariae, 2009, p. 129). The relation is reciprocal as certain emotions and cognitions can be a risk factor for developing chronic pain. In addition, emotions and cognition can also be a consequence of chronic pain (Gatchel et al., 2007, pp. 599, 603f). The definition of pain in the biopsychosocial model contributes to an understanding of why there is such a difference in the experience of the same

painful stimulation, and that the intensity of pain does not necessarily correspond to the injury (Orchardson, 2002, p. 281).

Experimental pain

In this study experimental pain have been applied, therefore it is important to be aware of the differences between clinical pain and experimental pain. *Clinical pain* can be defined as acute pain resulting from a major injury or surgery (Edens & Gil, 1995, p. 197) that can become a *chronic pain* if it persists over a long period of time (ibid.). In contrary *experimental pain* is a short standardize stimulus, where the intensity and the modality (e.g., cold pressor, mechanical or electrical) of the pain is controlled (ibid.). Pain reports can, therefore, more easily be quantified and standardized under these controlled conditions (ibid., p. 198). However, experimental pain and clinical pain are substantially different, since experimental pain is more predictable than clinical pain, have an established ending point and no tissue damage will occur as a result of experimental pain (ibid.). In addition, experimental pain does not have potential implications for the individual's quality of life as clinical pain might (ibid., p. 197).

Pain stimulations can vary in intensity, modality, and unpleasantness (Rainville et al., 1992, p. 265). In this study, a cold pressor pain is applied, which is a gradually increasing thermal stimulation of the skin (Edens & Gil, 1995 p. 199). It has been argued that cold pressor pain is one of the forms of experimental pain that mimics chronic pain best because it produces unpleasantness (Rainville et al., 1992; Mitchell et al., 2004 p. 233). Other benefits with using the cold pressor task, is that it is one of the most reliable an objective measures of pain coping behaviour (Wilson et al, 1995 p. 224) and the time of the task enables catastrophizing thinking to occur, compared to other shorter painful stimulations (Roditi et al., 2009, p. 110) In addition it has a good reliability and validity (Edens & Gill, 1995, p. 198; Mitchell et al., 2004 p. 233) and the method is widely used to investigating pain catastrophizing (e.g. Bialosky et al., 2008; Jackson et al. 2005; Kristiansen et al., 2014; Roditi et al, 2009; Severeijns et al., 2004; Sullivan, 2000).

Pain Catastrophizing

Generally pain catastrophizing has been defined as ”*an exaggerated negative mental set brought to bear during actual or anticipated pain experience*” (Sullivan et al., 2001, p 53). The concept has been widely studied in the pain area, and it has been found to be an influential psychological construct in relation to pain ratings and pain related disabilities (Flink et al., 2013, p. 215). However, there has been a tendency in the pain literature to defined pain catastrophizing merely as the content of its measuring scales (ibid., p. 218). Therefore, it can be argued that the theoretical foundation of the construct is in need of further investigation (ibid., p. 215).

This chapter is subdivided into a theoretical part consisting of four sections and a review part consisting of two sections. The first theoretical section will review the relation between pain catastrophizing and pain perception. Hereafter the pain catastrophizing scale will be presented, since it is the most used measuring scale of pain catastrophizing. Thirdly, a theoretical overview of tree of the most widely discussed theories of pain catastrophizing in the pain literature will be given. Lastly, Flink and colleagues (2013) term *catastrophic worry* that builds on the other theories will be described. The current study is based on the theory of catastrophic worry.

The theoretical overview will be followed by a review of studies using similar methods as used in this study. The review consists of studies that have applied the catastrophizing interview and studies that have attempted to manipulate pain catastrophizing.

Catastrophizing and pain perception

Several studies have found that pain catastrophizing has an impact on pain and pain disabilities (see Keefe et al., 2004; Sullivan et al 2001 for review). For example, Sullivan and colleagues (2001) propound that it is a consistent finding that catastrophizing is related to elevated pain ratings in a clinical sample (p. 53). Keefe and colleagues (2004) support this notation, and ads that high level of catastrophizing can lead to more disability, longer hospitalisation and more pain behaviour (p. 196). Furthermore, findings have supported that it is an important factor even after controlling

for depression (Keefe et al., 2004, p. 196). For the most part, the studies have been done in a clinical sample (ibid.).

However, some studies have supported that pain ratings are influenced by pain catastrophizing even in a healthy population enduring experimental pain (Kristiansen et al., 2014; Sullivan, 2001; Sullivan, 2000) In Sullivan's (2000) study it was found that the subscales rumination and helplessness of the standard pain catastrophizing scale (PCS) significantly correlated with pain ratings during a cold pressor task. Likewise, Kristiansen and colleagues (2014) found that even a small difference in PCS score could influence pain ratings in healthy subjects during a cold pressor task for does participant who could endure the task for at least 120 seconds (p. 143).

Unfortunately, most of the studies considering pain catastrophizing have been correlations studies, hindering any determination of casualization. Therefore, it cannot be fully determined if catastrophizing lead to poor adjustment of pain, or vice versa (Keefe, 2004, p. 197).

The Pain Catastrophizing Scale (PCS)

The pain catastrophizing scale is one of the most widely used measures of pain catastrophizing (Sullivan, 1995). It consists of three different subscales: rumination, magnification, and helplessness. *Rumination* is described as an inability to inhibit pain-related thoughts that create an intense focus on pain and the negative thoughts related to it (Sullivan et al., 1995 p. 525). *Magnification* is described as a tendency to overestimate the threat of the pain and to have a tendency to have much unpleasantness when in pain (ibid.). *Helplessness* is described as a negative belief about one's ability to cope with pain, and a tendency to perceive oneself as helpless in a painful situation (ibid.). Rumination and Helplessness have the highest correlation with pain ratings, and it is suggested that these subscales are more consistent in relation to different types of painful experiences. On the other hand, magnification might be better at predicting the pain ratings for certain types of painful experiences (ibid.). Rumination is the factor that explains most of the variance in pain ratings, suggesting that persistent attention directed at pain, might be one of the main factors that have an influence on pain ratings (ibid.).

The standard-PCS is criticized for relying on the recollection of past painful events, which might not be exact (Sullivan et al., 1995, p. 531). Furthermore, the standard-PCS assumes that individuals' cognitive and emotional reaction is not depended on the pain situation (ibid.). Nevertheless, the individual's test-retest scores of the standard-PCS have been found to be stable across six to teen weeks (ibid.). For example, the test-retest reliability coefficient with a six week interval for the standard-PCS has suggested a good reliability (r=.75) (Turner & Aaron, 2001, p. 67). Indicating that pain catastrophizing is a rather stable trait influenced by underlying schemata or personality traits (ibid., p. 66).

On the contrary, several studies have found the PCS scores correlates more strongly with ratings of pain if the PCS is administered after the pain stimuli compared to before the pain stimuli (Campbell et al., 2010; Dixon et al 2004; Edwards et al., 2006). Thus, suggesting that *situational pain catastrophizing* defined as the PCS rated in relation to a specific pain situation (situational-PCS), is more indicative than the *dispositional pain catastrophizing,* defined as the PCS rated in relation to pain in general (standard-PCS). Taking together, this new perspective might indicate that catastrophizing is not a stable characteristic but instead is affected by the specific pain experience and the emotional state of the individual (Turner & Aaron, 2001, p. 68). This view is supported by findings suggesting that cognitive-behavioural interventions can reduce pain catastrophizing in individuals with chronic pain (Sullivan et al., 2001, p. 56).

A third option is that pain catastrophizing could be both dispositional and situational-influenced, meaning that underlying traits or schemata, might only be expressed or activated in response to specific painful situations of affective states (Turner & Aaron, 2001, p. 69). The question becomes if pain catastrophizing can be manipulated.

Theories of pain catastrophizing

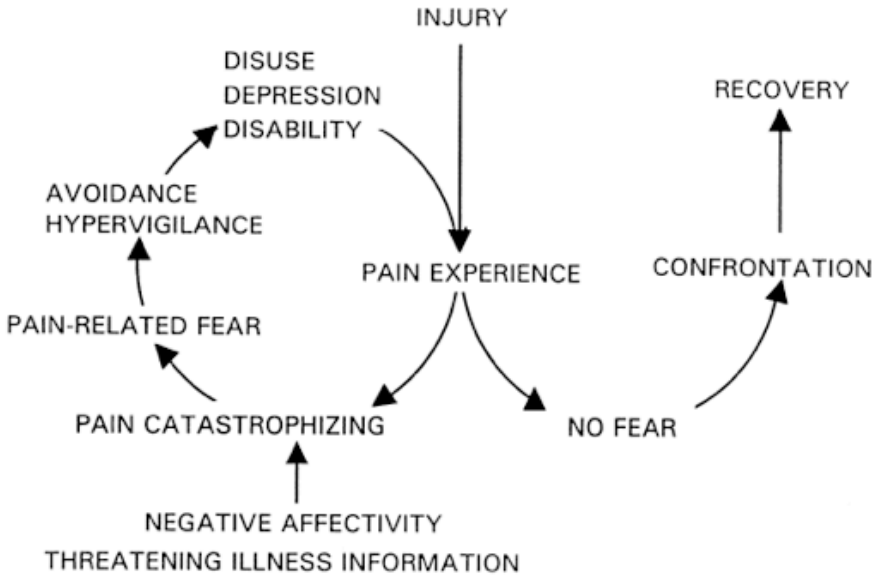
The aim of this section is to introduce the theoretical framework of pain catastrophizing. Three of the most widely discussed theories of pain catastrophizing in the pain

area will be presented. Some of the theories will be described in shorter terms, as they do not concern the main scope of this study.

The fear-avoidance model of pain (FAM)

Many people experience different kinds of acute pain but few people develop chronic pain (Leeuw et al., 2007). Under the theoretical umbrella of the biopsychosocial model of pain, the *fear-avoidance model (FAM)* gives a possible account of why some people develop chronic pain (Vlaeyen & Linton, 2000, p. 317). The model illustrates a vicious circle (figure 1) that is initiated if a pain experience is catastrophically (mis)interpreted. Vlayen and Linton (2000) suggest that pain can be appraised as non-threatening or threatening, in the latter case catastrophizing plays an important role since it will lead the individual to enter into the fear-avoidance cycle with deleterious consequences to the individual, the problem is worsened and the pain is enhanced.

Figure 1 - The fear avoidance model



Factors in the model

In the FAM it is emphasised that pain experiences can be effect by the different factors in the model including the injury itself. For example, recent research suggests that pain severity has an effect on fear of pain and the individual's disability during acute and chronic pain (Leeuw et al., 2007, p. 79).

Pain catastrophizing is defined as "*an exaggerated negative orientation toward noxious stimuli"* (Vlaeyen & Linton, 2000, p. 320). It is perceived as a cognitive process, where the pain is viewed as severely threatening to self and others (Leeuw et al., 2007, p. 79f.) Catastrophizing is defined as the mediator of *pain-related fear* that is fear that arises as a result of pain catastrophizing (ibid., p. 78). The fear can develop into a fear of movements, reinjuring and fear of work-related activities (ibid.). The FAM thereby contributes to a better understanding of how pain catastrophizing, fear-avoidance behaviours and chronic pain are related, but FAM cannot explain the origin of catastrophizing. Some suggestions about the possible underlying mechanisms for catastrophizing have been presented, such as expectations, self-efficacy, beliefs about pain, negative affectivity, memories of past experiences and current psychological factors (Asmundson et al., 2004, pp. 8-10), but these are not further elaborated.

As a response to pain catastrophizing and pain-related fear, the individual can experience hypervigilance and have fear-avoidance behaviour (Leeuw et al., 2007, p 80; Vlaeyen & Linton, 2000, p. 325). *Hypervigilance* refers to an attention bias towards any stimuli that might be related to a threat (Vlaeyen & Linton, 2000, p. 325). Attention towards potentially painful stimuli can directly affect the individual's experiences of pain, and it consumes energy that could be used for more rewarding and relevant tasks (Leeuw et al., 2007, p. 81; Vlaeyen & Linton, 2000, p. 325). Pain-related fear and catastrophizing can thereby contribute to the individual's pain and pain disabilities by initiating hypervigilance. *Fear-avoidance behaviour* refers to behaviour that is believed to prevent or postpones pain and negative reactions that can be a consequent of pain (Leeuw et al., 2007, p 81; Vlaeyen & Linton, 2000, p. 317). Avoidance can be an adaptive behaviour in the acute phase of an injury because it motivates rest (Asmundson et al. 2004, p. 7). After the acute phase individuals normally engage in more and more activity which promotes rehabilitation. However some individuals are caught in their avoidance behaviour, and then the behaviour becomes maladaptive (ibid.).

Leeuw and colleagues (2007) have argued that avoidance behaviour and fear of pain can contribute to pain *disabilities*; defined as a reduction in the ability to engage in daily activities among people with chronic pain (p. 81) For example, findings suggest

that fear of pain can lead to a reduction in daily activity (Vlaeyen & Linton, 2000, pp. 317, 322) and that fear of pain may lead to avoidance behaviour that prevents the individual in engaging in pleasant and positive activities, such as being able to help friends and family. Consequently, the inability might end up adding to negative emotions and the risk of developing depression (ibid., p. 319). In addition, it is argued that avoidance behaviour can contribute to *disuse syndromes*, defined as the physiological and psychological effects of the reduction in physical activities (Leeuw et al., 2007, p. 81).

Maintaining factors

Classical conditioning is a process that can contribute to the maladaptive maintenance of pain-related fear and avoidance behaviour. *Classical conditioning* is a term for a certain kind of learning, where a natural stimulus is appraised negatively. In other words, a neutral stimulus occurring before a potentially painful experience can be appraised negatively in itself, which can generate an automatic physical response (muscle tension and activation of the sympathetic nerves system), leading to elevated fear and anxiety (Vlaeyen & Linton, 2000, p. 318f). For example, if an individual has back pain, the individual might start to predict that lifting boxes (a neutral stimulus) will produce pain. The movement in itself can thereby begin to signal a threat an enhance fear and pain.

Operant conditioning can also contribute to the maintenance of maladaptive behaviours. *Operant conditioning* references to learning that occur as a consequence of reinforcement (Asmundson et al., 2004, p. 8) or negative reinforcement defined as a removal of a punishment (Borkovec, 2004, p. 88). One of the problems with avoidance behaviour is that the individual is never confronted with the potential harmful situation, movement or activity. The avoidance behaviour thereby prevents disconfirmation of the individuals' beliefs. Following the previous example the individual will not lift any boxes and thereby the belief that lifting will lead to pain is not rejected (Leeuw et al., 2007, p. 77). Instead, avoidance behaviour (not lifting) is rewarded by the reduction of fear in the given moment, and the absences of pain, thereby the avoidance behaviour is negatively reinforced (Vlaeyen & Linton, 2000, p. 318). In this way, avoidance behaviour is maintained by classical and operant condition,

which makes it very difficult to alter beliefs and fears about pain, and for the individual to obtaining more adaptive coping strategies.

To conclude the fear-avoidance model provide an understanding of how pain catastrophizing can influence pain perception. Pain catastrophizing is positioned in a fear network, where it contributes to the maintenances of pain and pain disabilities. One of the shortcomings of the FAM is to predict avoidance behaviour when the pain is chronic, as chronic pain cannot be avoided. However, it can be argued that certain avoidances behaviour might be believed to increase pain or (re)injury even if the pain is chronic (Vlaeyen & Linton, 2000, p. 321). In additions, the FAM can be critiqued for its simplicity, as it might be questioned if chronic pain can simply be avoided by not conducting certain avoidance behaviour. The model, therefore, has to be interpreted in relation to the other factors in the biopsychosocial model.

The Communal Coping Model (CCM)

Sullivan (2004) presents the communal coping model (CCM), where the importance of the social context's influence on pain catastrophizing is emphasized (Flink et al., 2013, p. 217; Quartana et al., 2009, p. 6). The CCM thereby contributes to the fear-avoidance-model by considering the function of catastrophizing. It is argued that pain catastrophizing has a communal function, by means of *communicative pain behaviours,* defined as a manner of conducting oneself when in pain, for example, facial expressions and voicing of pain (Sullivan et al., 2004, p. 220). Communicative pain behaviours can evoke empathy, support from others, as well as lower expectations from others (Edwards et al., 2011, p. 220; Sulivan et al., 2001, p. 60; Sullivan et al., 2004, p. 220), resulting in positive response from others that may reinforce and thereby maintaining pain catastrophizing (Sulivan et al., 2001, p. 60; Quartana et al., 2009, p. 6). Pain catastrophizing is thereby a behavioural coping strategy (Quaetana et al., 2009, p. 6), which motivates others to help oneself manage the threatening situation. The threat is thereby handled in a social context and not by the individual alone (Sullivan et al., 2001, p. 60). It has been suggested that pain catastrophizing is connected to a perception of an inability of coping with pain by oneself leading to the individual seeking this support from others (Quatana et al., 2009, p. 7). It can, therefore, be argued that catastrophizing is an adaptive strategy in acute pain as it evokes help from others (ibid.). However, in the long term catastrophizing might lead to

more severe pain (Sullivan et al., 2001, p. 60), and negative responses from others instead of evoking social support (Quatana et al., 2009, p. 7).

Several studies have supported the theory (ibid., p. 6f). For example, Sullivan and colleagues' (2004) findings suggested that high catastrophizsers expressed a longer duration of communicative pain behaviours when an observer was present (Sullivan et al., 2004, p. 223). Whereas communicative pain behaviours where not influence by an observer when pain catastrophizing was low (ibid.). The findings suggest that the expression of catastrophizing may be influenced by the social context. Thus it is argued that pain catastrophizing is a communicational situation-based response since pain catastrophizing is expressed more when others are present (Tuner & Aaron, 2000, p. 69).

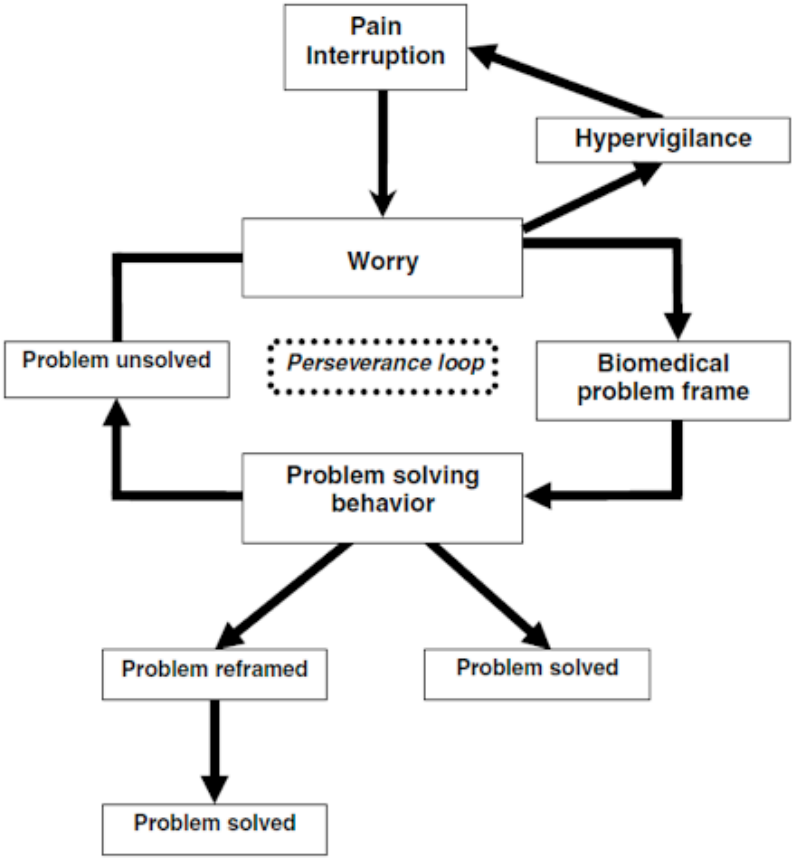
The CMM can be useful for understanding some of the elements that maintain catastrophizing. Furthermore, it raises the question, of what function pain catastrophizing serves. Meanwhile, the theory may be critiqued for being too narrow, as it only considers the social function of pain catastrophizing and does not define pain catastrophizing and its origin (Flink et al., 2013, p. 217).

The misdirected problem-solving model (MPSM)

The misdirected problem-solving model is based on existing theory, including the communal coping model and the fear-avoidance model (Flink et al., 2013, p. 217). Eccleston and Crombez (2007) presented the model in an effort to understand worry as a factor in chronic pain (p. 233), where catastrophizing can be conceptualized as an intense worry that gets worse and worse (Flink et al., 2012, p. 409). W*orry* is defined as a chain of negative thoughts concerning possible future threats that might have a negative outcome. It is perceived as a process that motivates problem-solving, avoidance behaviour, as well as attention to possible threats (Eccleston & Crombez, 2007, p. 233). Worry consist of a "what if…" questioning style, that is believed to prepare the individual for future threats and give the individual a possibility to avoid future negative consequences (ibid.). Eccleston and Crombez (2007) thereby perceive the individual as an active agent, who seeks solutions and worries about how to do so (p. 233). Worry is thereby defined in a problem-solving context.

Worries about social evaluation and physical wellbeing are argued to be common concerns. Worrying is often described as being hard to control, intrusive, and not always rational (Eccleston & Crombez, 2007, p. 233). It follows naturally that pain can generate worry, as pain often demands attention, and is often perceived as a threat (ibid.). Worry can be argued to be an adaptive process to seek a solution for future threats (Flink, et al., 2012, p. 12). However, Eccleston and Crombez (2007) argued that if worrying becomes maladaptive, the individual might end up in the perseverance loop (figure 2).

Figure 2 - The perseverance loop



The perseverance loop

Attention will continuously be drawn to the pain if it is persistent, resulting in increasing worries about the cause of pain and the consequences for self and others (Eccleston & Crombez, 2007, p. 234). Eccleston and Crombez (2007) argued that the general understanding of pain among laymen might still be defined in a *biomedical framework*, where the pain is seen as a physical reaction, that signals danger or serious injury (Flink et al., 2012, p. 409). This interpretation of pain might have server

consequence for the individual since worries might be fuelled even further if the pain is understood in these terms. Furthermore, the natural solution becomes to seek help from professional others, such as a doctor (Eccleston & Crombez, 2007 p. 234). This problem-solving strategy might not always be adaptive if the pain cannot be cured or relieved (ibid.). If this is the case unresolved pain can lead to even more worry, because the physical cause and solution are not found. The individual will thereby be even further motivated to seek a solution. However, if the pain is understood in a biomedical framework the possible solutions will be few, and will all be in relation to the physical aspect of pain and pain relieved. As a result, the individual can end up being stuck in a misdirected problem-solving strategy, where the individual continuously seeks pain relieved without success. Consequently, the individual gets caught in a perseverance loop, where no solution is given and the worry is continually fuelled (ibid., p. 235).

As a consequence worry and a biomedical framing of pain might end up preventing living a rich life despite the pain (Flink et al., 2013, p. 2017) and the effort to obtain pain relief might end up maintain the individual suffering and worrying instead of relieving it (Eccleston & Crombez, 2007, p. 235). Furthermore, a biomedical understanding of pain can elevate fear of different activities that might (re)injury and cause pain (ibid., p. 234), leading to the negative consequence describe in the fear-avoidance model. Confidence in problem solving might be a predictor for ending up in the perseverance loop. However, studies have not been able to confirm that individuals with chronic pain have poor problem-solving skills (Eccleston & Crombez, 2007, p. 234).

Fink and colleagues (2012) results supports the elements in the misdirected problem-solving model, as their results suggest that pain catastrophizing and medically orientated problem-solving behaviour (seek a doctor) are related. Conversely, they found that pain catastrophizing is the mediator between the biomedical framing and the medically orientated problem-solving strategy (Flink et al., 2012, p. p. 416). The direction of the model is therefore questioned, as it predicted that the biomedical framing is the mediator between catastrophizing and medically orientated problem-solving behaviour (ibid.). The results thereby indicate that pain a biomedical framing

of pain is a predictor for catastrophizing and not the other way around (Flink et al., 2012, p. 416), which is more in line with the fear-avoidance model.

Summary

The three theories each have different contributions to understanding pain catastrophizing. The fear-avoidance model (FAM) provides an understanding of how pain catastrophizing can influence pain perception. Whereas the communal coping model (CCM) raises the questions of what function pain catastrophizing may have and suggests that pain catastrophizing should be view in a social context. The misdirected problem-solving model (MPSM) also considers the function of pain catastrophizing and positions pain catastrophizing in a problem-solving context. In addition, the term worry is perceived as an integrated aspect of a pain catastrophizing process.

In the presented theories pain catastrophizing has been defined in different terms. The FAM and the MPSM conceptualising of pain catastrophizing are similar as the concept is defined as a cognitive process in both theories (Flink et al., 2012, p. 409; Vlaeyen & Linton, 2000. p. 230). However, the definition of catastrophizing is more elaborated in the MPSM, as it is described as consisting of a "what if…" questioning style (Eccleston & Crombez, 2007, p. 233). Furthermore, the process is more explicitly described as a process that can get worse and worse. In comparison pain catastrophizing is defined in relation to behaviour, specifically communicative pain behaviours in the CCM (Sullivan et al., 2004, p. 220).

All the theories describe a function or consequence of catastrophizing. In the FAM catastrophizing leads to pain-related fear and thereby avoidance behaviour and hypervigilance. In the CCM it is argued that the function of catastrophizing is the social support and empathy it can bring about in others, and lastly in MPSM it is suggested that catastrophizing function is to motivate a problem-solving behaviour. Pain catastrophizing can in all these models be seen as an adaptive function when the pain is acute since it promotes rest, prevention of a threatening situation by avoidance behaviour, help from others, and motivation to seek professional help. However, catastrophizing becomes maladaptive in chronic pain conditions.

In the CCM and the MPSM, the individual is view as an active problem solver. In the CCM the individual actively seeks support from others, and in the MPSM the individual actively seeks a solution to the pain.

Catastrophic worry

Tuner and Aaron (2000 p. 66) have argued that there is a tendency to conceptualize pain catastrophizing merely by the content of the pain catastrophizing scale, which is supported by Flink and colleagues (2013, p. 218). This conceptualisation leads to an understanding of catastrophizing defined by the content of the cognition (Flink et al., 2013, p. 221). Consequently, the process and function of pain catastrophizing are neglected, and it is not considered why people catastrophize (ibid., p. 218). Therefore, Flink and colleagues (2013) believe that this tendency hinders advancement in the theoretical underpinnings of catastrophizing (p. 218). For this reason, they argued that a new conceptualization of pain catastrophizing, termed catastrophic worry that focuses on the function of catastrophizing, is needed (ibid.). This new conceptualization is based on theories from current psychological literature and theories from the pain literature (CCM and MPSM)(ibid.). The theory builds on the assumption that catastrophizing has a function, as suggested in the communal coping model, as well as the notion that pain catastrophizing might be seen in relation to worry and problem-solving as proposed in the misdirected problem-solving model.

Definition of catastrophic worry

Flink and colleagues define catastrophizing, as a process comprised of repetitive negative thinking, resembling rumination and worry (Flink et al., 2013, p. 218). In the psychological literature *repetitive negative thinking* has been defined as "*a style of thinking about one´s problems (current, past, or future) or negative experiences (past or anticipated) that is repetitive, at least partly intrusive, and is difficult to disengage from*" (Ehring et al, 2011, in Flink et al., 2013 p. 218). This definition describes the insistent nature of the process of repetitive negative thinking (Flink et al., 2013, p. 219). Furthermore, it can be argued that the definition is in agreement with the term worry. Worry is often defined as *"... a chain of thoughts and images, negatively affect laden and relatively uncontrollable.* " (ibid.). This definition underpins the progress in worrying, as a developing chain of negative thoughts. Taken together,

worry can be defined as a respective negative thinking that is intrusive, passive, abstract and without a solution (Flink et al., 2013, p. 218f). By defining worry in these terms the content of the cognition is of less import, as it is the process and function that is of relevance. Therefore, Flink and colleagues (2013) argued that catastrophic worry is a better term for pain catastrophizing, when the aim is to understand the function and process of the pain catastrophizing (p. 219). Furthermore, they propose that the term catastrophic worry underlines the similarities between worry repetitive negative thinking and rumination (ibid.) and that catastrophic worry is perceived as a process that involves cognitions, behaviours, and emotions (ibid.).

The function of catastrophic worry

Flink and colleagues (2013) have argued that the function of catastrophic worry is to reduce negative emotions when in pain (p. 218). They have based this assumption on Stroebe and colleagues' (2007) theory and theories from the anxiety literature (Flink et al., 2013, p. 218).

Stroebe and colleagues (2007) present a theory concerning rumination in relation to bereavement (p. 462). In the bereavement, literature rumination has previously been defined as a confronting strategy where the individual is preoccupied with their sorrow (ibid.). Contrary to this conception Stroebe and colleagues (2007) argued that rumination can be defined as an avoidant strategy (p. 462), since it can be view as a counterproductive cognitive strategy the individual engages in to prevent confrontation with even worse feelings and thoughts (ibid., p. 467). When experiences the loss of a significant other it can have difficult to accept that the person is gone. By occupying one's thoughts with repetitive negative thinking, for example, about what the individual could have done to prevent the death of the other, the individual is not confronted with the loss of the loved one (ibid.). Thereby Stroebe and colleagues' (2007) theory support viewing rumination as an avoidance strategy. However, this strategy is maladaptive as it can result in poor problem solving because the real threat or issues (that the loved one is gone) is not addressed hindering any solution to the problem (ibid.).

Even though it can be argued that worrying relates to future events whereas rumination relates to past events (ibid., p. 465), Stroebe and colleagues argued rumination

and worry are similar concepts (p. 464). Therefore the function of rumination can be supported by the anxiety literature about worry. As an example, Borkovec has defined worry in following terms "*worry partly functions as a cognitive avoidance response to threatening stimuli… Worry distinctively involves a predominance of verbal thoughts whose function appears to be the cognitive avoidance of threat*" (in Stroebe et al., 2007, p. 468). This definition underlines that worry is a verbal process that functions as an avoidance strategy, which is comparable to the understanding of rumination in Stroebe and colleagues' theory. Worrying is thereby a way of occupying one's thoughts or distracting the individual from worse emotional threats (Borkovec et al., 2004, pp. 78, 82f; Stroebe et al., 2007, p. 468).

Studies have found that a verbal processing of fear does not initiate the same physiological response to a threat, as if the individual imagined the same threat (Borkovec et al., 2004, p. 83). Thereby the findings support that the physiological response to a threatening situation is muted by a verbal worrying process (ibid.). Furthermore, Borkovec and colleagues (2004) argued that the content of worrying might be superficial and less concrete than the underlying threats, and thereby worrying can be perceived as a distraction from these more threatening levels of content (p. 90). This argument is supported by Stöber, Tepperwien and Staak's (2000) study, where they found that the more worrisome the topic was the less concrete the content of the worrying was (p. 224)

In conclusion, it is argued that worrying is defined by its "what if…" questioning style, and that its function is to avoiding negative images, deeper underlying threats and the concomitant physiological responses (Borkovec et al., 2004, p. 83). Flink and colleagues (2013) have integrated this interpretation of the function of worry in their concept: catastrophic worry.

Maintaining factors of catastrophic worry

Flink and colleagues (2013) suggested that catastrophic worry is negatively reinforced since it dampers the emotional and physiological response to a threat (Flink et al., 2013, p. 218). The absence of a reaction is, therefore, a maintaining factor. Furthermore, worrying is often about future events that are believed to be threatening. A lot of threats therefore never actually happen and the individual usually copes better

with it than expected. Thereby the belief that catastrophic worry is a productive function is never disconfirmed but is negatively reinforced by the absence of the threat (Borkovec et al., 2004, pp. 87-88). Thereby catastrophic worry may be both positively and negatively reinforced in the short term. However, in the long term, catastrophic worry has negative consequences as it might bring to pain-related disability because it delays emotional responses and processing, which in turns increases anxiety and elicits depression (Flink et al., 2013, p. 218).

Summary

In summary, catastrophic worry is argued to be a form of repetitive negative thinking characterized by inflexibility and abstract content, which has the function of down-regulating negative emotional responses to a threat (Flink et al., 2013, p. 219). The individual can be trapped in repetitive, passive and abstract cognitions about future problems and negative experiences, which hinders the individual in engaging in problem solving (ibid.).

Thereby the theory builds on the conceptions that the individual is an active problem-solver as in the communal coping model (CCM) and the misdirected problem-solving model (MPSM). Furthermore, the theory about catastrophic worry suggests that catastrophic worry results in pore a problem-solving strategy, as in similar to the arguments in the MPSM.

Flink and colleagues (2013) argued that catastrophic worry is a transdiagnostic process meaning it is a function that courses vulnerability for several conditions hereunder, depression, anxiety and chronic pain. Therefore they propose that it is the process rather than the content that defines the construct (Flink et al., 2013, p. 219). In addition, this facilitate that catastrophic worry might be transferred to pain area (ibid., p. 218f).

The catastrophizing interview

Originally catastrophizing was described as a tendency to focus on the worst possible outcome in a situation with a possible unpleasant outcome (Tuner & Aaron, 2000, p. 65). In addition, it was argued that catastrophizing was related to a perception of

oneself as vulnerable and the impression of having lack of control when confronted with a threat (Tuner & Aaron, 2000, p. 65). Tuner and Aaron (2000) argue that this dimension of the catastrophizing is ill-represented in the current understanding and measures of pain catastrophizing, and it could be fruitful to further investigate this aspect (p. 66). Furthermore, they suggest that worry might be a construct closely related to catastrophizing (ibid., p. 68). The catastrophizing interview is a method that targets these dimensions, as it perceives catastrophizing as a process where worse and worse fear consequences are produced (ibid., p. 65). Therefore it can be argued to be a way of assessing Flink and colleagues' term catastrophic worry. In the following sections, catastrophizing will be described in the light of the catastrophizing interview and empirical studies will be presented.

Definition of catastrophizing in light of the catastrophizing interview

The catastrophizing interview technique is developed by Vasey & Borkovec (1992) to assess and study the automatic questioning style defined as catastrophizing (Vasey & Borkovec, 1992, p. 509f). The catastrophizing interview is a method that initiates a catastrophizing process by repeatedly asking what it is about the selected topic that is worrying, mimicking a "what if…" questioning style (ibid., pp. 508-510). Thereby it can be perceived as a way to initiates a process that resembles catastrophic worry.

The catastrophizing interview technique is based on Kendall and Ingram's theory, suggesting that individuals with anxiety have an automatic "what if…?" questioning style, which creates anxiety and worry (1987, p. 96). This internal dialog can be defined as *catastrophizing* if it is automatic, intrusive and elevates the individual's unpleasantness. Worrying can be an adaptive process preparing the individual for future threats (Hazlett-Stevens & Craske, 2003, p. 387). In comparison the catastrophizing process does not lead to a solution (Kendall & Ingram, 1987, p. 96), instead it leads to the production of worse and worse feared consequences to a specific worrying topic, as a result of the automatic "what if…?" questioning style (Davey and Levy 1998, p. 576). This definition of catastrophizing is thereby comparable to Flink and colleagues' (2013) theory, though the avoidance function of catastrophizing is more explicitly addressed in the theory concerning catastrophic worry.

Catastrophizing steps

Several studies have conducted the catastrophizing interview and found that high worriers produce more catastrophizing steps for a given worry (Davey & Levy, 1998; Hazlett-Stevens & Craske, 2003; Vasey & Borkovec, 1992). Supporting this notion even further, David and Levey's (1998) findings suggest that high worriers, in general, produce more catastrophizing steps, even if they have never elaborated the topic before, or have to produce positive consequences/steps.

Conversely, Provencher and colleagues (2000) were not able to replicate this result. The reason for the discrepancy may be methodological. Provencher and colleagues (2000) used the average of catastrophizing steps from several worrying topics of different intensity, whereas the other studies did not use an average but instead the number of catastrophizing steps from the most worrying topic. It is possible that it might have affected the results, as it is found that participants seem to generate fewer feared consequences when the worry is less intense (Provencher et al., 2000, p. 220). Contradicting this notion Stöber and colleagues (2000) found that the number of fear consequences did not differ between different levels of worrying topics (p. 223).

It should be noted that the participant, in general, produced more catastrophizing steps in Provencher and colleagues (2000) study compared to the other studies (Davey & Levy, 1998; Hazlett-Stevens & Craske, 2003; Stöber et al., 2000; Vasey & Borkovec, 1992). One explanation could be a difference in the stop rule of the interview. When the participant gave their last answer, they were asked if it was the worst possible outcome they could imagine. (Provencher et al., 2000, p. 214). The method thereby promotes more steps than in the other studies. Consequently, it is plausible that non-worriers produced more consequences than they would otherwise have done. Overall, however, it seems that high worriers produce more fear consequences as a result of the catastrophizing interview technic compared to low worriers.

One theory is that high worries or anxious individuals will have more highly elaborated threat schemata stored in long-term memory and that this information is stored in tight clusters making the information more accessible (ibid., p. 212). When activating one worry the next is easy to access. High-worriers should therefore be able to

produce more feared consequences, as they are content in their memory compared to non-worriers (Vasey & Borkovec, 1992, p. 506). The theory is support by David and Levy (1998) study, where they found that high worriers have a higher tendency to produces similar catastrophizing steps in relation to different topics (Davey & Levy, 1998, p. 580).

In addition, David and Levy (1998) study supports that high worriers, in general, tend to generate more catastrophizing steps even if asked to generate positive consequences (ibid., p. 578), suggesting that worriers have a tendency to keep analysing the problem. The catastrophizing interview is an open-ended task, with no explicit stop rule. Therefore the participants have to amply an implicit "stop role" to know when to end the interview (Davey, 2006, p. 169). It might be that worriers have an "as many as can" stop rule for worrying, so they have to address all issues surrounding the worry (ibid.). An explanation could be that these individual perceive worrying as a way of preventing negative and threating experiences in the future (Davey & Levy, 1998, p. 579), and thereby see catastrophizing as a vital process to prevent negative and threating experiences in the future (ibid., p. 580f). Furthermore worrying can be seen as a way to prevent failure, and thereby assuring approval (ibid., p. 584).

Ratings of unlikeliness and unpleasantness

Some findings support that high worriers perceive the consequences produced in the catastrophizing interview as more plausible than non-worriers (Vasey & Borkovec, 1992; Provencher et al., 2000). Provencher and colleagues (2000) suggest that highly elaborated and accessible threat schemata might contribute to the perceived likelihood of these events, based on the theory that the estimated likelihood of an event can be influenced by the ease the information comes to mind (p. 212). Thereby high-worriers might perceive the catastrophizing steps as more plausible than non-worriers because they come to mind more easily. Conversely, Hazlett-Stevens and Craske (2003) were not able to replicate these findings (p. 397). In comparison with the other studies Hazlett-Stevens and Craske (2003), gave the participants 6 particular topics, which might be the reason for the discrepancy (p. 398). It is plausible that the perceived likelihood merely is different for non-worriers compared to high-worries when it concerns the topic that is most worrying to the individual. In conclu-

sion, the individual's perceive likelihood might depend on the worrying topic (Hazlett-Stevens & Craske, 2003, p. 398).

Vasey and Borkovec (1992) have found that high-worriers discomfort ratings during the catastrophizing interview increased more during the interview compared to low-worriers. Similarly, Hazlett-Stevens and Craske (2003) findings suggest that high worriers have higher levels of negative mood at the end of the interview compared to low worriers. Provencher and colleagues (2000) argued that the catastrophizing interview might activate profound threat schemata and thereby render threatening information more accessible creating more anxiety during the interview (p. 221).

The last steps in the catastrophizing interview

Vasey and Borkovec (1992) argued that the catastrophizing interview can reveal a deeper level of meaning (p. 508), resembling underlying schemata. In continuation hereof, it has been argued, that the last produced catastrophizing step particularly reflect profound threat schemata (Provencher et al., 2000, p. 212f). This argument has been supported by Provencher and colleagues (2000). They found that high-worries last catastrophizing step was more severe than low-worries (ibid., p. 220). Additionally it was found that high worriers last produced statements had more similar content when comparing different topics compared to non-worriers (ibid., p. 221),

Underlying schemata

Several studies suggest that high worriers produce more catastrophizing steps related to failure and inadequacy reflecting a self-questioning schema (Davey & Levy, 1998; Hazlett-Stevens & Craske, 2003; Vasey & Borkovec 1992). In Davey & Levy (1998) study personal inadequacy was a theme that dominated among high worriers even if the topic were preselected (p. 581f).

Kendall & Ingram (1987) defines *schemata* as a structure through which the individual interprets the world and guides the individual's information processing. Schemata are formed by past experiences, which is stored in a way that influences our perception of future experiences (Kendall & Ingram, 1987, p. 90). Kendall and Ingram (1987) have argued that individuals with anxiety have two primary schemata that might be part of the maintenance of anxiety; a self-questioning schemata and a harm

full others schemata (Kendall & Ingram, 1987, p 92). The findings support that personal inadequacy is a theme that dominates among high-worriers even if the topic is preselected, suggesting that the answer to the internal dialogue of "what if…?" is appraised in light of the individuals own self-image. If the individual generally believed that problems are overwhelming and perceive their ability to coop with them poorly, it might be difficult to find a solution to the problem. Thereby the worrying process can continue, with the individual worrying even more about personal inadequacy (Davey & Levy, 1998, p. 584). In continuance hereof, Kendall and Ingram (1987) argue that the underlying self-inadequacy schemata interact negatively with the "what if…?" questioning style. They proposed that the "what if…" question style stops being a reflective process to evaluate and solve problems. Instead every "what if…?" questions comes to represent yet another problem the individual cannot handle, promoting uncertainty and anxiety (Kendall & Ingram, 1987, p. 96).

Summary

In summary several studies support that high worriers produce more catastrophizing steps for a given worry (Davey & Levy, 1998; Hazlett-Stevens & Craske, 2003; Vasey & Borkovec, 1992) and have more unpleasantness in relation to these (Vasey & Borkovec, 1992; Provencher et al., 2000; Hazlett-Stevens & Craske, 2003) and perceive these steps as more likely to happen than non-worriers (Vasey & Borkovec, 1992; Provencher et al., 2000).

Several processes seem to interact making the catastrophizing process more elaborated, unpleasant and likely. An "as many as can" stop rule and, a self-inadequacy schema can prevent the individual reaching a solution, and thereby prevents the catastrophizing process in reaching closure (Levy & Davey, 1998, p. 584). The prolonged process can create more uncertainty and anxiety because the individual is confirming the self-inadequacy schemata by not reaching a solution (Kendall & Ingram, 1987, p. 96). Furthermore, the more often the individual engages in the catastrophizing process the more elaborated and tight clustered the threat schemata becomes, making the information more accessible, which can make the individual perceive them as more plausible (Provencher et al., 2000. p. 212).

Can pain catastrophizing be manipulated?

Several studies have tried to manipulate pain catastrophizing by increasing the perceived threat related to the pain or by the use of self-statements. In the following sections, a review of these studies will be given.

The impact of exaggerated threat levels

Some studies have tried to increase pain catastrophizing by elevating the perceived threat related to the pain (Jackson et al. 2005; Severeiins et al., 2004). Jackson and colleagues (2005) have argued that individuals who perceive pain as threatening have a tendency to catastrophize more, which may lead to a reduction in pain tolerance threshold. Pain catastrophizing is seen as a link between fear of pain and reduction in pain tolerance threshold (Jackson et al., 2005, p. 443). The theoretical foundation for these studies therefore fits well with the fear-avoidance model of pain, that defines pain catastrophizing as a cognitive process, through which pain is (mis)interpret as being extremely threatening, which in turn can have an impact on fear of pain and the perceived pain (Leeuw et al., 2007, p. 79).

The studies investigate this theory by manipulating the threatening information the participants are given before an unpleasant pain task (Jackson et al. 2005; Severeijns et al., 2004). For example, Severeijns and colleagues (2005) tried to increase pain catastrophizing by telling the participants that there was a risk of fainting during a cold pressor task (p. 260). Their findings support that pain catastrophizing can be significantly manipulated, though the effect is small. Conversely, their findings do not support that pain catastrophizing has an effect on the participants' pain ratings (Severeijns et al., 2005, p. 262). In comparison, Jackson and colleagues findings indicate that manipulation of the perceived threat leads to a higher tendency to catastrophize and a lower pain tolerance (Jackson et al., 2004, p. 448).

The studies can be critiqued for not directly manipulate the cognition of catastrophizing, but instead rely on the manipulation of the perceived threat of pain (Bialosky et al., 2008, p. 36). Therefore it can be questioned if the studies investigate the causal relation between pain and pain catastrophizing or if they investigate other related constructs, such as fear of pain and anxiety in relation to pain. On the other hand, the

studies imply that the perceived threat level of pain has an impact on pain catastrophizing, and thereby that catastrophizing might be manipulated.

Self-statements and pain catastrophizing

Other studies have investigated the causal relation between pain catastrophizing and pain perception in a more direct way, by manipulation the specific cognitions catastrophizing is argued to comprise of (Bialosky et al., 2008, p. 36). The participants are given or select a self-statement from the pain catastrophizing scale (PCS), which they are asked to repeat during an unpleasant and potentially painful task (Bialosky et al., 2008; Roditi et al, 2009; Rusheweh et al., 2013). The theoretical assumption in these studies is consequently founded on the theory of pain catastrophizing scale, where pain catastrophizing is viewed as a stable process. Therefore there is a theoretical discrepancy in these studies because catastrophizing theoretically is view as stable, but the aim is to manipulate it.

Bialosky and colleagues (2008) did not manage to manipulate pain catastrophizing, and they suggest that it might be difficult to do so (p. 39). On the other hand, Roditi, Robinson, and Litwins (2009) found a small but non-significant within-subjects effect. Thereby their result is questionable but the findings might suggest that pain catastrophizing can be manipulated and have an effect on pain tolerance threshold (Roditi, et al., 2009, p. 113). Conversely, they did not find that manipulation of pain catastrophizing affected peak pain intensity, implying that the participants endured pain differentially despite that fact that they reported the same peak pain intensity (ibid., p. 114). It can, therefore, be debated if the only thing that changed were the participants' willingness to endure pain, as a result of the participants wished to please the experimenter (ibid.). The study was therefore vulnerable to *experimental demands,* defined as different kinds of signs in the experiment that gives the participant an idea about how they should react (Coolican, 2014, p. 106).

Rusheweyh and colleagues (2013) found significantly elevated pain ratings if a statement from PCS was repeated during an electrical stimulation of the sural nerve (pp. 726-728). In addition, the participants rated that they felt they had been able to increase their pain catastrophizing during the stimulation (ibid., p. 728). Compared to the other studies Rusherweyh and colleagues (2013) did not ask the participant to

repeat the statements aloud. In stead, the participants were urged to silently repeat the statements and engage in the thoughts and feeling relating to these (Rusheweyh et al., 2013, p. 727).

In summary, the sparse empirical studies suggest that it is a possibility that catastrophizing can be manipulated somewhat in an experimental design, but the effect is small. Manipulation through self-statements can be seen as a more direct way of doing so. Furthermore, it raises the question if catastrophizing can be perceived as a process or a more stable trait, challenging the theoretical assumptions of the construct.

Purpose

The study holds the concept of catastrophic worry presented by Flink and colleagues (2013) that argued that catastrophic worry is an integrated aspect of a pain catastrophizing process. From this argument, it follows that catastrophic worry might also have an impact on pain perception. By combining Flink and colleagues' (2013) argument with the theory and empery from pain catastrophizing the following problem statement emerges:

Are catastrophic worry and pain catastrophizing related concepts?

The first aim of this study is to investigate whether pain catastrophizing can be actively manipulated using the pain catastrophizing interview technique developed by Vasey and Borkovec (1992), by making healthy participants generate a number of catastrophizing steps within pain. Pain tolerance threshold (PTT), situational pain catastrophizing scale (PCSs), the number of catastrophic steps produces and the likelihood of the catastrophic steps will be measured. The second aim is to explore the cognitive content (threat schemata) that emerges during the pain catastrophizing interview technique using a thematic analysis.

In the theory presented it has been argued that pain catastrophizing has an impact on pain perception (Campbell et al., 2010; Dixon et al 2004; Edwards et al., 2005; Keefe et al., 2004; 4et al., 2013; Sullivan et al 2001; Sullivan, 2000; Turner & Aaron,

2001). In addition it has been argued that individuals with a high tendency to catastrophize will produce more steps in the catastrophizing interview (Davey & Levy, 1998; Hazlett-Stevens & Craske, 2003; Vasey & Borkovec, 1992). Several hypotheses have been deduced:

1. If the number of steps in the pain catastrophizing interview is a measure for pain catastrophizing, it follows that *subjects that generate a larger number of catastrophizing steps will have lower pain tolerance thresholds*.

2. In addition, if situational-PCS and the catastrophizing interview is both a measure of pain catastrophizing *it might follow that the ratings of the situational pain catastrophizing scale will be positively correlated with the number of catastrophizing steps produced in the catastrophizing interview.*

3. Furthermore, if pain catastrophizing has an impact on pain rating, *pain catastrophizing measured by the situational pain catastrophizing scale should be negatively correlated with pain tolerance threshold*.

4. It has been argued that individuals that have a tendency to catastrophize will rate their catastrophizing steps more likely (Provencher et al., 2000). The following hypothesis emerges: *the average of the rated likelihood of the steps in the catastrophizing interview will correlate with pain tolerance threshold.*

5. It has been suggested that individuals who have a tendency to catastrophize produce more steps in the catastrophizing interview concerning failure and inadequacy reflecting a self-questioning schema (Davey & Levy, 1998; Hazlett-Stevens & Craske, 2003; Kendall & Ingram, 1987; Vasey & Borkovec 1992). Leading to the following hypothesis: *participants who produce steps related to failure and inadequacy will have a lower pain tolerance than participants who did not.*

Method

Participants

The intention was to recruit 20 female students from Aalborg University. The participants were recruited a roundabout way, as fellow students were asked to participate. Previous studies have found a substantial gender difference in ratings of pain catastrophizing (Sullivan et al., 1995, p. 525; Sullivan et al., 2000). In addition, the researcher of this study is a young woman, which might have had a different impact on men compared to women (Levine & deSimone, 1991). To preclude this confounding factor only women were asked to participate.

To prevent health problems and other confounding factors that could affect the participants' pain perception, the following inclusion and exclusion criteria were made:

- The participant must give informed consent.
- The participants must be female.
- The participant must be healthy and pain free.

The participants were excluded if:

- The participant had chronic pain
- Had any blood pressure condition
- Had taken analgesic medication 24 hours prior to the experiment
- Had any problems with their dominant hand, scar, eczema, etc.
- Had any psychiatric disorder
- Had any neurological disorders
- Were pregnant or breastfeeding

The exclusion criteria were formulated based on previous studies (Bialosky et al., 2008; Jackson et al., 2005; Wilson et al., 1995), and recommendations from the supervisor of this study (L. Petrini, personal communication, 01.03.18).

Ethics

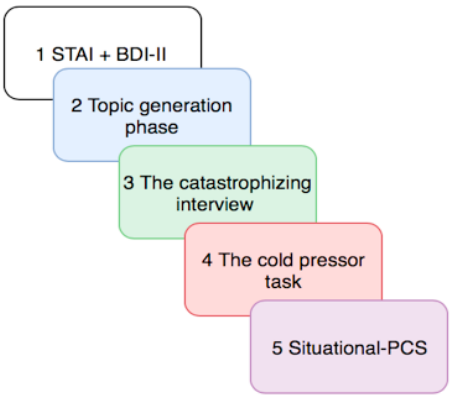
All participants gave informed consent, after a thorough instruction about the experiment verbally and in writing (appendix 1). The participant had control over the administered pain, as they could remove their hand from the cold pressor task at any

time. In addition, the participant could drop out of the experiment at any time, and several exclusion criteria were made, in accordance with the Declaration of Helsinki for medical research (2013). The study was supervised by Laura Petrini (Associate Professor at SMI and Department of Communication and Psychology, Aalborg University), who has previous experience with the cold pressor apparatus and pain research and several pilots were made with Laura Petrini supervising. All information was handled anonymously and confidentially. After the experiment, the participants were debriefed about catastrophizing and why the experiment was conducted. All the questions the participants' had were answered after the concluded experiment.

Procedure

The aim of the study and how the experiment was going to proceed was explained, followed by the participants signing the informed consent (appendix 2). Afterwards, the participants were asked some general questions, and filled out two scales: The Beck's Depression Inventory (BDI) and the State-Trait Anxiety Inventory (STAI), in this order.

Figure 3 - Overview of the procedure



Topic generation phase

Based on Gouin and colleagues' (2014) protocol, worry was described in the following terms:

> *"Worry is a chain of negative thoughts, about something that can have a negative consequence for you in the future. Typically people worry about something that hasn't happened yet, but that could happen in the future, and that is negative."* (p. 417)

The participants had two minutes to freely recall as many worrying experiences from their life as possible, based on Vasey and Borkovec's (1992) protocol. The topics were written down on a response sheet. Afterwards, the participants rated how worrying each topic was to them at the time of the experience, using a numerical rating

scale range from 0 (not worrying) to 100 (very worrying). The most worrying topic was elaborated by asking the participant about the experience. If the participant rated several topics as equally worrying, the most recent topic was chosen. If none of the most worrying topics were more recent the first topic the participant recalled was chosen. To illustrate the catastrophizing interview technique, this worrying topic was selected and the procedure was conducted until tree catastrophizing steps were produced (see below).

In continuation hereof, the participant completed the same task but this time in relation to a physically painful experience. The participants were asked to recall and write down physically painful experiences, and rate if they had any worries during these painful experiences, using a numerical rating scale ranging from 0 (not worrying) to 100 (very worrying). The topic for further elaboration and the full interview was selected in the same way as the worrying topic.

The Catastrophizing Interview Technique

Based on Provencher and colleagues' (2000) protocol, the researcher described the procedure of the interview and initiated the catastrophizing phase by asking "*What is it about (blank) that worries you?"* where blank was replaced with the most worrying painful topic. The participant generated a list of catastrophizing steps about the worrying painful topic by answering the question "*If (blank) actually happened, what are you afraid would happen next?"* where the blank was replaced with the participants' previous answer. For example, if the participant's most worrying painful experience was stomach ache, the first question would be "What is it about the stomach ache that worried you" If the participant replied "I was frightened about what it might be", the researcher asked "If you were actually frightened about what it might be, what were/are you afraid of would happen next?", and so on[1]. This sequence was continued until the participants did not have a reply. The participants were asked if their last reply was the worst possible consequence they could imagine. If not, the interview continued until this was the case.

[1] The example is taken from the current study (participant 22)

The participants wrote their replies down on a response sheet and were urged to produces only one answer and to keep the answer short and in between the appropriate lines on the response sheet. As argued by Davey and Levy (1998), this would help prevent an over-elaborated response with more than one worry, and a hardcopy of the interview would be made (p. 578). As in Vasey and Borkovec's (1992) study, the participants rated their discomfort on a numerical rating scale range from 0 (no discomfort) to 100 (extreme discomfort) after every catastrophizing step. They were asked to rate it according to their discomfort in the present moment in relation to the catastrophizing steps. After the interview was completed the researcher repeated the catastrophizing steps that were generated and asked the participant to rate the likelihood (0-100%) of each reply, if the last reply actually happen.[2]

The cold pressor task

The participants placed their non-dominant hand in warm water (33-36°C) for 15 sec. to stabilize skin temperature. Their hand temperatures were measured using a digital thermometer held tightly in the palm of the hand. The temperature of the hand was between 29-33°C before the participants submerge their non-dominant hand in cold water (5°C). The hand was held two centimetres above the wrist with the palm of the hand facing up in a relaxed position to standardize the procedure, as recommended by Birnie and colleagues (2012, p. 823). The participants were instructed to verbally state the moment they first felt pain during the cold pressor task, but to keep their hand in the cold water for as long as possible. The researcher was the only person in the room and placed at another table to avoid any distractions as recommended by Birnie and colleagues (2012, p. 823).

To ensure that there would be no adverse effects of the cold pressor task the maximum time the participant could have their hand in the cold water was set to three minutes. Unfortunately, two of the first three participants reached the maximum time. Therefore, the maximum was raised from three minutes to five minutes, after the first three participants, to prevent a ceiling effect of the task. As advocated by Birnie and colleagues (2012), the participants were not informed of the maximum time, as it could affect the participants' pain tolerance threshold (p. 823). However,

[2] See table 2 and 3 in "Topic analysis" for an example of the catastrophizing interview.

they were told that they could be asked to take their hand up before they chose to do so themselves.

Based on a study using a similar protocol (Roditi et al. 2009 p. 111). The participants' *pain detection threshold (PDT)* was defined as the time period between the immersion of the hand into the cold pressor apparatus to the moment the participant verbally stated they felt pain. The *pain tolerance threshold (PTT)* was defined as the time period from the immersion of the hand to the moment the participant withdrew their hand from the cold pressor apparatus. Both measurements (PDT and PTT) were recorded with a stopwatch.

Statements during the cold pressor task

During the cold pressor task, the participant had one or two statements from the catastrophizing interview in front of them on a piece of paper. The statements that related mostly to the pain were chosen, which was typically the first statements produced in the catastrophizing interview. The participants were instructed to repeat the statements internally and engage in the thoughts and feelings associated with them, during the cold pressor task.

The situational-PCS and debriefing

After the cold pressor task, the situational pain catastrophizing scale was administered (PCSs). Finally, the participants rated if they had been able to engage in the statement given and the thoughts and feelings associated with it during the cold pressor task, using a numerical rating scale ranging from 0 (thinking about all sort things) to 100 (fully engaging in the statement). After the experiment, the full purpose of the experiment was made clear to the participants.

Pilot

Several pilot studies were conducted, allowing the interviewer to acquired experience with the procedure. First, the researcher conducted a pilot on the catastrophizing interview technic on two young female psychology students. Both participants had no trouble understanding the procedure and produced several pain topics (4,11) and catastrophizing steps (9,10), suggesting that the procedure was easy to understand

and that the task was possible. Likewise, a pilot of the whole procedure went successfully.

Small alterations in the protocol were made based on the pilot. One alteration was to have the participant elaborate their free recall about the topic, which was most worrying to them, a bit further. Another alteration was made regarding the rating of discomfort. The two participants in the pilot study rated their discomfort differently, one according to how she felt here and now, and the other according to the feeling she had at the time of the worry. Therefore the instructions were changed to ensure the clarity of the task. Furthermore, the decision about which statements to select for the cold pressor task was modified. Originally the idea was to choose the last statement, since the theory suggests that it represents a core fear schemata (Provencher et al., 2000, p. 220; Vasey & Borkovec, 1992, p. 508), but it was found that these statements did not relate to the painful experiences per se; "*Helt alene"* (all alone) and "*At man ikke kunne komme ud af det igen"* (That you were not able to get out of it again). Therefore the statements relating mostly to pain were chosen for the cold pressor task.

Materials

The cold pressor apparatus

The cooling system and water flow were standardised using an electric-cooling apparatus (Thermo Scientific), containing 20 litres of water. The apparatus controlled the temperature and kept it stable during the task, which is very important since small alteration in temperature can affect pain tolerance threshold (PTT) (Mitchell et al., 2004, p. 235). A circulation system secured an even circulation of the water, preventing heat from building up around the hand, creating variability in the water temperature, which can affect the participant PTT (ibid.). Water temperature used in the cold pressor task in previous studies have varied between 0°C to 7°C (ibid., p. 234). 5°C (+/- 0.5°C) was chosen as a middle point. The temperature was chosen in hope that the temperature would be warm enough, so the duration of time the hand was submerged in the water would exceed at least a few seconds. In addition, to the water still being cold enough to prevent participants from reaching the maximum immersion time.

The situational-pain catastrophizing scale (PCSs)

The pain catastrophizing scale is a self-report measure of catastrophizing. It contains 13 statements reflecting thoughts and feelings that individuals can experience during pain. The scale has been developed on the base of qualitative studies examining this topic (Sullivan et al., 1995, p. 524f). In the standard-PCS, the participant is instructed to reflect on previous painful experiences and indicate to which degree they experience each statement on a scale from 0 (not at all) to 4 (all the time). The maximum score of the scale is 52. (ibid., p. 525). In the current study the instruction to the scale was altered, so the statements were rated in relation to the specific painful situation (appendix 3). The instruction is similar to what has been used in other studies (Edwards et al., 2006). As described in the theory, the scale consists of three subscales: rumination, helplessness, and magnification.

State-Trait Anxiety Inventory (STAI)

Spielberger's State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1983) was used in this study. The scale was in English, but because of the STAI simplicity (Mindgarden Inc., 2018), it was estimated that the participants' vocabulary in English was sufficient and therefore it was not perceived as a problem. The researcher was available if any translation was needed. The STAI is one of the most widely used self-rating scales in both clinical practice and research (Balsamo et al., 2013, p. 476). Moreover, the STAI takes around 10 minutes to administer and is thereby a quick assessment tool suitable for this study.

The STAI assesses the symptoms relating to anxiety in adults and distinguishes feelings of anxiety from depression (Mindgarden Inc, 2018). The instrument is divided into two sections containing 20 items each. The first part measures state anxiety, defined as a more temporary or fluctuating form of anxiety. Whereas the second part measures trait anxiety, defined as a more long-term personality trait (Rule & Traver, 1983, p. 276). State anxiety and trait anxiety are thereby regarded as two separate concepts (ibid.), supported by test-retest reliability (r=.40 (state), r=.86(trait) (ibid.).

Each item is rated on a four point likert scale from ("not at all" to "very much so"). The participant can score between 20 and 80 points, where the higher scores indicate

greater anxiety (Balsamo et al., 2013, p. 478). The statements are associated with the symptoms relating to anxiety, but some of the statements are positive and are believed to be related to the absence of anxiety and are therefore scored reversed (ibid., p. 476)

Several studies suggest that STAI has a good validity (Peterson & Heilbroner,1987; Smeets et al, 1997), and a good internal reliability in a non-clinical sample (α= .92) (Balsamo et al., 2013, p. 478). Though it is debated if the STAI-trait subscale can be considered as a pure measure of anxiety, or instead as a measure of general vulnerability to psychological disorders (ibid., p. 484). In this study, STAI is used to give a general indication of anxiety. Therefore the exact distinction between depression and anxiety is not as crucial as if used in a diagnostic relation.

Beck Depression Inventory (BDI- II)

Beck Depression Inventory is one of the most widely used self-reporting depression assessment tools. Its objective is to assess the present and degree of depressive symptoms in adults (Beck, et al., 1996, p. 589; Steer et al., 2000 p. 312). The BDI- II has been modified to make the scale consonant with the diagnostic criteria for major depressive disorders as described in the American Psychiatric Association's (1994) Diagnostic and Statistical Manual of Mental Disorders, 4th ed., (DSM-IV) (Beck, et al., 1996, p. 589). The items are based on a systematic review of statements from patients with depression (Beck et al., 1961, p. 562).

The scale consisting of 21 groups containing four items each. The four statements are ranked on a four-point likert scale ranging from 0 (the symptom is not present) to 3 (the symptom is severely present) (ibid.). The participant is asked to choose the statements that best resembled their condition during the past two weeks (Beck, et al., 1996, p. 589f). The scale ranges from 0 to 63 points and has the following scoring intervals: ≤13 normal or minimal depression; 14-19: mild depression; 20-28: moderate depression; ≥ 29: severe depression (ibid., p. 590). Several studies have found that BDI has a good validity in both a clinical sample (Steer 1999; Steer 2000) and a non-clinical sample (Storch et al., 2004). For example the correlation between Hamilton Depression Scale and BDI-II is found to be good (r=.71) (Steer et al., 1999, p. 188) and the internal reliability is acceptable (α= .90-.91) (Beck 1996a; Steer et al., 1999; Steer et al., 2000; Storch et al., 2004).

Results

Descriptive

20 young female participants were included in the study. All participants were students from Aalborg University. The majority were psychology students (15, 75%). 5 out of 20 participants had previously participated in experiments with experimental pain and 5 participants reached the maximum pain tolerance thresholds (PTT). Because the maximum time was increased to 300 sec., two participants had a PTT of 180 seconds and 3 participants had a PTT of 300 seconds. During the interview, it was reviled that two of the participants have had depression several years ago (14, 22[3]) and that one participant had self-harming behaviour when she was a teenager (13). Further descriptive data can be found in table 1.

Table 1
Descriptive data

Measure	M	SD	Range	
			Low	High
Age	22.50	1.61	20	26
Education (years)	16.40	1.57	14	18
PTT (sec)	100.21	99.02	26	300
BDI (max score 63)	6.60	6.24	0	23
PCSs (max score 52)	24.50	10.51	1	41
PCS (max score 52)	20.70	10.69	0	37
STAI-S*	45.28	7.93	35	60
STAI-T	51.00	11.03	35	72
Steps (CI)	9.95	6.41	3	26
Average likelihood (CI)**	55.55	17.55	16.00	83.33

*N=18 (Two participants did not rate one of the questions, therefor they were exclude from this analysis)
**N=17 (There was missing data from three participant, therefor they were exclude form this analysis)

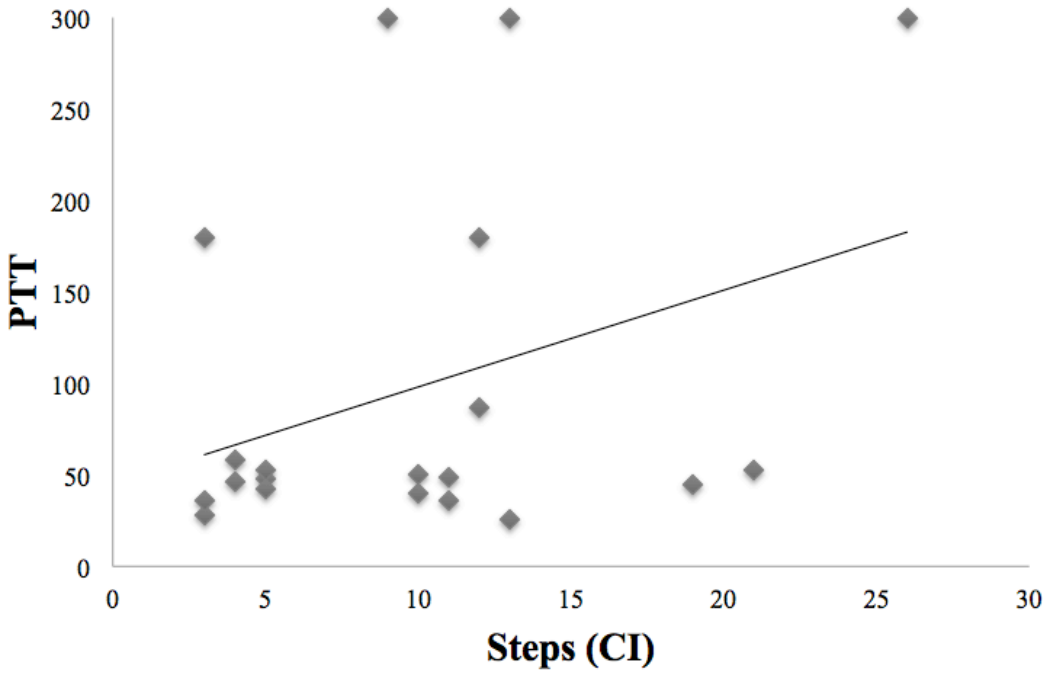
[3] Participant number

Statistical analysis

The aim of the statistical analysis was to test the presented hypotheses (see purposes). The data were tested for normality using the Shapiro-Wilk test. The pain tolerance thresholds were not normally distributed ($p < .001$*); therefore non-parametric tests have been used for all the analysis using this measure (Coolican, 2014, p. 457). The α-level was set at 0.05 (ibid., p. 415) and IBM SPSS V24 was used for all the statistical analysis.

1) *Subjects that generate a larger number of catastrophizing steps will have lower pain tolerance thresholds (PTT).* The literature supports a directional hypothesis; therefore a Spearman´s rho one-tailed analysis has been computed to assess the negative relationship between the number of steps produced in the catastrophizing interview (CI) and the pain tolerance thresholds (PTT). The result did not confirm the expected relation ($r=.246$, $n=20$ $p=.148$). Contradictory the correlation was positive as illustrated by the scatterplot (figure 3).

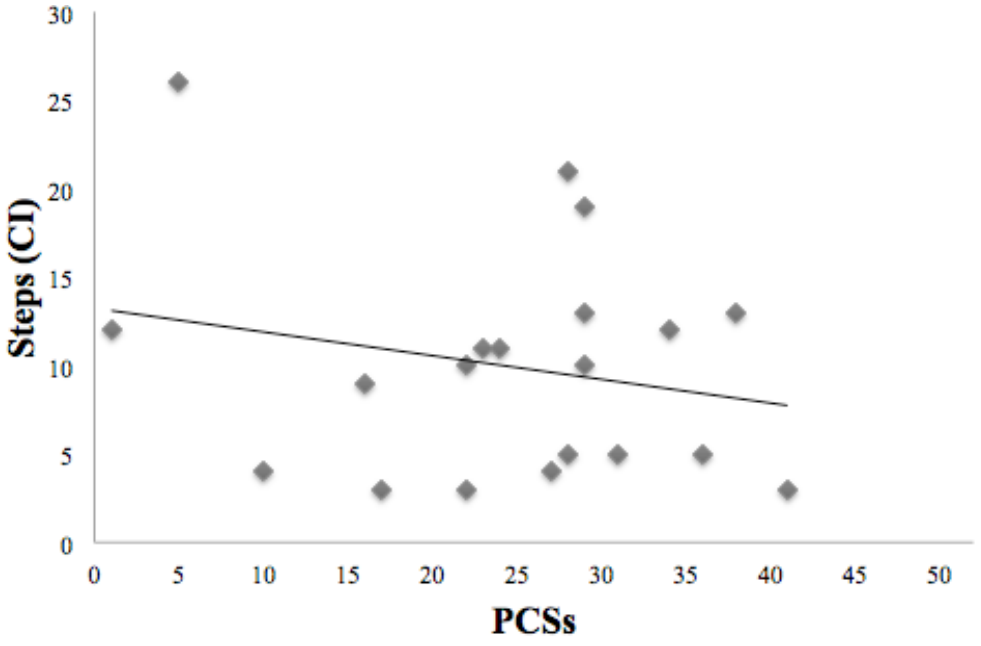
Figure 3



The correlation between pain tolerance thresholds and the number of steps produced in the catastrophizing interview

2) *The ratings of the situational pain catastrophizing scale will be positively correlated with the number of catastrophizing steps produced in the catastrophizing interview***.** In the theory, there is argumentation for a directional hypothesis. The number of steps produced in the catastrophizing interview was not normally distributed (p=0.024*), therefore, a non-parametric test was used. A Spearman´s rho one-tailed analysis has been computed to analysis the positive relationship between the ratings of the situational pain catastrophizing scale (PCSs) and the number of steps produced in the catastrophic interview (CI). No significant relation was found (r=.022, n=20, p=.463). The result does therefore not confirm any relation between situational-PCS and the number of produced steps it the (CI). The result is summarized in the scatterplot (figure 4).

Figure (4)

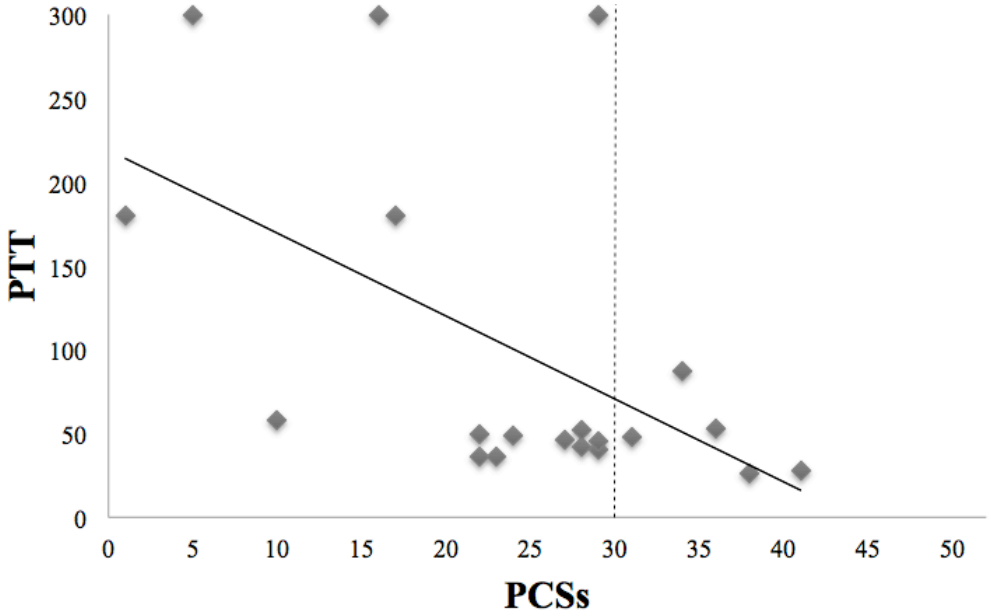


The correlation between the number of steps produced in the catastrophizing interview and the situational pain catastrophizing scale.

3) *Pain catastrophizing measured by the situational pain catastrophizing scale should be negatively correlated with pain tolerance threshold*. The literature supports a directional hypothesis; therefore a Spearman´s rho one-tailed analysis has been conducted to analyse the negative relationship between the ratings of the situational pain catastrophizing scale (PCSs) and pain tolerance threshold (PTT). There was a significant negative correlation between the two variables (r=-.491,

n=20, p=.014*). Supporting a negative correlation between ratings of the PCSs and PTT. A scatterplot summarizes the results (Figure 5).

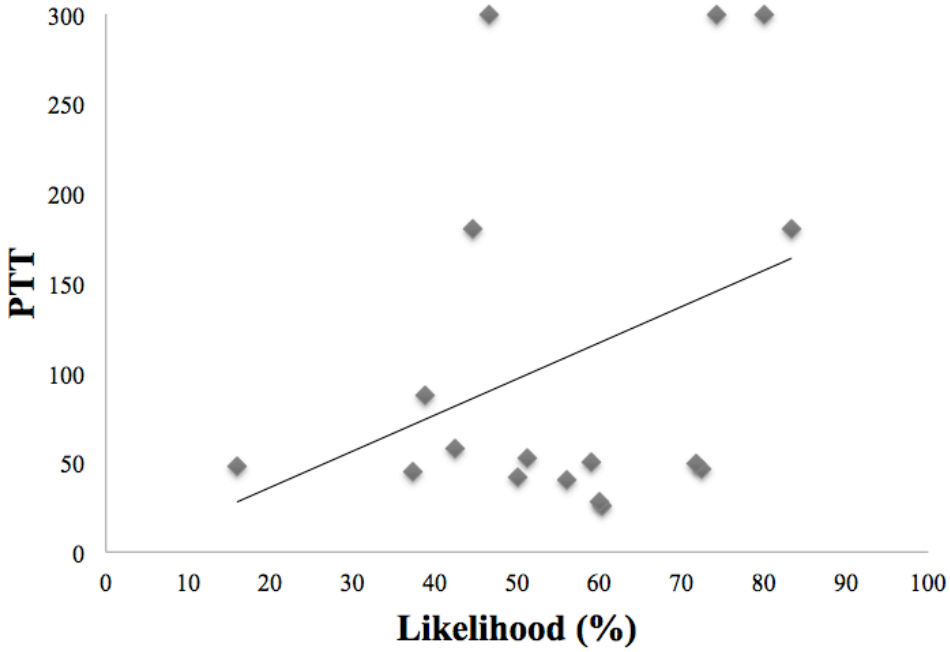
Figure 5



The correlation between pain tolerance thresholds and the ratings of the situational pain catastrophizing scale. A score of 30 represents clinically relevant levels of pain catastrophizing (- - -)

4) *The average of the rated likelihood of the steps in the catastrophizing interview will correlate with pain tolerance threshold.* This hypothesis is more explorative therefore a specific direction is difficult to predict, consequently, a two-tailed analysis was conducted (Coolican, 2014, p. 430). Three participants were excluded from this analysis because of missing data. A Spearman´s rho 2-tailed analysis was computed to analyse the relationship between the average likelihood of the steps produced in the catastrophizing interview (CI) and the pain tolerance threshold (PTT). A non-significant positive correlation was found (r=.138, n=17 p=.598). The result can therefore not confirm any relation between the average likelihood (CI) and the PTT. The result is illustrated in the scatterplot (figure 6)

Figure 6



The correlation between pain tolerance thresholds (PTT) and the average ratings of likelihood of the produced steps in the pain catastrophizing interview (CI).

5) *Participants who produce steps related to failure and inadequacy will have a lower pain tolerance than participants who did not.* Five participants (2,13,14,16,24[4]) produce steps in the catastrophic interview that was related to inadequacy/self-criticisms (see topic analysis). One of the participants (24) reached the maximum pain tolerance threshold (300 sec). A Mann-Whitney U test was used to determine if there was a difference in pain tolerance threshold (PTT) between participants who had reported inadequacy/self-criticisms with participants who had not. Participant reporting inadequacy/self-criticism had a lower pain tolerance threshold (Mdn=45,00, n=5) compared to participants who had not (Mdn=52,50, n=15), however, the result was not significant (U=25.50, p=.294).

6) Because the mean of the situational pain catastrophizing scale (PCSs) was found to be high (24.50) it could be suggested that the catastrophizing interview manipulated the participants' pain catastrophizing. Leading to a new hypothesis: *the*

[4] Participants' number

participants' ratings on the situational pain catastrophizing scale (PCSs) would be higher than their rating of the pain catastrophizing scale (PCS). To investigate this assumption the pain catastrophizing scale standard-PCS was sent out by email and rated by the participants six weeks after the experiment. All participants rated the standard-PCS. The rating of the situational-PCS and the standard-PCS were normally distributed (p=.394 and p=.220).

A one-tailed paired-samples t-test was conducted to compare the participants' ratings of the situations pain catastrophizing scale (PCSs) with their rating of the standard pain catastrophizing scale (PCS). There was not a significant difference in the ratings of the situational-PCS (M=24.50, SD=10.51) and their rating of the standard-PCS (M=20.70 SD=10.69); (t(19)=1.390, p=.09). The rating of the situational PCS that were related to the experimental pain was thereby higher than the ratings of the PCS six weeks after the experiment.

If pain catastrophizing is a stable trait it would be expected that the ratings of the pain catastrophizing scale will be related to the situational pain catastrophizing scale. A Pearson two-tailed analysis was conducted to analyse the relation between the two scales. A non-significant positive correlation was found (r=.335, n=20, p=.149). Furthermore, the theory predicts that the pain catastrophizing scale will be negatively correlated with the pain tolerance threshold (PTT) (Kristiansen et al., 2014; Sullivan, 2001; Sullivan, 2000). A Pearson two-tailed analysis was conducted to analyse the relation between the ratings of the PCS and the PTT. A non-significant negative correlation was found (r=--003, n=20, p=-989). The pain catastrophizing scale does thereby not relate to the situational pain catastrophizing scale or the pain tolerance thresholds.

7) During the experiment, it became clear that several participants reported difficulties in engaging in the statements they were asked to repeat during the cold pressor task. When asked some of the participants replied that they could not concentrate on repeating the statements, because the current pain captured their attention. This description can be seen as a form of hypervigilance response. Based on the theory that hypervigilance can directly affect the individual's experiences of pain (Leeuw et al., 2007, p. 81; Vlaeyen & Linton, 2000, p. 325), a new hypothe-

sis was develop: *Participants that were less able to engage in the statements during the cold pressor task would have a lower pain tolerance than participants who rated a high engagement in the statements.*

The participants were divided into two groups by the median (35). 3 participants (5,20,22) were excluded from the analysis, because their rating of their engagement conflicted with what they told the researcher after the experiment or with their ratings of two of the items in the PCSs that are related to this aspect (9. I can't seem to keep it out of my mind and 10. I keep thinking about how much it hurts). Participant 5 rated her ability to engage in the statements low (20 % of the time). After the experiment, the participant said it was hard to connect the present pain with the statement given, and that it had been the present pain that took her attention. However, this was contradicted by the participant's rating of two of the items in the PCSs (9. I can't seem to keep it out of my mind; 10. I keep thinking about how much it hurts), which she rated as only having to a slight degree. Participant 20 rated her ability to engage in the statements high (50 % of the time). Contradictory to the two items in the PCSs (9. I can't seem to keep it out of my mind; 10. I keep thinking about how much it hurts) which she rated as having all the time. Supported by her statement after the experiment, where she told the researcher that it was hard to connect the present pain with the statement given and that it had been the present pain that had taken her attention. Participant 22 rated her ability to engage in the statements high (40% of the time). However, this was contradicted by her statement after the experiment, where she commented that it had been very difficult to repeat the statements because it had hurt very much, and the present pain took over. The 3 participant ratings are thereby contradictory and they were taken out of the analysis.

A Mann-Whitney U test was conducted to investigate if there was a difference in pain tolerance threshold (PTT) between participants who had a low engagement in the statements during the cold pressor task (> 35 % of the time) with participants who had rated a high engagement (<35% of the time). Participants reporting a low engagement had a significant lower PTT (Mdn=45.00 n=8) compared to participants who reported a high engagement (Mdn=58.00 n=9); (U=12.50 p=.023*).

Topic analysis

Method

Following the guidelines described by Nowell and colleagues (2017), the researcher conducted a thematic analysis of the catastrophizing steps. The thematic analysis was conducted in a deductive manner as the themes were based on previous theory and empery. The researcher was, however, open to new themes emerging.

Firstly the researcher familiarises her-self white the data (Nowell et al., 2017, p. 5). This was done during the data collection, where the researcher generated some initial perspectives on the content of the pain interviews. Additionally, she read through the pain interviews systematically gaining further ideas about possible topics. Afterwards, initial themes were generated (ibid,). Following a deductive method, a three-tiered hierarchically coding was conducted based on Vasey and Borkovec (1992) thematic analysis (p.510f).

Three-tiered hierarchical system

Firstly the statements were categorised into three; 1) threats to self 2) treats to significant others 3) miscellaneous threats.

Secondly, category one and two were further categorised according to a) physical b) psychological c) social and education d) miscellaneous threats. Thirdly category one and two were divided even further. All categories are not defined in Vasey and Borkovec (1992). Therefore this step was more inductive, though some inspiration was taken from the themes mentioned by Vasey and Borkovec (1992, p. 510f).

As recommended by Nowell and colleagues (2017, pp. 8-11), possible codes were written down. These codes were then searched for themes, which could describe the material in a meaningful way in relation to the research question. The themes were systematically refined, returning to the data and the initial codes. The names were defined in a way that captured the essence of the theme, as described by Nowell and colleagues (2017, pp. 8-11).

Analysis

Two examples of the catastrophic interview are given in table 2 and 3, to illustrate the interview in its whole. The first interview is an example of a shorter interview that was primarily about the physical aspect of pain. The other interview is an example of a longer interview, where more psychological threats are present. It should be noticed that participant 14 reported have had depression two years ago.

Table 2

Participant 12 Worrying topic: stomach ache Catastrophic steps (4)	Discomfort	Likelihood (%)
Det bliv være og være (It became worse and worse)	0	100
At jeg skulle operares for blindtarmsbetændelse (That I had to have operation for appendicitis)	0	10
Bange for operationen (Scare of the operation)	0	60
At jeg ville få smerter pga. operationen (That the operation would result in pain)	0	0

Table 3

Participant 14 Worrying topic: stomach ache course by digestion problems Catastrophic steps (13)	Discomfort	Likelihood (%)
Kunne komme når som helst (It could come any time)	60	90
At nogen ville opdage det (That someone would found out)	60	20
At de ville dømme mig (That they would judge me)	50	40
Det ville definere mig (It would defined me)	50	40
At det ville påvirke mig psykisk (That it would affect me mentally)	60	40
At tage afstand til de situationer hvor jeg kunne opleve smerten (To distance oneself from situations where I could experience the pain)	60	70
At smerten skal forhindre mig i at leve som jeg gerne vil (That the pain will prevent me from living the way I would like to)	60	70
At jeg vil blive for selvbevidst of bekymret (That I would become to self-conscious and worried)	50	60
At jeg vil blive deprimeret (That I would become depressed)	60	50
At jeg gjorde skade på mig selv (That I would harm my self)	65	70
At jeg vil prøve på at begå selvmord (That I would attempt suicide)	75	55
At jeg har fejlet (That I have failed)	70	90
At nogen vil blive skuffet over mig (That some people would be disappointed in me)	70	90

Threats to self

All the participants reported threats to self (100%) and the majority of the statement concerned this topic (161 out of 199 statements, 80,9%). The topic was defined broadly, consisting of all negative threats or possible consequences to self. The statements could be categorised into physical, psychological, social and miscellaneous threats to self. The topics are summaries in figure 7.

Physical threats to self

17 out of 20 participants reported physical threats to self (85%), and 58 statements out of 161 regarded physical threats to self (36%). 3 participants solely reported physical threats to self (15%). These statements could be further categorised into, pain itself, illness, limitations, and death

*S*ome of these worries were about the pain itself: "*Den ulidelige smerte" (The unbearable pain)* (5)[5]. In additions some of these statements were about the persistence of pain: "*At det ikke ville stoppe*" (That it would not stop) (6). Yet others worried about the pain increasing "*Det blev være og være*" (It will go from bad to worse) and "*At jeg gør noget forkert og får flere smerter*te*"* (That I will do something wrong that will make the pain worse) (2).

Furthermore, some of the participants worried about what the pain might indicate: "Er der noget galt med mig" (Is something wrong with me) (9); and if the pain was a sign of illness: "At blive syg" (To become ill) (9) and "Om det var kræft" (If it was cancer) (22). In additions some worried about the limitations the pain might have on the participants' life "Ting jeg ikke længere kunne" (Things I could not do anymore) (22) and "Manglende førlighed" (Lack of mobility) (21). Finally, some participants worried about dying "At dø" (To die) (9).

[5] The participant's number

Psychological threats to self

12 out of 20 participants reported psychological threats to self (60%), and 51 statements out of 161 were about this topic (31,7%). 1 participant solely reported psychological threats to self. The statements could be categorised into depression, mental problems, inadequacy/self-criticism, and self-harm.

9 participants (45%) reported statements concerning depression. Some of them referred directly to depression "Blive deprimeret" (Becoming depressed) (18), whereas others where about a general depressed mood: "Gå ud over humør" (It will affect my mood) (18). Yet others were about a feeling of hopelessness: " At jeg bare ville give op" (That I would just give up) (24) and "Meningsløshed" (Meaninglessness) (2). 2 participants (10%) reported worries about mental problems: "Blive 'genganger' i psykiatrien" (Be a returning patients at the psychiatric ward) (1) and "Spiseforstyrrelse vendte tilbage" (A previous eating disorder would return) (22).

5 out of 20 participants (25%) reported inadequacy: "At jeg har fejlet" (That I have failed)(14) and "Om jeg ville være i stand til det" (If I was capable) (16) Additionally some of the statements were worries about self-criticism "Jeg kan ikke lide mig selv pga. bitterhed" (I do not like myself because of bitterness) (2) and "At jeg ville begynde at hade mig selv" (That I would start hating myself) (16).

3 of these participants also reported worries about self-harm that could be mentally or physically: "At jeg ville pine mig selv" (That I would torment myself) (16) and "At jeg gjorde skade på mig selv" (That I would harm myself) (14).

Social threats to self

In Vasey and Borkovec (1992) content analysis a financial theme was present (p.510f), however, none of the statements in the present interview concerned this aspect. Therefore the theme was changed from "financial and social" to "social". 10 out of 20 reported social threats to self (50%) and 38 out of 161 statements were about this topic (23,6%). This topic was categorizing into loneliness, negative evaluations by others and education.

6 participants reported statements concerning loneliness: “Blive ensom” (Becoming lonely) (18) and “Være alene om det” (To be alone with it) (10). In additions, 4 participants reported worries about negative evaluation by others *“At de ville dømme mig”* (That they would judge me) (16) and *“Om folk ikke ville forstå det eller tro, at det er pyller fx. på en arbejdsplads* (If people would not understand or believe it, and think that I was just fussing, for example at work (16). 2 participants reported worries about education: “Tag et semester om” (To resit the semester) (8) and “Livsvalg blev truffet for mig andgående videregående uddannelse” (A life choice was taken for my regarding which education I could take (21).

Miscellaneous threats to self

7 out of 20 participants reported miscellaneous threats to self (35%) and 13 out of 161 statements concerned this topic (8%). Most of these statements were about the general quality of life (6 out of 13, 46%): “Indflydelse på liv den gang” (Influence on my life at that time) (21) and “Forringet livskvalitet” (Reduced life quality) (23).

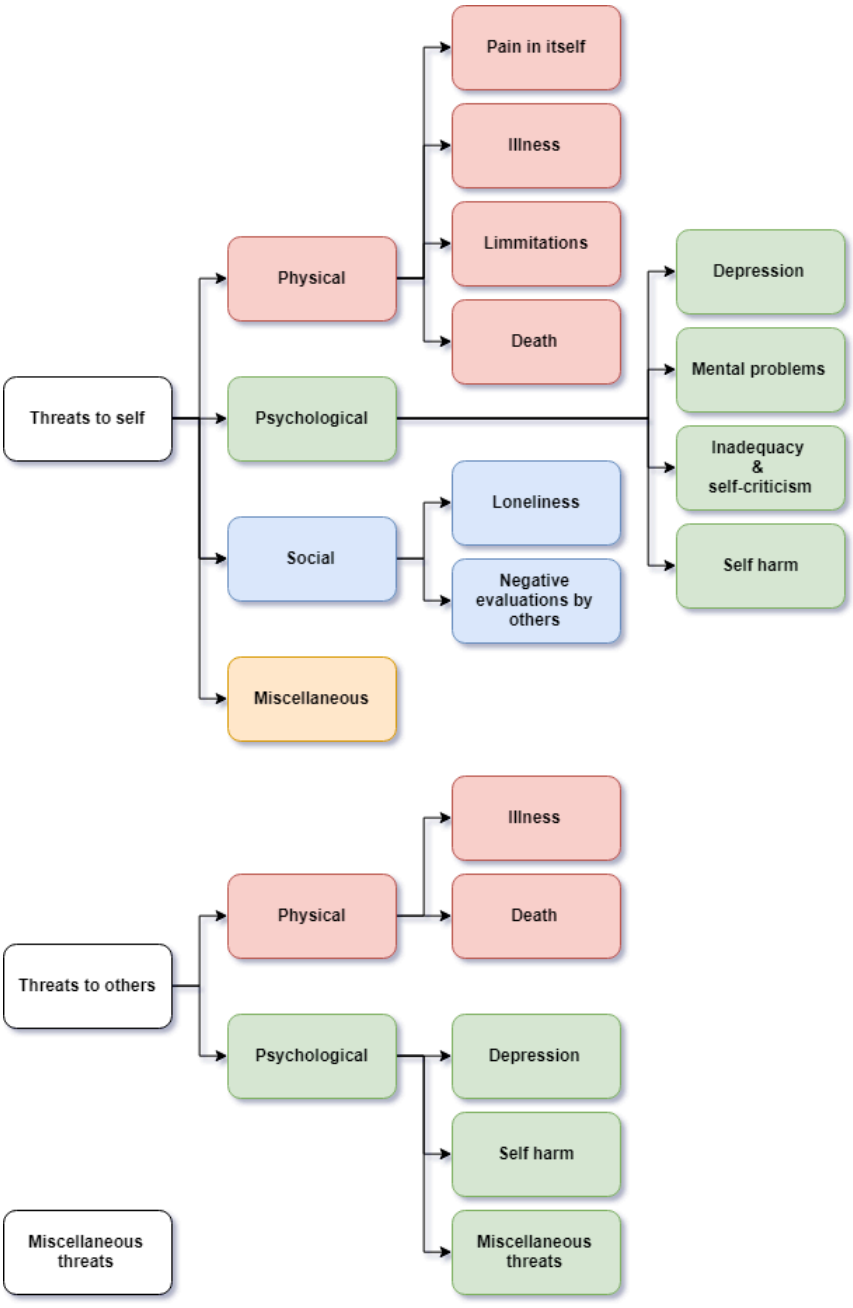
Threats to others

This topic will be described in less detailed as it is not the scope of this study. 8 out of 20 participants reported threats to others (40%) and 25 out of 199 of the statements concerned this topic (12,6%). Mostly these worries were a response to what would happen if the participant died. 4 participants reported physical threats to others such as illness and death: “Hvad hivs barnet ikke kunne klare fødslen” (What if the child could not survive childbirth) (5) and “At de døde” (That they would die) (8). 5 participants reported psychological threats to others. These concerned, depression, self-harm and miscellaneous topics. For example “At det ville såre min familie” (That it would hurt my family) (8), “At de ville blive deprimeret” (That they would become depressed) (1) and “At nogen i familien tog selvmord” (That someone in my family would commit suicide) (1). 4 participants reported miscellaneous threats to others. All of these were about general life quality: “At det ville ødelægge deres mulighed for at leve deres liv” (That it would prevent them from living their lives) (8)

Miscellaneous threats

7 out of 20 participants reported Miscellaneous threats (35%) and 13 out of 199 of statements concerned this topic (6,5%). A lot of these concerns were about children and labour: “Tanken om fødslen” (The thought of labour) (5) and “Manglende lyst til at få børn igen” (Would not want to have children again) (23). To of the statements concerned the lack of control about when the pain occurred “At få migræne udenfor hjemmet” (To have a migraine will I as not home) (16) and “Det kom uventet” (It came unexpectedly) (4).

Figure 7 - Overview of the topics



Discussion

In this paper, the catastrophizing interview has been conducted to explore if it is a useful tool for studying the relation between catastrophic worry and pain catastrophizing. It was found that the catastrophizing interview could be conducted when the main topic was pain. Moreover, it was not confirmed that the measures of the catastrophizing interview (number of steps and average likelihood) were related to pain tolerance threshold or pain catastrophizing. Therefore the main hypothesis of this study cannot be confirmed, as no correlation between the measures of catastrophic worry, pain catastrophizing and pain perception was found. On the other hand, the results do imply that the participants' pain catastrophizing was manipulated by the catastrophizing interview, as an increase (although not significant) of the situational-PCS (measured immediately after the cold pressor task) as compared with the standard-PCS (six weeks follow-up) was found. Inclinations can, therefore, be made towards there being a relation between pain catastrophizing and catastrophic worry. Lastly, it was found that the themes produced in the catastrophizing interview, when the main topic was pain, were similar to Vasey & Borkovec's (1992) findings. This suggested that the catastrophizing interview might be applied in the pain area. In addition, these were not solely about pain, as many different themes could be deduced from the catastrophic interview.

The purpose of this study was to empirically explore a new theoretical foundation of pain catastrophizing. Different hypotheses presented in the worrying literature were tested, to investigate the relation between pain catastrophizing and the term catastrophic worry presented by Flink and colleagues (2013). The study thereby attempts to shed some light on the theoretical underpinning of pain catastrophizing that might lead to new models, measures, and treatments. One of the main problems to date is to establish causation between pain catastrophizing and pain ratings. Only a few studies have investigated causation by manipulating catastrophizing prior to pain stimulation and ratings (Bialosky et al., 2008; Roditi et al, 2009; Ruscheweyh et al., 2013). This study has attempted to manipulate pain catastrophizing in a different way. Therefore the result might contribute to the debate, concerning whether pain catastrophizing can be manipulated (reduced or enhanced) and consequently, if catastrophizing is a

stable personality trait, or if it is a state response that varies over time as a consequence of situational circumstances. In addition, it was of interest to study the cognitive content of catastrophic worry to explore the construct further. In the next section, these questions will be discussed in relation to the study's results.

Are catastrophic worry and pain catastrophizing related concepts?

When comparing the theoretical underpinnings of the catastrophizing interview with the three subscales in the pain catastrophizing scale (PCS), similarities emerge. Firstly the constant questioning style consisting of "what if…" can be compared with the subscale "rumination" of the PCS. The feeling of personal inadequacy can be compared with the subscale "helplessness". Lastly the belief that catastrophizing is a productive problem-solving process, may lead to a tendency to exaggerate the threat, which is similar to the subscale "magnification". The similarities of the theoretical foundation regarding of catastrophic worry and pain catastrophizing support a possible relation between the to concepts (Flink et al., 2013, p. 219f). However, the term catastrophic worry emphasises that pain catastrophizing is a process and that it has a function.

Several studies have found that individuals who have a tendency to worry produce more steps in the catastrophizing interview compared to non-worries (Davey & Levy, 1998; Hazlett-Stevens & Craske, 2003; Vasey & Borkovec, 1992). Furthermore, Flink and colleagues (2013) argued that catastrophic worry and pain catastrophizing are related concepts, leading to the assumption that both concepts are related to the participants' pain tolerance threshold (PTT). To test this assumption it was investigated if the number of steps produced in the catastrophic interview would be negatively correlated with the PTT. The study did not confirm this hypothesis, as a positive non-significant relation was found between the two variables. Therefore nothing conclusive can be said about the relation between catastrophizing steps and PTT.

It might, still follow that the situational-PCS and the number of catastrophizing steps are related. This was further investigated, but no significant correlation between the

two variables was found. Suggesting that the number of catastrophizing steps is not related to pain catastrophizing or PTT. To assure that this result could not be attributed to the situational-PCS, an analysis was conducted to verify that the situational-PCS was related to the PTT. The result supports a significant negative correlation between the situational-PCS and the PTT, adding to previous findings (Campbell et al., 2010; Dixon et al 2004; Edwards et al., 2006). Thereby, the results support the assumption that a high level of pain catastrophizing is related to low PTT, and that situational-PCS is a reliable measure. In conclusion, it cannot be deduced if catastrophic worry and pain catastrophizing are related concepts. Conversely, the results suggest that the number of catastrophizing steps are not related to pain catastrophizing and therefore might not be a good measure of the concept.

In the current study, some methodological problems could account for these findings. The main topic was preselected to be pain. The catastrophizing interview, thereby, relies on a recollection of past painful experiences that might not be exact (Sullivan et al., 1995, p. 531) and might have happened a long time ago. Consequently, the thoughts and feeling related to the pain topic might not be so intense, compared to a more recent worrying topic that is still on going. Therefore, it might follow that the pain topic has been more worrying to some participant than to others, leading to a possible difference in the number of produced catastrophizing steps. This assumption is supported by Provencher and colleagues' (2000) findings, which indicate that the intensity of the worrying topic can affect the number of catastrophizing steps produced (p. 200). Contrary, Davey and Levy's (1998) findings suggest that individuals who have a tendency to worry produce the same kind of steps to different main topics (p. 580), leading to the assumption that the main topic is of less relevance. Supported by, the findings that high worriers, in general, produce more steps in the interview process, even if the participants had to produce positive steps about a preselected neutral scenario (Davey & Levy, 1998, p. 578). To conclude, it can be debated if the number of steps produced in the catastrophizing interview is a reliable measure of catastrophic worry when the main topic is preselected to be pain.

In addition, a difference in the stop rule of the catastrophic interview might have influenced the results. In the current study, the participants were asked if the last step they produced were the worst possible outcome they could imagine, based on Pro-

vencher and colleagues' protocol (2000). This alteration of the catastrophizing interview's stop rule might have promoted more steps. Summarizing the results from other similar studies supports this assumption (see table 4 and table 5).

Table 4
Number of steps produced in the catastrophizing interview

Study	Mean high-worriers	SD	Mean non-worriers	SD
Vasey & Borkovec (1992)	8.9	2.1	5.9	2.4
Hazlett-Stevens & Craske (2003)	8.74	2.44	6.61	2.44
Provencher et al., (2000)	14.8	3.3	10.8	4.2

Table 5
Number of steps produced in the catastrophizing interview

Study	Mean	SD
Davey & Levey (1998)	9.23	3.70
Deshenes et al (2016)	7.12	2.57
The current study	9.95	6.41

The tables illustrate that the participants in Provencher and colleagues' (2000) study, and the participants in this study, produced more catastrophizing steps compared to other studies (Davey & Levy, 1998; Hazlett-Stevens & Craske, 2003; Stöber et al., 2000; Vasey & Borkovec, 1992). Suggesting that the used stop rule in this study, in general, promoted more catastrophizing steps. In addition, Provencher and colleagues' (2000) findings did not support the notion that high worries produced more steps than non-worriers. Therefore, it could be suggested that non-worriers produced more catastrophizing steps than they would otherwise have done, as a result of the stop rule of the interview. Leading to the argument that the number of catastrophizing steps might not be the best measure of catastrophic worry when this stop rule is used. Taken together, it might follow that methodological problems account for the fact that the number of catastrophizing steps did not relate to pain tolerance threshold or the situational-PCS.

It has been argued that individuals who have a tendency to catastrophize will find their catastrophizing steps more likely (Provencher et al., 2000). Therefore it was

further investigated if the average likelihood of the catastrophizing steps would be a better measure of catastrophic worry. Nevertheless, no significant correlation was found between the average likelihood of the catastrophizing steps or the pain tolerance threshold.

To conclude, catastrophic worry measured by the number of catastrophizing steps and the average likelihood, is not related to pain catastrophizing (measure by the situational-PCS). The current study can therefore not determine if catastrophic worry and pain catastrophizing are related concepts.

Can pain catastrophizing be manipulated?

In this study, a high situational-PCS score was found (24.50, SD=10.51) and five of the participants' scores were above 30, which has been considered the cut-off score for clinical relevancy (Sullivan, 2009, p. 7). Furthermore, the mean situational-PCS in this study was higher than the standard-PCS and situational-PCS found in other studies (Kristiansen et al., 2013; Dixon et al., 2004). These findings are interesting since experimental pain should not infuse as high pain catastrophizing compared to a clinical pain, because the participant is in control of the pain, and know it will not result in any damage or have any implications for their future life. Therefore, this finding leads to the assumption that pain catastrophizing might have been manipulated in the current study.

On the other hand, Sullivan and colleagues (2001) found a higher average standard-PCS score in a sample of healthy women (M=26.6, SD=10,4) and that women, in general, tend to rate the standard-PCS higher than men. Thence it could be argued that the high situational-PCS score found in the current study, is due to gender differences, as only women were included in the study. In addition, it has been found that depression is significantly correlated with pain catastrophizing (Sullivan et al., 2001, p. 56), which might question the result. However, depression and anxiety were also measured and no high scores were found, in spite of some of the participants reporting having had depression and self-harming behaviours. Nevertheless, no exact PCS score is argued to clearly separate high catastrophizing from non-catastrophizing (Kristiansen et al., 2014, p. 142), making any conclusion difficult.

To investigate if the catastrophizing interview manipulated pain catastrophizing the situational-PCS was compared to the standard-PCS. The findings indicate that pain catastrophizing might have been manipulated, as the situational-PCS was higher than the standard-PCS, although the result was not significant. Additionally, the study did not have a control group condition. Therefore, it cannot be fully determined if the difference between the two scales was caused by manipulation of pain catastrophizing or a general difference in the scales. This critique could be valid, as there has only been found a moderate correlation between the two scales (Dixon et a., 2004; Edwards et al, 2005). In the current study, no significant correlation was found between the situational-PCS and the standard-PCS, supporting this assumption. In addition, Edwards and colleagues (2005) found that only the situational-PCS and not the standard-PCS correlated with PTT in a cold pressor task. In the present research, a similar result has been found. It can, therefore, be discussed if the two scales are comparable and if the situational-PCS is a more accurate measure of pain catastrophizing.

There is a problem with comparing results from the different studies because there is no widely accepted measure of situational pain catastrophizing. Several studies have modified the wording of the PCS to make them relate more to experimental pain, and have reduced the scale to six items that were most relevant to experimental pain (Campbell et al., 2010; Edwards et al., 2006). Reducing the scale so drastically without validation can be problematic, as it is no longer certain what the scale actually measures. In the current study, only the wording of the introduction to the scale was changed as done in other studies (Dixon et al., 2004). Thereby, the comparison between the situational-PCS and the standard-PCS becomes more straightforward. However, there might be statements in the standard-PCS that do not convey well to the experimental pain situation (e.g. 3. “It’s terrible and I think it’s never going to get any better”, and 13. “I wonder whether something serious may happen”). These statements are not very likely in experimental pain, which might lead to lower ratings of the situational-PCS. Nonetheless, the situational-PCS was found to be higher than the standard-PCS, suggesting that the items could be rated in relation to experimental pain.

In conclusion, the findings of this study might indicate that pain catastrophizing can be manipulated, which could be interesting to study in a larger sample with a control group. If it could be argued that pain catastrophizing has been manipulated by the catastrophizing interview, there might be a relation between catastrophic worry and pain catastrophizing. Nevertheless, these results are obscured by the differences that have been found between the situational-PCS and the standard-PCS, questioning if the standard-PCS can be view as the control measure of pain catastrophizing.

Engagement in the statements

After the experiment, the participants rated how much they were able to engage in the statement they were asked to repeat during a cold pressor task. Originally the statements were meant to manipulate pain catastrophizing, as in other studies (Bialosky et al., 2008; Roditi et al, 2009; Rusheweh et al., 2013). However, the participants' accounts contradicted this assumption. For example, one participant (9[6]) rated her engagement to be zero percent because she thought of the sensation in her hand. Another participant (2) commented that she could only think of how badly it had hurt. These statements could be viewed as a form of hypervigilance towards the present pain (Leeuw et al., 2007, p. 81; Vlaeyen & Linton, 2000, p. 325), implying the statement did not function as intended. The analysis revealed that participants who rated a low engagement in the statement during the cold pressor task had a significantly lower pain tolerance threshold (PTT) compared to participants who rated a higher engagement. This result implies that the statements functioned as a distraction rather than increasing pain catastrophizing. Moreover, it supports that hypervigilance can directly affect the individuals' experiences of pain, as the participants who could not engage in the statements, because of the present pain, had a lower PTT.

This result could clarify why other studies using similar methods have had trouble manipulating pain catastrophizing (Bialosky et al., 2008; Roditi et al, 2009; Rusheweh et al., 2013). However, the statements in the present study were not related to the current pain, which could have made it difficult to connect them to the present pain sensations. Statements more related to the current pain sensation as used in the other studies (Bialosky et al., 2008; Roditi et al, 2009; Rusheweh et al., 2013),

[6] Participant ID

might have given other results. Nonetheless, it would be advisable to make sure the statements function as intended.

The content of catastrophic worry

To study the concepts of catastrophic worry even further a deductive thematic analysis was performed. In the current study, it was found that 80.9% of the catastrophizing steps were about "threats to self", which is similar to Vasey and Borkovec's (1992) findings (90%). A lot of the same themes were present in both studies, such as "illness/injury", "death", "depression", "negative evaluation by others", and "feelings of loneliness". Conversely, "financial worries" was not present in the current study, which might be a result of the financial security of the welfare state in Denmark. The theme "failure/ineffectiveness of self" was in this study titled "inadequacy/self-criticism", as this definition appeared more fitting for the statements. The descriptions of the themes in Vasey and Borkovec's (1992) study are vague making a more detailed comparison difficult.

An interesting finding in the current study was that not all participants reported "physical threats to self", as might have been accepted since the main topic was pain. Furthermore, only 36% of the statements about "threats to self" related to physical threats, whereas 60% were related to psychological threats. Gathering these results, the worrying themes deduced from the catastrophizing interview were not solely about pain and its physical consequences. In conclusion, it could be argued that the catastrophizing interview can be applied in the pain area and that it yields similar themes as other worrying topics, indicating that catastrophic worry might be transdiagnostic.

Inadequacy and self-criticism

In the theoretical chapter, it has been proposed that individuals who have a tendency to catastrophize will have a self-questioning schema consisting of failure and inadequacy (Davey & Levy, 1998; Hazlett-Stevens & Craske, 2003; Kendall & Ingram, 1987; Vasey & Borkovec 1992). As this theme was found in the present study, it was investigated if the participants who produced steps relating to this theme would have a lower pain tolerance threshold (PTT) than participants who did not. No difference

was found and only 5 participants reported inadequacy/self-criticisms, making it difficult to say anything conclusive on the matter.

Some of the statements in this theme were similar to the statements from the subscale "helplessness" in the PCS. For example, the statement "Om jeg ville være i stand til det" (If I was capable) produced by one of the participants could be compared to the statement "I feel I can't go on" from the PCS. Conversely, some of the statements in this theme were about self-criticisms "At jeg ville begynde at hade mig selv" (That I would start hating myself) (16) and these statements were not solely about pain. The theme is, therefore, more extensive than the "helplessness" subscale in the PCS.

In conclusion

In conclusion, the results do not confirm any relation between the number of catastrophizing steps and pain catastrophizing. Therefore it might be argued that catastrophic worry and pain catastrophizing are two different concepts. Supported by the findings that catastrophic worrying produced in the catastrophizing interview was related to future threats and were not just about the pain. Contrary, to pain catastrophizing that, is related to the present pain experience. Nevertheless, the results do imply that the catastrophizing interview might have increased pain catastrophizing, suggesting that catastrophic worry is an integrated part of pain catastrophizing. Although, this result is speculative and further research is required to determine any possible manipulation effect.

If any manipulation effect of pain catastrophizing can be confirmed, the assumption that pain catastrophizing influences pain perception can be further strengthened, and it would have implications for assessment and treatment of chronic pain. Firstly, pain catastrophizing should be assessed and treated as early as possible. In addition, it might be better to focus on the process rather than the content of pain catastrophizing in cognitive-behavioural therapy. Lastly, it could be argued that the situational-PCS could be a more sensitive tool than the standard-PCS for assessing pain catastrophizing, and it can be a preferable tool to use when it is possible, as it assumes that the specific situation does have an effect on pain catastrophizing.

Even though, the sample of this study was nonclinical a lot of different worries were produced concerning pain. In addition, some of the worries produced by this sample are a reality for individuals with chronic pain (e.g. the pain will persist and the limitations cause by pain). Therefore, there might be a difference in catastrophic worry in a clinical sample compared to a nonclinical one. Furthermore, the current study does not address when catastrophic worry becomes maladaptive and what separates normal worrying from catastrophic worry. A future study that explored any difference in catastrophic worry between a clinical sample and a healthy sample would be very interesting.

Applying the term catastrophic worry in the area of pain, have provided a new way of investigating pain catastrophizing that might yield answers about the process and function of pain catastrophizing. Therefore it could be argued that the theory advances the current theories of pain catastrophizing by including the worrying aspect.

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Appendix

Appendix 1

Deltagerinformation:

Dette projekt udføres i forbindelse med min afhandling i psykologi ved Aalborg Universitet.

Det er vigtig, at du inden forsøget ved, hvad det går ud på, og hvorfor jeg gennemfører forsøget. Derfor vil jeg gerne bede dig om at læse nedstående grundigt.

Du kan ikke deltage i forsøget hvis:

- Du har kroniske smerter
- Du har taget smertestillende inden for de sidste 24 timer før forsøget
- Hvis du har nogle problemer med dine hænder, sår eller lignede
- Du har nogle psykiatriske diagnoser
- Du har neurologiske problemer
- Hvis du har et tidligere eller nuværende stofmisbrug
- Hvis du har forhøjet eller for lavet blodtryk
- Hvis du er gravid eller ammer

Forsøgets formål: er at undersøge den måde, vi tænker om smerte, og den måde vi generelt tænker på i forhold til smerte**.**

Tid: ca. 60 min.

Forsøgets forløb:
Samtykke: Inden forsøget går i gang, vil jeg fortælle om forsøgets forløb, hvorefter jeg vil bede dig underskrive en samtykkeerklæring, hvis du stadig vil deltage. Du har ret til betænkningstid inden du underskriver. Det er frivilligt, om du vil deltage, og du kan til hver en tid trække dit samtykke tilbage uden nogen begrundelse.

Selve forsøget: Du vil under forsøget blive spurgt ind til nogle oplevelser, som bekymre dig generelt, og i forhold til smertefulde oplevelser du har haft. Du vil blive bedt om at putte din hånd i koldt vand og holde din hånd i vandet så længe som muligt. Denne del handler om din subjektive oplevelse af smerte, og det er derfor også dig som bestemmer, hvornår du har nået din maximale smertetolerance. Mens du har din hånd i vandet, vil du blive bedt om at vurdere, hvornår det gør ondt. Du vil også blive bedt om at udfylde forskellige spørgeskemaer omhandlende angst, depression og smerte.

Bivirkninger: Der er ingen alvorlige bivirkninger eller risici forbundet med forsøget. Du vil dog kunne opleve smerte og ubehag. Din hånd kan blive rød, efter du har haft den i det kolde vandet, men dette vil forsvinde kort tid efter. Der kan være risici ved forsøget, som vi endnu ikke kender til. Det er derfor vigtigt, at du fortæller mig, hvis du oplever problemer med dit helbred, mens forsøget står på.

Afbrydelse af forsøget: Jeg kan til enhver tid afbryde forsøget, hvis jeg vurderer, at du reagerer uventet på forsøget eller, at det viser sig, at du på anden vis ikke er egnet til videre deltagelse i forsøget.

Fortrolighed: Alt information du opgiver undervejs i forsøget vil blive behandlet anonymt og fortroligt.

Vejledt: Projektet er vejledt af Laura Petrini, lektor ved Center for Sanse-Motorisk Interaktion og Center for Cognitive Neuroscience ved Aalborg Universitet.

Er du interesseret i at deltage eller har yderligere spørgsmål, kan du kontakte mig pr. mail eller telefon.

Med venlig hilsen
Cilla Guldborg
Email: cguldb13@student.aau.dk
Mobil: 61 33 52 10

Appendix 2

Samtykkeerklæring

Informeret samtykke til deltagelse i forsøg i forbindelse med speciale i psykologi Aalborg Universitet.

Erklæring fra forsøgsperson:
Jeg har fået skriftlig og mundtlig information, og jeg ved nok om formålet, metode samt fordele og ulemper til at sige ja til at deltage. Jeg har forstået, at jeg frit og på ethvert tidspunkt kan stille spørgsmål, der måtte falde mig ind vedrørende projektet og de metoder, de den studerende bruger. Jeg har forstået, at jeg kan tage kontakt til (Cilla Guldborg), på et hvilket som helst tidspunkt via. telefonnummer eller e-mail, som der fremgår i deltagerinformationen.

Jeg har forstået, at alle data, som den studerende uddrager fra undersøgelsen, observationer og spørgeskemaer til brug i den studerendes projekt, ikke under nogen omstændigheder vil indeholde navne eller andre identificerbare karakteristika. Jeg har forstået, at min anonymitet vil blive beskyttet, og at alle informationer, jeg stiller til rådighed, vil være fortrolige.

Min deltagelse i dette projekt og denne undersøgelse er frivillig, og jeg har ret til at sige nej til at deltage. Jeg kan frit vælge at undlade at svare på nogle eller alle spørgsmål uden nogen konsekvenser. Jeg kan på et hvilket som helst tidspunkt stoppe undersøgelsen uden nogen konsekvenser.

Jeg giver samtykke til at deltage i forskningsprojektet og samt at jeg har fået en kopi af den skriftlige information om projektet til eget brug.

Forsøgspersonens navn:_____

Dato: _____ Underskrift:_____

Erklæring fra den, der afgiver information:
Jeg erklære, at forsøgspersonen har modtaget mundtlig og skriftelig information om forsøget. Efter min overbevisning, er der givet tilstrækkelig information til, at der kan træffes beslutning om deltagelse i forsøget.

Navnet på den, der har afgivet information:

Data:_____ Underskrift:_____

Appendix 3

Situational Pain Catastrophizing Scale (PCSs)

I dette spørgeskema er vi interesseret i tanker og følelser, som du havde mens du deltog i denne smerte opgave. Nedenfor er der 13 forskellige sætninger, som beskriver forskellige tanker og følelser, som kan være forbundet med smerte. Angiv i hvilken grad du havde disse tanker og følelser under smerte opgaven, ved at sætte ring om det tal, der bedst passer til din oplevelse ud for hver sætning.

0= slet ikke, 1 = i ringe grad, 2= i nogen grad, 3 = i høj grad, 4 = i meget høj grad

Nr.	Erklæring	Slet ikke (0)	I ringe grad (1)	I nogen grad (2)	I høj grad (3)	I meget høj grad (4)
1	Det bekymrer mig hele tiden, om smerterne vil forsvinde.					
2	Jeg føler, at jeg ikke kan mere.					
3	Det er frygtelig, og jeg tænker, at det aldrig bliver bedre.					
4	Det er forfærdeligt, og jeg føler mig overvældet af smerterne.					
5	Jeg føler, at jeg ikke kan holde det ud længere.					
6	Jeg bliver bange for at smerterne vil blive værre.					
7	Jeg tænker hele tiden på andre smertefulde oplevelser.					
8	Jeg ønsker desperat, at smerten vil forsvinde.					
9	Jeg kan ikke lade være med at tænke på mine smerter.					
10	Jeg bliver ved med at tænke på hvor ondt det gør.					
11	Jeg bliver ved med at tænke på, hvor meget jeg ønsker, at smerten skal holde op.					
12	Der er intet jeg kan gøre for at mindske intensiteten af mine smerter.					
13	Jeg tænker på om der kunne ske noget alvorligt.					

Appendix 4

Steps and topics from the catastrophizing interview

The pain topic from the catastrophizing interview

Participant ID	Pain topic
1	Migræne
2	Skuldersmerter
3	Kom til at stikke øjendråbe – pipette i øjet i går
4	Restaurant – Ekstrem mavesmerte
5	Graviditet/fødsel
6	Blindtarms betændelse (da hun var lille)
8	Efter smerter i benet
9	Stikkende jag i hovedet
10	Operation
12	Mavepine
13	Selvskade: hånd banket i væg
14	Mavesmerter ved fordøjelsesproblemer
15	Tandlæge besøg, bore i nerve
16	Hovedpine efter at tage briller af og på hele dagen
18	Da mit korsbånd blev revet over
20	Nyresten (under graviditeten)
21	Brækket arm
22	Ondt i maven
23	Mavepiner - stofskifteandfald
24	Dehydrering på ferie

The catastrophizing steps used for the cold pressor task

Participant ID	Statement selected for the cold pressor task
1	Kronisk migræne og Nedsat livskvalitet
2	At jeg gør noget forkert og får flere smerter
3	Kunne ikke overskue konsekvenserne
4	Om det var slemt
5	Den ulidelige smerte
6	At have ondt i maven og At det ikke ville stoppe
8	Der ville være smerte de kommende dage
9	Er der noget galt med mig
10	Smerten
12	Det blev være og være
13	Hvad det kunne lede til hvis det fortsatte
14	At tage afstand til de situationer hvor jeg kunne opleve smerten og At smerten skal forhindre mig i at leve som jeg gerne vil.
15	Tanken om det vil ske igen og At jeg skriger/græder
16	At jeg i et tidsrum kun ligger i smerte
18	Blive ved med at gøre ondt
20	Jeg var gravid
21	Manglende førlighed
22	Bange for, hvad det var
23	Hvor land tid skal anfaldet vare?
24	Om det kunne udvikle sig til noget mere alvorligt

The last catastrophizing step produced in the catastrophizing interview

Participant ID	Last statement
1	At nogen I min familie tog selvmord
2	At leve længe (uden at have lyst til det)
3	Ulykkelig
4	Konstant håbløshed (for andre i familien)
5	At måske være alene når man bliver gammel
6	At der var noget galt
8	At vi kedede os (Efter hende og hendes familie var døde)
9	At blive hurtig glemt (Efter hun er død)
10	Være alene om det
12	At jeg ville få smerter pga. operationen
13	Frygt for at ende med at gøre skade på mig selv
14	At nogen vil blive skuffet over mig
15	At jeg skriger/græder
16	At jeg har spildt mit liv
18	Blive deprimeret
20	At de ikke kunne finde ud af, hvad der var galt
21	Bange for at jeg aldrig ville finde den rigtige ud.
22	Side for mig selv/ensom
23	At frygt står i vejen for det jeg ønsker
24	At jeg bare ville trække mig ind i mig selv