

Features for Emotion Recognition

a comparative study of feature selection methods



By	Andreas De Lille
Supervisors	prof. dr. ir. Joni Dambre dr. ir. Pieter Van Mierlo
Counsellor	ir. Thibault Verhoeven

Content

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

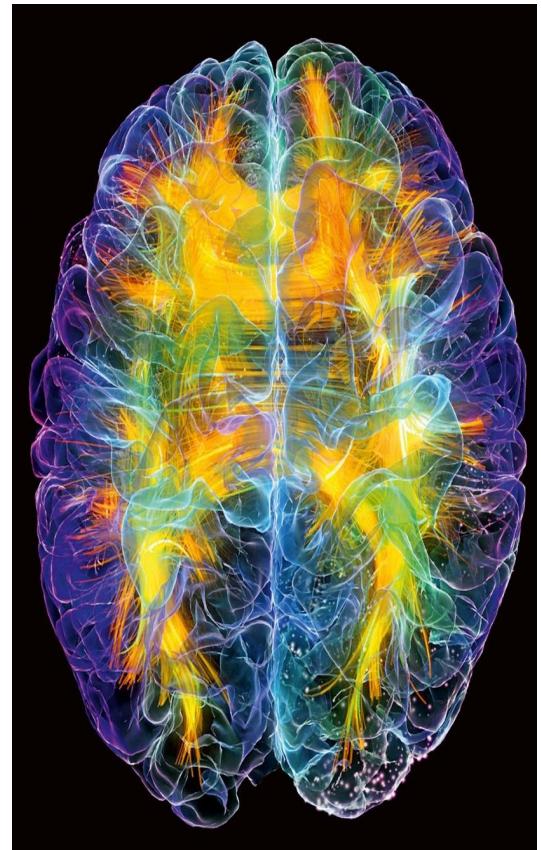
Emotion



Expression



Physiological



Emotion in the
brain

Emotion Classification



Unpleasant

Active

Arousal

Fear

Excited

Valence

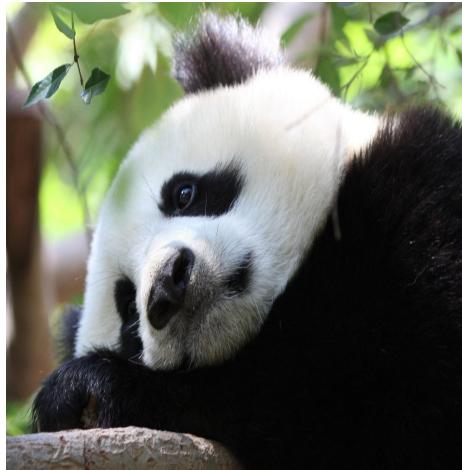
Pleasant



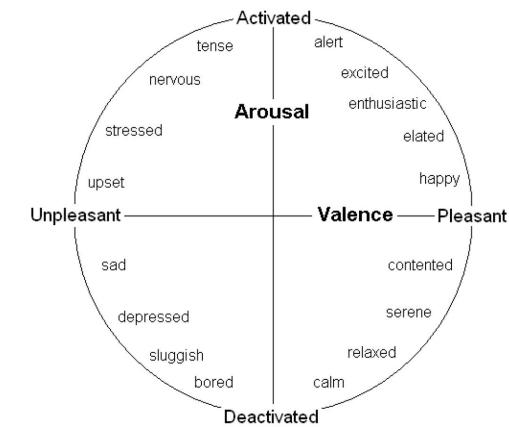
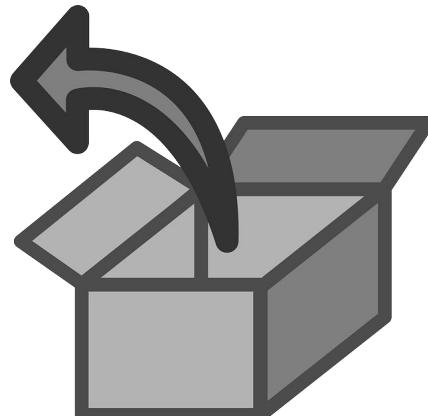
Bored

Relaxed

Inactive



Emotion recognition using ML



Input:
physiological
signals

Extract Features

Machine learning

Output:
valence/arousal

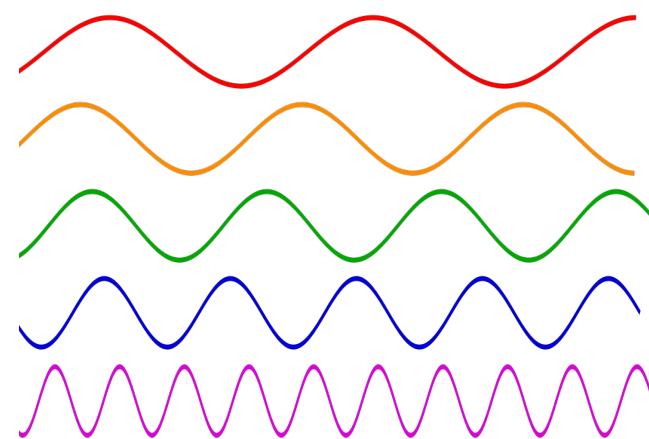
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Electroencephalography (EEG)



Different channels



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

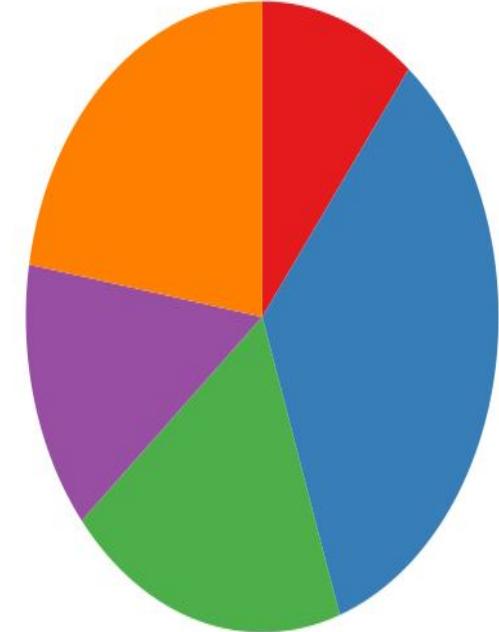
Different frequency bands

EEG features



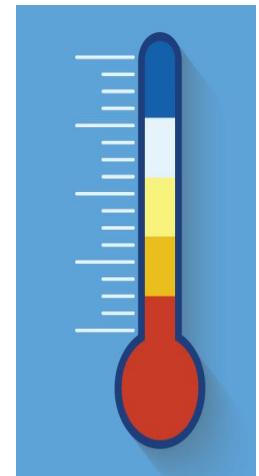
Power of a
specific channel

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



Fractions of
different
wavebands

Non - EEG Features



Heart Rate

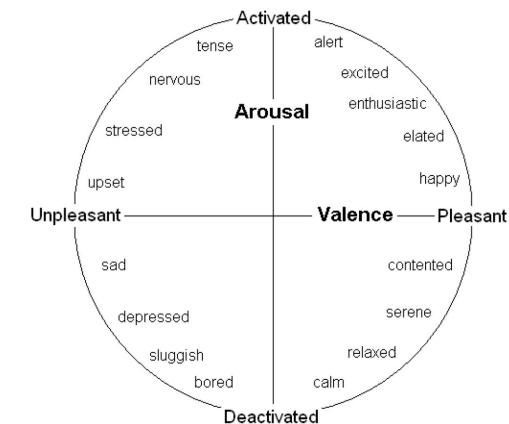
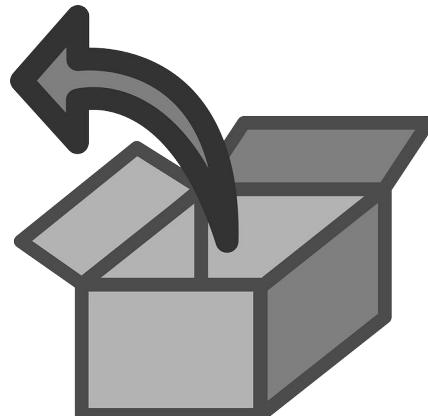
Respiration
Rate

Perspiration

Blood pressure

Skin Temp.

Emotion recognition using ML - recap



Input:
physiological
signals

Extract Features

Machine learning

Output:
valence/arousal

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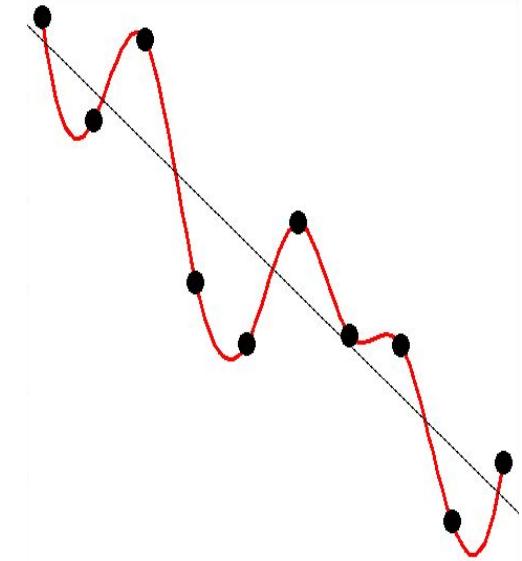
Problem: not all features are good features



Disagreement
on Features

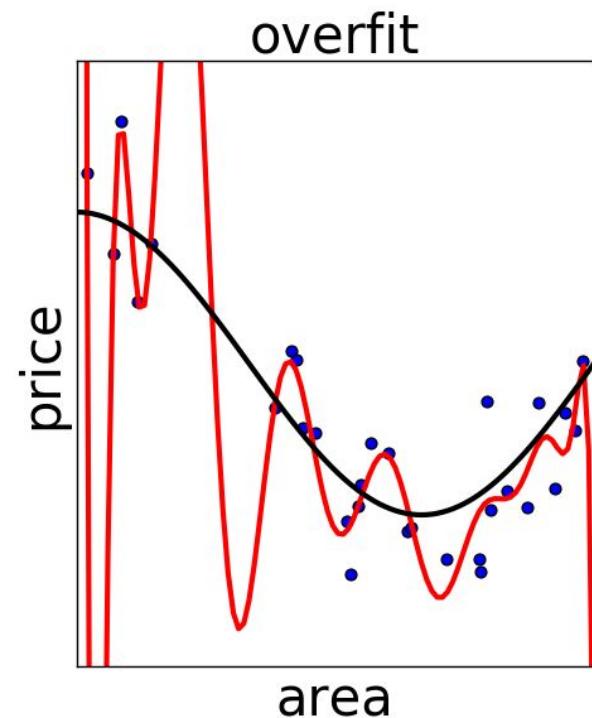
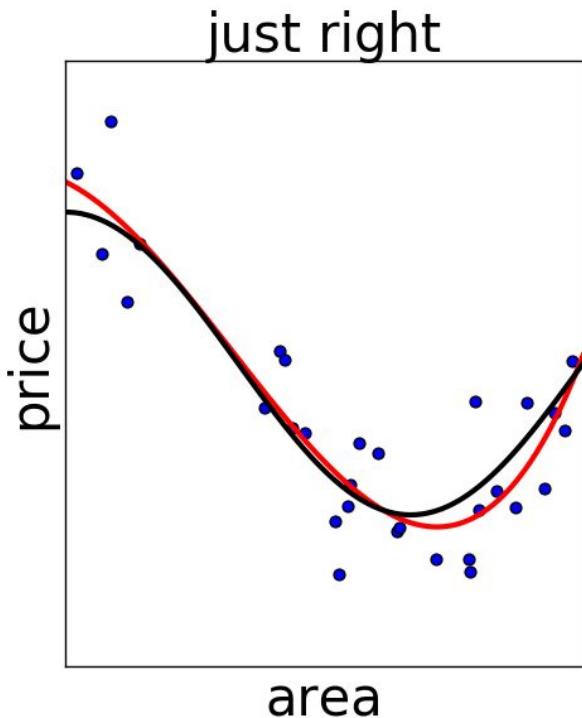
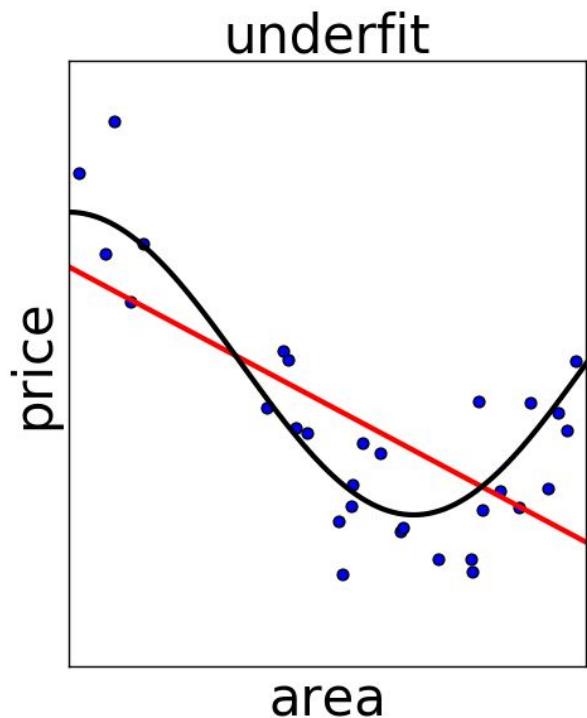


Personal
Differences



Overfitting

Over- & underfitting



Goal



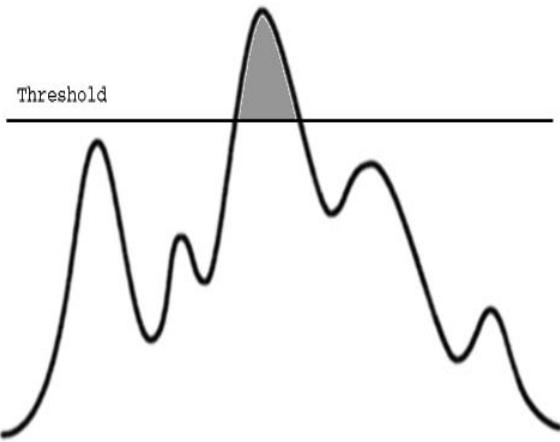
Find good features
-> person specific
-> cross-subject

EEG vs non-EEG vs All

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Feature Selection Methods



Filter Methods

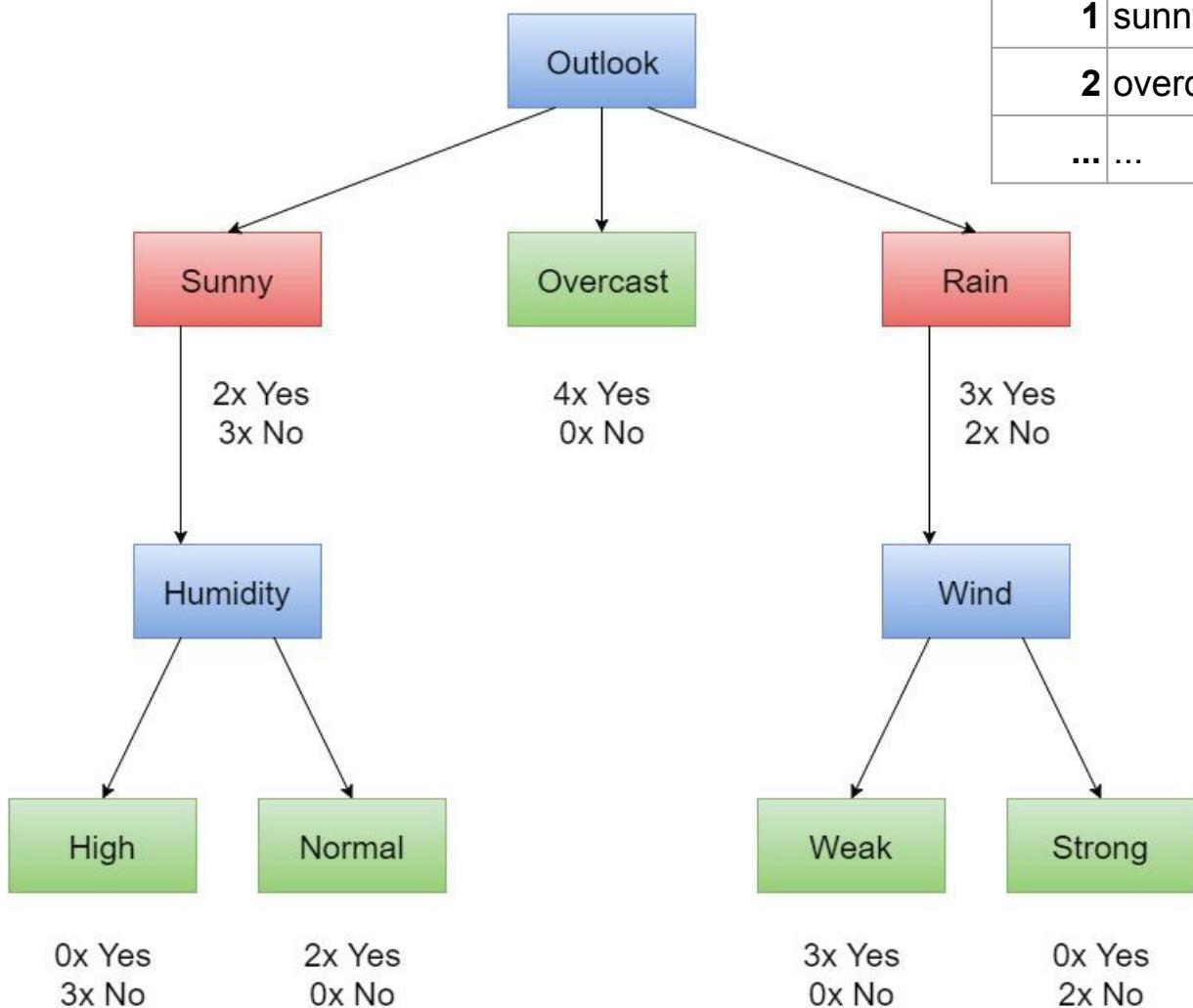


Wrapper Methods



Embedded
Methods

RF method: will person X play tennis today?

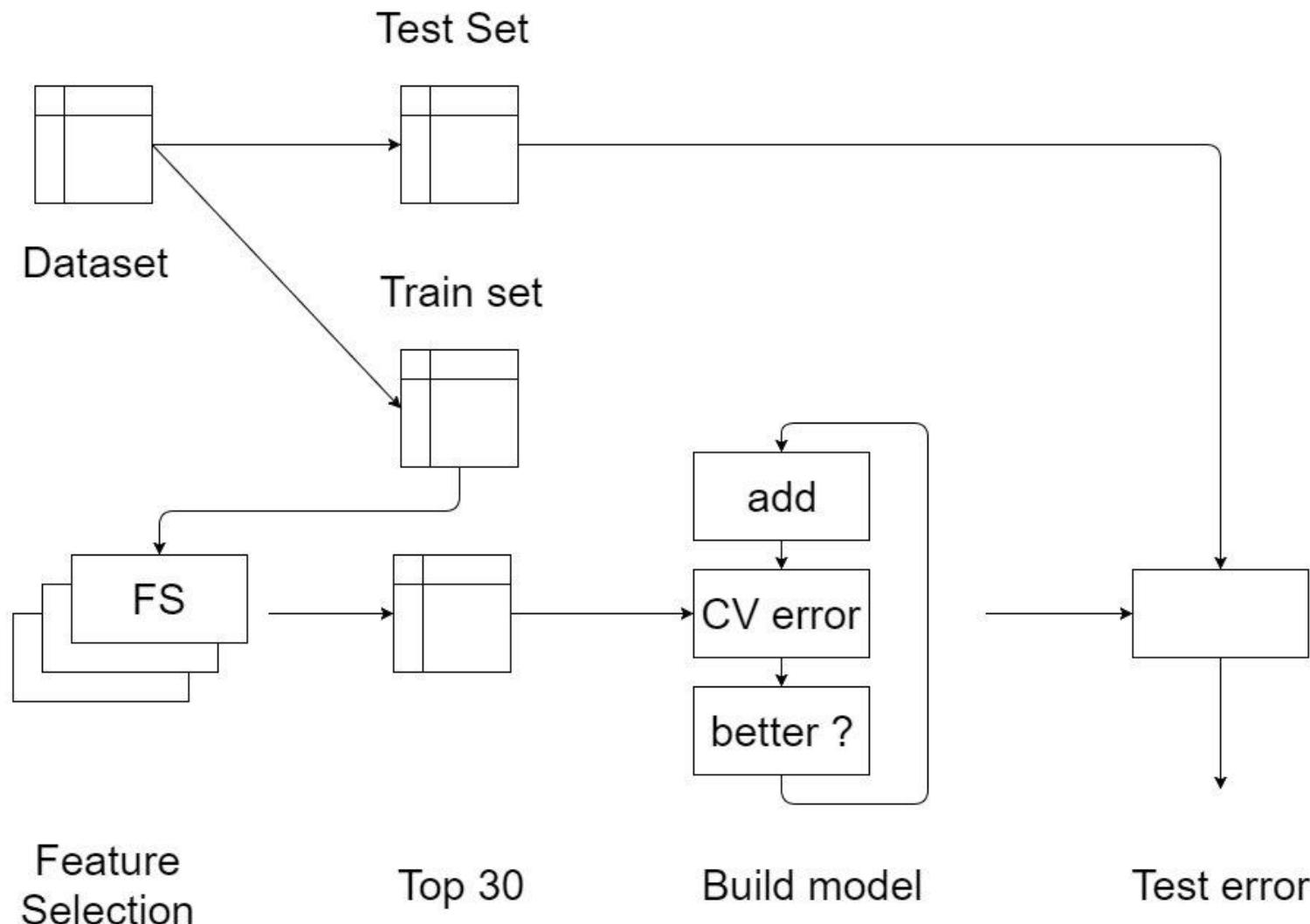


Day	Outlook	Humidity	Wind	tennis
1	sunny	high	weak	no
2	overcast	high	weak	yes
...

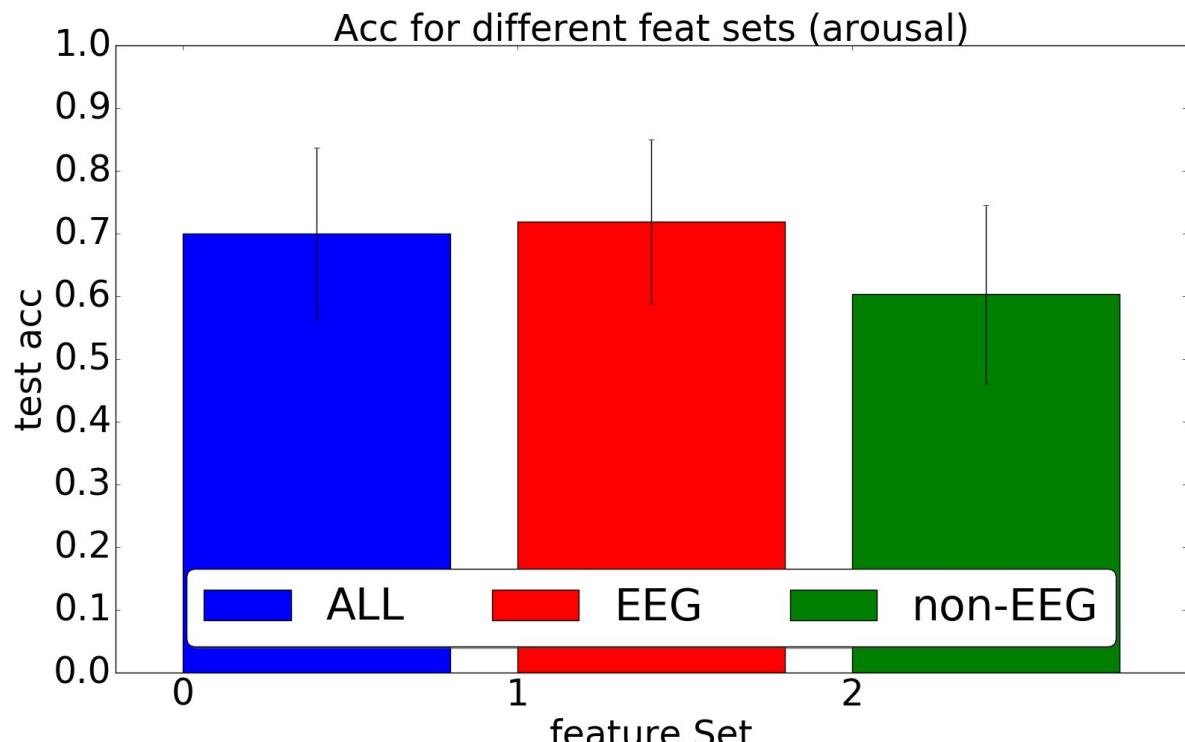
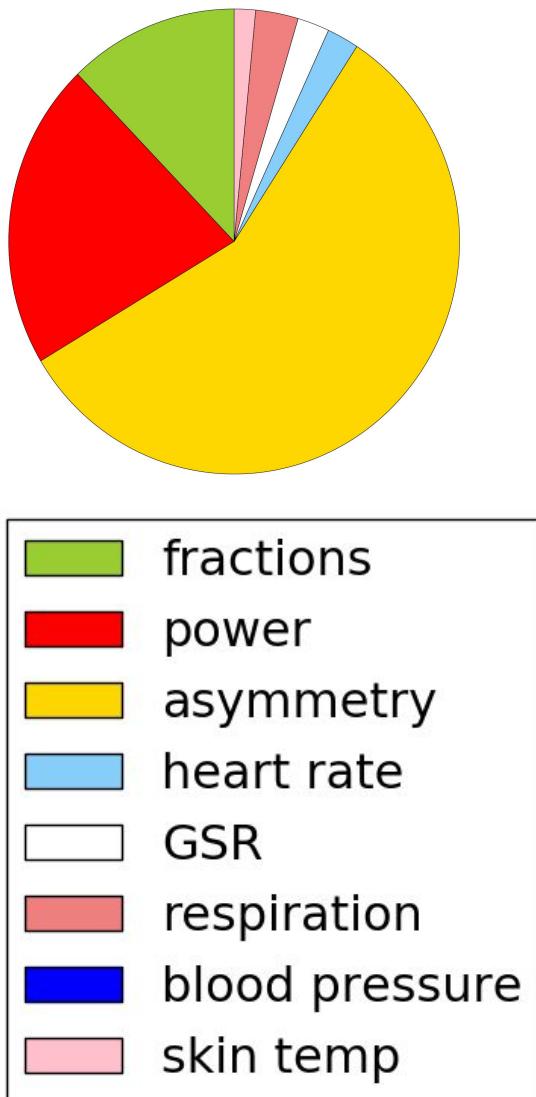
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General Flow

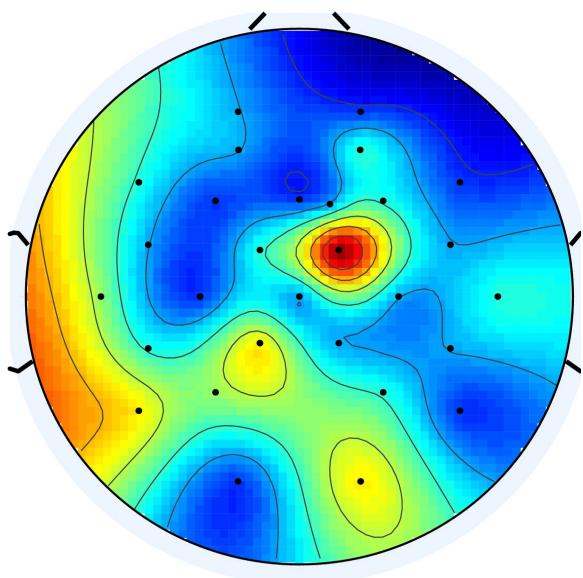


Results person specific (arousal)

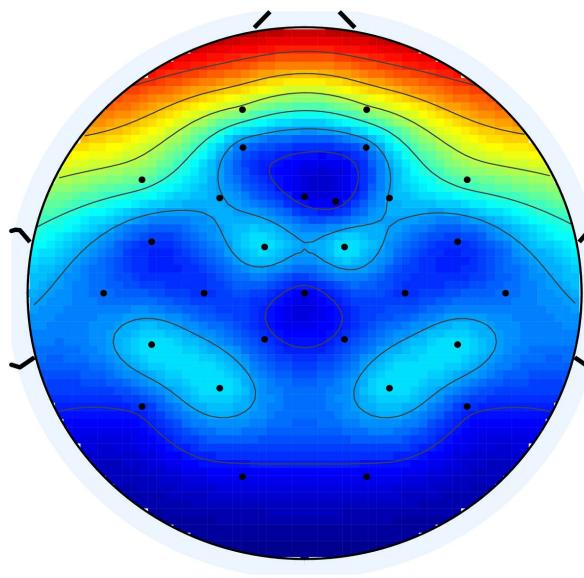


P-values		
ALL / EEG	ALL / non-EEG	EEG / non-EEG
0.4386	5.891×10^{-7}	1.201×10^{-4}

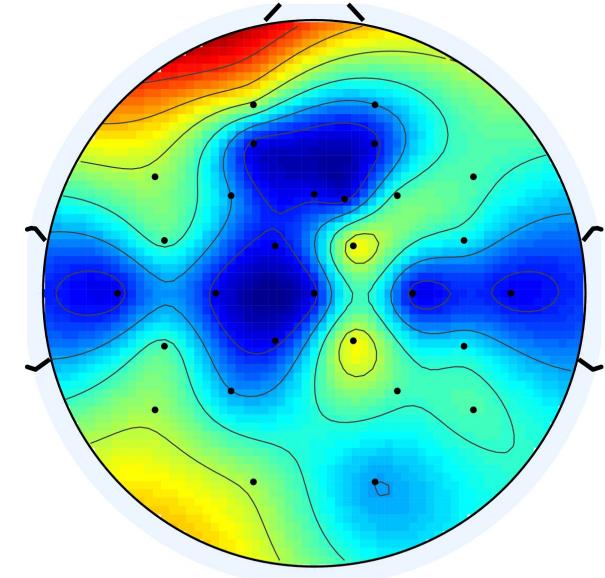
Used EEG regions (arousal)



Separate channels

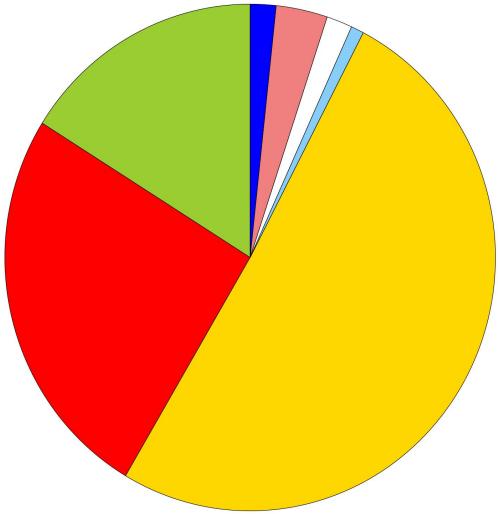


Left / Right
asymmetry

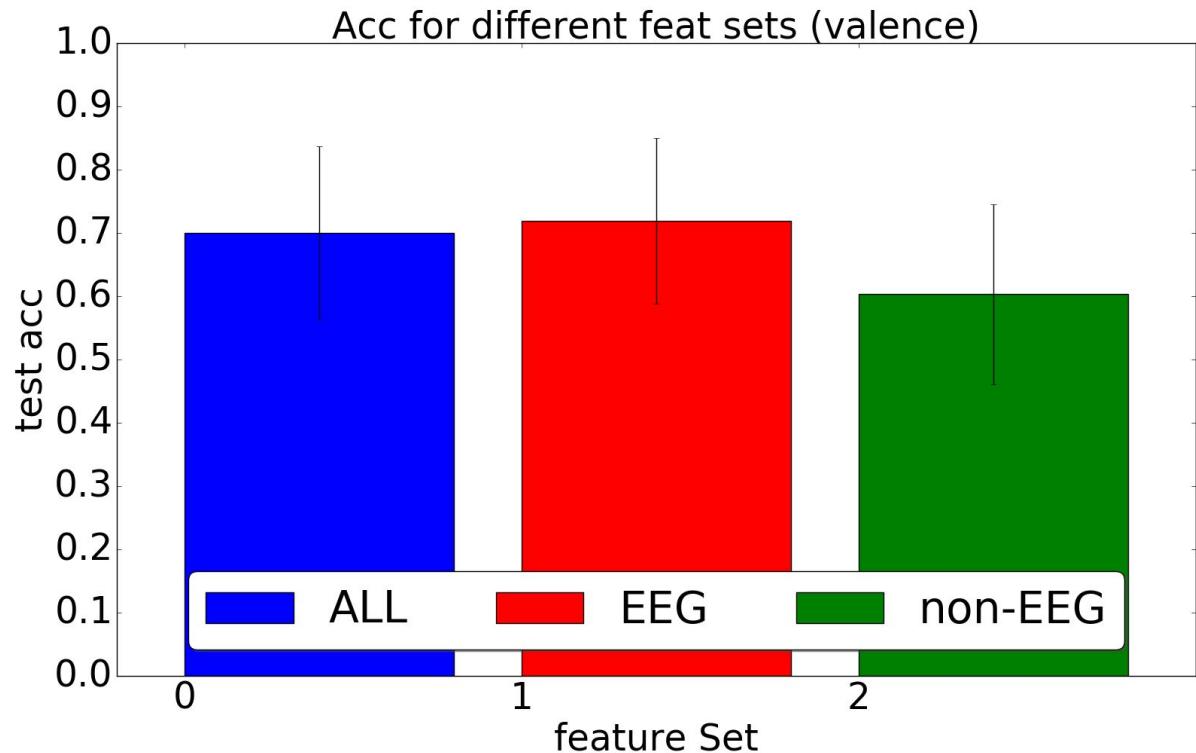


Front / Back
asymmetry

Results person specific (valence)

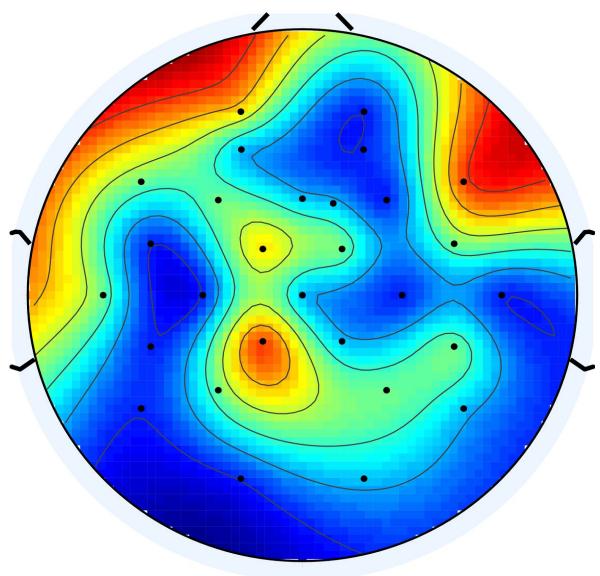


[green square]	fractions
[red square]	power
[yellow square]	asymmetry
[light blue square]	heart rate
[white square]	GSR
[pink square]	respiration
[dark blue square]	blood pressure
[light pink square]	skin temp

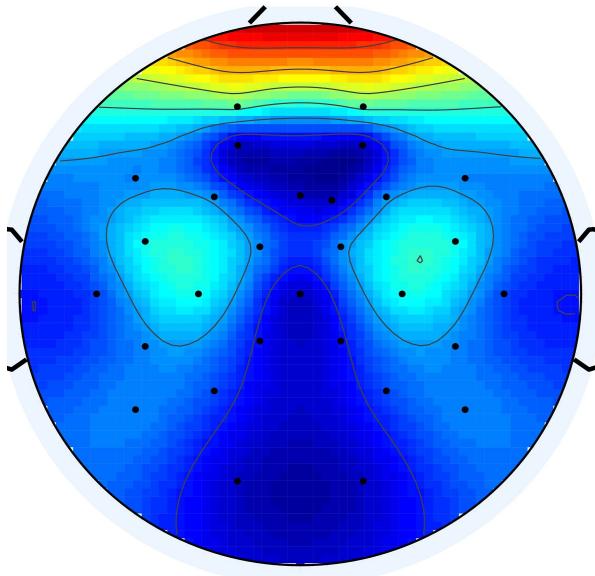


P-values		
ALL / EEG	ALL / non-EEG	EEG / non-EEG
0.6817	1.993×10^{-9}	1.763×10^{-6}

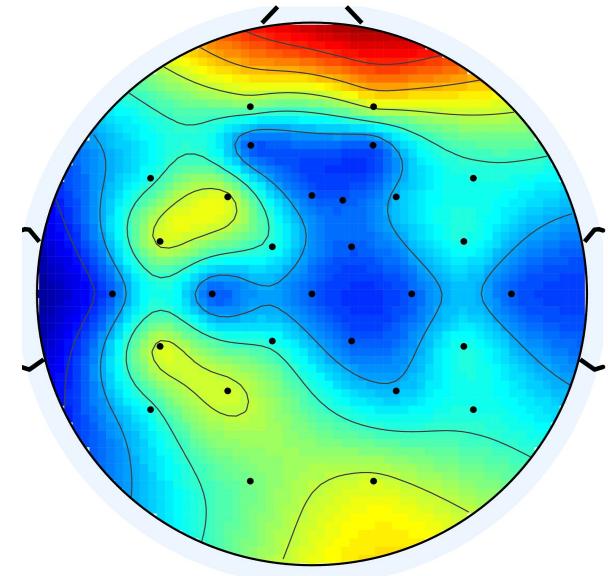
Used EEG regions (valence)



Separate channels

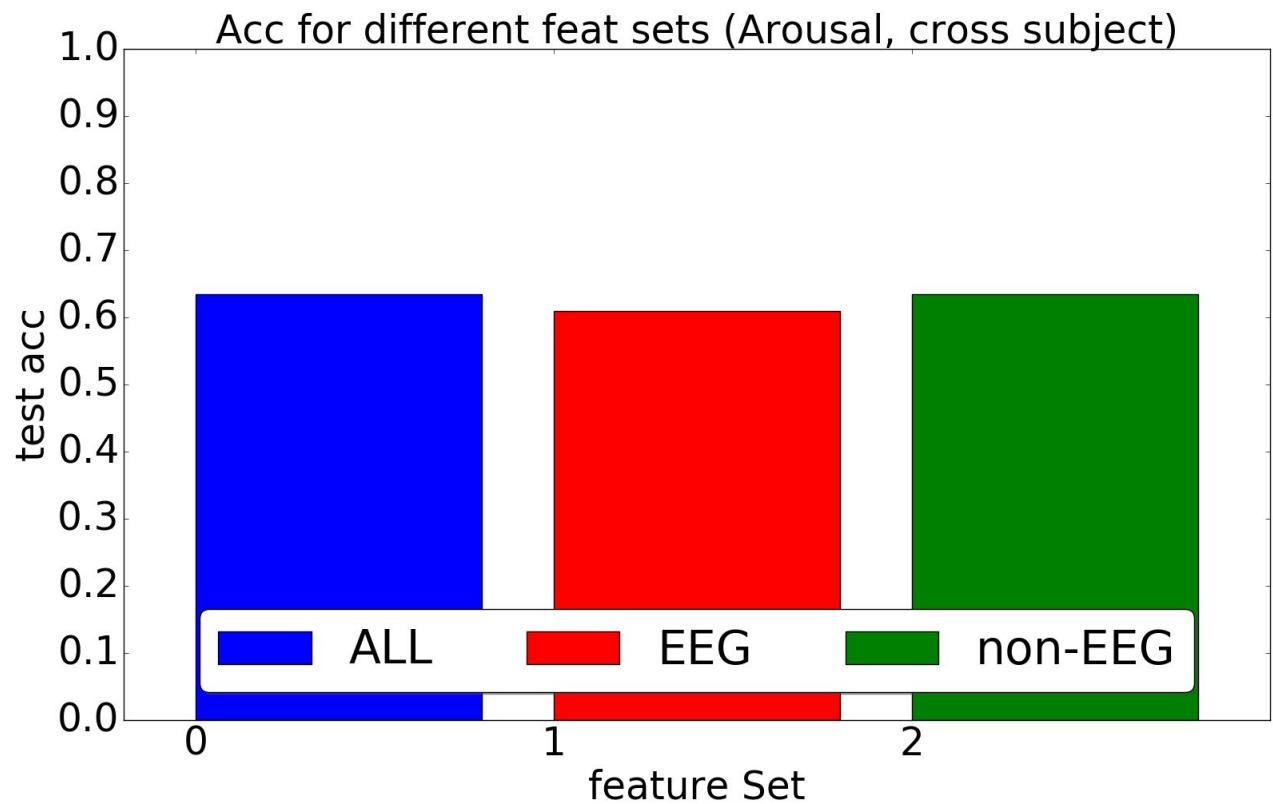
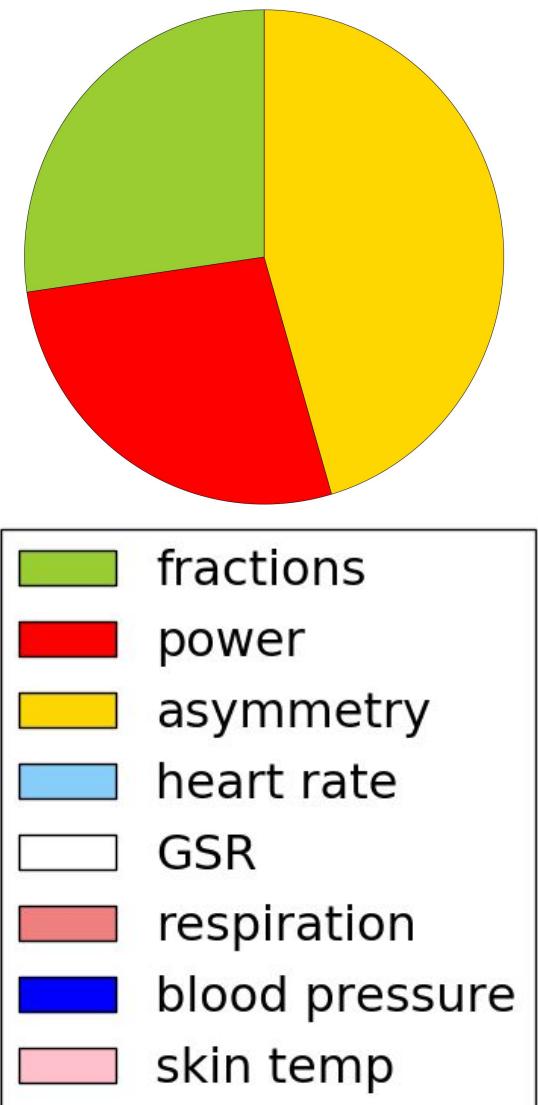


Left / Right
asymmetry

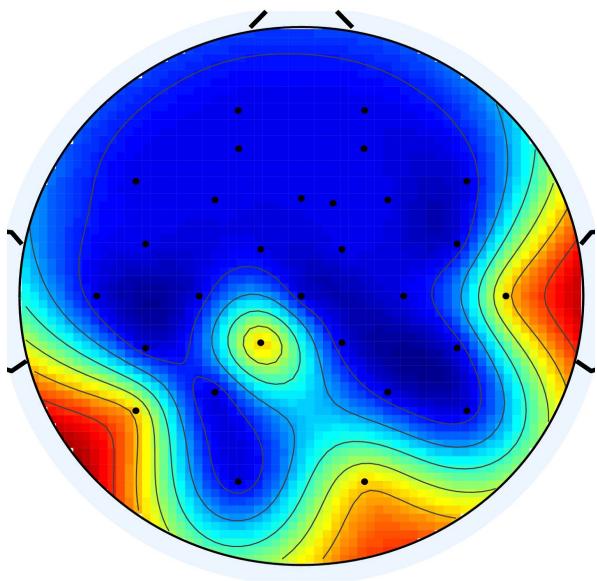


Front / Back
asymmetry

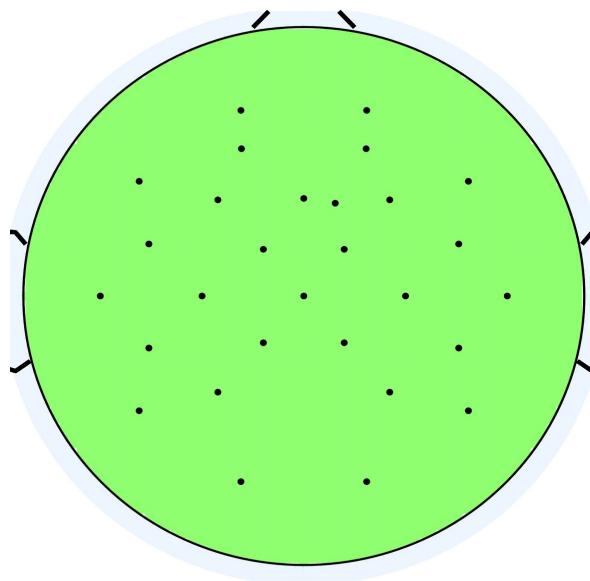
Results cross subject (arousal)



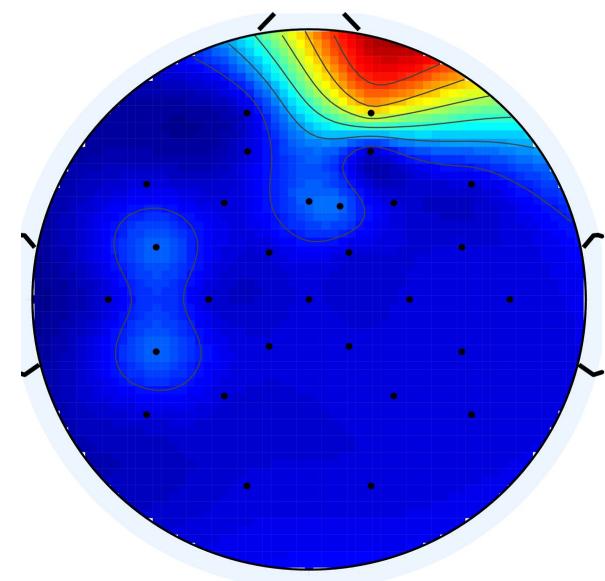
Used EEG regions (arousal)



Separate channels

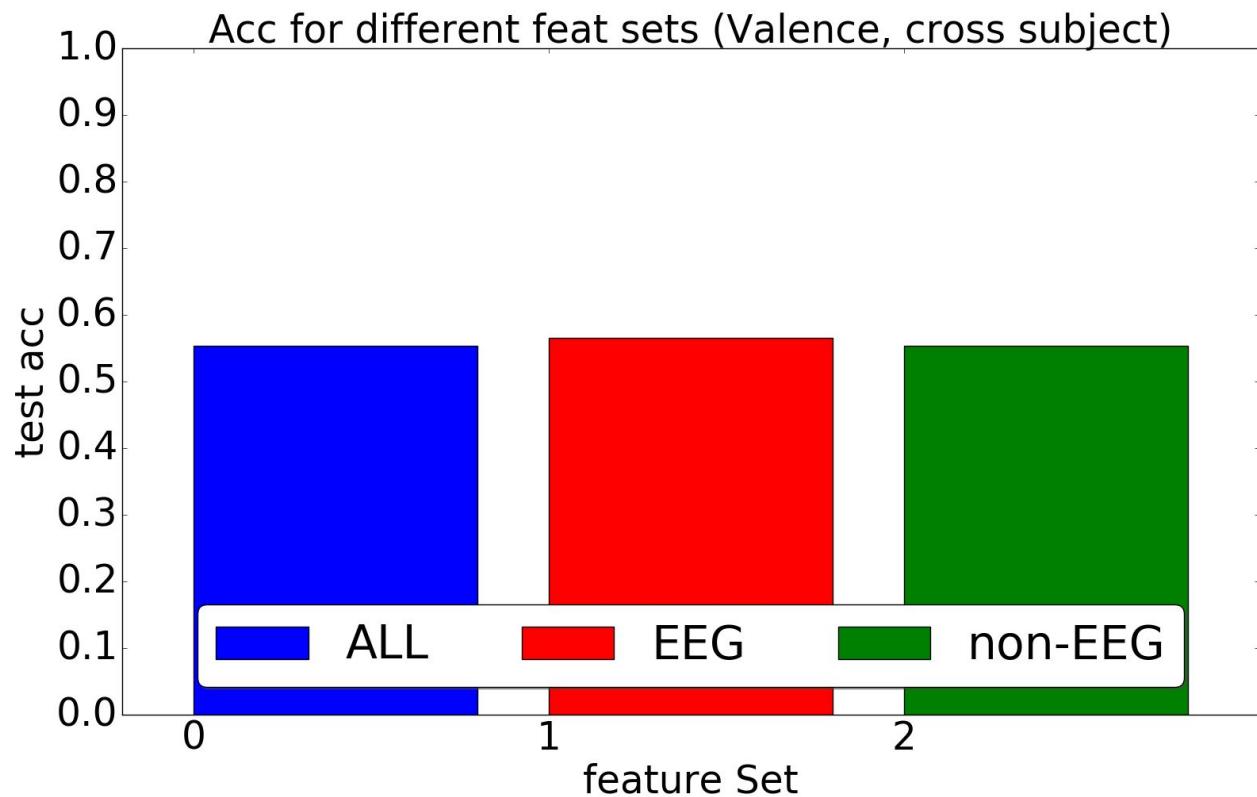
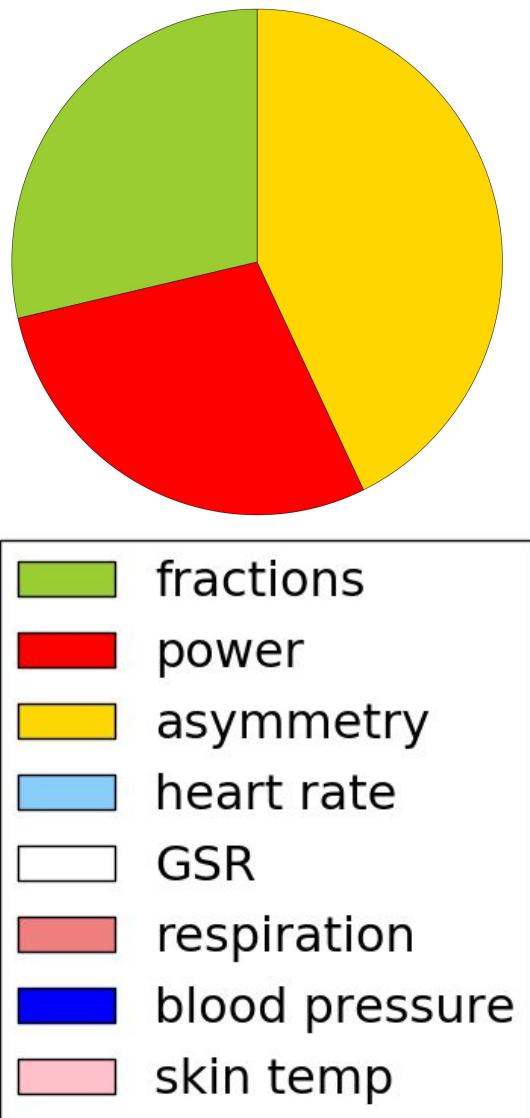


Left / Right
asymmetry

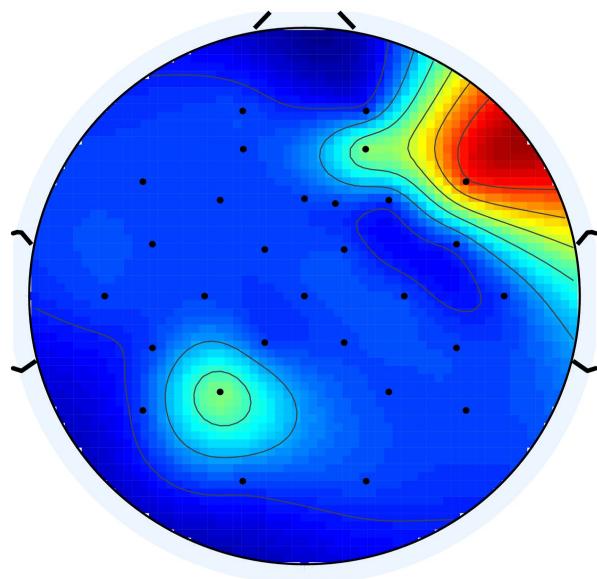


Front / Back
asymmetry

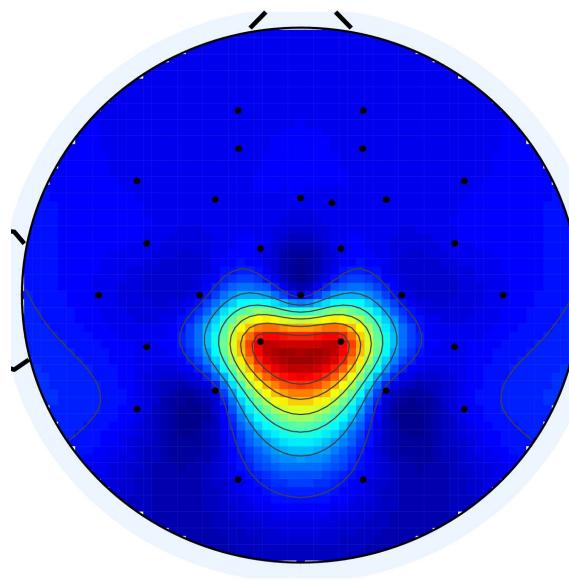
Results cross subject (valence)



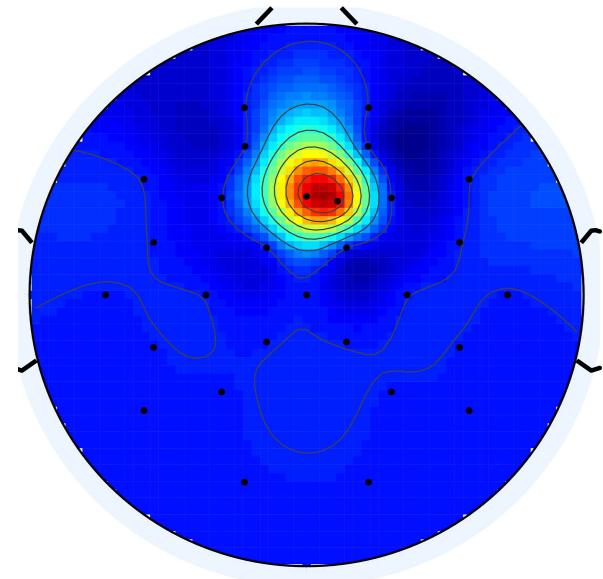
Used EEG regions (valence)



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

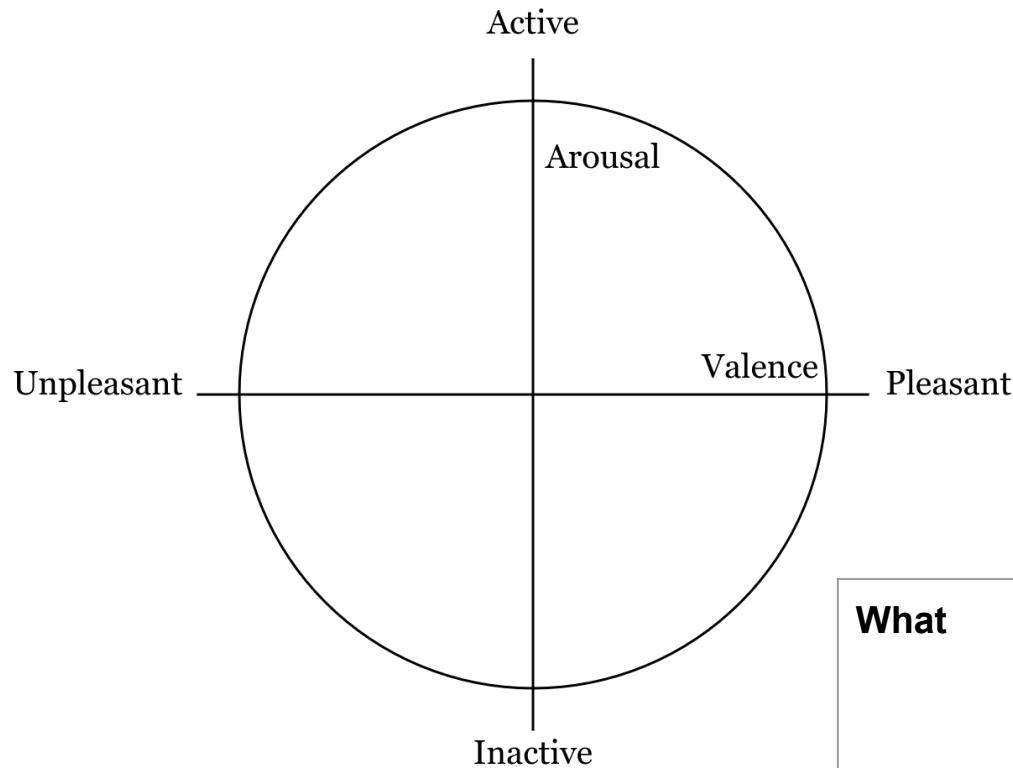
Cross subject:

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

Content

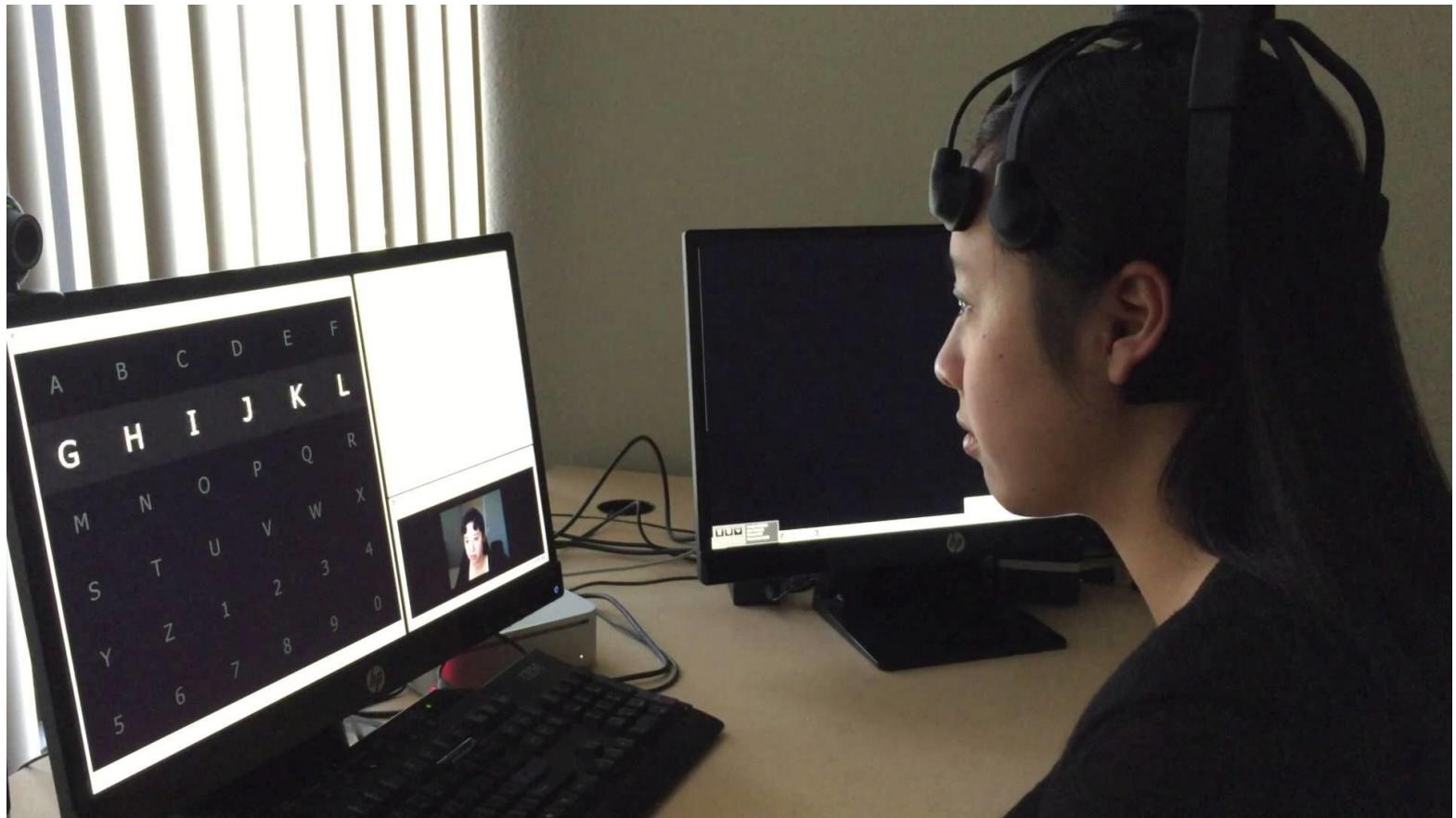
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Prediction probability vs label



What	Person specific (correlation)	Cross subject (correlation)
Arousal	0.00439	0.07254
Valence	0.10738	0.05722

Link to P300 Speller



Questions

