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To what extent are motor choice and color percept represented in dorsal premotor cortex?

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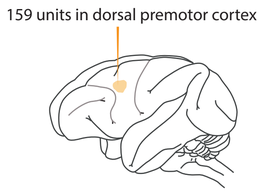
Background and motivation

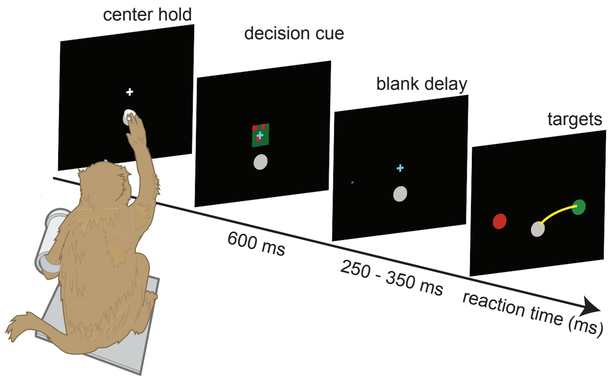
1. How can we best visualize neural data?
2. How early and how well can we decode color percept and motor choice?
3. How many neurons are needed to accurately decode motor choice?
4. How stable is the neural representation?

Electrophysiology recordings during a perceptual decision making task

Animal must report the dominant checkerboard color by reaching to the target of that color

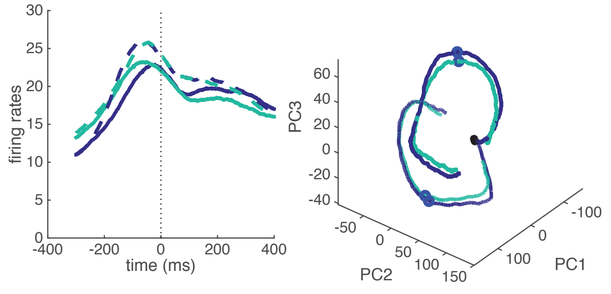
Units are recorded during behavior





Simple averaging does not convey the true dynamics of neural activity during reaching

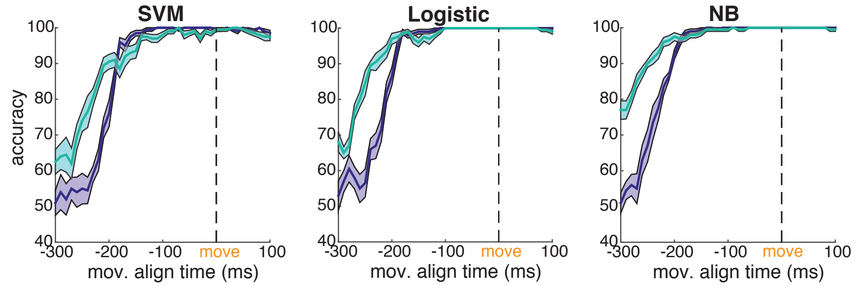
faster reaction time | slower reaction time



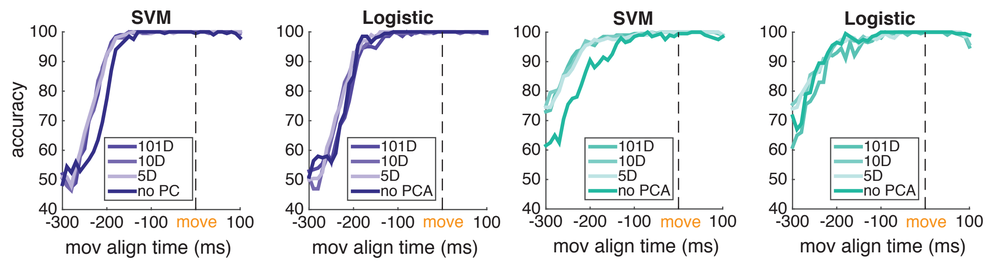
Analysis methods

We used three decoders (SVM kernelized with a RBF, logistic regression, and naive Bayes) to decode motor choice or dominant checkerboard color from neural data (101 units; 100 reaches/condition) over time. Decoder performance was quantified using 10-fold cross-validation.

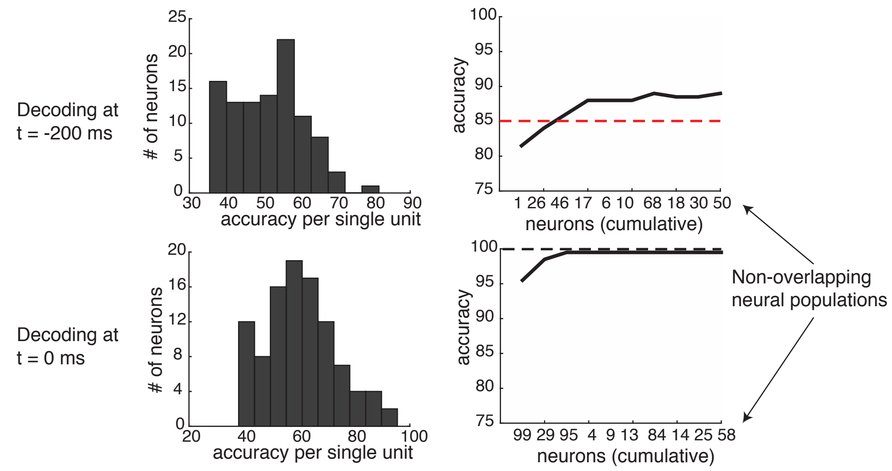
We can decode motor choice, but not color percept, on unprocessed neural data



Decoding motor choice using data projected onto their principal components increases model performance for SVM

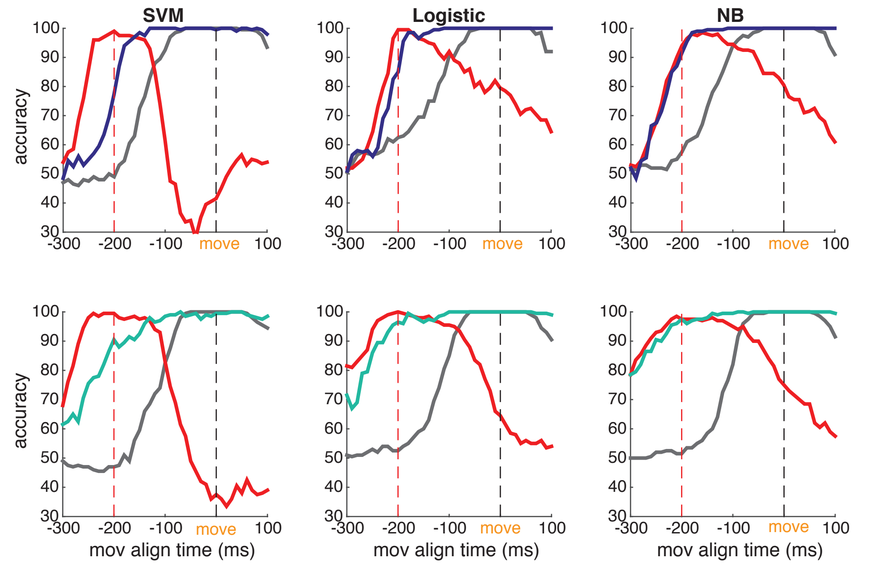


Forward feature selection reveals that motor choice can be decoded with very few neurons



Investigating decoder stability reveals that neural representation of motor choice dynamically evolves prior to movement onset

movement onset decoder (time 0) | pre-movement decoder (time -200)



Summary

- The difference in neural activity pattern is clearer when we visualize the data in PCA space.
- We can decode action choice, but not color percept. For longer reaction times, we can accurately decode action choice to the movement onset time.
- Decoding using only 5 PCs achieves the same or better prediction accuracy as a decoder trained on the full, un-processed neural data.
- Decoding using only 3-4 neurons achieves the same or better prediction accuracy as the decoder trained on the full population.
- Neural representations evolve throughout the trial, and our results suggest they are stable for ~200 ms. It appears that different populations of neurons are encoding the motor choice at different times in the trial.

Acknowledgments

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