Functional Connectivity Modulated by Conscious Thoughts During Resting-State fMRI Scans



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INTRODUCTION

Previous research has suggested that ongoing in-scanner experiences modulate patterns of functional connectivity (FC) during resting-state fMRI (rsfMRI)^{1,2,3,4}. However, how much these experiences contribute to individual variability in rsfMRI FC remains unknown. Quantifying how much of the variability is due to state-level effects (e.g., in-scanner thoughts) will help us better understand what rsfMRI FC represents and explain variance in clinical applications (i.e., biomarkers). Here, we aim to analyze the relationship between FC and reported in-scanner experiences using rsfMRI data annotated with subjects' descriptions of their in-scanner thoughts using the Short New York Cognition Questionnaire.





- I thought about other people I thought about myself I thought about past events I thought about future events
- I thought about something negative I thought about something positive

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Subjects complete the SNYCQ immediately upon completing a resting-state scan⁵, reporting the content and form of their in-scanner thoughts retrospectively.

- Group A (low Factor 1 loadings and high Factor 2 loadings) consists of scans described as being accompanied by negative thoughts about one's surroundings in the form of words (Figure 1).
- Group B (high Factor 1 loadings and low
 Factor 2 loadings) consists of scans
 described as being accompanied by positive
 thoughts other people in the form of
 images (Figure 1).

463 15-minute resting-state fMRI scans from 133 subjects (from MPI-



Figure 4. Description of Connectome-Based Predictive Modeling⁸ (figure taken directly from Shen et al. 2017)

r = 0.35 p=2.03e-14 Non-parametric p=2.00e-04					
0.0	0.2	0.4 Factor1	0.6 observed	0.8	1.0

Figure 7. (a) Edges contributing to the prediction of Factor 1. (b) Observed versus predicted values of Factor 1. Each dot represents a scan. 0.0 0.0 0.2 0.4 0.6 0.8 1.0 Factor2 observed

Figure 8. (a) Edges contributing to the prediction of Factor 2.(b) Observed versus predicted values of Factor 2. Each dot represents a scan.

- Predictions of Factor 1 loadings relied primarily on positive edges between default mode and sensory networks and negative edges within the visual network (Figure 7a).
- Predictions of Factor 2 loadings relied primarily on positive edges between visual and all other networks and negative edges between sensory and default mode networks (Figure 8a).

CONCLUSIONS

- Scanner experience modulates resting-state FC.
- We were able to predict the low-dimensional factor loadings using FC, as well as answers to the SNYCQ (not shown here).
- State-level phenomena (what subjects are thinking) adds inter-subject variability to FC estimates that may obscure our ability to reliably detect trait-level effects (e.g., clinical conditions).

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This research was possible thanks to the support of the NIMH Intramural Research Programs ZIA-MH002783 & ZIC-MH002968