



## Threat of pain influences social context effects on verbal pain report and facial expression

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### ABSTRACT

Current theoretical models of pain catastrophizing have diverging predictions regarding the role of social context and perceived threat on pain expression. The communal coping model of catastrophizing predicts that high pain catastrophizers display more pain expression in the presence of another, regardless of the threat value of the pain, while a cognitive appraisal model predicts high pain catastrophizers to express more pain when pain has increased threat value, regardless of social context. A 2 × 2 factorial design was used to test the validity of both predictions. Healthy participants with varying levels of pain catastrophizing were exposed to a cold pressor task, consisting of a 60 s immersion and 60 s recovery period. Interestingly, the immersion results revealed that beyond and independent from the effects of pain catastrophizing, the effect of threat on verbal pain report and facial expression was dependent on social context and vice versa. In a threatening context, perceived threat of pain mediated the inhibitory effect of social presence on pain expression, suggesting that the observer acted as a safety signal. In the recovery period, social presence enhanced facial expression, but only when no threat was induced. The results are discussed in terms of the dynamic interaction between social context and threat appraisals.

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### Introduction

Pain is a universal experience that affects human beings across the life span, and serves an important protective function. Pain urges to interrupt ongoing activity, to escape the source of threat to the body, and to withdraw for healing to take place (Eccleston & Crombez, 1999).

Over the past decade, there has been increasing interest in questions concerning the influence of social context on the experience of pain and associated pain behavior (Keefe & Porter, 2007; Tait, 2007). Traditionally, the role of social context was framed in social modeling (Craig, 1978) and operant conditioning processes (Fordyce, 1976). Indeed, important others have been shown to influence the experience of pain and how pain is expressed (Craig,

1975; Hadjistavropoulos & Craig, 2002; Turkat & Guise, 1983). These studies seem to suggest that punishing responses are associated with inhibited expression of verbal and non-verbal pain behavior, while empathic responses are associated with behaviors of greater magnitude (Flor, Knost, & Birbaumer, 2002; Jolliffe & Nicholas, 2004; Lousberg, Schmidt, & Groenman, 1992).

More recently, individual differences in the way how pain is catastrophically interpreted have also been examined in a social context of a refined communal coping model (CCM) (Lackner & Gurtman, 2004; Sullivan et al., 2001; Thorn, Ward, Sullivan, & Boothby, 2003). Pain catastrophizing has been conceptualized as a way of eliciting empathic responses from others (Sullivan, Adams, & Sullivan, 2004; Sullivan et al., 2001; Thorn, Keefe, & Anderson, 2004; Thorn et al., 2003). The CCM predicts that high pain catastrophizers will express pain in especially in the presence of others, because they feel vulnerable and feel the need to seek support from others through the expression of pain.

Evidence for the CCM is provided by Sullivan et al. (2004) who showed that during a cold pressor task, healthy subjects scoring

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high on pain catastrophizing displayed more pain expression in the presence of a neutral observer as compared those who performed the task alone. For the low pain catastrophizers, social context did not affect their pain expression during the pain task. Using a similar experimental pain task, Vervoort and colleagues found children high in pain catastrophizing displayed equal amounts of pain behavior in the presence of both of their parent and a stranger. Their low catastrophizing counterpart, however, were found to express significantly less pain in the presence of a stranger as compared to the presence of own their parent (Vervoort et al., 2008).

Of interest, however, is that studies finding support for CCM have not varied the threat value of the noxious stimulus. Indeed, a number of investigations have shown that threatening information about pain influences pain intensity and pain tolerance (Arntz & Claassens, 2004; Jackson et al., 2005; Vlaeyen, Kole-Snijders, Boeren, & van Eek, 1995). The central thesis of a cognitive appraisal model (CAM) is that idiosyncratic interpretation of a stimulus determines how strongly it is perceived, and which affect it elicits. The CAM assumes that individuals who catastrophize about pain habitually assign increased threat value to innocuous stimuli, thereby experiencing increased pain-related fear. There is accumulating evidence that catastrophic interpretations of pain produce increased pain-related fear and associated escape, avoidance and safety seeking behaviors, both in experimental and clinical settings (Lethem, Slade, Troup, & Bentley, 1983), for a review, see (Vlaeyen & Linton, 2000).

Although the role of the social context is not specified in the CAM it is arguable that certain social contexts might represent safety cues that signal to the individual that imminent threat will be reduced (e.g. (Lohr, Olatunji, & Sawchuk, 2007; Tang et al., 2007)). To our knowledge, no studies exist that have manipulated both the threat value of the pain as well as the social presence during a pain task in one single experiment. Manipulations of threat and social presence afford an interesting opportunity to examine competing predictions of CCM and CAM, and to elucidate the relative contribution of the threat value of pain and the presence of a neutral observer in subjects with varying levels of pain catastrophizing. Because both models are not specified in terms of the dependent variable, we decided to include a verbal and non-verbal measure of pain expression in the current study. This is also in line with the recommendation to use both kinds of measures in the assessment of pain because of their unique informational value (Hadjistavropoulos & Craig, 2002). A comparison of CCM and CAM models of pain catastrophizing is not only of theoretical importance, but also has potential clinical implications as tailored and specific treatment of patients who score high on pain catastrophizing are scarce (Thorn, Boothby, & Sullivan, 2002; Thorn et al., 2007). Additionally, current exposure-based treatments for patients with increased pain-related fear have not explicitly addressed the involvement of the social context (Leeuw et al., 2008; Vlaeyen, de Jong, Geilen, Heuts, & van Breukelen, 2001).

## Methods

### Design

We have chosen a design that allows testing the predictions based on the CCM as well as those based on the CAM. High and low pain catastrophizing healthy subjects were exposed to a cold pressor task in a  $2 \times 2$  factorial design in which both threat of pain (THREAT) and social context (SOCIAL) were experimentally manipulated. Participants were exposed to the pain stimulus for 60 s, followed by a 60 s recovery period. Perceived threat of the cold pressor task was assessed at baseline, after the THREAT

manipulation and after the immersion. Pain catastrophizing was dichotomized for the purpose of pre-stratification in the random assignment procedure, but kept continuous when used as covariate in the analyses. Dependent variables were *pain report* using numerical rating scales and *facial expression* using a standardized observational coding system. Threat of pain was manipulated using the verbal instruction that “*Exposure to ice cold water can lead to freezing in the long term*” in combination with “*Your blood pressure is rather high but just within the limits to allow participation to the cold water procedure*”. This manipulation was successfully used previously (Van Damme, Crombez, Van Nieuwenborgh-De Wever, & Goubert, 2008).

The hypothesis based on the CCM was that high pain catastrophizers would report more pain and display more facial expression of pain in the presence of an observer compared to those who were alone during the pain procedure, irrespective of the threat value of the pain. Hence, we expected a statistical SOCIAL\*Pain catastrophizing interaction, as previously found by Sullivan and colleagues (Sullivan et al., 2004). In contrast, the hypothesis based on CAM was that high pain catastrophizers would express more pain, and that this effect is amplified when pain is perceived as threatening, compared to high pain catastrophizers who are faced with pain that is less threatening, irrespective of the presence of an observer. Therefore we expected a statistical THREAT\*Pain catastrophizing interaction. As an additional test of CAM, we also examined whether any inhibitory ‘safety’ effects of social presence on pain expression were indeed mediated by changes in perceived threat of pain.

### Participants

From a sample of 224 students and staff who responded favorably to advertisements that were posted at different campus sites of Maastricht University, 152 met the selection criteria and agreed to participate in the experiment. A screening procedure was used to exclude participants who had a medical condition that might be adversely affected by the cold pressor task procedure, and participants who were reporting current pain or a chronic pain condition. Five participants did not complete the cold pressor task and removed their hand before the end of the 60 s immersion time. For three of these participants whose immersion time exceeded 40 s, the missing 60 s pain rating was replaced by the previous (40 s) pain rating. Two participants withdrew their hand before the 40 s pain rating, and their data were excluded for further analyses, as well as the data of another participant who failed to complete one of the questionnaires. The final sample of 149 participants consisted of 61 men and 88 women, with a mean age of 33.3 years ( $SD = 9.3$ ) and 29.6 years ( $SD = 11.3$ ) respectively. It can be shown that for the present  $2 \times 2$  between subject design this  $N$  is sufficient to detect a medium effect (main or interaction) size  $d = .50$  with power = .80 using alpha = .05 two-tailed. Participants were randomized into one of four conditions: No threat/no observer ( $N = 39$ ), no threat/observer present ( $N = 37$ ), threat/no observer ( $N = 35$ ), threat/observer present ( $N = 38$ ). Pre-stratification on pain catastrophizing and gender was used to ensure equal levels of pain catastrophizing and gender distributions in all 4 groups. A total score on the Pain Catastrophizing Scale of 16 was used for stratification in high and low catastrophizers (Van Damme, Crombez, Bijttebier, Goubert, & Van Houdenhove, 2002).

### Apparatus

The cold pressor task consisted of a refrigerated unit (30–50–30 cm) that maintained circulating water ranging between 2° and

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