



UNIVERSITY OF
OXFORD

DEPARTMENT OF
**COMPUTER
SCIENCE**

Preventing Lunchtime Attacks: Fighting Insider Threats With Eye Movement Biometrics

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Threat Model

- Typical scenario: “Lunchtime Attack”
 - Attacker uses a co-worker’s unlocked workstation while he is at lunch
- Other scenarios
 - Cleaning staff access workstation after hours
 - Compromised, or even wilfully shared password
- Insider threats are a significant problem:
 - 33% of electronic crimes committed by insiders
 - 60% of those involve a compromised account
 - 43% are performed locally, using physical access to the workstation

Why Eye Movements?



Pitt Early Autism Study for Infants



Market Research



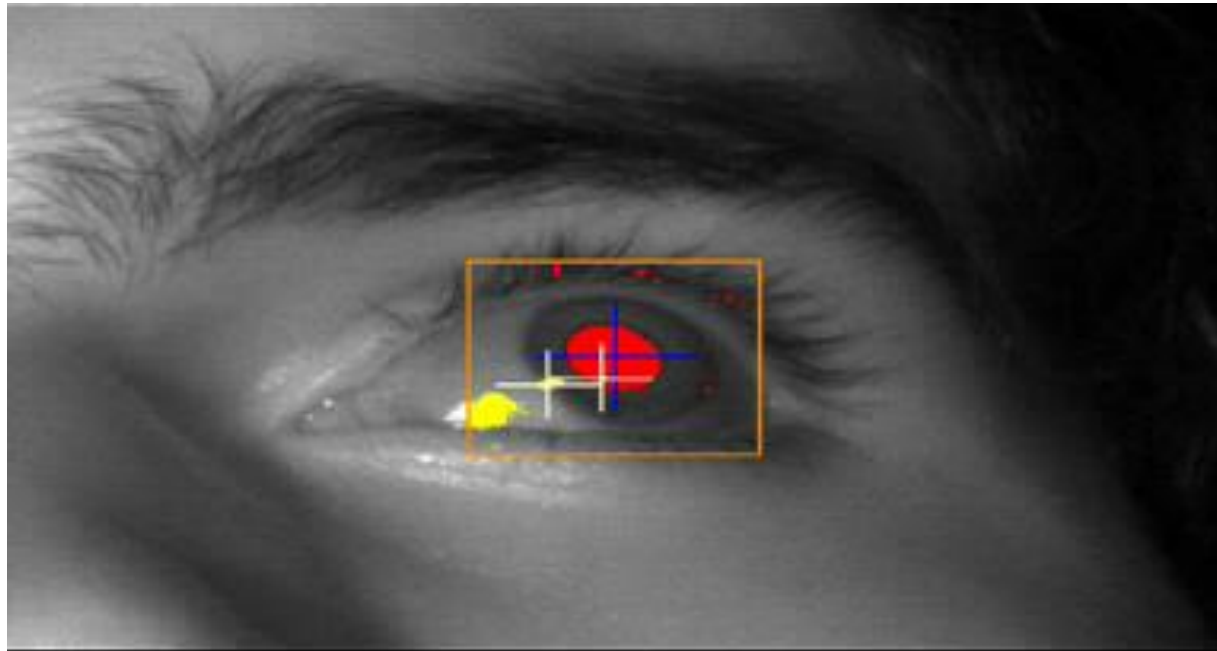
Gaze-Based PIN entry, De Luca et al., 2007



Eyetracking prototype for the PS4

Introduction to Eye Tracking

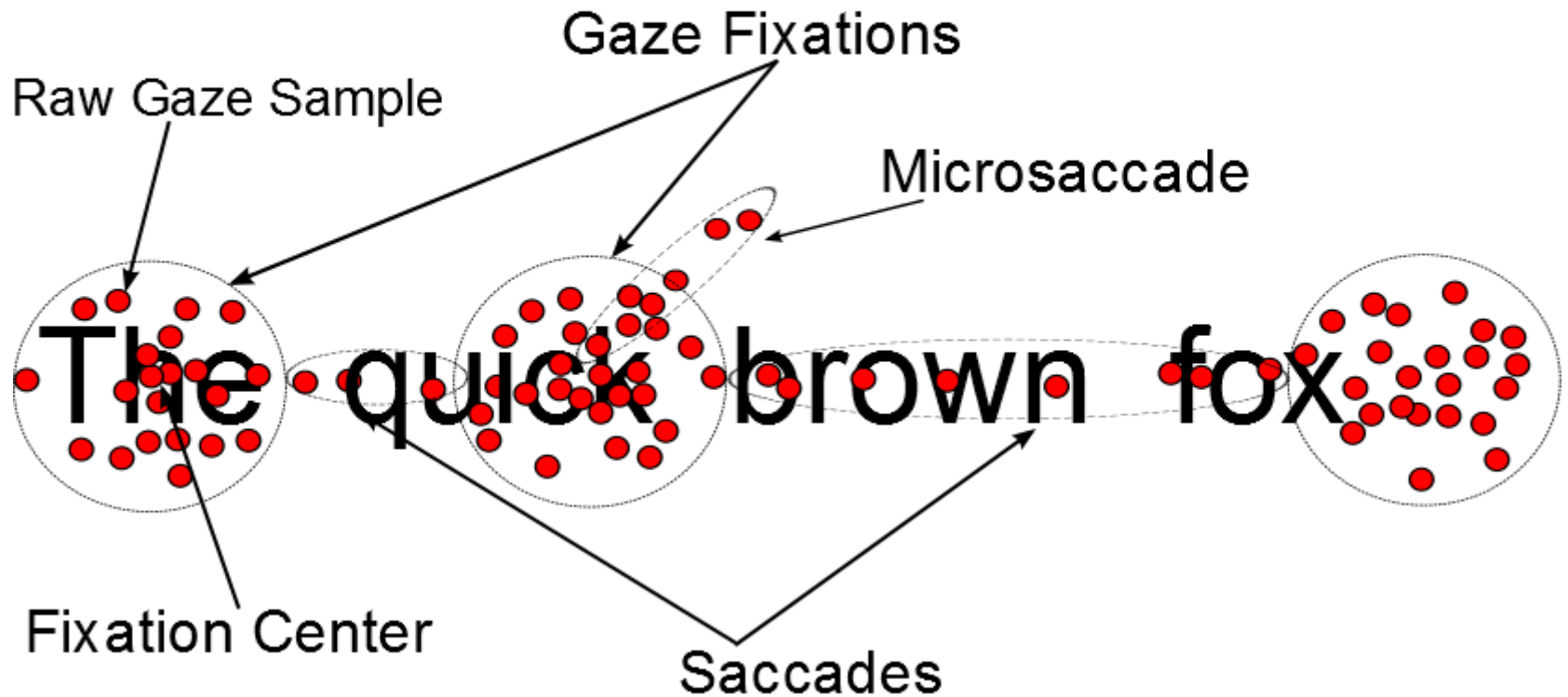
- Several types of trackers
 - Eye-attached
 - Electric potential measurement
 - **Video-Based**



Research Questions

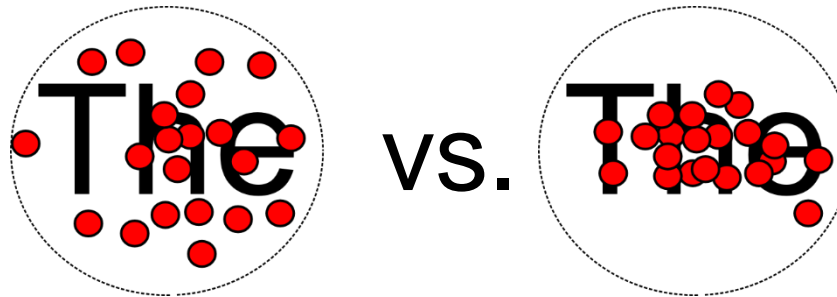
- What kind of eye movements have been identified in related work?
- Can we derive biometric features from these movements?
- Are they useful for transparent continuous authentication?
- Are the features stable over time?
- How quickly can imposters be detected?
- How likely are false positives?

Different Types of Eye Movements



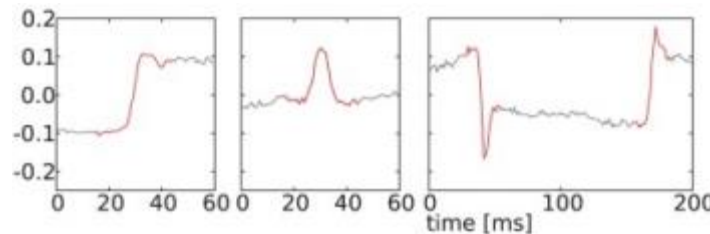
Discriminative Features

Spatial Features



Feature	RMI
Spatial features	
Distance from Center - Max	1.2%
Distance from Center - Mean	2.52%
Distance from Center - Min	0.72%
Distance from Center - Stdev	1.21%
Distance from previous fixation	0.66%
Max Pairwise Distance	1.23%
Max Pairwise Distance X only	1.06%
Max Pairwise Distance Y only	0.84%
Saccade Direction	0.08%

Temporal Features



Temporal features	
Acceleration - Max	2.49%
Acceleration - Mean	0.35%
Duration of Saccade	1.09%
Duration of Fixation	0.9%
Pairwise Speed - Max	4.95%
Pairwise Speed - Mean	5.36%
Pairwise Speed - Stdev	1.77%

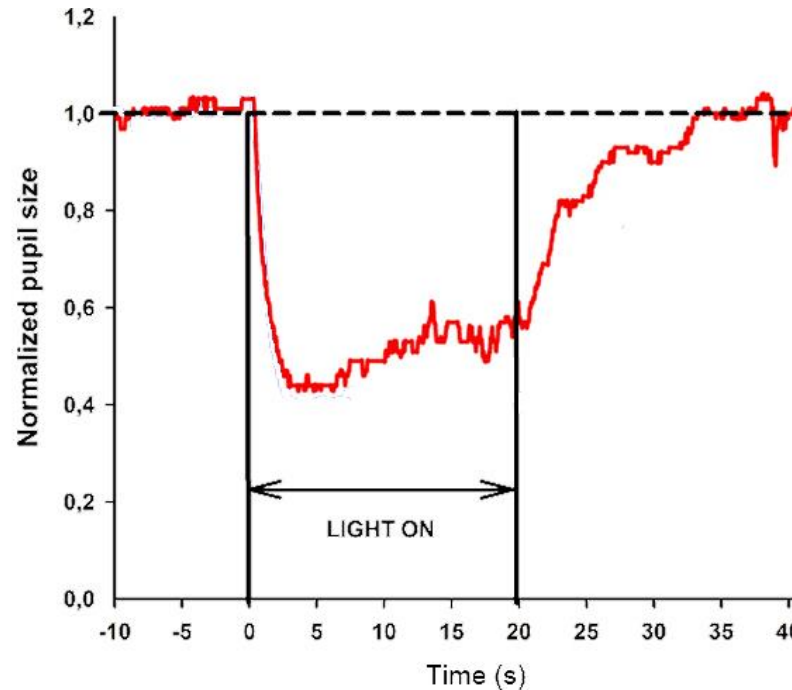
Pupil Diameter



Pupil features	
Pupil Diameter - Max	19.84%
Pupil Diameter - Mean	20.27%
Pupil Diameter - Min	20.26%
Pupil Diameter - Range	1.19%
Pupil Diameter - Stdev	0.98%

Pupil Diameter

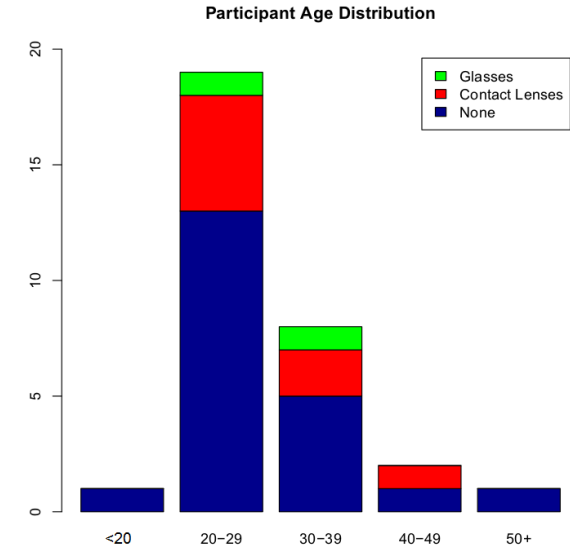
- Pupil diameter can be influenced through light stimulation



Herbst et al., 2011

- Is reliable authentication possible without using this feature?

Study Design



Session 1

30 subjects

2 weeks

Session 2

20 subjects

1 hour

Session 3

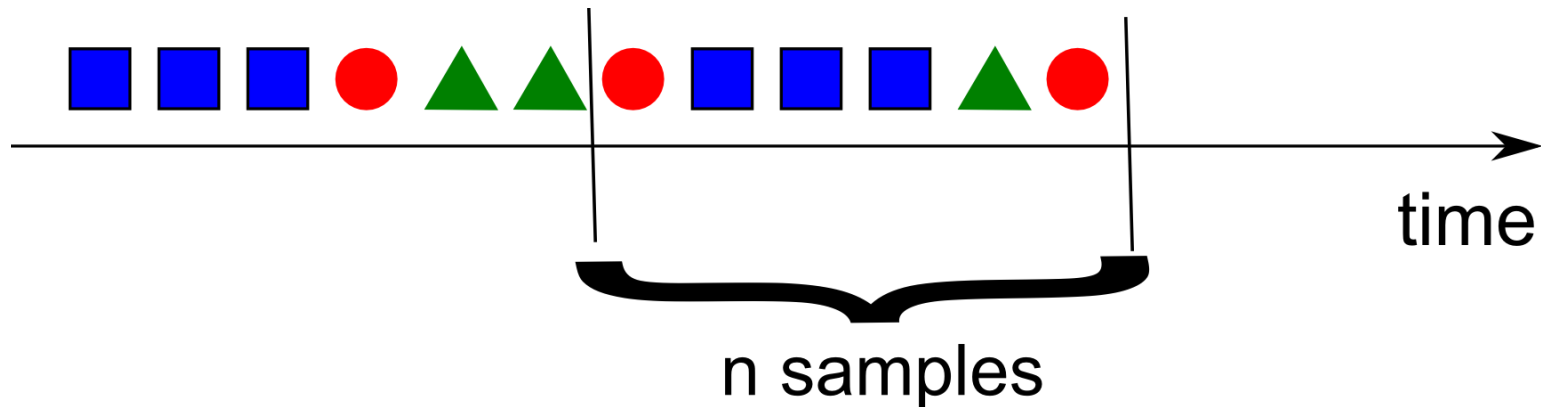
20 subjects

Long-term stability

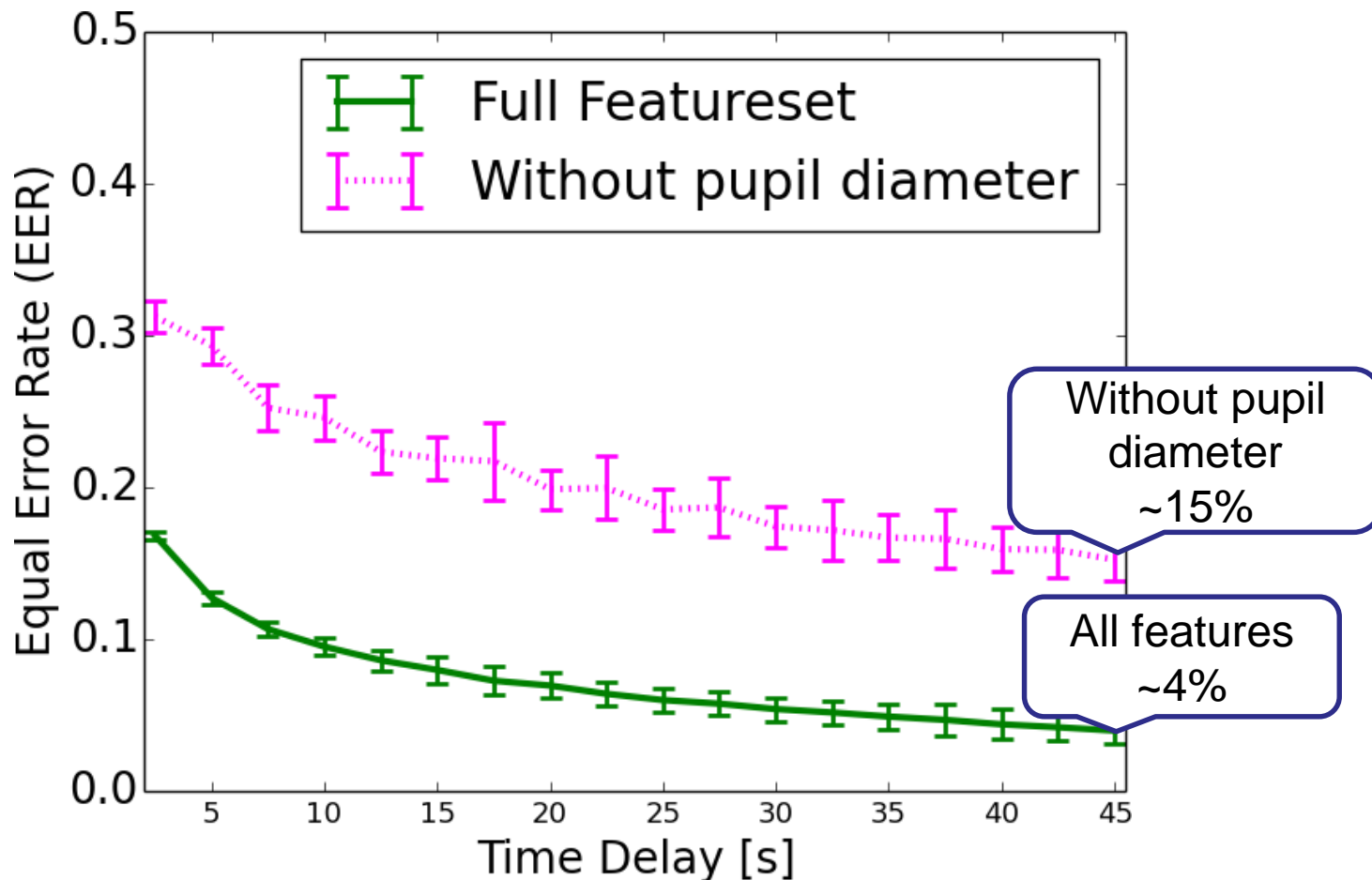
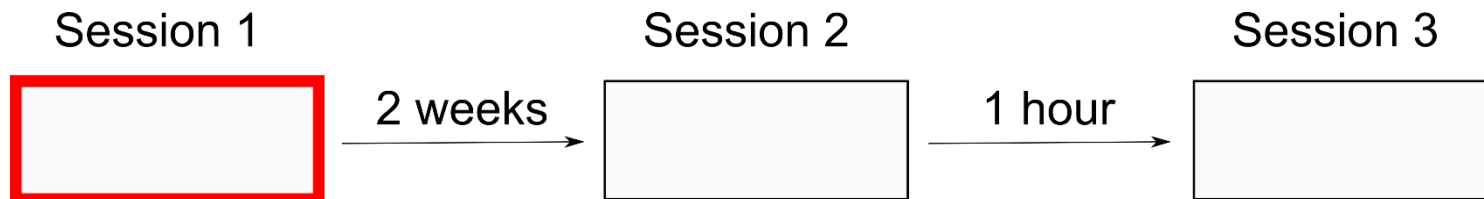
Technical Artefacts

Classification Methodology

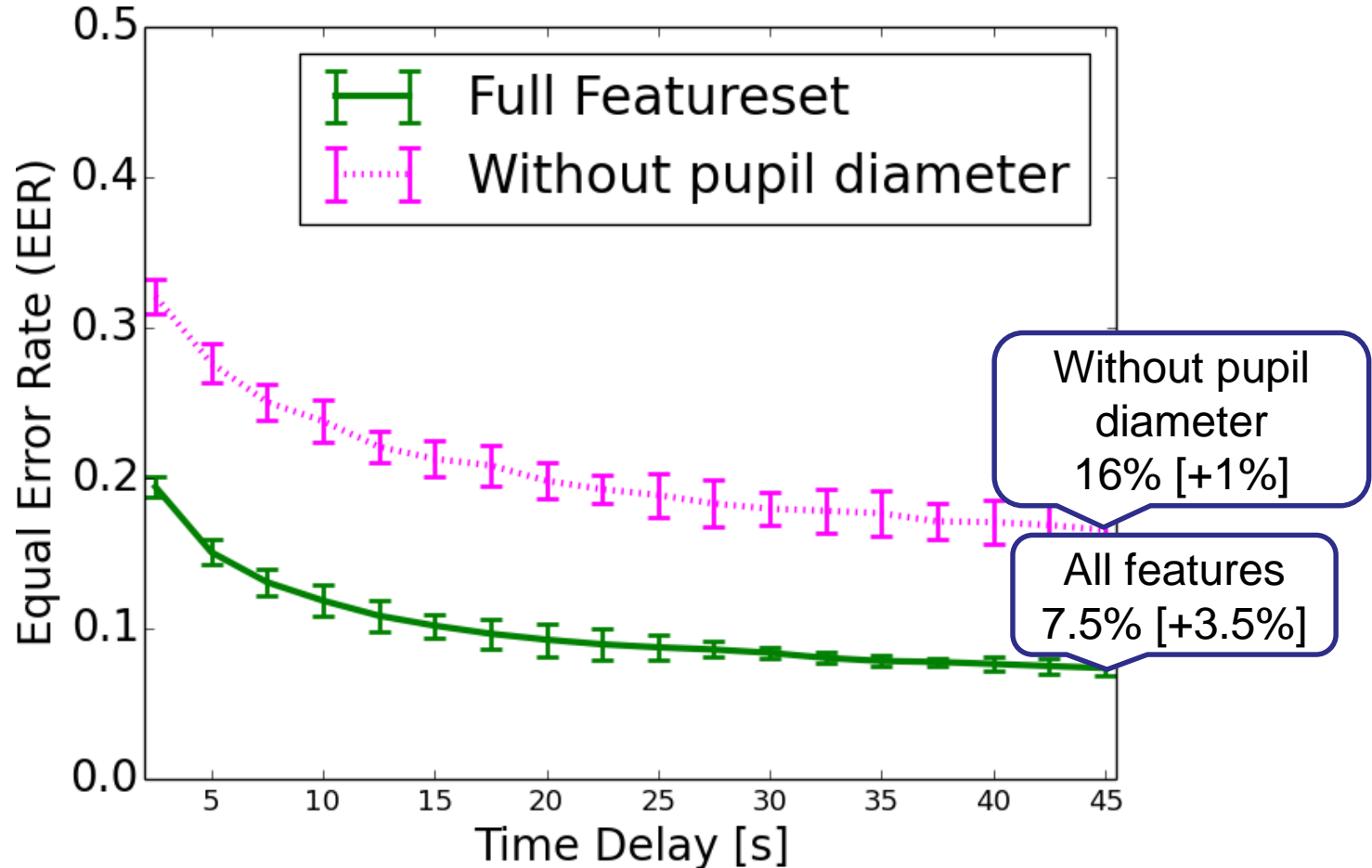
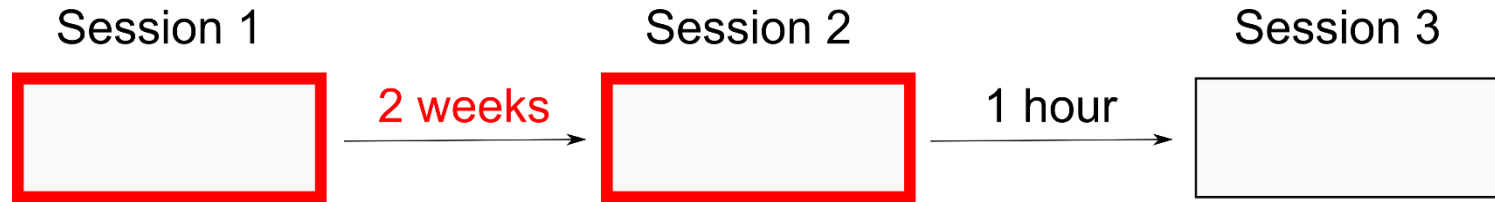
- Two classifiers
 - K-nearest neighbors
 - Support Vector Machines
- 5-fold stratified cross-validation
- Sliding window of size n



Results – Single Session



Results – Over Two Weeks



Conclusion – Questions?

- A new biometric based on eye movements
- High distinctiveness
- Remarkably stable over time
- Future Work
 - Feasible with low-cost devices?
 - Practical considerations

Thank you for your attention. Questions?

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