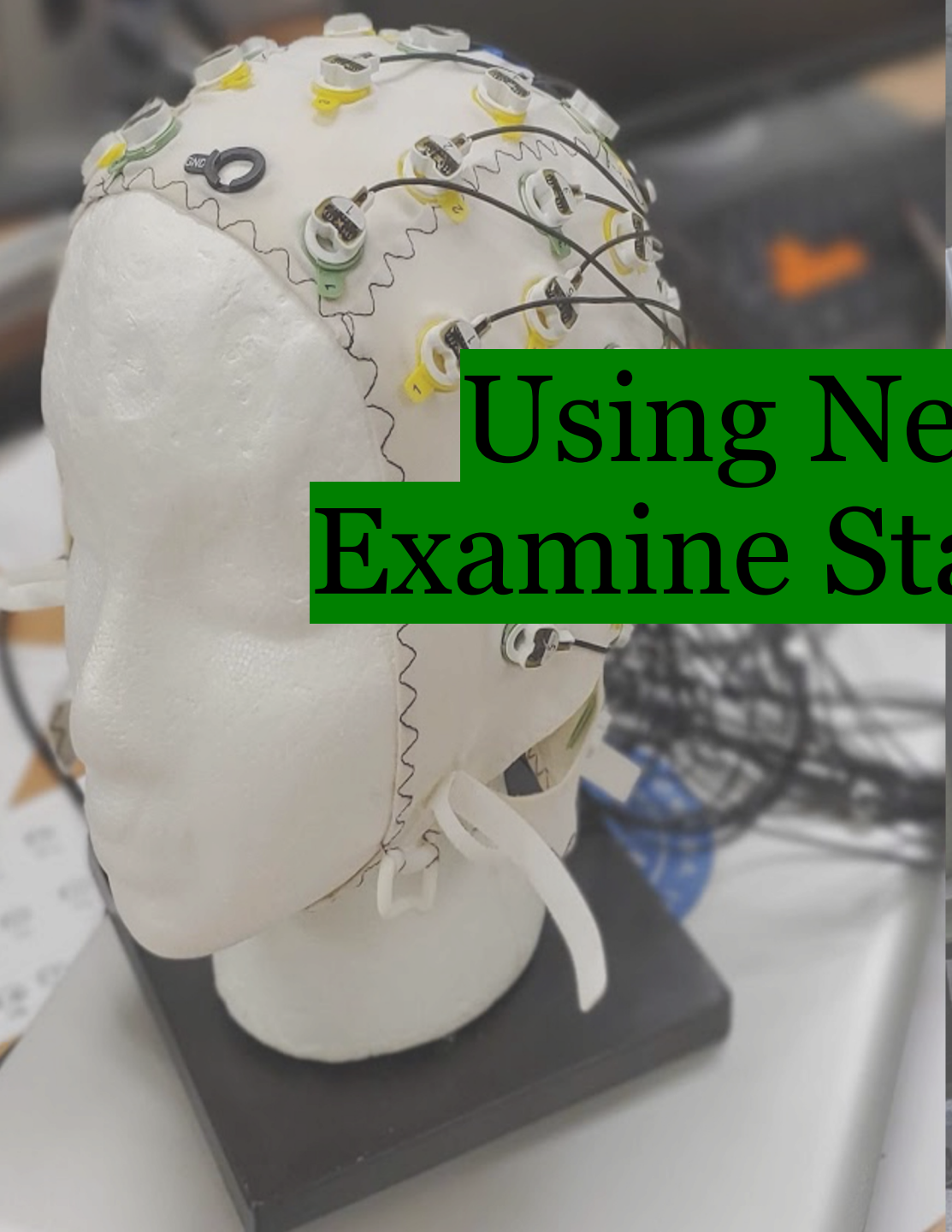
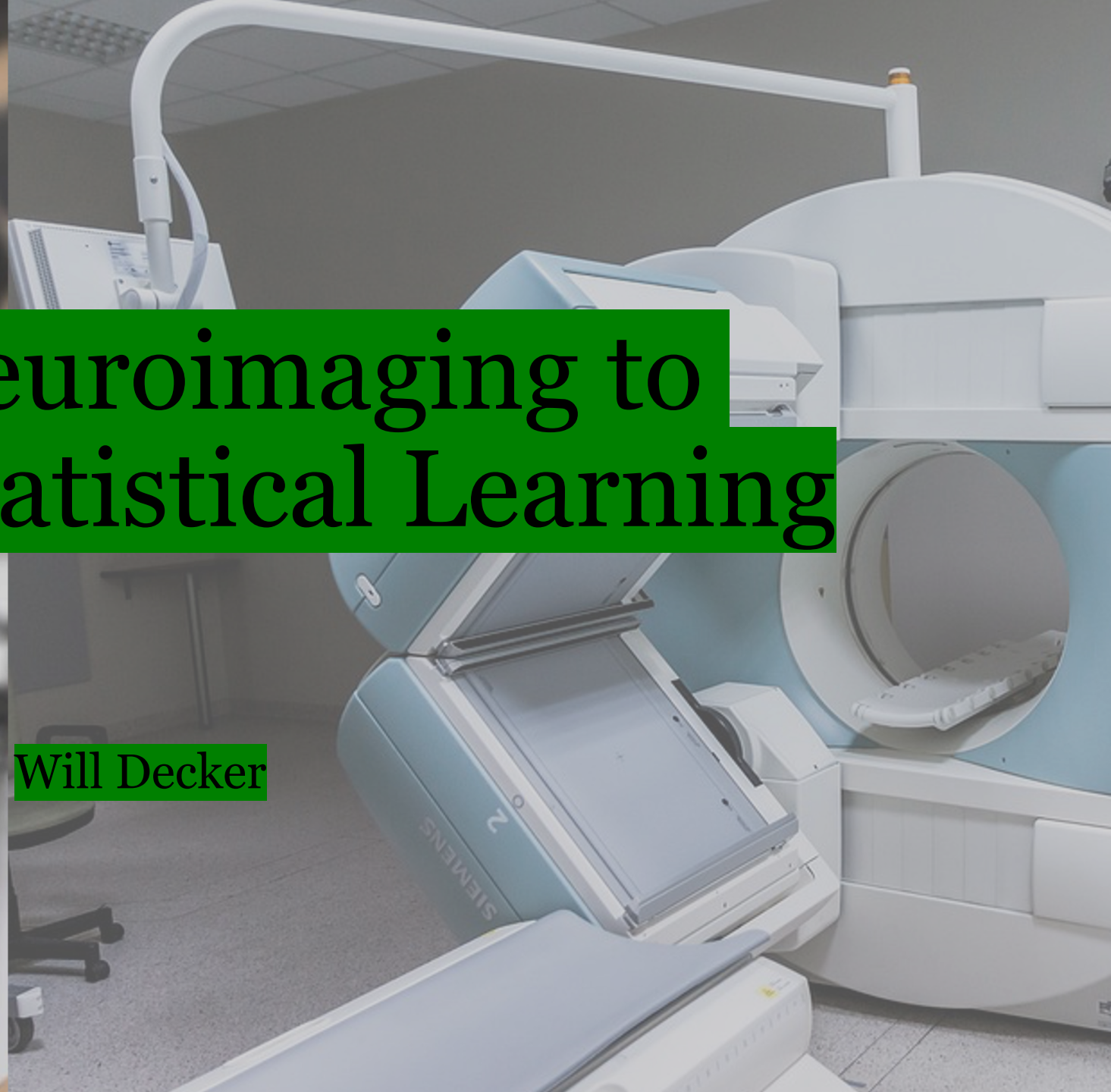




Using Neuroimaging to Examine Statistical Learning

Will Decker

What is Statistical Learning?

Statistical Learning (SL)

- SL is the brain's ability to detect and track statistical regularities in the environment.
- It is a continuous and implicit process as the environment is fluid and typically lacks stagnant boundaries.
- We employ SL across multiple cognitive domains including linguistic processing, visual processing, auditory processing, tactile processing and more.

Auditory Statistical Learning

Jenny Saffran, PhD

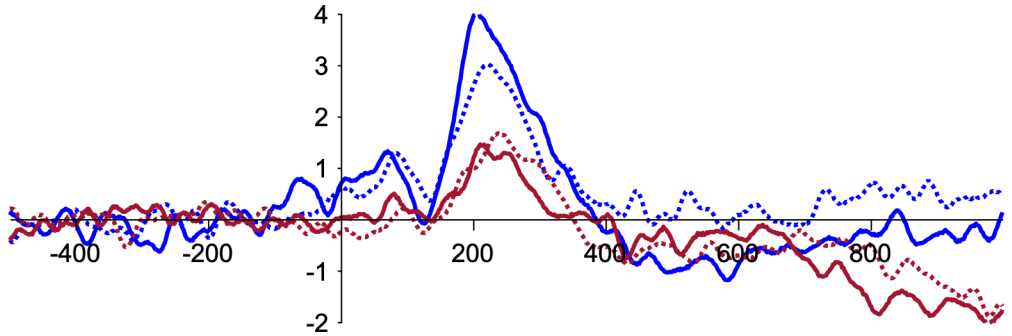
- Auditory SL is how we acquire language.
- The brain begins to recognize statistical patterns in speech/auditory input.
- In doing so, the brain can identify word boundaries with the use of transitional probabilities to extract words.
- Over time, the brain applies syntactic and semantic meaning to these words.
- Auditory SL has been demonstrated in infants and subserves how the human learns language (e.g., Saffran et al., 1996;1999).

Neuroimaging

Electroencephalography (EEG)

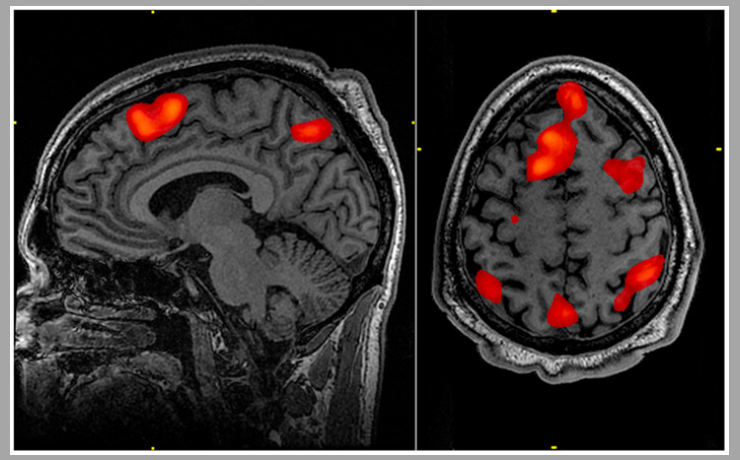
- EEG is a common and relatively cheap neuroimaging method used to study a variety of cognitive processes by measuring the neuronal activity at the cortex
- EEG has a high *temporal* resolution; this means it is particularly good at elucidating the timing of cognitive mechanisms.
- An example of this is through event related potentials (ERPs).
- ERPs are spikes in neural

activity time locked to a stimulus.



Functional Magnetic Resonance Imaging (fMRI)

- fMRI makes use of the brain's hemodynamic response, called the blood oxygenation level dependent (BOLD) signal.
- fMRI has a high *spatial* resolution and is particularly good at identifying the function of a specific region of the brain.
- To extrapolate this information, researchers employ specific experimental paradigms to capture the BOLD signal, like blocked designs or slow-event designs.



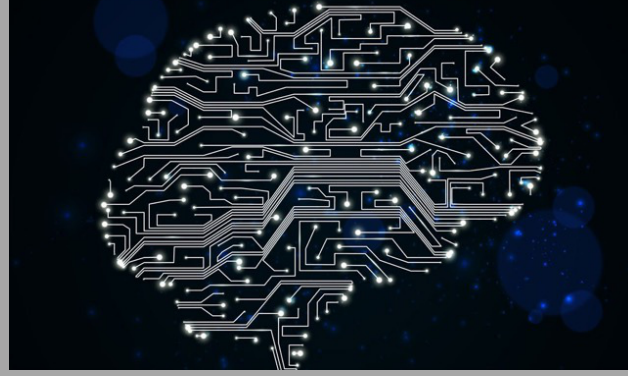
What can Neuroimaging tell us About Statistical Learning?

Neuroimaging + Statistical Learning

- Neuroimaging allows us to understand the temporal and spatial dynamics of SL's representation in the brain.
- We now know the facilitatory role that attention plays in auditory SL. This is important because SL is described as an *implicit* process—which typically does *not* require attention (Schneider et al., 2022).
- We know know that the superior temporal gyrus (STG) and inferior frontal gyrus (IFG) are particularly active during auditory SL (Karuza et al., 2013).
  - These regions of the brain are domain *general* meaning that the functioning that occurs in these regions is not specific to auditory SL.

What’s left to learn?

What's left to learn?



- Little is known about the distributed patterns of activity in the brain *during* the actual process of learning of statistical patterns embedded within language.
- To test this, we can present participants with streams of sound that either contain statistical patterns or random sequences while in an MRI scanner.
- We can then conduct a specific analysis called a functional connectivity sliding window correlation. Which will allow us to identify the brain regions involved in auditory SL *during* the period of learning.

Questions?

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