

# Voluntary temporal attention improves perception even in the absence of temporal competition

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## Background

- Perception can be impaired when successive stimuli appear close together in time, demonstrating **temporal competition** for representational resources<sup>1-2</sup>
- **Voluntary temporal attention** can enhance the perception of a stimulus at a relevant moment in time at the expense of earlier and later stimuli<sup>3-5</sup>
- Determining whether these perceptual trade-offs require temporal competition would provide insight into the mechanisms of selection by voluntary temporal attention

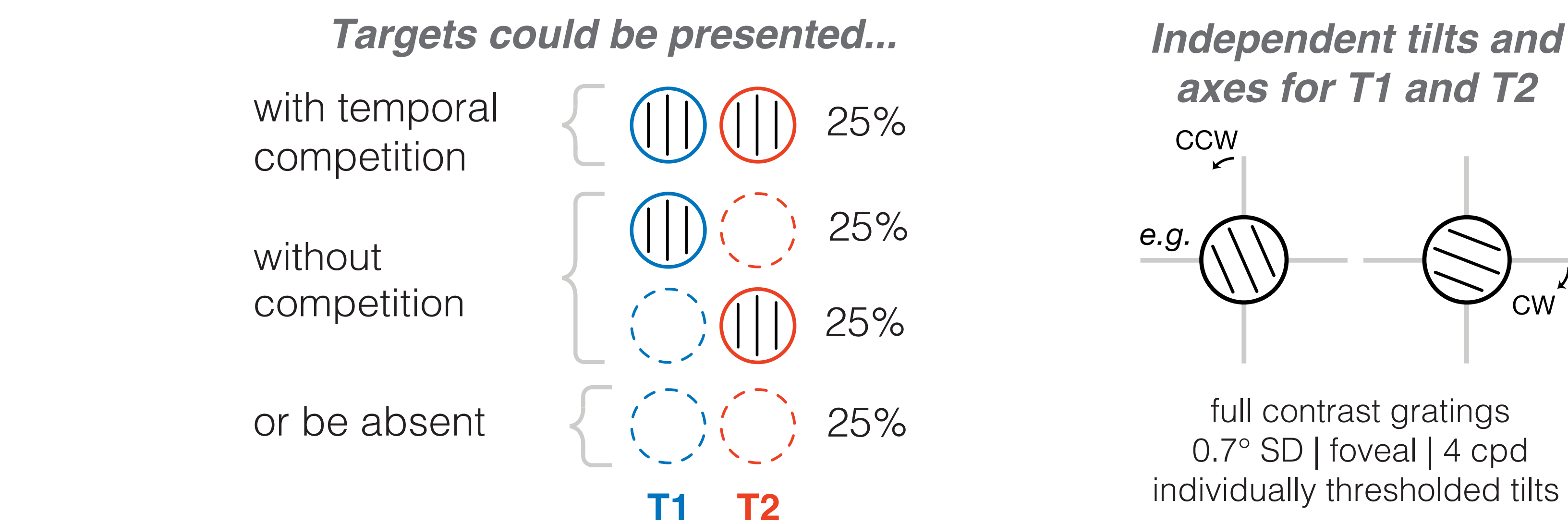
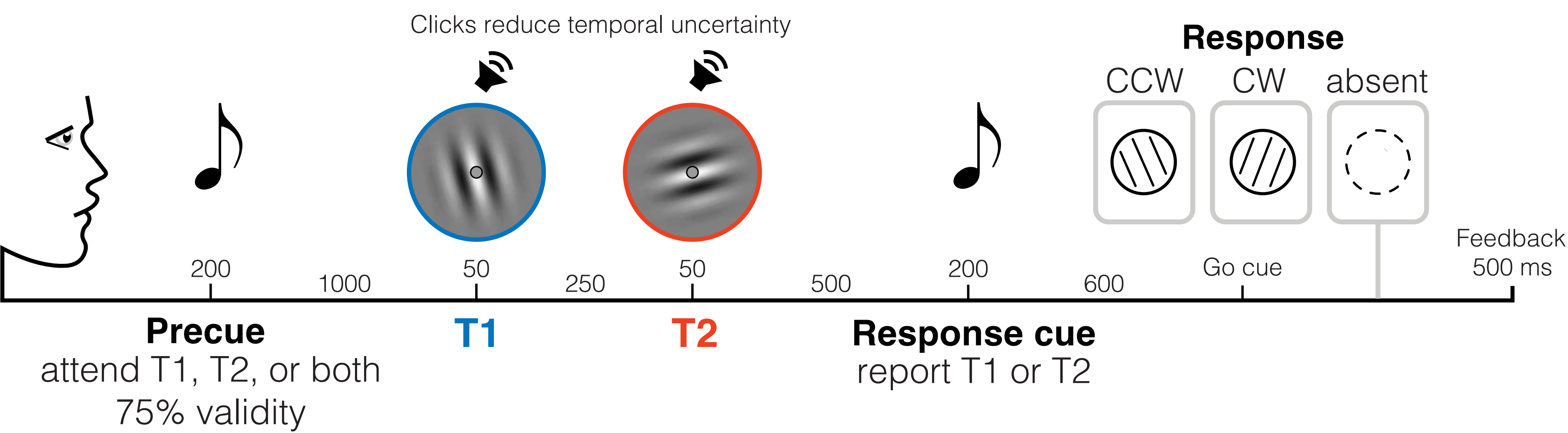
## Question

*Does voluntary temporal attention enhance performance even without temporal competition?*

## Temporal cueing task

*Independent manipulation of voluntary temporal attention and temporal competition*

n = 15 | 2-3 sessions | 1280 trials per observer  
online fixation monitoring



## References

1. Tkacz-Domb & Yeshurun (2021). Cognition, 206, 104506.
2. Sahar & Yeshurun (2024). J Exp Psychol Gen, 153(2), 339-351.
3. Denison, Carrasco & Heeger (2021). Nat Hum Beh, 5, 1674-1685.
4. Denison, Tian, Heeger & Carrasco (2024). Nat Comm, 15, 9061.
5. Zhu, Tian, Carrasco & Denison (2024). PNAS Nexus, 3(12).
6. Desimone (1998). Phil Trans R Soc Lond B, 353(1373):1245-55.

## Hypotheses

*If voluntary temporal attention...*

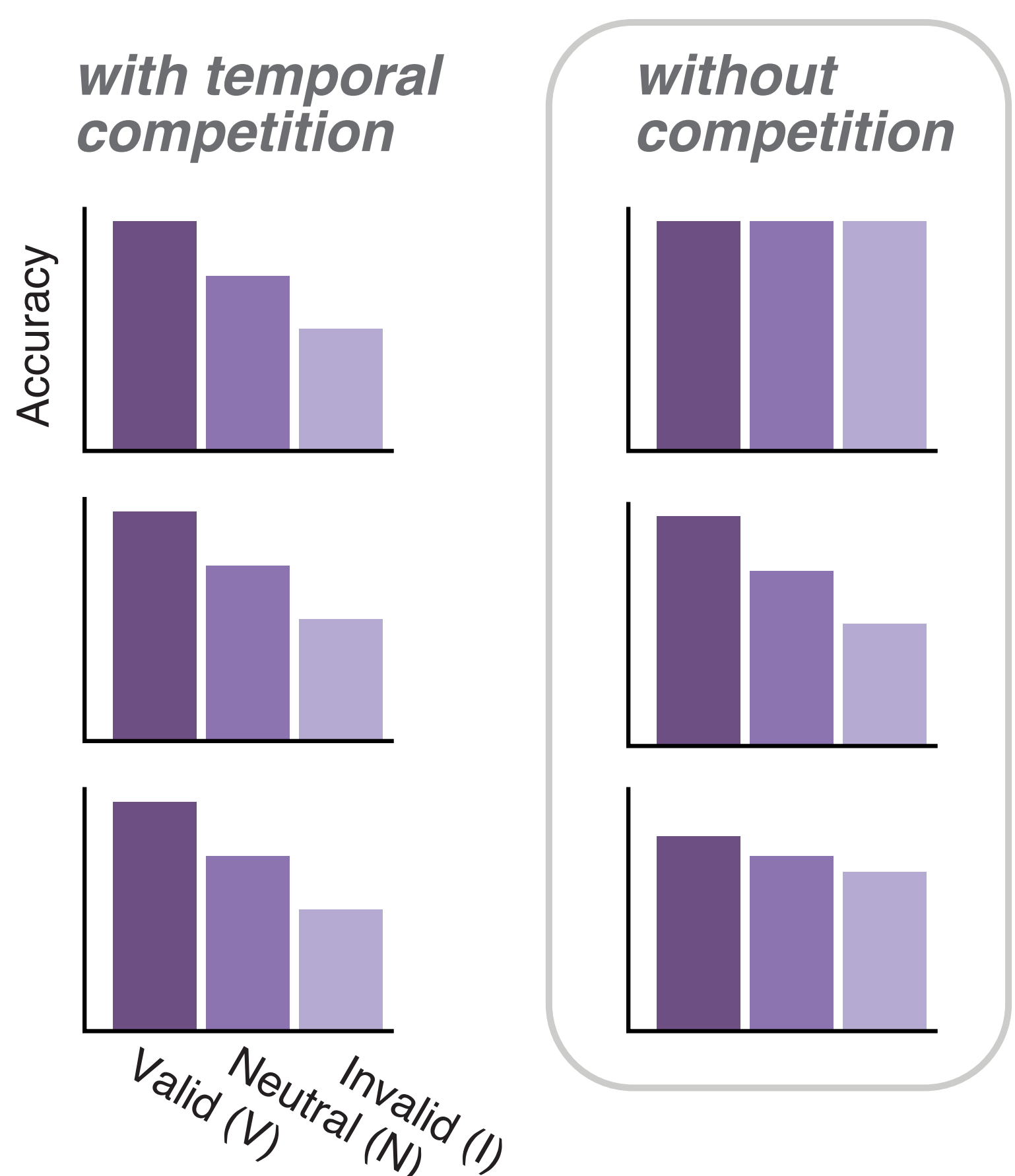
- ① selects among actively *competing* stimulus representations<sup>6</sup>
- ② biases stimulus representations *prior* to a competitive stage<sup>4,5</sup>
- ③ interacts with temporal competition<sup>3</sup>

*then attention should affect performance...*

only when there is temporal competition

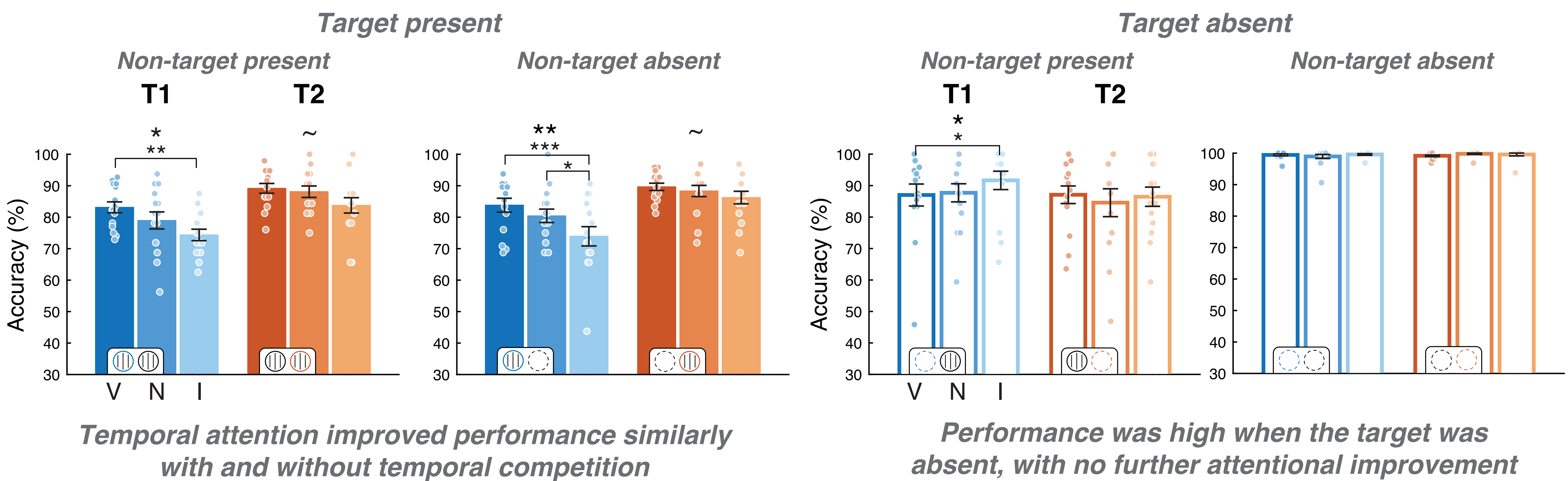
even without temporal competition

more with than without temporal competition



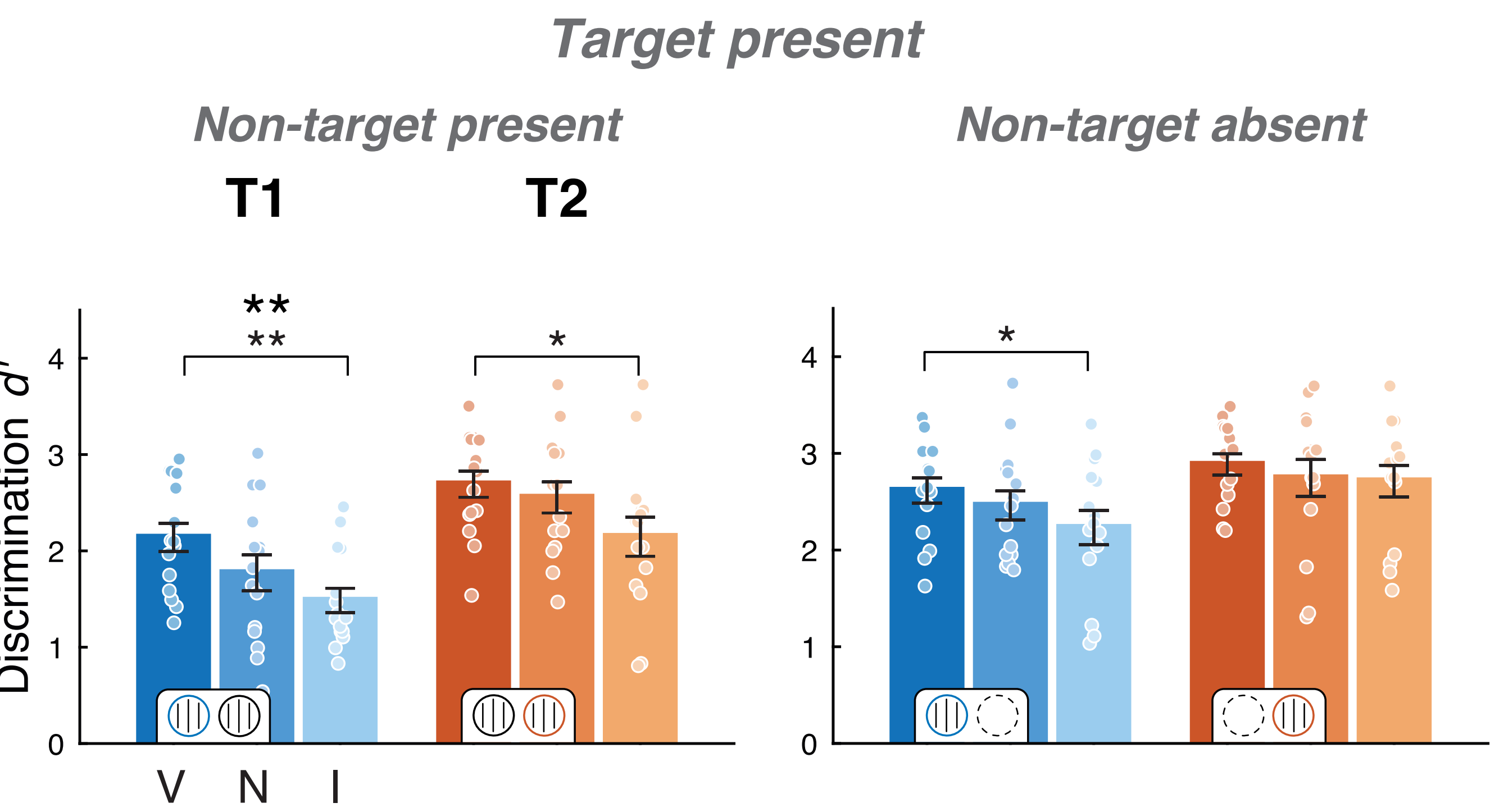
## Results

*Voluntary temporal attention enhanced performance even without temporal competition*

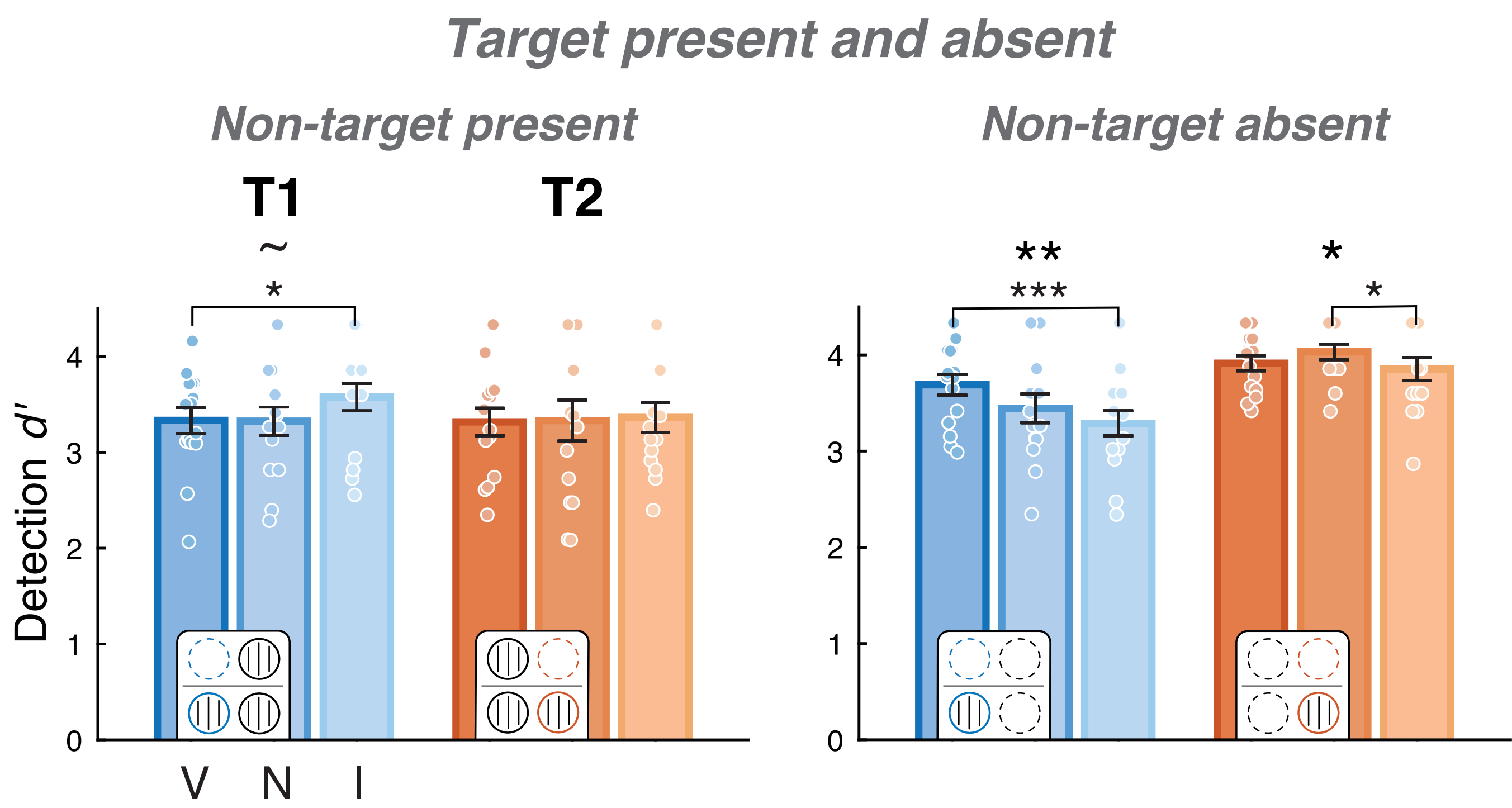


## Signal detection theory analysis

*Temporal attention enhanced T1 tilt discrimination sensitivity with and without temporal competition*

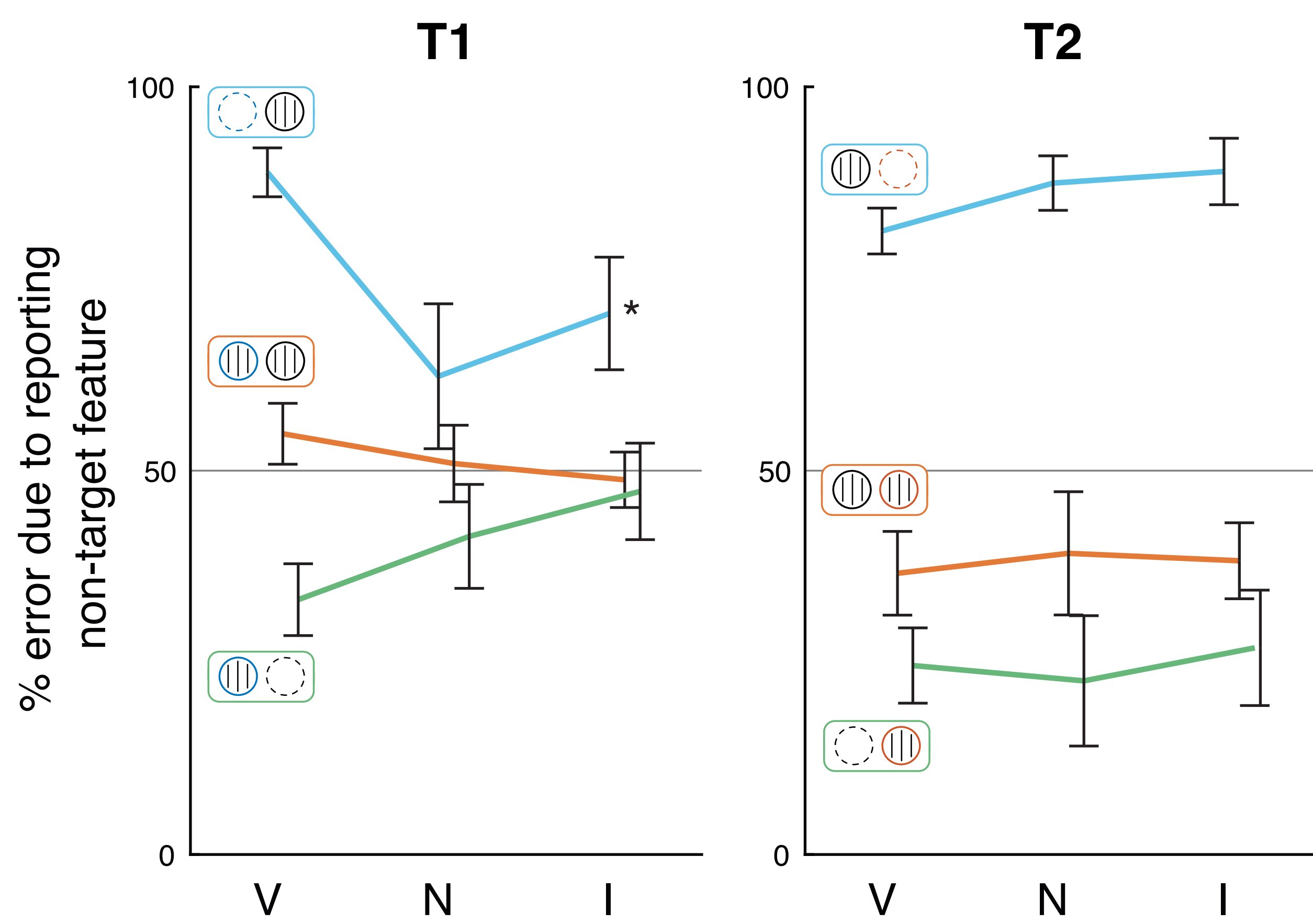
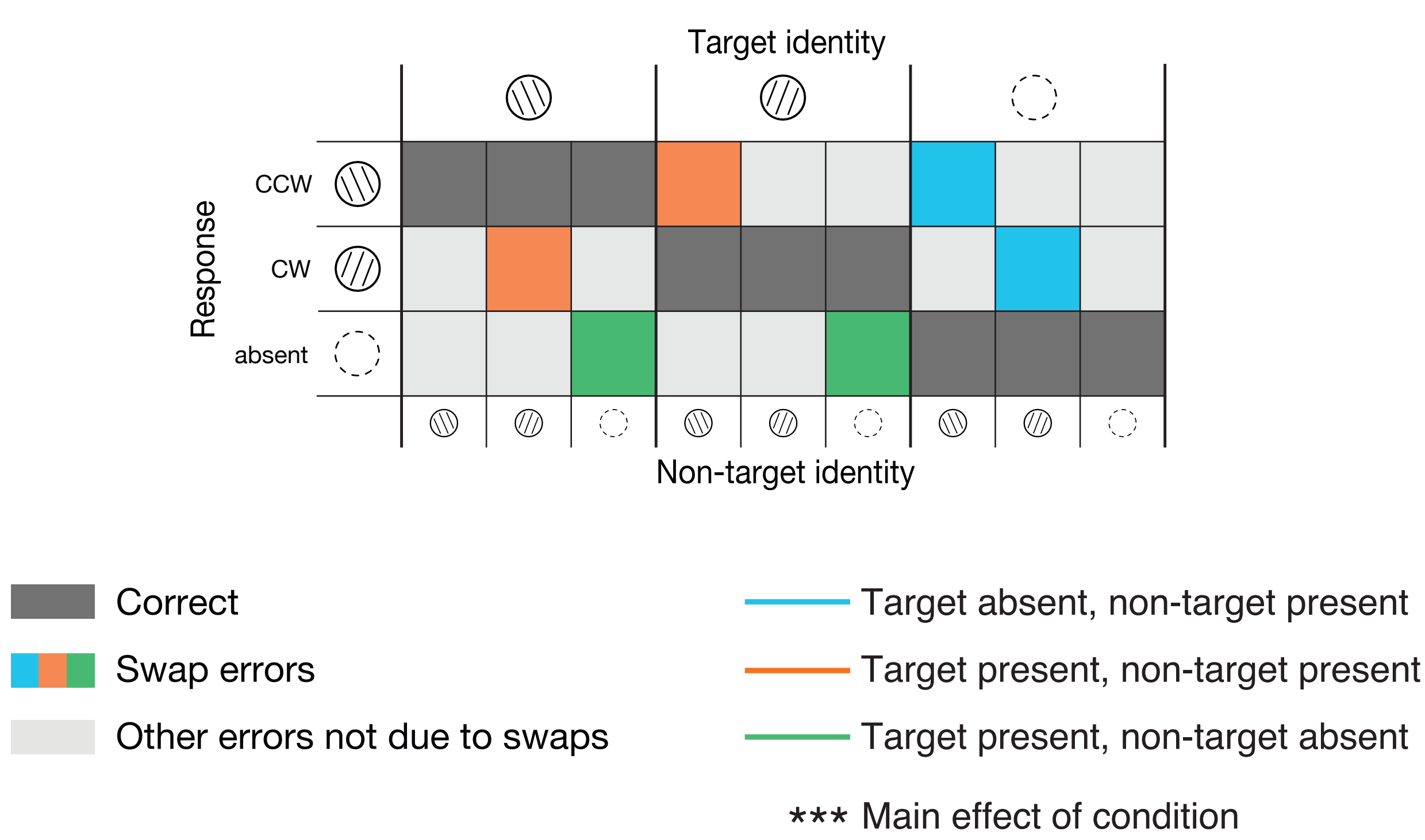


*Temporal attention improved detection sensitivity when the non-target was absent*



Error bars indicate ± 1 SEM. ~p<0.1, \*p<0.05, \*\*p<0.01, \*\*\*p<0.001.

*Higher rate of swap errors when the non-target was present*



## Conclusions

- Voluntary temporal attention enhanced performance even without temporal competition
- The attentional improvement was similar whether a target was presented with or without competition
- **These results suggest that temporal attention biases stimulus information prior to a competitive stage**