

Chronic pain or symptoms of persistent pain are often associated with the experience of pain despite the regeneration of damaged tissues or the healing of an injury. Learning mechanisms such as classical conditioning may contribute to persistence of pain symptoms. Classical conditioning involves learning a response by pairing a neutral environmental stimulus with a stimulus that elicits a specific reaction. Previous research indicates that people can "learn" to perceive pain as more or less intense. However, the potential of classical conditioning to influence not only the intensity but also the spatial aspect of perceived pain remains unclear. If classical conditioning plays a role in the spatial perception of pain, this mechanism may cause non-painful signals from regenerated tissue to still be experienced as painful, modulating the perception of those signals. The result of such a process could be long-lasting pain symptoms in the area of the original injury, despite tissue regeneration.

One factor that affects the speed and efficiency of learning through classical conditioning is the salience of the unconditioned stimulus. In other words, the more intense or noticeable the stimulus, the greater its informational value and the more effective the learning process. In the case of a sensitized nervous system, post-injury pain felt over a large area may become more salient and, therefore, more susceptible to conditioning processes. Another key factor in classical conditioning is the extinction process, in other words – unlearning the acquired response. This involves exposing an individual to the conditioned stimulus without the unconditioned stimulus that originally triggered the response. Previous studies show that an extinguished response can reappear when the person is in a different environment/context than the one in which extinction occurred. Additionally, the response may return upon re-exposure to the unconditioned stimulus. If these two effects play a role in spatial pain perception, they could explain spontaneous reappearance of pain symptoms depending on changes in a patient's context (e.g., return to a different physical activity), another minor injury in the same location (e.g., caused by movement), or a low-intensity pain signal from nearly regenerated tissue. A crucial question is whether learning processes can only modulate pain signals—making pain feel more or less spread out—or whether they can also induce a pain response in the absence of actual pain signals. To date, studies attempting to answer this question have been very limited and inconclusive. Finding the answer is essential, as it would help determine whether classical conditioning merely amplifies pain sustained by other mechanisms or whether it can independently contribute to the persistence of pain symptoms.

The planned project will involve three experimental studies. The aim of the first experiment is to test the hypothesis that increased sensitivity to the unconditioned (pain-inducing) stimulus facilitates more effective learning of spatial pain responses. The second experiment will test the hypothesis that an extinguished spatial pain response can reappear due to context change or re-exposure to the unconditioned stimulus. The final experiment will investigate whether learning processes can only modulate pain signals or whether they can elicit a spatial pain response in the absence of such signals. This project aims not only to expand knowledge about the key factors and mechanisms of classical conditioning in the context of pain responses but also to focus on its spatial dimension.