Adaptation of spontaneous activity in V1 to novel stimulus statistics

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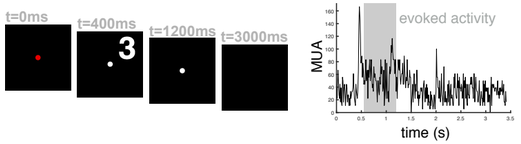
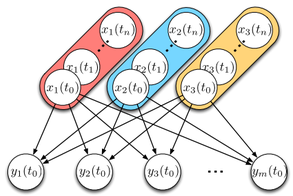
Experimental paradigm

- Awake macaques performing passive viewing task
- Extracellular recordings of multiunit spike trains
- unfamiliar set of stimuli



- Stimulus trials interleaved and flanked by blank trials during a session
- One of the stimuli is overrepresented

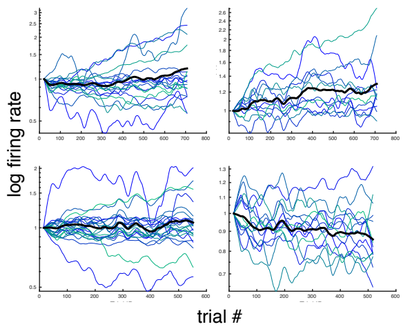
Dynamic latent variable models



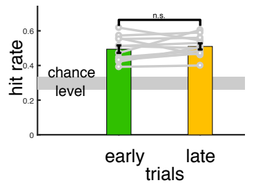
- Gaussian Process Factor Analysis (GPFA)
- ~20-dimensional spike trains projected into a 5-dimensional latent space
- generative model captures within-trial variability
- spontaneous and evoked trials fitted jointly or separately
- Decoding: GPFAs fitted to trials with responses to individual stimuli, and choosing the model for which a test trial's likelihood is maximal

Response adaptation during sessions

- adapted of population activity over the course of a measurement session is investigated
- diverse long-term trends in the firing rates

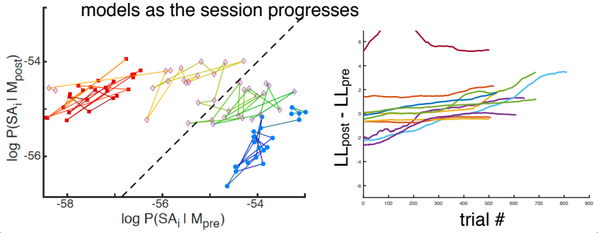


- efficiency of stimulus encoding is investigated for early and late trials
- stimulus identity can be decoded from early and late responses equally well



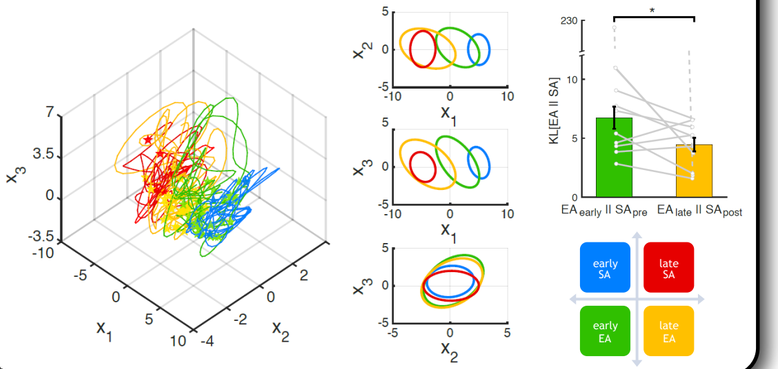
Evolution of likelihoods

- for quantitative evaluation of spontaneous and evoked activities at different stages of exposure, separate models are fitted for early and late trials
- likelihood of every trial is evaluated under each model, revealing how well a given model describes activity patterns in the trial
- interleaved blank trials are gradually better explained by models describing post-exposure activity
- evoked trials are also undergoing a transformation: later trials are better explained by post-exposure blank models as the session progresses



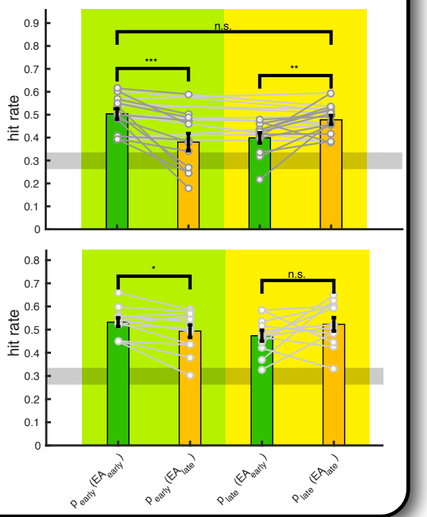
Adaptation in the dynamics of the latent space

- changes in within-trial dynamics during a session are investigated by assessing latent trajectories inferred by GPFA models
- a drift in the latent space is apparent, resulting from the trends in the firing rate in each session
- evoked and spontaneous activities become more similar as the session progresses



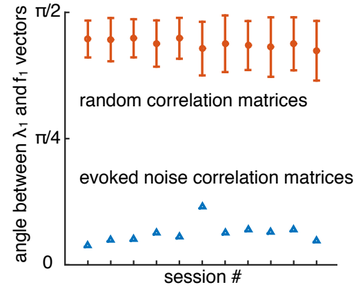
Transformation of response statistics

- transformations in the code are investigated by fitting separate GPFA models to early and late stimulus trials
- decoding of early trials under models fitted to late trials deteriorates compared to decoding the late trials under the same model
- removing the diverse trend from the rates, decoding performance recovers



Noise correlations

- relationship between the properties of the transformation of response statistics and noise correlations is investigated
- first eigenvector of the noise correlation matrix (λ_1) is calculated (for one particular stimulus)
- latent factor explaining the higher variance is obtained (f_1)
- principal direction of noise correlations closely matches the direction of the drift of population responses



Conclusions

- during passive viewing sessions, systemic changes occur in the spiking statistics of the macaque V1
- stimuli are decodable using a dynamic latent variable model from early and late trials equally well
- evoked activity becomes more similar to spontaneous activity as the session progresses
- decodability suggests that firing rate trends unrelated to the stimulus set are present in the data

Acknowledgements

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