

Local edge perturbations as a measure for community persistence in complex networks

Brennan Klein

klein.br@northeastern.edu

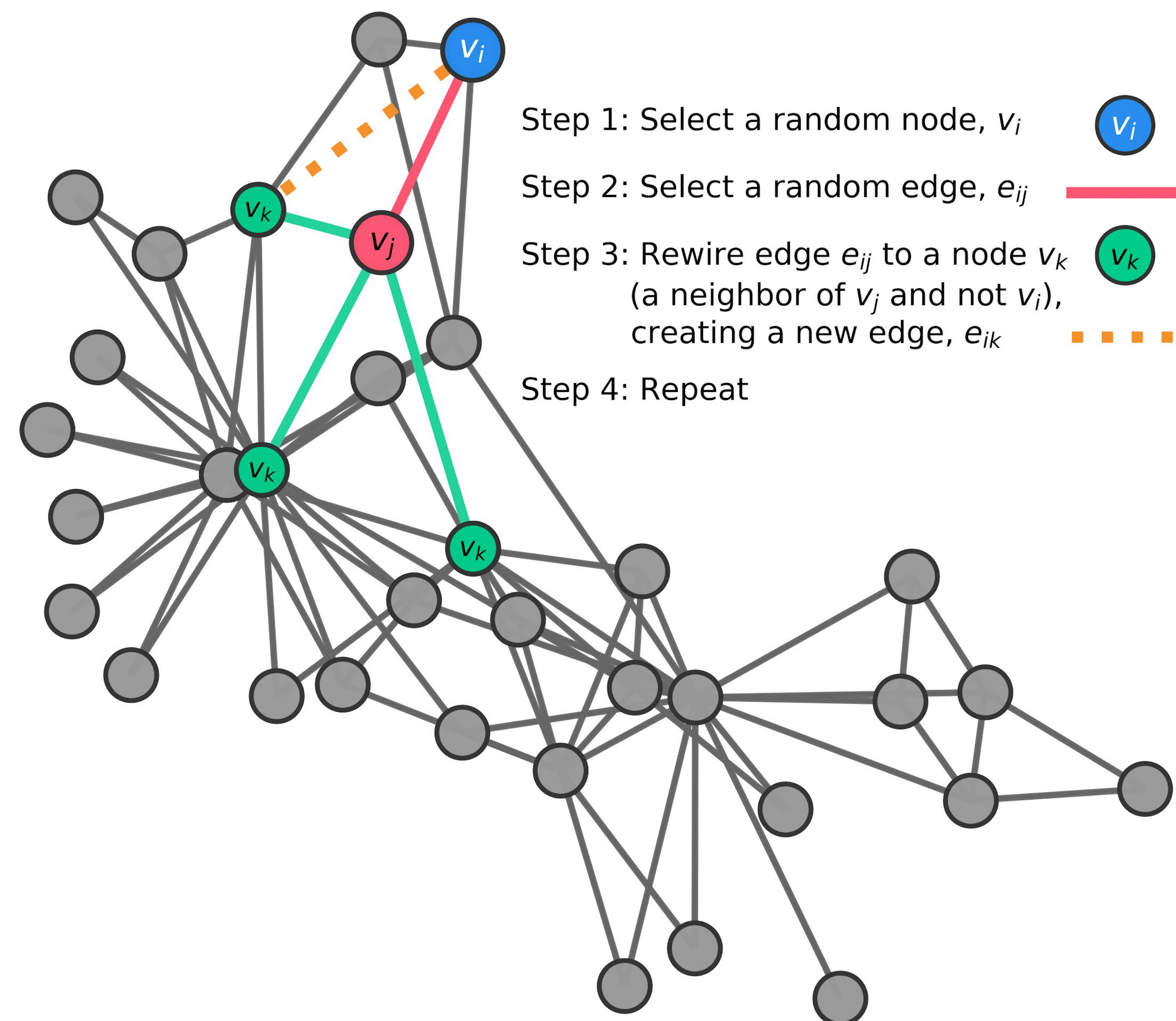
Stefan McCabe

mccabe.s@northeastern.edu



Northeastern University
Network Science Institute

Local edge perturbation (LEP)



Key takeaways

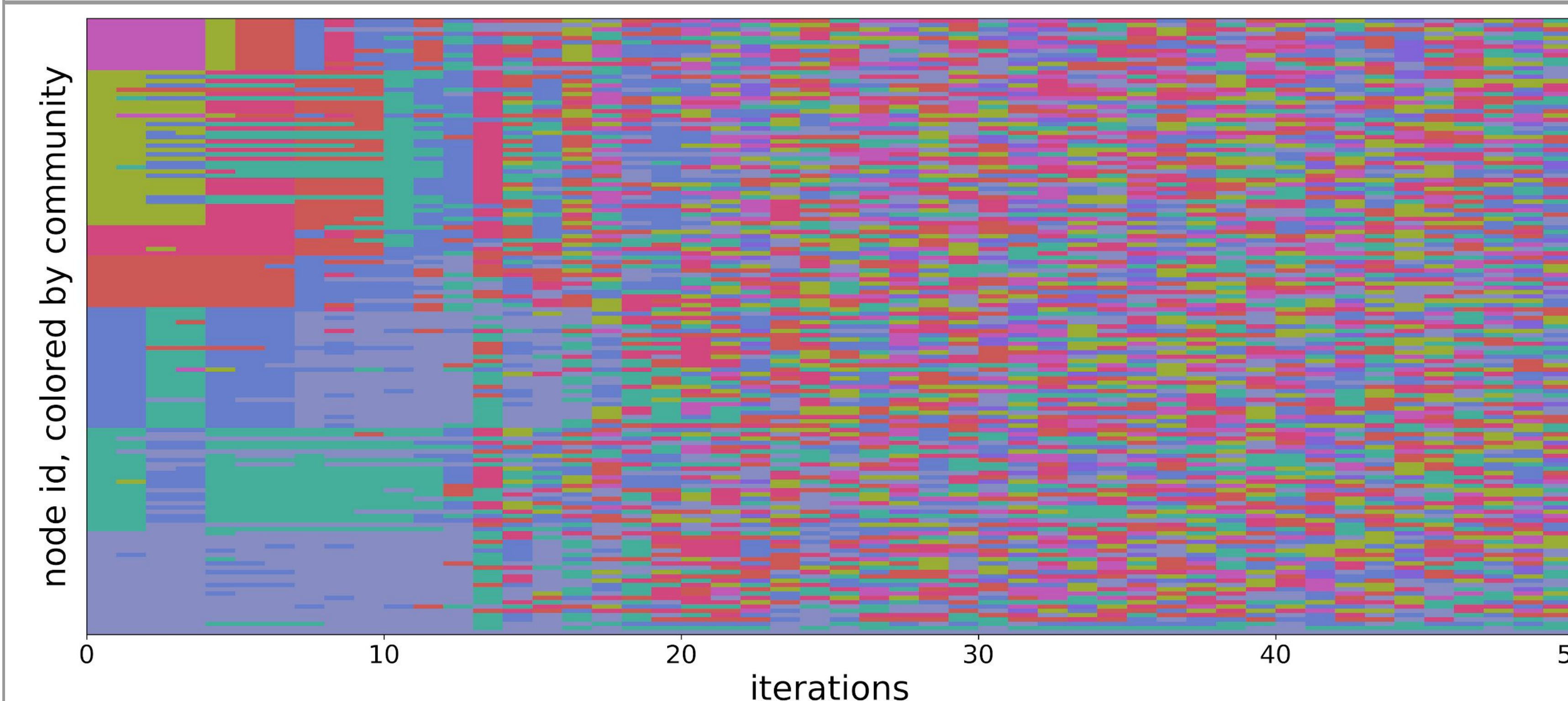
1. Network communities are common and often have crucial roles in maintaining normal functioning.
2. Community structure can decay due to noise, which can in turn affect behavior or function.
3. We define a local edge rewiring scheme designed to quantify the persistence of community structure.

Advice we would love

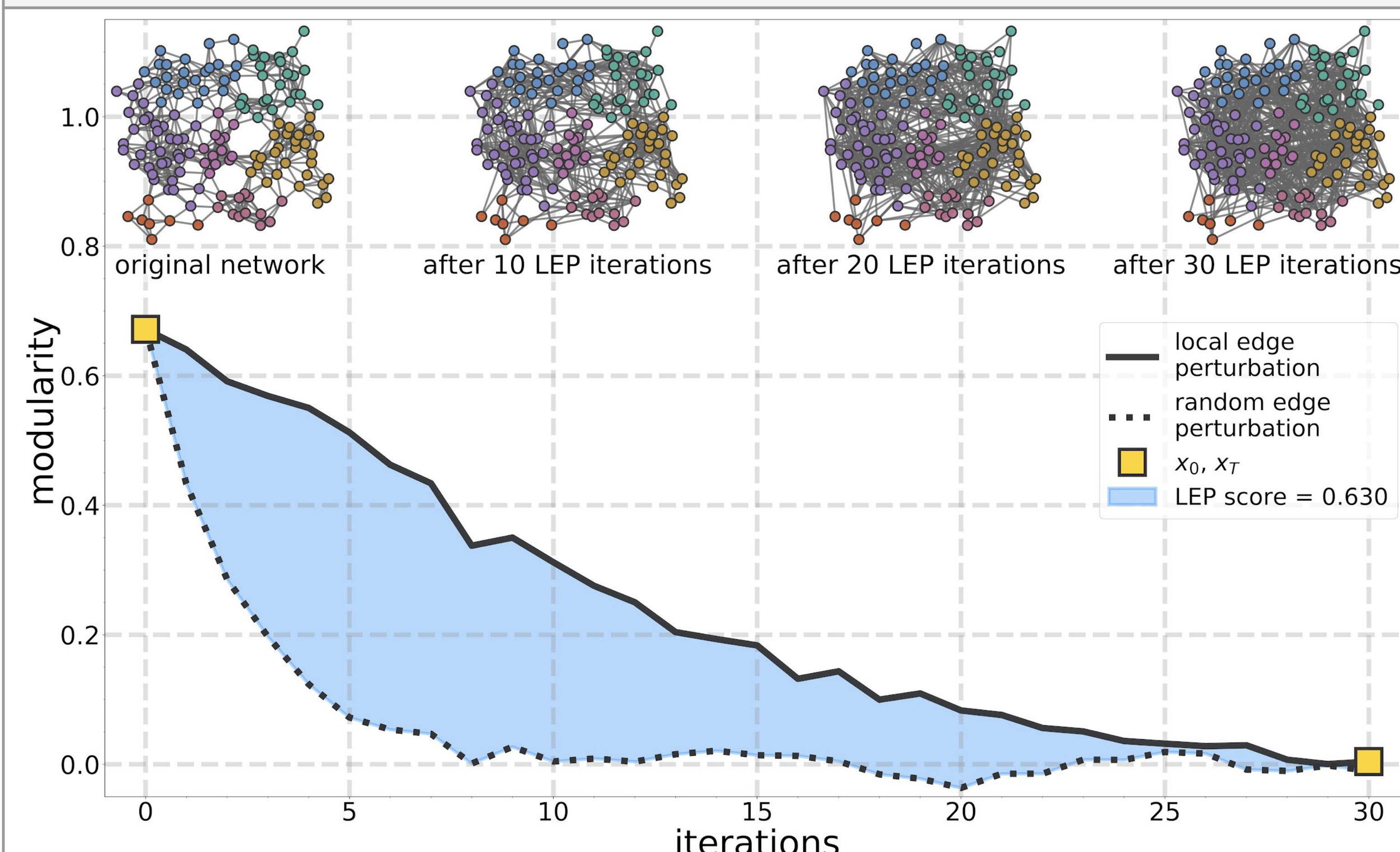
1. We tested this method on brain networks: any other applications?
2. Can we use this for comparing community detection methods?

Community persistence: what and why?

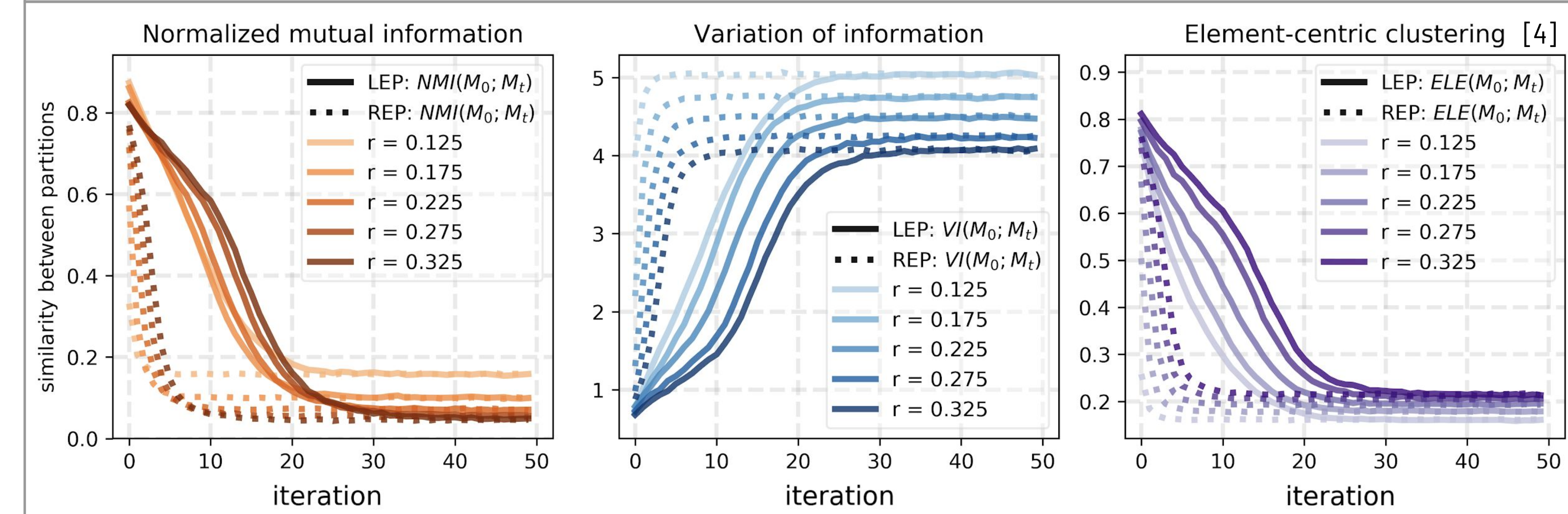
We observe community structure across a wide range of networks [1]. Often, this modular structure is crucial for the typical functioning of the network. Existing methods [2] assess community robustness via random edge rewiring, which can impose unrealistic assumptions about plausible network connections.



Decay of community structure

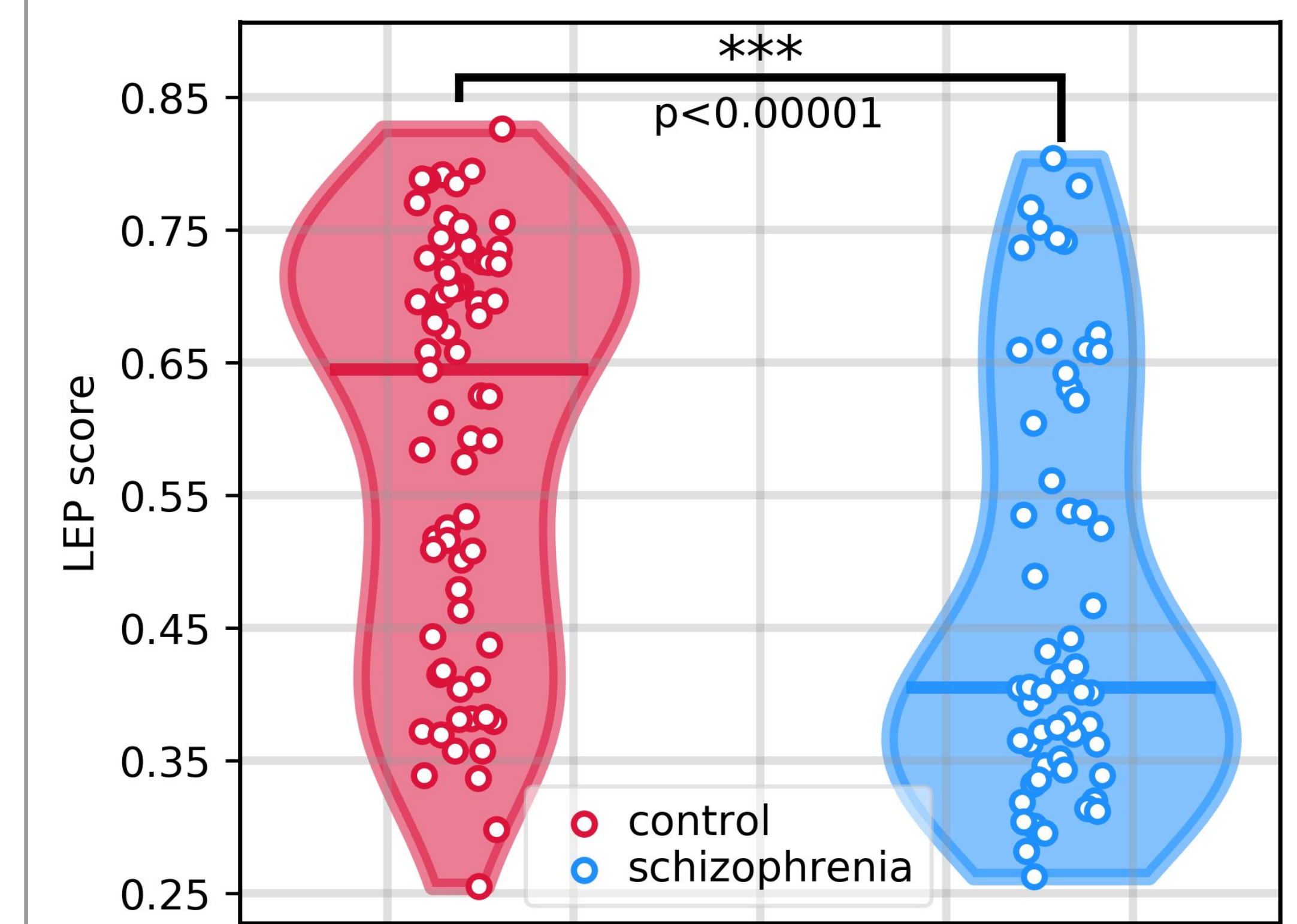


Local rewiring reveals patterns in modularity loss



Community persistence: robustness of function

We calculated the LEP scores of the functional networks of 62 patients who have been diagnosed with schizophrenia as well as healthy controls [3], and we observed significantly **higher** LEP scores in brains of healthy controls, suggesting a crucial role played by network modularity.



References

- [1] Fortunato, S. (2010). Community detection in graphs. *Physics Reports*, 486(3-5), 75-174.
- [2] Karrer, B., Levina, E., & Newman, M. E. (2008). Robustness of community structure in networks. *Physical Review E*, 77(4), 046119.
- [3] Vaša, F., Bullmore, E. T., & Patel, A. X. (2018). Probabilistic thresholding of functional connectomes: Application to schizophrenia. *Neuroimage*, 172, 326-340.
- [4] Gates, A. J., Wood, I. B., Hetrick, W. P., & Ahn, Y. Y. (2017). On comparing clusterings: An element-centric framework unifies overlaps and hierarchy. arXiv preprint arXiv:1706.06136.

