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Competing Goals Attenuate Avoidance Behavior in the Context of Pain

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Abstract: Current fear-avoidance models consider pain-related fear as a crucial factor in the development of chronic pain. However, pain-related fear often occurs in a context of multiple, competing goals. This study investigated whether pain-related fear and avoidance behavior are attenuated when individuals are faced with a pain avoidance goal and another valued but competing goal, operationalized as obtaining a monetary reward. Fifty-five healthy participants moved a joystick toward different targets. In the experimental condition, a movement to one target (conditioned stimulus [CS+]) was followed by a painful unconditioned stimulus (pain-US) and a rewarding unconditioned stimulus (reward-US) on 50% of the trials, whereas the other movement (nonreinforced conditioned stimulus [CS−]) movement was not. In the control condition, the CS+ movement was followed by the pain-US only. Results showed that pain-related fear was elevated in response to the CS+ compared to the CS− movement, but that it was not influenced by the reward-US. Interestingly, participants initiated a CS+ movement slower than a CS− movement in the control condition but not in the experimental condition. Also, in choice trials, participants performed the CS+ movement more frequently in the experimental than in the control condition. These results suggest that the presence of a valued competing goal can attenuate avoidance behavior.

***Perspective:** The current study provides experimental evidence that both pain and competing goals impact on behavioral decision making and avoidance behavior. These results provide experimental support for treatments of chronic pain that include an individual's pursuit of valuable daily life goals, rather than limiting focus to pain reduction only.*

***Key words:** Goals, avoidance, pain-related fear, reward, motivation.*

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A wealth of evidence endorses the role of pain-related fear in the development and maintenance of (chronic) pain problems.[17,20,29,44,48,53,57] Recently, it has been suggested that pain-related fear should be considered within a motivational context. More specifically, the experience of pain not only might lead to the development of pain-related fear but also may activate the goal to control or avoid (further) harm.[9,29,46,47] However, the goal to avoid pain does not occur in a motivational vacuum.[9,29,46,47] Indeed, to avoid bodily harm or pain is often only one goal in a context of other, often competing, goals.[6,9,23,25,41,46,51,53,58] In a context of multiple goals, the pursuit of one goal may possibly interfere with the pursuit of other goals. This may give rise to goal conflicts during which the same response elicits

opposing outcomes.[3] Previous research has shown that individuals with chronic pain often have to weigh the value of pain avoidance against the costs of withdrawal from previously valued activities[16,40,43,48] and they experience difficulties deciding which goal to pursue.[11,19,39] Studies investigating the influence of competing goals on pain-related fear, avoidance behavior, and associated decision-making behavior are scarce. Most experimental pain research on goals has focused on goal pursuit and attentional processes, indicating that pursuing nonpain goals can inhibit the attentional bias to pain.[24,48,51]

Although fear conditioning models are widely accepted as an experimental approach to investigate how fear is acquired, motivational factors have not yet been incorporated into these models.[8] A well-established paradigm to study the acquisition of movement-related fear of pain is the voluntary joystick movement (VJM) paradigm,[32,34,35] which exemplifies a typical human fear conditioning experiment: a conditioned stimulus (CS+), that is, arm movements performed with a joystick, is followed by an aversive electrocutaneous stimulus, that is, painful unconditioned stimulus (pain-US). After repeated pairings with the unconditioned stimulus (US), the CS+ becomes a threat signal and thus starts to elicit fear responses (conditioned response). In a differential fear conditioning paradigm, a control stimulus (CS−) is included that is never followed by the US, which thus becomes a safety signal.[10]

In the present study, we adapted the VJM paradigm to experimentally create goal competition by introducing lottery tickets representing a monetary reward as a reinforcing US, to investigate whether pain-related fear and avoidance behavior are attenuated when individuals are confronted with a pain avoidance goal and a competing goal, that is, obtaining the reward. In the control condition, a movement toward one target (CS+) was followed by a painful stimulus (US), whereas another movement (CS−) was not. In the experimental condition, a rewarding conditioned stimulus (reward-US) accompanied the pain-US, thus installing competition between an inclination to avoid pain and an inclination to obtain a reward. We hypothesized that a concurrent reward-US would lead to 1) reduced fear responses, that is, less self-reported pain-related fear for a painful (CS+) movement; 2) less avoidance tendencies, that is, lower response latencies for CS+ movements in the experimental condition; and 3) less avoidant decision-making behavior, that is, choosing to perform the painful movement instead of the safe movement. Additionally, we explored whether the importance of both the pain-avoidance and the approach-reward goal was associated with participants' decision-making behavior.

Methods

Participants

Fifty-five healthy individuals (28 men, mean [M] age = 21.62, standard deviation [SD] = 3.45) volunteered. Ten participants (18%) were left-handed. Participants were recruited by means of flyers distributed at the University of Leuven, advertisements (both online and on paper), and the Experiment Management System of the Faculty of Psychology and Educational Sciences of the University of Leuven (Belgium). Participants received either course credits or €10 for their participation. Exclusion criteria were insufficient knowledge of the Dutch language, dyslexia, cardiovascular diseases, lung diseases, neurologic diseases (eg, epilepsy), other serious medical conditions, current diagnosis of psychiatric disorders, chronic or acute pain, being asked to avoid stressful situations by a general practitioner, presence of electronic medical devices (eg, pacemaker), use of anxiolytics or antidepressants, pregnancy, and deteriorated vision that is not corrected.

Participants received information, both orally and in writing, that painful electrocutaneous stimuli would be administered, but that the intensity of the stimulus would be individually selected. Participants were given the opportunity to ask for additional information. All participants provided a written informed consent. Ethical approval was obtained through the Ethics Committee of the Faculty of Psychology and Educational Sciences of the University of Leuven (Belgium), registered no. S55216. Because of a technical failure, 3 participants did not receive any electrocutaneous stimulus during the experiment. Two other participants did not adhere to the experimental instructions, and thus their responses were unreliable. These 5 participants were excluded from the statistical analyses. Statistical analyses were conducted on a sample of 50 participants (26 male; M age = 21.36 years, SD = 3.28; 20% left-handed).

Apparatus and Stimuli

The experiment was run on a Windows XP computer (Dell OptiPlex 755; Dell, Round Rock, TX) with 2 GB random-access memory and an Intel Core2 Duo processor (Intel, Santa Clara, CA) at 2.33 GHz and an ATI Radeon 2400 graphics card (Advanced Micro Devices, Sunnyvale, CA) with 256 MB of video random-access memory. The experiment was programmed in Affect, version 4.0.[42] An electrocutaneous stimulus of 20 ms duration served as the pain-US. The pain-US was delivered by an Isolated Bipolar Current Stimulator (DS5; Digitimer Ltd, Welwyn Garden City, England) through surface SensorMedics electrodes (1 cm diameter; SensorMedics Corp, San Diego, CA) filled with K-Y gel (Johnson & Johnson, New Brunswick, NJ) that were attached to the wrist of the dominant hand. The stimulus intensity was individually determined during a preexperimental calibration procedure, selecting a stimulus at tolerance level. A monetary reward in the form of lottery tickets (reward-US) was introduced in the experimental condition. A single reward-US always represented 2 lottery tickets. These lottery tickets represented a chance to win an extra 50€ reimbursement. Movements performed using a Paccus Hawk Joystick (Paccus Interfaces BV, Almere, the Netherlands) in 4 different directions served as CSs (ie, toward the left, right, upward, or downward). Participants