Reducing the low-prevalence effect: Does similarity search translate to binary decisions?

Greer Gillies[1], Benjamin Wolfe[1,2], & Anna Kosovicheva[1,2]
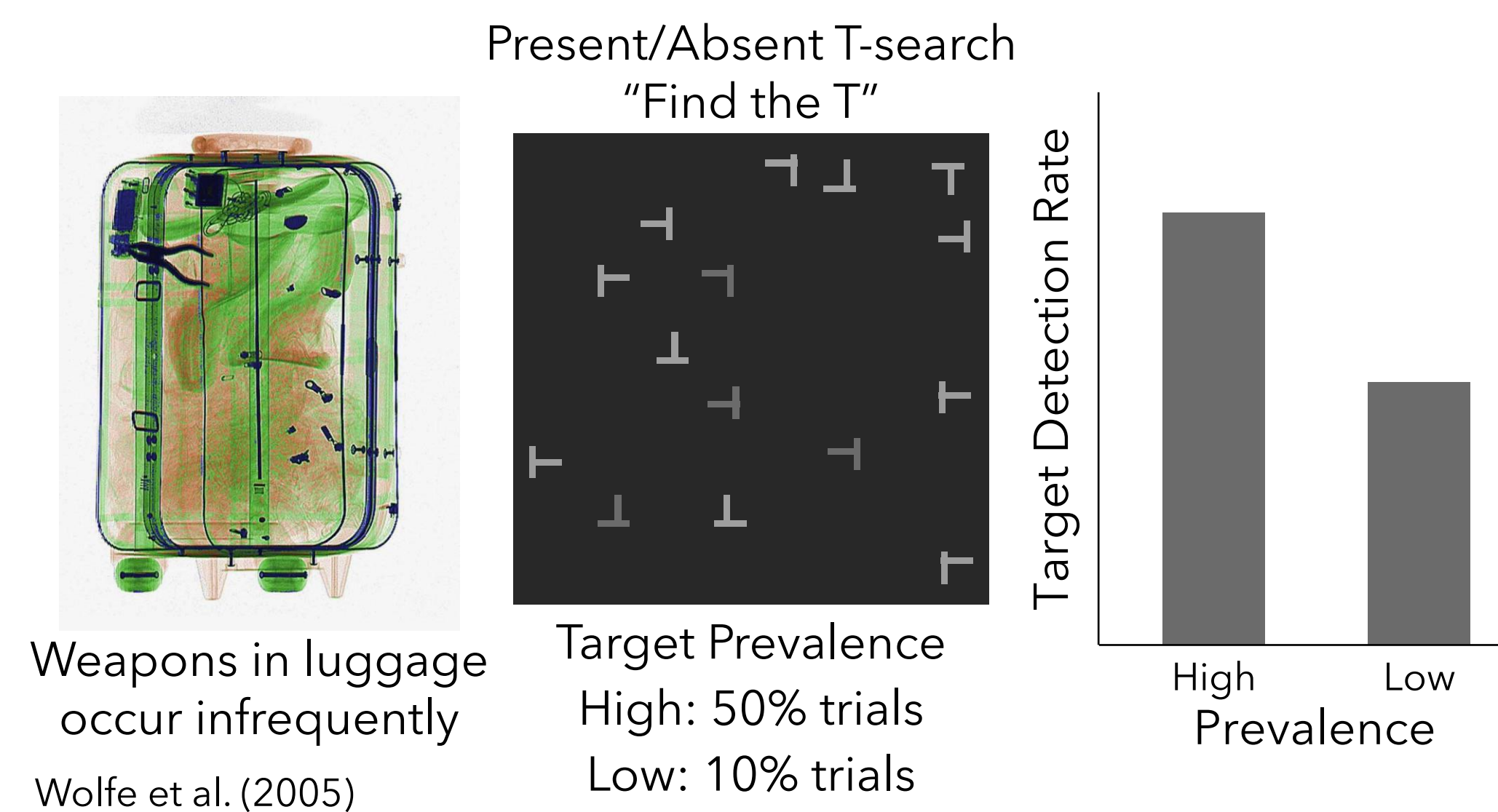Department of Psychology
[1]University of Toronto; [2]University of Toronto, Mississauga

UNIVERSITY OF TORONTO

APPLY LAB

The Low Prevalence Effect (LPE)

Rare targets are frequently missed

Present/Absent T-search
"Find the T"

Weapons in luggage occur infrequently
Wolfe et al. (2005)

Target Prevalence
High: 50% trials
Low: 10% trials

Target Detection Rate — High / Low Prevalence

If you don't find it often, you often don't find it

The LPE is highly resistant to interventions

Similarity search: a possible way to eliminate the LPE?

Similarity Search
"Find the most T-like shape"

"T-ness"
True-T
Near-T's
Non-T

True-T Prevalence
High: 50% trials
Low: 10% trials

True-T Detection Rate — High / Low Prevalence

Taylor et al., 2022
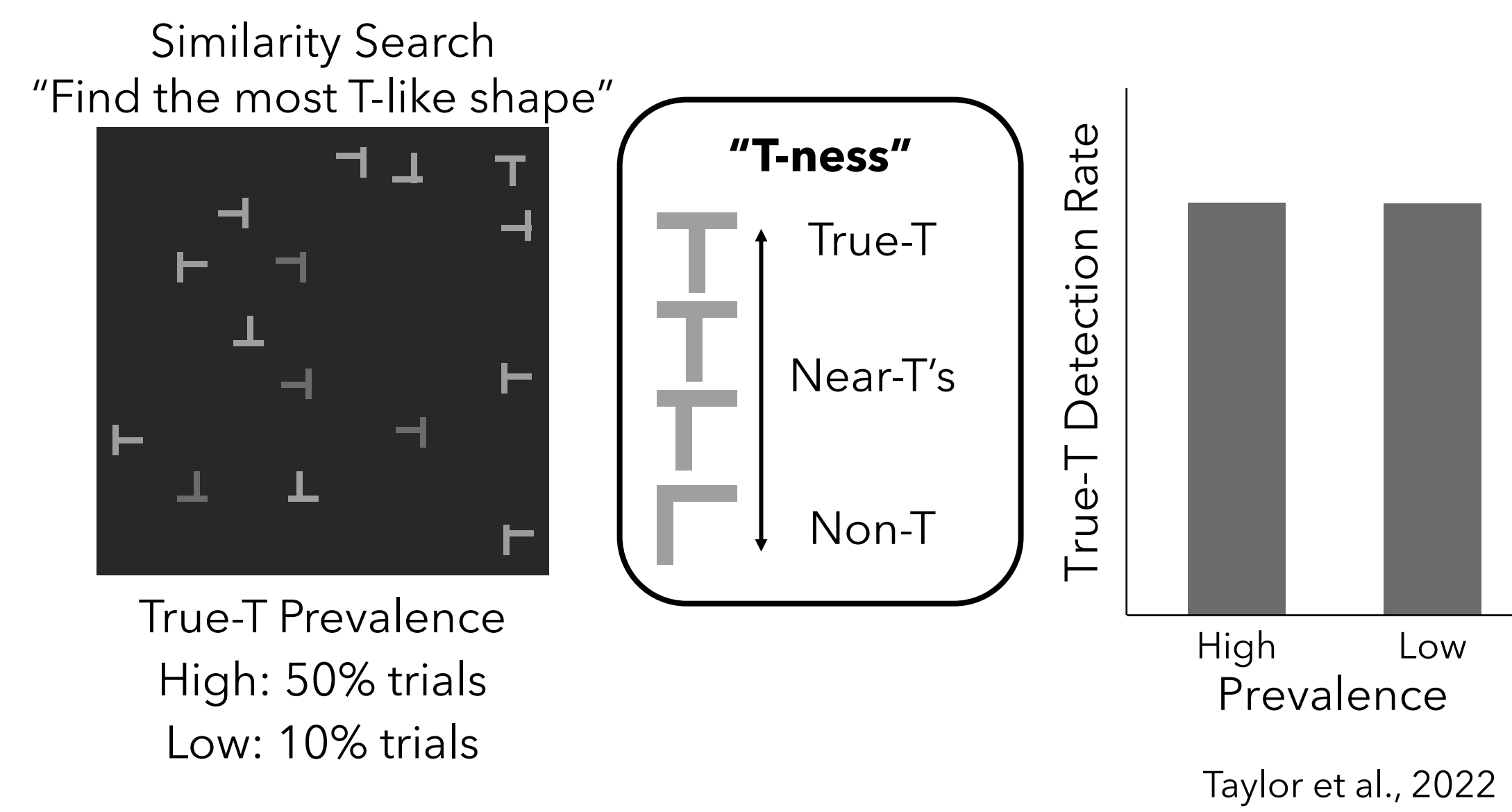
Does similarity search translate to decisions you need to make about the selected target?
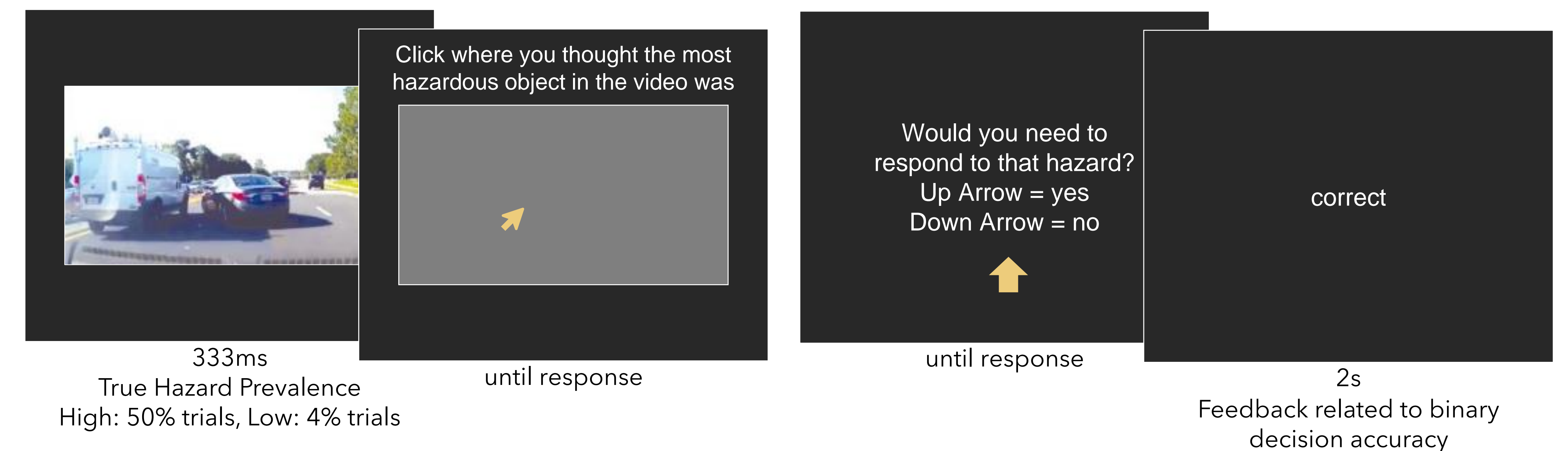
Does similarity search translate to binary decisions?

Experiment 1

Similarity Search Display
"Find the most T-like shape"

until response

True-T Prevalence
High: 50% trials, Low: 10% trials

Similarity Search Only

2s
Feedback related to search accuracy
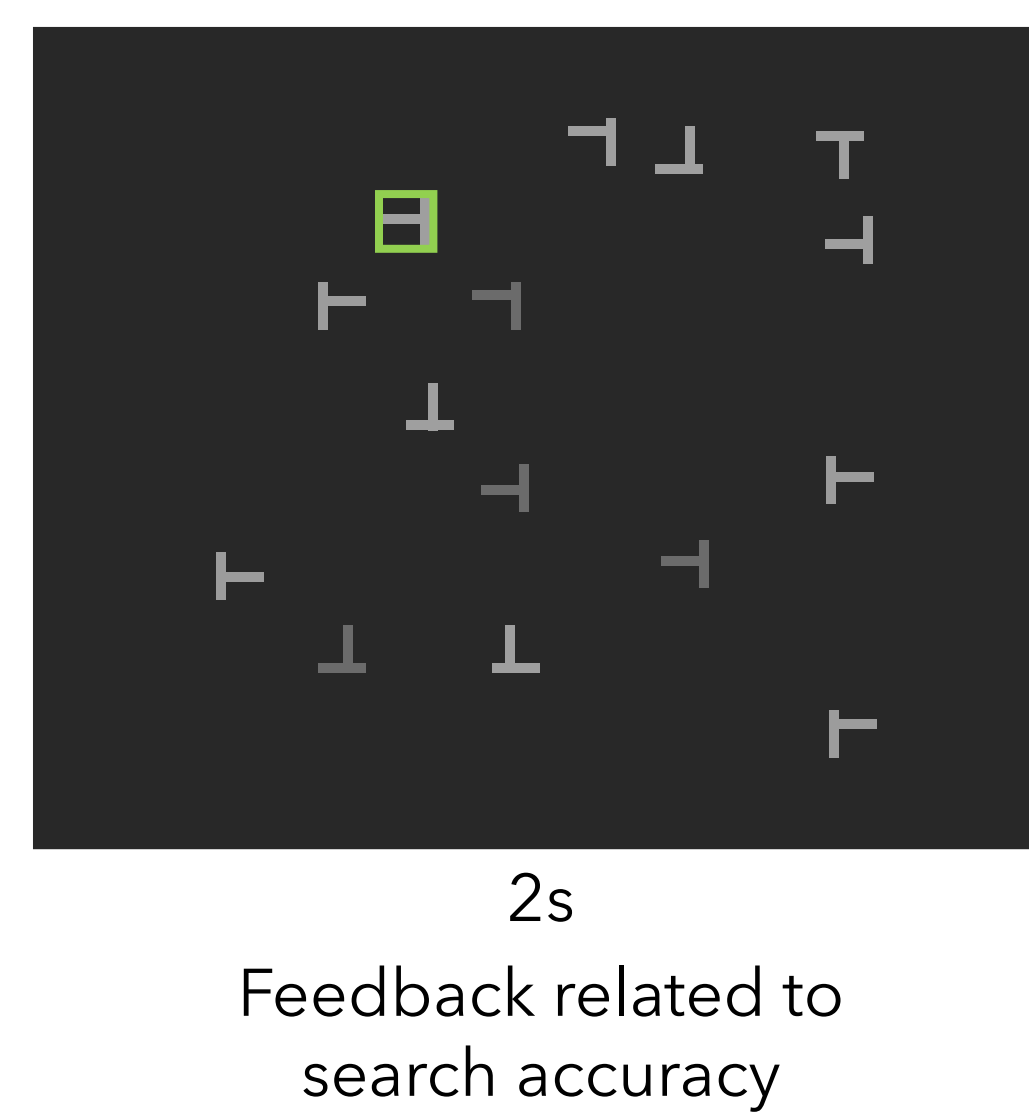
Similarity Search + Binary Decision

Was that image a "true-T"?

Up Arrow Key = yes
Down Arrow Key = no

until response

correct

2s
Feedback related to binary decision accuracy
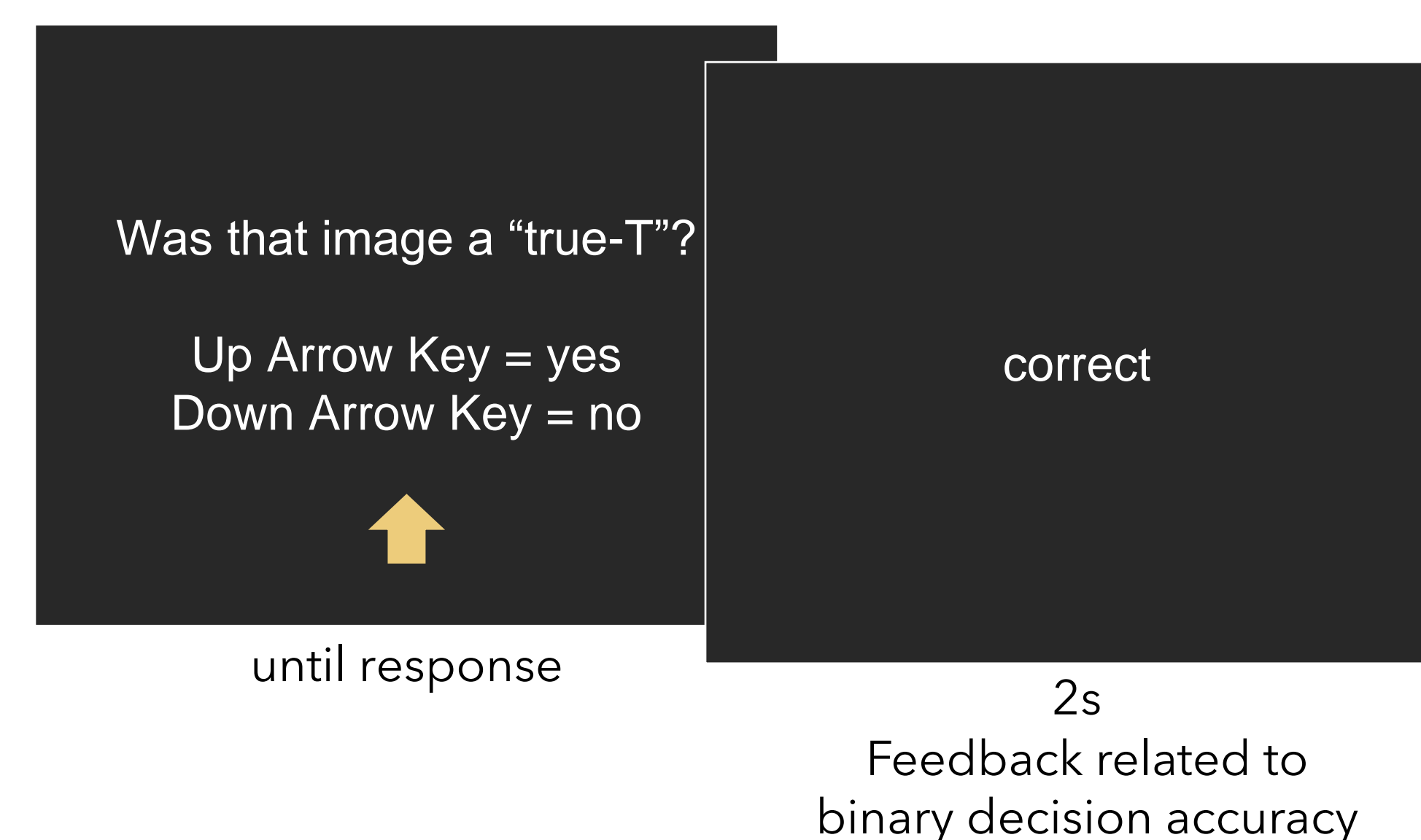
Experiment 1 Results

Similarity Search Performance

True-T Hit Rate

- sim search only
- sim search + binary decision

N = 34

Prevalence — high / low
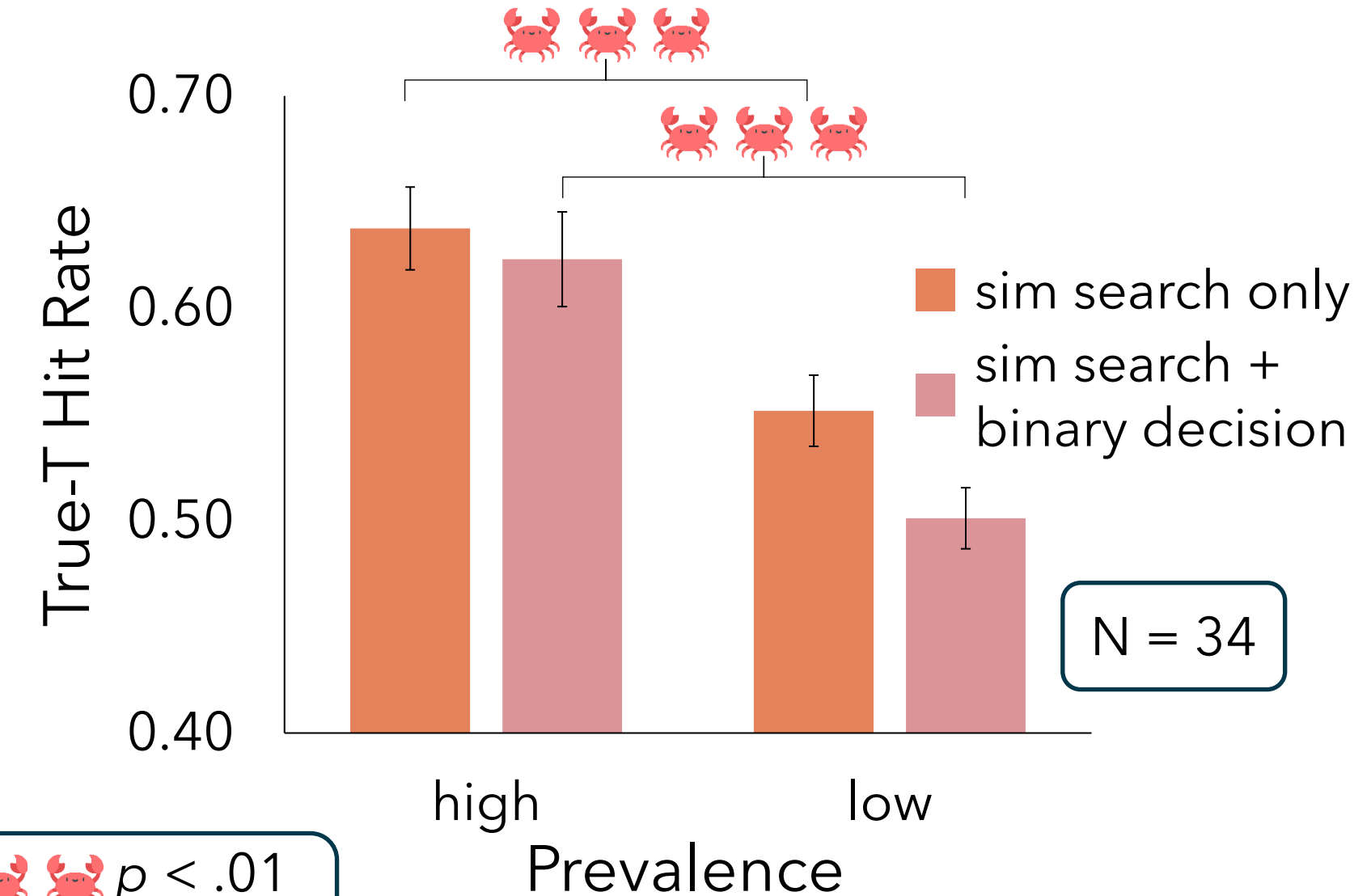
$p < .01$
$p < .001$

LPE for both tasks

Binary Decision Task Performance

Hit Rate — high / low Prevalence

False Alarm Rate — high / low Prevalence
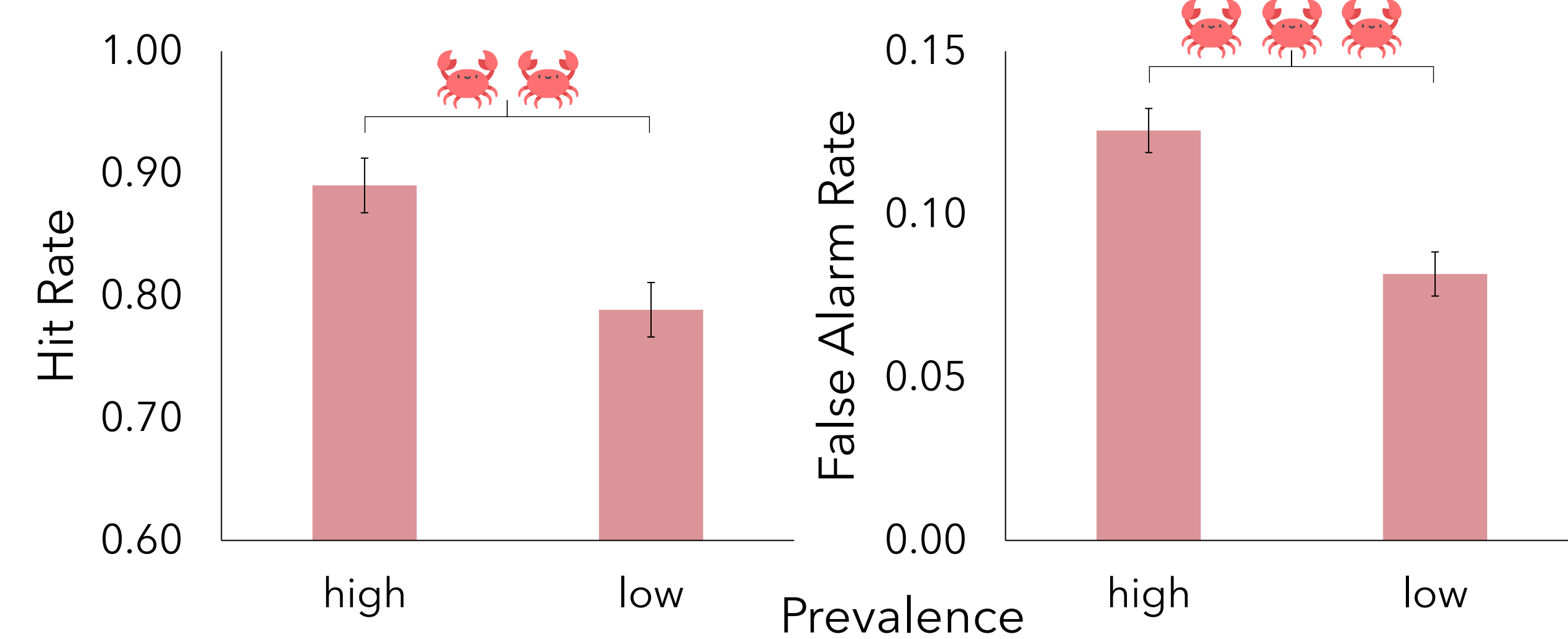
Less likely to classify a "true-T" as a T when successfully found during periods of low prevalence

The LPE for similarity search and binary decision tasks are not correlated, $r^2 = .02$ (ns)
Separate decision-making processes for similarity search and binary decision tasks?

Does similarity search translate to naturalistic scenarios?

Observers miss rare road hazards in natural videos, despite target complexity and variability
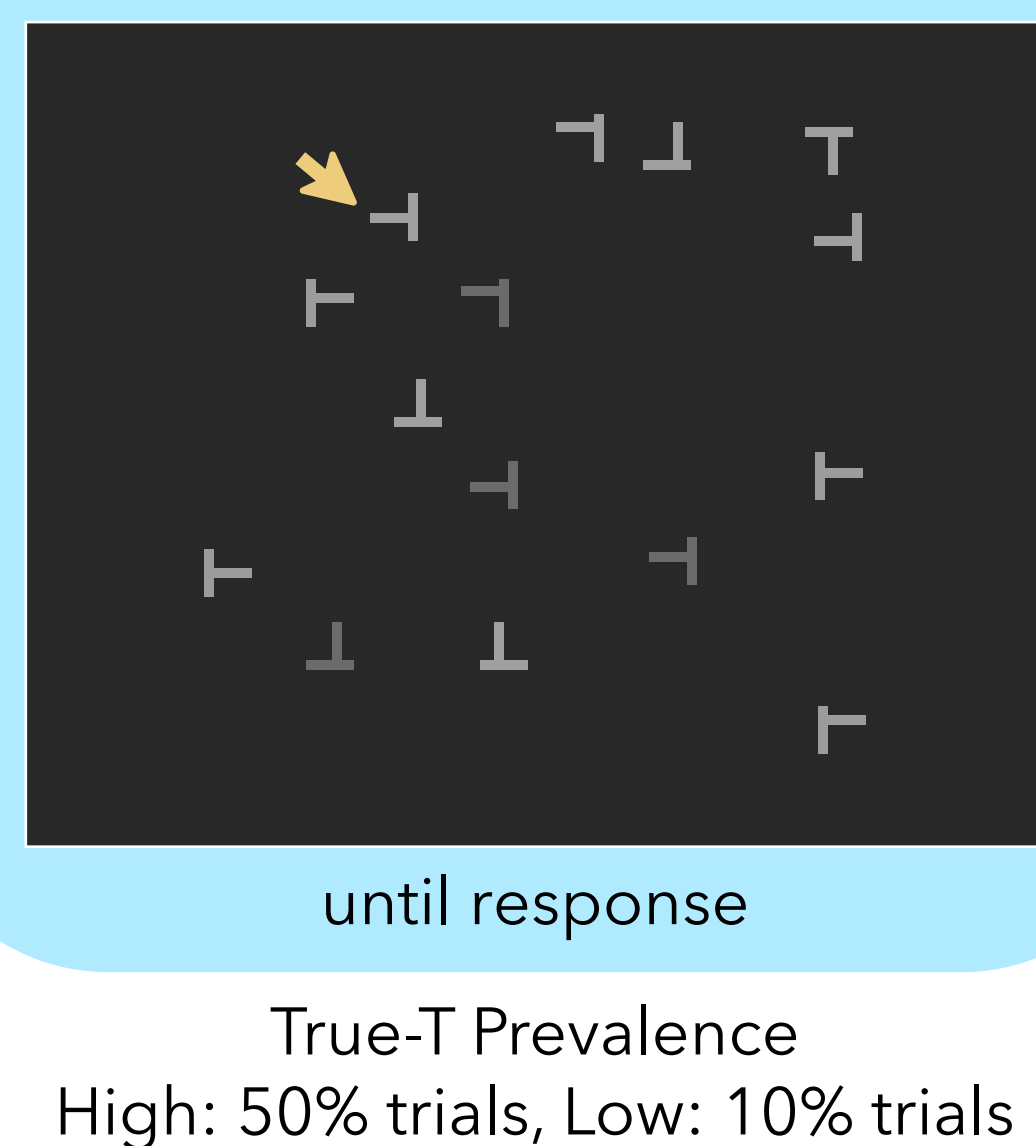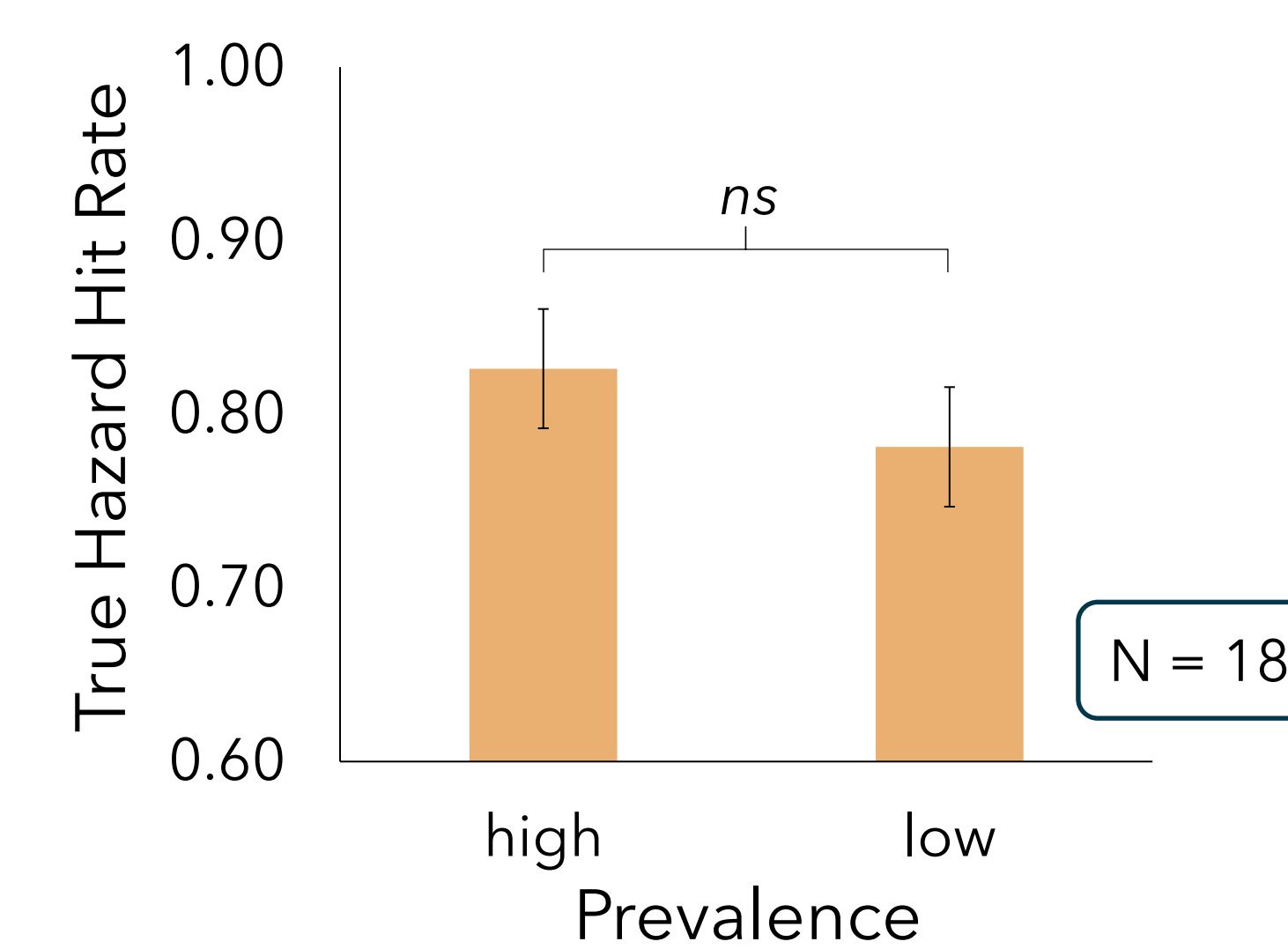
Hazard Present
Wolfe et al., 2020; Kosovicheva et al., 2023

Hazard Absent

Hazard Detection Rate — High / Low Prevalence

Experiment 2

Hazard Localization

Click where you thought the most hazardous object in the video was

333ms
True Hazard Prevalence
High: 50% trials, Low: 4% trials

until response

Binary Decision

Would you need to respond to that hazard?
Up Arrow = yes
Down Arrow = no

until response

correct

2s
Feedback related to binary decision accuracy

Experiment 2 Results

Hazard Localization Performance

True Hazard Hit Rate

ns

N = 18

Prevalence — high / low

Binary Decision Performance

Hit Rate — high / low

False Alarm Rate — high / low
Prevalence

No LPE: Participants were equally likely to click on the hazards on hazard-present trials
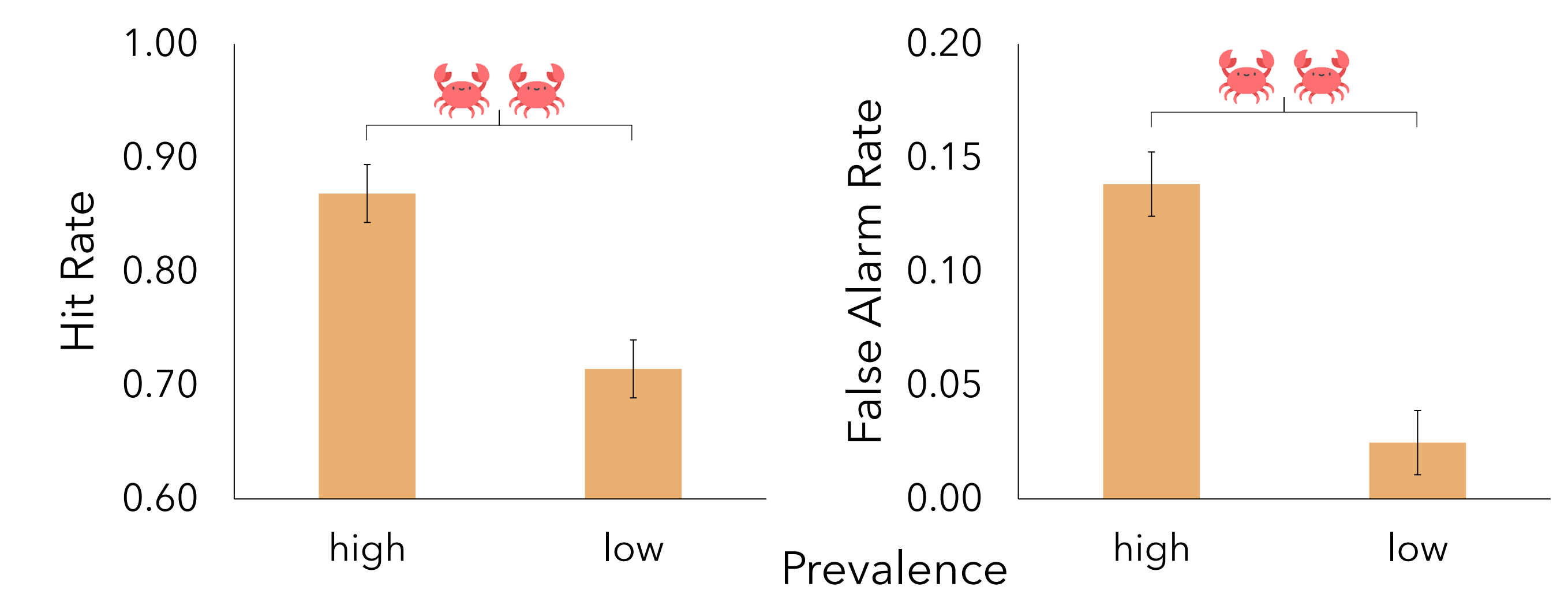
Hazards selected in the localization task were less likely to be judged as requiring a response under low prevalence

The difference in hit rate between the prevalence conditions on the hazard localization and binary decision tasks are not correlated, $r^2 = .05$ (ns)

Conclusions

- In some situations, similarity search can help observers locate targets during periods of low target prevalence
- However, this did not translate to the binary decision task
- Lack of correlation between search/localization + binary decisions suggests these may be two distinct decision-making processes

contact
greer.gillies@mail.utoronto.ca

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