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# Iris IQ of a Sample Population

**Valorie S. Valencia, PhD**

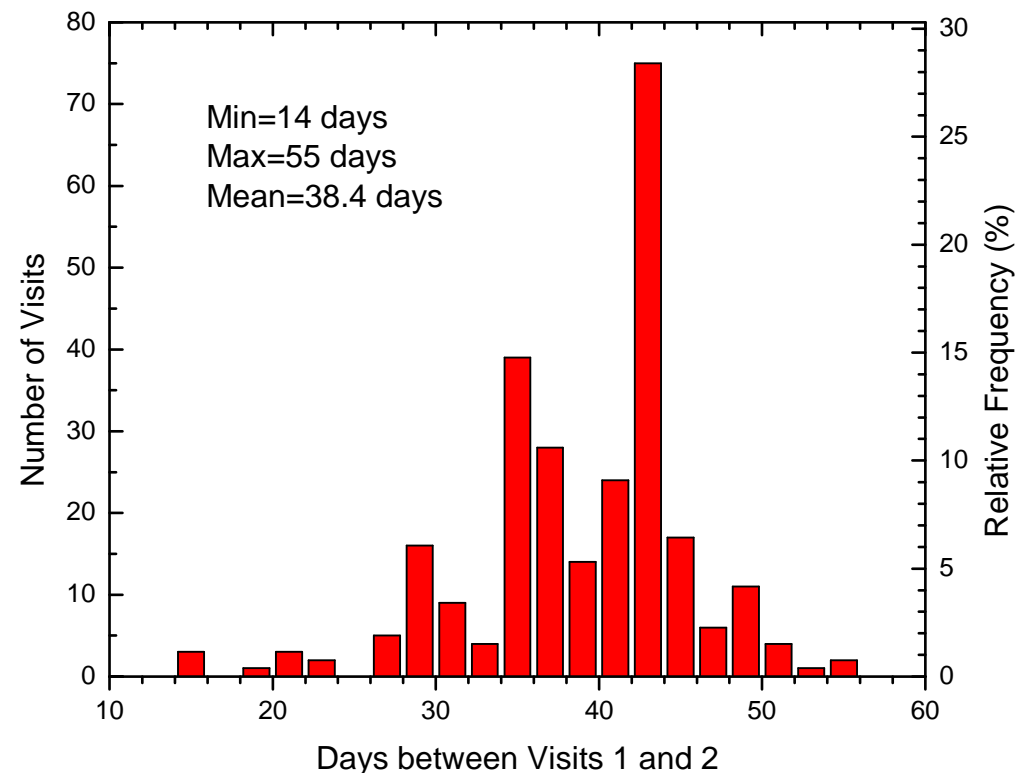
Biometric Quality Workshop II

November 7-8, 2007

National Institute of Standards and Technology

# Iris IQ Data Analysis

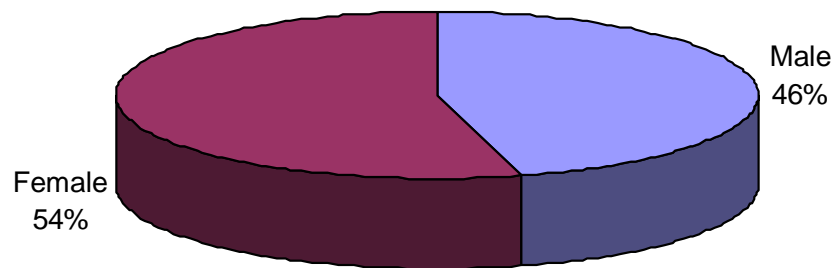
- Performed with iris images collected using three commercial iris recognition cameras
  - From NIJ/DHS Iris Recognition Study 2006 (IRIS06)
    - Award No. 2005-IJ-CX-K066
  - Product A, Product B, Product C (names not identified)
- Data collected in standard indoor office environment using BioAPI 1.1 test harness interface
- About 29,000 ISO/IEC 19794-6 compliant iris images collected from ~300 live test subjects
- Two visits separated by ~6 weeks
  - Visit 1
    - 297 live human test subjects
    - Enrollment and 6 recognition attempts
  - Visit 2
    - 264 repeat test subjects
    - 6 recognition attempts



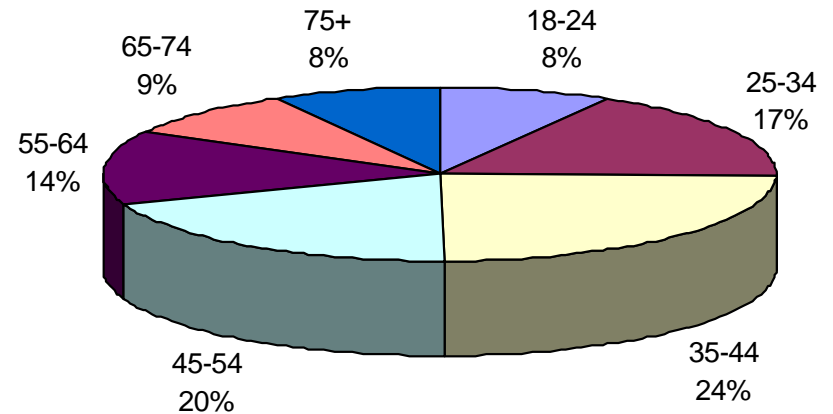
# Visit 2 Demographics Pie Charts

(264 test subjects completed both Visits 1 and 2)

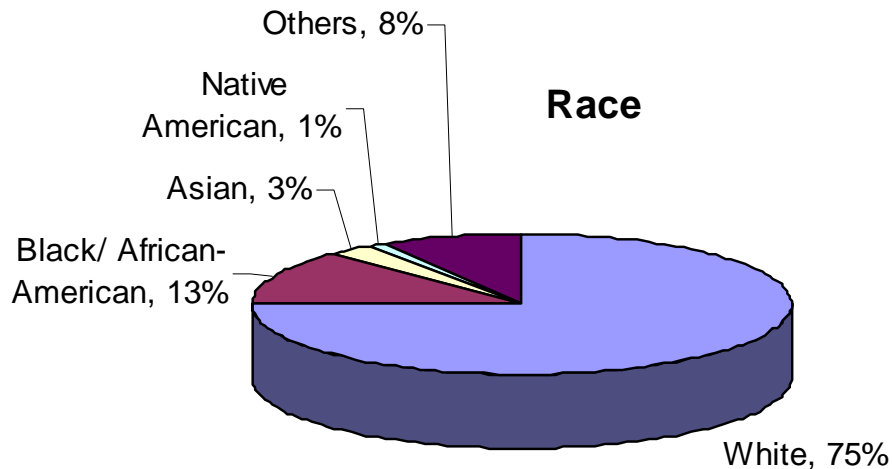
### Gender



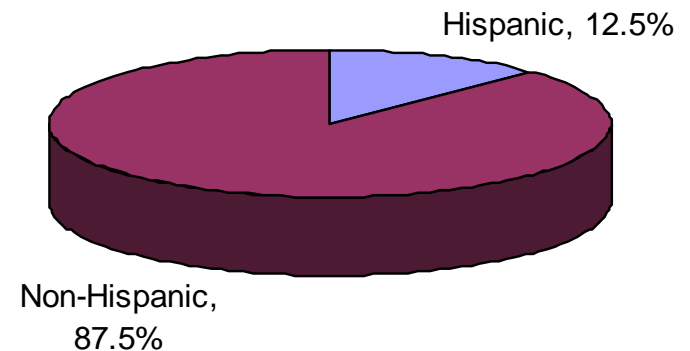
### Age



### Race



### Heritage



**Target demographic profile based on 2000 US Census**

# Iris IQ Evaluation

- Analysis performed with Daugman 2007 template generation, matching, and quality algorithms
- Special thanks to:
  - Professor John Daugman



[www.cl.cam.ac.uk/~jgd1000/](http://www.cl.cam.ac.uk/~jgd1000/)

- The iris recognition vendors that kindly supplied the products that were evaluated

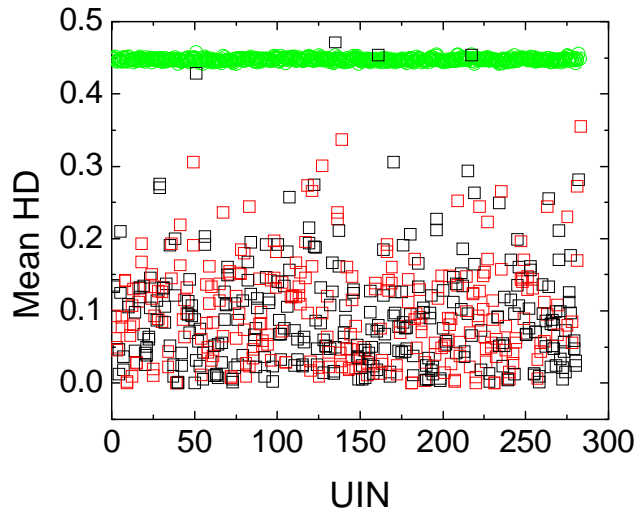
# Image IQ Analysis Details

- “Bad” images removed for this analysis
- Genuine scores from all recognition attempts included in analysis
  - Represents average **single-attempt** performance over Visits 1 and 2
- Left and right eyes treated as separate individuals
  - Represents average performance of left and right eyes

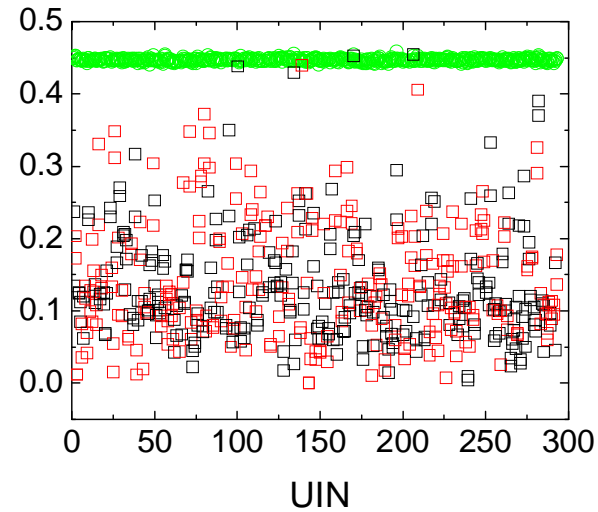
|  | Self Reported | Confirmed during review | Assigned during review | Measured during data collection | Filterable |
|--|---------------|-------------------------|------------------------|---------------------------------|------------|
| <b>Demographics</b>  |               |                         |                        |                                 |            |
| Gender   | ✓             |                         |                        |                                 | ✓          |
| Race   | ✓             |                         |                        |                                 | ✓          |
| Ethnicity (Hispanic/Latino)  | ✓             |                         |                        |                                 | ✓          |
| Age  | ✓             |                         |                        |                                 | ✓          |
| Eye color  | ✓             |                         | ✓                      |                                 | ✓          |
| Height   | ✓             |                         |                        |                                 |            |
| Standing eye height  |               |                         |                        | ✓                               |            |
| Occupation   | ✓             |                         |                        |                                 |            |
| <b>Image Parameters (Hints)</b>  |               |                         |                        |                                 |            |
| Bad picture  |               |                         | ✓                      |                                 | ✓          |
| Bad features   |               |                         | ✓                      |                                 | ✓          |
| Obstruction  |               |                         | ✓                      |                                 | ✓          |
| Bad placement  |               |                         | ✓                      |                                 | ✓          |
| Bad environment  |               |                         | ✓                      |                                 | ✓          |
| <b>Features / Conditions</b>   |               |                         |                        |                                 |            |
| Left eye / Right eye   |               | ✓                       |                        |                                 | ✓          |
| Glasses  | ✓             | ✓                       |                        |                                 | ✓          |
| Contacts   | ✓             |                         |                        |                                 | ✓          |
| Hard Contacts  |               | ✓                       |                        |                                 | ✓          |
| Eye conditions:<br>amblyopia (lazy eye), acrus senilis, blepharoptosis (droopy eyelid), blindness, cataracts, detached retina, glass eye, glaucoma, macular degeneration, pink eye, recent trauma, strabismus, surgery (radial keratotomy, cataract, lasix, corneal replacement, other), unreactive pupil, other | ✓             |                         |                        |                                 |            |

# Gender vs Hamming Distance (HD)

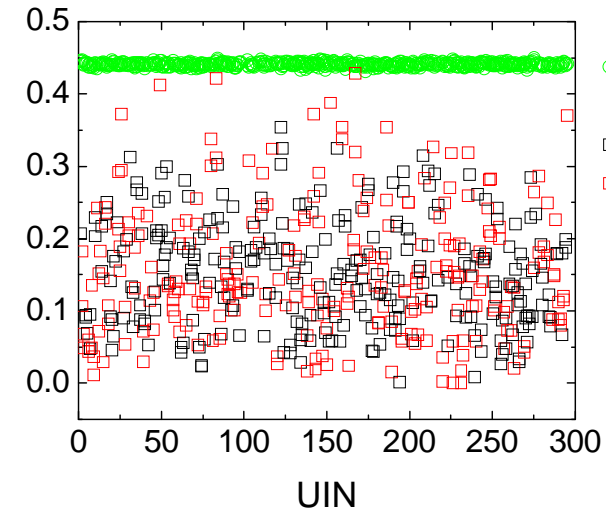
Product A



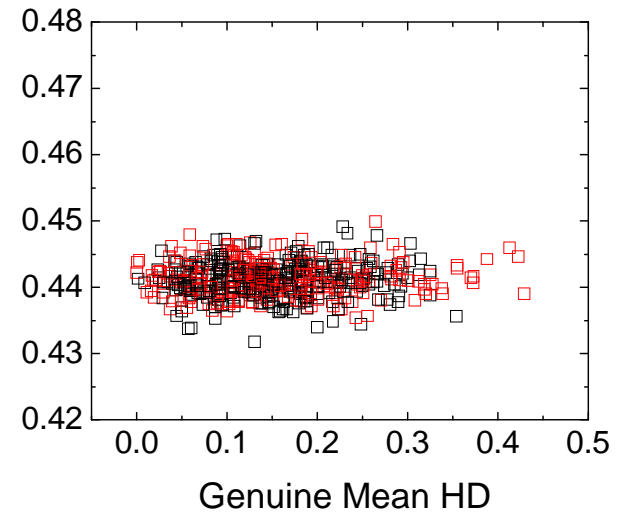
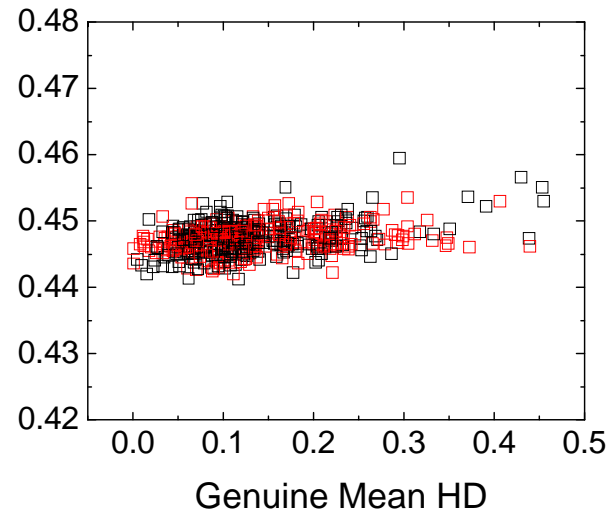
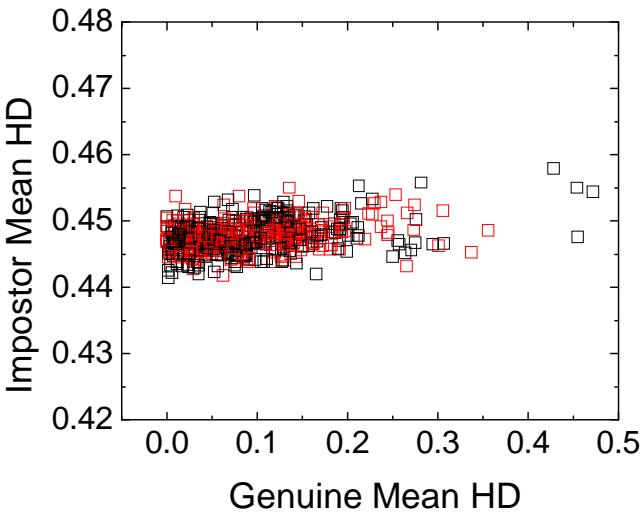
Product B



Product C

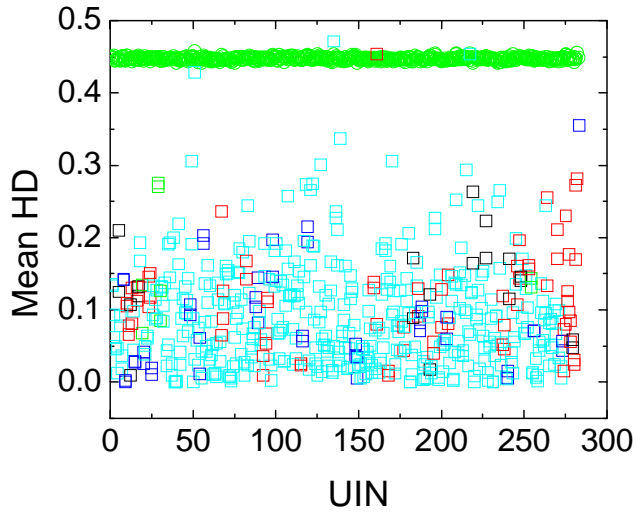


○ Impostor  
■ Genuine  
□ Female  
□ Male

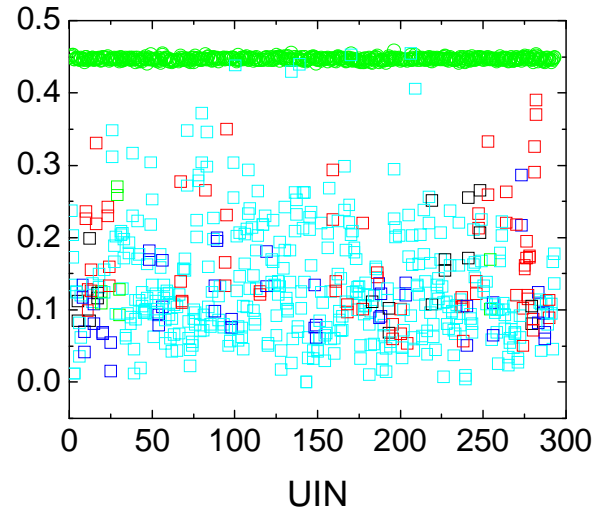


# Race vs HD

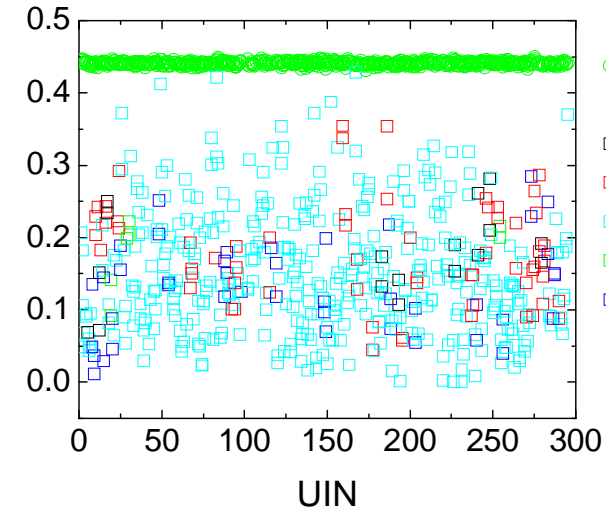
## Product A



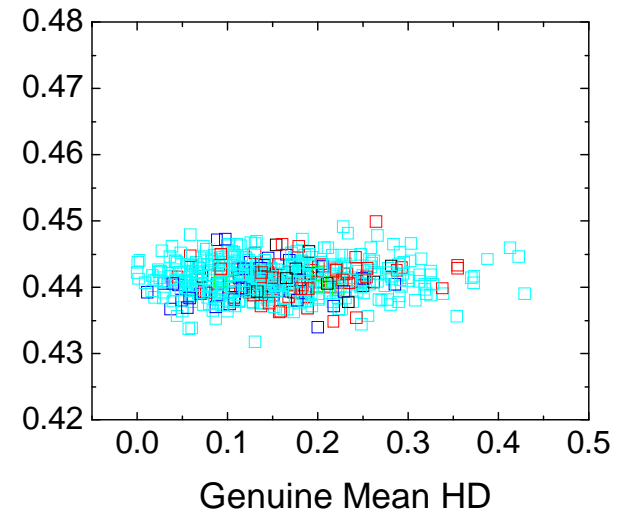
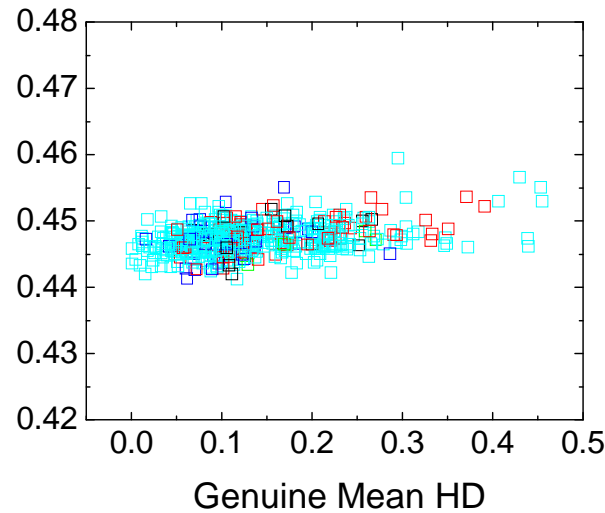
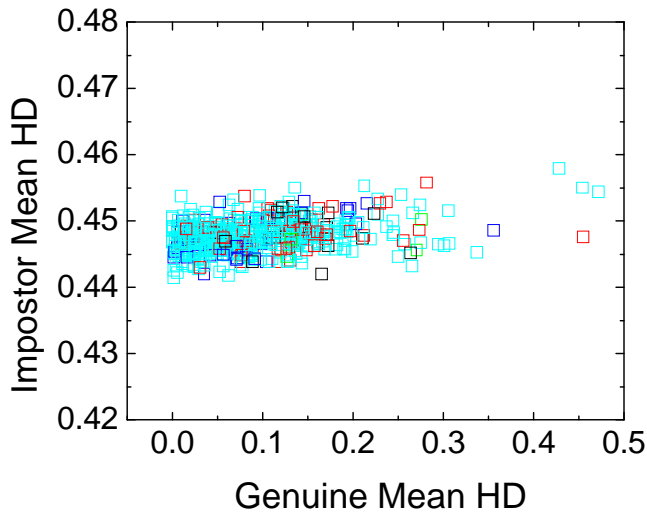
## Product B



## Product C

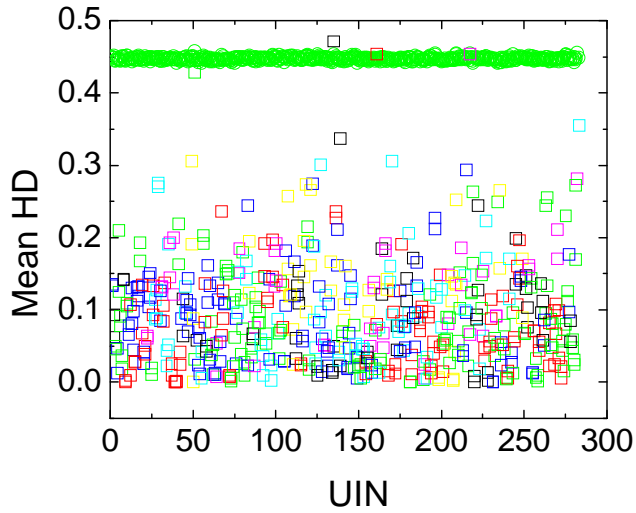


- Impostor
- Genuine
- Asian
- Black
- White
- Native Am
- Other

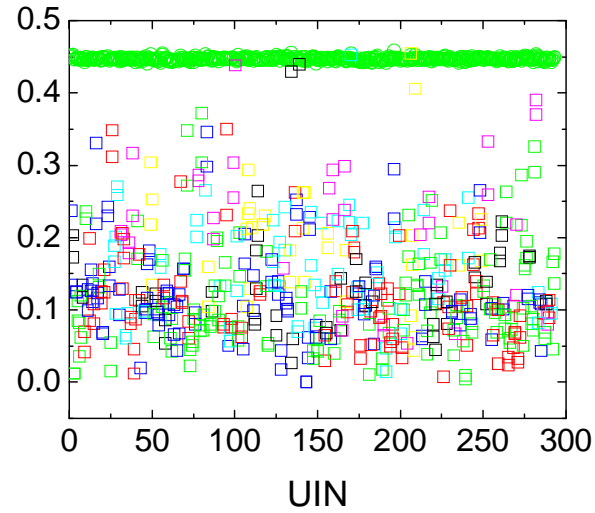


# Age vs HD

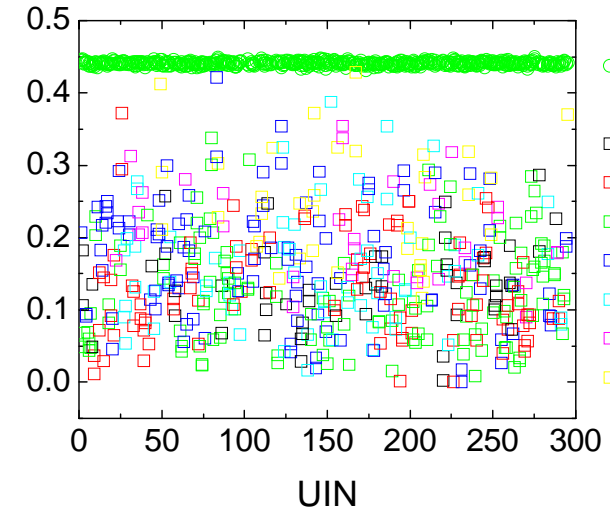
## Product A



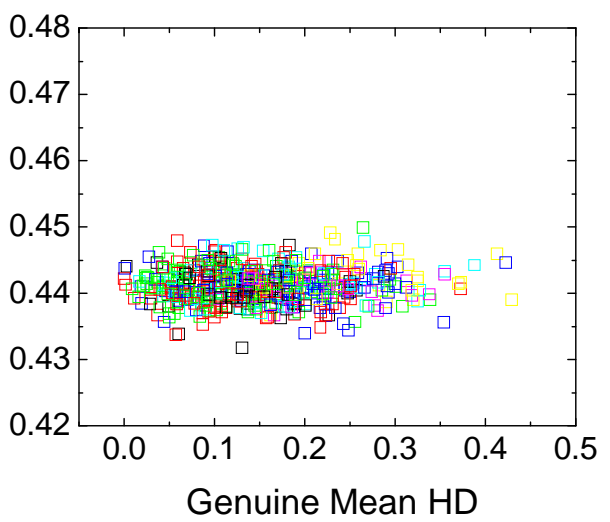
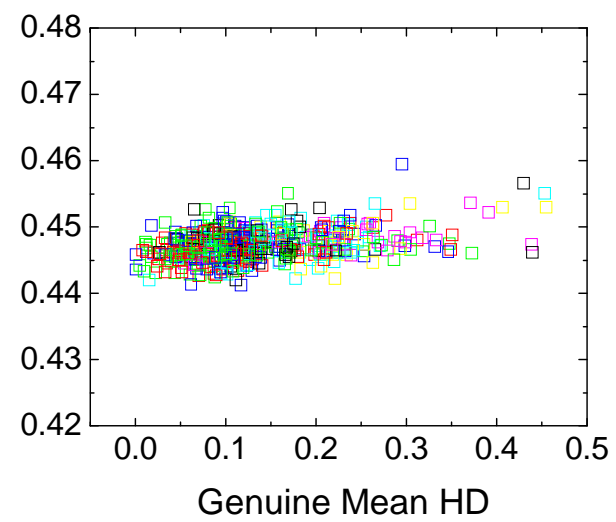
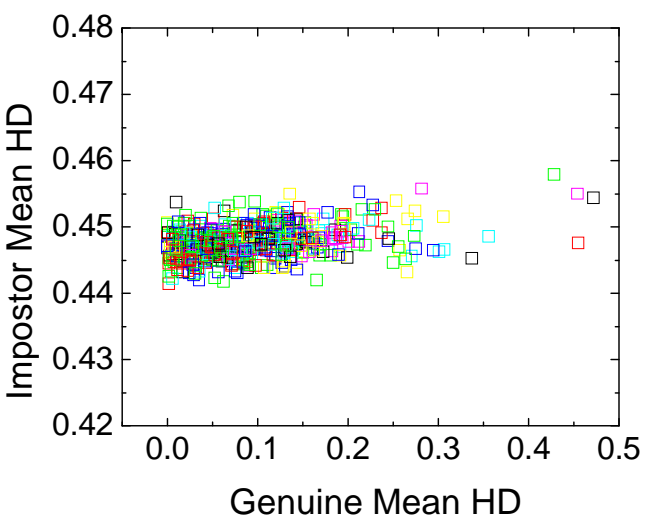
## Product B



## Product C



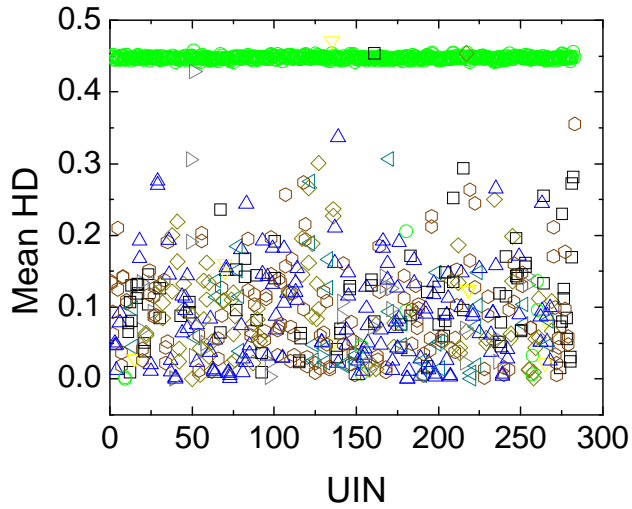
- Impostor
- Genuine
- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65-74
- 75+



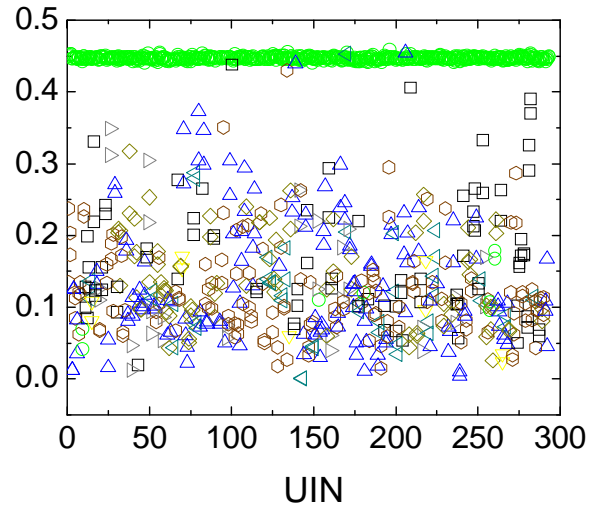


# Eye Color vs HD

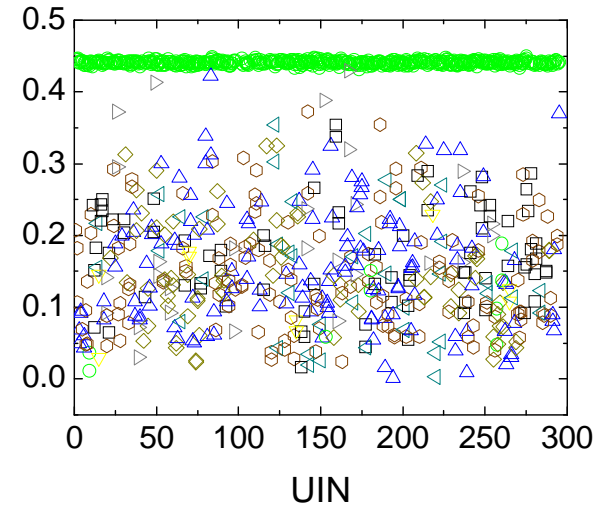
Product A



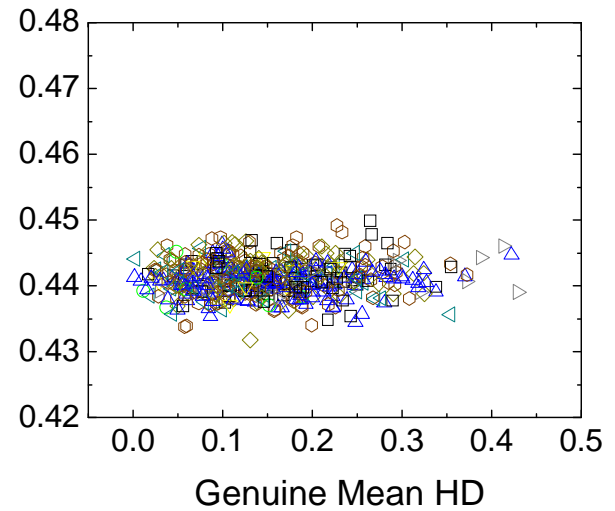
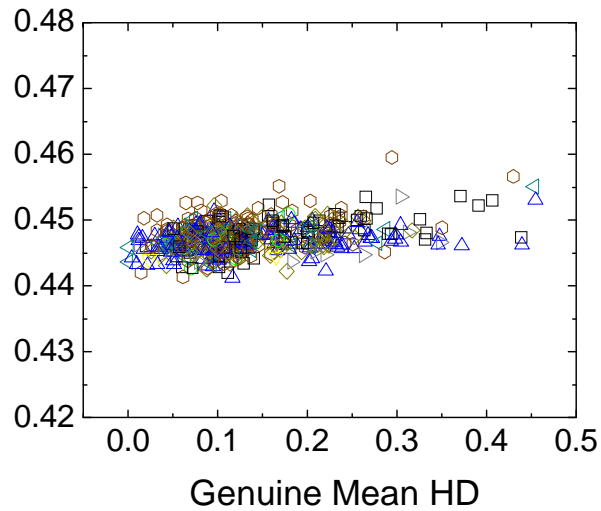
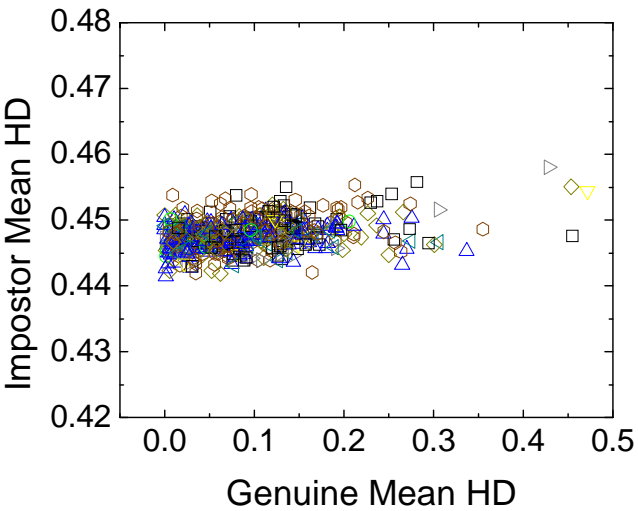
Product B



Product C

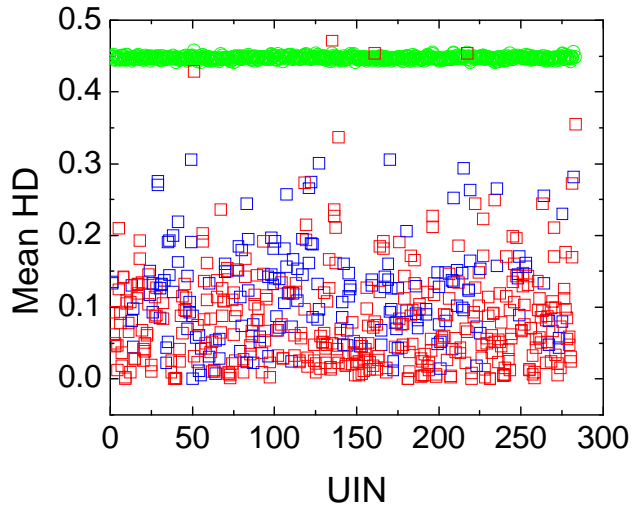


- Impostor
- Genuine
- ▲ Blue
- ▼ Amber
- Green
- ▲ Blue Gn
- ◆ Hazel
- ▲ Grey
- Brown
- Dark Bn

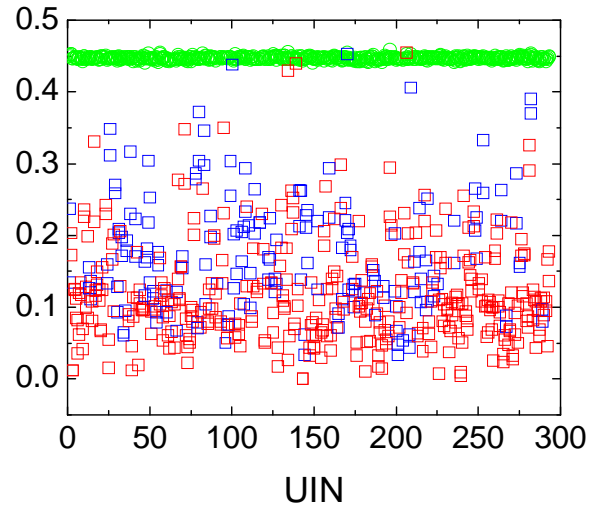


# Wear Glasses vs HD

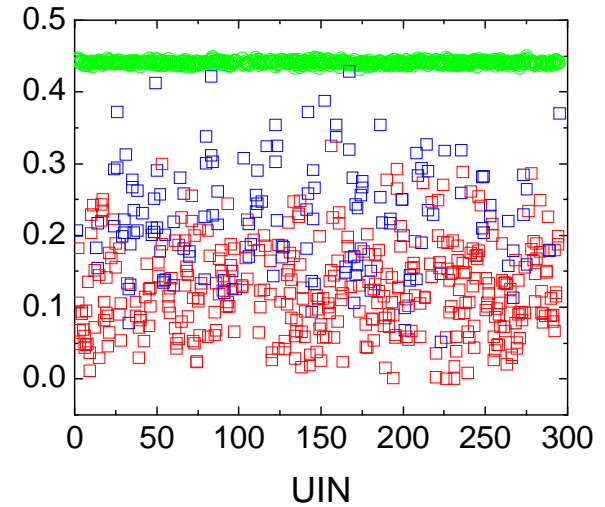
Product A



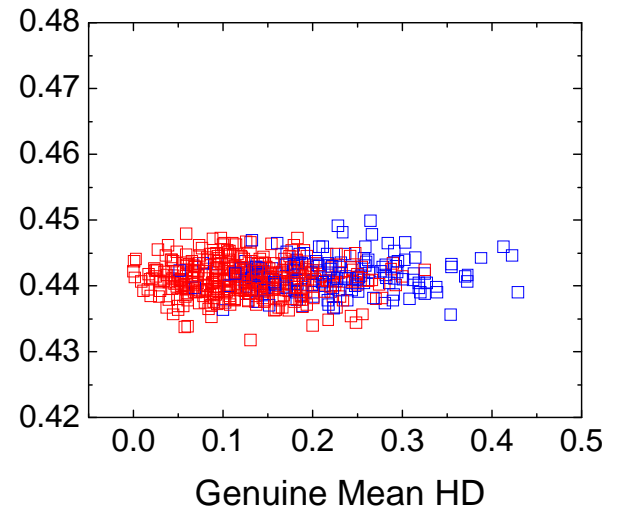
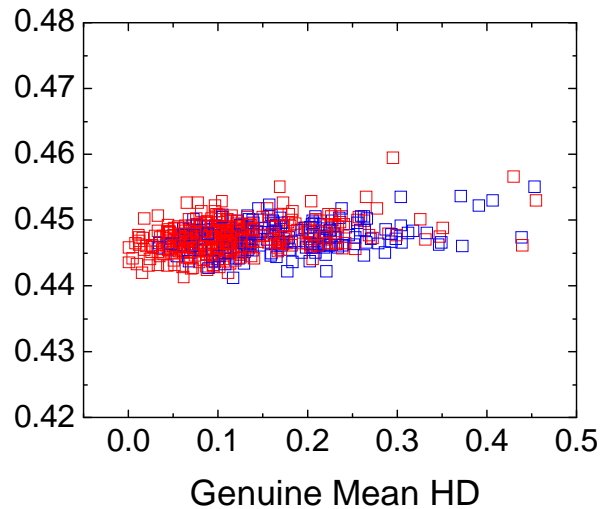
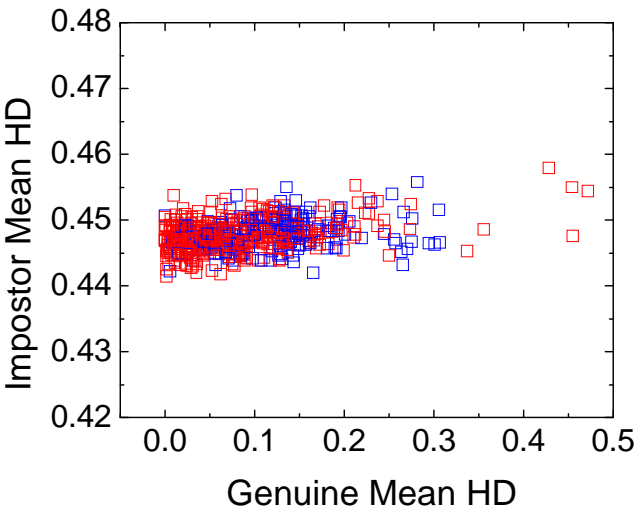
Product B



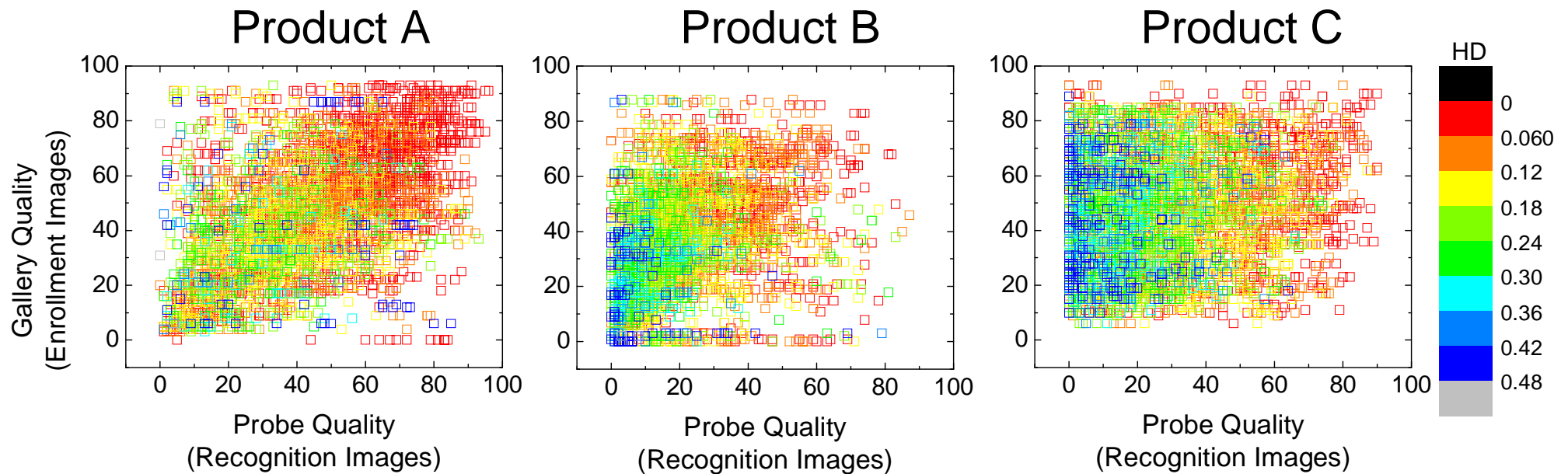
Product C



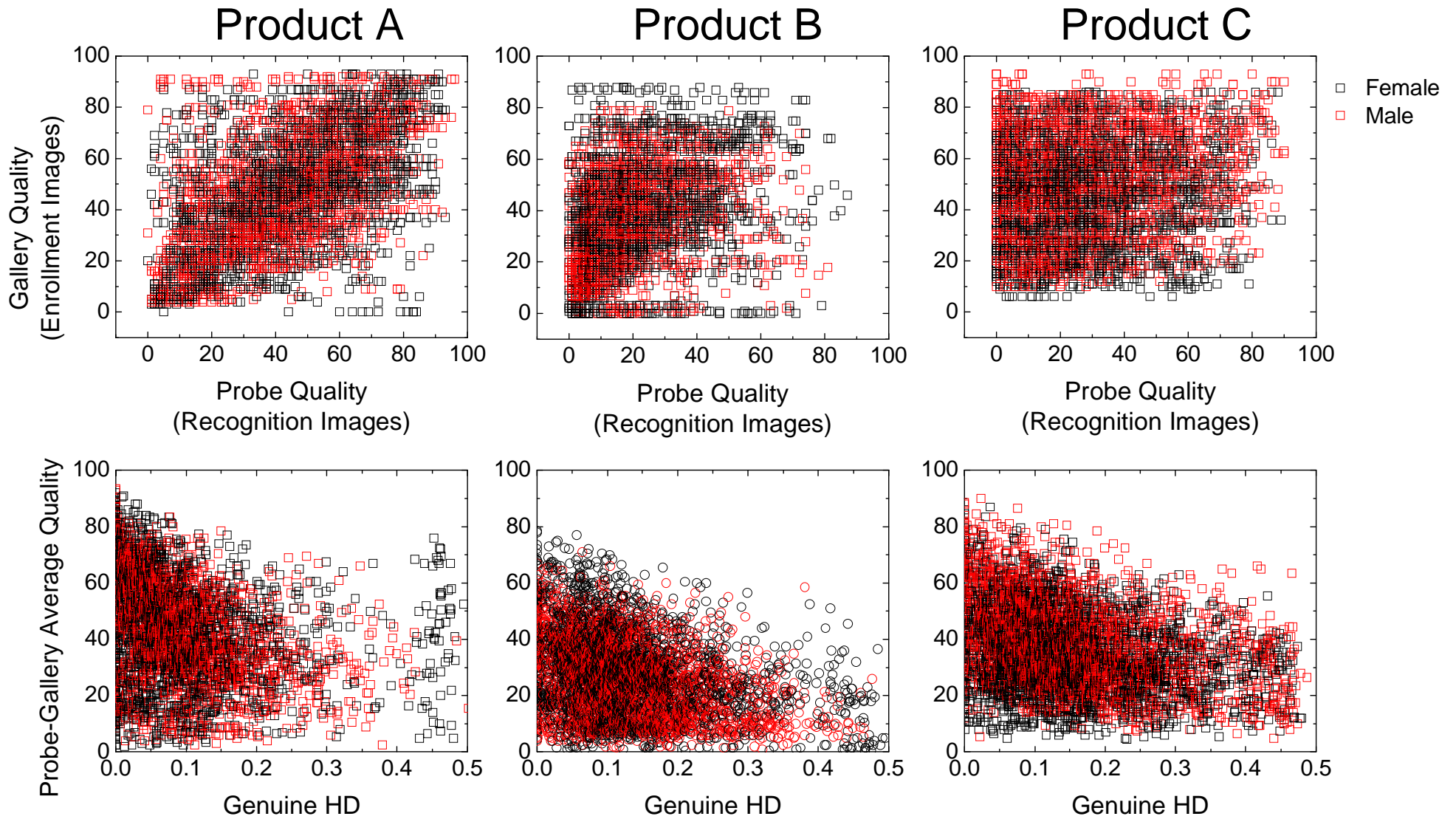
- Impostor
- Genuine
- Wear Glasses
- No Glasses



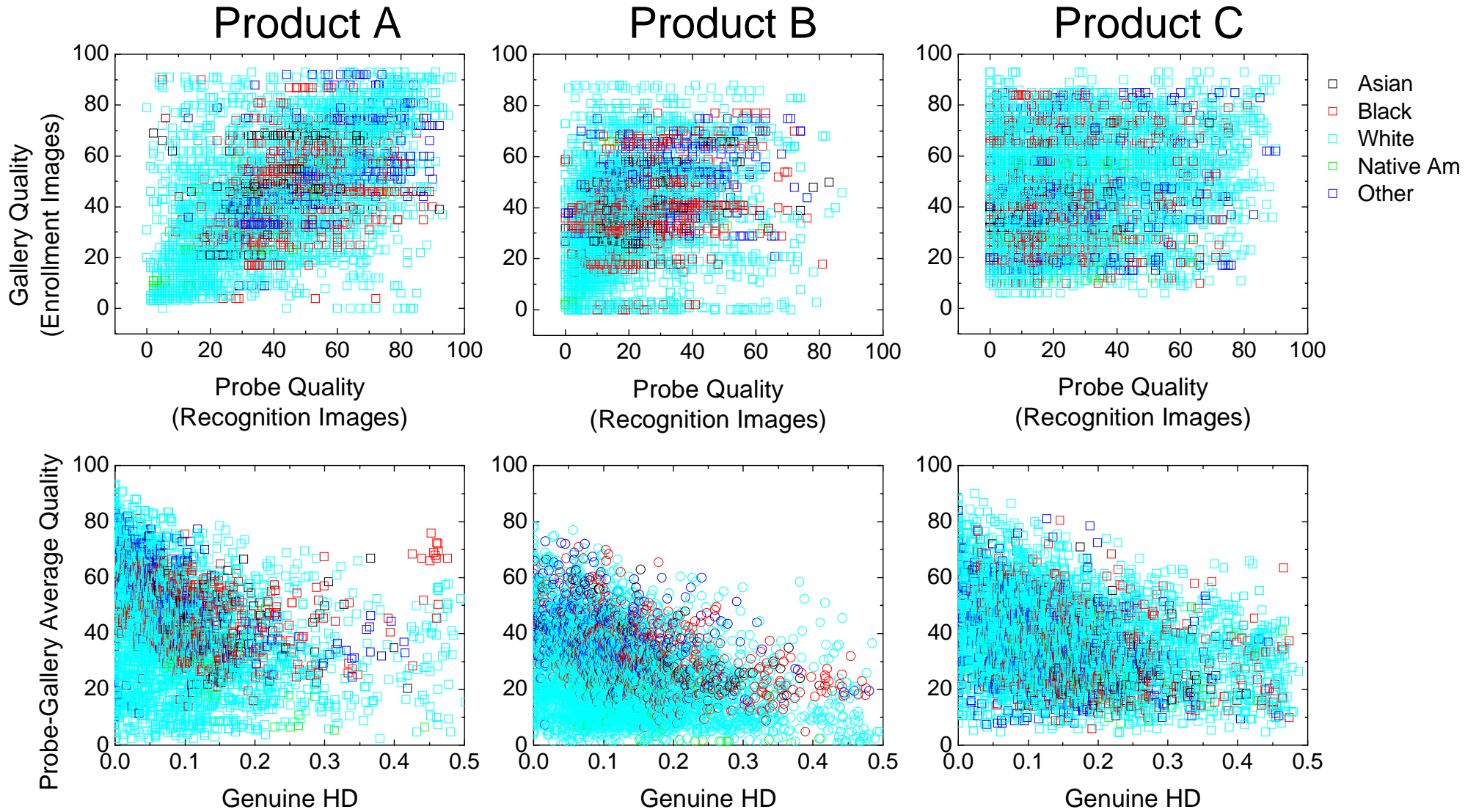
# Hamming Distance vs Quality



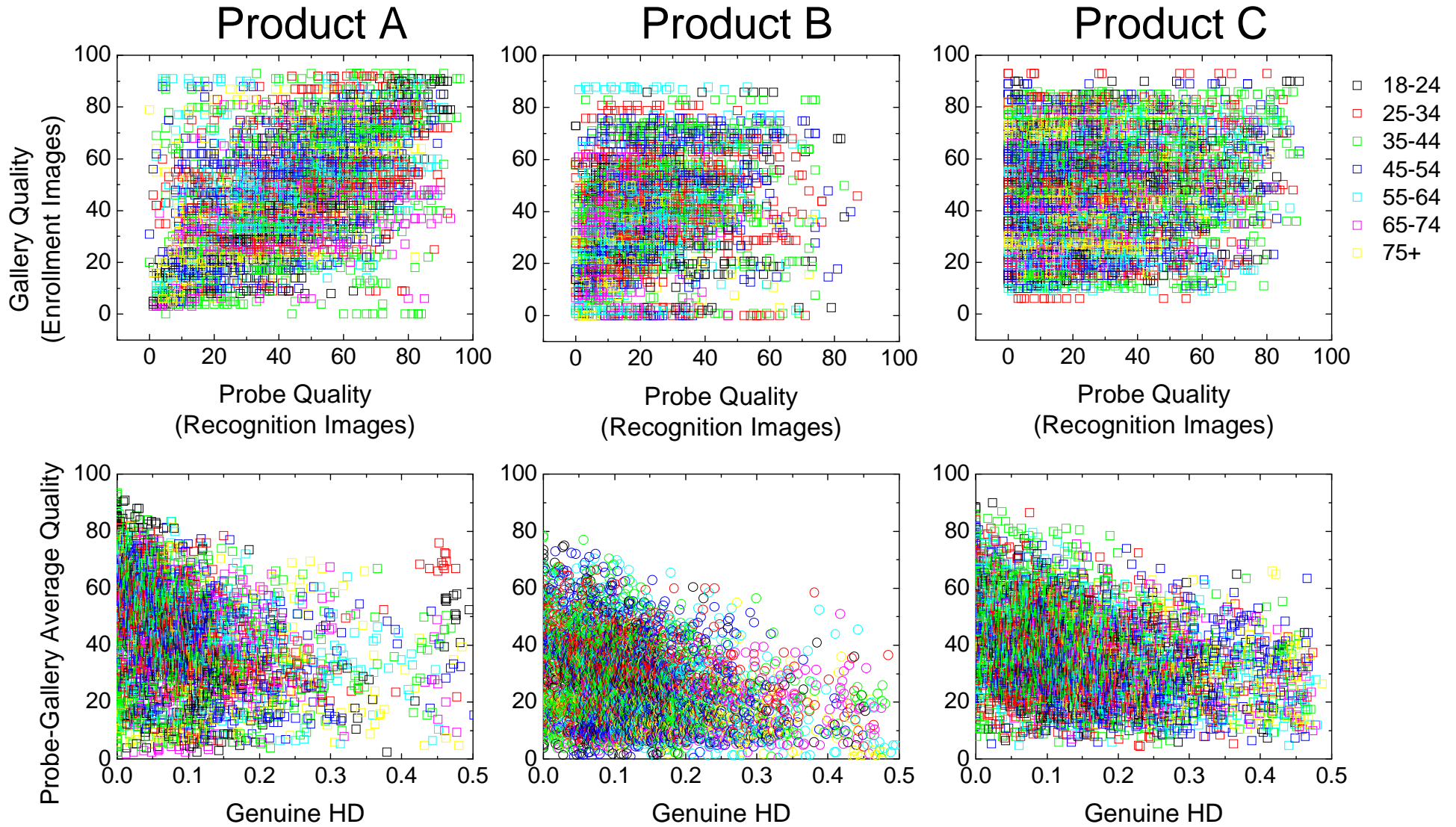
# Gender vs Quality



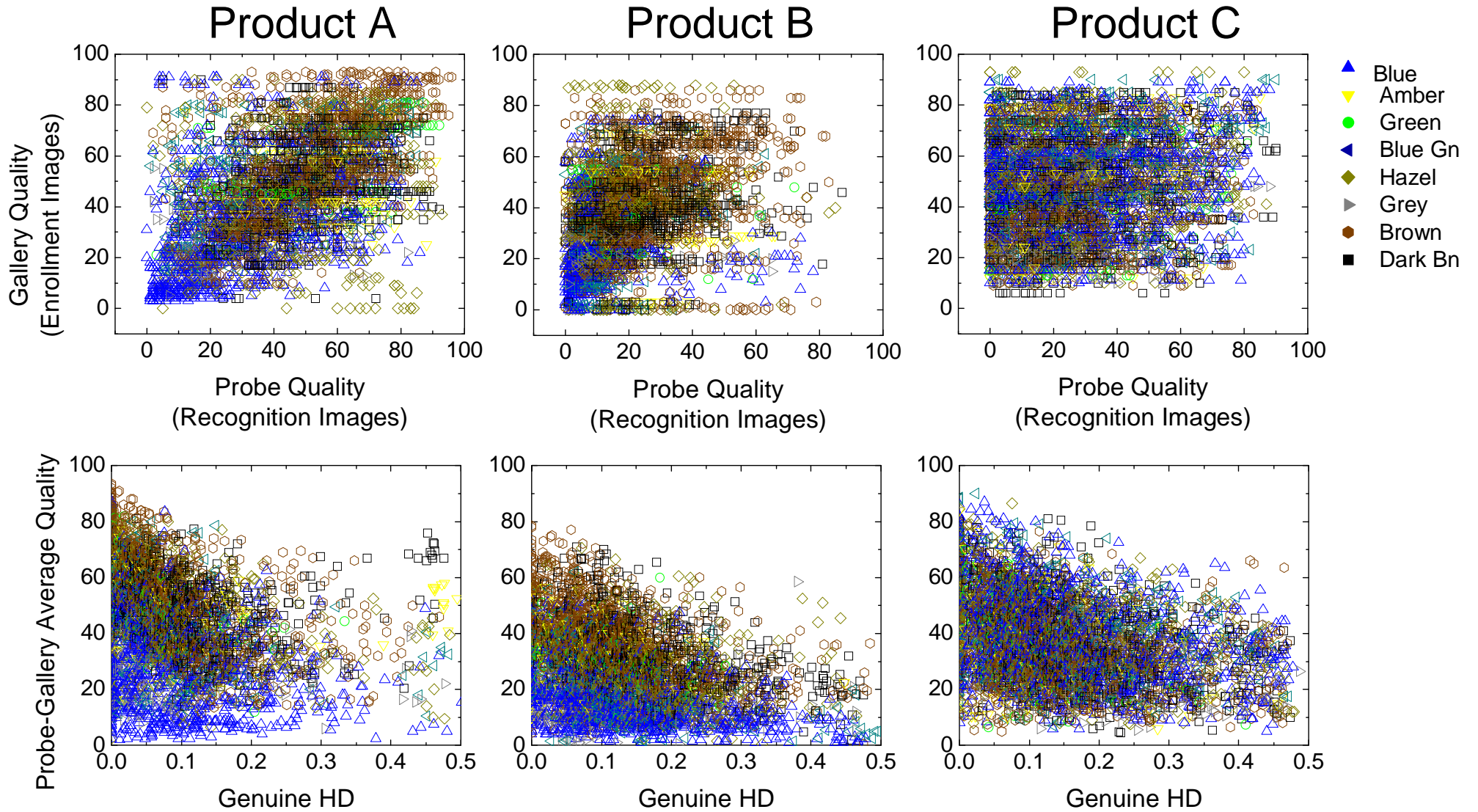
# Race vs Quality



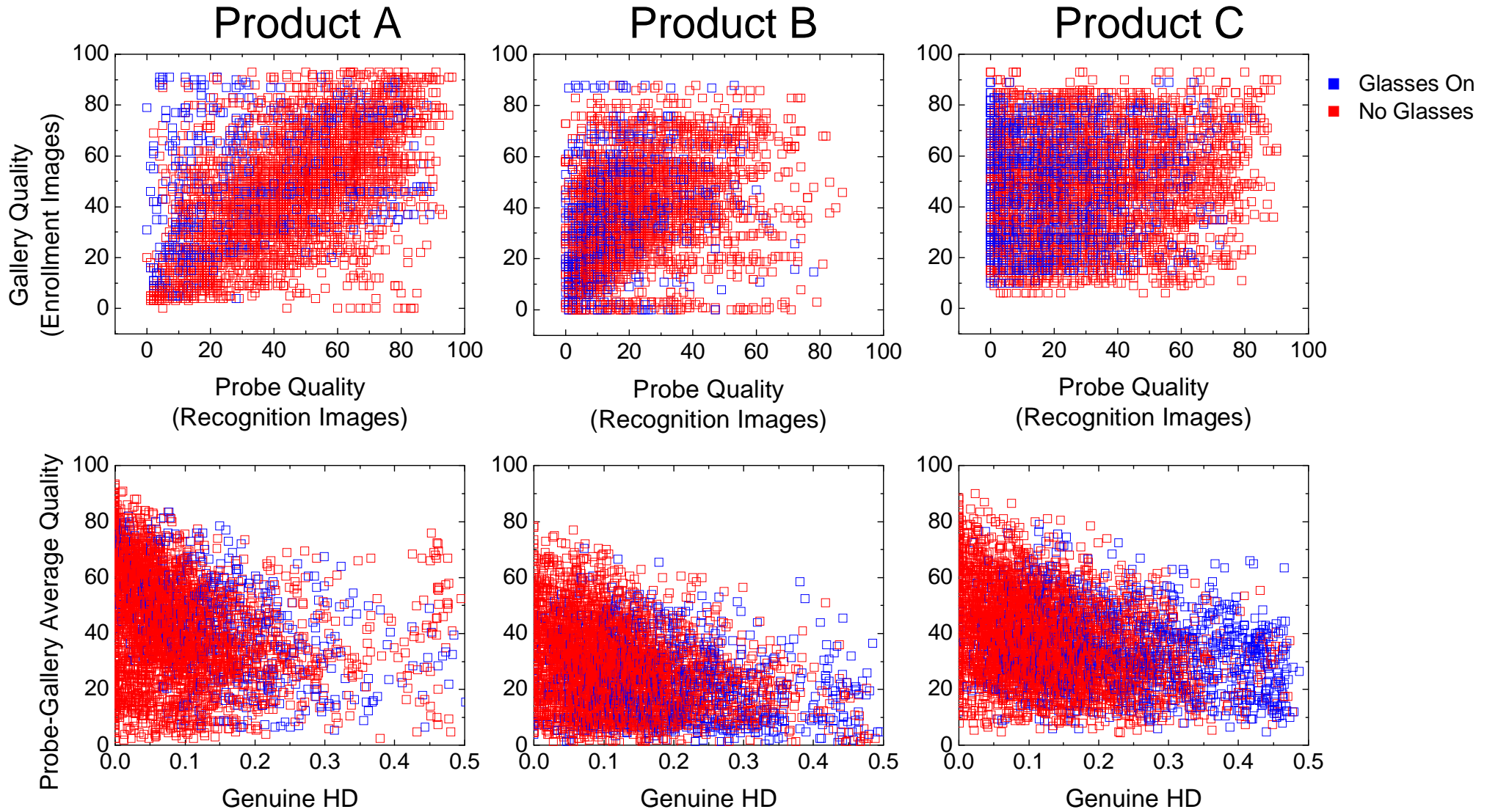
# Age vs Quality



# EyeColor vs Quality



# Glasses On vs Quality







# Conclusions



- No clear conclusions, only more questions
  - Race and age do not appear to influence iris recognition matching performance
  - Poor eyesight and wearing glasses appear to degrade matching performance
- Work in progress, stay tuned . . .





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# Thank You!!

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