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Trying to Fix a Painful Problem: The Impact of Pain Control Attempts on the Attentional Prioritization of a Threatened Body Location

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Abstract: Motivational accounts of pain behavior and disability suggest that persisting attempts to avoid or control pain may paradoxically result in heightened attention to pain-related information. We investigated whether attempts to control pain prioritized attention to the location where pain was expected, using a tactile change detection paradigm. Thirty-seven undergraduate students had to detect changes between 2 consecutively presented patterns of tactile stimuli at various body locations. One of the locations was made threatening by occasionally administering a pain-eliciting stimulus. Half of the participants (pain control group) were encouraged to actively avoid the administering of pain by pressing a button as quickly as possible, whereas the other participants (comparison group) were not. The actual amount of painful stimuli was the same in both groups. Results showed that in the comparison group, the anticipation of pain resulted in better detection of tactile changes at the pain location than at the other locations, indicating an attentional bias for the threatened location. Crucially, the pain control group showed a similar attentional bias, but also when there was no actual presence of threat. This suggests that although threat briefly prioritized the threatened location, the goal to control pain did so in a broader, more context-driven manner.

Perspective: ***This study investigates the impact of attempts to control pain on somatosensory processing at the pain location. It provides further insight into the motivational mechanisms of pain-related attention. It also points to the negative consequences of trying to control uncontrollable pain, such as is often the case in chronic pain.***

Key words: *Pain control, spatial attention, experimental pain, tactile processing, attentional bias.*

Pain is perhaps the most universally understood motivator. As an evolutionary threat indicator, it is prone to automatically demand attentional resources and to redirect one's current goal pursuit toward the higher order goal of self-protection.[8,9,24] Pain is thus capable of automatically interrupting ongoing attentional processes, allowing the initiation of adaptive responses such as escaping, avoiding, or controlling the threat. Such bottom-up interruptions have been well documented, particularly when pain is intense or unexpected.[18,20,33]

We have an increasing understanding of how and when pain-related information that is irrelevant to one's ongoing tasks or goals captures attention.[9] However, when pain persists, pain control or avoidance itself may become one's focal goal.[6,10,30] It is largely unknown how pain-related information is processed when this pain goal is pursued. According to the neurocognitive model of attention to pain, attentional prioritization of pain-related information may also occur in a top-down fashion, that is, driven by goals.[18] Goals are believed to direct attention through the activation of attentional control settings—a set of stimulus features kept in working memory to facilitate processing of goal-relevant information.[13] All stimuli relevant to a focal goal will then be prioritized.[12] When the focal goal is pain-related, this top-down influence should translate into heightened attention to stimuli that share features with the attentional set defined by the pain

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goal, such as somatosensory modality and body location where pain is expected. It has been shown that the mere expectation of pain facilitates somatosensory processing at the threatened body part.[29,31] However, it is yet unclear to what extent such effect is modulated by the goal to control pain, as this goal has rarely been activated in a laboratory situation. An exception is the study by Notebaert and colleagues,[23] in which it was shown that attempting to avoid pain increased attentional bias to visual cues signaling pain. However, that study does not allow any conclusions about the extent to which attention was directed to the threatened body location.

The scarcity of studies using somatosensory paradigms is remarkable. A noteworthy number of theoretical models maintain that dysfunctional attentional processes play a significant part in chronic pain.[3,6,10,36] Triggered by a strong fixation on pain control goals, chronic pain patients have been suggested to be hypervigilant to somatosensory cues, that is, to allocate an excessive amount of attention to bodily changes, which in turn may exacerbate their condition.[6] Studying the effects of pain control motivation on attention for somatosensory stimuli could further our understanding of dysfunctional attentional mechanisms in these patients.

The aim of the present study was to investigate if attention is prioritized to a body location where pain is expected, and whether this prioritization is more pronounced when the goal to control pain is actively pursued. In order to measure attention to the threatened body location, we used a tactile change detection (TCD) paradigm.[14,32] This paradigm requires participants to judge whether 2 subsequently presented tactile stimulation patterns are the same. In half of the trials, the same pattern was presented twice. In the other half, 1 stimulus location was changed between patterns. One of the locations was made threatening by occasionally administering a pain stimulus. Half of the participants (pain control group) were encouraged to actively avoid the administering of pain by pressing a button as quickly as possible, whereas the other participants (comparison group) were not. We expected that when under threat, tactile changes at the threatened location would be better detected than changes at the other locations (Hypothesis 1). Crucially, we expected that this effect would be more pronounced in the pain control group than in the comparison group (Hypothesis 2).

Method

Participants

Thirty-seven Ghent University students participated in this study, in exchange for course credits. Twenty-seven of them were female. Seven of the participants were left-handed. All of the participants had normal or corrected-to-normal vision and normal hearing. The study protocol was approved by the Ethics Committee of the Faculty of Psychology and Educational Sciences of Ghent University. The experiment took approximately 1 hour 15 minutes.

Apparatus and Stimulus Material

The experiment was conducted in a normally illuminated room, with participants sitting on a chair in front of a laptop screen (HP Compaq nc6120 Notebook, 15″ TFT display; Hewlett-Packard, Palo Alto, CA). Tactile stimuli consisted of vibrations, presented by means of 8 resonant-type tactors (C-2 Tactor, Engineering Acoustics, Inc, Casselberry, FL) consisting of a housing of 3.05 cm diameter and .79 cm height, with a skin contactor of .76 cm diameter. The stimuli could be administered on 8 different body locations, 4 of which were situated on each side of the body: the back of the hand, close to the elbow joint on the inner arm, above the knee, and above the inner side of the ankle (Fig 1). Tactors were attached directly to the skin surface by means of double-sided tape rings and were amplified by a custom-built device. Tactor frequency was set to 200 Hz, and the stimulus duration was set to 200 milliseconds. Two electrodes were also taped to 1 of the tactor locations. The selection of this location was counterbalanced across participants. Similar to the tactor settings, the electrostimulator (DS5; Digitimer, Welwyn Garden City, United Kingdom) was set to a 200 Hz frequency and a duration of 200 milliseconds. Amplitude for each of the devices was determined by means of adaptive procedures, as described in the Procedure section.

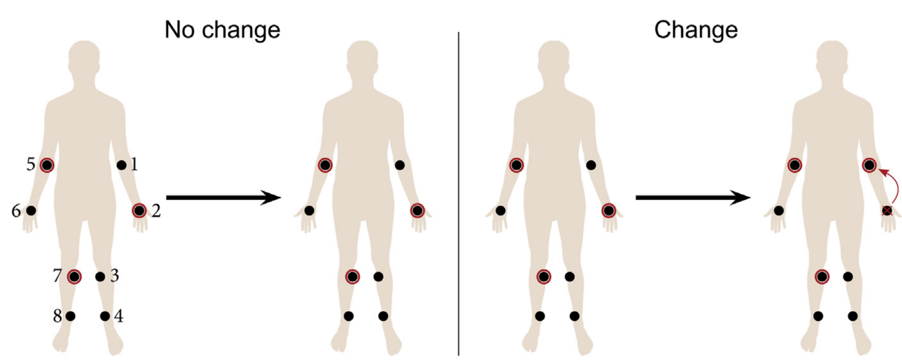

Figure 1. Example of typical trial without change in the tactile pattern (left side) and trial with change (right side). Tactor locations are numbered (see Table 1 for mean intensities).