The Relation between Gist and Item Memory Over a Month

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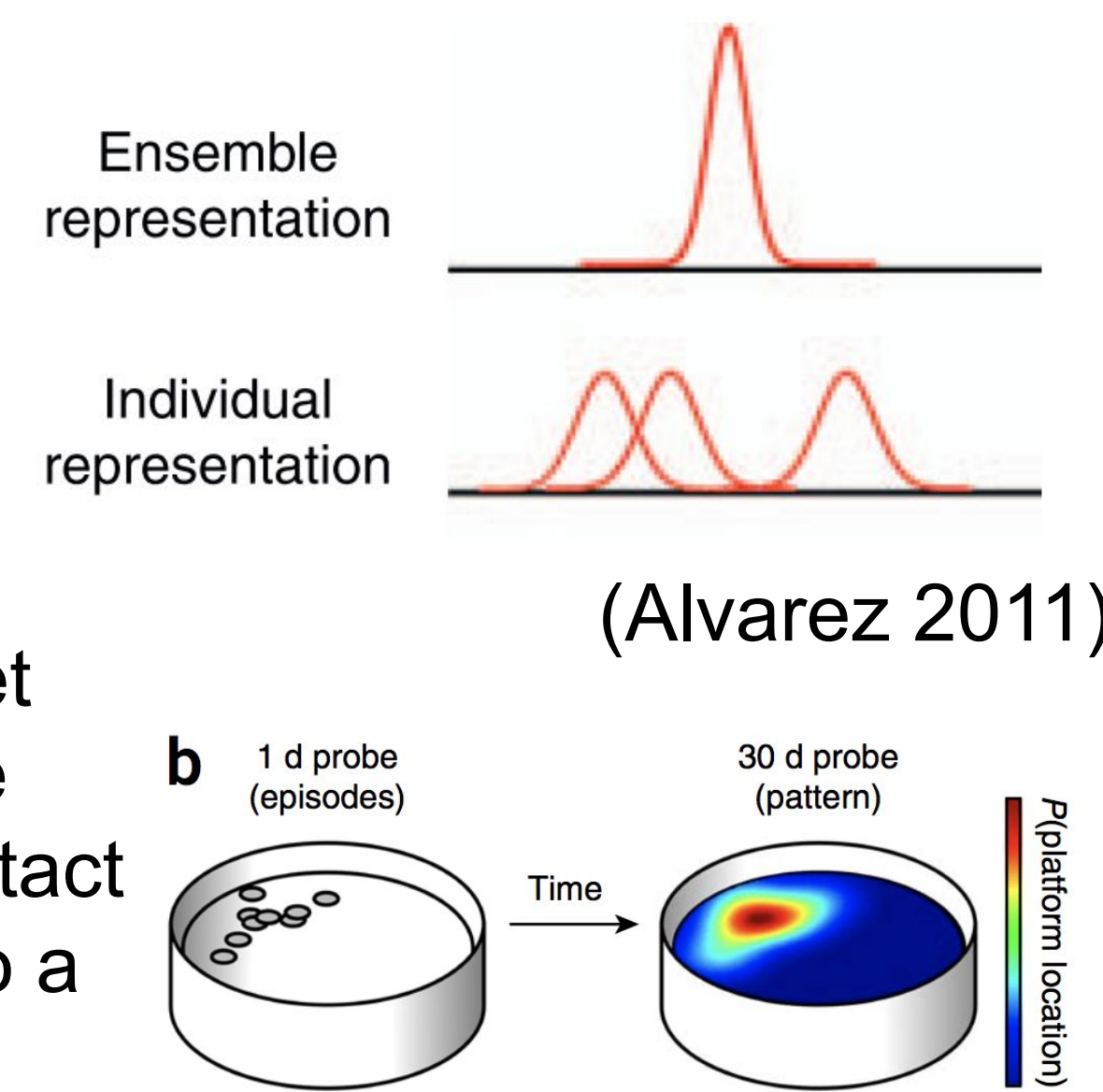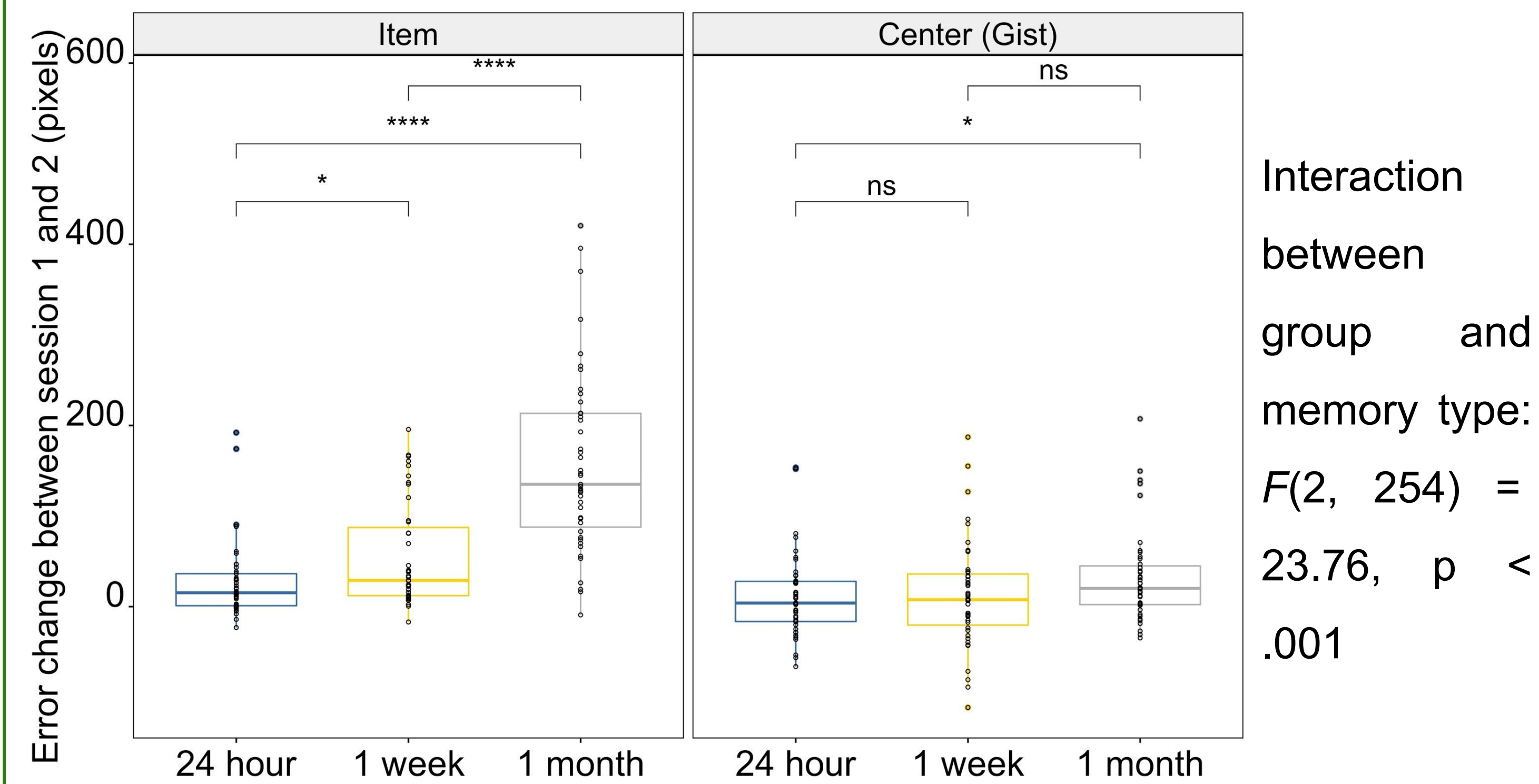University of Pennsylvania

Background

- How do learners extract memory for generalities (gist memory) across individual instances?
- Gist memory preserves/improves over time whereas item memory decays in longer retention (Posner & Keele 1970; Richards et al., 2014). This could be because imprecise item memory can still support a relatively intact gist representation, or the gist develops into a stable form independent of item memory.
- Examining the relation between these two forms of memory in longer retention will be helpful in disentangling these two possibilities.
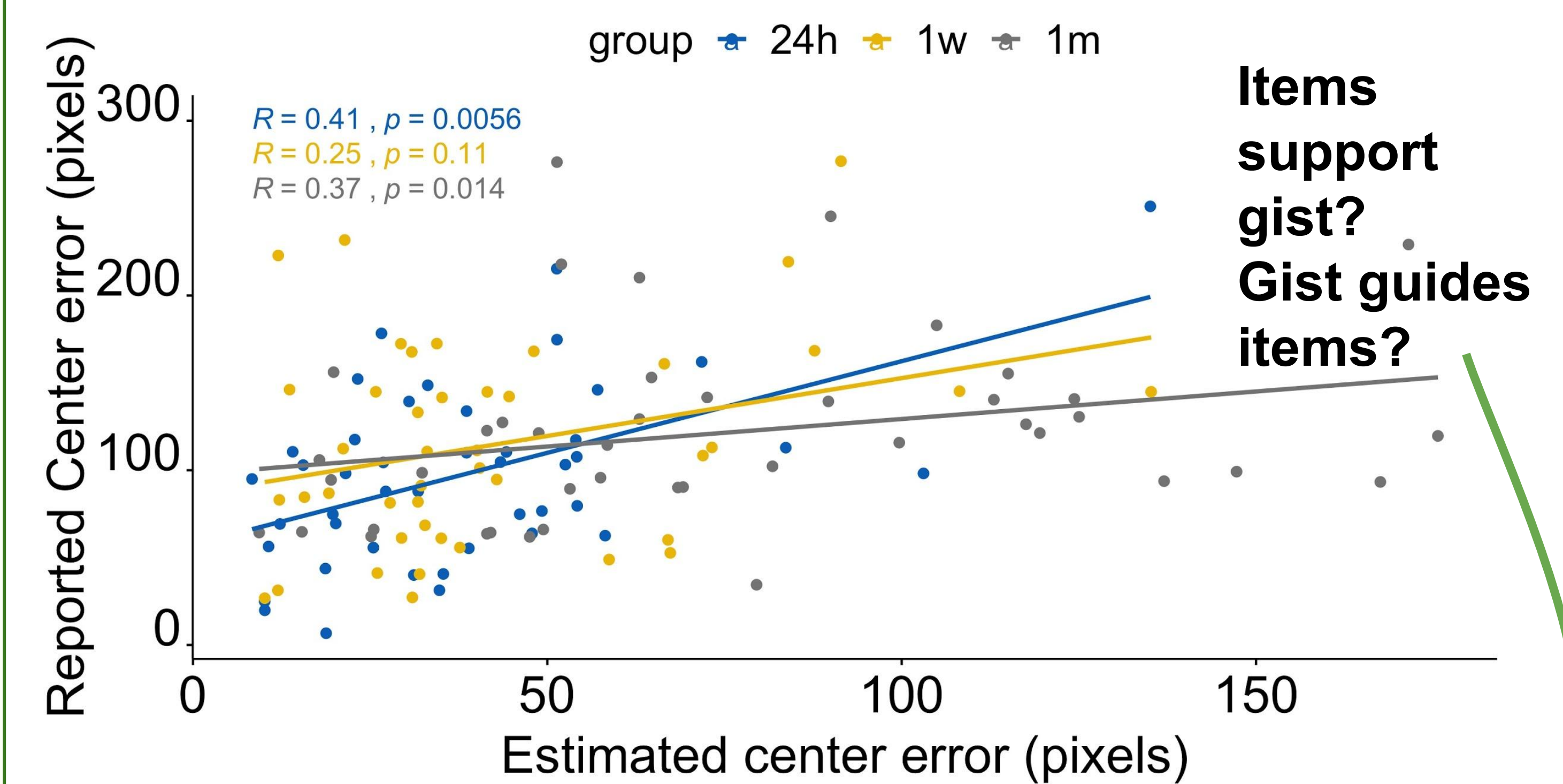
Two experiments track the development of item, gist memory, and their relation over a month of retention.

Ensemble representation
Individual representation
(Alvarez 2011)

b 1 d probe (episodes) → 30 d probe (pattern)
Time
P(platform location)

Item Memory: (X, Y) coordinates associated with landmark names

Gist memory: Reported center of the landmarks (**Unseen**)

Restaurant   Hospital
Museum   Center   Coffee Shop
University   Bus Station

Experiment I
Session 1: Participants learned 6 landmark locations individually on a screen. Gist memory test: estimate the center of these landmarks. Item memory test: recall the landmark locations individually.
Session 2:
After 24 hours (*n* = 44) /1 week (*n* = 43)/1 month (*n* = 43), participants came back to have gist and item memory tests again.

Error analysis

- Encoded Item
- Retrieved Item
- Item Error
- True Center from encoded items
- Reported Center
- Estimated Center from retrieved items
- Center Error
- Estimated Center Error

reflects the amount of gist information available in item memories

I.1 Gist memory decreased less than item memory over time

Error change between session 1 and 2 (pixels)

Item | Center (Gist)
24 hour | 1 week | 1 month
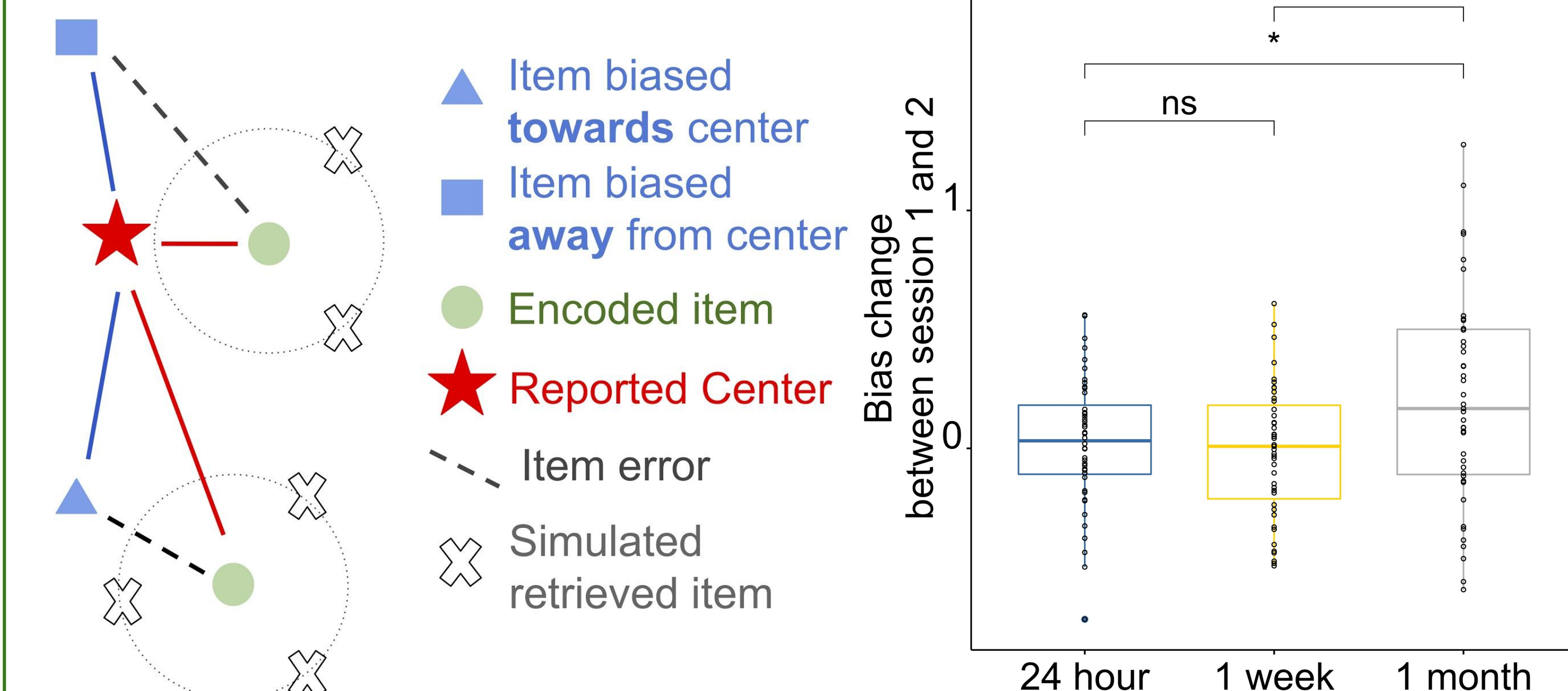
Interaction between group and memory type: $F(2, 254) = 23.76$, $p < .001$

I.2 Positive correlation between error in estimated gist from items and error in gist memory at 24 hours and 1 month

group: 24h | 1w | 1m

$R = 0.41$, $p = 0.0056$
$R = 0.25$, $p = 0.11$
$R = 0.37$, $p = 0.014$

Reported Center error (pixels)
Estimated center error (pixels)

Items support gist? Gist guides items?

a significantly positive relationship between reported center error and estimated center error for all participants ($rs(124) = .37$, $p < .0001$)

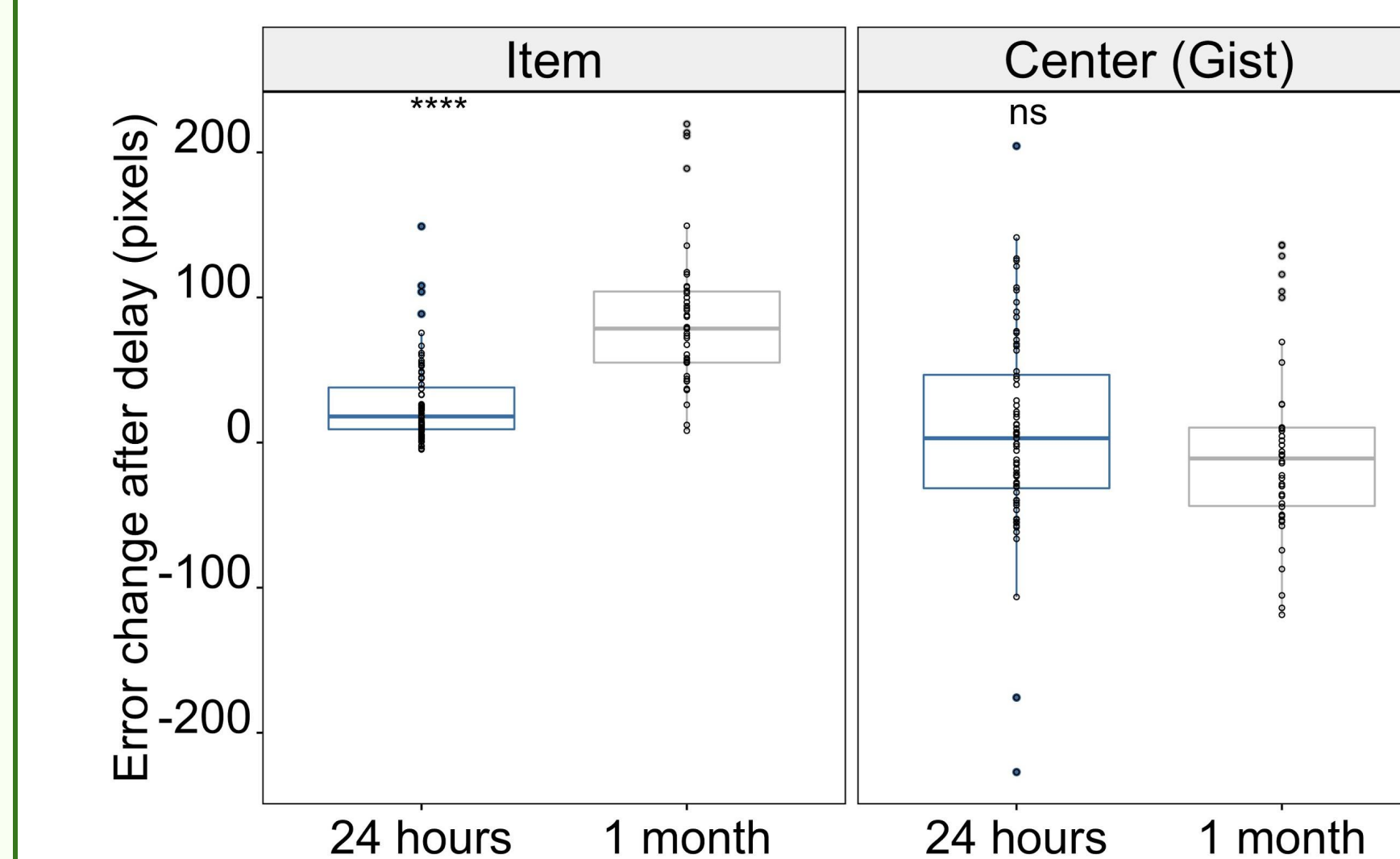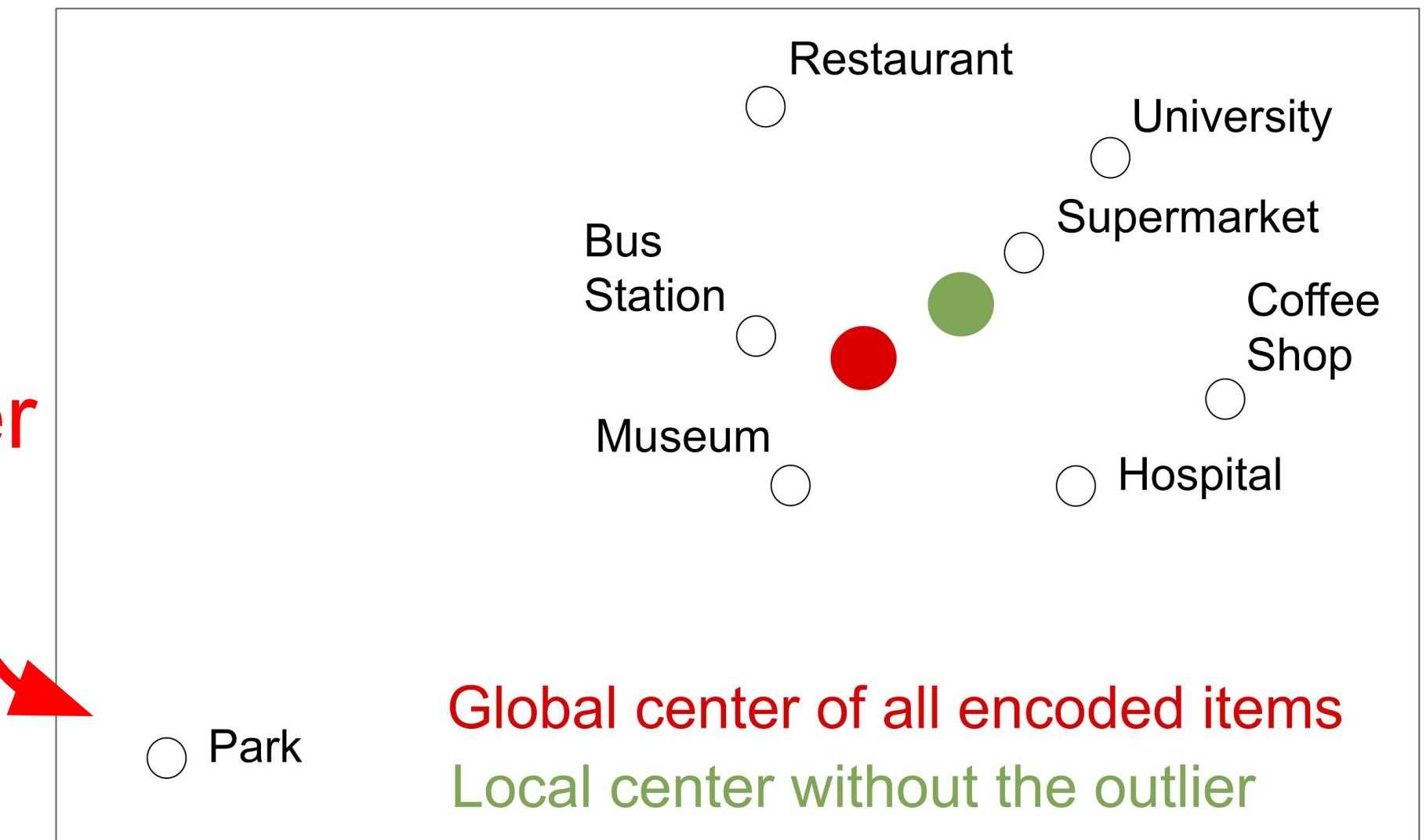## I.3 Item memories were increasingly biased towards the reported center after one month

- Item biased **towards** center
- Item biased **away** from center
- Encoded item
- Reported Center
- Item error
- Simulated retrieved item

Bias change between session 1 and 2
24 hour | 1 week | 1 month

Only the bias value at one month was significantly higher than 0, $t(42) = 3.80$, $p < .001$.

Experiment II
Within-subjects design: After 24 hours and 1 month, 42 participants came back to have gist and item memory tests again.

Restaurant
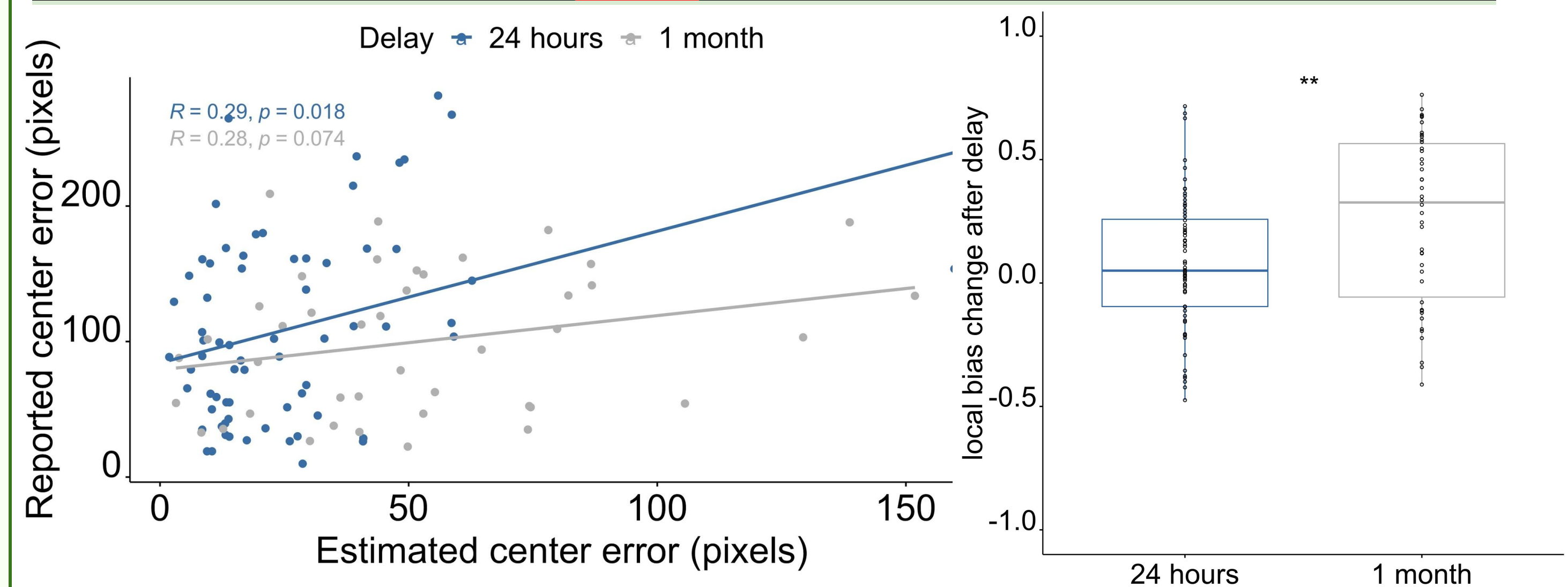University
Bus Station   Supermarket
Coffee Shop
Museum   Hospital
Park

Outlier

Global center of all encoded items
Local center without the outlier

II.1 Gist memory decreased less than item memory over time

Error change after delay (pixels)
Item | Center (Gist)
24 hours | 1 month

Interaction between group and memory type: F(1, 216) = 31.17, p < .001

I.2 Positive correlation between estimated gist error and gist memory error at 24 hours
I.3 Item memories without the outliers were increasingly biased towards their **local** cluster center after one month

Delay: 24 hours | 1 month
$R = 0.29$, $p = 0.018$
$R = 0.28$, $p = 0.074$

Reported center error (pixels)
Estimated center error (pixels)

local bias change after delay
24 hours | 1 month

Conclusions

- We replicated previous reports of slower decay of gist memory compared to item memory in between subjects (Exp. 1) and a within subjects (Exp. 2) designs.
- A positive relation between item and gist memory persisted across time; however, the *source* of the relation changed such that after long delays, item retrieval is biased in the direction of remembered gist.
- The finding that item retrieval is biased towards the center of the spatial distribution excluding an outlier item indicates that the summary statistic is not simply an average of the items.
- Our results connect theories in visual working memory and long-term memory by characterizing the quantitative change of strength of item and gist memories as well as their relationship over time with consolidation.

References and Acknowledgement
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