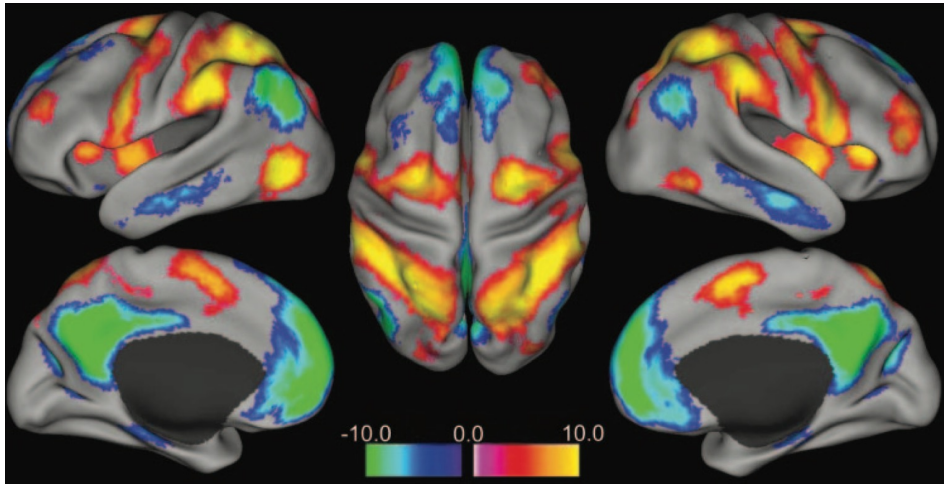
Do arousal fluctuations alter functional connectivity?

Somayeh “Bahar” Shahsavarani

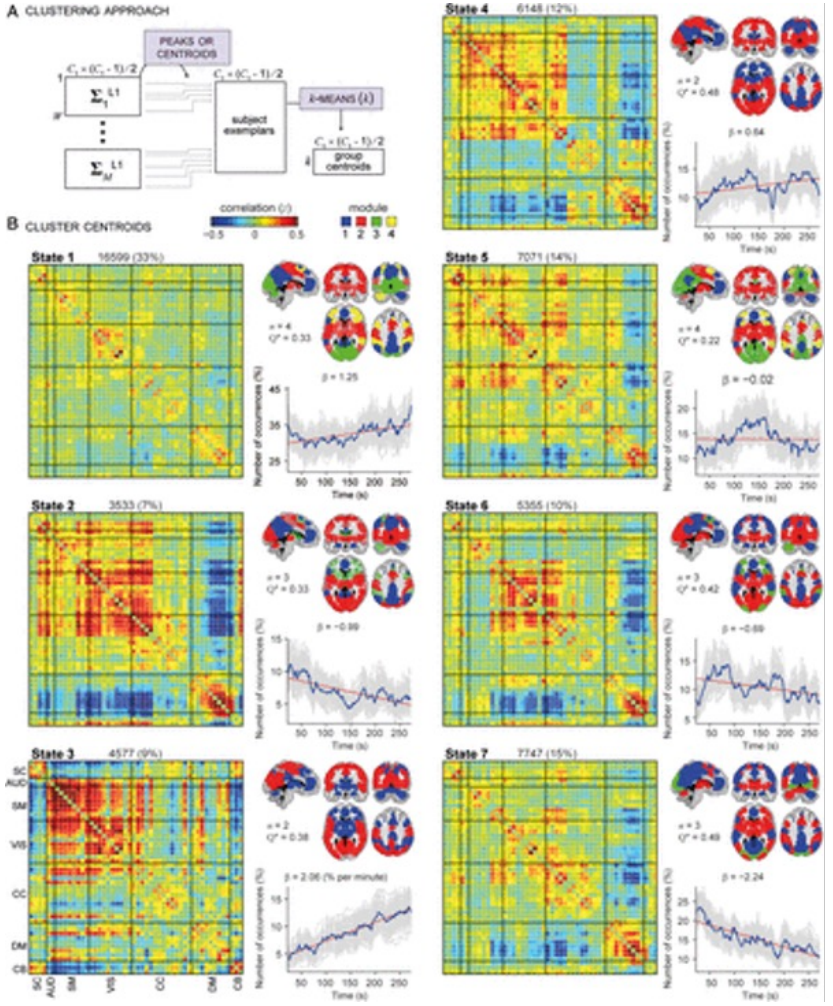
Hillman Lab, Columbia University, New York City, NY, USA

Bandettini Lab, National Institute of Mental Health, Bethesda, MD, USA

Spontaneous BOLD* signals measured by fMRI are organized into dynamic functional neural networks



Fox et al., 2005

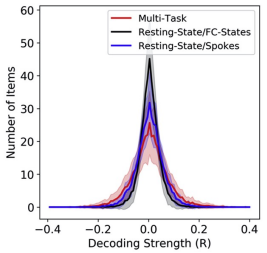


Allen et al., 2014

*Blood Oxygen Level Dependent

Fluctuating correlations of fMRI signals may be explained by variations in ongoing cognition

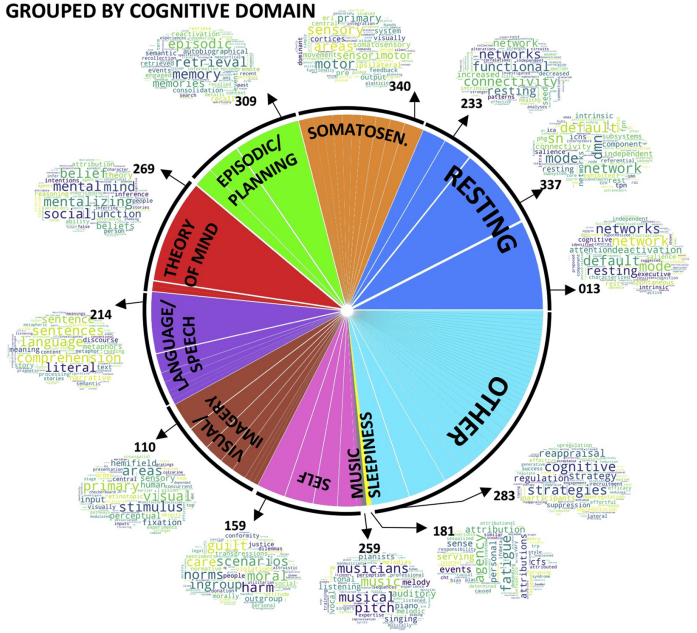
(A) AVERAGE DISTRIBUTIONS OF DECODING STRENGTH



(B) TOPICS MOST OFTEN MARKED AS OUTLIERS FOR REST (SPOKES)

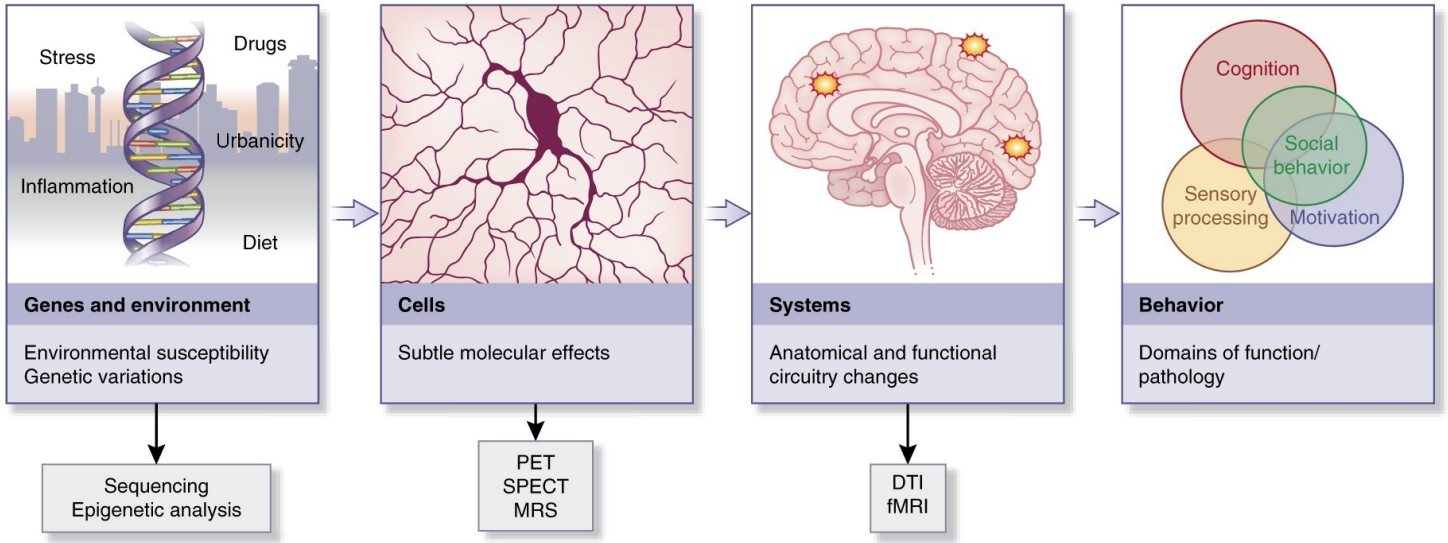
TOPIC	% TIMES MARKED AS OUTLIER
269_mental_mentalizing_social	8.36
13_network_default_mode	7.22
337_dmn_network_default	6.46
309_memory_retrieval_episodic	5.32
214_comprehension_sentences_language	4.94
283_strategies_cognitive_reappraisal	3.04
339_reasoning_relational_analogical	3.04
188_future_events_past	2.66
159_moral_guilt_harm	2.28
369_referential_reference_judgments	2.28
233_connectivity_functional_networks	2.28
113_arithmetic_calculation_mathematical	2.28
110_visual_areas_stimulus	2.28
376_memory_working_task	1.90
215_network_networks_common	1.90

(C) PERCENTAGE OF TIMES TOPIC IS MARKED AS POSITIVE OUTLIER, GROUPED BY COGNITIVE DOMAIN



Gonzalez-Castillo et al., 2019

Developing fMRI-based biomarkers of neurological and psychiatric diseases

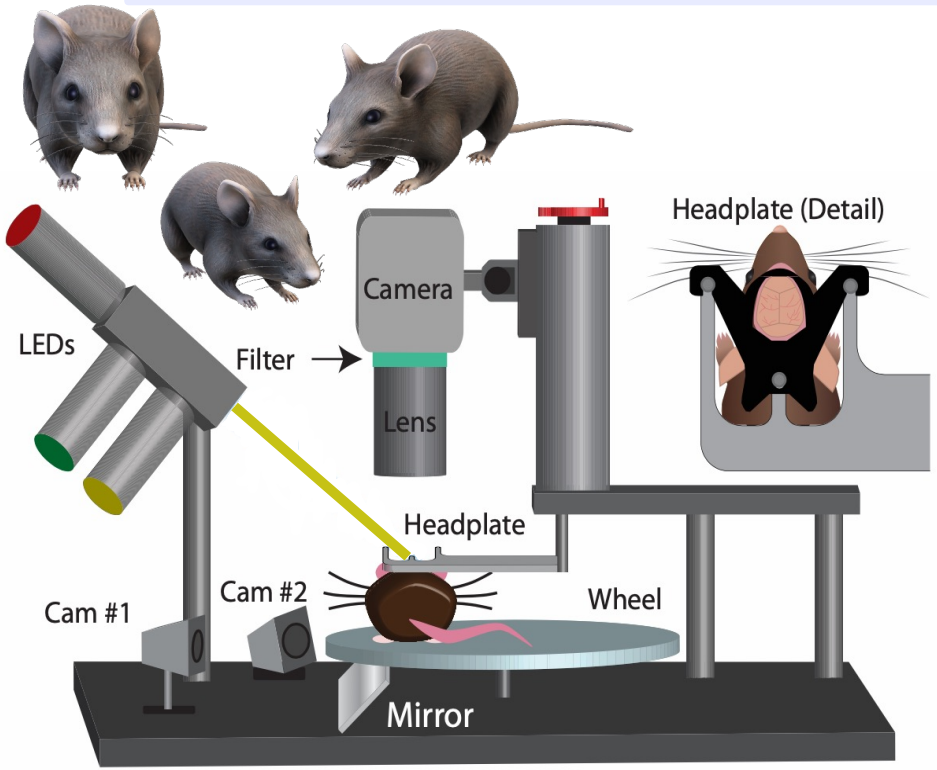


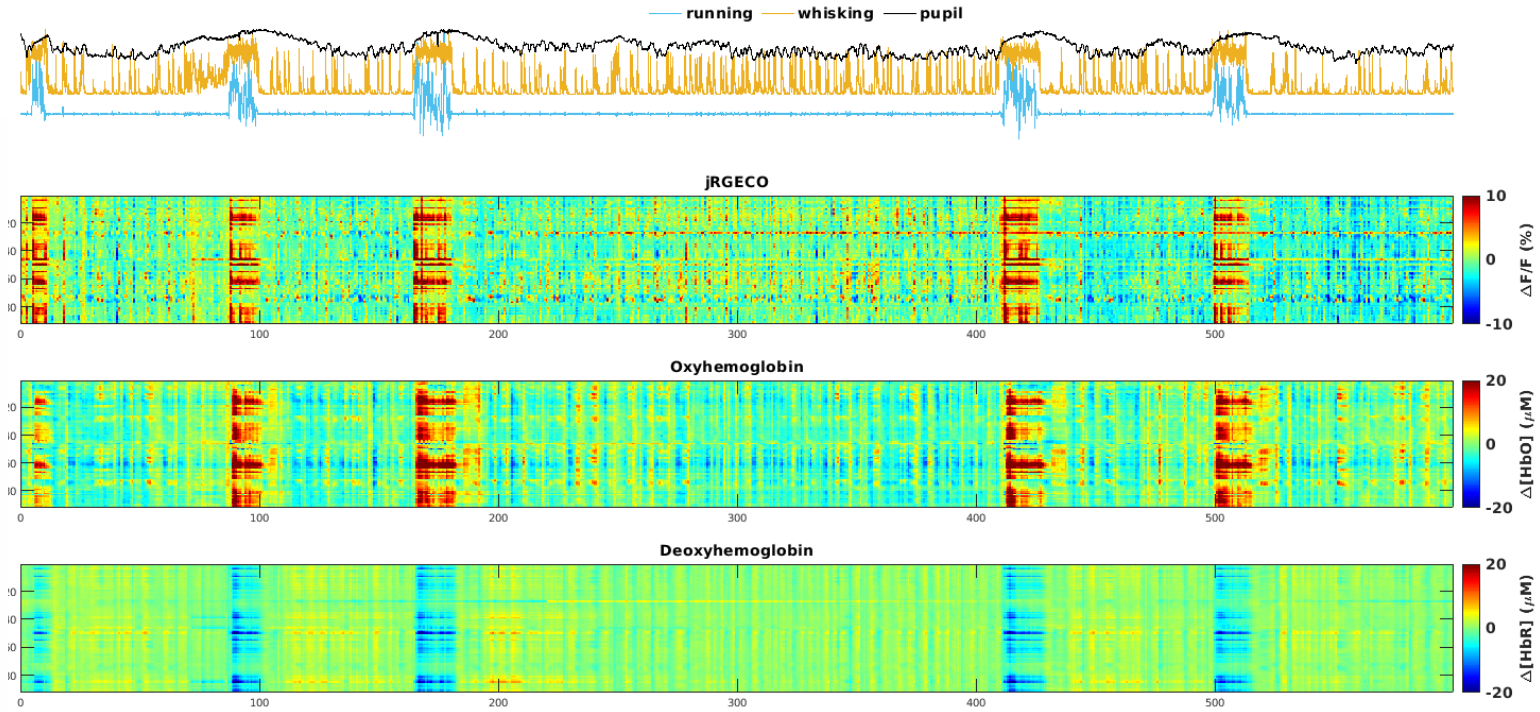
Debbie Maizels/Nature Publishing Group

Abi-Dargham & Horga., 2016

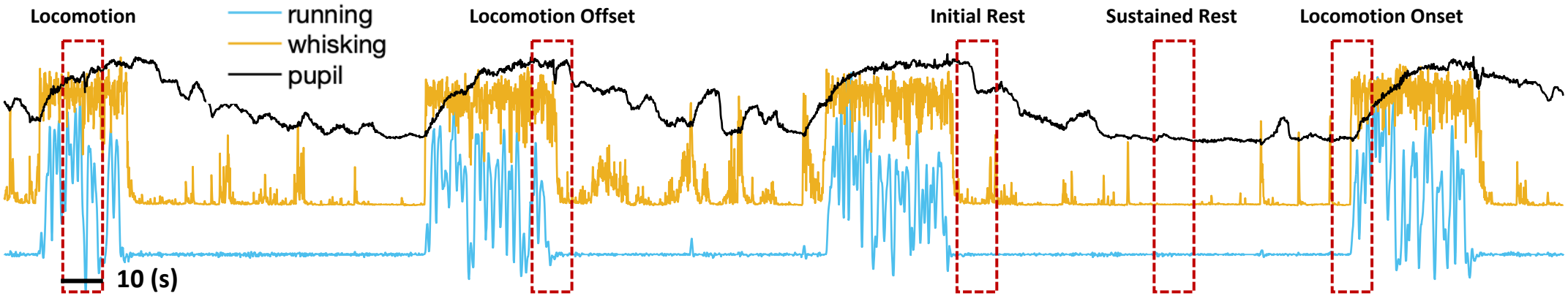
Characterizing what drives the underlying neural phenomena that induce the dynamics of functional connectivity as observed in fMRI data

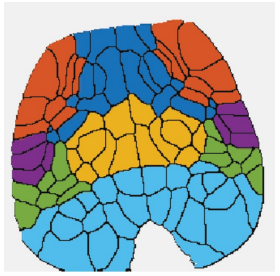
Can spontaneous changes in neuronal patterns of FC be explained by behavioral or physiological variables in the awake, behaving mouse?

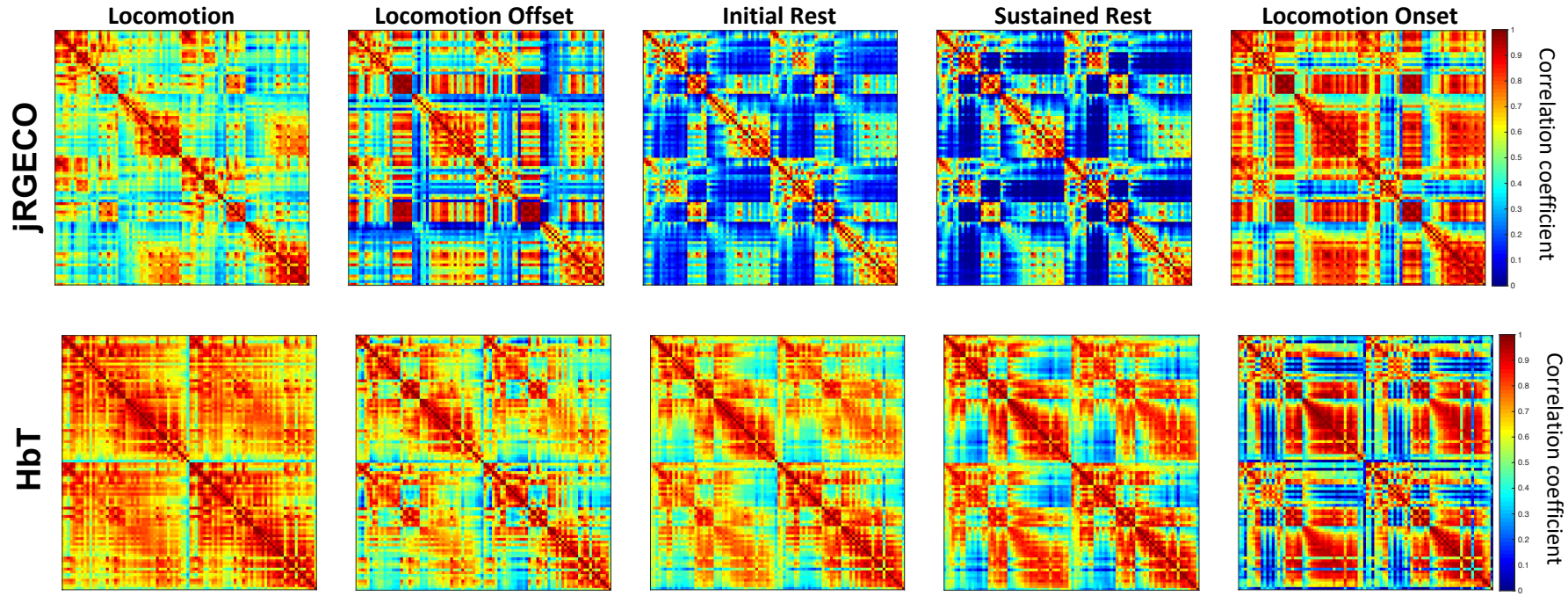




Behavior driven brain states

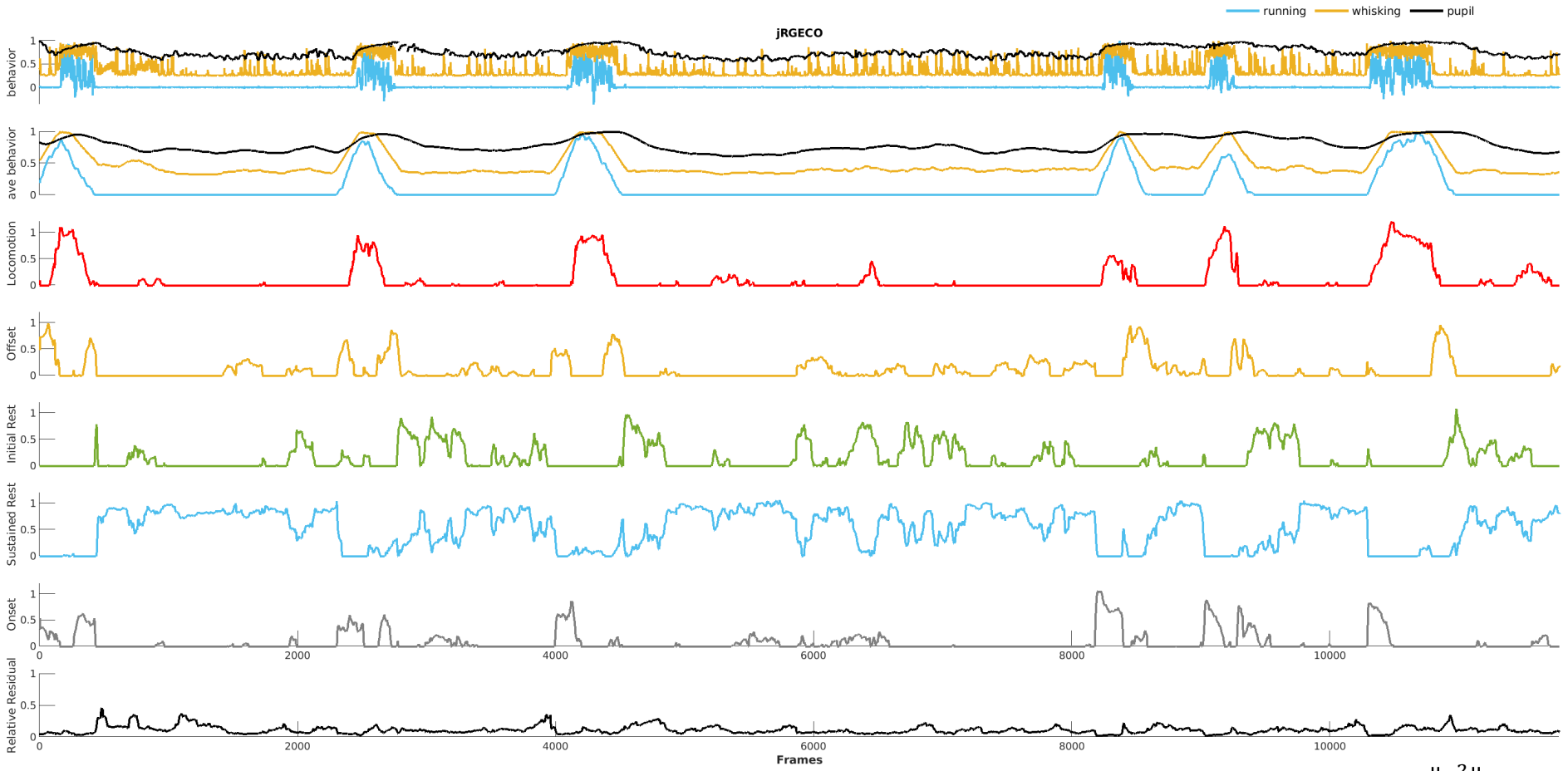






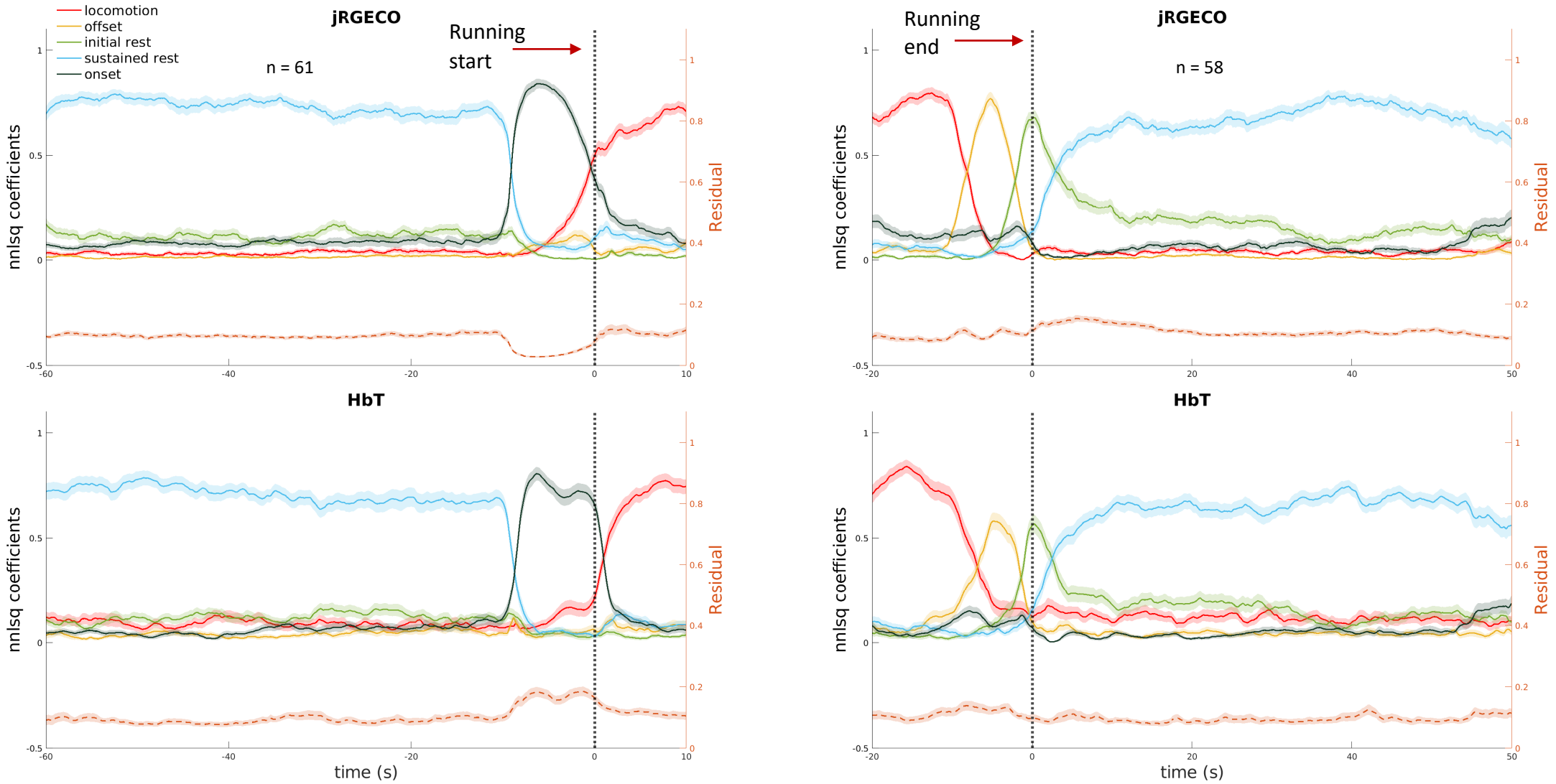
Reconstruction every FC map using non-negative least squares

One example of recording sessions

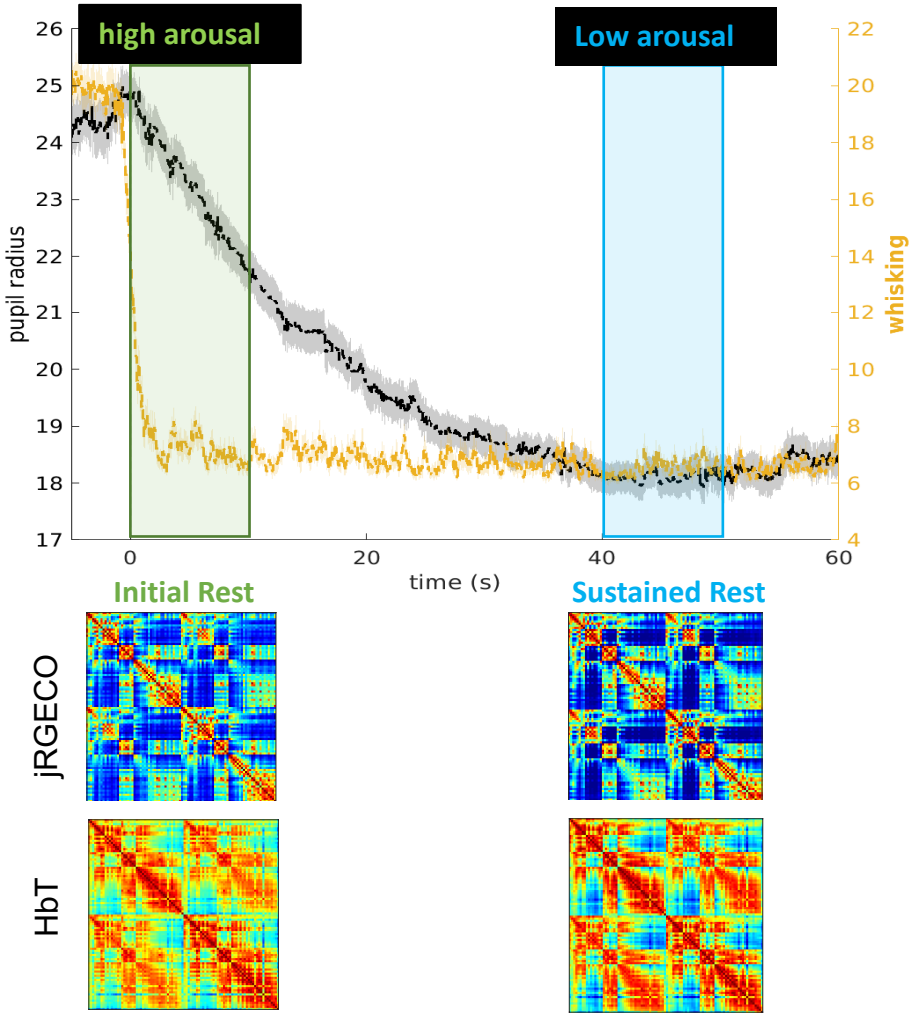


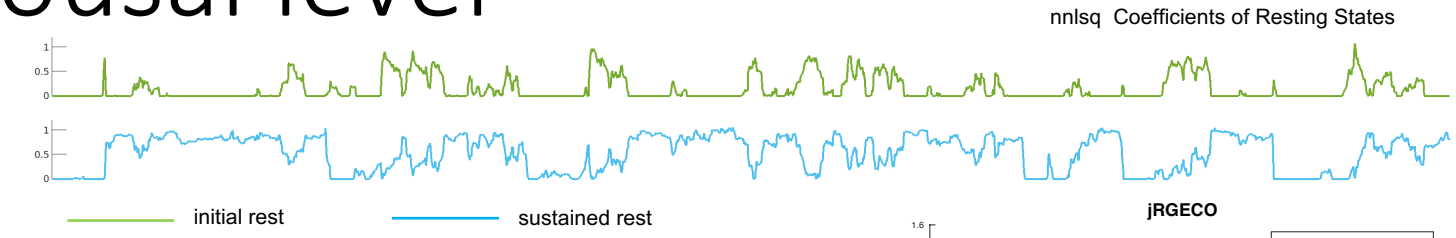
Relative residual: $\frac{\|\epsilon^2\|_1}{\|d^2\|_1}, \|\epsilon^2\|_1 = \|(d - cx)^2\|_1$

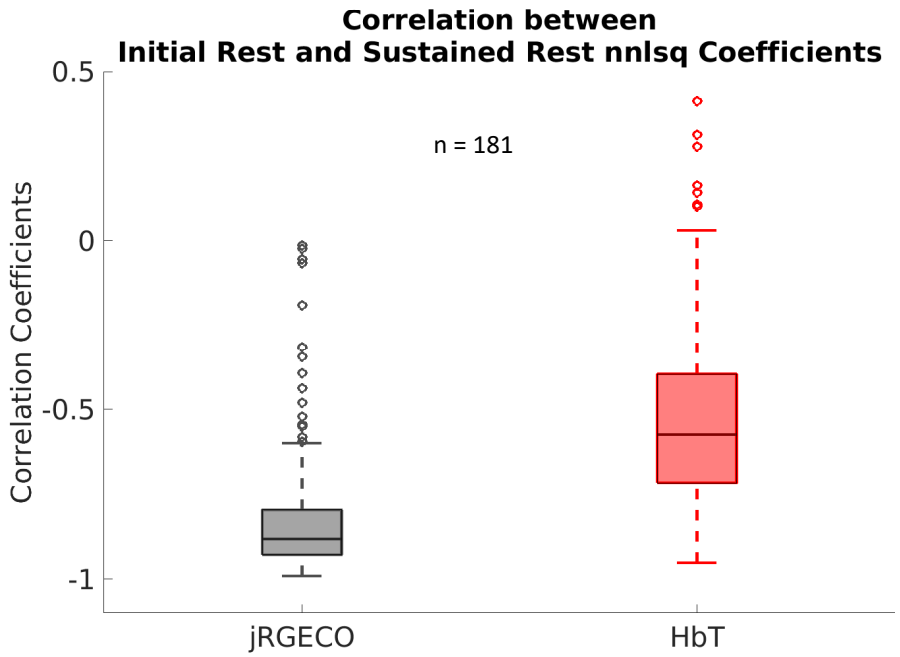
Spontaneous fluctuating correlations are linked to behavior

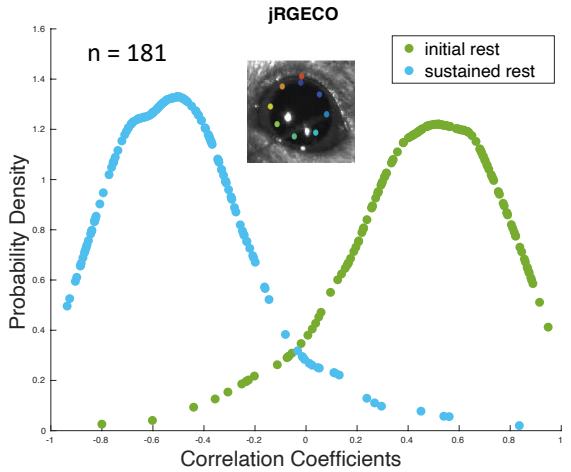


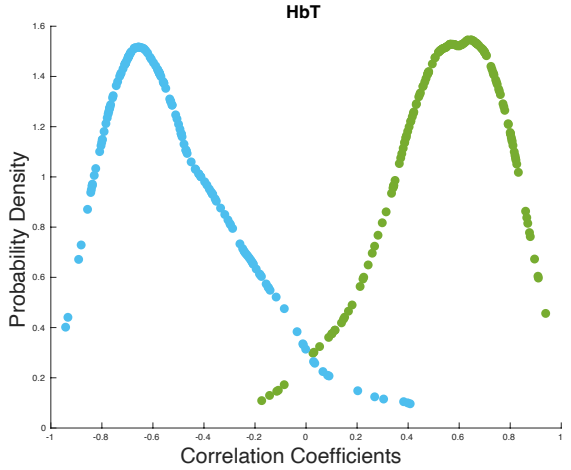
Spontaneous changes in resting-state FC can be explained by arousal level











Summary

- Captured neural activity, exhibiting time-resolved correlation patterns
- Identified ‘brain states’ representing not only changes in physical activity but also switches between the resting states
  - These switches corresponded to pupil size, suggesting the resting states track changes in arousal
- These effects were detected in hemodynamic responses
- Our study provides evidence supporting that fMRI resting state dynamic functional connectivity can capture neural state transitions, tracking changes in arousal and behavior

Elizabeth Hillman
PI

Nic Thibodeaux
PhD Candidate

Fatema Lodgher
PhD Candidate

COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK

@HillmanLab

Bahar Shahsavarani
Post-Doc

Weihao Xu
PhD Candidate

CJ Nwokeabia
Research Staff

COLUMBIA | ZUCKERMAN INSTITUTE
Mortimer B. Zuckerman Mind Brain Behavior Institute

ss6238@columbia.edu

Peter Bandettini
PI

Javier Gonzalez-Castillo
Staff Scientist

Daniel Handwerker
Staff Scientist

NIH
National Institute of Mental Health

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