

# Single-timepoint functional connectivity patterns during brief motor events

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## Idea

Patients with epilepsy have brief spikes of focal epileptic activity that induce dynamic changes in functional connectivity (FC) => *these FC changes could be used to detect and localize this epileptic activity.*

Here we use edge timeseries<sup>1</sup> and co-activation patterns (CAPs)<sup>2</sup> to capture the single-timepoint FC dynamics of single finger taps, brief focal events on a similar timescale to epileptic spikes.

## Questions

**Q1.** If we know **event timing** (tap, epileptic spike on EEG) → what are the **spatial patterns** of the event?

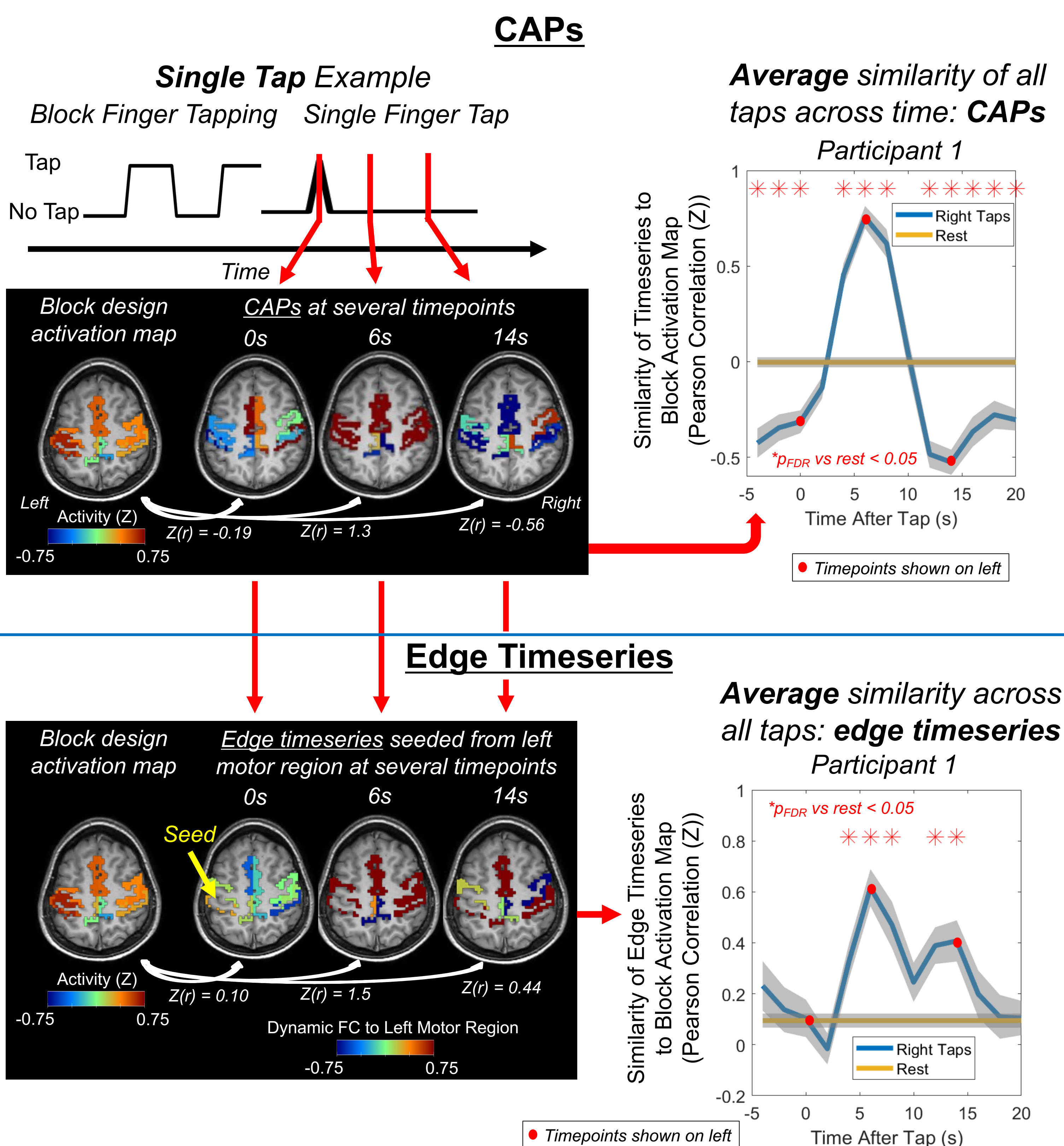
**Q2.** If we have a **spatial pattern** (brain activity/FC pattern) of the event → can we detect the **event timings**?

## Data

**Participants:** Three healthy right-handed adults (2 female; 24, 24, and 29 years old)  
**fMRI data** (TR = 2 s, 3x3x4 mm<sup>3</sup>)

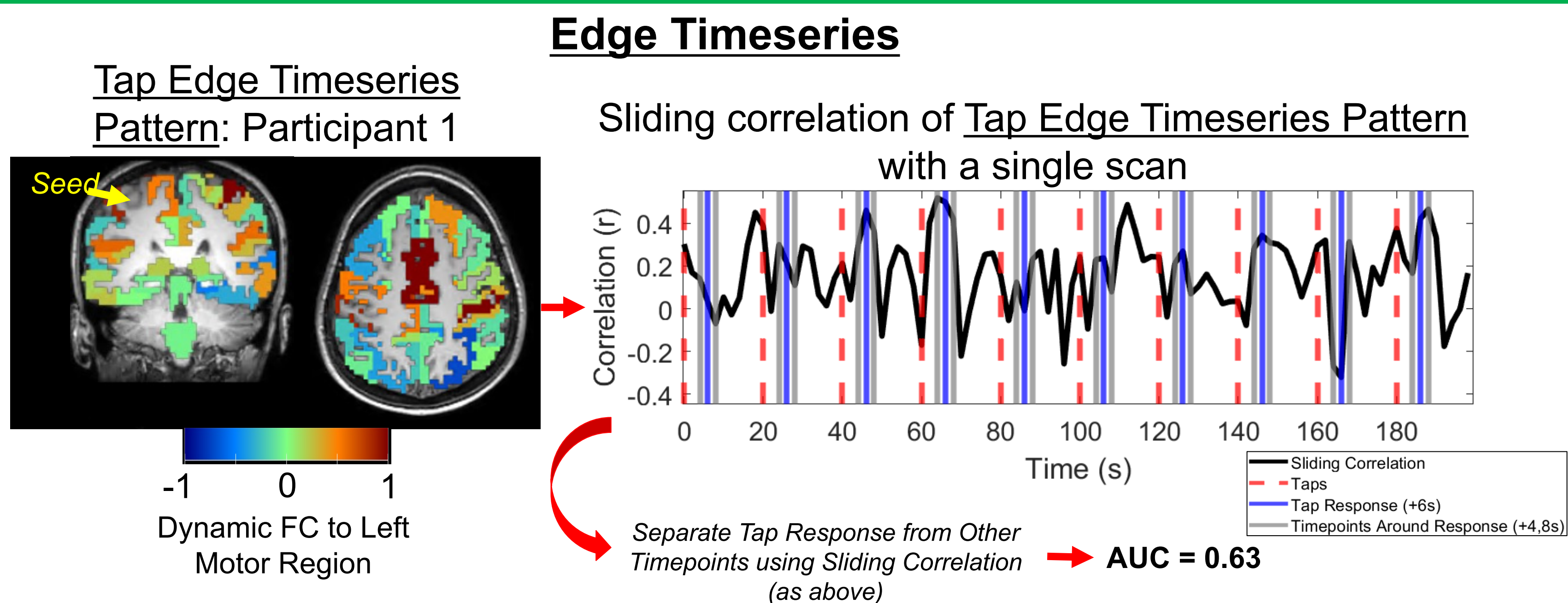
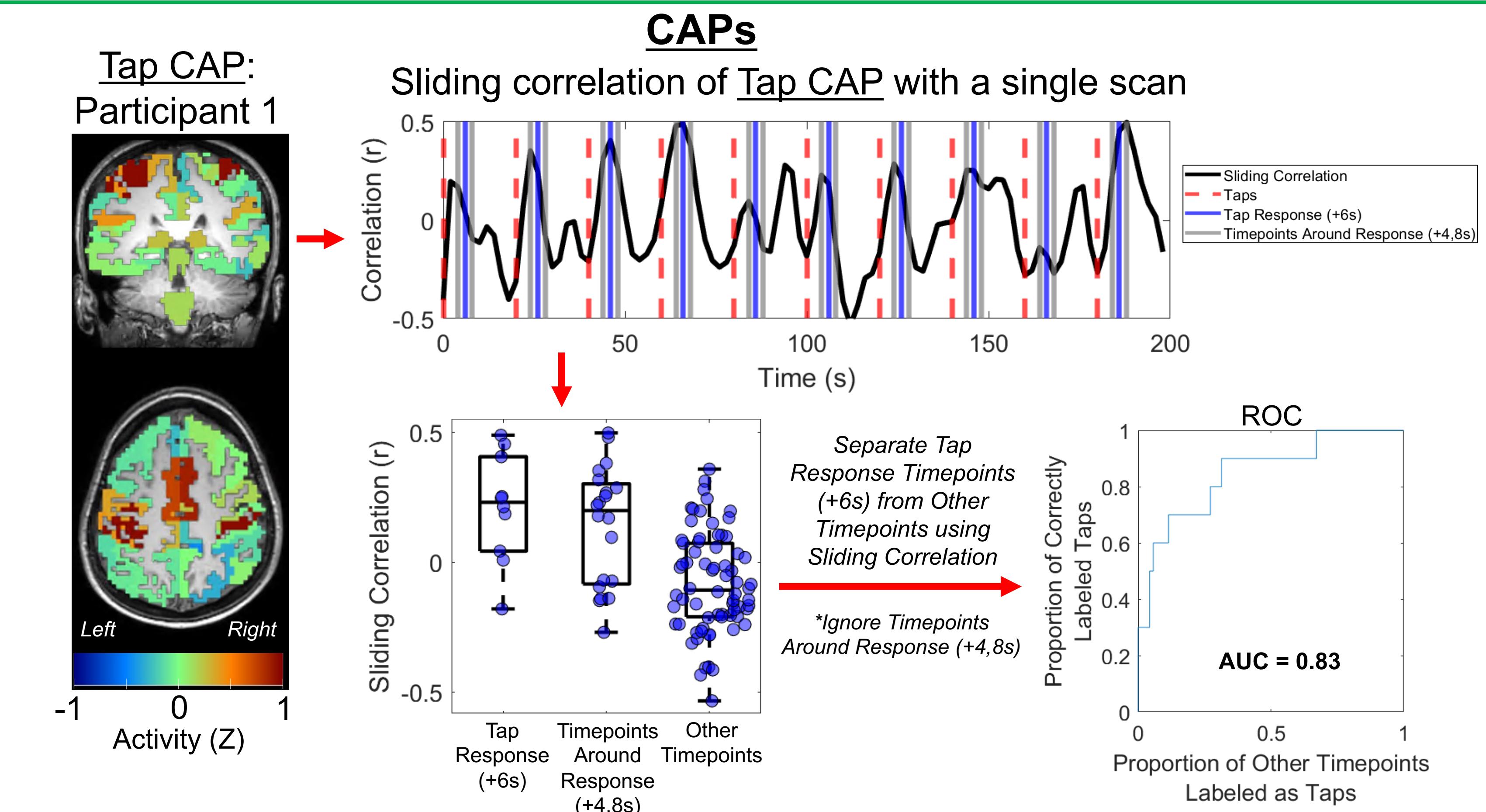
- Paradigms: resting-state (10 min); block design finger tapping (20s blocks; 3.33 min); event-like finger tapping scans (single right-hand finger taps at least 20s apart)
- Regional timeseries temporally Z-scored
- Edge timeseries: multiplication of Z-scored regional timeseries at each timepoint to obtain a timeseries of dynamic FC for each edge

**Q1.** At the time of taps, do the **spatial patterns** of CAPs and edge timeseries resemble the block design tapping activation map?

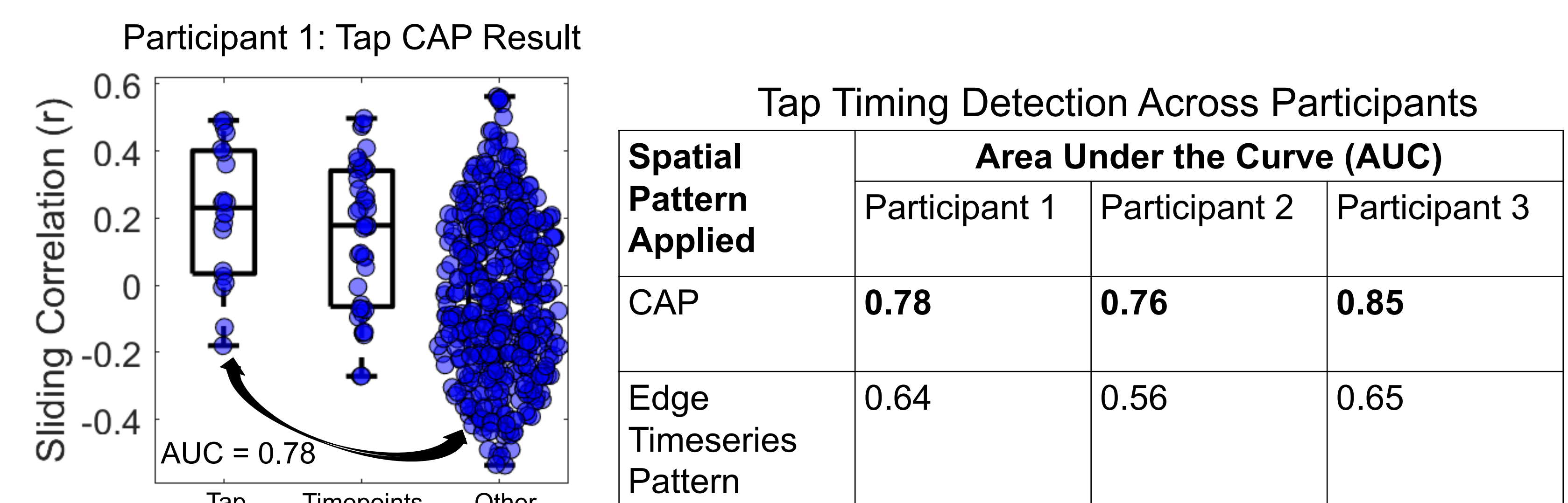


- Timeseries (CAPs) at brief motor events resemble the block activation map at the expected hemodynamic lag (6s)
- Edge timeseries at brief motor events resemble the block activation map at multiple timepoints after taps (6s and ~12-14s)

**Q2.** Can we use a **spatial pattern** to detect the **timing of taps**?



Applying the **spatial patterns** (CAPs/edge timeseries) from each pair of two subjects to the third subject (leave-one-out) to **detect tap timing**



- CAPs can identify the timing of tap events with better accuracy than edge timeseries
- Several timepoints not during taps resemble the spatial patterns at taps (CAPs, edge timeseries), which could lead to false identification of events (taps/epileptic spikes)

## Future Directions

- Assess individual variability of spatial patterns
- Determine which regions of spatial patterns contribute most to accurate tap timing detection
- Assess the specificity of event detection (how often do events occur at rest?)
- Goal: Apply this method to detect spiking events in epileptic patients

## References

- Esfahlani et al., 2020. *PNAS* 117(45): 28393-28401.
- Liu and Duyn, 2013. *PNAS* 110(11): 4392-4397.

## Funding

NIH T32 EB021937, R01 NS075270, R01 NS108445, R01 NS110130, R00 NS097618