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Between the Devil and the Deep Blue Sea: Avoidance-Avoidance Competition Increases Pain-Related Fear and Slows Decision-Making

Nathalie Claes,[*,†] Geert Crombez,[†,‡] Ann Meulders,[*] and Johan W. S. Vlaeyen[*,§]

[*]*Health Psychology, University of Leuven, Leuven, Belgium.*
[†]*Department of Experimental-Clinical and Health Psychology, Ghent University, Ghent, Belgium.*
[‡]*Centre for Pain Research, The University of Bath, Bath, Somerset, United Kingdom.*
[§]*Department of Clinical Psychological Science, Maastricht University, Maastricht, The Netherlands*

Abstract: Successful adjustment to dynamic environments requires the simultaneous pursuit of multiple goals. However, the pursuit of multiple goals may bring about goal conflict. Despite evidence indicating that goal conflict can have a detrimental effect on subjective well-being, little is known about the effects of goal competition in the context of pain. This experiment investigated whether different types of goal competition increase pain-related fear and slow pain-related decision-making. Forty-six participants completed a cross-directional movement task in which they learned to associate movements in 1 direction (eg, left) with pain, and movements in the opposite direction (eg, right) with safety; and that movements in other directions (eg, up and down) were associated with reward and loss of reward, respectively. In the test phase, both phases were combined, creating different types of goal competition. The results showed that participants were most afraid of movements associated with 2 concurrent avoidance goals, and the least afraid of movements associated with approach-approach competition. Additionally, participants were slower in making a choice when presented with an avoidance-avoidance competition compared with approach-approach and avoidance-approach competition. These findings suggest that avoidance-avoidance competition increased fear and slowed decision-making compared with other types of competition.

***Perspective:** This study provides experimental evidence for the differential effects of various goal conflicts on pain-related fear and decision-making. This knowledge may improve our understanding of patients' behavior when experiencing goal conflict and may contribute to improving treatments by addressing multiple goals patients are pursuing, and not just pain avoidance/reduction.*

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***Key words:** Avoidance, motivation, goals, reward, pain.*

Pain-related fear and avoidance behavior are considered key factors in the development and maintenance of chronic pain problems.[18,25,31,51] However, there are unresolved issues that merit further scientific scrutiny. One of the concerns is that these defensive responses may vary within and across individuals and situations, dependent on the motivational context in which pain takes place.[10,45,53,56,59] When experiencing pain, the goal to avoid (further) harm is often activated within a context of multiple competing goals, such as maintaining a relationship or engaging in regular exercise. There may, however, be an incompatibility or competition between these goals, which may bring about goal conflicts.[5,43] Goal competition arises when there is competition between 2 incompatible forces or responses of equal value, such as approach and avoidance tendencies. For example, it has been suggested that individuals experiencing chronic pain often pit the costs and benefits of pain avoidance against those of other activities, usually resulting in the

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Address reprint requests to Nathalie Claes, MSc, Department of Psychology, University of Leuven, Tiensestraat 102, Box 3726, 3000 Leuven, Belgium. E-mail: Nathalie.claes@ppw.kuleuven.be

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prioritization of avoiding pain at the expense of other life goals.[17,44,49] Furthermore, different types of goal competition can be distinguished, on the basis of the valence of the outcome[11,20]: 1) competition between tendencies to approach different desirable outcomes or goals, termed approach-approach competition; 2) avoidance-avoidance competition, that is, being hemmed in by negative outcomes, all instilling avoidance tendencies; and 3) approach-avoidance competition, which occurs when an event is associated with negative and positive outcomes, and thus instills approach and avoidance tendencies.[16,32,39,41] Note that from this point of view, the absence of a positive stimulus is functionally equivalent to the presence of an aversive stimulus, and vice versa.[34] Research in humans showed that avoidance-avoidance conflicts are more difficult and thus take longer to solve than approach-approach competition, whereas approach-avoidance competition is situated somewhere in between.[3,7,11,23,32,33,39,41,47] Preliminary cross-sectional evidence suggests that goal conflicts are associated with pain-related fear,[27] greater reported pain intensity,[21] and negative affect.[13,14,19] Experimental research has shown that introducing a concurrent reward reduced avoidance behavior, although pain-related fear remained unaltered, whereas this effect was moderated by the importance of pain avoidance and reward-seeking.[8,9] Furthermore, Schrooten et al[46] investigated the relations between pain-related choice behavior and pain perception when presented with different goal conflicts and showed that during avoidance-avoidance conflicts, more choice switching was associated with higher fear levels. However, more research is needed scrutinizing the effects of different types of goal competition on pain-related fear and pain-related decision-making. Building on previous experimental studies,[8,9] the current experiment investigated the effect of different types of goal competition in a context of pain by using a cross-directional joystick movement task.[35,36,38] Participants performed joystick movements in 2 acquisition phases in counterbalanced order, each creating different movement-outcome associations. In the pain acquisition phase, movements were associated with a painful stimulus or safety. In the reward acquisition phase, movements were followed by the gain or loss of reward, comprised of lottery tickets. In subsequent phases, movements predicted either 1 or 2 of the outcomes, creating different types of goal competition. On the basis of existing literature indicating that avoidance-avoidance competition is more difficult to solve and evokes more conflict behavior than other types of competition,[32,39] we expected that avoidance-avoidance competition (pain and loss of reward) would lead to greater pain-related fear, longer choice latencies when choosing between 2 aversive outcomes, and less willingness to perform these movements compared with approach-approach competition (safety and reward). Approach-avoidance competition (pain and reward; safety and loss of reward) was expected to be associated with intermediate levels of pain-related fear and speed of decision-making.

Methods

Participants

Fifty-one healthy individuals (16 male, mean age = 22.25 years, SD 2.73) completed the experiment, for which they either received credits to fulfill course requirements or 10 euros. Participants were recruited via the online recruitment system of the Faculty of Psychology and Educational Sciences of the KU Leuven and via flyers distributed across campus. There were 7 health- and safety-related exclusion criteria: 1) pregnancy, 2) current or history of cardiovascular diseases, 3) chronic or acute respiratory disease (eg, asthma), 4) neurological diseases (eg, epilepsy, 5) cardiac pacemaker or presence of any other electronic medical devices, 6) other severe medical conditions, and 7) being asked by their physician to avoid stressful situations. Six additional task-related exclusion criteria were formulated a priori as well: 1) insufficient understanding and knowledge of the Dutch language, 2) acute or chronic pain, or pain at the wrist/hand or related areas that interfere with performing joystick movements, 3) hearing problems, 4) problems with eyesight that are uncorrected by lenses or glasses, including color blindness, 5) not successfully learning the contingencies during the pain/reward acquisition phase, defined as wrongly answering 1 of the contingency check questions at least 5 times in a row, and 6) reporting that pain avoidance and earning tickets were unimportant, which may indicate that our experimental manipulation did not work. All participants gave informed consent after receiving study information orally and in writing. The current study was approved by the Ethical Committee of the Faculty of Psychology and Educational Sciences, KU Leuven, Belgium (registration number S56294). Four participants did not successfully learn the contingencies during the acquisition phase, and 1 participant indicated both goals were unimportant. Therefore, these participants were all excluded from further data analysis. The remaining sample consisted of 46 participants (16 male), with a mean age of 22.24 years (SD 2.71).

Apparatus and Stimuli

Software

The experiment was programmed in Affect, version 4.0,[22,48] and run on a Windows XP computer (Dell OptiPlex 755; Dell, Round Rock, TX) with 2 gigabytes of random access memory, 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.

Stimulus Material

Participants completed a cross-directional joystick movement task.[35] A larger circle divided in 8 equally large quadrants was visible on the middle of the computer screen. These quadrants served as discriminative stimuli (S^D), each representing a different movement

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