A: Datasheet

Algorithm: vts_000

Developer: Viettel Group

Submission Date: 2021_03_12

Template size: 2048 bytes

Template time (2.5 percentile): 492 msec

Template time (median): 492 msec

Template time (97.5 percentile): 497 msec

Investigation:

Frontal mugshot ranking 272 (out of 279) −− FNIR(1600000, 0, 1) = 0.5937 vs. lowest 0.0009 from sensetime_005

Mugshot webcam ranking 232 (out of 241) −− FNIR(1600000, 0, 1) = 0.6075 vs. lowest 0.0062 from sensetime_005

Mugshot profile ranking 126 (out of 210) −− FNIR(1600000, 0, 1) = 0.9086 vs. lowest 0.0587 from xforwardai_002

Immigration visa−border ranking 151 (out of 168) −− FNIR(1600000, 0, 1) = 0.6066 vs. lowest 0.0013 from visionlabs_010

Immigration visa−kiosk ranking 150 (out of 165) −− FNIR(1600000, 0, 1) = 0.7394 vs. lowest 0.0568 from cloudwalk_hr_000

Identification:

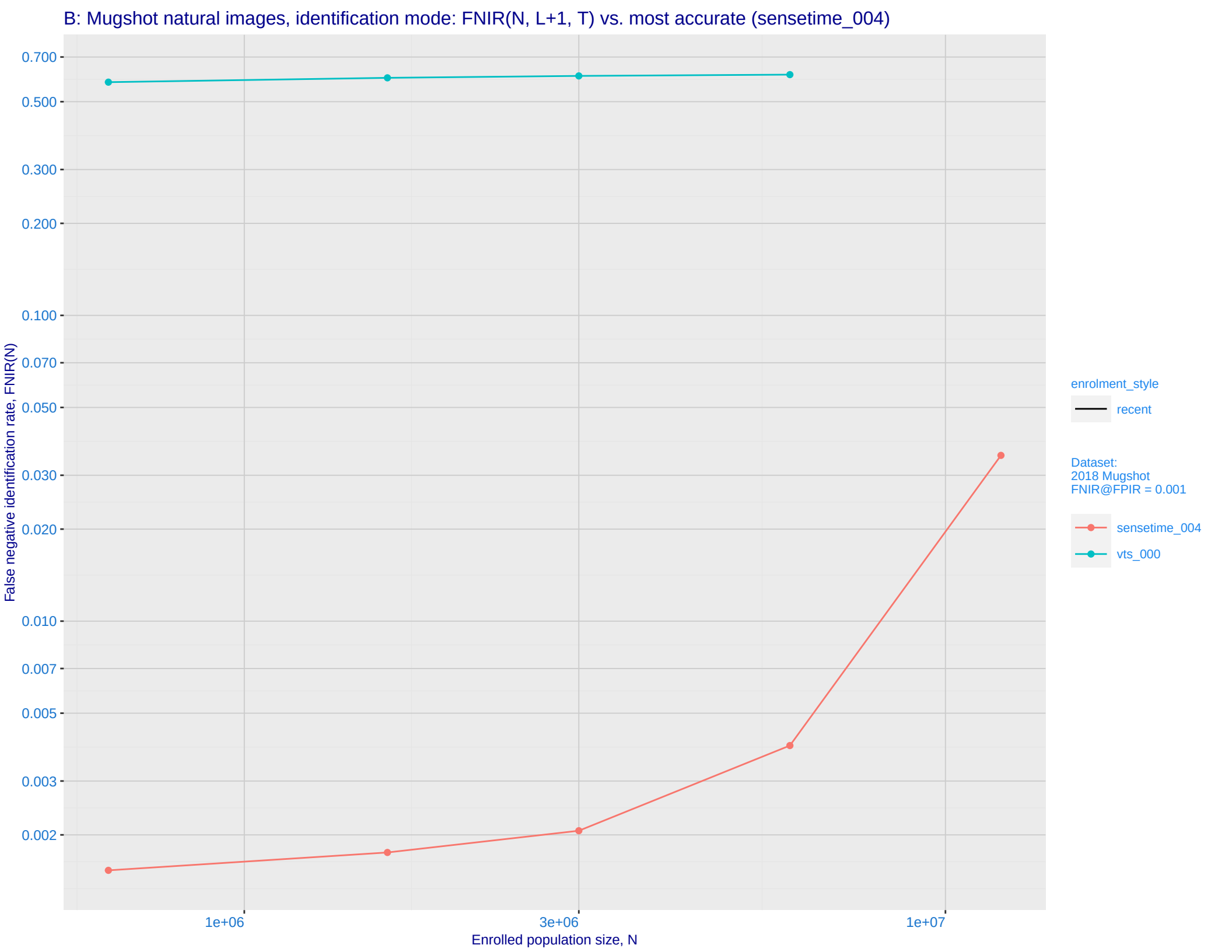
Frontal mugshot ranking 240 (out of 279) −− FNIR(1600000, T, L+1) = 0.5984, FPIR=0.001000 vs. lowest 0.0018 from sensetime_004

Mugshot webcam ranking 200 (out of 236) −− FNIR(1600000, T, L+1) = 0.6193, FPIR=0.001000 vs. lowest 0.0122 from sensetime_003

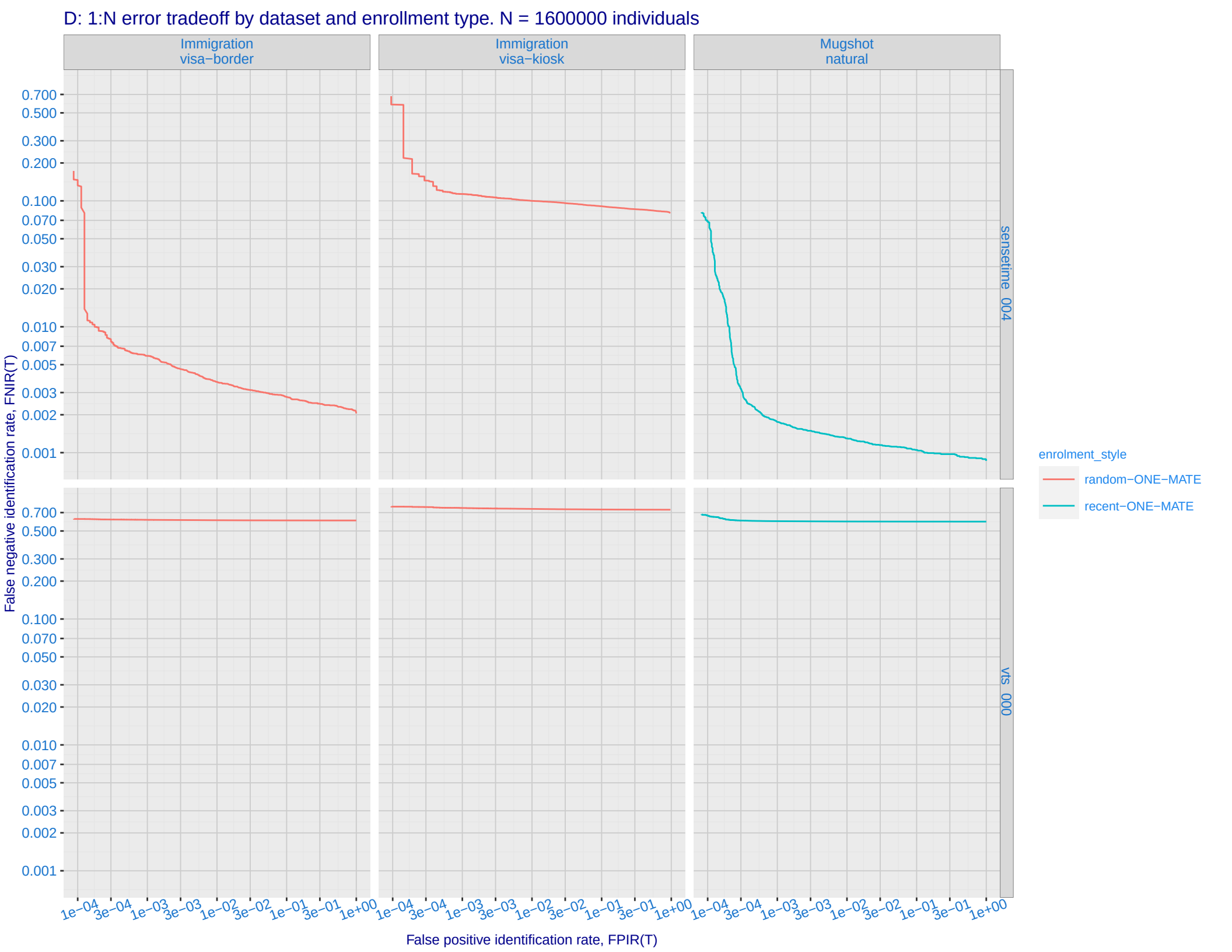
Mugshot profile ranking 147 (out of 209) −− FNIR(1600000, T, L+1) = 0.9993, FPIR=0.001000 vs. lowest 0.1331 from cloudwalk_hr_000

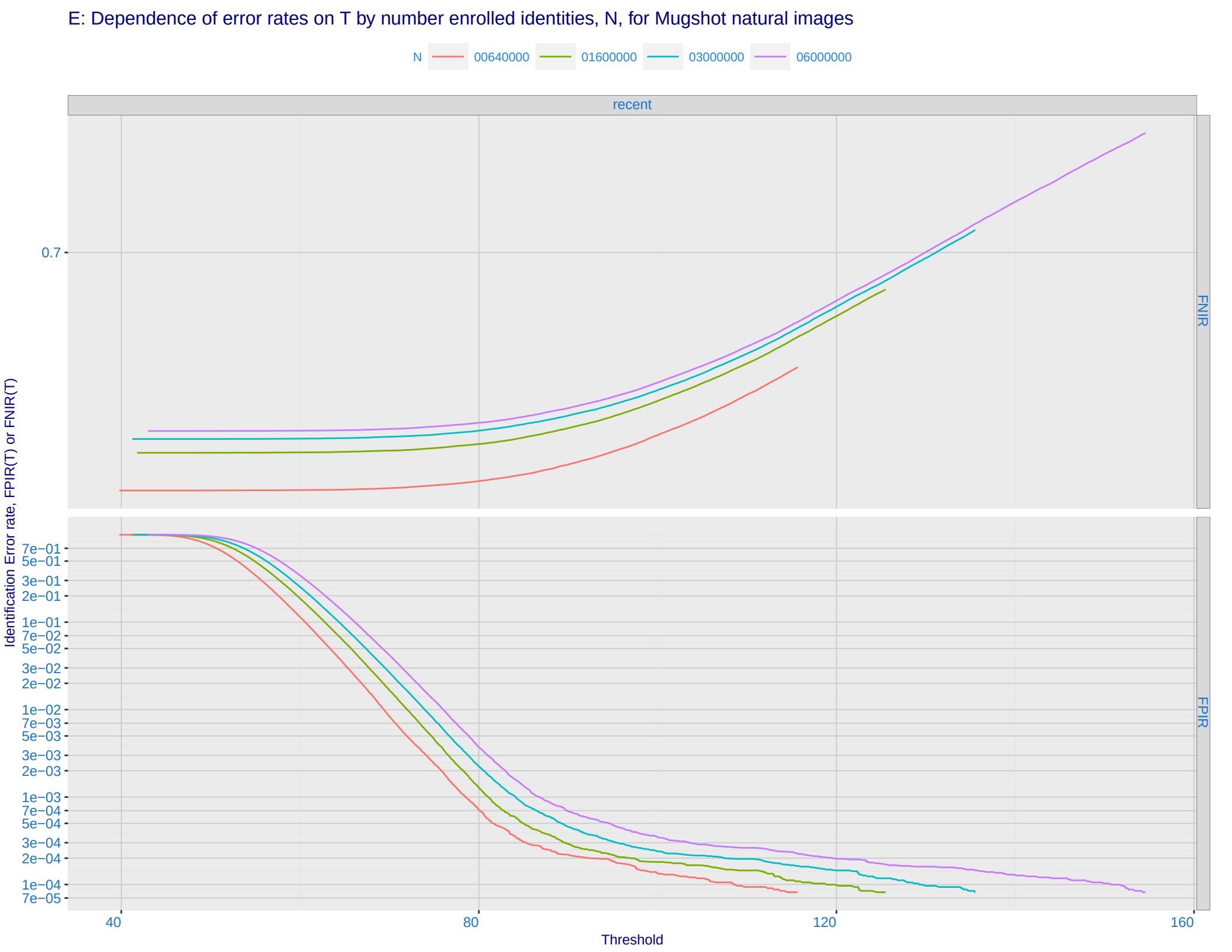
Immigration visa−border ranking 128 (out of 167) −− FNIR(1600000, T, L+1) = 0.6133, FPIR=0.001000 vs. lowest 0.0047 from idemia_008

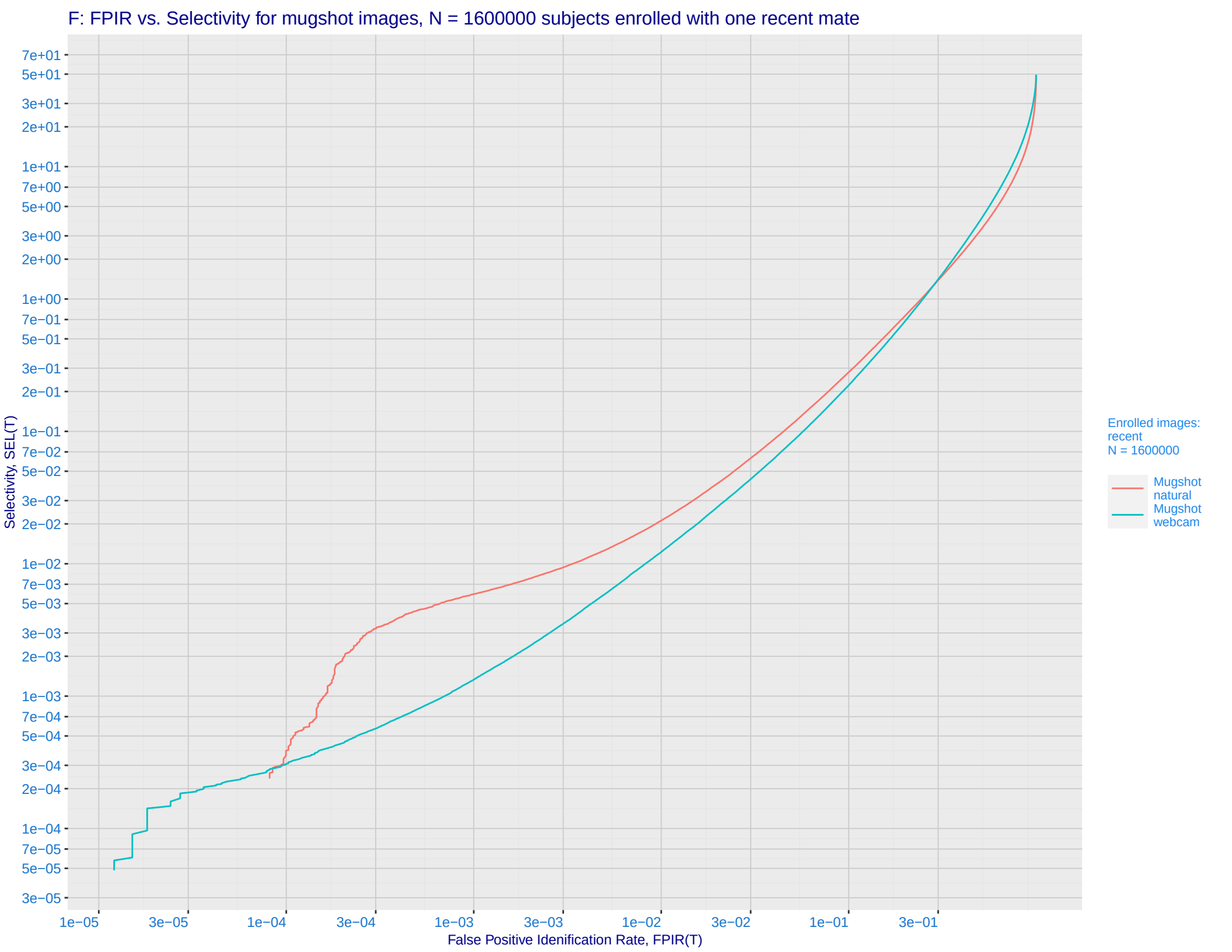
Immigration visa−kiosk ranking 95 (out of 162) −− FNIR(1600000, T, L+1) = 0.7614, FPIR=0.001000 vs. lowest 0.0996 from cloudwalk_hr_000

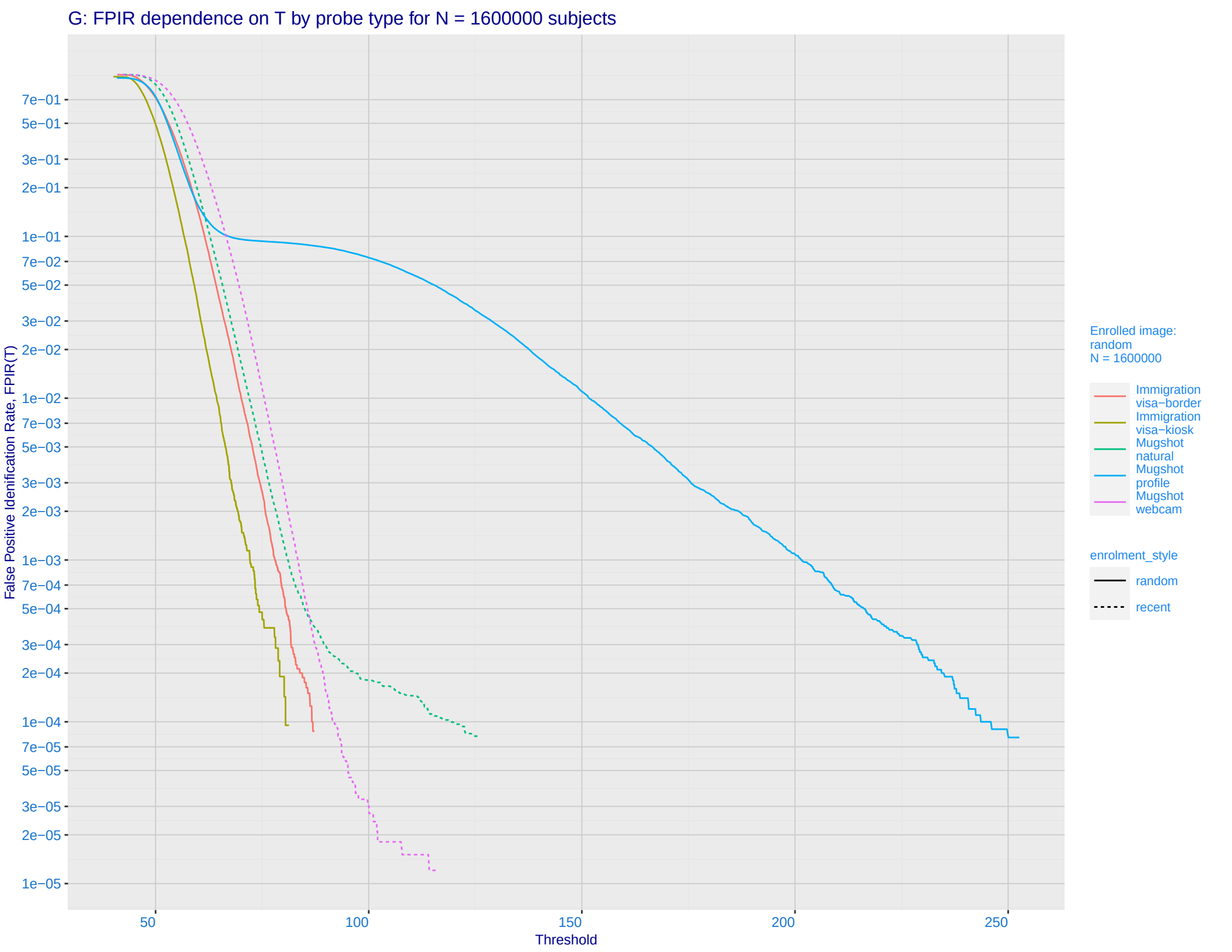

B: Mugshot natural images, identification mode: FNIR(N, L+1, T) vs. most accurate (sensetime_004)
False negative identification rate, FNIR(N)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
1e+06
3e+06
1e+07
Enrolled population size, N
enrolment_style
recent
Dataset:
2018 Mugshot
FNIR@FPIR = 0.001
sensetime_004
vts_000

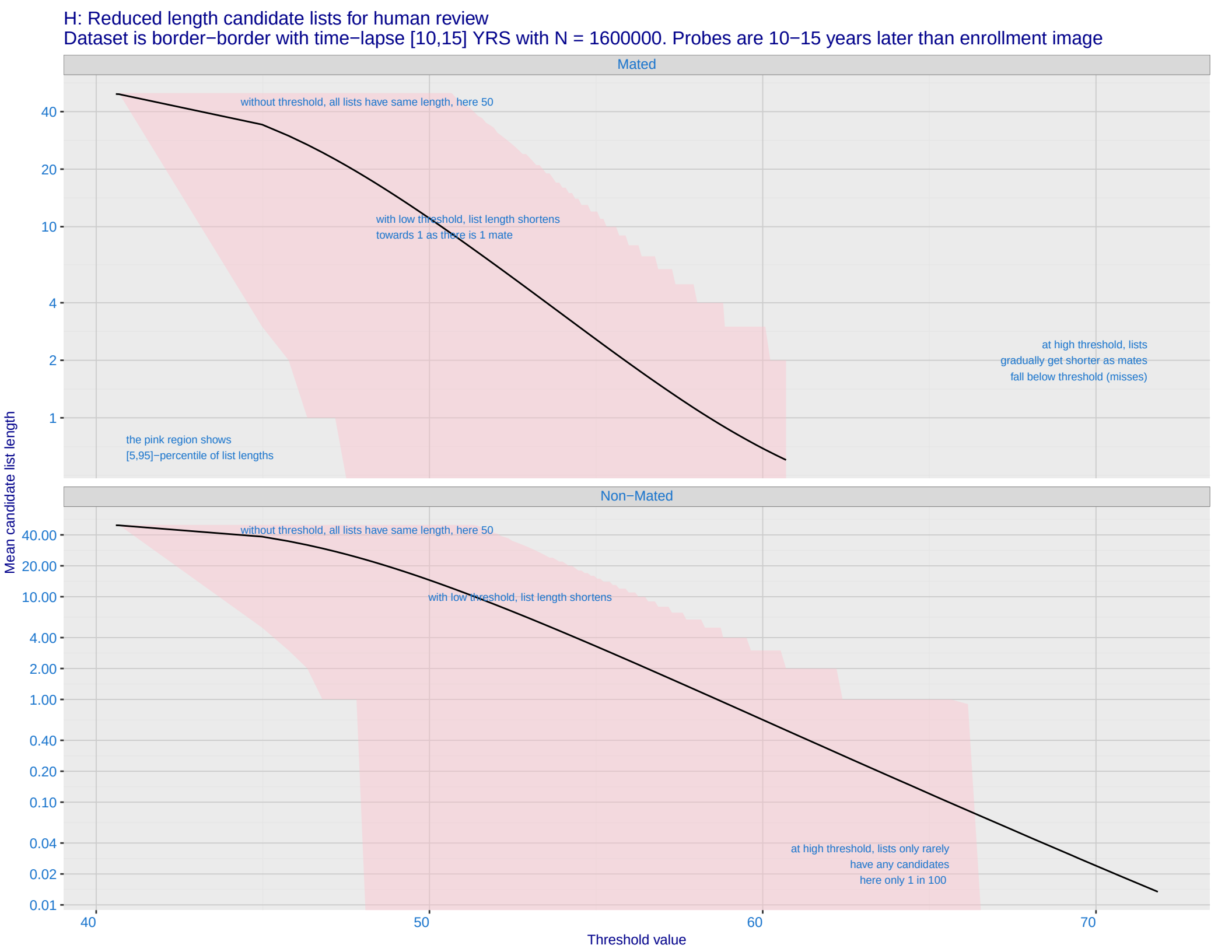

C: Evolution of accuracy for VTS algorithms on three datasets 2018 − present
1.0
0.8
0.6
False negative identification rate (FNIR) at false match rate (FPIR) = 0.010000
Mar 12
Date algorithm submitted to FRVT
Dataset
Mugshot−ProfileView
Mugshot−Webcam
Visa−Border
Visa−Kiosk

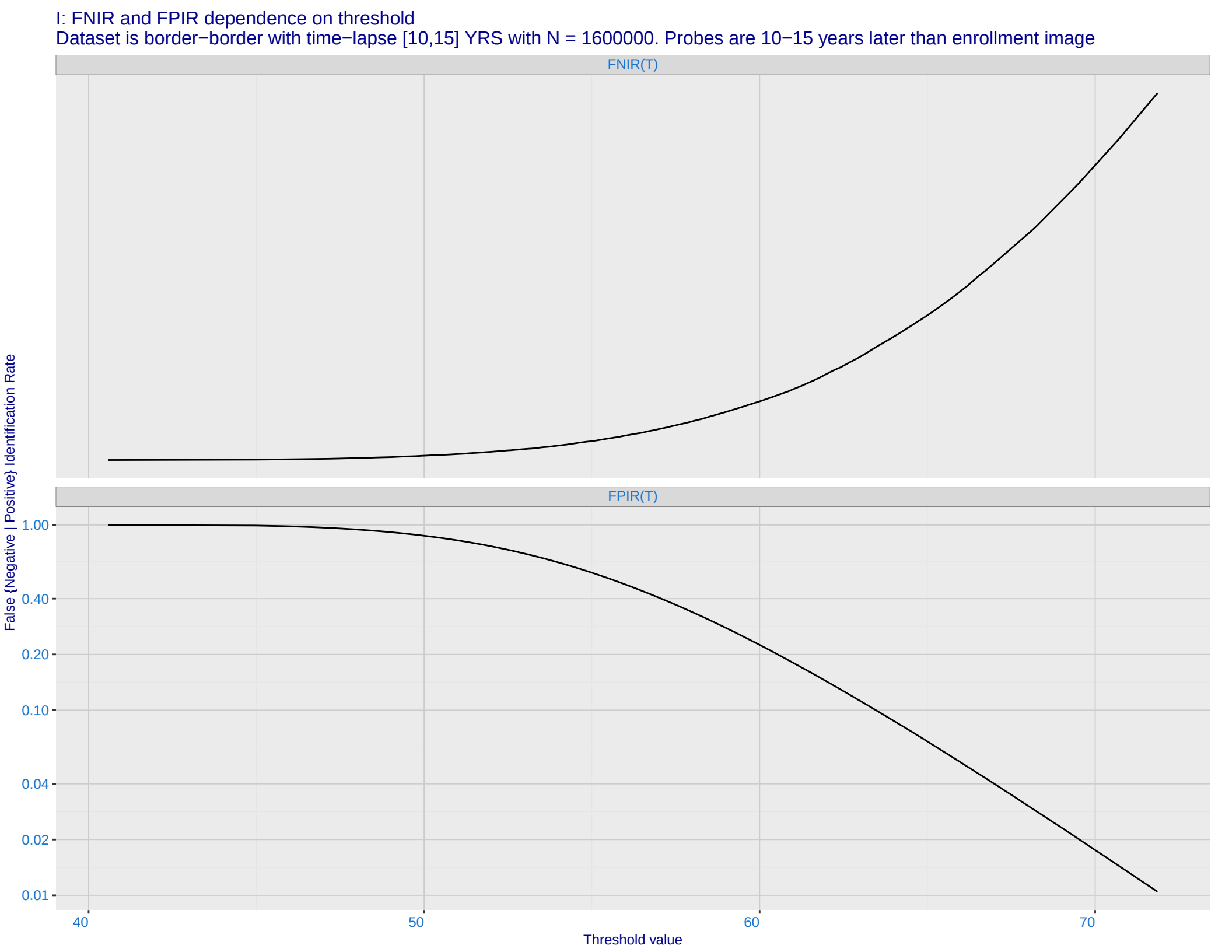

D: 1:N error tradeoff by dataset and enrollment type. N = 1600000 individuals
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
sensetime_004
vts_000
False negative identification rate, FNIR(T)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e−04
3e−04
1e−03
3e−03
1e−02
3e−02
1e−01
3e−01
1e+00
False positive identification rate, FPIR(T)
enrolment_style
random−ONE−MATE
recent−ONE−MATE

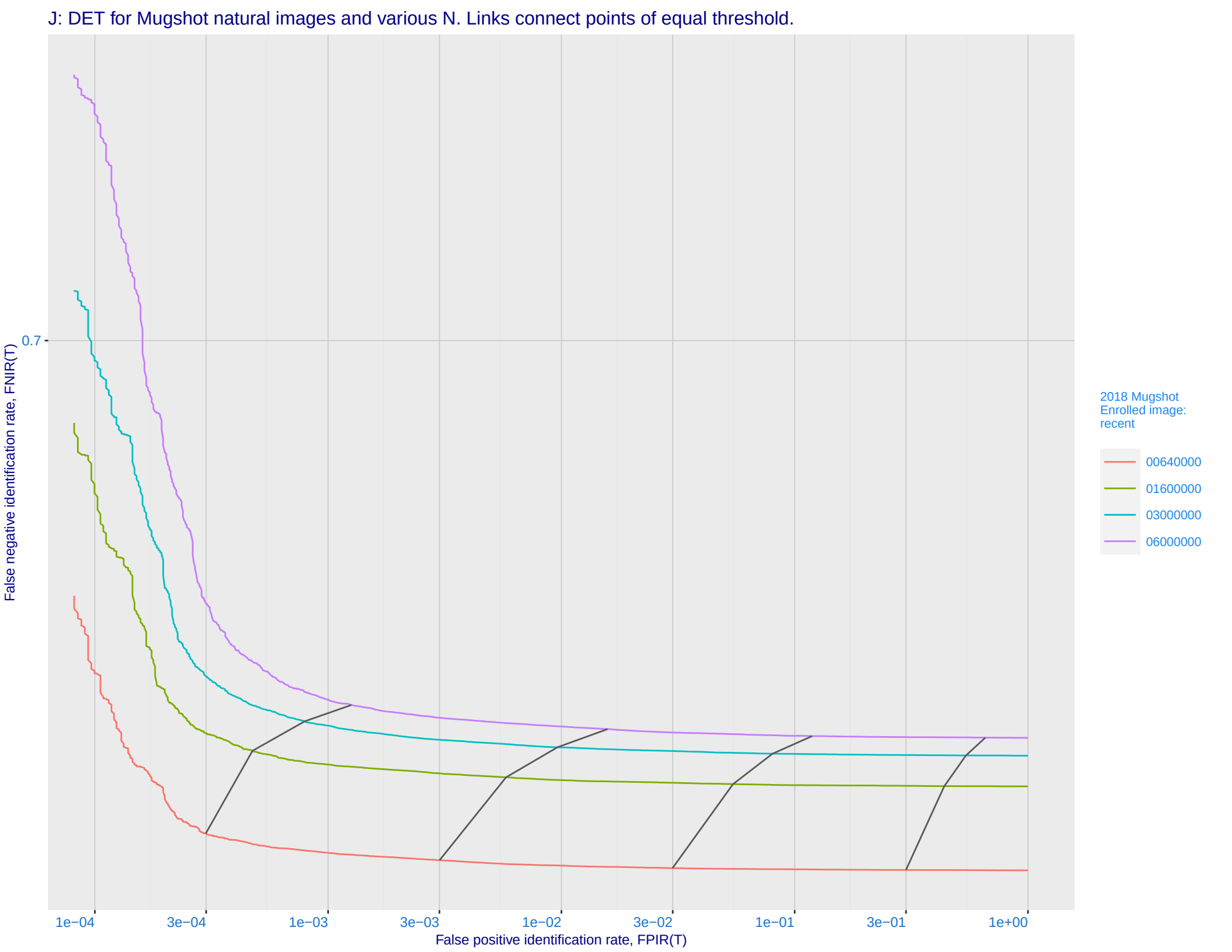

E: Dependence of error rates on T by number enrolled identities, N, for Mugshot natural images
N
00640000
01600000
03000000
06000000
recent
FNIR
FPIR
0.7
Identification Error rate, FPIR(T) or FNIR(T)
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05
40
80
120
160
Threshold


F: FPIR vs. Selectivity for mugshot images, N = 1600000 subjects enrolled with one recent mate
Selectivity, SEL(T)
7e+01
5e+01
3e+01
2e+01
1e+01
7e+00
5e+00
3e+00
2e+00
1e+00
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05
5e−05
3e−05
1e−05
3e−05
1e−04
3e−04
1e−03
3e−03
1e−02
3e−02
1e−01
3e−01
False Positive Idenification Rate, FPIR(T)
Enrolled images:
recent
N = 1600000
Mugshot
natural
Mugshot
webcam

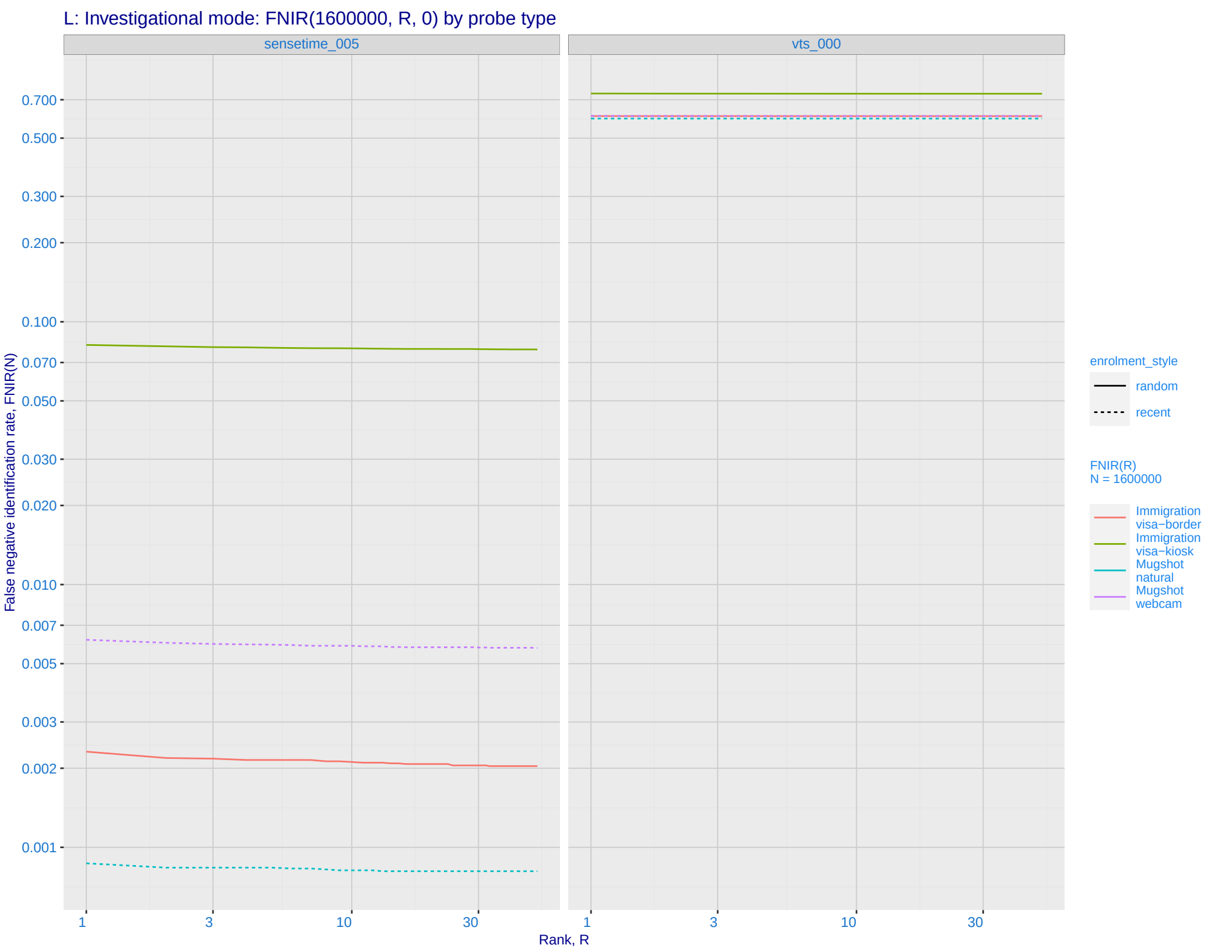

G: FPIR dependence on T by probe type for N = 1600000 subjects
False Positive Idenification Rate, FPIR(T)
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05
5e−05
3e−05
2e−05
1e−05
50
100
150
200
250
Threshold
Enrolled image:
random
N = 1600000
Immigration
visa−border
Immigration
visa−kiosk
Mugshot
natural
Mugshot
profile
Mugshot
webcam
enrolment_style
random
recent


H: Reduced length candidate lists for human review
Dataset is border−border with time−lapse [10,15] YRS with N = 1600000. Probes are 10−15 years later than enrollment image
Mated
without threshold, all lists have same length, here 50
with low threshold, list length shortens
towards 1 as there is 1 mate
at high threshold, lists
gradually get shorter as mates
fall below threshold (misses)
the pink region shows
[5,95]−percentile of list lengths
Non−Mated
without threshold, all lists have same length, here 50
with low threshold, list length shortens
at high threshold, lists only rarely
have any candidates
here only 1 in 100
Mean candidate list length
Threshold value

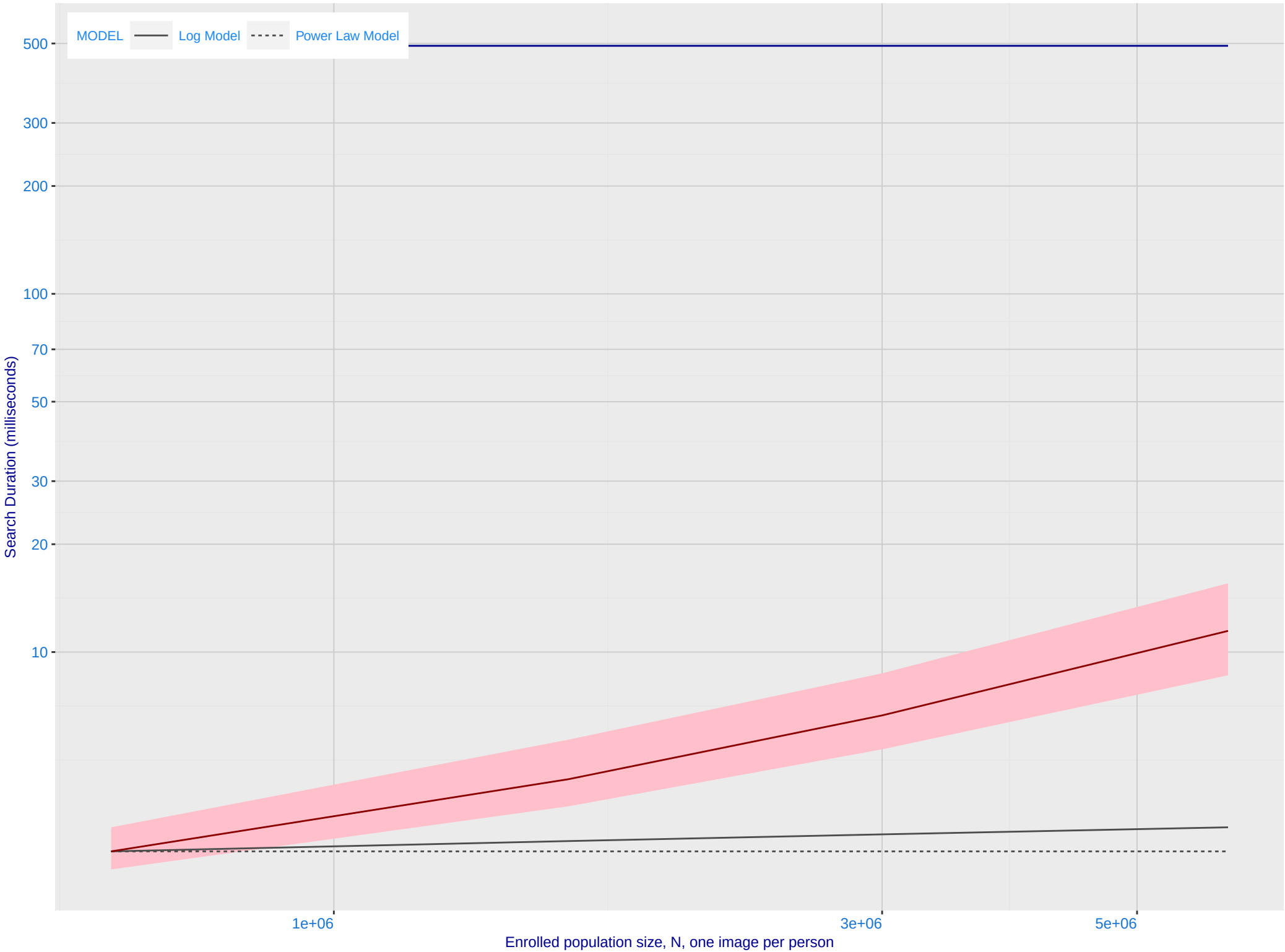

I: FNIR and FPIR dependence on threshold
Dataset is border−border with time−lapse [10,15] YRS with N = 1600000. Probes are 10−15 years later than enrollment image
FNIR(T)
FPIR(T)
False {Negative | Positive} Identification Rate
1.00
0.40
0.20
0.10
0.04
0.02
0.01
40
50
60
70
Threshold value

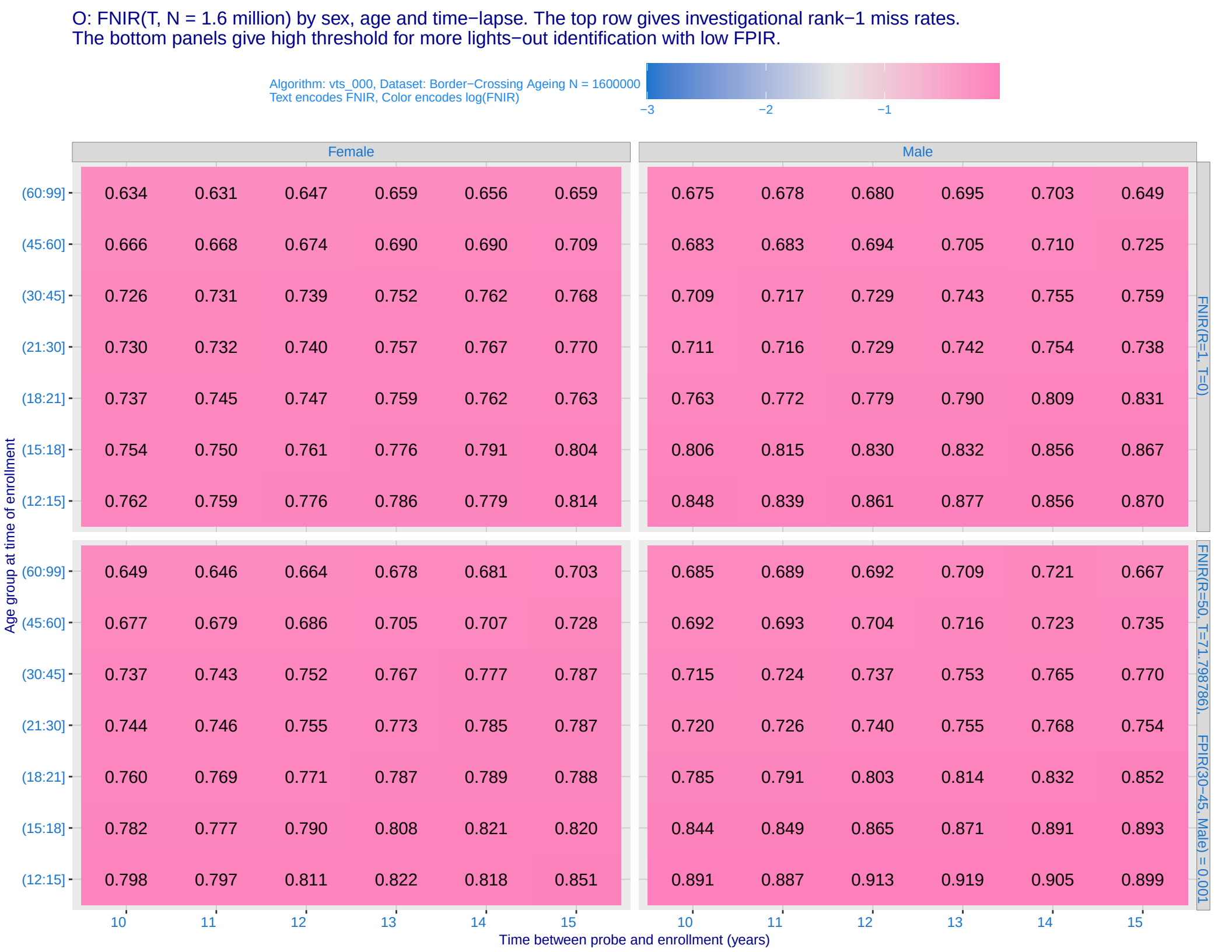

J: DET for Mugshot natural images and various N. Links connect points of equal threshold.
0.7
False negative identification rate, FNIR(T)
1e−04
3e−04
1e−03
3e−03
1e−02
3e−02
1e−01
3e−01
1e+00
False positive identification rate, FPIR(T)
2018 Mugshot
Enrolled image:
recent
00640000
01600000
03000000
06000000


K: Investigational mode: FNIR(N, 1, 0) vs. most accurate (sensetime_005)
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
Mugshot webcam
False negative identification rate, FNIR(N)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e+06
3e+06
1e+07
Enrolled population size, N
enrolment_style
random
recent
FNIR@Rank = 1
sensetime_005
vts_000

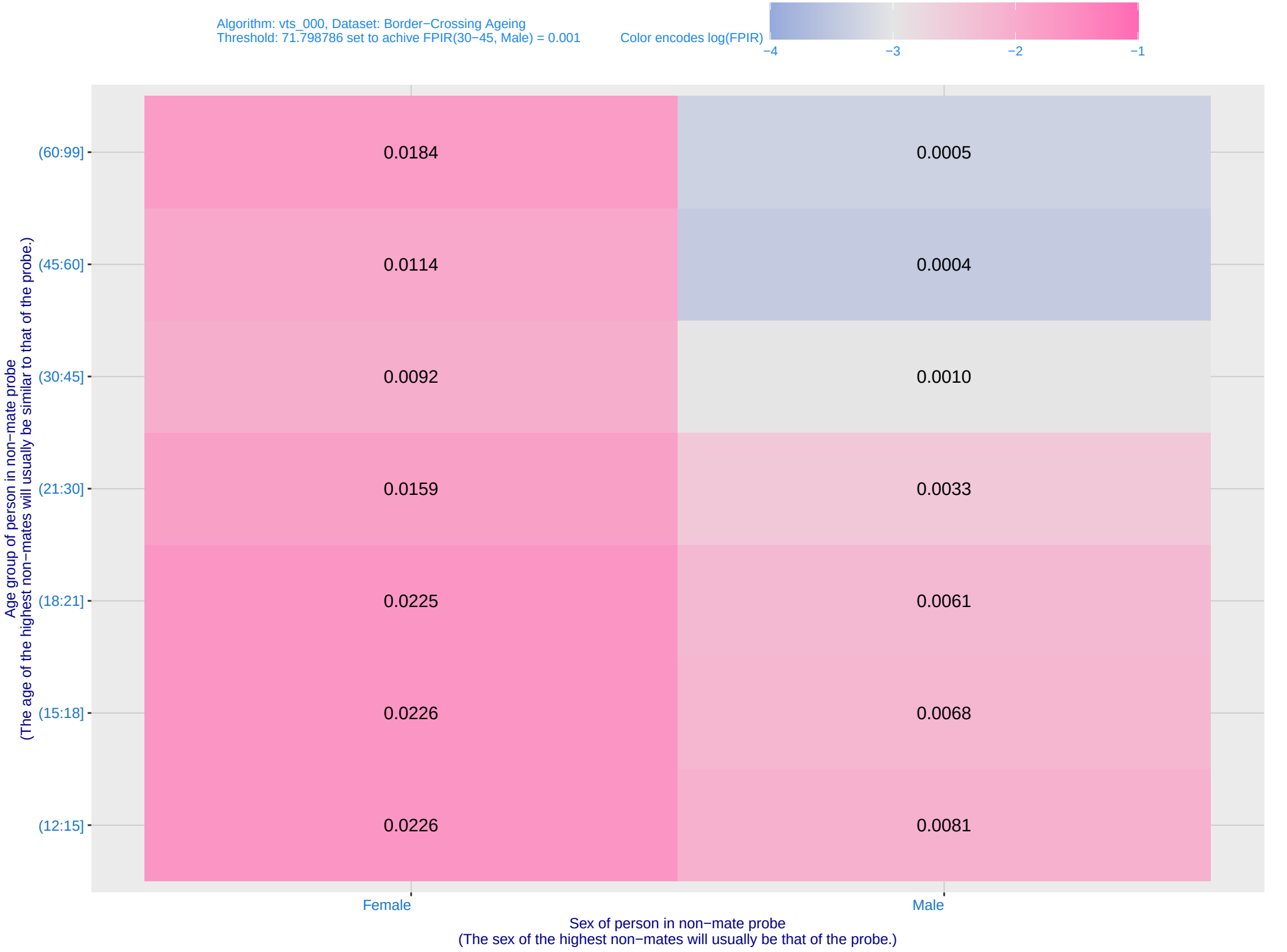

L: Investigational mode: FNIR(1600000, R, 0) by probe type
sensetime_005
vts_000
False negative identification rate, FNIR(N)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1
3
10
30
Rank, R
enrolment_style
random
recent
FNIR(R)
N = 1600000
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
Mugshot webcam

M: Template duration; search duration vs. N. The blue and pink ribbon covers 95 percent of observed measurements.
The template generation time is independent of N. The log and power−law models are fit to the first two (N,T) observations

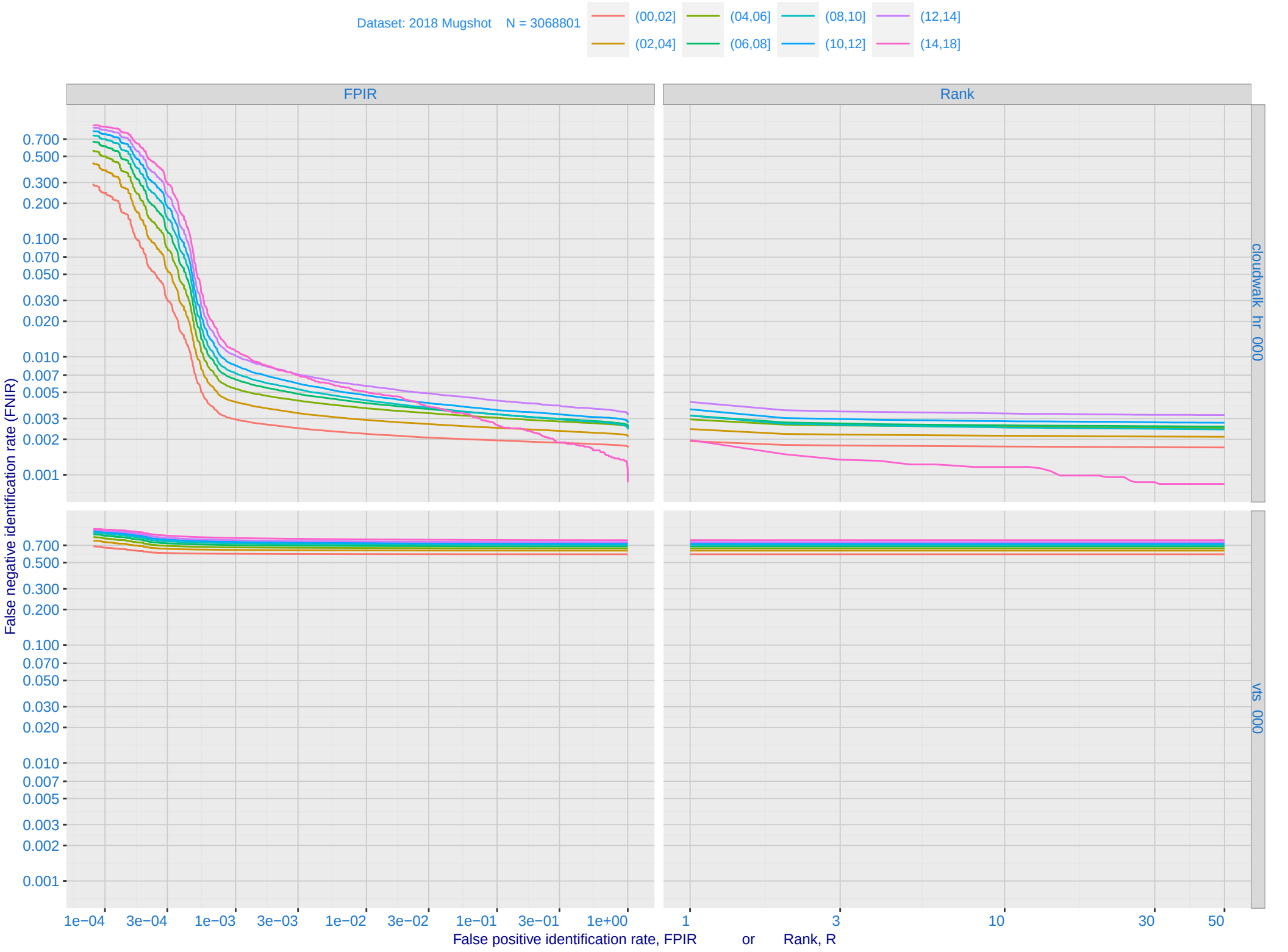


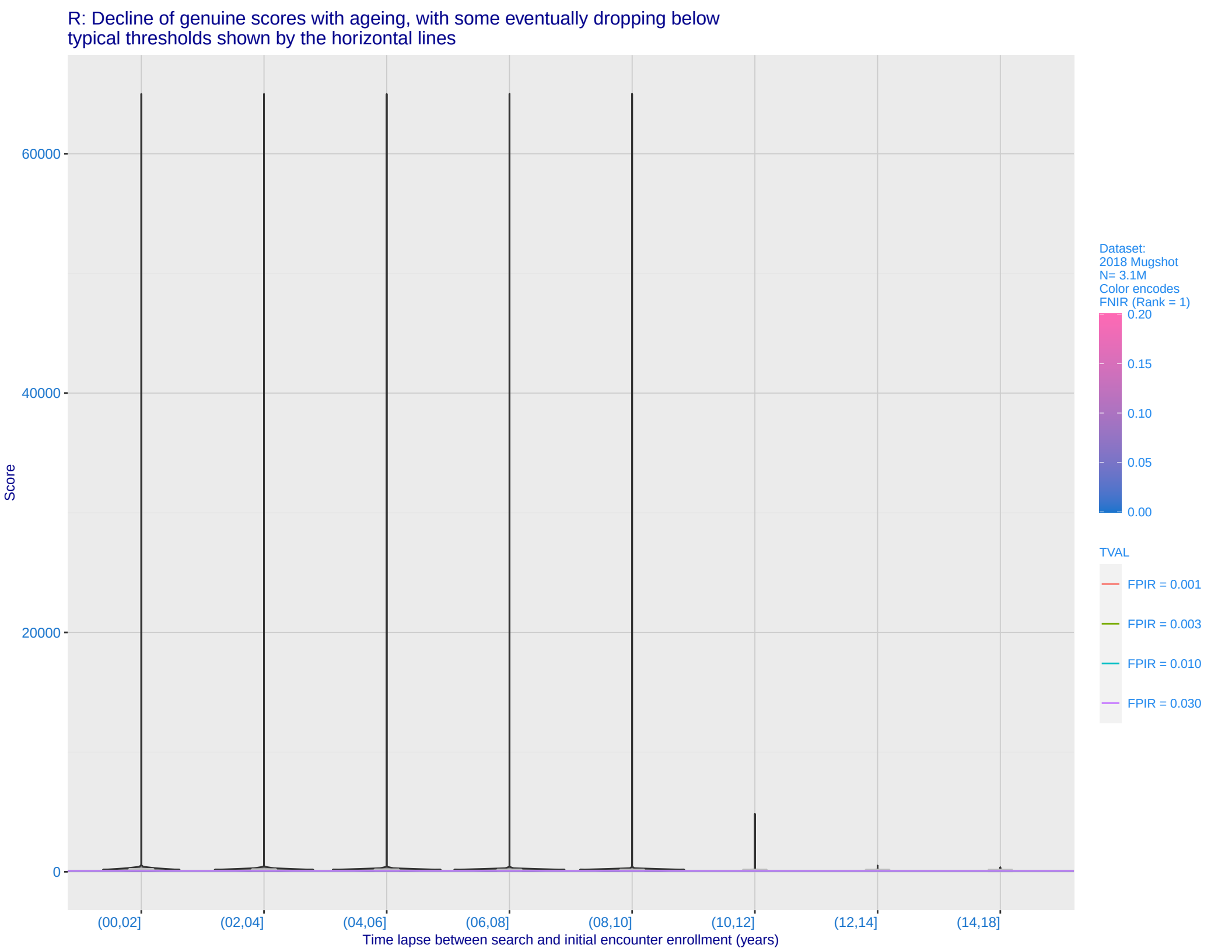

O: FNIR(T, N = 1.6 million) by sex, age and time−lapse. The top row gives investigational rank−1 miss rates.
The bottom panels give high threshold for more lights−out identification with low FPIR.
Algorithm: vts_000, Dataset: Border−Crossing Ageing N = 1600000
Text encodes FNIR, Color encodes log(FNIR)
−3
−2
−1
Female
Male
(60:99]
(45:60]
(30:45]
(21:30]
(18:21]
(15:18]
(12:15]
0.634 0.631 0.647 0.659 0.656 0.659
0.666 0.668 0.674 0.690 0.690 0.709
0.726 0.731 0.739 0.752 0.762 0.768
0.730 0.732 0.740 0.757 0.767 0.770
0.737 0.745 0.747 0.759 0.762 0.763
0.754 0.750 0.761 0.776 0.791 0.804
0.762 0.759 0.776 0.786 0.779 0.814
0.675 0.678 0.680 0.695 0.703 0.649
0.683 0.683 0.694 0.705 0.710 0.725
0.709 0.717 0.729 0.743 0.755 0.759
0.711 0.716 0.729 0.742 0.754 0.738
0.763 0.772 0.779 0.790 0.809 0.831
0.806 0.815 0.830 0.832 0.856 0.867
0.848 0.839 0.861 0.877 0.856 0.870
FNIR(R=1, T=0)
0.649 0.646 0.664 0.678 0.681 0.703
0.677 0.679 0.686 0.705 0.707 0.728
0.737 0.743 0.752 0.767 0.777 0.787
0.744 0.746 0.755 0.773 0.785 0.787
0.760 0.769 0.771 0.787 0.789 0.788
0.782 0.777 0.790 0.808 0.821 0.820
0.798 0.797 0.811 0.822 0.818 0.851
0.685 0.689 0.692 0.709 0.721 0.667
0.692 0.693 0.704 0.716 0.723 0.735
0.715 0.724 0.737 0.753 0.765 0.770
0.720 0.726 0.740 0.755 0.768 0.754
0.785 0.791 0.803 0.814 0.832 0.852
0.844 0.849 0.865 0.871 0.891 0.893
0.891 0.887 0.913 0.919 0.905 0.899
FNIR(R=50, T=71.798786), FPIR(30−45, Male) = 0.001
Age group at time of enrollment
10 11 12 13 14 15
10 11 12 13 14 15
Time between probe and enrollment (years)

P: FPIR(N = 1.6 million) by sex and age. It is typical for false positive identification rates to be higher in women except in their teens.



Q: Identification FNIR(N, T, L+1) and Investigational FNIR(N, 0, R) under ageing




R: Decline of genuine scores with ageing, with some eventually dropping below typical thresholds shown by the horizontal lines
Score
60000
40000
20000
0
(00,02]
(02,04]
(04,06]
(06,08]
(08,10]
(10,12]
(12,14]
(14,18]
Time lapse between search and initial encounter enrollment (years)
Dataset:
2018 Mugshot
N= 3.1M
Color encodes
FNIR (Rank = 1)
0.20
0.15
0.10
0.05
0.00
TVAL
FPIR = 0.001
FPIR = 0.003
FPIR = 0.010
FPIR = 0.030