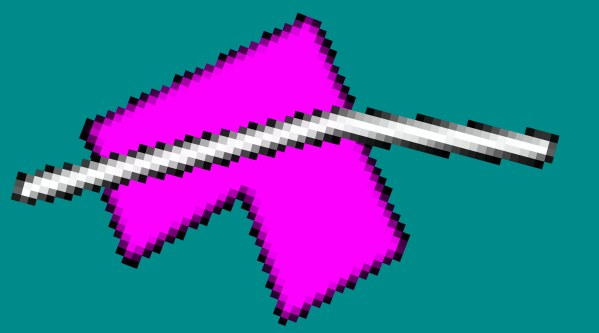


# Pink Shapes or White Lines: Modelling How We Allocate Our Attention



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## BACKGROUND & AIMS

### Background

- Attentional set-shifting is a cognitive process that involves shifting attentional focus to previously irrelevant information.
- CANTAB Intra-Extra Dimensional Set Shift Task (IED)<sup>1</sup> assesses this ability. Individuals with psychiatric diagnoses such as OCD<sup>2</sup>, schizophrenia<sup>3</sup>, depression<sup>4</sup> score higher errors on the extra-dimensional set shifting stage, indicating impaired ability.

### Aims

- Build a computational model of IED to elucidate variation in set-shifting variability in terms of the interaction between attention and learning.

## METHODS

### Online Data Collection

On the IED task, participants use trial and error to learn which feature determines the correct stimulus on each stage of the task. Task data was collected from 731 healthy adults online via Prolific Academic. Participants were over 18 years of age, fluent in English, and had no history of head injury, mental or neurological disorder.

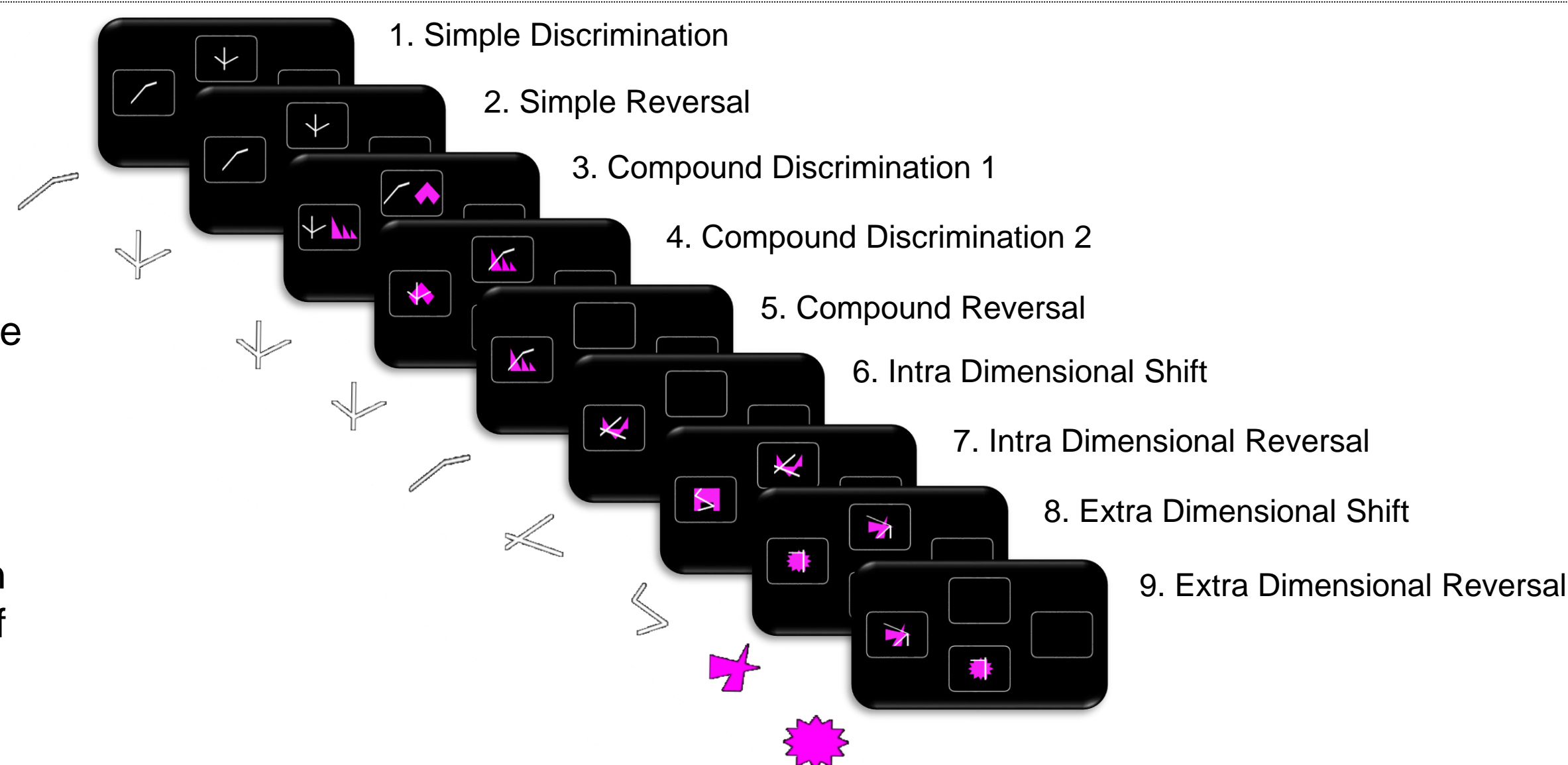


Figure 1. CANTAB IED task stages and their target features.

### Computational Model

Neural network uses feature weights and dimension weights to estimate value of each stimulus on each trial; backpropagation updates the network's weights for features and dimensions. Maximum likelihood estimation was used to fit subject-specific parameters, which were then used to simulate IED task data for each participant.

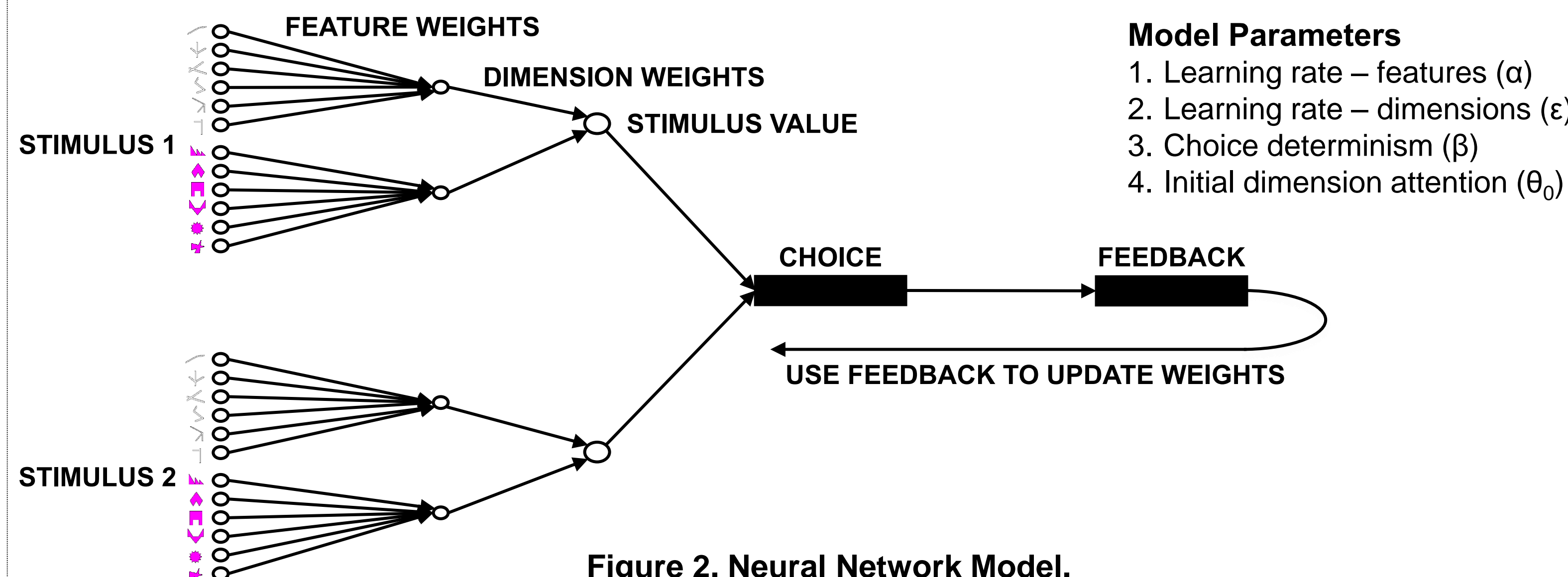


Figure 2. Neural Network Model.

## RESULTS

Model simulations make more errors on final stage of task compared to real humans

Many human participants find it hard to switch attention to pink shapes that were previously irrelevant and fail this stage

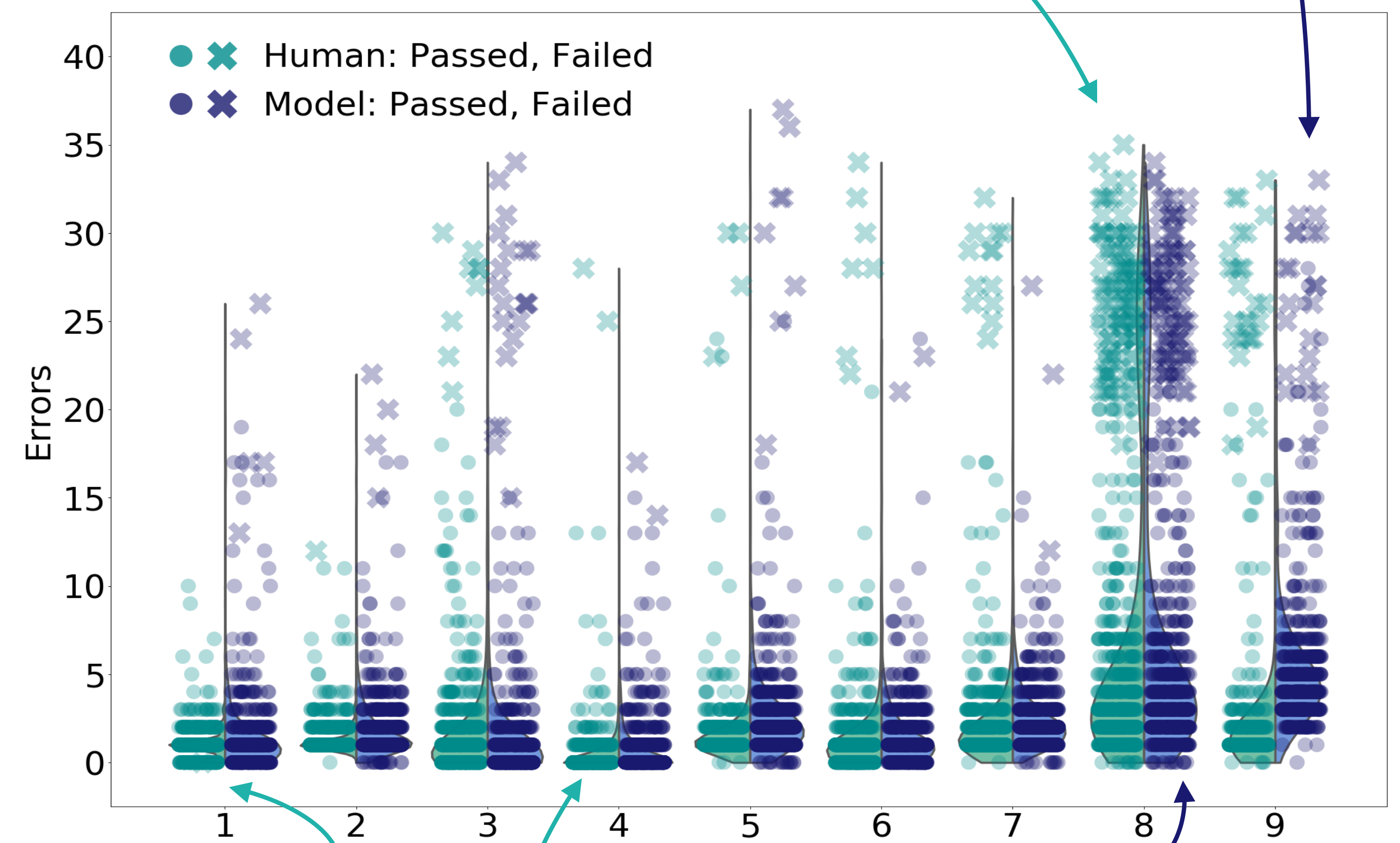


Figure 3. Human data and model simulations of IED task. Annotations highlight key features.

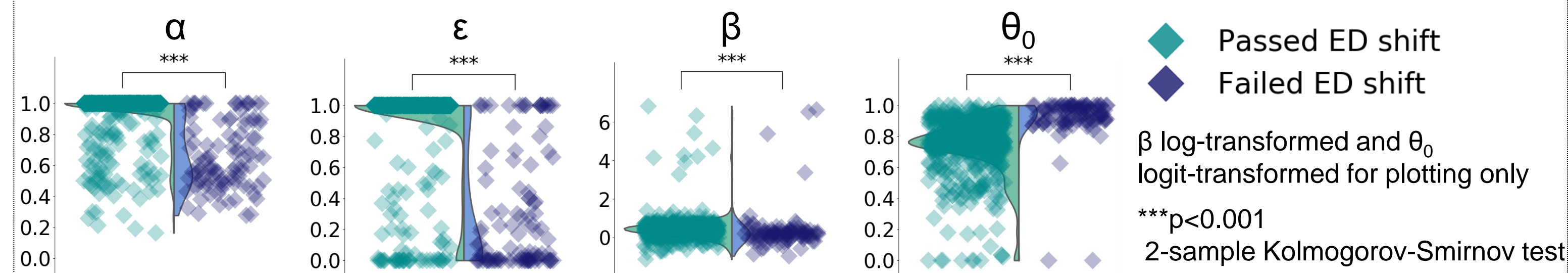


Figure 4. Parameter estimates by whether participant passed or failed extra-dimensional (ED) shift.

## CONCLUSIONS

- Model is able to capture almost all variation present in participants IED performance.
- Model suggests participants who fail the ED shift do so because they initially learn to attend to a specific stimulus dimension, and their dimension learning is too slow for them to shift attention to another dimension.
- This suggests a potential mechanistic explanation for the difficulties patient populations exhibit in attentional set shifting.

<sup>1</sup> Downes J. J., Roberts A. C., Sahakian B. J., Evenden J. L., Morris R. G., Robbins T. W. (1989). Impaired extra-dimensional shift performance in medicated and unmedicated Parkinson's disease: evidence for a specific attentional dysfunction. *Neuropsychologia* 27 1329–1343.

<sup>2</sup> Veale D. M., Sahakian B. J., Owen A. M., Marks I. M. (1996). Specific cognitive deficits in tests sensitive to frontal lobe dysfunction in obsessive-compulsive disorder. *Psychol Med.* ;26:1261–9.

<sup>3</sup> Elliott R., McKenna P. J., Robbins T. W., Sahakian B. J. (1995). Neuropsychological evidence for frontostriatal dysfunction in schizophrenia. *Psychol Med.*; 25(3):619–630.

<sup>4</sup> Beate B.C., Sahakian B.J., Levy R. (1996). Cognitive performance in tests sensitive to frontal lobe dysfunction in the elderly depressed. *Psychol Med.* 26:591–603.