The role of similarity and bias in letter acuity measurements: a noisy template model

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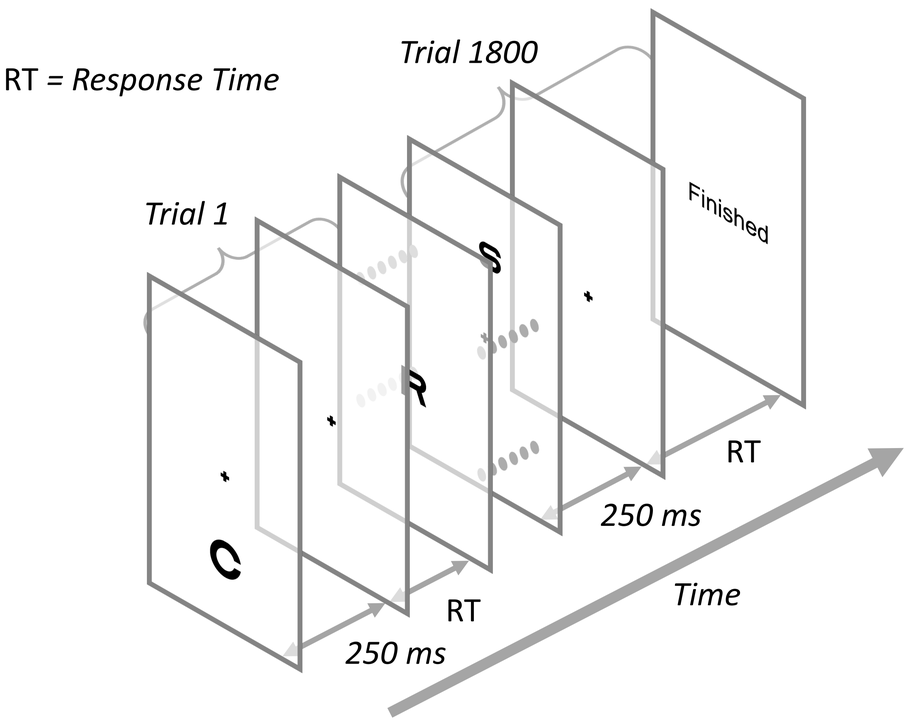
BACKGROUND

- Letters have complex structure, and it is likely that letter bias and similarity between letters are sources of non-random errors in letter identification tasks[1-3]
- Here we introduce a novel and significant extension to our recently derived model[4], to reveal the joint effect of bias and similarity in letter identification.

METHODS

- Letter identification task, with sizes spanning the acuity limit; 10 naïve Ss
- 10 Sloan letters, presented singly for 250 ms
- Central and 3˚ eccentricity in upper and lower visual field
- Method of constant stimuli (1800 trials/subject)

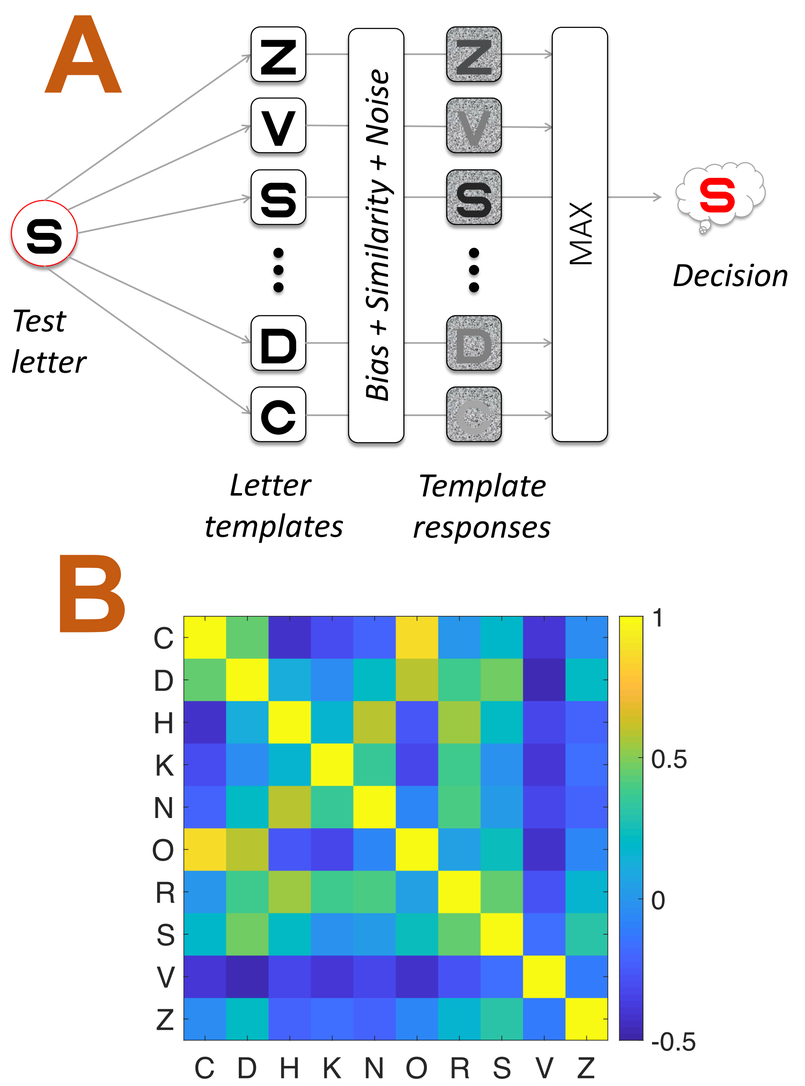


- Data collated as a *stimulus-response matrix*: each cell counts the number of times a given letter was chosen in response to the letter presented.

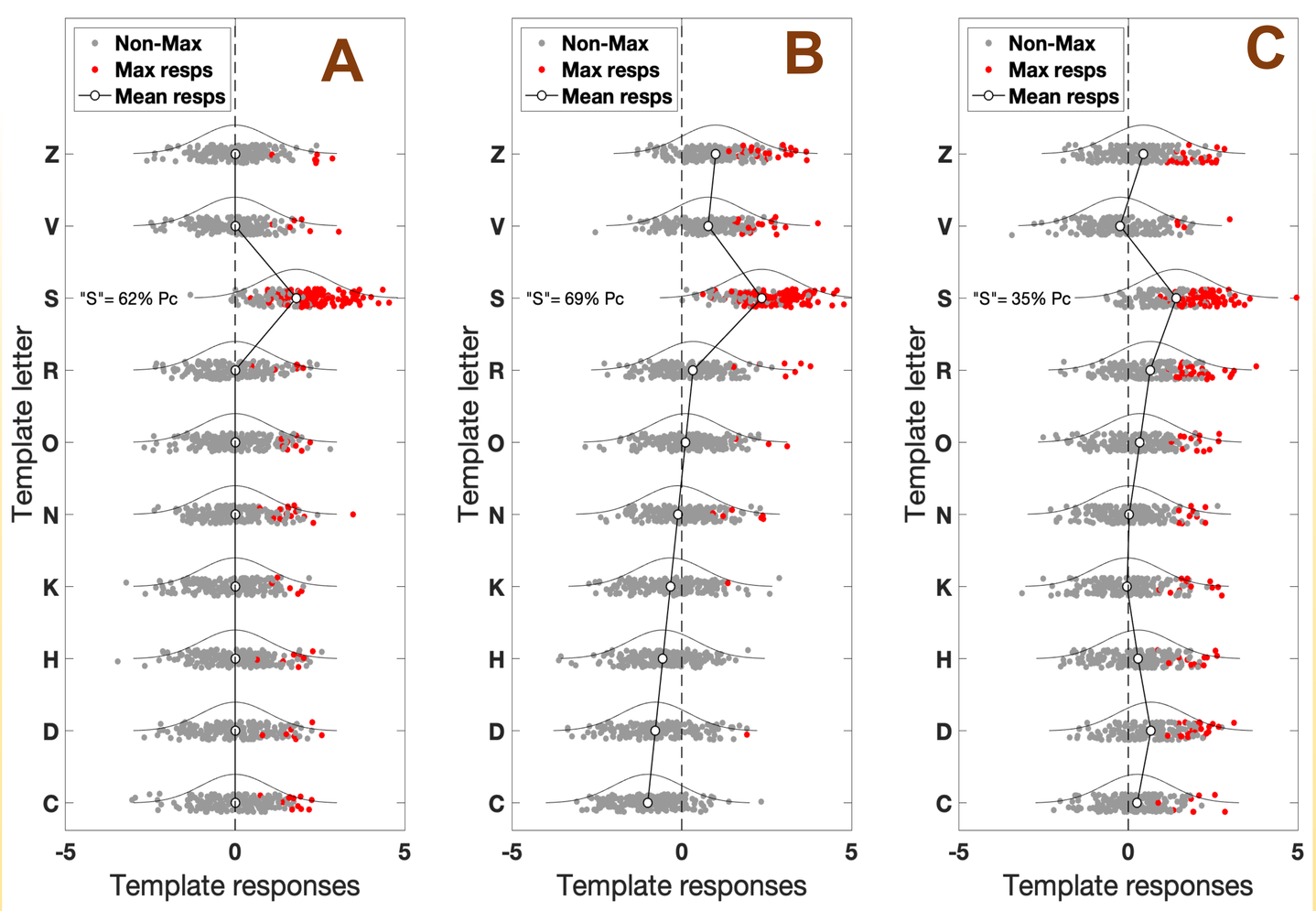
MODEL

(**A**) The "noisy template" model[4] was extended to capture letter biases & effects of between-letter similarity in experimental data.

(**B**) The optotype correlation matrix[5] was used to model similarity.

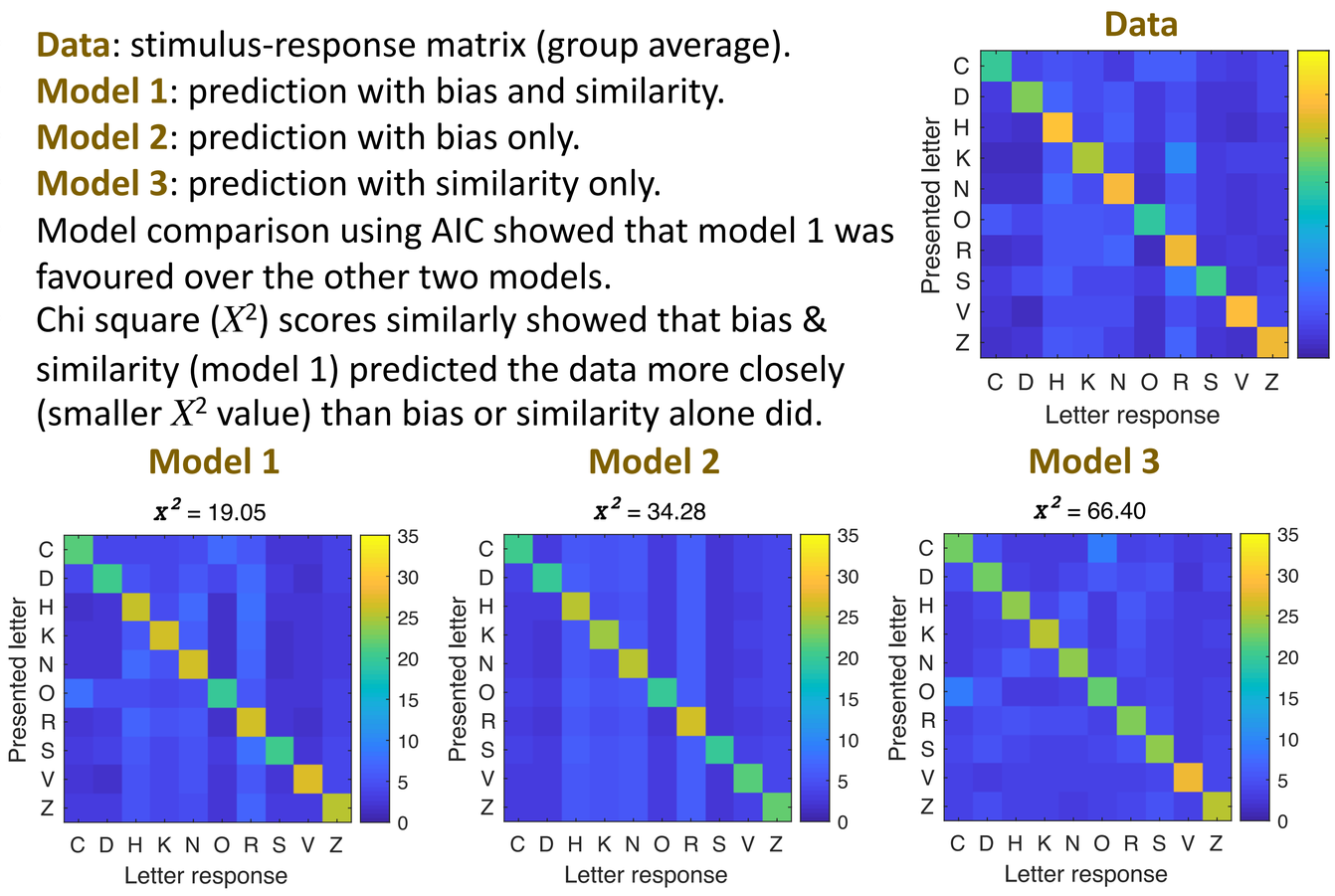


- The Noisy Template Model:
  - **A** without biases or similarity.
  - **B** with biases but no similarity.
  - **C** with similarity but no biases.
- Model parameters are Baseline sensitivity, Bias gradient, Confusion strength.
- The model was fitted to the observed number of responses.



RESULTS

- **Data**: stimulus-response matrix (group average).
- **Model 1**: prediction with bias and similarity.
- **Model 2**: prediction with bias only.
- **Model 3**: prediction with similarity only.
- Model comparison using AIC showed that model 1 was favoured over the other two models.
- Chi square (X^2) scores similarly showed that bias & similarity (model 1) predicted the data more closely (smaller X^2 value) than bias or similarity alone did.



CONCLUSIONS

- Letter biases and between-letter similarity together shape the pattern of correct responses (negative diagonal) and errors (off-diagonal) in the letter identification task with Sloan letters.
- In future work, it will be important to investigate the impact of bias and similarity on the estimated acuity using letters as optotypes.

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