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Emotional Regulation and Acute Pain Perception in Women

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Abstract: Emotional regulation is an important variable in the experience of pain. Currently, there are no experimental investigations of the relation between emotional regulation and pain. The goal of the present study work was to analyze differences in pain perception and mood generated by the cold-pressor (CPT) experimental paradigm in women with high and low emotional regulation. Two groups of women were formed as a function of their level of emotional regulation: women with high emotional repair (N = 24) and women with low emotional repair (N = 28), all of whom performed the CPT. The results show that the women with a high score in emotional repair reported having experienced less sensory pain and affective pain during the immersion, as well as a more positive affective state before beginning the task. During the experimental task, they also reported a better mood, thus displaying lower impact of the experience of pain.

Perspective: ***Emotional regulation is proposed as a key element to manage the emotional reaction that accompanies the experience of acute pain experimentally induced by the CPT experimental paradigm in a sample of healthy women.***

Key words: *Emotional regulation, affective state, acute pain, experimental task, cold-pressor.*

Pain is a complex experience that is not determined simply by the intensity of the nocioceptive stimulation, but rather, the role of psychological factors must be taken into account in order to understand pain.[13] There are many psychological variables that may influence the perception of pain,[30] but emotion seems particularly important. The scientific literature has revealed consistent evidence that emotional aspects directly modulate the intensity, frequency, and duration of pain.[18,22,31]

Within this context, diverse variables related to negative emotions such as depression,[44] anxiety,[35] sensitivity to anxiety,[23] and fear of pain,[19] and inadequate coping strategies such as catastrophizing have been studied.[21,39] However, few studies have focused on analyzing the role of emotional regulation or of beliefs in the ability to regulate emotional experience, variables that may further our understanding of the individual differences in the emotion-pain relation.[18]

Emotional regulation has been defined as a process by which people influence the kind of emotions they have, when they have them, how they experience them, and how they express them. Gross[16] stated that emotional regulation may take place throughout the entire process of emotional generation, and established 2 large groups of emotional-regulation strategies: those that focus on the antecedents of the emotion and those that focus on the emotional response. Strategies of emotional regulation that focus on the antecedents of the emotion will vary as a function of the moment in which the individual finds himself within the process.[16] He proposes cognitive reappraisal as a specific regulation strategy. This strategy consists of changing the meaning of a situation, so that the person reinterprets an emotionally relevant situation in neutral or nonaffective terms.[17] In recent years, a growing body of research has focused on investigating the extent to which differences in emotional regulation can explain aspects related to people's psychological[8,33] and physical health.[3,7,34] Regarding pain, emotional regulation may be an important factor, especially if we consider the emotional content that accompanies the experience of pain. Various studies have revealed some results in this direction. Hamilton et al[18] analyzed the relation between emotional regulation, emotional intensity, and the affective response to pain in a sample of women with rheumatoid arthritis. The results revealed a combined effect of emotional regulation and emotional intensity, suggesting that the magnitude of the response to pain varies as a function of both variables. Thus, in moments of more intense pain, women with high emotional intensity and low ability to regulate their

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emotions presented a worse affective response. In this vein, González et al[15] showed how emotional regulation is related to more use of active strategies, as well as better daily functioning and less deterioration in a sample of patients with diverse chronic pain problems. Likewise, Connelly et al,[5] using a prospective design to assess daily changes in the intensity of affect in a group of people with rheumatoid arthritis, found that emotional regulation was a significant predictor of lower perception of pain. On the other hand, Van Middendorp et al[40] indicate that emotion regulation is not of direct importance for perceived somatic health of patients with rheumatoid arthritis, but that it may be important for psychological well-being and social functioning. According to these authors, emotional regulation may be a key variable to better understand the experience of pain and to improve intervention with people who have this problem.

Despite some evidence of the influence of emotional regulation on the experience of pain in people with chronic pain, to date, and to the best of our knowledge, there has been no experimental research on the relationship between emotional regulation and the experience of pain. The goal of the present work was to analyze differences in pain perception and mood generated by the cold-pressor (CPT) experimental paradigm in women with high and low emotional regulation. We hypothesize that people with high ability to regulate their emotions, in comparison with those with a low level of emotional regulation, will show a lower level both of sensory pain and affective pain during CPT, as well as better mood both before and during the process.

Methods

Participants

In the first phase, 177 university students from the Psychology Faculty of the Complutense University of Madrid (Spain) were participants. Mean age was 21.54 years (SD = 2.81). Due to their low representativeness in this sample (only 10%), males were excluded. Other exclusion criteria were: suffering some problem of chronic pain (fibromyalgia, chronic fatigue syndrome, etc), circulatory problems, hypertension, diabetes, or taking some kind of analgesic. We then formed 2 groups of women as a function of their score on the Emotional Repair subscale of the Trait Meta-Mood Scale (see below) (1 standard deviation above and below the mean): women with high emotional repair (n = 24, mean age = 21.21, SD = 1.26) and women with low emotional repair (n = 28, mean age = 21.54, SD = .83), who carried out the CPT.

Pain-Induction Technique

Following Keogh and Mansoor[25] and Keogh et al,[24] the pain-induction technique used in the current study was the CPT. In order to standardize testing procedures, participants place their nondominant hand in a cold water bath maintained at a temperature of 1°C (±.5). The cold-pressor apparatus consisted of a container filled with ice-cold water. The temperature of the water was held constant by using a thermometer and periodically adding ice to the container. The ice was removed from the container and the water temperature was recorded for each participant prior to the actual immersion. Participants are asked to keep their hand immersed for as long as they can bear (5-minute maximum), but are instructed that they can withdraw at any time without penalty. This task is viewed as having excellent reliability and validity.[6,43] The pain-induction method complied with the International Association for the Study of Pain Ethical Guidelines,[20] and also received the approval of the ethical committee of the Complutense University of Madrid.

Pain Measures

Sensory and Affective Pain

Two dimensions associated with the induced pain were assessed: sensory pain and affective pain.[9] Every 15 seconds during the CPT, participants verbally rated their perception of the strength of the painful stimulus (sensory pain) and the unpleasantness of the pain generated by the painful stimulus (affective pain) using a numerical rating scale (NRS), where: 0 corresponded to no pain and 10 to unbearable pain. The NRS score was used as a measure of sensory and affective pain.

Time of Immersion

Total time (measured in seconds) from the moment of placing the hand in the tray of cold water until the moment of spontaneous hand withdrawal was defined as time of immersion. Duration of the ice-cold water immersion was recorded with a stopwatch. A cut-off time of 5 minues was set for safety reasons. Time of immersion for participants who did not withdraw their hand for the entire 5 minutes was recorded as 300 seconds.

Psychological Measures

Emotional Regulation

The Emotional Repair subscale of the Trait Meta-Mood Scale (TMMS[34]) was used to assess emotional regulation. The TMMS was designed to assess how people reflect upon their moods, and it evaluates the extent to which people attend to and value their feelings (Attention), feel clear rather than confused about their feelings (Clarity), and use positive thinking to repair negative moods (Repair). Adequate internal consistency, as well as convergent and discriminative validity, have been reported for this scale.[34] Fernández-Berrocal et al[12] have developed a Spanish shorter version of the Trait Meta-Mood Scale with 24 items (8 for each subscale). This Spanish version has also shown high internal consistency (Cronbach's alphas Attention = .9, Clarity = .9, Repai r = .86), and test-retest reliability was satisfactory (*r*s ranging from .6 to .83).[12] The Repair subscale had adequate reliability in the present study (Cronbach's alpha .87).

Affective State

The Spanish translation[36] of the Positive and Negative Affect Schedule (PANAS[42]) was used. The PANAS is

a self-report adjective checklist that contains 2 subscales of 10 items designed for the assessment of Positive Affect (active, alert, attention, determined, enthusiastic, excited, inspired, interested, proud, and strong) and Negative Affect (afraid, ashamed, distressed, guilty, hostile, irritable, jittery, nervous, scared, and upset). An Affective state score is computed by subtracting the negative affect score from the positive affect score.[1,10,38] For each of the 20 emotion-related words, participants use a 5-point scale (1 = very slightly or not at all, 5 = extremely) to rate the extent to which they feel each state before and after the CPT. Therefore, participants provide ratings at 2 different times, before the task (preaffective state) and after the task; in the present case, participants rated the extent to which they felt during the task (affective state during the task). The scale had adequate reliability in this study (Cronbach's alpha .73).

Procedure

The current study followed a between-group design. The between-group factor was emotional-regulation group (high vs low). The dependent variables were time of immersion, affective pain, sensory pain, and affective state before and during the task.

In the first phase of the study, the tests were administered in a single 15-minute session during normal class hours and in the presence of the main investigator. Participation was voluntary.

One month later, the women who formed the 2 experimental groups (high emotional-regulation group and low emotional-regulation group) were requested to participate in the second phase of the study, which was also voluntary. Upon arriving at the laboratory, the participants were given the following written instructions:

"You are going to undergo a physically painful experience. Our goal is to assess your degree of pain. For this purpose, you should place your nondominant hand in a tray of very cold water. It is important to keep your hand in the tray for as long as possible; nevertheless, you can remove your hand if you feel that you cannot stand the painful experience any longer. Periodically (every 15 seconds), we will ask you about the degree of sensory and affective pain you are feeling. You can respond on a 0-10 scale for each one of these variables, where 0 is no pain and 10 is unbearable pain."

Once they had read the instructions, the participants consented to carry out the task. Before starting, they completed the Positive and Negative Affect Scale (PANAS[36]). They then carried out the CPT. Immediately after removing their hands from the water, the participants again completed the PANAS, reporting their affective state during the task.

Results

The descriptive statistics of the psychological and pain-related variables are shown in Table 1. To analyze the existence of differences between the women with high and low emotional repair in the perception of pain and the affective state during the CPT, we carried out several analyses of variance. In order to control for the effect on these variables of affective state prior to the task, it was included along with age as a covariate in each analysis (the covariate sex was not used because all the participants were female). Analysis of variance was chosen as the statistical procedure, as it permitted an analysis of the difference between groups while controlling the effect of the covariate.

Table 1. Summary of Pain and Psychological Variables

Measure	N	Observed Range	Mean (SD)
Sensory pain	52	3.1–10.	7 (1.78)
Affective pain	52	2–10.	6.69 (2.02)
Pre-affective state	52	–.1–3.5	1.76 (.82)
Affective state during the task	52	–.8–3.6	1.54 (1)
Time of immersion	52	3–300	118.11 (108.36)
Repair	52	1.38–5	3.13 (1.04)

Group Differences in Pain-Related Variables

The results of the diverse analyses of variance are shown in Table 2. As can be observed, although the group of women with high emotional repair presented a higher mean time of immersion than the low repair group, the difference did not reach statistical significance ($F(1, 51) = 2.64$, $P > .05$, $\eta^2 = .05$). However, there were significant differences in the pain-related variables. Specifically, the group with high emotional repair showed a lower rate of sensory pain ($F(1, 51) = 4.59$, $P < .05$, $\eta^2 = .09$) and a lower rate of affective pain ($F(1, 51) = 7.12$, $P < .05$, $\eta^2 = .13$) during the CPT. According to Cohen,[4] the effect size can be considered medium in both cases ($\eta^2 = .09$ and $\eta^2 = .13$).

Group Differences in Affective State

First, we examined the differences in affective state of the groups before undergoing the CPT. The analysis of variance revealed that, including age as covariate, the group of women with high emotional repair displayed significantly better prior affective state ($F(1, 51) = 15.81$, $P < .0001$. $\eta^2 = .24$). During the CPT, the group of

Table 2. Group Differences in Pain Variables and Affective State During the Task Controlling for Age And Pre-Affective State

	Low Emotional Repair (N = 28)	High Emotional Repair (N = 24)		
Dependant variables	Mean (SD)	Mean (SD)	P	η^2
Sensory pain	7.38 (1.72)	6.55 (1.78)	.03	.09
Affective pain	7.39 (1.67)	5.88 (2.12)	.01	.12
Pre-affective state	1.4 (.73)	2.2 (.73)	.0001	.24
Affective state during the task	1.03 (.81)	2.13 (.88)	.01	.13
Time of immersion	92.82 (95.27)	147.62 (117.03)	.11	.05

Table 3. Relationships Between Affect—Prior and During the Task—And Pain-Related Variables

	1	2	3	4	5
Pre-affective state		.61**	.09	–.11	.07
Affective state during the task			–.12	–.42*	.17
Sensory pain				.65**	–.2
Affective pain					–.23
Time of immersion					

*$P < .005$.
**$P < .001$.

women with high emotional repair again presented better affective state in comparison with the low repair group ($F(1, 51) = 7.19$, $P < .05$, $\eta^2 = .13$), after controlling for the effect of prior affective state and age (see Table 2). In this case, the effect sizes can be considered large ($\eta^2 = .24$) and medium ($\eta^2 = .13$), respectively.[4]

Relationships Between Affect —Prior and During the Task— And Pain-Related Variables

Table 3 shows the results of the bivariate correlation analyses between affect prior to the task, affect during the task, sensory pain, affective pain, and time of immersion. Table 3 shows that although there is a high-magnitude positive correlation between prior affect and affect generated during the task (r = .61, $P = .0001$), no significant relations were found between prior affect and pain-related variables (r = .09, $P = .499$, for sensory pain; r = –.11, $P = .412$, for affective pain). However, the women who reported a more positive affective state during the immersion also displayed less affective pain, and a high-magnitude negative correlation between the 2 variables was found (r = –.42, $P = .002$), but they did not display less sensory pain, and no significant correlations were found in this case (r = –.12, $P = .39$). The bivariate relation between sensory pain and affective pain was high and positive (r = .65, $P = .0001$). Finally, although positive correlations were found between time of immersion and affective variables, and negative correlations between time of immersion and pain-related variables, these correlations were not statistically significant.

Discussion

Throughout the literature, emotional variables have been shown to be very important for the understanding of pain and to explain individual differences in the experience of pain.[22] So much so that the diverse theoretical models have even included emotional reactivity as part of the definition of pain.[20,28]

In the present work, we analyzed the influence of emotional regulation in acute pain by means of the CPT. Emotional regulation is proposed as a key element to manage the emotional reaction that accompanies the experience of pain. This hypothesis has been explored in diverse studies that use samples of people with problems of clinical pain.[18,22] In the present work, we attempted to extend these results by analyzing the relation between emotional repair and acute pain induced experimentally in a sample of healthy women using the CPT experimental paradigm. This task has been extensively employed in the study of pain, and allows greater control over the painful stimulation as well as the assessment of diverse indicators that are important in studying the relationships between pain and psychological variables.[19]

Different pain-related variables were examined. As regards time of immersion, although it was related in the expected direction to other pain-related variables and affective variables, these relationships were not statistically significant, owing probably to the small sample size in our study. With regard to pain, the women with high scores in emotional repair reported having experienced less sensory pain and affective pain during the immersion. These results coincide with those found by other authors who have related emotional repair to a lower perception of pain in people with chronic pain,[5,15] or who have prospectively associated a lower intensity of pain with hospitalized people [29] or with menopausal women.[7]

With regard to affect, 2 results are noteworthy. The women with more skill to regulate their affect displayed a better mood before beginning the task. On arriving at the laboratory and before beginning the experimental task, the participants with higher emotional repair reported a better mood, despite the fact that a potentially painful situation was being presented. These results are in accordance with the findings of other studies[3,10,37] and suggest that people who perceive themselves as being more capable of managing their moods have a higher capacity to deal with this stressful experience adequately. However, once the experimental task was over, the participants with high scores in emotional repair also reported a better mood, thus showing a lower impact of the experience of pain. It is also noteworthy that the women with a better mood during the immersion showed less affective pain, but not less sensory pain. According to the model of Melzack and Casey,[27] affective pain seems to be more closely related to the subjective quality of the experience of pain. Women with a more positive affective state during the experimental task may interpret the painful experience as less aversive.

As shown in our results, despite undergoing the same painful stimulus, the women perceived the painful sensation differently as a function of their self-reported capacity to regulate their moods. The perception of pain varies considerably as a function of emotional and mood factors, and the person's psychological state when pain is produced is very important in appraising it and rating its intensity. From this perspective, the women with higher emotional repair may perceive the experimental task as less aversive because they use their emotional knowledge[14,17] and they trust their capacity to manage the negative feelings that pain or the stressful situation might provoke. We hypothesize that being able to manage one's emotions can forestall the onset of negative

emotions, such as anxiety, or the use of inadequate coping strategies, such as catastrophizing, which have been shown to be associated with the perception of pain.[21,23]

On interpreting the results obtained, it is important to take into account some limitations of this study. Emotional regulation was measured through self-report using the Emotional Repair subscale of the Trait Meta-Mood Scale. Future studies should include ability measures of emotional regulation such as the emotional regulation branch of the MSCEIT.[2] Another aspect to take into account is that the sample of our work is made up exclusively of women, which means that the results obtained cannot be generalized to the male population. Most, but not all, studies find that women report higher levels of pain than men in experimental tasks of acute pain.[26,32] The relation between pain and some psychological variables differs in men and women, and there are differences in the way that they feel and appraise the painful experience. It is also necessary to take into account the well-known differential pattern of men and women in the subscale of emotional regulation used in this study. The works carried out in this vein show that men present a higher capacity to regulate their affects than women, whereas women tend to pay more attention to their moods.[11] This different emotional profile can lead males to cope with the presence of a painful experience differently due to their higher capacity to manage their emotions. Therefore, future research should extend the study to include the male population and analyze the existence of possible differences.

Our work has revealed that women who perceive themselves as having higher emotional repair deal with the CPT better, are able to reduce its emotional impact, and experience it as less painful. Based on this, new questions arise: Exactly what do we do when we regulate our moods? What mechanisms do we set off when we begin the process of emotional regulation? And, of the mechanisms that make up regulation, which ones are effective and which are not? The answers to these questions deserve to be explored in future research that analyzes the relation between emotional regulation and pain. No doubt, clearer knowledge of the way in which emotional regulation affects pain or of which regulation strategies are more useful will allow us to improve psychological interventions with people who suffer pain-related problems, within the context of previous research that has shown the implications of emotional regulation in populations with chronic pain.[41]

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