

Multimodal ageing (and habituation)



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Definition

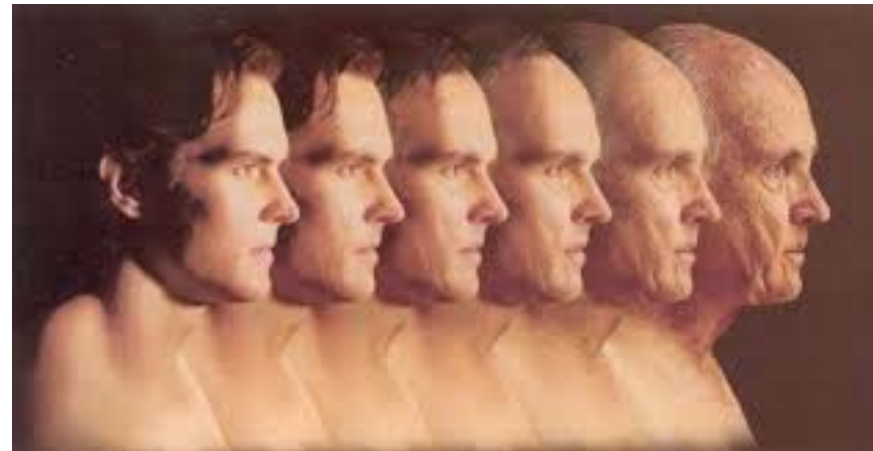
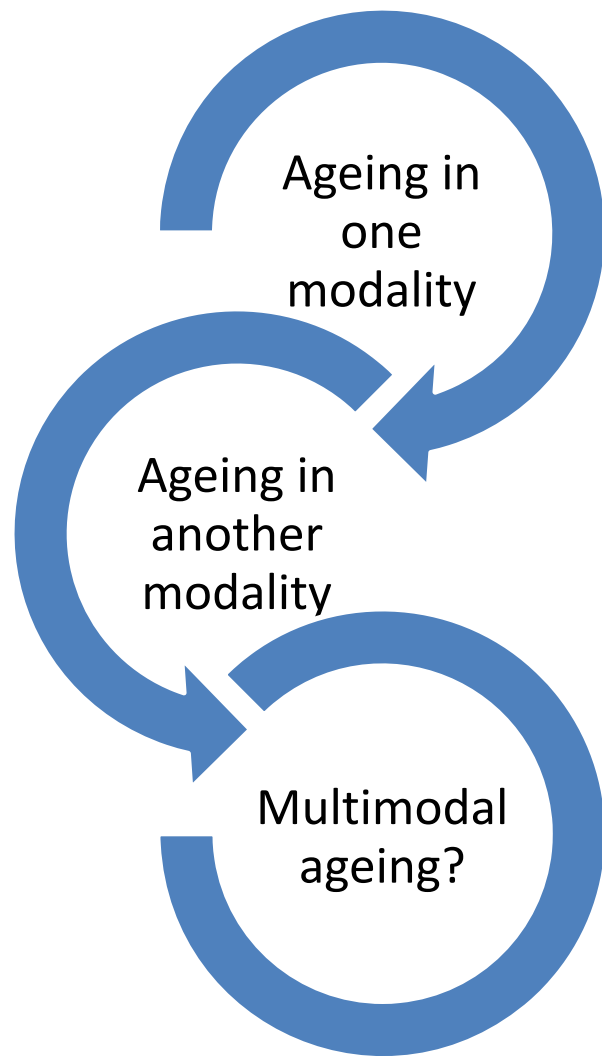
Two approaches

Methodology

Experiments

Conclusions

Multimodal Ageing



“Ageing is the accumulation of changes in a person over time”

Irreversible process?

Performance change over time

Low frequency

Ageing

Gradual
change

Environ
ment

Drastic
change

Behavio
ural

High frequency

Compound
changes

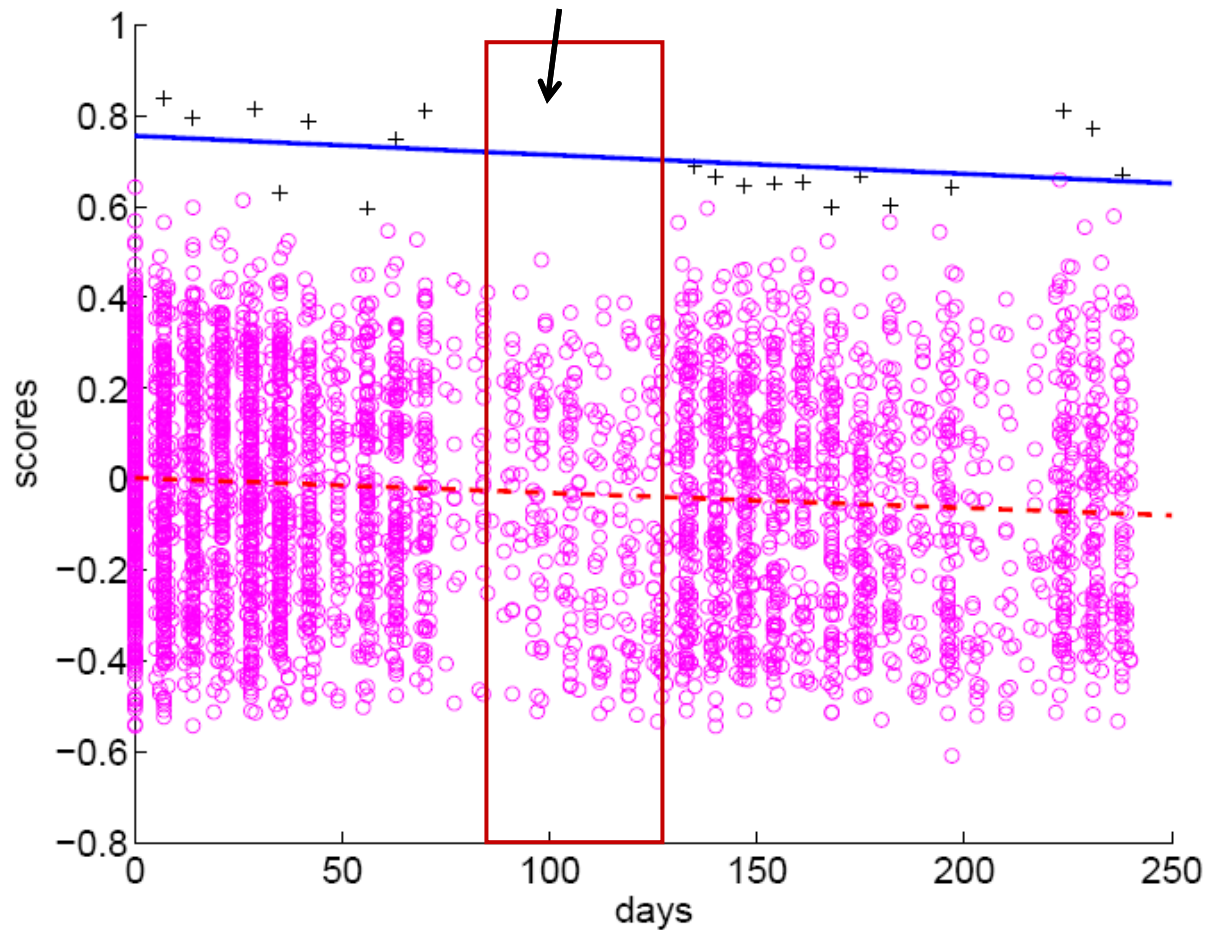
Unobservable (unless controlled for)

Observable

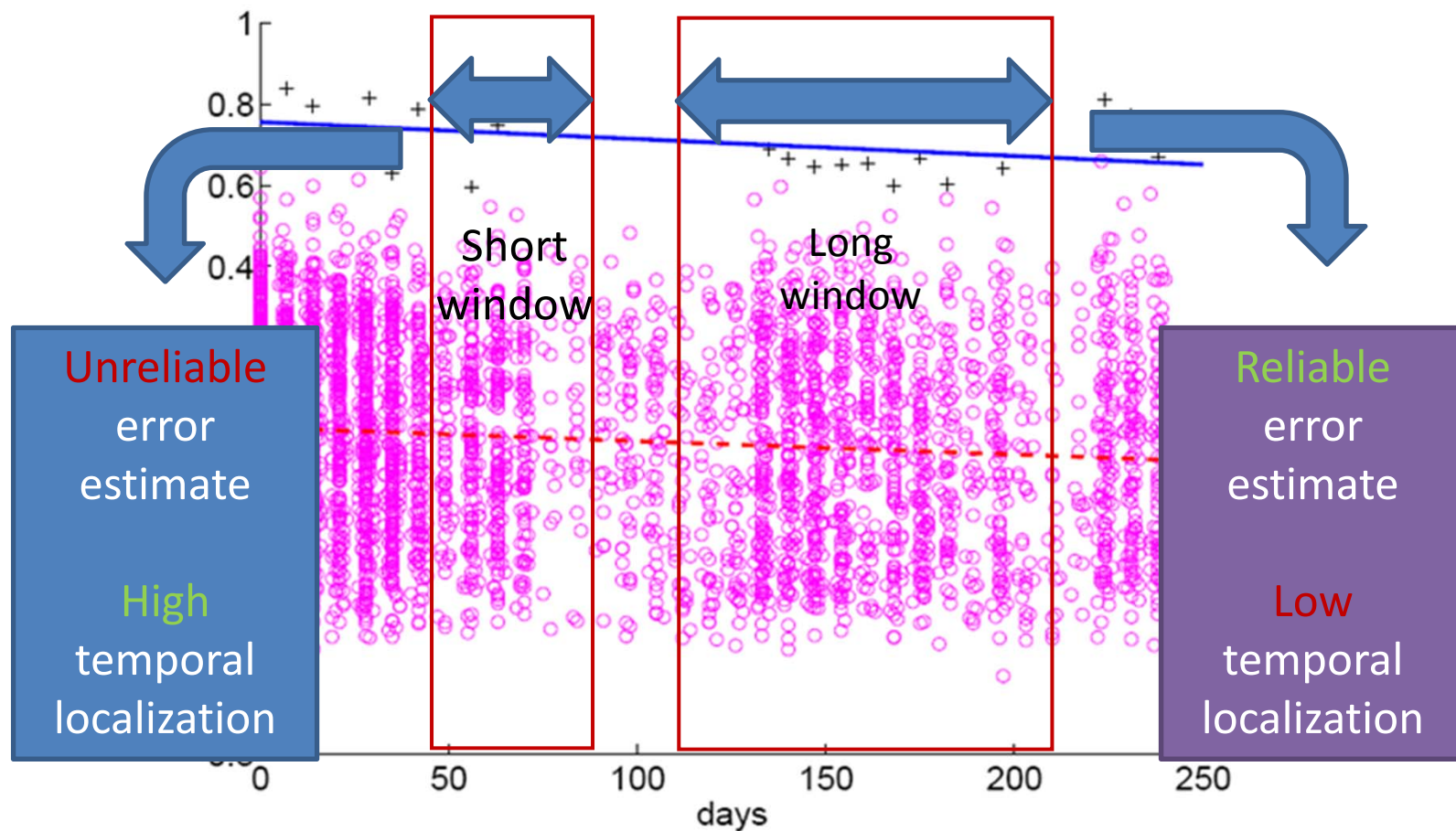
M
E
N
U

The windowing approach

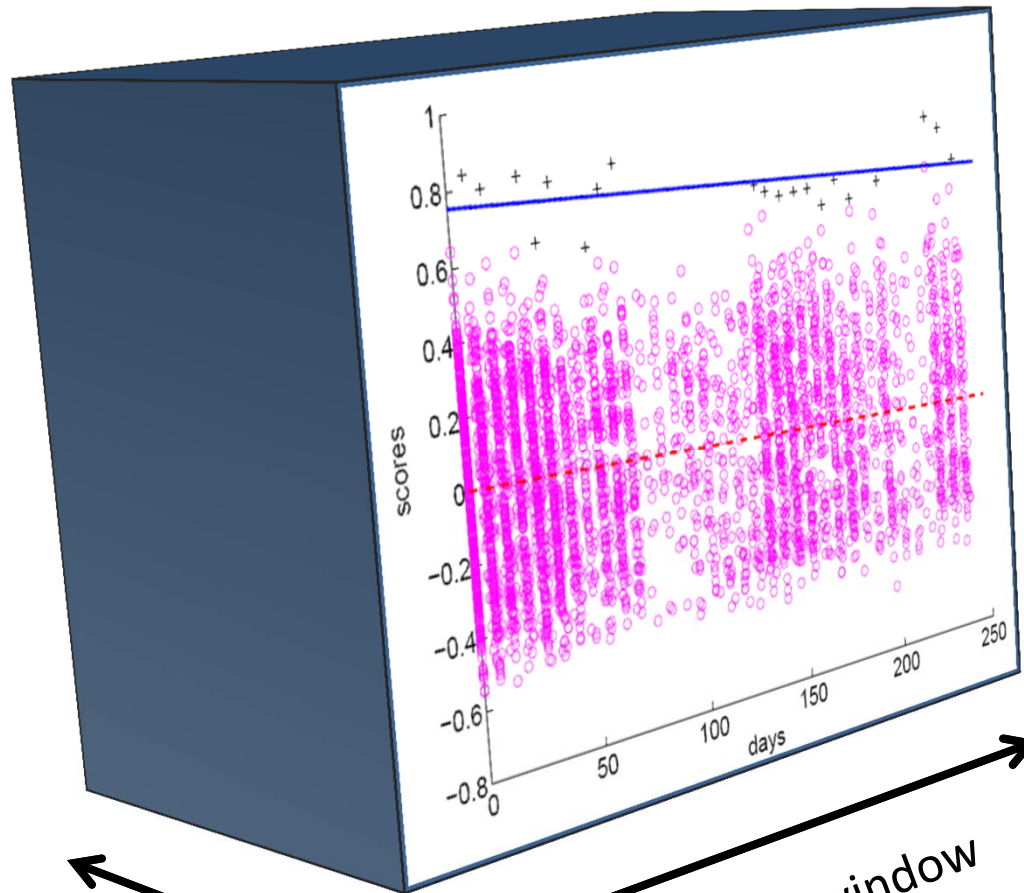
No or few genuine scores observed!



Dilemma: Reliable error or finer temporal resolution?



The windowing approach

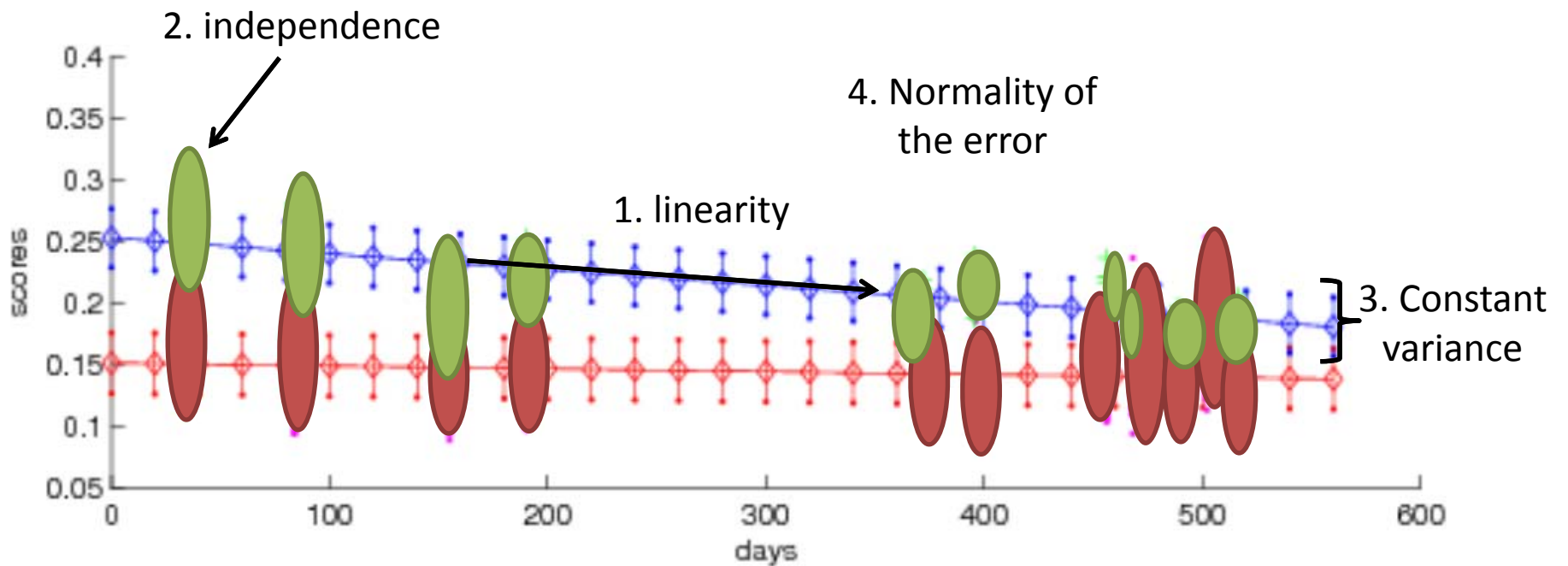


Cannot model
subject-specific
performance

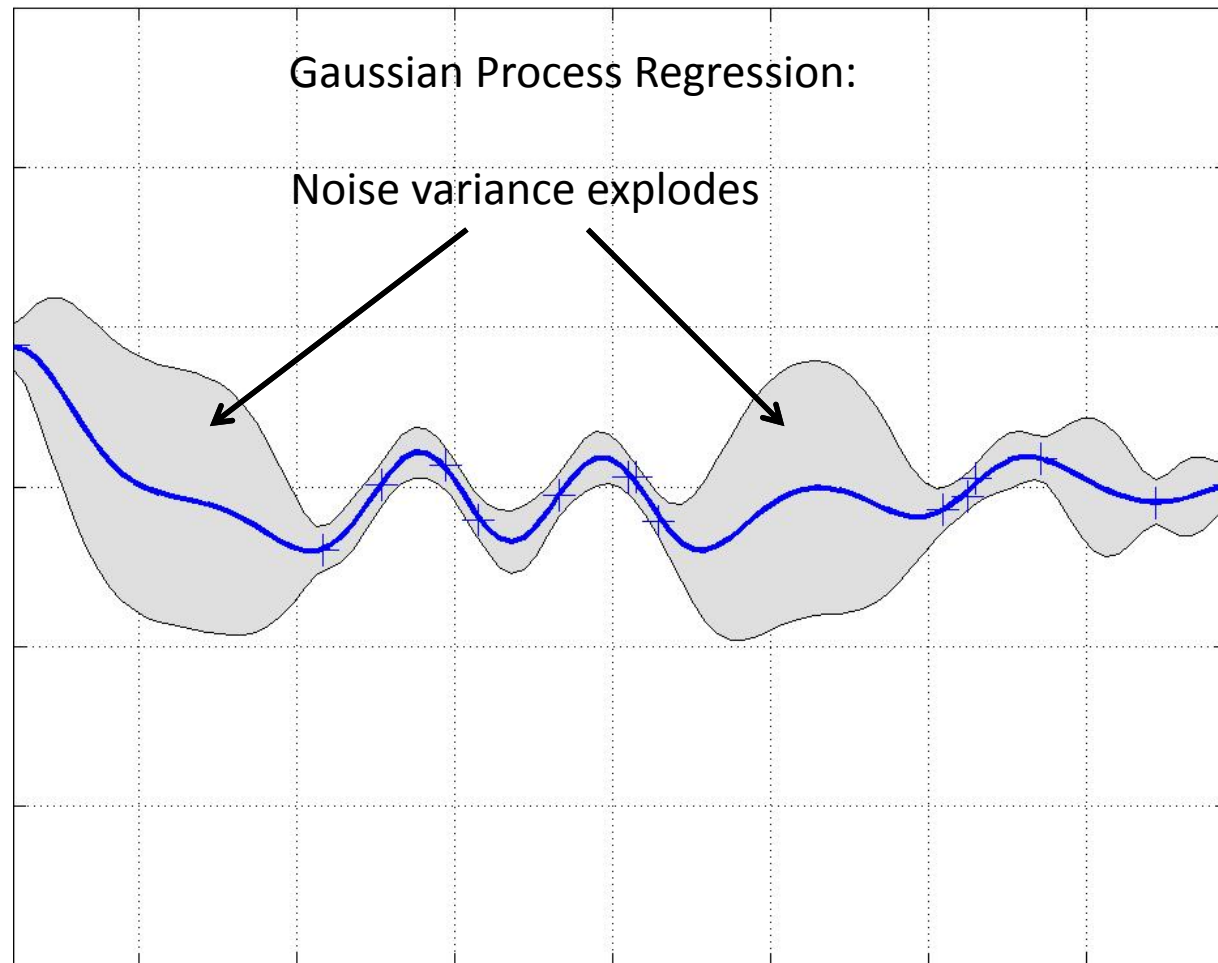
Stack the scores due
to all templates
together

Scan the window
through time

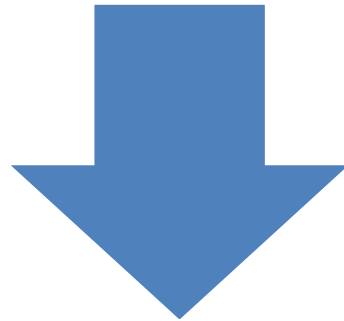
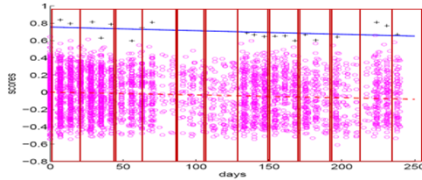
The regression approach



Choice of regression matters



windowing



Cannot model subject-specific performance



Dilemma between reliable error estimate & fine temporal resolution



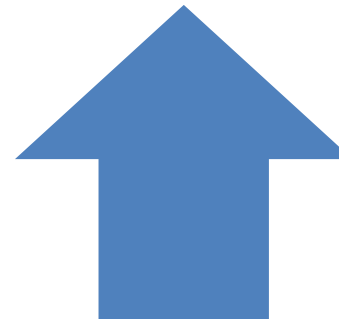
Subject-specific performance



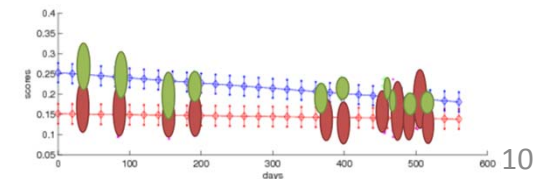
Parametric error model (sensitive to *minute* changes)

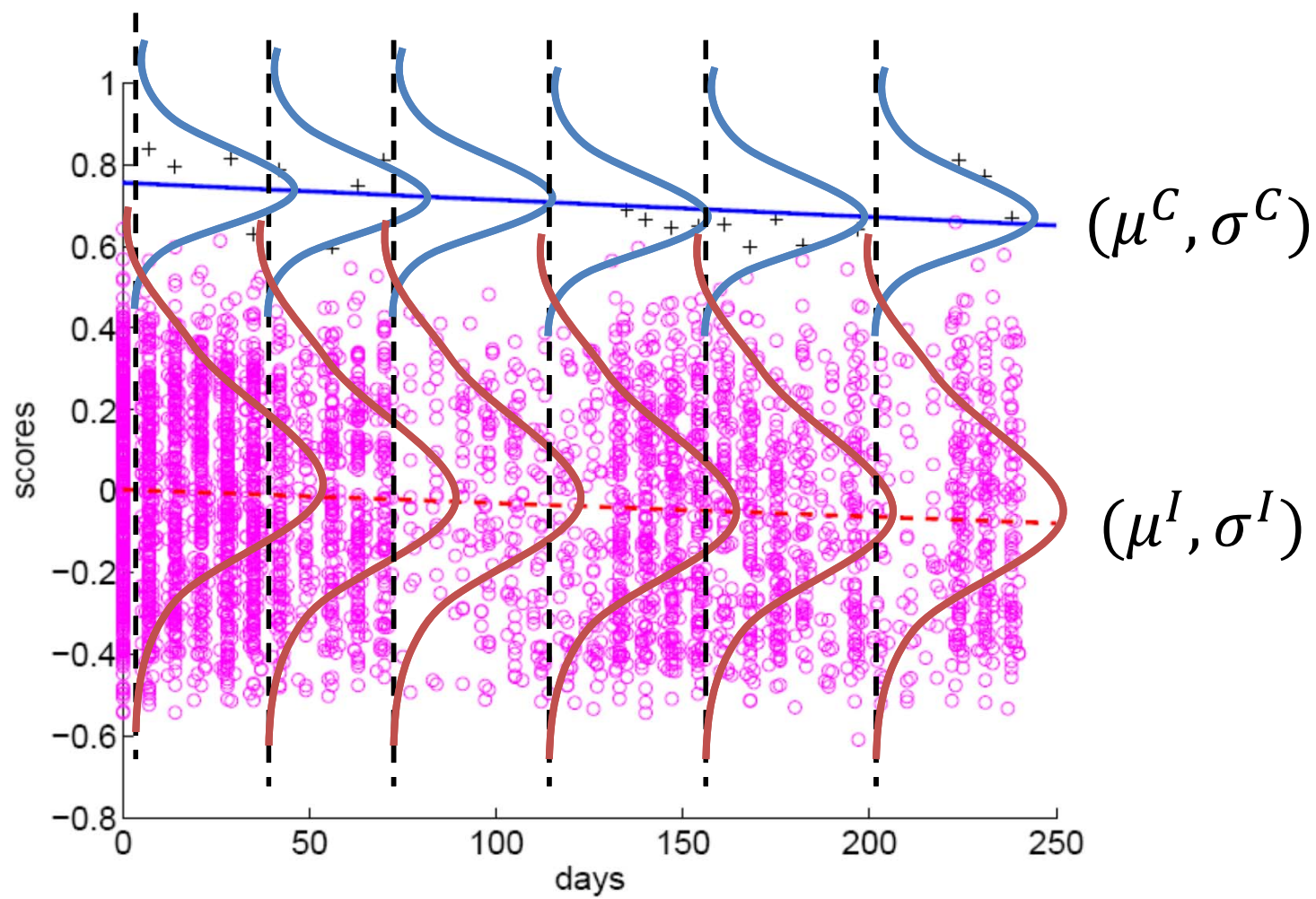


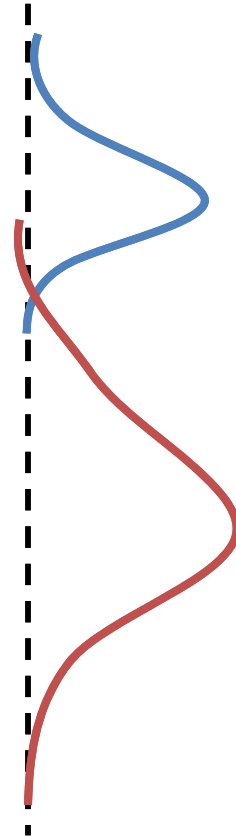
Rely on the smoothness assumption



regression





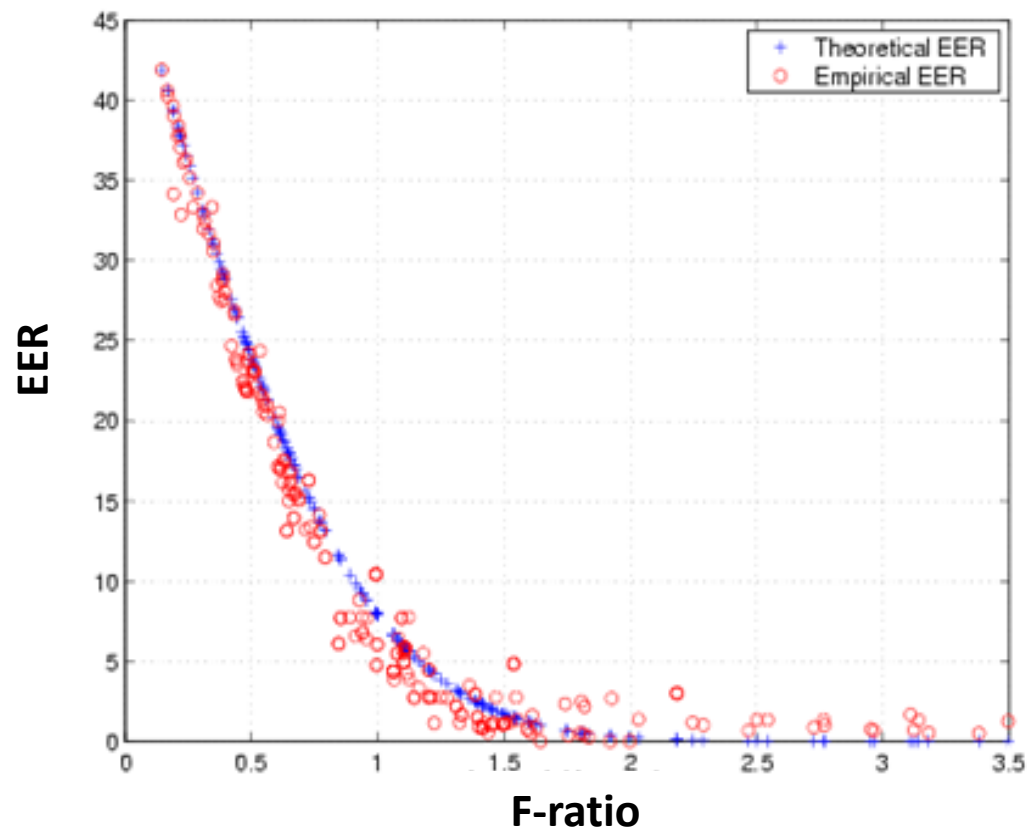
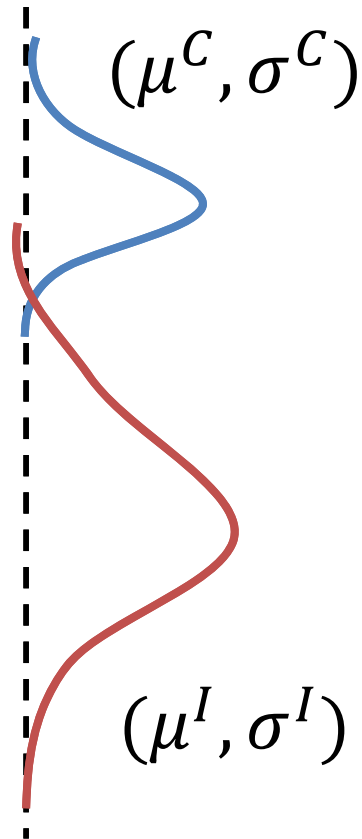


$$\text{F-ratio} = \frac{\mu^C - \mu^I}{\sigma^C + \sigma^I}$$

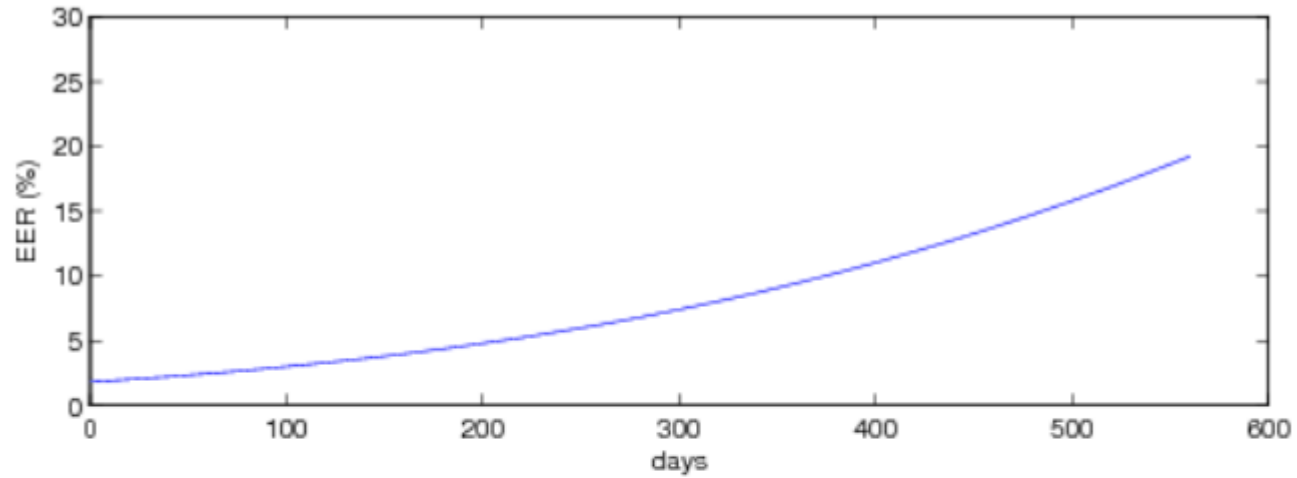


$$\text{EER} = \frac{1}{2} - \frac{1}{2} \text{erf} \left(\frac{\text{F-ratio}}{\sqrt{2}} \right)$$

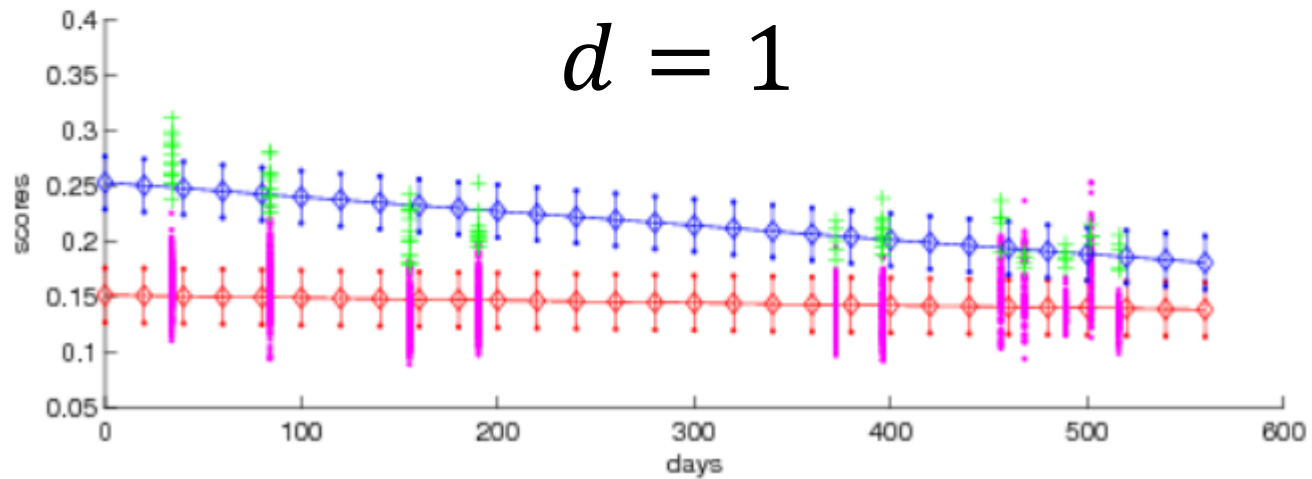
$$\text{erf}(z) = \frac{2}{\sqrt{\pi}} \int_0^z \exp[-x^2] dx$$



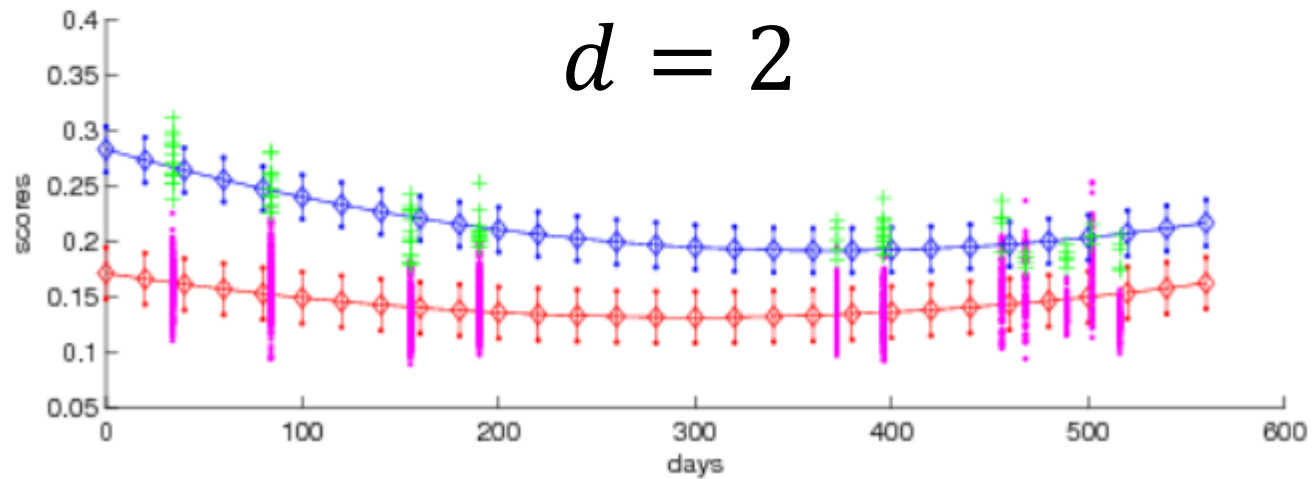
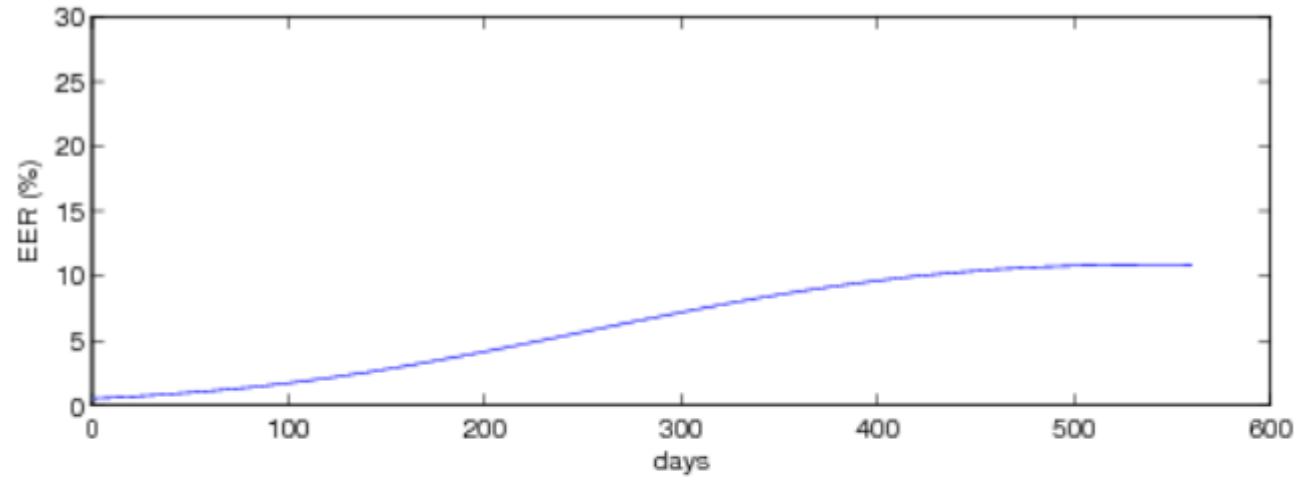
Polynomial regression



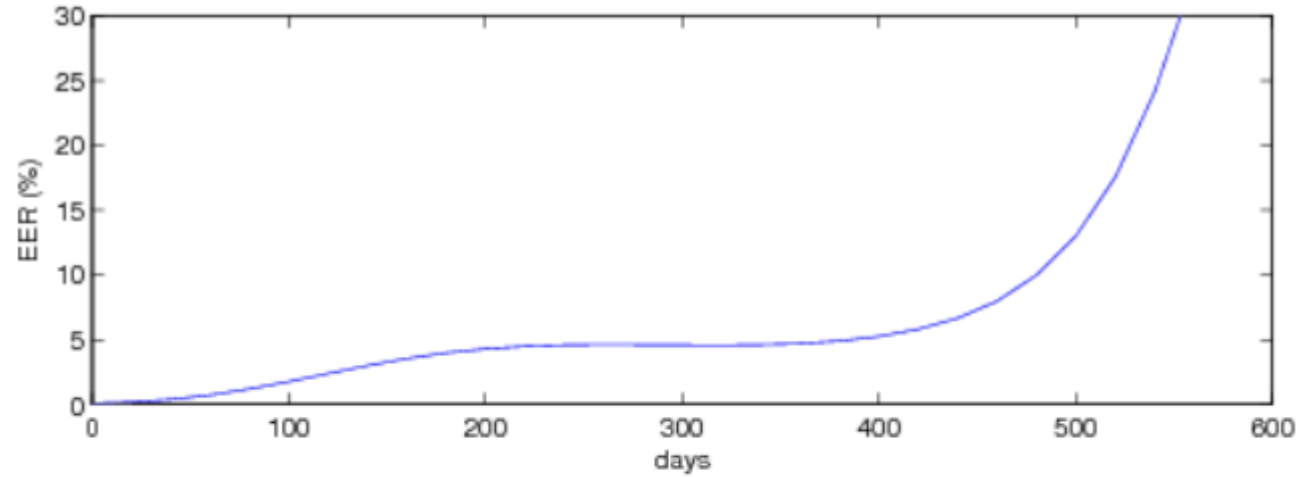
$d = 1$



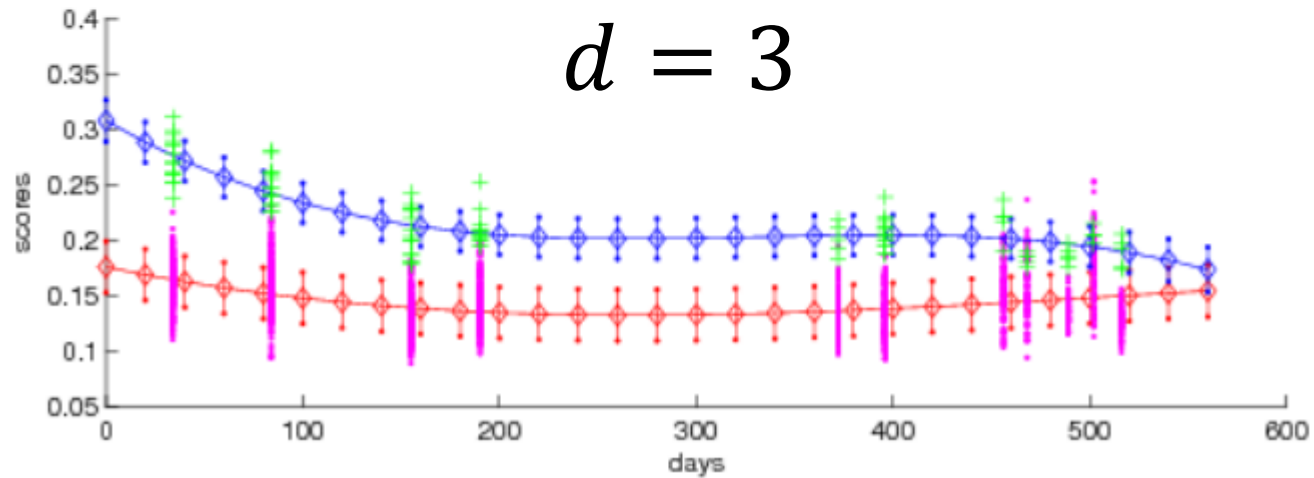
Polynomial regression



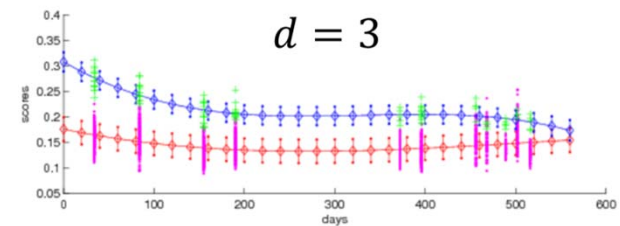
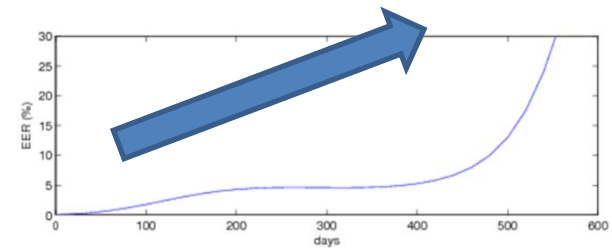
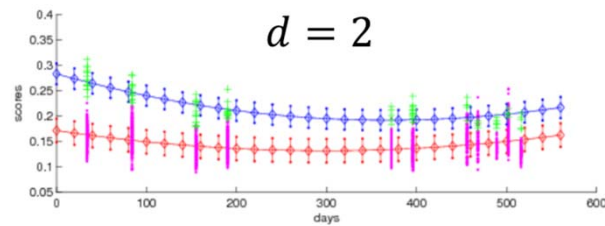
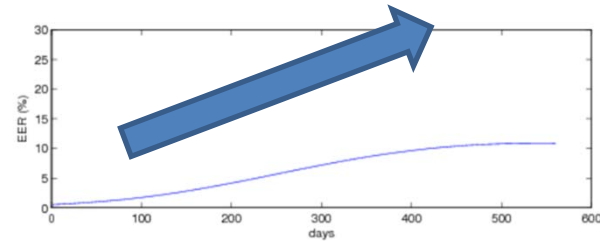
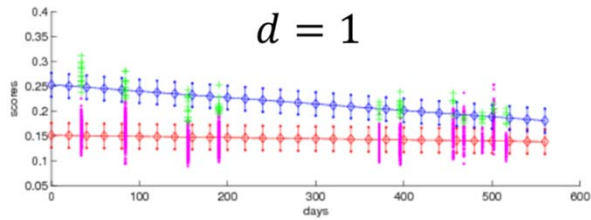
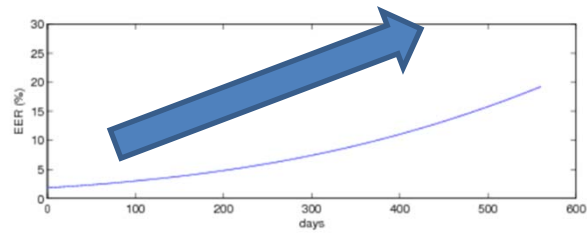
Polynomial regression



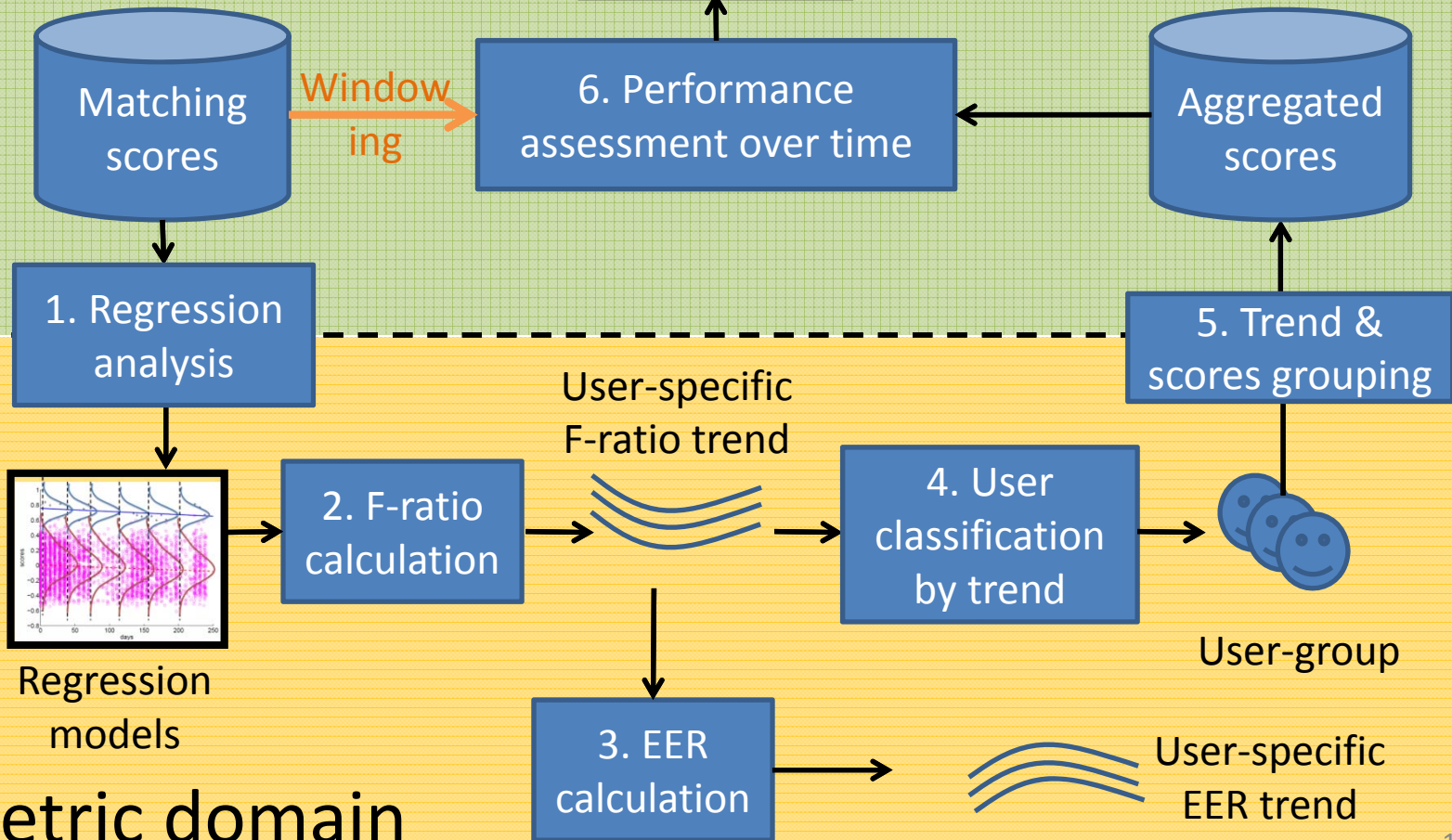
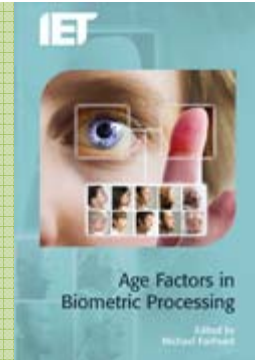
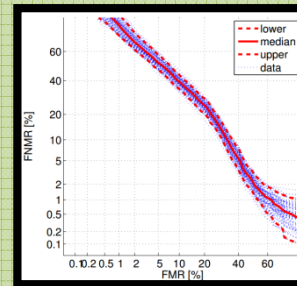
$d = 3$



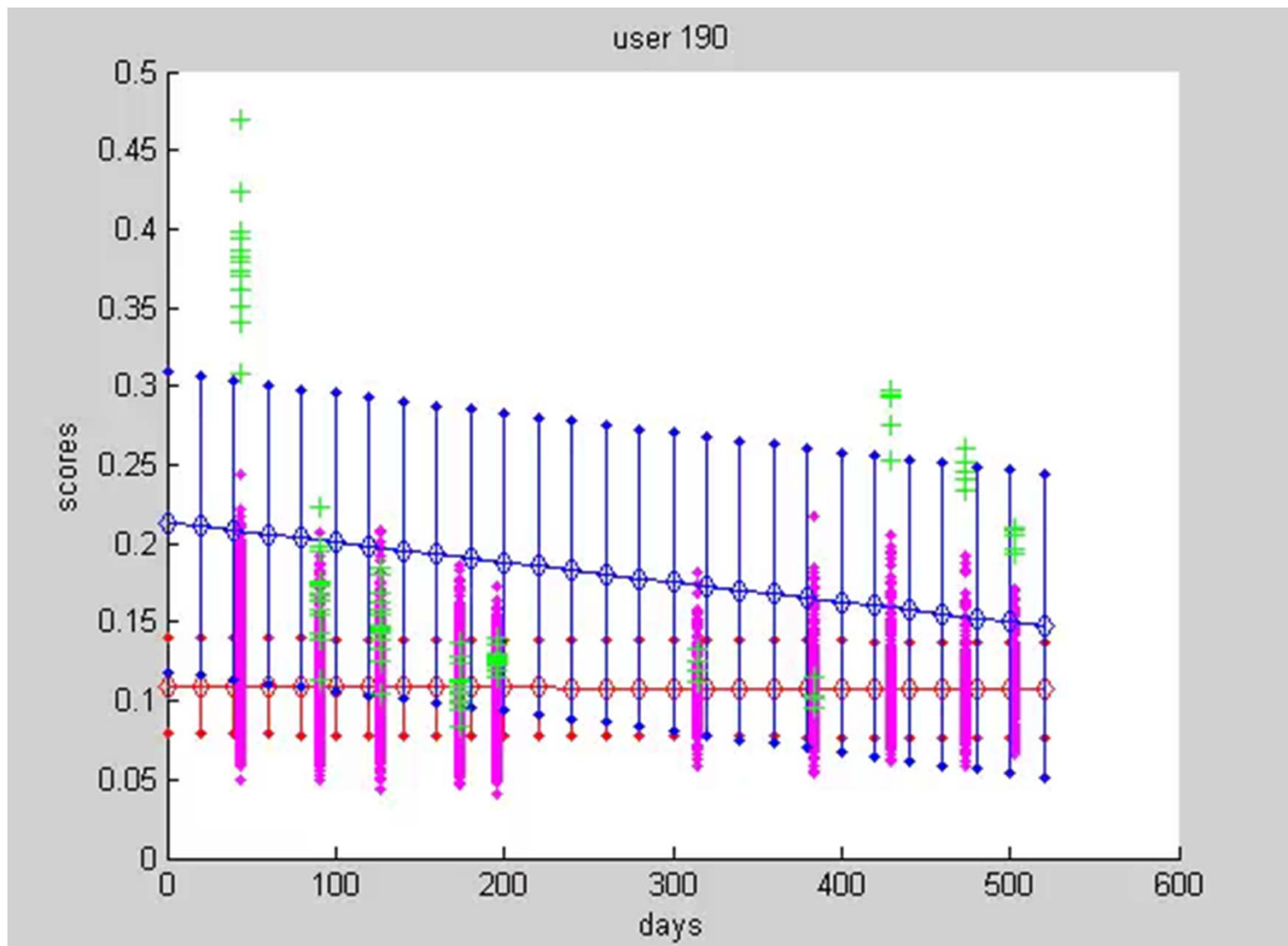
Detecting trends



Score domain



Parametric domain



Dataset

Protocols

Classifiers

Results

Mobio Dataset

Population size

- 150 subjects (6 locations)

Samples per subject

- 192 videos

Device

- Nokia device



Days covered

- 500-600 days

Setting

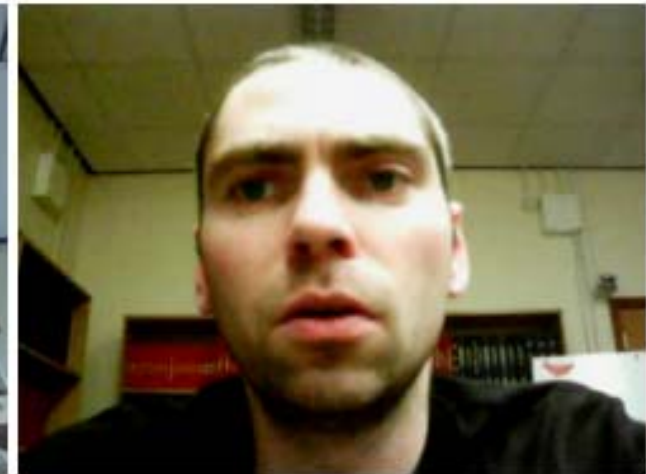
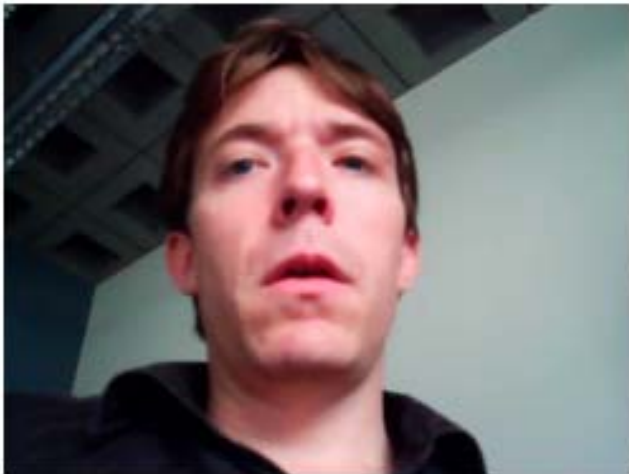
- Office environment (unconstrained)

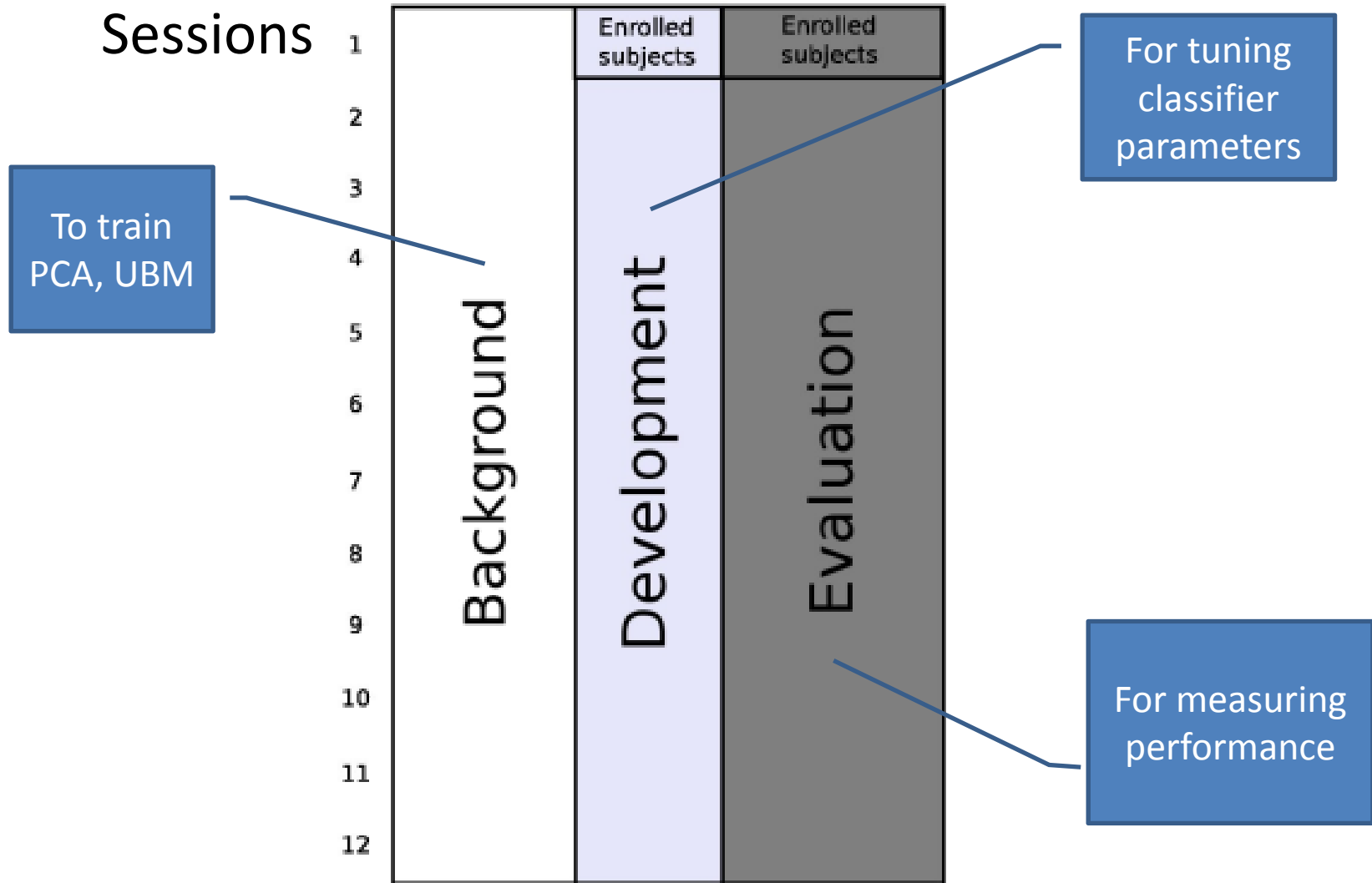
Dataset

Protocols

Classifiers

Results



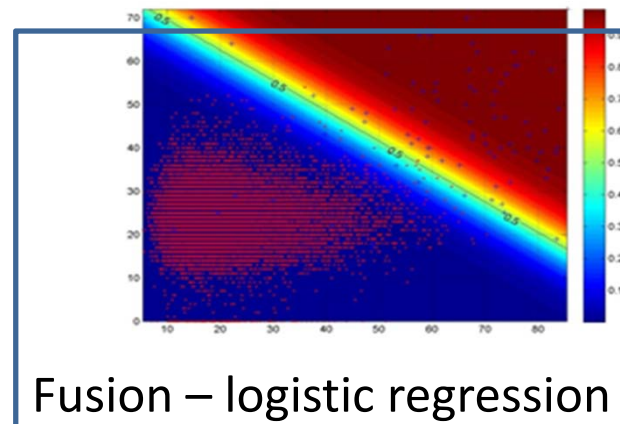
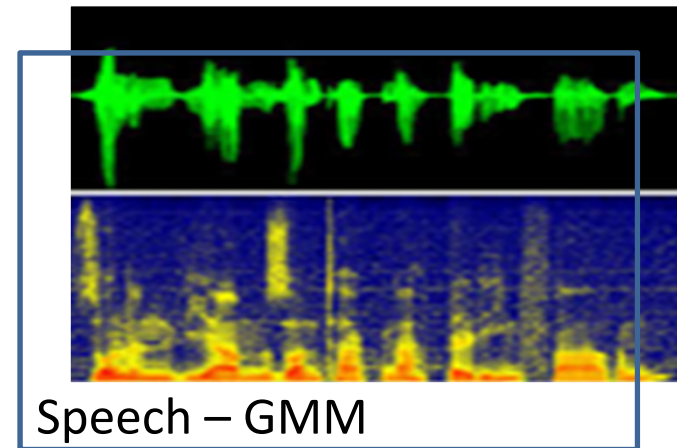
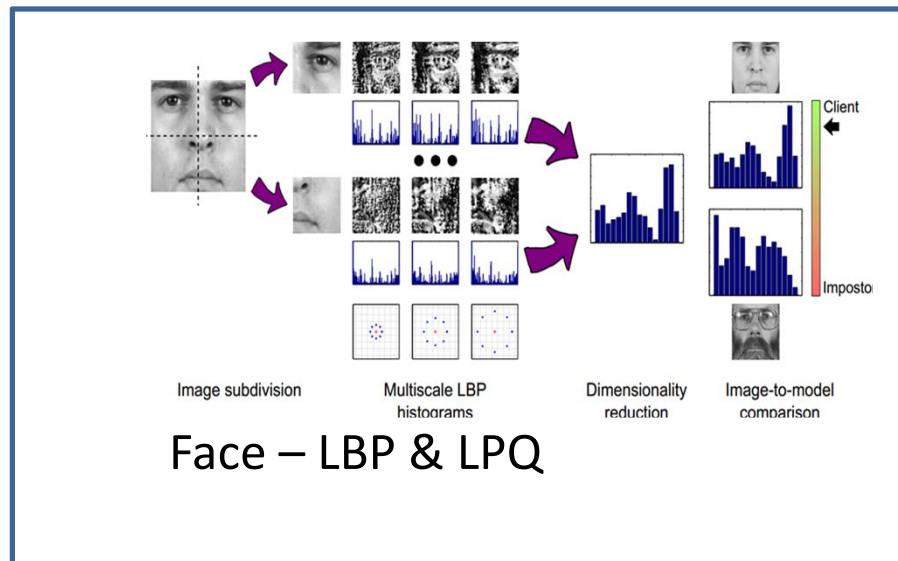


Dataset

Protocol

Classifiers

Results

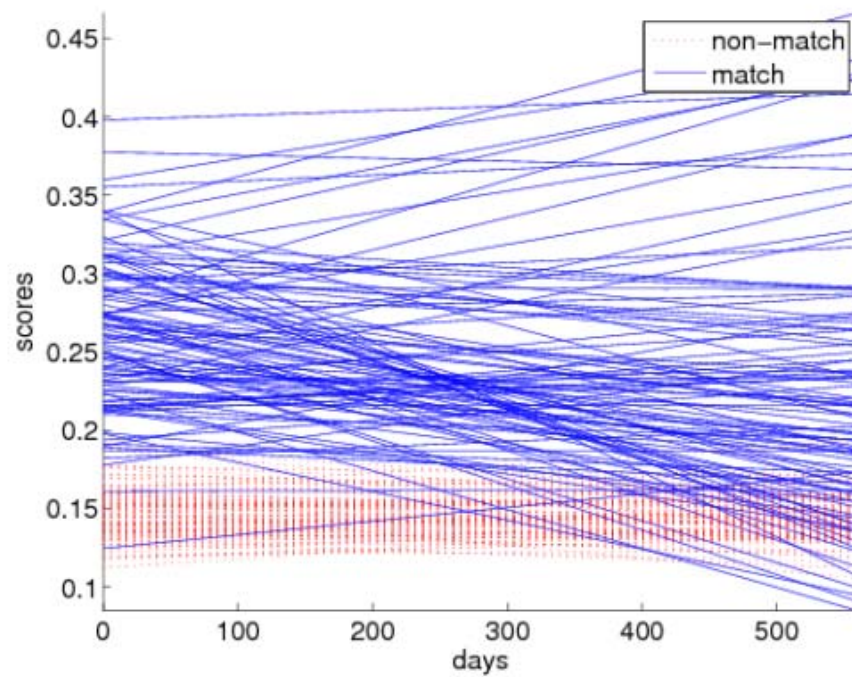


Dataset

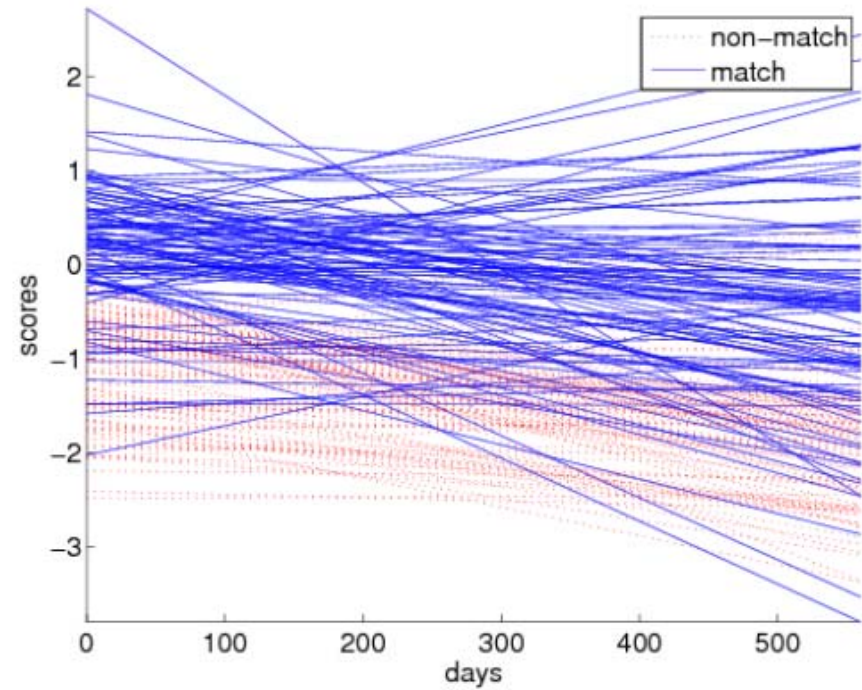
Protocol

Classifiers

Results



Face1: MLBP



Speech (GMM)

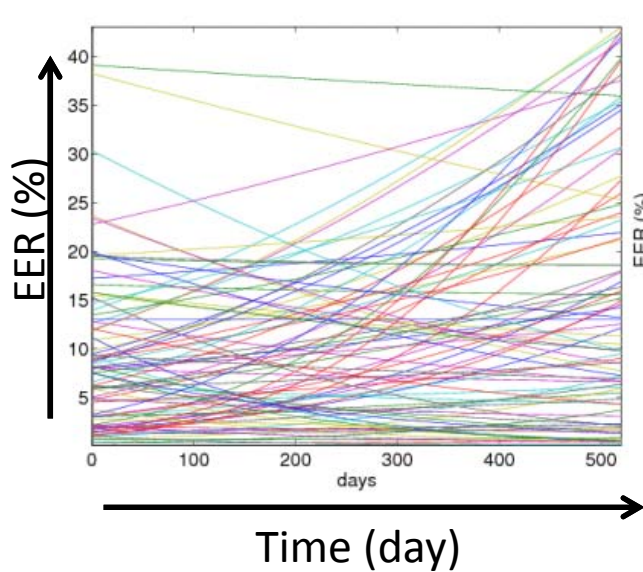
(Similar for Face2: MLPQ)

Dataset

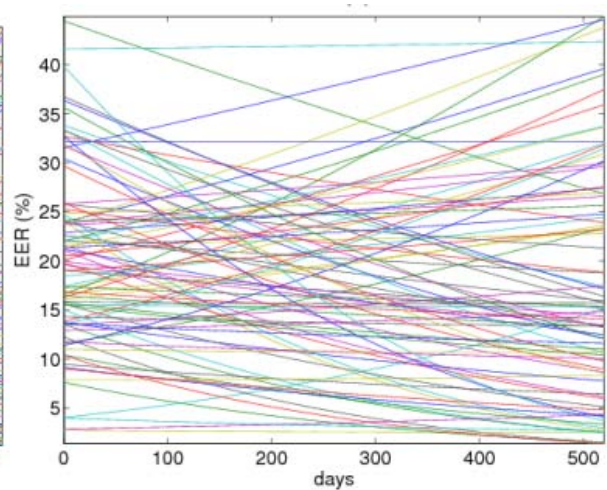
Protocol

Classifiers

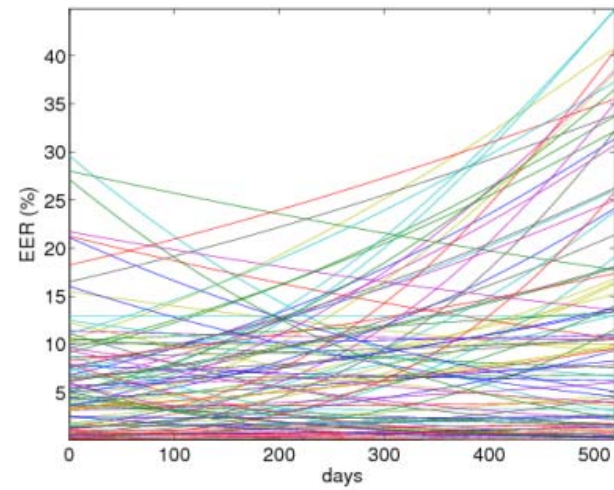
Results



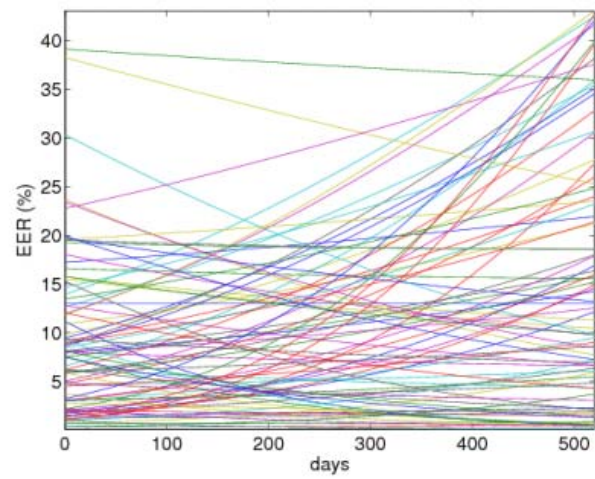
Face1

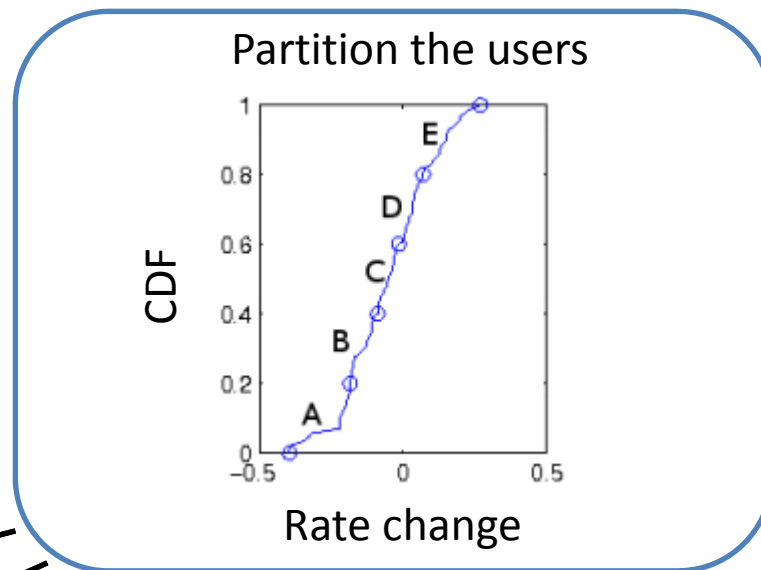
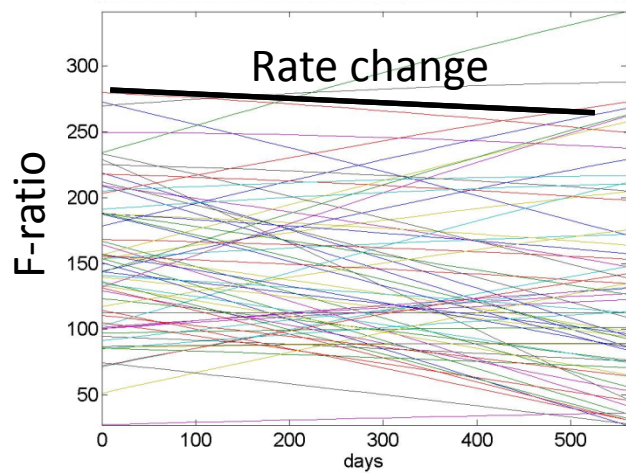


Speech



Face1+Face2+Speech





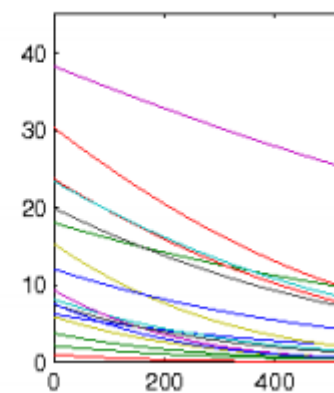
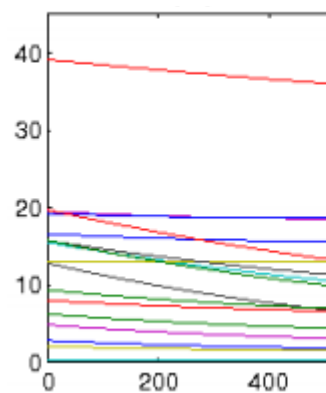
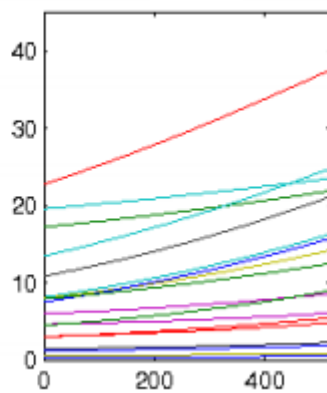
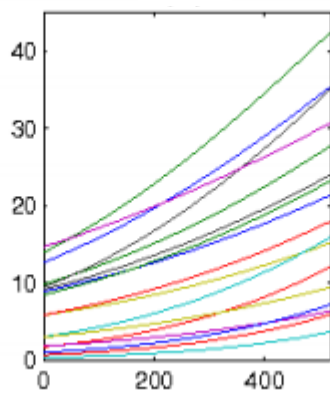
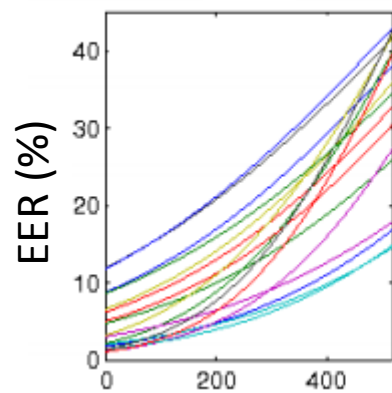
(1)

(2)

(3)

(4)

(5)



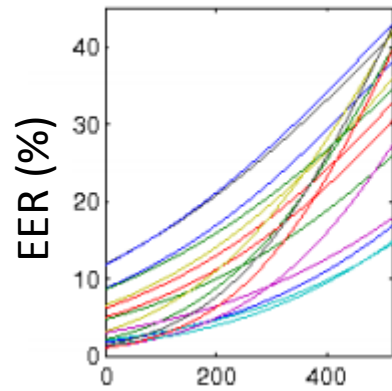
Dataset

Protocol

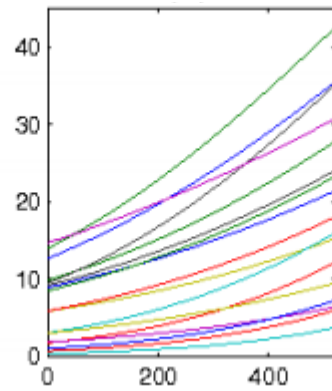
Classifiers

Results

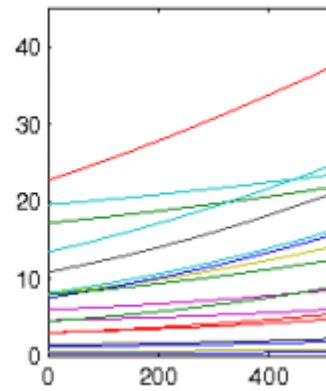
(1)



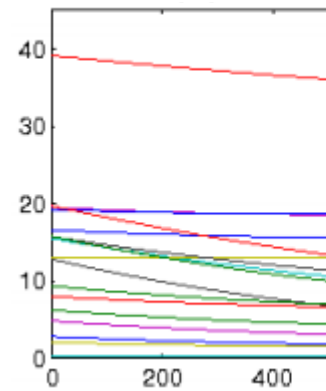
(2)



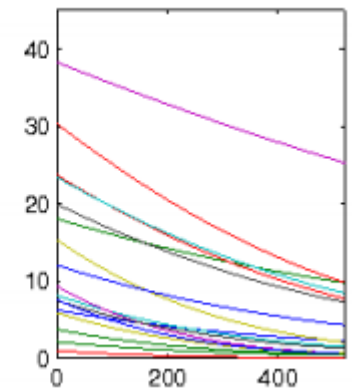
(3)



(4)



(5)

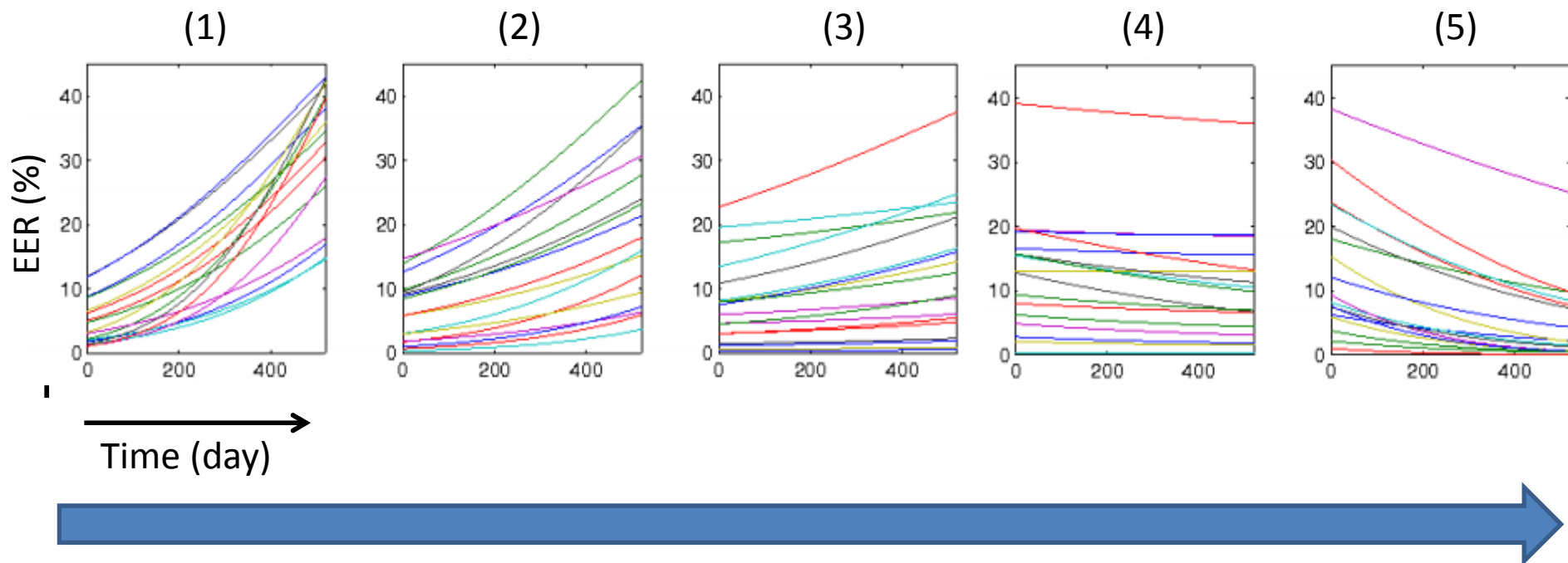


Dataset

Protocol

Classifiers

Results



Getting worse

Stable

Getting better

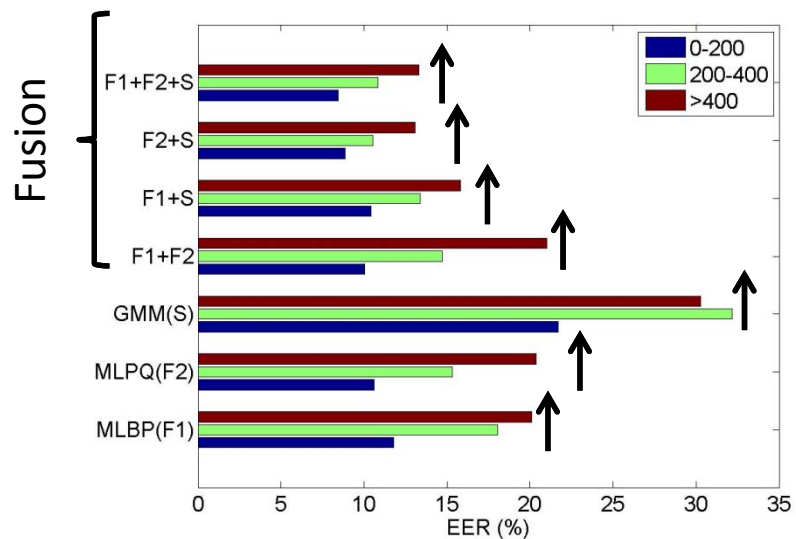
Dataset

Protocol

Classifiers

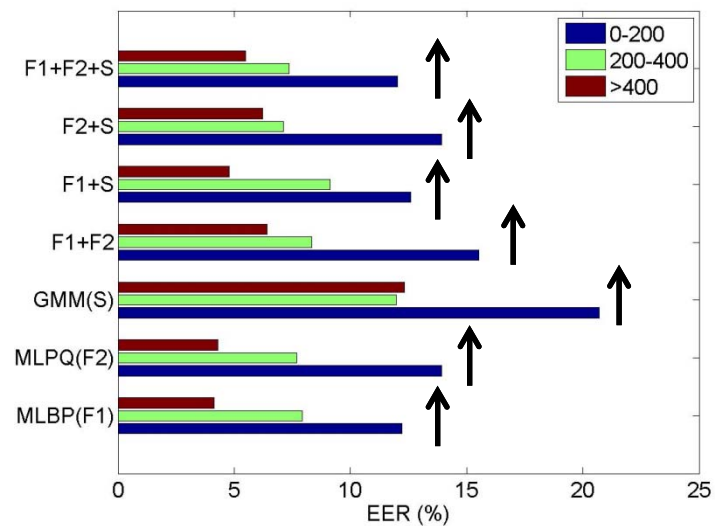
Results

(1)



Getting worse

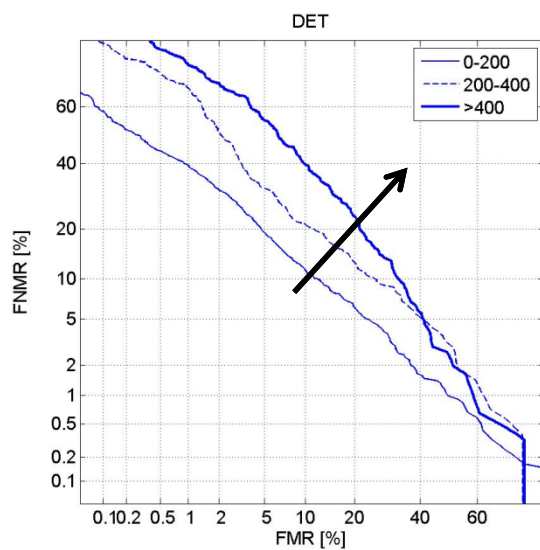
(5)



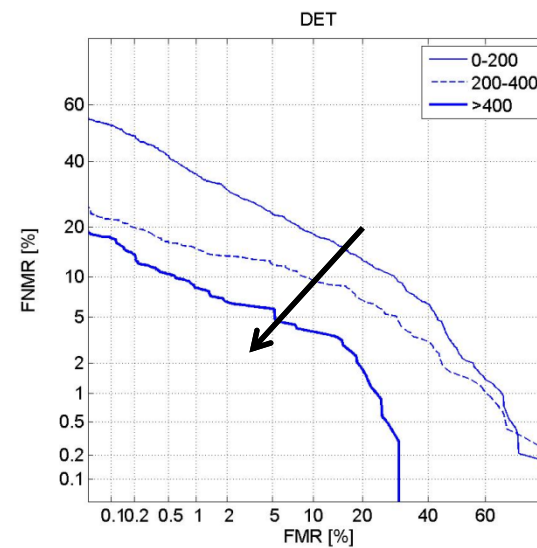
Getting better

Face (MLPQ)

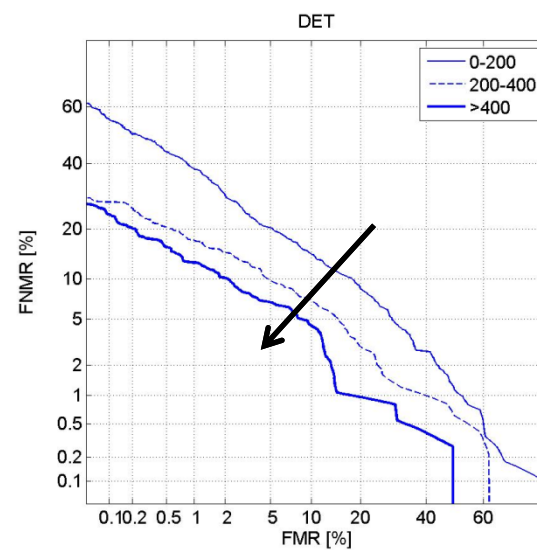
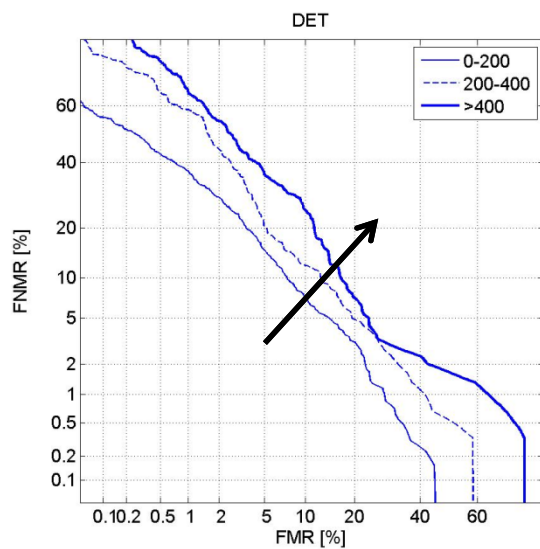
Partition 1 (getting worse)



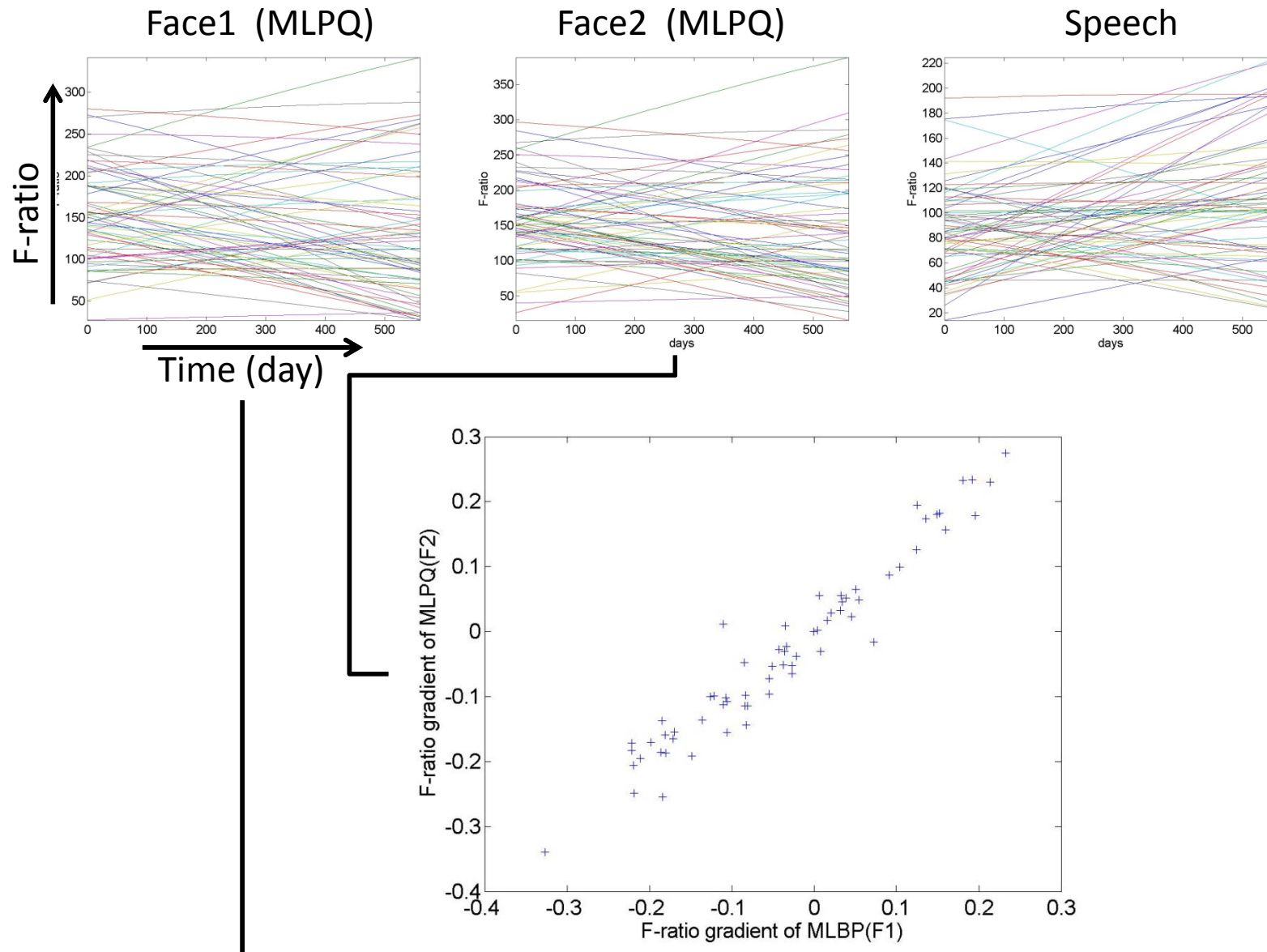
Partition 5 (getting better)



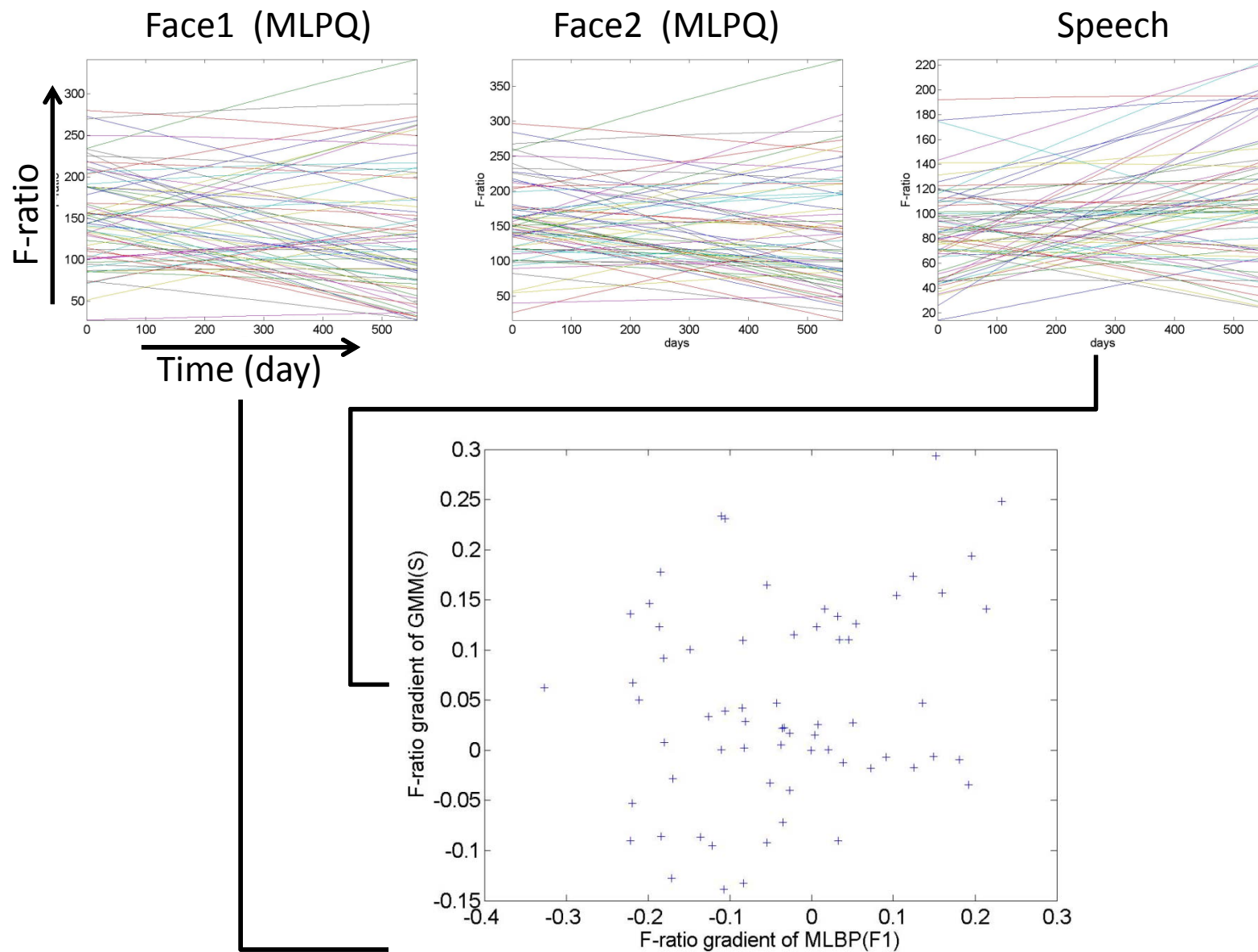
Face 1 +
Face 2 +
Speech



Modality correlation in ageing?



Modality correlation in ageing?



Conclusions

Ageing

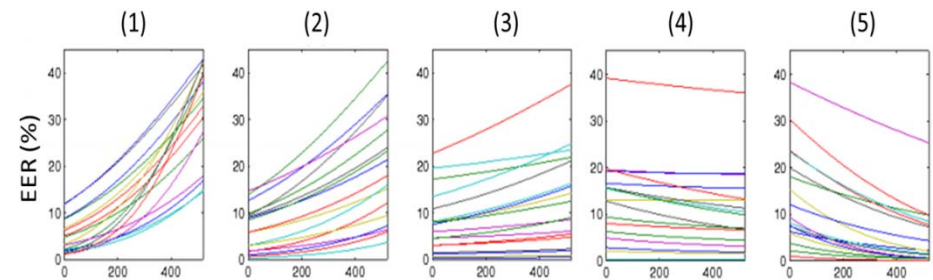
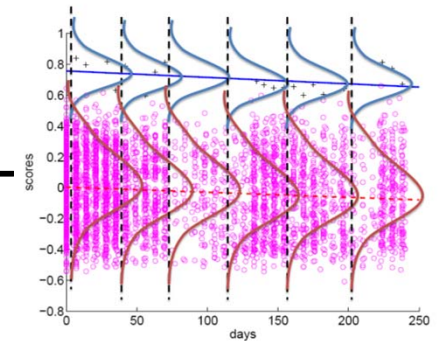
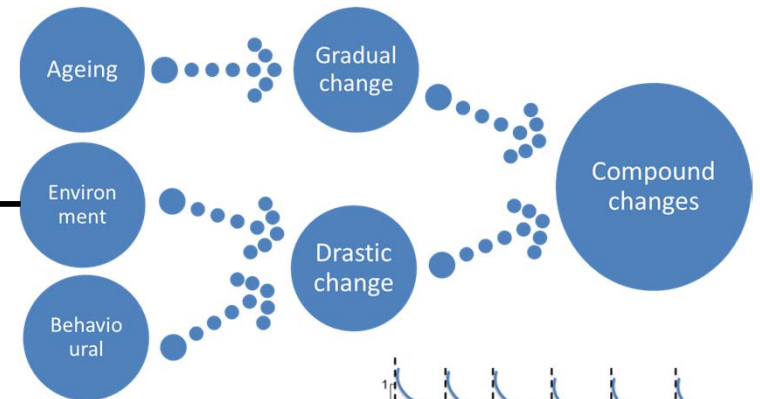
- Complex issue

Contribution

- A framework to detect ageing

Findings

- Ageing and habituation
- Subject-dependency



Questions?

Email to n.poh@surrey.ac.uk

Thanks to the MOBIO project and partners
Chan Chi Ho, Medha Pandit, Josef Kittler
IBPC conference and special session

Ageing

- Complex issue

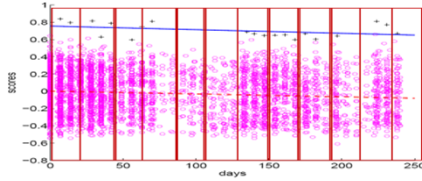
Contribution

- A tool to detect ageing

Findings

- Ageing and habituation
- Subject-dependency

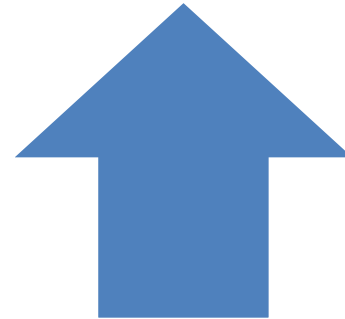
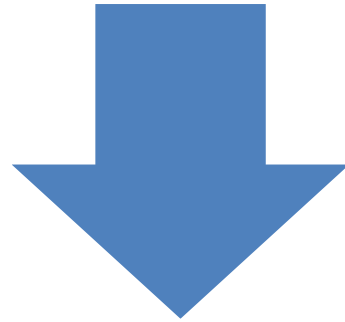
windowing



Cannot model subject-specific performance




Vulnerable to sparse observations & discontinuities

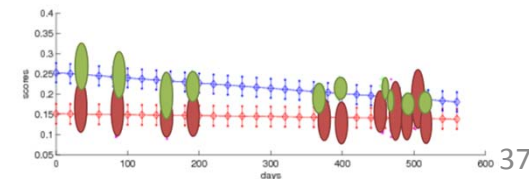


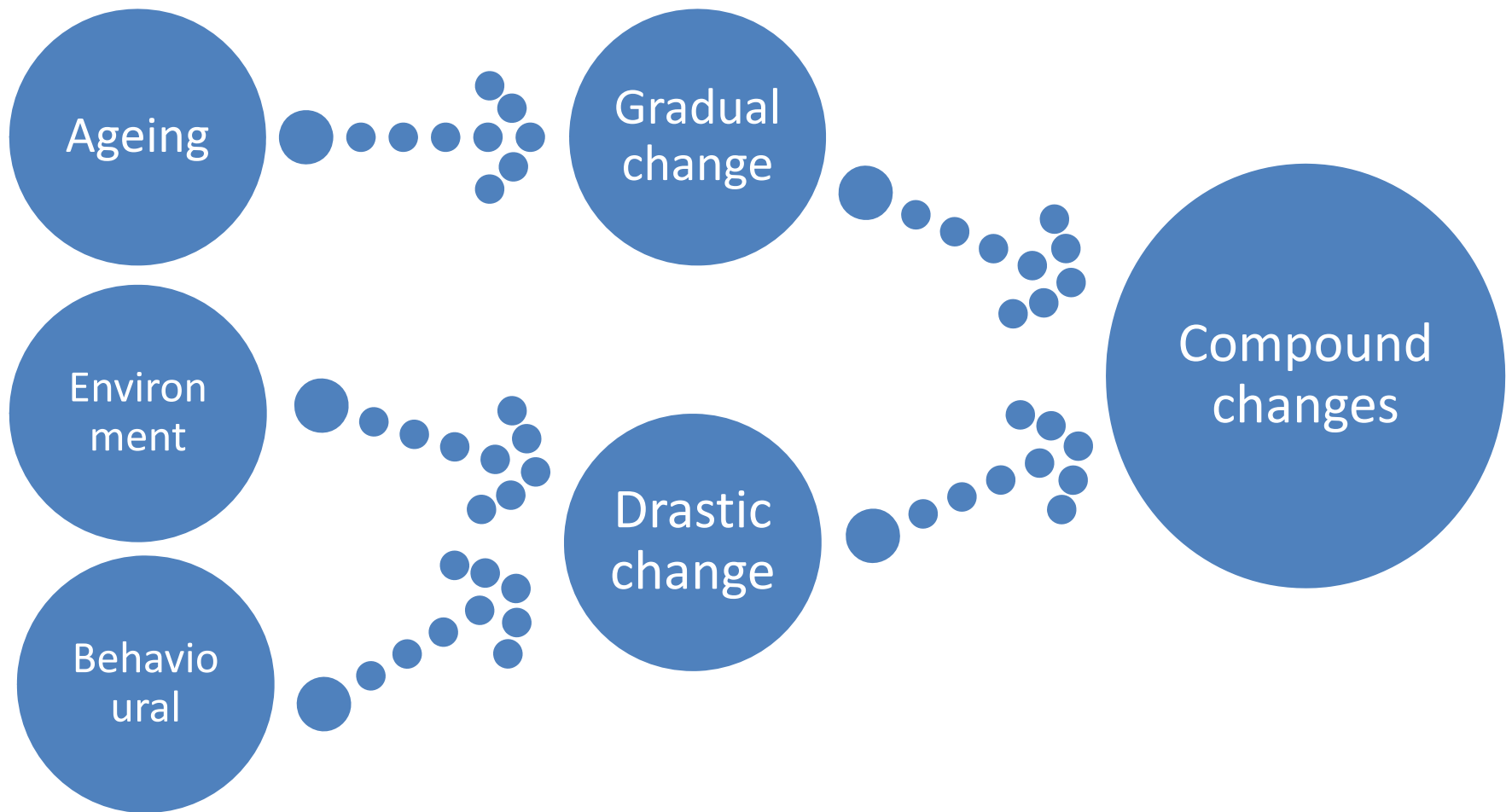
 Rely on smoothness assumptions

 Subject-specific performance

 Parametric error model (sensitive to *minute* changes)

regression





Ageing

