

Tonic Pain Selectively Alters Mid-Latency Somatosensory Processing While Preserving Tactile Performance: An ERP Study Using the Cold Pressor Test

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1 Introduction

- Chronic pain affects 41% of UK population and has significant impact on cognitive and sensory processing¹.
- Pain and touch share overlapping neural networks in the somatosensory system and compete for limited attentional resources.
- Tonic pain experimentally (prolonged) mimics chronic pain network dynamics, it involves somatomotor, frontoparietal, and dorsal attention systems. Differs neurobiologically from phasic pain (short-lasting)^{3,4}
- Previous research shows conflicting results: Some studies show tonic pain impairs tactile processing⁵, others show facilitation⁶, while phasic pain can enhance tactile perception⁷

2 Objectives

This study aims to investigate how tonic pain modulates tactile perception and neural processing.

Three main objectives:

- Measure reaction times and accuracy in response to tactile stimuli under pain vs. no-pain conditions
- Record and analyse EEG data to investigate pain-induced changes in tactile ERPs
- Examine role of psychological factors (pain catastrophising) in modulating tactile perception under pain

3 Methods

PARTICIPANTS:

- Counterbalanced within-subject design: **26 participants** (14 females, 12 males, mean age 28 years).

CP SETUP:

- Pain** condition: left hand immersed in circulating water at **10°C** for 5-7 minutes
- No-pain** condition: left hand immersed in room-temperature water (**25°C**) for 5-7 minutes

EEG RECORDING:

- 64-channel BioSemi system, sampling rate 2048 Hz
- ERP components: **P45, N80, P100, N140, P300**
- Electrodes of interest: **C3** (contralateral) and **C4** (ipsilateral) to stimulated hand

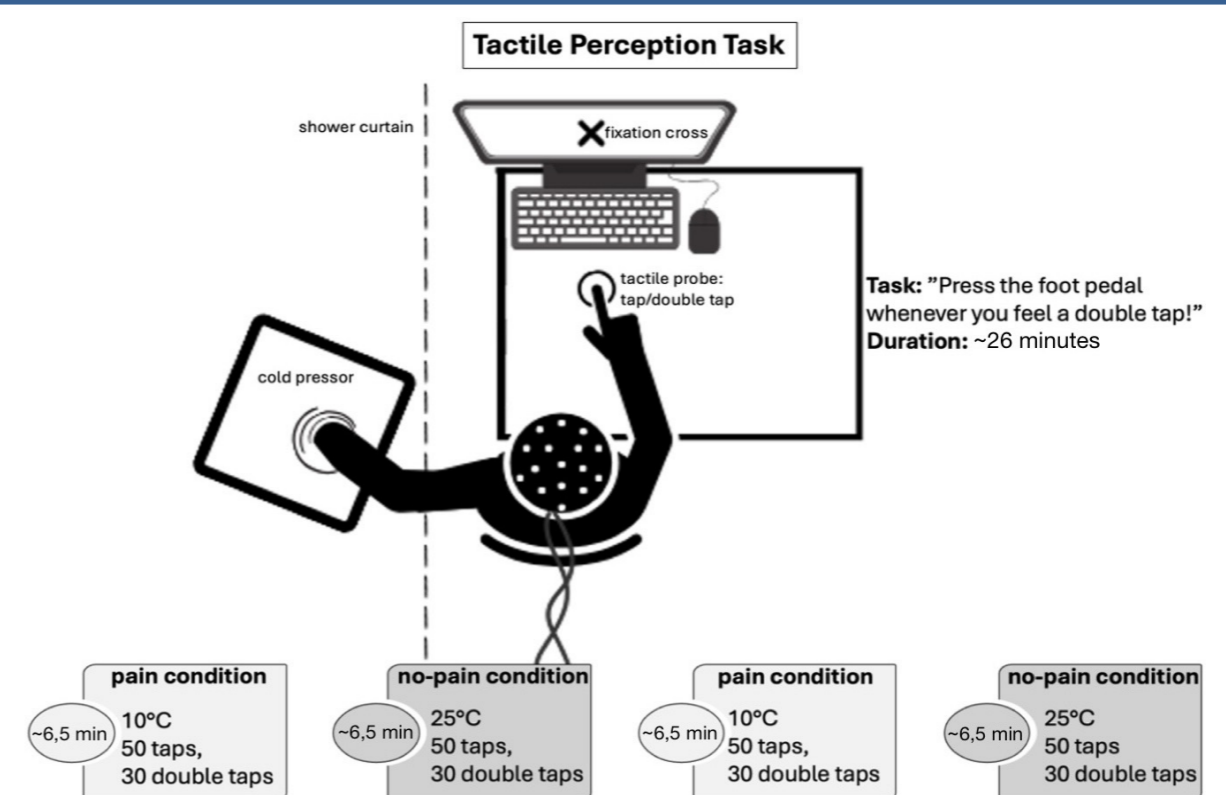


Figure 1. Schematic Overview of the Experimental Paradigm and Procedure

4 Results

ERP COMPONENTS

- N140 (KEY FINDING):** Condition × Laterality interaction ($p=.0300$)
- P45, N80, P100:** Significant laterality effects, no pain modulation
- Increased ipsilateral activity during pain
- Contralateral activity unchanged
- P300:** No effects - late cognitive processing preserved

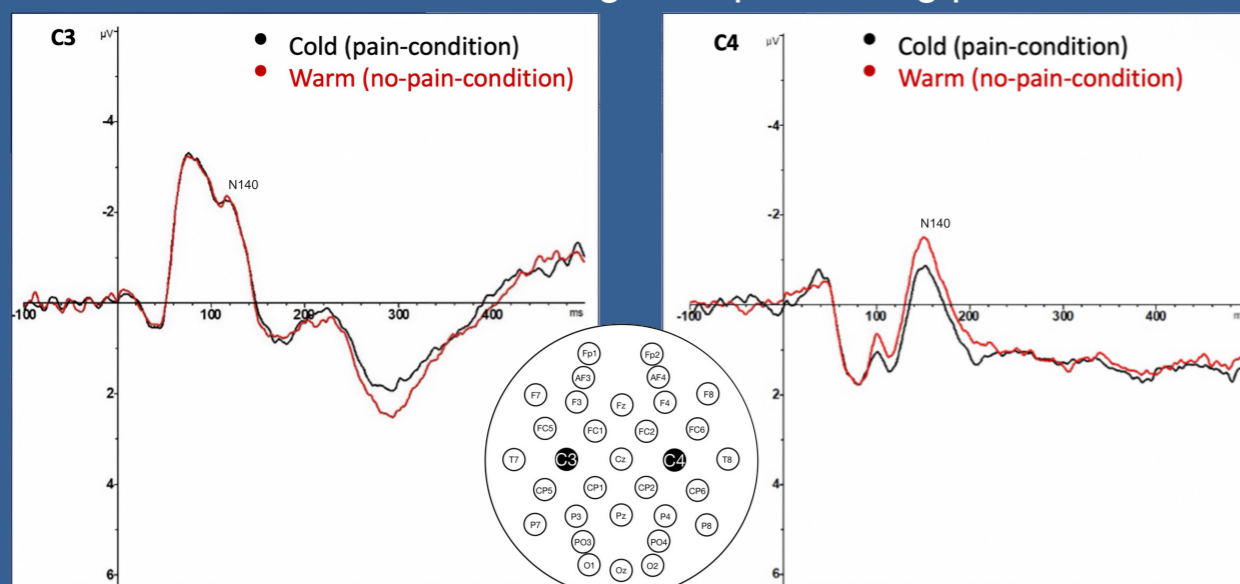


Figure 2. Grand-average ERPs (-100 to 500 ms) at C3 and C4 for tactile stimuli under pain (cold, black) and no-pain (warm, red) conditions. C3 reflects contralateral, C4 ipsilateral responses.

BEHAVIOURAL

- Pain catastrophising negatively correlated with accuracy in no-pain

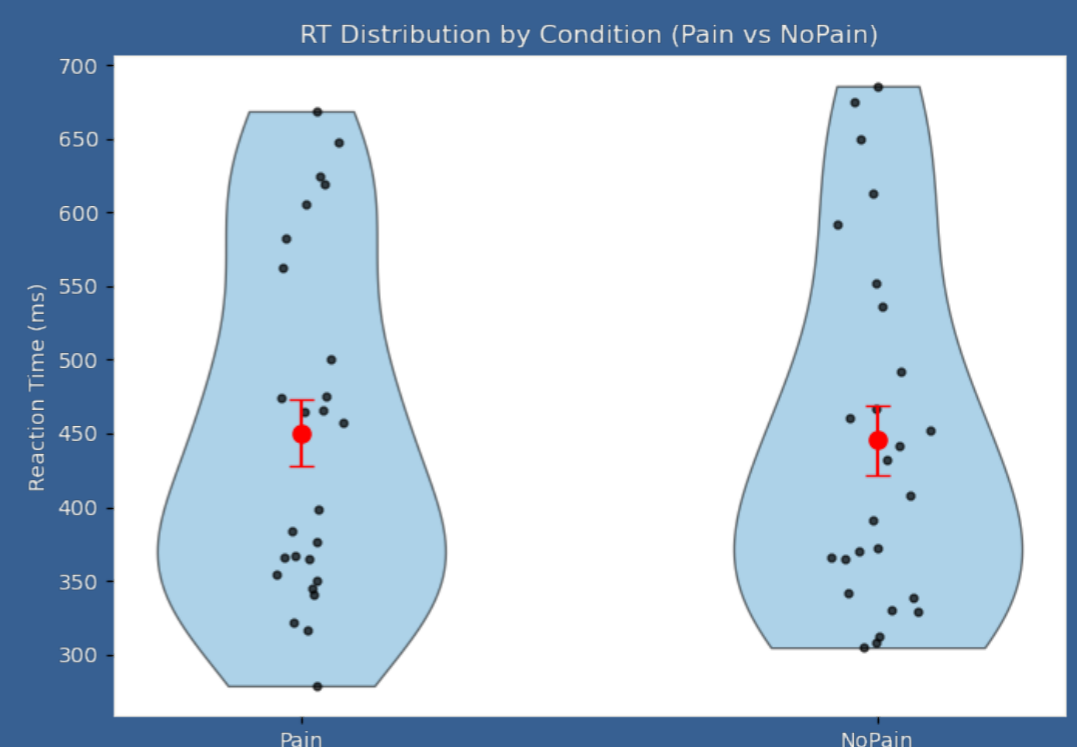


Figure 3. Reaction time distributions for Pain vs. No-Pain conditions. RTs did not differ between conditions.

5 Discussion

- Tonic pain does not impair tactile speed or accuracy; participants perform equally well with or without pain.
- Mid-latency N140 ERP is selectively modulated by pain; shows increased ipsilateral amplitude, indicating attentional reallocation, not global inhibition
- Early ERP components (P45, N80, P100) and late (P300) remain unaffected, demonstrating that core sensory registration and cognitive evaluation are intact under pain
- Methodological variation, e.g. in cold pressor temperature/duration, is a major research limitation, urging further standardisation

6 Conclusion

- Pain reroutes attention in tactile tasks without disrupting performance or high-level processing.
- The N140 ERP may serve as a biomarker for sensory-attentional pain therapies or interventions.
- Follow-up study with different task and adjusted cold pressor setting

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DATA AVAILABILITY:

OSF: <https://doi.org/10.17605/OSF.IO/THW5U>
Preregistration: <https://doi.org/10.17605/OSF.IO/AGF5P>

CORRESPONDENCE

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