Abstract # 2912

Trait paranoia shapes inter-subject synchrony in brain activity during an ambiguous social narrative

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Motivation

On a behavioral level, different individuals often react differently to the same stimulus, especially when it is complex and/or emotionally evocative.

On a neural level, cognitive tasks evoke individual differences in functional brain organization above and beyond what can be observed at rest [1].

This led us to ask the following question:

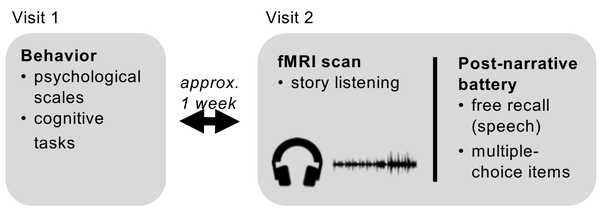
Can we design a bespoke task to draw out individual variability in neural activity that is relevant to a particular trait of interest, akin to a "stress test" for the brain?

Methods

Stimulus: We drafted an original narrative to serve as the stimulus for this experiment. The story was designed to be deliberately ambiguous, such that some individuals would find it highly suspicious, while others less so.

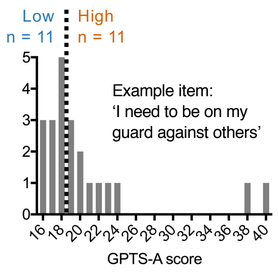
Participants: n = 22, all healthy volunteers

Protocol: The study took place over two visits to the lab to mitigate any demand characteristics or priming between the trait paranoia scale and the stimulus.



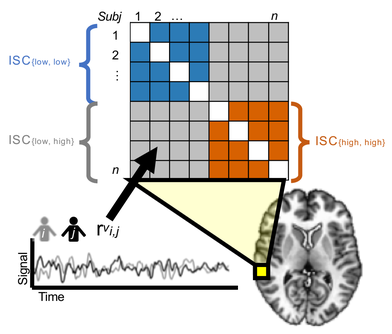
fMRI data collection: Subjects listened to an audio recording of the story (total duration = 21 minutes, spaced into 3 runs). Following each run, they answered multiple-choice comprehension questions to ensure attention.
Scan parameters: 3T, voxel size = 2mm^3, TR = 1s

Trait paranoia: Our primary measure of interest was subscale A of the Green et al. Paranoid Thoughts Scale [2].



Scores on this scale are exponentially distributed in the healthy population. Participants were divided via median split into a high- and low-paranoia group.

fMRI data analysis: Our primary approach to fMRI data analysis was inter-subject correlation, using a recently developed linear mixed-effects model to appropriately account for the correlation structure embedded in the data [3].

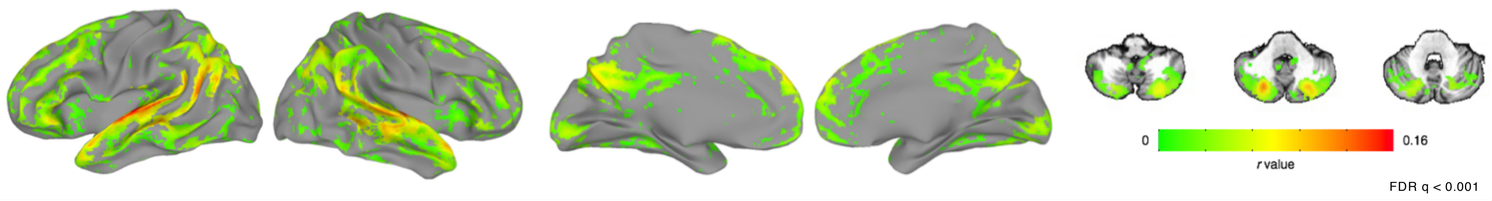


Speech data analysis: Free-recall speech data were transcribed and submitted to Linguistic Inquiry and Word Count (LIWC) [4], which determines how much of each participant's speech falls into various semantic and syntactic categories. Resulting features were related to trait paranoia scores using partial least-squares regression.

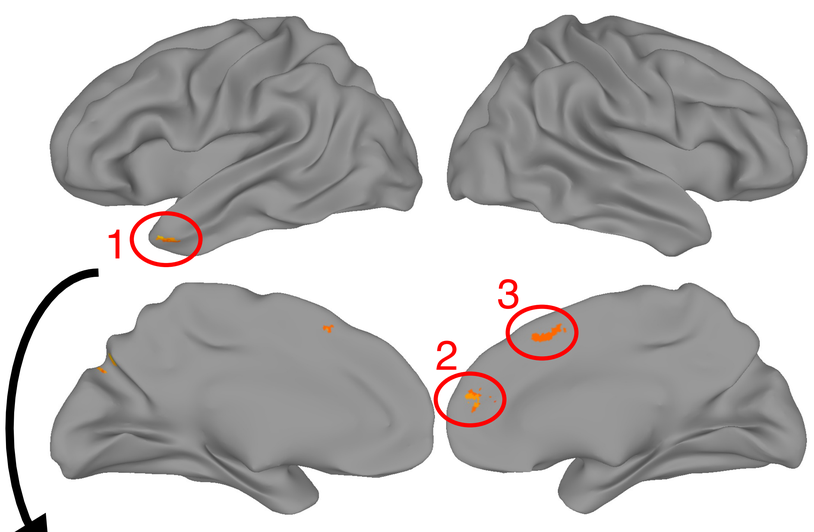
Results

1. Story listening evokes widespread neural synchrony across all subjects

Areas of significant inter-subject correlation (ISC) across all pairs of n = 22 participants:



2. Certain brain regions are more synchronized among high- (relative to low-) paranoia pairs

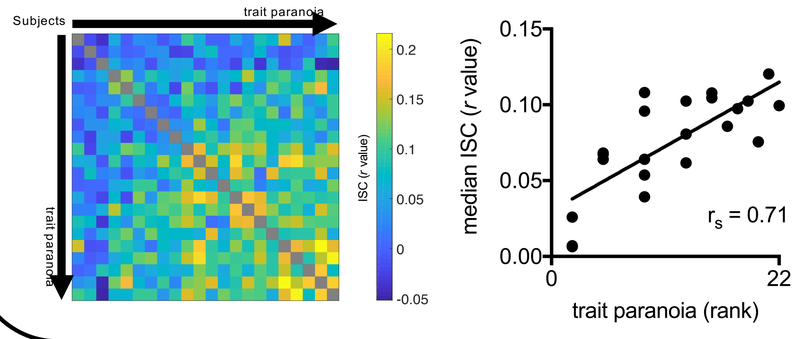


ISC{high, high} > ISC{low, low}:

1. L temporal pole
2. R medial PFC
3. R dorsomedial PFC
4. L precuneus

All paranoid participants are alike, all not-paranoid participants are not-paranoid in their own way.

Post-hoc analysis of left temporal pole
ISC varies with trait paranoia continuously (not just categorically):

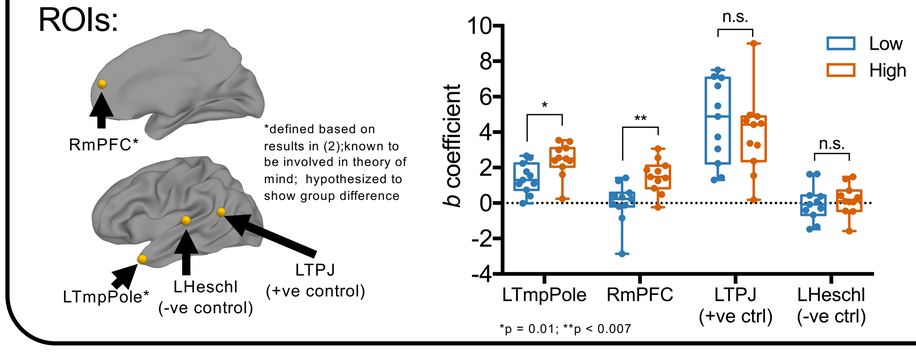


Control analyses:
Paranoia, either categorical or continuous, was unrelated to:
- demographics: age, sex, education
- trait-level cognitive ability: performance on tasks of working memory, fluid IQ, verbal IQ
- state-related attention to the story: accuracy on multiple-choice comprehension questions, number of words in free-recall speech data
- fMRI data quality measures: head motion, tSNR

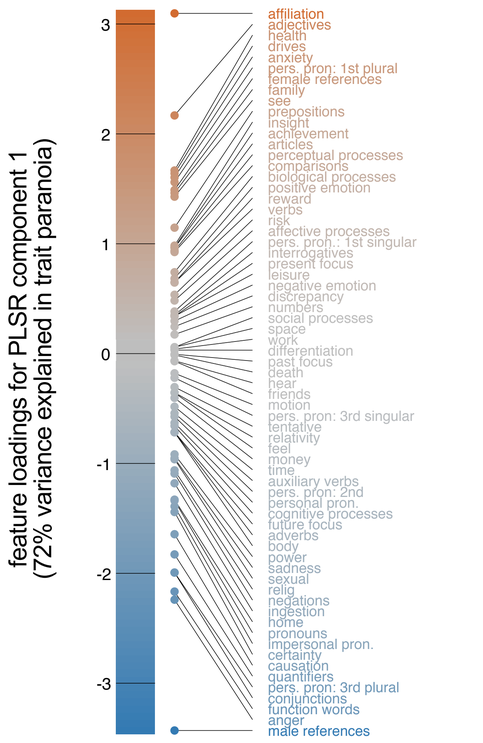
3. High-paranoia individuals show more evoked activity to "mentalizing events"

Event-related analysis of timepoints when the main character is experiencing an ambiguous social interaction or explicitly mentalizing about other characters:

ROIs:



4. Features of speech also relate to trait paranoia:



Examples from subjects' speech:

Affiliation
"…but they become **friends** once she gets to know her better."

Health
"…there were a series of **patients** that had a **fever** accompanied by a **rash**…"

Anxiety
"…she almost **panicked**…"

Anger
"…and she **yells** at him…"

Conclusions

A personality trait, in this case paranoia, can act as an intrinsic "prime," yielding different neural and behavioral responses to the same stimulus across individuals.

Naturalistic paradigms may be a happy medium between resting-state acquisitions (too unconstrained) and traditional tasks (less ecologically valid) for studying both group-level functional brain organization as well as individual differences.

This approach may be extended to other stimuli and phenotypes; it is a preliminary step toward a brain "stress test" for present or future mental illness.

References: [1] Finn et al., *NeuroImage* 2017. [2] Green et al., *Psychol. Med.* 2008. [3] Chen et al., *NeuroImage* 2017. [4] Pennebaker et al., 2015. http://liwc.wpengine.com

This work was recently published: Finn et al., *Nature Communications* (2018) DOI: 10.1038/s41467-018-04387-2