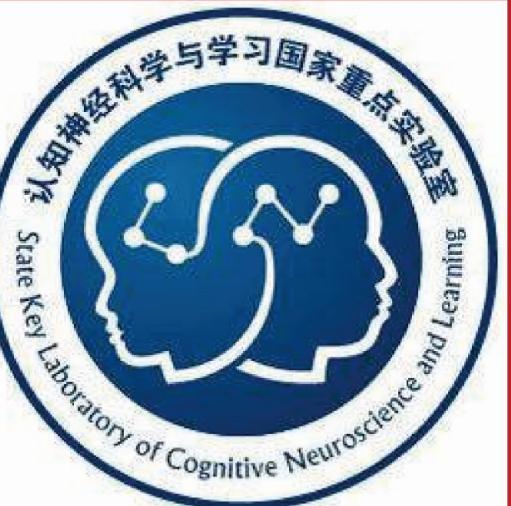


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Junxing Xian¹, Yini He^{2,1}, Xiaohan Tian¹, Yingjie Peng²,
Jing Lou¹, Bing Liu^{1*}, Ang Li^{2*}

1. State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University, Beijing, 100091, China.
2. State Key Lab of Brain and Cognitive Science, Institute of Biophysics, Chinese Academy of Sciences, Beijing, 100101, China.

Probing Individual Differences in the Topological Landscape of Naturalistic Brain Dynamics

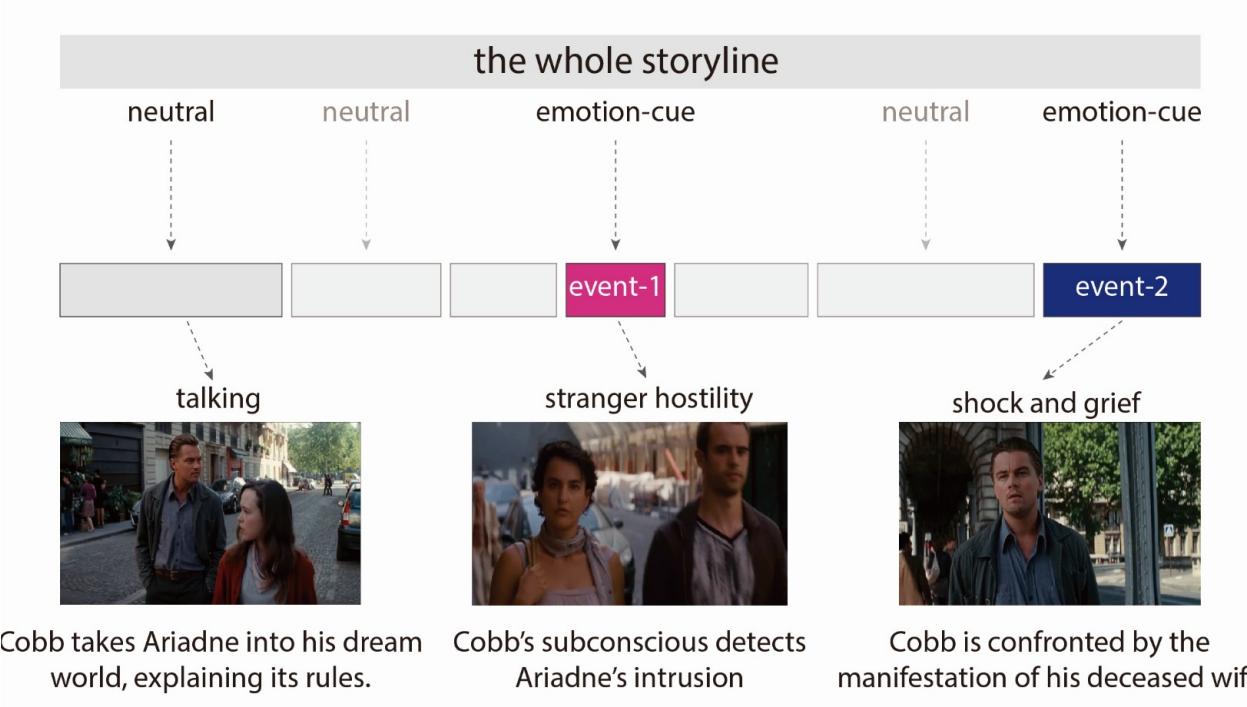
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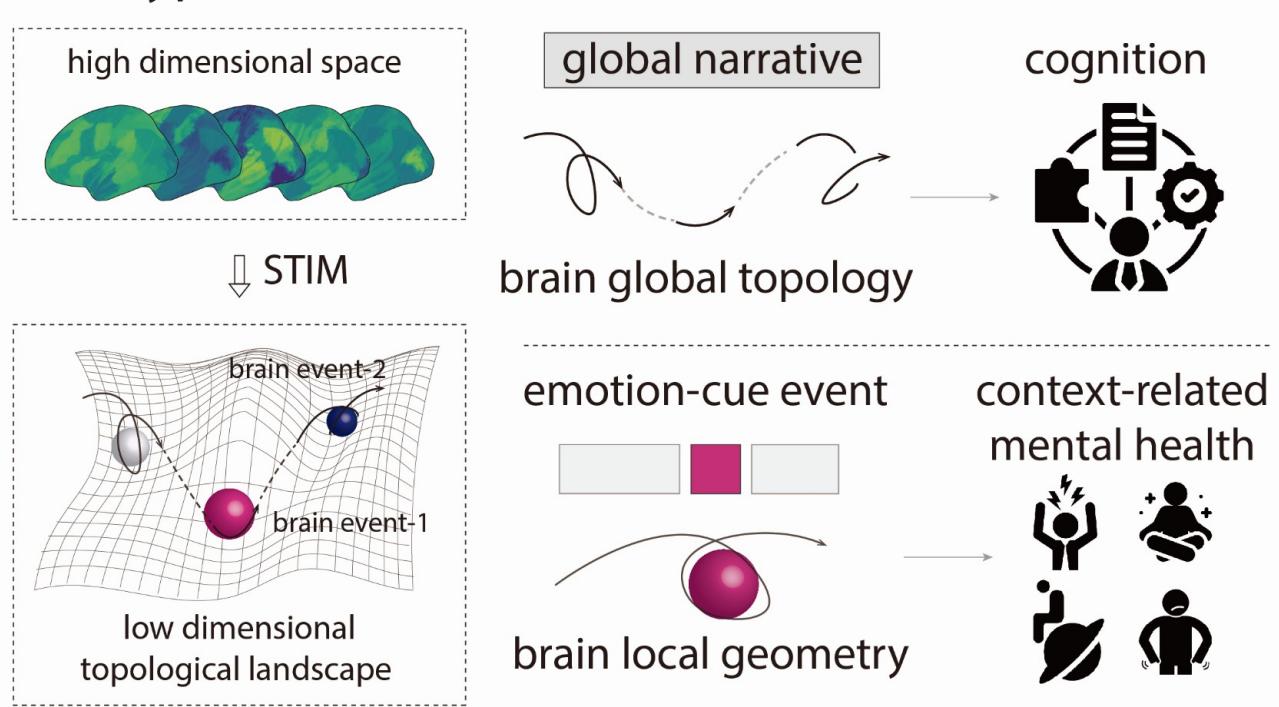
Introduction

Understanding individual differences in real-world brain dynamics is crucial for psychiatry. We present STIM, a topological data analysis framework that reliably captures each person's low-dimensional brain landscape and local dynamics under naturalistic stimuli like movie watching. Applied to large-scale fMRI data, STIM reveals distinct global (cognition-related) and local (context-related mental health) topological features. These features significantly correlate with individual cognitive abilities and psychological well-being, generalize across datasets, and detect mental abnormalities such as autism. STIM provides a powerful unsupervised tool for personalized insights into brain function in complex, realistic scenarios.

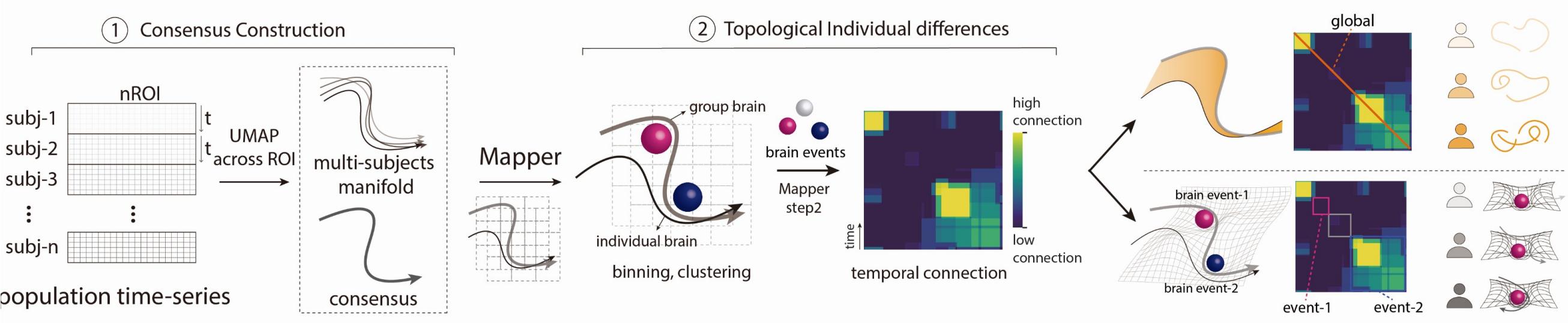
The hierarchical structure of naturalistic stimuli



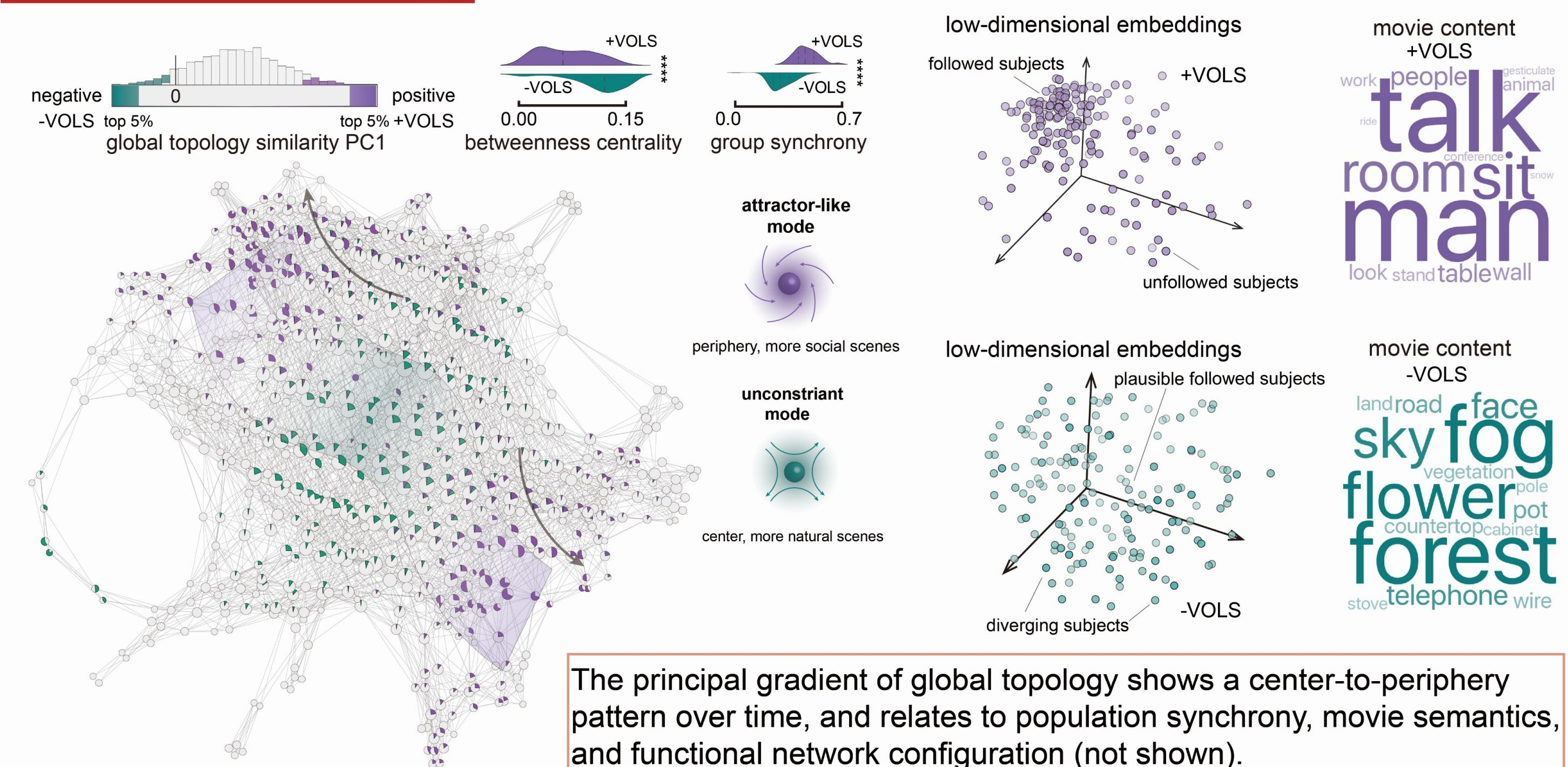
Our hypothesis



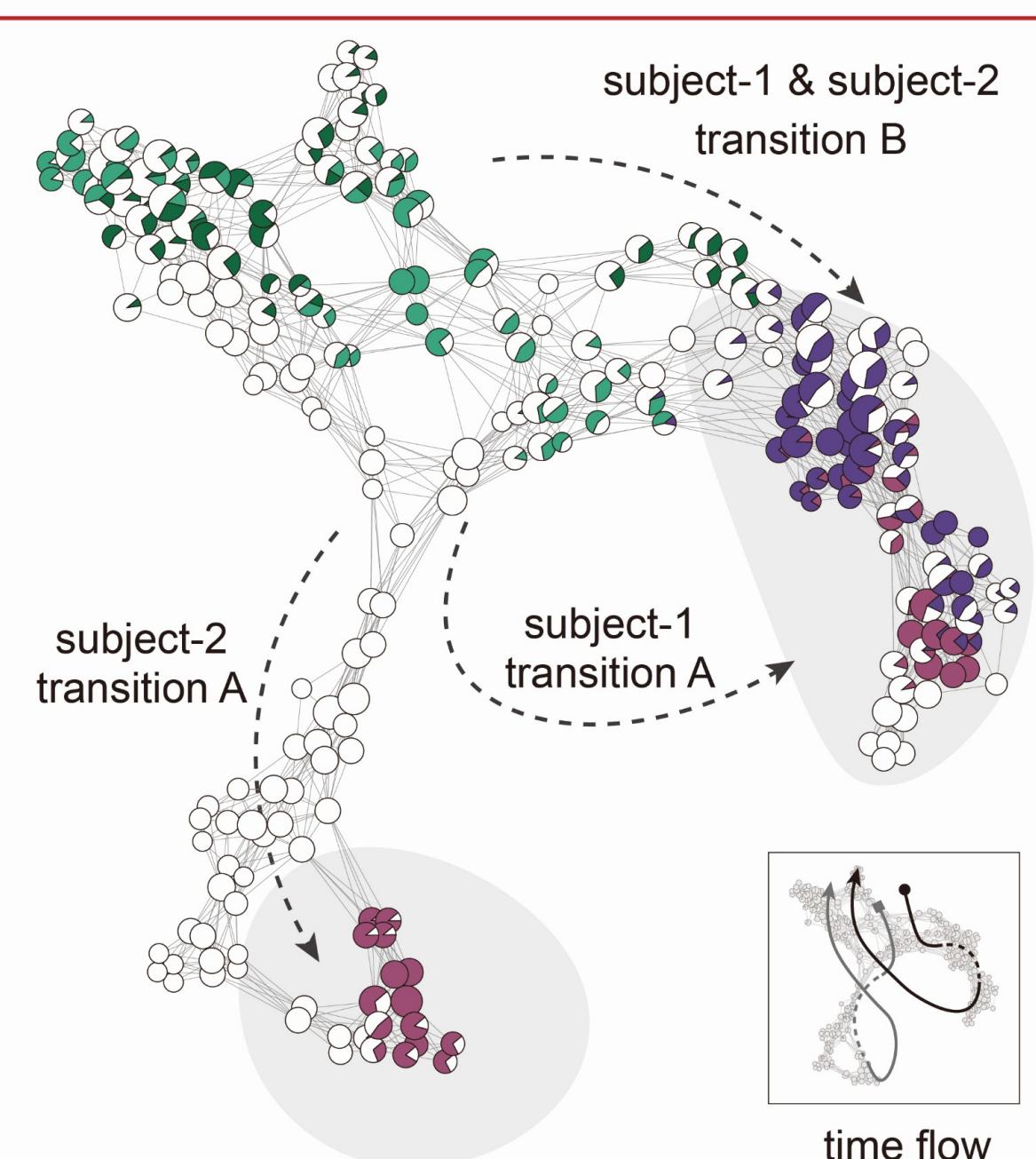
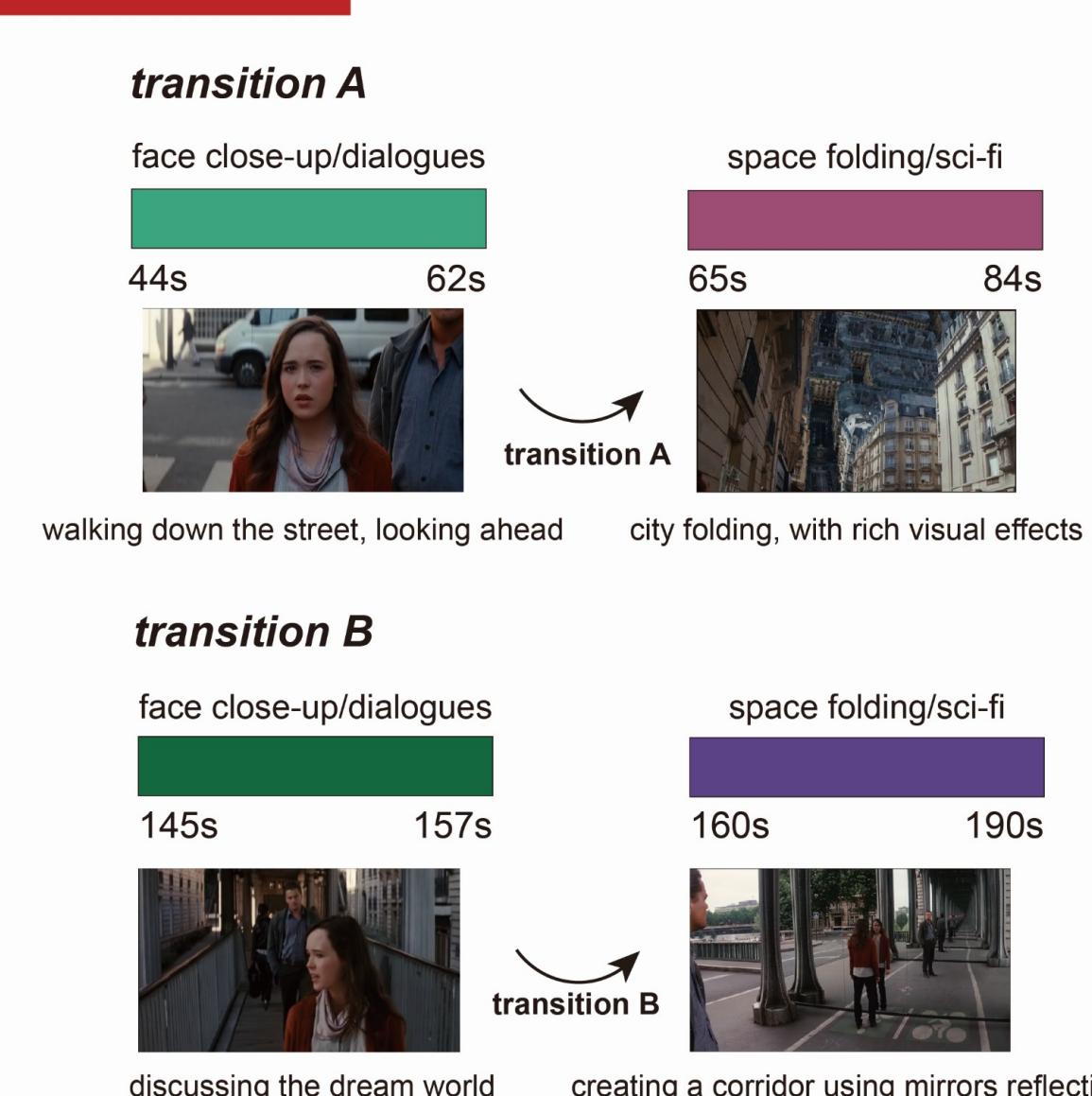
Synchronized Topological Individual Mapper (STIM) pipeline



Global Topology

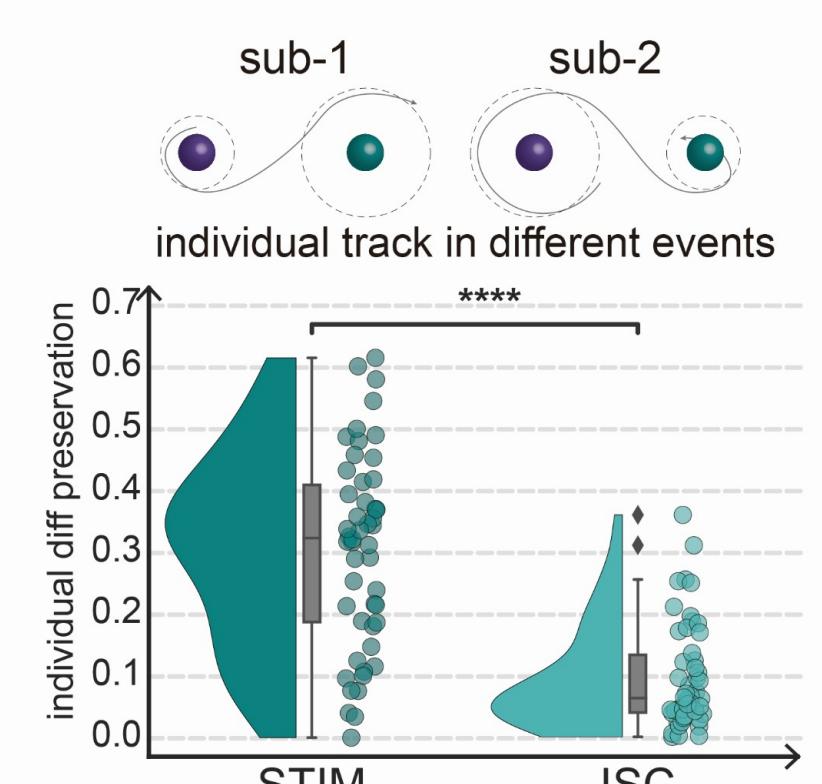
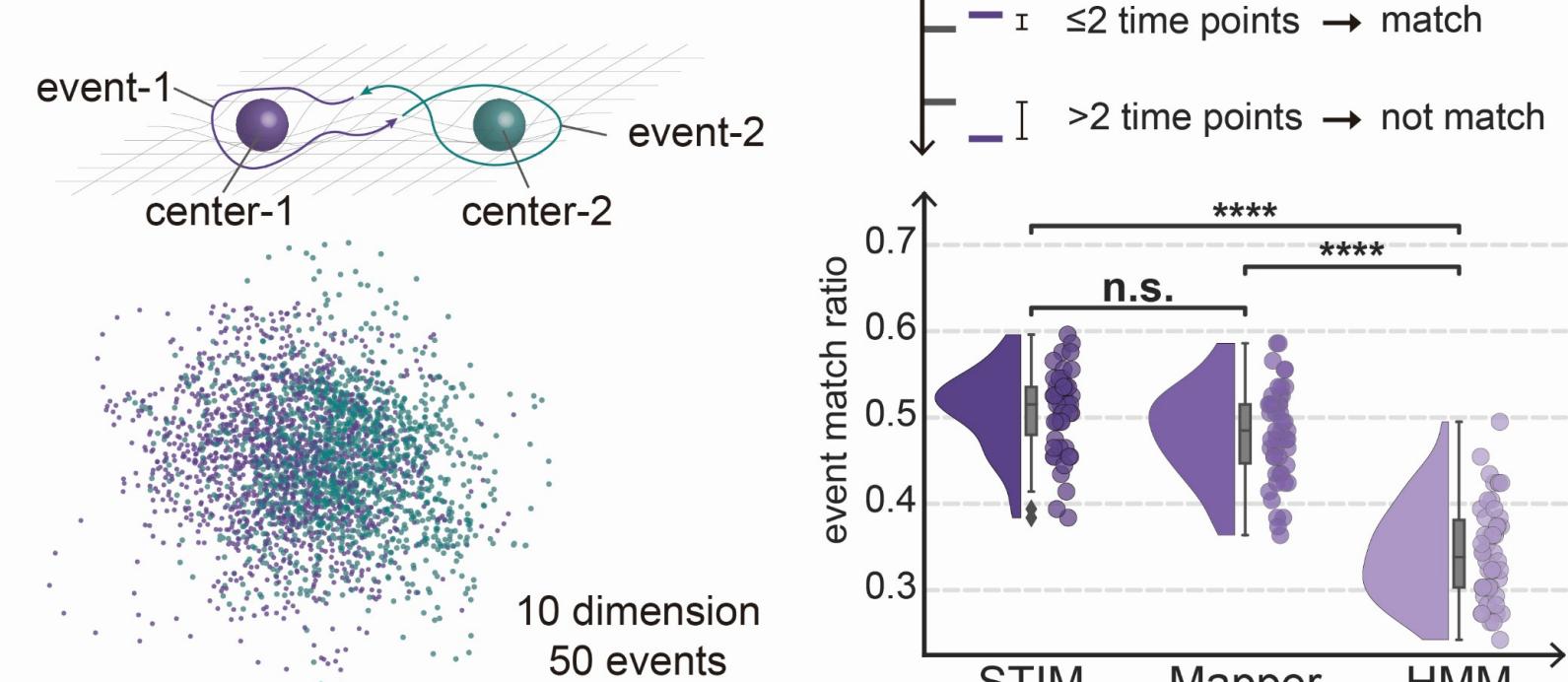


STIM



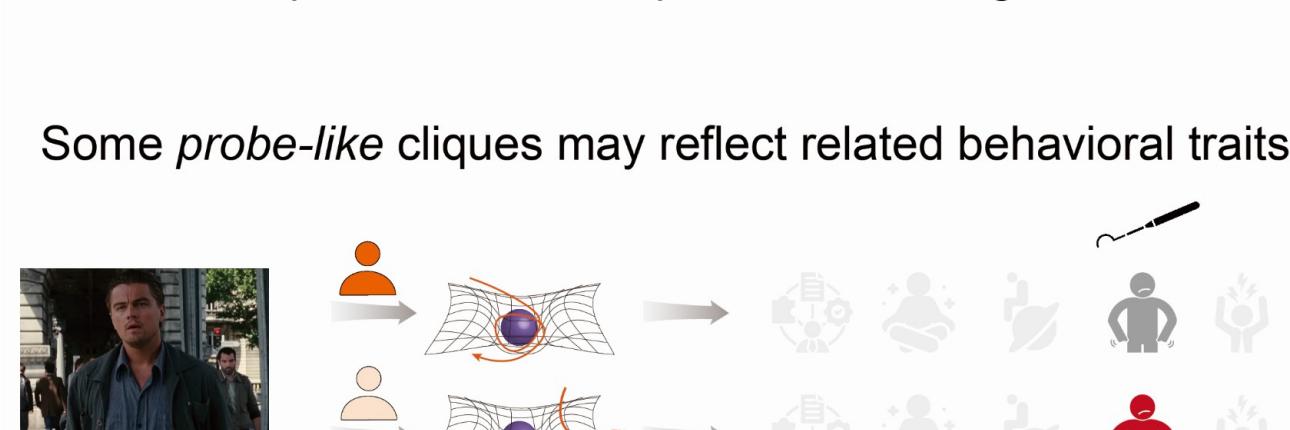
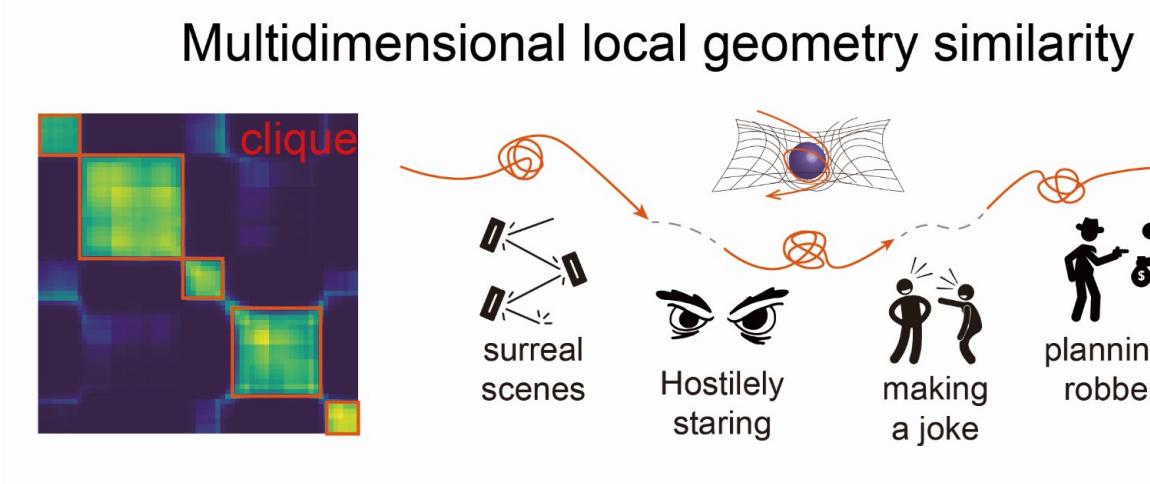
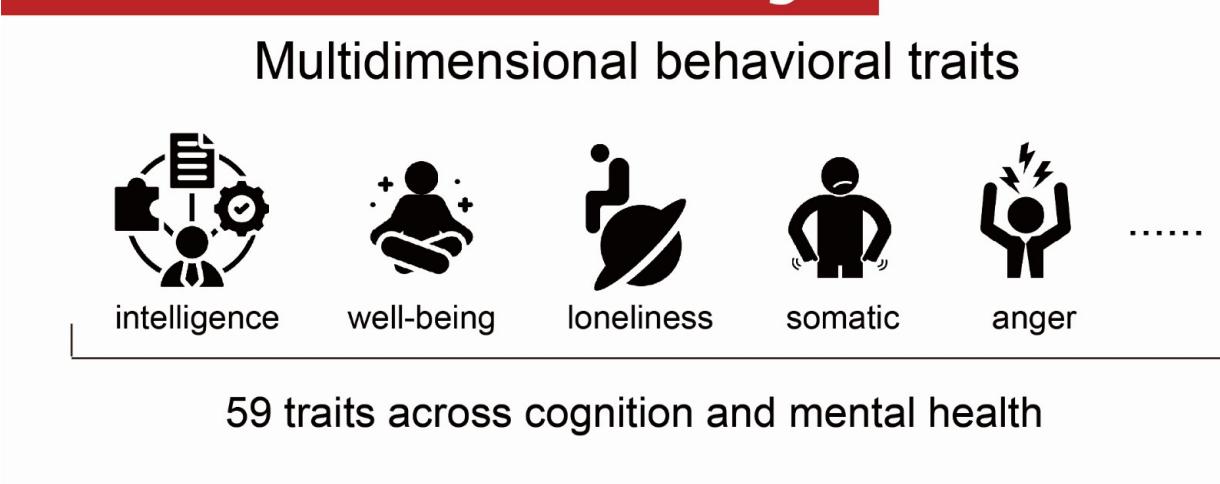
STIM maps different individuals into a common low-dimensional space while preserving individual-specific dynamic topology.

two attractor-like states

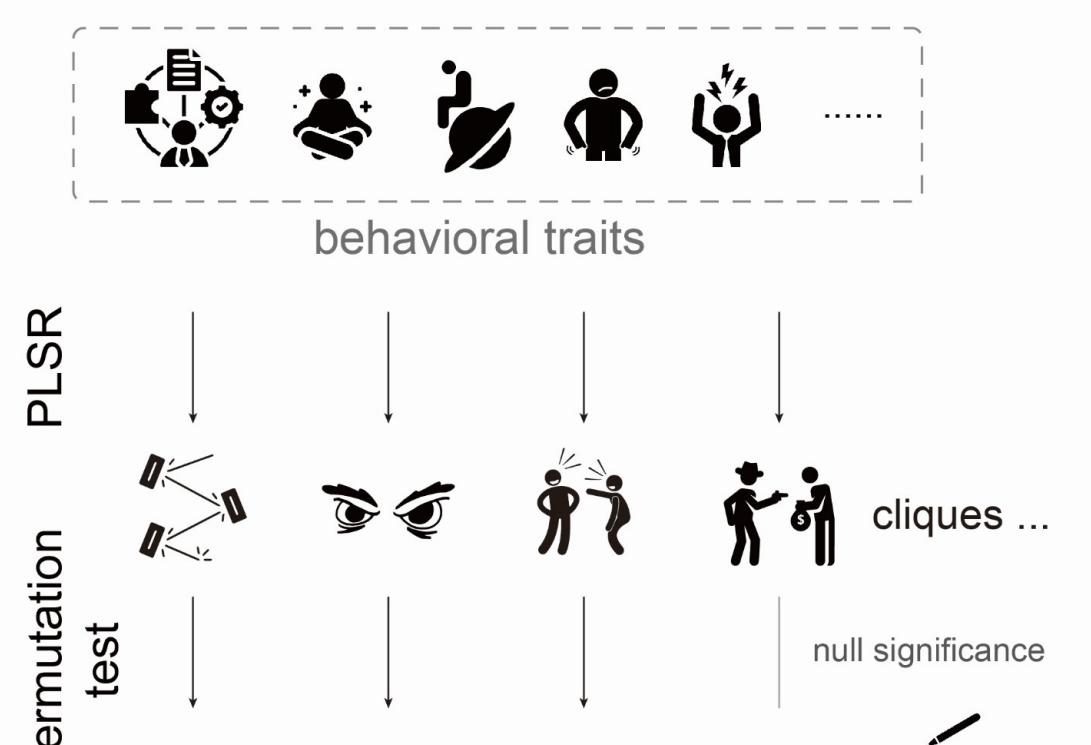


STIM achieves more accurate event segmentation and better preserves individual differences in simulated data.

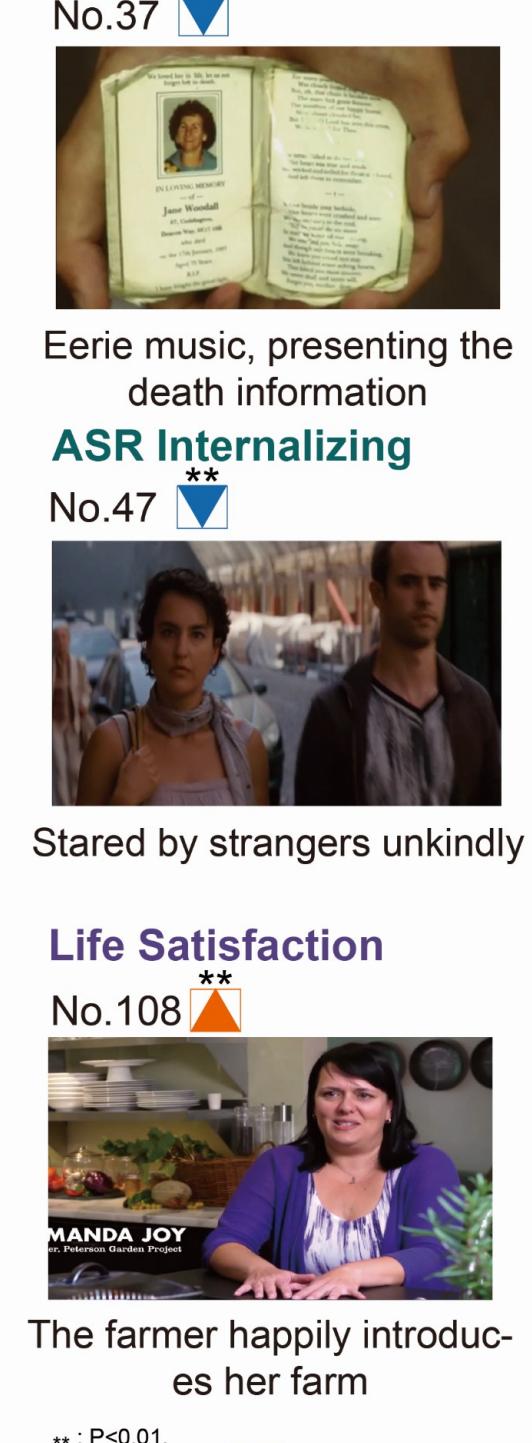
Local Geometry



Selection of probe-like cliques



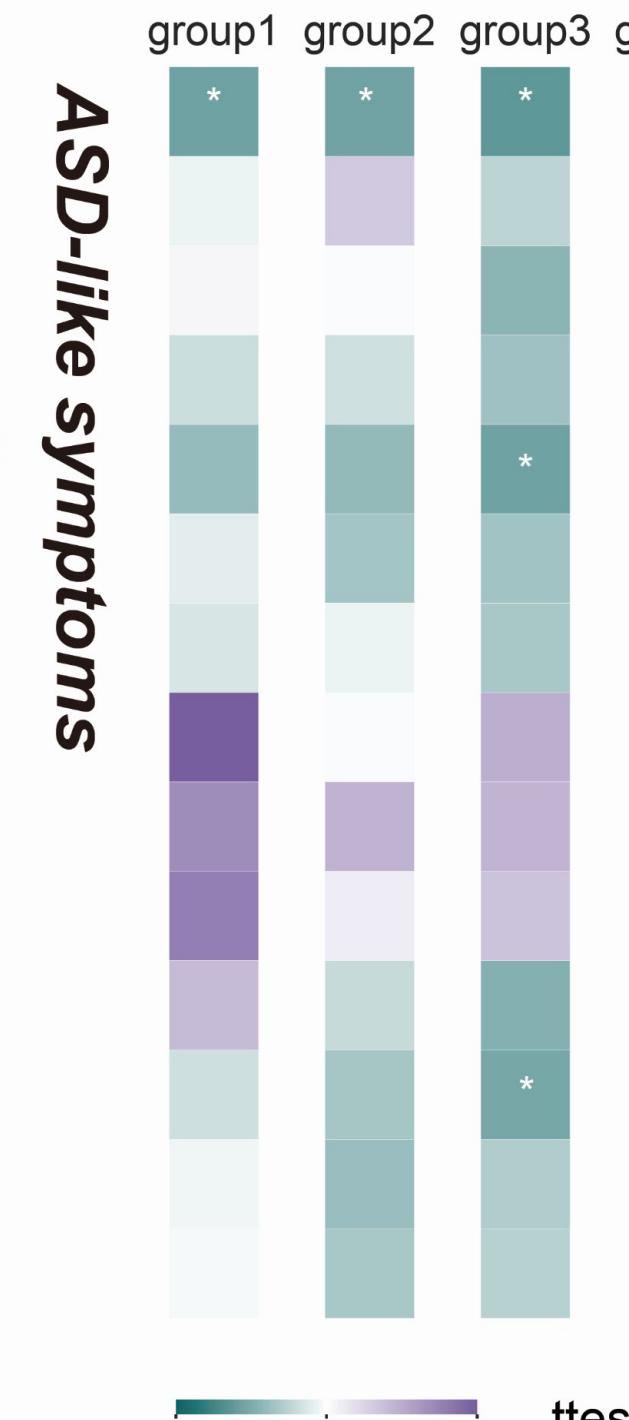
DSM Somatic Problems



Repetitive Behaviors



Increased severity



ASD-like symptoms

