Neural Code Comparison Of The Sensory And Motor Periods In Primate Superior Colliculus Neurons

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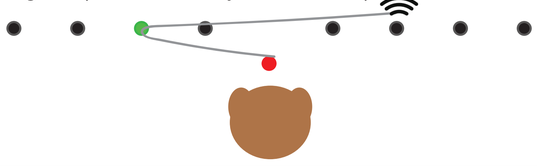
Introduction

Our perceptual experience is incredibly rich and complex as it almost always contains information from multiple senses that is presented at the same time. However, it remains unclear how such information is preserved in the neural code. Previous work from our laboratory proposed that the brain could encode two sound locations via time division multiplexing, or fluctuating signals that sequentially "represent" each stimulus that is presented in the auditory-responsive inferior colliculus (Caruso et al., 2018). In this study, we tested mutliplexing in a multisensory brain structure by recording single unit neural activity from the superior colliculus (SC) while monkey performed an audio-visual localization task.

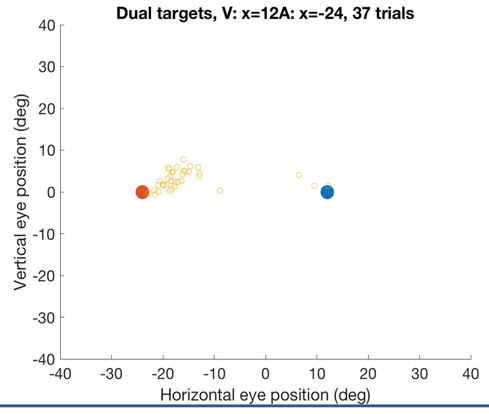
Methods

Single unit recording of 53 cells in monkey SC

Audio-visual localization task: saccadic eye movement(s) indicated perception of a signal target (auditory or visual) or two simultaneous targets (both auditory and visual)

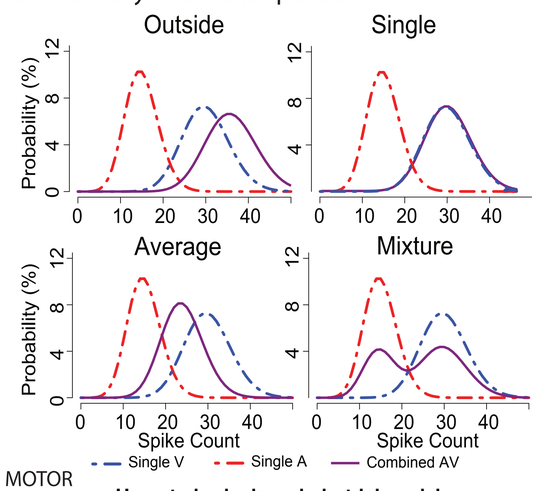


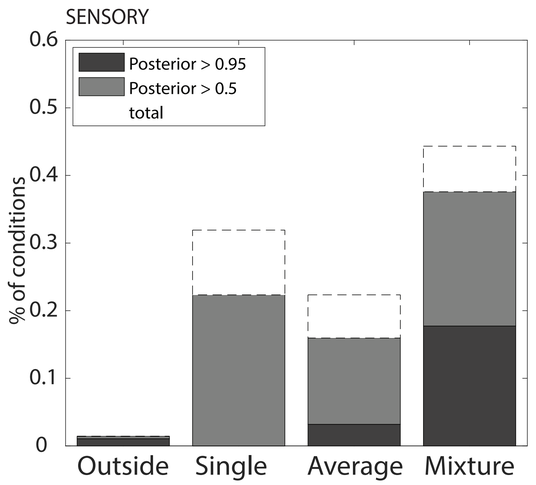
Monkey Can Perceptually Preserve Information About Visual And Auditory Targets Presented Simultaneously



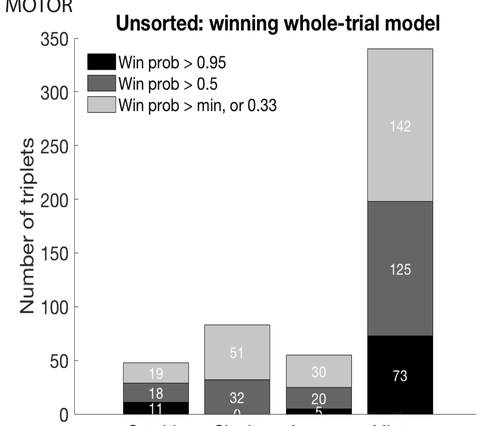
Mixtures of Poissons Suggest Multiplexing In SC

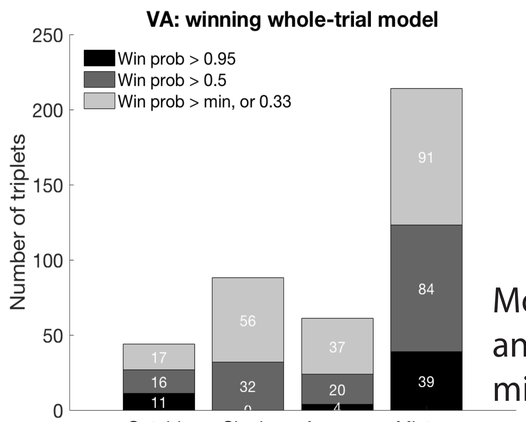
It is well established that SC neurons encode the direction, amplitude, and velocity of the next saccadic eye movement. We examined both the sensory period (i.e., 300 ms after the stimulus onset) and the motor period (i.e., 250 ms centered around saccade initiation) to determine how information of the stimuli is perserved in both sensory and motor period.

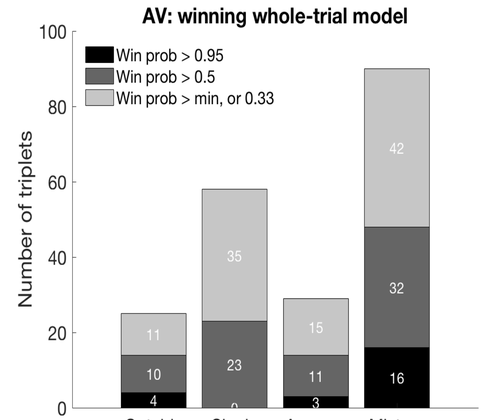


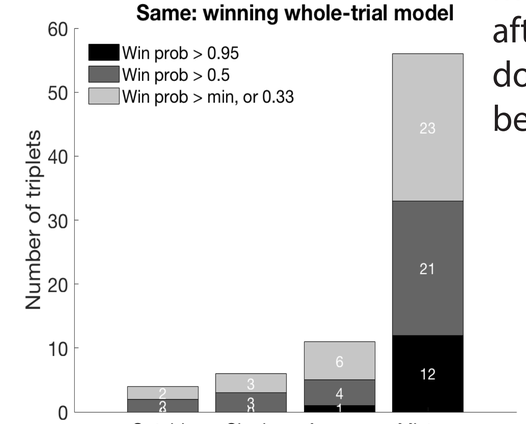


MOTOR





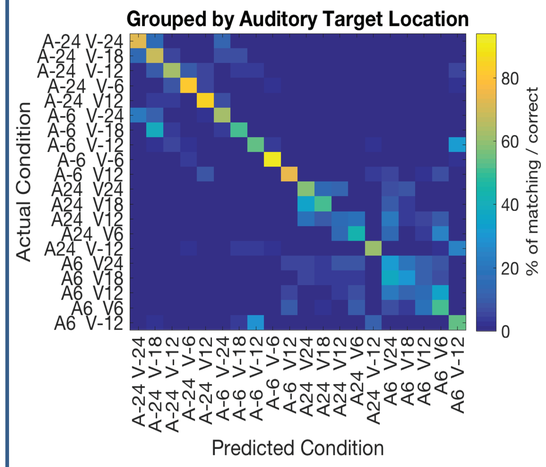


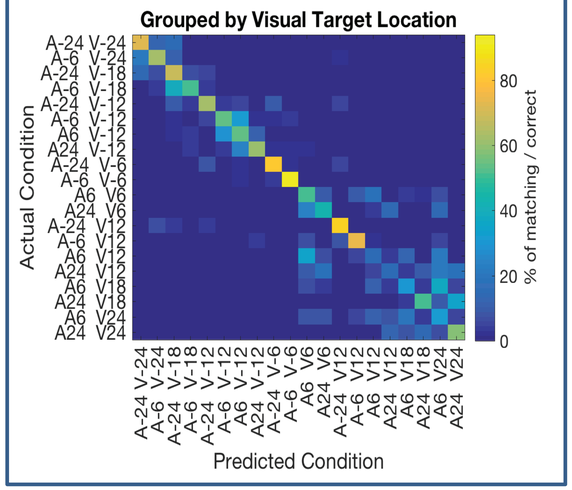


More singles and fewer mixtures in the motor period after breaking down trials by behavior.

Neural Data Analysis: Decoding

We tested how much information about the two targets is contained in the neural response during the motor period with a maximum likelihood decoding algorithm. The testing set consists of one trial from every neuron in the specific testing condition. Then, we obtained the rest of trials in each condition for each neuron to calculate the distribution per neuron for every condition and used these distributions parameters as training data. We tested our decoder with 100 iterations and calculated the percentage of correct predictions.





Acknowledgments
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References
1. Alais D, Burr D. Curr Biol. 2004;14(3):257-262
2. Caruso, V. C., Mohl, J. T., Glynn, C., Lee, J., Willett, S. M., Zaman, A., ... & Groh, J. M. Nat. Commun. 2018; 9(1), 2715

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