How does pain experienced in everyday life impact memory?

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How do the normal pains of everyday life, such as headaches and backaches, influence our ability to think? Recent studies suggest that healthy individuals in pain also show deficits in working memory, or the cognitive process of holding and manipulating information over short periods of time. Prior research suggests that pain-related impairments in

working memory depend on an individual's level of emotional distress. Yet the specific brain and psychological factors underlying the role of emotional distress in contributing to this relationship are not well understood.

A new study, titled "Modeling neural and self-reported factors of affective distress in the relationship between pain and working memory in healthy individuals," and published in the journal *Neuropsychologia* sought to address this gap in the literature. The study was authored by recent University of Miami psychology Ph.D. graduate students Steven Anderson, Joanna Witkin, and Taylor Bolt and their advisors Elizabeth Losin, director of the Social and Cultural Neuroscience Laboratory at the University of Miami; Maria Llabre, professor and associate chair of the Department of Psychology; and Claire Ashton-James, senior lecturer at the University of Sydney.

The study used publicly available brain imaging and self-report data from the Human Connectome Project (HCP), a large-scale project sponsored by the National Institutes of Health (NIH) which aims to construct a map of the complete structural and functional connections in the healthy human brain. Brain imaging and self-report data from 416 HCP participants were analyzed using structural equation modeling (SEM), a statistical technique for modeling complex relationships between multiple variables. In the 228 participants who reported experiencing some level of pain in the 7 days prior to the study, the authors found that higher pain intensity was directly associated with worse performance a commonly used test of working memory, the n-back task. In the n-back task, participants are shown a series of letters and asked whether the letter they are seeing appeared some number of screens previously. The more screens back in the sequence participants are asked to recall, the more working memory is required.

In addition, the authors found that higher pain intensity was indirectly

associated with worse working memory performance through increased activity in a particular region in the center of the frontal cortex during the n-back task, the ventromedial prefrontal cortex (vmPFC). The vmPFC is a brain region involved in pain, affective distress, and cognition. Interestingly, the relationship between everyday pain and vmPFC brain activity in this study is similar to prior findings in patients with chronic pain.

"We found that healthy participants with even low levels of reported pain had different levels of activity in the vmPFC during the n-back task compared to healthy participants who didn't report pain. Surprisingly, this pattern of activity was more similar to patients with chronic pain than healthy patients who are exposed to pain manipulations in a laboratory," said Witkin.

In contrast, the authors found that certain aspects of emotional distress reported by participants, such as anger, fear, and perceived stress, were not associated with working memory performance.

"Studies looking at the relationship between pain and cognition have typically focused on patients with chronic pain or research participants given experimentally-induced pain," noted Anderson. "Even though pain is a common experience for many people, we know surprisingly little about how the everyday experience of pain impacts cognition."

Using the publicly available HCP dataset allowed the researchers to include data from a much larger group of participants than is typical in brain imaging studies due to the high cost of brain scans. This large sample enabled authors to use structural equation modeling, a statistical technique that allows for the understanding of complex relationships between multiple variables that in this case may help explain how pain decreases working memory. The authors note that their findings have potential implications in both clinical and non-clinical settings.

"This study highlights the real impact that pain can have on our ability to think even in healthy people, and points how this may come about in the brain," said Losin.

More information: Steven R. Anderson et al, Modeling neural and self-reported factors of affective distress in the relationship between pain and working memory in healthy individuals, *Neuropsychologia* (2021). DOI: 10.1016/j.neuropsychologia.2021.107766

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