NEUROHACKADEMY

Paranormal Events

Exploring the influence of traits and semantic content on neural event boundaries

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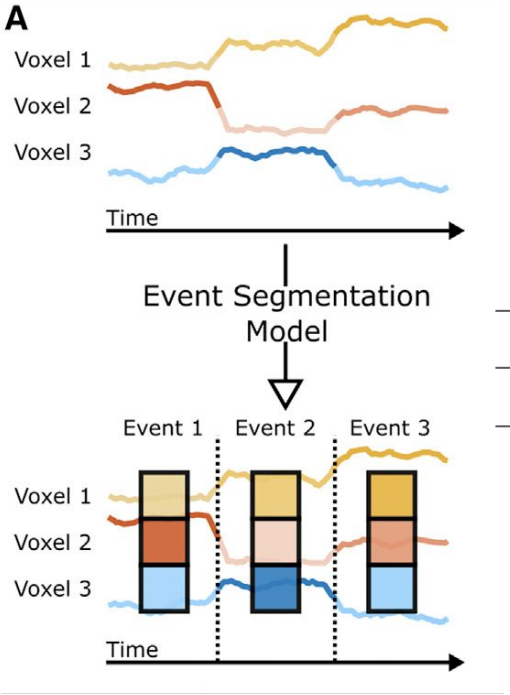
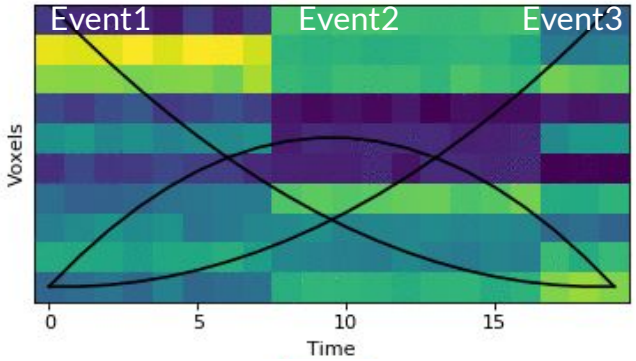
Background

We break continuous experience into discrete events and use it to organize our memory

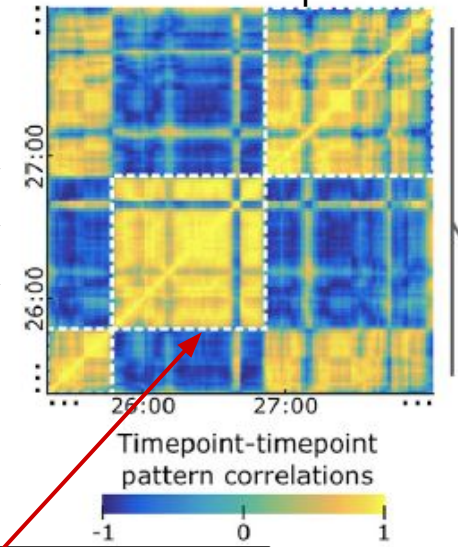
Hidden Markov Model (HMM)



The model works by:



Model Output



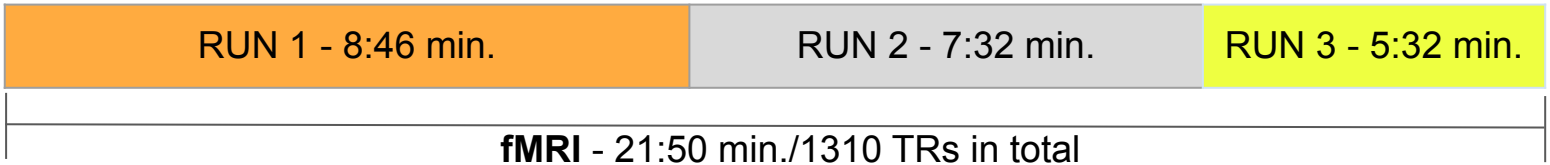
HMM identified boundaries

Baldassano et al., (2017)

Dataset

N = 22
(we used 17)

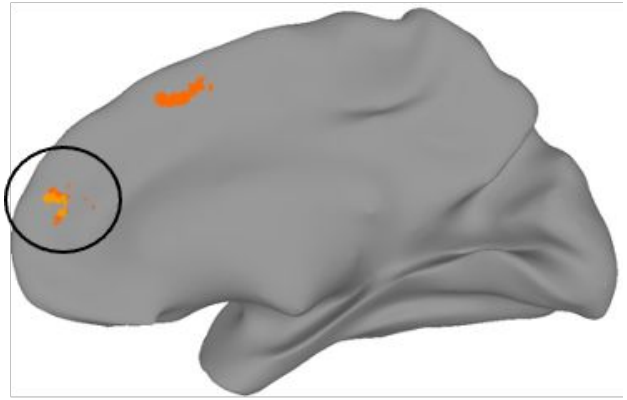
Story: *paranoia-inducing ambiguous social narrative*



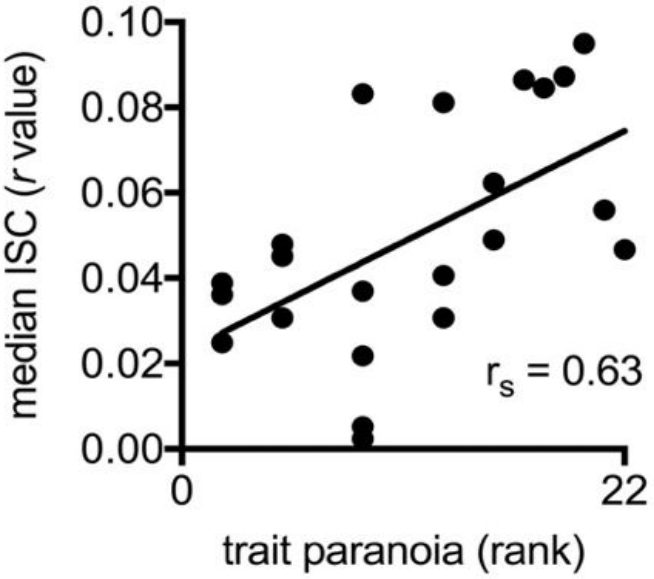

```
The two men stood in the doorway, not wanting to come any closer,
as if they were afraid the patient might be contagious.
```


Dataset: https://gin.g-node.org/ljchang/Paranoia

Subjects that are similar in their levels of trait-level paranoia are similar in their neural activity



R medial PFC



Finn *et al.*, (2018)

Goals

1. Can we replicate past findings in a new, different dataset?

2. Are individual differences in neural event segmentation related to **trait** individual differences?

3. Are individual differences in neural event segmentation related to **stimulus** characteristics?

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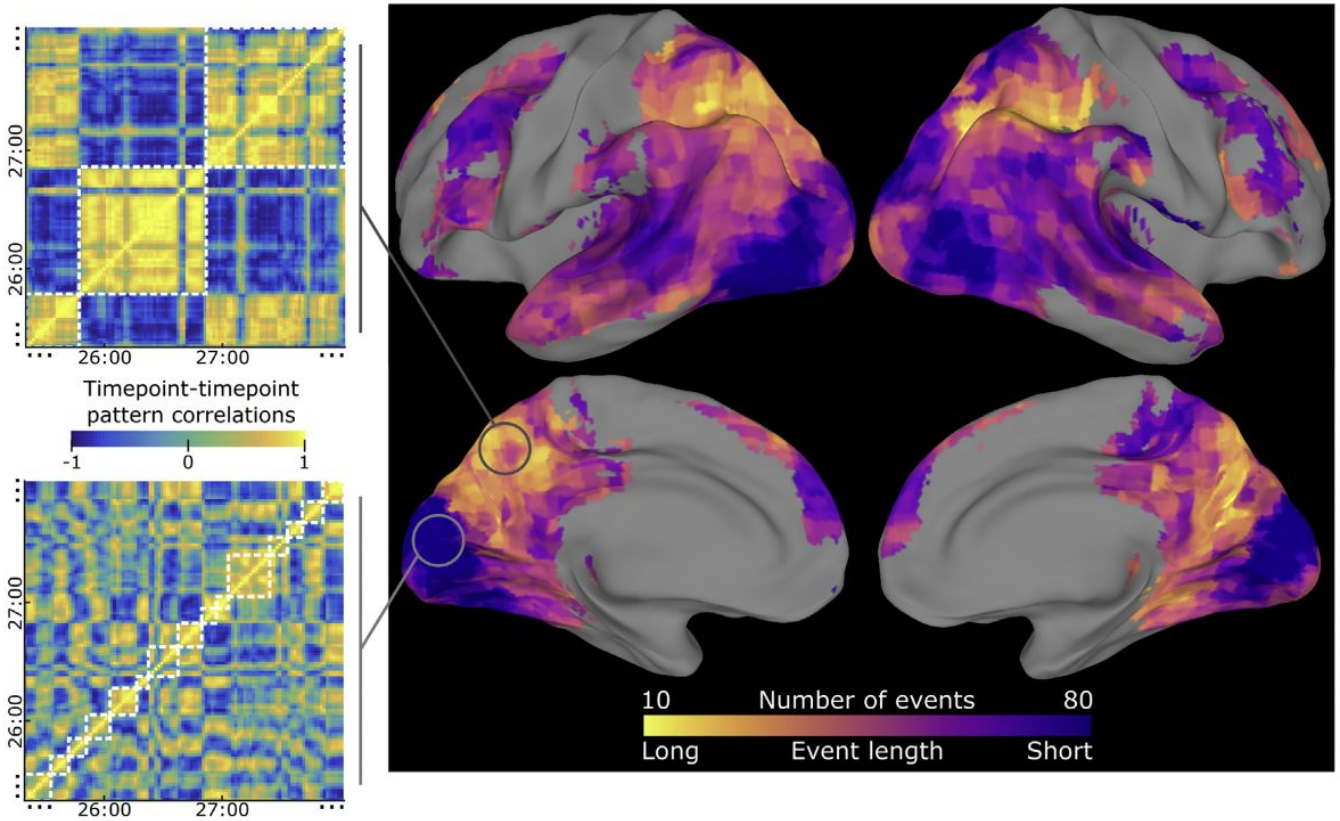
Replicating prior results

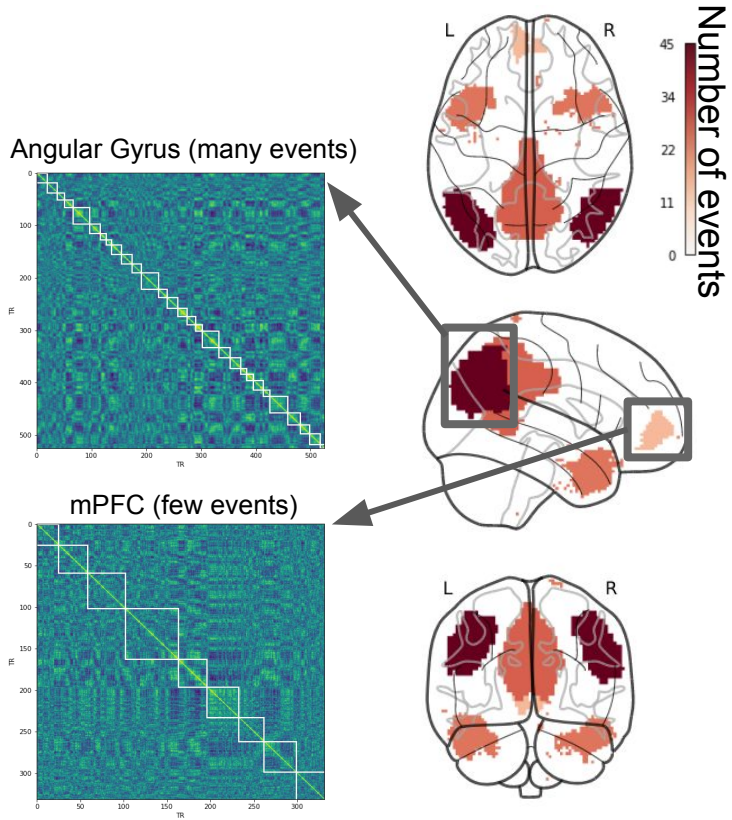


Baldassano et al., (2017)

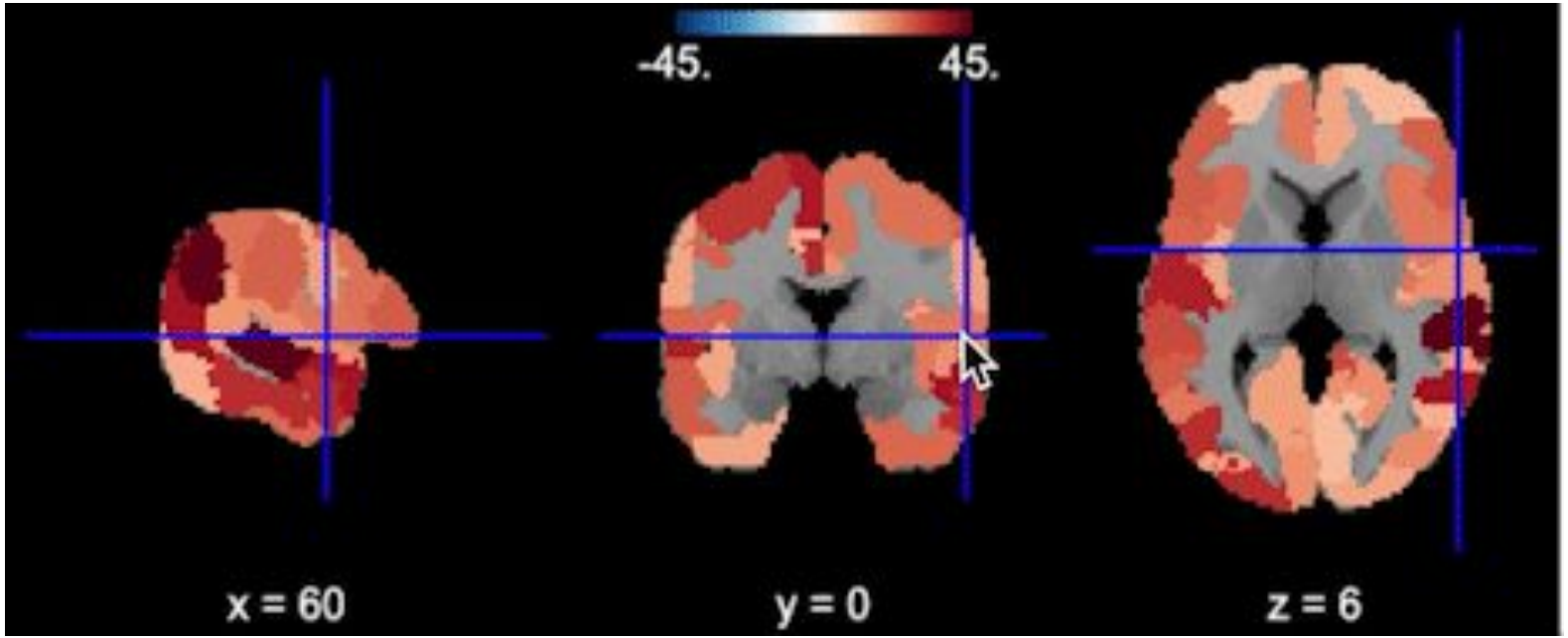
Replicating prior results

We hand-selected some regions that have been shown to track event representation in the brain in previous literature:

- Posterior Medial Cortex (PMC)
- Angular Gyrus (AG)
- medial Prefrontal Cortex (mPFC)
- Temporal Pole



Confirming event rate in our stimulus



Schaeffer *et al.*, (2018); 100 Node, 7 Network

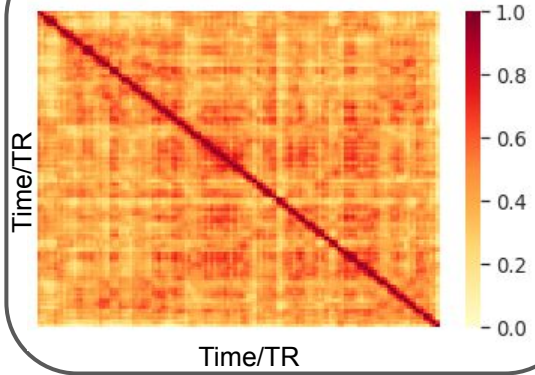
Are there semantic shifts in the stimulus that we can detect and ultimately relate to individual differences in segmentation?

Story Text

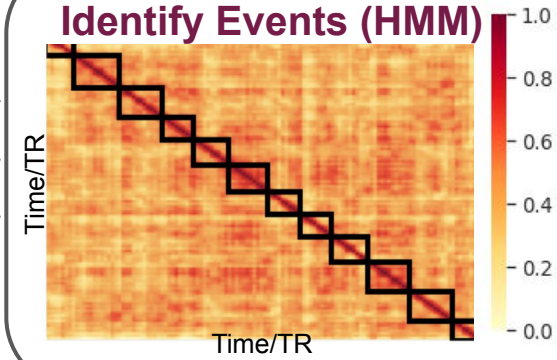
1. Topic Vectors
2. USE Vectors
3. Sentiment values
4. Human Annotated Boundaries

control

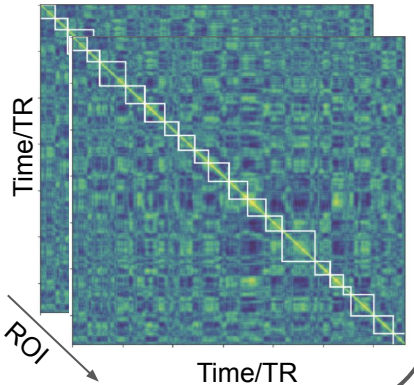
Text Similarity Matrix



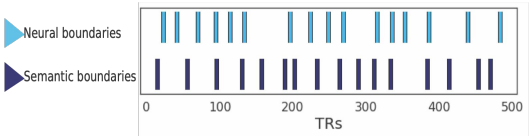
Identify Events (HMM)



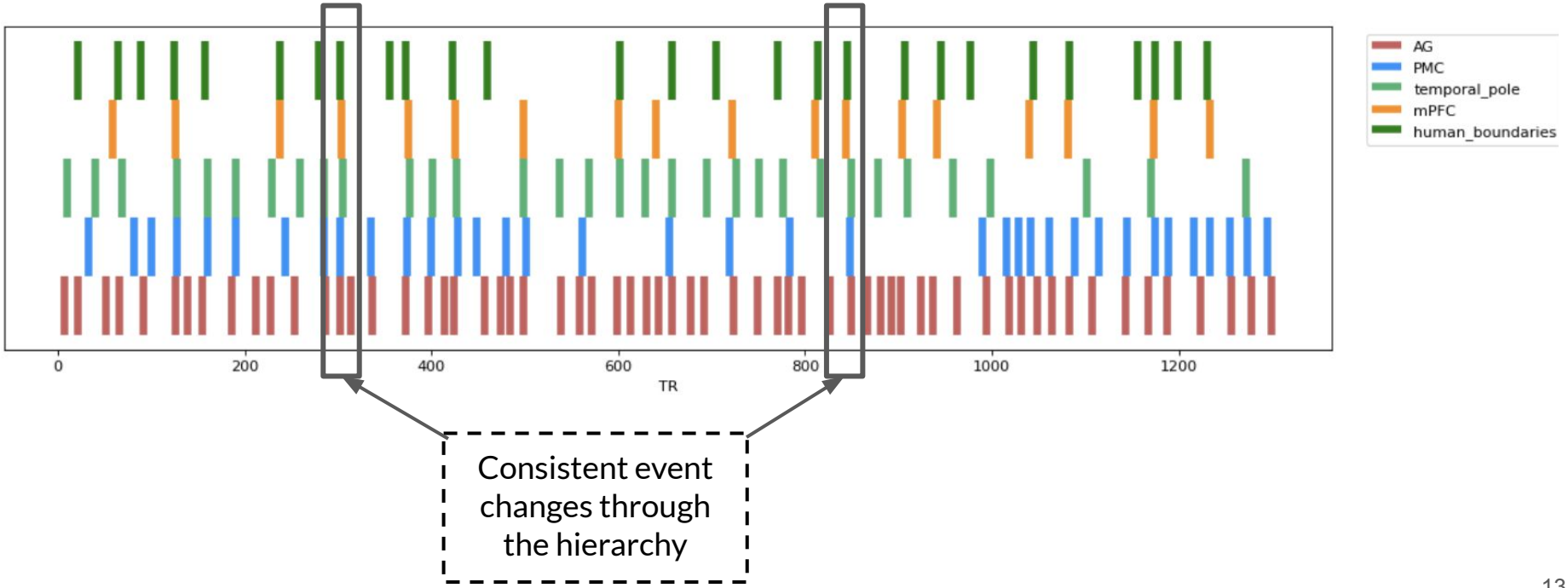
Neural Event Boundaries



Alignment in Text Boundaries and Event Boundaries

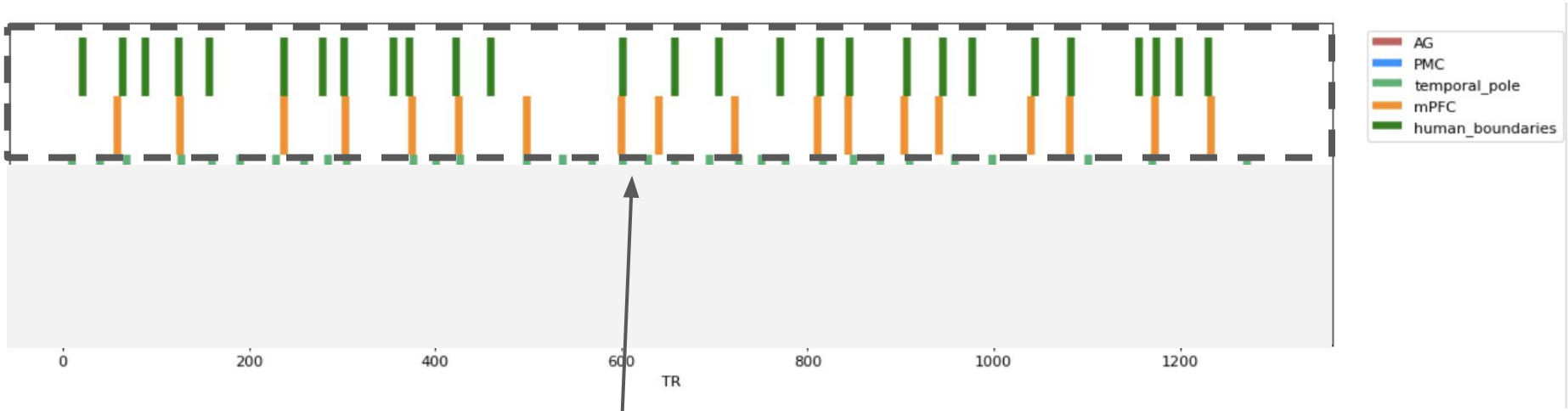


Comparing similarity in boundaries



nPermutations = 1000

Similarity in Boundaries



Human(Clara)-annotated boundary
align with mPFC boundary

z-score : 6.18
p < .001

nPermutations = 1000

Goals

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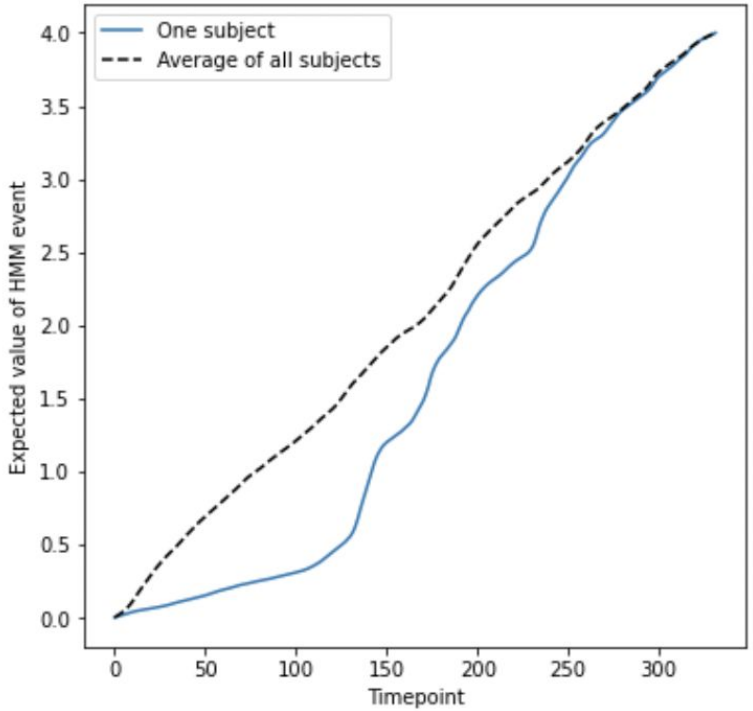
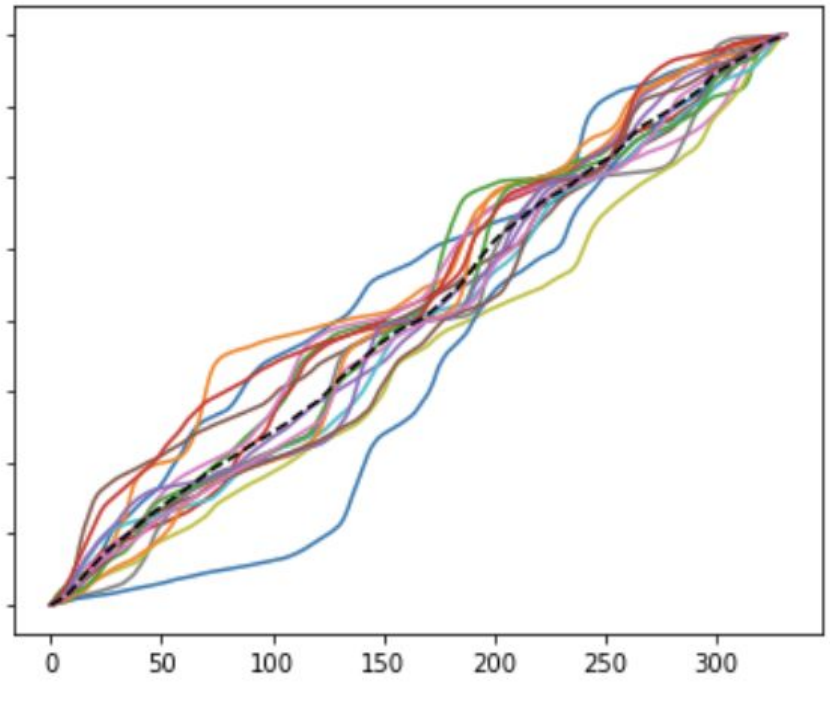
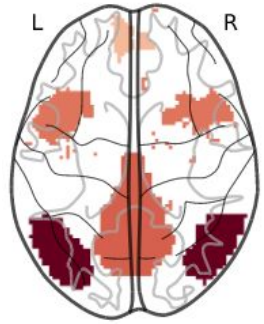
2. **Are individual differences in neural event segmentation related to trait individual differences?**

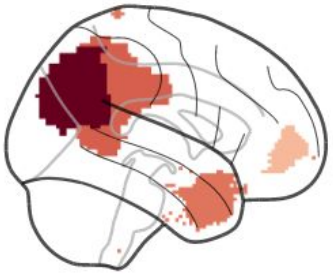
3. Are individual differences in neural event segmentation related to stimulus characteristics?

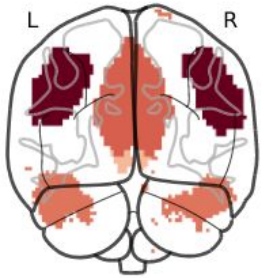
People differ in how they segment experiences into events









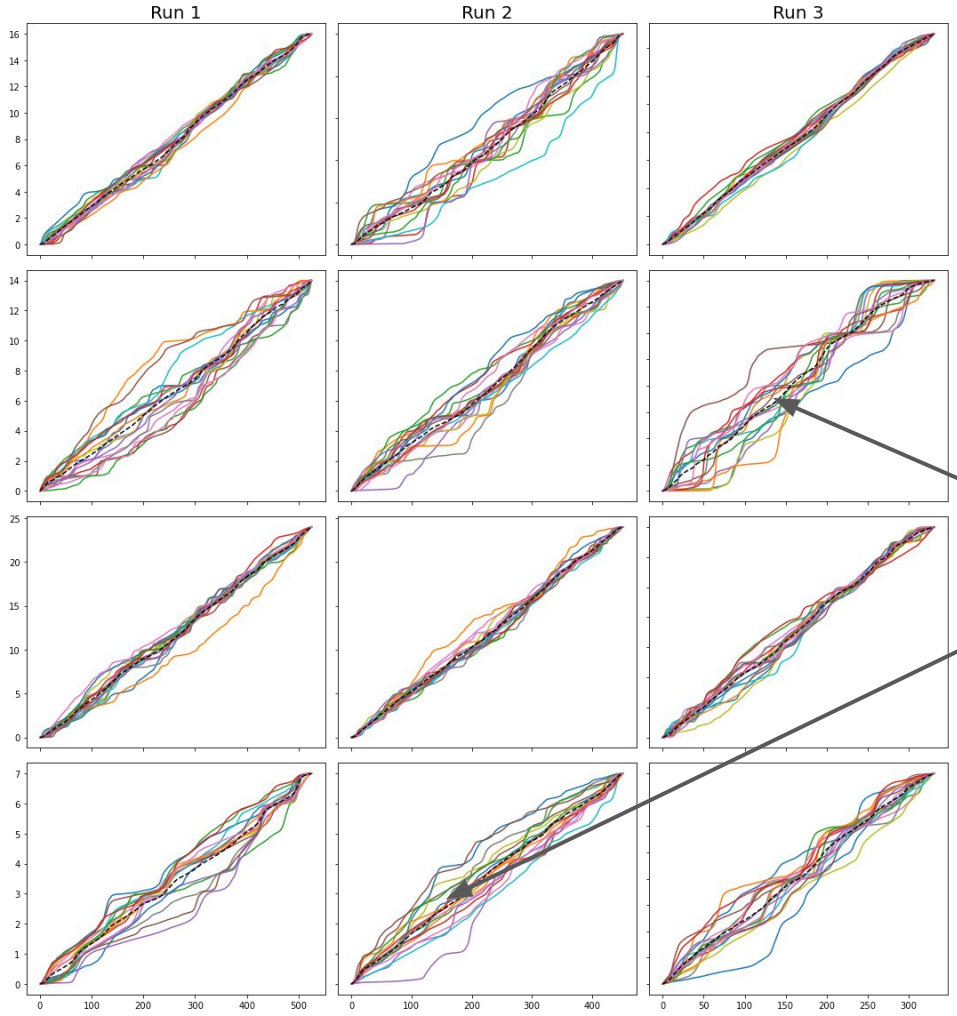


PMC

mPFC

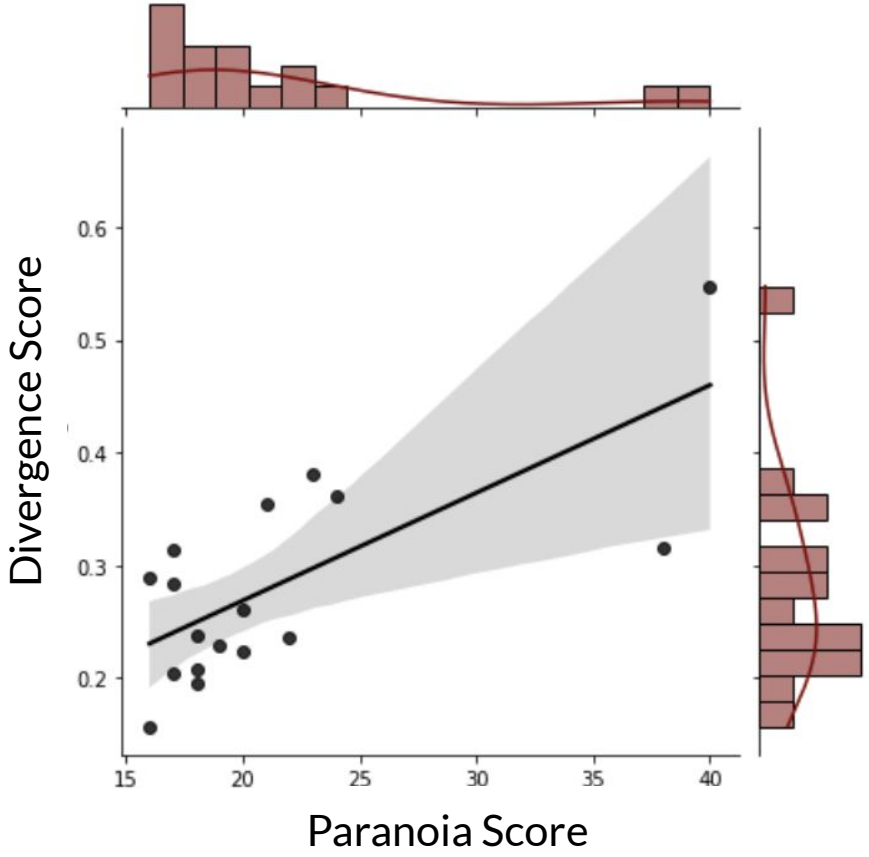
AG

TP



Individuals diverge from the average

Subjects that are more paranoid also have more idiosyncratic event boundaries



p=.001

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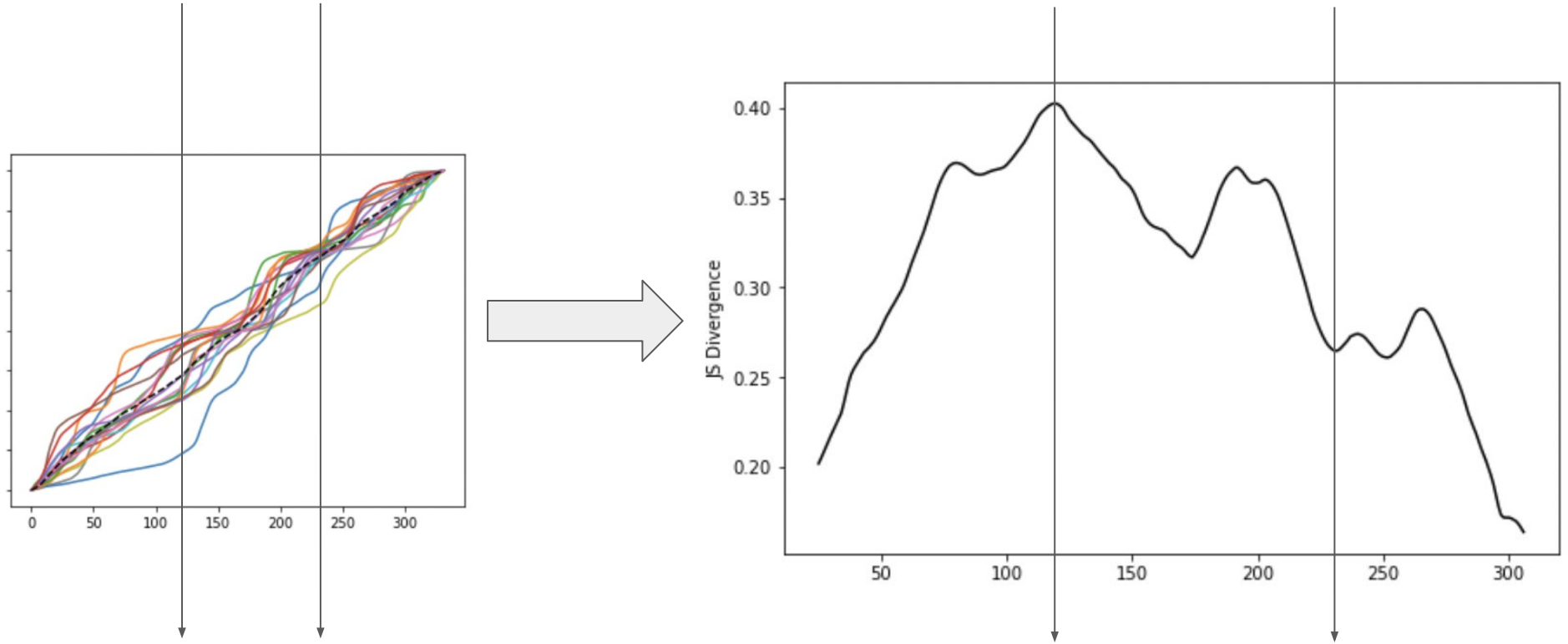
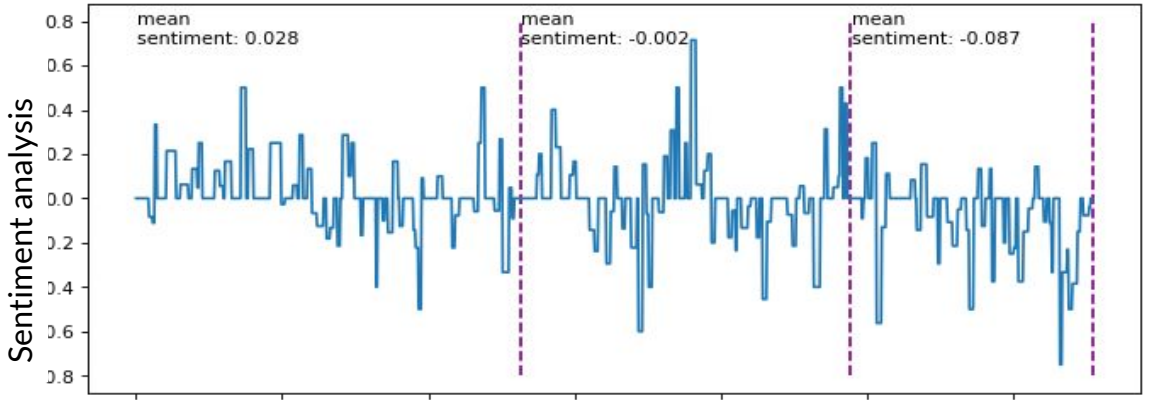
The dynamic of the divergence

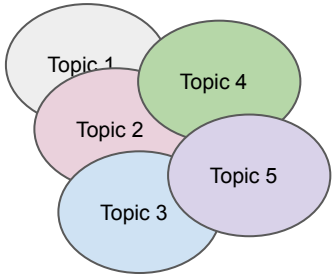


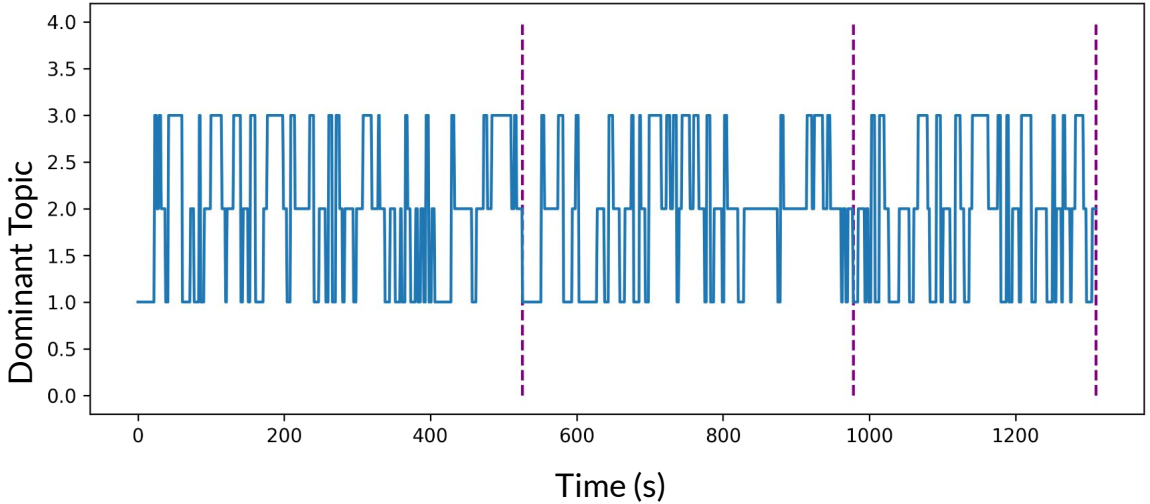
Both topics and sentiment change throughout the stimulus

Sentiment Analysis

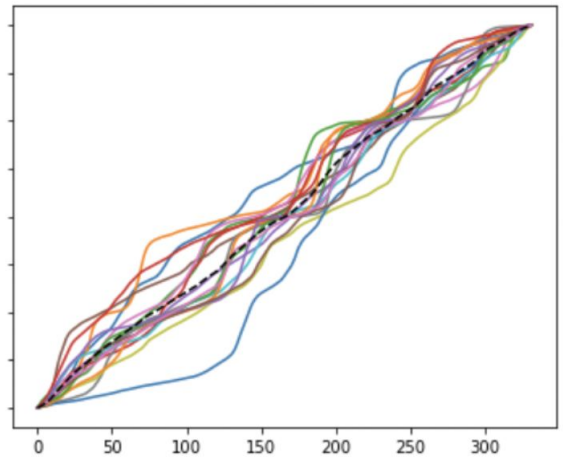


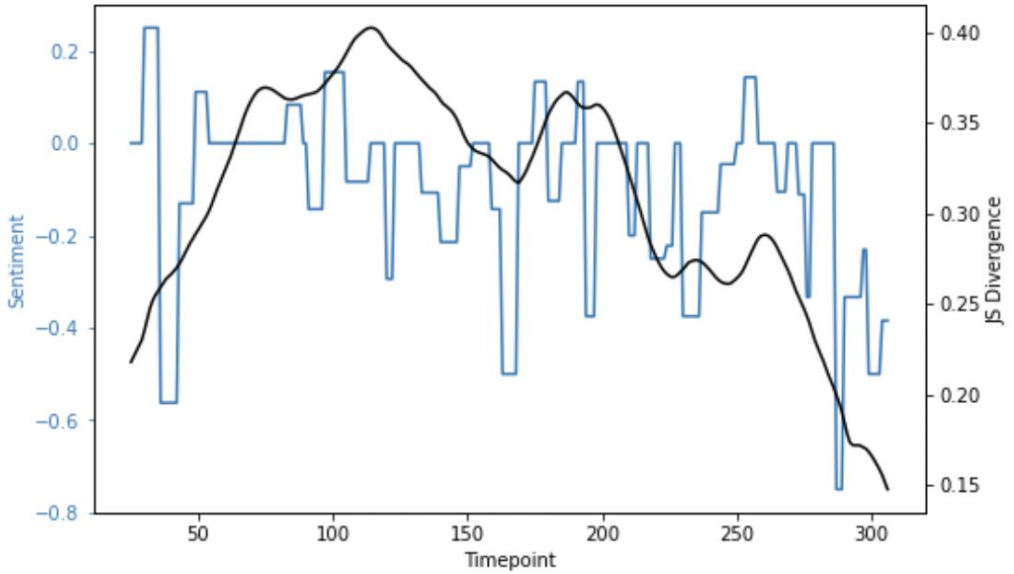
Topic Modeling



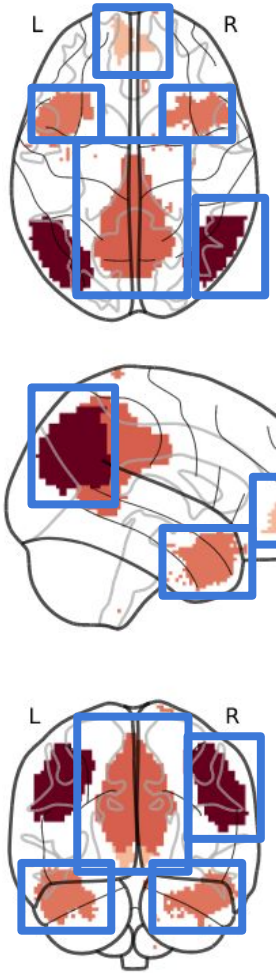


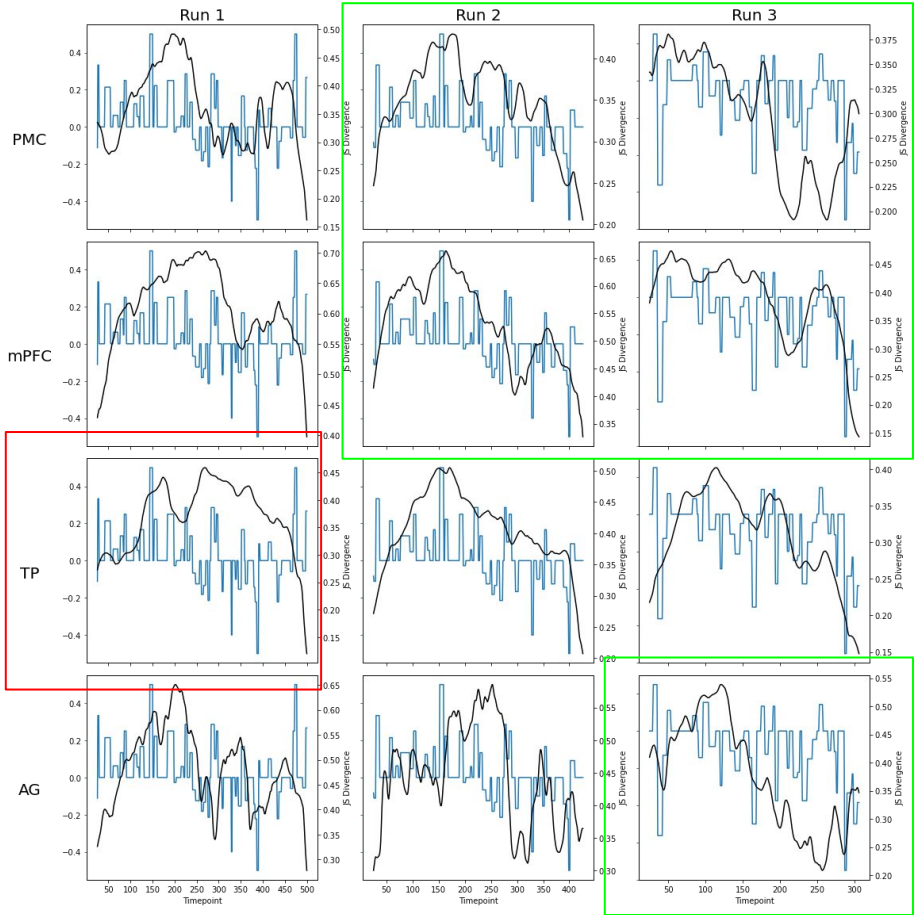
Higher divergence is reflective of sentiment changes in the stimulus over time





Divergence corresponds with sentiment across regions





Pos

Neg

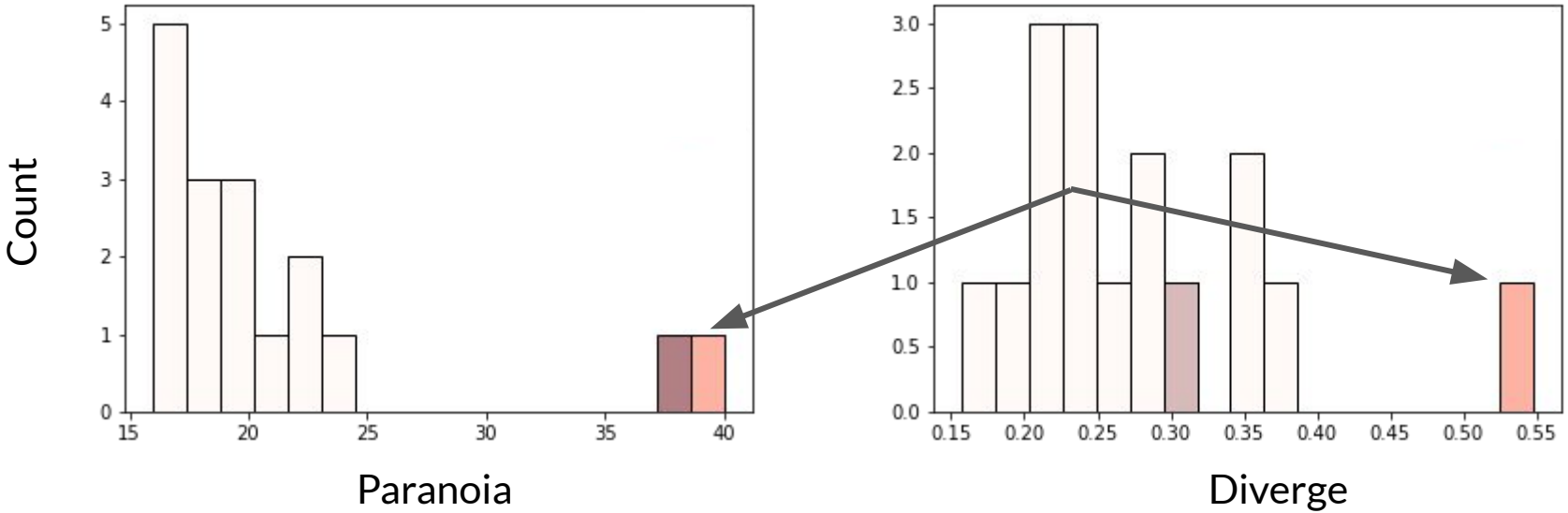
Conclusion

- As previously shown, event changes vary across the cortex and correlate with human annotations of event switches
- Sentiment and topics change throughout the stimulus, but we need to improve our sensitivity in detecting these changes
- (Maybe) some relationship between individual differences in paranoia and the divergence
- (Maybe) some relationship between stimulus characteristics and the divergence

Thank you!

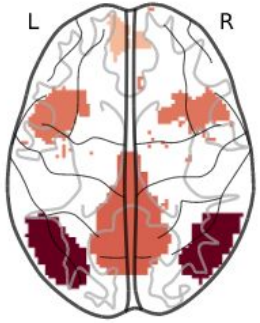
Divergence & individual differences

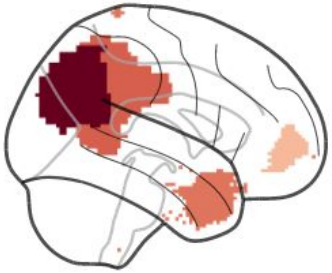
Subjects that are more paranoid also have more idiosyncratic event boundaries

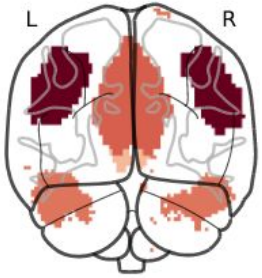


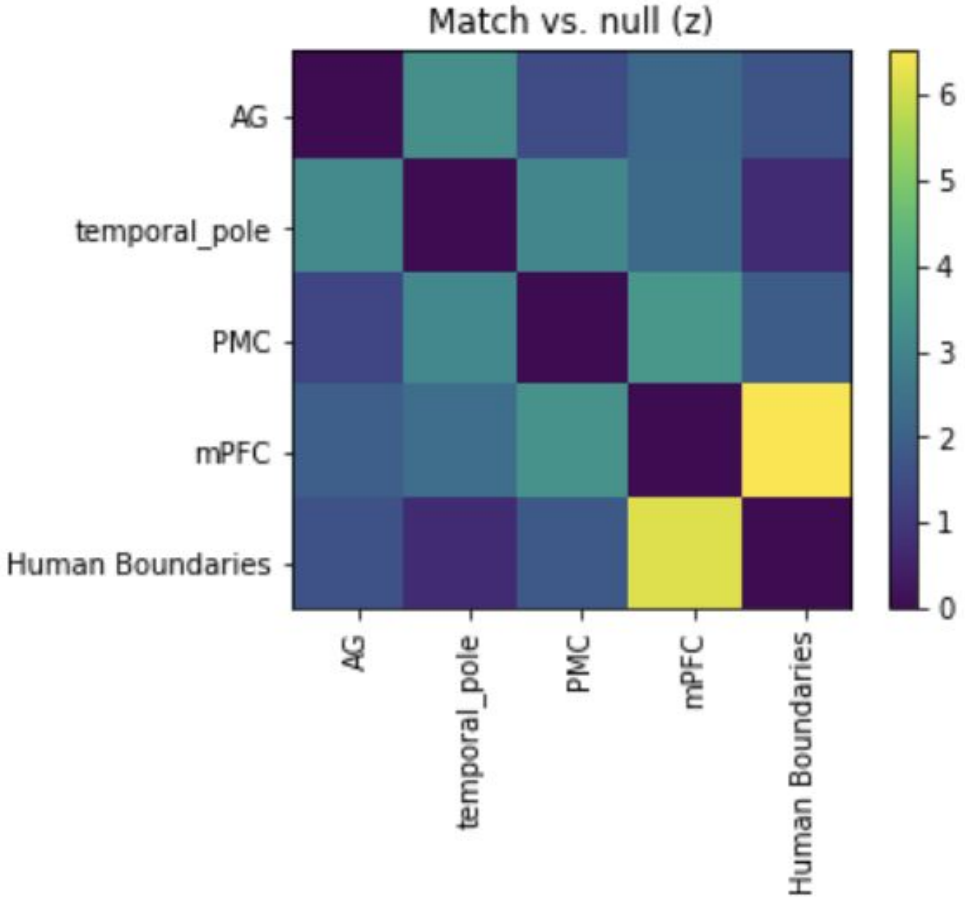
Goal

1. Is the Divergence in event segmentation related to individual differences
2. Check if the event segmentation divergence is related to stimuli characteristics in a different dataset
3. Check if the divergence is related to individual differences
4. **Capture event boundaries in an audio narrative using NLP tools and see if semantic shifts reflect neural state (event) shifts**









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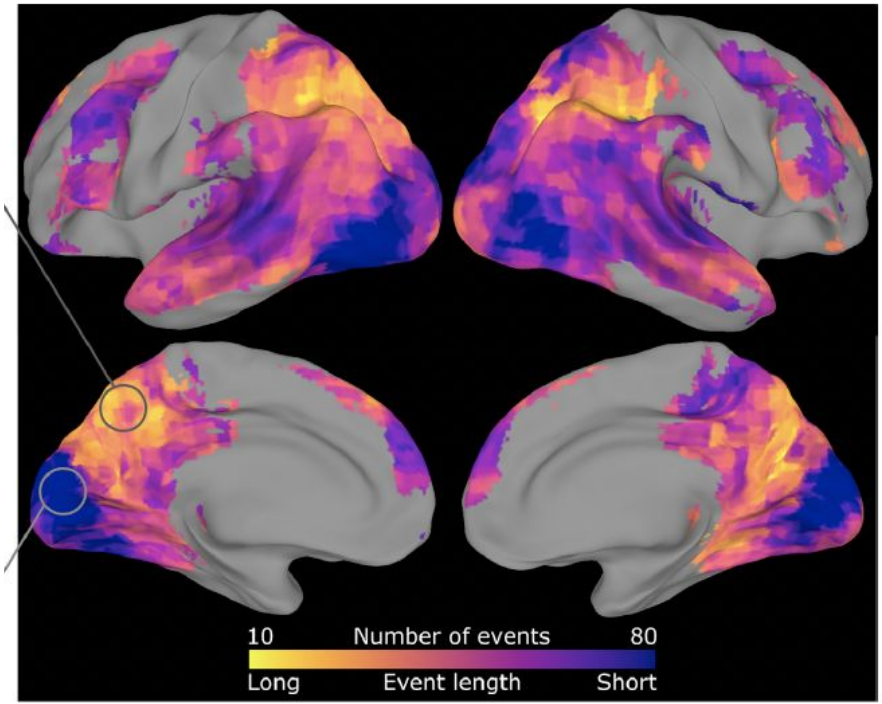
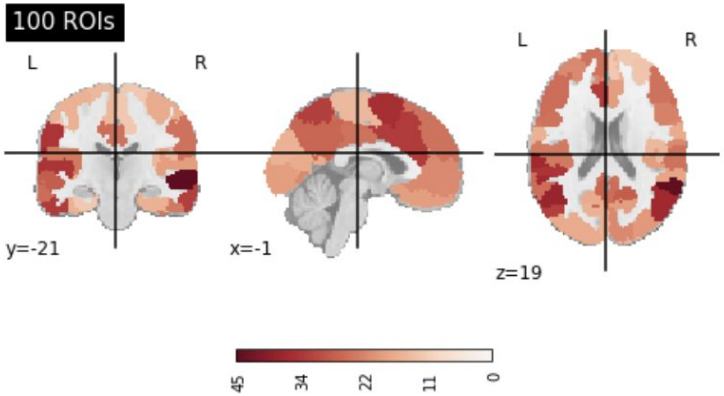
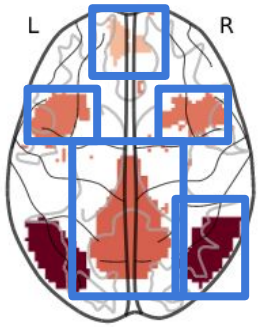
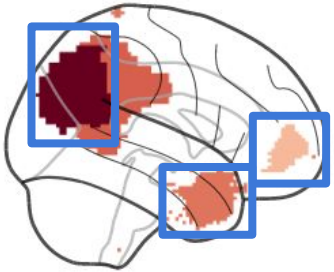
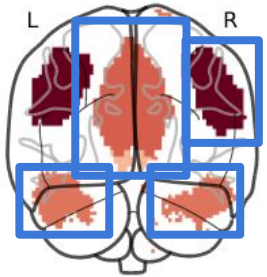




Number of events







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