# UNCERTAINTY MODULATES VERIDICAL TEMPERATURE SENSATION AND ILLUSORY PAIN IN A VOLATILE LEARNING ENVIRONMENT

AARHUS
UNIVERSITET
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SCANDINAVIAN ASSOCIATION FOR THE STUDY OF PAIN
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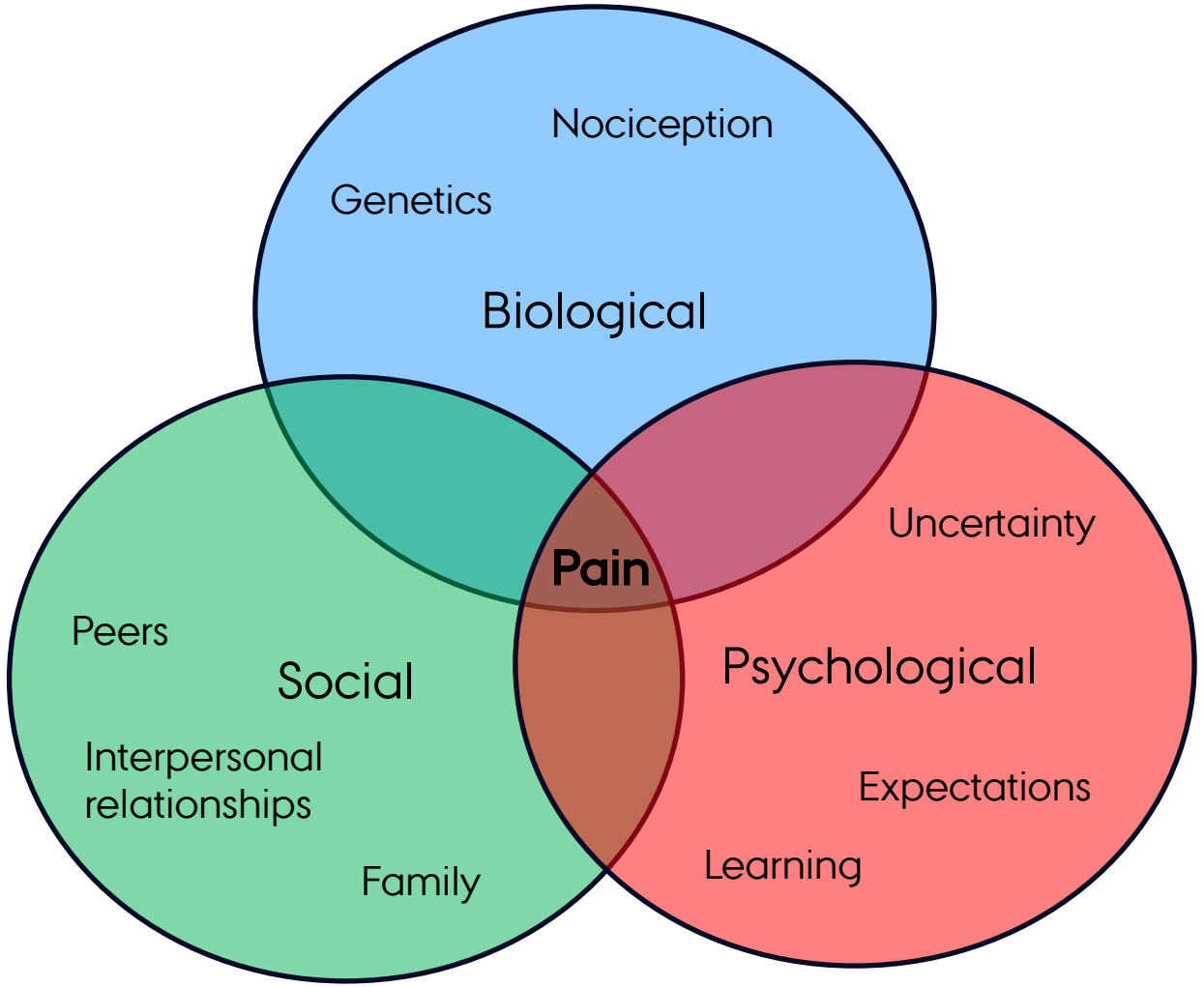
# Experimentally induced illusory pain

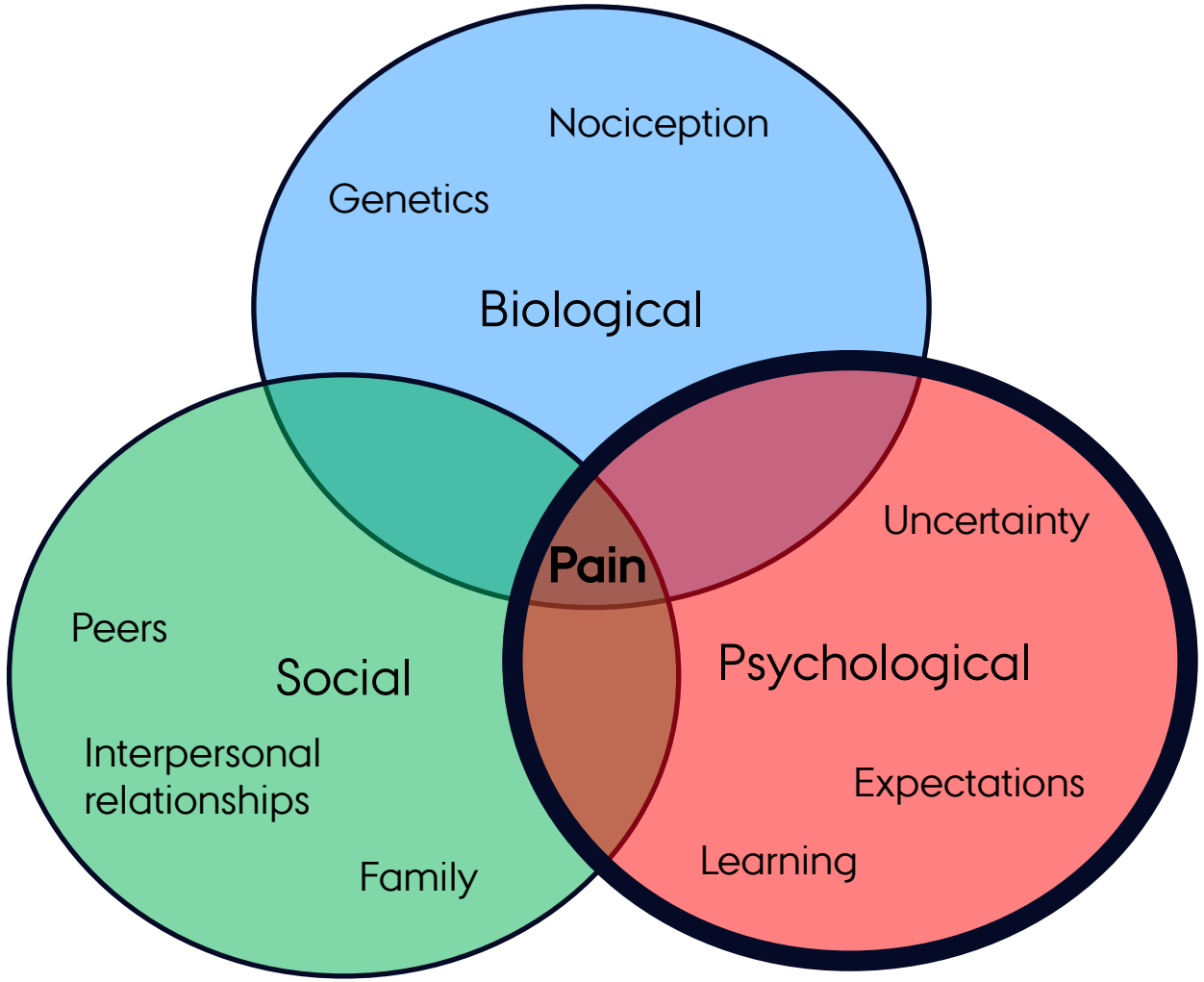
## The Thermal Grill Illusion (TGI)

| | |
|---|---|
| Warm | Warm |
| Cold | Cold |
| Warm | Warm |
| Cold | Cold |
| Warm | Warm |

# Biopsychosocial model of pain



# Biopsychosocial model of pain



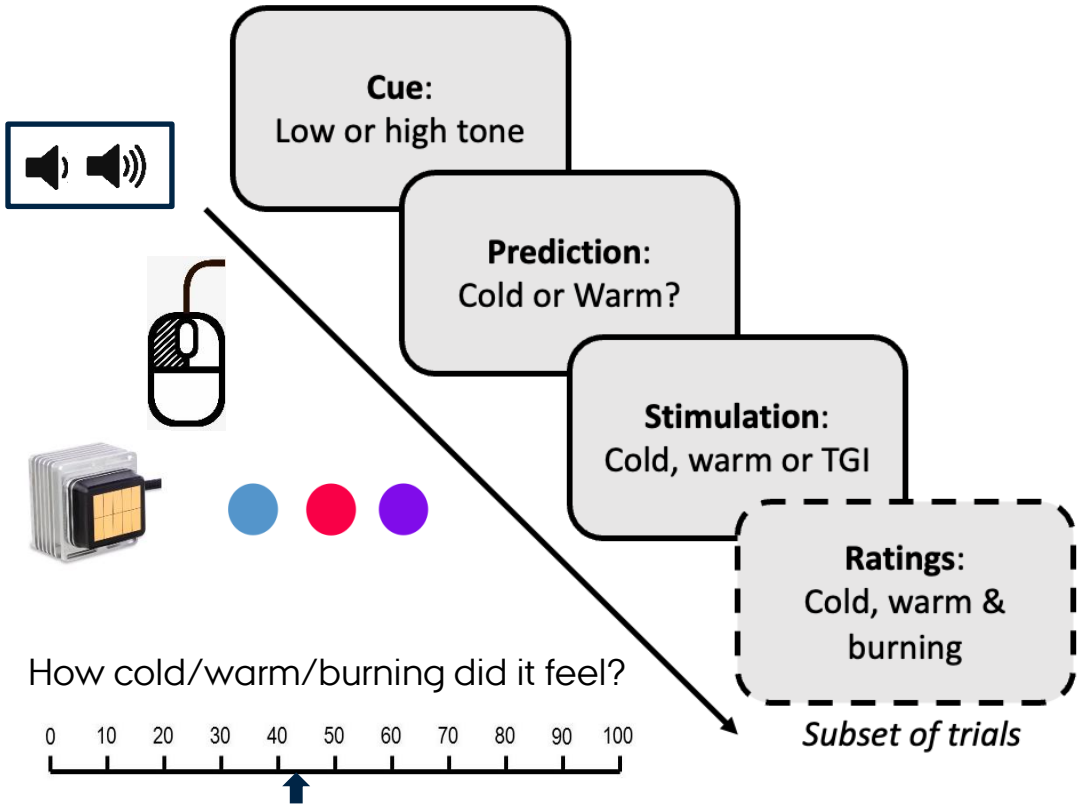
# Hypothesis

- We hypothesized that both expectations and their uncertainty would modulate veridical thermal sensation and illusory pain.

# METHODS

# The Probabalistic Thermal Learning Task (TPL)

N = 274



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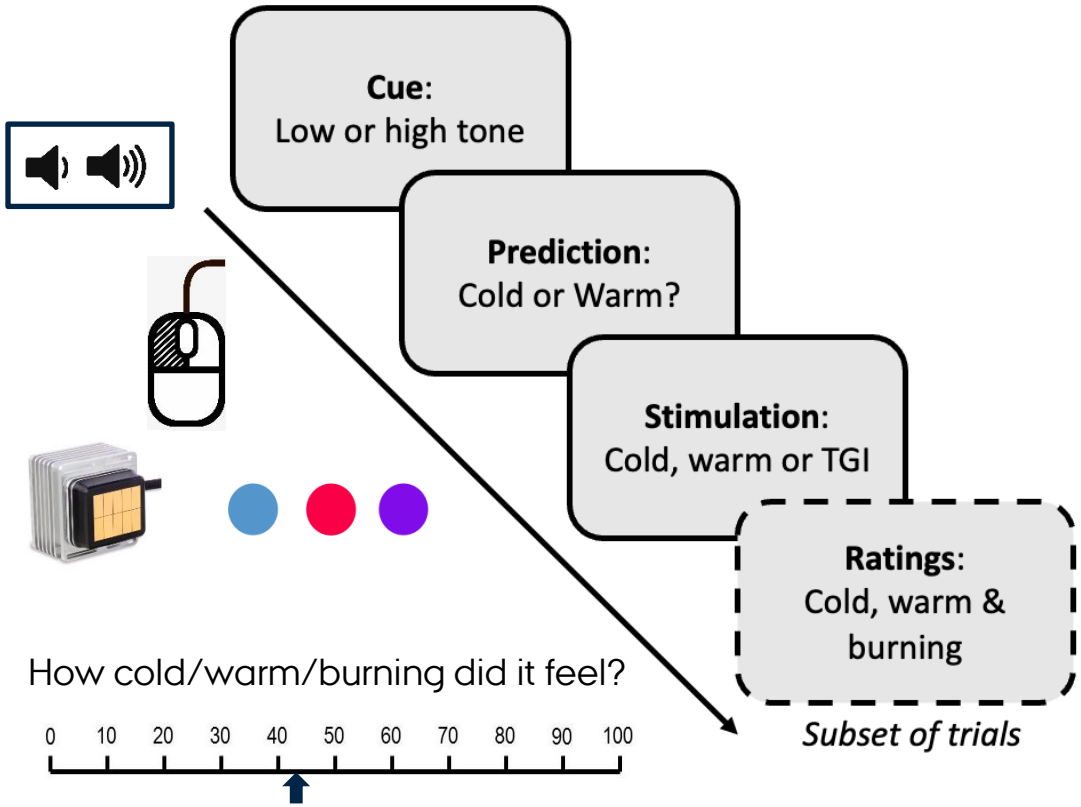


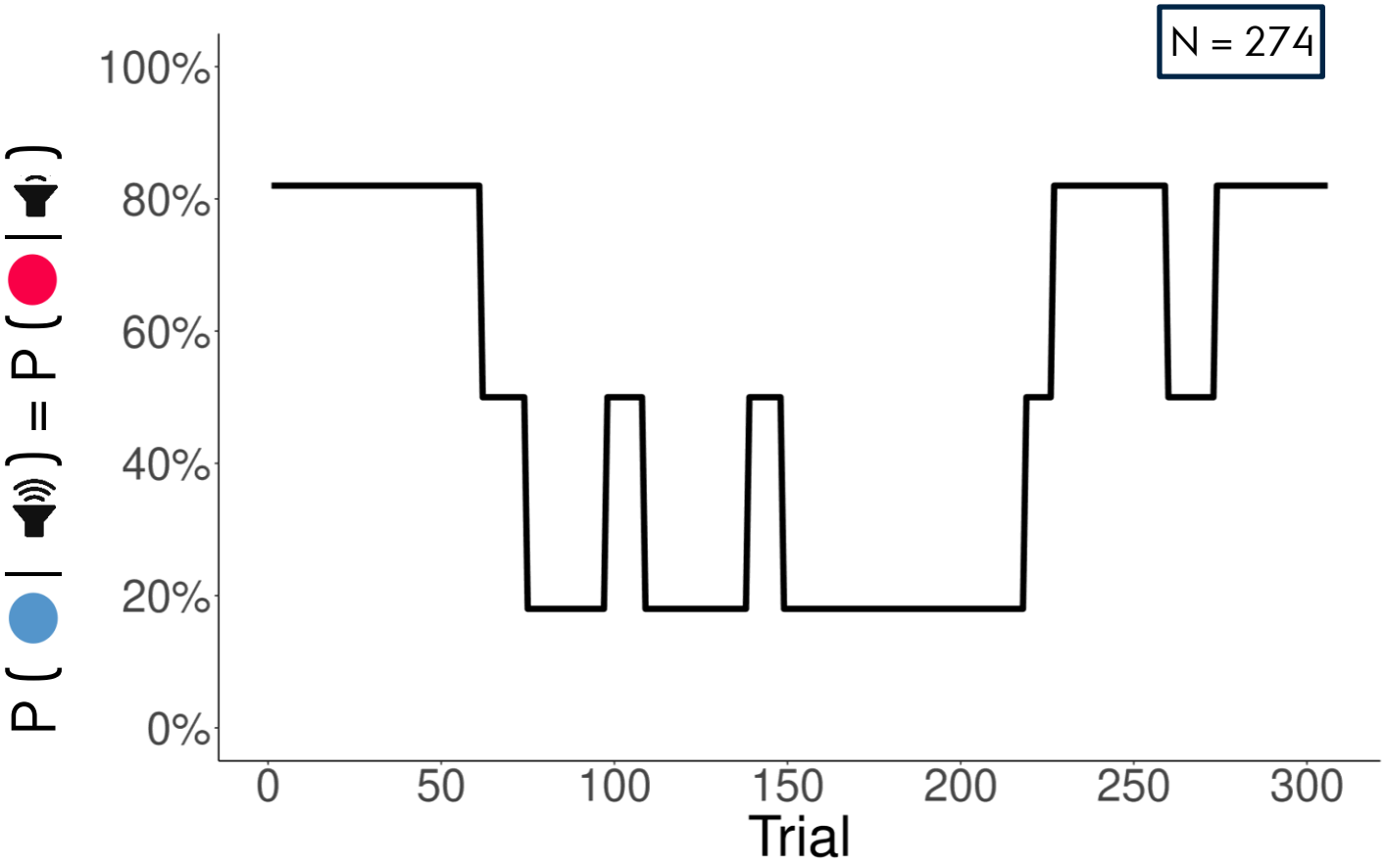

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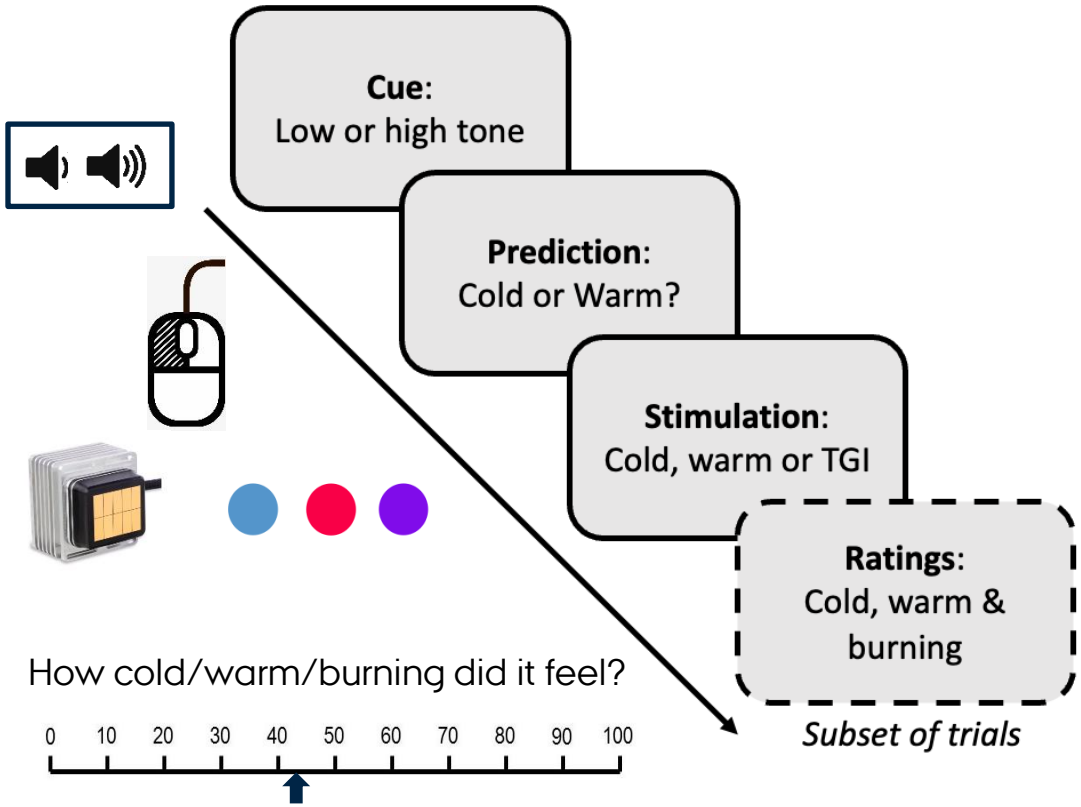


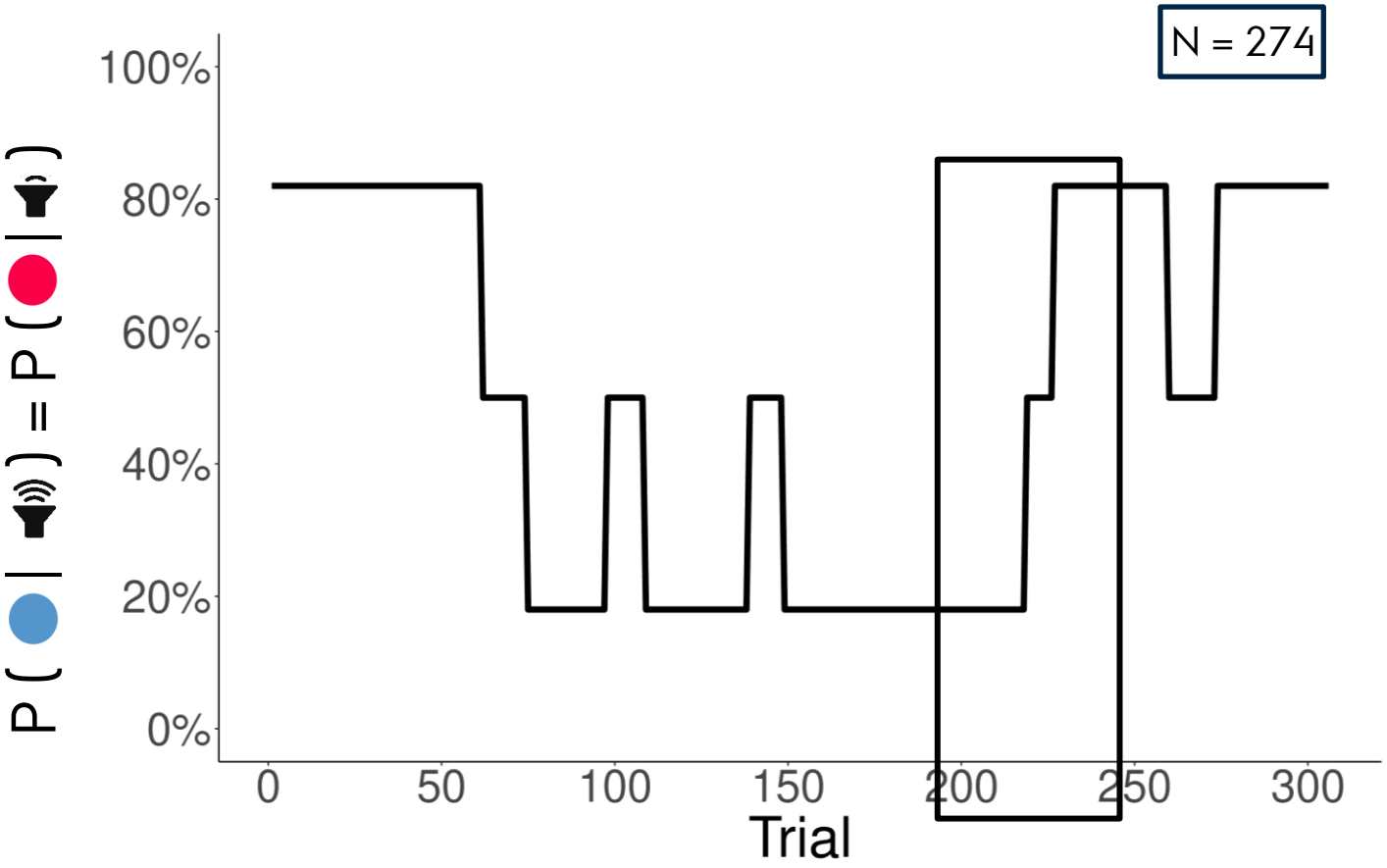

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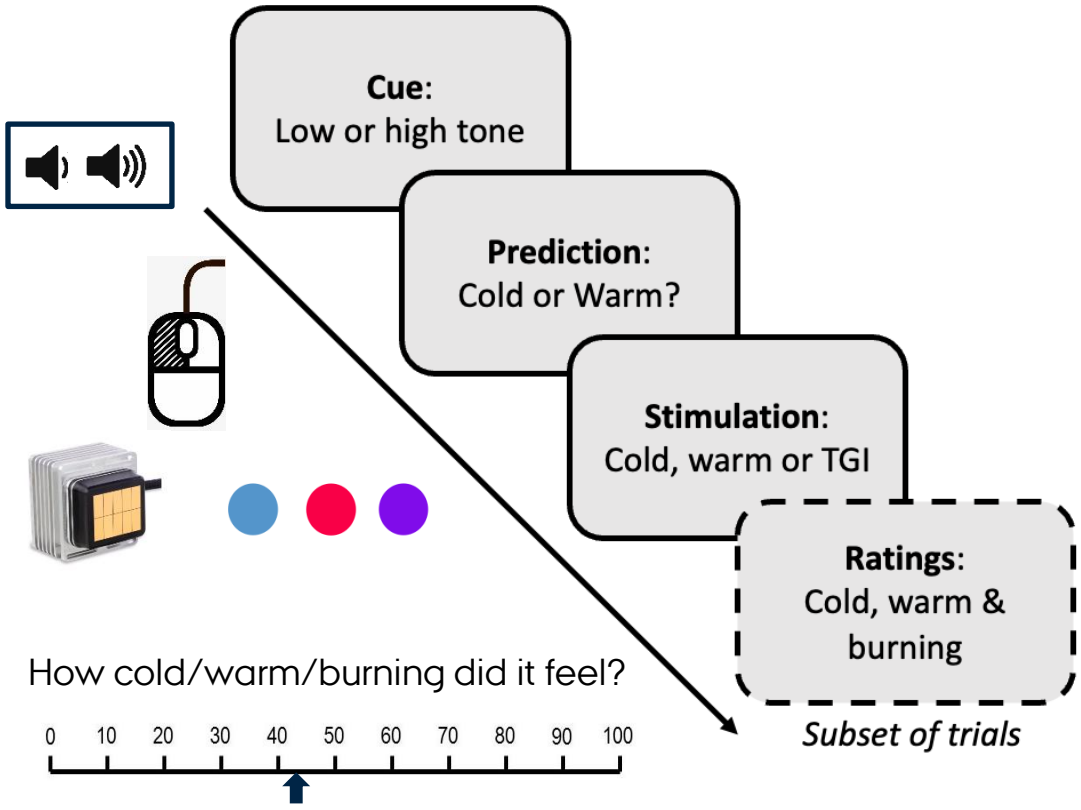


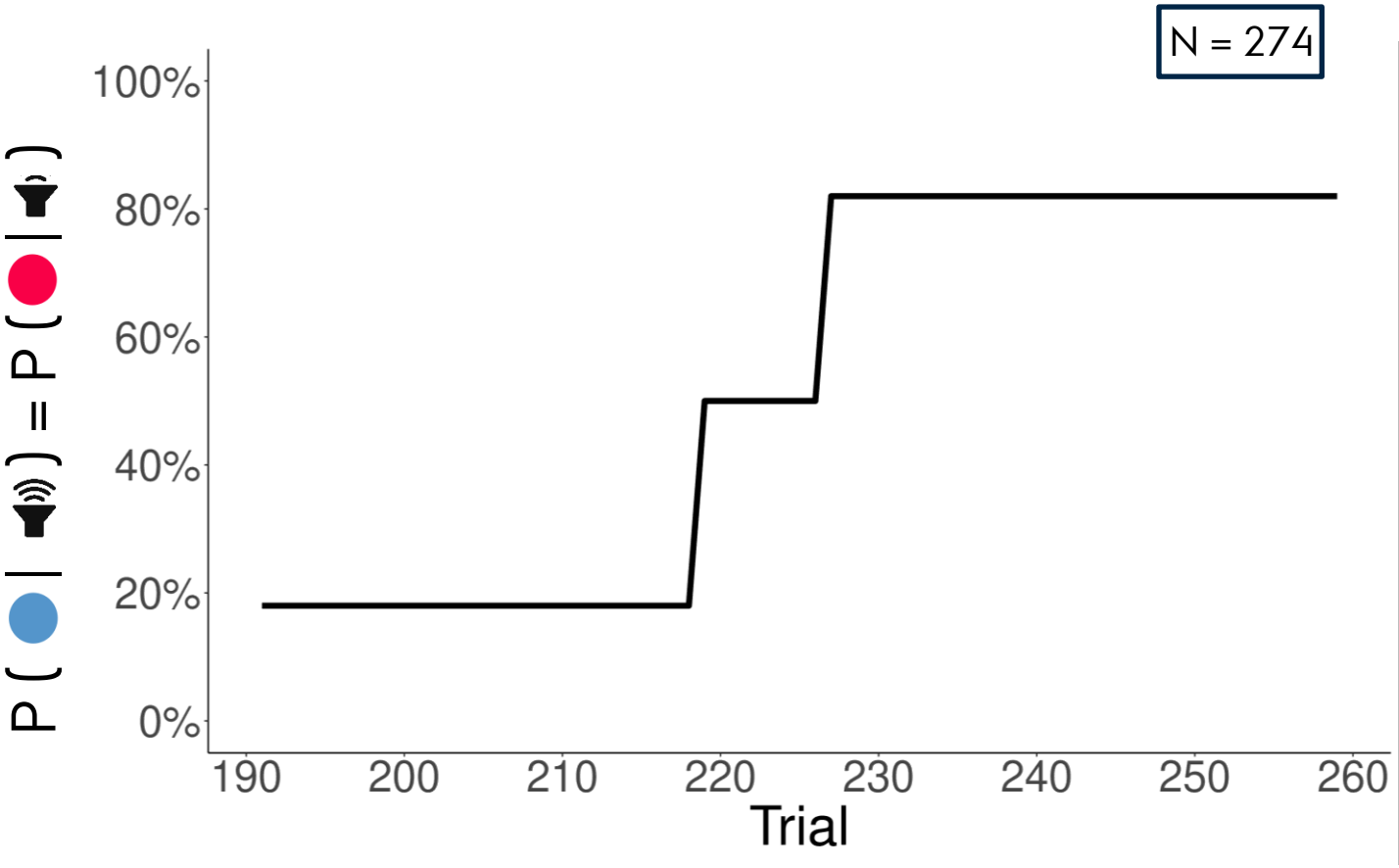

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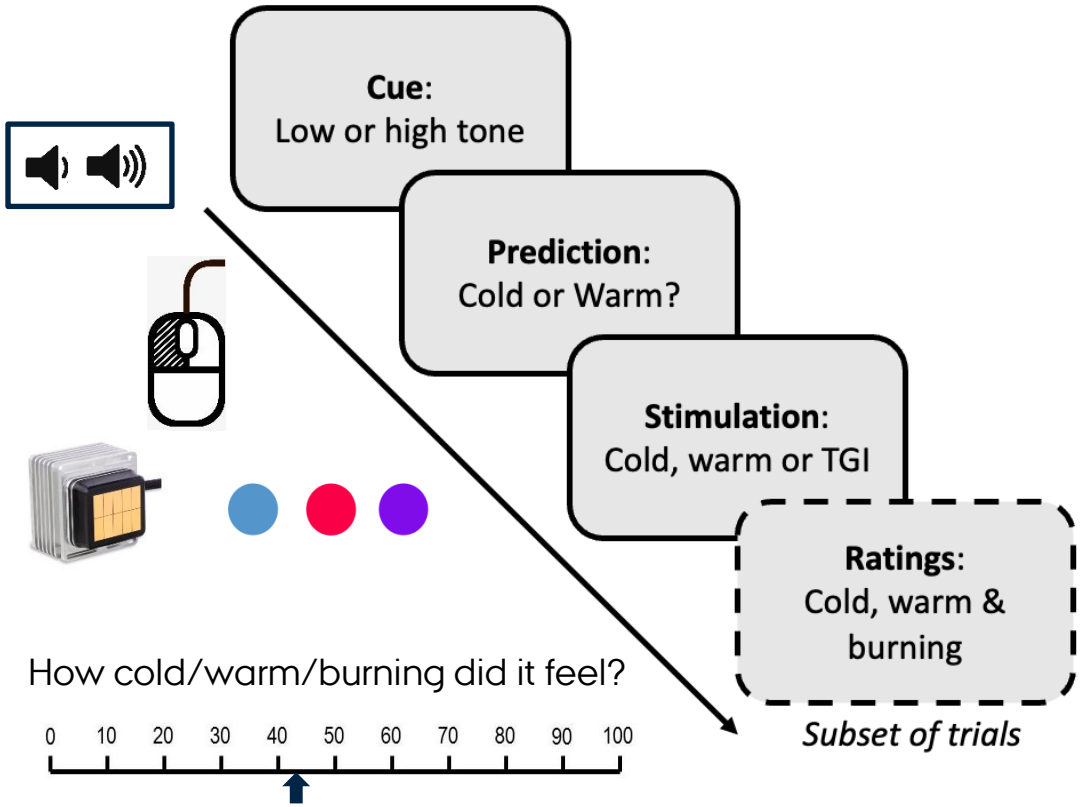


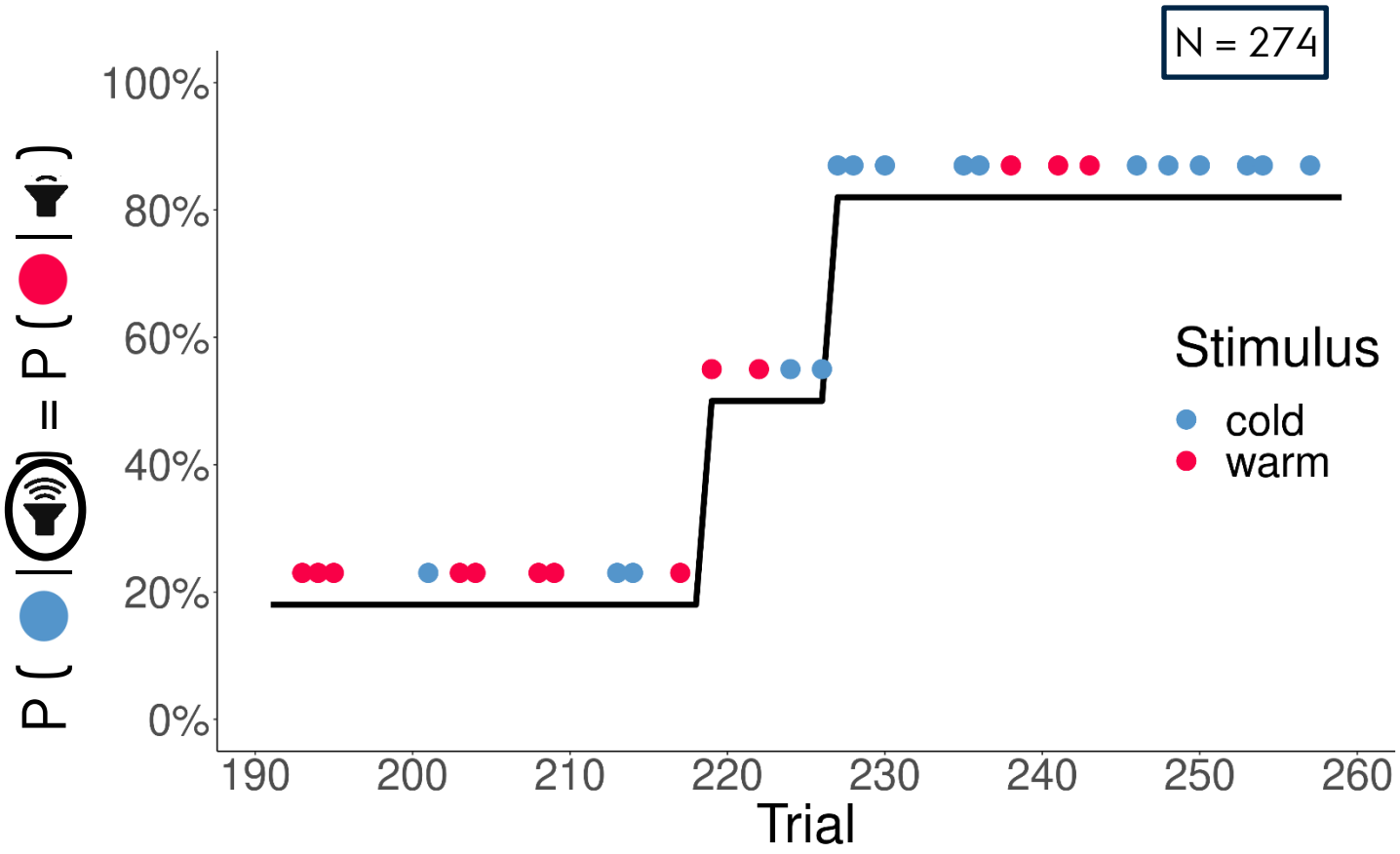

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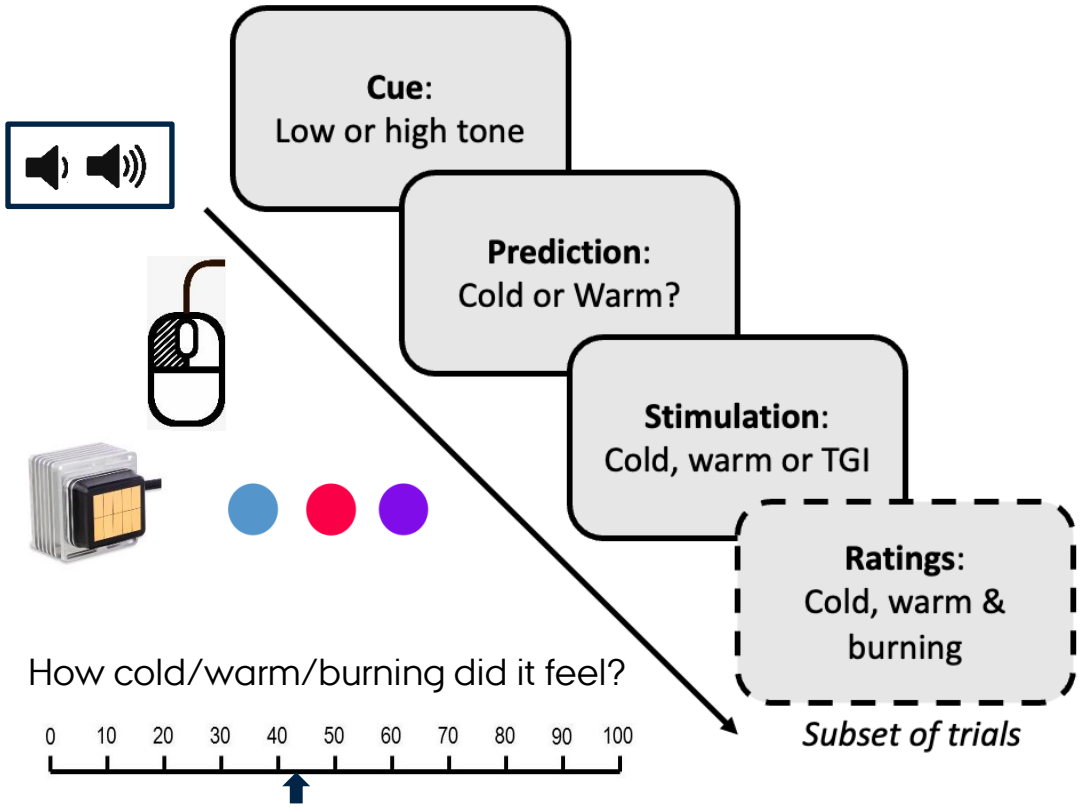


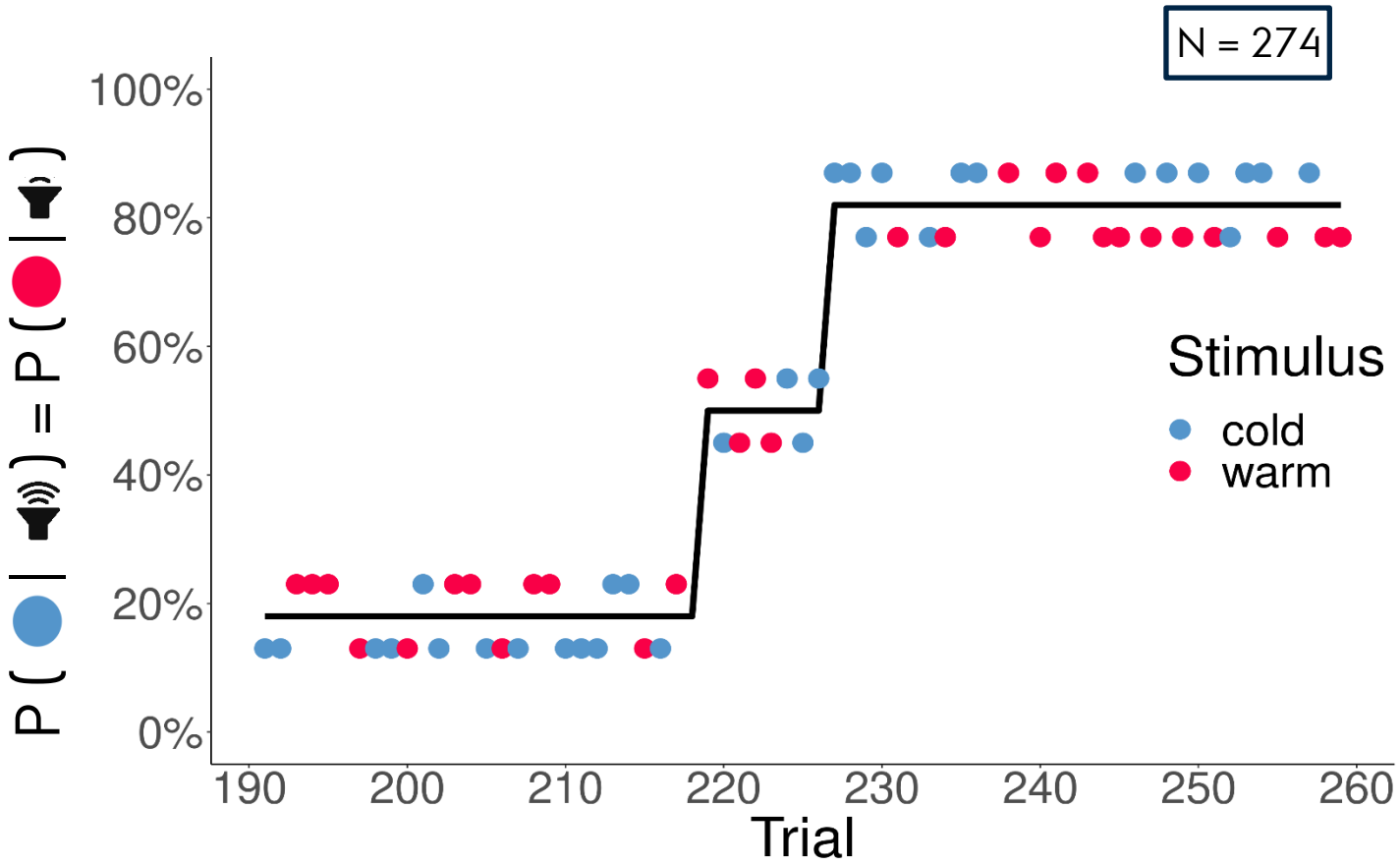

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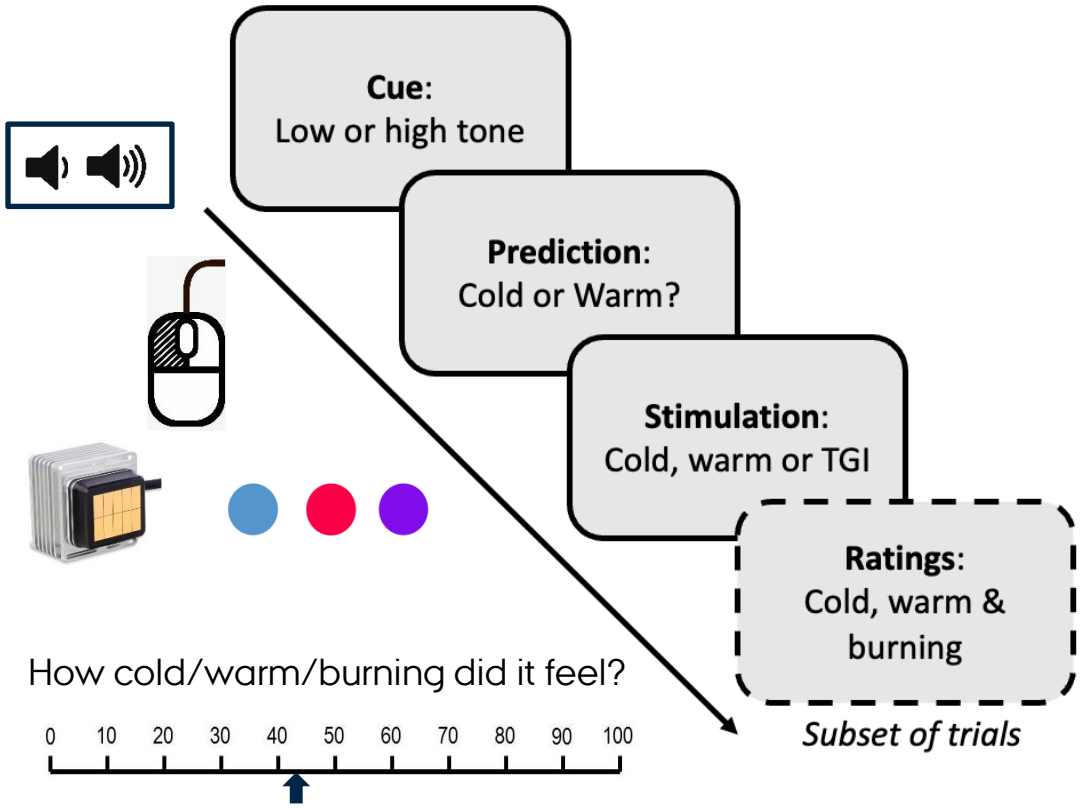


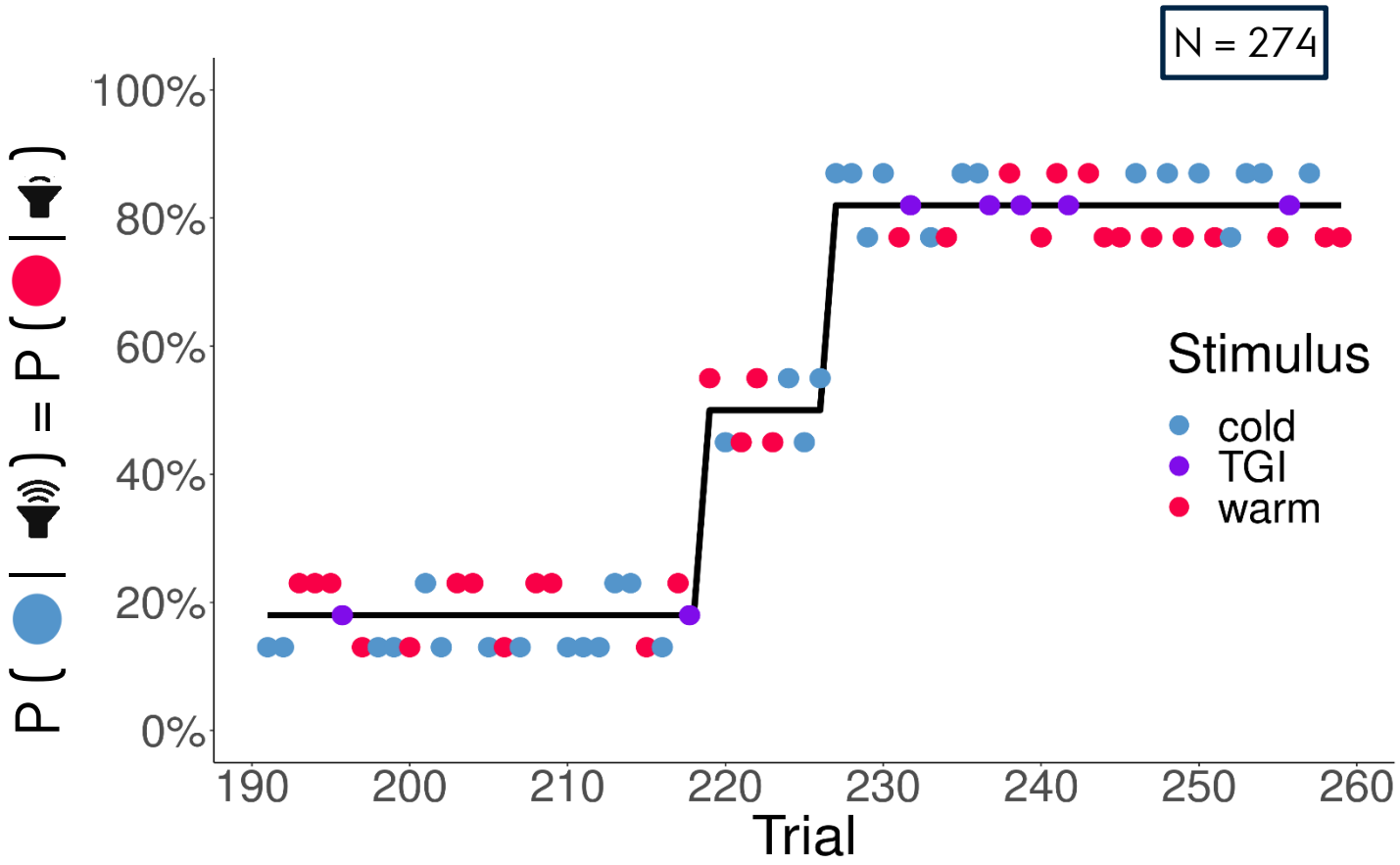

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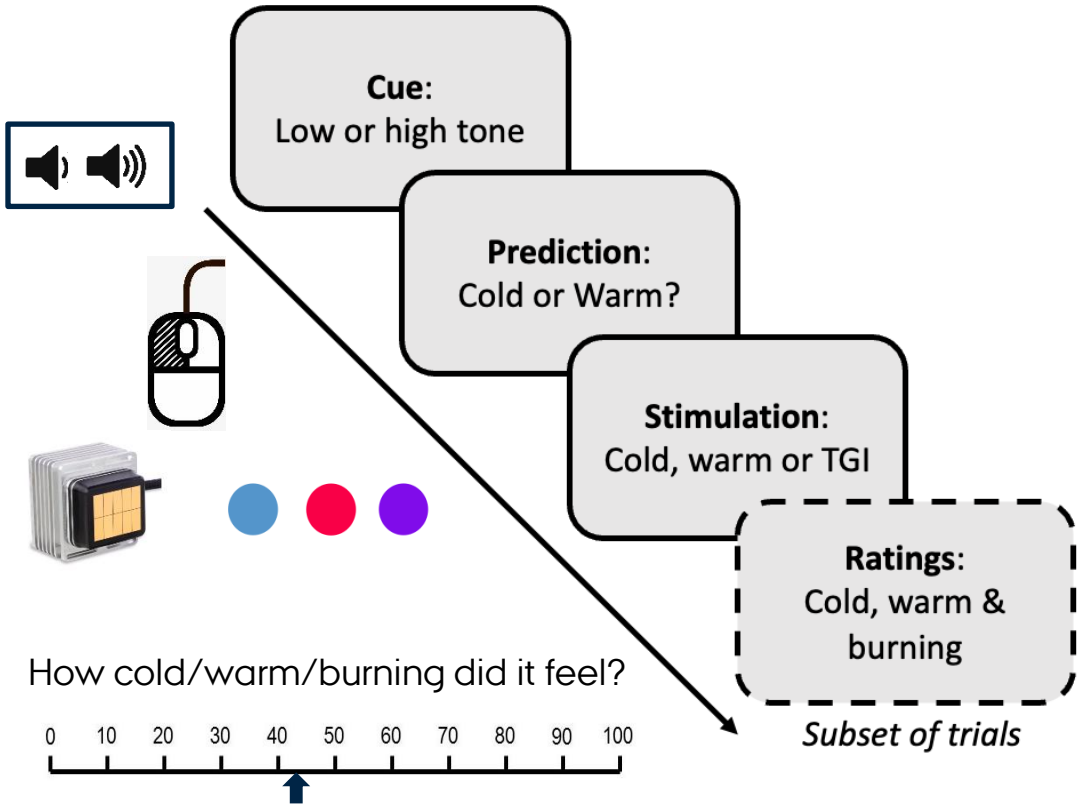


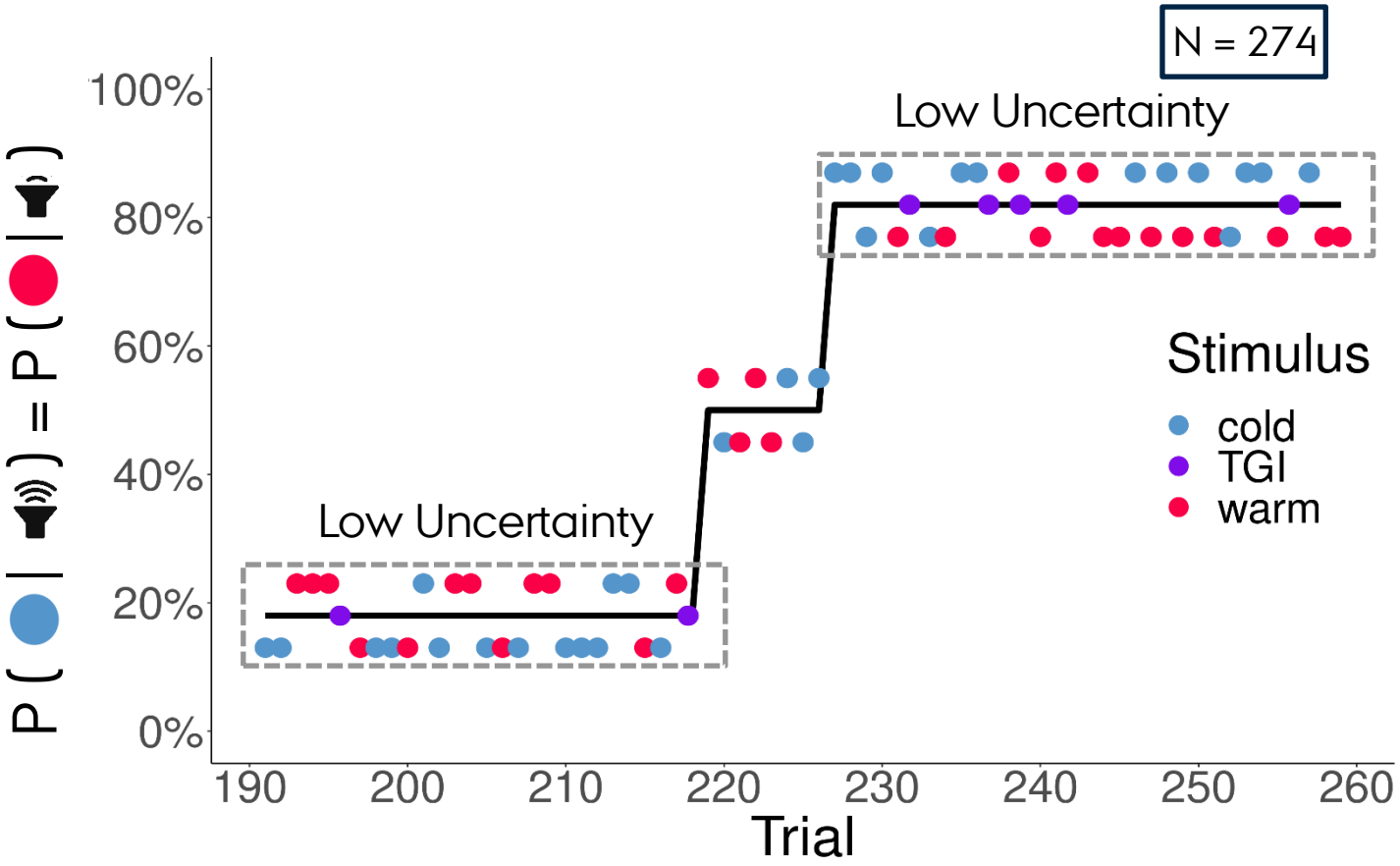

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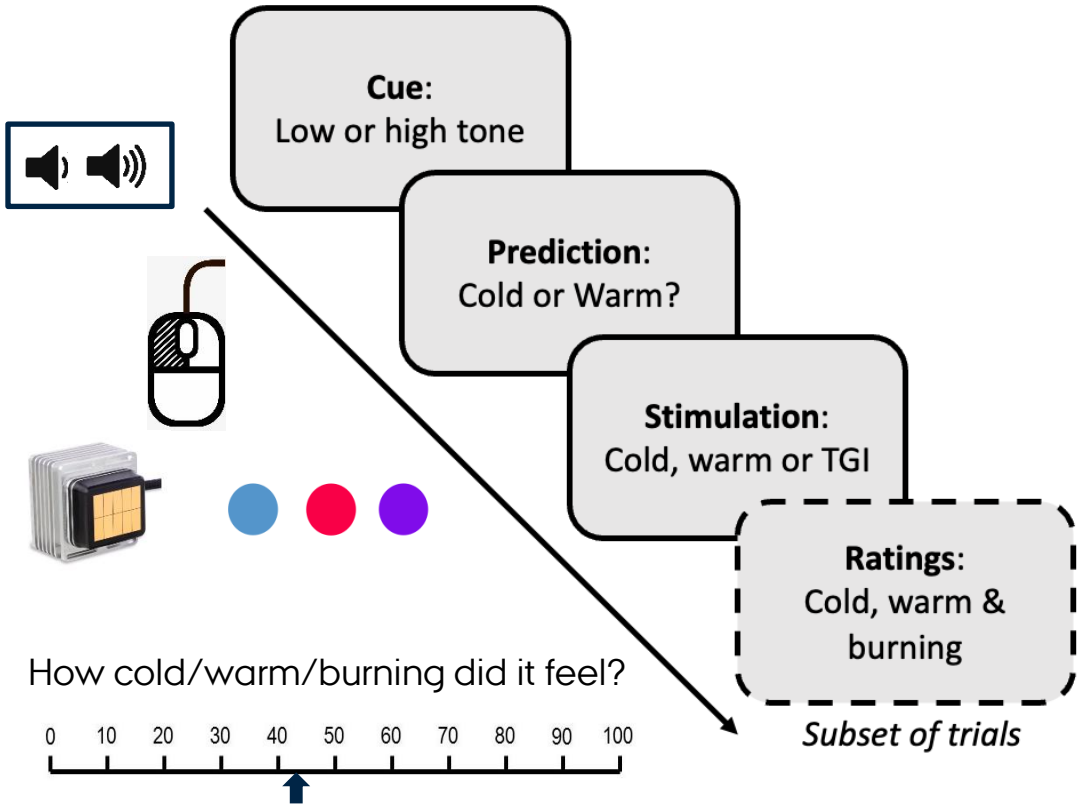
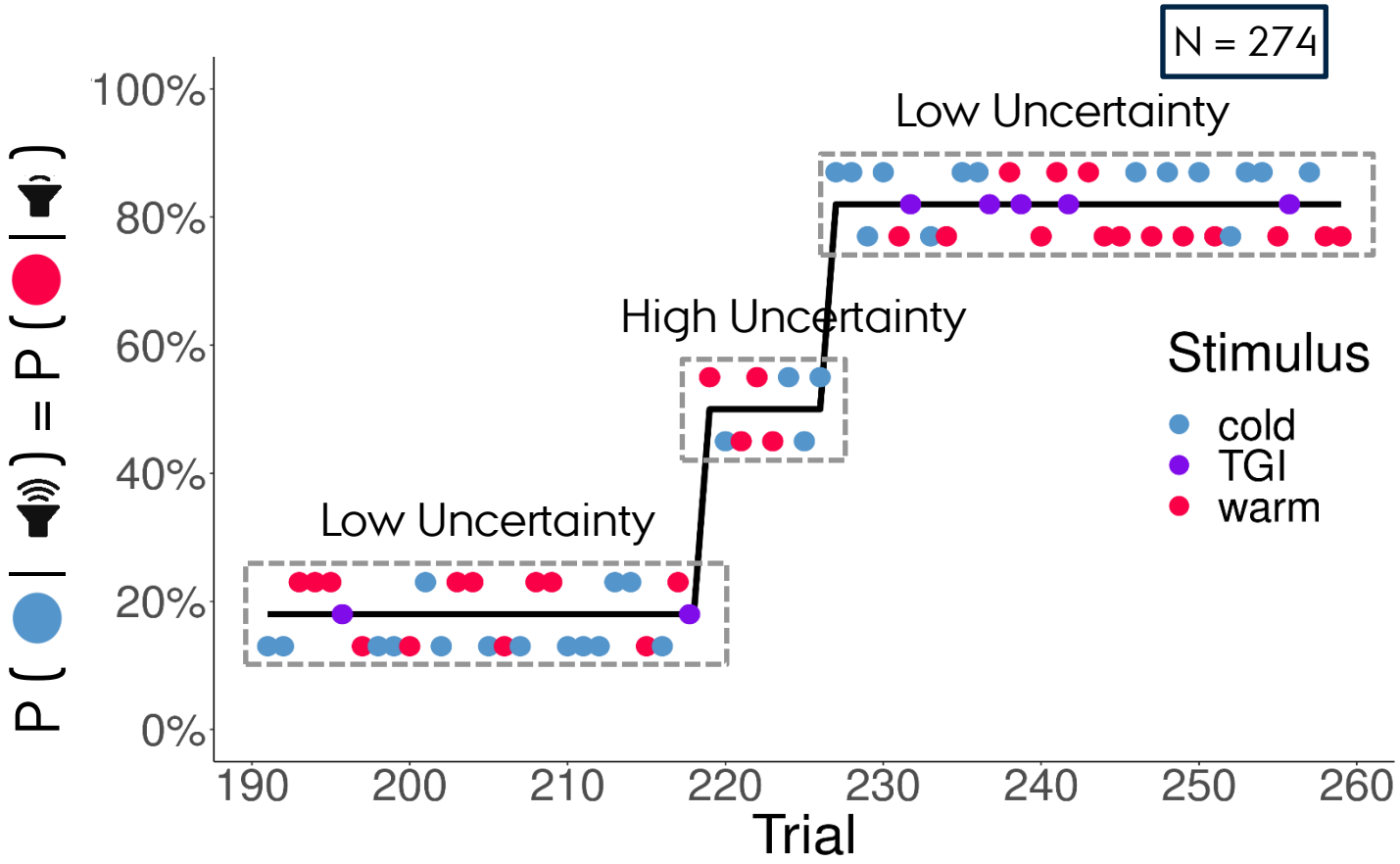
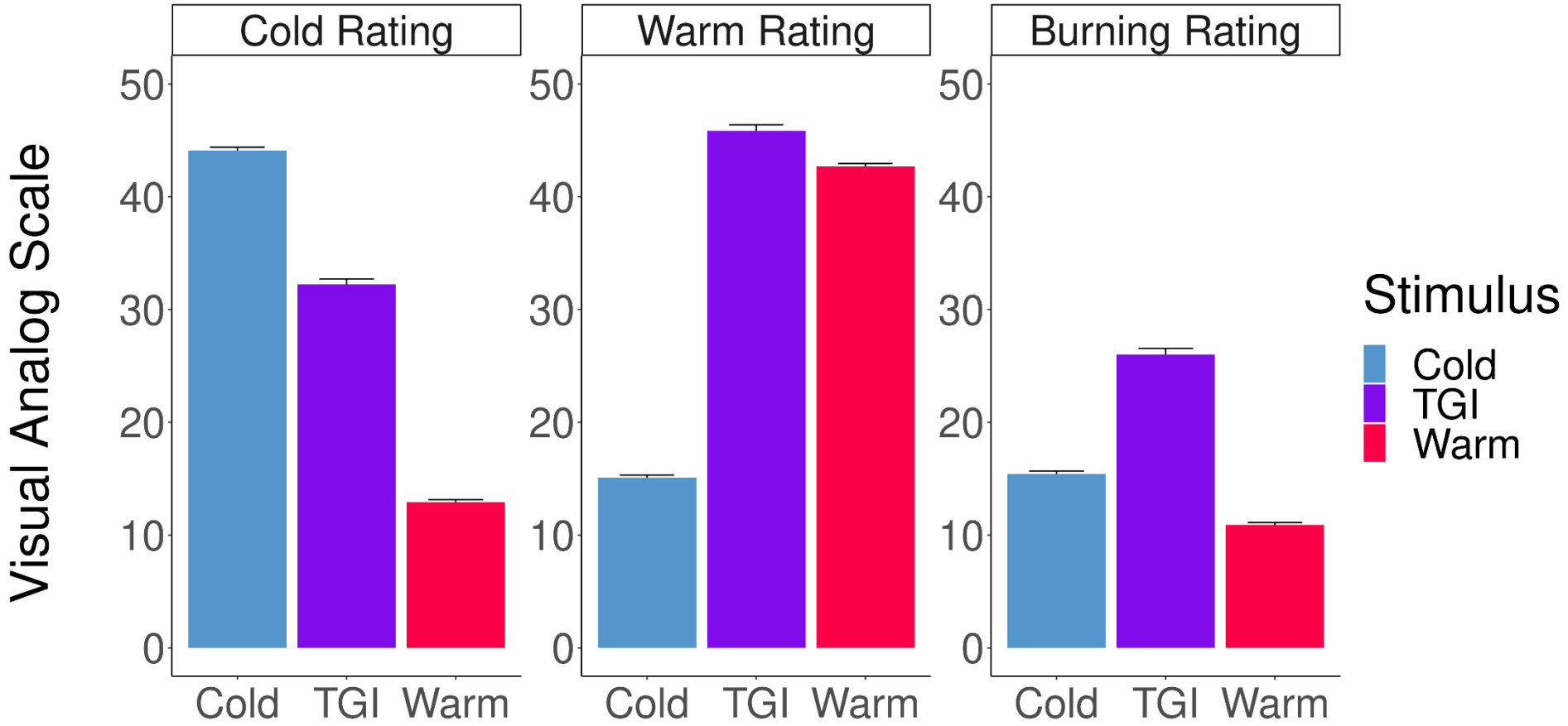


# RESULTS

# Visual analog ratings for stimuli



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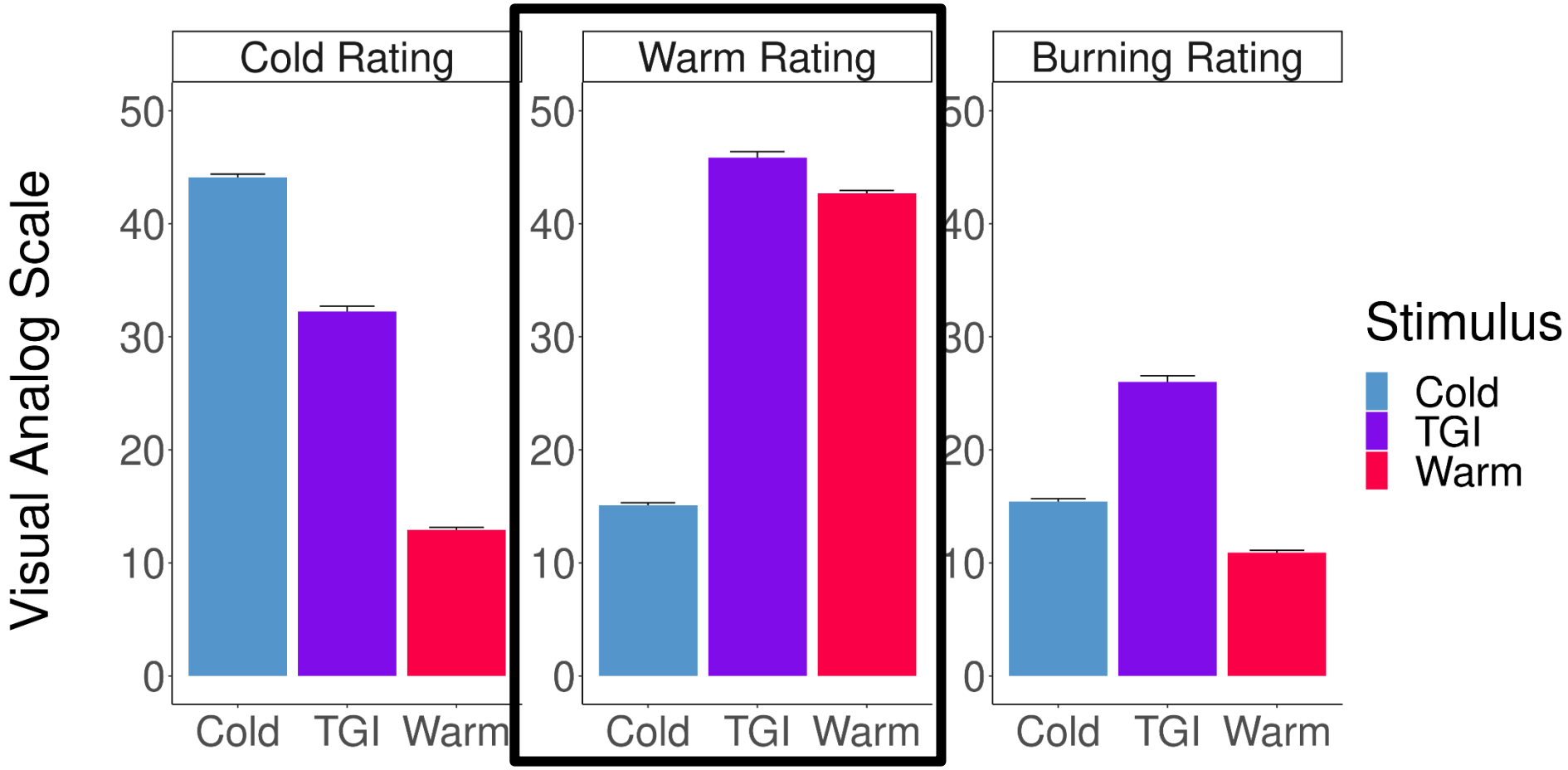
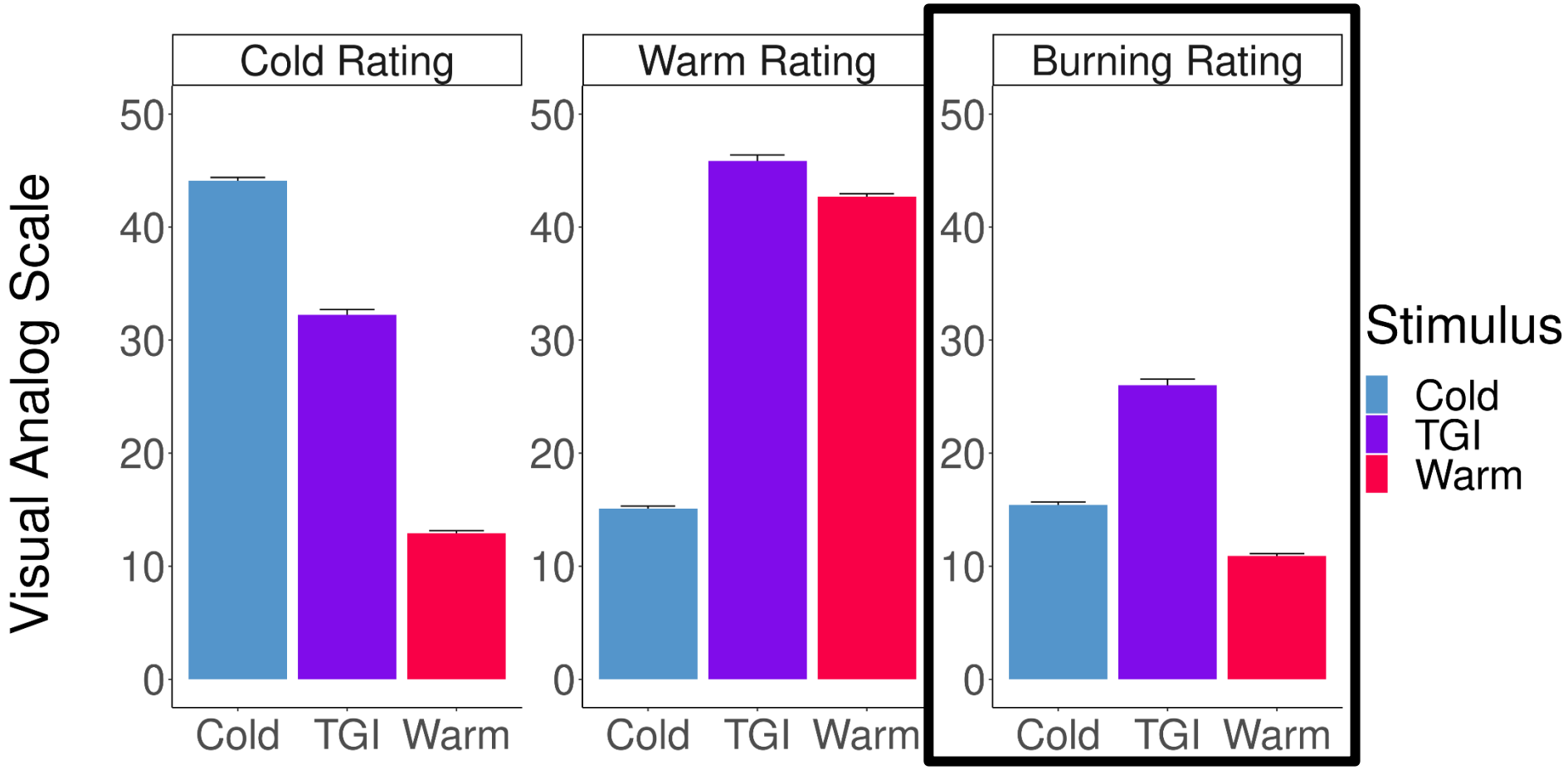
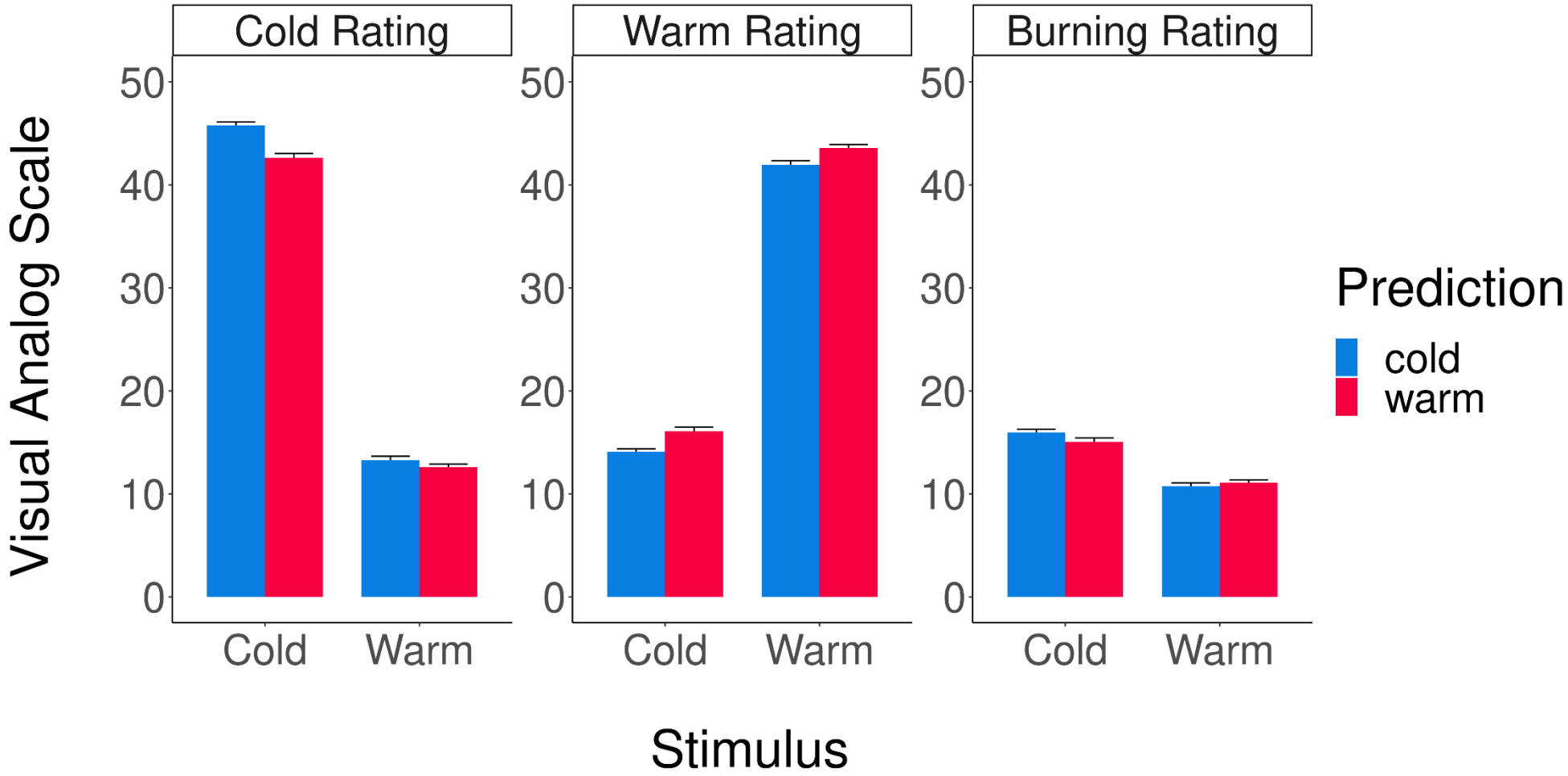


# Visual analog ratings for stimuli

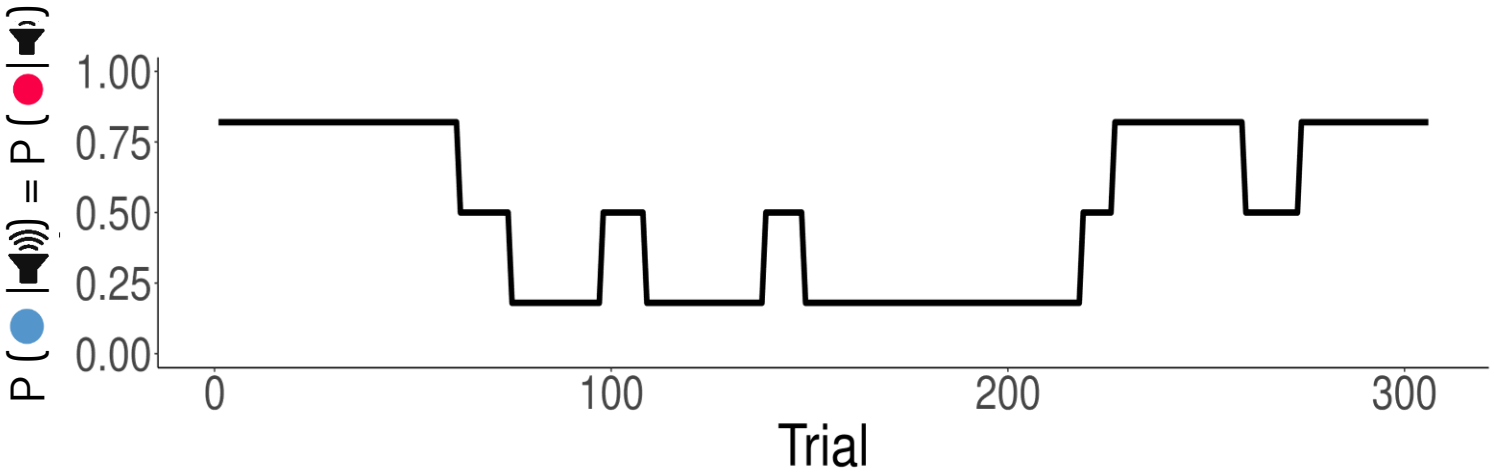


# Expectations modulate veridical themal sensation

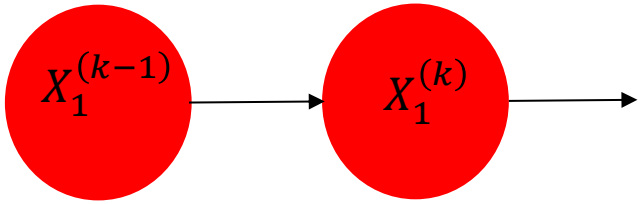


# Learning model

# Example learning trajectory



# Learning model

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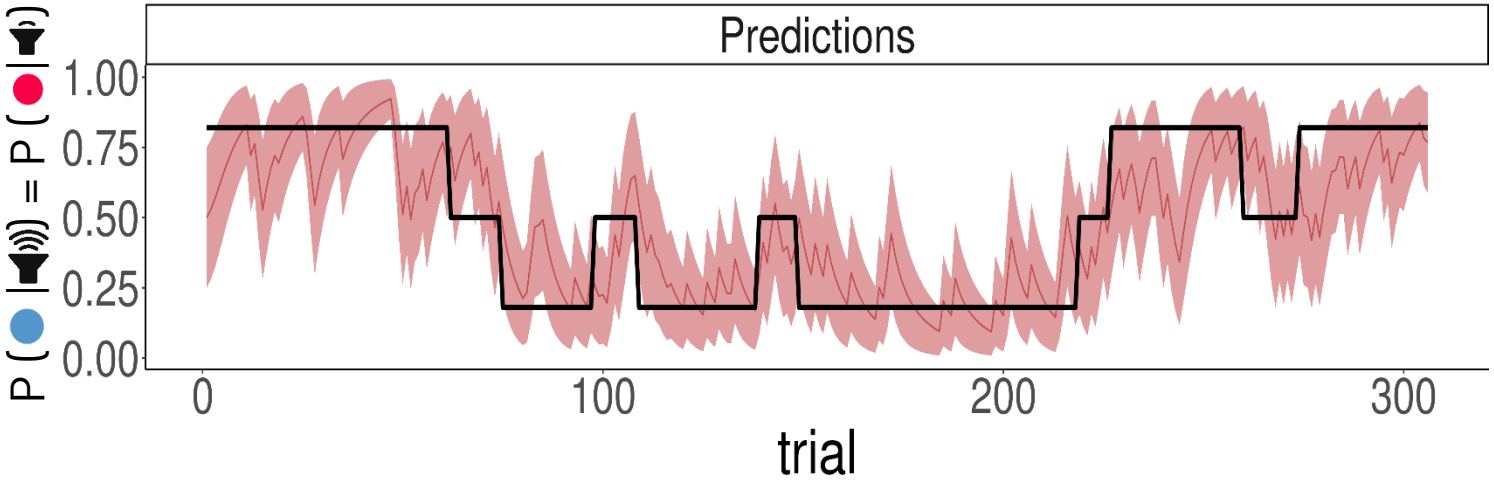

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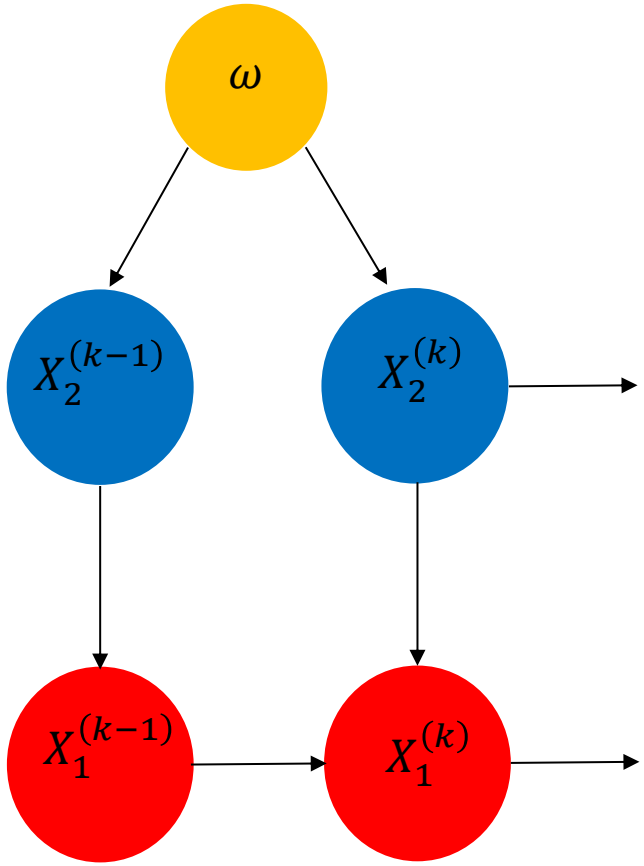
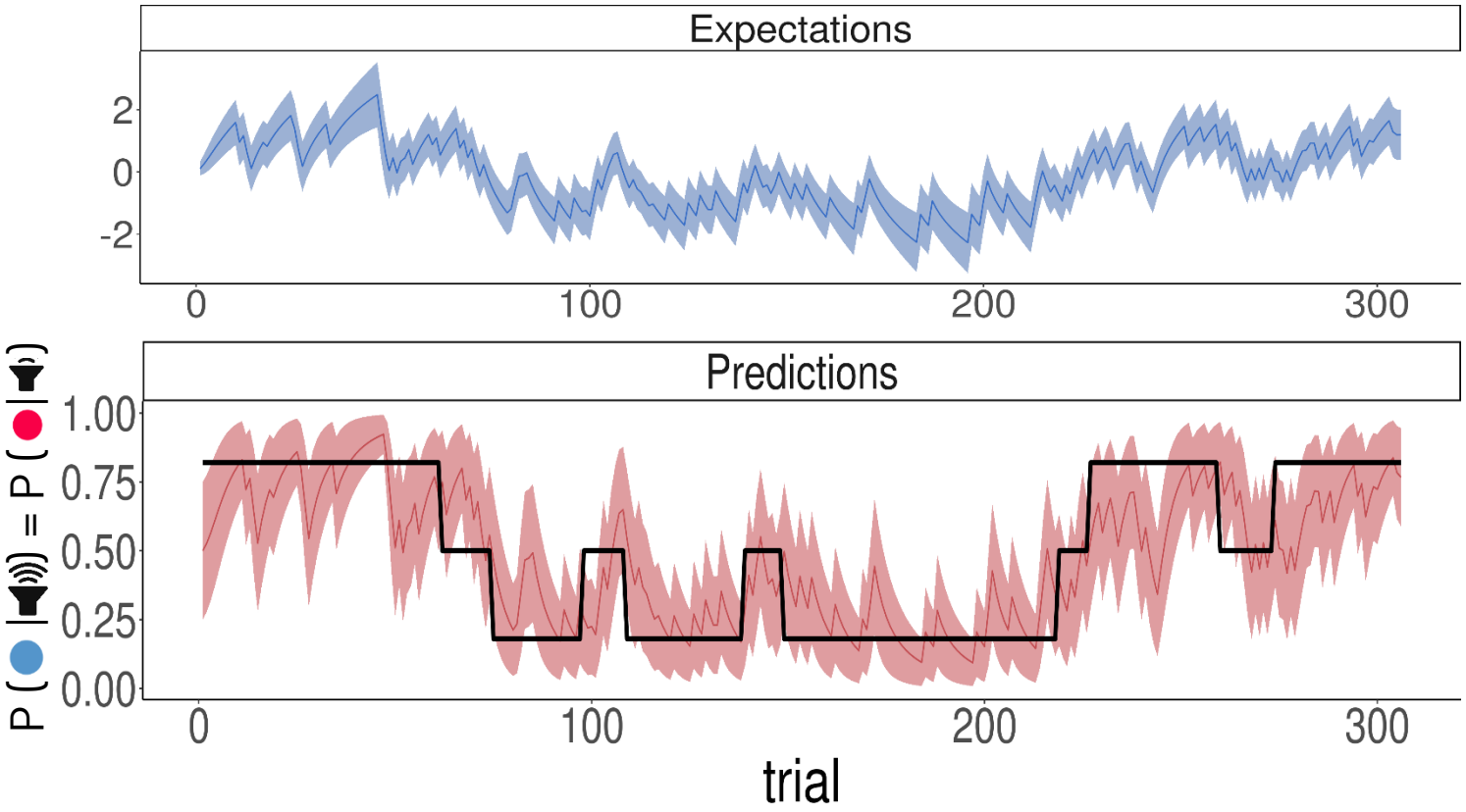
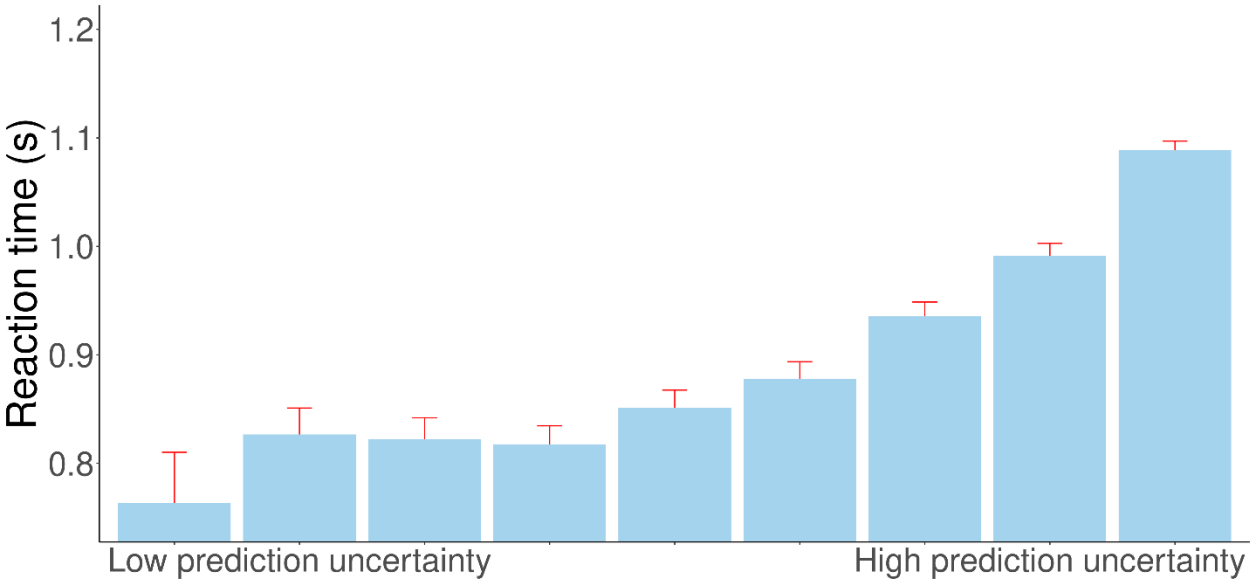
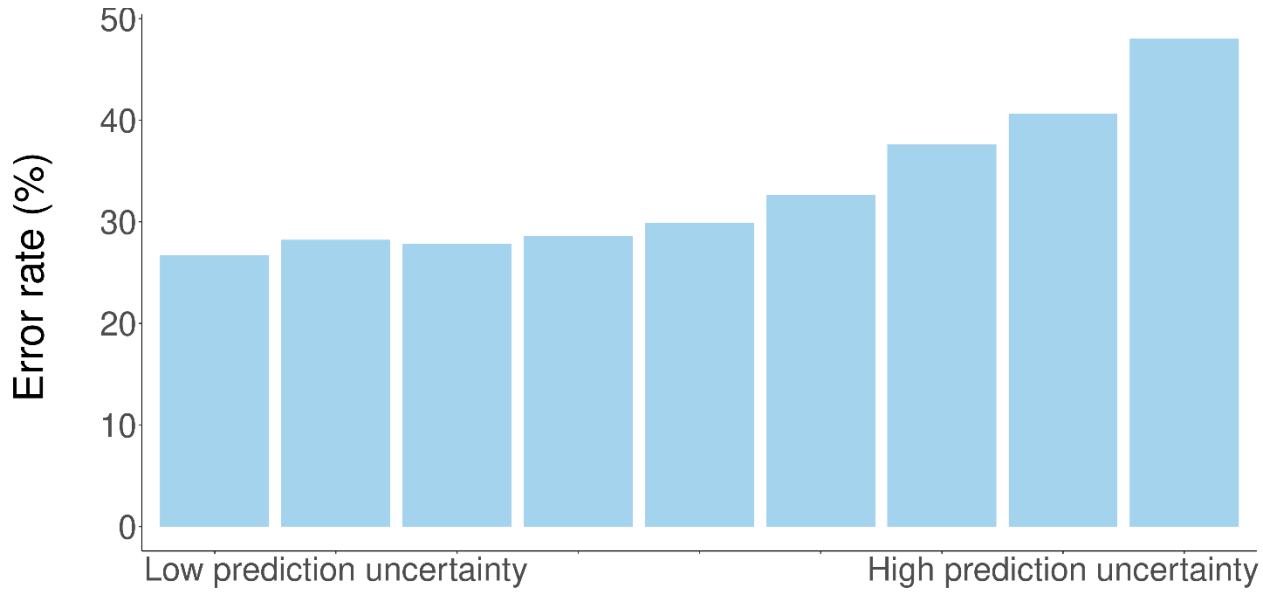



# Example learning trajectory

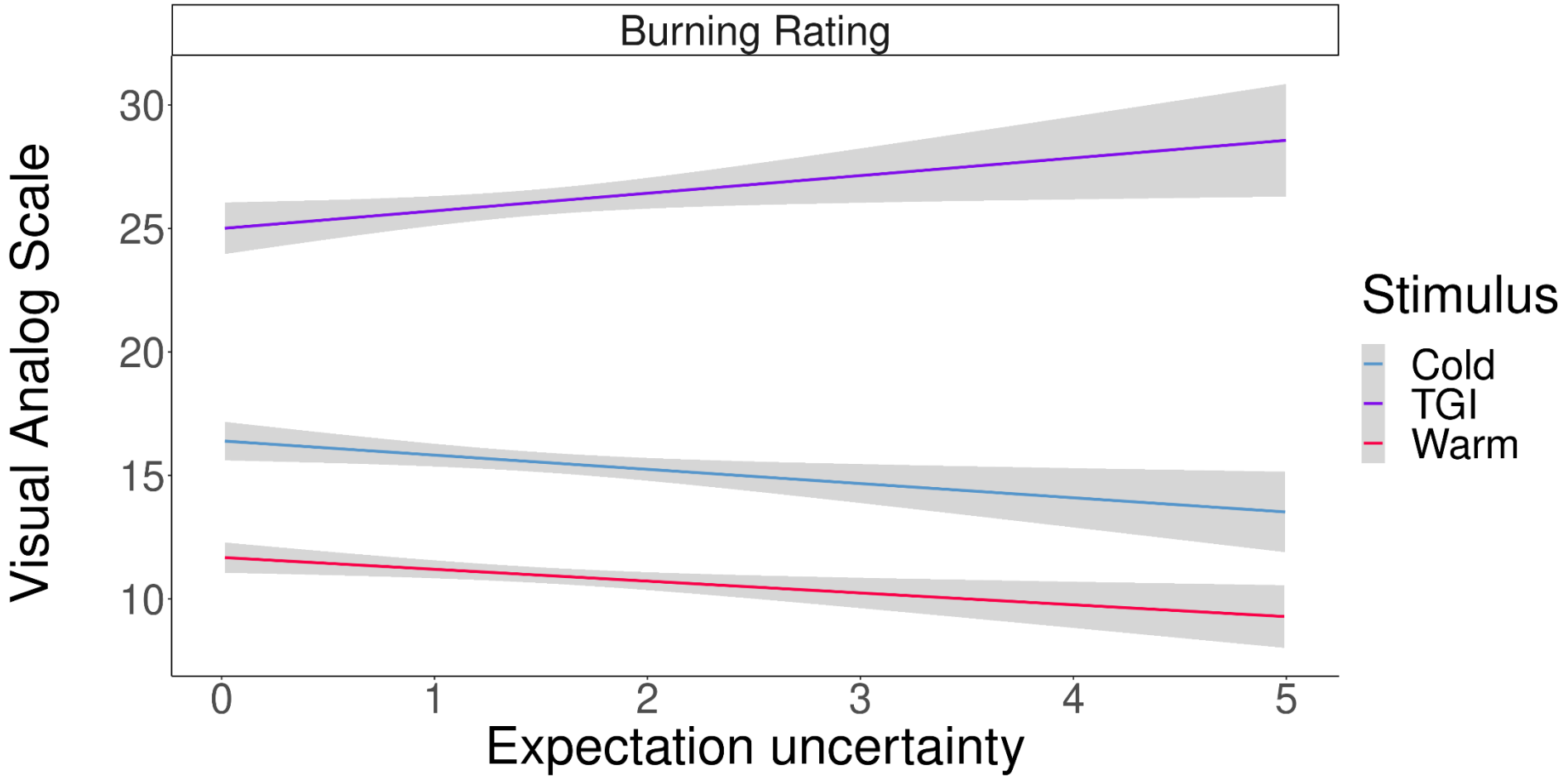


# Prediction uncertainty increases reaction time and error rates

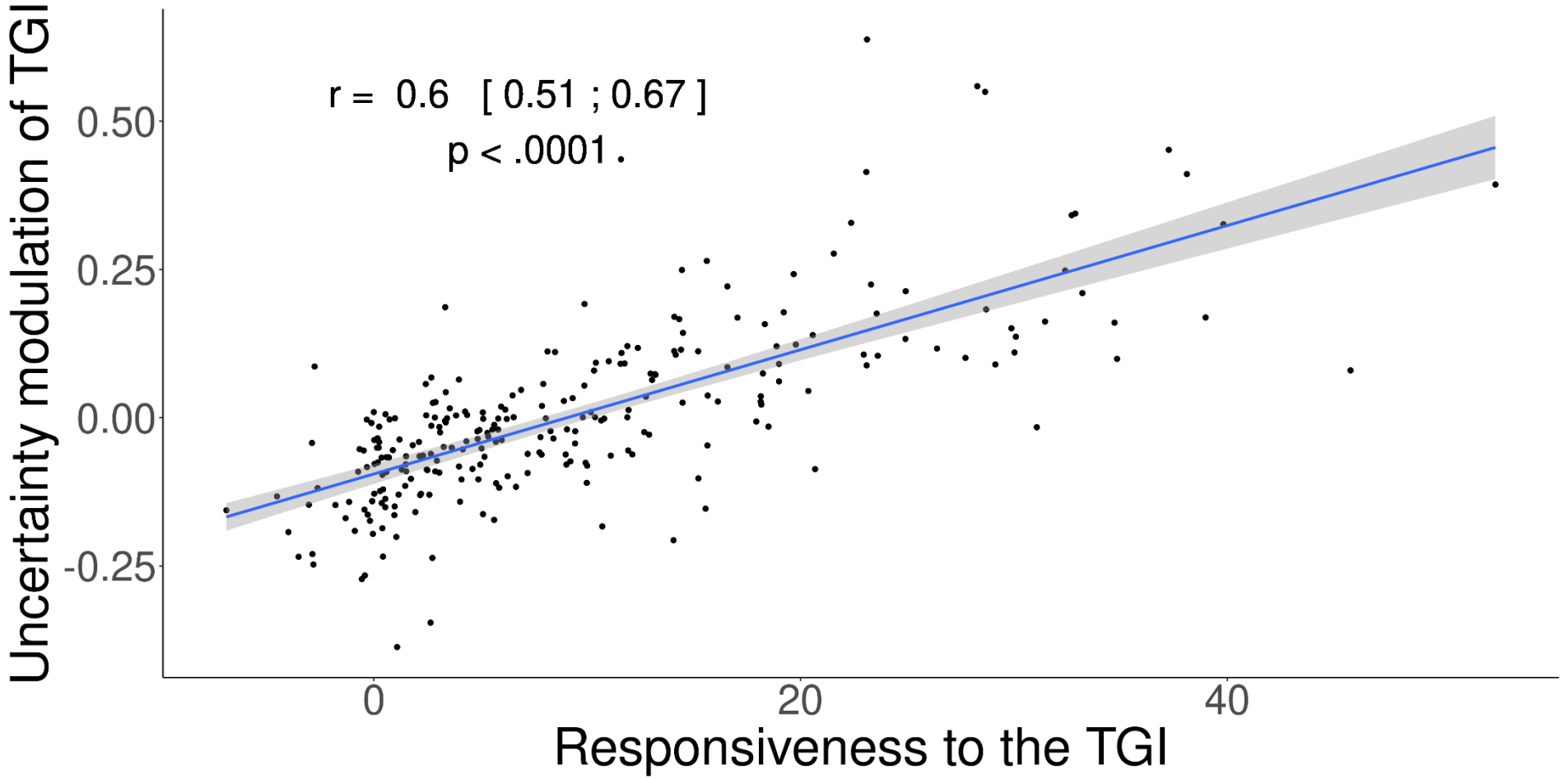


# Illusory pain and expectation uncertainty

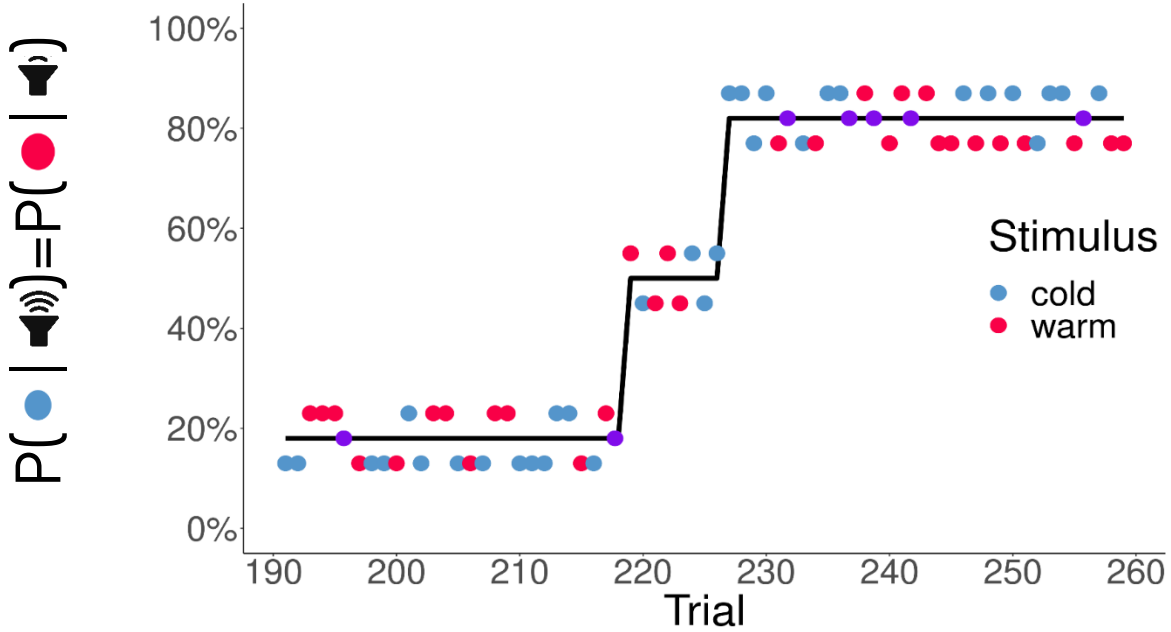


# Responsiveness to the TGI modulated by the extent expectation uncertainty modulates the burning



# SUMMARY

# Development of the TPL



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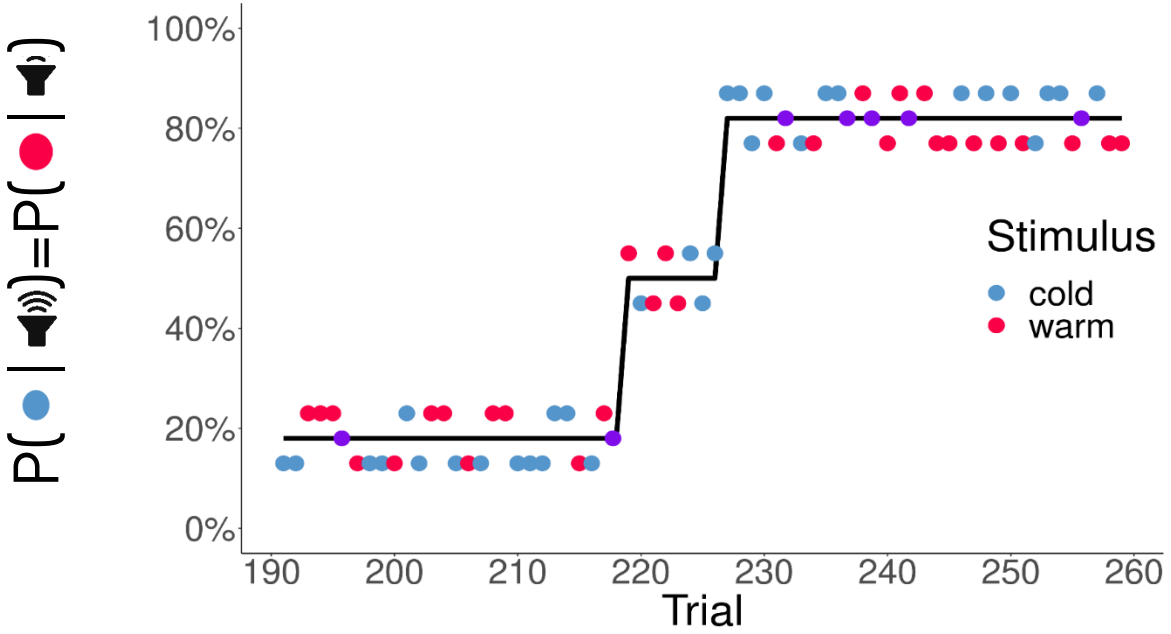
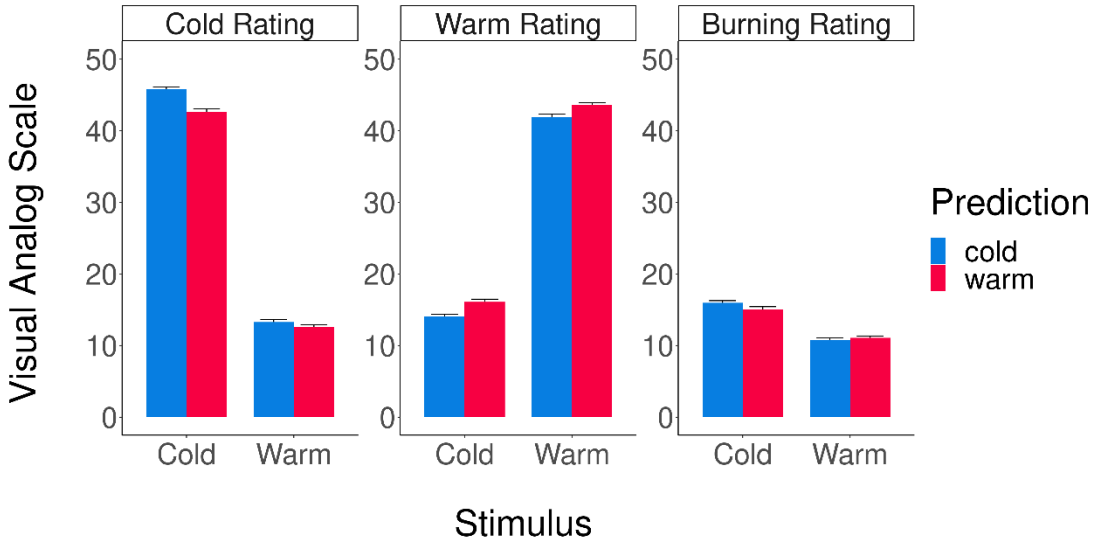
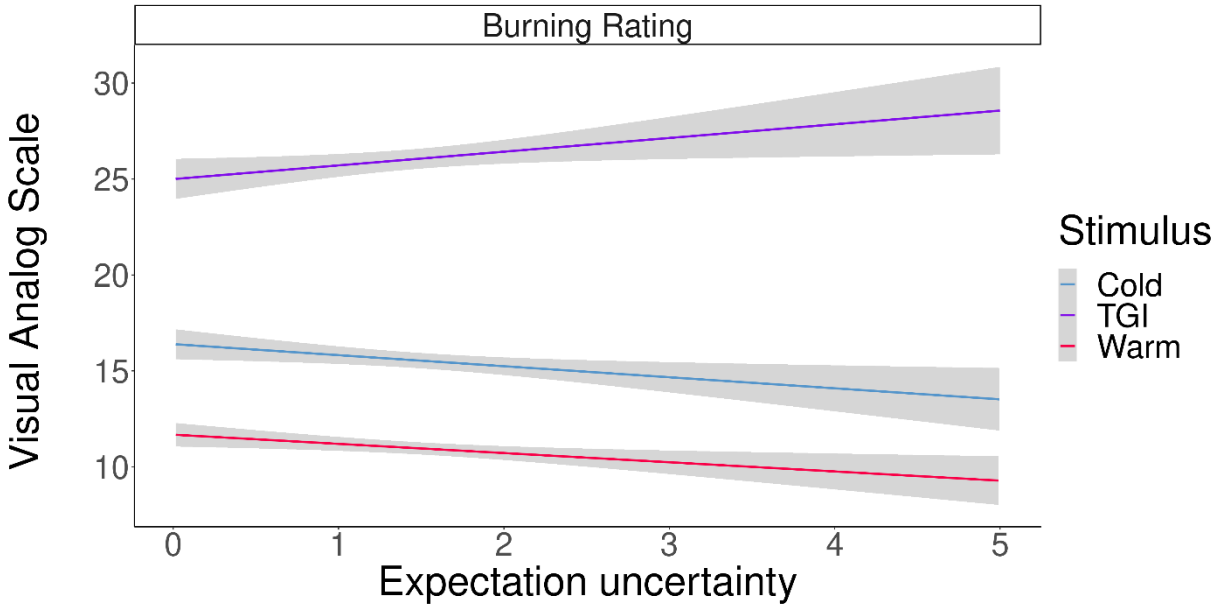



# Expectations shape veridical thermal sensation



# Illusory pain is modulated by expectation uncertainty



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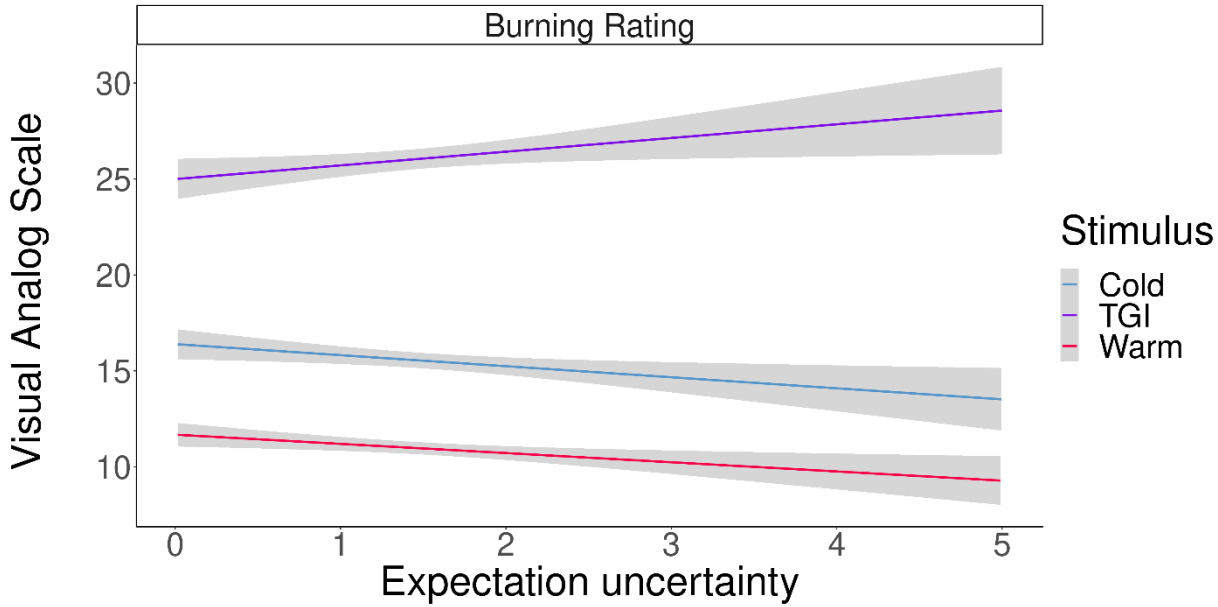
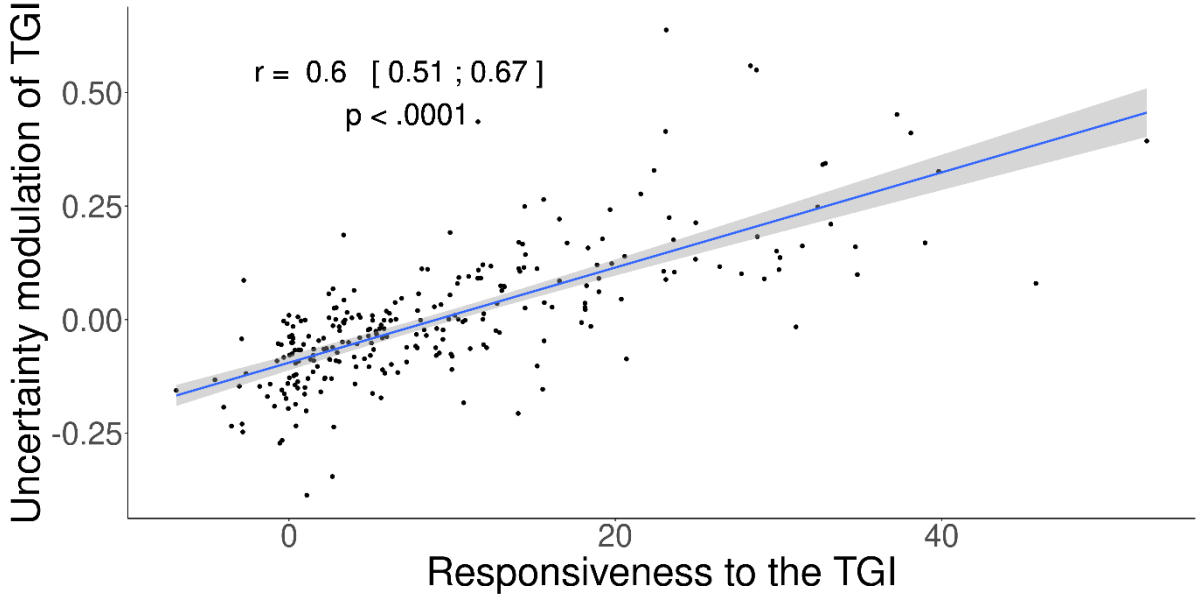



# The responsiveness to the Illusion is associated with the amount the illusory pain is modulated by expectation uncertainty



# Thanks to:

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Professor

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Associate Professor

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Lektor

**Camilla Eva Andersen**
PhD student

**Dr Camila Sardeto**
Post doc

**Dr Alex Mitchell**
Post doc

**Daniel Elmstrom Christensen**
Student Assistant

**Rebecca Astrid Böhme**
Student Assistant

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HGF:

$$\Delta\mu_2 = \sigma_2 \cdot \delta_1$$

$$\sigma_2 = \frac{1}{\frac{1}{\widehat{\sigma_2}} + \widehat{\sigma_1}}$$

Rescorla-Wagner:

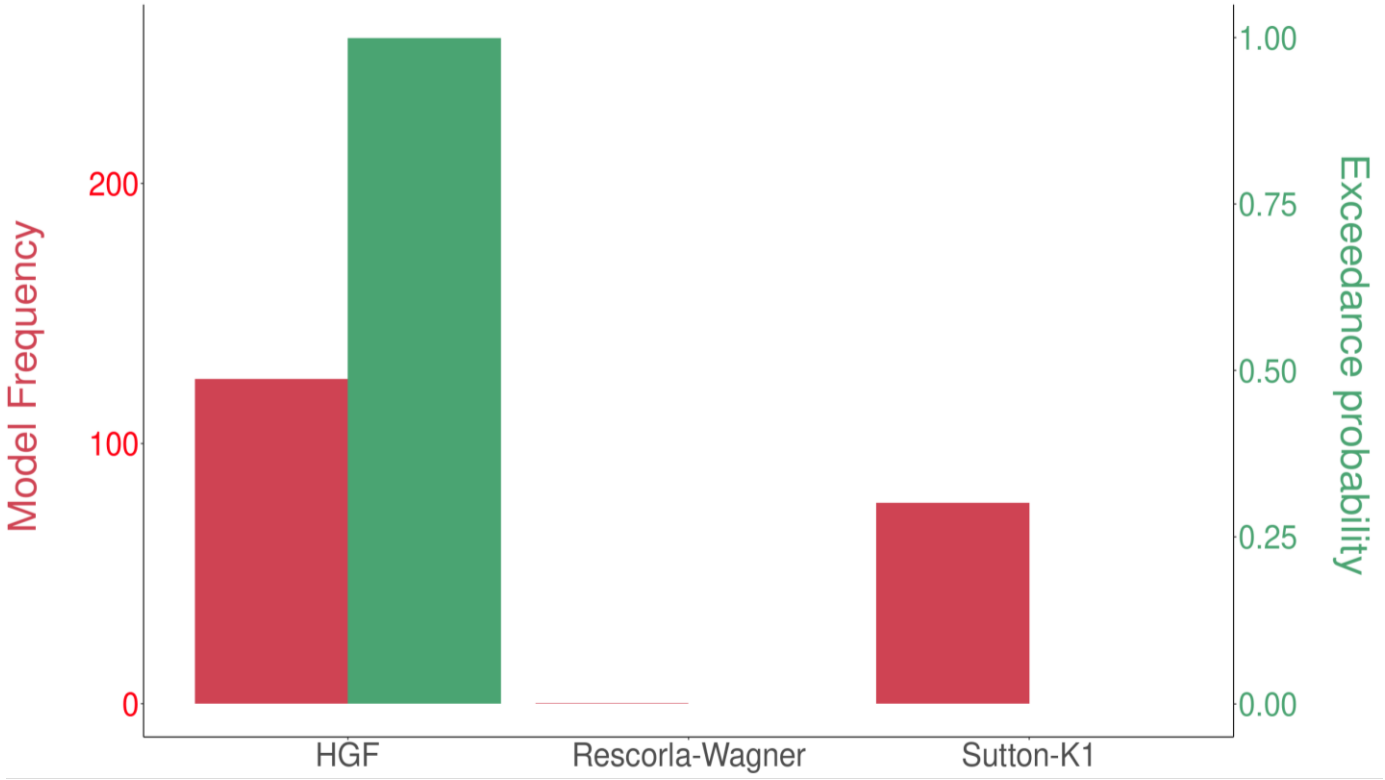
$$\Delta V_A = \alpha_A \cdot \beta_1 \cdot (\lambda_1 - V_A)$$

Sutton K1:

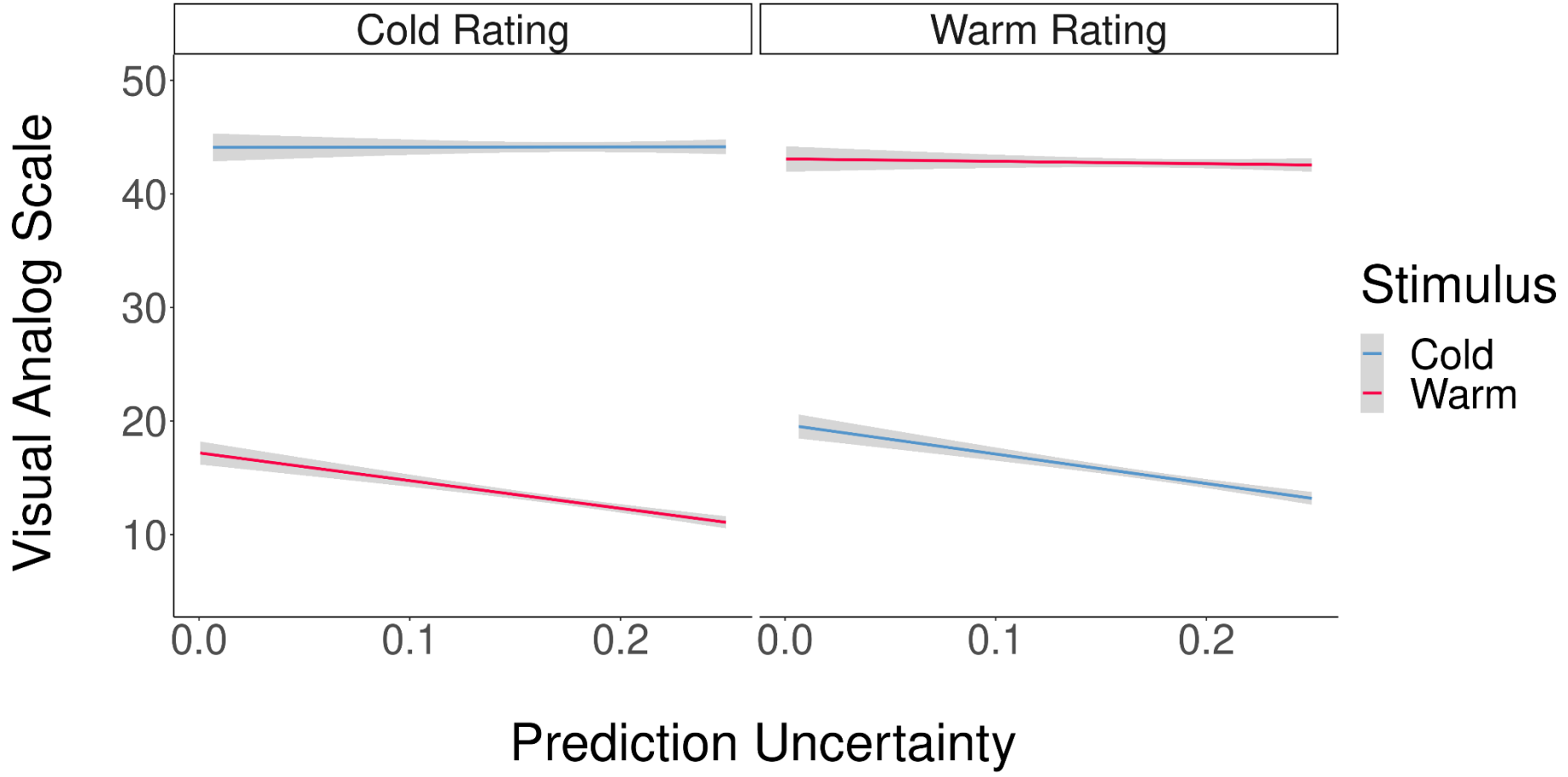
$$\Delta h = \alpha \cdot \delta$$

$$\alpha = e^{\left[\frac{\beta}{\widehat{h} + e^{\beta}}\right]}$$

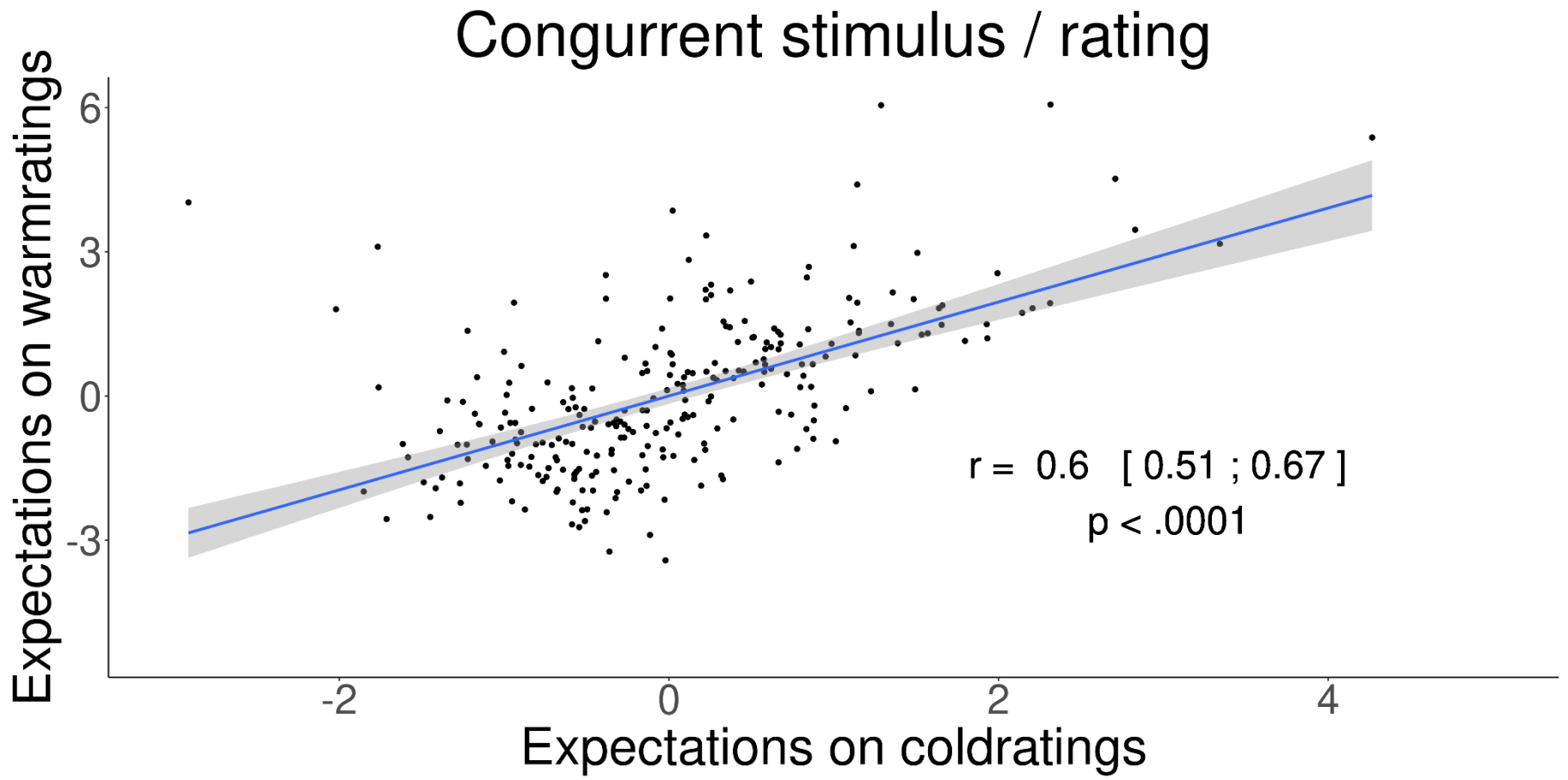
# Model Comparison



# VERIDICAL THERMAL SENSATION MODULATED BY PREDICTION UNCERTAINTY



# INDIVIDUAL DIFFERENCES ANALYSIS



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