

# Quantification of the sensitivity and communication responses in high and low-grooming honey bees (*Apis mellifera*)



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# *Varroa destructor*

- Introduced to *Apis mellifera* from *A. cerana*
  - *A. cerana* naturally resistant
  - *A. mellifera* much more susceptible



# *Varroa destructor*

- Control:
  - Chemical
  - Cultural
  - Mite-resistant bees



# Grooming Behaviour

## Auto-grooming



## Allo-grooming



## Grooming Invitation Dance (Haydak, 1945)

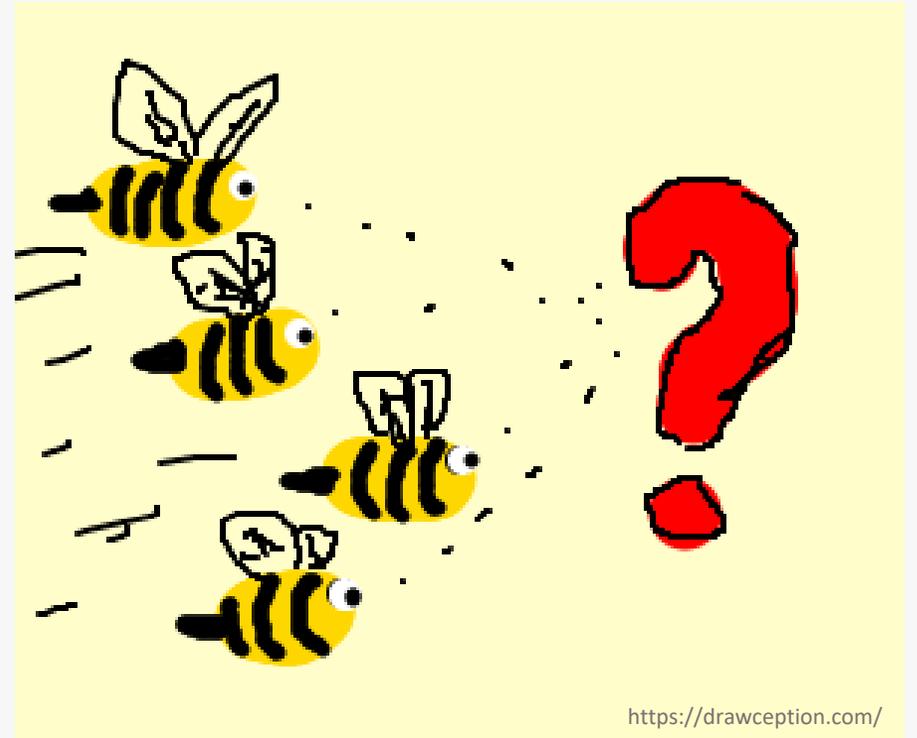
# Grooming Behaviour: What we know

- Primary mechanism of resistance in *A. cerana* (Peng et al., 1987)
- Exists in *A. mellifera* but to lesser extent (Peng et al., 1987; Buchler et al., 1992)
  - Mechanism of tracheal mite resistance in *A. mellifera* (Pettis & Pankiw, 1998)
  - Higher in some subspecies (Moretto et al., 1993; Guzman-Novoa et al., 2012; Rinderer, 2011)
- Heritable trait (Moretto et al., 1993; Ehrhardt et al., 2007; Stinimirovic et al., 2010; Hamiduzzaman et al., 2017; Hunt et al. 2016)
  - Current screening methods are slow and labour intensive
    - Mite-mortality rate, Mite Damage



# Research Question

- Do high-grooming bees have heightened sensitivity to external stimuli and a heightened ability to communicate that sensitivity?



# Hypotheses

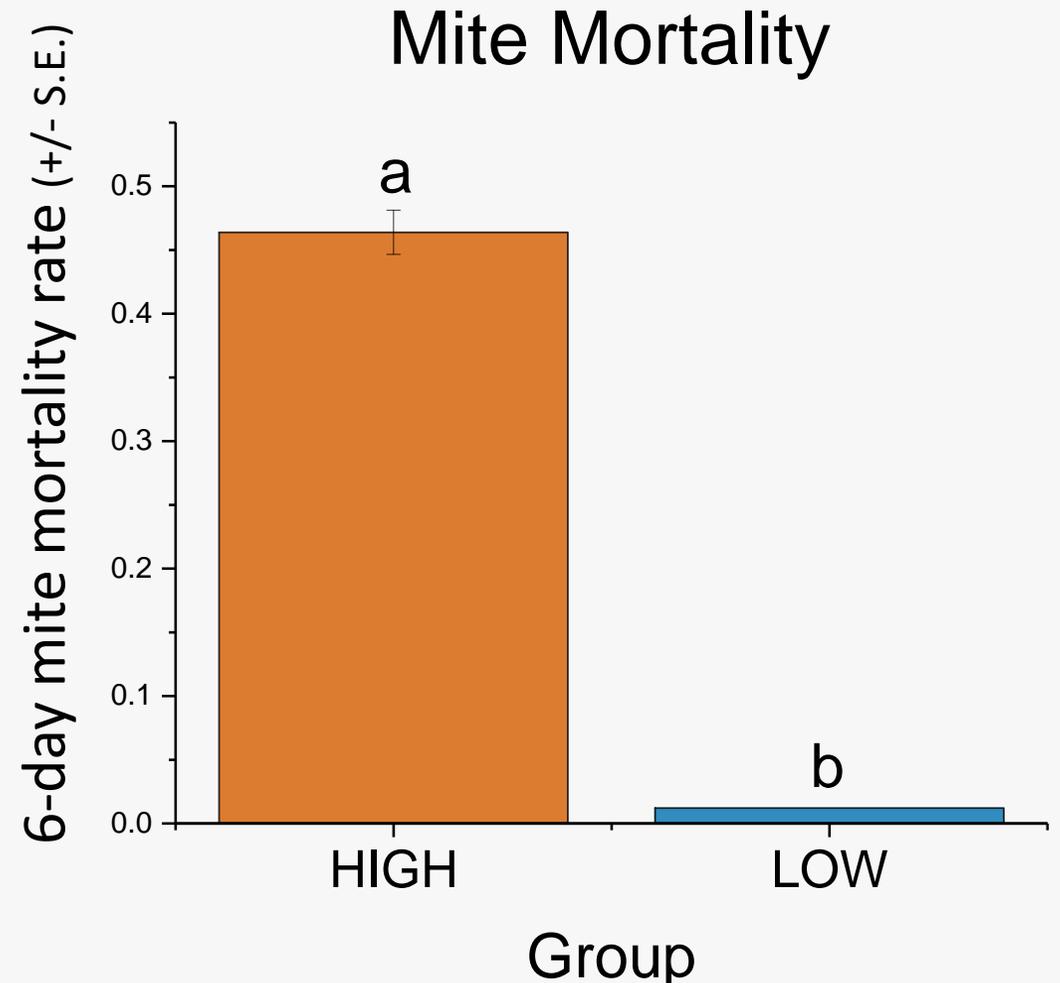
- **H1:** High-grooming bees have heightened sensitivity to varroa as well as a secondary standardized stimulus – chalk dust (Land & Seeley, 2004)
- **H2:** High-grooming bees have enhanced sensitivity over different body regions
- **H3:** High-grooming bees exhibit increased communication in the form of dances, sound, or heat (pheromones?)

# Selection of Colonies



# Selection of Colonies

- From BeeOmics project at UM (200 colonies)
  - Selected 15 highest and 15 lowest grooming colonies using 2 selection metrics:
    - Mite Mortality Rate
    - Mite Damage



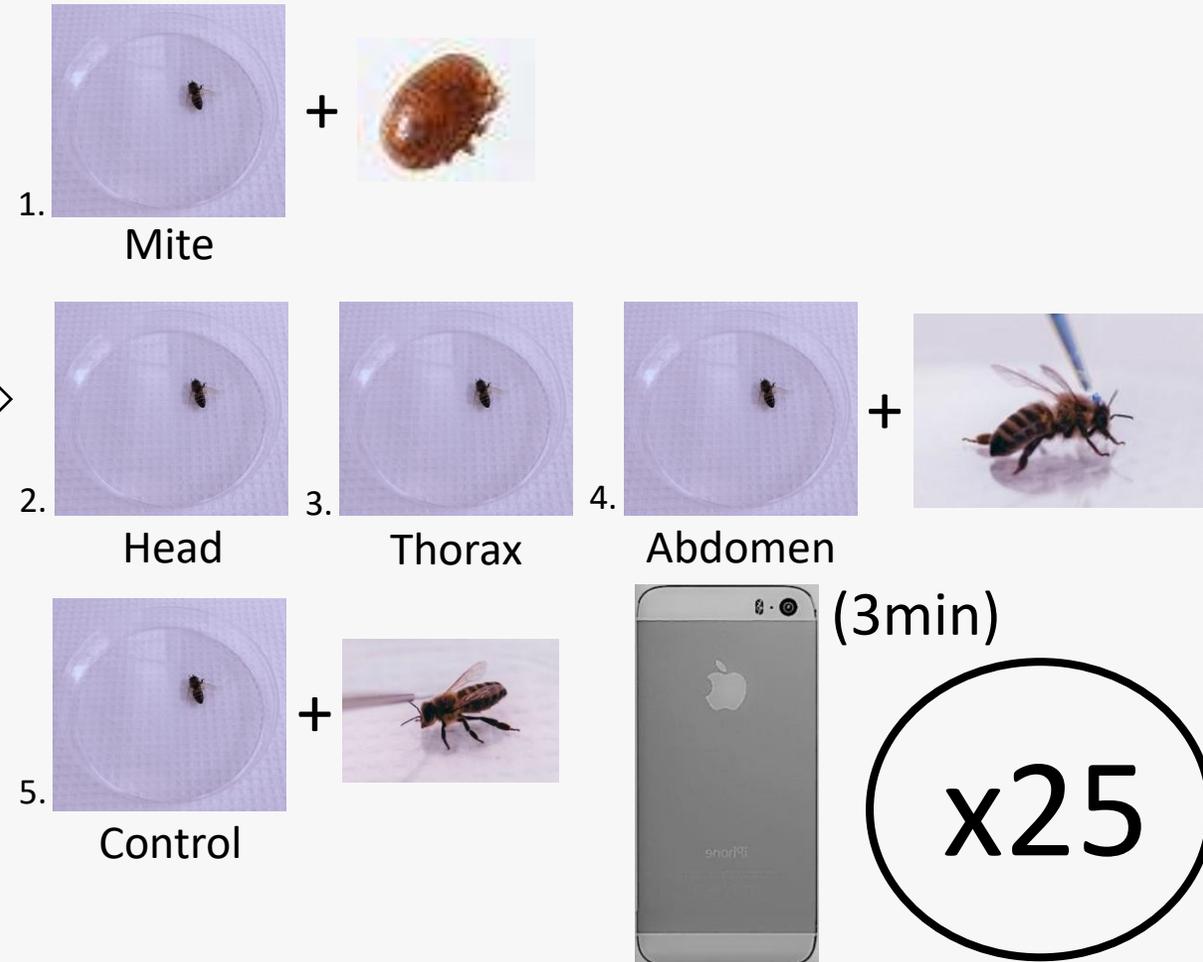
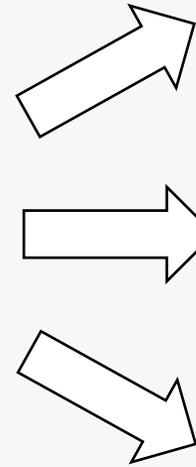
# Experiment # 1

Summer 2017

15 High-Grooming  
15 Low-Grooming



125  
Bees



3010-10

C



Control

M



Mite



Head

T



Thorax

A



Abdomen

C



Control

M



Mite



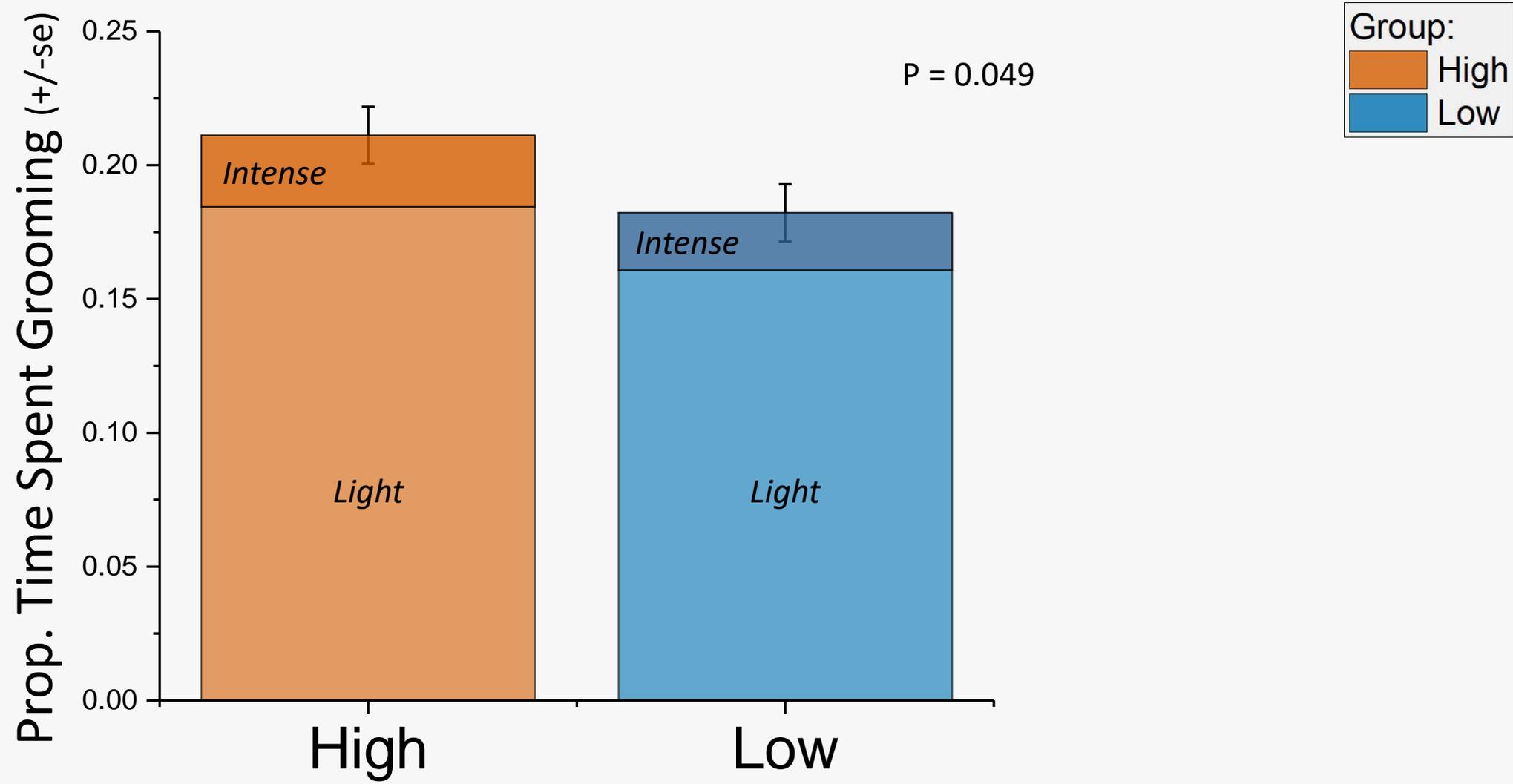
Light Grooming



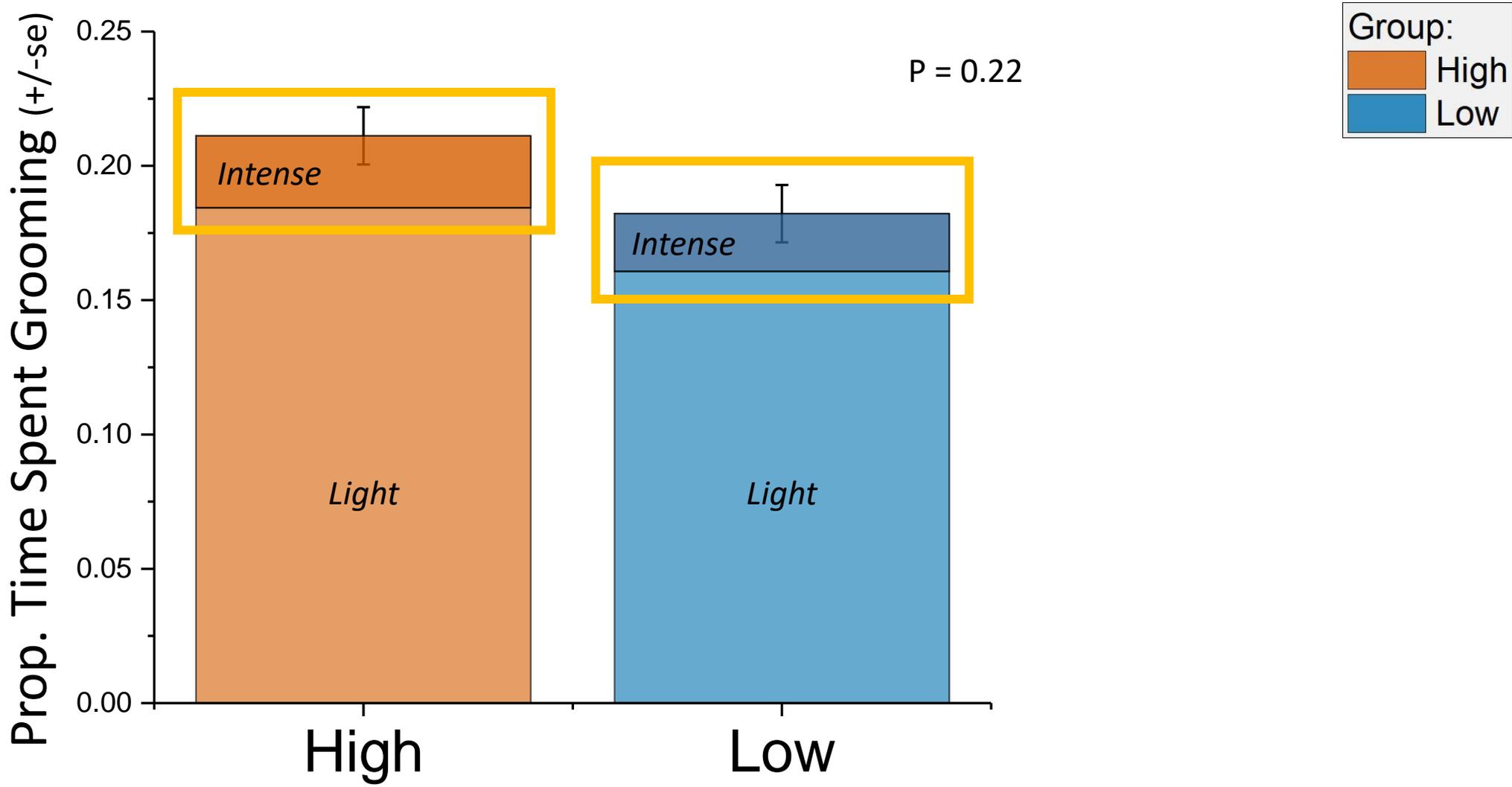
Intense Grooming

# Results

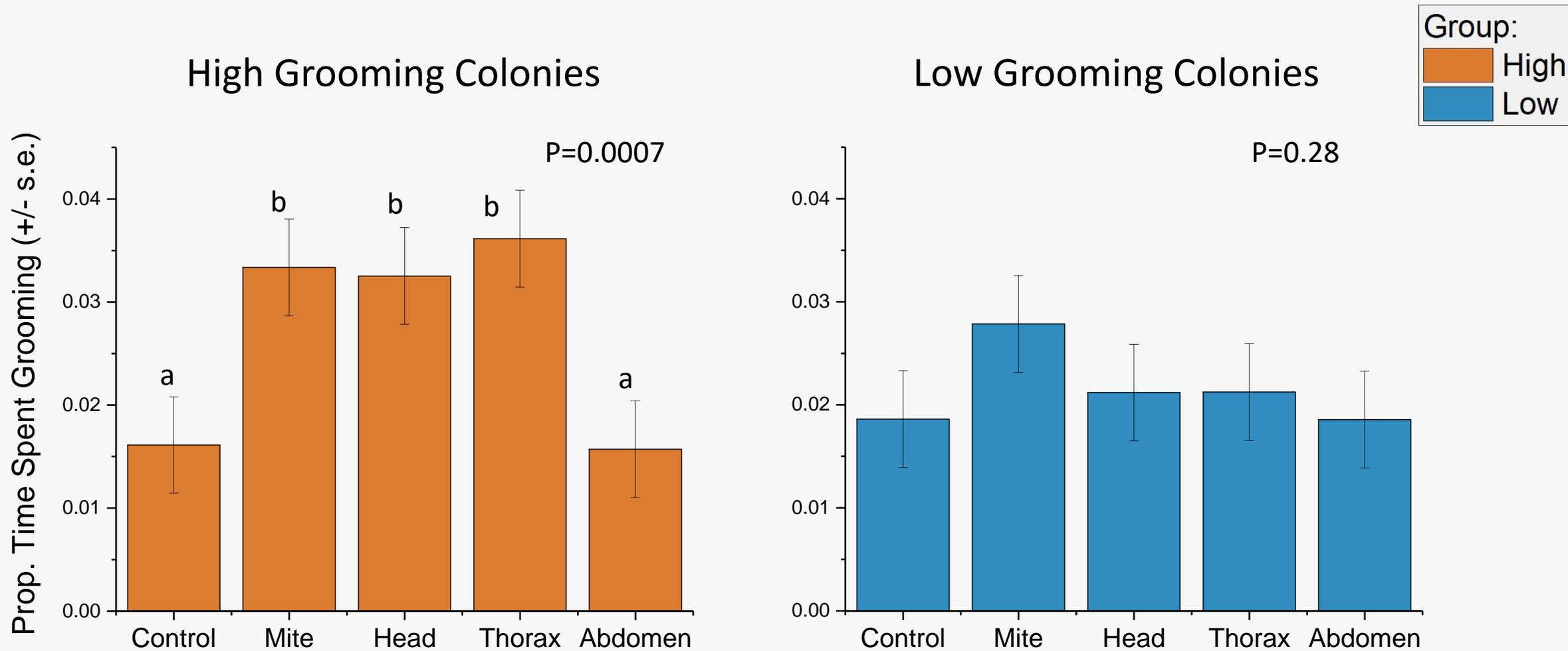
# Total Grooming



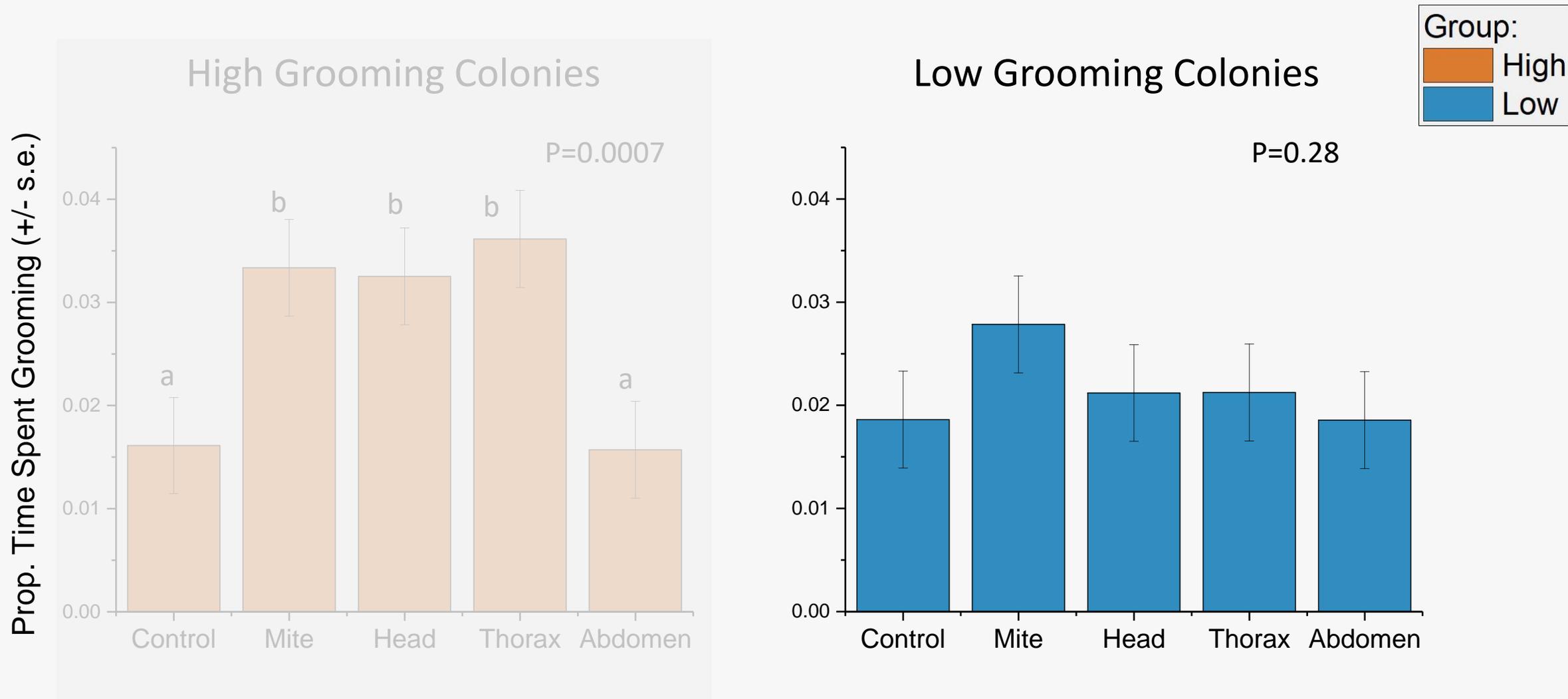
# Total Grooming



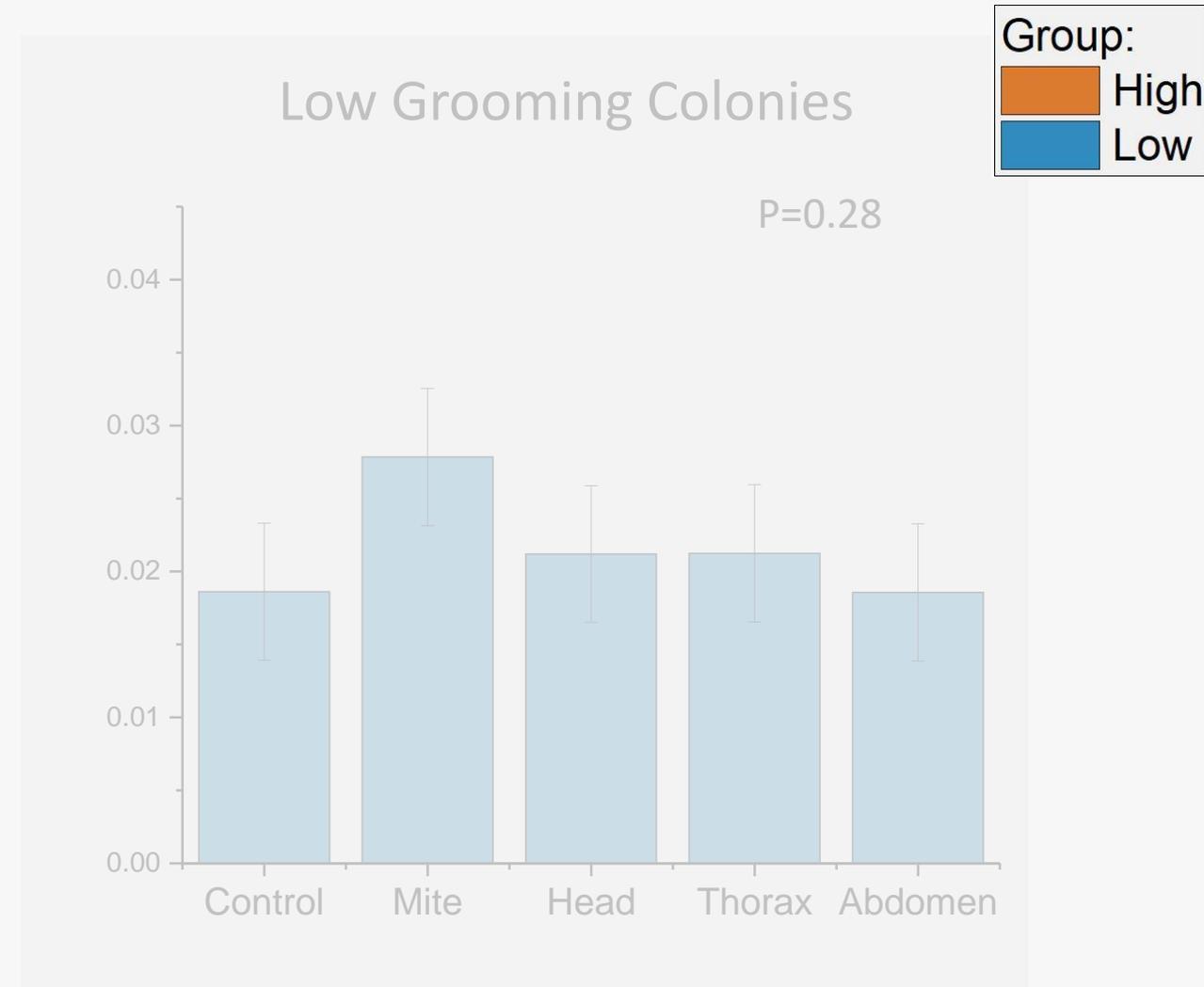
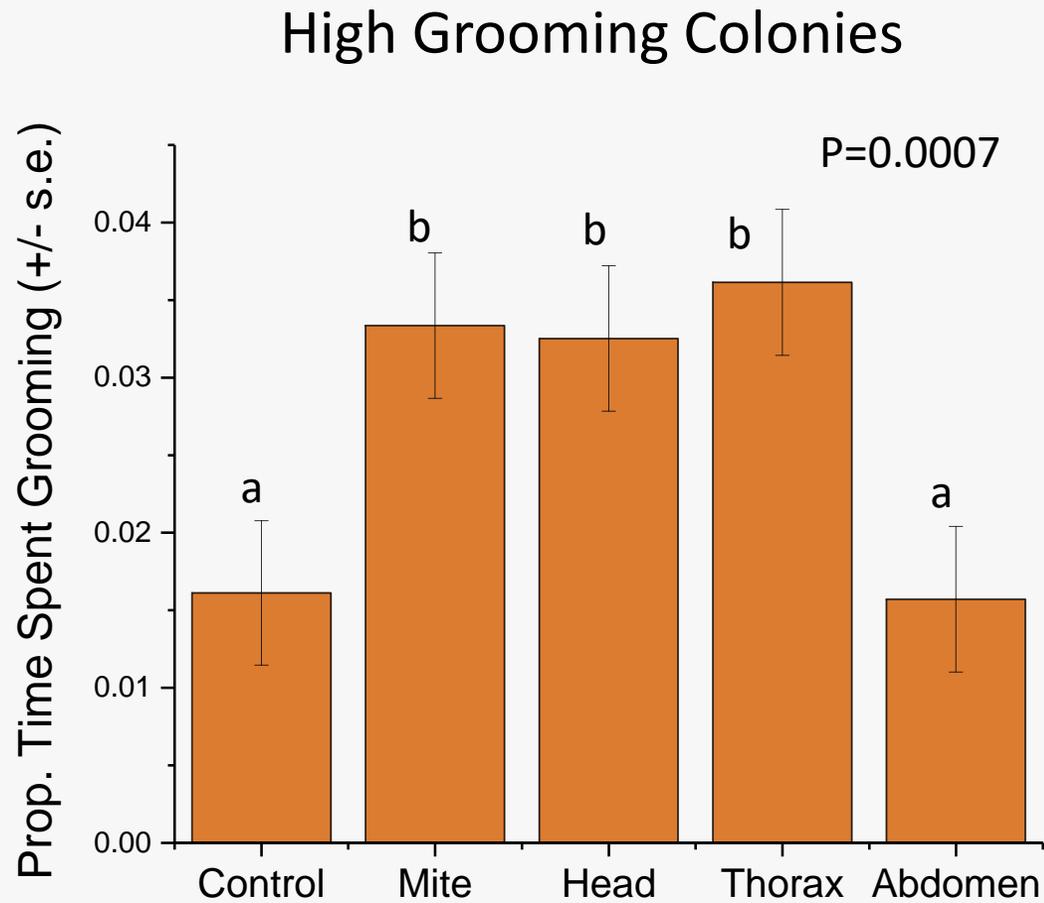
# *Intense Grooming*



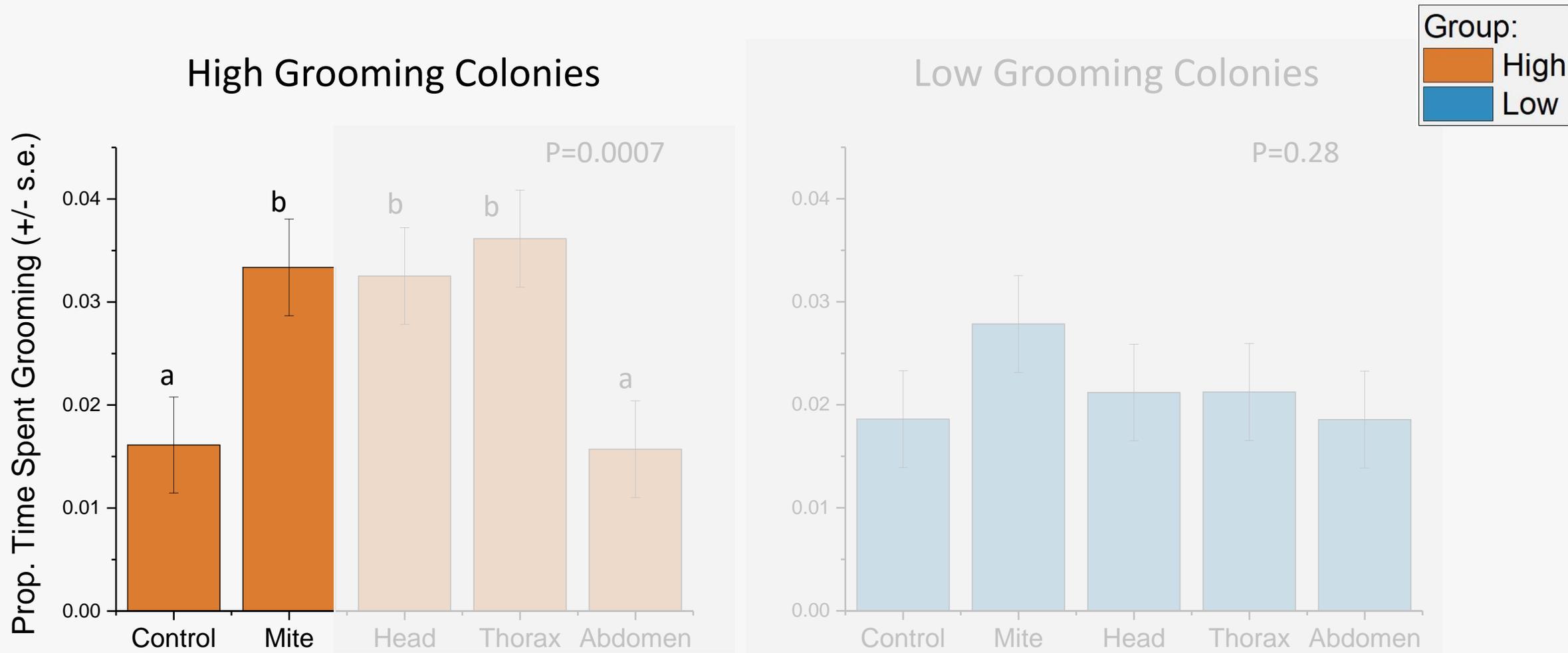
# *Intense Grooming*



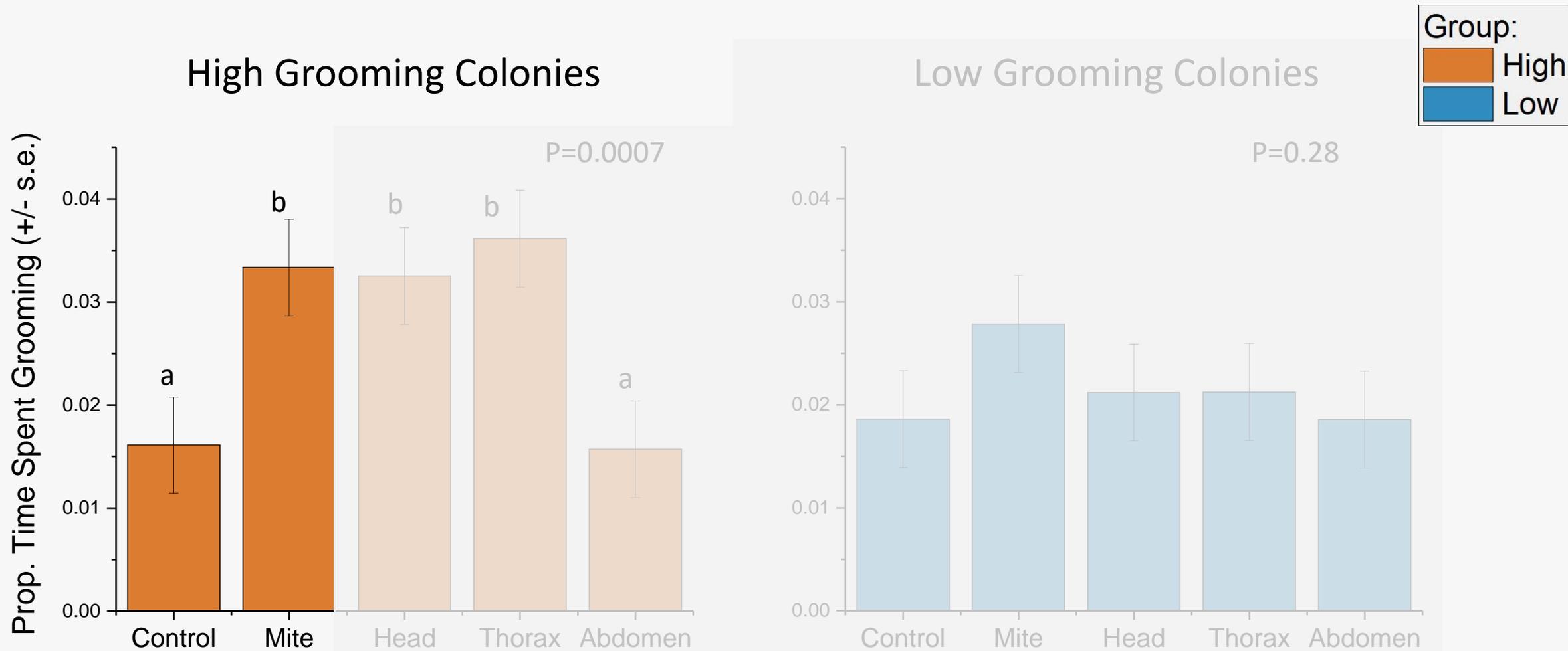
# *Intense Grooming*



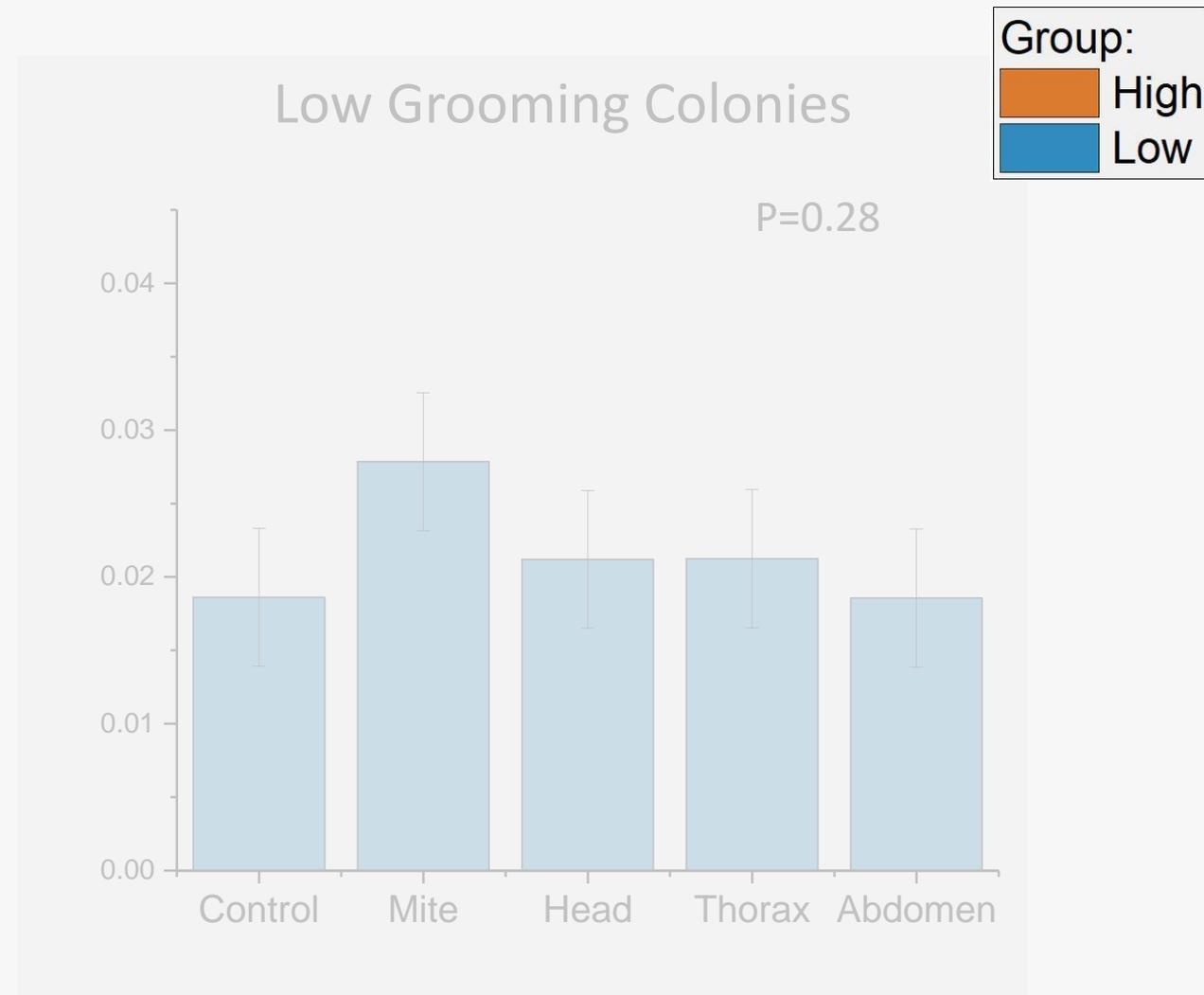
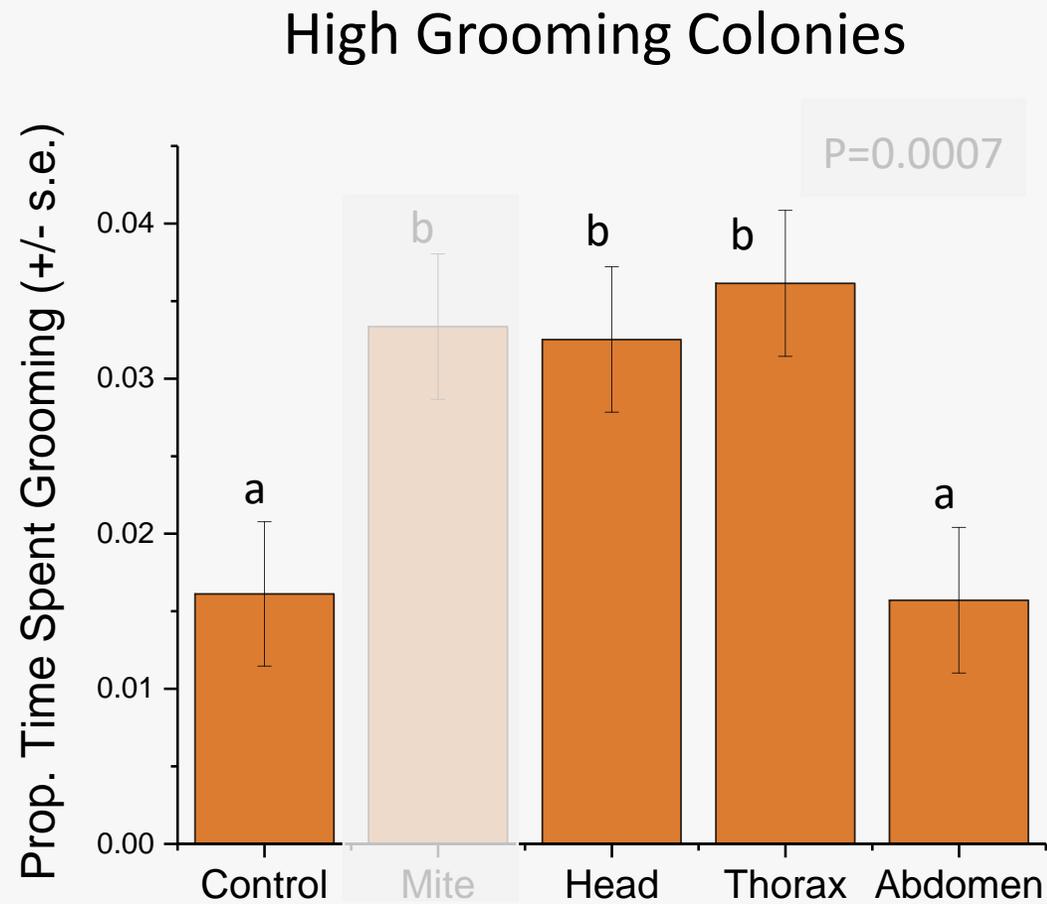
# *Intense Grooming*



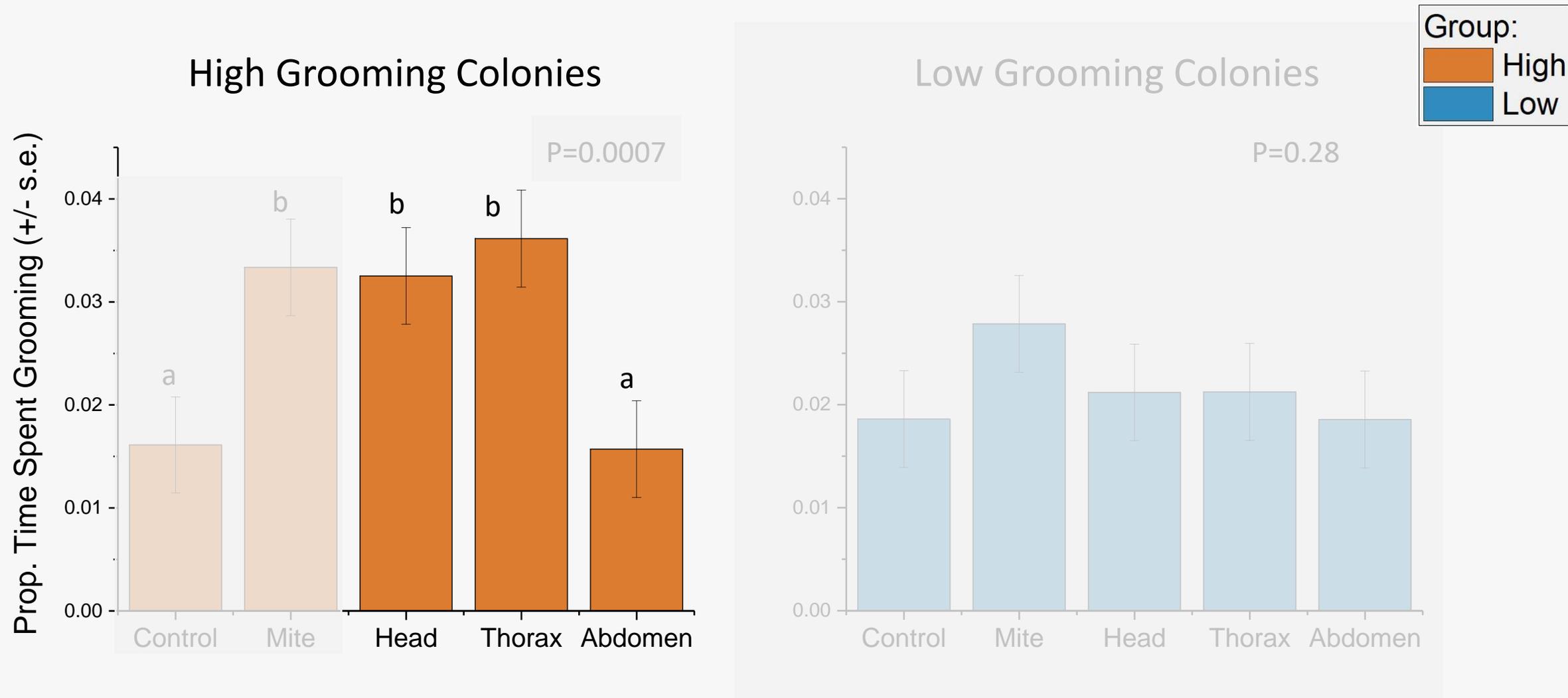
# H1: Heightened sensitivity to **varroa** and chalk dust



# H1: Heightened sensitivity to varroa and **chalk dust**



## H2: Enhanced sensitivity over different **body regions**



# Experiment # 2

September 2017

9 High-grooming  
9 Low-grooming



~125 bees

~125 bees



+



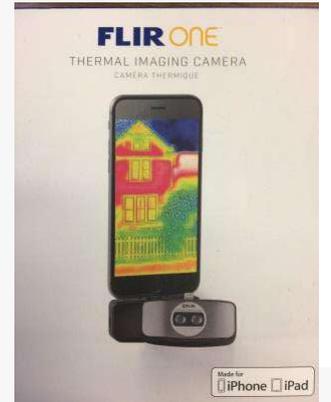
x20  
(2min)



+



x20  
(2min)





3010 - v



## Observations (2 mins):

- Auto-Grooming
  - Light (Y/N)
  - Intense (Y/N)
  - Score (1,2,3,4)



## Observations (2 mins):

- Auto-Grooming
  - Light (Y/N)
  - Intense (Y/N)
  - Score (1,2,3,4)
- Grooming Invitation Dances
  - # Light (= 0.1)
  - # Intense (= 1.0)
  - Score



## Observations (2 mins):

- Auto-Grooming
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  - Score (1,2,3,4)
- Grooming Invitation Dances
  - # Light (= 0.1)
  - # Intense (= 1.0)
  - Score
- Allo-grooming
  - # Light (= 0.1)
  - # Intense (= 1.0)
  - Score

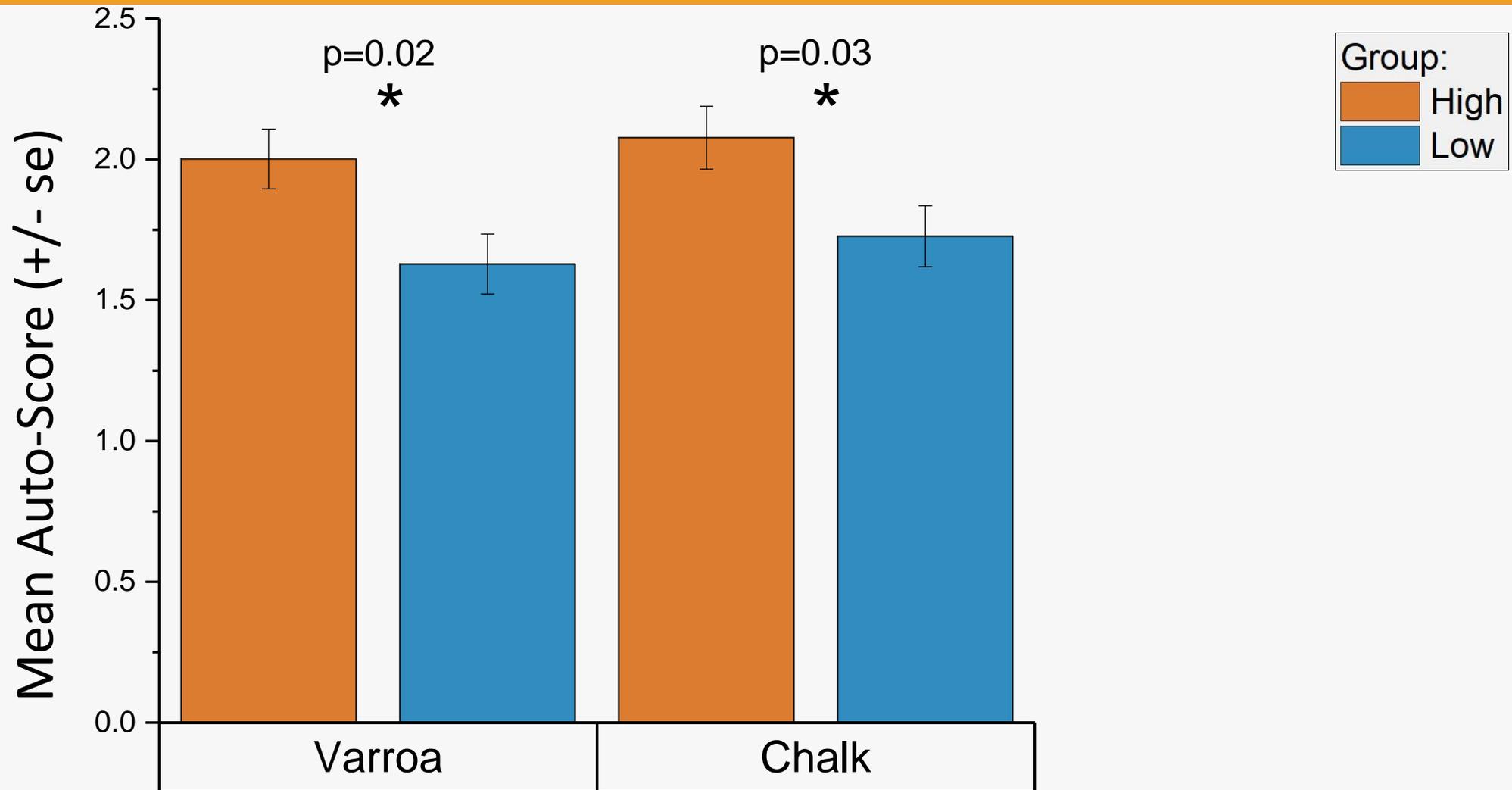


## Observations (2 mins):

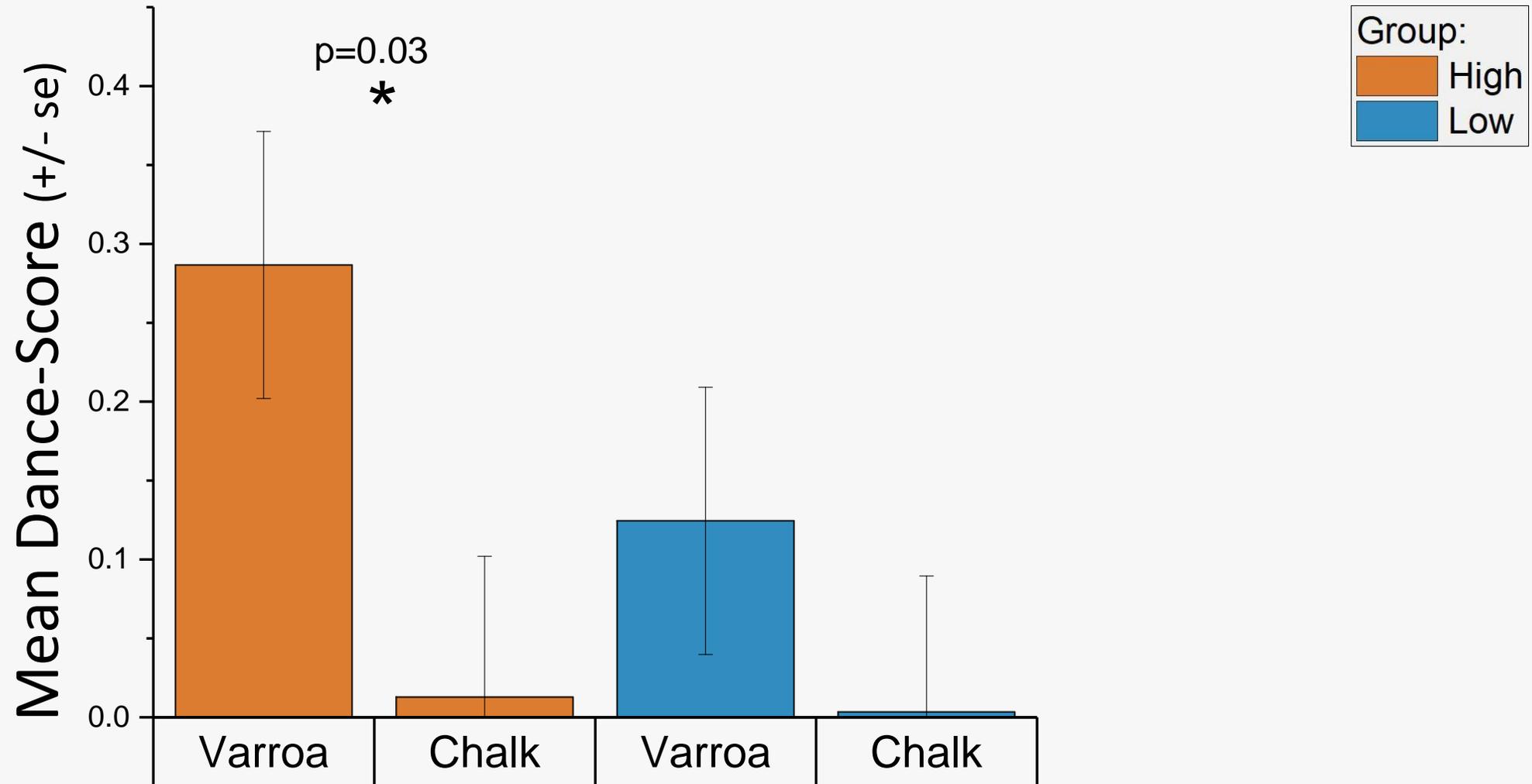
- Auto-Grooming
  - Light (Y/N)
  - Intense (Y/N)
  - Score (1,2,3,4)
- Grooming Invitation Dances
  - # Light (= 0.1)
  - # Intense (= 1.0)
  - Score
- Allo-grooming
  - # Light (= 0.1)
  - # Intense (= 1.0)
  - Score
- Trophallaxis
  - # Light (= 0.1)
  - # Intense (= 1.0)
  - Score

# Results

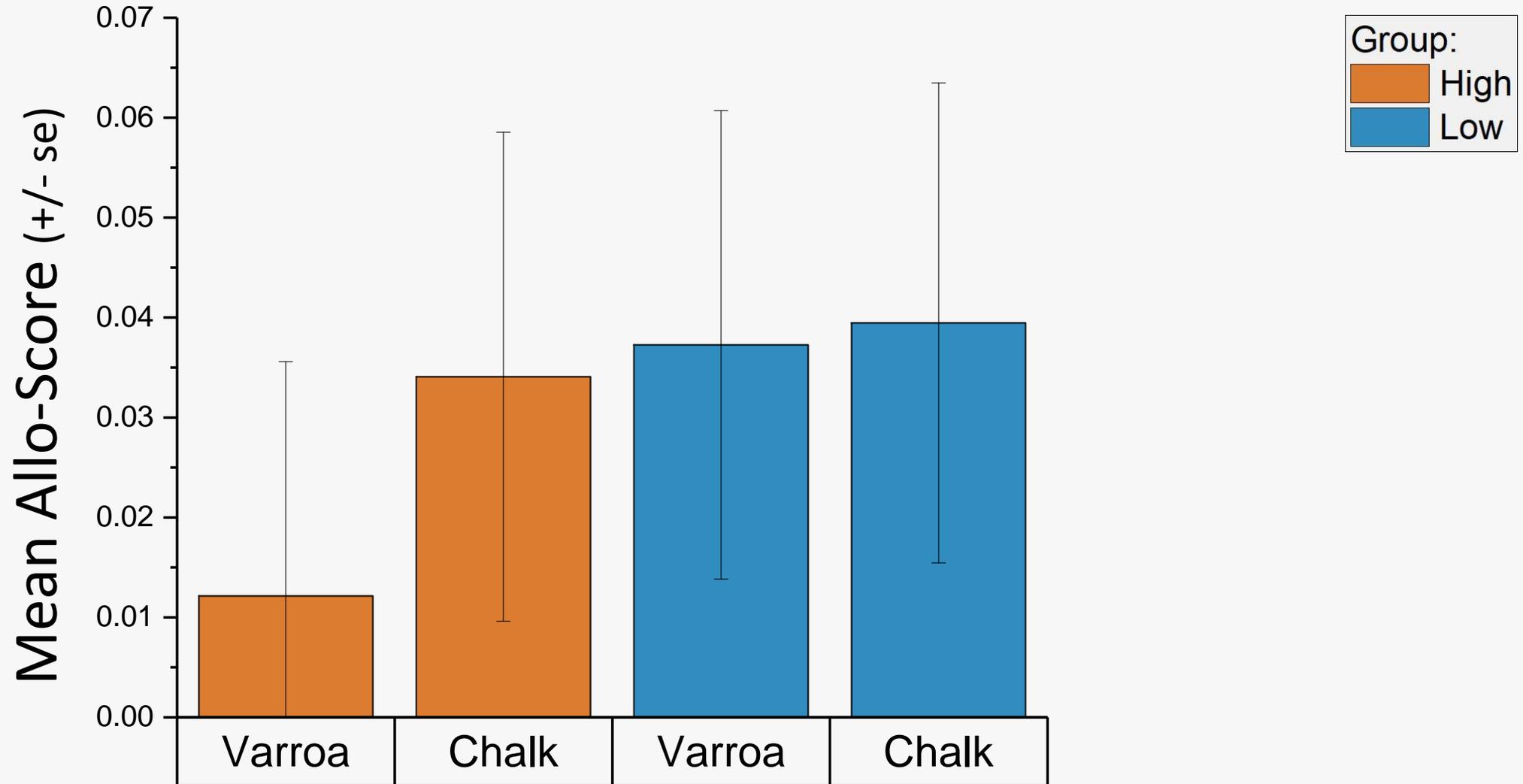
# Auto-Grooming



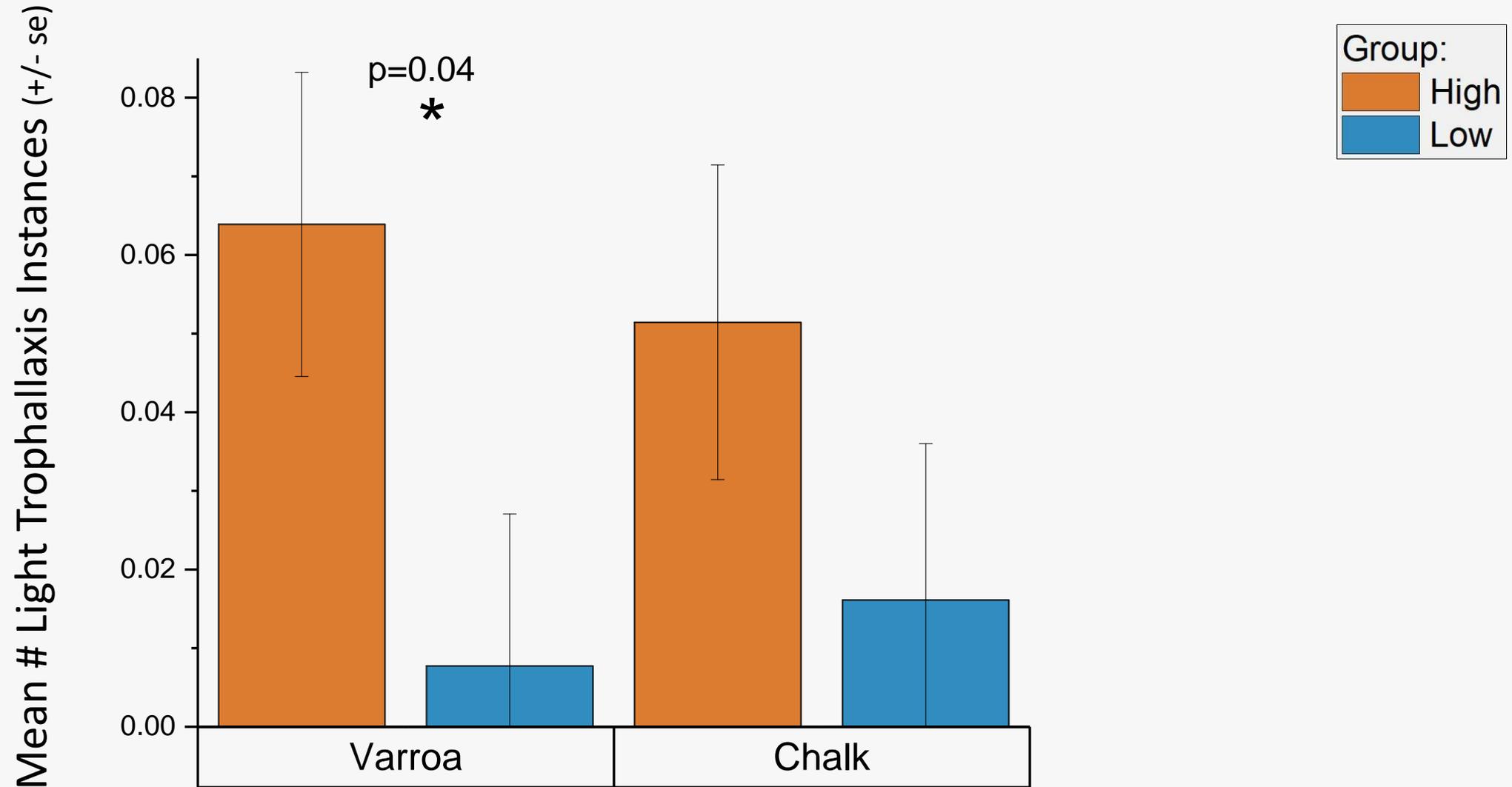
# Dancing



# Allo-Grooming

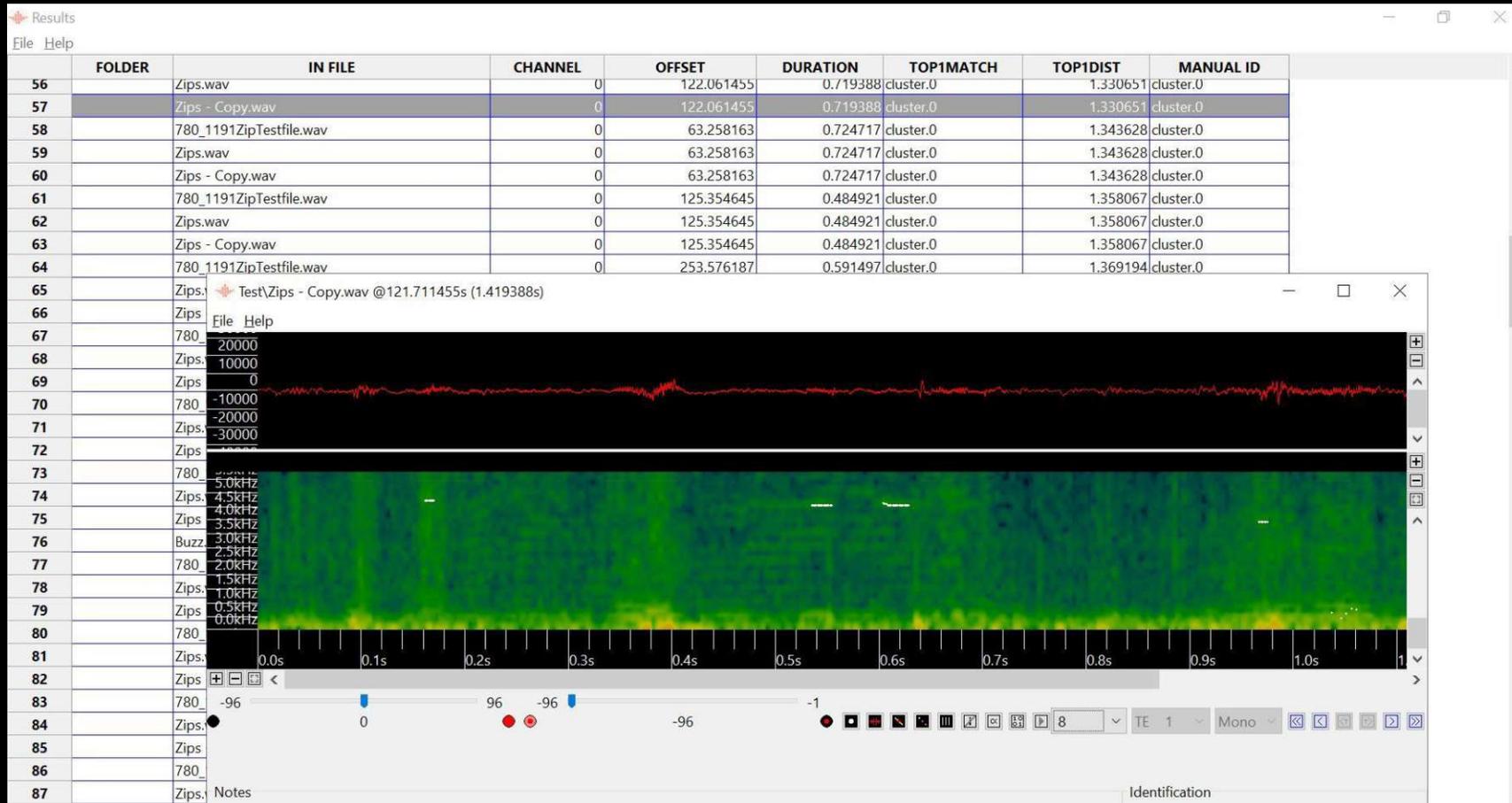


# Trophallaxis



# Sound Analysis (In progress)

Kaleidoscope Pro





## Sound Analysis

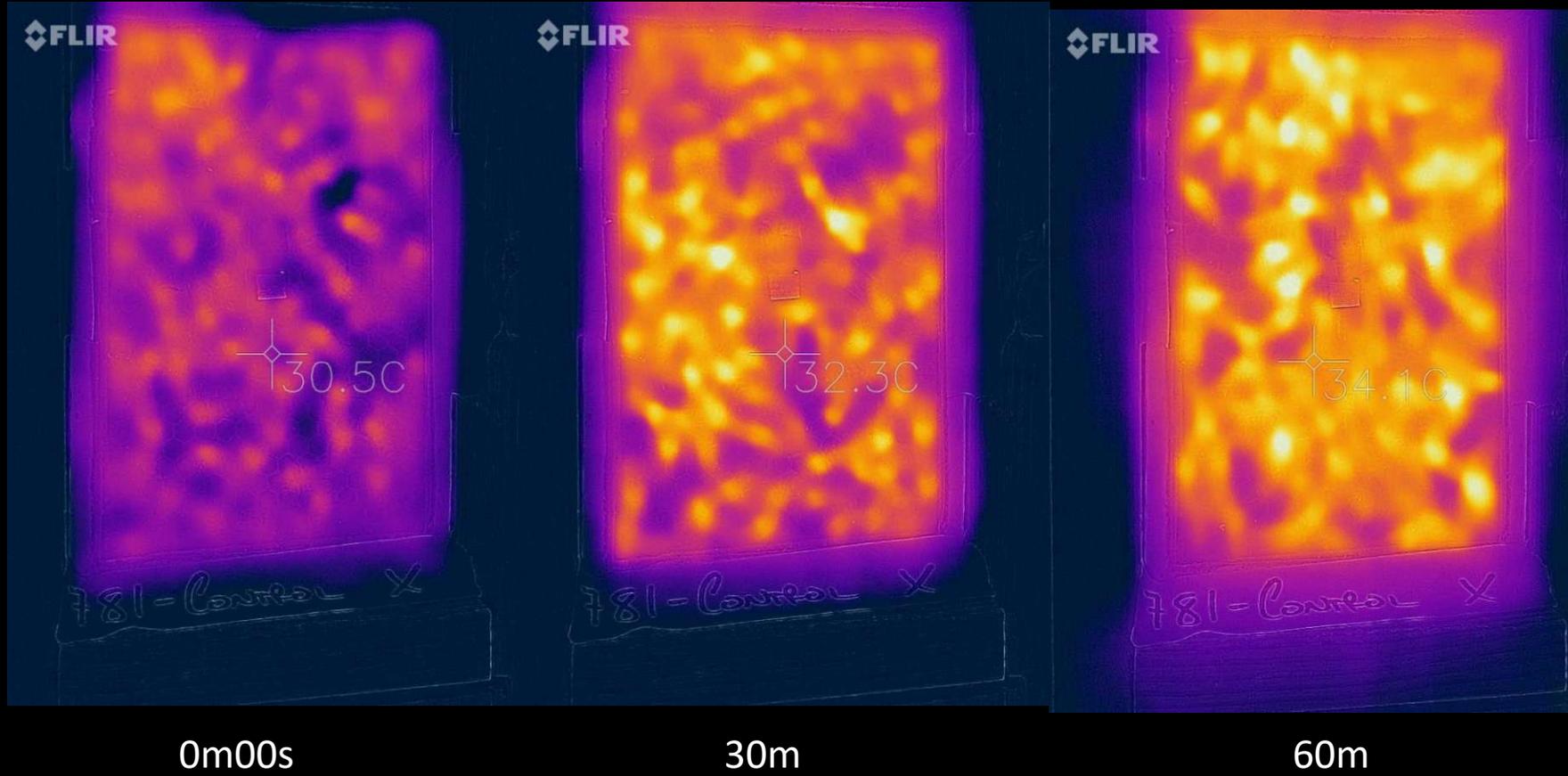
- Worker piping (Thom, C .et al., 2002; Nieh. J et al, 2000)



## Sound Analysis

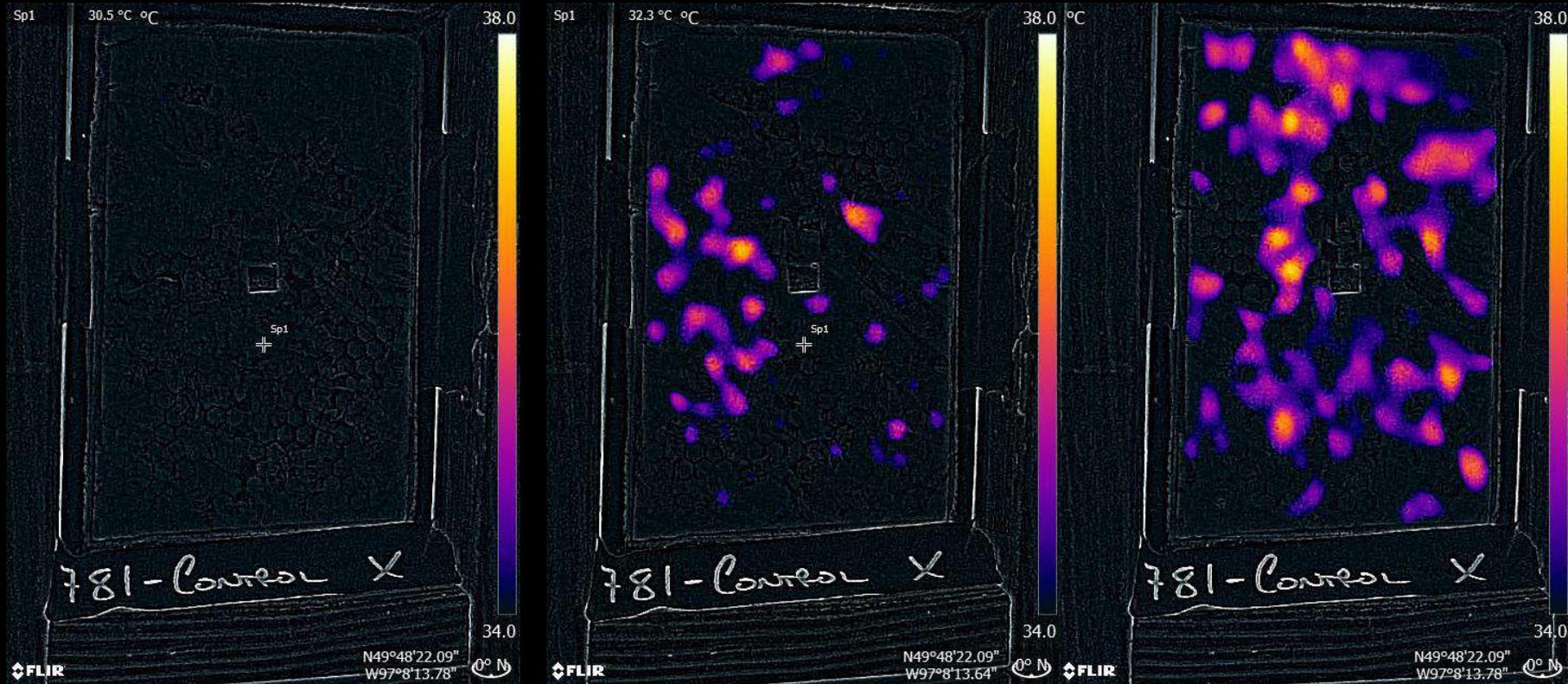
- Worker piping (Thom, C .et al., 2002; Nieh. J et al, 2000)
- Mass Cage Response

# Heat Responses



# Heat Responses

FLIR Tools+



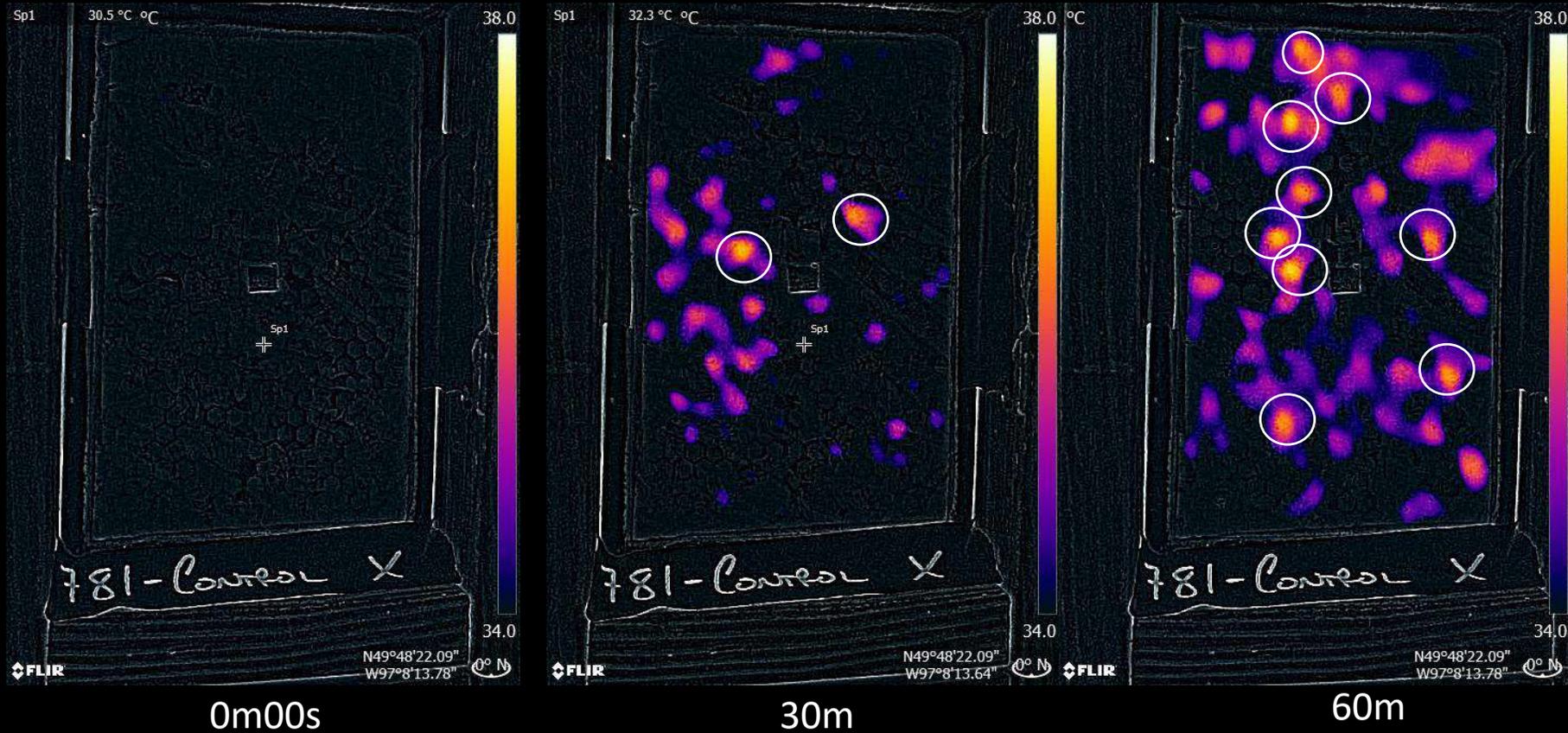
0m00s

30m

60m

# Heat Responses

Analysis using *Image-J* software



# Summary

## Experiment #1

- High-grooming bees:
  - Heightened intense grooming responses to both Varroa & Chalk dust
  - Enhanced sensitivity in the Head and Thorax
- Chalk Dust Bioassay for grooming?

## Experiment #2

- More Auto-grooming with either stimulus in High VS Low grooming bees
- Higher # Trophallaxis responses in High Grooming bees
- Dance responses higher with Varroa stimulus
  - High grooming bees may yet show significantly higher responses with more repetition
- Sound and heat analysis may yet show interesting results

# Summary



- Proteomic Correlations with Beeomics project?

# Acknowledgements

- Advisor: Dr. Rob Currie
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Beeomics



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