Stability of the Iris Match Distribution

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This is a re-arranged and shortened version of a talk given various places in the last year.

The re-arrangement is meant to make a balanced view of the results more clear.

Iris Biometrics Performance

The popularity of iris is due in large part to amazing performance claims:

"… ***the false match rate stands at 1 in 1.2 million using one eye and can be as low as 1 in 1.44 trillion using two eyes."*** ***- Iridian press release***

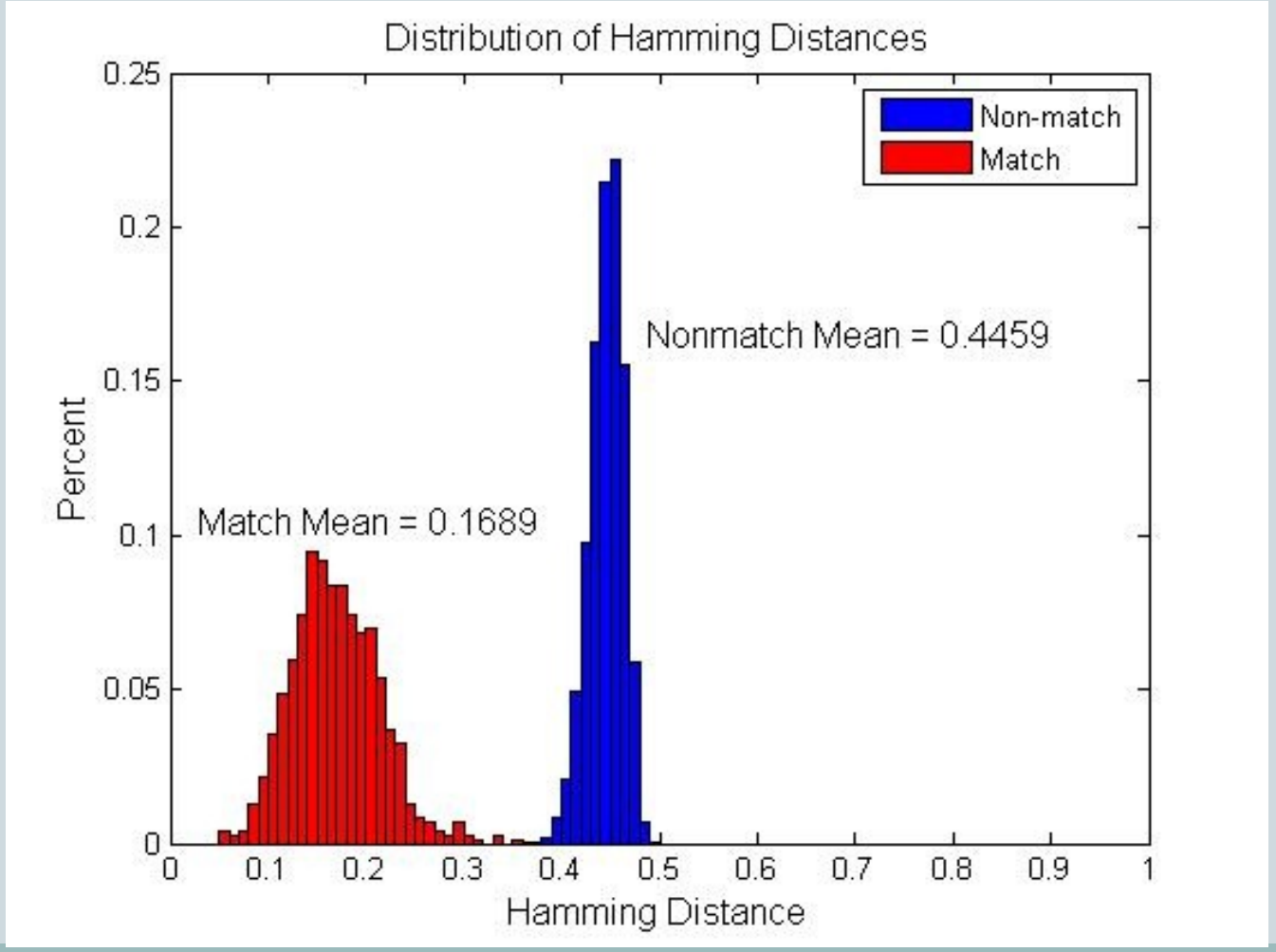
Iris Biometrics Performance

In a verification context, the FMR is in the tail of the non-match (imposter) distribution toward the match (genuine).

The FRR is in the tail of the match distribution toward the non-match.

Iris Biometrics Performance

The "1 in 1.2 million FMR" is a claim about the stability of the non-match distribution.



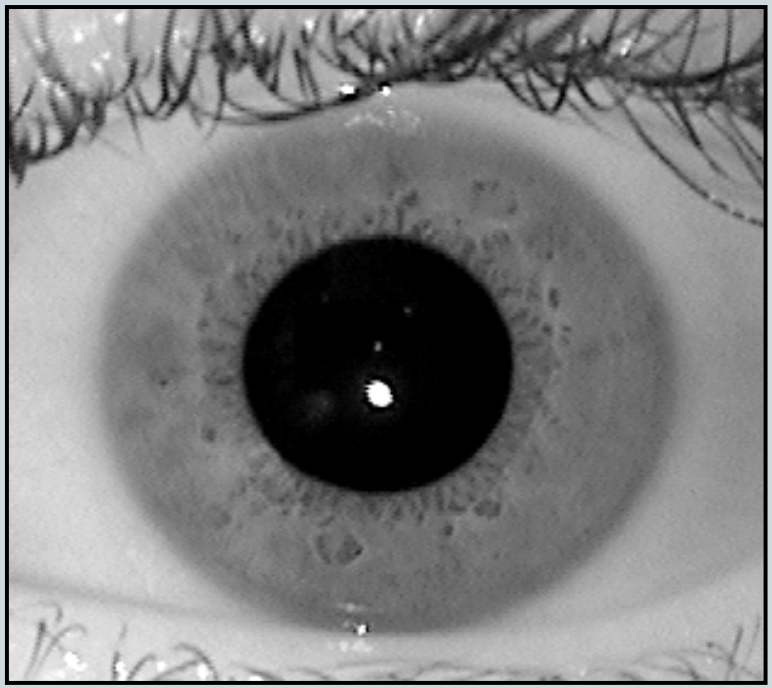
Iris Biometrics Performance

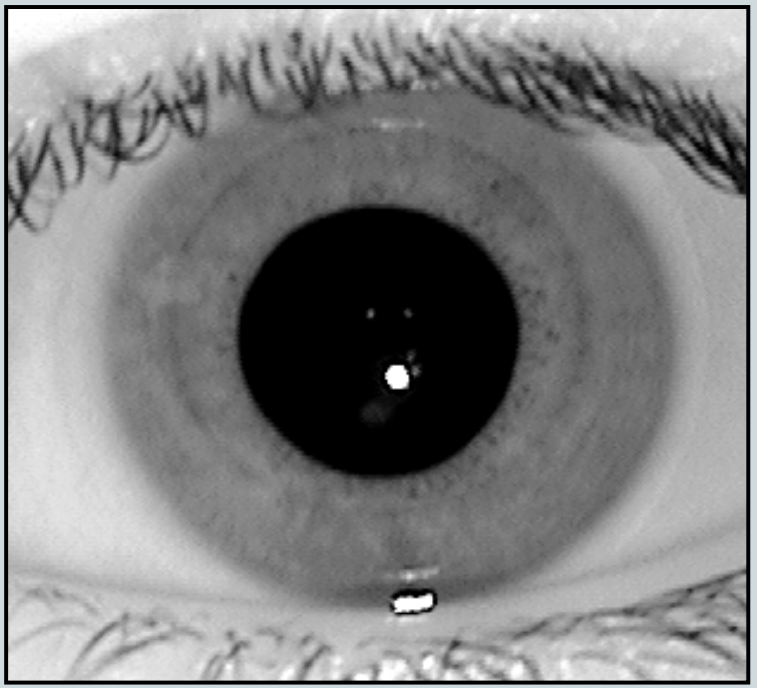
We have investigated conditions of:

- Contact lenses
- Template aging
- Cross-sensor matching
- Pupil dilation

for their effect on the two distributions.

Contact Lenses





Even normal prescription contact lenses do result in visible artifacts in iris images.

Contact Lenses

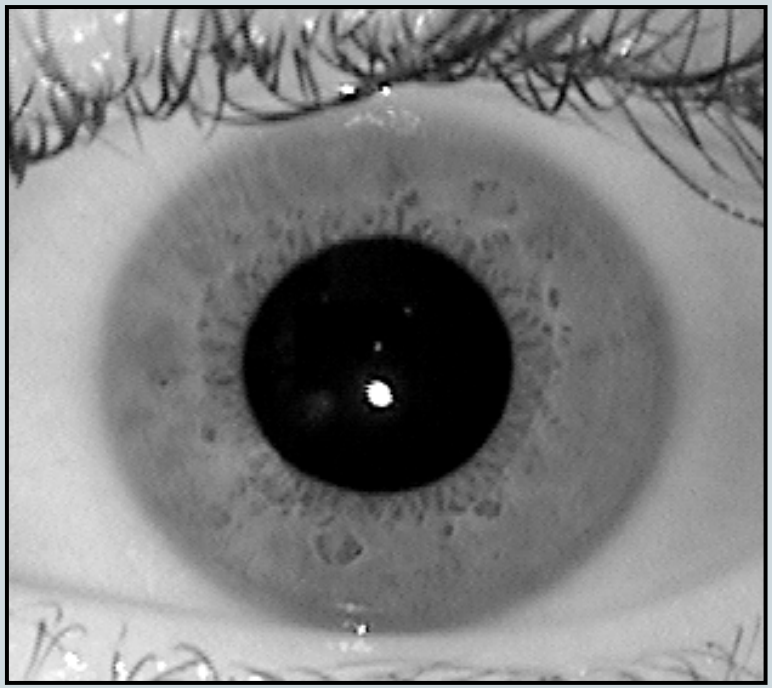


image without contact lens

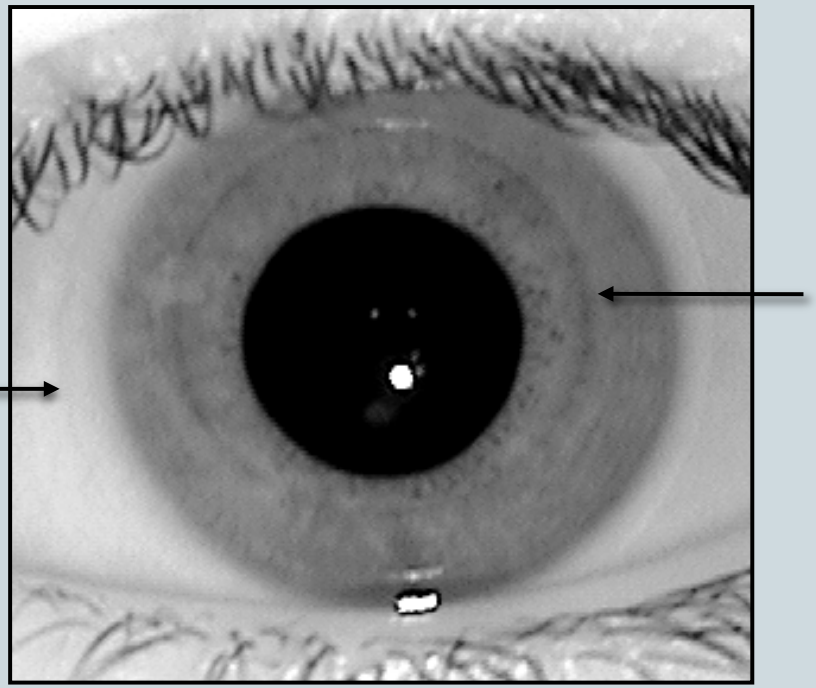


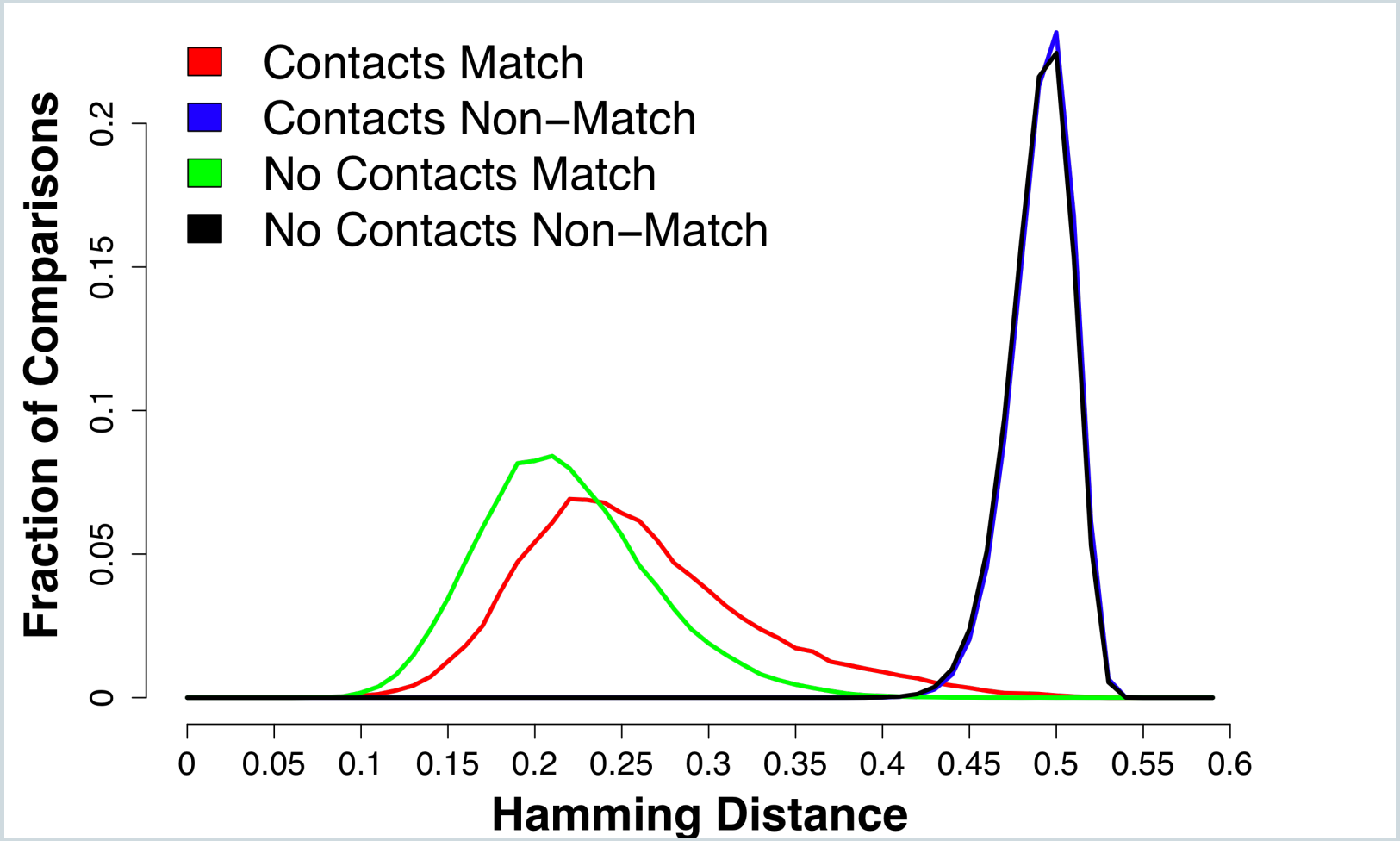
image with contact lens

Contact Lenses

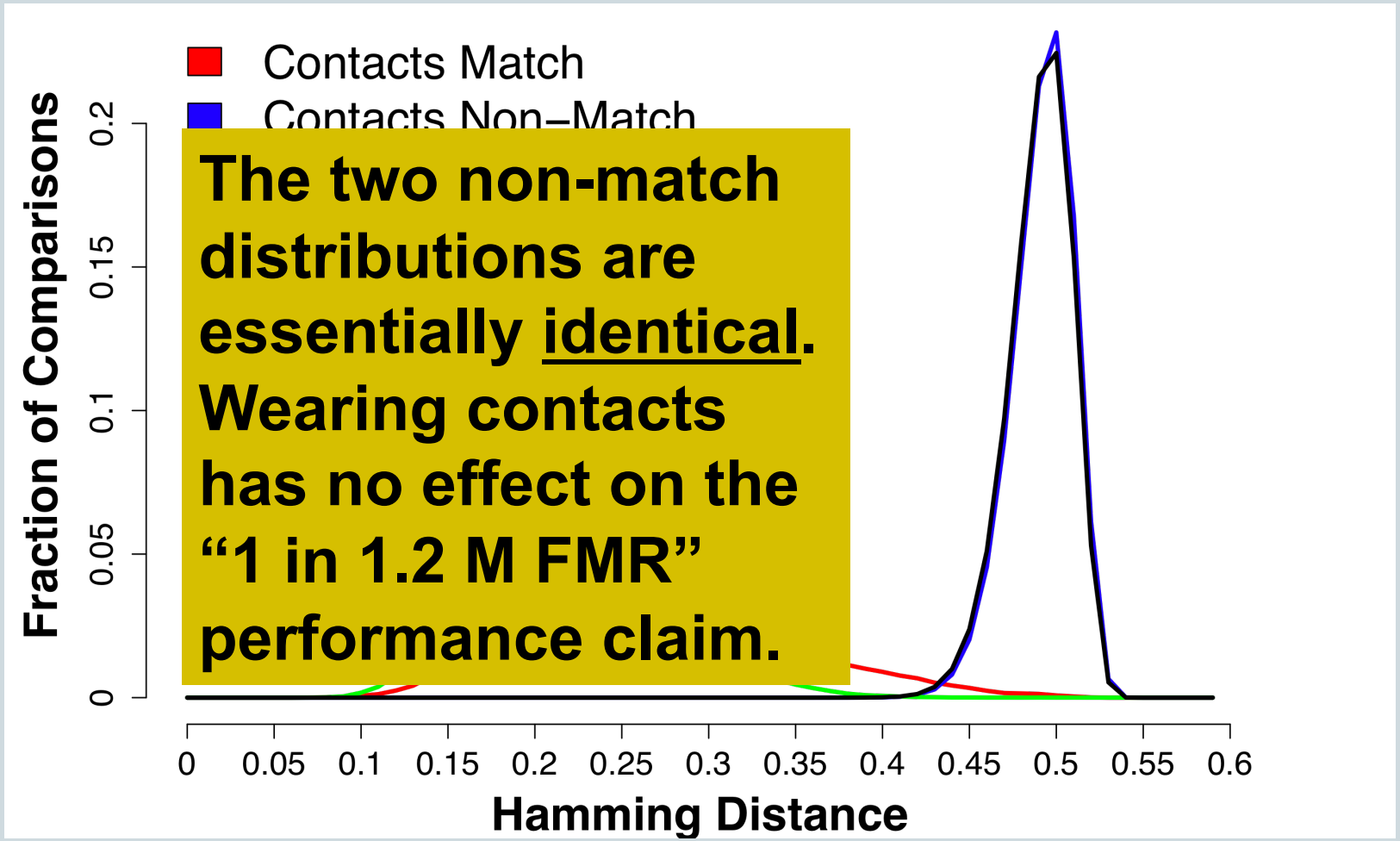
Experimental materials:

- 30 persons imaged using LG 2200
- 15 wearing contacts, 15 no contacts
- At least 20 images of each iris
- Modified ICE baseline software

Contact Lenses

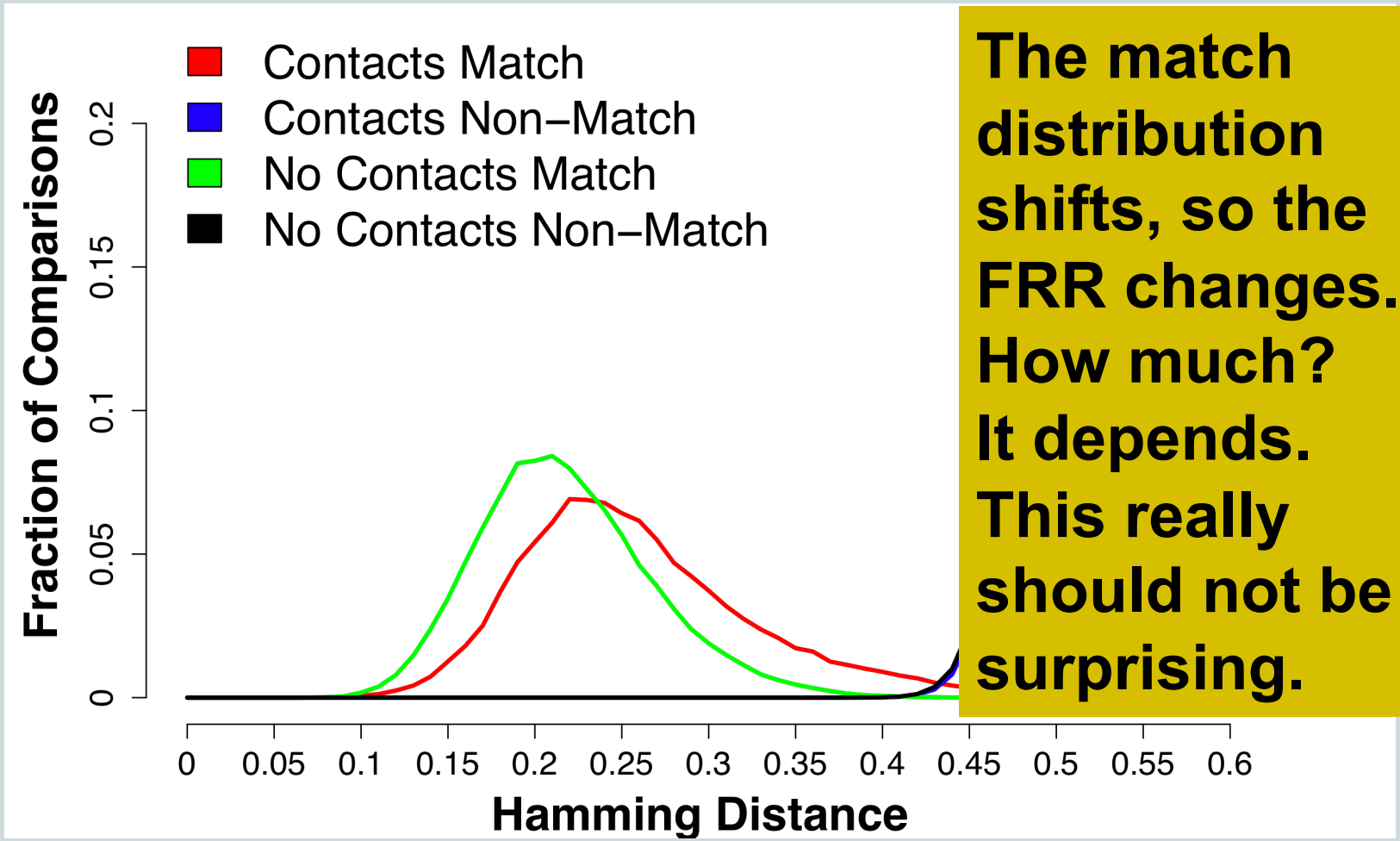


Contact Lenses



The two non-match distributions are essentially identical. Wearing contacts has no effect on the "1 in 1.2 M FMR" performance claim.

Contact Lenses

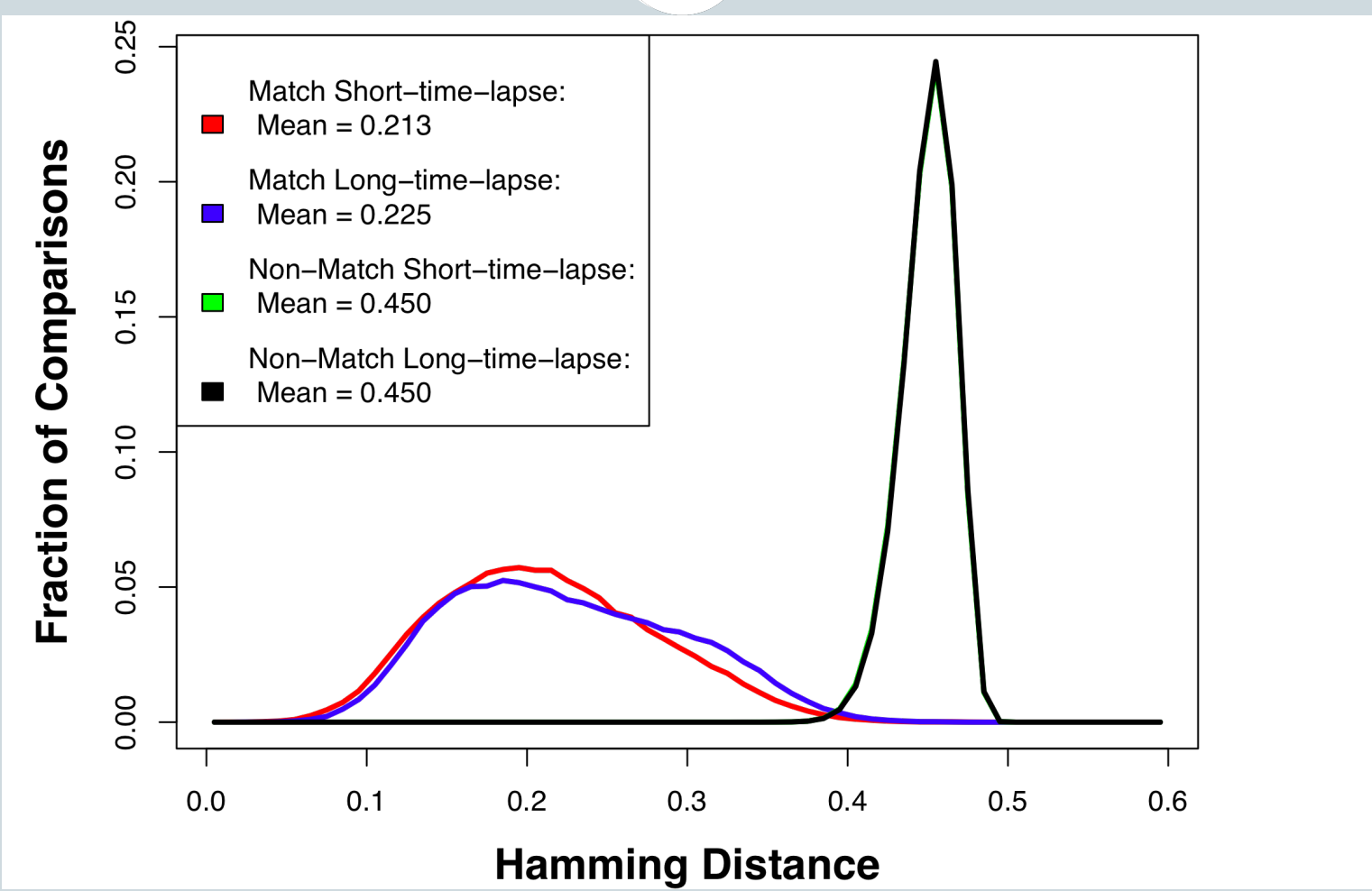


The match distribution shifts, so the FRR changes. How much? It depends. This really should not be surprising.

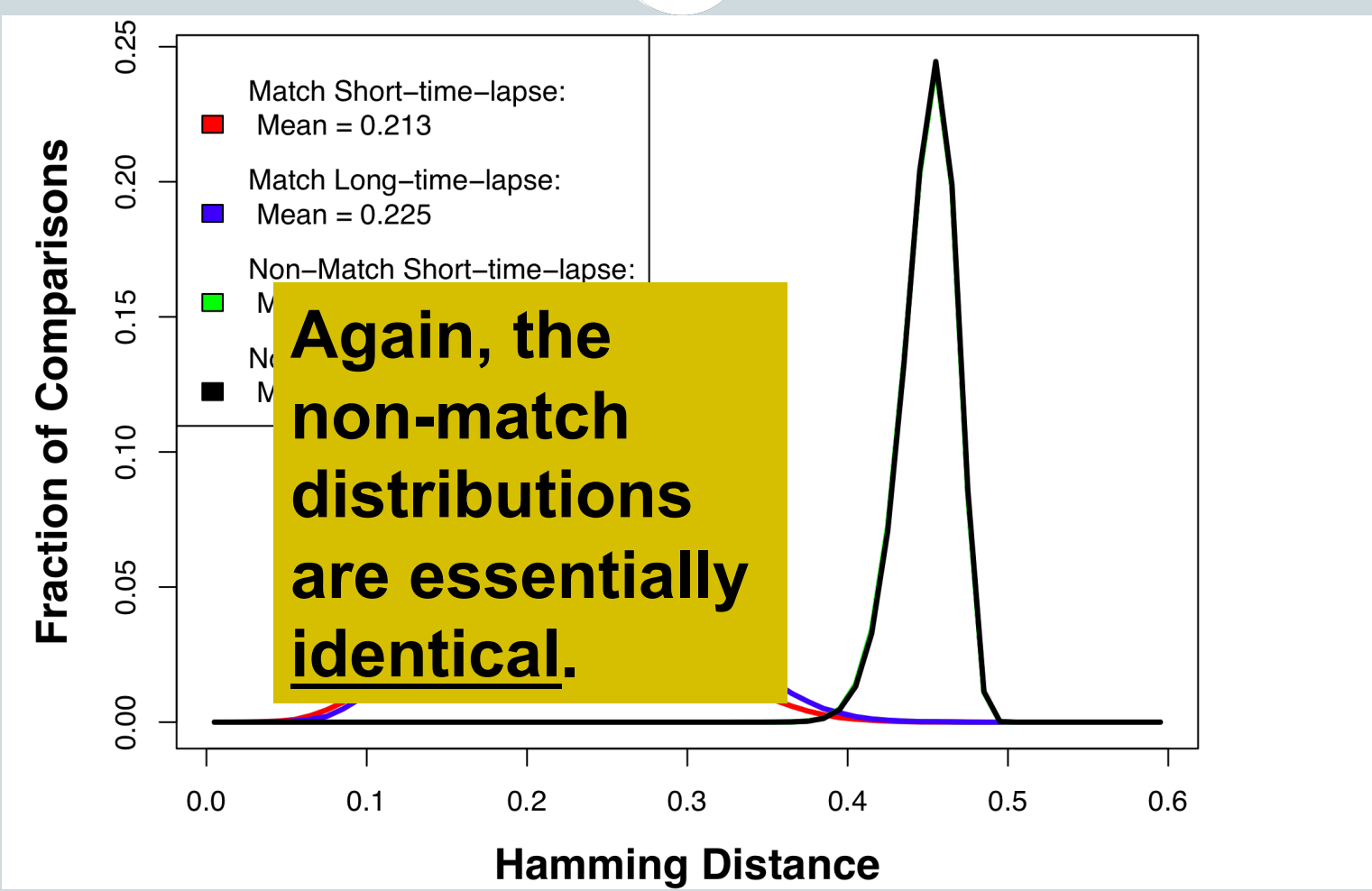
Template Aging

- 26 irises imaged with LG 2200 between 2004 and 2008
- Compare <= 120 days time lapse with >= 1200 days
- Manual review for image quality
- No change in contact lens wearing
- Modified ICE software, plus other

Template Aging

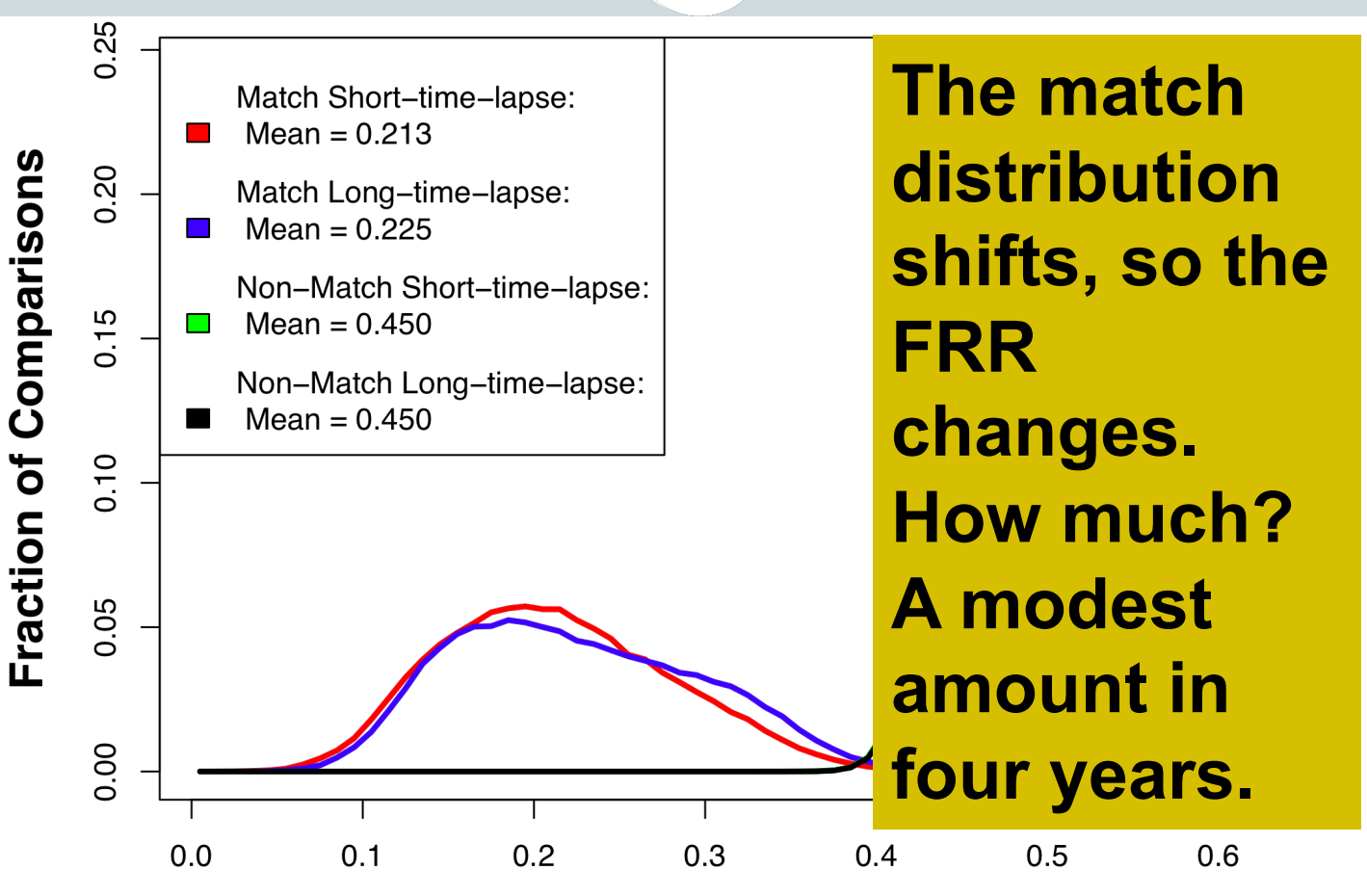


Template Aging



Again, the non-match distributions are essentially identical.

Template Aging



The match distribution shifts, so the FRR changes. How much? A modest amount in four years.

Sensor Inter-Operability

LG 2200

LG 4000

Various good reasons to upgrade.

Sensor Inter-Operability

- 465 persons, 930 irises
- 10,730 LG 2200 images
- 9,784 LG 4000 images
- Modified ICE software
- LG 2200 – LG 4000 versus LG 2200 – LG 2200 matching

Sensor Inter-Operability

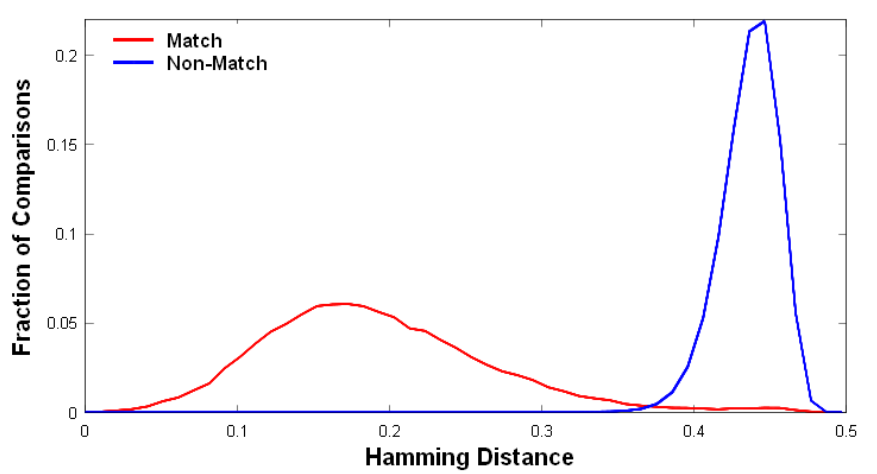
LG 2200 LR Non-Match

- **Mean = 0.43, SD = 0.027**

LG 2200 LR Match

- **Mean = 0.18, SD = 0.079**

d-prime = 4.27



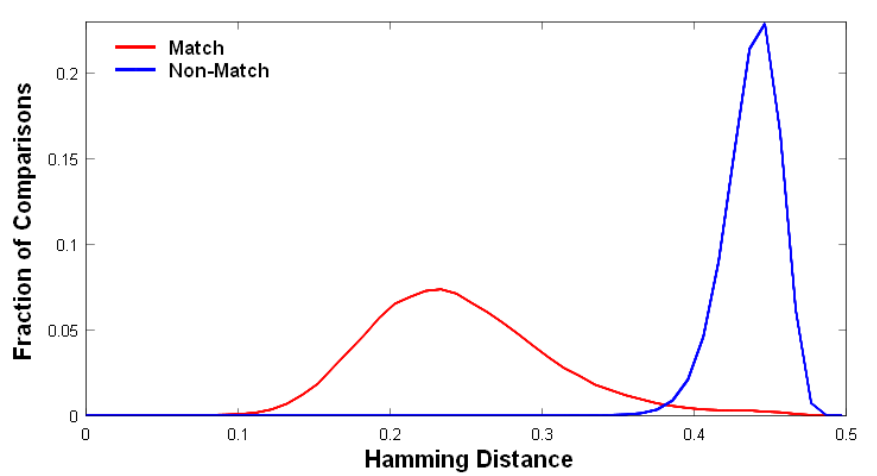
2200-4000 Non-Match:

- **Mean = 0.44, SD = 0.026**

2200-4000 Match:

- **Mean = 0.24, SD = 0.068**

d-prime = 3.92



Sensor Inter-Operability

LG 2200 LR Non-Match

- Mean = 0.43, SD = 0.027

LG 2200 LR Match

- Mean

d-prime

2200-40

- Mean

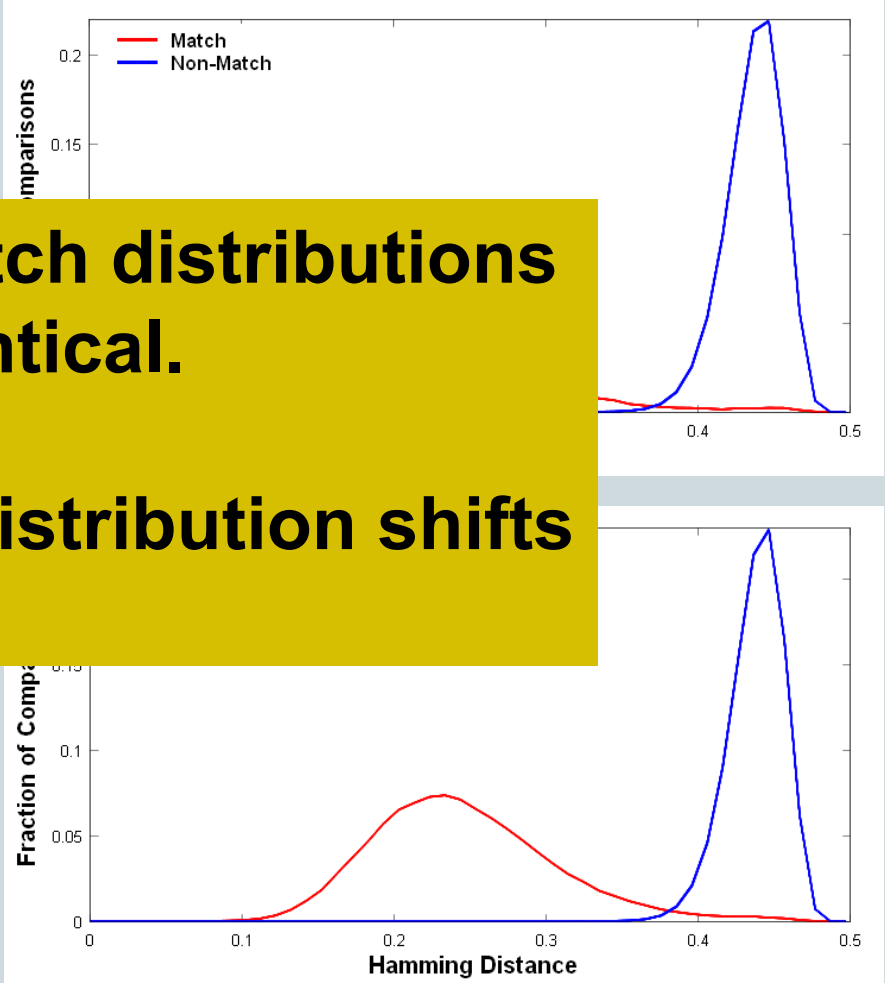
2200-4000 Match:

- Mean = 0.24, SD = 0.068

d-prime = 3.92

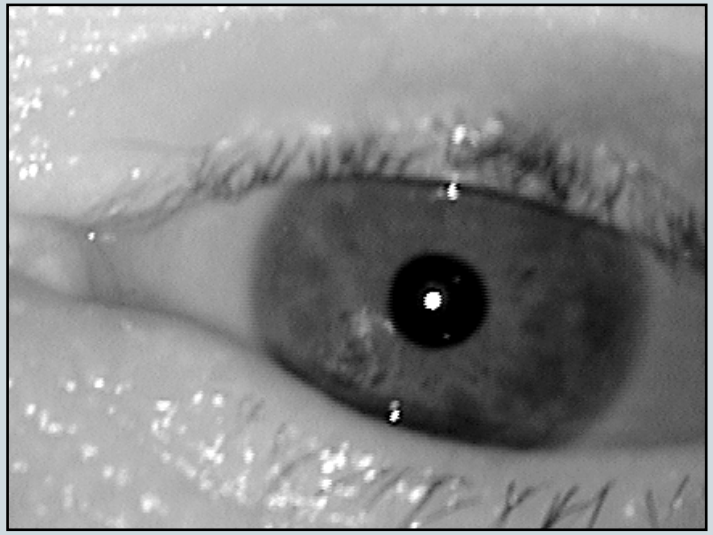
Again, the non-match distributions are essentially identical.

Again, the match distribution shifts by some amount.

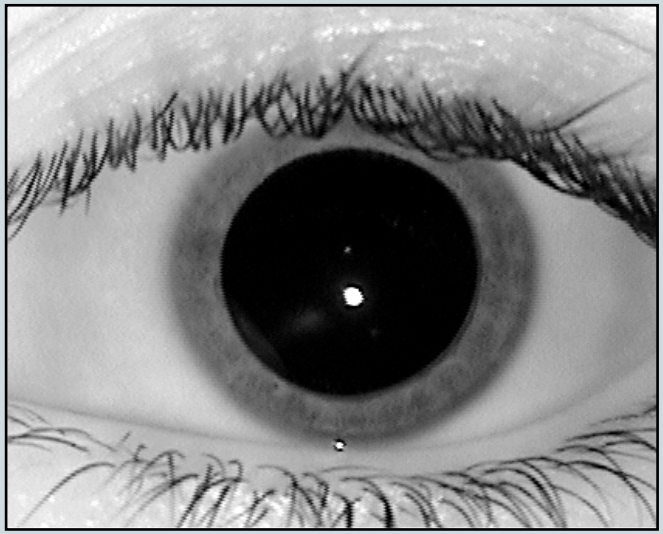


Pupil Dilation

$$\text{Pupil dilation ratio} = \frac{\text{pupil radius}}{\text{iris radius}}$$



Min dilation ratio in this dataset = 0.25



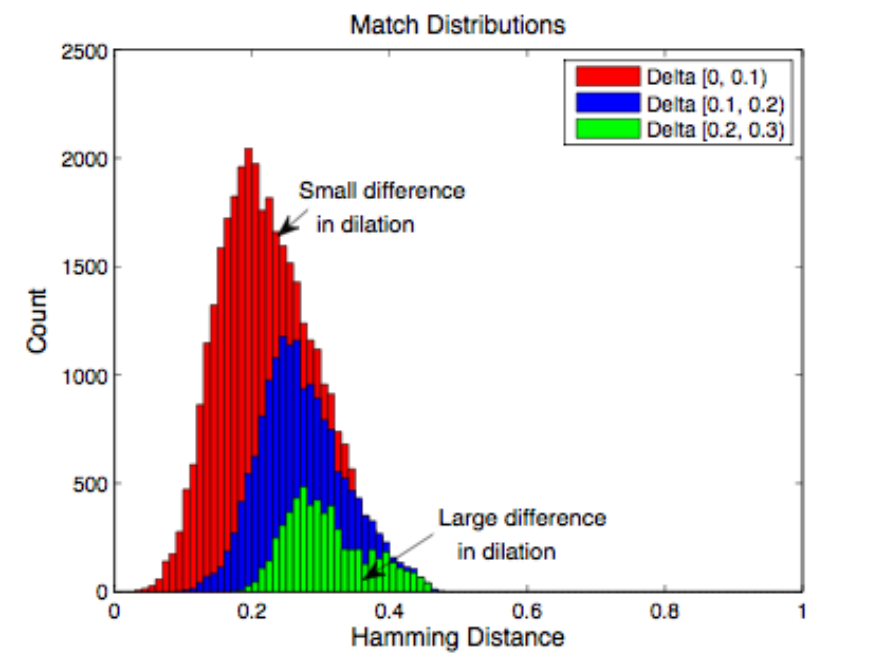
Max dilation ratio in this dataset = 0.70

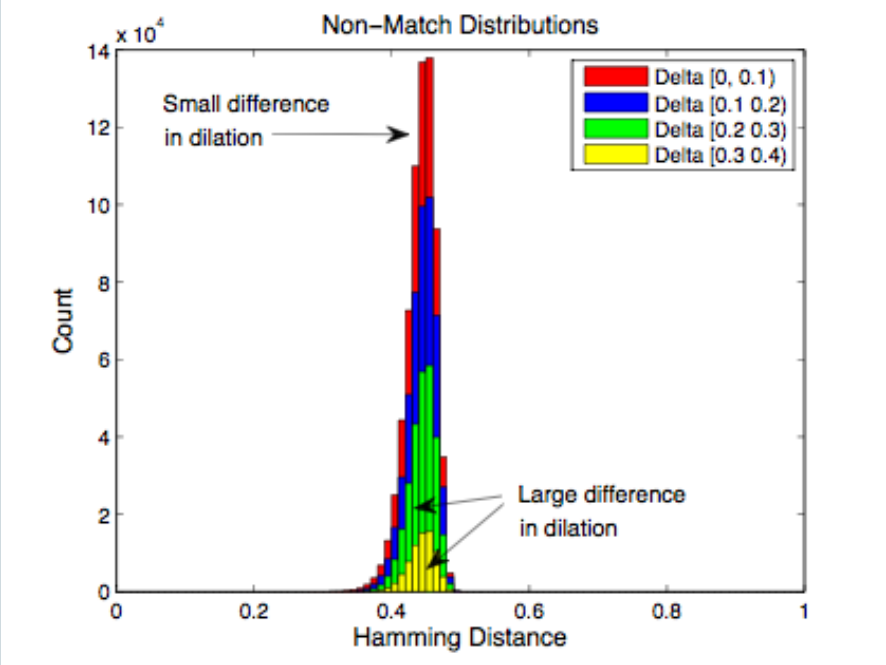
Pupil Dilation

- 18 persons imaged using LG 2200
- Total of 632 iris images
- 28% of images taken with lights off, to induce normal dilation
- Modified ICE software
- How does different dilation ratio in images affect distributions?

Pupil Dilation

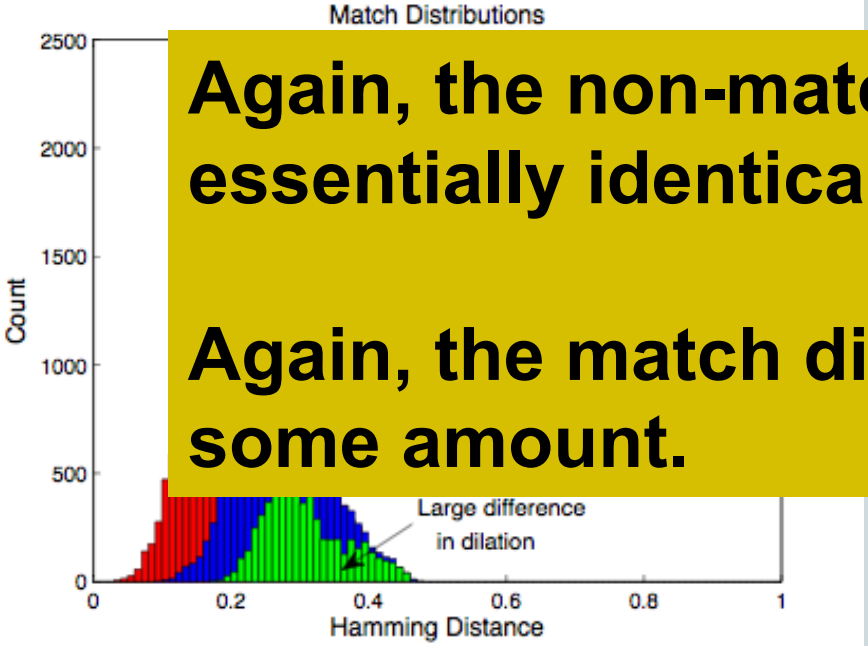
Effects of increasing difference in dilation:

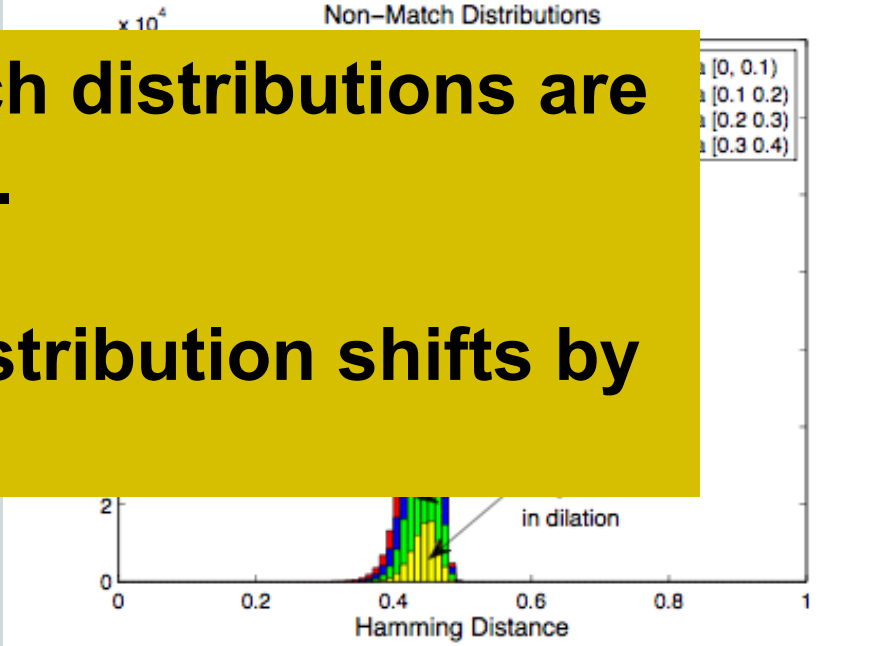




Pupil Dilation

Effects of increasing difference in dilation:





Again, the non-match distributions are essentially identical.

Again, the match distribution shifts by some amount.

Conclusions

The non-match distribution is highly stable with respect to all conditions that we have examined.

The match distribution shifts due to various conditions; more research is needed to understand the details.

Questions ?

Copies of supporting papers available at:

http://www.cse.nd.edu/~kwb/iris_biometrics.htm