A: Datasheet

Algorithm: nec_004

Developer: NEC

Submission Date: 2021_07_19

Template size: 1104 bytes

Template time (2.5 percentile): 961 msec

Template time (median): 965 msec

Template time (97.5 percentile): 986 msec

Investigation:

Frontal mugshot ranking 17 (out of 307) −− FNIR(1600000, 0, 1) = 0.0014 vs. lowest 0.0009 from sensetime_006

Mugshot webcam ranking 14 (out of 269) −− FNIR(1600000, 0, 1) = 0.0087 vs. lowest 0.0057 from sensetime_006

Mugshot profile ranking 84 (out of 238) −− FNIR(1600000, 0, 1) = 0.5380 vs. lowest 0.0550 from sensetime_006

Immigration visa−border ranking 30 (out of 196) −− FNIR(1600000, 0, 1) = 0.0029 vs. lowest 0.0009 from sensetime_006

Immigration visa−kiosk ranking 14 (out of 193) −− FNIR(1600000, 0, 1) = 0.0752 vs. lowest 0.0487 from cubox_000

Identification:

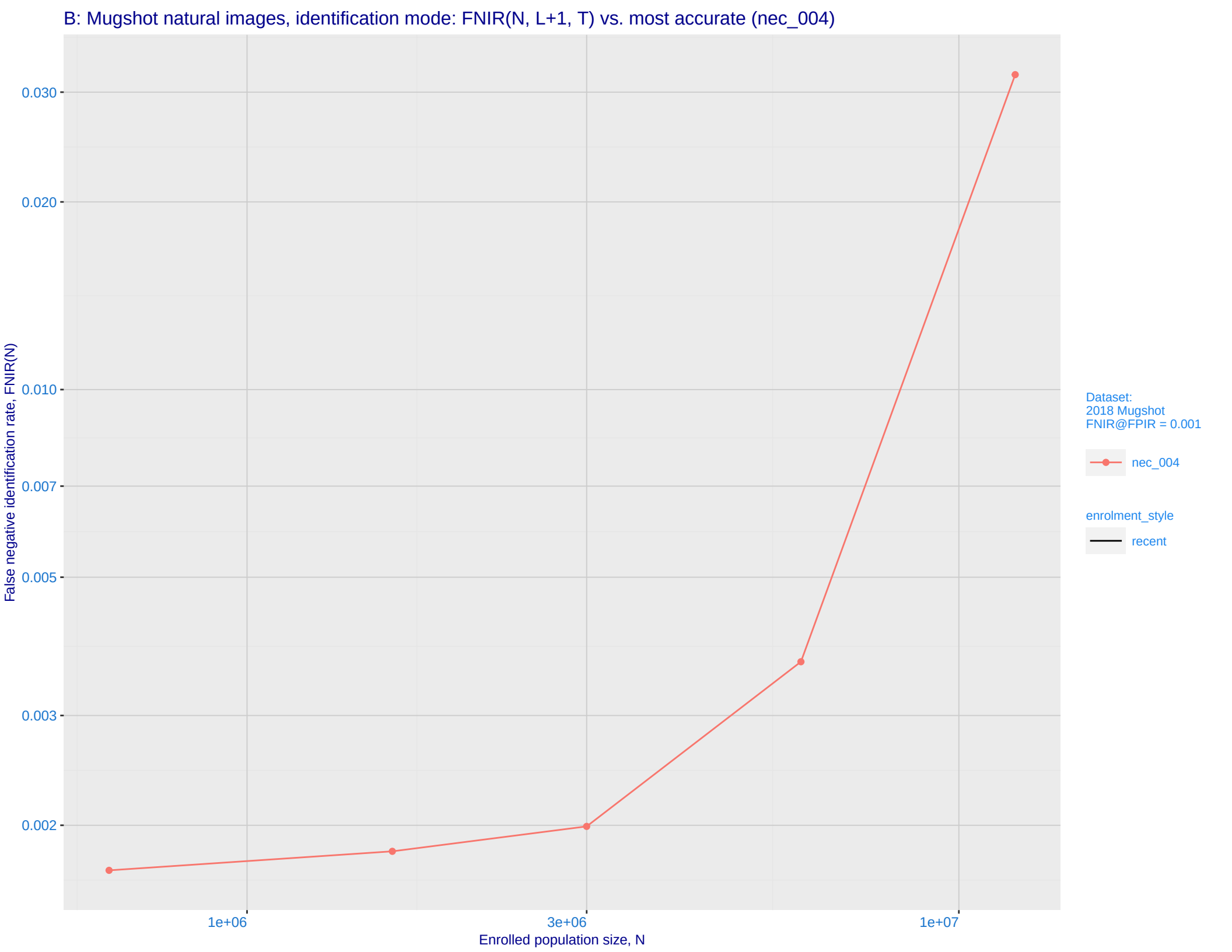
Frontal mugshot ranking 3 (out of 307) −− FNIR(1600000, T, L+1) = 0.0018, FPIR=0.001000 vs. lowest 0.0018 from sensetime_004

Mugshot webcam ranking 4 (out of 267) −− FNIR(1600000, T, L+1) = 0.0129, FPIR=0.001000 vs. lowest 0.0122 from sensetime_003

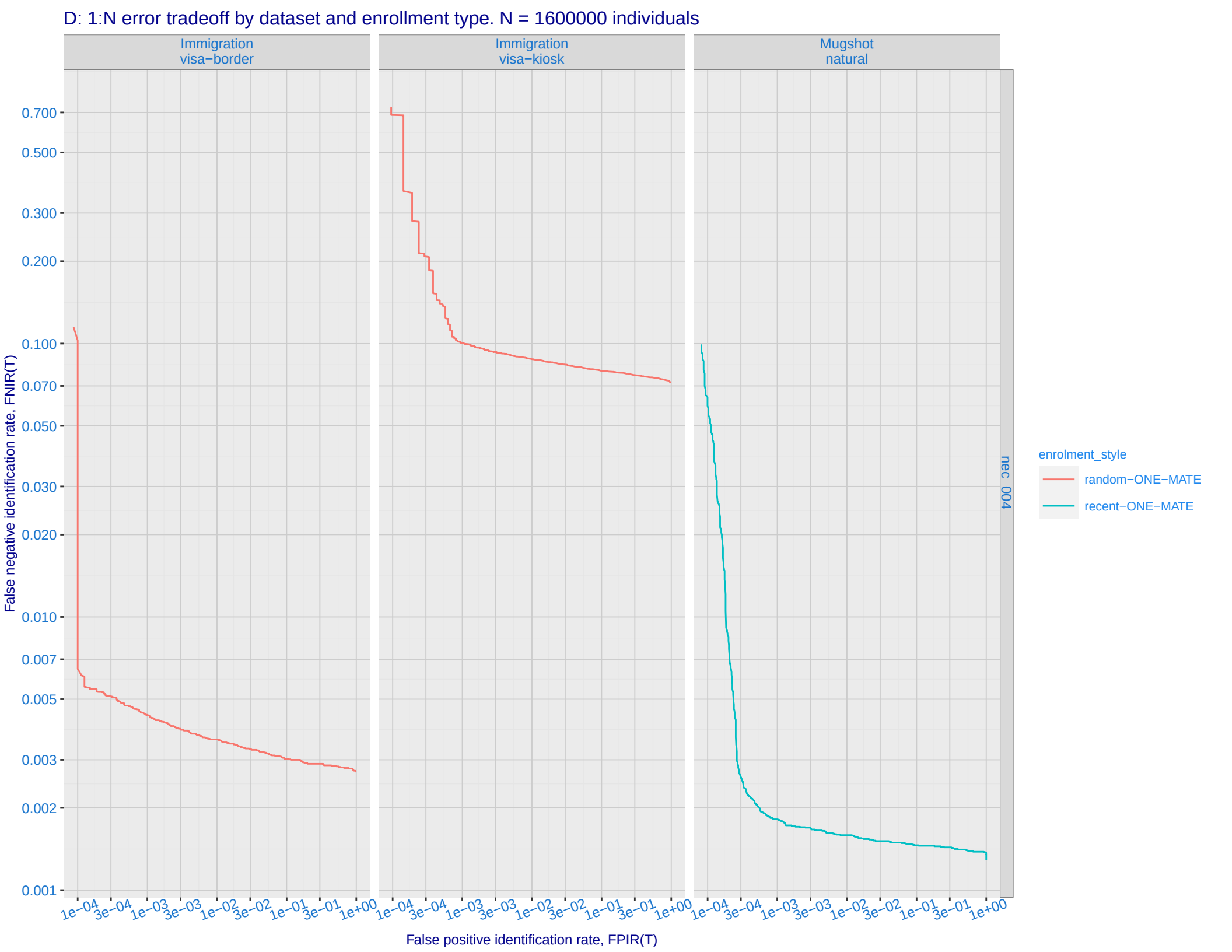
Mugshot profile ranking 24 (out of 237) −− FNIR(1600000, T, L+1) = 0.6220, FPIR=0.001000 vs. lowest 0.1331 from cloudwalk_hr_000

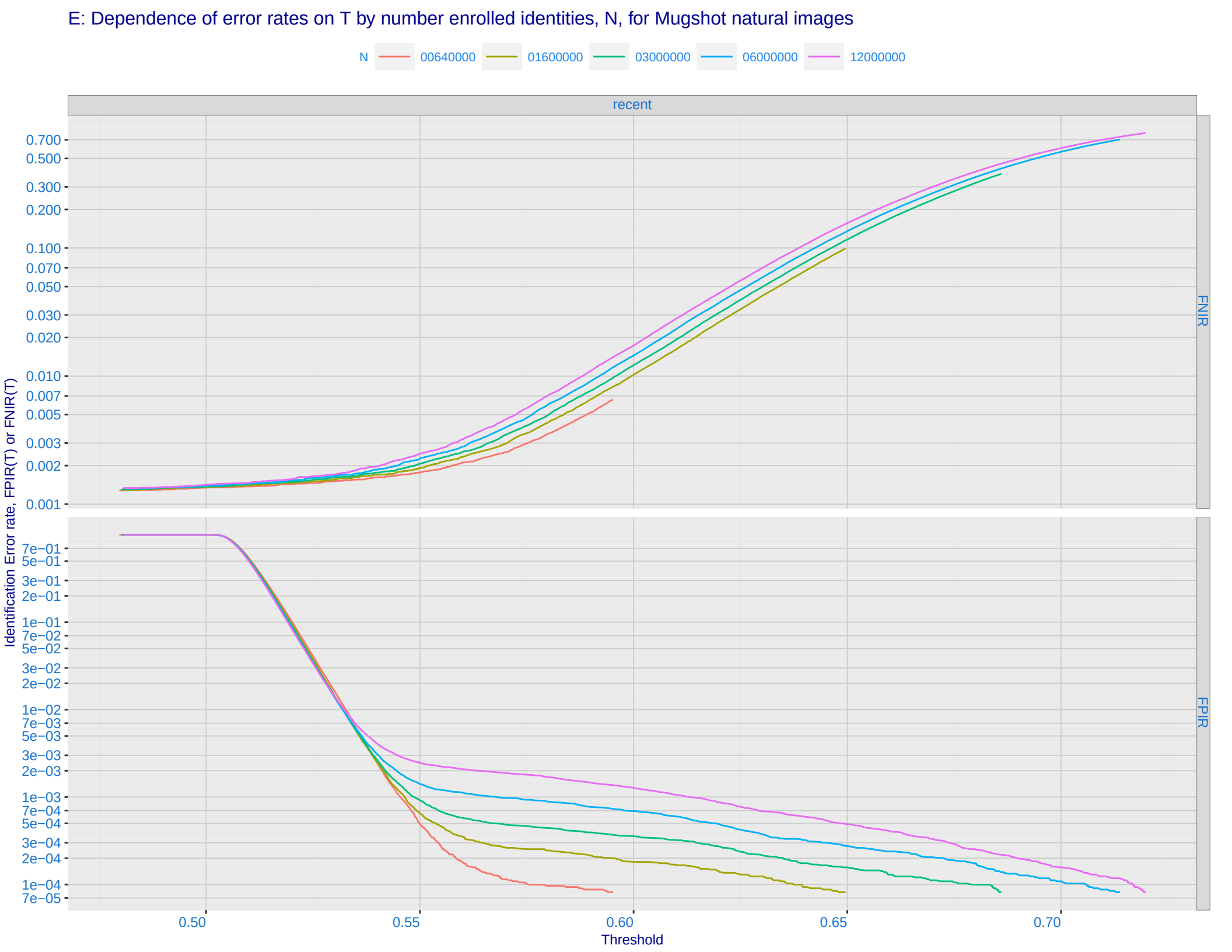
Immigration visa−border ranking 3 (out of 195) −− FNIR(1600000, T, L+1) = 0.0044, FPIR=0.001000 vs. lowest 0.0039 from sensetime_006

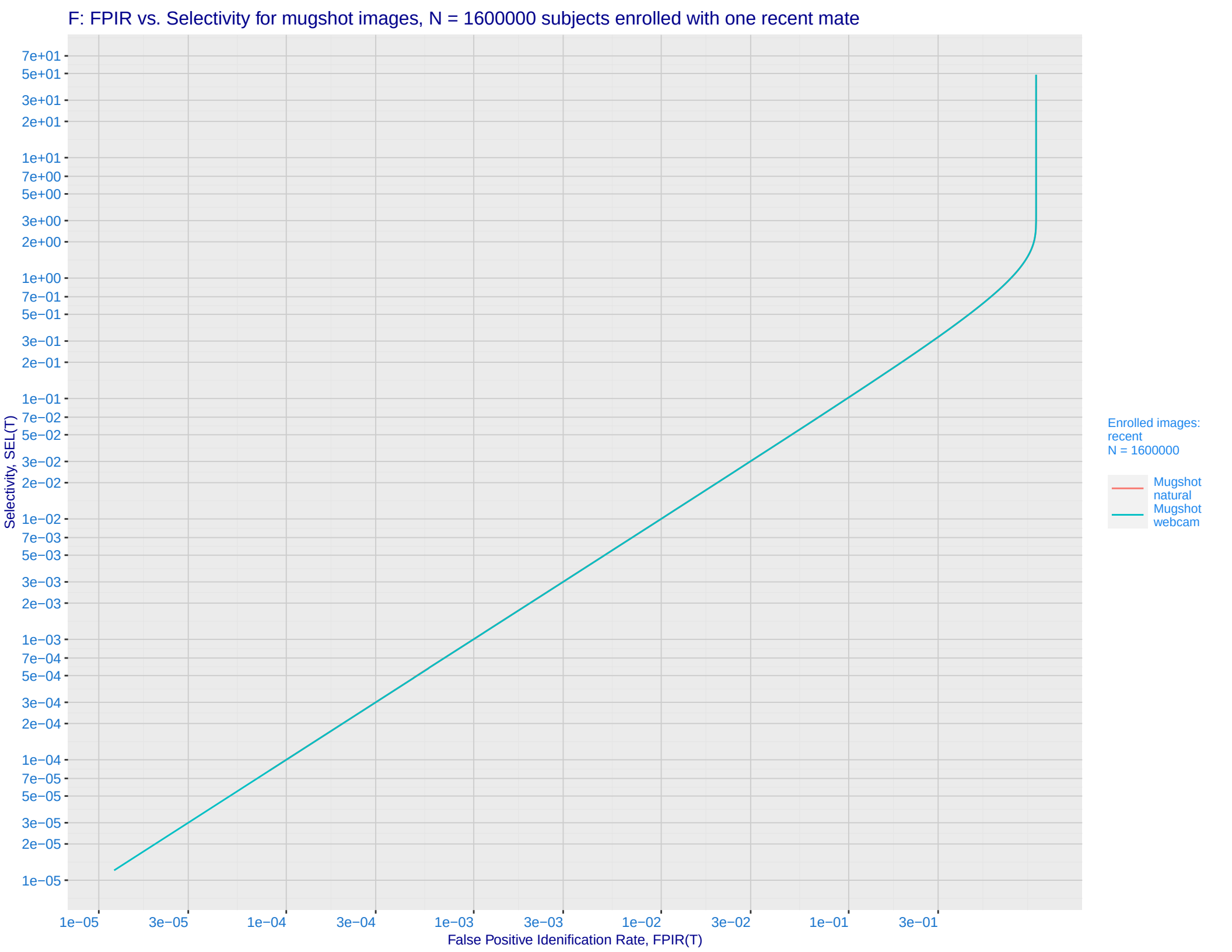
Immigration visa−kiosk ranking 6 (out of 190) −− FNIR(1600000, T, L+1) = 0.1004, FPIR=0.001000 vs. lowest 0.0729 from cubox_000

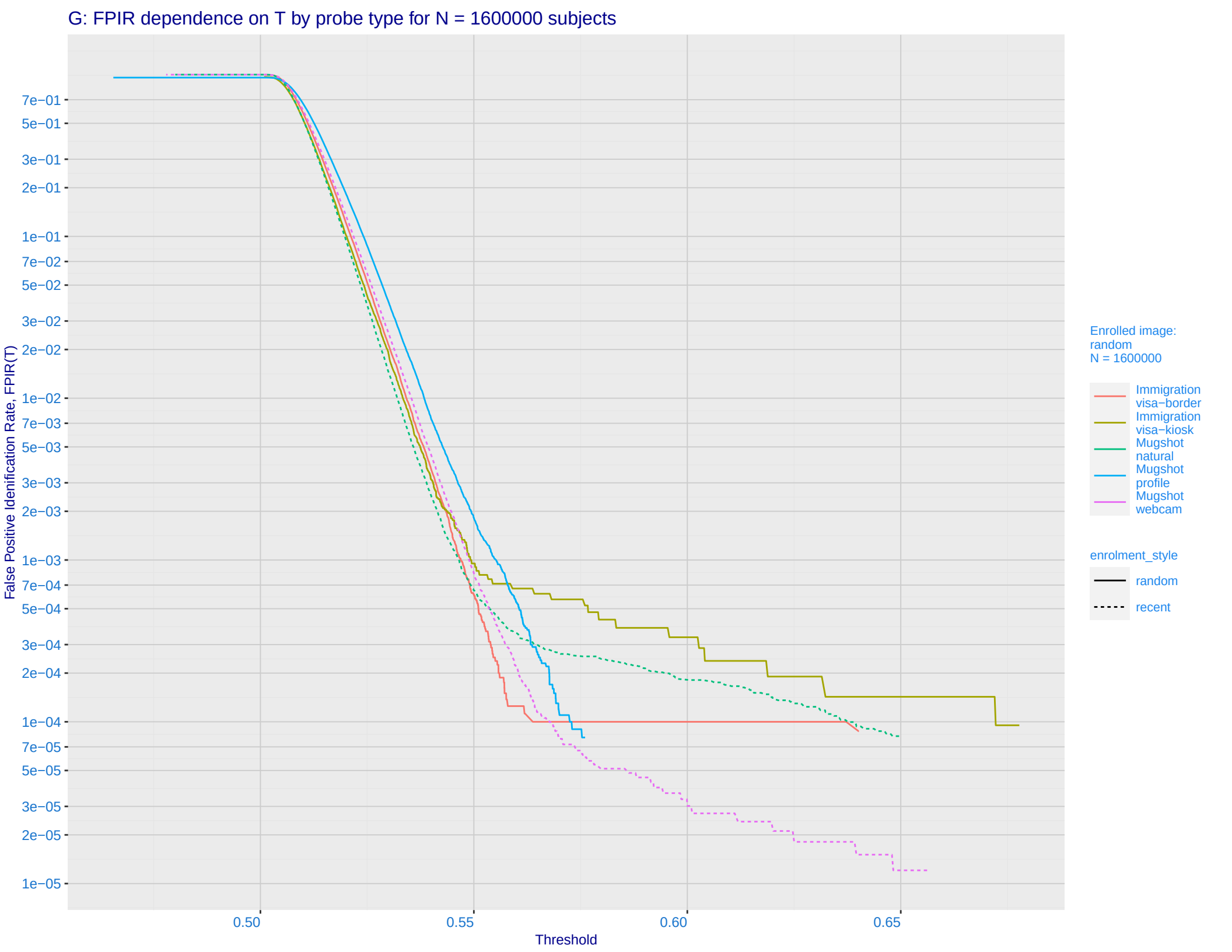

B: Mugshot natural images, identification mode: FNIR(N, L+1, T) vs. most accurate (nec_004)
False negative identification rate, FNIR(N)
0.030
0.020
0.010
0.007
0.005
0.003
0.002
1e+06
3e+06
1e+07
Enrolled population size, N
Dataset:
2018 Mugshot
FNIR@FPIR = 0.001
nec_004
enrolment_style
recent

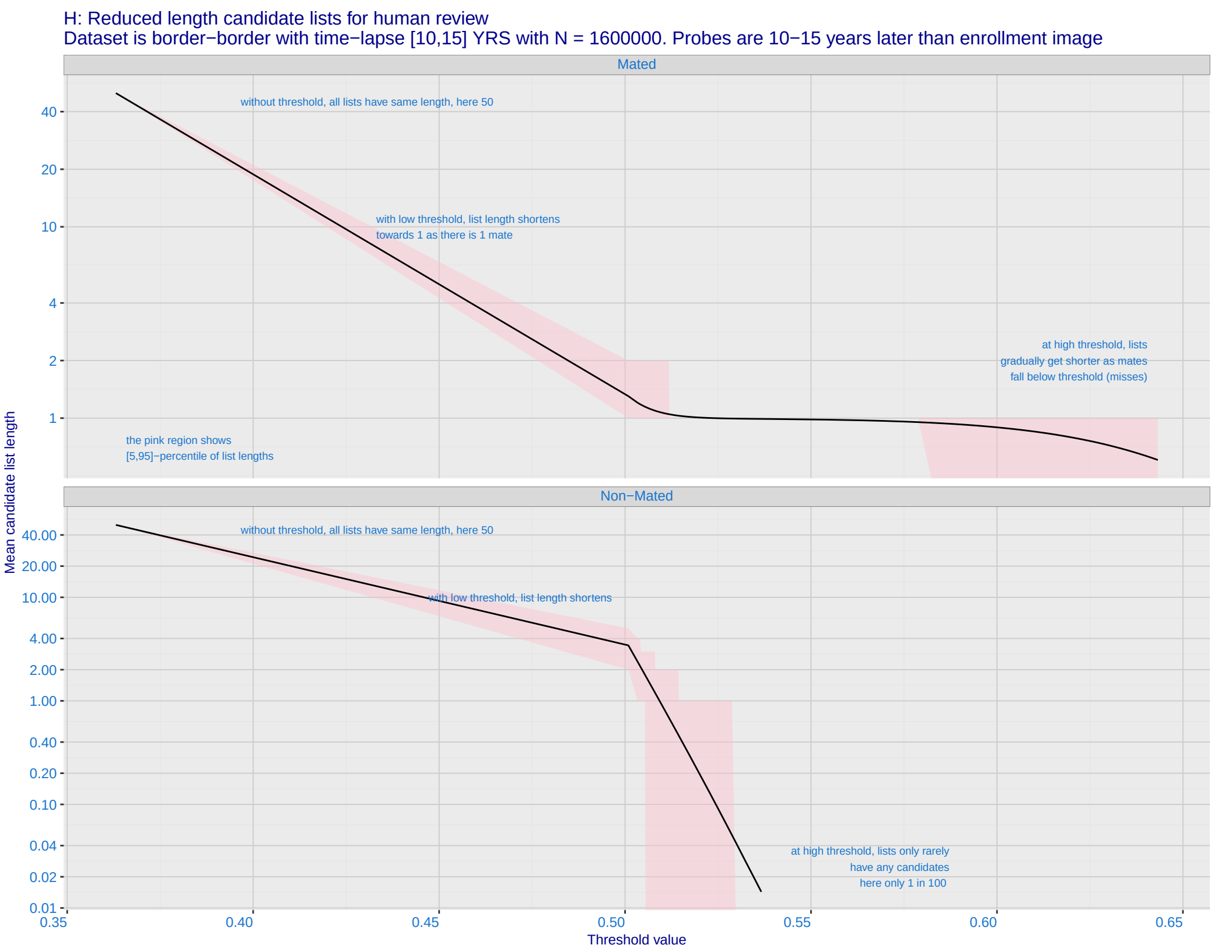
C: Evolution of accuracy for NEC algorithms on three datasets 2018 − present

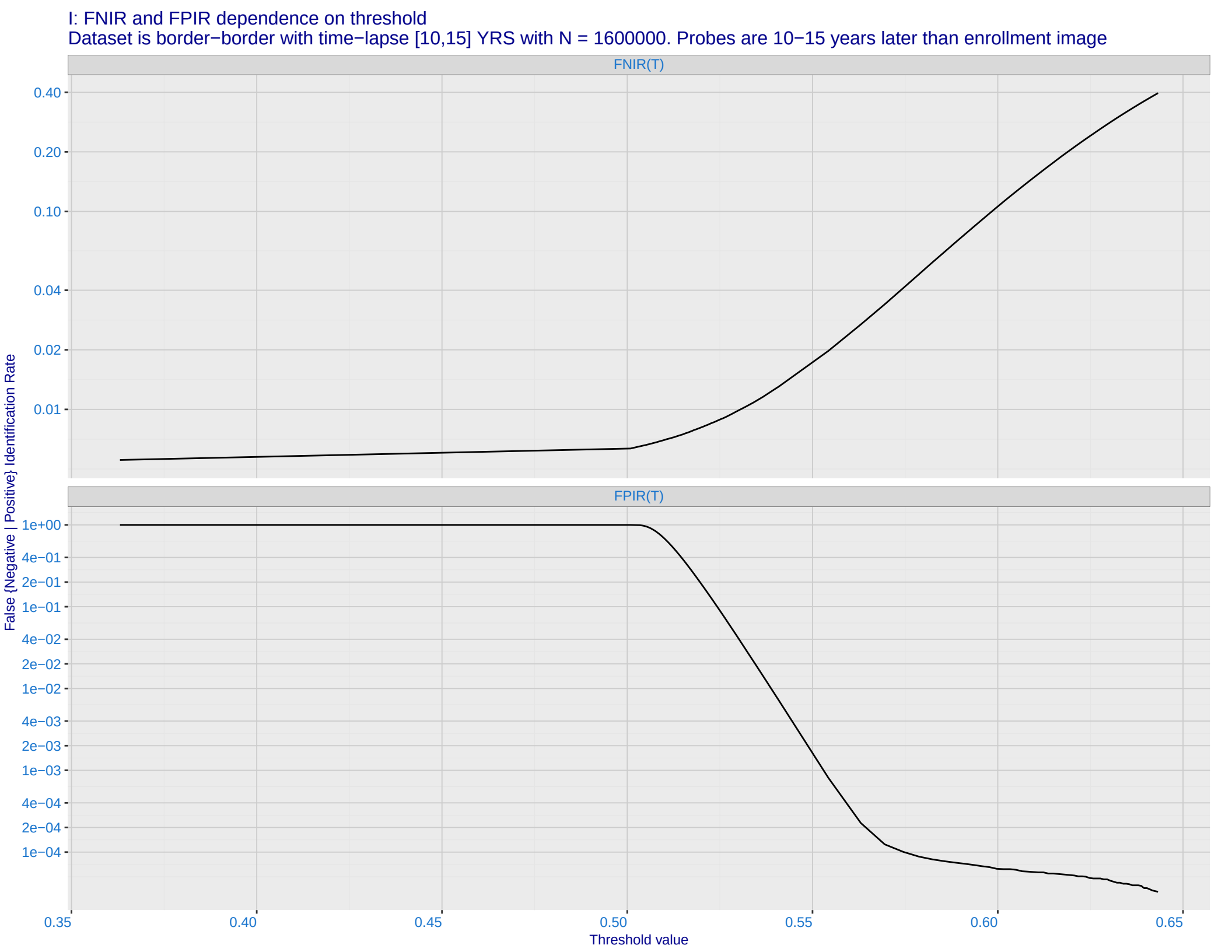

D: 1:N error tradeoff by dataset and enrollment type. N = 1600000 individuals
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
nec 004
False negative identification rate, FNIR(T)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e−04
3e−04
1e−03
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

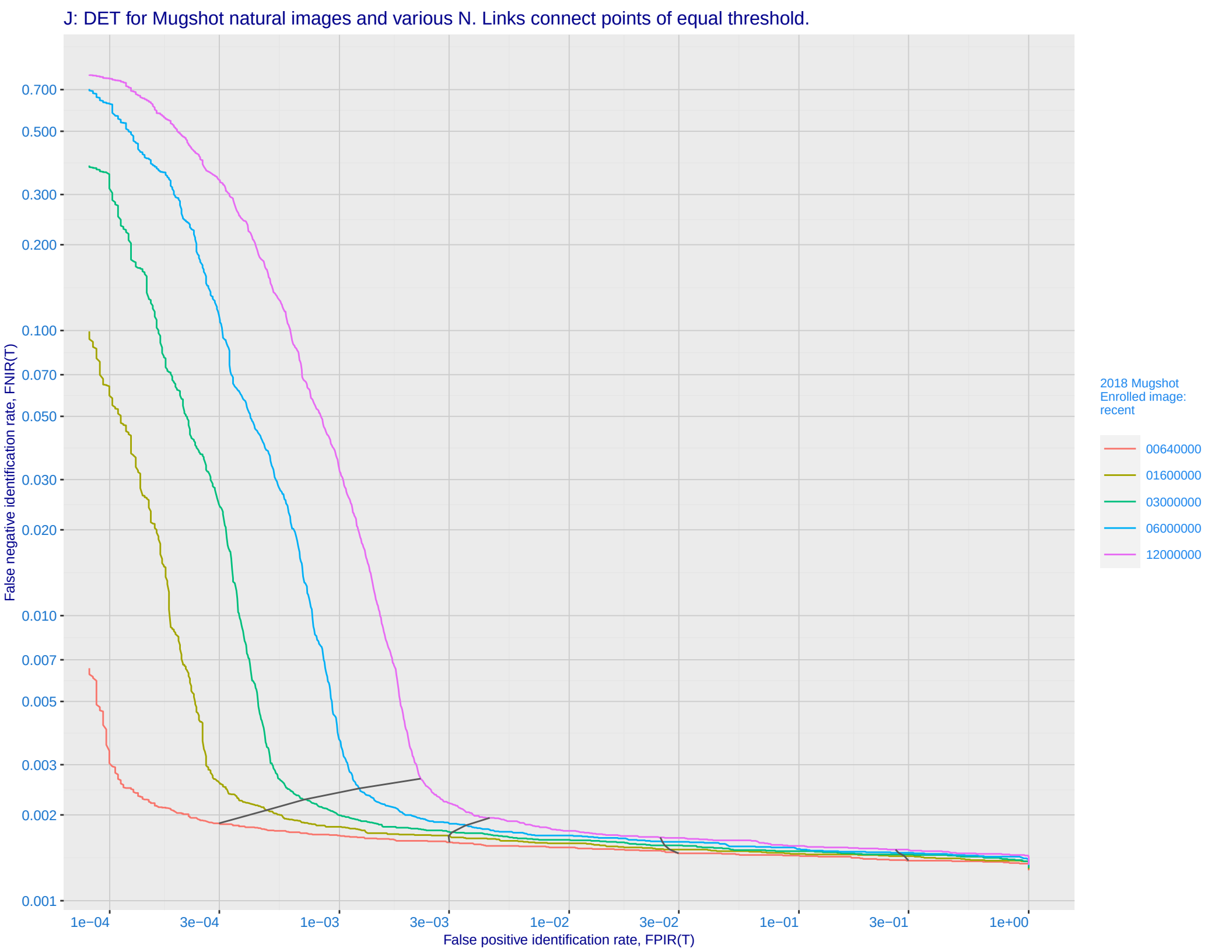

E: Dependence of error rates on T by number enrolled identities, N, for Mugshot natural images
N
00640000
01600000
03000000
06000000
12000000
recent
FNIR
FPIR
Identification Error rate, FPIR(T) or FNIR(T)
0.700
0.500
0.300
0.200
0.100
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
7e−01
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
0.50
0.55
0.60
0.65
0.70
Threshold

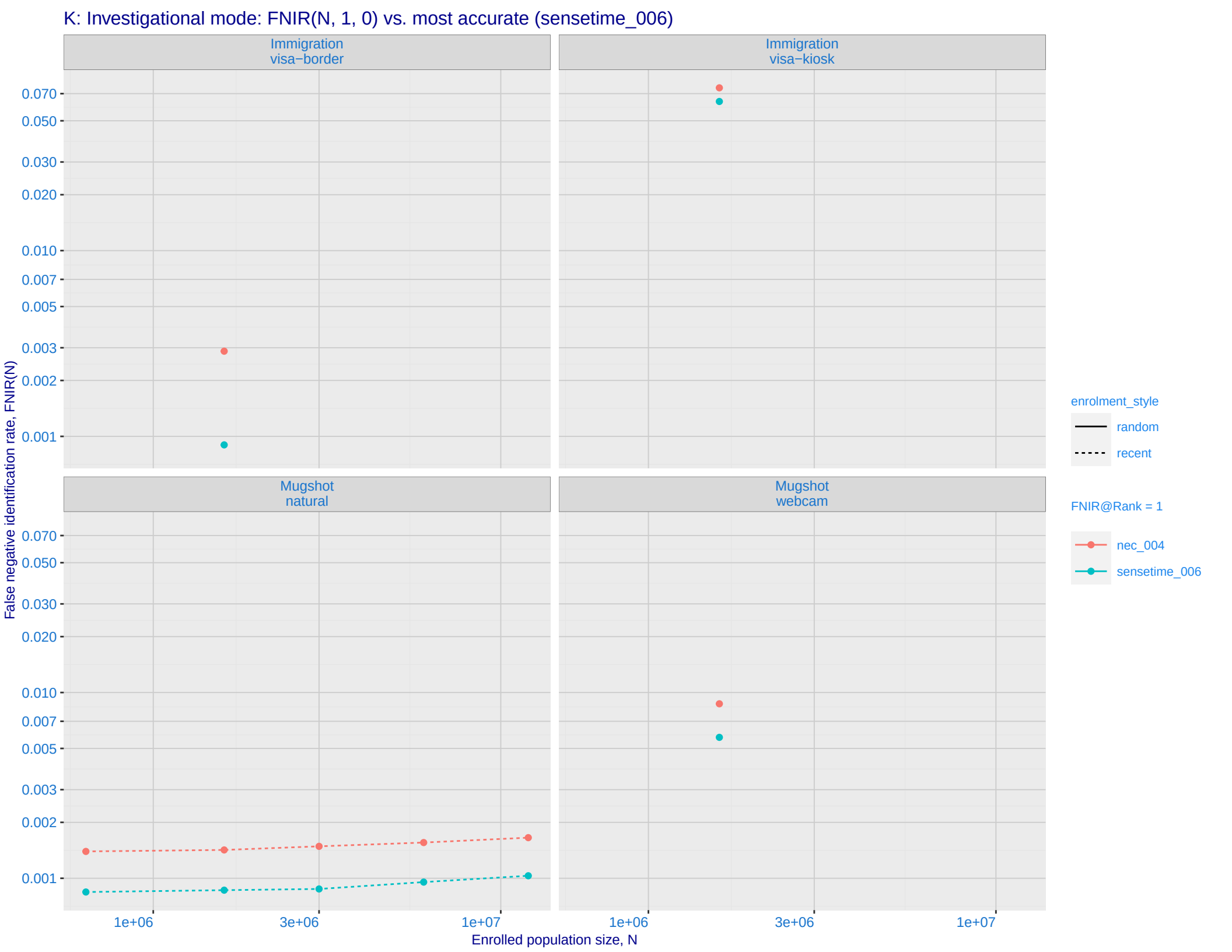

F: FPIR vs. Selectivity for mugshot images, N = 1600000 subjects enrolled with one recent mate
Selectivity, SEL(T)
7e+01
5e+01
3e+01
2e+01
1e+01
7e+00
5e+00
3e+00
2e+00
1e+00
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05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

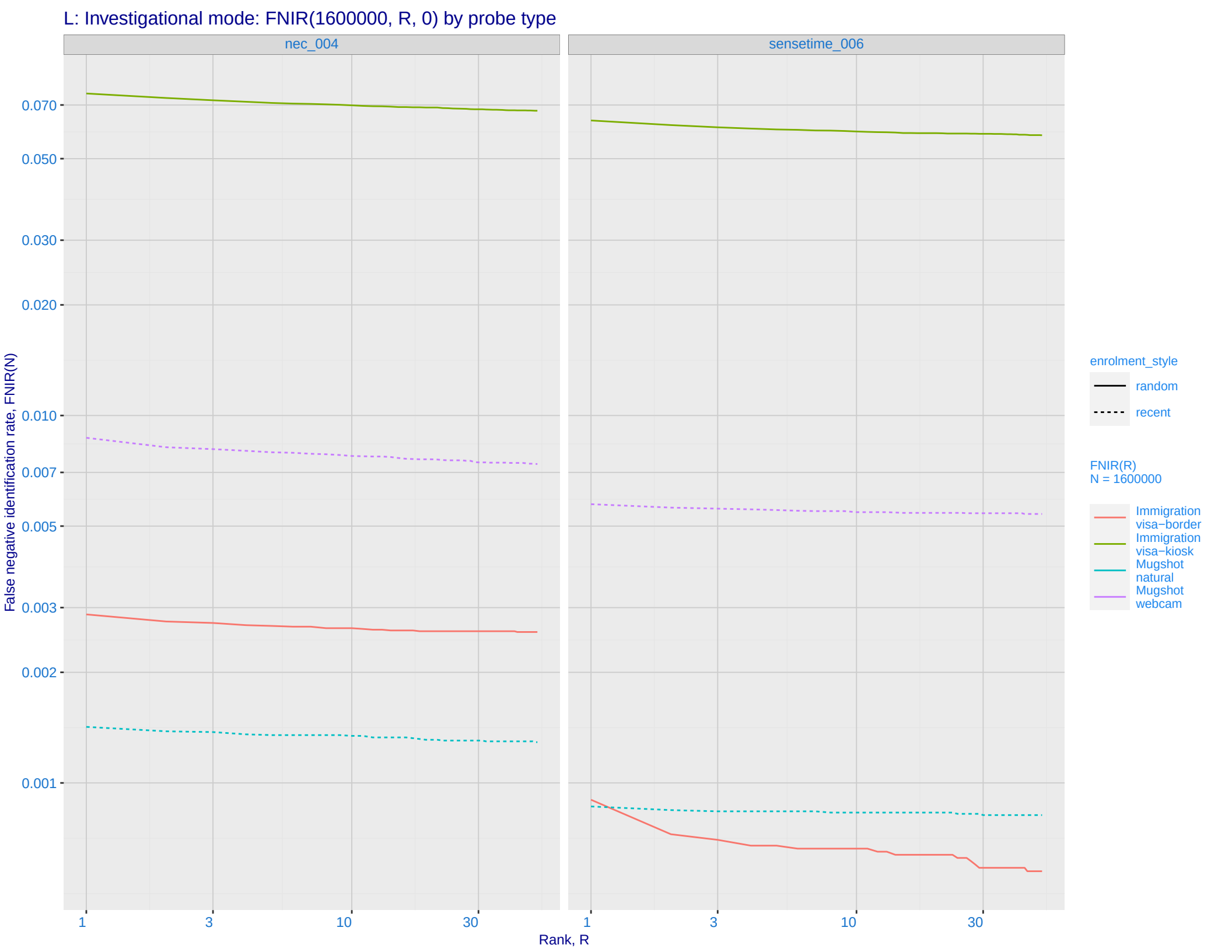

G: FPIR dependence on T by probe type for N = 1600000 subjects
False Positive Idenification Rate, FPIR(T)
7e−01
5e−01
3e−01
2e−01
1e−01
7e−02
5e−02
3e−02
2e−02
1e−02
7e−03
5e−03
3e−03
2e−03
1e−03
7e−04
5e−04
3e−04
2e−04
1e−04
7e−05
5e−05
3e−05
2e−05
1e−05
0.50
0.55
0.60
0.65
Threshold
Enrolled image:
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

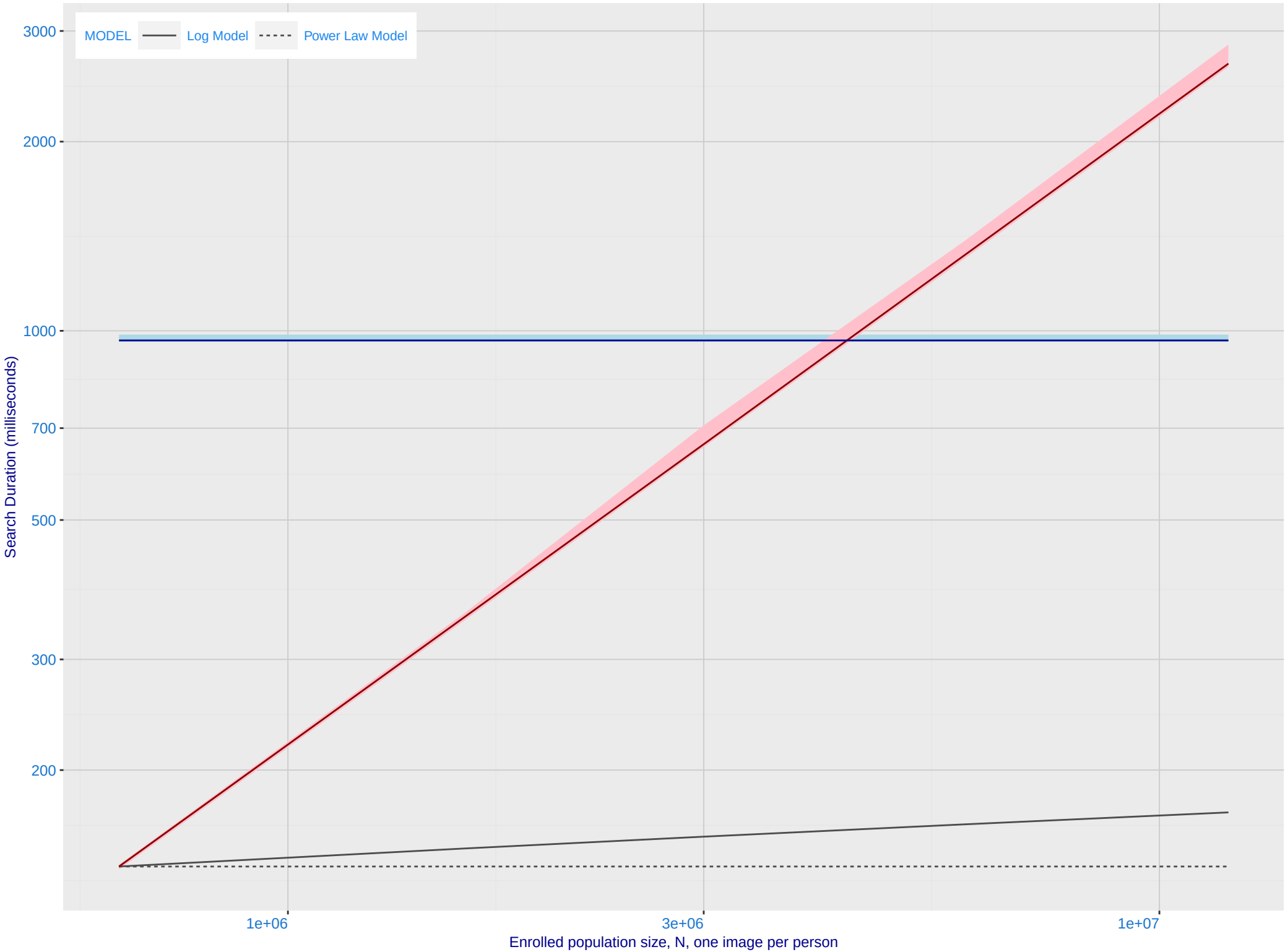

I: FNIR and FPIR dependence on threshold
Dataset is border−border with time−lapse [10,15] YRS with N = 1600000. Probes are 10−15 years later than enrollment image
FNIR(T)
FPIR(T)
False {Negative | Positive} Identification Rate
0.40
0.20
0.10
0.04
0.02
0.01
1e+00
4e−01
2e−01
1e−01
4e−02
2e−02
1e−02
4e−03
2e−03
1e−03
4e−04
2e−04
1e−04
0.35
0.40
0.45
0.50
0.55
0.60
0.65
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

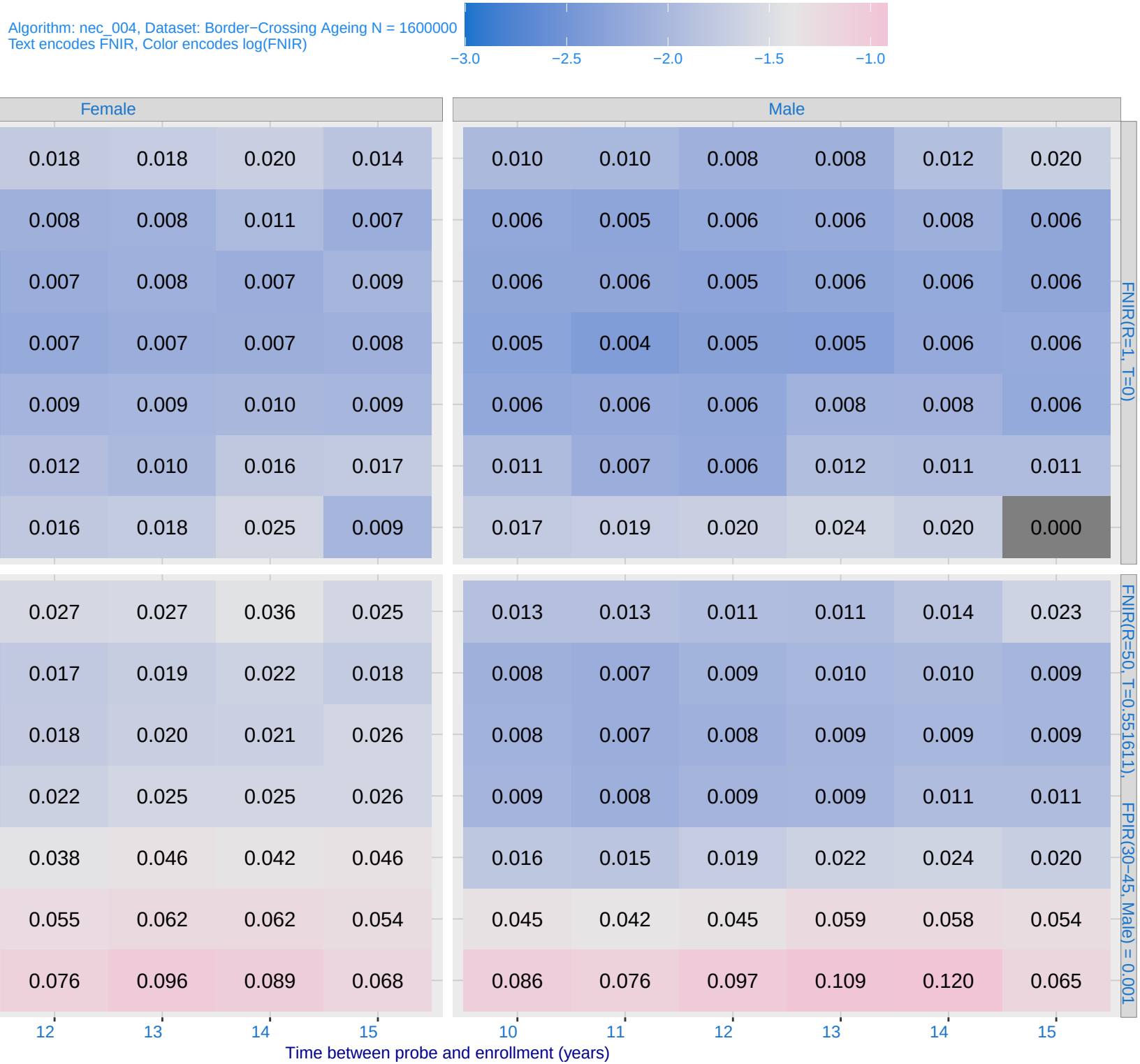

K: Investigational mode: FNIR(N, 1, 0) vs. most accurate (sensetime_006)
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
Mugshot webcam
False negative identification rate, FNIR(N)
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1e+06
3e+06
1e+07
Enrolled population size, N
enrolment_style
random
recent
FNIR@Rank = 1
nec_004
sensetime_006

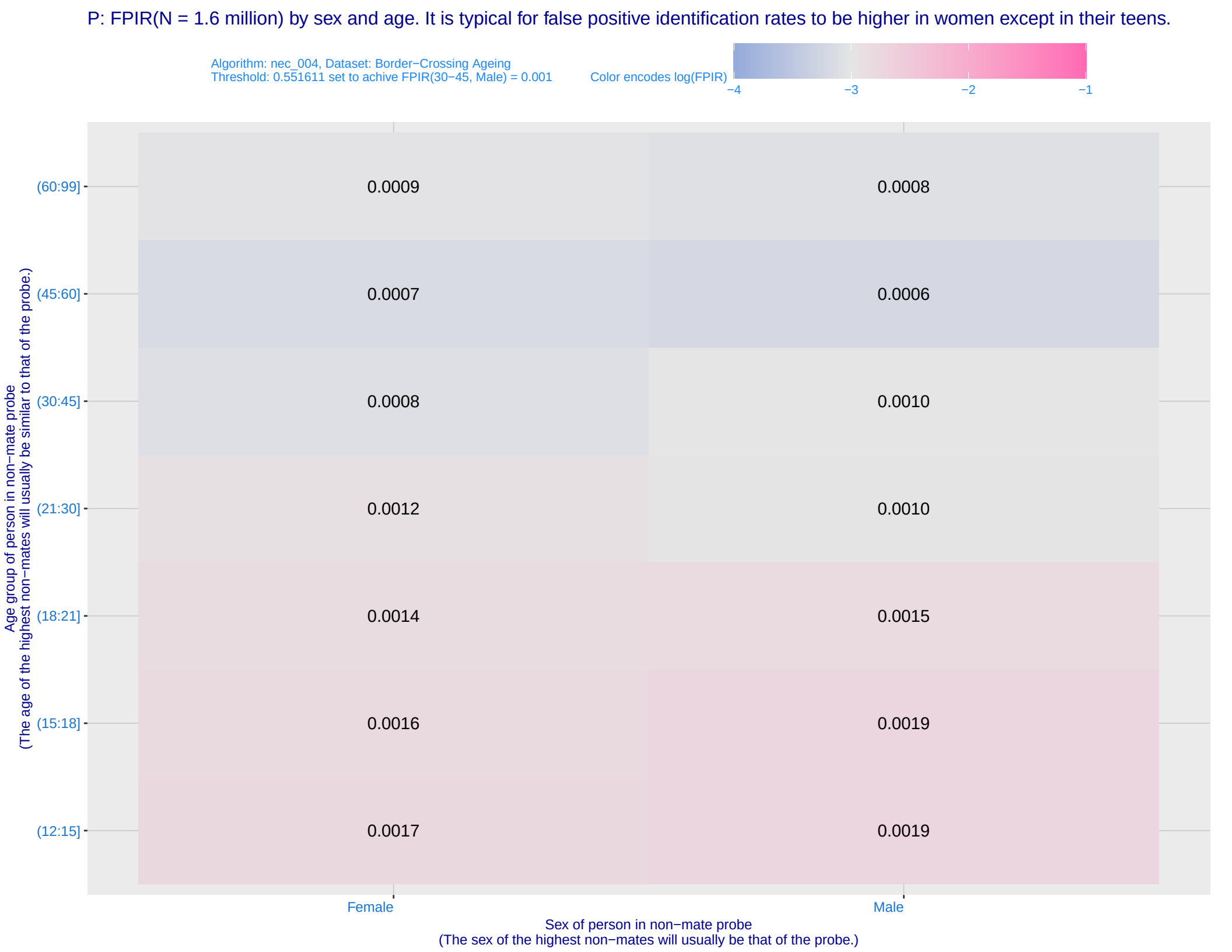

L: Investigational mode: FNIR(1600000, R, 0) by probe type
nec_004
sensetime_006
False negative identification rate, FNIR(N)
0.070
0.050
0.030
0.020
0.010
0.007
0.005
0.003
0.002
0.001
1
3
10
30
Rank, R
enrolment_style
random
recent
FNIR(R)
N = 1600000
Immigration visa−border
Immigration visa−kiosk
Mugshot natural
Mugshot webcam

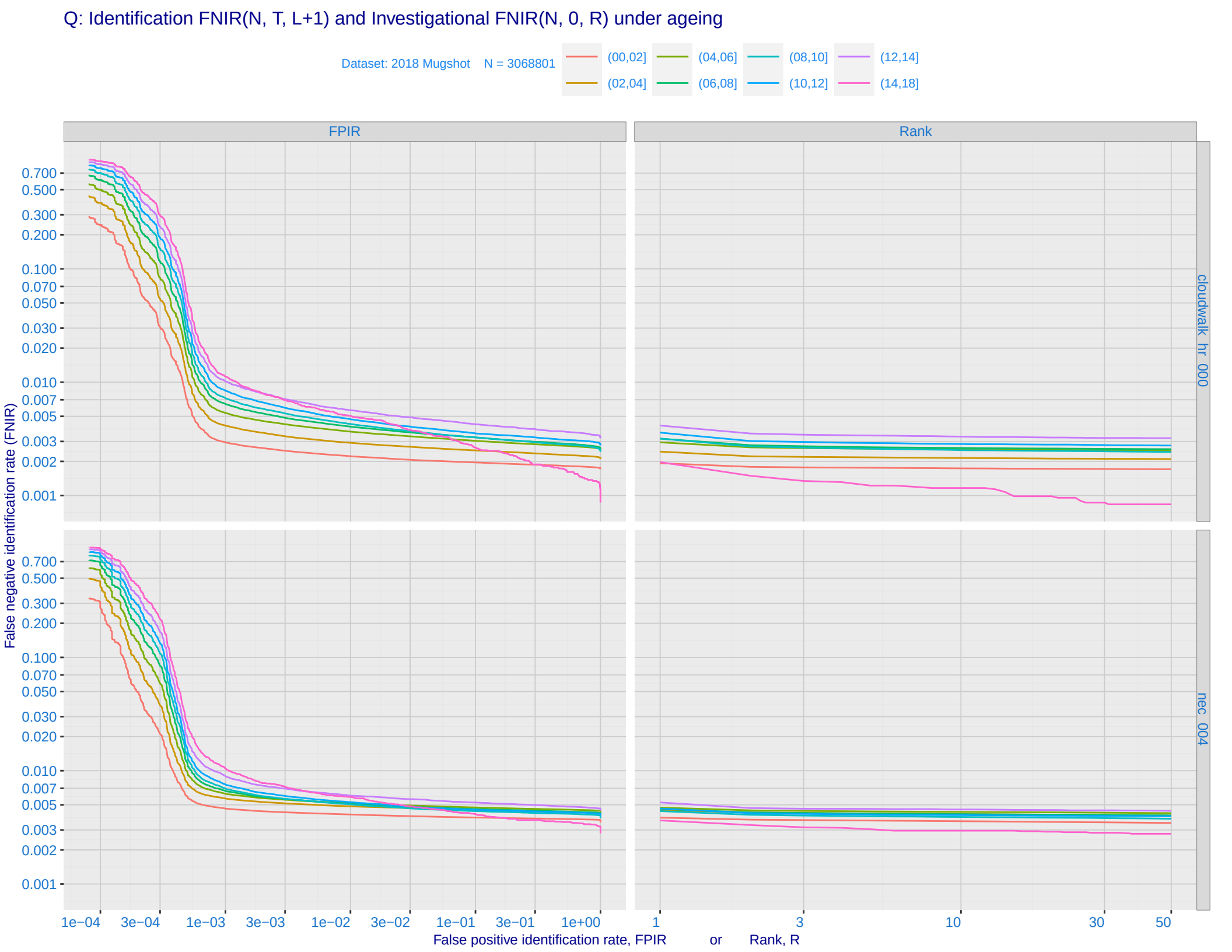
M: Template duration; search duration vs. N. The blue and pink ribbon covers 95 percent of observed measurements.
The template generation time is independent of N. The log and power−law models are fit to the first two (N,T) observations

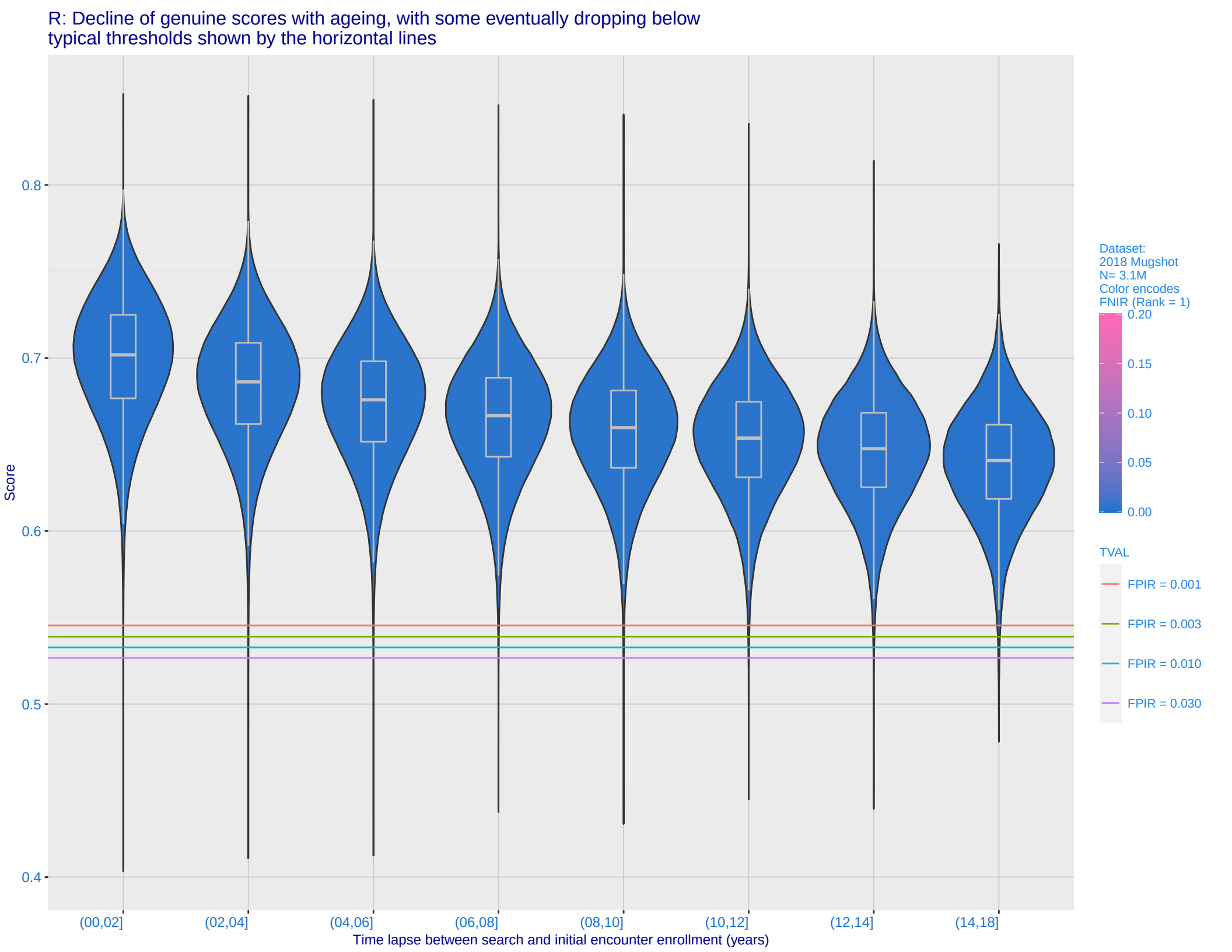


O: FNIR(T, N = 1.6 million) by sex, age and time−lapse. The top row gives investigational rank−1 miss rates.
The bottom panels give high threshold for more lights−out identification with low FPIR.




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.
Algorithm: nec_004, Dataset: Border−Crossing Ageing
Threshold: 0.551611 set to achive FPIR(30−45, Male) = 0.001
Color encodes log(FPIR)
−4
−3
−2
−1
(60:99]
(45:60]
(30:45]
(21:30]
(18:21]
(15:18]
(12:15]
0.0009
0.0008
0.0007
0.0006
0.0008
0.0010
0.0012
0.0010
0.0014
0.0015
0.0016
0.0019
0.0017
0.0019
Age group of person in non−mate probe
(The age of the highest non−mates will usually be similar to that of the probe.)
Female
Male
Sex of person in non−mate probe
(The sex of the highest non−mates will usually be that of the probe.)


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
nec 004
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
Score
0.8
0.7
0.6
0.5
0.4
(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