A: Datasheet

Algorithm: kakao_001

Developer: Kakao Enterprise

Submission Date: 2022_06_08

Template size: 2048 bytes

Template time (2.5 percentile): 958 msec

Template time (median): 962 msec

Template time (97.5 percentile): 1028 msec

Investigation:

Mugshot webcam ranking 40 (out of 337) −− FNIR(1600000, 0, 1) = 0.0091 vs. lowest 0.0055 from sensetime_008

Mugshot profile ranking 6 (out of 306) −− FNIR(1600000, 0, 1) = 0.0577 vs. lowest 0.0521 from sensetime_007

Immigration visa−border ranking 6 (out of 264) −− FNIR(1600000, 0, 1) = 0.0009 vs. lowest 0.0006 from cloudwalk_mt_001

Immigration visa−kiosk ranking 2 (out of 209) −− FNIR(1600000, 0, 1) = 0.0438 vs. lowest 0.0395 from cloudwalk_mt_001

Identification:

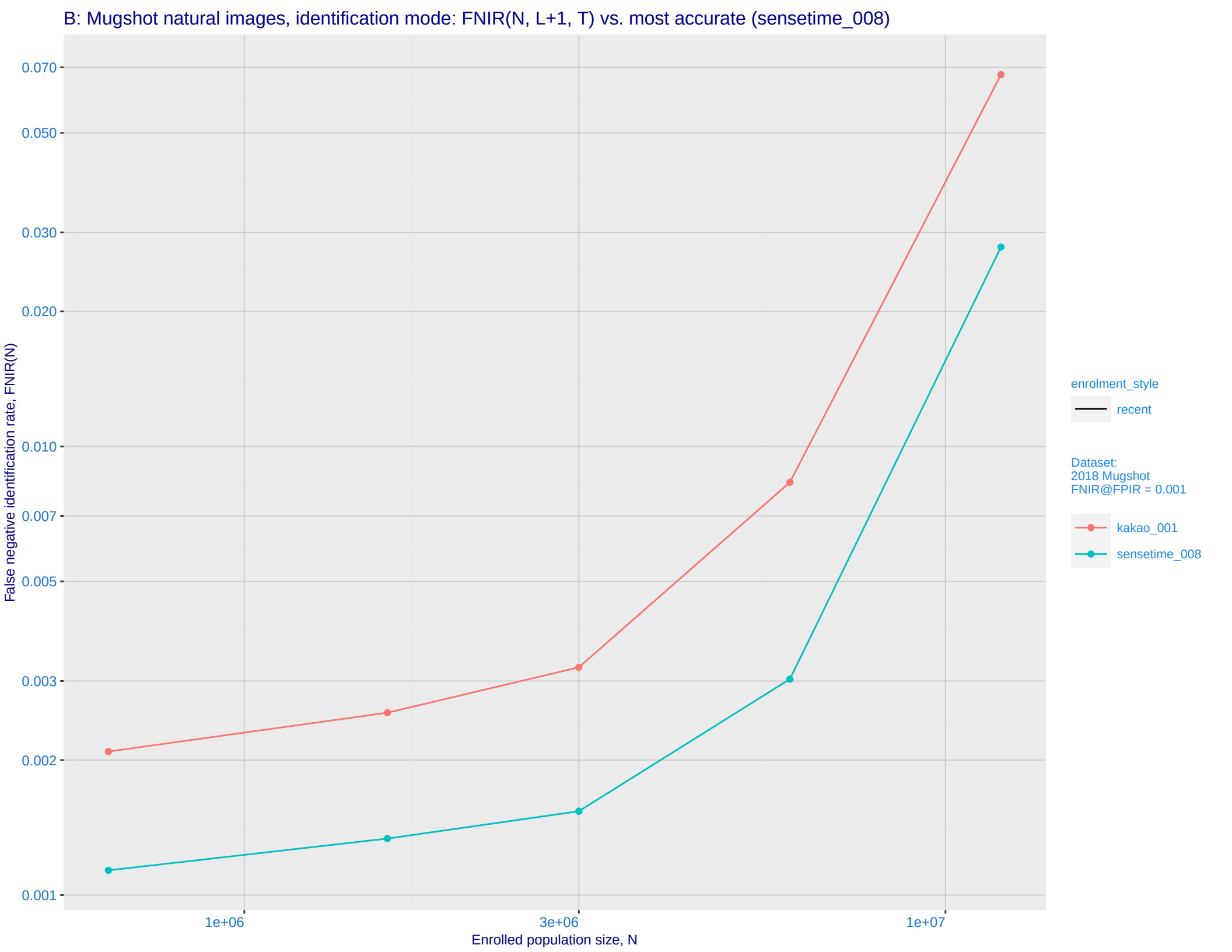
Frontal mugshot ranking 19 (out of 375) −− FNIR(1600000, T, L+1) = 0.0025, FPIR=0.001000 vs. lowest 0.0013 from sensetime_008

Mugshot webcam ranking 20 (out of 335) −− FNIR(1600000, T, L+1) = 0.0174, FPIR=0.001000 vs. lowest 0.0090 from sensetime_008

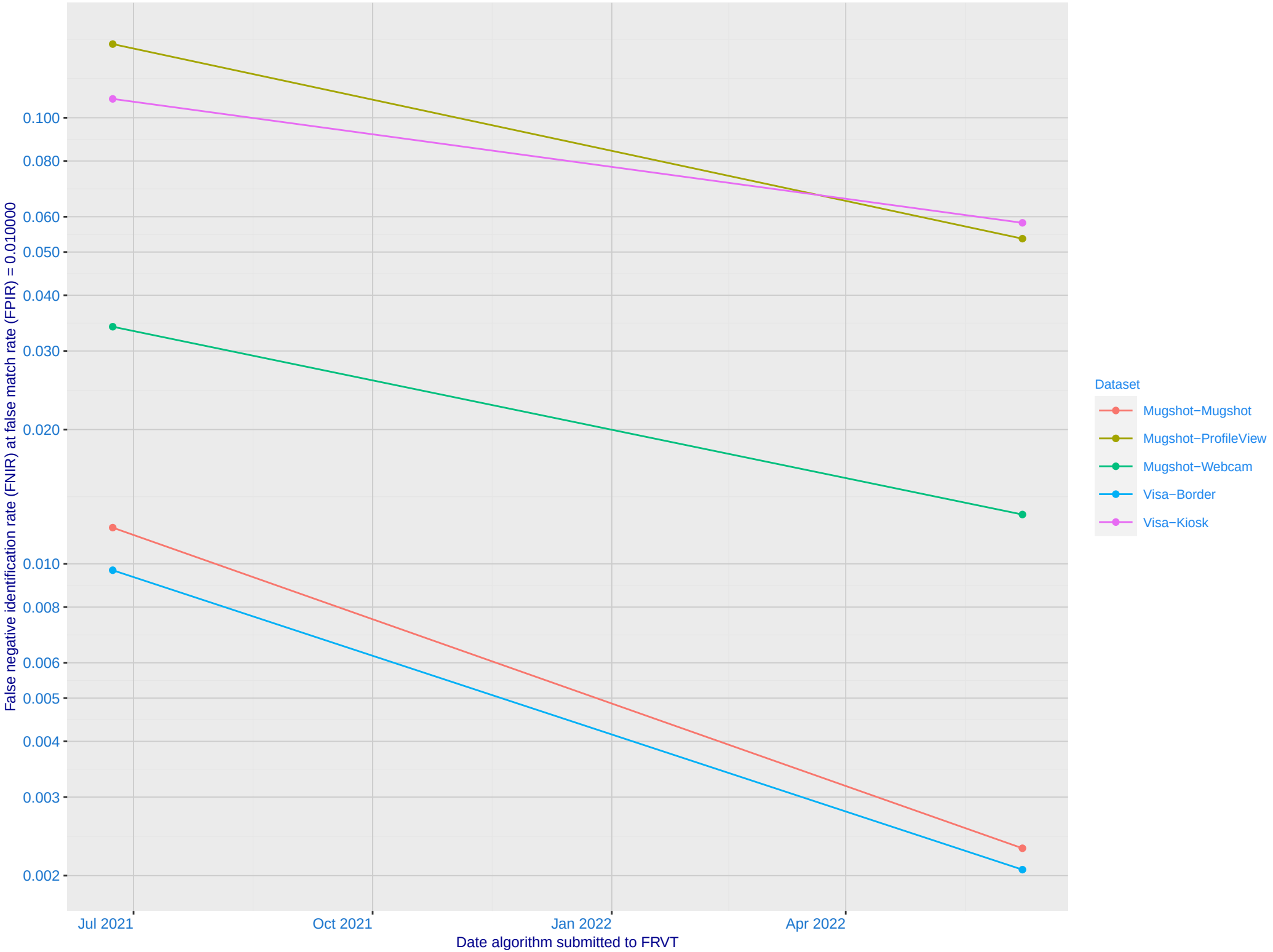
Mugshot profile ranking 5 (out of 305) −− FNIR(1600000, T, L+1) = 0.1590, FPIR=0.001000 vs. lowest 0.0698 from cloudwalk_mt_001

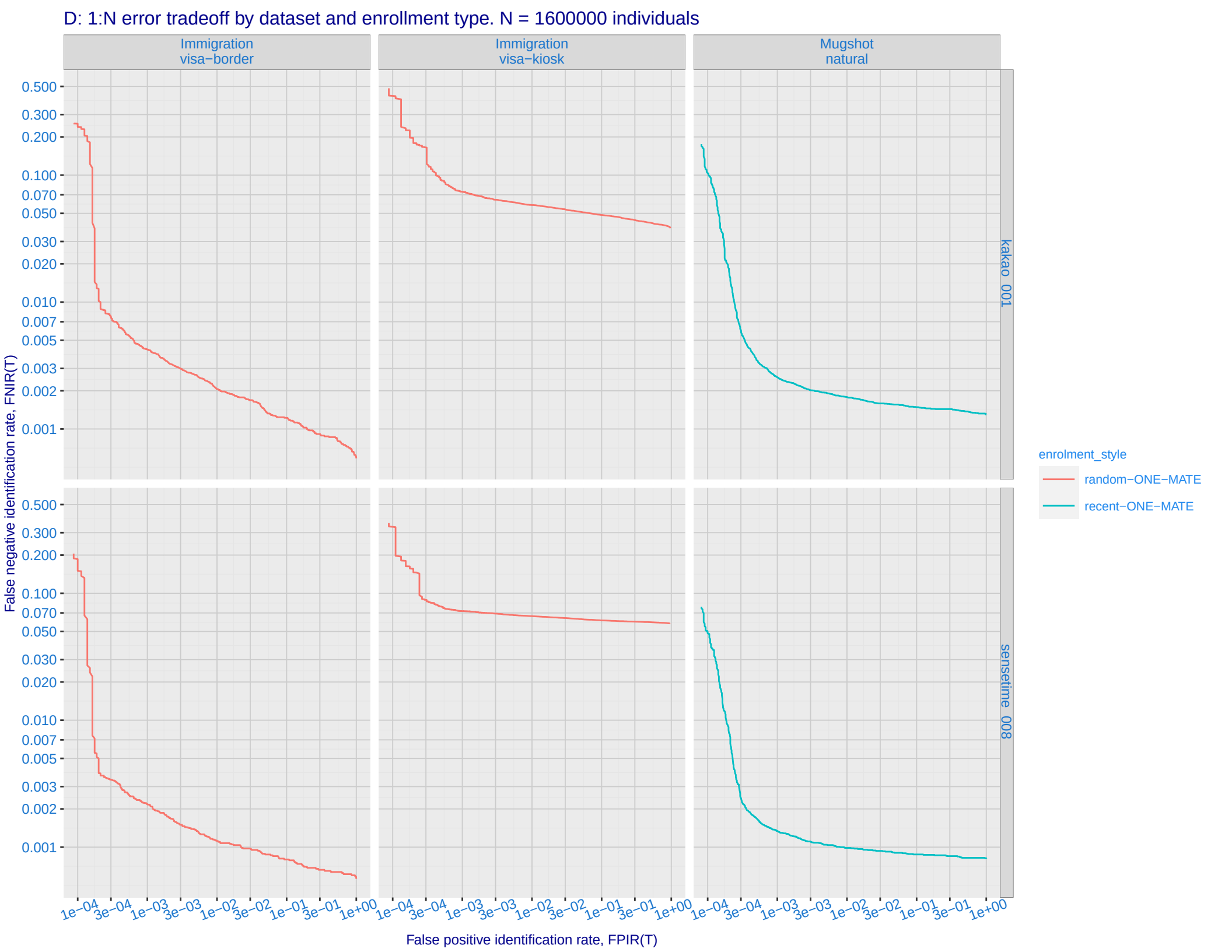
Immigration visa−border ranking 10 (out of 263) −− FNIR(1600000, T, L+1) = 0.0042, FPIR=0.001000 vs. lowest 0.0013 from cloudwalk_mt_001

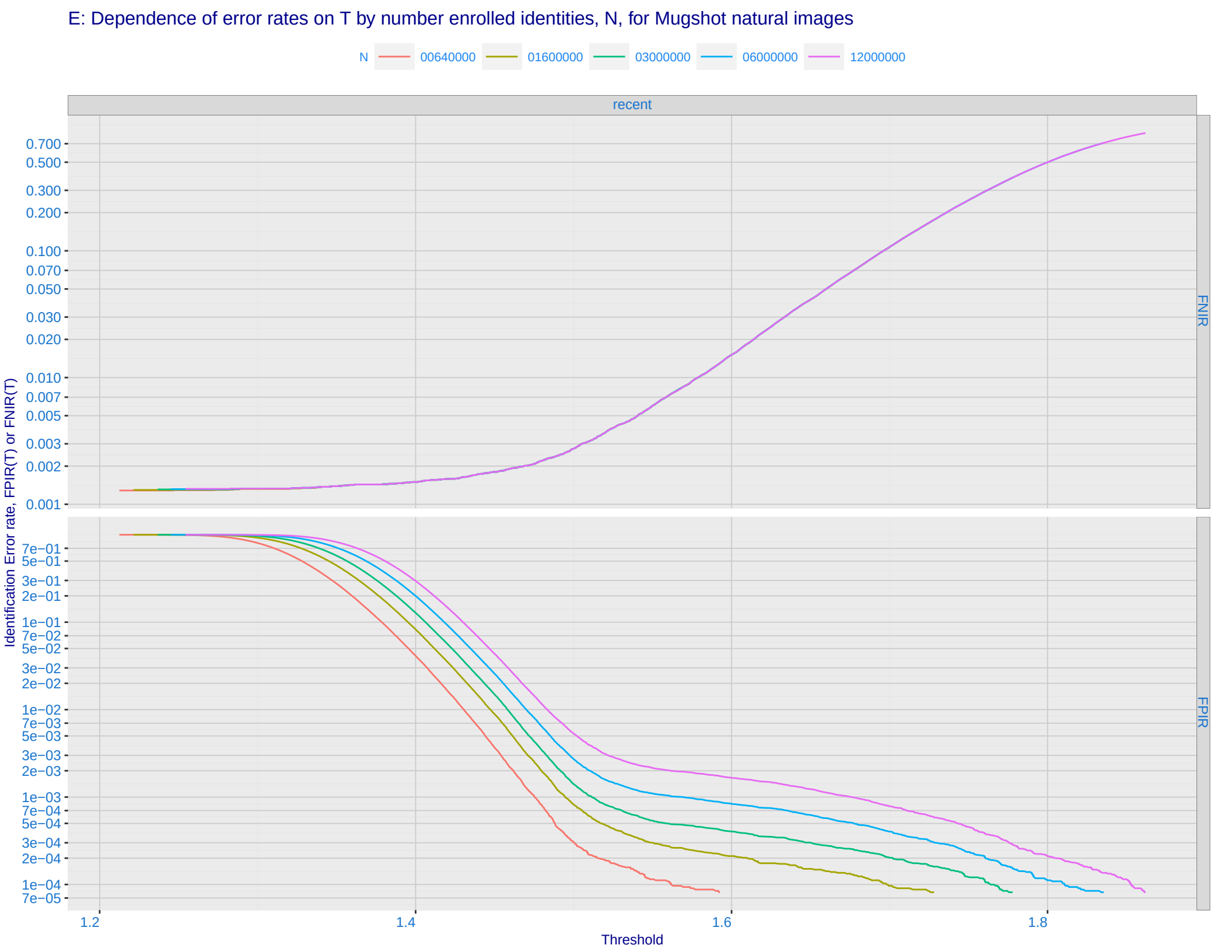
Immigration visa−kiosk ranking 7 (out of 209) −− FNIR(1600000, T, L+1) = 0.0740, FPIR=0.001000 vs. lowest 0.0532 from cloudwalk_mt_001

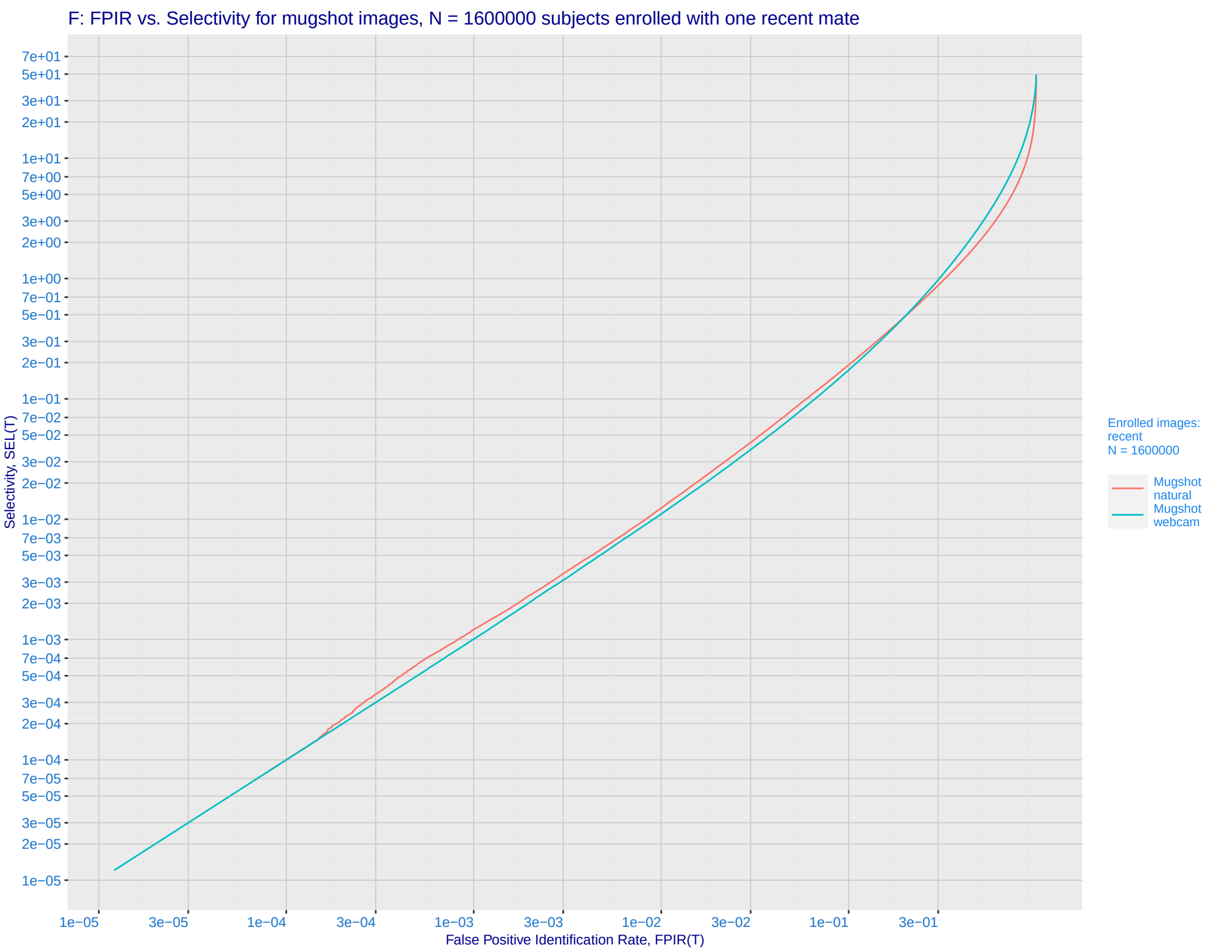

B: Mugshot natural images, identification mode: FNIR(N, L+1, T) vs. most accurate (sensetime_008)
False negative identification rate, FNIR(N)
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e+06
3e+06
1e+07
Enrolled population size, N
enrolment_style
recent
Dataset:
2018 Mugshot
FNIR@FPIR = 0.001
kakao_001
sensetime_008

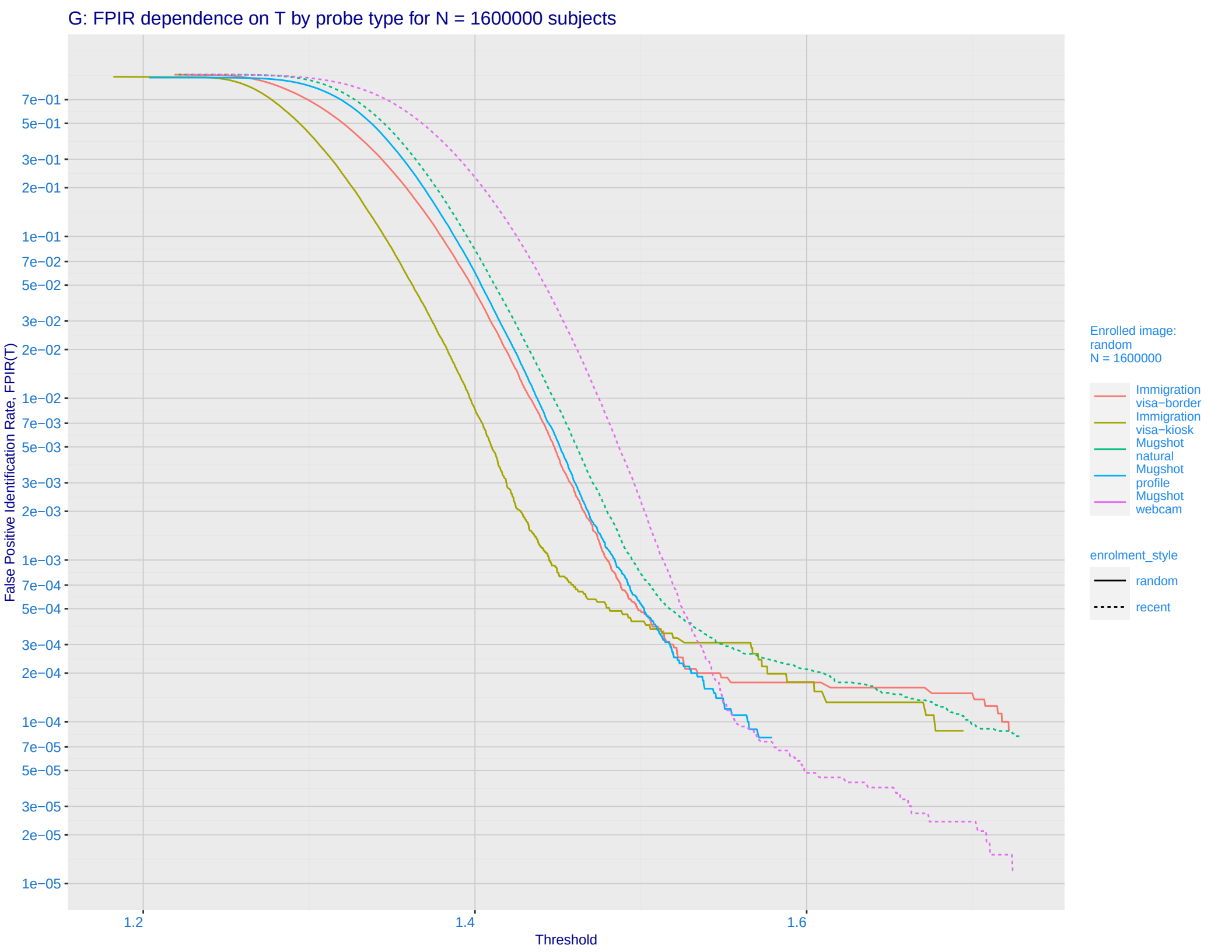
C: Evolution of accuracy for KAKAO algorithms on three datasets 2018 − present

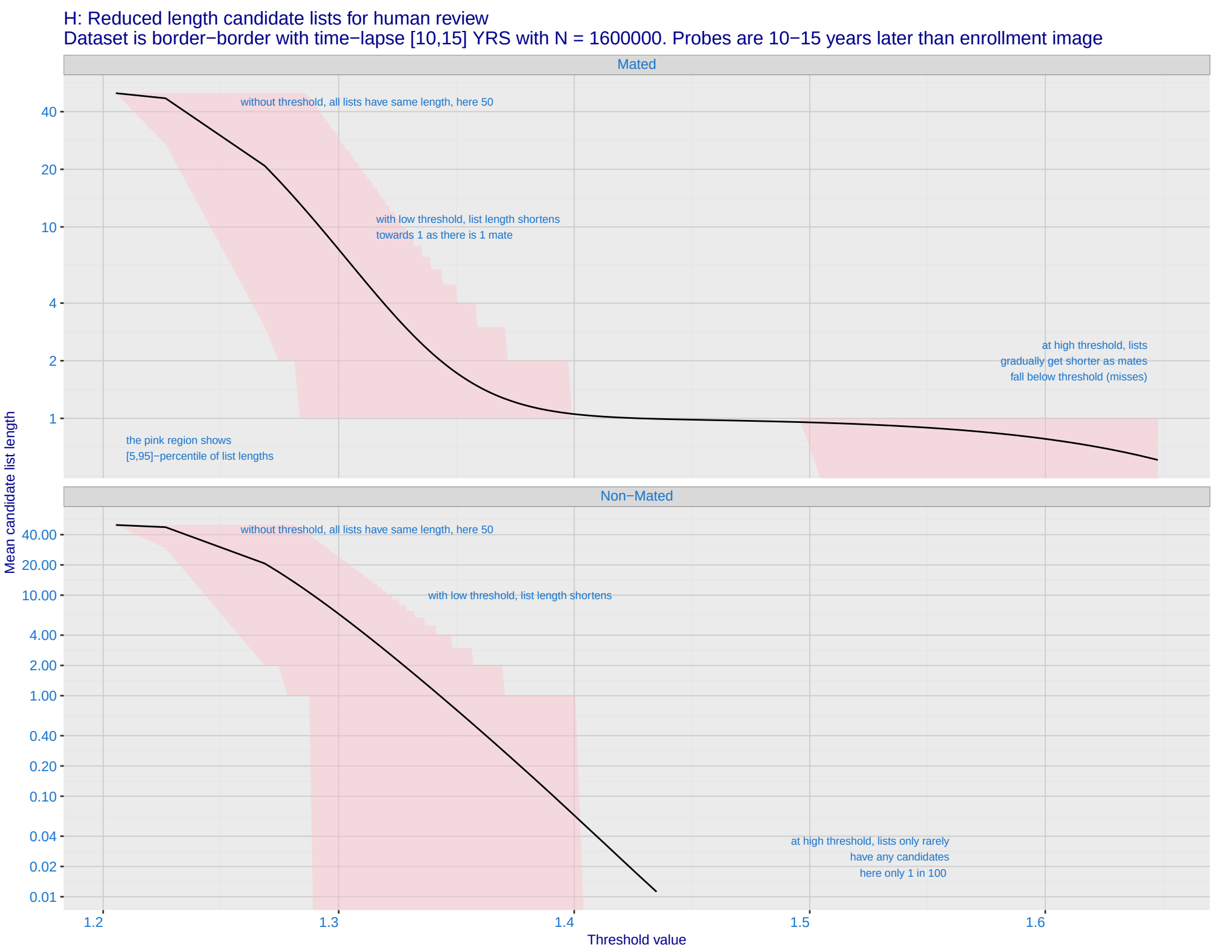


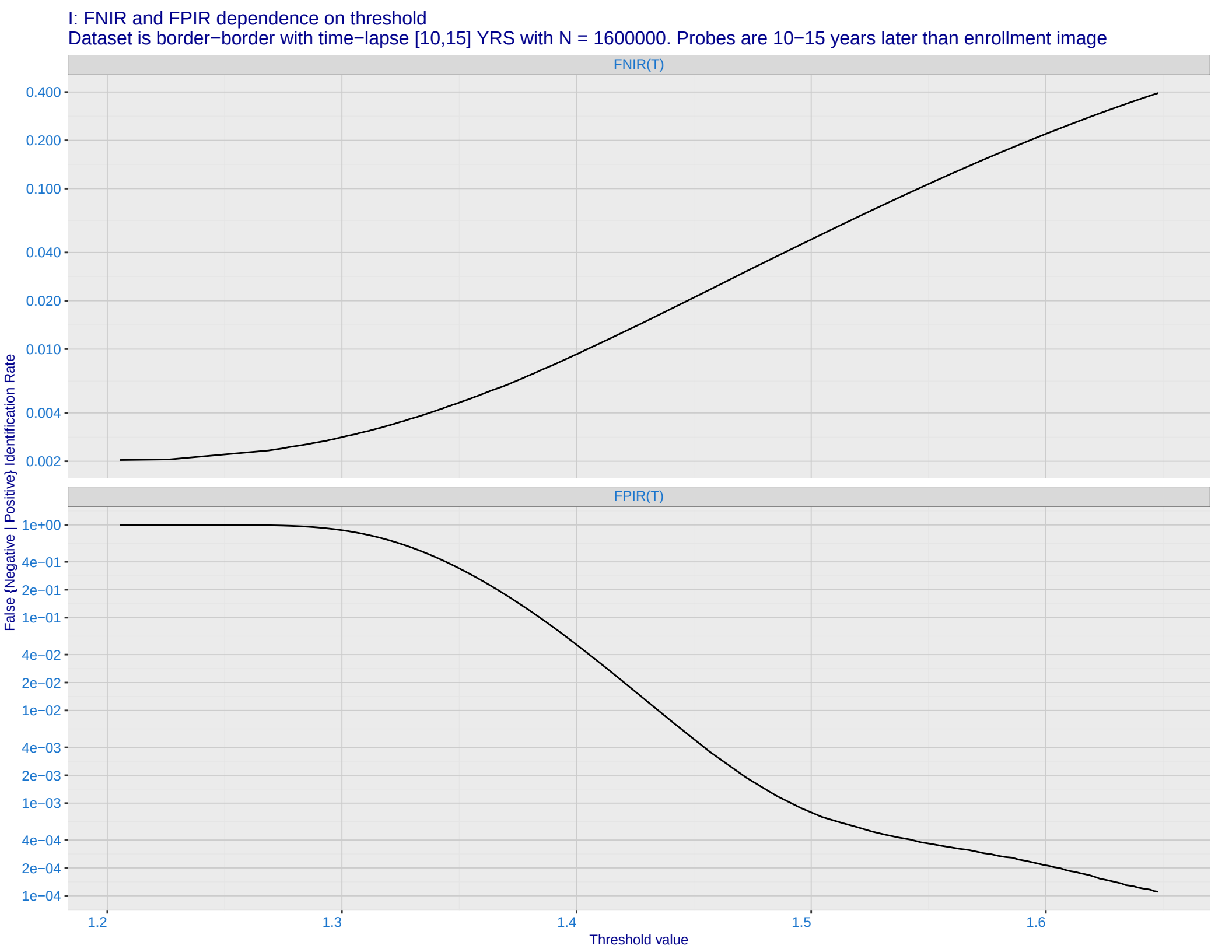

D: 1:N error tradeoff by dataset and enrollment type. N = 1600000 individuals
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
kakao 001
sensetime 008
False negative identification rate, FNIR(T)
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e−04
3e−04
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

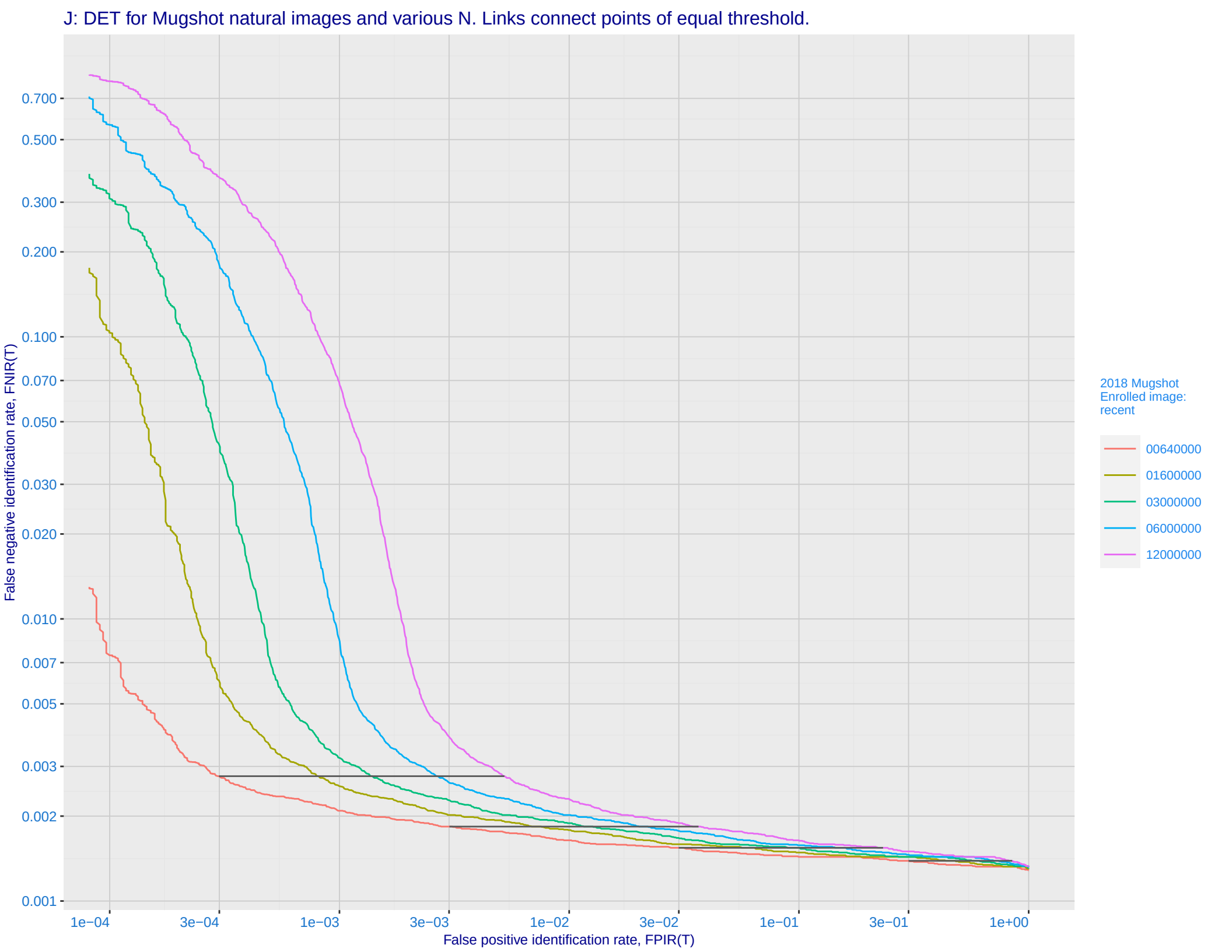

E: Dependence of error rates on T by number enrolled identities, N, for Mugshot natural images
N
00640000
01600000
03000000
06000000
12000000
recent
FNIR
FPIR
Identification Error rate, FPIR(T) or FNIR(T)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
7e−01
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
1.2
1.4
1.6
1.8
Threshold

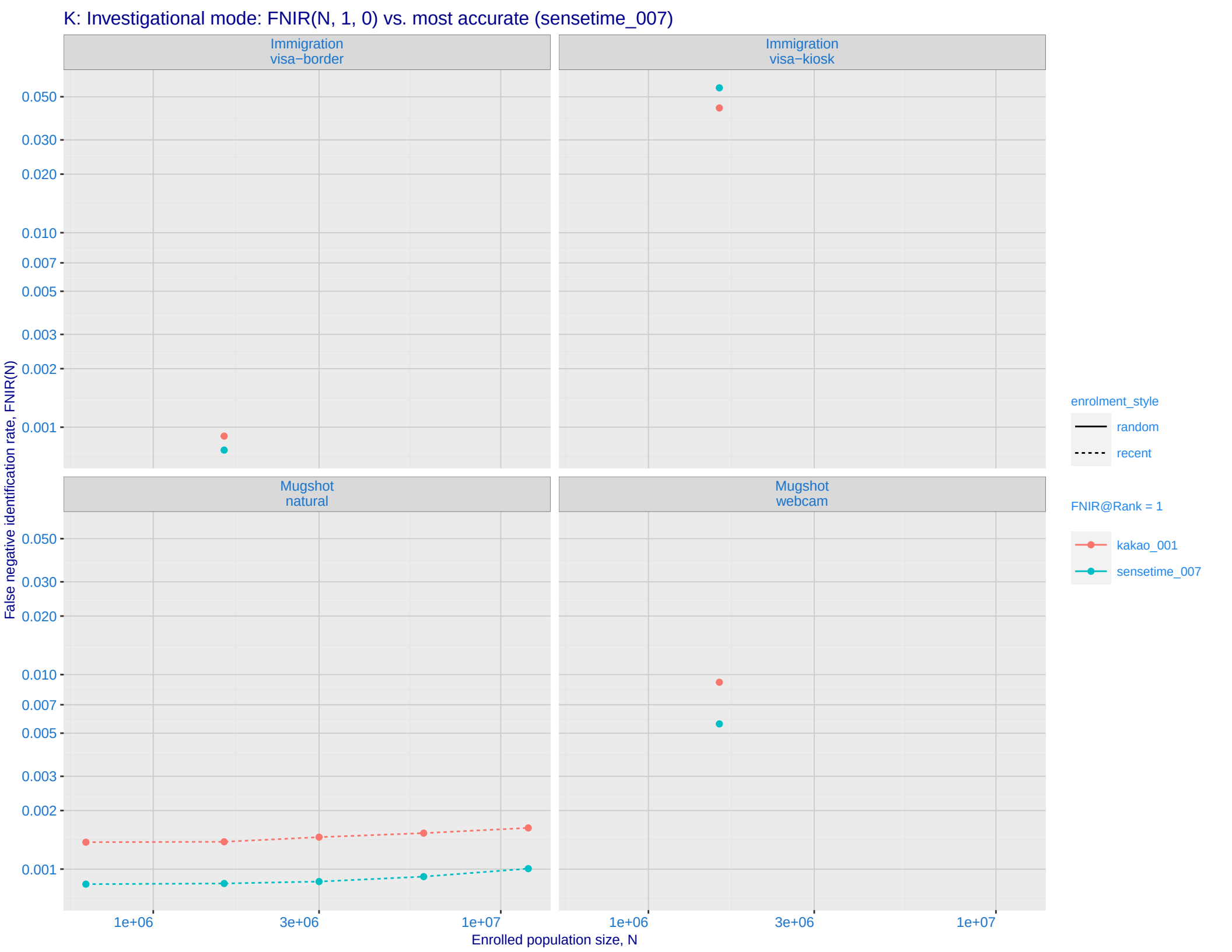

F: FPIR vs. Selectivity for mugshot images, N = 1600000 subjects enrolled with one recent mate
Selectivity, SEL(T)
7e+01
5e+01
3e+01
2e+01
1e+01
7e+00
5e+00
3e+00
2e+00
1e+00
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05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

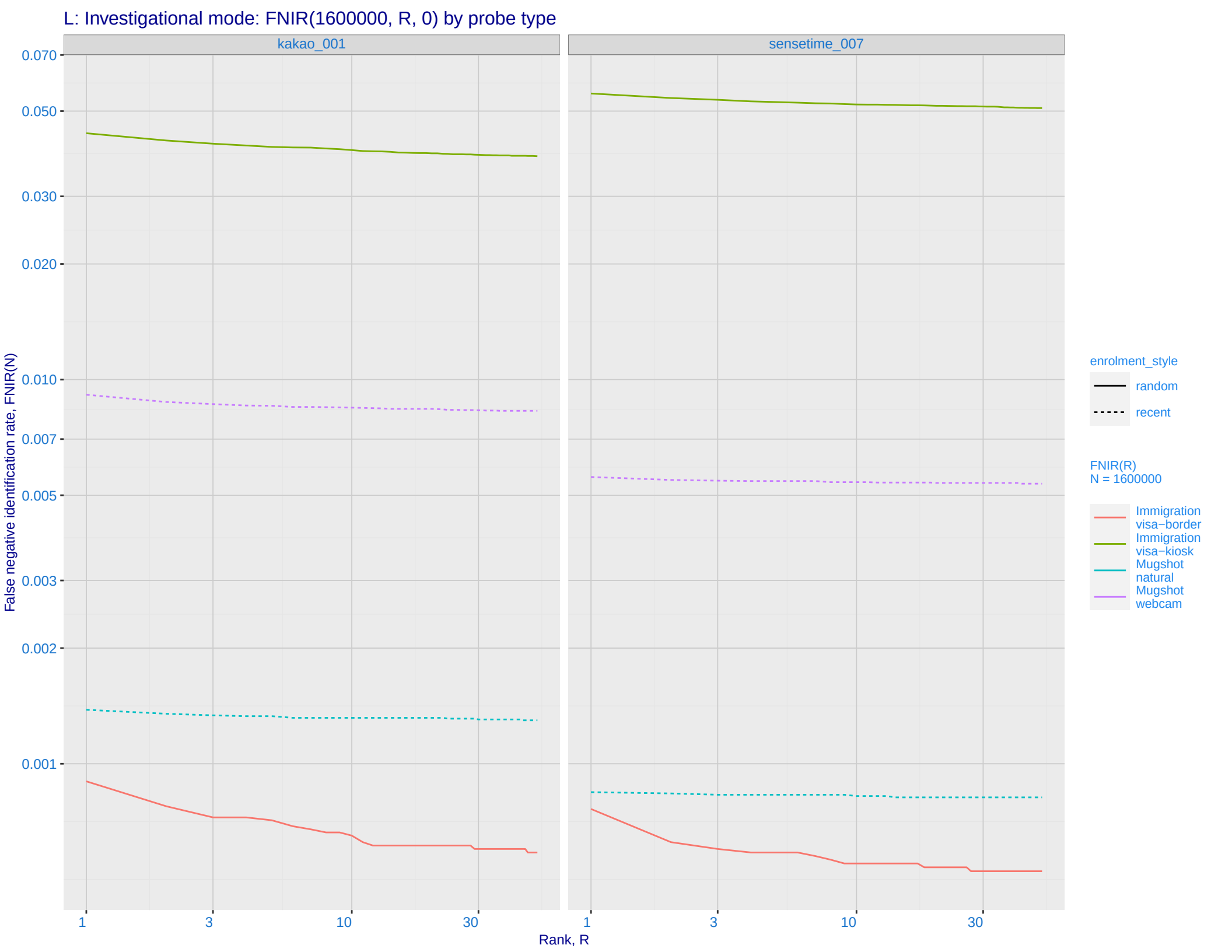

G: FPIR dependence on T by probe type for N = 1600000 subjects
False Positive Identification Rate, FPIR(T)
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05
5e−05
3e−05
2e−05
1e−05
1.2
1.4
1.6
Threshold
Enrolled image:
random
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

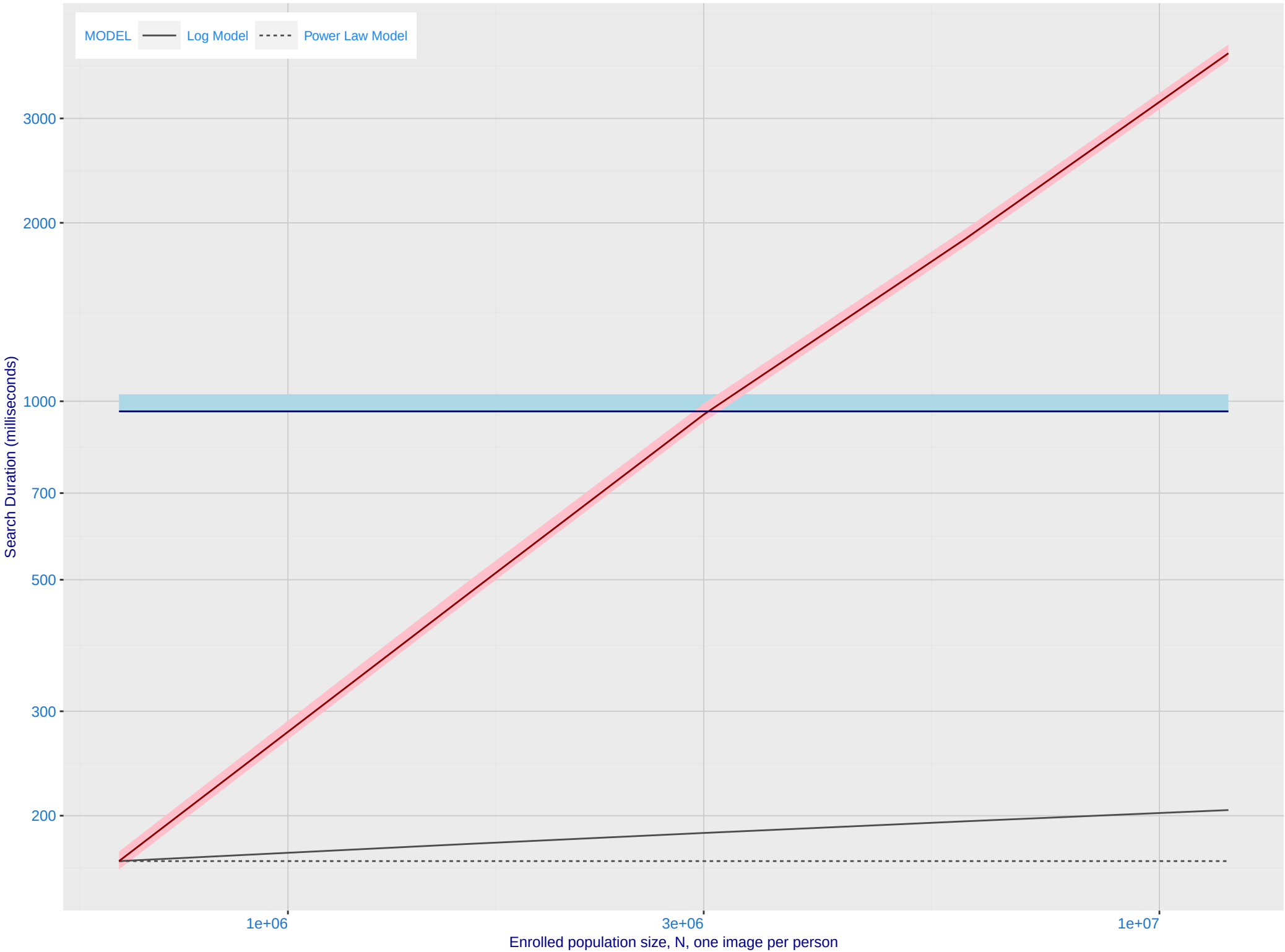

I: FNIR and FPIR dependence on threshold
Dataset is border−border with time−lapse [10,15] YRS with N = 1600000. Probes are 10−15 years later than enrollment image
FNIR(T)
0.400
0.200
0.100
0.040
0.020
0.010
0.004
0.002
FPIR(T)
1e+00
4e−01
2e−01
1e−01
4e−02
2e−02
1e−02
4e−03
2e−03
1e−03
4e−04
2e−04
1e−04
False {Negative | Positive} Identification Rate
1.2
1.3
1.4
1.5
1.6
Threshold value

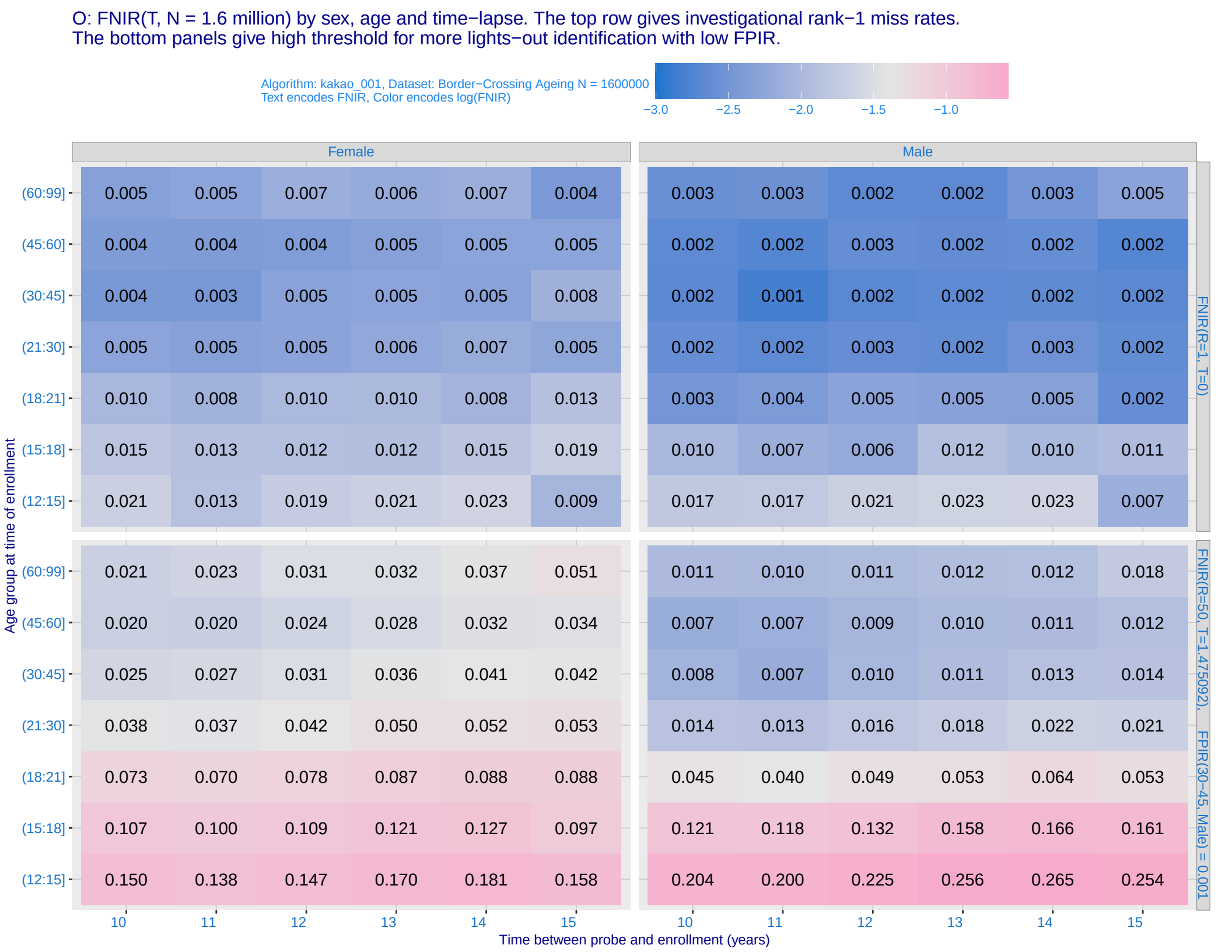

J: DET for Mugshot natural images and various N. Links connect points of equal threshold.
False negative identification rate, FNIR(T)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e−04
3e−04
1e−03
3e−03
1e−02
3e−02
1e−01
3e−01
1e+00
False positive identification rate, FPIR(T)
2018 Mugshot
Enrolled image:
recent
00640000
01600000
03000000
06000000
12000000


K: Investigational mode: FNIR(N, 1, 0) vs. most accurate (sensetime_007)
Immigration
visa−border
Immigration
visa−kiosk
Mugshot
natural
Mugshot
webcam
False negative identification rate, FNIR(N)
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
kakao_001
sensetime_007

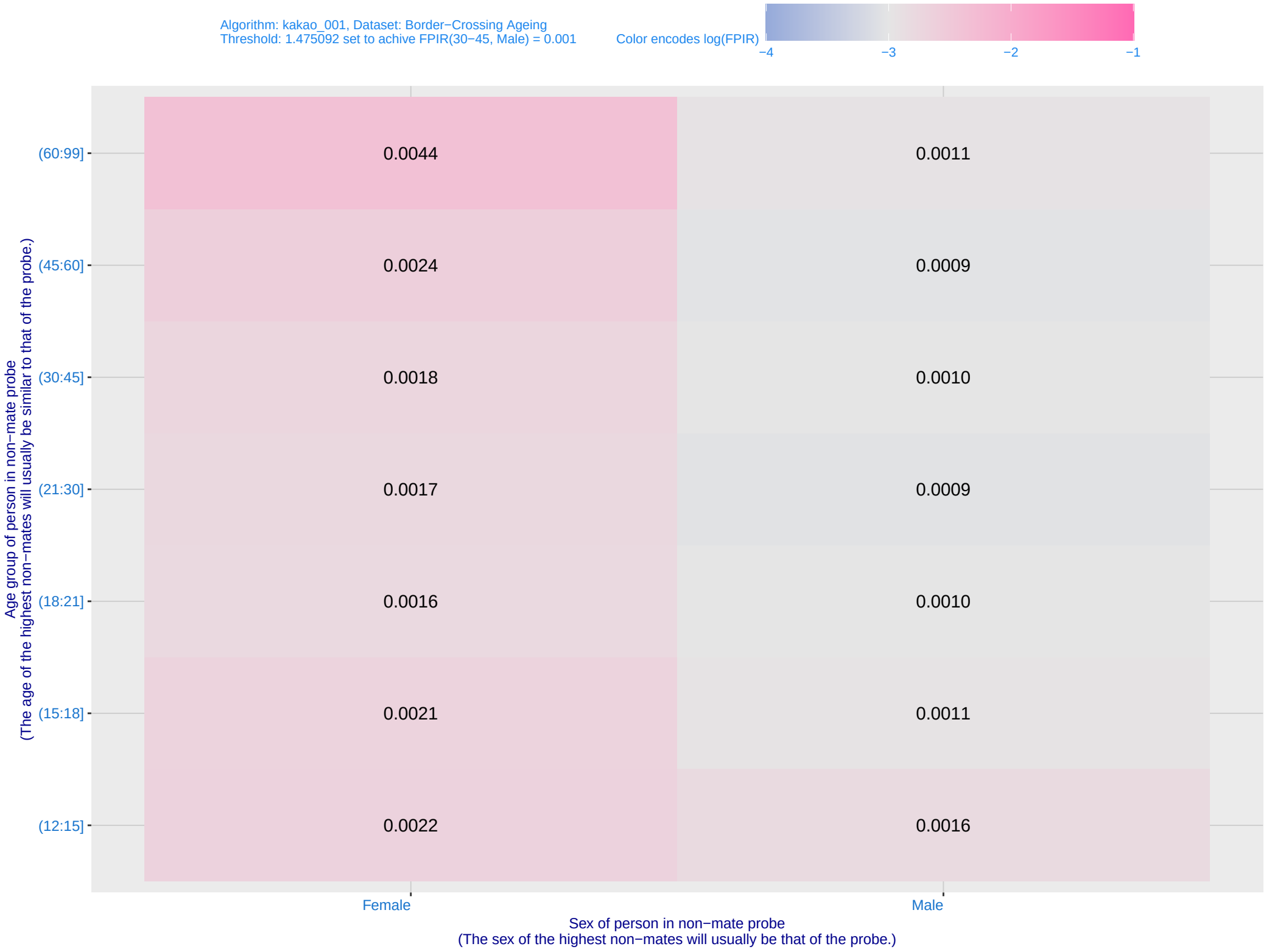

L: Investigational mode: FNIR(1600000, R, 0) by probe type
kakao_001
sensetime_007
False negative identification rate, FNIR(N)
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1
3
10
30
Rank, R
enrolment_style
random
recent
FNIR(R)
N = 1600000
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
Mugshot webcam

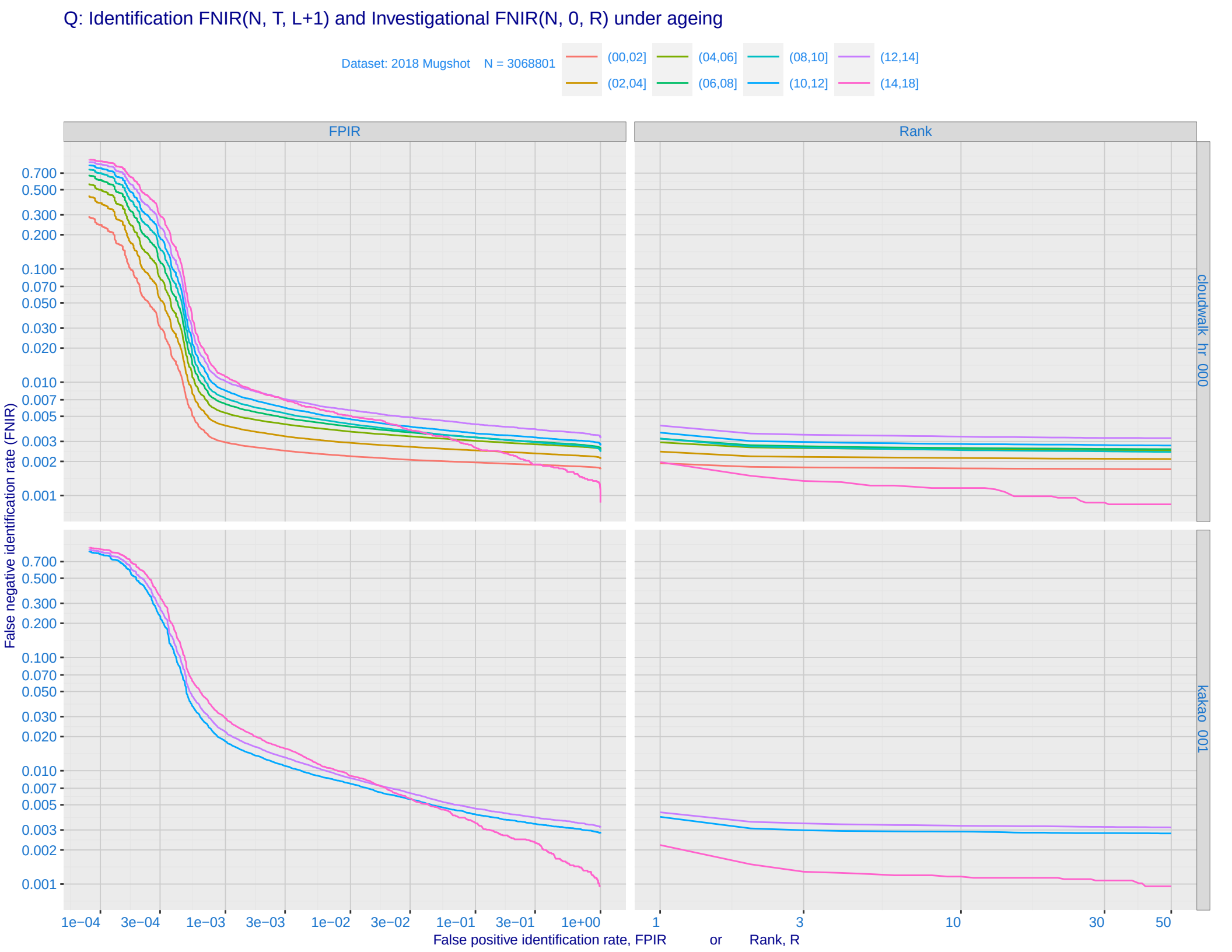
M: Template duration; search duration vs. N. The blue and pink ribbon covers 95 percent of observed measurements.
The template generation time is independent of N. The log and power−law models are fit to the first two (N,T) observations




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: kakao_001, Dataset: Border−Crossing Ageing N = 1600000
Text encodes FNIR, Color encodes log(FNIR)
−3.0
−2.5
−2.0
−1.5
−1.0
Female
Male
FNIR(R=1, T=0)
FNIR(R=50, T=1.475092), FPIR(30−45, Male) = 0.001
Age group at time of enrollment
(60:99]
(45:60]
(30:45]
(21:30]
(18:21]
(15:18]
(12:15]
0.005 0.005 0.007 0.006 0.007 0.004
0.004 0.004 0.004 0.005 0.005 0.005
0.004 0.003 0.005 0.005 0.005 0.008
0.005 0.005 0.005 0.006 0.007 0.005
0.010 0.008 0.010 0.010 0.008 0.013
0.015 0.013 0.012 0.012 0.015 0.019
0.021 0.013 0.019 0.021 0.023 0.009
0.003 0.003 0.002 0.002 0.003 0.005
0.002 0.002 0.003 0.002 0.002 0.002
0.002 0.001 0.002 0.002 0.002 0.002
0.002 0.002 0.003 0.002 0.003 0.002
0.003 0.004 0.005 0.005 0.005 0.002
0.010 0.007 0.006 0.012 0.010 0.011
0.017 0.017 0.021 0.023 0.023 0.007
0.021 0.023 0.031 0.032 0.037 0.051
0.020 0.020 0.024 0.028 0.032 0.034
0.025 0.027 0.031 0.036 0.041 0.042
0.038 0.037 0.042 0.050 0.052 0.053
0.073 0.070 0.078 0.087 0.088 0.088
0.107 0.100 0.109 0.121 0.127 0.097
0.150 0.138 0.147 0.170 0.181 0.158
0.011 0.010 0.011 0.012 0.012 0.018
0.007 0.007 0.009 0.010 0.011 0.012
0.008 0.007 0.010 0.011 0.013 0.014
0.014 0.013 0.016 0.018 0.022 0.021
0.045 0.040 0.049 0.053 0.064 0.053
0.121 0.118 0.132 0.158 0.166 0.161
0.204 0.200 0.225 0.256 0.265 0.254
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
Dataset: 2018 Mugshot N = 3068801
(00,02]
(02,04]
(04,06]
(06,08]
(08,10]
(10,12]
(12,14]
(14,18]
FPIR
Rank
cloudwalk hr 000
kakao 001
False negative identification rate (FNIR)
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
1
3
10
30
50
False positive identification rate, FPIR or Rank, R

R: Decline of genuine scores with ageing, with some eventually dropping below typical thresholds shown by the horizontal lines