Categorization Alters Perception: Assessing Potential Predictors of Pain Categorization Biases

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Introduction

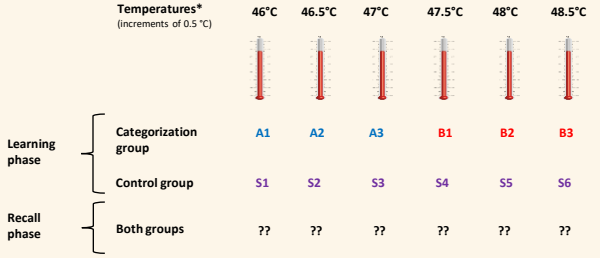
Background

Categorization constitutes an efficient tool when confronted with overwhelming sensory information from our environment. Grouping perceptual stimuli into categories can facilitate inferences about unobserved features of a stimulus based on its category membership, and the rapid integration of novel stimuli based on the stimuli characteristics. However, categorization can also result in poorer differentiation of stimuli falling within the same category (i.e., assimilation) and exaggerated differentiation of stimuli belonging to different categories (i.e., accentuation). These effects have been successfully demonstrated for visual, auditory, social and interoceptive stimuli. However, little is known about the influence of categorization processes in the nociceptive realm.

Research aim

Given the well-documented influence of prior information/beliefs on pain perception, we expected to observe both assimilation and accentuation effects in an adapted version of a recently developed pain categorization paradigm[1] .We also conducted exploratory analyses to identify potential psychological correlates of these categorization biases.

Pain categorization paradigm



* Note that the temperature range was individually calibrated for each participant.

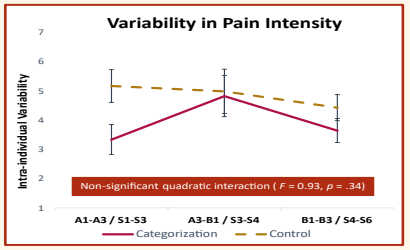
This procedure helps create an implicit category border between the lower (i.e., A1-A3) and higher temperature range (i.e., B1-B3) in the categorization group. Stimuli labels in the control group (i.e., S1-S6) instead implies a continuum.

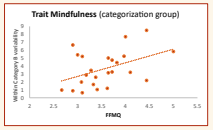
Trial timeline example for the learning phase

Trial timeline example for the recall phase

Results

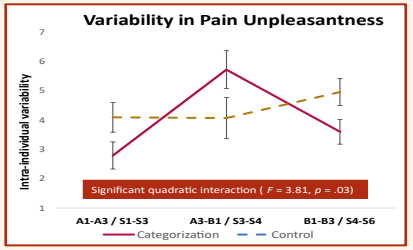
Learning phase





High trait mindfulness (within the categorization group) was associated with increased variability in intensity ratings (i.e., reduced perceived similarity) for within category B stimuli.

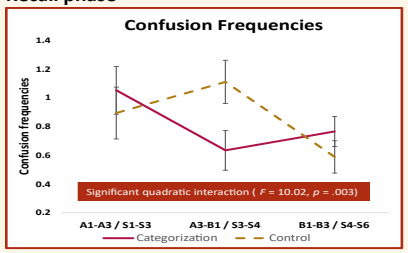
We found no significant quadratic Group*Category interaction effect for pain intensity ratings. However, the categorization group did report increased perceived similarity for stimuli within category A *(t*(46) = -2.41, *p* = .02).

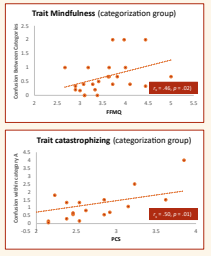


No significant associations between the self-report questionnaires and intra-individual variability in pain unpleasantness ratings

There was a significant quadratic Group*Category interaction effect for pain unpleasantness ratings, indicating that the categorization group reported increased perceived similarity for stimuli within categories (assimilation) and reduced perceived similarity for stimuli between categories (accentuation).

Recall phase





The categorization group was more likely to confuse stimuli within category (assimilation) and less likely to confuse stimuli between category (accentuation), compared to the control group. High trait mindfulness was linked to reduced accentuation for between category stimuli, while trait pain catastrophizing was associated with increased confusion frequencies for stimuli within category A.

There were no group differences in confidence ratings.

Methods

Participants

- 48 healthy volunteers (65% female; mean age = 23.04, SD = 2.91) were randomly assigned to either the categorization or control group.

Pain stimulation

- Noxious stimuli – administered via a contact thermal stimulator (Somedic AB, Sweden)
- A pain calibration procedure was conducted to determine individual pain sensitivity.
- Six temperatures (in increments of 0.5°C) were derived from this procedure for each participant.

Questionnaires

- Trait pain catastrophizing (PCS) [2]
- Trait mindfulness (FFMQ) [3]
- Intolerance of Uncertainty (IUS) [4]
- Suggestibility (SSS) [5]
- State pain catastrophizing (SCS) [6]
- State mindfulness (TMS) [7]

Experimental session timeline

Discussion

We observed evidence of assimilation and accentuation effects in the categorization group across both the learning and recall phases. Our results show that merely assigning abstract labels to stimuli can significantly alter pain perception and decision making. These findings are of particular clinical relevance given the common use of verbal labels (e.g., 'mild pain', severe pain', throbbing pain') in medical consultations. We also found tentative evidence that psychological traits such as pain catastrophizing and mindfulness may magnify or mitigate these categorization biases. Given the prevalence of maladaptive safety behaviours and misinterpretation of bodily signals in various chronic pain conditions, identifying potential predictors of these categorization biases constitutes an important next step in pain categorization research.

References
1. van der Meulen, M. A., Anton, F., & Petersen, S. (2017). Painful decisions: How classifying sensations can change the experience of pain. European Journal of Pain, 21(9), 1602-1610.
2. Sullivan, M. J., Bishop, S. R., & Pivik, J. (1995). The pain catastrophizing scale: development and validation. Psychological assessment, 7(4), 524.
3. Baer, R. A., Smith, G. T., Lykins, E., Button, D., Krietemeyer, J., Sauer, S., ... & Williams, J. M. G. (2008). Construct validity of the five facet mindfulness questionnaire in meditating and nonmeditating samples. Assessment, 15(3), 329-342.Sullivan, M. J., Bishop, S. R., & Pivik, J. (1995). The pain catastrophizing scale: development and validation. Psychological assessment, 7(4), 524.
4. Carleton, R. N., Norton, M. P. J., & Asmundson, G. J. (2007). Fearing the unknown: A short version of the Intolerance of Uncertainty Scale. Journal of anxiety disorders, 21(1), 105-117.
5. Kotov, R. I., Bellman, S. B., & Watson, D. B. (2004). Multidimensional Iowa suggestibility scale (MISS).
6. Edwards, R. R., Smith, M. T., Stonerock, G., & Haythornthwaite, J. A. (2006). Pain-related catastrophizing in healthy women is associated with greater temporal summation of and reduced habituation to thermal pain. The Clinical journal of pain, 22(8), 730-737.
7. Lau, M. A., Bishop, S. R., Segal, Z. V., Buis, T., Anderson, N. D., Carlson, L., ... & Devins, G. (2006). The Toronto mindfulness scale: Development and validation. Journal of clinical psychology, 62(12), 1445-1467.