Effect of Cognitive Control on the Structure of fMRI Derived Graphs

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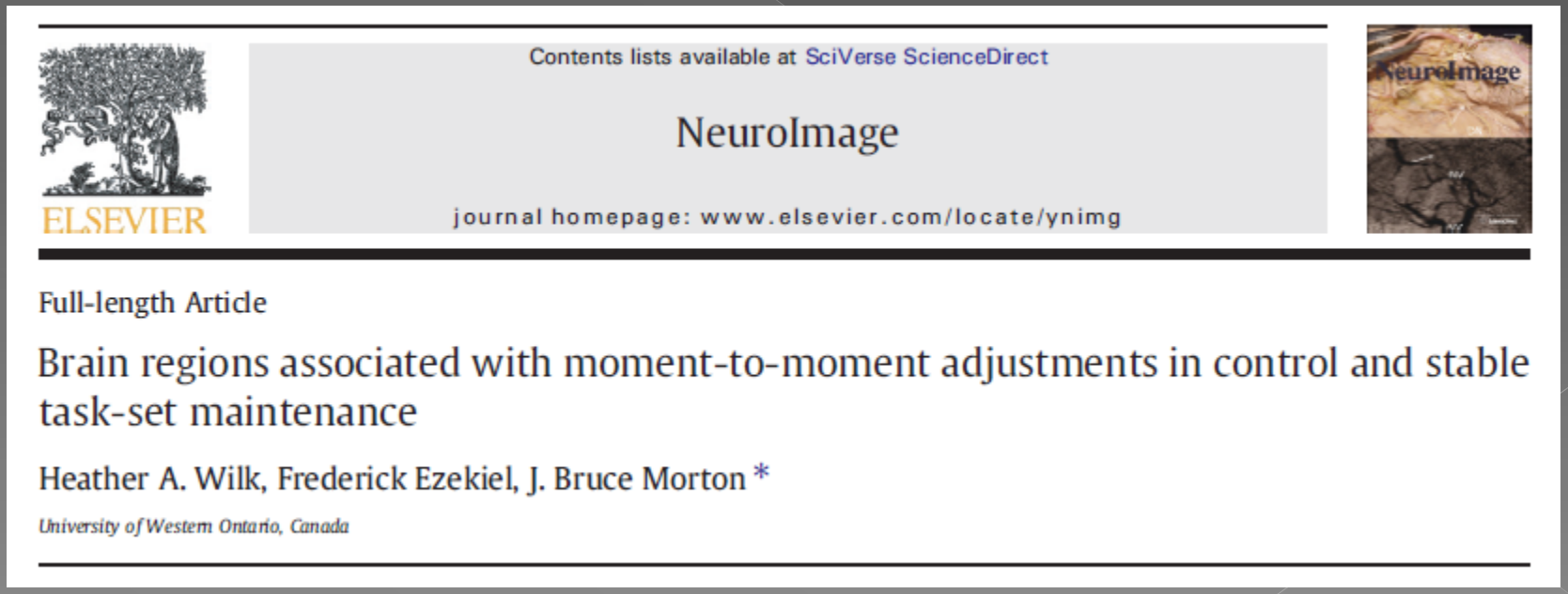
Research Focus

- Look at fMRI and MEG activation within a graph-theoretical framework
- Hopefully, this higher-order perspective will offer new insights

Preliminary Application

- Apply graph-analytical techniques to data from Wilk, Ezekiel and Morton (2011)



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ELSEVIER

Full-length Article

Brain regions associated with moment-to-moment adjustments in control and stable task-set maintenance

Heather A. Wilk, Frederick Ezekiel, J. Bruce Morton *

University of Western Ontario, Canada

Task

- Participants were administered a size congruency task:
  - On each trial, two digits differing both in physical and numerical magnitude were presented simultaneously
  - Participants indicated with a button press which digit was numerically greater

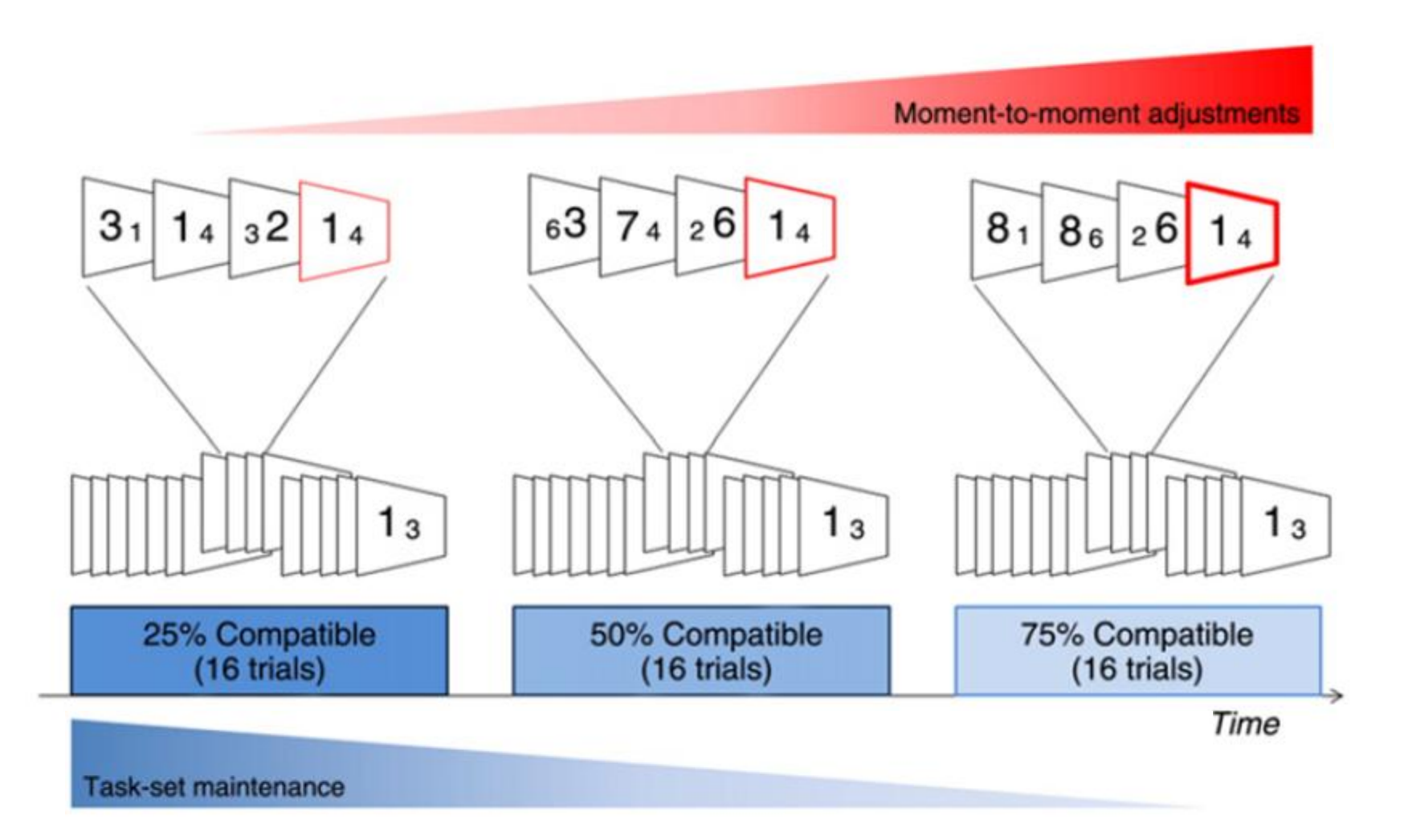
(Wilk, Ezekiel & Morton, 2011)

Task Continued

- On compatible trials, the numerically larger digit was physically larger

Task Continued

- On incompatible trials, the numerically larger digit was physically smaller



(Wilk, Ezekiel & Morton, 2011)

Graph-Theoretical Approach

Approach

- Compare graphs derived from BOLD response data from the four conditions
  - Resting
  - 25% compatible trials
  - 50% compatible trials
  - 75% compatible trials

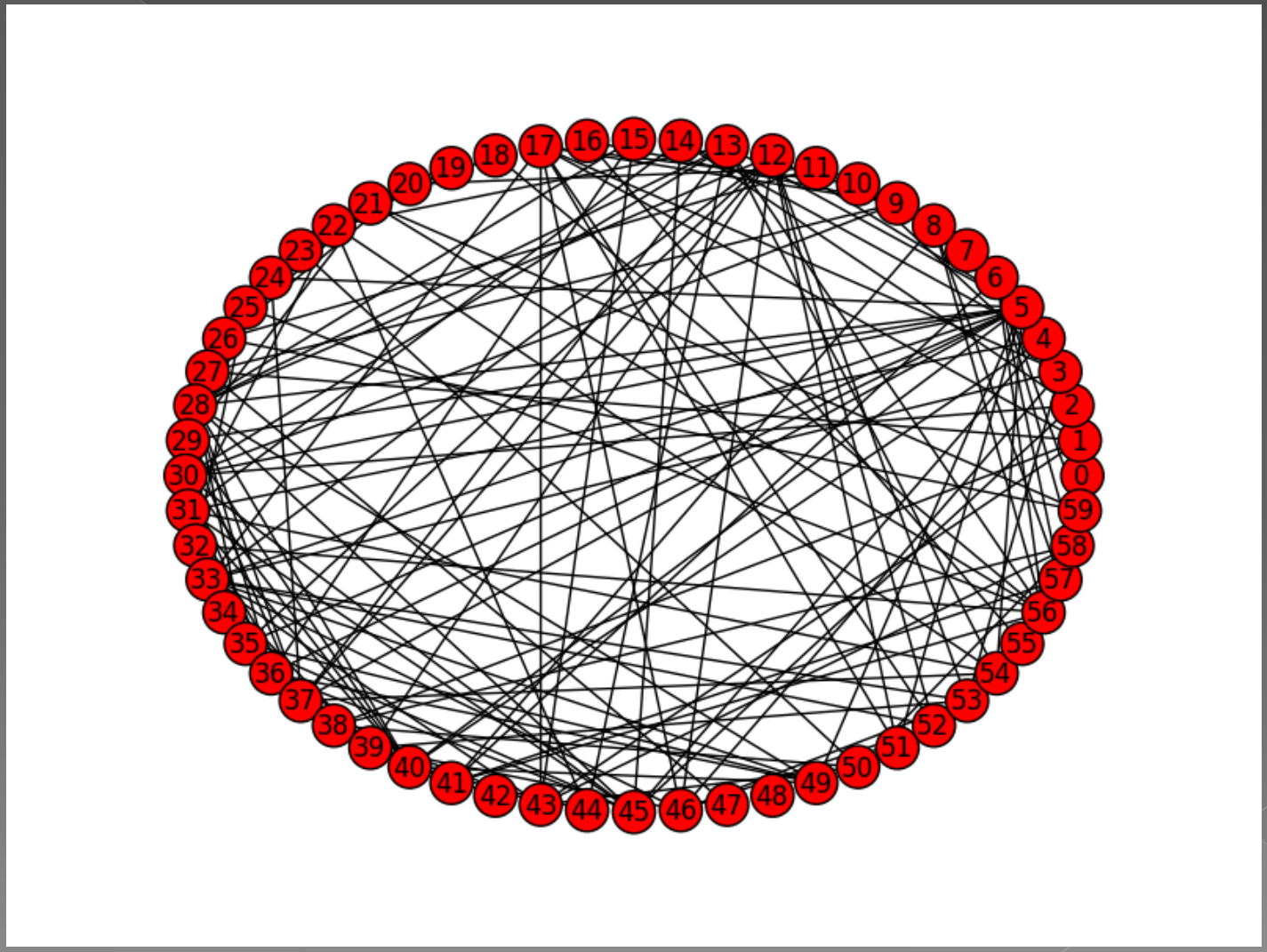
Graph Structure

- Used atlas generated via Spatially Constrained Spatial Clustering to determine ROIs
  - See Craddock et al. (2011)
- ROIs are used as nodes in the graphs
- For each pair of nodes, draw an edge if the two ROIs (nodes) are correlated above threshold

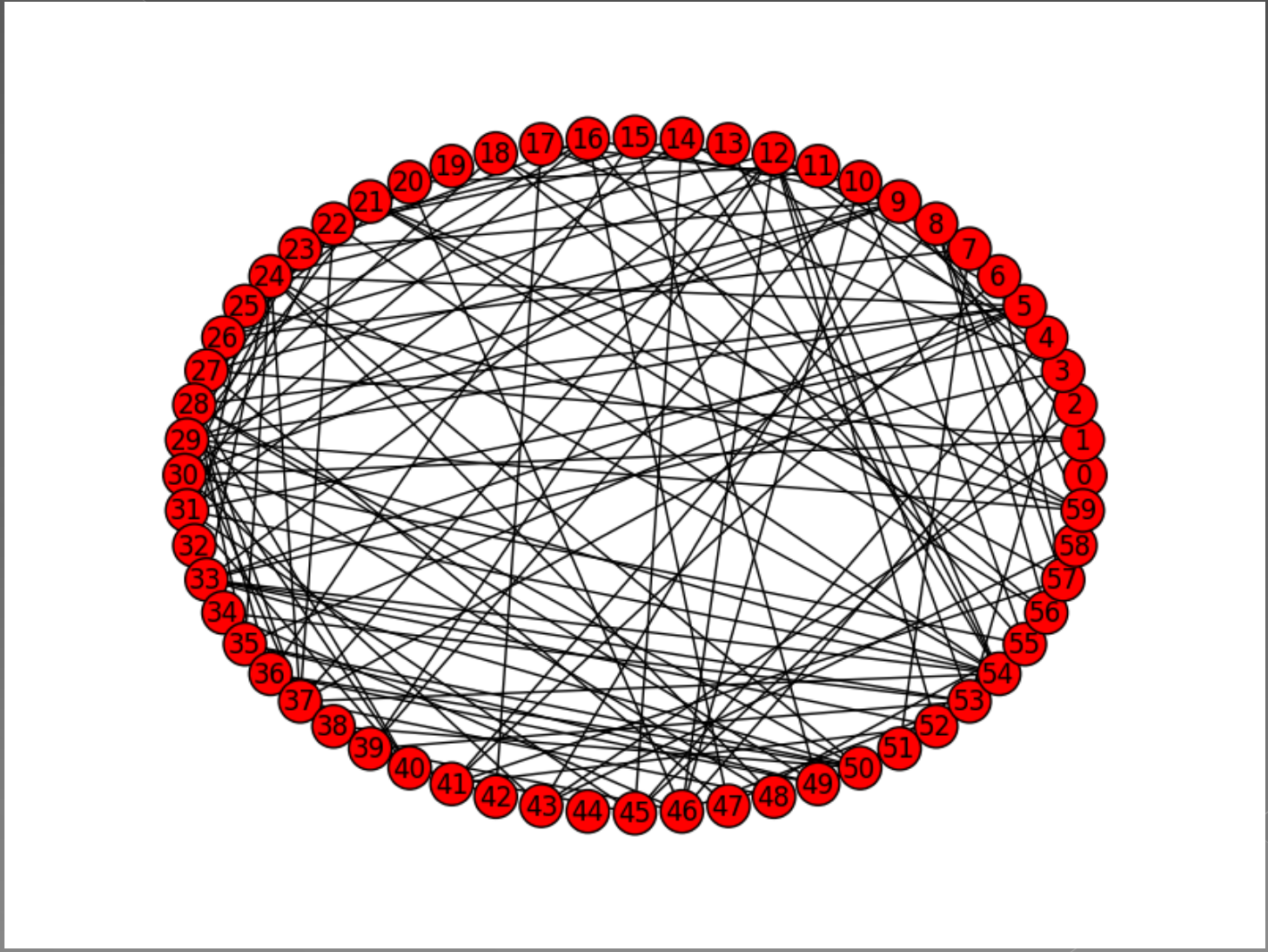
Graph Generation

1. Perform standard fMRI pre-processing
2. Extract BOLD time series for each ROI
3. Compute the Pearson Correlation Matrix for each condition within ROI time series
4. Draw an edge between two ROIs (nodes) if they are correlated above threshold over the condition's time series

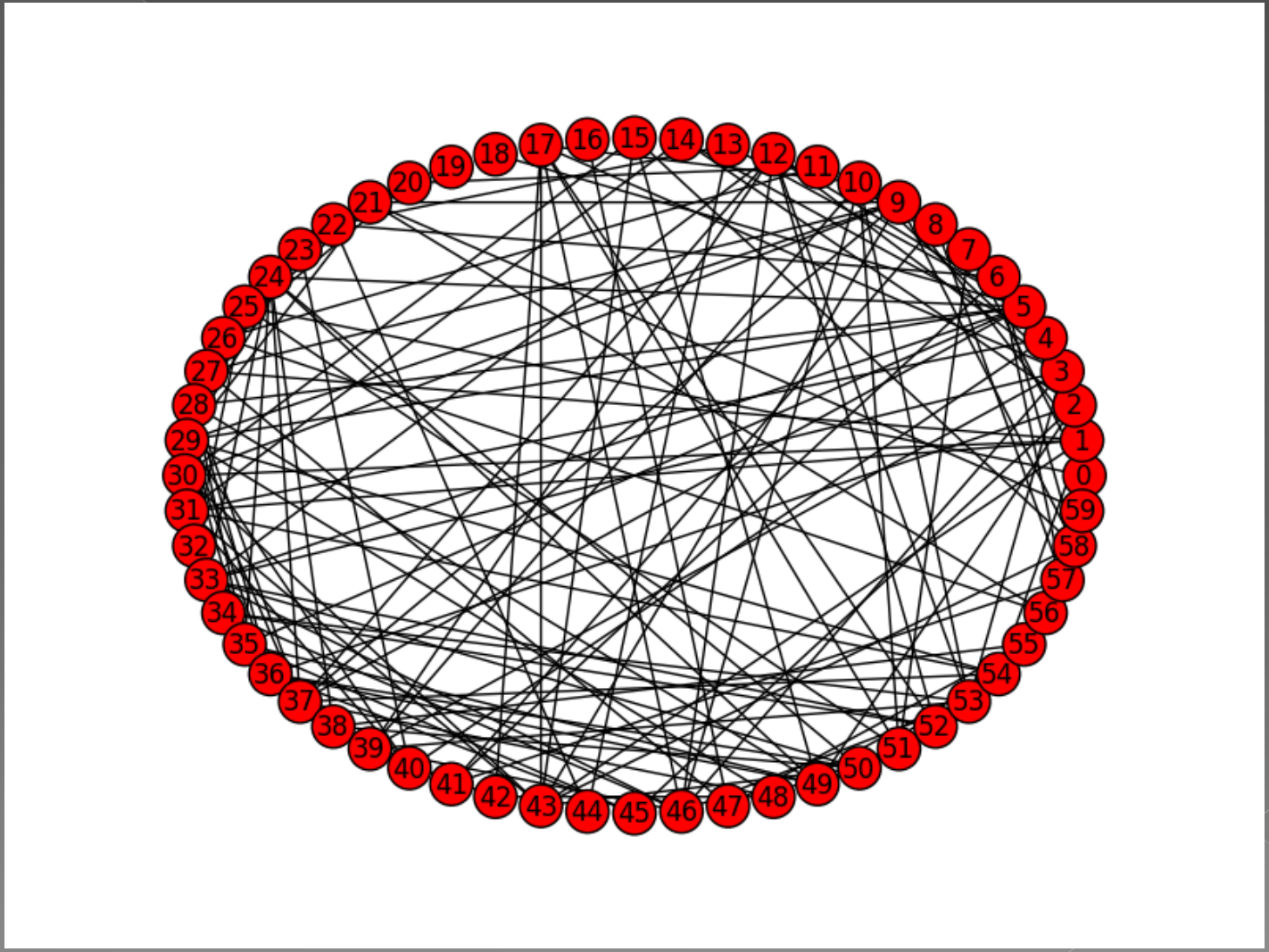
Resting State



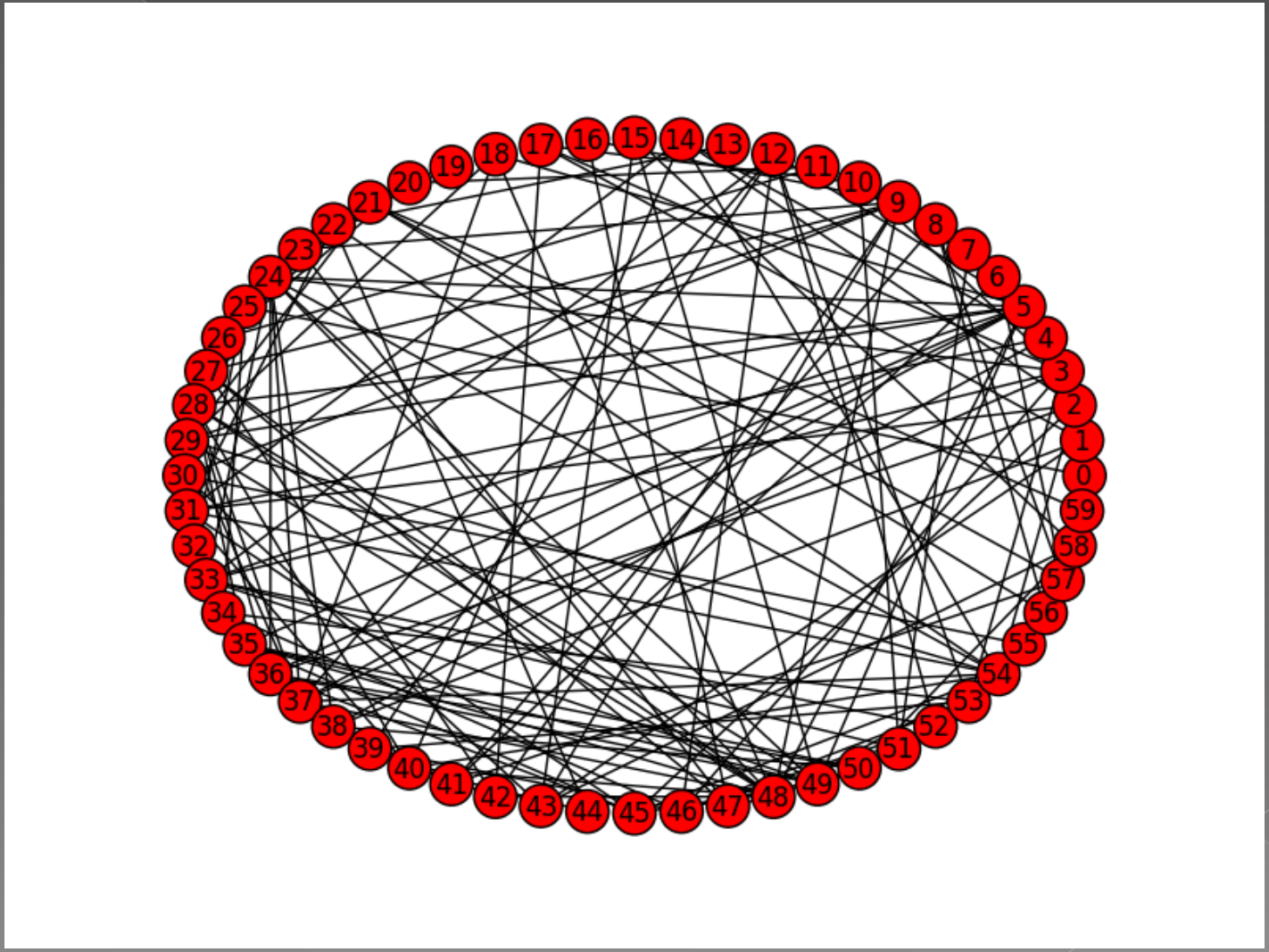
25% Compatible Trial Condition



50% Compatible Trial Condition



75% Compatible Trial Condition



Next Steps

- Improve graph generation methods
- Investigate which graph metrics are most informative
  - Whole-graph vs. node-specific