Investigating the Trial Novelty Effect on Modeling the Neural Activity in Face-Selective Areas

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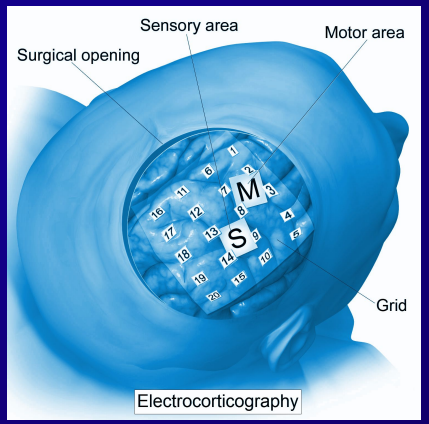
Introduction

Introduction

Background and Project Question

- ECOG: face-house images with noise
- In the literature: face (FFA) and place (PPA) selective areas (1,2)
- Contextual novelty may enhance and/or facilitate visual processing (3)
- ? Effect of trial novelty
  - Novel or repeated with respect to previous trial



(4)

(1)

Significance

- Go beyond a statistical comparison, to apply the modeling and compare model-fit performances

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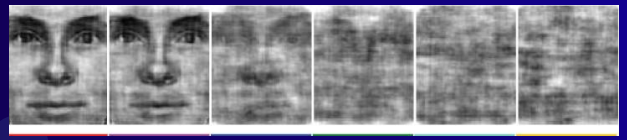
Methodology

Methodology

Study design

Face-house stimuli with noise
Noise level: 0 to 100, #21
Report face stimuli



(1)

Data collection

Miller (2019) ECOG:
Face-house 2nd experiment

Data analysis

Training and testing
Linear regression
Decision-tree regressor - to capture non-linearity

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Results

Results

Data analysis

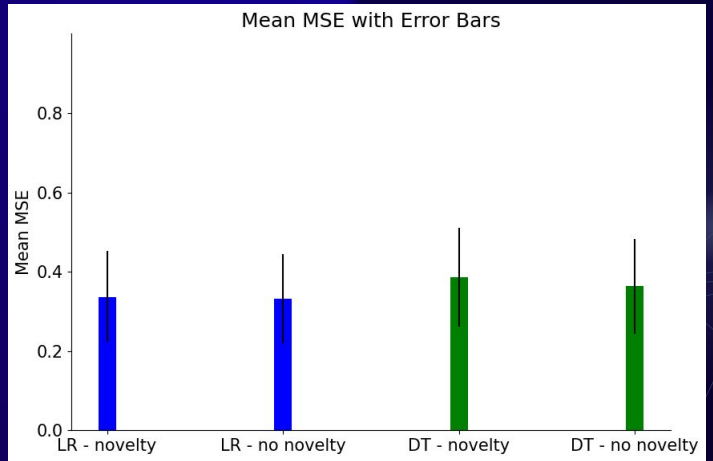
MSEs for..
2 different regressor
2 model
5 subjects

MSE comparison t-test:

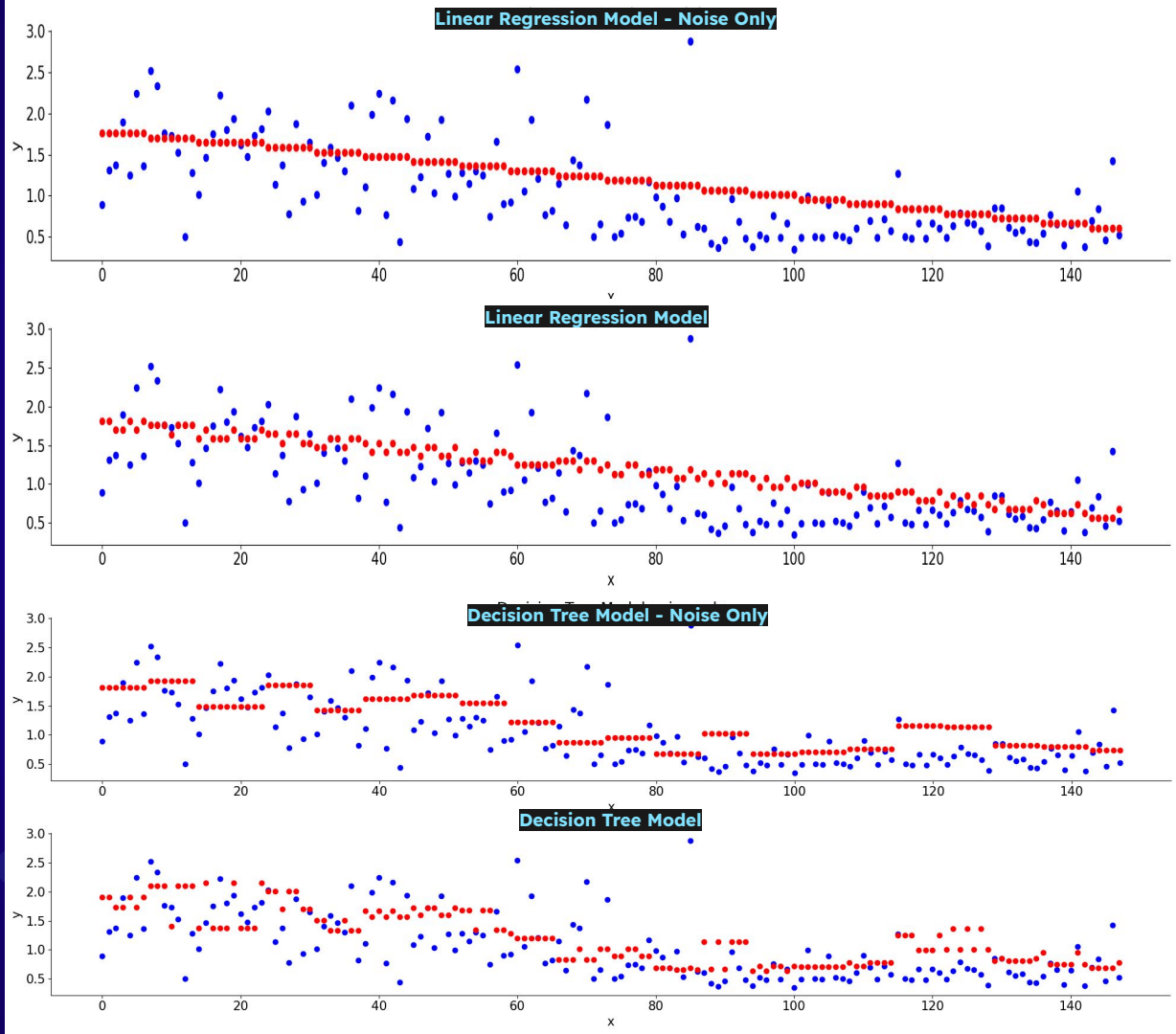
- LR: p = 0.27
- DT: p < .05
- LR vs DT: p < .05

Limitations

Our model may not be strong enough to capture the variability inherent to neural recordings…
Excluding outliers?



Results


Linear Regression Model - Noise Only
Linear Regression Model
Decision Tree Model - Noise Only
Decision Tree Model
y
x
0
20
40
60
80
100
120
140
0.5
1.0
1.5
2.0
2.5
3.0

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Discussion

Discussion

Summary

Linear Regression did not produce differences between the models…

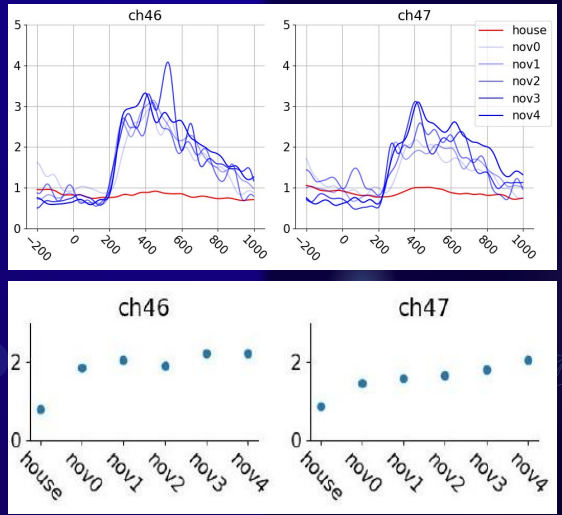
While Decision-Tree Regressor showed a statistical significance, favoring the model with only noise (no-novelty)

Is it the methodological limitation or novelty indeed has no effect?

Limitations

Using only two levels of novelty

The model that has very small number of parameters



Conclusions

Need for a more complex methodology for modeling

Whether the effect is specific to some noise levels due to interactions with novelty, remains to be investigated…

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Resources

Resources

1. Miller, K. J., Schalk, G., Hermes, D., Ojemann, J. G., and Rao, R. P. (2016). Spontaneous decoding of the timing and content of human object perception from cortical surface recordings reveals complementary information in the event-related potential and broadband spectral change. PLoS computational biology 12(1): e1004660. doi: 10.1371/journal.pcbi.1004660

2. Miller, K. J., Hermes, D., Pestilli, F., Wig, G. S., and Ojemann, J. G. (2017). Face percept formation in human ventral temporal cortex. Journal of neurophysiology 118(5): 2614-2627. doi: 10.1152/jn.00113.2017

3. The physiology of perception in human temporal lobe is specialized for contextual novelty. Kai J. Miller, Dora Hermes, Nathan Witthoft, Rajesh P. N. Rao, and Jeffrey G. Ojemann. Journal of Neurophysiology 2015 114:1, 256-263

4. https://en.wikipedia.org/wiki/Electrocorticography

Thanks

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Code and Results