# Uncertainty in Thermosensory Expectations Enhances an Illusion of Pain

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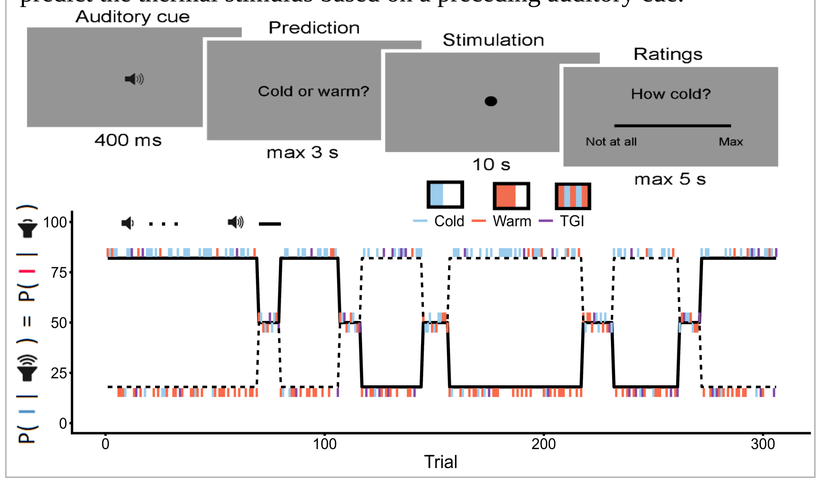
## Background and Methods

The thermal grill illusion (TGI) is an illusory pain experience elicited by the simultaneous interleaved innocuous cold and warm stimuli.

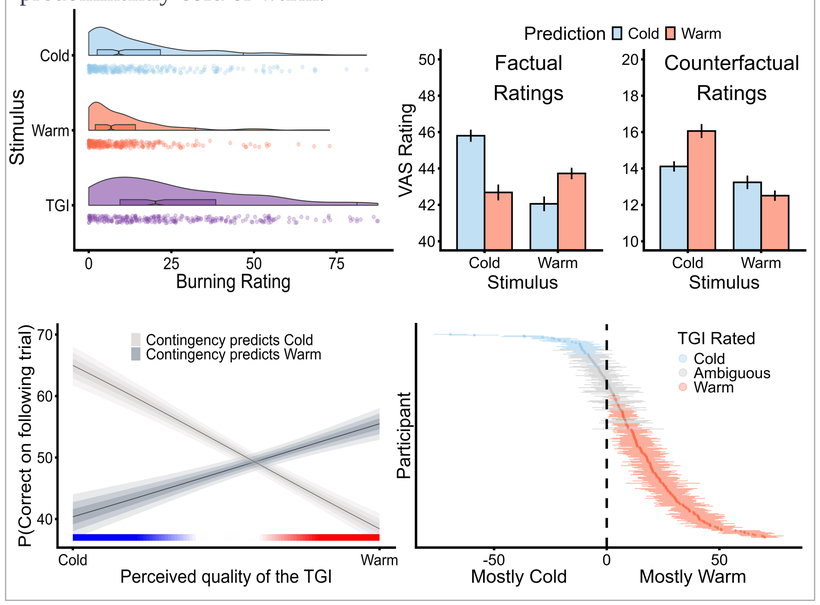
Using a reversal learning paradigm we show how expectations shape thermosensory experiences and illusory pain and how these results are linked to structural properties of the brain.

273 Subjects participated in reversal learning; participants were to predict the thermal stimulus based on a preceding auditory cue.



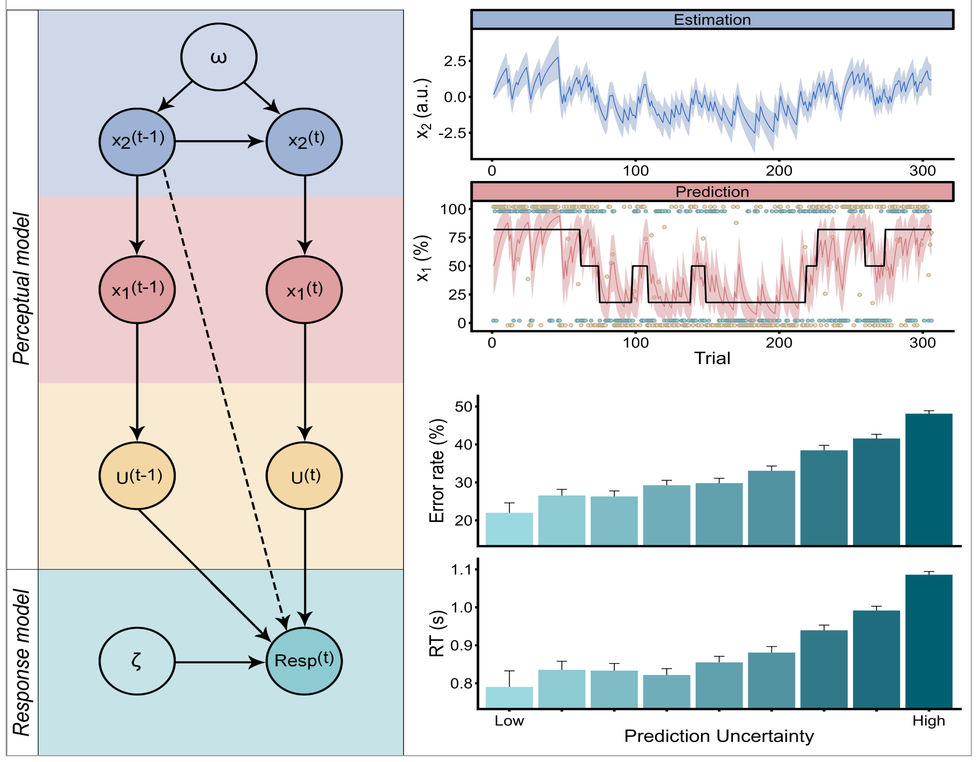

## Behavioral Results

Behavioral results showed that participants perceived the TGI stimulus as more burning compared to the innocuous stimuli, and that participants' thermosensory predictions significantly influenced the perceived stimulation intensity. Further, participants learned differently from the TGI trials, depending on whether they perceived it as predominantly cold or warm.

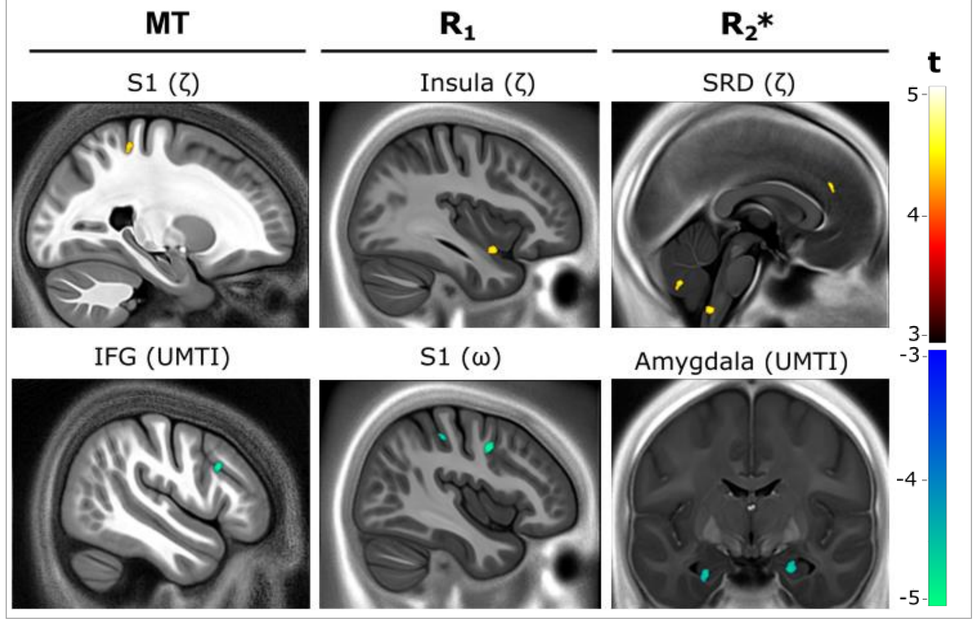



## Computational modeling

We employed several computational learning models to analyze learning and uncertainty trajectories. Using Bayesian model selection, we found that the hierarchical gaussian filter (HGF) best described the participants' learning.

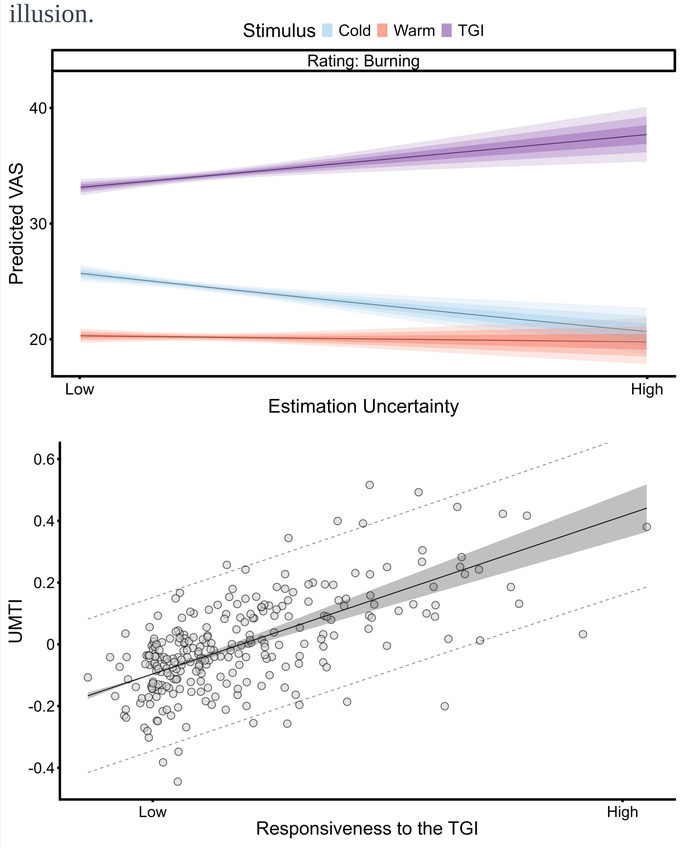



## Quantitative Brain Imaging Results




## Computational results

We show that uncertainties affect how innocuous stimulation and illusory pain are perceived. Importantly, various types of uncertainties impact innocuous and illusory pain in distinct ways. Finally, there is a strong correlation between the influence of uncertainties on illusory pain and susceptibility to the illusion.




## Summary

- Our novel probabilistic learning task reveals the impact of expectations on thermosensation
- Learning-based expectations shape veridical thermosensory experiences and illusory pain.
- The brain's myeloarchitecture relates to the effects of uncertainty in the Thermal Grill Illusion.

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