

Pain-related cognitive biases

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Impact Chapter

This chapter describes the relevance and potential scientific and societal impact of this research. It briefly outlines the societal relevance of the findings, their research impact including dissemination plans, and the potential clinical impact.

Societal relevance

Globally, the prevalence of chronic pain is very high, with developed countries reporting an age-standardized prevalence of 37.3% and developing countries experiencing an even higher rate of 41.1% (Tsang et al., 2008). This substantial prevalence has profound implications for social healthcare systems (Breivik et al., 2013), with those affected often requiring nearly twice the amount of resources compared to the general population (Henschke et al., 2015). Considering the substantial health burden and associated financial costs of chronic pain, it is important to gain a deeper understanding of the factors that contribute to the development and persistence of chronic pain.

Multiple psychological and social influences play a significant role in shaping an individual's perception of pain. One significant factor is pain-related cognitive biases (CBs) which include attention bias (AB, selectively attending to pain-related stimuli) (Crombez et al., 2013; Schoth et al., 2012; Todd et al., 2018), interpretation bias (IB, the tendency to interpret ambiguous information as more threatening or pain-related) (Schoth & Lioffi, 2016), and memory bias (MB, recall pain as more intense than originally experienced) (Schoth et al., 2020), have been implicated in the development and perpetuation of chronic pain (Hirsch et al., 2006; Pincus & Morley, 2001; Todd et al., 2015; Van Ryckeghem et al., 2019). Hence, the objective of this doctoral thesis is to delve into the mechanisms of pain-related CBs in the context of chronic pain, with a particular focus on exploring their interrelationships and combined effects on the overall experience of pain outcomes. Despite the foundational nature of the current doctoral dissertations and their limited direct societal implications, there is a desire to uncover the reason for the development and maintenance of chronic pain, to reduce the considerable societal burden that its treatment imposes.

Research impact

The scientific contribution of this doctoral thesis resides in its advancement of our knowledge about pain-related CBs, particularly their interrelationships and joint influences on pain outcomes. *Chapter 2* summarized the existing empirical research on the interplays of CBs

related to pain and highlights the inconsistency of results, attributable to factors such as sample diversity, symbolic stimuli used, and separate paradigms. In *Chapters 3, 4, and 5* of the thesis, experimental studies were conducted to investigate various pain-related CBs. Chapter 3 revealed a positive correlation between AB and IB yet no discernible combined effects in experimental outcomes. *Chapter 4* found a negative correlation between AB and IB as well as a positive association between AB and MB in an ambiguous context. Nevertheless, AB and IB failed to predict pain outcomes collectively. *Chapter 5* uncovered the interplay between AB for pain cues and MB for ambiguous cues, alongside the interactive effects of AB and IB on sensory and affective pain reports during the cold pressor task (CPT). However, the interrelationships among CBs and their predictive capacity for pain outcomes remained unaffected by the presence of threat.

The novelty of this doctoral thesis lies in its comprehensive review of current empirical studies regarding pain-related CBs, identification of paradigm limitations, and provision of recommendations for future research (*Chapter 2*). Drawing inspiration from the literature review, Chapter 3 utilized identical facial expressions to investigate AB and IB, whereas *Chapters 4 and 5* introduced the innovative PainAIM paradigm, integrating real pain stimuli and enabling simultaneous assessment of multiple CBs. In sum, the findings of this doctoral thesis offer tentative support for interrelationships among pain-related CBs and their combined contribution to pain outcomes. Finally, the improvements to the research paradigm and the suggestions for future research in this thesis are not confined to the pain domain, but also offer valuable insights and inspiration for other research domains assigning a key role to CBs within the onset and exacerbation of (mental) health and psychiatric conditions, e.g., chronic itch (van Laarhoven et al., 2020), depression (Everaert et al., 2012), (social) anxiety (Kuckertz & Amir et al., 2014), and addiction (Boffo et al., 2019).

The outcomes of this doctoral research were and further will be disseminated through diverse channels with interested parties, e.g. scholars and clinicians in the field including: oral and poster presentations at (inter)national conferences and symposia, publications in relevant scientific journals targeting theoretical and clinical advancements in understanding the development and treatment of (chronic) pain, and through social media platforms like Google Scholar. Research communication occur via Open Science principles (preregistration and data sharing on OSF platform, Open Access publication strategy) which advances knowledge dissemination by enabling broad sharing of findings without geographical or institutional limitations.

Clinical impact

The fundamental approach employed in the current doctoral thesis limits the direct clinical applicability of its findings, necessitating cautious interpretation. However, it provides insights into the interconnection between pain-related CBs and their joint influence on pain outcomes. This understanding paves the way for more effective therapeutic interventions, such as cognitive bias modification (CBM) techniques. Over the years, researchers and practitioners have recognized the significance of CBs in pain and embarked on developing treatments aimed at modifying AB or IB towards pain stimuli, including CBM-A (Heathcote et al., 2018; Schoth et al., 2013; Sharpe et al., 2012; Sharpe et al., 2015; Todd et al., 2016) and CBM-I (An et al., 2020) approaches. While results have been mixed, future research could explore the potential of simultaneously targeting multiple biases to achieve clinically meaningful and lasting improvements in symptoms (see (Brosan et al., 2011)). Additionally, given the limitations of the current methodology or design of the paradigm, the dynamics of CBs have not been fully validated. However, given the dynamic nature of CBs, future cognitive treatments should also consider incorporating contextual and motivational factors, such as cognitive-behavioral therapy, acceptance and commitment therapy, or motivational interviewing, to enhance individuals' goal awareness and reshape their motivational beliefs, and reduce the negative contribution of CB to pain.