

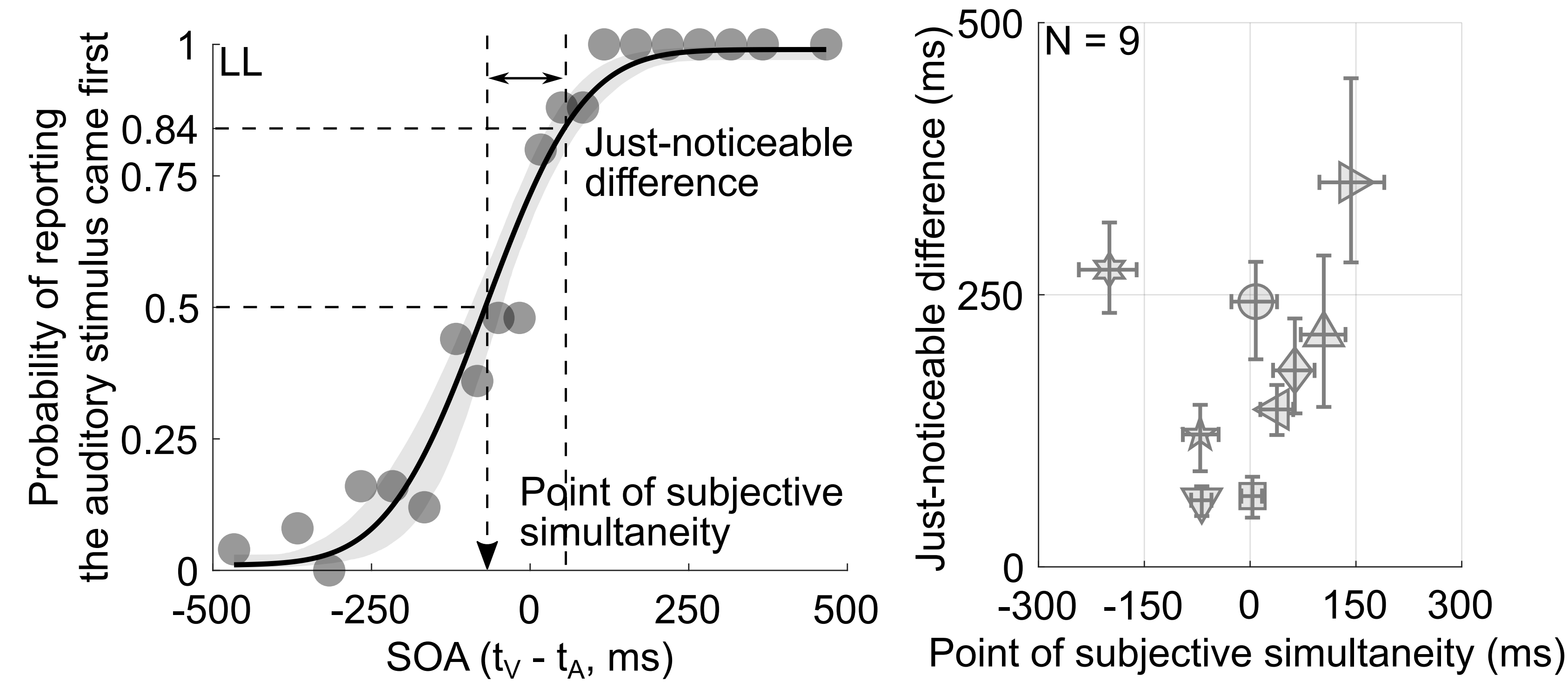
Research question

How do temporal discrepancies impact the integration of spatially discrepant visual and auditory stimuli?

Pre-expt. 1: Temporal perceptual biases

Goal: Estimate audiovisual temporal bias and discriminability

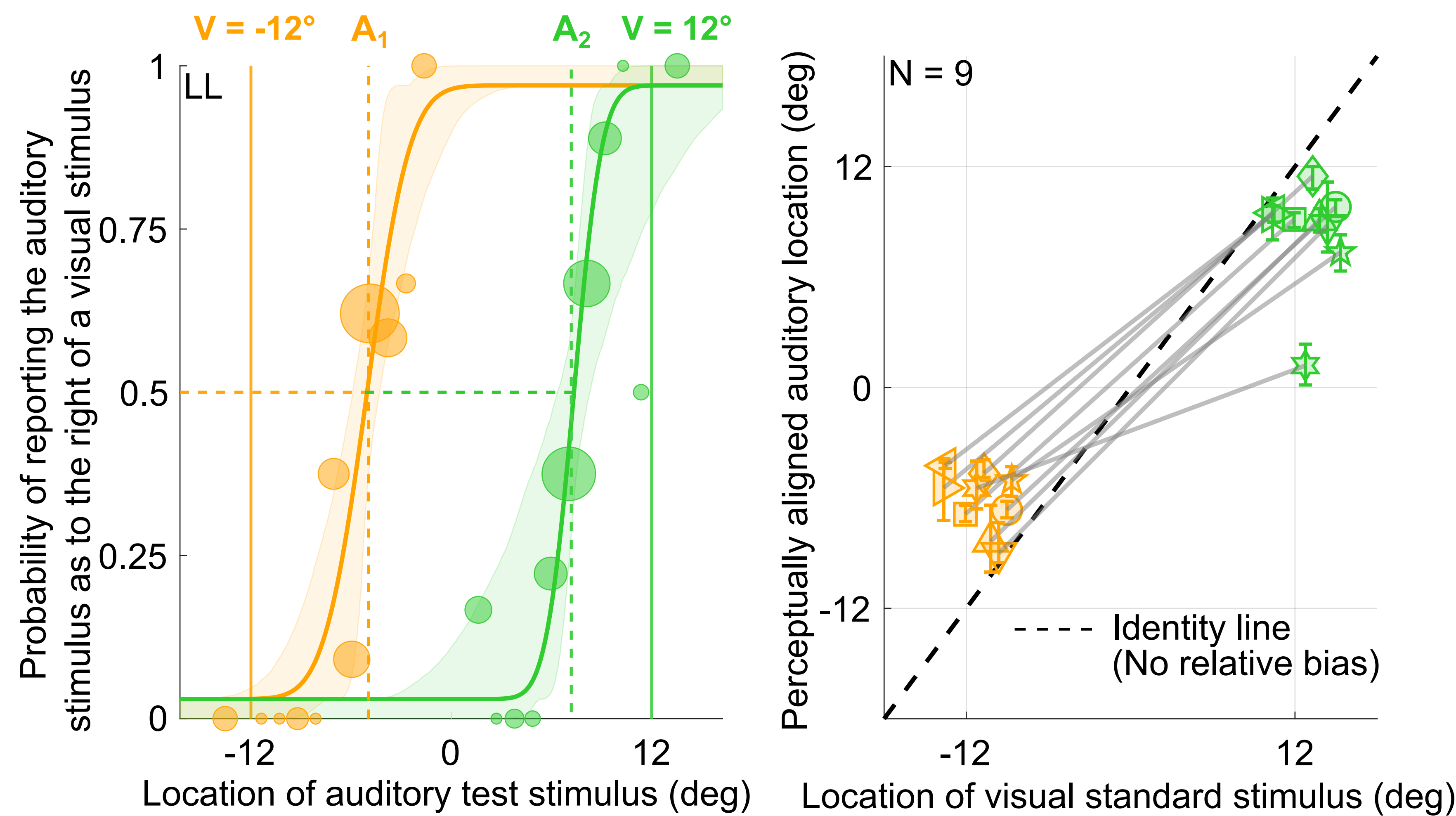
Task: Which stimulus came first, auditory or visual?



Pre-expt. 2: Spatial perceptual biases

Goal: Identify auditory locations perceived as co-located with two pre-selected visual stimulus locations.

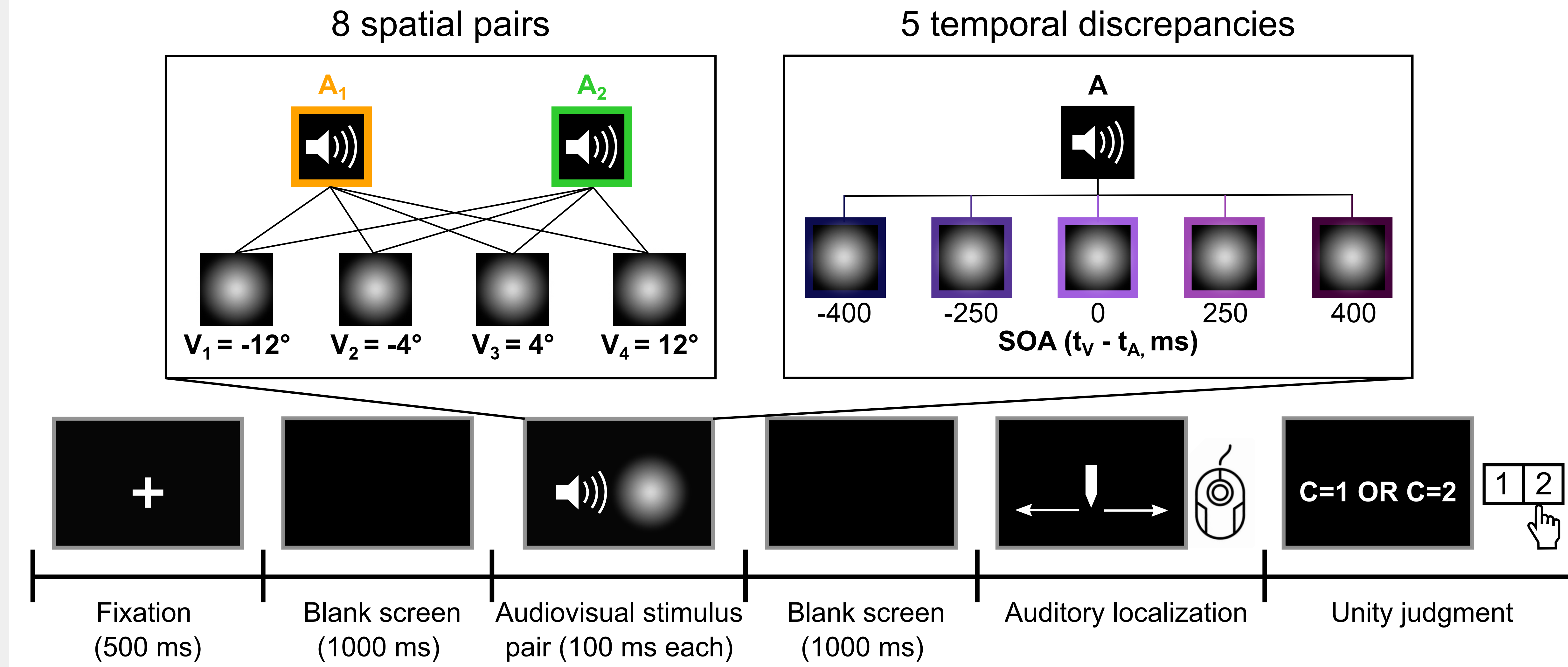
Task: Was the auditory to the left or right of the visual stimulus?



Main expt: Audiovisual spatiotemporal perception

Goal: Determine how spatiotemporal discrepancies impact audiovisual spatial perception

Task: Location estimation and unity judgments



Models and model comparison

We fitted variations of the Bayesian causal-inference model for cross-modal spatiotemporal perception (McGovern et al., 2016) jointly to all the data:

Strategies for unity judgments:

Spatiotemporal discrepancy based (heuristic)
Common-cause posterior based

Strategies for location estimation:

Model averaging Model selection

M1	
M2	M3

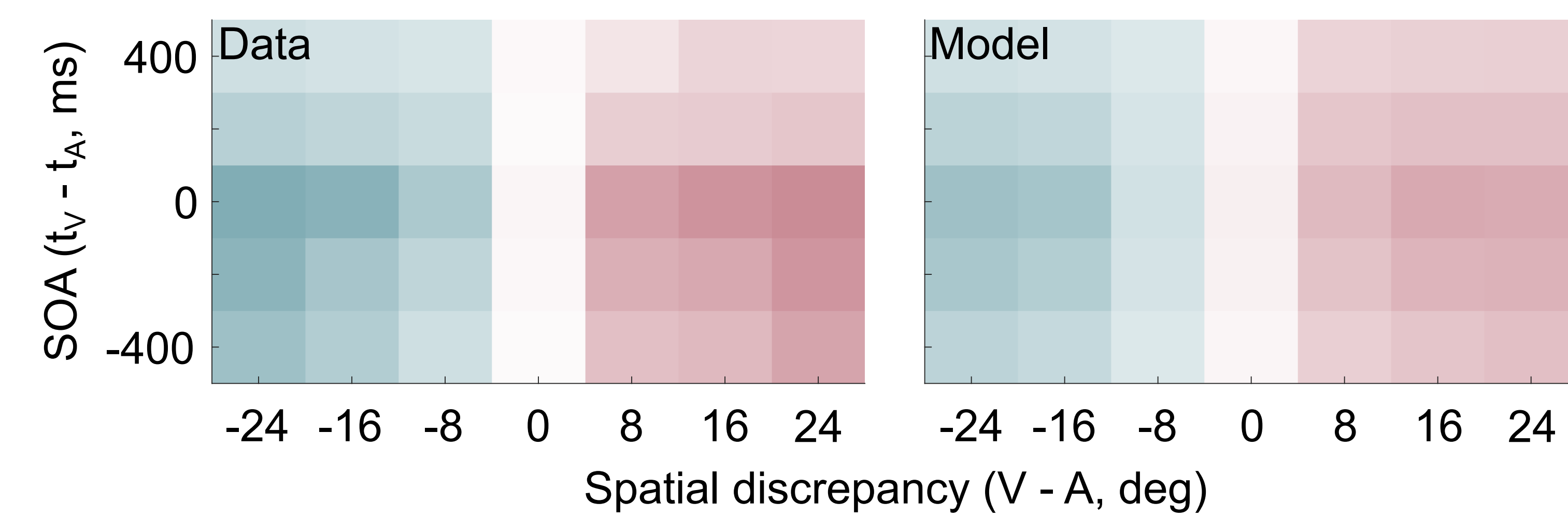
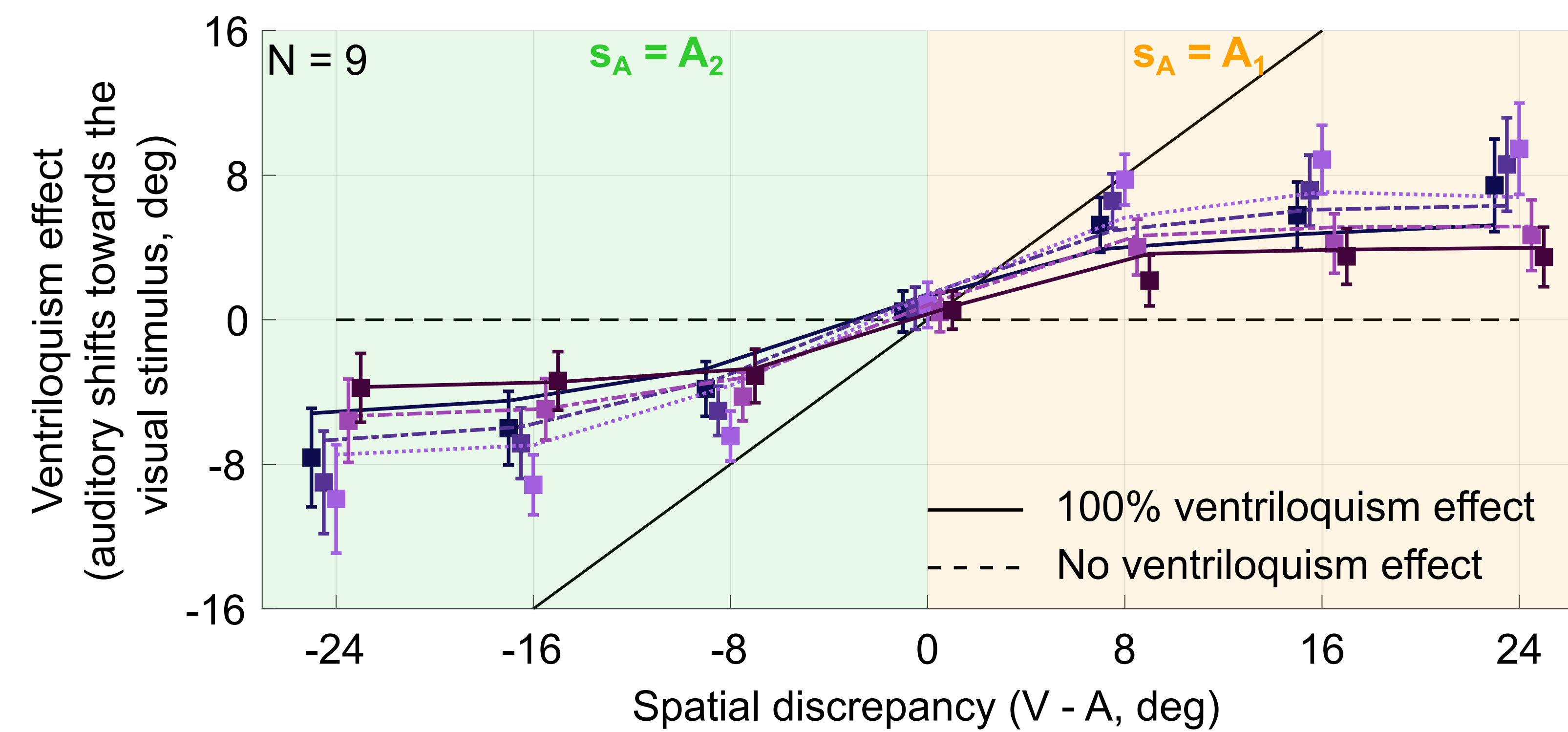
- Model averaging: $\hat{s}_A = \hat{s}_{A,C=1}P(C=1|m_A, m_V, m_{\Delta_t}) + \hat{s}_{A,C=2}P(C=2|m_A, m_V, m_{\Delta_t})$
 - Model selection: $\hat{s}_A = \hat{s}_{A,C=1}$ only if $P(C=1|m_A, m_V, m_{\Delta_t}) > 0.5$
 - Spatiotemporal discrepancy based (heuristic): report C=1 only if $|\hat{s}_A - \hat{s}_V| < \epsilon_s$ AND $|\hat{s}_{\Delta_t}| < \epsilon_t$
 - Common-cause posterior based: report C=1 only if $P(C=1|m_A, m_V, m_{\Delta_t}) > 0.5$
- (Notation: $\hat{s}$ - location estimate; m - sensory measurement; ϵ - internal criterion; C - # causes)

Model	FH	ZL	ZY	AD	MD	JH	BS	LL	HHL	ΔAIC	# of wins
M1	0	0	6.7	0	3.8	0	0	0	0	7	7
M2	12.5	2.6	32.4	10.6	0	22.1	116.1	8.1	844.8	1	1
M3	67.9	208.8	0	57.3	171.5	109.1	97.3	69.4	964.5	1	1

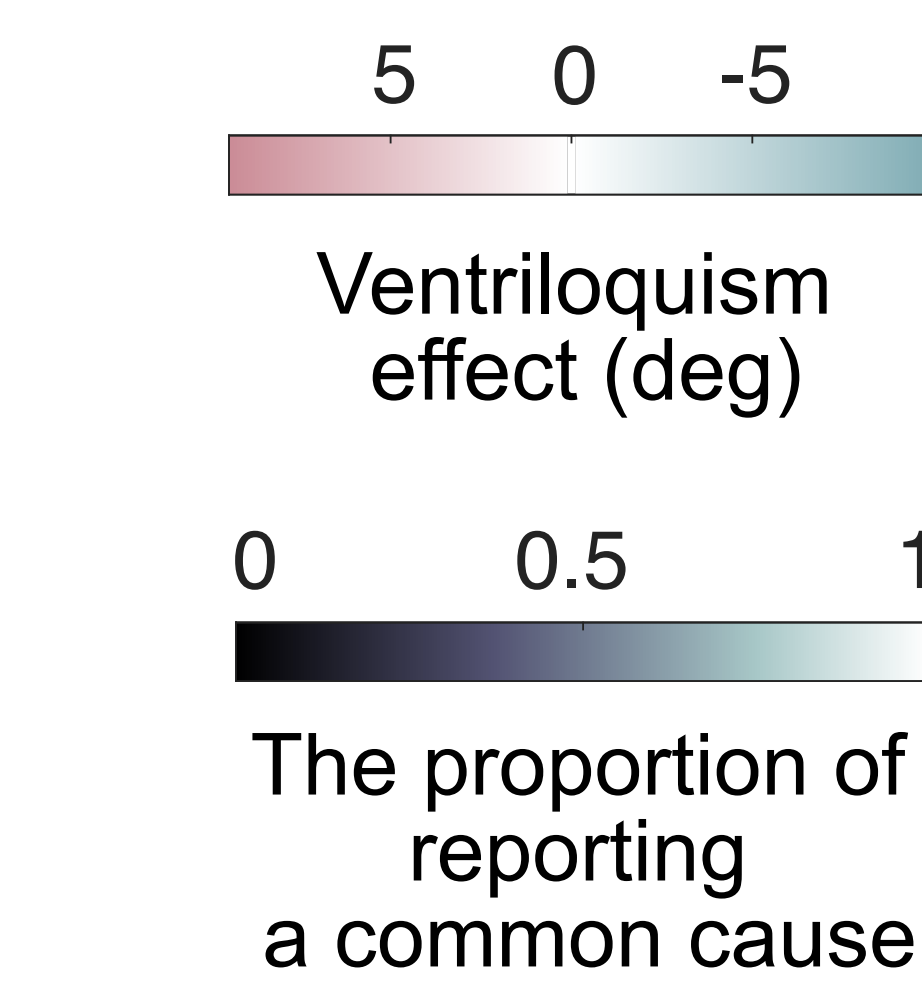
Color scale for ΔAIC : 0 (white) to ≥ 7 (dark grey). Better model performance is indicated by lower ΔAIC values.

Behavioral data and model predictions

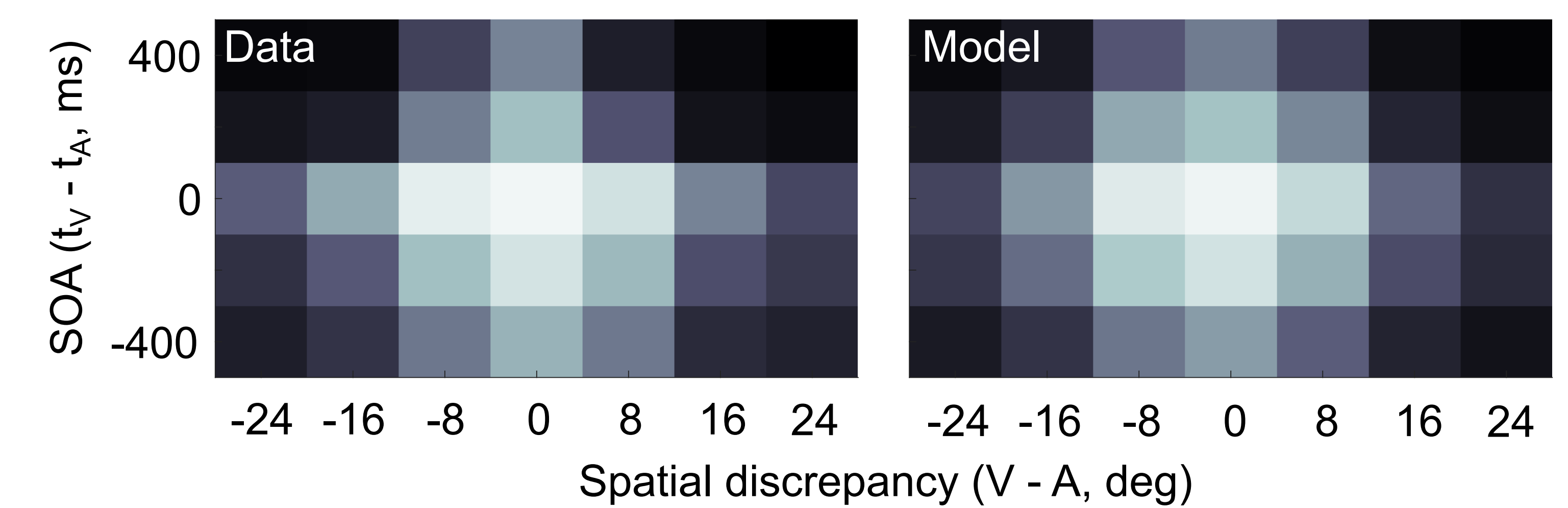
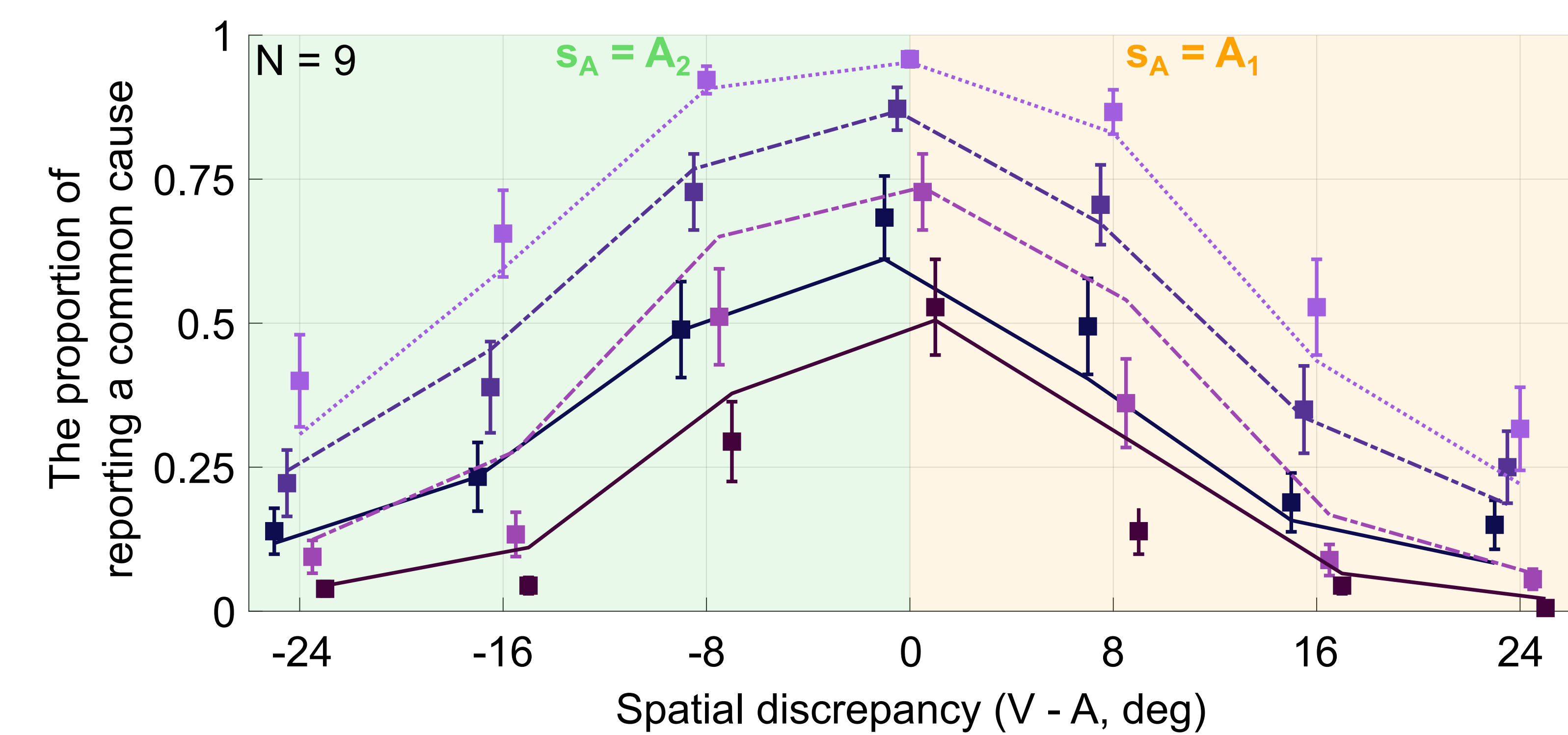
Location estimation



Data	Model
400	400
250	250
0	0
-250	-250
-400	-400



Unity judgments



Conclusion

- Temporal alignment matters in spatial tasks; discrepancies in time and space jointly determine audiovisual integration.
- People tend to adopt model averaging to estimate location, and a heuristic strategy (spatiotemporal discrepancy based) to judge unity.