Investigating Effect of Noise on the Error Rate of Recognizing Faces/Houses under the Limited Perceptual Load

Pod: Snarling Coyotes

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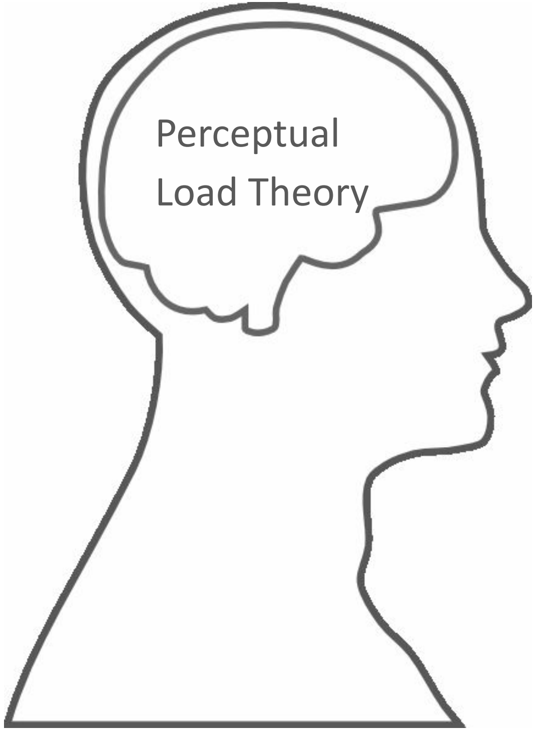


Background Information

- **Perceptual load** theory suggests that the efficiency of **selective attention** is dependent on both perceptual and cognitive loads.
- Perception is often analysed as a process in which causal events from the environment act on a subject to produce states in the brain.
- **Face recognition** is one of the methods to study perceptual load.

Effect of Noise in Face stimuli on Perceptual Load

Averaged broadband responses to face stimuli from the noisy task.

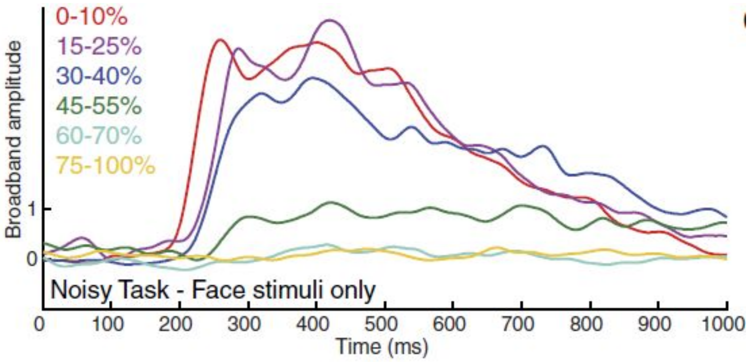


Fig.2

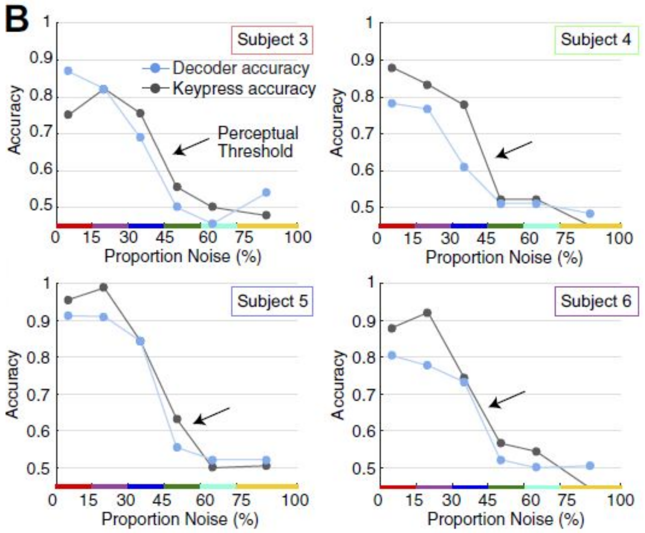


Fig. 3

Decoder and subject keypress accuracy in 4 subjects, as a function of noise.

Data and Experimental Protocol

ECoG data + Noise

Subdural grids
Strips of platinum {electrodes}

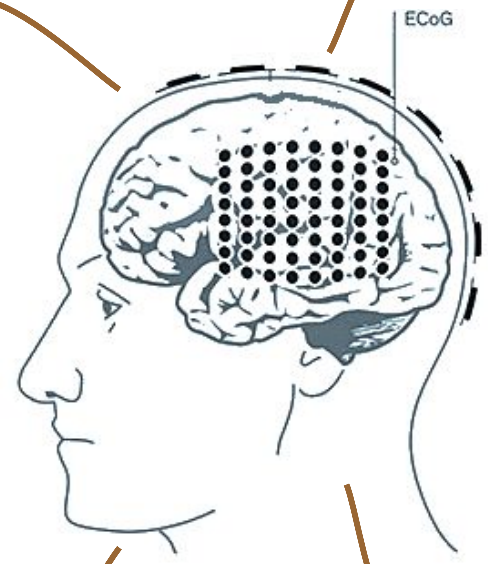
Miller’s Dataset

Images < Faces, Houses>

Stimulus = [1: 600]

Sampling rate = 1000Hz

Notch-filtered @ 60, 120, 180, 240 and 250 Hz

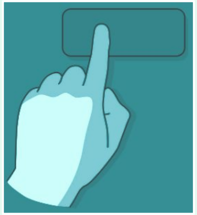


Seven subjects

< *Epileptic Patients* >

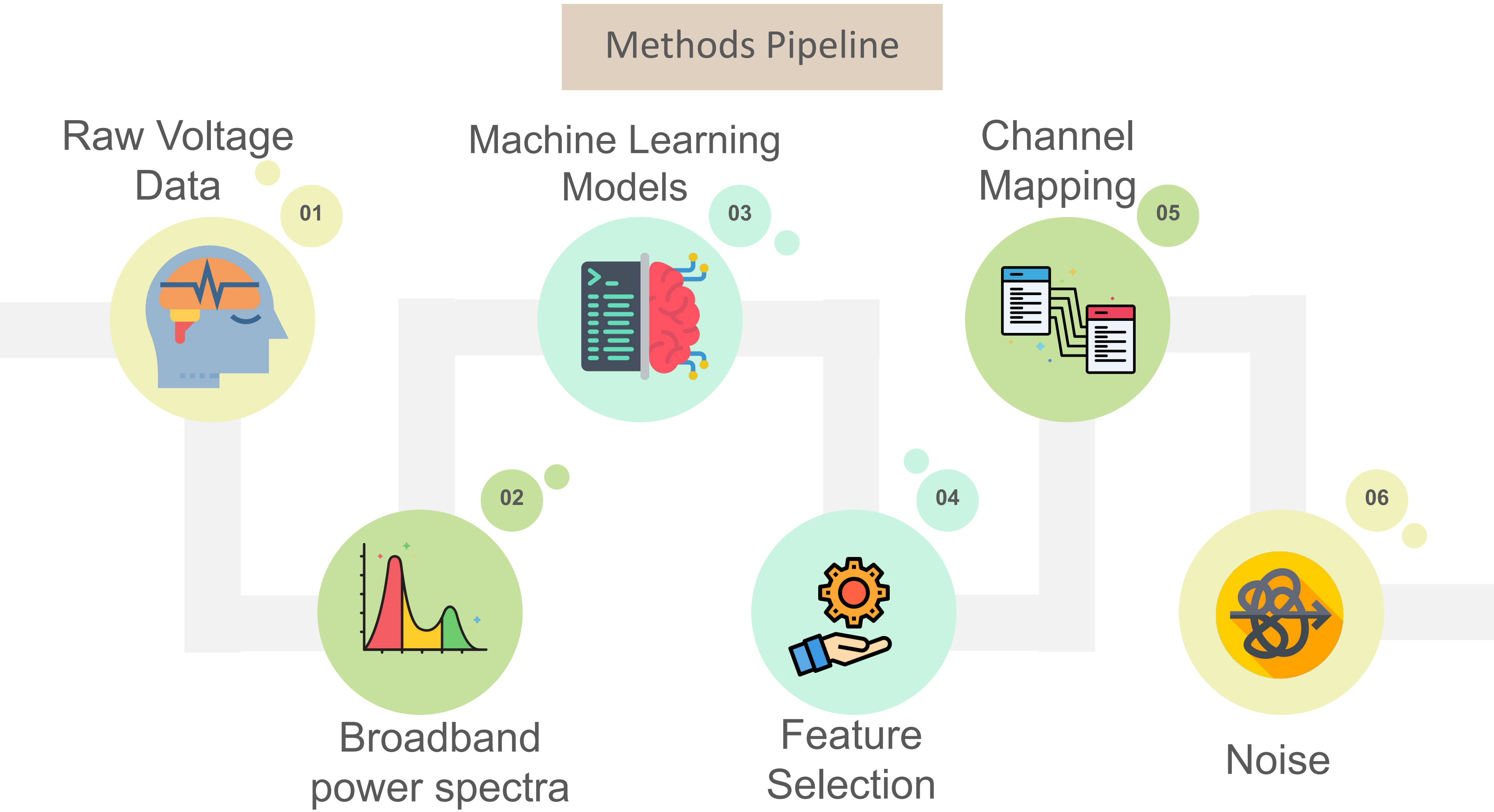
4 males
3 females

>> only 5 pressed



Continuous voltage data
< channel, time>
Stimulus category
{ 1 = House
2 = Face }

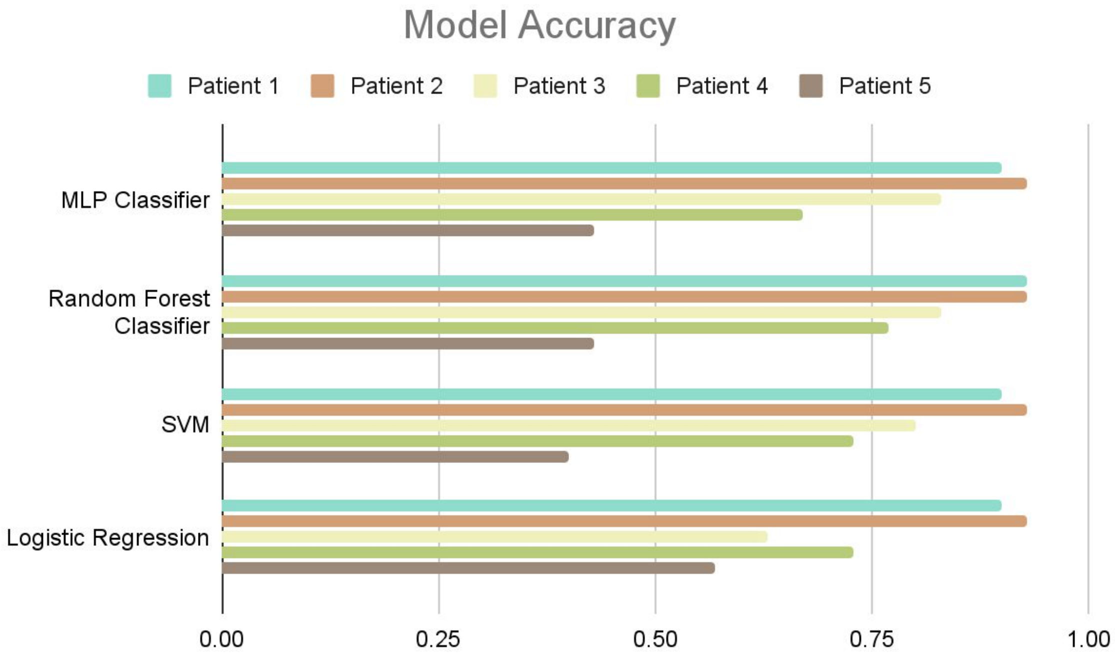
Noise % = [0: 100]
Onset time
Offset time

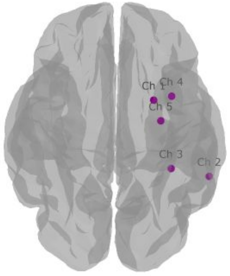


Methods Pipeline
Raw Voltage Data
01
Broadband power spectra
02
Machine Learning Models
03
Feature Selection
04
Channel Mapping
05
Noise
06

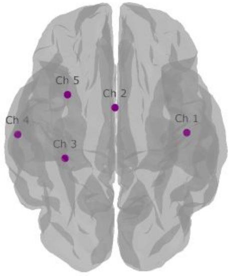
Model Accuracies that has been trained and tested with patients' responses (after tuning hyperparameters)

Machine learning based classifiers were used to predict the response of each patient for different stimuli.

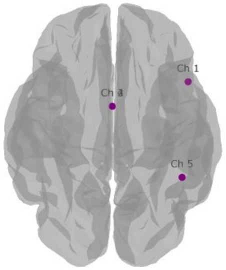




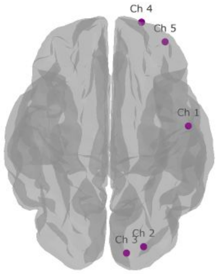
Patient 1



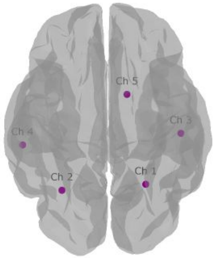
Patient 2



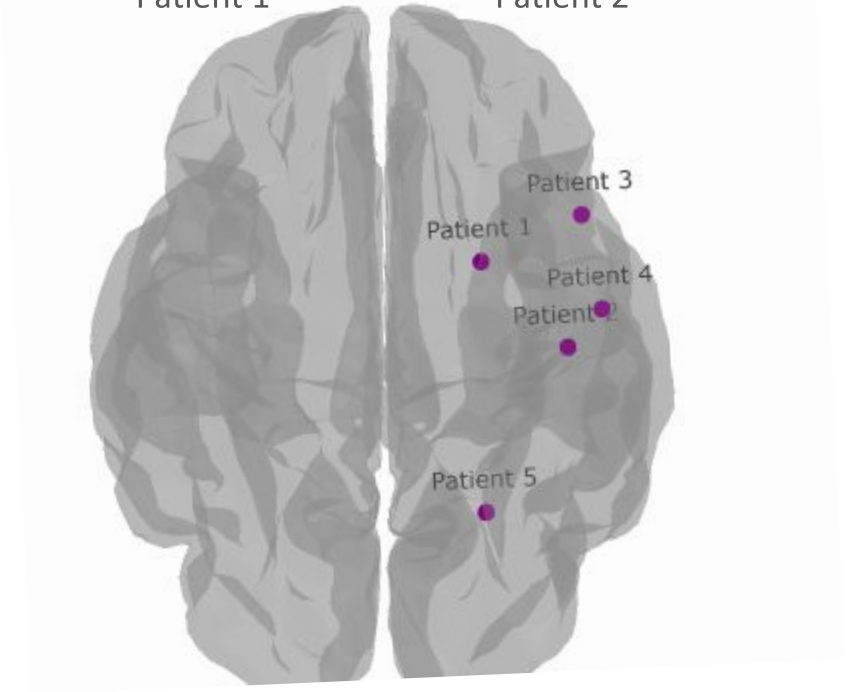
Patient 3



Patient 4

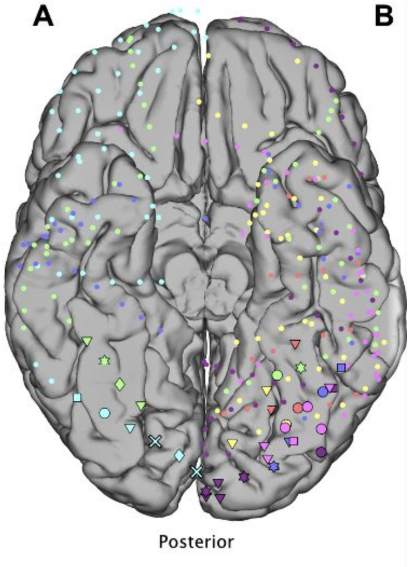


Patient 5

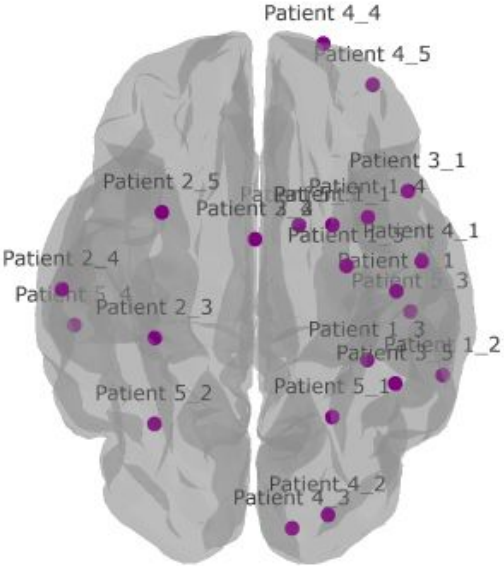


The Most Important Channel for Each Patient According to Logistic Regression Model

The Top Five Most Important Channels for Each Patient According to Logistic Regression Model



All Patient in one 3D brain graph
(according to Miller's model)

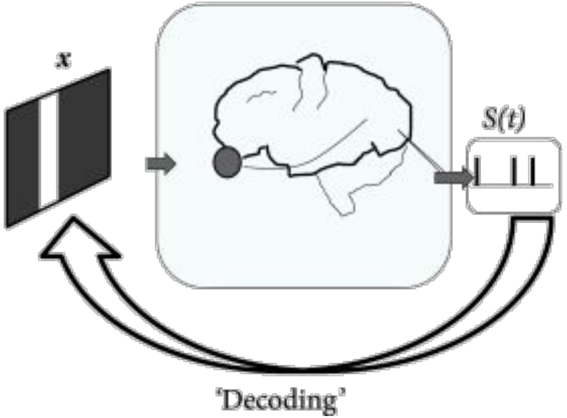


All Patient in one 3D brain graph
(according to our model)

Concentrated in a region that matches with the paper's prediction

Conclusion

Since our model predictions for actual labels match with that of patient predictions, we can say that our model is a good representative of neural decoding in patients. So we can go ahead with analysing the effect of noise on patients' decisions by using the models.



Future Work

- We could train the classifiers on data from experiment 1 and use them to predict accuracies on our test set from experiment 2. The difference in accuracy, if any, could then be attributed to the presence of noise in experiment 2.
- We can also check how the accuracy changes when we remove non-important / negatively contributing channels from our input.
- We can extract out different frequency bands from the data and see if one kind of oscillations are more relevant than the others.

References

1. Murphy, G., Groeger, J.A. & Greene, C.M. (2016) Twenty years of load theory—Where are we now, and where should we go next?. Psychon Bull Rev 23, 1316–1340
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4. Miller, K. J., Hermes, D., Pestilli, F., Wig, G. S., & Ojemann, J. G. (2017). Face percept formation in human ventral temporal cortex. Journal of neurophysiology, 118(5), 2614-2627.