

Optimism lowers pain: Evidence of the causal status and underlying mechanisms

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ABSTRACT

Previous studies have demonstrated a relation between dispositional optimism and lower pain sensitivity, but the causal status of this link remains unclear. This study sought to test the causal status by experimentally inducing a temporary optimistic state by means of writing about and visualizing a future best possible self. In addition, we explored pain expectations and (situational) pain catastrophizing as possible underlying mechanisms of the link between optimism and pain. Seventy-nine university students participated in a cold pressor task (CPT). Before the CPT, half of them received the optimism manipulation and the other half a control manipulation. Induced optimism was related to lower pain intensity ratings during the CPT compared to the control group, thereby experimentally confirming causality. This effect was not explained by pain-related expectations about the task. Situational pain catastrophizing, however, did seem to mediate the relation between optimism and pain. This study is novel in that it confirms the causal status of optimism towards pain. Additionally, the results reveal that positive interventions might provide a useful alternative in reducing pain catastrophizing as an extremely relevant target in pain treatment.

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1. Introduction

Optimism has been demonstrated to be related to better psychological and physical well-being, especially in times of adversity [8,30–33]. When confronted with pain, optimists show both better adjustment [1,2,5,28,41] and less pain sensitivity [2,10,14,22]. Despite accumulating evidence on the relationship between optimism and pain, 2 important issues still need to be resolved.

First, it is not unthinkable that less pain leads to more optimism instead of the reverse. Although longitudinal [2,24,26] and laboratory [14] studies provide preliminary evidence, the causal status of optimism towards pain has not been confirmed by experimental data so far. Second, information about the mechanism or mechanisms underlying the relationship between optimism and pain is still scarce. Understanding the mechanisms of resilience can be used to stimulate adaptive responses to pain. From the literature, several possible working mechanisms can be extracted.

A first mechanism that could explain the relation between optimism and pain is the expectation of pain. Dispositional optimism has been defined as a generalized positive outcome expectancy

[32]. From a theoretical point of view, one could expect this generalized positive outcome expectancy to translate into more positive (or less negative) expectations about pain. The role of pain-related expectations in the experience of pain has been emphasized repeatedly [9,20,23], but at least one study disconfirmed that pain expectancy is the underlying mechanism explaining the relation between optimism and pain.

A second possible mechanism underlying the optimism–pain association might be the appraisal of pain. Optimists are less inclined to process negative information [14] and tend to shift their focus to the positive features of a situation. More specifically, optimism was previously found to be negatively associated with pain catastrophizing [3,36]. Pain-specific negative appraisals [37] typically result in heightened levels of pain intensity [18,19,40]. A recent correlational study suggested that indeed pain catastrophizing could mediate the relationship between optimism and pain [15]. Whether optimism actually leads to less catastrophizing about upcoming pain remains to be established.

The aim of the present study was to investigate whether optimism is causally related to experimental pain sensitivity. Optimism is induced with a best possible self manipulation. This manipulation entails writing and visualizing about a positive future and was previously found to successfully induce a temporary state of optimism [27,29]. It is hypothesized that participants report less pain during

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and after a cold pressor task (CPT) after the best possible self exercise than after a neutral writing and visualization exercise. Additionally, the role of 2 potential explanatory mechanisms is investigated. More specifically, it is examined whether the relation between induced optimism and reported pain intensity is mediated by expected pain intensity or situational pain catastrophizing.

2. Methods

2.1. Participants

Seventy-nine students from Maastricht University between the ages of 18 and 35 years participated in this experiment. Their participation was compensated by means of course credit or financial compensation. Informed consent was obtained from each participant at the beginning of the experiment. Participants were excluded if they had prior experience with the CPT or with the writing and visualization exercise. The final sample of 79 participants consisted of 15 men and 64 women, with a mean age of 22.59 years ($SD = 2.86$).

2.2. Apparatus

A Plexiglas bath tank of $36 \times 30/15$ cm ($W \times L/D$; Julabo ED-19A; Julabo Seelbach, Germany) with an open heating bath circulator was used for the CPT. The water was maintained circulating and at a constant temperature of 5°C ($\pm 0.03^\circ\text{C}$). A plastic unit with water at room temperature (20°C) was placed next to the bath tank.

2.3. Optimism manipulation

Participants were randomly assigned to perform either a best possible self (BPS) or a typical day (TD) writing and visualization exercise. Both exercises have successfully been used in the past as, respectively, an optimism induction or a control exercise [27,29]. Both exercises consisted of the following elements. First, participants were instructed to think about their BPS (experimental condition) or about a TD (control condition) for the duration of 1 min. Next, they were requested to write about this topic uninterrupted for 15 min. Finally, they were asked to imagine the story they wrote down as vividly as possible during 5 min.

The instructions for the BPS exercise, which were also adopted in other studies [27,29,35], were based on the pioneering work of King [21]. The instructions for the TD exercise were based on the work of Sheldon and Lyubomirsky [35]. Forty participants performed the BPS and 39 the TD exercise.

2.4. Measures

2.4.1. Dispositional optimism

To ensure that there were no baseline differences in optimism between participants before the experimental manipulation, dispositional optimism was measured with the revised Life Orientation Test (LOT-R) [33]. This questionnaire consists of 3 positively and 3 negatively framed items, such as, 'In uncertain times, I usually expect the best' or 'if something can go wrong for me, it will' and 4 filler items. Items are scored on a 5-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. The LOT-R results in a total score reflecting a broad generalized positive outcome expectancy, with higher scores representing higher levels of optimism. The LOT-R has been found to be a valid and reliable measurement instrument [33]. Cronbach's alpha in the current sample was .69.

2.4.2. (Situational) pain catastrophizing

Pain catastrophizing was measured with the Dutch version of the Pain Catastrophizing Scale (PCS) [37,38]. Participants were

asked to indicate to what extent each of 13 statements applied to them when in pain. Items such as 'I keep thinking about how much it hurts' or 'I wonder whether something serious might happen' are answered on a 5-point Likert scale ranging from 0 = not at all to 4 = always. The PCS was administered at the beginning of the experiment to check whether there were no initial differences in pain catastrophizing between participants in the 2 conditions.

After pain induction, situational pain catastrophizing (S-PCS) was assessed. The instructions of the PCS were adjusted in such a way that all items referred to the experience of the CPT [11]. Situational pain catastrophizing has been demonstrated to correlate more strongly to experimental pain responses than a trait measure of pain catastrophizing [6]. Indices for internal consistency in the current sample were $\alpha_{\text{PCS}} = .89$ and $\alpha_{\text{S-PCS}} = .91$.

2.4.3. Expected and experienced pain intensity ratings

To measure expected pain intensity, participants were asked to answer the question, 'How much pain do you expect during the cold pressor task?' on a visual analogue scale (VAS) ranging from 0 = no pain at all to 100 = extreme pain.

Experienced pain intensity ratings were obtained by asking participants to verbally communicate with a number between 0 and 100 how much pain they felt ranging from 0 = no pain at all to 100 = extreme pain.

2.4.4. Manipulation check

2.4.4.1. Future expectations. Expectations for positive and negative future outcomes were measured with the questionnaire for Future Expectations (FEX). This scale is an adaptation of the Subjective Probability Task (SPT) [25], which has previously been demonstrated to be sensitive to an optimism manipulation [27,29]. The FEX consists of an equal number of positive and negative statements referring to future outcomes. These positive and negative future outcomes are equally distributed across 5 domains (Health, Professional, Social, Personal, and General).

Ten statements such as 'You will have health problems' or 'People will find you dull and boring' result in a total score for negative expectations (FEX-Neg). Ten statements such as 'You will get a lot of satisfaction out of life' or 'You will make good and lasting friendships' make up a total score for positive expectations (FEX-Pos). Participants are asked to judge the likelihood of each statement on a 7-point scale, with 1 = not likely at all to occur to 7 = extremely likely to occur. Internal consistency for both scales in this sample were $\alpha_{\text{FEX-Pos}} = .80$ and $\alpha_{\text{FEX-Neg}} = .85$ for the pre-manipulation measurement and $\alpha_{\text{FEX-Pos}} = .87$ and $\alpha_{\text{FEX-Neg}} = .89$ in the post-manipulation phase.

2.4.4.2. Positive and negative mood. State mood was measured on a VAS ranging from 0 = not at all to 100 = extremely. Responses to the questions 'How positive are you feeling at this moment?' and 'How negative are you feeling at this moment?' resulted in a state measure for positive mood (MOOD-Pos) and negative mood (MOOD-Neg). The measurement of affect was used as a secondary manipulation check. Previous studies have found effects of the BPS manipulation on both future expectations and (positive) affect [27,29].

2.4.4.3. Quality of writing and imagery. Two VAS scales ranging from 0 to 100 were administered as a check for possible qualitative differences between the BPS and TD exercise [29]. Participants were asked to answer the following questions: 'How well could you imagine yourself in the situation you described in your writing?' (not at all–extremely well) and 'How vivid were the pictures you imagined?' (not vivid at all–very vivid).

2.5. Procedure

Participants were recruited for participation in a study examining the influence of visualization on pain during a CPT. At their

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