

# Features for Emotion Recognition

a comparative study of feature selection methods



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# Content

- **Basic concepts**
  - Emotion
  - valence/arousal
  - Emotion recognition with machine learning
- Features
  - EEG
  - non-EEG
- Problem Statement
- Approach
- Results
- Future Research

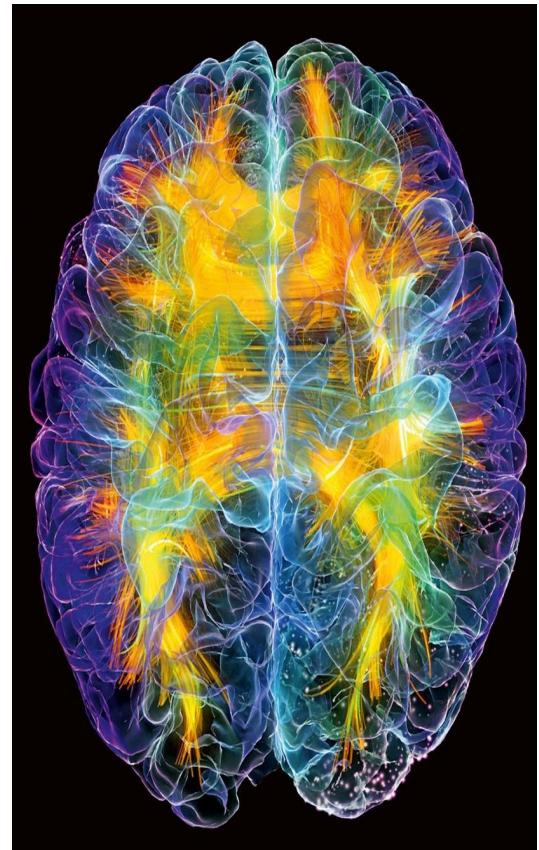
# Emotion



Expression



Physiological



Emotion in the  
brain

# Emotion Classification



Unpleasant

Active

Arousal

Fear

Excited

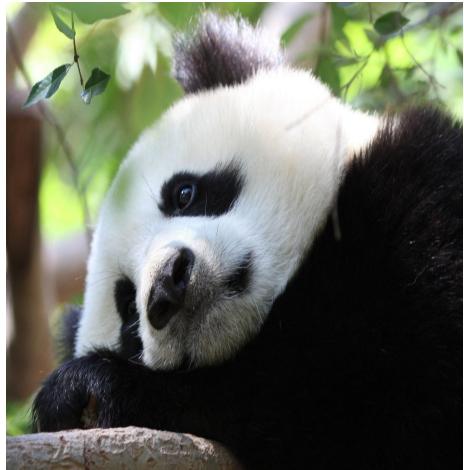
Valence

Pleasant

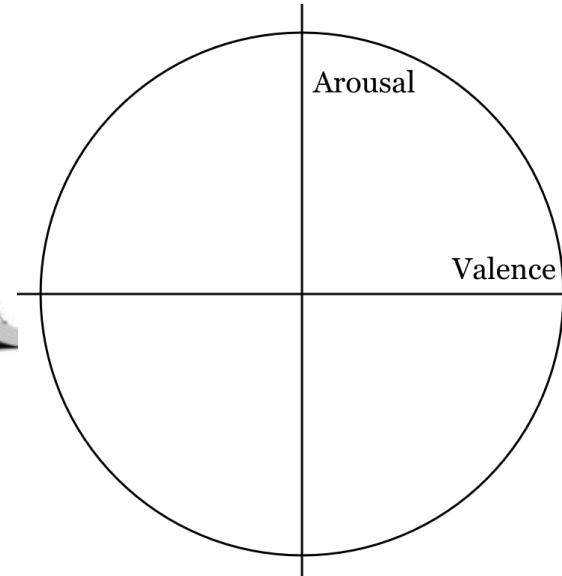
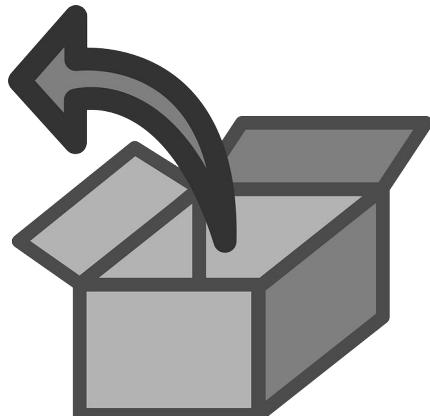
Inactive

Bored

Relaxed



# Emotion recognition using ML



Input:  
physiological  
signals

Extract Features

Machine learning

Output:  
valence/arousal

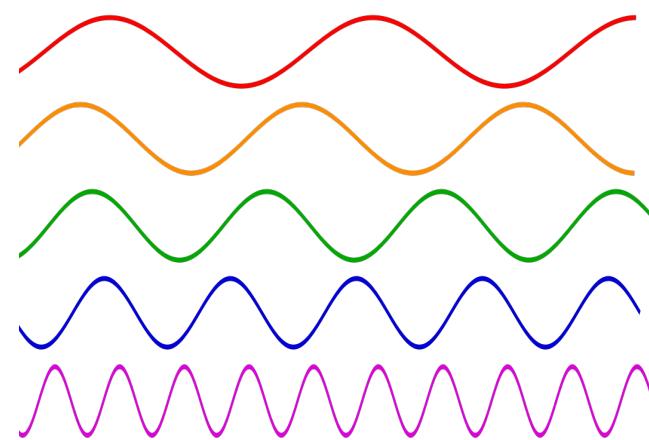
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# Electroencephalography (EEG)



Different channels



Delta	0 - 4
Theta	4 - 8
Alpha	8 - 13
Beta	13-30
Gamma	30-50

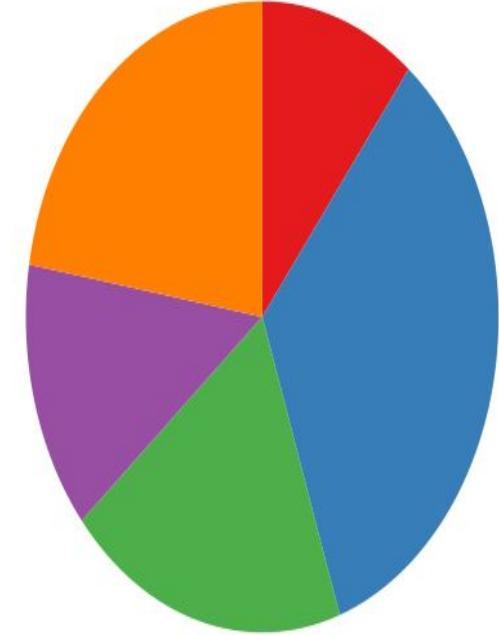
Different frequency bands

# EEG features



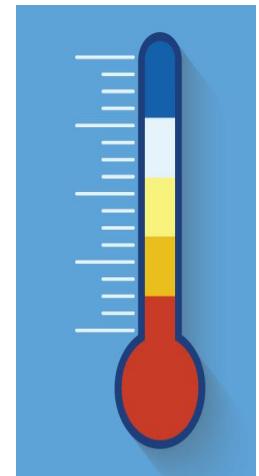
Power of a  
specific channel

(A)symmetry  
features  
- Left vs. Right  
- Front vs. Back



Fractions of  
different  
wavebands

# Non - EEG Features



Heart Rate

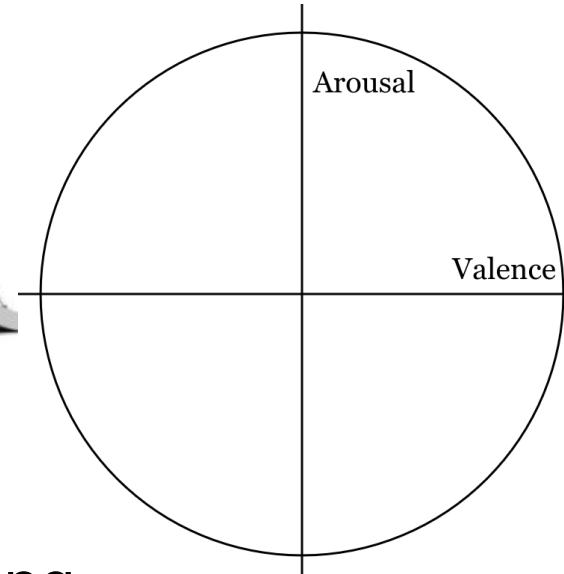
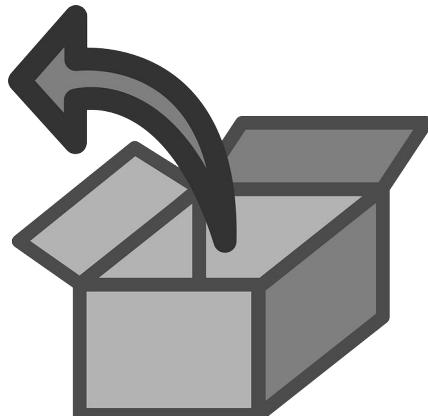
Respiration  
Rate

Perspiration

Blood pressure

Skin Temp.

# Emotion recognition using ML - recap



Input:  
physiological  
signals

Extract Features

Machine learning

Output:  
valence/arousal

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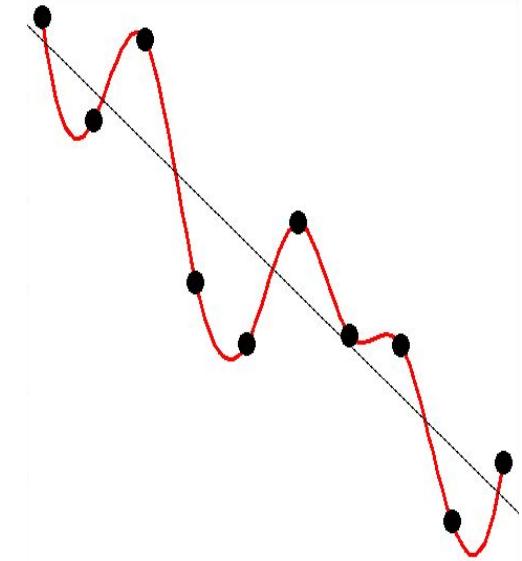
# Problem: not all features are good features



Disagreement  
on Features

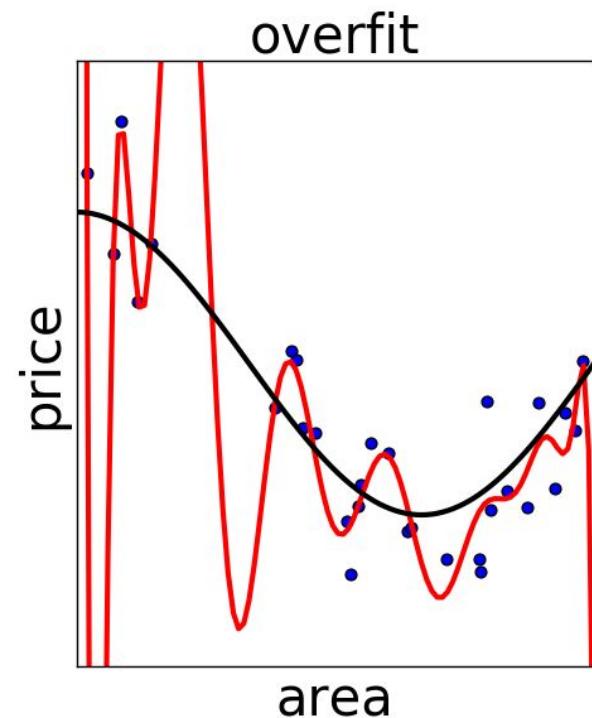
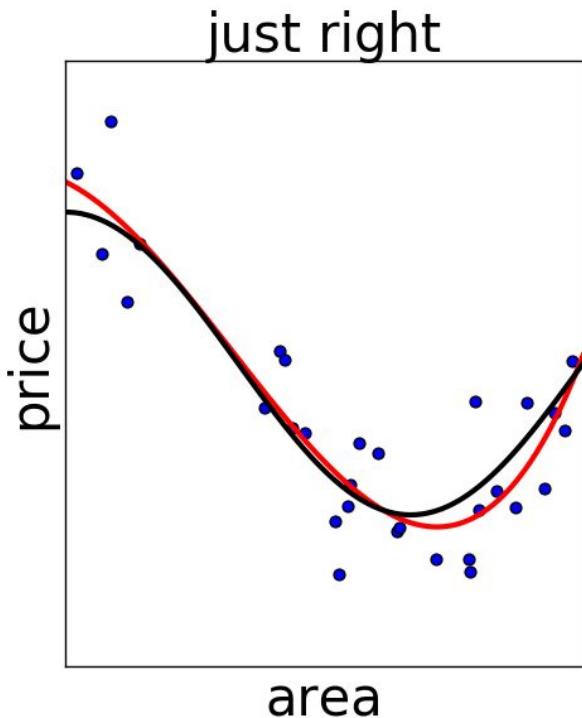
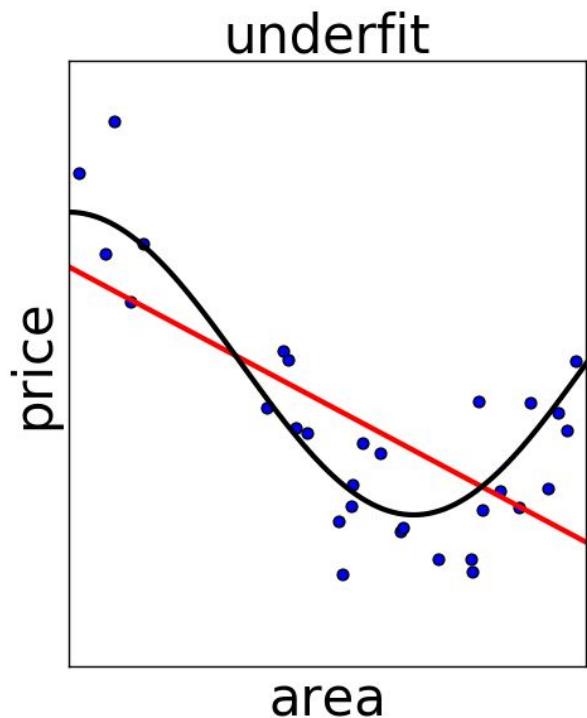


Personal  
Differences



Overfitting

# Over- & underfitting



# Goal



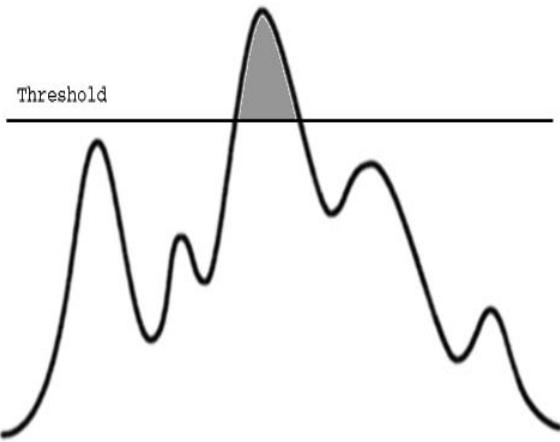
Find good features  
-> person specific  
-> cross-subject

EEG vs non-EEG vs All

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# Feature Selection Methods



Filter Methods

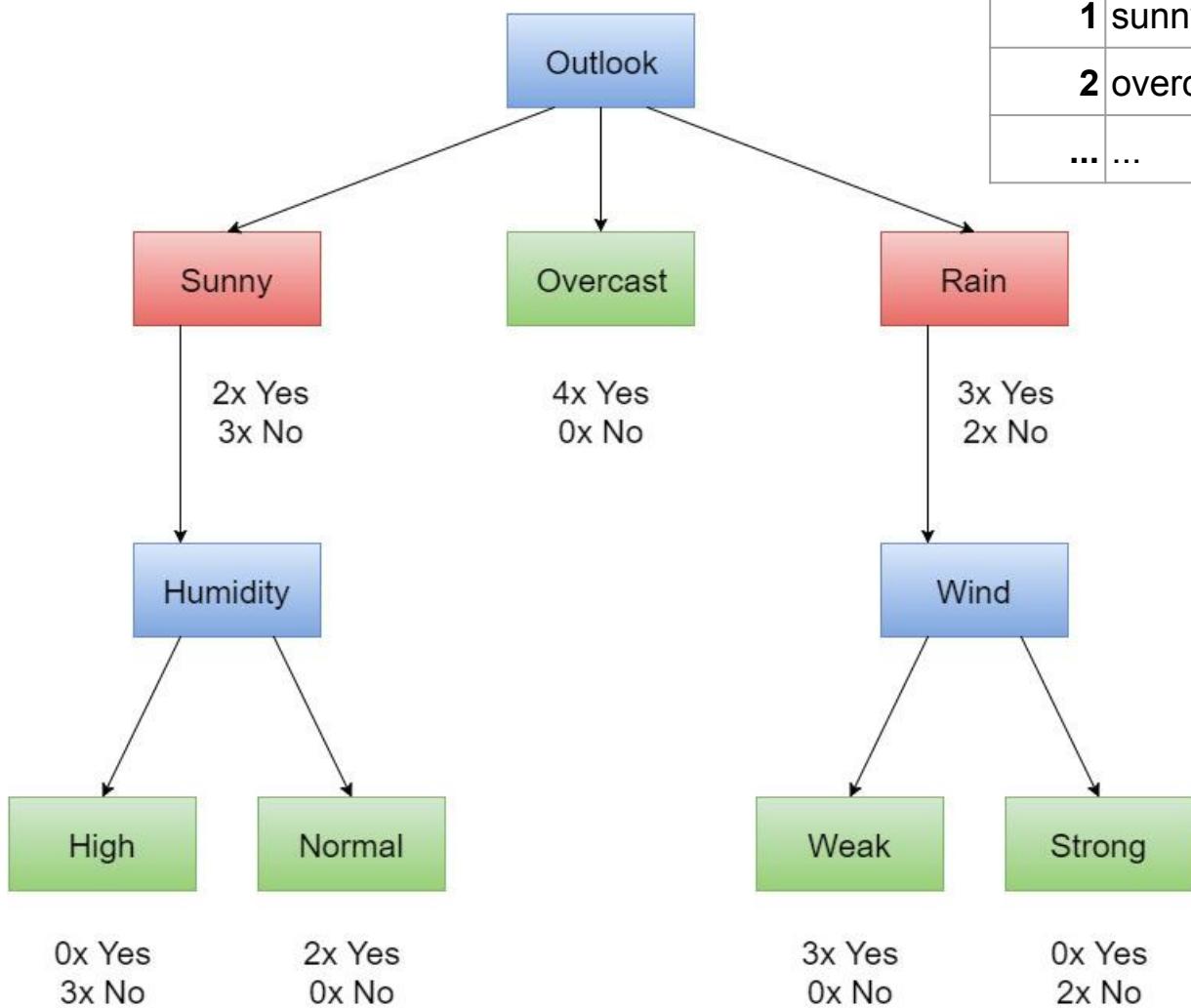


Wrapper Methods



Embedded  
Methods

# RF method: will person X play tennis today?

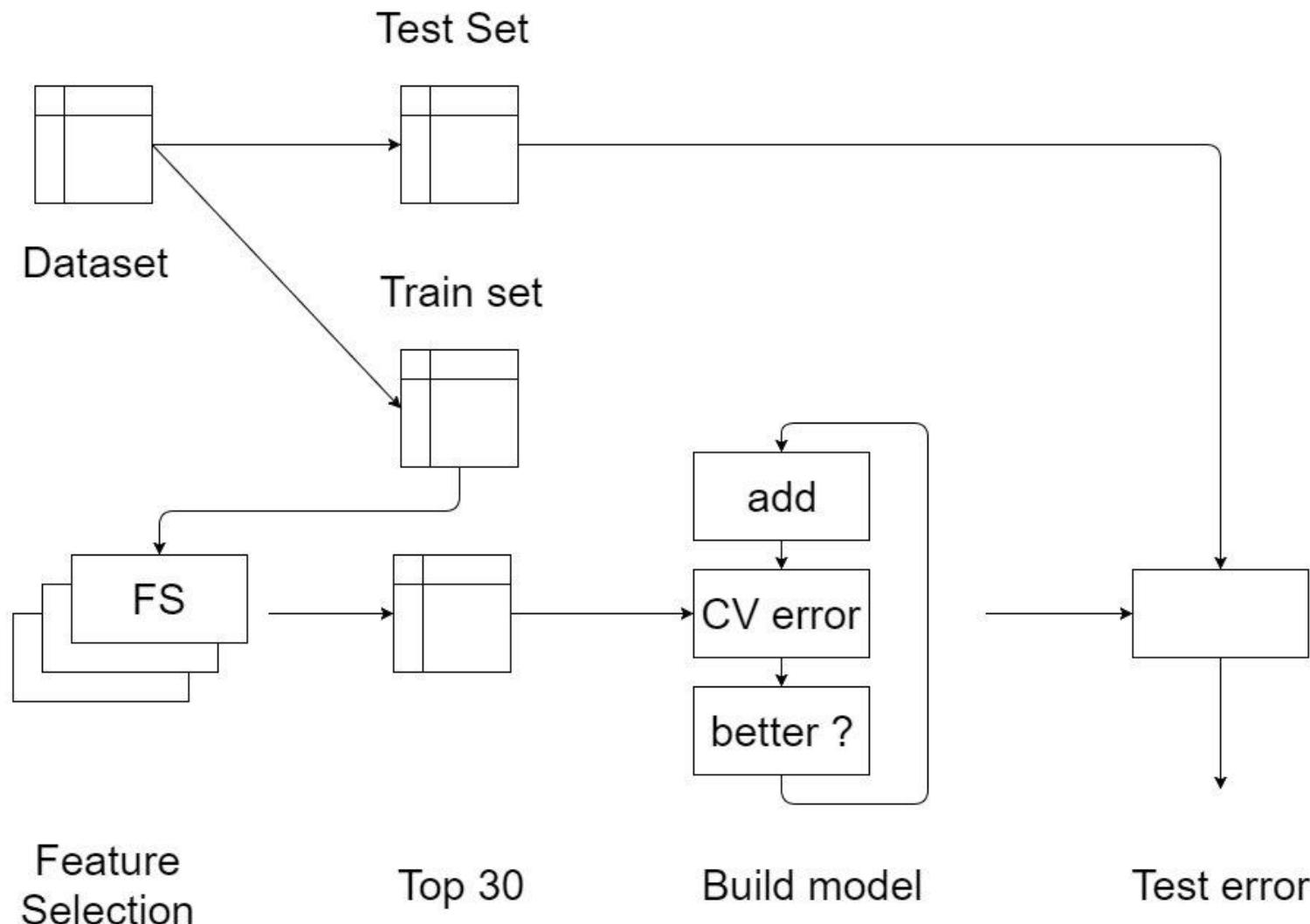


Day	Outlook	Humidity	Wind	tennis
1	sunny	high	weak	no
2	overcast	high	weak	yes
...	...	...	...	...

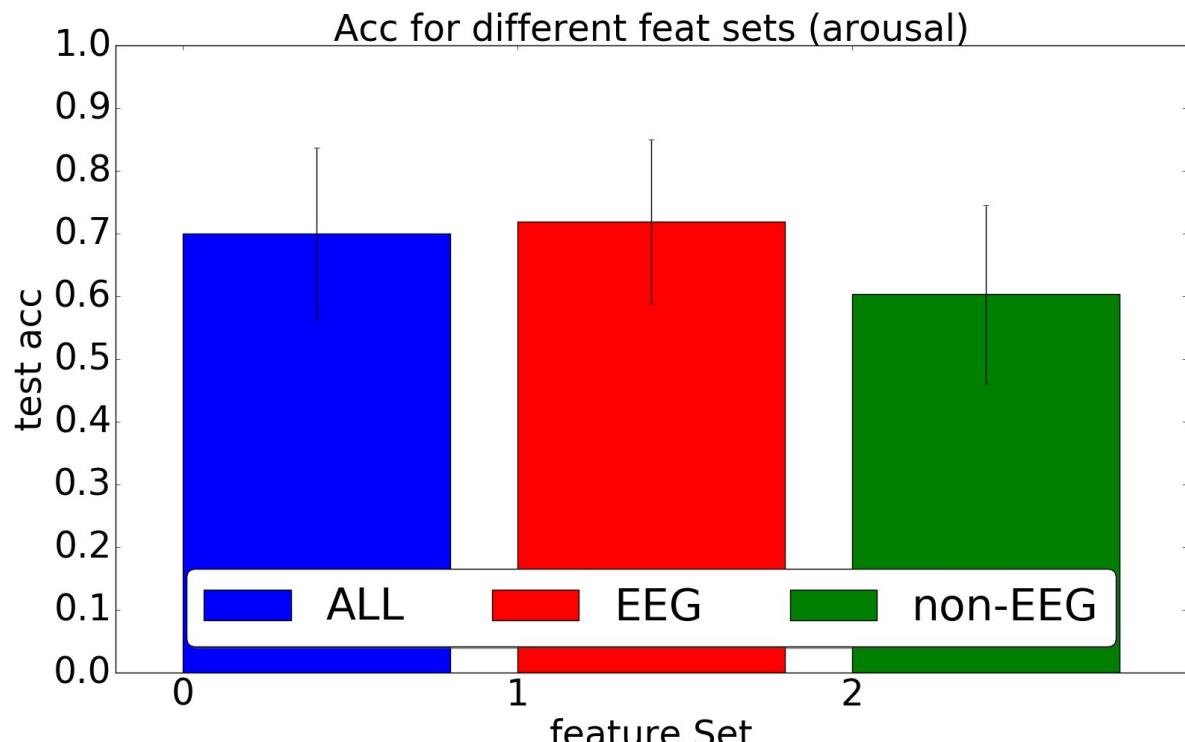
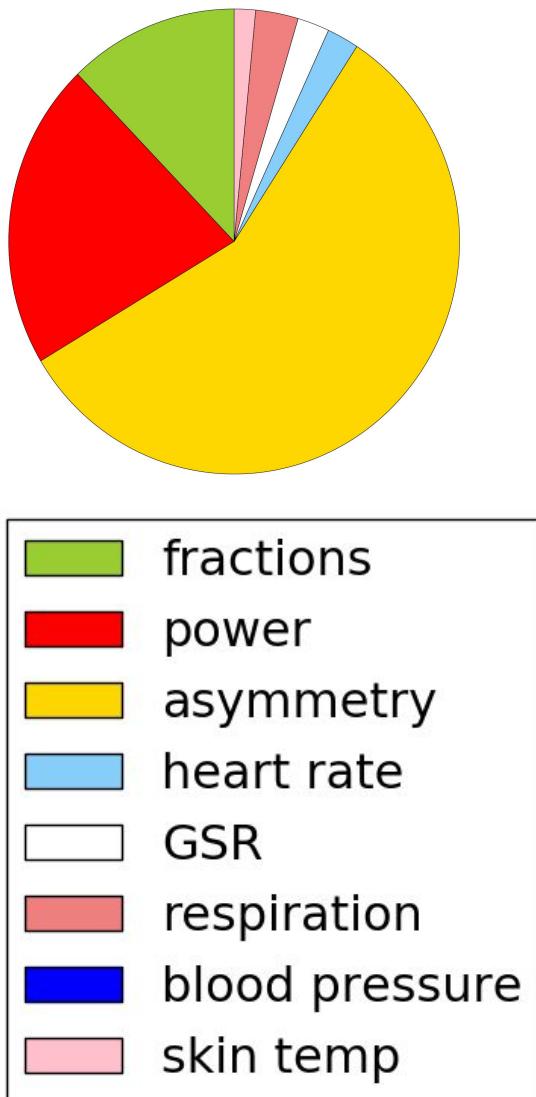
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# General Flow

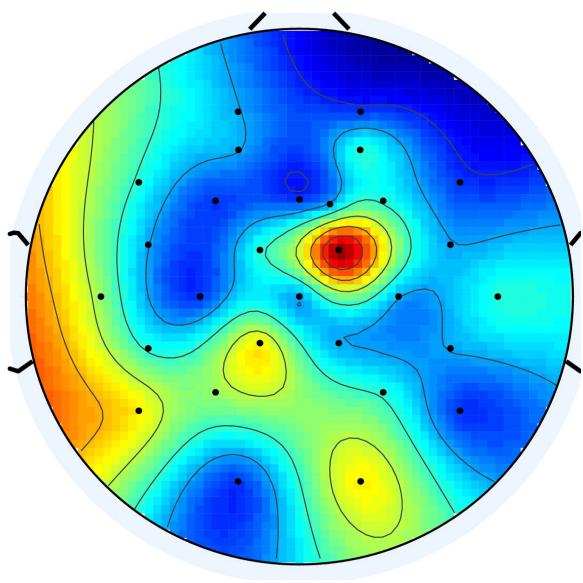


# Results person specific (arousal)

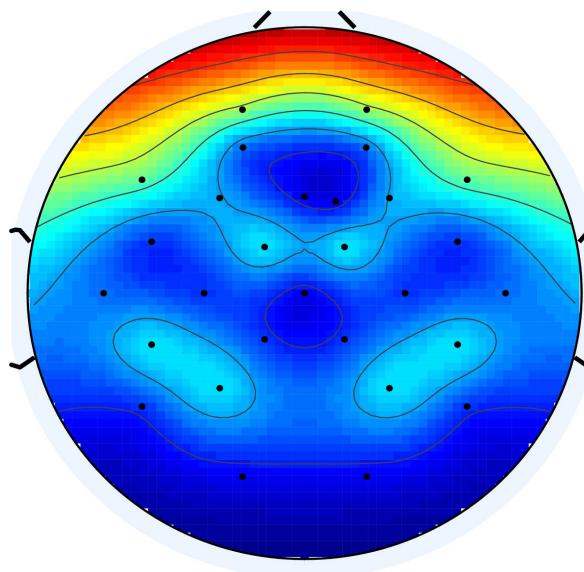


P-values		
ALL / EEG	ALL / non-EEG	EEG / non-EEG
0.4386	$5.891 \times 10^{-7}$	$1.201 \times 10^{-4}$

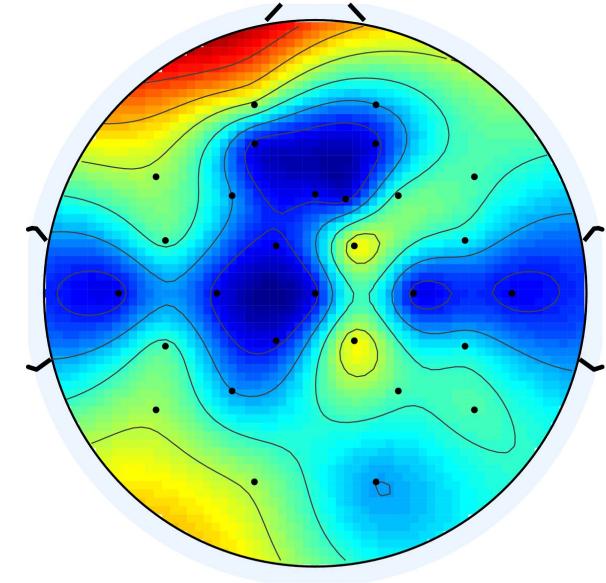
# Used EEG regions (arousal)



Separate channels

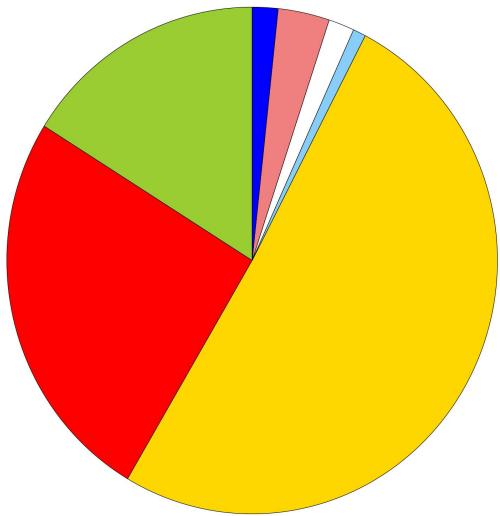


Left / Right  
asymmetry

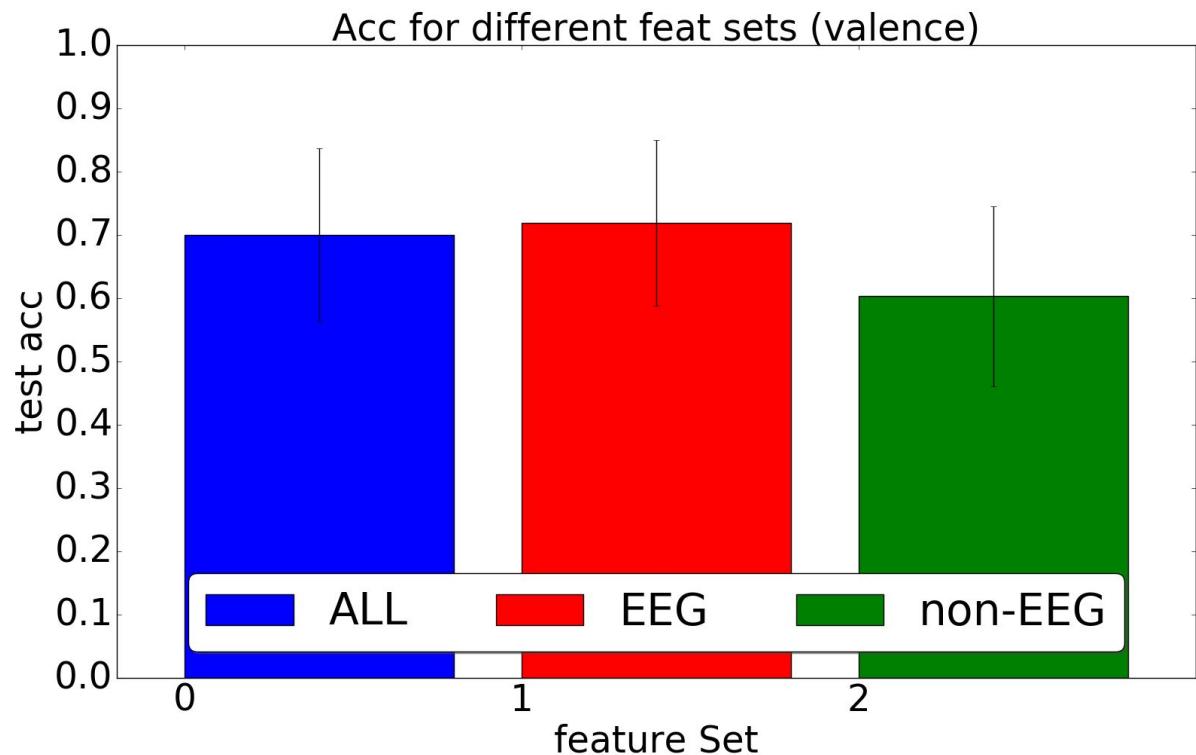


Front / Back  
asymmetry

# Results person specific (valence)

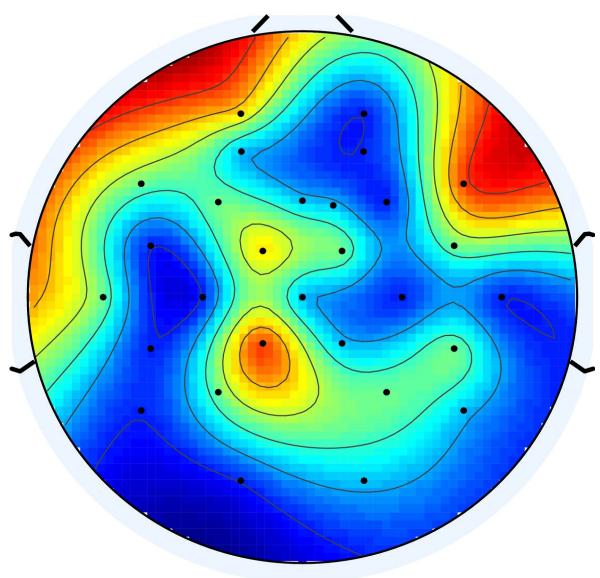


[green square]	fractions
[red square]	power
[yellow square]	asymmetry
[light blue square]	heart rate
[white square]	GSR
[pink square]	respiration
[dark blue square]	blood pressure
[light pink square]	skin temp

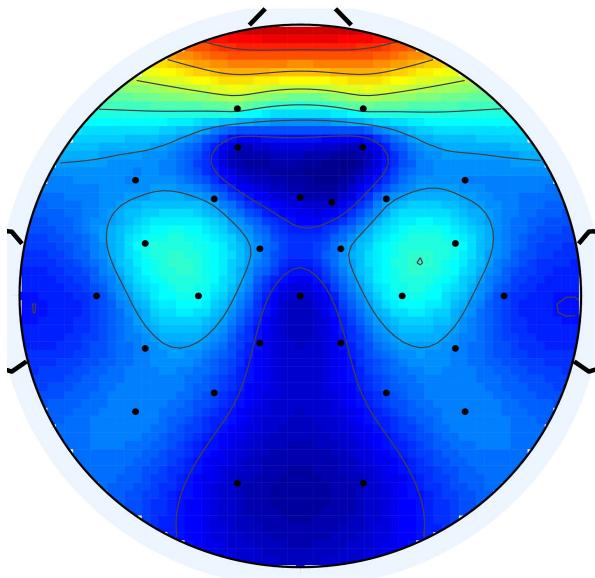


P-values		
ALL / EEG	ALL / non-EEG	EEG / non-EEG
0.6817	$1.993 \times 10^{-9}$	$1.763 \times 10^{-6}$

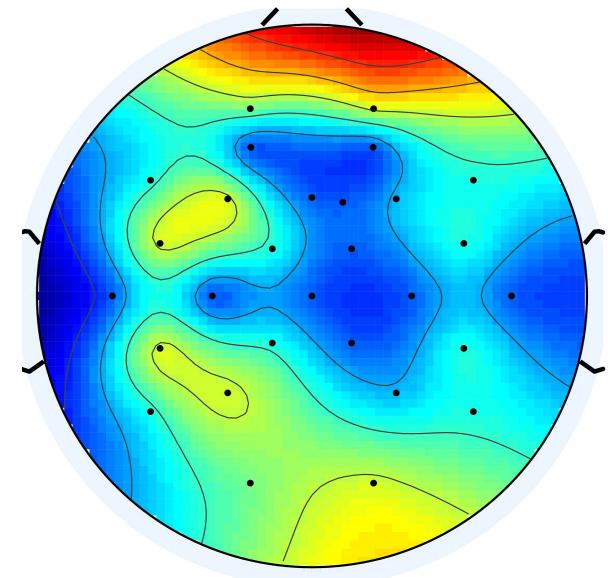
# Used EEG regions (valence)



Separate channels

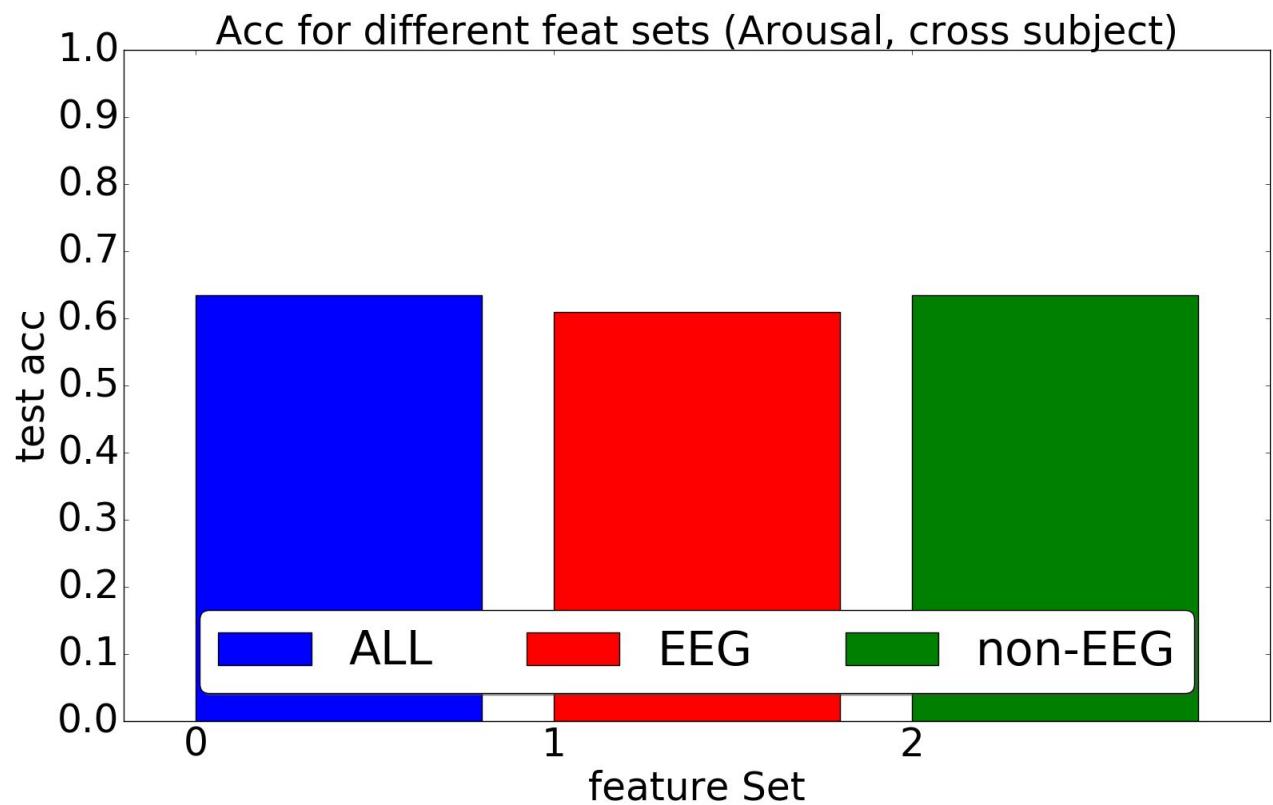
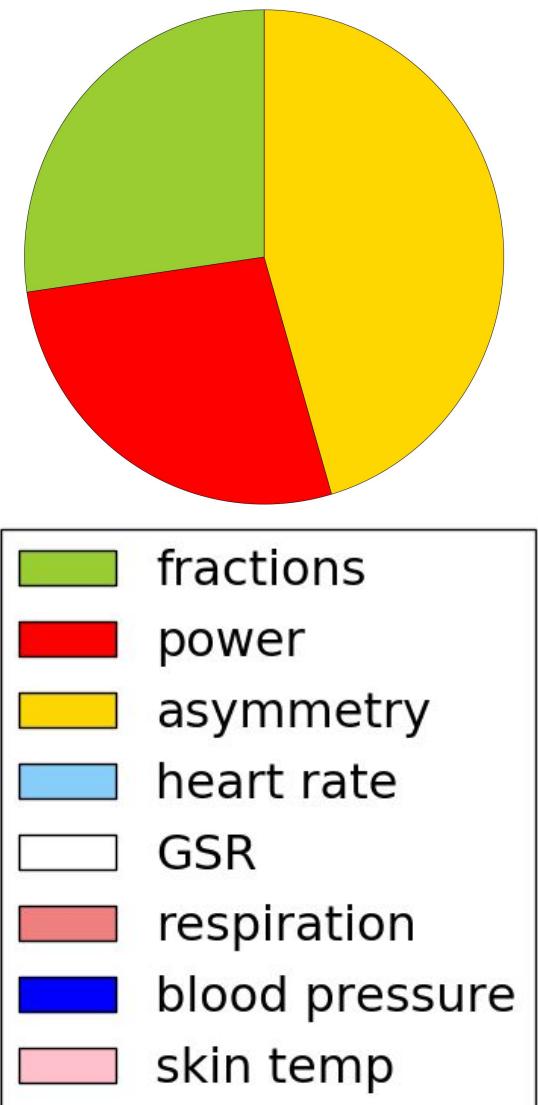


Left / Right  
asymmetry

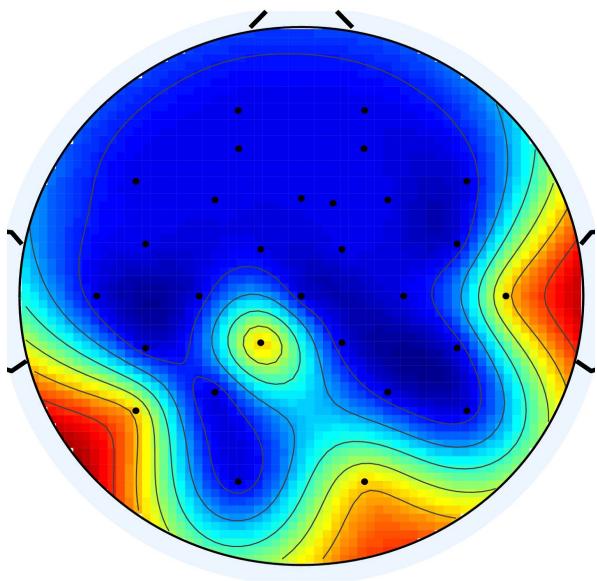


Front / Back  
asymmetry

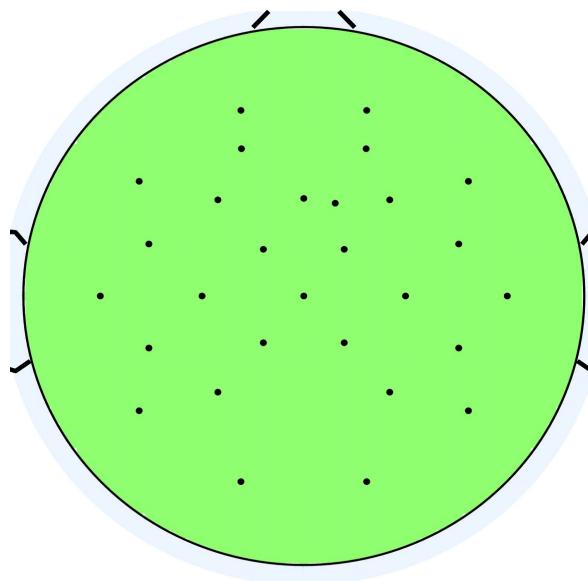
# Results cross subject (arousal)



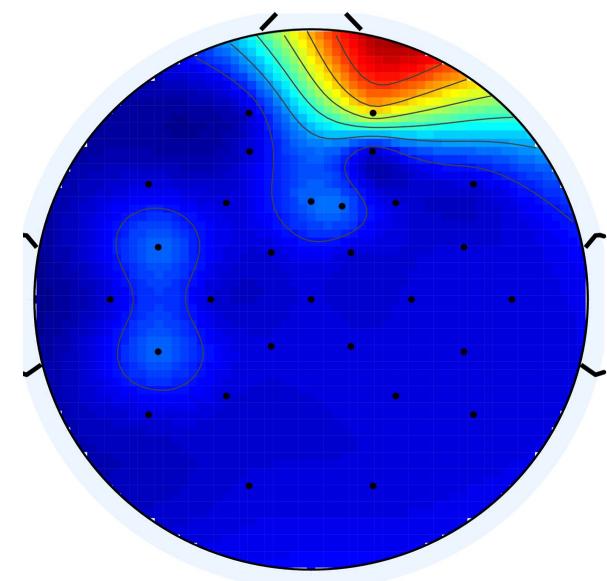
# Used EEG regions (arousal)



Separate channels

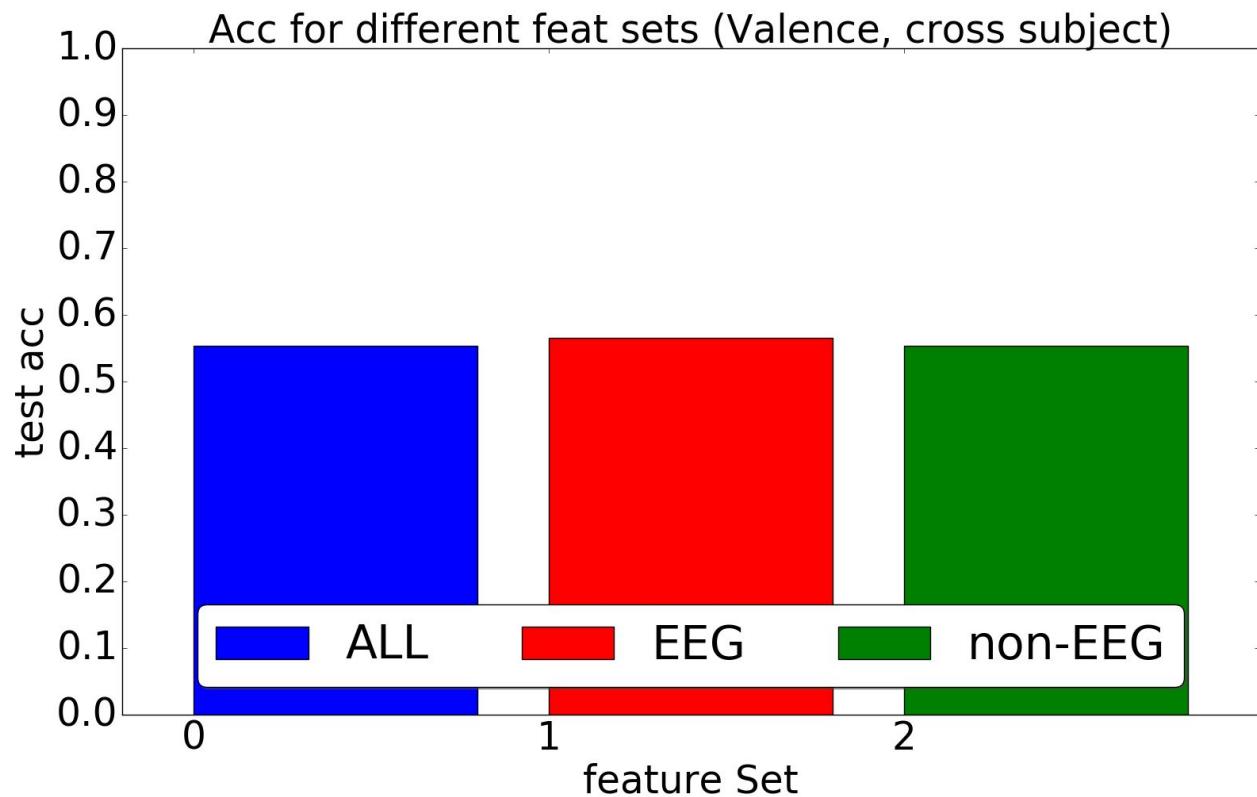
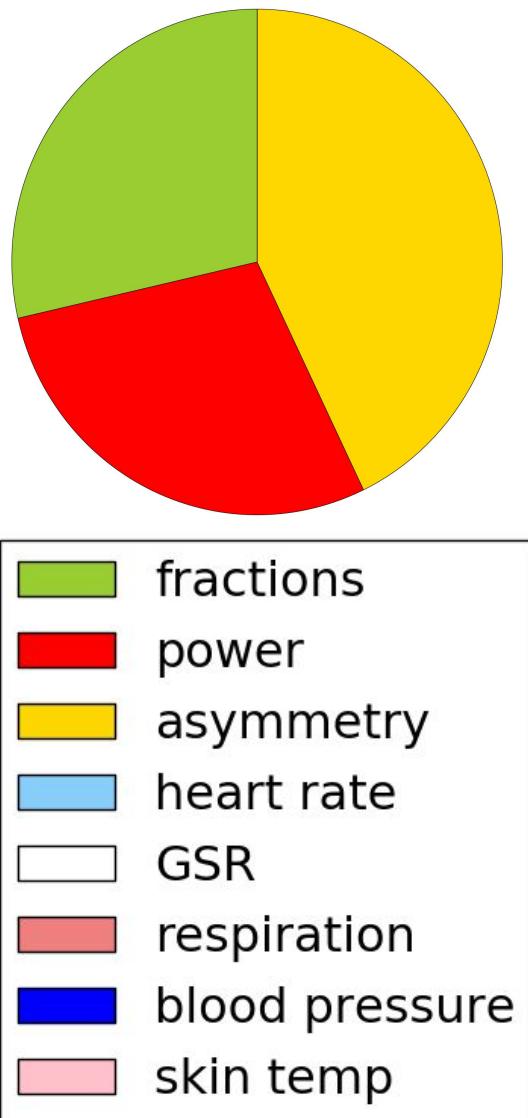


Left / Right  
asymmetry

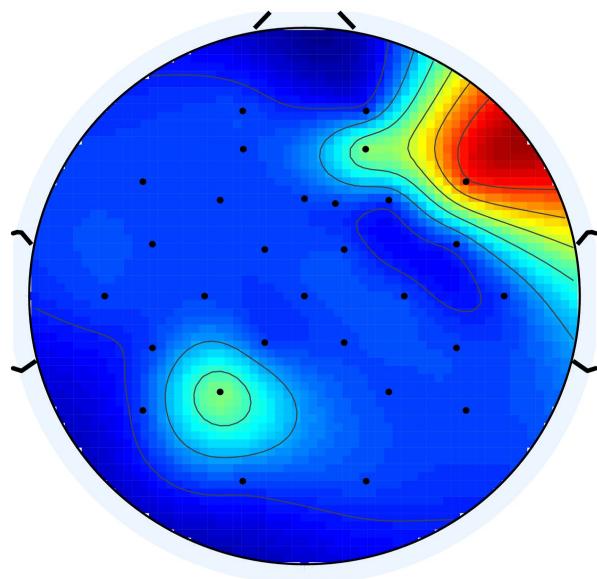


Front / Back  
asymmetry

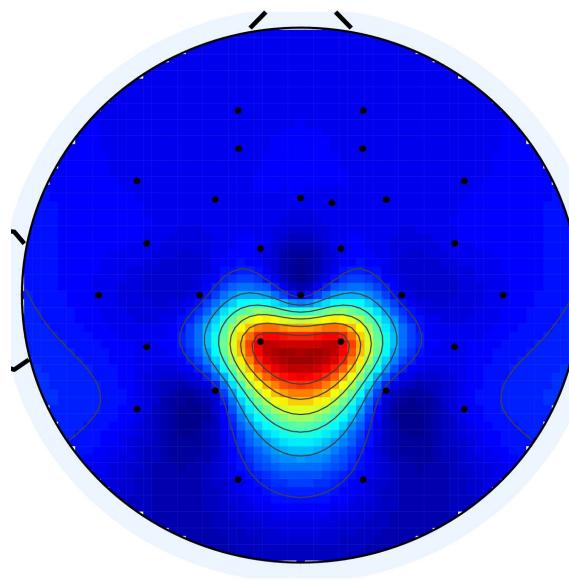
# Results cross subject (valence)



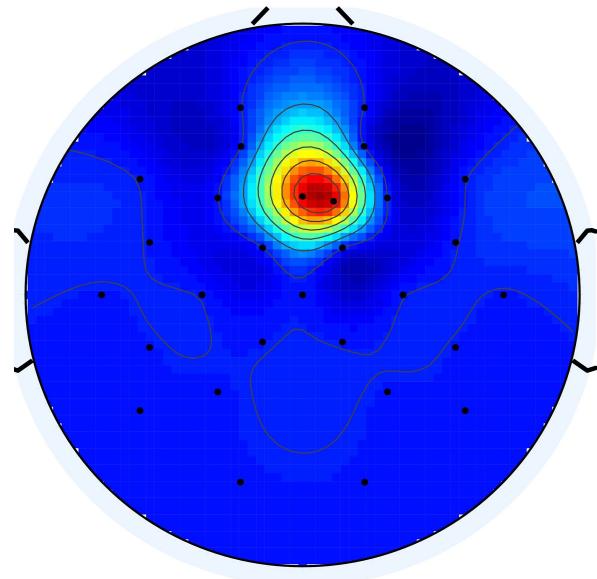
# Used EEG regions (valence)



Separate channels



Left / Right  
asymmetry



Front / Back  
asymmetry

# Conclusion

Person specific:

- EEG features are dominant
  - Asym features seem to work quite well, which concurs with literature
- Adding non-EEG features does not improve acc

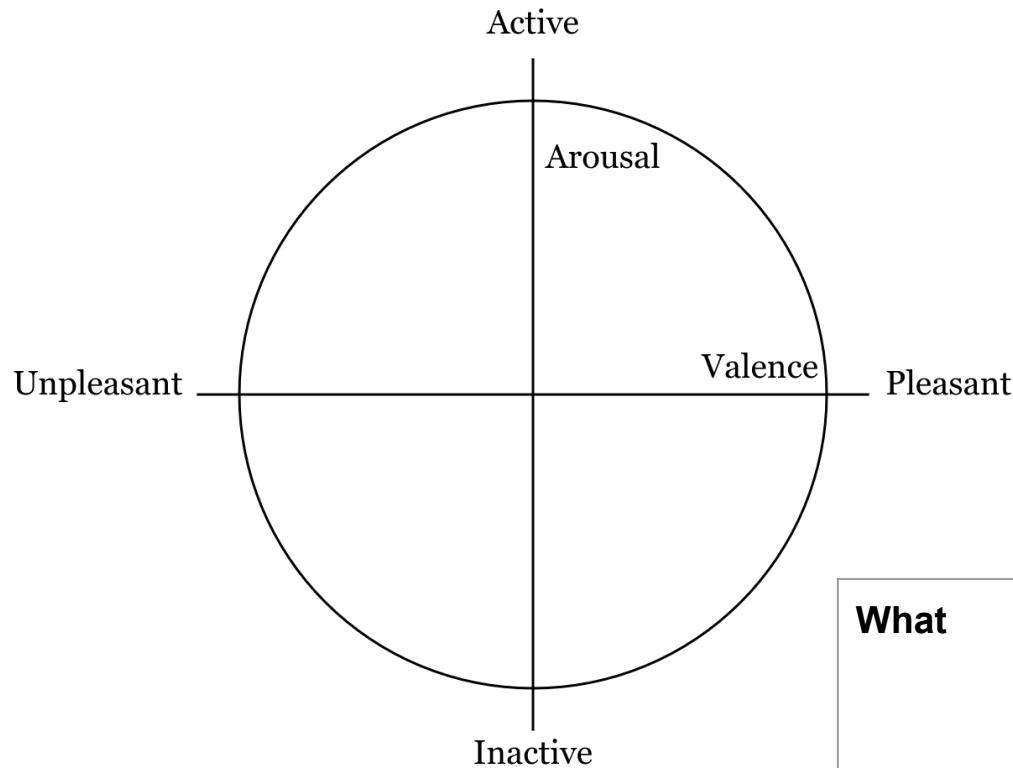
Cross subject:

- EEG features are chosen over non-EEG features
- Difference with non-EEG is not significant
- Accuracy might be to low to draw conclusions

# Content

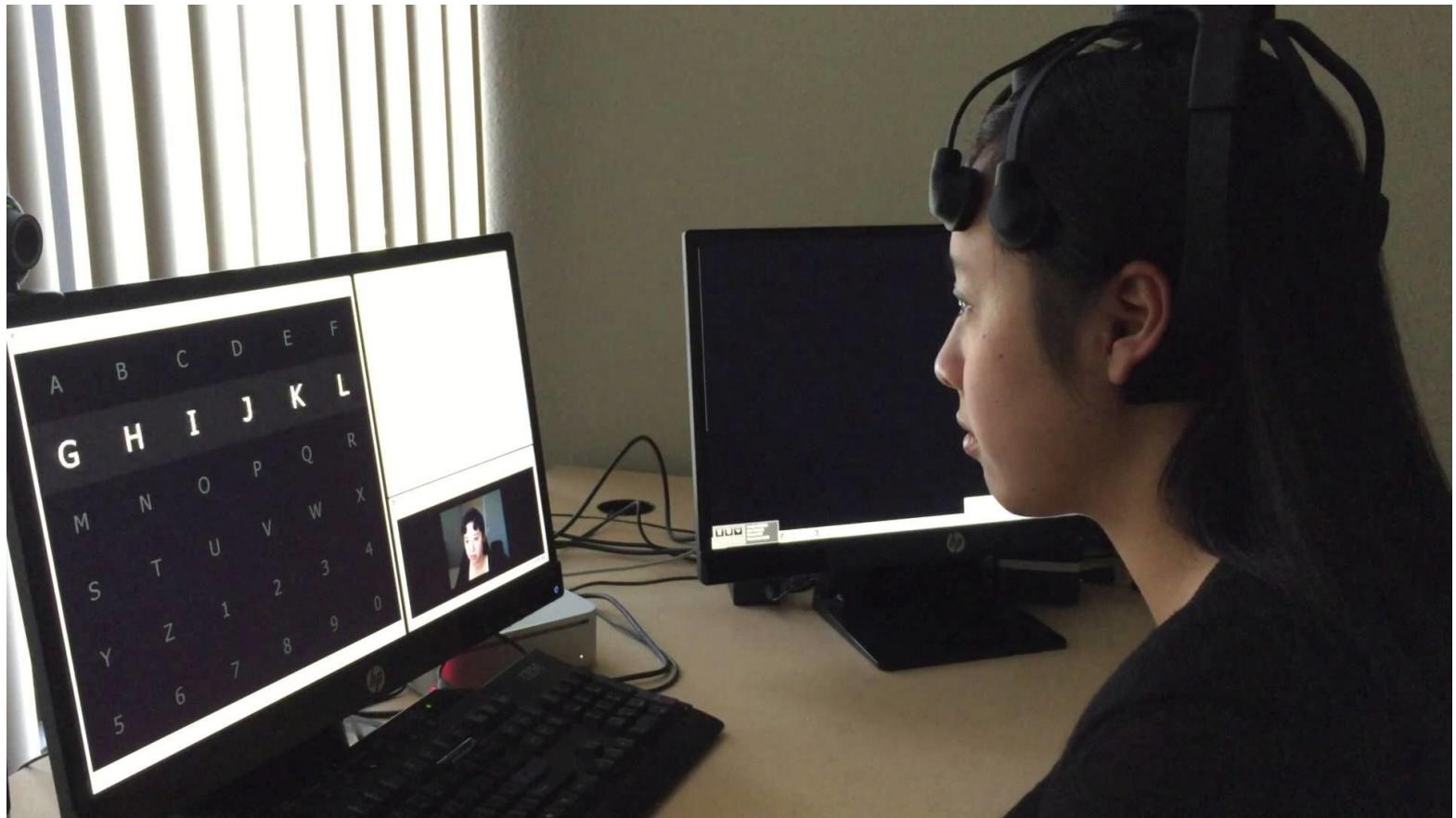
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# Prediction probability vs label



What	Person specific (correlation)	Cross subject (correlation)
<b>Arousal</b>	0.00439	0.07254
<b>Valence</b>	0.10738	0.05722

# Link to P300 Speller



# Questions

