NISTIR XXXX Draft

Ongoing Face Recognition Vendor Test (FRVT)

Part 1: Verification

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DISCLAIMER

Specific hardware and software products identified in this report were used in order to perform the evaluations described in this document. In no case does identification of any commercial product, trade name, or vendor, imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the products and equipment identified are necessarily the best available for the purpose.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

FRVT STATUS

This report is a draft NIST Interagency Report, and is open for comment. It is the sixteenth edition of the report since the first was published in June 2017. Prior editions of this report are maintained on the FRVT website, and may contain useful information about older algorithms and datasets no longer used in FRVT.

FRVT remains open: All four tracks of the FRVT remain open to new algorithm submissions indefinitely. This report will be updated as new algorithms are evaluated, as new datasets are added, and as new analyses are included. Comments and suggestions should be directed to frvt@nist.gov.

Changes since June 2019:

- This report adds results for algorithms from 18 developers submitted in early June 2019. These are from CTBC Bank, Deep Glint, Thales Cogent, Ever AI Paravision, Gorilla Technology, Imagus, Incode, Kneron, N-Tech Lab, Neurotechnology, Notiontag Technologies, Star Hybrid, Videonetics, Vigilant Solutions, Winsense, Anke Investments, CEIEC, and DSK. Nine of these are new participants.
- Several other algorithms have been submitted and are being evaluated. Results will be released in the next report, scheduled for August 1. That report will include results for new datasets.
- Older algorithms from Everai, Thales Cogent, Gorilla Technology, Incode, Neurotechnology, N-Tech Lab and Vigilant Solutions have been retired, per the policy to list only two algorithms per developer.

Changes since April 2019:

- This report adds results for nine algorithms from nine developers submitted in early June 2019. These are from Tencent Deepsea, Hengrui, Kedacom, Moontime, Guangzhou Pixel, Rank One Computing, Synesis, Sensetime and Vocord.
- Another 23 algorithms have been submitted and are being evaluated. Results will be released in the next report, scheduled for July 3.
- Older algorithms for Rank One, Synesis, and Vocord have been retired, per the policy to list only two algorithms per developer.

Changes since February 2019:

- This report adds results for 49 algorithms from 42 developers submitted in early March 2019.
- This report omits results for algorithms that we retired. We retired for three reasons: 1. The developer submitted a new algorithm, and we only list two. 2. The algorithm needs a GPU, and we no longer allow GPU-based algorithms. 3. Inoperable algorithms.
- Previous results for retired algorithms are available in older editions of this report linked here.
- The mugshot database used from February 2017 to January 2019 has been replaced with an extract of the mugshot database documented in NIST Interagency Report 8238, November 2018. The new mugshot set is described in section 2.3 and is adopted because:
  - It has much better identity label integrity, so that false non-match rates are substantially lower than those reported in FRVT 1:1 reports to date - see Figure 30.
  - It includes images collected over a 17 year period such that ageing can be much better characterized - - see Figure 110.
- Using the new mugshot database, Figure 110 shows accuracy for four demographic groups identified in the biographic metadata that accompanies the data: black females, black males, white females and white males.

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- The report adds Figure 9 with results for the twenty human-difficult pairs used in the May 2018 paper *Face recognition accuracy of forensic examiners, superrecognizers, and face recognition algorithms* by Phillips et al. [1].
- The report uses an update to the wild image database that corrects some ground truth labels.
- Some results for the child exploitation database are not complete. They are typically updated less frequently than for other image sets.

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	Developer	Short	Seq.	Validation	Config[1]	Template		GPU	Comparison Time (ns)[3]	
	Name	Name	Num.	Date	Data (KB)	Size (B)	Time (ms)[2]		Genuine	Impostor
1	3DiVi	3divi	003	2018-10-09	191636	[124] 4096 ± 0	[89] 650 ± 90	No	[23] 627 ± 11	[26] 623 ± 32
2	Adera Global PTE Ltd	adera	001	2019-06-17	0	[112] 2560 ± 0	[4] 97 ± 0	No	[65] 1604 ± 71	[66] 1649 ± 56
3	Alchera	alchera	000	2019-03-01	258450	[65] 2048 ± 0	[80] 587 ± 13	No	[91] 3189 ± 32	[91] 3031 ± 142
4	Alchera	alchera	000	2019-03-01	174013	[63] 2048 ± 0	[85] 627 ± 11	No	[94] 3342 ± 81	[93] 3243 ± 47
5	AllGoVision	allgovision	000	2019-03-01	172509	[76] 2048 ± 0	[51] 384 ± 8	No	[123] 29903 ± 406	[124] 29735 ± 194
6	Amplified Group	amplifiedgroup	001	2019-03-01	0	[27] 866 ± 2	[3] 93 ± 0	No	[127] 57803 ± 4210	[127] 56365 ± 1196
7	Anke Investments	anke	003	2019-02-27	340160	[101] 2056 ± 0	[117] 811 ± 23	No	[9] 425 ± 28	[11] 437 ± 32
8	Anke Investments	anke	004	2019-06-27	349388	[100] 2056 ± 0	[84] 625 ± 1	No	[24] 633 ± 22	[28] 632 ± 34
9	AnyVision	anyvision	002	2018-01-31	662659	[37] 1024 ± 0	[21] 248 ± 0	No	[128] 74069 ± 188	[128] 74019 ± 198
10	AnyVision	anyvision	004	2018-06-15	401001	[33] 1024 ± 0	[43] 355 ± 1	No	[72] 1891 ± 51	[70] 1829 ± 85
11	Aware	aware	003	2018-10-19	377729	[115] 3108 ± 0	[113] 783 ± 10	No	[57] 1392 ± 42	[60] 1334 ± 80
12	Aware	aware	004	2019-03-01	427829	[109] 2084 ± 0	[128] 900 ± 10	No	[54] 1279 ± 50	[59] 1287 ± 100
13	Ayonix	ayonix	000	2017-06-22	58505	[38] 1036 ± 0	[1] 18 ± 2	No	[22] 621 ± 23	[25] 620 ± 26
14	Bitmain	bitmain	001	2018-10-17	287734	[1] 64 ± 0	[59] 444 ± 88	No	[71] 1887 ± 31	[72] 1877 ± 26
15	Camvi Technologies	camvitech	002	2018-10-19	236278	[35] 1024 ± 0	[100] 677 ± 7	No	[21] 612 ± 26	[23] 603 ± 20
16	Camvi Technologies	camvitech	003	2019-03-01	285657	[29] 1024 ± 0	[108] 750 ± 3	No	[18] 571 ± 23	[20] 565 ± 26
17	China Electronics Import-Export Corp	ceiec	001	2019-03-01	159618	[36] 1024 ± 0	[37] 314 ± 3	No	[121] 22831 ± 108	[121] 22813 ± 120
18	China Electronics Import-Export Corp	ceiec	002	2019-06-12	269063	[62] 2048 ± 0	[82] 612 ± 17	No	[81] 2188 ± 57	[80] 2301 ± 56
19	Gemalto Cogent	cogent	003	2019-03-01	698290	[28] 973 ± 0	[130] 952 ± 0	No	[111] 12496 ± 75	[111] 11822 ± 163
20	Gemalto Cogent	cogent	004	2019-06-14	722919	[56] 1983 ± 0	[129] 941 ± 28	No	[114] 14448 ± 56	[114] 15882 ± 81
21	Cognitec Systems GmbH	cognitec	000	2018-10-19	474759	[89] 2052 ± 0	[18] 224 ± 1	No	[98] 3835 ± 108	[97] 3782 ± 83
22	Cognitec Systems GmbH	cognitec	001	2019-03-01	476809	[95] 2052 ± 0	[33] 297 ± 17	No	[100] 4253 ± 59	[99] 4102 ± 167
23	CTBC Bank Co. Ltd	ctbcbank	000	2019-06-28	257208	[66] 2048 ± 0	[77] 568 ± 43	No	[96] 3551 ± 87	[100] 4805 ± 209
24	Cyberextruder	cyberex	001	2017-08-02	121211	[9] 256 ± 0	[127] 893 ± 25	No	[43] 1083 ± 16	[47] 1079 ± 19
25	Cyberextruder	cyberex	002	2018-01-30	168909	[60] 2048 ± 0	[68] 532 ± 6	No	[70] 1803 ± 14	[69] 1779 ± 22
26	Cyberlink Corp	cyberlink	001	2019-03-01	222009	[98] 2052 ± 0	[57] 425 ± 29	No	[77] 2051 ± 32	[77] 2060 ± 31
27	Cyberlink Corp	cyberlink	002	2019-06-12	222311	[91] 2052 ± 0	[92] 656 ± 22	No	[82] 2264 ± 71	[89] 2649 ± 195
28	Dahua Technology Co. Ltd	dahua	001	2018-10-19	283642	[83] 2048 ± 0	[46] 363 ± 6	No	[6] 367 ± 10	[7] 354 ± 16
29	Dahua Technology Co. Ltd	dahua	002	2019-03-01	526452	[64] 2048 ± 0	[86] 628 ± 7	No	[11] 461 ± 23	[13] 454 ± 20
30	Deepglint	deepglint	001	2019-06-21	569802	[121] 4096 ± 0	[102] 721 ± 4	No	[97] 3680 ± 35	[96] 3517 ± 182
31	Tencent Deepsea Lab	deepsea	001	2019-06-03	147497	[30] 1024 ± 0	[87] 630 ± 7	No	[59] 1401 ± 37	[62] 1467 ± 50
32	Dermalog	dermalog	005	2018-02-02	0	[2] 128 ± 0	[6] 130 ± 11	No	[14] 499 ± 22	[16] 500 ± 22
33	Dermalog	dermalog	006	2018-10-18	0	[3] 128 ± 0	[67] 532 ± 12	No	[15] 506 ± 23	[14] 459 ± 23
34	Digital Barriers	barriers	002	2019-03-01	83002	[102] 2056 ± 0	[15] 209 ± 11	No	[113] 13409 ± 228	[113] 13267 ± 206
35	DSK	dsk	000	2019-06-28	11967	[18] 512 ± 0	[35] 304 ± 47	No	[107] 7152 ± 115	[107] 7134 ± 111
36	Ever AI	everai	002	2019-03-01	561727	[125] 4096 ± 0	[109] 758 ± 0	No	[26] 644 ± 14	[27] 624 ± 35
37	Ever AI	everai	002	2019-07-01	539802	[120] 4096 ± 0	[99] 674 ± 4	No	[31] 699 ± 20	[32] 713 ± 47
38	Glory Ltd	glory	000	2018-06-06	0	[15] 418 ± 0	[8] 165 ± 2	No	[106] 7003 ± 84	[105] 6978 ± 71
39	Glory Ltd	glory	001	2018-06-08	0	[53] 1726 ± 0	[53] 393 ± 2	No	[110] 9607 ± 128	[110] 9539 ± 182
40	Gorilla Technology	gorilla	002	2018-10-17	93869	[43] 1132 ± 0	[40] 322 ± 14	No	[88] 2715 ± 68	[88] 2585 ± 84
41	Gorilla Technology	gorilla	003	2019-06-19	94409	[42] 1132 ± 0	[42] 334 ± 25	No	[89] 2840 ± 42	[90] 2865 ± 87
42	Hikvision	hik	001	2019-03-01	667866	[47] 1408 ± 0	[90] 651 ± 0	No	[13] 488 ± 19	[15] 477 ± 22
43	Hengrui AI Technology Ltd	hr	000	2019-03-01	284600	[107] 2057 ± 0	[81] 600 ± 2	No	[115] 16747 ± 238	[115] 16627 ± 220
44	Hengrui AI Technology Ltd	hr	001	2019-06-04	346156	[106] 2057 ± 0	[93] 665 ± 3	No	[117] 17816 ± 260	[117] 17878 ± 464

Notes	
1	The configuration size does not capture static data included in libraries. We do not count these because some algorithms include common ancilliary libraries for image processing (e.g. openCV) or numerical computation (e.g. blas).
2	The median template creation times are measured on Intel®Xeon®CPU E5-2630 v4 @ 2.20GHz processors or, for GPU-enabled implementations, NVidia Tesla K40.
3	The comparison durations, in nanoseconds, are estimated using std::chrono::high_resolution_clock which on the machine in (2) counts 1ns clock ticks. Precision is somewhat worse than that however. The ± value is the median absolute deviation times 1.48 for Normal consistency.

Table 1: Summary of algorithms and properties included in this report. The red superscripts give ranking for the quantity in that column.

	Developer	Short	Seq.	Validation	Config[1]	Template		GPU	Comparison Time (ns)[3]	
	Name	Name	Num.	Date	Data (KB)	Size (B)	Time (ms)[2]		Genuine	Impostor
45	ID3 Technology	id3	003	2018-10-05	265951	[11]264 ± 0	[38]316 ± 19	No	[56]1330 ± 25	[61]1354 ± 28
46	ID3 Technology	id3	004	2019-03-01	171526	[10]264 ± 0	[72]541 ± 11	No	[45]1135 ± 23	[52]1156 ± 32
47	Idemia	Idemia	003	2018-10-19	427244	[14]352 ± 0	[47]368 ± 6	No	[105]6654 ± 75	[101]4835 ± 90
48	Idemia	Idemia	004	2019-03-01	406924	[13]352 ± 0	[36]306 ± 5	No	[103]5592 ± 518	[104]5533 ± 426
49	Institute of Information Technologies	ittvision	000	2019-03-01	237317	[34]1024 ± 0	[14]197 ± 8	No	[62]1537 ± 81	[58]1282 ± 20
50	Imagus Technology Pty Ltd	imagus	000	2019-06-19	183453	[78]2048 ± 0	[58]425 ± 24	No	[46]1145 ± 25	[68]1718 ± 63
51	Imperial College London	imperial	000	2019-03-01	370120	[71]2048 ± 0	[95]669 ± 1	No	[79]2130 ± 32	[76]2052 ± 100
52	Imperial College London	imperial	001	2019-03-01	370260	[81]2048 ± 0	[97]671 ± 0	No	[78]2090 ± 28	[78]2062 ± 74
53	Incode Technologies Inc	incode	003	2019-03-01	170632	[123]4096 ± 0	[50]384 ± 11	No	[74]1928 ± 44	[71]1876 ± 81
54	Incode Technologies Inc	incode	004	2019-06-12	260224	[61]2048 ± 0	[61]479 ± 23	No	[73]1913 ± 60	[84]2443 ± 114
55	Innovatrics	innova	004	2018-10-19	0	[40]1076 ± 0	[52]391 ± 0	No	[109]8573 ± 274	[108]7929 ± 244
56	Innovatrics	innova	005	2019-03-01	0	[41]1076 ± 0	[78]577 ± 1	No	[116]16880 ± 194	[116]17232 ± 385
57	Intellivision	intellivision	001	2017-10-10	43692	[104]2056 ± 0	[2]62 ± 2	No	[85]2573 ± 91	[87]2544 ± 38
58	iQIYI Inc	iqface	000	2019-03-01	268819	[129]4750 ± 32	[69]538 ± 26	No	[131]636433 ± 38446	[131]632654 ± 85615
59	Is It You	isityou	000	2017-06-26	48010	[130]19200 ± 0	[5]113 ± 5	No	[129]237517 ± 1318	[129]237374 ± 1279
60	Innovation Systems	isystems	001	2018-06-12	274621	[57]2048 ± 0	[31]291 ± 9	No	[17]557 ± 16	[19]564 ± 22
61	Innovation Systems	isystems	002	2018-10-18	358984	[74]2048 ± 0	[120]822 ± 8	No	[33]749 ± 31	[29]632 ± 28
62	ITMO University	itmo	005	2018-10-19	482155	[128]4173 ± 0	[110]759 ± 1	No	[112]13214 ± 164	[112]12576 ± 257
63	ITMO University	itmo	006	2019-03-01	599187	[111]2121 ± 0	[118]814 ± 1	No	[122]26154 ± 148	[122]26217 ± 260
64	Kakao Corp	kakao	001	2019-03-01	107616	[32]1024 ± 0	[49]379 ± 1	No	[38]930 ± 22	[42]948 ± 38
65	Kakao Corp	kakao	002	2019-06-19	479406	[84]2048 ± 0	[106]747 ± 6	No	[68]1720 ± 62	[67]1715 ± 83
66	Kedacom International Pte	kedacom	000	2019-06-03	245292	[12]292 ± 0	[64]506 ± 3	No	[27]684 ± 14	[30]682 ± 16
67	Kneron Inc	kenron	003	2019-07-01	58366	[69]2048 ± 0	[29]281 ± 3	No	[102]5237 ± 63	[103]5274 ± 99
68	Lookman Electroplast Industries	lookman	002	2018-06-13	138200	[24]548 ± 0	[9]173 ± 1	No	[20]610 ± 19	[24]612 ± 22
69	Lookman Electroplast Industries	lookman	004	2019-06-03	244775	[23]548 ± 0	[65]507 ± 5	No	[36]871 ± 29	[41]878 ± 29
70	Megvii/Face++	megvii	001	2018-06-15	1361523	[82]2048 ± 0	[74]543 ± 0	No	[101]5228 ± 32	[102]5252 ± 60
71	Megvii/Face++	megvii	002	2018-10-19	1809564	[127]4100 ± 0	[88]644 ± 0	No	[126]50630 ± 183	[126]47591 ± 716
72	Xiamen Meiya Pico Information Co. Ltd	meiya	001	2019-03-01	280055	[87]2049 ± 0	[83]622 ± 12	No	[108]8356 ± 615	[109]8134 ± 97
73	MicroFocus	microfocus	001	2018-06-13	104524	[8]256 ± 0	[25]264 ± 18	No	[1]215 ± 8	[1]217 ± 10
74	MicroFocus	microfocus	002	2018-10-17	96288	[6]256 ± 0	[23]259 ± 18	No	[4]337 ± 34	[2]230 ± 25
75	Moontime Smart Technology	mt	000	2019-06-03	372169	[85]2049 ± 0	[103]724 ± 12	No	[67]1678 ± 47	[65]1614 ± 85
76	Neurotechnology	neurotech	005	2019-03-01	270450	[7]256 ± 0	[55]399 ± 0	No	[2]238 ± 10	[3]237 ± 7
77	Neurotechnology	neurotech	006	2019-06-26	525541	[19]512 ± 0	[101]678 ± 56	No	[16]513 ± 14	[18]535 ± 26
78	Nodeflux	nodeflux	000	2019-03-01	347079	[59]2048 ± 0	[73]542 ± 1	No	[93]3283 ± 51	[95]3285 ± 56
79	Nodeflux	nodeflux	001	2019-03-01	262553	[73]2048 ± 0	[20]247 ± 1	No	[92]3242 ± 81	[94]3255 ± 93
80	NotionTag Technologies Private Limited	notiontag	000	2019-06-12	92753	[25]584 ± 0	[75]548 ± 64	No	[125]44672 ± 269	[125]44593 ± 358
81	N-Tech Lab	ntech	006	2019-03-01	7901590	[114]2600 ± 0	[107]749 ± 1	No	[41]1055 ± 93	[40]844 ± 48
82	N-Tech Lab	ntech	007	2019-06-25	2509686	[116]3348 ± 0	[115]792 ± 3	No	[49]1209 ± 59	[56]1267 ± 65
83	Guangzhou Pixel Solutions Co. Ltd	pixelall	002	2019-06-06	0	[113]2560 ± 0	[13]191 ± 1	No	[50]1223 ± 56	[54]1230 ± 47
84	Panasonic R+D Center Singapore	psl	001	2018-10-12	382035	[105]2056 ± 0	[114]785 ± 16	No	[3]298 ± 13	[4]292 ± 14
85	Panasonic R+D Center Singapore	psl	002	2019-02-28	804934	[92]2052 ± 0	[126]888 ± 9	No	[64]1590 ± 48	[48]1133 ± 78
86	Rank One Computing	rankone	006	2019-02-27	0	[5]165 ± 0	[16]210 ± 1	No	[10]443 ± 26	[9]395 ± 22
87	Rank One Computing	rankone	007	2019-06-03	0	[4]165 ± 0	[19]245 ± 5	No	[28]688 ± 20	[22]601 ± 16
88	Realnetworks Inc	realnetworks	002	2019-02-28	95328	[55]1848 ± 0	[22]250 ± 2	No	[55]1285 ± 17	[55]1247 ± 42

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	Name	Name	Num.	Date	Data (KB)	Size (B)	Time (ms)[2]		Genuine	Impostor
89	Realnetworks Inc	realnetworks	003	2019-06-12	95334	$^{54}1848 \pm 0$	$^{11}177 \pm 10$	No	$^{61}1516 \pm 29$	$^{63}1522 \pm 60$
90	KanKan Ai	remarkai	000	2019-03-01	240152	$^{58}2048 \pm 0$	$^{121}829 \pm 7$	No	$^{37}873 \pm 4$	$^{39}835 \pm 35$
91	KanKan Ai	remarkai	001	2019-03-01	241857	$^{94}2052 \pm 0$	$^{122}831 \pm 6$	No	$^{51}1229 \pm 20$	$^{38}805 \pm 56$
92	Saffe Ltd	saffe	001	2018-10-19	85973	$^{45}1280 \pm 0$	$^{28}281 \pm 1$	No	$^{53}1274 \pm 19$	$^{57}1277 \pm 26$
93	Saffe Ltd	saffe	002	2019-03-01	260622	$^{77}2048 \pm 0$	$^{119}817 \pm 11$	No	$^{32}717 \pm 7$	$^{33}714 \pm 29$
94	Sensetime Group Ltd	sensetime	002	2018-10-19	531783	$^{88}2052 \pm 0$	$^{104}725 \pm 3$	No	$^{84}2546 \pm 102$	$^{82}2371 \pm 45$
95	Sensetime Group Ltd	sensetime	002	2018-10-19	531783	$^{96}2052 \pm 0$	$^{116}797 \pm 3$	No	$^{87}2713 \pm 90$	$^{81}2301 \pm 25$
96	Shaman Software	shaman	000	2017-12-05	0	$^{122}4096 \pm 0$	$^{91}653 \pm 16$	No	$^{7}380 \pm 25$	$^{8}379 \pm 31$
97	Shaman Software	shaman	001	2018-01-13	0	$^{118}4096 \pm 0$	$^{32}294 \pm 2$	No	$^{25}635 \pm 19$	$^{12}441 \pm 25$
98	Shenzhen Inst. Adv. Integrated Tech. CAS	SIAT	002	2018-06-13	486842	$^{97}2052 \pm 0$	$^{79}579 \pm 0$	No	$^{34}769 \pm 13$	$^{35}750 \pm 13$
99	Shenzhen Inst. Adv. Integrated Tech. CAS	SIAT	004	2019-03-01	940063	$^{126}4100 \pm 0$	$^{96}670 \pm 0$	No	$^{99}4013 \pm 45$	$^{98}3782 \pm 173$
100	Smilart	smilart	002	2018-02-06	111826	$^{31}1024 \pm 0$	$^{10}176 \pm 16$	No	$^{119}18784 \pm 136$	$^{119}18795 \pm 151$
101	Smilart	smilart	003	2018-06-18	67339	$^{17}512 \pm 0$	$^{12}180 \pm 12$	No	$^{58}1395 \pm 74$	$^{44}1027 \pm 66$
102	Star Hybrid Limited	starhybrid	001	2019-06-19	100509	$^{67}2048 \pm 0$	$^{45}358 \pm 82$	No	$^{42}1075 \pm 51$	$^{46}1078 \pm 53$
103	Synesis	synesis	004	2019-03-01	270628	$^{80}2048 \pm 0$	$^{105}735 \pm 15$	No	$^{8}424 \pm 14$	$^{10}430 \pm 22$
104	Synesis	synesis	005	2019-06-06	146509	$^{72}2048 \pm 0$	$^{17}211 \pm 9$	No	$^{19}599 \pm 23$	$^{21}581 \pm 32$
105	Tech5 SA	tech5	001	2018-10-19	636346	$^{119}4096 \pm 0$	$^{66}522 \pm 5$	No	$^{44}1087 \pm 34$	$^{36}799 \pm 44$
106	Tech5 SA	tech5	002	2019-03-01	1150887	$^{46}1280 \pm 0$	$^{111}780 \pm 10$	No	$^{60}1406 \pm 120$	$^{45}1048 \pm 57$
107	Tevian	tevian	003	2018-10-19	791725	$^{86}2049 \pm 0$	$^{56}404 \pm 15$	No	$^{5}350 \pm 11$	$^{6}338 \pm 25$
108	Tevian	tevian	004	2019-03-01	863474	$^{68}2048 \pm 0$	$^{63}506 \pm 30$	No	$^{12}474 \pm 31$	$^{5}326 \pm 20$
109	TigerIT Americas LLC	tiger	002	2018-06-13	341638	$^{103}2056 \pm 0$	$^{54}393 \pm 20$	No	$^{80}2135 \pm 29$	$^{79}2137 \pm 38$
110	TigerIT Americas LLC	tiger	003	2018-10-16	426164	$^{99}2056 \pm 0$	$^{60}458 \pm 21$	No	$^{76}2031 \pm 35$	$^{75}2029 \pm 38$
111	TongYi Transportation Technology	tongyi	005	2019-06-12	1140701	$^{110}2089 \pm 0$	$^{7}165 \pm 1$	No	$^{120}18924 \pm 65$	$^{120}20158 \pm 103$
112	Toshiba	toshiba	002	2018-10-19	813606	$^{50}1560 \pm 0$	$^{71}541 \pm 0$	No	$^{95}3521 \pm 369$	$^{85}2449 \pm 124$
113	Toshiba	toshiba	003	2019-03-01	984125	$^{51}1560 \pm 0$	$^{70}540 \pm 0$	No	$^{83}2390 \pm 41$	$^{83}2407 \pm 81$
114	China University of Petroleum	upc	001	2019-06-05	0	$^{39}1052 \pm 0$	$^{76}551 \pm 15$	No	$^{90}3114 \pm 44$	$^{92}3165 \pm 97$
115	VCognition	vcog	002	2017-06-12	3229434	$^{131}61504 \pm 5$	$^{44}357 \pm 25$	No	$^{130}296154 \pm 3077$	$^{130}296436 \pm 4183$
116	Visidon	visidon	001	2019-02-26	170262	$^{90}2052 \pm 0$	$^{39}316 \pm 6$	No	$^{52}1258 \pm 38$	$^{50}1148 \pm 109$
117	Veridas Digital Authentication Solutions S.L.	veridas	001	2019-03-01	196540	$^{70}2048 \pm 0$	$^{98}671 \pm 21$	No	$^{104}5748 \pm 20$	$^{106}7111 \pm 148$
118	Veridas Digital Authentication Solutions S.L.	veridas	000	2019-03-01	193466	$^{22}512 \pm 0$	$^{94}669 \pm 20$	No	$^{69}1733 \pm 81$	$^{73}1934 \pm 44$
119	Videonetics Technology Pvt Ltd	videonetics	001	2019-06-19	30875	$^{16}512 \pm 0$	$^{24}262 \pm 3$	No	$^{47}1153 \pm 38$	$^{49}1142 \pm 65$
120	Vigilant Solutions	vigilant	006	2019-03-01	343048	$^{49}1548 \pm 0$	$^{123}841 \pm 8$	No	$^{39}939 \pm 32$	$^{31}711 \pm 37$
121	Vigilant Solutions	vigilant	007	2019-06-27	255600	$^{48}1548 \pm 0$	$^{62}493 \pm 6$	No	$^{35}803 \pm 35$	$^{37}800 \pm 40$
122	Beijing Vion Technology Inc	vion	000	2018-10-19	228219	$^{93}2052 \pm 0$	$^{41}333 \pm 1$	No	$^{124}39839 \pm 3561$	$^{123}26830 \pm 2241$
123	Vision-Box	visionbox	000	2019-02-26	176501	$^{79}2048 \pm 0$	$^{34}304 \pm 7$	No	$^{66}1648 \pm 57$	$^{53}1192 \pm 42$
124	Vision-Box	visionbox	001	2019-03-01	256869	$^{75}2048 \pm 0$	$^{131}983 \pm 7$	No	$^{48}1161 \pm 22$	$^{51}1154 \pm 20$
125	VisionLabs	visionlabs	006	2019-03-01	353044	$^{21}512 \pm 0$	$^{26}270 \pm 0$	No	$^{30}698 \pm 19$	$^{34}734 \pm 28$
126	VisionLabs	visionlabs	007	2019-06-12	357204	$^{20}512 \pm 0$	$^{27}272 \pm 0$	No	$^{40}965 \pm 41$	$^{43}972 \pm 31$
127	Vocord	vocord	006	2019-03-01	559457	$^{26}768 \pm 0$	$^{125}886 \pm 1$	No	$^{75}2020 \pm 72$	$^{74}1969 \pm 62$
128	Vocord	vocord	007	2019-06-06	587489	$^{52}1664 \pm 0$	$^{112}780 \pm 2$	No	$^{86}2593 \pm 83$	$^{86}2526 \pm 59$
129	Winsense Co. Ltd	winsense	000	2019-06-17	270819	$^{44}1280 \pm 0$	$^{30}283 \pm 1$	No	$^{63}1551 \pm 31$	$^{64}1532 \pm 42$
130	Zhuhai Yisheng Electronics Technology	yisheng	004	2018-06-12	486351	$^{117}3704 \pm 0$	$^{48}378 \pm 12$	No	$^{29}693 \pm 137$	$^{17}526 \pm 34$
131	Shanghai Yitu Technology	yitu	003	2019-03-01	1525719	$^{108}2082 \pm 0$	$^{124}860 \pm 0$	No	$^{118}18305 \pm 71$	$^{118}18286 \pm 62$

Notes	
1	The configuration size does not capture static data included in libraries. We do not count these because some algorithms include common ancilliary libraries for image processing (e.g. openCV) or numerical computation (e.g. blas).
2	The median template creation times are measured on Intel®Xeon®CPU E5-2630 v4 @ 2.20GHz processors or, for GPU-enabled implementations, NVidia Tesla K40.
3	The comparison durations, in nanoseconds, are estimated using std::chrono::high_resolution_clock which on the machine in (2) counts 1ns clock ticks. Precision is somewhat worse than that however. The $\pm$ value is the median absolute deviation times 1.48 for Normal consistency.

Table 3: Summary of algorithms and properties included in this report. The red superscripts give ranking for the quantity in that column.

		FALSE NON-MATCH RATE (FNMR)											
	Algorithm	CONSTRAINED, COOPERATIVE								LESS CONSTRAINED, NON-COOP.			
	Name	VISAMC		VISA		VISA		MUGSHOT		WILD		CHILD EXP	
	FMR	0.0001		1E-06		0.0001		1E-05		0.0001		0.01	
1	3divi-003	0.0318	88	0.0588	89	0.0097	79	0.0389	86	0.0867	85	0.536	17
2	adera-001	0.1021	103	0.1757	103	0.0368	102	0.1823	109	0.1965	100	0.720	38
3	alchera-000	0.0165	59	0.0243	50	0.0086	75	0.0125	46	0.0370	48	-	
4	alchera-001	0.0183	63	0.0299	63	0.0078	70	0.0142	53	0.0372	49	-	
5	allgovision-000	0.0346	90	0.0527	86	0.0210	94	0.0232	75	0.0607	79	-	
6	amplifiedgroup-001	0.5034	122	0.5848	122	0.2999	123	0.6973	121	0.4250	114	-	
7	anke-003	0.0131	44	0.0213	42	0.0056	46	0.0094	21	0.0302	20	-	
8	anke-004	0.0080	21	0.0154	27	0.0031	18	0.0073	9	0.0288	14	-	
9	anyvision-002	0.0660	98	0.0898	95	0.0387	103	0.0928	102	0.2227	102	0.696	32
10	anyvision-004	0.0267	83	0.0385	77	0.0081	71	0.0258	77	0.0470	66	0.463	7
11	aware-003	0.0793	100	0.1161	100	0.0288	100	0.1028	103	0.3180	111	0.851	47
12	aware-004	0.0690	99	0.0949	98	0.0257	97	0.0837	100	0.0516	72	-	
13	ayonix-000	0.4351	119	0.4872	117	0.2299	120	0.6150	119	0.3635	112	0.843	45
14	bm-001	0.7431	127	0.9494	128	0.6188	128	0.9586	125	0.9935	118	0.884	50
15	camvi-002	0.0125	39	0.0221	46	0.0049	40	0.0089	19	0.0288	13	0.576	20
16	camvi-003	0.0184	64	0.0320	68	0.0062	52	0.0134	50	0.0300	18	-	
17	ceiec-001	0.0328	89	0.0475	83	0.0163	89	0.0295	81	0.0847	82	-	
18	ceiec-002	0.0161	57	0.0193	38	0.0124	87	0.0122	44	0.0465	65	0.516	15
19	cogent-003	0.0091	22	0.0188	37	0.0032	19	0.0098	26	0.0406	55	-	
20	cogent-004	0.0064	13	0.0116	18	0.0024	14	0.0096	23	0.0379	50	0.718	37
21	cognitec-000	0.0116	34	0.0177	33	0.0036	23	0.0118	41	0.0953	89	0.837	43
22	cognitec-001	0.0126	40	0.0185	36	0.0047	37	0.0120	43	0.0598	78	-	
23	ctbcbank-000	0.0168	60	0.0250	55	0.0064	53	0.0146	56	1.0000	126	-	
24	cyberextruder-001	0.1972	111	0.2547	110	0.0755	112	0.4686	117	0.1747	97	0.780	41
25	cyberextruder-002	0.0811	101	0.1336	102	0.0265	98	0.1465	107	0.1000	90	0.610	24
26	cyberlink-001	0.0131	43	0.0210	41	0.0050	41	0.0439	90	0.0318	32	-	
27	cyberlink-002	0.0114	33	0.0195	39	0.0044	32	0.0101	27	0.0298	17	0.500	11
28	dahua-001	0.0250	78	0.0466	82	0.0108	84	0.0228	73	0.0457	64	0.504	13
29	dahua-002	0.0129	41	0.0157	29	0.0090	77	0.0116	40	0.0323	34	-	
30	deepglint-001	0.0040	6	0.0062	5	0.0014	7	0.0047	4	0.0278	5	0.401	4
31	deepsea-001	0.0136	46	0.0215	44	0.0071	66	0.0142	54	0.0347	43	0.561	18
32	dermalog-005	0.1526	109	0.1823	105	0.0658	110	0.2580	112	0.0855	84	0.684	30
33	dermalog-006	0.0253	79	0.0369	75	0.0172	92	0.0171	62	0.0623	80	0.585	21
34	digitalbarriers-002	0.3360	116	0.3690	115	0.0968	115	0.0877	101	0.0436	59	-	
35	dsk-000	0.1526	108	0.2169	107	0.0765	113	0.3787	116	0.2201	101	-	
36	everai-002	0.0104	30	0.0159	30	0.0041	30	0.0063	6	0.0294	15	-	
37	everai-paravision-003	0.0034	2	0.0050	3	0.0011	3	0.0036	2	0.0278	6	-	
38	glory-000	0.1094	104	0.1286	101	0.0514	107	0.2179	110	0.4762	116	0.894	51
39	glory-001	0.0902	102	0.1082	99	0.0410	104	0.1642	108	0.4261	115	0.883	49
40	gorilla-002	0.0256	80	0.0413	78	0.0076	69	0.0478	93	0.0507	70	0.616	25
41	gorilla-003	0.0165	58	0.0291	60	0.0053	43	0.0205	69	0.0359	46	0.976	55
42	hik-001	0.0096	26	0.0125	19	0.0036	25	0.0093	20	0.0271	1	-	
43	hr-000	0.0265	82	0.0434	79	0.0112	86	0.0340	83	0.1902	99	-	
44	hr-001	0.0044	7	0.0072	8	0.0019	10	0.0073	10	0.0303	21	-	
45	id3-003	0.0361	91	0.0757	92	0.0104	83	0.0292	80	0.0848	83	0.586	22
46	id3-004	0.0198	68	0.0344	70	0.0084	73	0.0238	76	-		-	
47	idemia-003	0.0222	71	0.0316	67	0.0082	72	0.0188	65	0.0578	77	0.617	26
48	idemia-004	0.0160	56	0.0244	52	0.0065	54	0.0199	68	0.0309	27	-	
49	iit-000	0.1516	107	0.1981	106	0.0620	109	0.0828	99	-		-	
50	imagus-000	0.0642	96	0.0882	93	0.0330	101	0.0497	94	0.1158	91	-	
51	imperial-000	0.0067	15	0.0108	16	0.0022	13	0.0080	14	0.0281	8	-	
52	imperial-001	0.0094	25	0.0154	28	0.0033	20	0.0072	8	0.0276	3	-	
53	incode-003	0.0142	49	0.0249	54	0.0054	44	0.0448	91	0.0318	31	-	
54	incode-004	0.0077	19	0.0132	21	0.0034	21	0.0096	24	0.0313	29	-	
55	innovatrics-004	0.0194	66	0.0292	61	0.0068	61	0.0344	84	0.0454	62	0.465	8
56	innovatrics-005	0.0230	73	0.0353	72	0.0085	74	0.0398	88	0.0301	19	-	
57	intellivision-001	0.1335	106	0.2205	108	0.0417	105	0.1090	105	0.2445	103	0.777	40
58	iqface-000	0.0091	23	0.0143	24	0.0043	31	0.0075	13	0.0381	51	0.649	28
59	isityou-000	0.5682	124	0.7033	124	0.4145	126	1.0000	127	1.0000	122	1.000	59
60	isystems-001	0.0149	53	0.0245	53	0.0067	59	0.0138	52	0.0524	75	0.515	14

Table 4: FNMR is the proportion of mated comparisons below a threshold set to achieve the FMR given in the header on the fourth row. FMR is the proportion of impostor comparisons at or above that threshold. The light grey values give rank over all algorithms in that column. The green column applies to "matched-covariates" i.e. impostors of the same sex, age group, and country of birth. The pink column uses only same-sex impostors; All others are zero effort. The pink column includes effects of extended ageing, and is the most important. Missing entries for visa, mugshot and wild images generally mean the algorithm did not run to completion. For child exploitation, missing entries arise because NIST executes those runs only infrequently.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

		FALSE NON-MATCH RATE (FNMR)											
	Algorithm	CONSTRAINED, COOPERATIVE								LESS CONSTRAINED, NON-COOP.			
	Name	VISAMC		VISA		VISA		MUGSHOT		WILD		CHILD EXP	
	FMR	0.0001		1E-06		0.0001		1E-05		0.0001		0.01	
61	isystems-002	0.0118	35	0.0182	35	0.0066	55	0.0111	34	0.0516	73	0.488	10
62	itmo-005	0.0182	62	0.0345	71	0.0067	60	0.0181	63	0.0433	57	0.481	9
63	itmo-006	0.0125	38	0.0220	45	0.0046	34	0.0149	57	0.0329	37	-	
64	kakao-001	0.4553	121	0.5532	121	0.2034	119	0.6580	120	1.0000	131	-	
65	kakao-002	0.0625	95	0.1779	104	0.0168	91	0.0791	98	1.0000	124	-	
66	kedacom-000	0.0055	9	0.0081	10	0.0027	15	0.0111	36	0.2511	105	-	
67	kneron-003	0.0542	93	0.0902	96	0.0218	95	0.0346	85	0.3053	110	-	
68	lookman-002	0.0297	85	0.0547	88	0.0102	82	0.0339	82	0.2640	108	-	
69	lookman-004	0.0074	18	0.0099	13	0.0037	26	0.0124	45	0.2516	106	-	
70	megvii-001	0.0157	54	0.0244	51	0.0045	33	0.0392	87	0.0916	87	0.442	6
71	megvii-002	0.0104	29	0.0145	25	0.0036	24	0.0225	71	0.0692	81	0.301	1
72	meiya-001	0.0171	61	0.0275	59	0.0066	57	0.0159	61	0.0363	47	-	
73	microfocus-001	0.4482	120	0.5524	120	0.2309	121	0.7256	122	0.2567	107	0.689	31
74	microfocus-002	0.3605	117	0.5057	118	0.1566	118	0.5783	118	0.1582	96	0.652	29
75	mt-000	0.0100	28	0.0170	31	0.0047	36	0.0074	12	0.0326	36	-	
76	neurotechnology-005	0.0141	48	0.0300	64	0.0051	42	0.0108	32	0.0332	38	-	
77	neurotechnology-006	0.0098	27	0.0136	22	0.0040	29	0.0105	30	0.0303	22	0.591	23
78	nodeflux-000	1.0000	130	1.0000	130	1.0000	130	1.0000	130	1.0000	128	-	
79	nodeflux-001	1.0000	131	1.0000	131	1.0000	131	1.0000	131	1.0000	129	-	
80	notiontag-000	0.6669	125	0.7885	125	0.3222	125	0.3715	115	0.1807	98	-	
81	ntechlab-006	0.0078	20	0.0111	17	0.0021	12	0.0112	37	0.0275	2	-	
82	ntechlab-007	0.0056	10	0.0076	9	0.0018	9	0.0073	11	0.0276	4	0.332	2
83	pixelall-002	0.0193	65	0.0340	69	0.0066	56	0.0127	48	0.0342	42	-	
84	psl-001	0.0549	94	0.0927	97	0.0198	93	0.0096	22	0.0431	56	0.624	27
85	psl-002	0.0107	31	0.0180	34	0.0048	39	0.0089	18	0.0295	16	-	
86	rankone-006	0.0242	75	0.0460	81	0.0070	63	0.0119	42	0.0538	76	-	
87	rankone-007	0.0197	67	0.0366	74	0.0057	48	0.0113	38	0.0450	60	-	
88	realnetworks-002	0.0248	77	0.0358	73	0.0099	80	0.0513	95	0.0334	39	-	
89	realnetworks-003	0.0259	81	0.0372	76	0.0100	81	0.0541	96	0.0335	41	-	
90	remarkai-000	0.0147	52	0.0257	57	0.0062	51	0.0102	28	0.0304	23	-	
91	remarkai-001	0.0144	50	0.0256	56	0.0061	50	0.0102	29	0.0308	26	-	
92	saffe-001	0.4339	118	0.5261	119	0.2340	122	0.7539	124	0.3887	113	0.897	52
93	saffe-002	0.0119	36	0.0206	40	0.0054	45	0.0107	31	0.0308	25	-	
94	sensetime-001	0.0063	12	0.0092	11	0.0030	17	0.0130	49	1.0000	121	0.700	33
95	sensetime-002	0.0068	16	0.0098	12	0.0035	22	0.0143	55	0.9999	119	0.531	16
96	shaman-000	0.9297	129	0.9774	129	0.9128	129	0.9990	126	0.9575	117	0.962	54
97	shaman-001	0.3346	115	0.4616	116	0.1360	117	0.2368	111	0.1498	95	0.899	53
98	siat-002	0.0091	24	0.0126	20	0.0039	28	0.0109	33	0.0520	74	0.428	5
99	siat-004	0.0067	14	0.0099	14	0.0028	16	0.0152	59	1.0000	120	-	
100	smilart-002	0.2440	114	0.3532	114	0.0821	114	-		-		0.700	34
101	smilart-003	0.6944	126	0.8836	126	0.1088	116	0.0695	97	0.1190	92	-	
102	starhybrid-001	0.0108	32	0.0138	23	0.0058	49	0.0081	15	0.0350	44	-	
103	synesis-004	0.0310	86	0.0480	84	0.0166	90	0.0476	92	0.1319	93	-	
104	synesis-005	0.0147	51	0.0226	48	0.0073	68	0.0153	60	0.0334	40	-	
105	tech5-001	0.0130	42	0.0176	32	0.0037	27	0.0218	70	0.0938	88	0.838	44
106	tech5-002	0.0046	8	0.0063	6	0.0009	2	0.0113	39	0.0310	28	-	
107	tevian-003	0.0217	70	0.0298	62	0.0067	58	0.0230	74	0.0456	63	0.504	12
108	tevian-004	0.0228	72	0.0304	65	0.0069	62	0.0226	72	0.0394	53	-	
109	tiger-002	0.0658	97	0.0889	94	0.0227	96	0.1083	104	0.0512	71	0.786	42
110	tiger-003	0.0313	87	0.0602	91	0.0087	76	0.0188	66	0.0482	68	0.561	19
111	tongyi-005	0.0073	17	0.0146	26	0.0019	11	0.0187	64	0.0399	54	-	
112	toshiba-002	0.0134	45	0.0222	47	0.0048	38	0.0097	25	0.0434	58	0.710	35
113	toshiba-003	0.0125	37	0.0214	43	0.0047	35	0.0085	17	0.0282	9	-	
114	upc-001	0.0234	74	0.0519	85	0.0071	65	0.0291	79	0.0314	30	-	
115	vcog-002	0.7522	128	0.9033	127	0.5040	127	-		-		0.752	39
116	vd-001	0.0243	76	0.0452	80	0.0093	78	0.0271	78	0.1389	94	-	
117	veridas-001	0.1998	113	0.2724	111	0.0742	111	0.2987	114	0.0501	69	-	
118	veridas-002	0.1733	110	0.2257	109	0.0528	108	0.2617	113	0.0450	61	-	
119	videonetics-001	0.5483	123	0.6446	123	0.3063	124	0.7517	123	0.2986	109	-	
120	vigilantsolutions-006	0.1264	105	0.3221	112	0.0136	88	0.0150	58	0.0321	33	-	

Table 5: FNMR is the proportion of mated comparisons below a threshold set to achieve the FMR given in the header on the fourth row. FMR is the proportion of impostor comparisons at or above that threshold. The light grey values give rank over all algorithms in that column. The green column applies to "matched-covariates" i.e. impostors of the same sex, age group, and country of birth. The pink column uses only same-sex impostors; All others are zero effort. The pink column includes effects of extended ageing, and is the most important. Missing entries for visa, mugshot and wild images generally mean the algorithm did not run to completion. For child exploitation, missing entries arise because NIST executes those runs only infrequently.

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		FALSE NON-MATCH RATE (FNMR)											
	Algorithm	CONSTRAINED, COOPERATIVE								LESS CONSTRAINED, NON-COOP.			
	Name	VISAMC		VISA		VISA		MUGSHOT		WILD		CHILD EXP	
	FMR	0.0001		1E-06		0.0001		1E-05		0.0001		0.01	
121	vigilantsolutions-007	0.0202	69	0.0307	66	0.0070	64	0.0136	51	0.0306	24	-	
122	vion-000	0.0419	92	0.0590	90	0.0288	99	0.0422	89	0.2479	104	0.876	48
123	visionbox-000	0.0293	84	0.0541	87	0.0110	85	0.0197	67	0.0476	67	-	
124	visionbox-001	0.0159	55	0.0270	58	0.0072	67	0.0111	35	0.0389	52	-	
125	visionlabs-006	0.0037	3	0.0066	7	0.0012	4	0.0041	3	0.0285	11	-	
126	visionlabs-007	0.0038	4	0.0048	2	0.0012	6	0.0036	1	0.0286	12	0.371	3
127	vocord-006	0.0062	11	0.0102	15	0.0016	8	0.0082	16	0.0282	10	-	
128	vocord-007	0.0039	5	0.0053	4	0.0012	5	0.0061	5	0.0280	7	0.847	46
129	winsense-000	0.0140	47	0.0228	49	0.0056	47	0.0125	47	0.0352	45	-	
130	yisheng-004	0.1988	112	0.3329	113	0.0475	106	0.1147	106	0.0908	86	0.715	36
131	yitu-003	0.0015	1	0.0026	1	0.0003	1	0.0066	7	0.0325	35	-	

Table 6: FNMR is the proportion of mated comparisons below a threshold set to achieve the FMR given in the header on the fourth row. FMR is the proportion of impostor comparisons at or above that threshold. The light grey values give rank over all algorithms in that column. The green column applies to "matched-covariates" i.e. impostors of the same sex, age group, and country of birth. The pink column uses only same-sex impostors; All others are zero effort. The pink column includes effects of extended ageing, and is the most important. Missing entries for visa, mugshot and wild images generally mean the algorithm did not run to completion. For child exploitation, missing entries arise because NIST executes those runs only infrequently.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

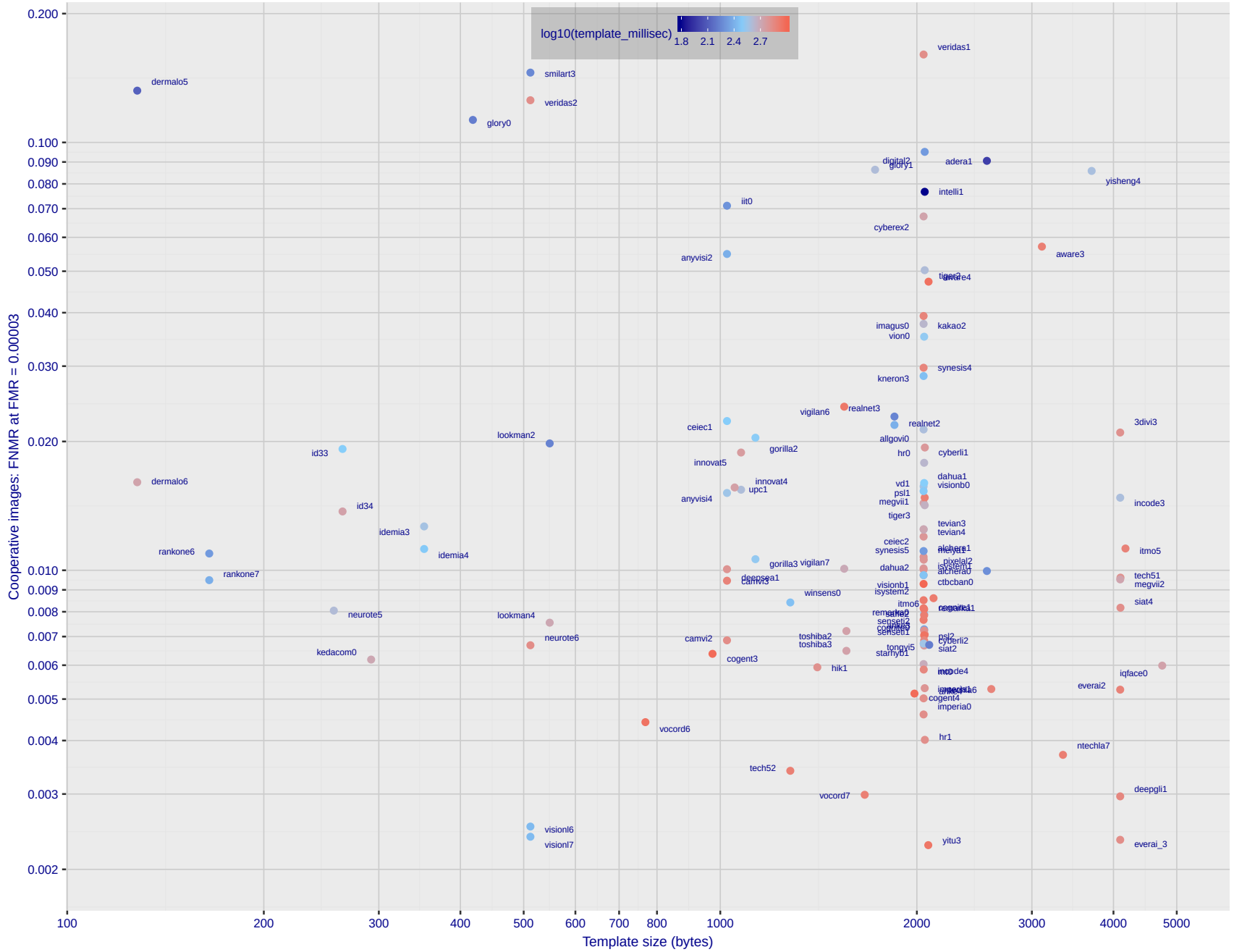


Figure 1: The points show false non-match rates (FNMR) versus the size of the encoded template. FNMR is the geometric mean of FNMR values for visa and mugshot images (from Figs. 23 and 30) at a false match rate (FMR) of 0.0001. The color of the points encodes template generation time - which spans at least one order of magnitude. Durations are measured on a single core of a c. 2016 Intel Xeon CPU E5-2630 v4 running at 2.20GHz. Algorithms with poor FNMR are omitted.

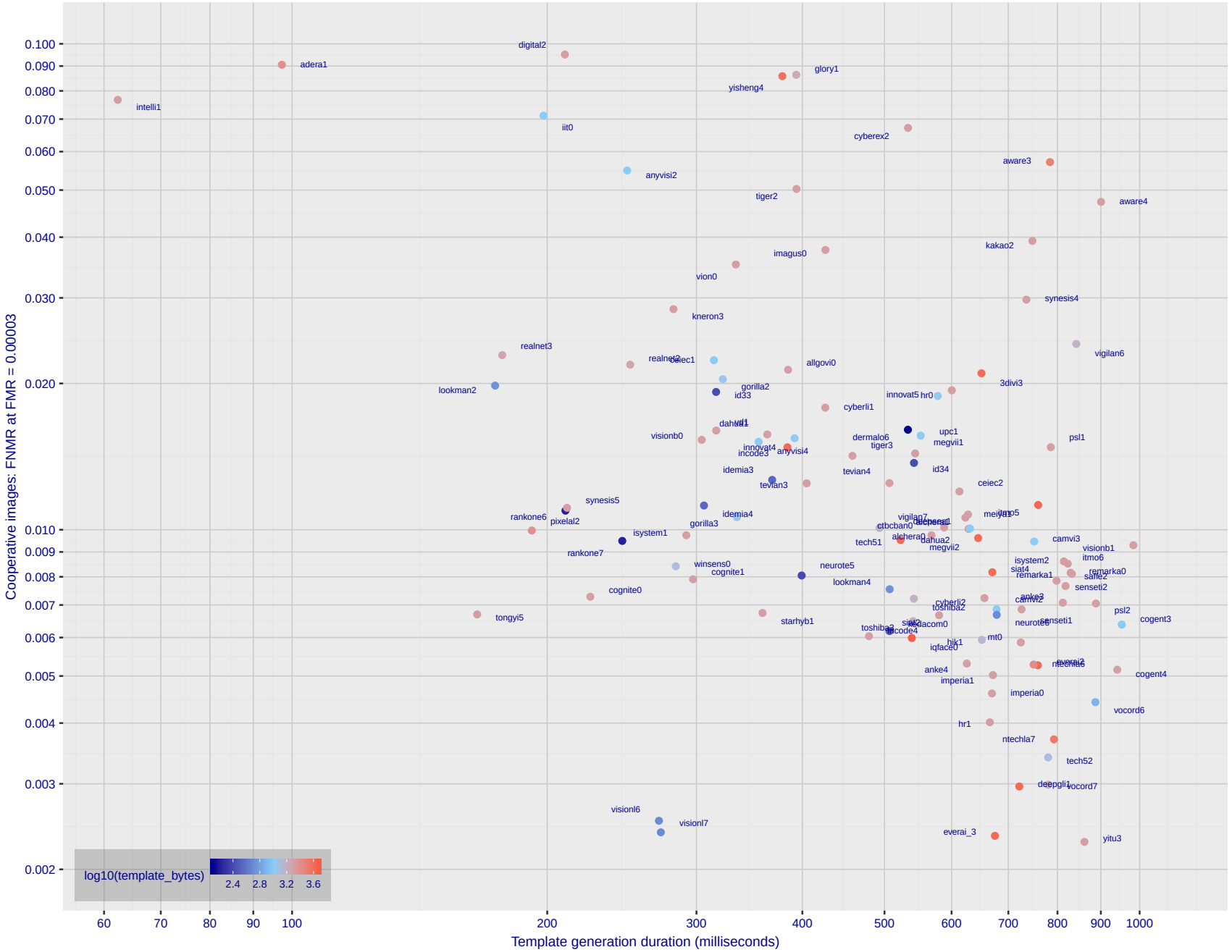


Figure 2: The points show false non-match rates (FNMR) versus the duration of the template generation operation. FNMR is the geometric mean of FNMR values for visa and mugshot images (from Figs. 23 and 30) at a false match rate (FMR) of 0.0001. Template generation time is a median estimated over 640 x 480 pixel portraits. It is measured on a single core of a c. 2016 Intel Xeon CPU E5-2630 v4 running at 2.20GHz. The color of the points encodes template size - which span two orders of magnitude. Algorithms with poor FNMR are omitted.

1 Metrics

1.1 Core accuracy

Given a vector of N genuine scores, u, the false non-match rate (FNMR) is computed as the proportion below some threshold, T:

$$\text{FNMR}(T) = 1 - \frac{1}{N}\sum_{i=1}^{N} H(u_i - T) \tag{1}$$

where $H(x)$ is the unit step function, and $H(0)$ taken to be 1.

Similarly, given a vector of N impostor scores, v, the false match rate (FMR) is computed as the proportion above T:

$$\text{FMR}(T) = \frac{1}{N}\sum_{i=1}^{N} H(v_i - T) \tag{2}$$

The threshold, T, can take on any value. We typically generate a set of thresholds from quantiles of the observed impostor scores, v, as follows. Given some interesting false match rate range, $[\text{FMR}_L, \text{FMR}_U]$, we form a vector of K thresholds corresponding to FMR measurements evenly spaced on a logarithmic scale

$$T_k = Q_v(1 - \text{FMR}_k) \tag{3}$$

where Q is the quantile function, and FMR_k comes from

$$\log_{10}\text{FMR}_k = \log_{10}\text{FMR}_L + \frac{k}{K}\ [\log_{10}\text{FMR}_U - \log_{10}\text{FMR}_L] \tag{4}$$

Error tradeoff characteristics are plots of FNMR(T) vs. FMR(T). These are plotted with $\text{FMR}_U \to 1$ and FMR_L as low as is sustained by the number of impostor comparisons, N. This is somewhat higher than the "rule of three" limit $3/N$ because samples are not independent, due to re-use of images.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

2 Datasets

2.1 Child exploitation images

- ▷ The number of images is on the order of 10^4.
- ▷ The number of subjects is on the order of 10^3.
- ▷ The number of subjects with two images on the order of 10^3.
- ▷ The images are operational. They are taken from ongoing investigations of child exploitation crimes. The images are arbitrarily unconstrained. Pose varies considerably around all three axes, including subject lying down. Resolution varies very widely. Faces can be occluded by other objects, including hair and hands. Lighting varies, although the images are intended for human viewing. Mis-focus is rare. Images are given to the algorithm without any cropping; faces may occupy widely varying areas.
- ▷ The images are usually large from contemporary cameras. The mean interocular distance (IOD) is 70 pixels.
- ▷ The images are of subjects from several countries, due to the global production of this imagery.
- ▷ The images are of children, from infancy to late adolescence.
- ▷ All of the images are live capture, none are scanned. Many have been cropped.
- ▷ When these images are input to the algorithm, they are labelled as being of type ”EXPLOITATION” - see Table 4 of the FRVT API.

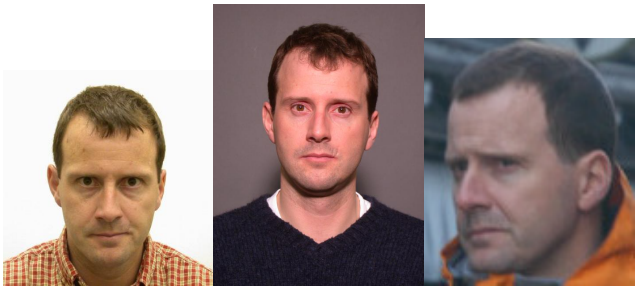
2.2 Visa images

- ▷ The number of images is on the order of 10^5.
- ▷ The number of subjects is on the order of 10^5.
- ▷ The number of subjects with two images on the order of 10^4.
- ▷ The images have geometry in reasonable conformance with the ISO/IEC 19794-5 Full Frontal image type. Pose is generally excellent.
- ▷ The images are of size 252x300 pixels. The mean interocular distance (IOD) is 69 pixels.
- ▷ The images are of subjects from greater than 100 countries, with significant imbalance due to visa issuance patterns.
- ▷ The images are of subjects of all ages, including children, again with imbalance due to visa issuance demand.
- ▷ Many of the images are live capture. A substantial number of the images are photographs of paper photographs.
- ▷ When these images are input to the algorithm, they are labelled as being of type ”ISO” - see Table 4 of the FRVT API.

2.3 Mugshot images

- ▷ The number of images is on the order of 10^6.
- ▷ The number of subjects is on the order of 10^6.
- ▷ The number of subjects with two images on the order of 10^6.

FNMR(T) “False non-match rate”
FMR(T) “False match rate”



(a) Visa (b) Mugshot (c) Wild

Figure 3: The figure gives simulated samples of image types used in this report.

- ▷ The images have geometry in reasonable conformance with the ISO/IEC 19794-5 Full Frontal image type.
- ▷ The images are of variable sizes. The median IOD is 105 pixels. The mean IOD is 113 pixels. The 1-st, 5-th, 10-th, 25-th, 75-th, 90-th and 99-th percentiles are 34, 58, 70, 87, 121, 161 and 297 pixels.
- ▷ The images are of subjects from the United States.
- ▷ The images are of adults.
- ▷ The images are all live capture.
- ▷ When these images are input to the algorithm, they are labelled as being of type ”mugshot” - see Table 4 of the FRVT API.

2.4 Wild images

- ▷ The number of images is on the order of 10^5.
- ▷ The number of subjects is on the order of 10^3.
- ▷ The number of subjects with two images on the order of 10^3.
- ▷ The images include many photojournalism-style images. Images are given to the algorithm using a variable but generally tight crop of the head. Resolution varies very widely. The images are very unconstrained, with wide yaw and pitch pose variation. Faces can be occluded, including hair and hands.
- ▷ The images are of adults.
- ▷ All of the images are live capture, none are scanned.
- ▷ When these images are input to the algorithm, they are labelled as being of type ”WILD” - see Table 4 of the FRVT API.

3 Results

3.1 Test goals

- ▷ To state overall accuracy.
- ▷ To compare algorithms.

FNMR(T) “False non-match rate”
FMR(T) “False match rate”

3.2 Test design

Method: For visa images:

- ▷ The comparisons are of visa photos against visa photos.
- ▷ The number of genuine comparisons is on the order of 10^4.
- ▷ The number of impostor comparisons is on the order of 10^{10}.
- ▷ The comparisons are fully zero-effort, meaning impostors are paired without attention to sex, age or other covariates. However, later analysis is conducted on subsets.
- ▷ The number of persons is on the order of 10^5.
- ▷ The number of images used to make 1 template is 1.
- ▷ The number of templates used to make each comparison score is two corresponding to simple one-to-one verification.

For mugshot images:

- ▷ The comparisons are of mugshot photos against mugshot photos.
- ▷ The number of genuine comparisons is on the order of 10^6.
- ▷ The number of impostor comparisons is on the order of 10^8.
- ▷ The impostors are paired by sex, but not by age or other covariates.
- ▷ The number of persons is on the order of 10^6.
- ▷ The number of images used to make 1 template is 1.
- ▷ The number of templates used to make each comparison score is two corresponding to simple one-to-one verification.

Method: For wild images:

- ▷ The comparisons are of wild photos against wild photos.
- ▷ The number of genuine comparisons is on the order of 10^6.
- ▷ The number of impostor comparisons is on the order of 10^7.
- ▷ The comparisons are fully zero-effort, meaning impostors are paired without attention to sex, age or other covariates.
- ▷ The number of persons is on the order of 10^4.
- ▷ The number of images used to make 1 template is 1.
- ▷ The number of templates used to make each comparison score is two corresponding to simple one-to-one verification.

For child exploitation images:

- ▷ The comparisons are of unconstrained child exploitation photos against others of the same type.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

- The number of genuine comparisons is on the order of 10^4.
- The number of impostor comparisons is on the order of 10^7.
- The comparisons are fully zero-effort, meaning impostors are paired without attention to sex, age or other covariates.
- The number of persons is on the order of 10^3.
- The number of images used to make 1 template is 1.
- The number of templates used to make each comparison score is two corresponding to simple one-to-one verification.
- We produce two performance statements. First, is a DET as used for visa and mugshot images. The second is a cumulative match characteristic (CMC) summarizing a simulated one-to-many search process. This is done as follows.
  - We regard M enrollment templates as items in a gallery.
  - These M templates come from $M > N$ individuals, because multiple images of a subject are present in the gallery under separate identifiers.
  - We regard the verification templates as search templates.
  - For each search we compute the rank of the highest scoring mate.
  - This process should properly be conducted with a 1:N algorithm, such as those tested in NIST IR 8009. We use the 1:1 algorithms in a simulated 1:N mode here to a) better reflect what a child exploitation analyst does, and b) to show algorithm efficacy is better than that revealed in the verification DETs.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

3.3 Failure to enroll

	Algorithm	Failure to Enrol Rate[1]							
	Name	CHILD-EXPLOIT		MUGSHOT		VISA		WILD	
1	3divi-003	0.1806	43	0.0007	92	0.0006	86	0.0294	104
2	adera-001	0.1928	44	0.0003	66	0.0005	83	0.0505	114
3	alchera-000	-	131	0.0004	82	0.0014	112	0.0038	75
4	alchera-001	-	131	0.0004	81	0.0014	111	0.0038	74
5	allgovision-000	-	131	0.0026	116	0.0052	129	0.0131	96
6	amplifiedgroup-001	-	131	0.0189	131	0.0279	135	0.1390	126
7	anke-003	-	131	0.0001	46	0.0004	59	0.0006	48
8	anke-004	-	131	0.0001	47	0.0004	67	0.0006	53
9	anyvision-002	0.4866	57	0.0070	126	0.0090	131	0.1146	122
10	anyvision-004	0.1660	40	0.0001	55	0.0004	64	0.0080	87
11	aware-003	0.3314	53	0.0016	111	0.0013	108	0.0745	119
12	aware-004	-	131	0.0002	58	0.0005	73	0.0014	65
13	ayonix-000	0.0000	3	0.0113	128	0.0137	133	0.1194	123
14	bm-001	0.0000	9	0.0000	29	0.0000	14	0.0000	11
15	camvi-002	0.0000	4	0.0000	19	0.0000	21	0.0000	17
16	camvi-003	-	131	0.0000	2	0.0000	2	0.0000	1
17	ceiec-001	-	131	0.0029	119	0.0023	119	0.0068	83
18	ceiec-002	0.2482	50	0.0036	120	0.0031	124	0.0081	88
19	cogent-003	-	131	0.0001	44	0.0004	62	0.0009	61
20	cogent-004	0.0000	7	0.0000	4	0.0000	5	0.0000	3
21	cognitec-000	0.6342	60	0.0007	93	0.0007	92	0.0388	111
22	cognitec-001	-	131	0.0008	97	0.0010	95	0.0185	100
23	ctbcbank-000	-	131	0.0011	103	0.0019	116	0.0868	121
24	cyberextruder-001	0.5338	58	0.0024	114	0.0029	123	0.0597	117
25	cyberextruder-002	0.2672	51	0.0027	117	0.0028	122	0.0335	109
26	cyberlink-001	-	131	0.0073	127	0.0005	75	0.0008	55
27	cyberlink-002	0.1463	39	0.0004	75	0.0004	71	0.0007	54
28	dahua-001	0.0000	17	0.0000	28	0.0000	30	0.0000	26
29	dahua-002	-	131	0.0024	115	0.0022	118	0.0009	58
30	deepglint-001	0.0000	11	0.0000	13	0.0000	15	0.0000	12
31	deepsea-001	0.0000	10	0.0000	6	0.0000	7	0.0000	5
32	dermalog-005	0.1796	41	0.0013	107	0.0041	126	0.0163	98
33	dermalog-006	0.1797	42	0.0013	106	0.0041	127	0.0163	99
34	digitalbarriers-002	-	131	0.0028	118	0.0027	121	0.0071	84
35	dsk-000	-	131	0.0000	10	0.0000	11	0.0000	8
36	everai-002	-	131	0.0002	61	0.0004	45	0.0004	44
37	everai-paravision-003	-	131	0.0002	57	0.0004	52	0.0004	42
38	glory-000	0.0000	8	0.0053	124	0.0013	109	0.1565	127
39	glory-001	0.0000	13	0.0051	123	0.0010	96	0.1651	128
40	gorilla-002	0.1347	35	0.0003	74	0.0004	72	0.0117	92
41	gorilla-003	0.1347	34	0.0003	73	0.0004	70	0.0043	78
42	hik-001	-	131	0.0000	23	0.0000	25	0.0000	21
43	hr-000	-	131	0.0003	69	0.0008	93	0.0034	73
44	hr-001	-	131	0.0001	39	0.0004	53	0.0003	38
45	id3-003	0.3032	52	0.0016	112	0.0011	106	0.0317	107
46	id3-004	-	131	0.0015	110	0.0011	105	-	131
47	idemia-003	0.0481	20	0.0000	31	0.0004	46	0.0042	77
48	idemia-004	-	131	0.0000	34	0.0004	49	0.0003	39
49	iit-000	-	131	0.0007	91	0.0011	100	0.0836	120
50	imagus-000	-	131	0.0010	102	0.0012	107	0.0347	110
51	imperial-000	-	131	0.0000	15	0.0000	17	0.0000	14
52	imperial-001	-	131	0.0000	26	0.0000	28	0.0000	24
53	incode-003	-	131	0.0004	86	0.0007	89	0.0014	64
54	incode-004	-	131	0.0004	85	0.0007	88	0.0014	63
55	innovatrics-004	0.1170	33	0.0000	37	0.0004	66	0.0041	76
56	innovatrics-005	-	131	0.0000	38	0.0004	65	0.0006	49
57	intellivision-001	0.5495	59	0.0048	122	0.0042	128	0.1358	124
58	iqface-000	0.0000	12	0.0000	22	0.0000	24	0.0000	20
59	isityou-000	0.4714	56	0.0023	113	0.0010	98	0.0663	118
60	isystems-001	0.1421	37	0.0010	100	0.0007	90	0.0128	94

Table 7: FTE is the proportion of failed template generation attempts. Failures can occur because the software throws an exception, or because the software electively refuses to process the input image. This would typically occur if a face is not detected. FTE is measured as the number of function calls that give EITHER a non-zero error code OR that give a "small" template. This is defined as one whose size is less than 0.3 times the median template size for that algorithm. This second rule is needed because some algorithms incorrectly fail to return a non-zero error code when template generation fails.

[1] *The effects of FTE are included in the accuracy results of this report by regarding any template comparison involving a failed template to produce a low similarity score. Thus higher FTE results in higher FNMR and lower FMR.*

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

	Algorithm	Failure to Enrol Rate[1]							
	Name	CHILD-EXPLOIT		MUGSHOT		VISA		WILD	
61	isystems-002	0.1421	38	0.0010	101	0.0007	91	0.0128	95
62	itmo-005	0.1353	36	0.0005	88	0.0002	32	0.0075	85
63	itmo-006	-	131	0.0004	84	0.0004	63	0.0006	52
64	kakao-001	-	131	0.0002	62	0.0005	77	0.0310	105
65	kakao-002	-	131	0.0002	63	0.0005	81	0.0310	106
66	kedacom-000	-	131	0.0000	12	0.0000	13	0.0000	10
67	kneron-003	-	131	0.0044	121	0.0016	115	0.1823	129
68	lookman-002	-	131	0.0000	21	0.0000	23	0.0000	19
69	lookman-004	-	131	0.0000	18	0.0000	20	0.0000	16
70	megvii-001	0.0274	19	0.0007	94	0.0004	51	0.0152	97
71	megvii-002	0.0274	18	0.0054	125	0.0004	50	0.0126	93
72	meiya-001	-	131	0.0004	87	0.0010	99	0.0025	70
73	microfocus-001	0.0791	31	0.0008	96	0.0016	114	0.0220	103
74	microfocus-002	0.0791	30	0.0008	95	0.0016	113	0.0220	102
75	mt-000	-	131	0.0002	60	0.0004	68	0.0004	40
76	neurotechnology-005	-	131	0.0004	78	0.0004	55	0.0018	66
77	neurotechnology-006	0.1068	32	0.0004	79	0.0004	56	0.0018	67
78	nodeflux-000	-	131	0.0001	48	0.0002	33	0.0003	34
79	nodeflux-001	-	131	0.0001	49	0.0002	34	0.0003	35
80	notiontag-000	-	131	0.0000	16	0.0000	18	0.0000	15
81	ntechlab-006	-	131	0.0000	30	0.0004	43	0.0003	33
82	ntechlab-007	0.0682	29	0.0001	40	0.0004	47	0.0005	47
83	pixelall-002	-	131	0.0000	9	0.0000	10	0.0001	31
84	psl-001	0.0000	14	0.0000	27	0.0000	29	0.0000	25
85	psl-002	-	131	0.0000	11	0.0000	12	0.0000	9
86	rankone-006	-	131	0.0000	25	0.0000	27	0.0000	23
87	rankone-007	-	131	0.0003	68	0.0004	69	0.0043	79
88	realnetworks-002	-	131	0.0004	77	0.0003	37	0.0004	41
89	realnetworks-003	-	131	0.0004	76	0.0003	36	0.0004	43
90	remarkai-000	-	131	0.0000	3	0.0000	3	0.0000	29
91	remarkai-001	-	131	0.0000	17	0.0000	19	0.0000	30
92	saffe-001	0.0000	15	0.0000	14	0.0000	16	0.0000	13
93	saffe-002	-	131	0.0000	24	0.0000	26	0.0000	22
94	sensetime-001	0.0631	28	0.0000	33	0.0004	58	0.0003	36
95	sensetime-002	0.3345	54	0.0011	104	0.0005	84	0.0218	101
96	shaman-000	0.0000	5	0.0000	20	0.0000	22	0.0000	18
97	shaman-001	0.0000	1	0.0000	1	0.0000	1	0.0000	27
98	siat-002	0.0616	25	0.0000	36	0.0004	61	0.0048	81
99	siat-004	-	131	0.0000	35	0.0004	60	0.0003	37
100	smilart-002	0.2422	47	0.0003	72	0.0011	102	0.0575	116
101	smilart-003	-	131	0.0014	108	0.0013	110	0.0555	115
102	starhybrid-001	-	131	0.0009	99	0.0023	120	0.0044	80
103	synesis-004	-	131	0.0164	130	0.0035	125	0.0485	113
104	synesis-005	-	131	0.0001	45	0.0005	74	0.0021	68
105	tech5-001	0.0000	2	0.0004	80	0.0003	39	0.0409	112
106	tech5-002	-	131	0.0001	43	0.0003	35	0.0000	28
107	tevian-003	0.2430	49	0.0003	65	0.0005	85	0.0076	86
108	tevian-004	-	131	0.0002	59	0.0005	82	0.0057	82
109	tiger-002	0.0619	26	0.0001	52	0.0004	57	0.0082	90
110	tiger-003	0.0619	27	0.0001	50	0.0004	54	0.0082	89
111	tongyi-005	-	131	0.0000	5	0.0000	6	0.0000	4
112	toshiba-002	0.0000	16	0.0000	8	0.0000	9	0.0000	7
113	toshiba-003	-	131	0.0001	53	0.0001	31	0.0002	32
114	upc-001	-	131	0.0003	64	0.0003	41	0.0011	62
115	vd-001	-	131	0.0004	83	0.0009	94	0.0024	69
116	veridas-001	-	131	0.0001	51	0.0005	78	0.0006	50
117	veridas-002	-	131	0.0001	54	0.0005	80	0.0006	51
118	videonetics-001	-	131	0.0015	109	0.0010	97	0.0112	91
119	vigilantsolutions-006	-	131	0.0001	42	0.0004	48	0.0005	46
120	vigilantsolutions-007	-	131	0.0001	41	0.0004	44	0.0005	45

Table 8: FTE is the proportion of failed template generation attempts. Failures can occur because the software throws an exception, or because the software electively refuses to process the input image. This would typically occur if a face is not detected. FTE is measured as the number of function calls that give EITHER a non-zero error code OR that give a "small" template. This is defined as one whose size is less than 0.3 times the median template size for that algorithm. This second rule is needed because some algorithms incorrectly fail to return a non-zero error code when template generation fails.

[1] *The effects of FTE are included in the accuracy results of this report by regarding any template comparison involving a failed template to produce a low similarity score. Thus higher FTE results in higher FNMR and lower FMR.*

	Algorithm	Failure to Enrol Rate[1]							
	Name	CHILD-EXPLOIT		MUGSHOT		VISA		WILD	
121	vion-000	0.6388	61	0.0130	129	0.0078	130	0.1389	125
122	visionbox-000	-	131	0.0005	90	0.0011	104	0.0028	72
123	visionbox-001	-	131	0.0005	89	0.0011	103	0.0028	71
124	visionlabs-006	-	131	0.0003	71	0.0005	79	0.0009	60
125	visionlabs-007	0.1939	45	0.0003	70	0.0005	76	0.0008	57
126	vocord-006	-	131	0.0003	67	0.0003	40	0.0008	56
127	vocord-007	0.0000	6	0.0001	56	0.0004	42	0.0009	59
128	winsense-000	-	131	0.0000	7	0.0000	8	0.0000	6
129	yisheng-004	0.4279	55	0.0013	105	0.0006	87	0.0321	108
130	yitu-003	-	131	0.0009	98	0.0000	4	0.0000	2

Table 9: FTE is the proportion of failed template generation attempts. Failures can occur because the software throws an exception, or because the software electively refuses to process the input image. This would typically occur if a face is not detected. FTE is measured as the number of function calls that give EITHER a non-zero error code OR that give a "small" template. This is defined as one whose size is less than 0.3 times the median template size for that algorithm. This second rule is needed because some algorithms incorrectly fail to return a non-zero error code when template generation fails.
[1] *The effects of FTE are included in the accuracy results of this report by regarding any template comparison involving a failed template to produce a low similarity score. Thus higher FTE results in higher FNMR and lower FMR.*

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

3.4 Recognition accuracy

Core algorithm accuracy is stated via:

- **Cooperative subjects**
  - The summary table of Figure 6;
  - The visa image DETs of Figure 23;
  - The mugshot DETs of Figure 30;
  - The mugshot ageing profiles of Figure 110;
  - The human-difficult pairs of Figure 9
- **Non-cooperative subjects**
  - The photojournalism DET of Figure 36
  - The child-exploitation DET of Figure 39;
  - The child-exploitation CMC of Figure 41.

Figure 89 shows dependence of false match rate on algorithm score threshold. This allows a deployer to set a threshold to target a particular false match rate appropriate to the security objectives of the application.

Figure 75 likewise shows FMR(T) but for mugshots, and specially four subsets of the population.

Note that in both the mugshot and visa sets false match rates vary with the ethnicity, age, and sex, of the enrollee and impostor - see section 3.6. For example figure 49 summarizes FMR for impostors paired from four groups black females, black males, white females, white males.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

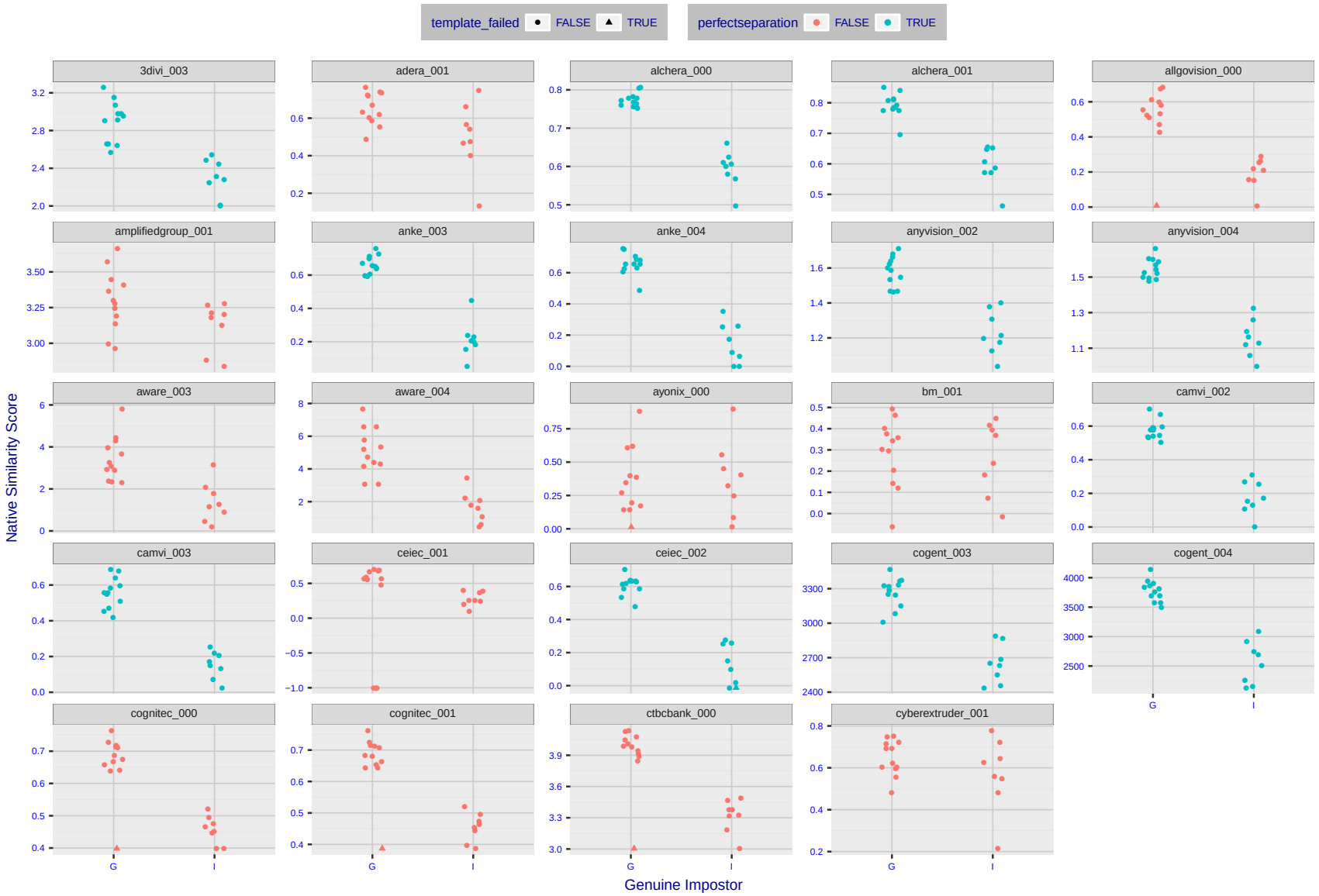


Figure 4: The Figure shows, in blue, algorithms that correctly separate the 12 genuine and 8 impostor pairs used in the May 2018 paper Face recognition accuracy of forensic examiners, superrecognizers, and face recognition algorithms *(Phillips et al. [1]). In red are algorithms that are imperfect. Some algorithms fail only because they failed to make a template e.g. due to face detection failure (shown as a triangle). Others fail because the pairs were selected for that study because they had been difficult for three leading algorithms used in FRVT 2006. Caution: Given the small sample size (n=20) the figure may change substantially if larger or different sets were used.*

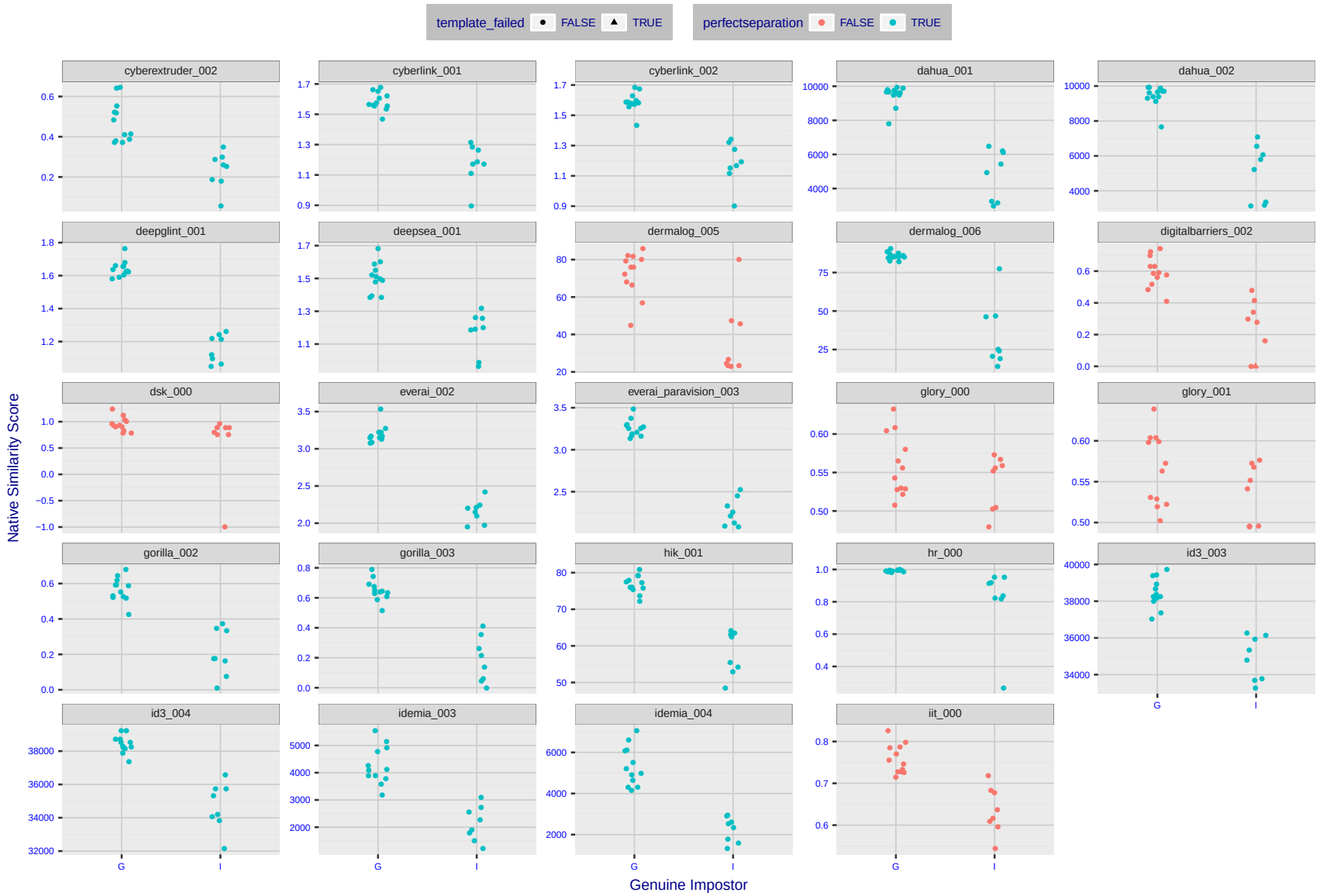


Figure 5: The Figure shows, in blue, algorithms that correctly separate the 12 genuine and 8 impostor pairs used in the May 2018 paper Face recognition accuracy of forensic examiners, superrecognizers, and face recognition algorithms *(Phillips et al. [1]). In red are algorithms that are imperfect. Some algorithms fail only because they failed to make a template e.g. due to face detection failure (shown as a triangle). Others fail because the pairs were selected for that study because they had been difficult for three leading algorithms used in FRVT 2006. Caution: Given the small sample size (n=20) the figure may change substantially if larger or different sets were used.*

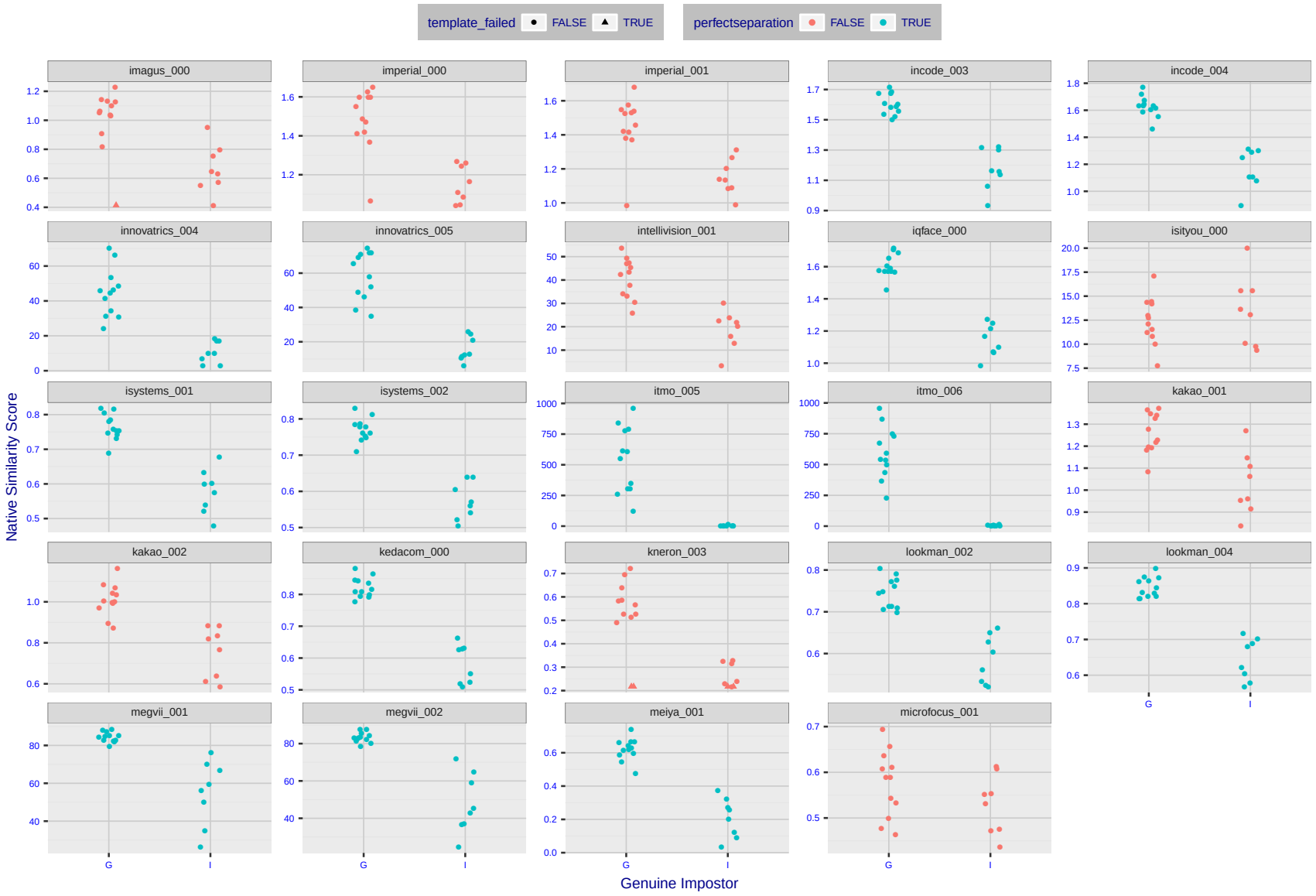


Figure 6: The Figure shows, in blue, algorithms that correctly separate the 12 genuine and 8 impostor pairs used in the May 2018 paper Face recognition accuracy of forensic examiners, superrecognizers, and face recognition algorithms *(Phillips et al. [1]). In red are algorithms that are imperfect. Some algorithms fail only because they failed to make a template e.g. due to face detection failure (shown as a triangle). Others fail because the pairs were selected for that study because they had been difficult for three leading algorithms used in FRVT 2006. Caution: Given the small sample size (n=20) the figure may change substantially if larger or different sets were used.*

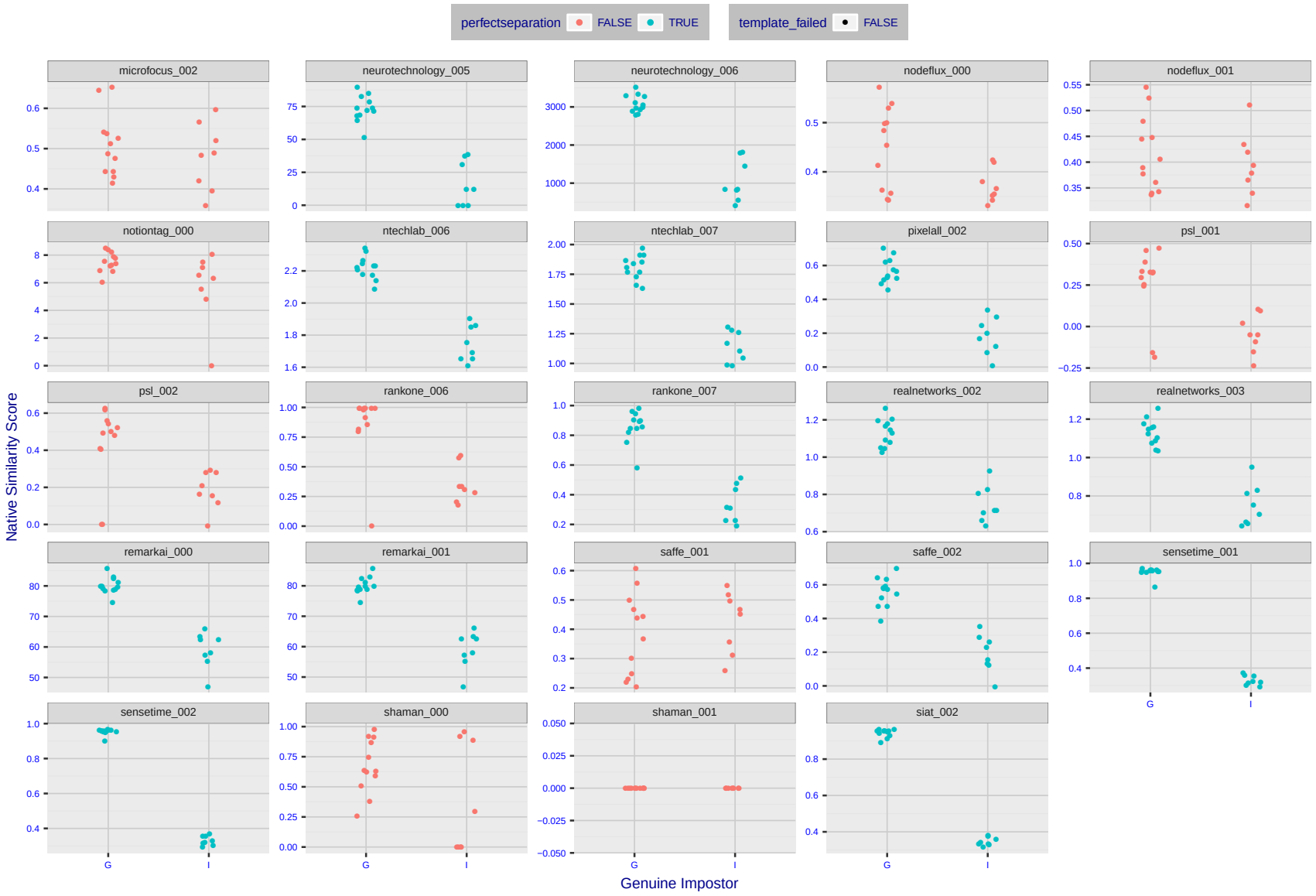


Figure 7: The Figure shows, in blue, algorithms that correctly separate the 12 genuine and 8 impostor pairs used in the May 2018 paper Face recognition accuracy of forensic examiners, superrecognizers, and face recognition algorithms *(Phillips et al. [1]). In red are algorithms that are imperfect. Some algorithms fail only because they failed to make a template e.g. due to face detection failure (shown as a triangle). Others fail because the pairs were selected for that study because they had been difficult for three leading algorithms used in FRVT 2006. Caution: Given the small sample size (n=20) the figure may change substantially if larger or different sets were used.*

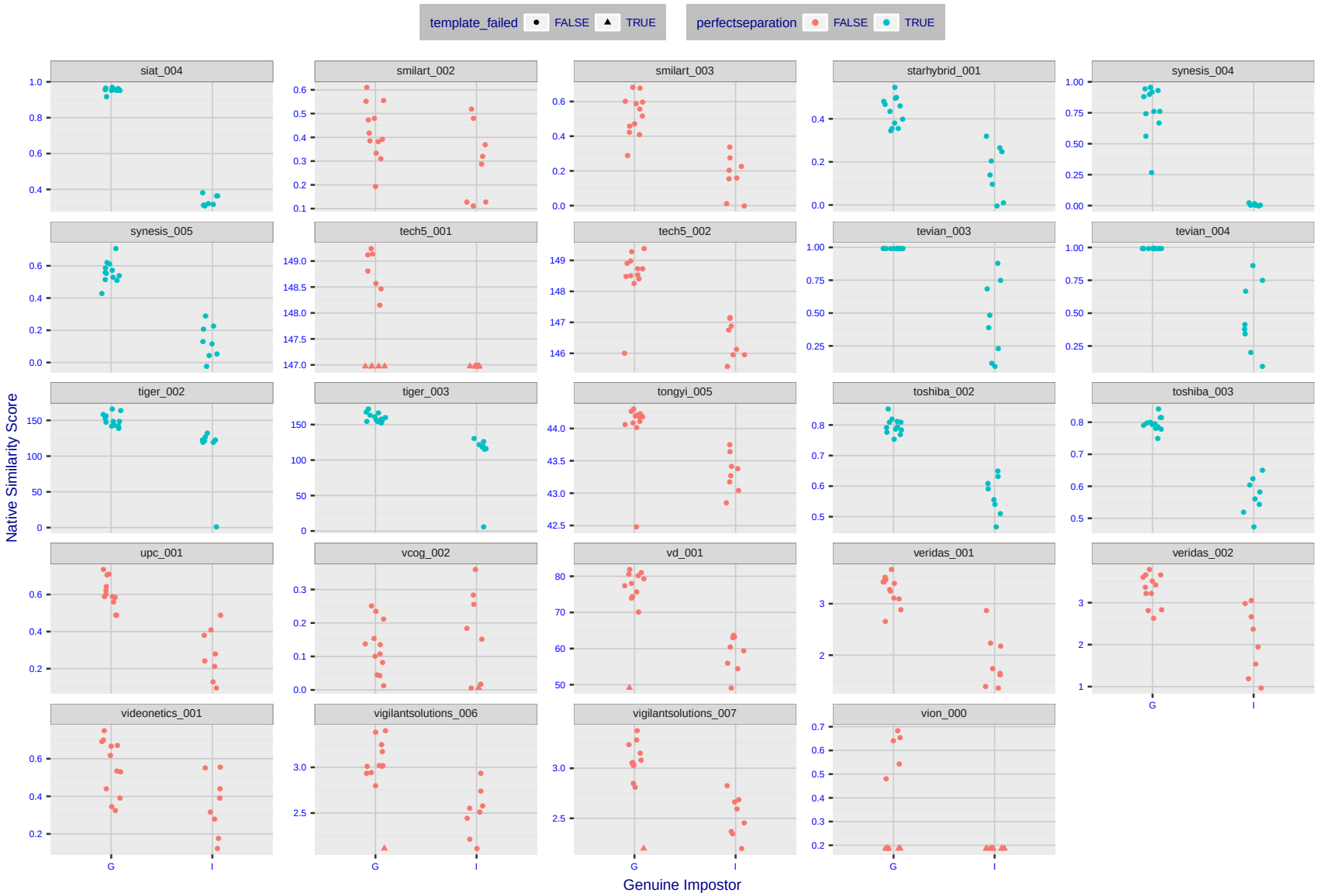


Figure 8: The Figure shows, in blue, algorithms that correctly separate the 12 genuine and 8 impostor pairs used in the May 2018 paper Face recognition accuracy of forensic examiners, superrecognizers, and face recognition algorithms *(Phillips et al. [1]). In red are algorithms that are imperfect. Some algorithms fail only because they failed to make a template e.g. due to face detection failure (shown as a triangle). Others fail because the pairs were selected for that study because they had been difficult for three leading algorithms used in FRVT 2006. Caution: Given the small sample size (n=20) the figure may change substantially if larger or different sets were used.*

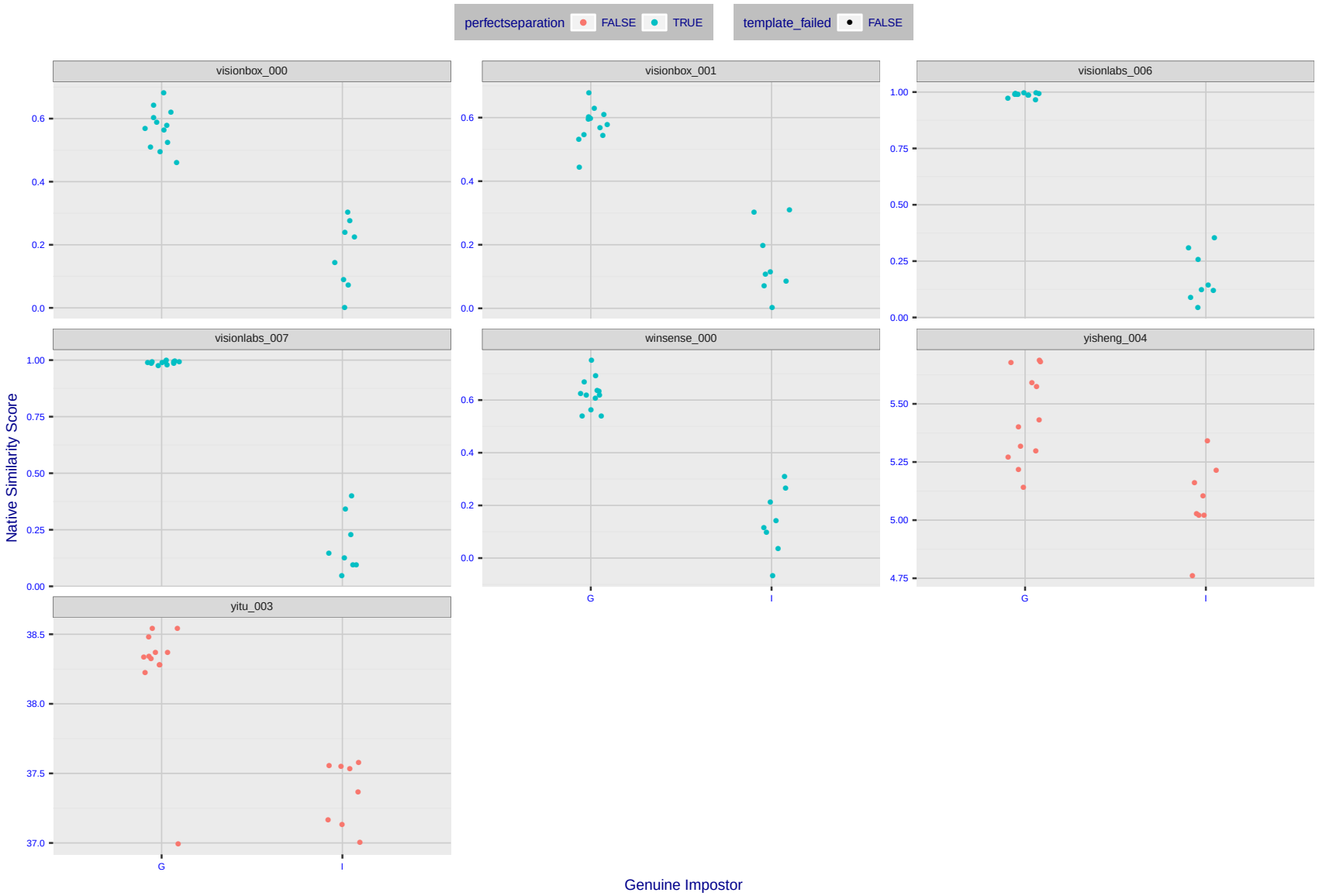


Figure 9: The Figure shows, in blue, algorithms that correctly separate the 12 genuine and 8 impostor pairs used in the May 2018 paper Face recognition accuracy of forensic examiners, superrecognizers, and face recognition algorithms *(Phillips et al. [1]). In red are algorithms that are imperfect. Some algorithms fail only because they failed to make a template e.g. due to face detection failure (shown as a triangle). Others fail because the pairs were selected for that study because they had been difficult for three leading algorithms used in FRVT 2006. Caution: Given the small sample size (n=20) the figure may change substantially if larger or different sets were used.*

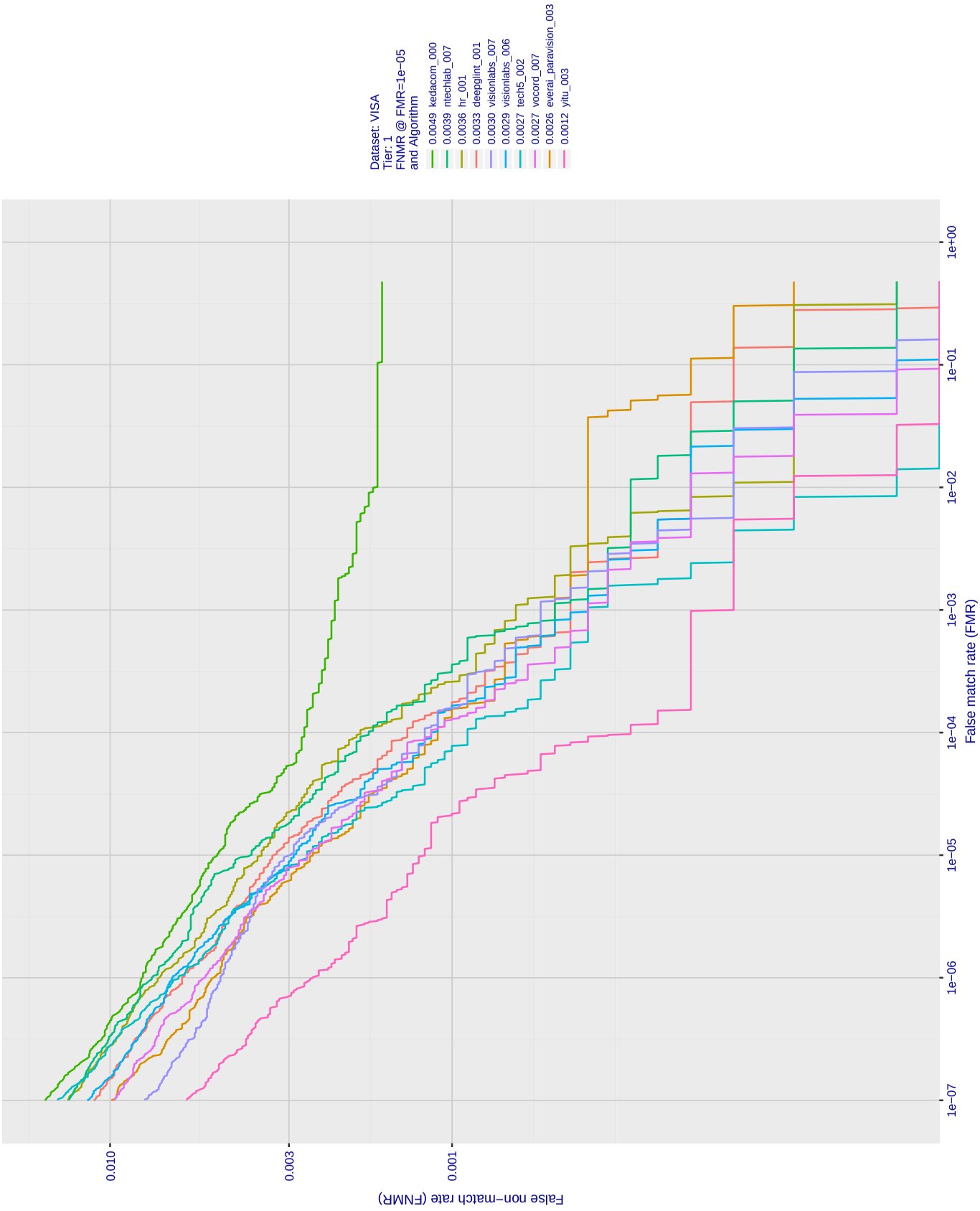


Figure 10: For the visa images, detection error tradeoff (DET) *characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of* FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

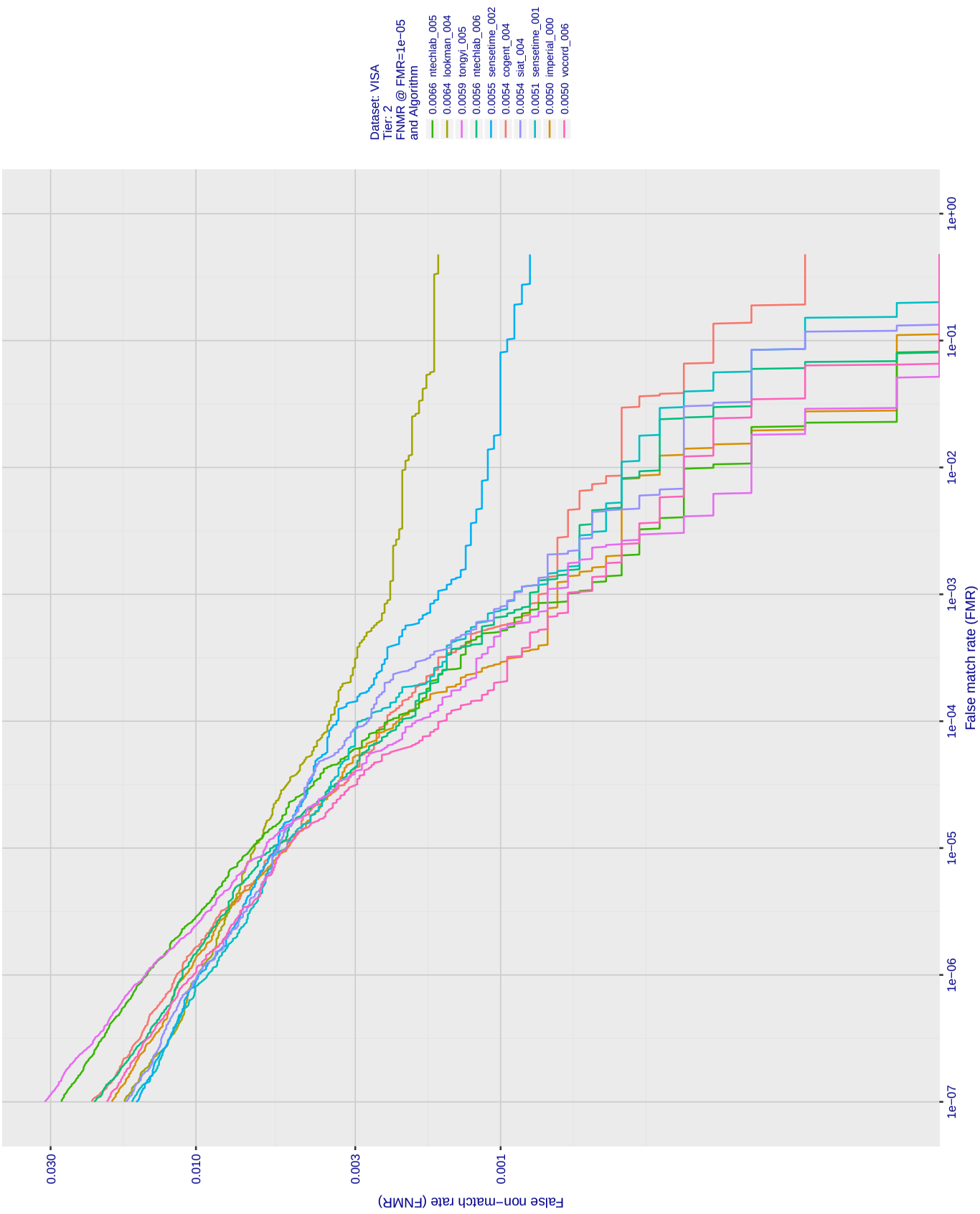


Figure 11: For the visa images, detection error tradeoff (DET) *characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of* FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

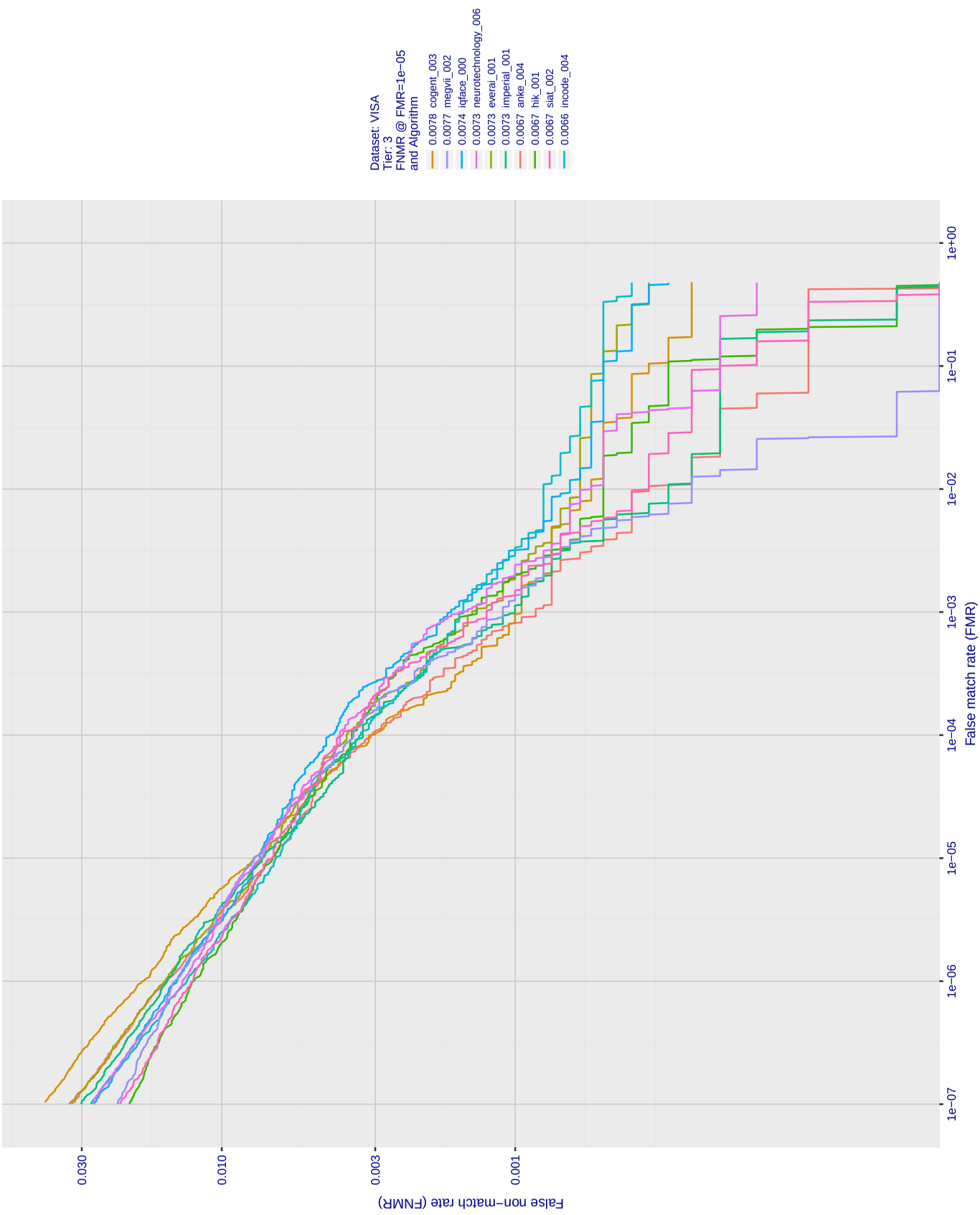


Figure 12: For the visa images, detection error tradeoff (DET) *characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of* FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

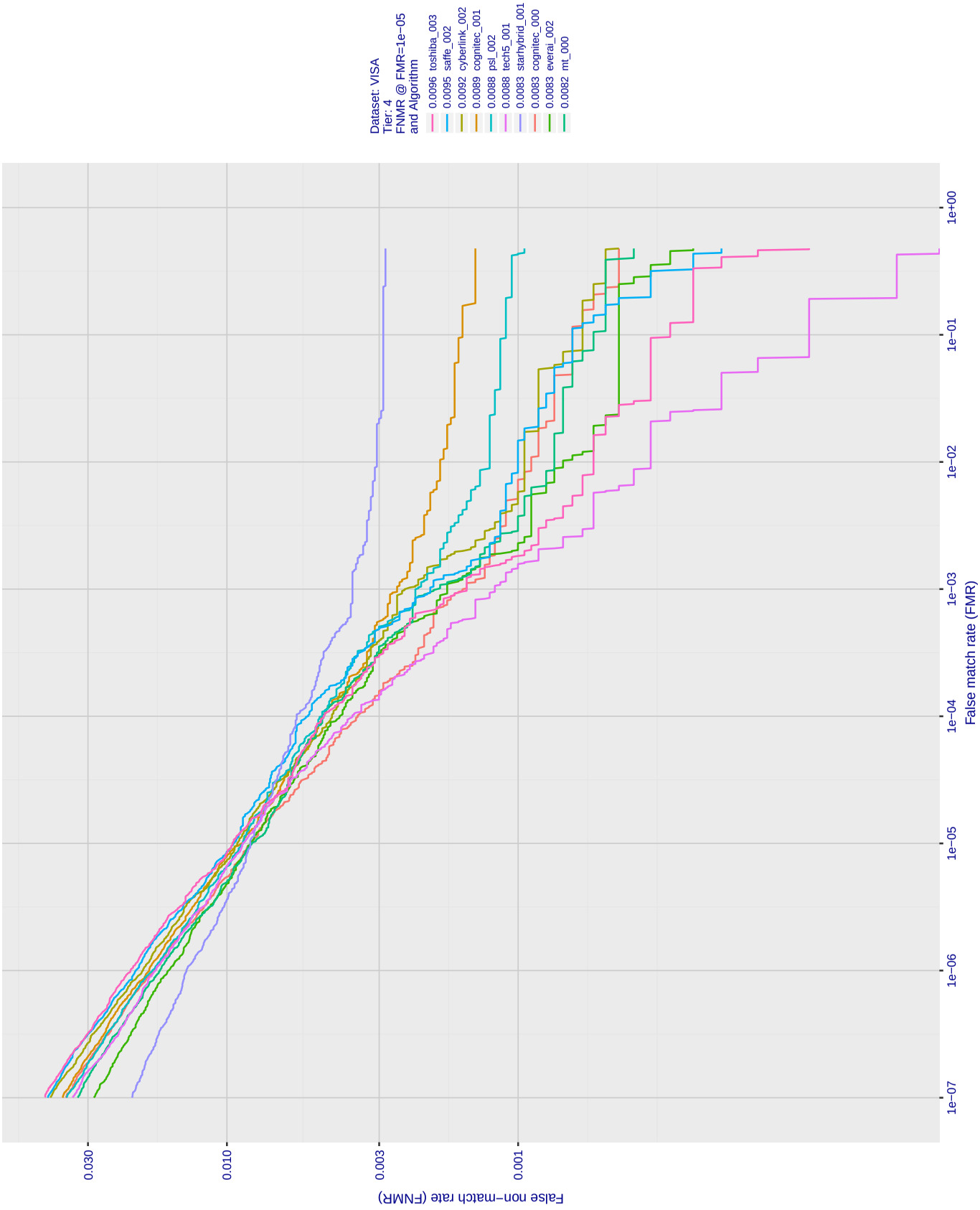


Figure 13: For the visa images, detection error tradeoff (DET) *characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of* FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

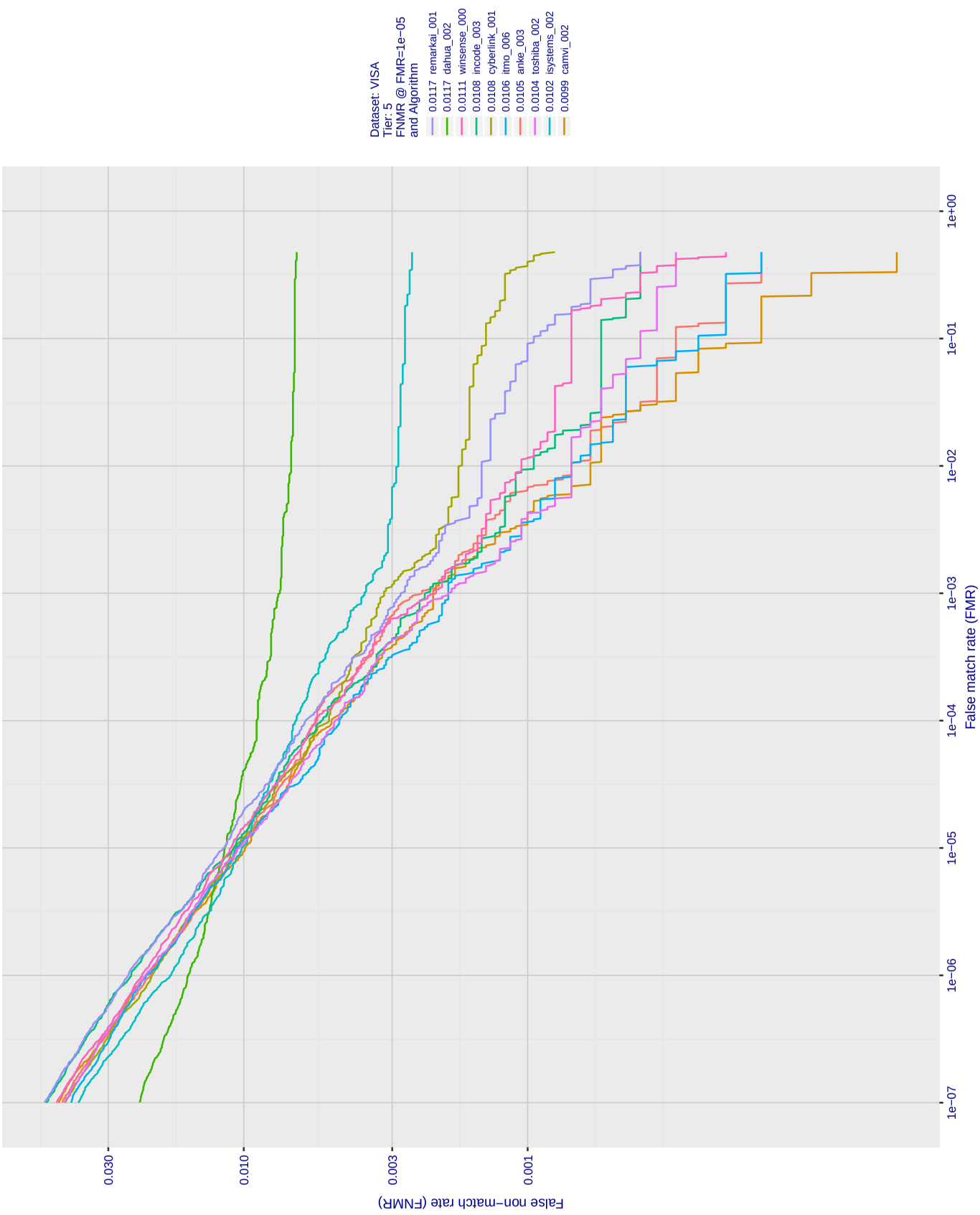


Figure 14: For the visa images, detection error tradeoff (DET) *characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of* FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

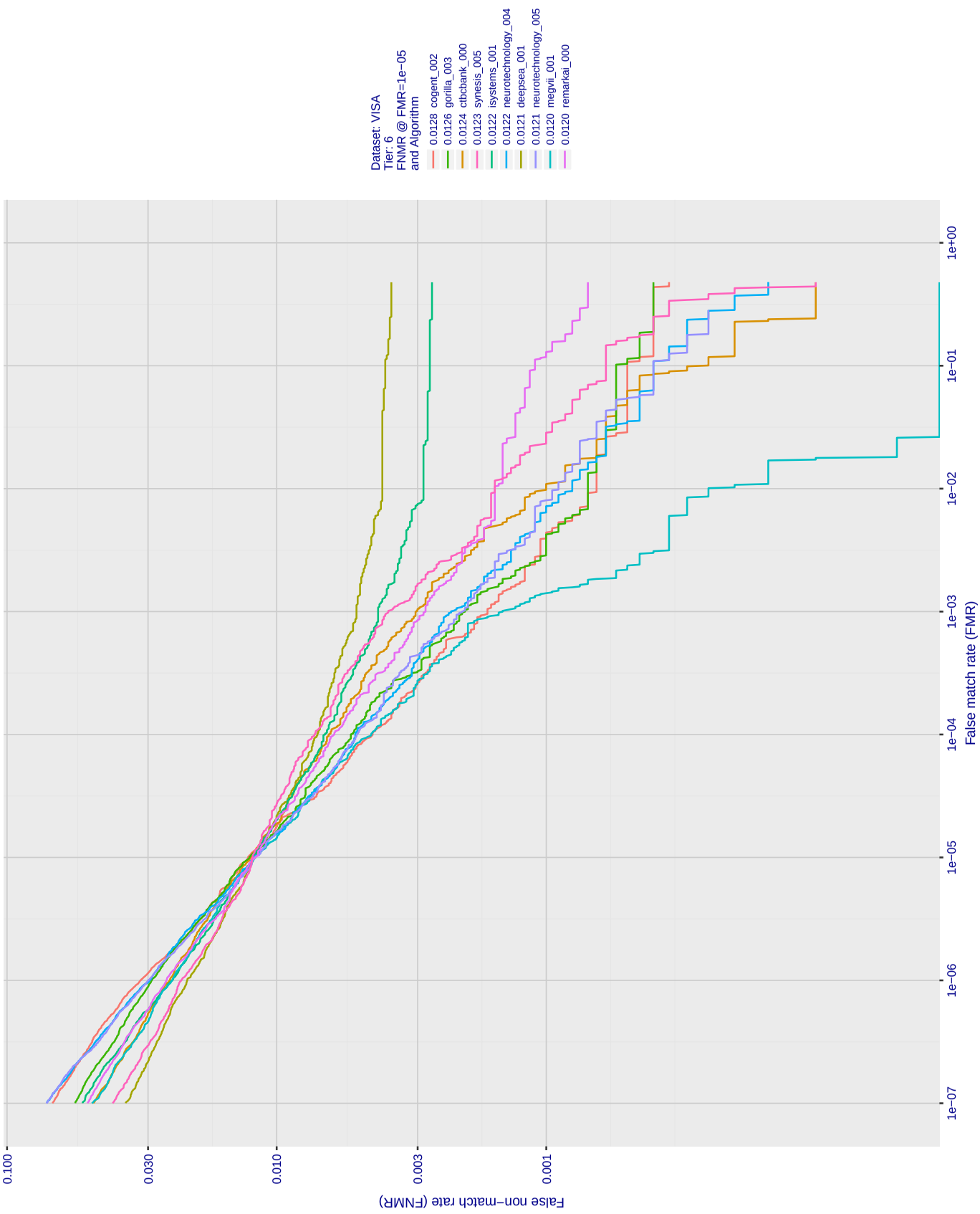


Figure 15: For the visa images, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

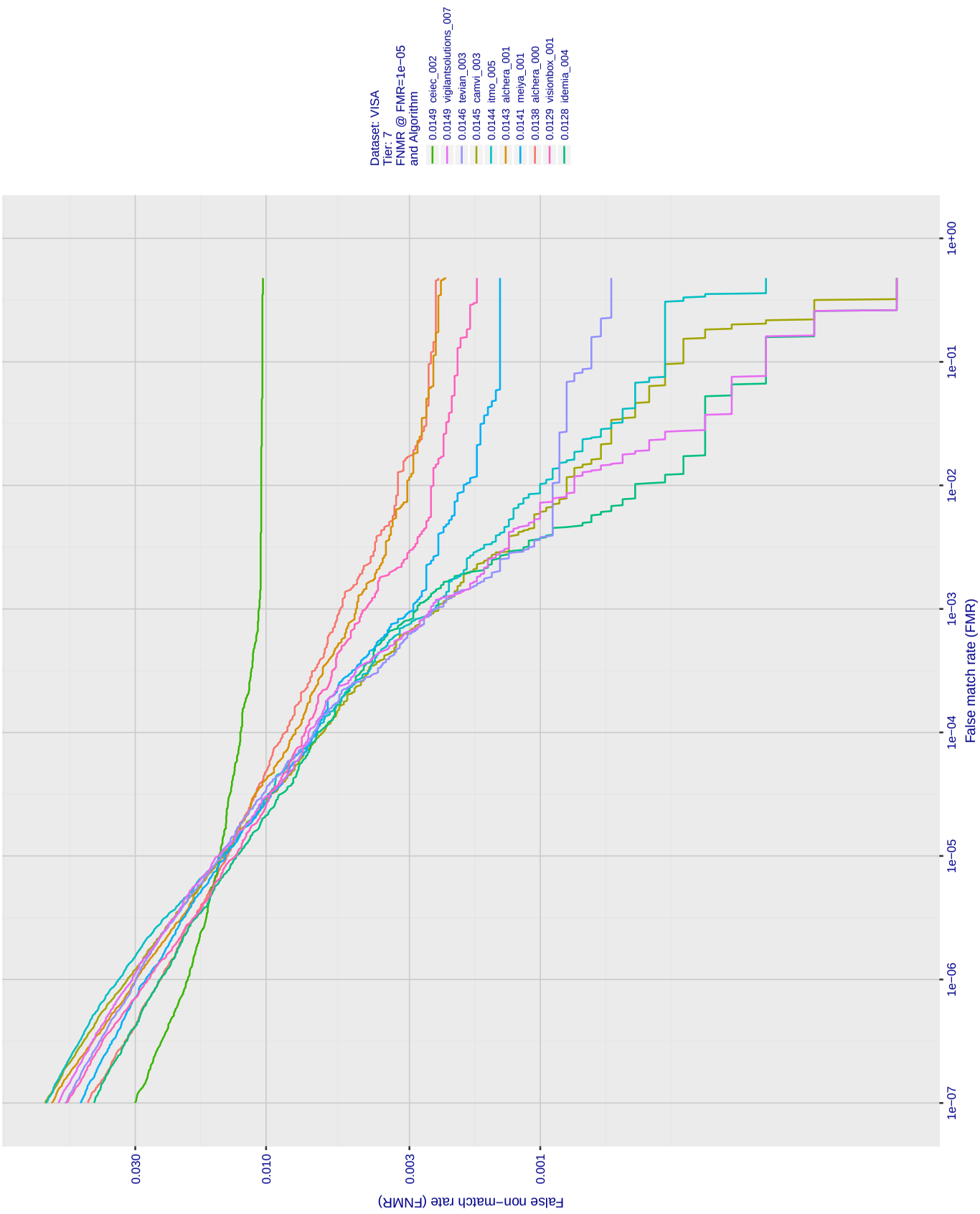


Figure 16: For the visa images, detection error tradeoff (DET) *characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of* FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

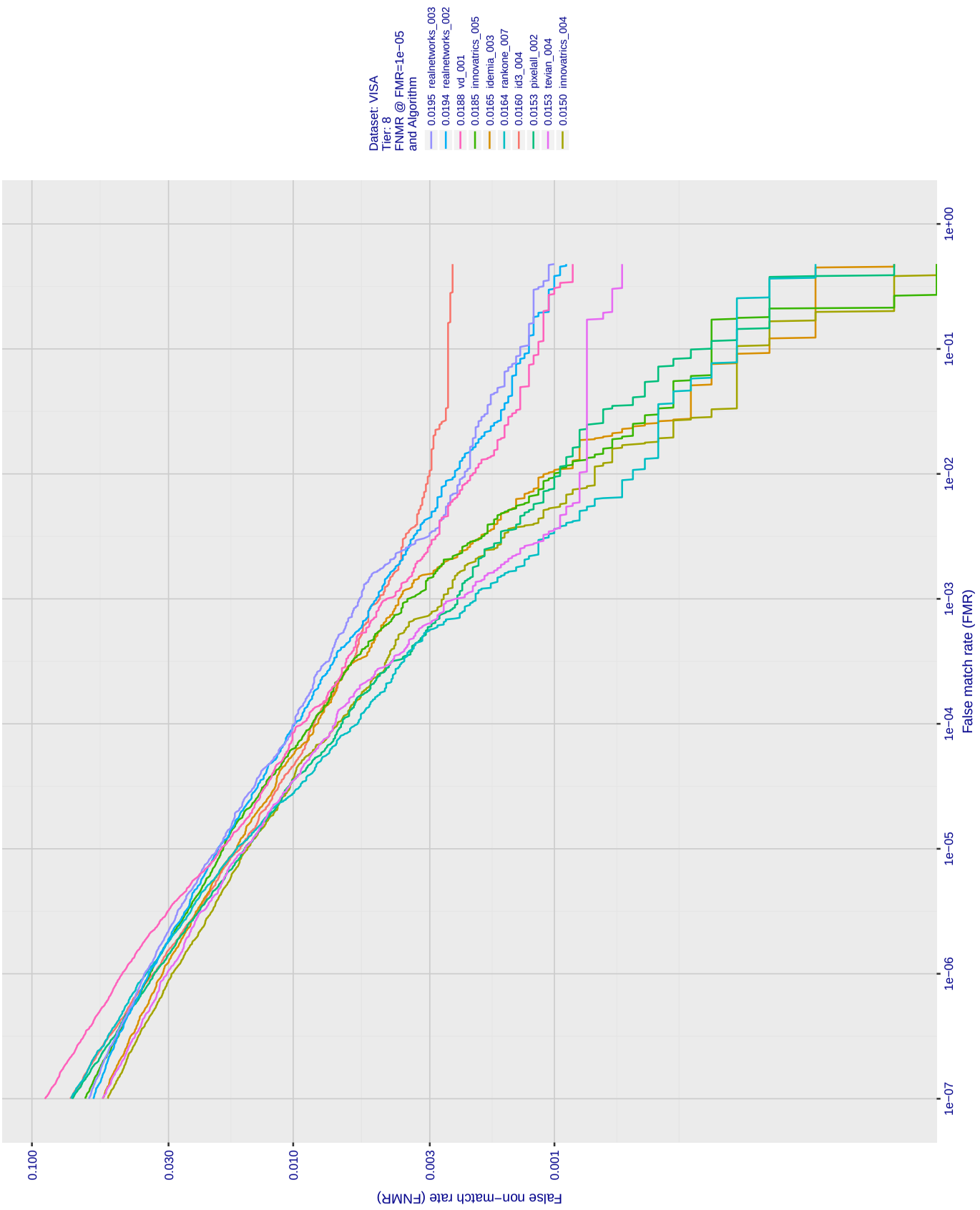


Figure 17: For the visa images, detection error tradeoff (DET) *characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of* FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

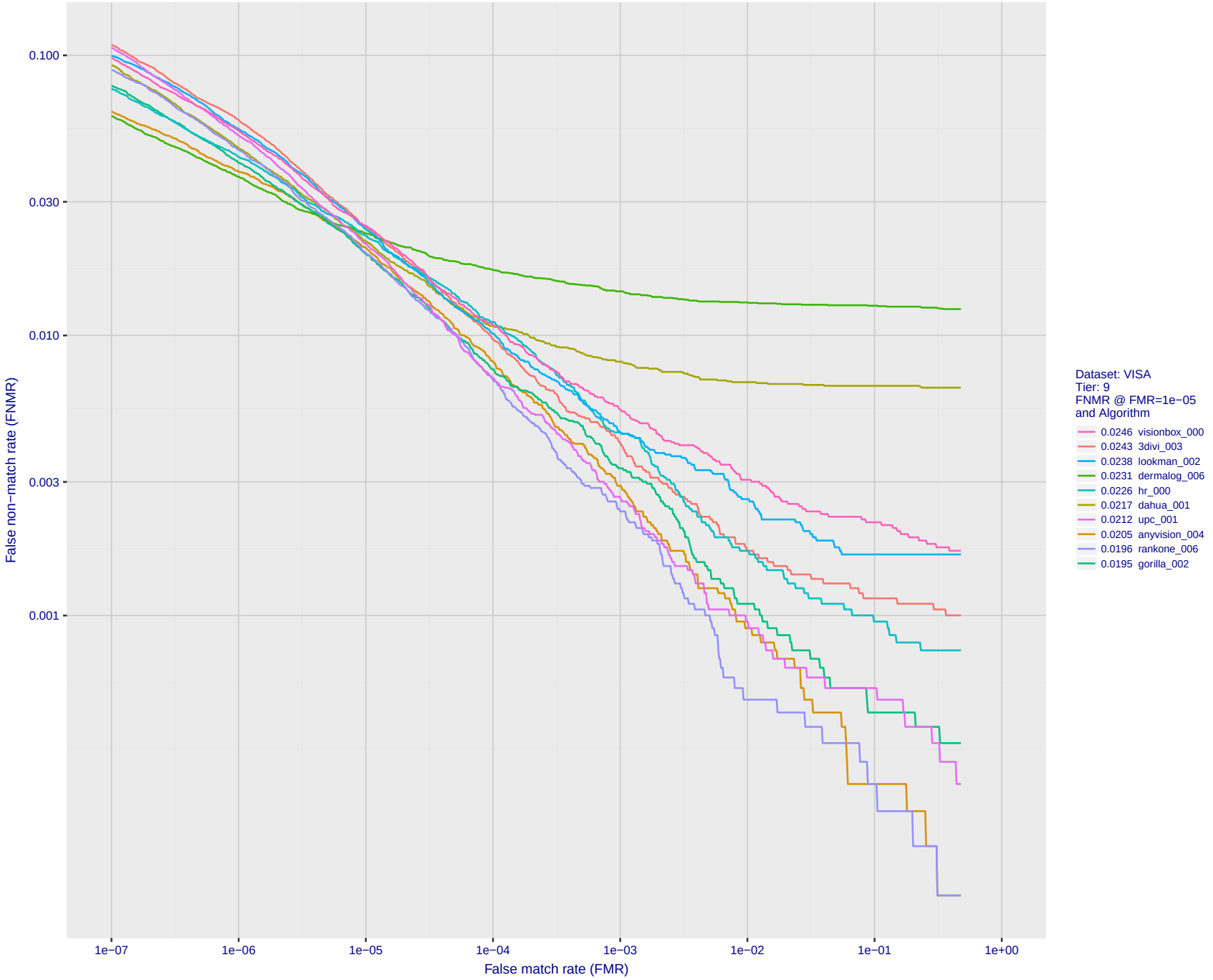


*Figure 18: For the visa images, detection error tradeoff (*DET*) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of* FMR*.*

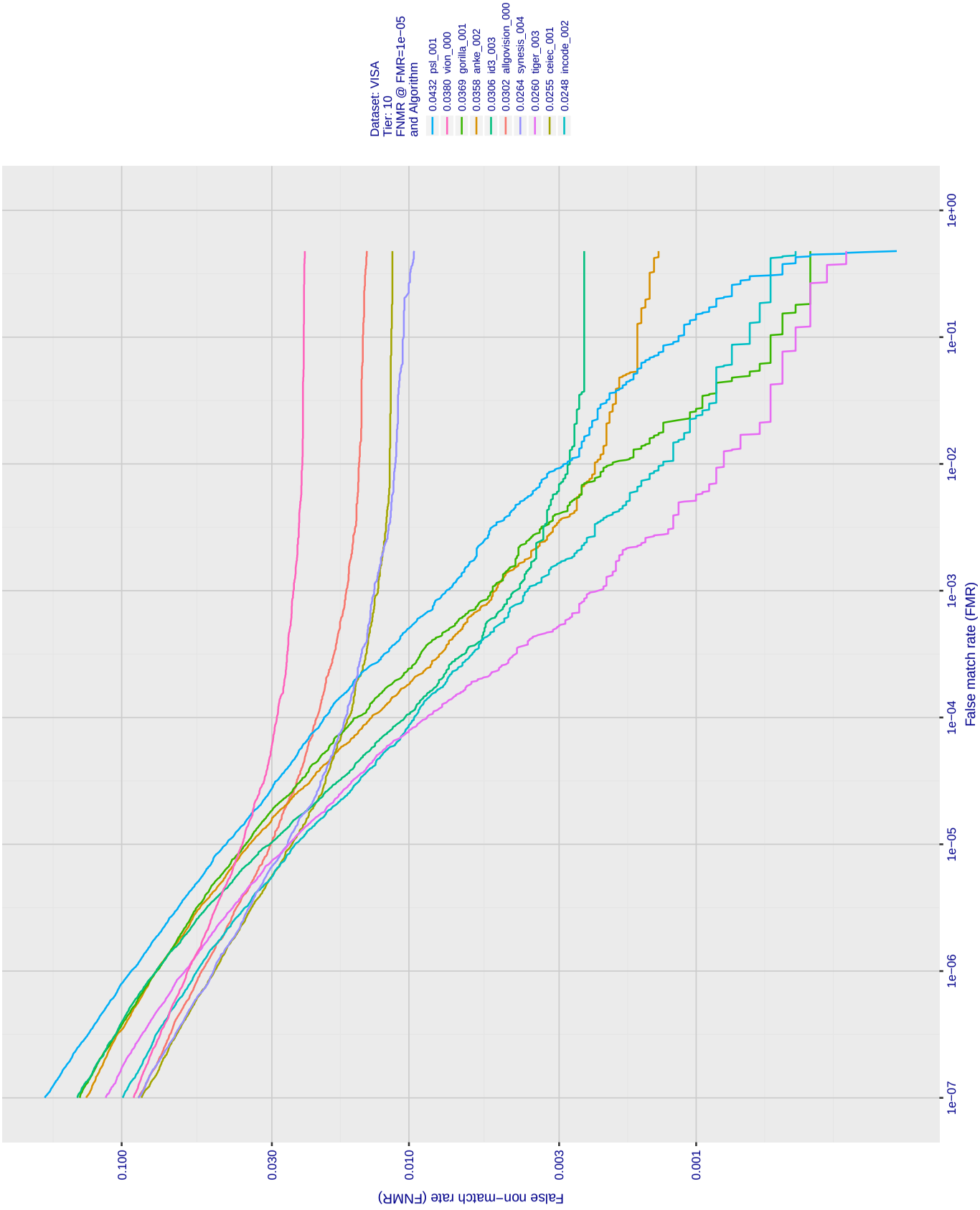


Figure 19: For the visa images, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

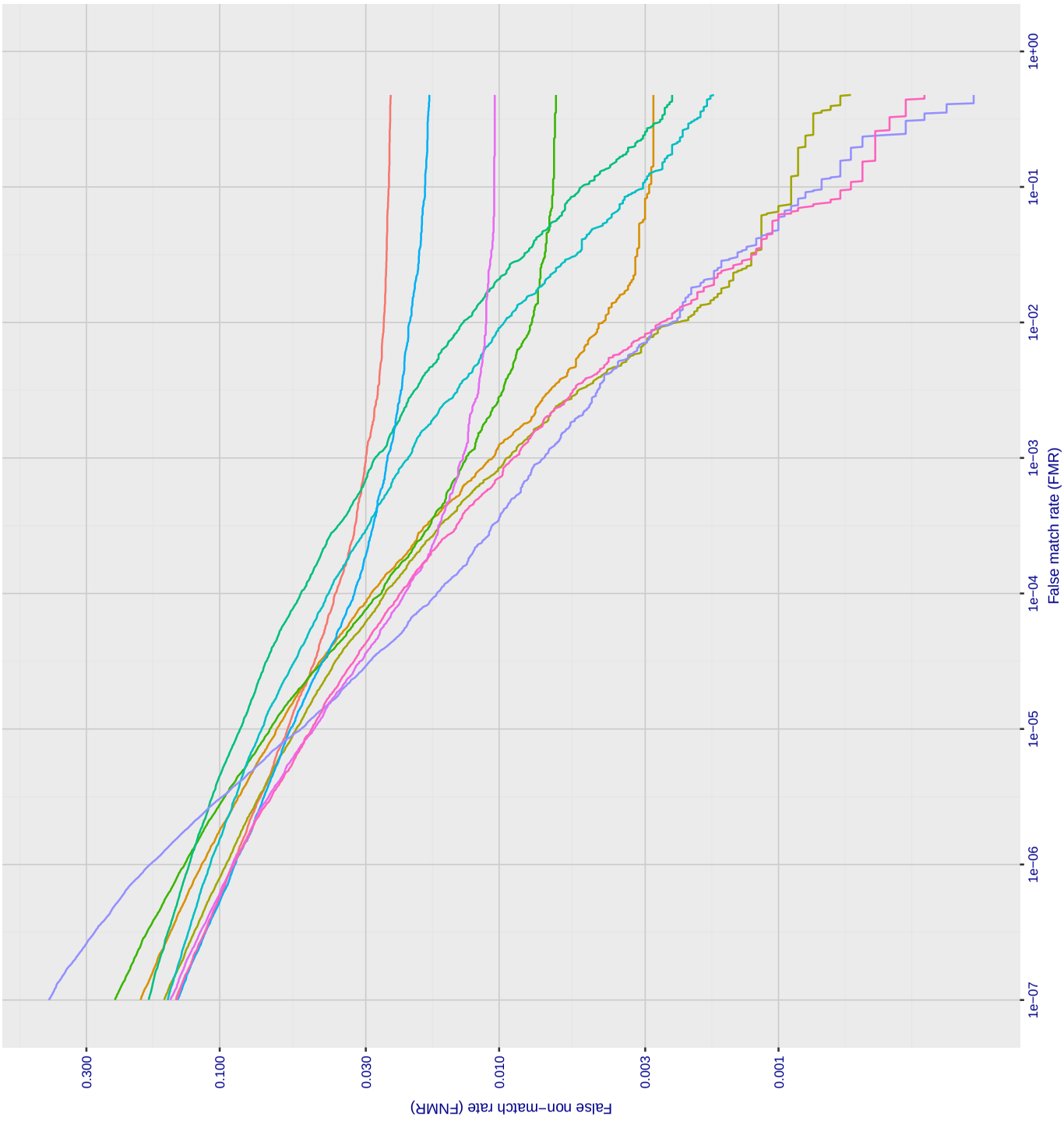


Figure 20: For the visa images, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

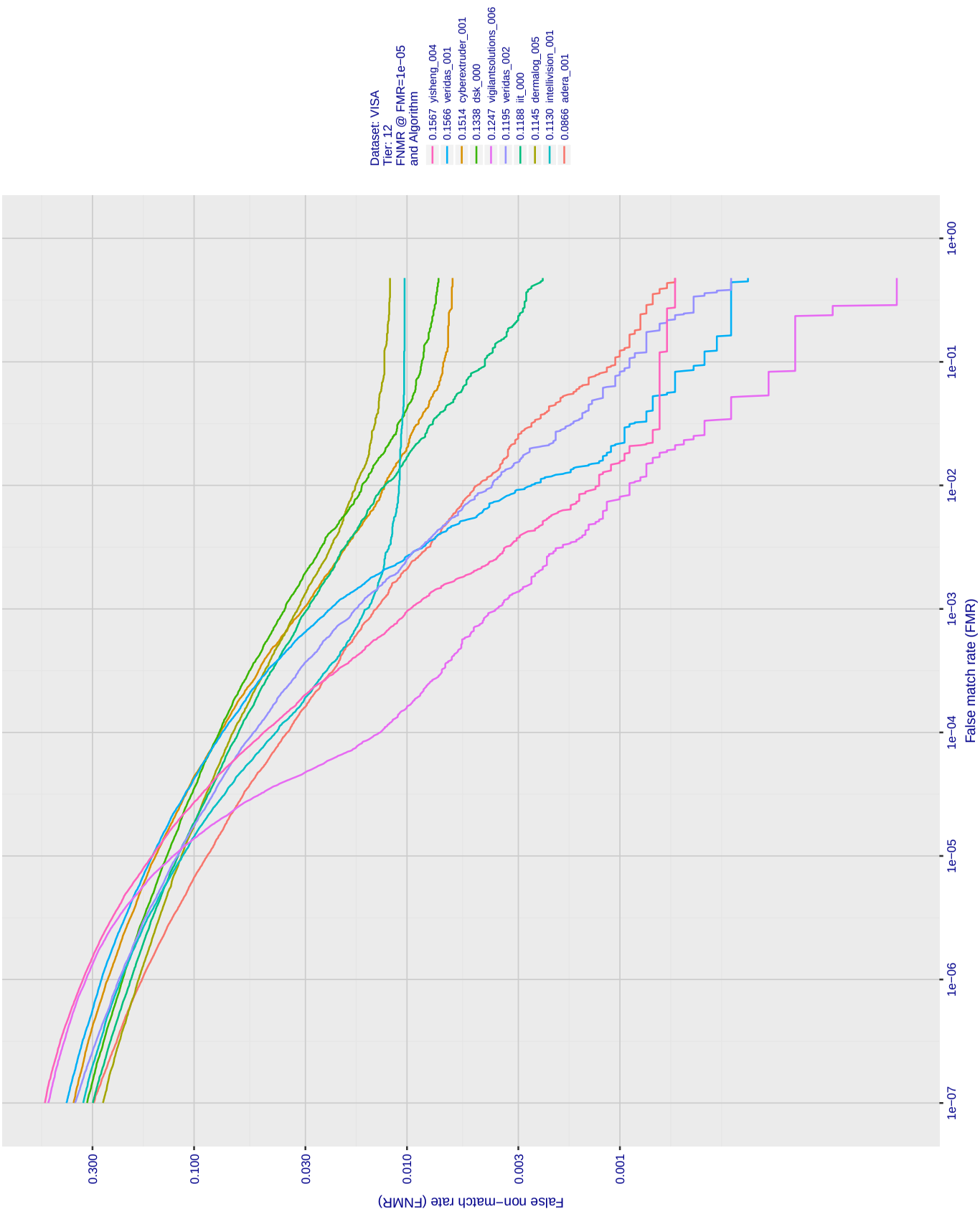


Figure 21: For the visa images, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

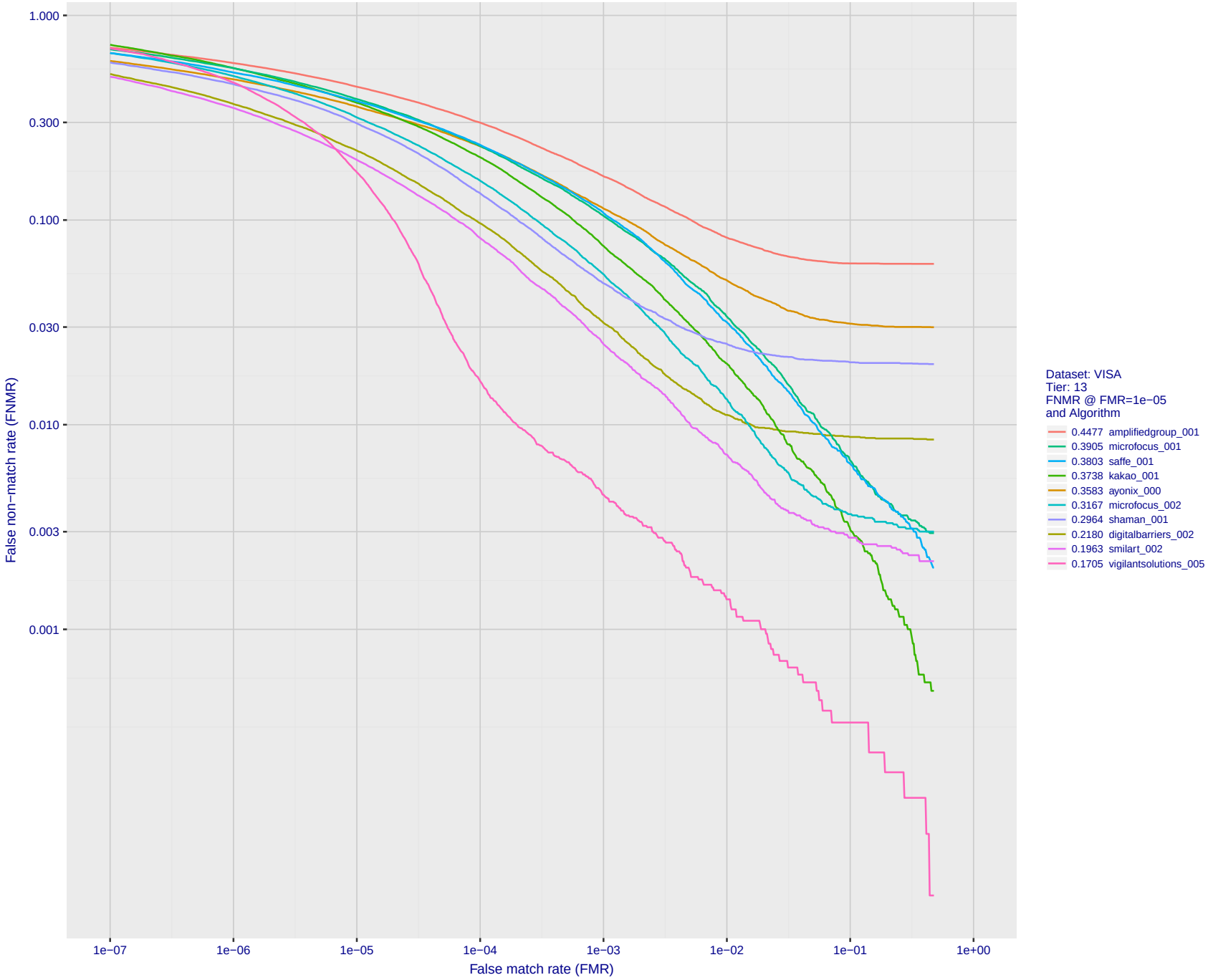


Figure 22: For the visa images, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of FMR.

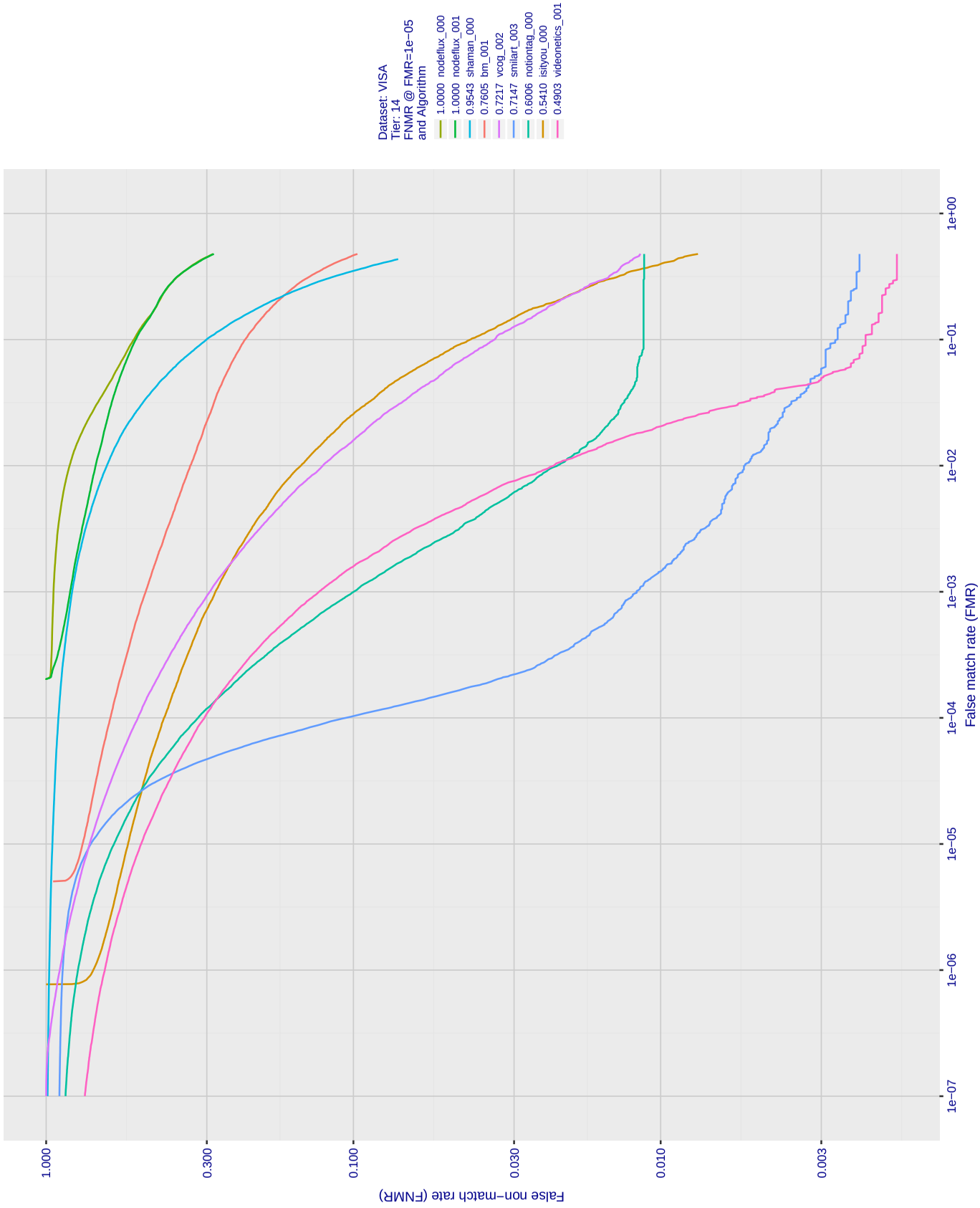


Figure 23: For the visa images, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

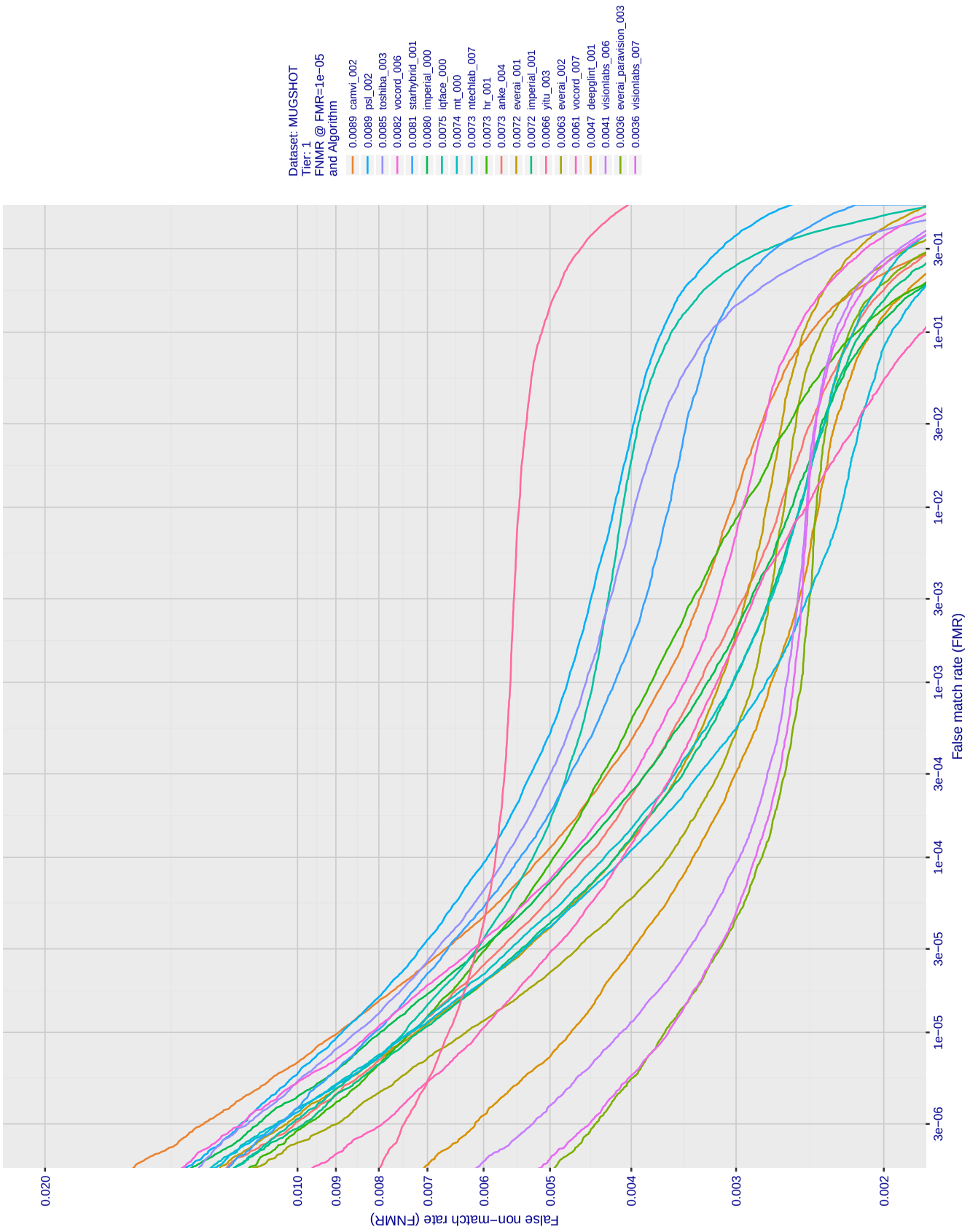


Figure 24: For the mugshot images, detection error tradeoff (DET) *characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show decades of* FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

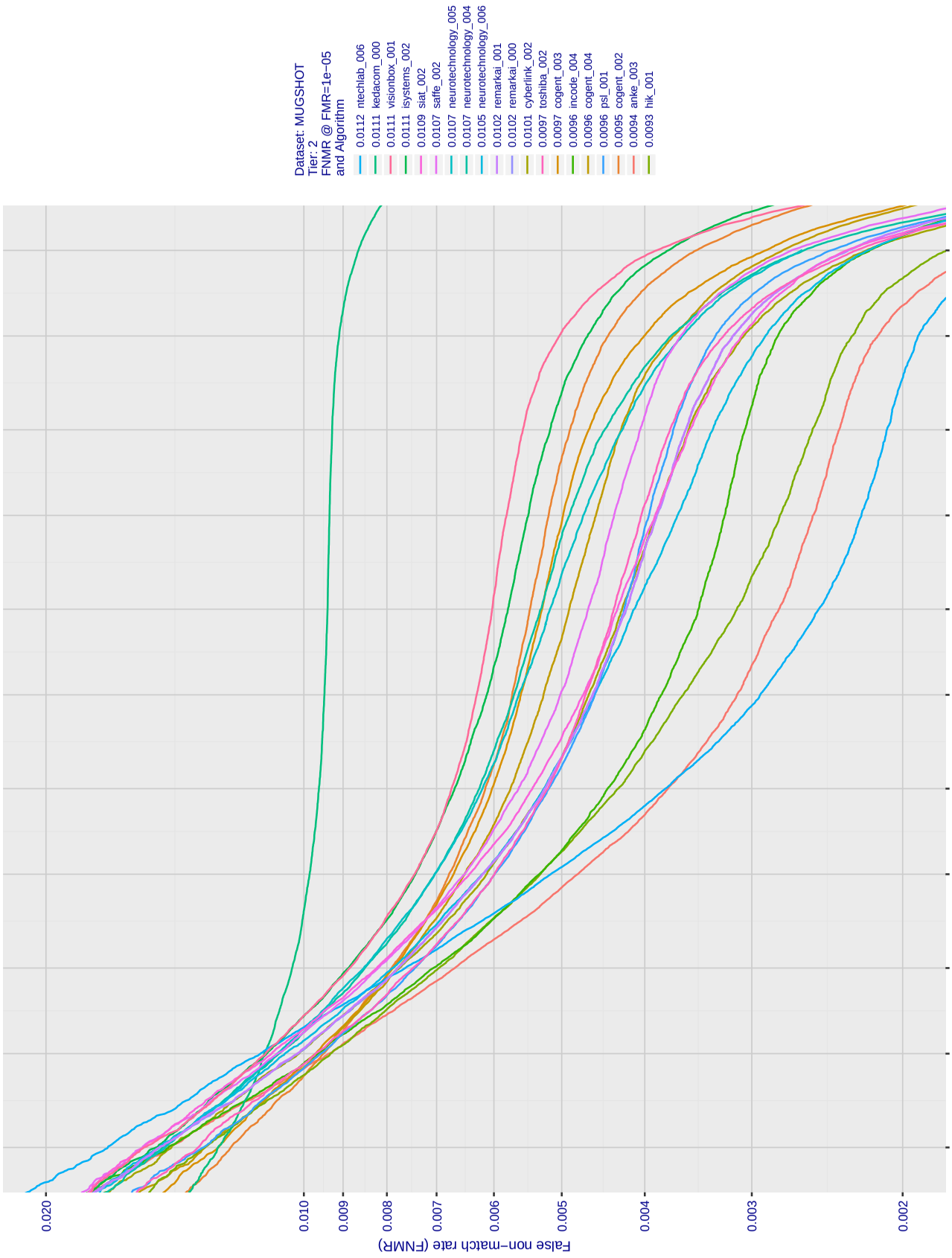


Figure 25: For the mugshot images, detection error tradeoff (DET) *characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show decades of* FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

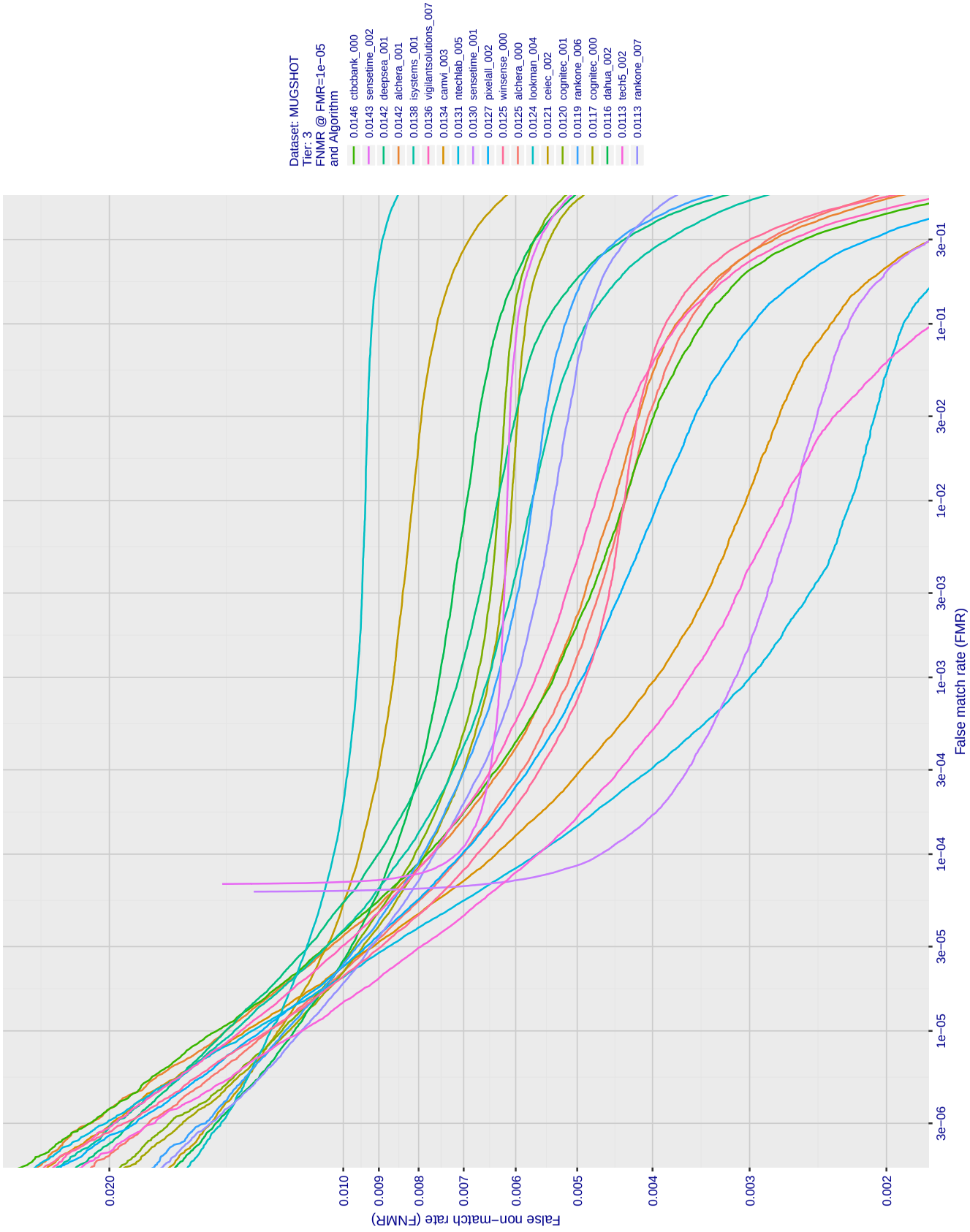


Figure 26: For the mugshot images, detection error tradeoff (DET) *characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show decades of* FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

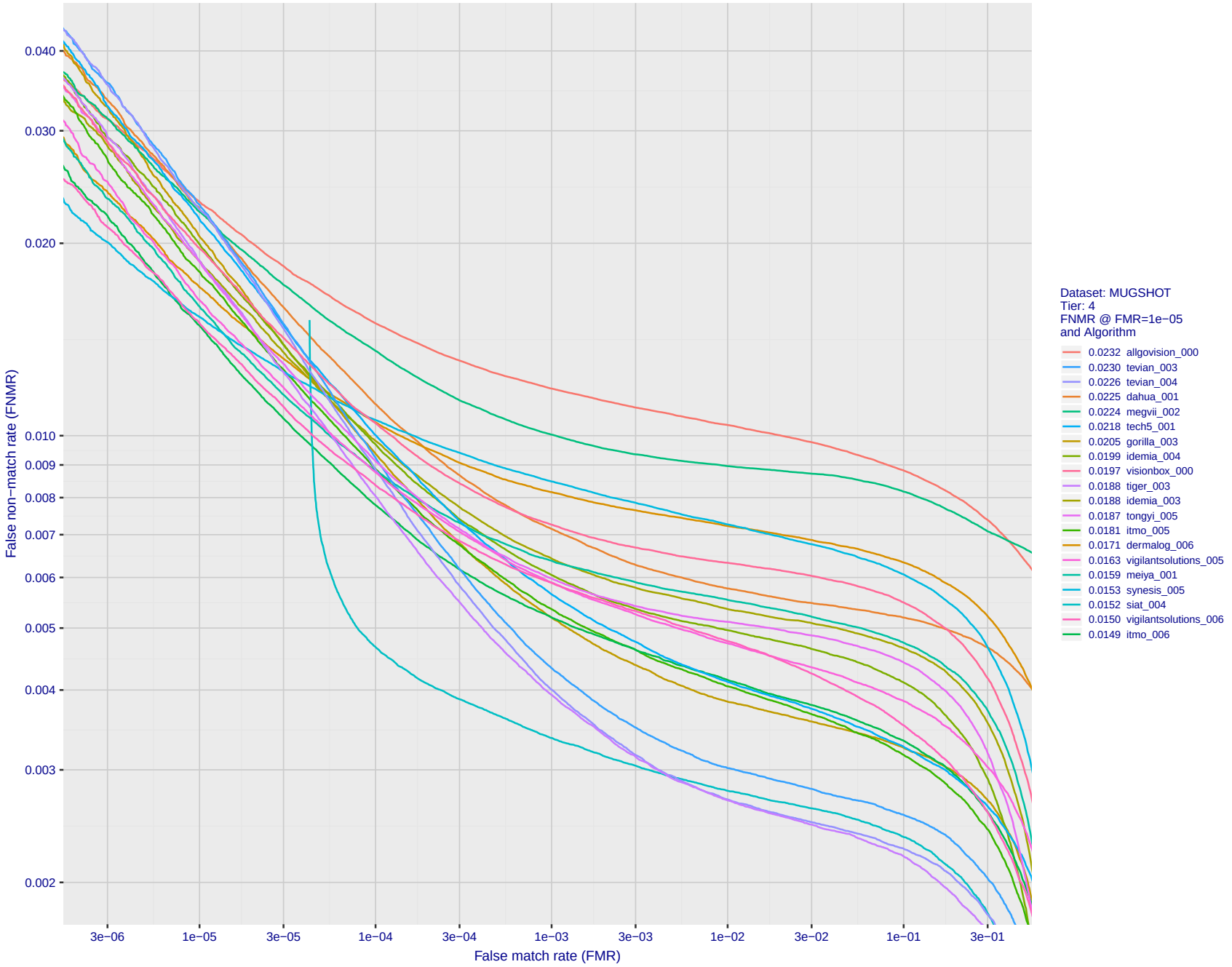


*Figure 27: For the mugshot images, detection error tradeoff (*DET*) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show decades of* FMR.

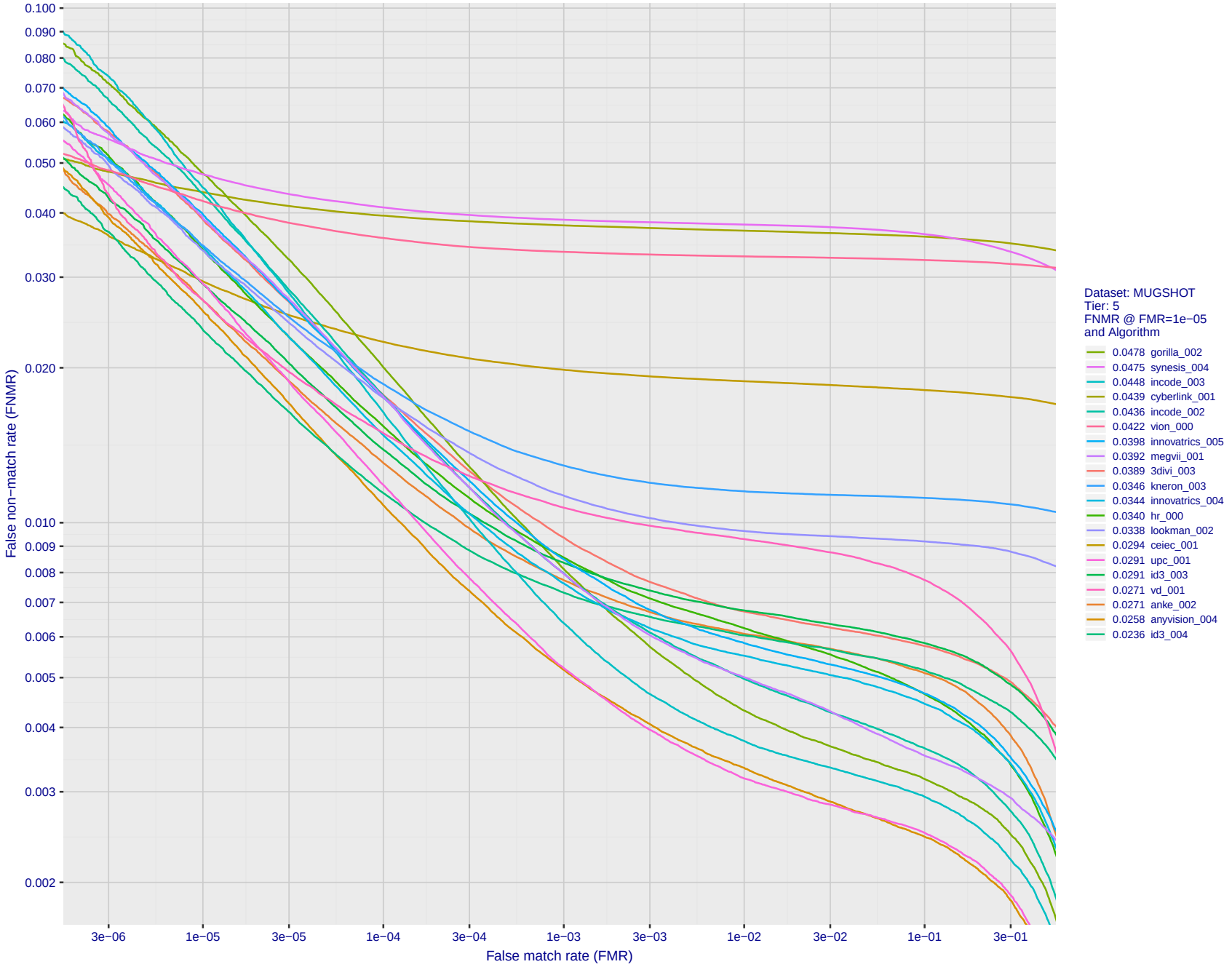


Figure 28: For the mugshot images, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show decades of FMR.

2019/07/05 07:20:46
FNMR(T) "False non-match rate"
FMR(T) "False match rate"

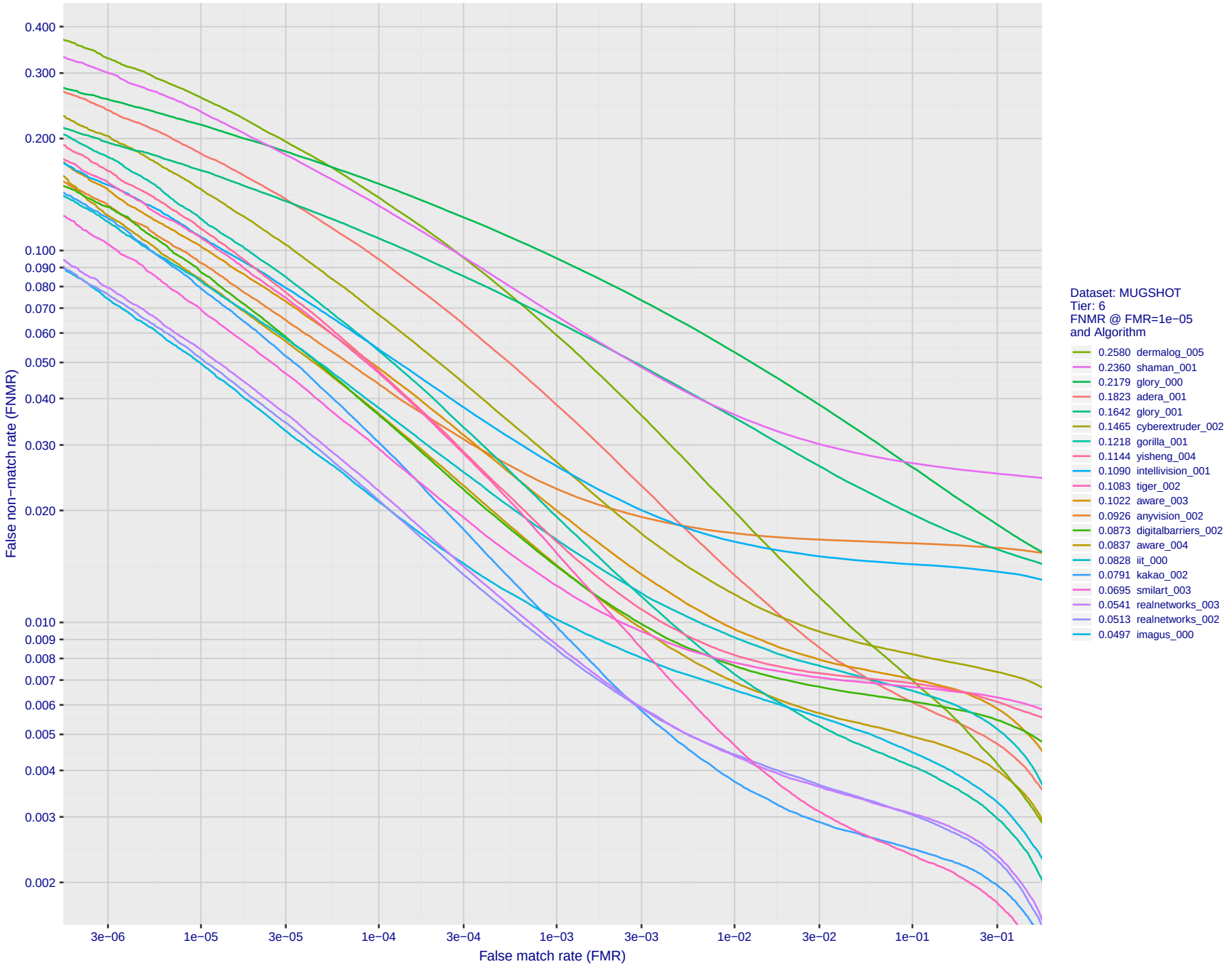


Figure 29: For the mugshot images, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show decades of FMR.

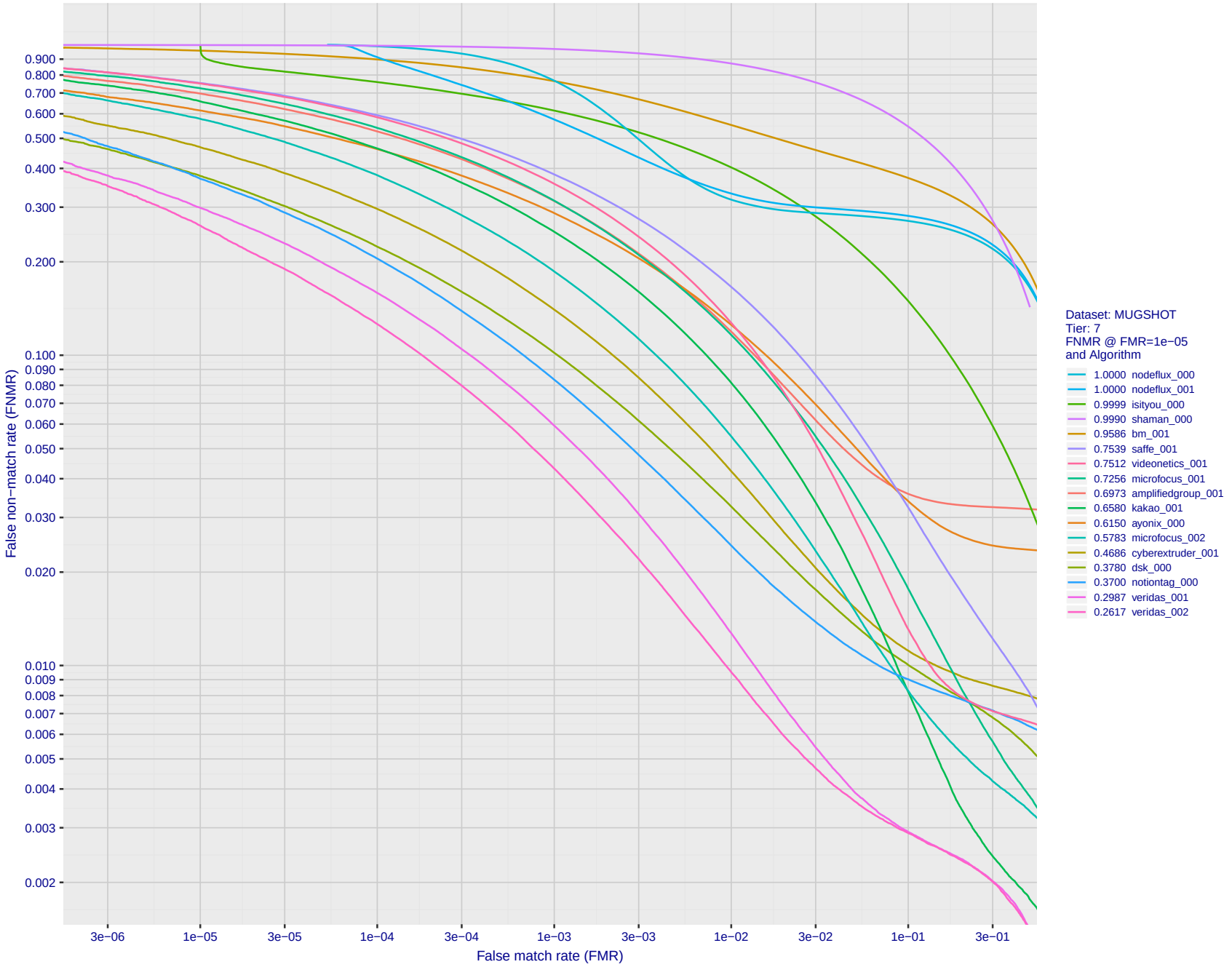


Figure 30: For the mugshot images, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show decades of FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

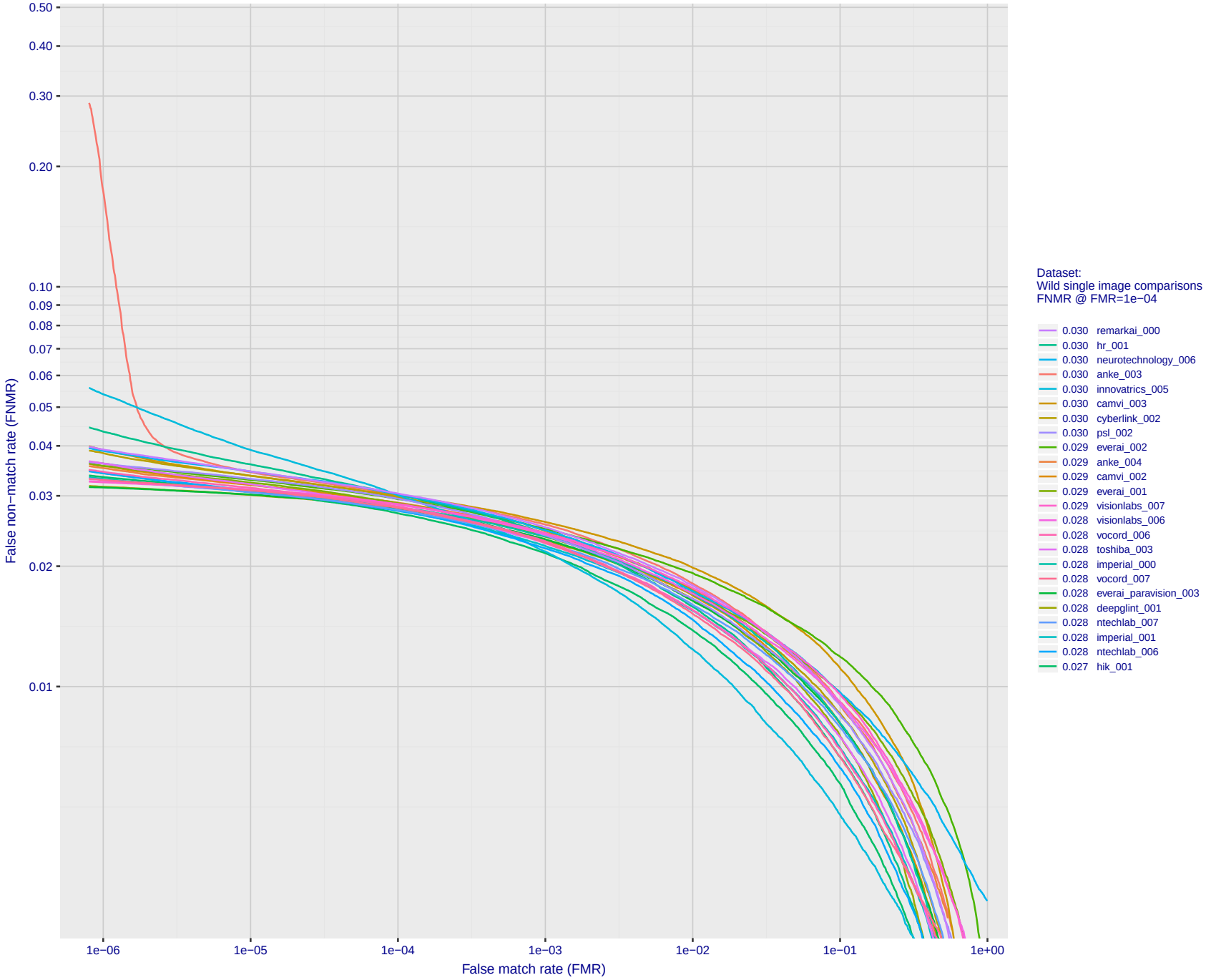


*Figure 31: For the 2018 wild image comparisons, detection error tradeoff (*DET*) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show several decades of* FMR.

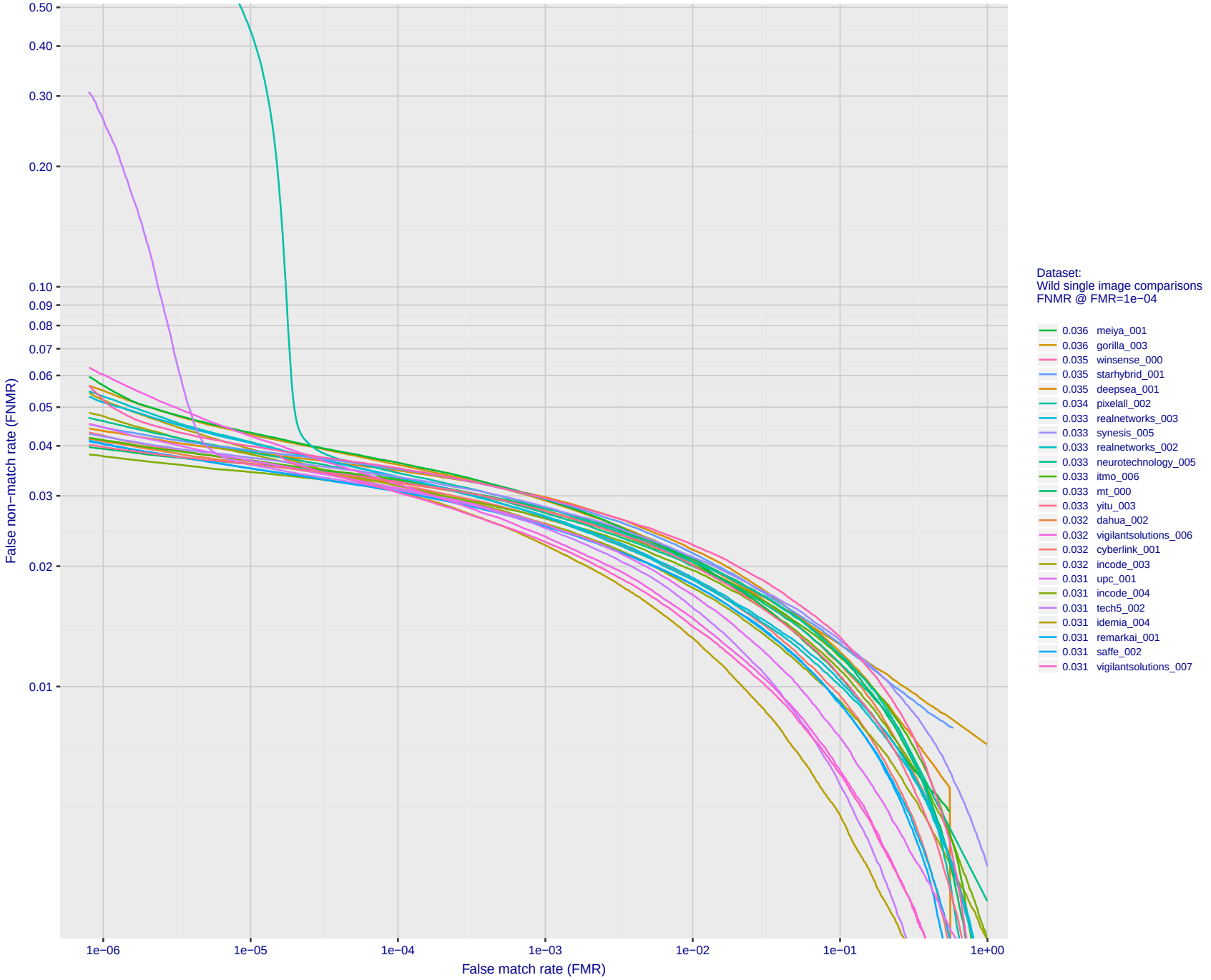


*Figure 32: For the 2018 wild image comparisons, detection error tradeoff (*DET*) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show several decades of* FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

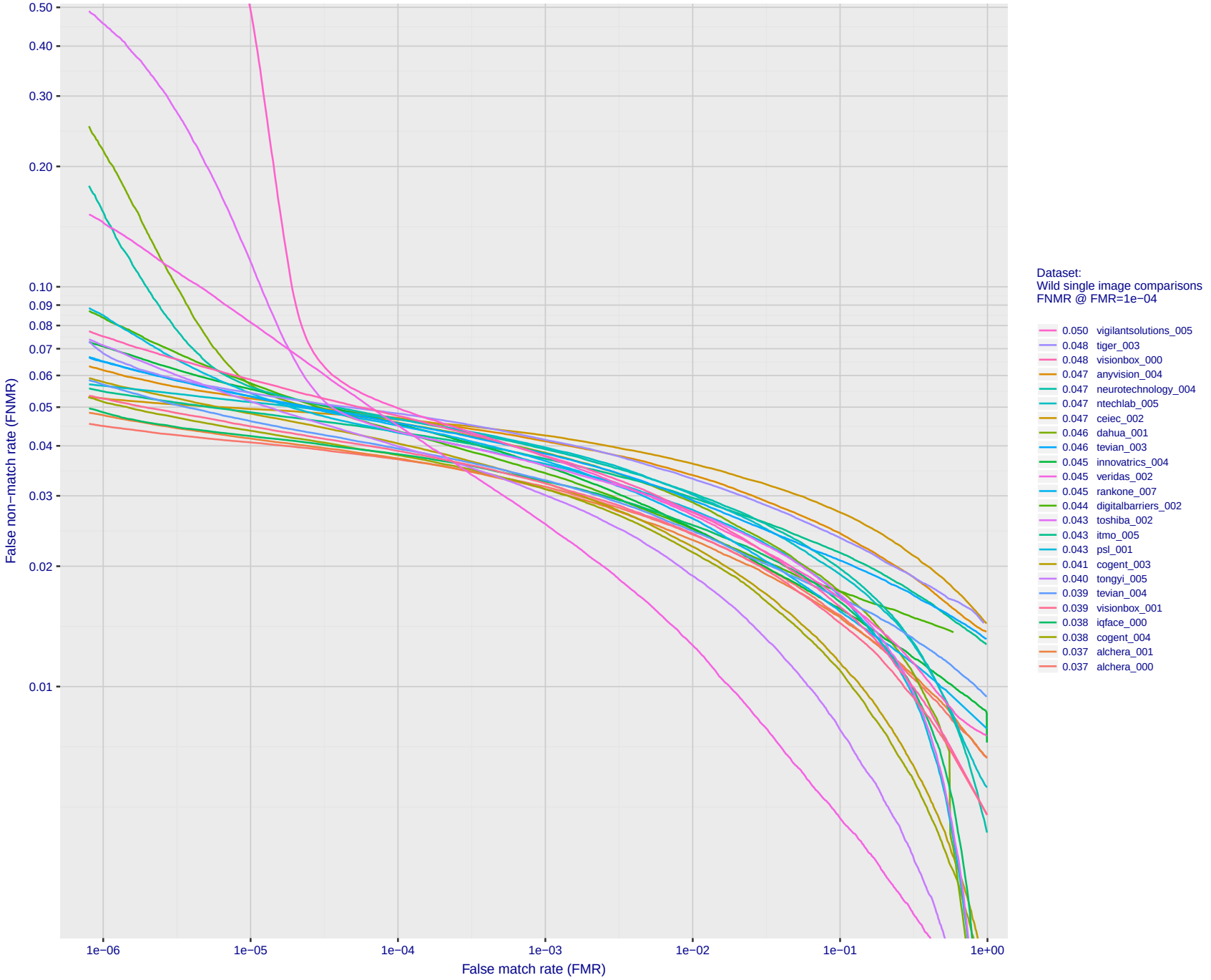


*Figure 33: For the 2018 wild image comparisons, detection error tradeoff (*DET*) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show several decades of* FMR.

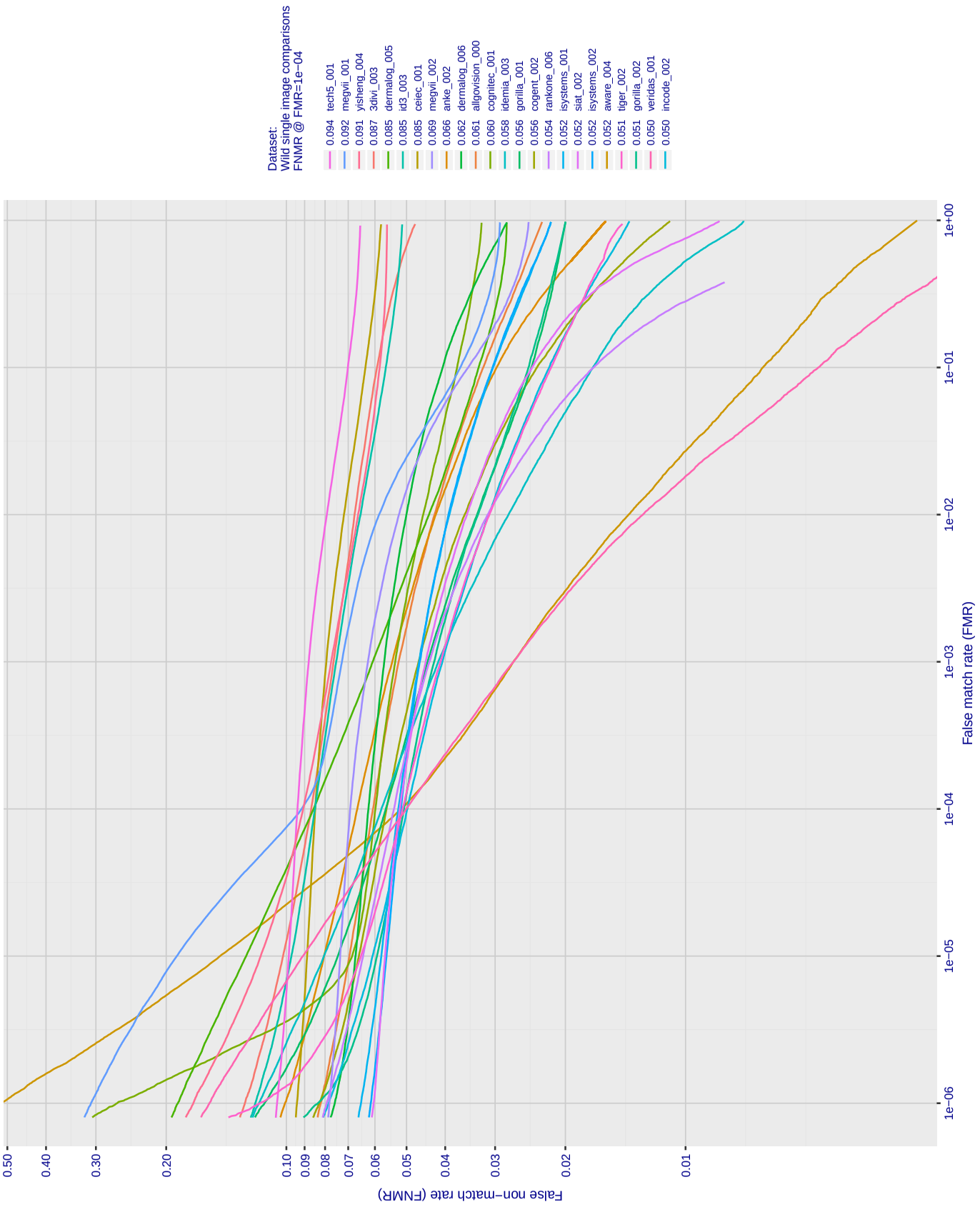


Figure 34: For the 2018 wild image comparisons, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show several decades of FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

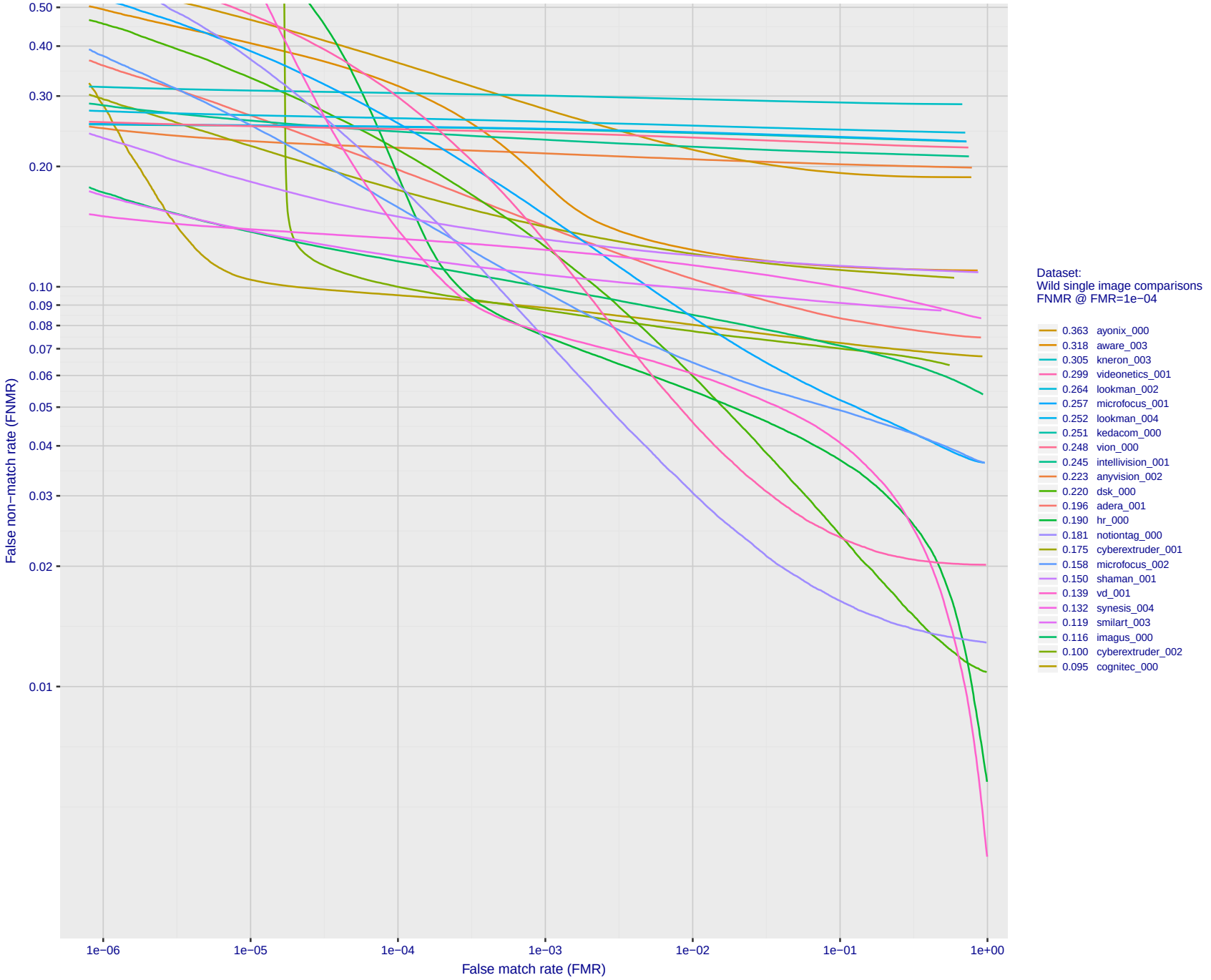


Figure 35: For the 2018 wild image comparisons, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show several decades of FMR.

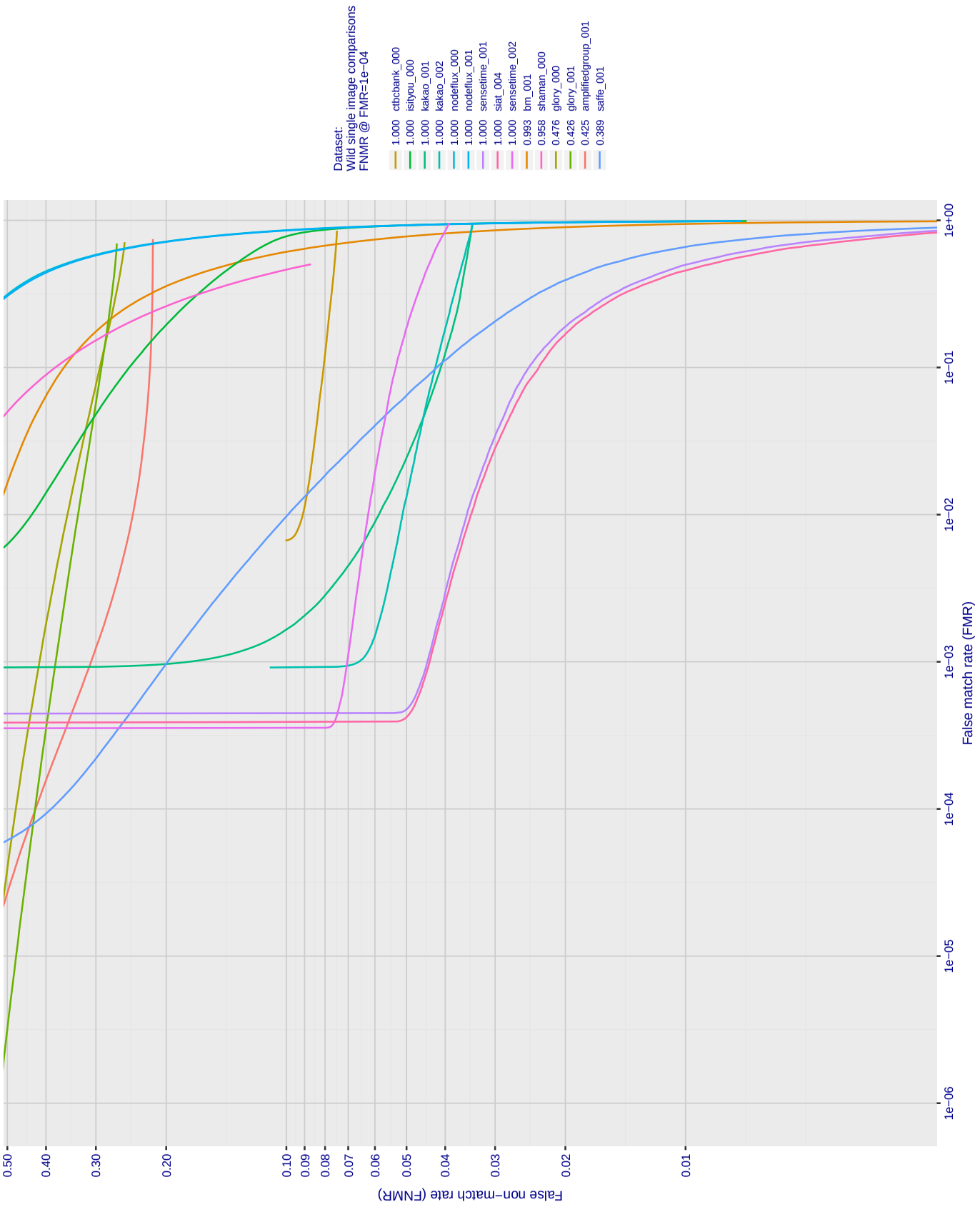


Figure 36: For the 2018 wild image comparisons, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show several decades of FMR.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

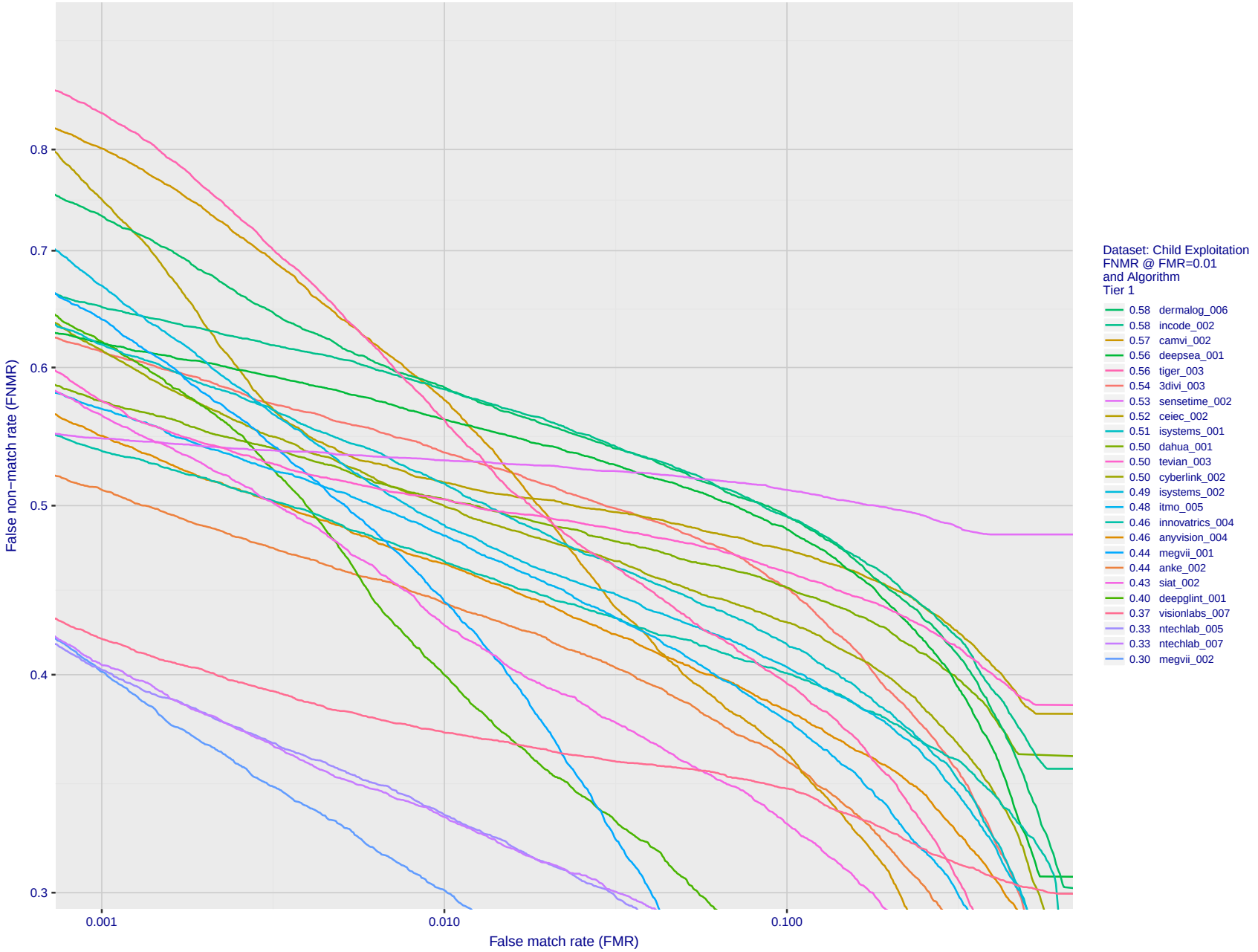


*Figure 37: For child exploitation images, detection error tradeoff (*DET*) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of* FMR*. Accuracy is poor because many images have adverse quality characteristics, and because detection and enrollment fails.*

2019/07/05 07:20:46
FNMR(T) "False non-match rate"
FMR(T) "False match rate"

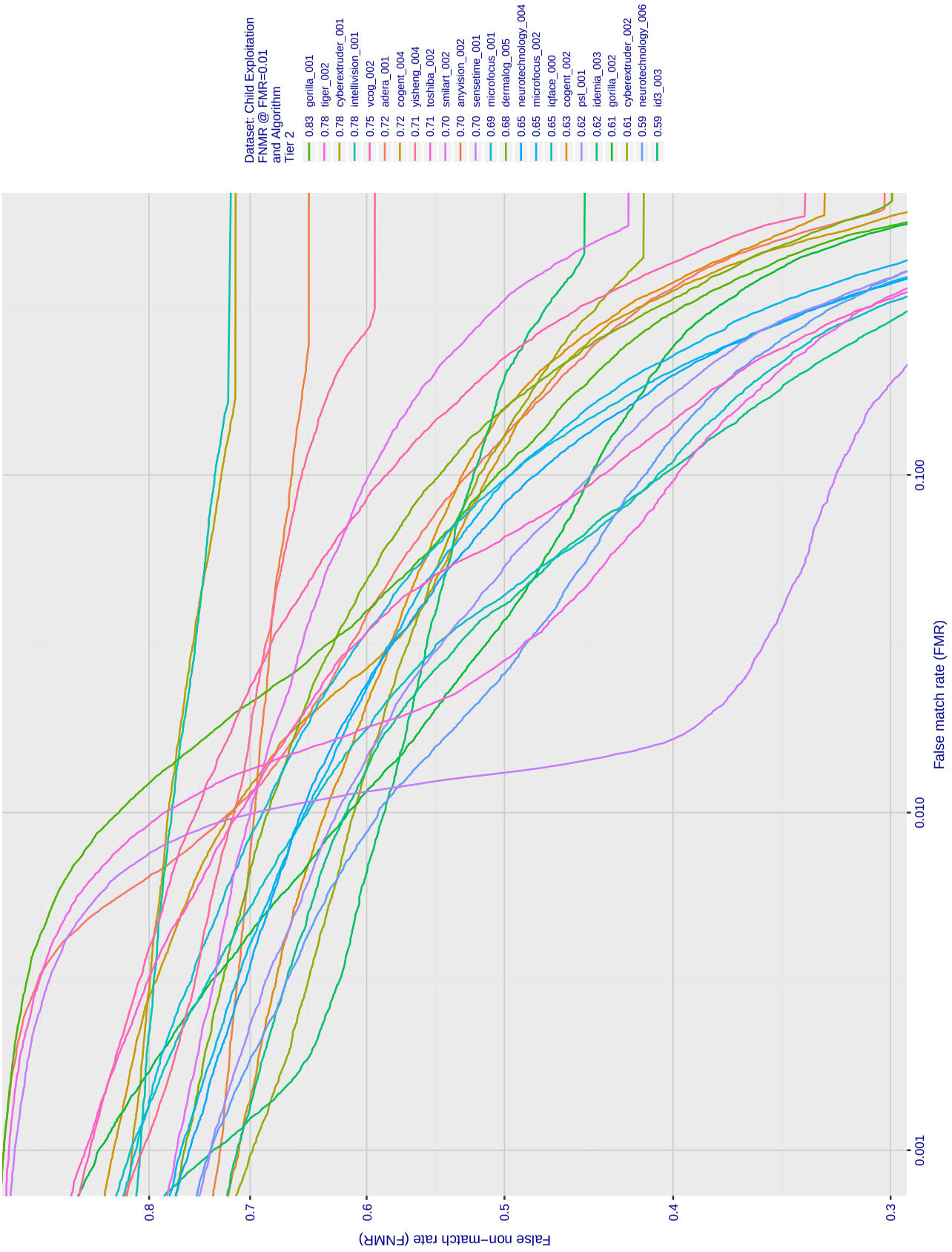


Figure 38: For child exploitation images, detection error tradeoff (DET) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of FMR. Accuracy is poor because many images have adverse quality characteristics, and because detection and enrollment fails.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

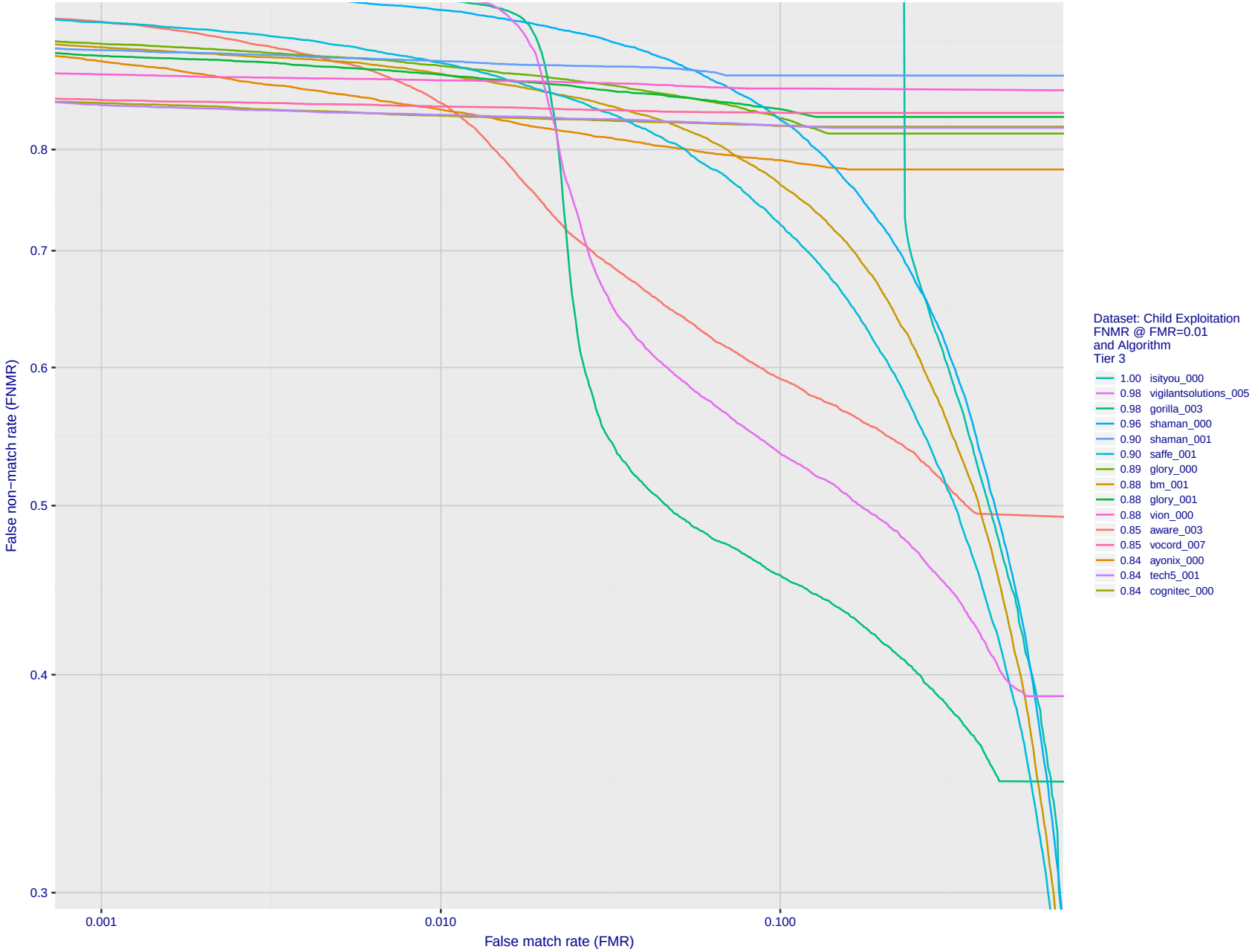


*Figure 39: For child exploitation images, detection error tradeoff (*DET*) characteristics showing false non-match rate vs. false match rate plotted parametrically on threshold, T. The scales are logarithmic in order to show many decades of* FMR*. Accuracy is poor because many images have adverse quality characteristics, and because detection and enrollment fails.*

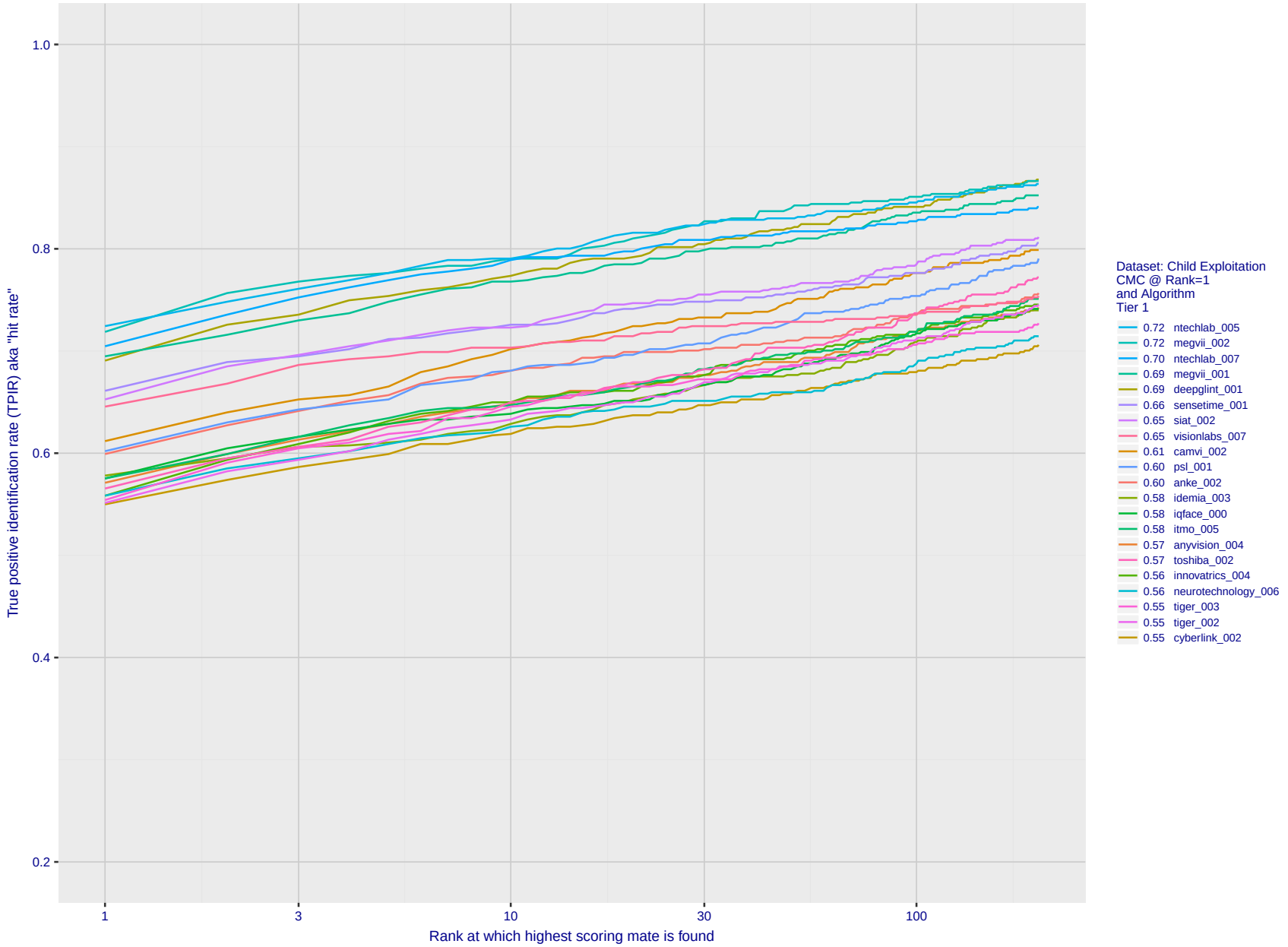


Figure 40: For child exploitation images, cumulative match characteristics (CMC) showing true positive identification rate vs. rank. This is simulation of a one-to-many search experiment - see discussion in section 3.2. The scales are logarithmic in order to show the effect of long candidate lists. Accuracy is poor but much improved relative to the 1:1 DETs of Fig. 39 because a search can succeed if any *of a subject's several enrolled images matches the search image with a high score.*

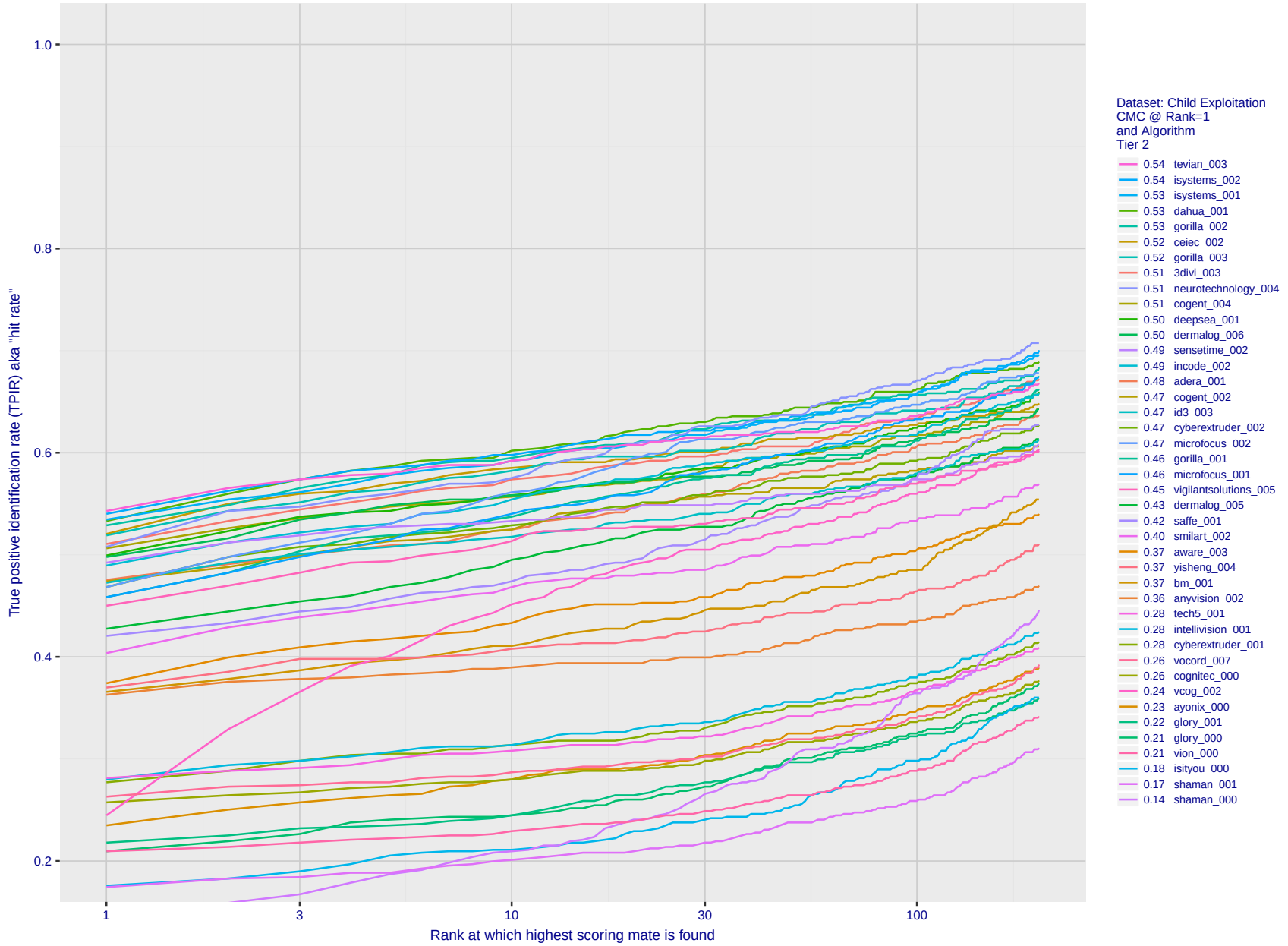


Figure 41: For child exploitation images, cumulative match characteristics (CMC) showing true positive identification rate vs. rank. This is simulation of a one-to-many search experiment - see discussion in section 3.2. The scales are logarithmic in order to show the effect of long candidate lists. Accuracy is poor but much improved relative to the 1:1 DETs of Fig. 39 because a search can succeed if any of a subject's several enrolled images matches the search image with a high score.

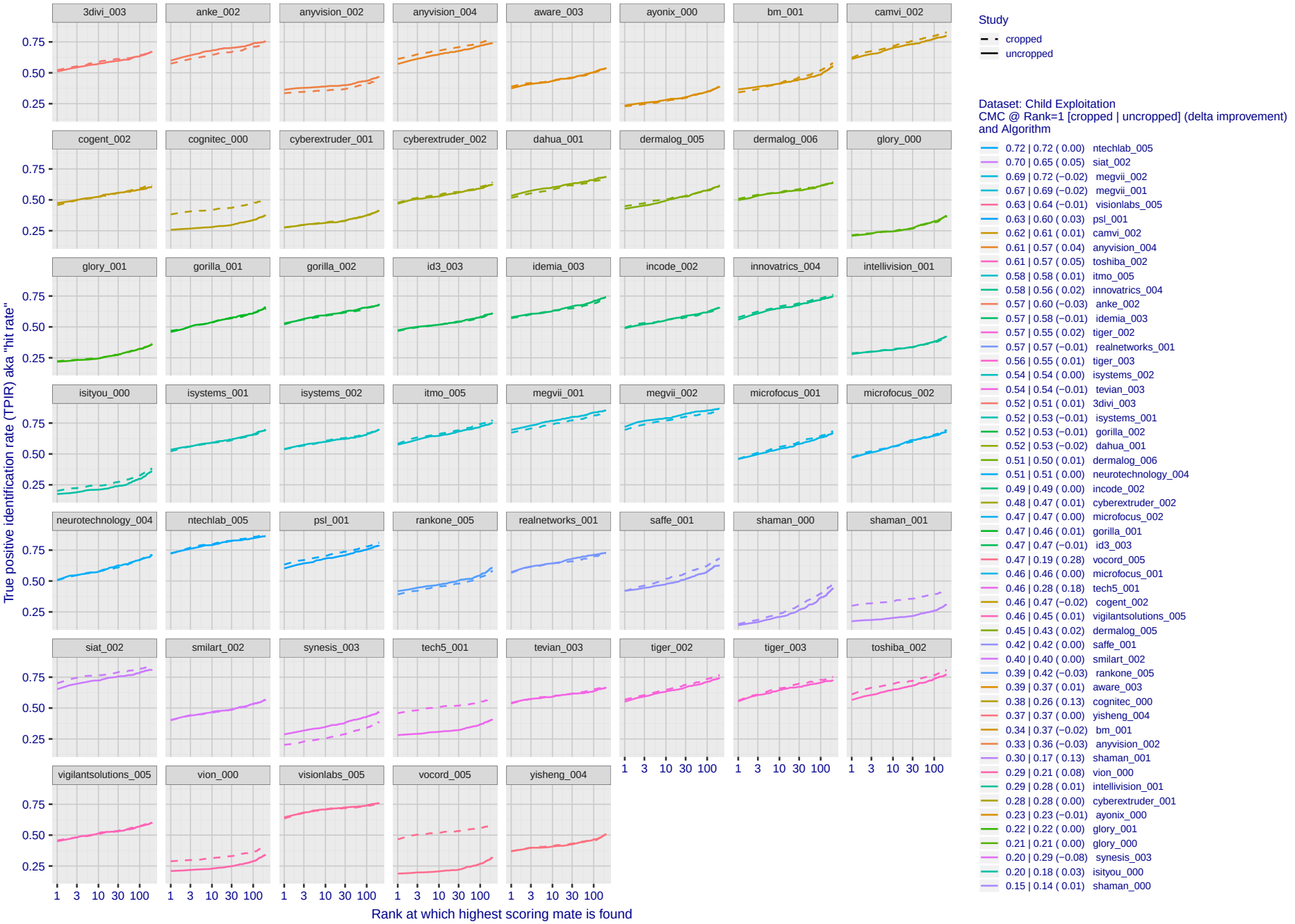


Figure 42: For child exploitation images, cumulative match characteristics (CMC) showing true positive identification rate vs. rank for two cases: 1. Whole image provided to the algorithm; 2. Human annotated rectangular region, cropped and provided to the algorithm. The difference between the traces is associated with detection of difficult faces, and fine localization.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

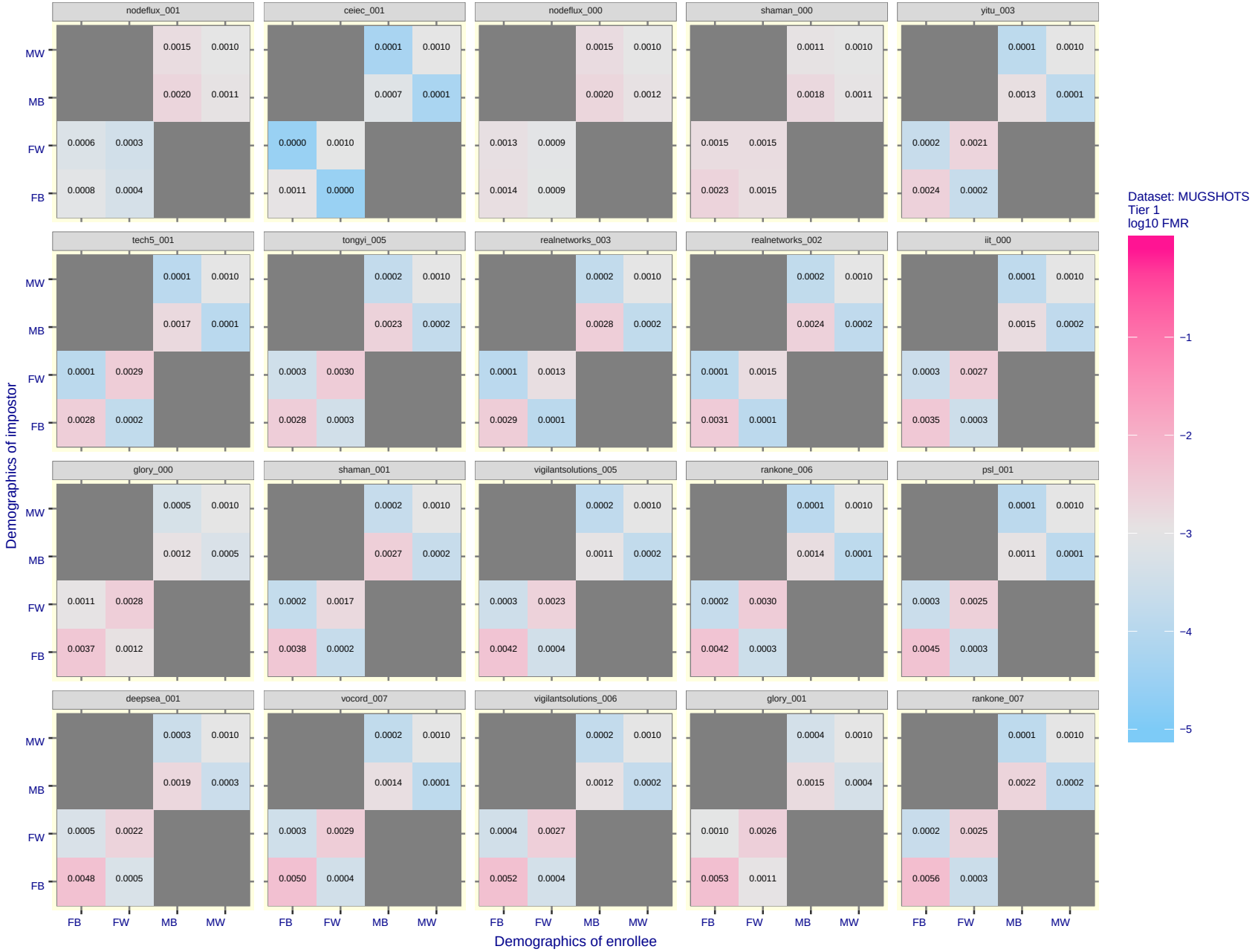


Figure 43: For the mugshot images, FMR *for same-sex impostor pairs of images annotated with codes for black female, black male, white female, white male. The threshold is set for each algorithm to give* FMR *= 0.001 for white males which is the demographc that usually gives the lowest* FMR*. This means the top right box is the same color in all panels. The panels are sorted over multiple pages in order of* FMR *on black females, which is the demographc that usually gives the highest* FMR*.*

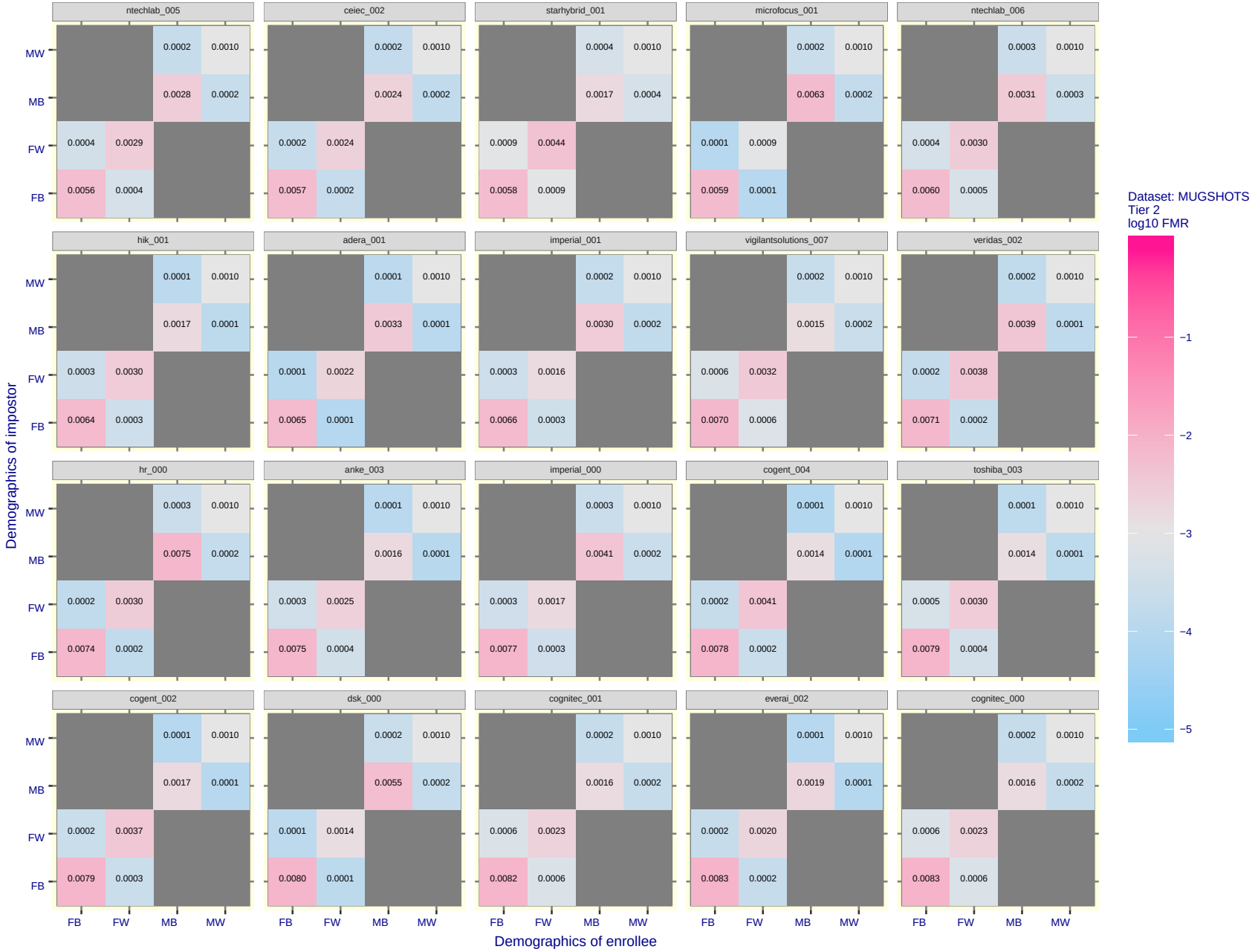


Figure 44: For the mugshot images, FMR *for same-sex impostor pairs of images annotated with codes for black female, black male, white female, white male. The threshold is set for each algorithm to give* FMR *= 0.001 for white males which is the demographc that usually gives the lowest* FMR*. This means the top right box is the same color in all panels. The panels are sorted over multiple pages in order of* FMR *on black females, which is the demographc that usually gives the highest* FMR*.*

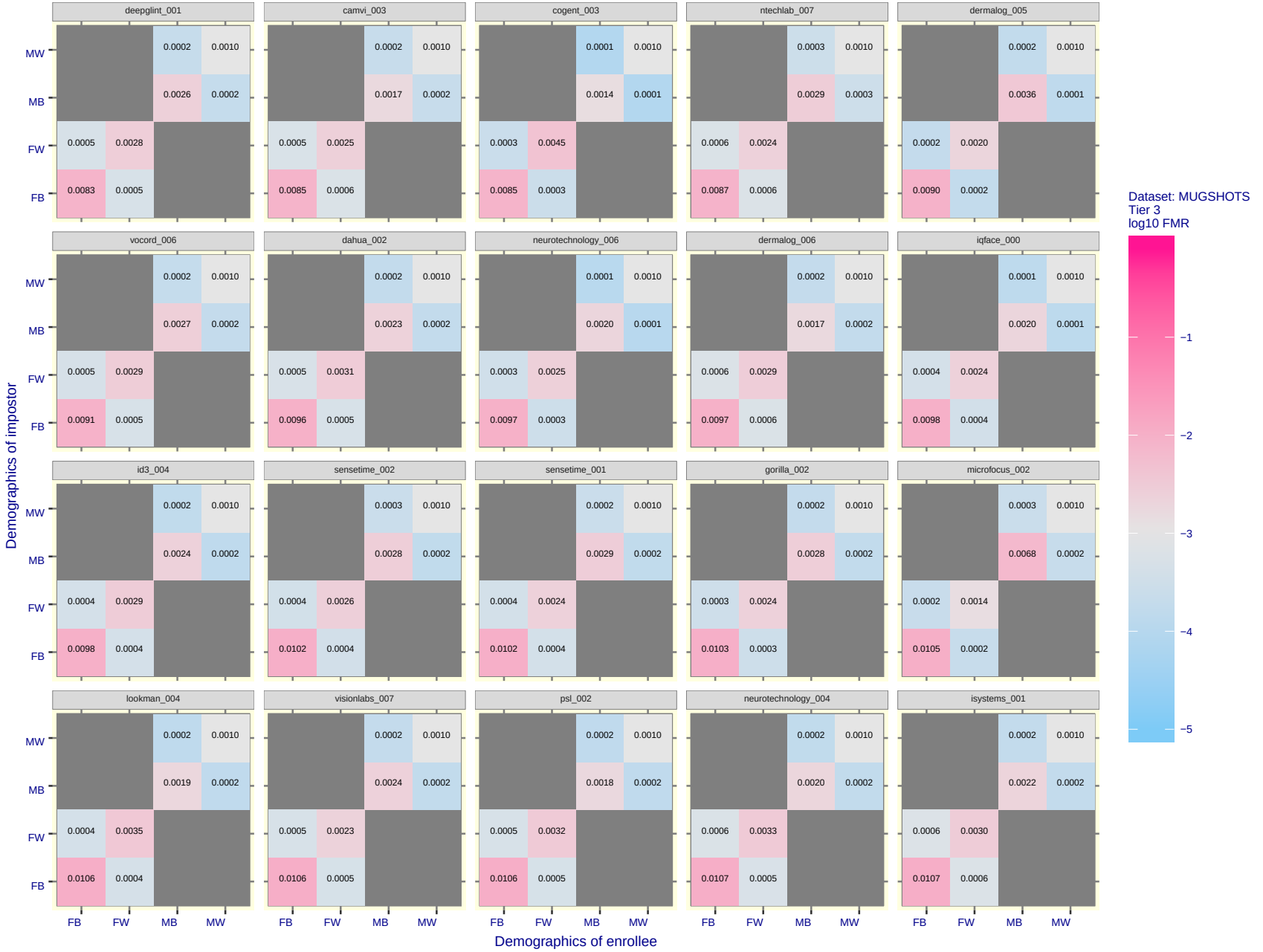


Figure 45: For the mugshot images, FMR *for same-sex impostor pairs of images annotated with codes for black female, black male, white female, white male. The threshold is set for each algorithm to give* FMR *= 0.001 for white males which is the demographc that usually gives the lowest* FMR*. This means the top right box is the same color in all panels. The panels are sorted over multiple pages in order of* FMR *on black females, which is the demographc that usually gives the highest* FMR*.*

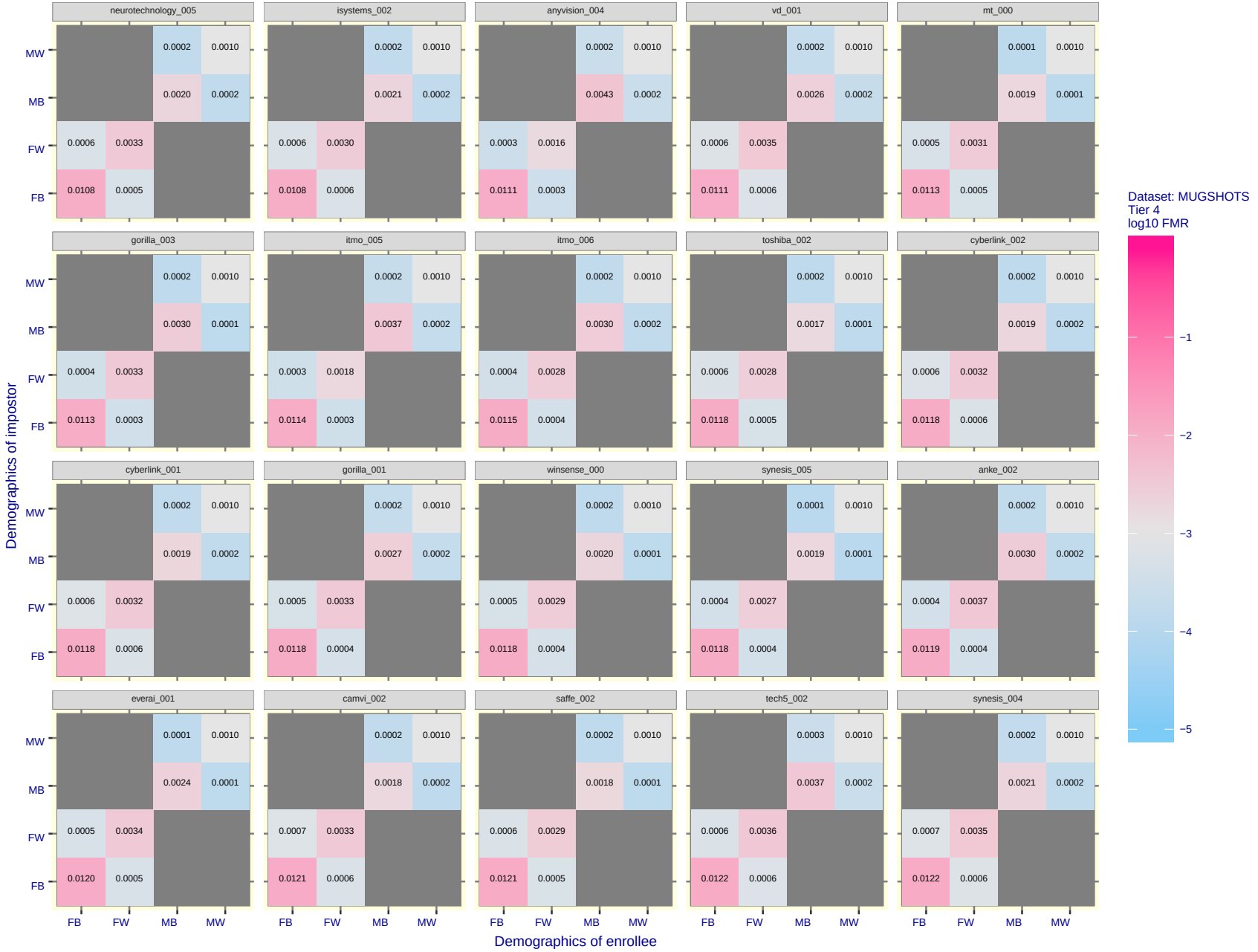


Figure 46: For the mugshot images, FMR *for same-sex impostor pairs of images annotated with codes for black female, black male, white female, white male. The threshold is set for each algorithm to give* FMR *= 0.001 for white males which is the demographc that usually gives the lowest* FMR*. This means the top right box is the same color in all panels. The panels are sorted over multiple pages in order of* FMR *on black females, which is the demographc that usually gives the highest* FMR*.*

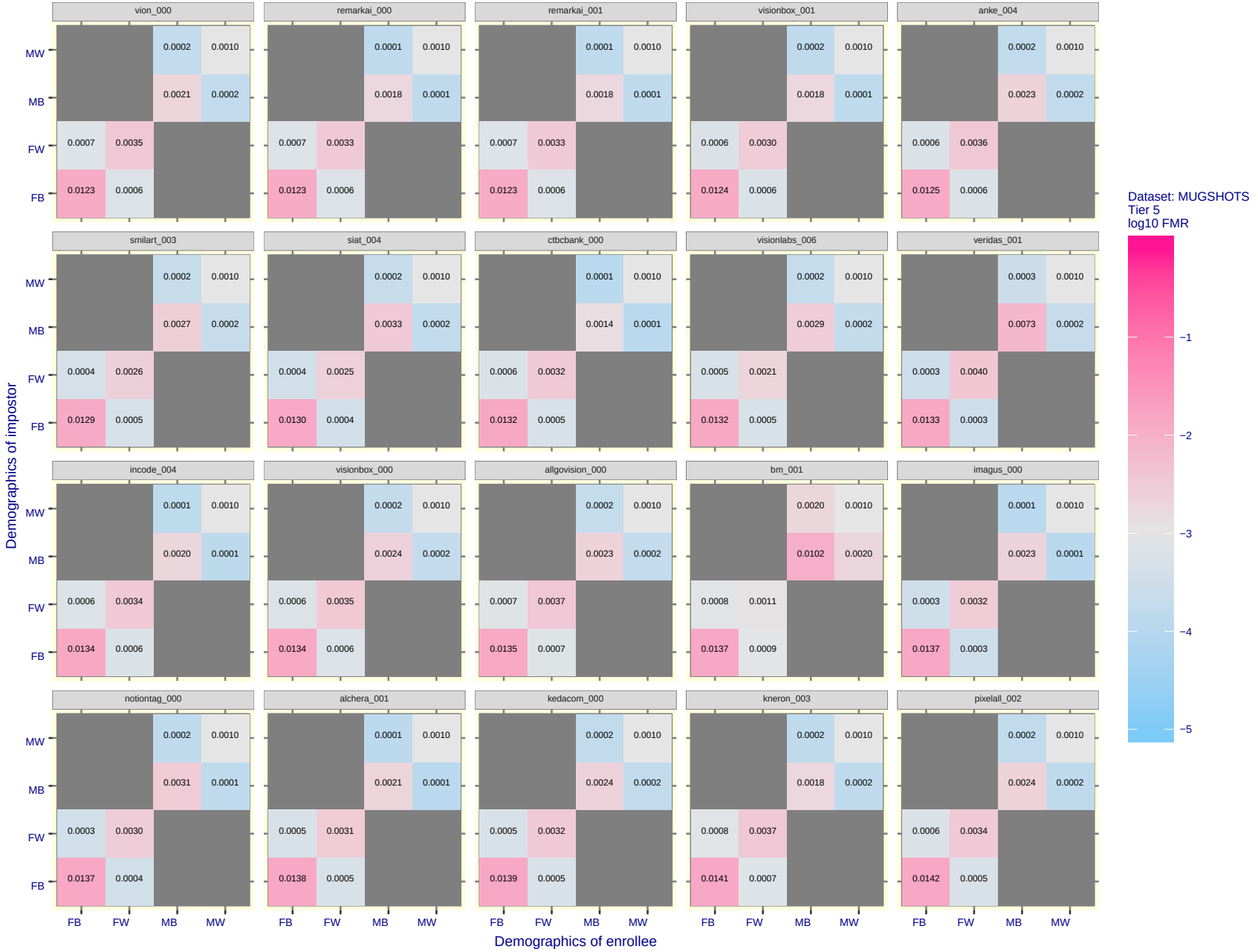


Figure 47: For the mugshot images, FMR *for same-sex impostor pairs of images annotated with codes for black female, black male, white female, white male. The threshold is set for each algorithm to give* FMR *= 0.001 for white males which is the demographc that usually gives the lowest* FMR*. This means the top right box is the same color in all panels. The panels are sorted over multiple pages in order of* FMR *on black females, which is the demographc that usually gives the highest* FMR*.*

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

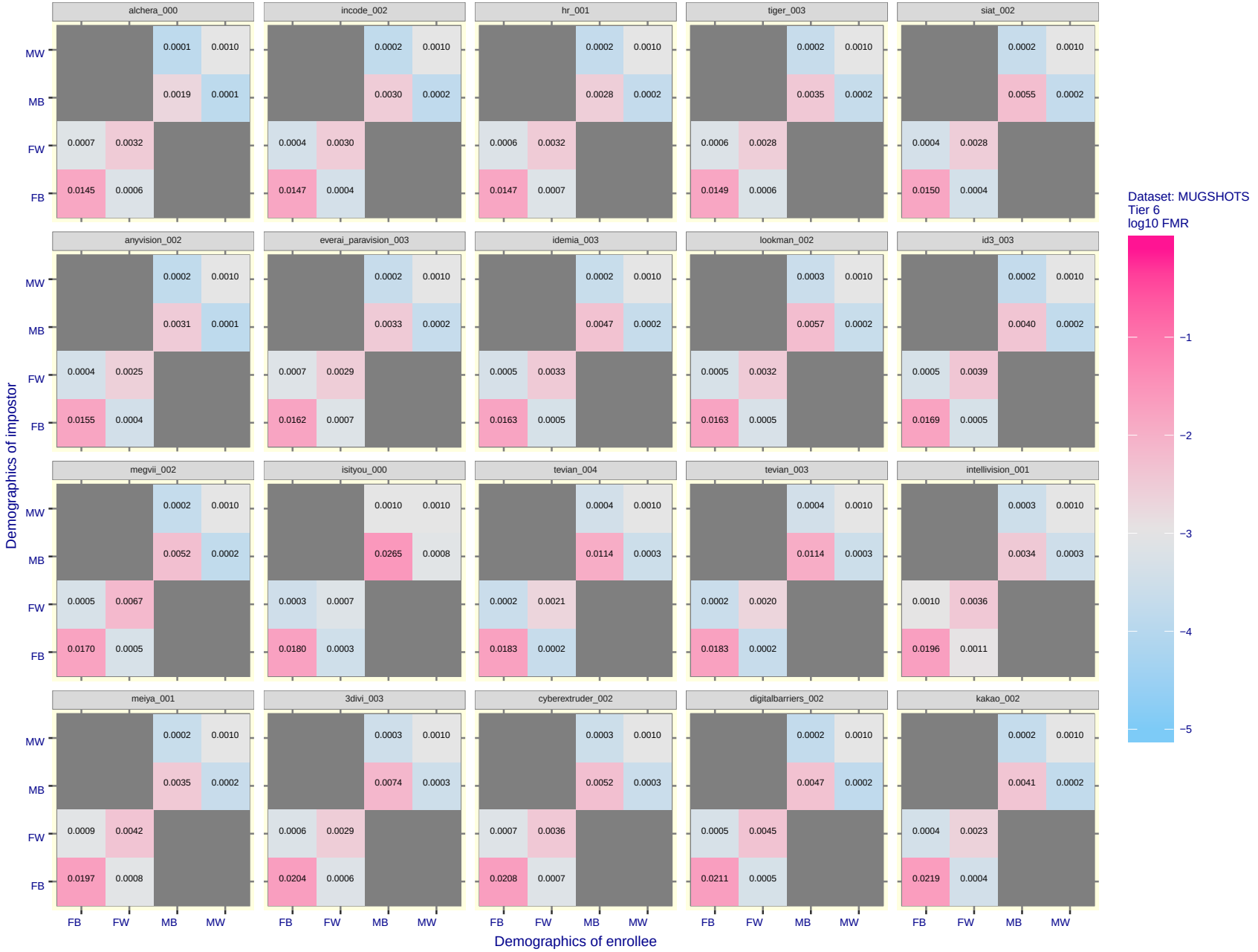


Figure 48: For the mugshot images, FMR *for same-sex impostor pairs of images annotated with codes for black female, black male, white female, white male. The threshold is set for each algorithm to give* FMR *= 0.001 for white males which is the demographc that usually gives the lowest* FMR*. This means the top right box is the same color in all panels. The panels are sorted over multiple pages in order of* FMR *on black females, which is the demographc that usually gives the highest* FMR*.*

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FNMR(T) "False non-match rate"
FMR(T) "False match rate"

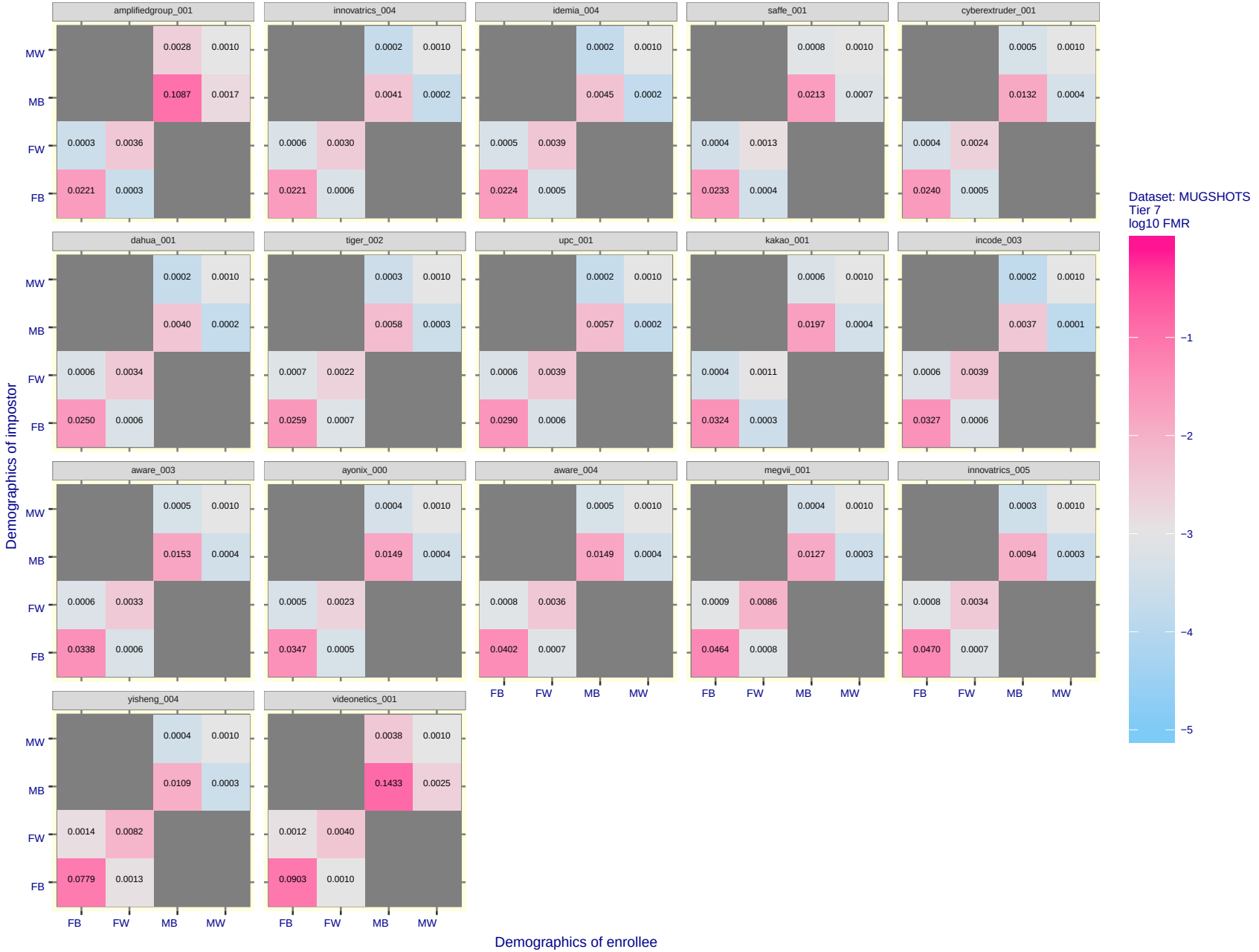

Figure 49: For the mugshot images, FMR *for same-sex impostor pairs of images annotated with codes for black female, black male, white female, white male. The threshold is set for each algorithm to give* FMR *= 0.001 for white males which is the demographc that usually gives the lowest* FMR*. This means the top right box is the same color in all panels. The panels are sorted over multiple pages in order of* FMR *on black females, which is the demographc that usually gives the highest* FMR*.*

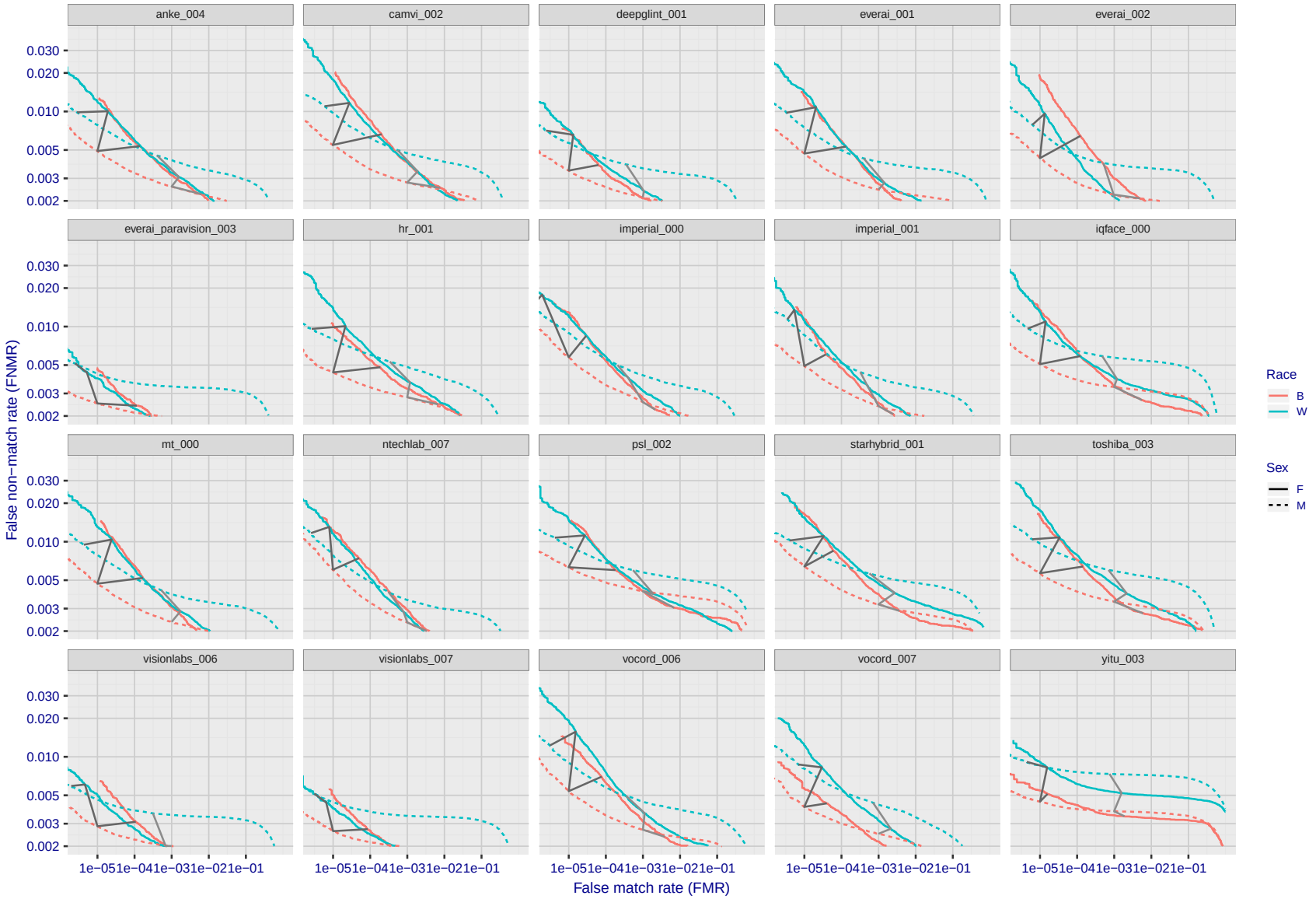

Figure 50: For the mugshot images, error tradeoff characteristics for white females, black females, black males and white males. The Z-shaped grey lines correspond to fixed thresholds, showing both *FNMR and FMR vary at one T value. Note: Many of the plots will naively be read as saying women gives worse error rates than men because the solid traces lie above the dotted ones. However, this is misleading and incomplete: The grey lines show the traces reveal horizontal shifts. Thus for the cogent-003 algorithm FNMR for men is* higher *than for women* at a fixed threshold *but, at the same time, FMR is higher for women - see Figure 75. As access control systems almost always operate at a fixed threshold, the naive interpretation is incorrect.*

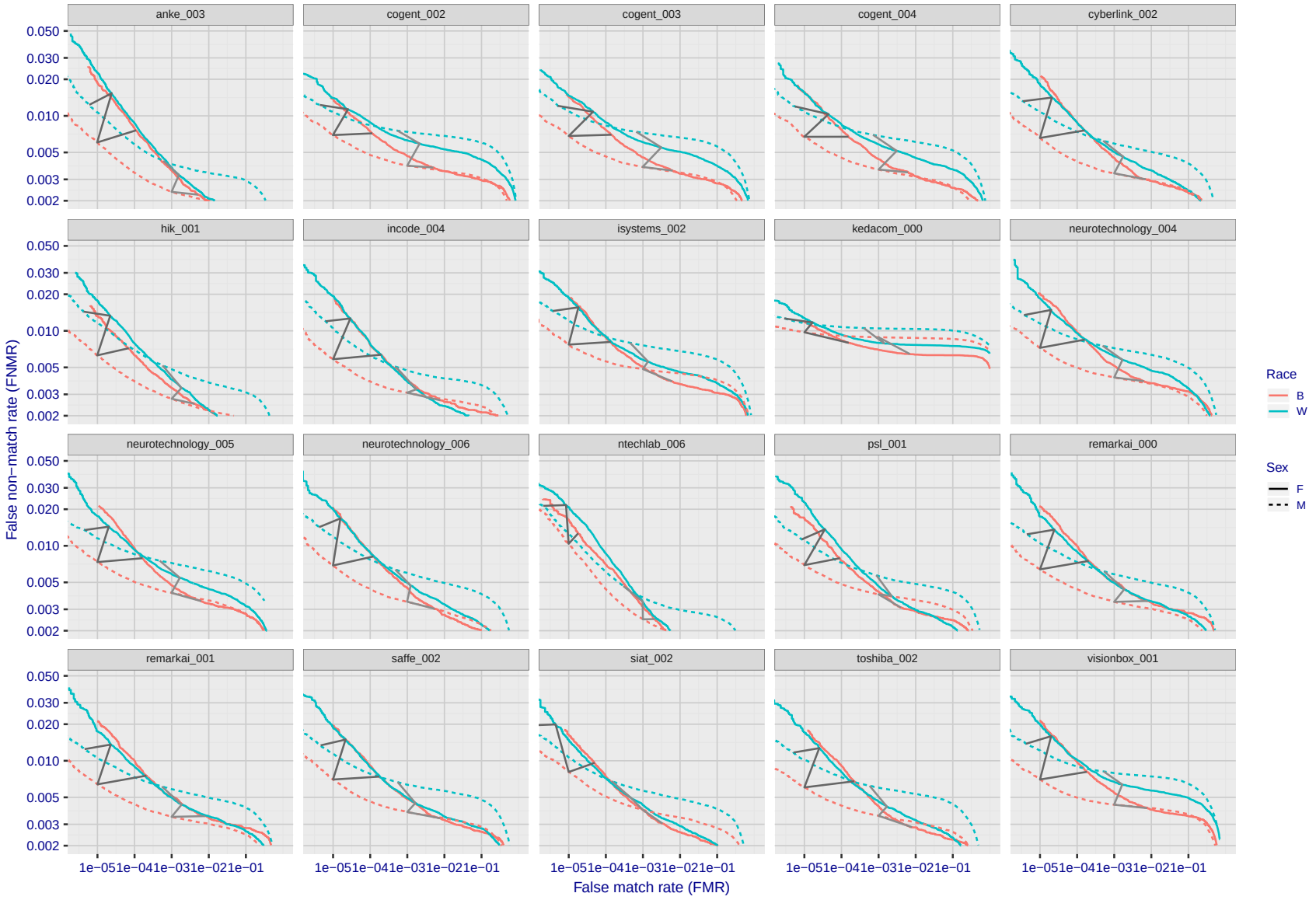

Figure 51: For the mugshot images, error tradeoff characteristics for white females, black females, black males and white males. The Z-shaped grey lines correspond to fixed thresholds, showing both *FNMR and FMR vary at one T value. Note: Many of the plots will naively be read as saying women gives worse error rates than men because the solid traces lie above the dotted ones. However, this is misleading and incomplete: The grey lines show the traces reveal horizontal shifts. Thus for the cogent-003 algorithm FNMR for men is* higher *than for women* at a fixed threshold *but, at the same time, FMR is higher for women - see Figure 75. As access control systems almost always operate at a fixed threshold, the naive interpretation is incorrect.*

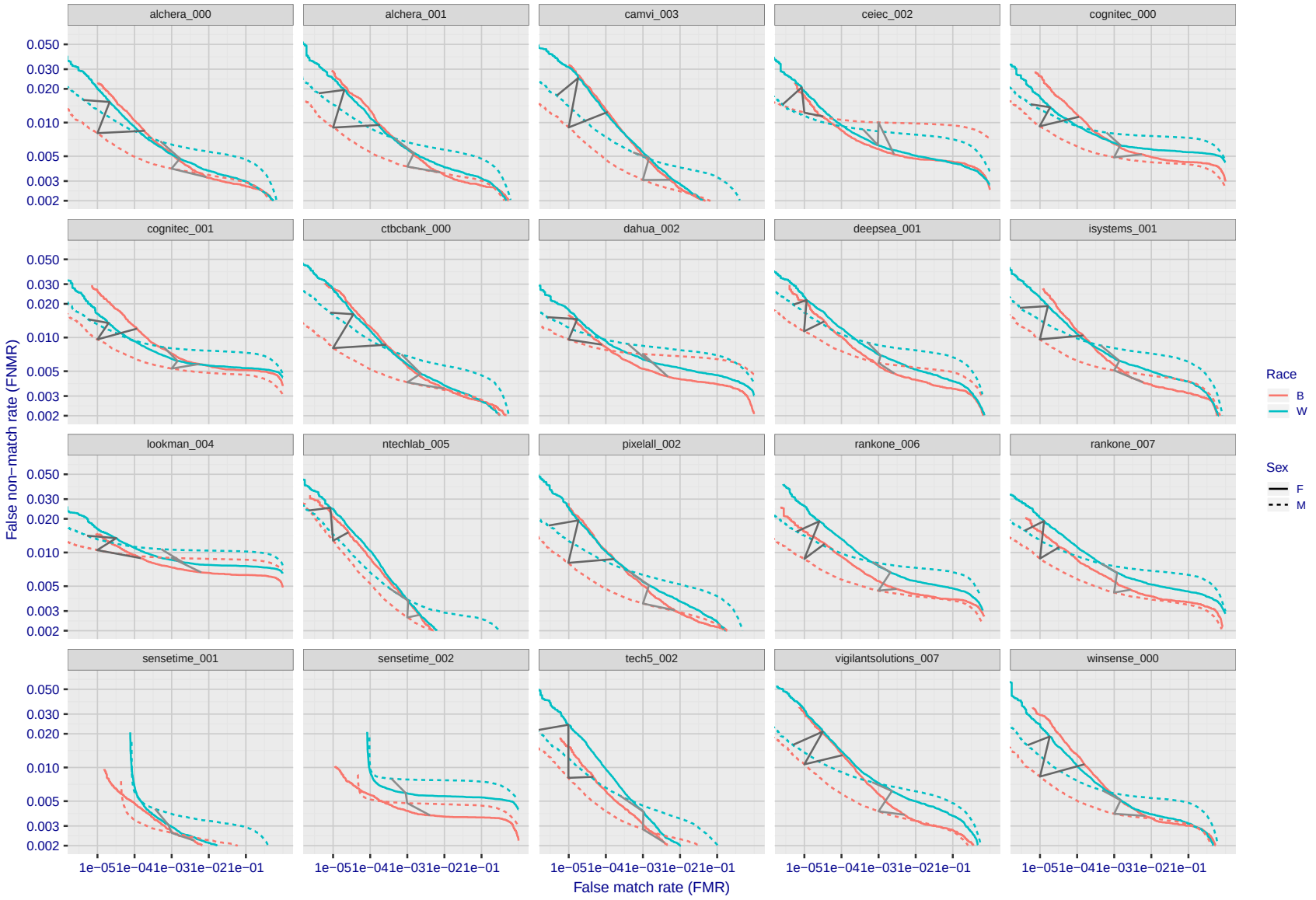

Figure 52: For the mugshot images, error tradeoff characteristics for white females, black females, black males and white males. The Z-shaped grey lines correspond to fixed thresholds, showing both *FNMR and FMR vary at one T value. Note: Many of the plots will naively be read as saying women gives worse error rates than men because the solid traces lie above the dotted ones. However, this is misleading and incomplete: The grey lines show the traces reveal horizontal shifts. Thus for the cogent-003 algorithm FNMR for men is* higher *than for women* at a fixed threshold *but, at the same time, FMR is higher for women - see Figure 75. As access control systems almost always operate at a fixed threshold, the naive interpretation is incorrect.*

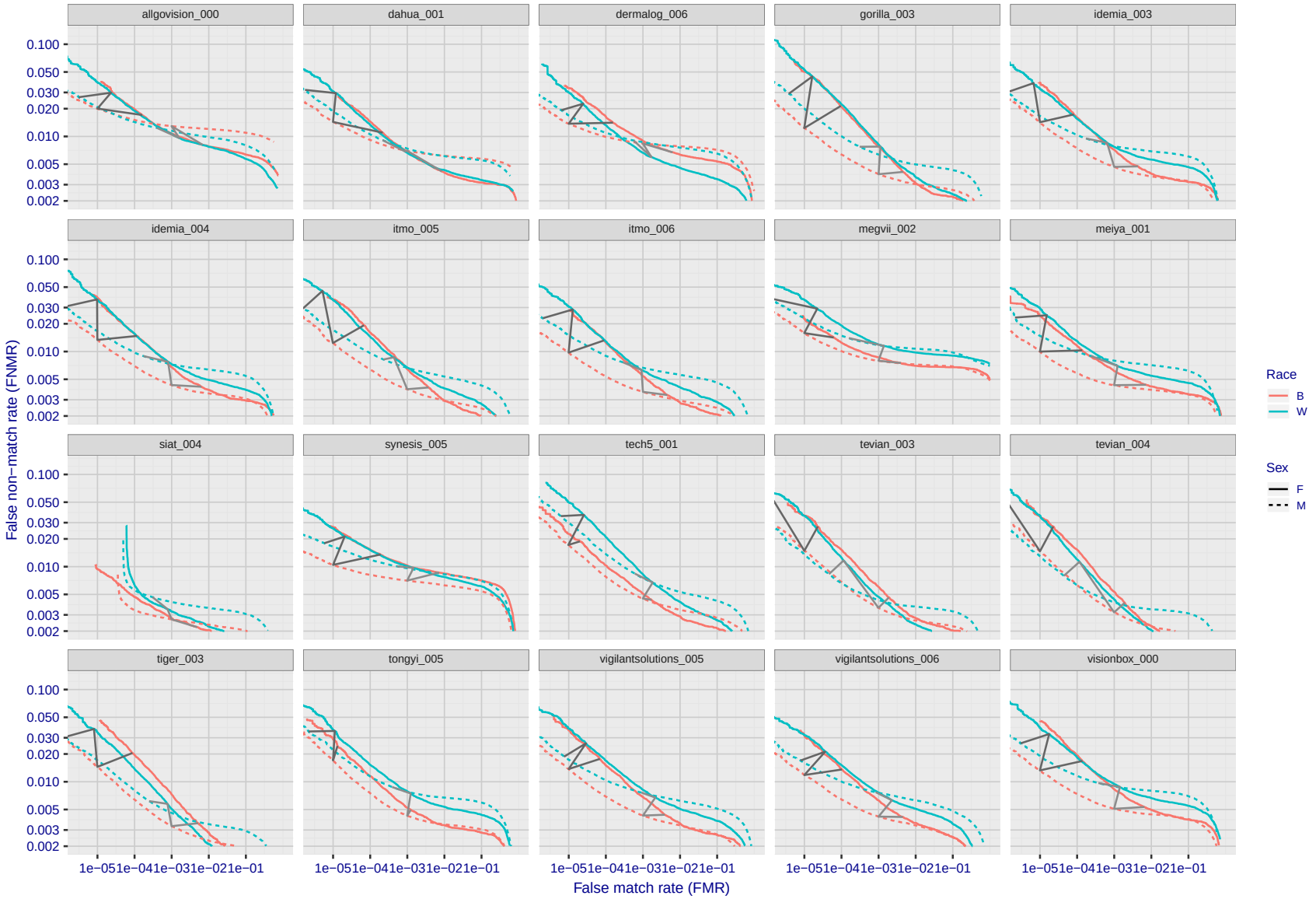

Figure 53: For the mugshot images, error tradeoff characteristics for white females, black females, black males and white males. The Z-shaped grey lines correspond to fixed thresholds, showing both *FNMR and FMR vary at one T value. Note: Many of the plots will naively be read as saying women gives worse error rates than men because the solid traces lie above the dotted ones. However, this is misleading and incomplete: The grey lines show the traces reveal horizontal shifts. Thus for the cogent-003 algorithm FNMR for men is* higher *than for women* at a fixed threshold *but, at the same time, FMR is higher for women - see Figure 75. As access control systems almost always operate at a fixed threshold, the naive interpretation is incorrect.*

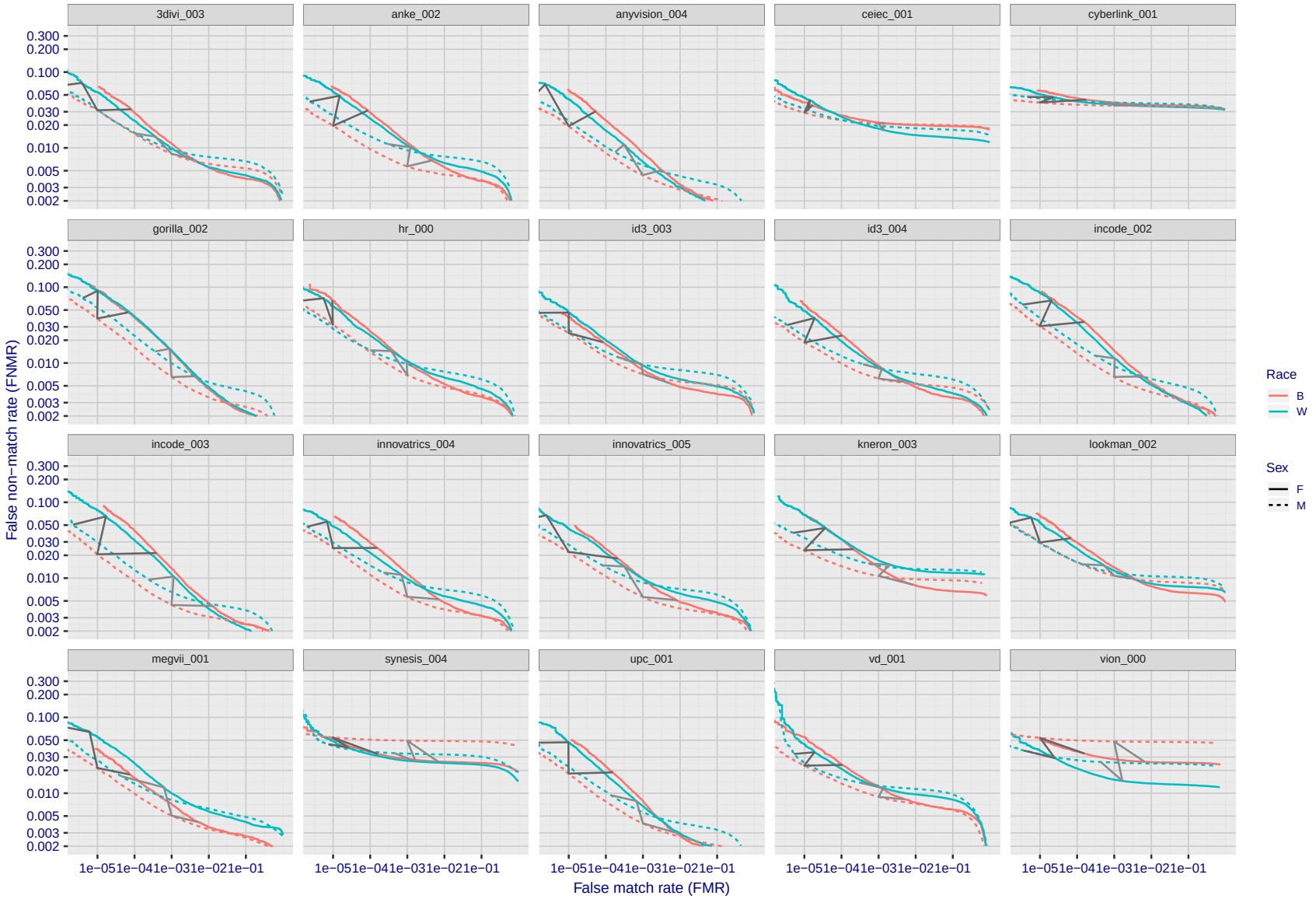

Figure 54: For the mugshot images, error tradeoff characteristics for white females, black females, black males and white males. The Z-shaped grey lines correspond to fixed thresholds, showing both *FNMR and FMR vary at one T value. Note: Many of the plots will naively be read as saying women gives worse error rates than men because the solid traces lie above the dotted ones. However, this is misleading and incomplete: The grey lines show the traces reveal horizontal shifts. Thus for the cogent-003 algorithm FNMR for men is* higher *than for women* at a fixed threshold *but, at the same time, FMR is higher for women - see Figure 75. As access control systems almost always operate at a fixed threshold, the naive interpretation is incorrect.*

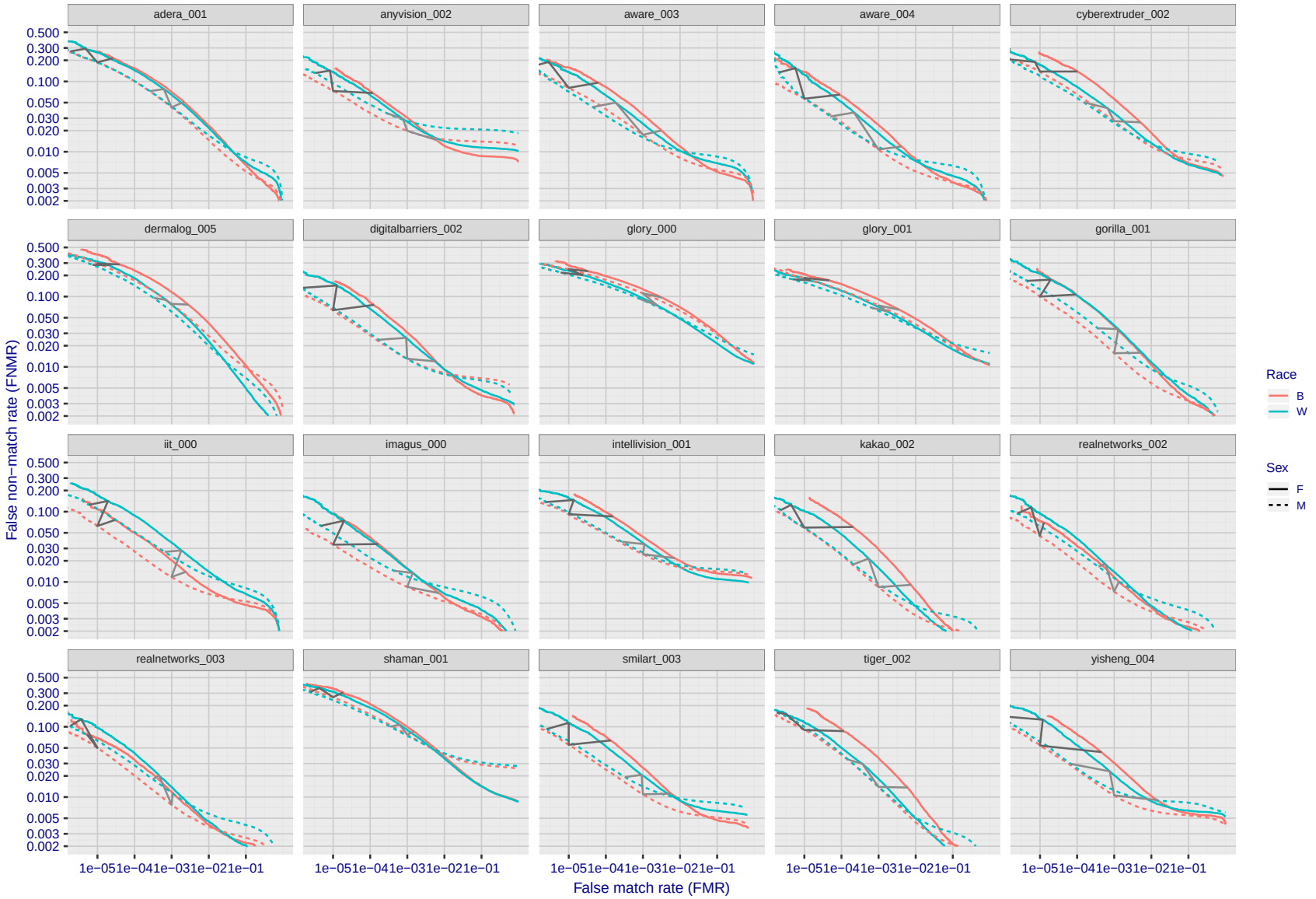

Figure 55: For the mugshot images, error tradeoff characteristics for white females, black females, black males and white males. The Z-shaped grey lines correspond to fixed thresholds, showing both *FNMR and FMR vary at one T value. Note: Many of the plots will naively be read as saying women gives worse error rates than men because the solid traces lie above the dotted ones. However, this is misleading and incomplete: The grey lines show the traces reveal horizontal shifts. Thus for the cogent-003 algorithm FNMR for men is* higher *than for women* at a fixed threshold *but, at the same time, FMR is higher for women - see Figure 75. As access control systems almost always operate at a fixed threshold, the naive interpretation is incorrect.*

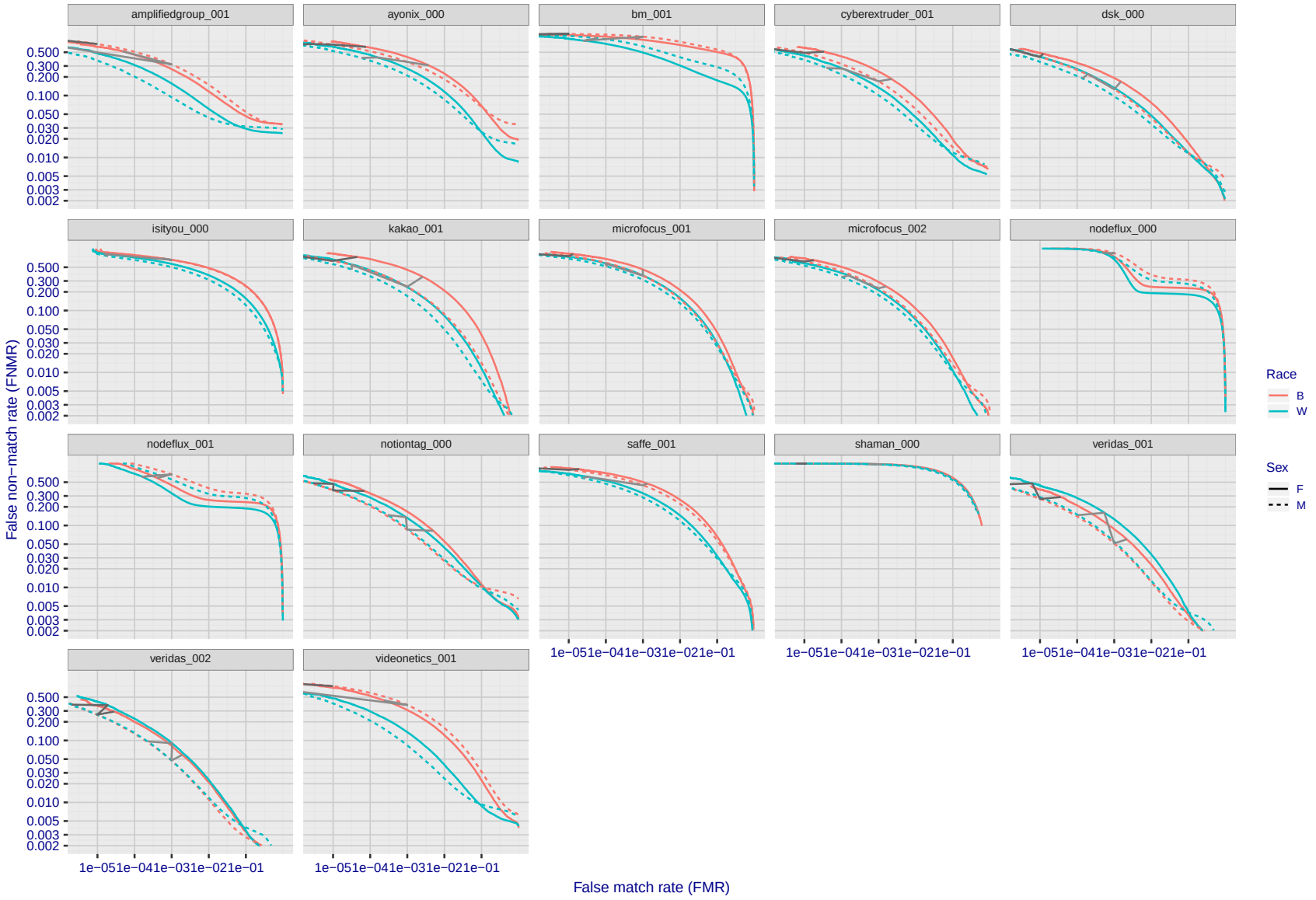

Figure 56: For the mugshot images, error tradeoff characteristics for white females, black females, black males and white males. The Z-shaped grey lines correspond to fixed thresholds, showing both *FNMR and FMR vary at one T value. Note: Many of the plots will naively be read as saying women gives worse error rates than men because the solid traces lie above the dotted ones. However, this is misleading and incomplete: The grey lines show the traces reveal horizontal shifts. Thus for the cogent-003 algorithm FNMR for men is* higher *than for women* at a fixed threshold *but, at the same time, FMR is higher for women - see Figure 75. As access control systems almost always operate at a fixed threshold, the naive interpretation is incorrect.*

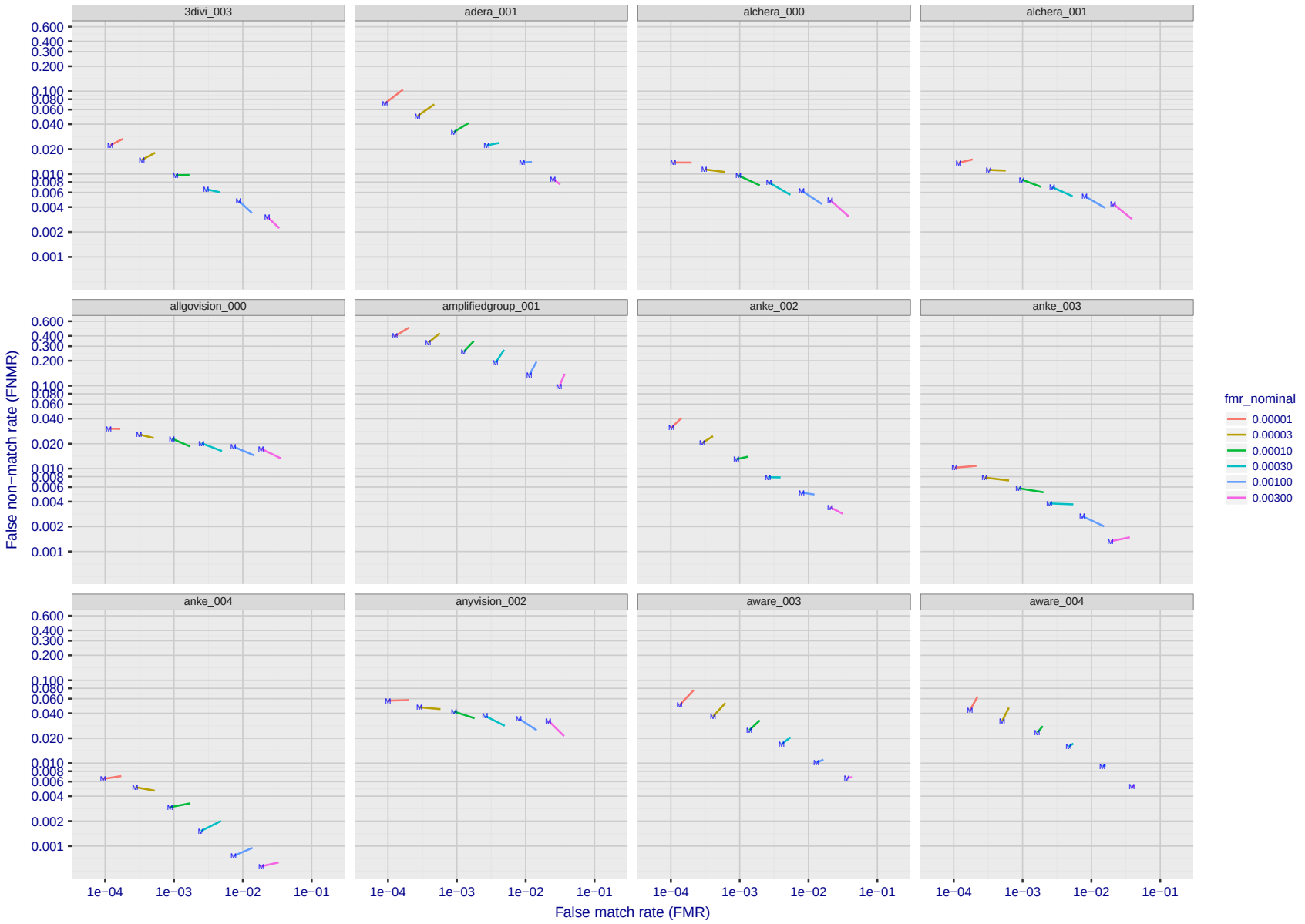

Figure 57: For the visa images, FNMR and FMR at six operating points along the DET characteristic. At each point a line is drawn between (FMR,FNMR)$_{\text{MALE}}$ and (FMR,FNMR)$_{\text{FEMALE}}$ showing how which sex has lower FMR and/or FNMR. The "M" label denotes male, the other end of the line corresponds to female. The six operating thresholds are selected to give the nominal false match rates given in the legend, and are computed over all impostor pairs regardless of age, sex, and place of birth. The plotted FMR values are broadly an order of magnitude larger than the nominal rates because FMR is computed over demographically-matched impostor pairs i.e individuals of the same sex, from the same geographic region (see section 3.6.1), and the same age group (see section 3.6.2).

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FNMR(T) "False non-match rate"
FMR(T) "False match rate"

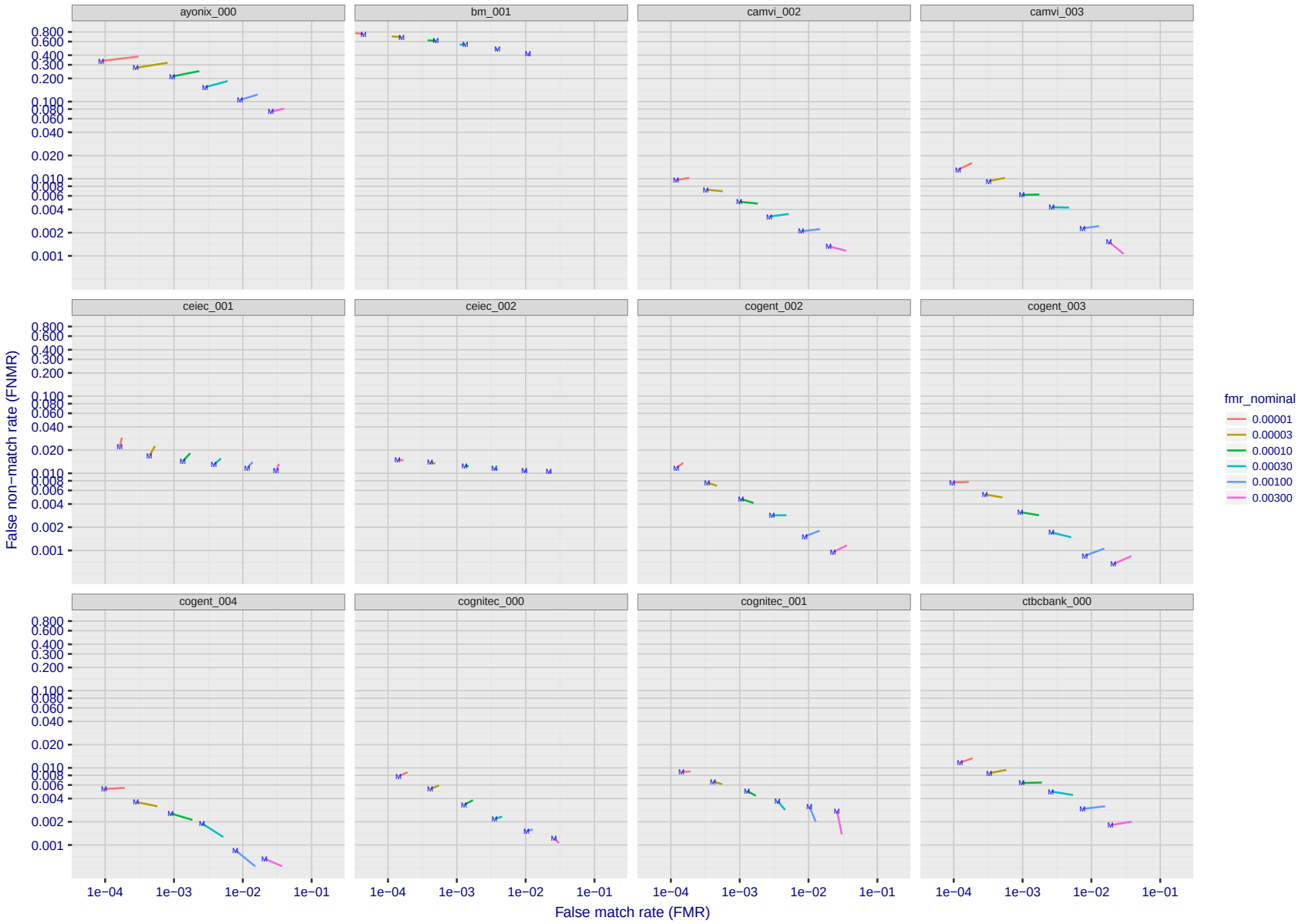

Figure 58: For the visa images, FNMR and FMR at six operating points along the DET characteristic. At each point a line is drawn between (FMR,FNMR)$_{\text{MALE}}$ and (FMR,FNMR)$_{\text{FEMALE}}$ showing how which sex has lower FMR and/or FNMR. The "M" label denotes male, the other end of the line corresponds to female. The six operating thresholds are selected to give the nominal false match rates given in the legend, and are computed over all impostor pairs regardless of age, sex, and place of birth. The plotted FMR values are broadly an order of magnitude larger than the nominal rates because FMR is computed over demographically-matched impostor pairs i.e individuals of the same sex, from the same geographic region (see section 3.6.1), and the same age group (see section 3.6.2).

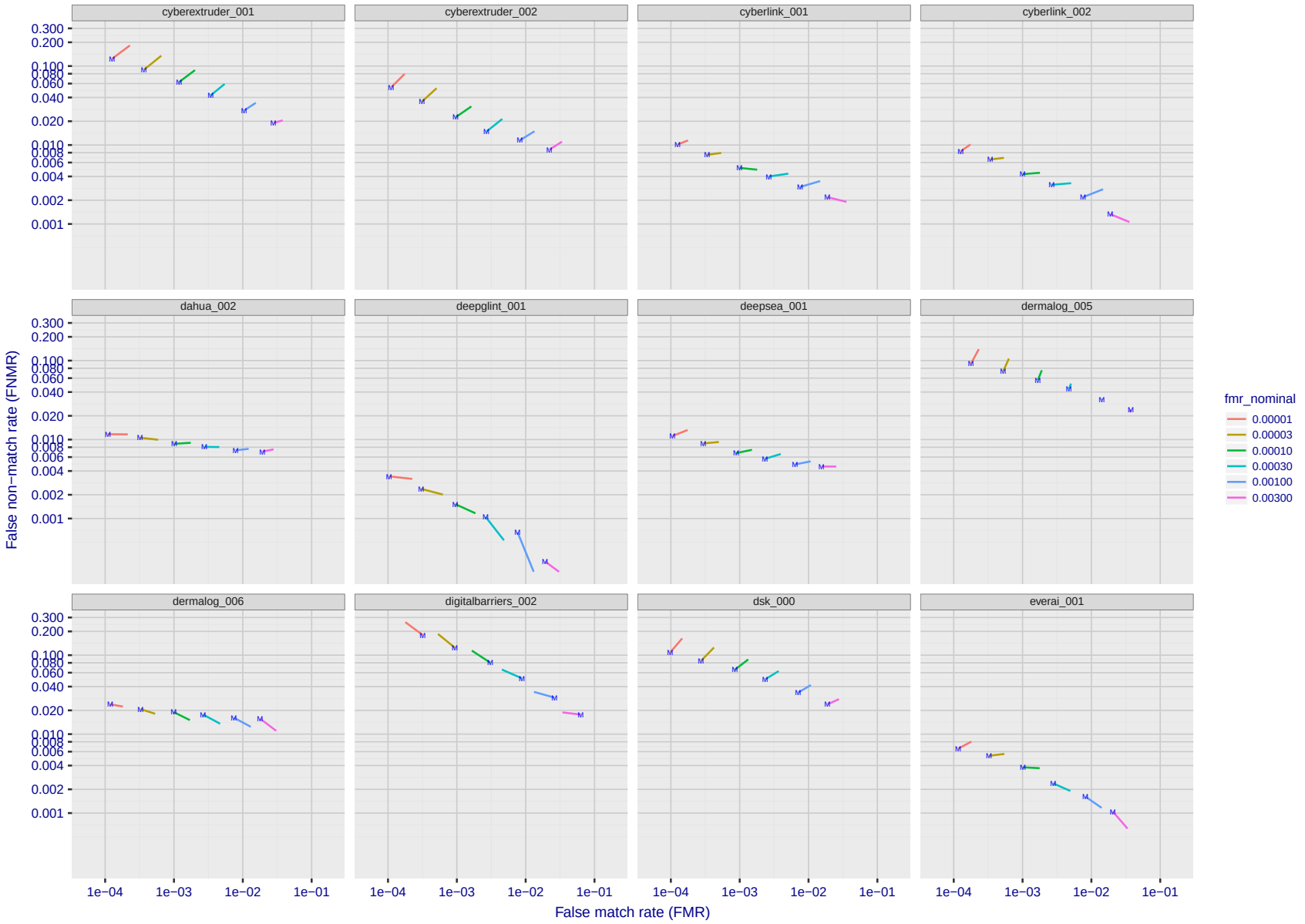

Figure 59: For the visa images, FNMR and FMR at six operating points along the DET characteristic. At each point a line is drawn between (FMR,FNMR)$_{\text{MALE}}$ and (FMR,FNMR)$_{\text{FEMALE}}$ showing how which sex has lower FMR and/or FNMR. The "M" label denotes male, the other end of the line corresponds to female. The six operating thresholds are selected to give the nominal false match rates given in the legend, and are computed over all impostor pairs regardless of age, sex, and place of birth. The plotted FMR values are broadly an order of magnitude larger than the nominal rates because FMR is computed over demographically-matched impostor pairs i.e individuals of the same sex, from the same geographic region (see section 3.6.1), and the same age group (see section 3.6.2).

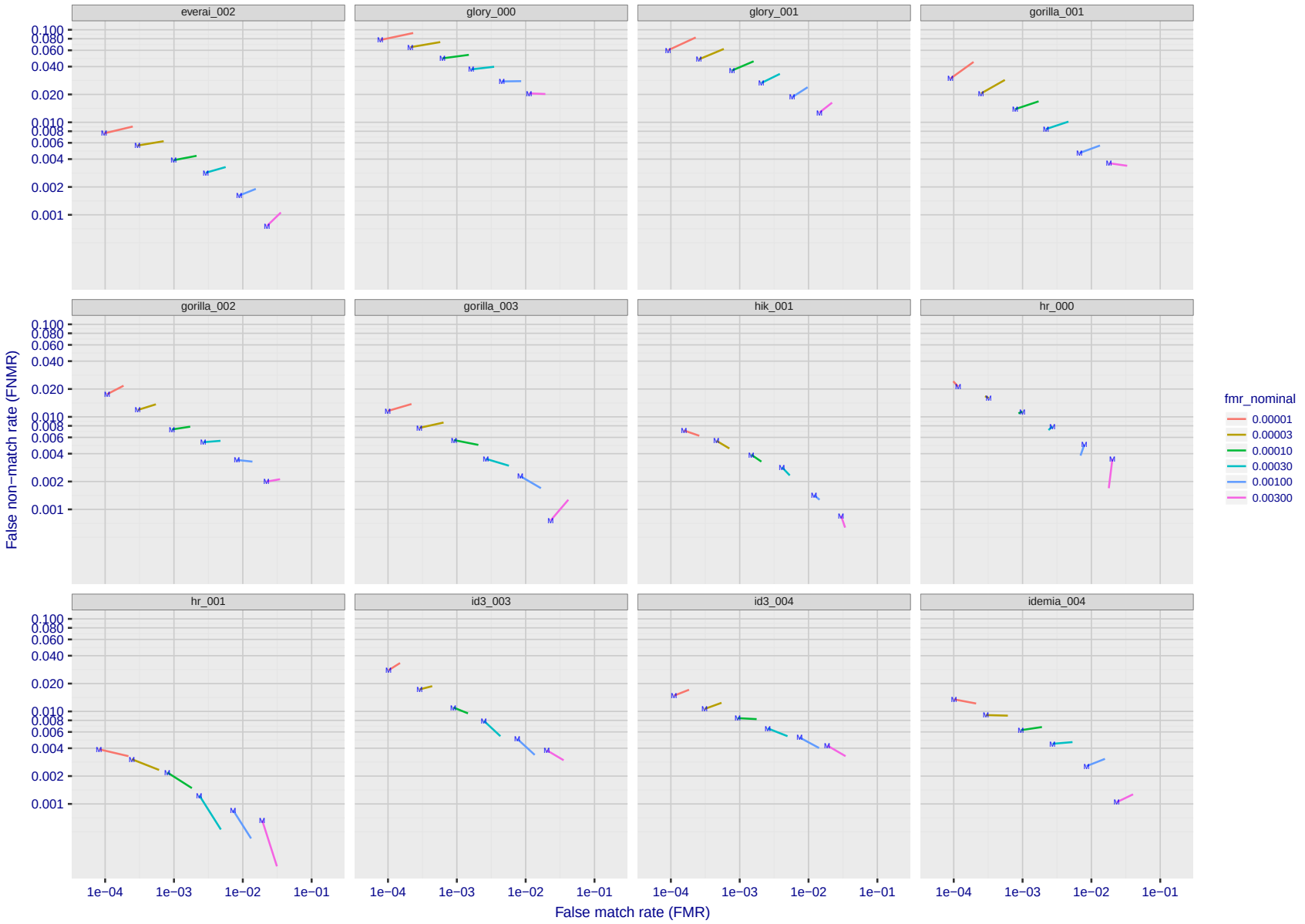

Figure 60: For the visa images, FNMR and FMR at six operating points along the DET characteristic. At each point a line is drawn between (FMR,FNMR)$_{\text{MALE}}$ and (FMR,FNMR)$_{\text{FEMALE}}$ showing how which sex has lower FMR and/or FNMR. The "M" label denotes male, the other end of the line corresponds to female. The six operating thresholds are selected to give the nominal false match rates given in the legend, and are computed over all impostor pairs regardless of age, sex, and place of birth. The plotted FMR values are broadly an order of magnitude larger than the nominal rates because FMR is computed over demographically-matched impostor pairs i.e individuals of the same sex, from the same geographic region (see section 3.6.1), and the same age group (see section 3.6.2).

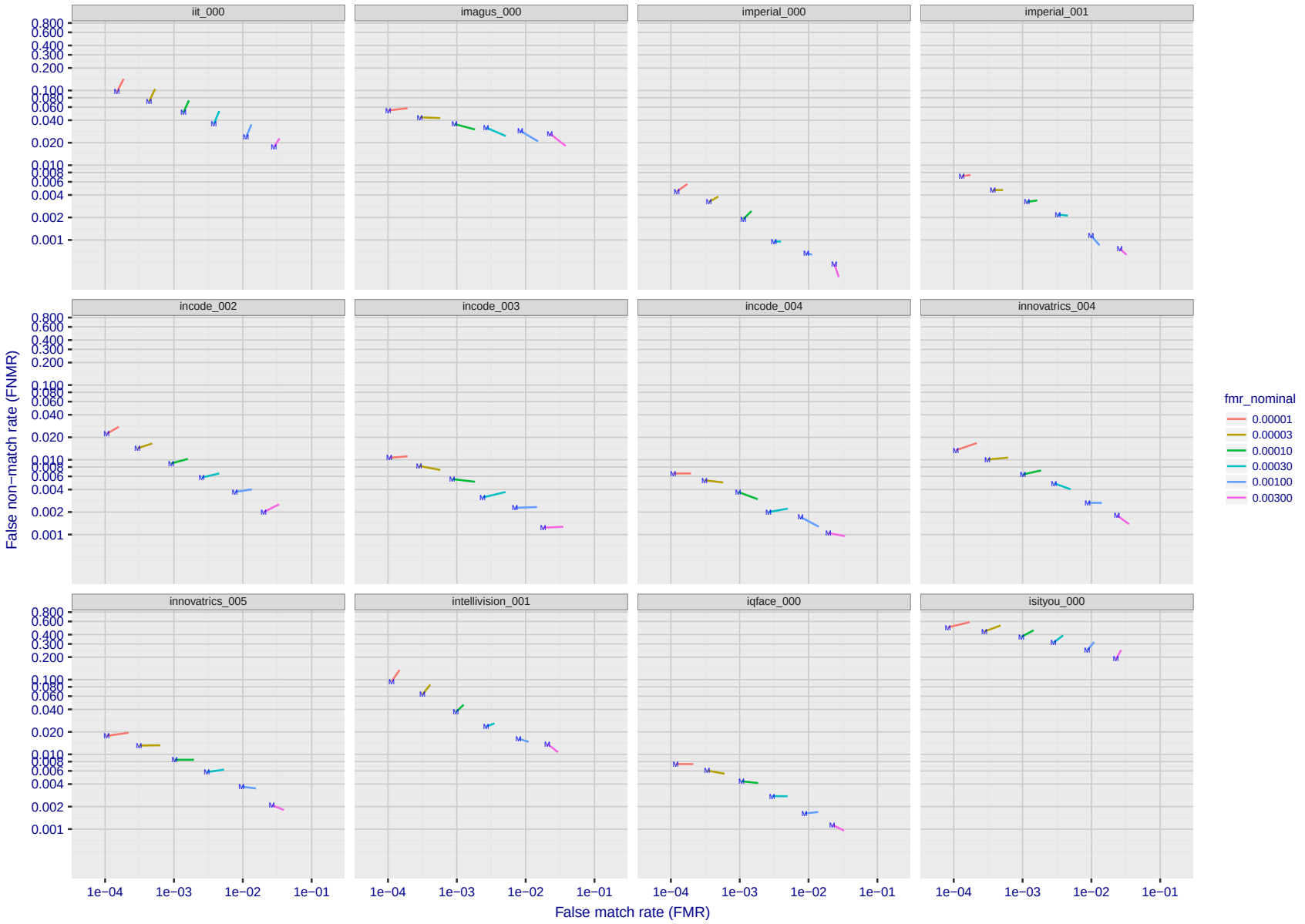

Figure 61: For the visa images, FNMR and FMR at six operating points along the DET characteristic. At each point a line is drawn between (FMR,FNMR)$_{\text{MALE}}$ and (FMR,FNMR)$_{\text{FEMALE}}$ showing how which sex has lower FMR and/or FNMR. The "M" label denotes male, the other end of the line corresponds to female. The six operating thresholds are selected to give the nominal false match rates given in the legend, and are computed over all impostor pairs regardless of age, sex, and place of birth. The plotted FMR values are broadly an order of magnitude larger than the nominal rates because FMR is computed over demographically-matched impostor pairs i.e individuals of the same sex, from the same geographic region (see section 3.6.1), and the same age group (see section 3.6.2).

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FNMR(T) "False non-match rate"
FMR(T) "False match rate"

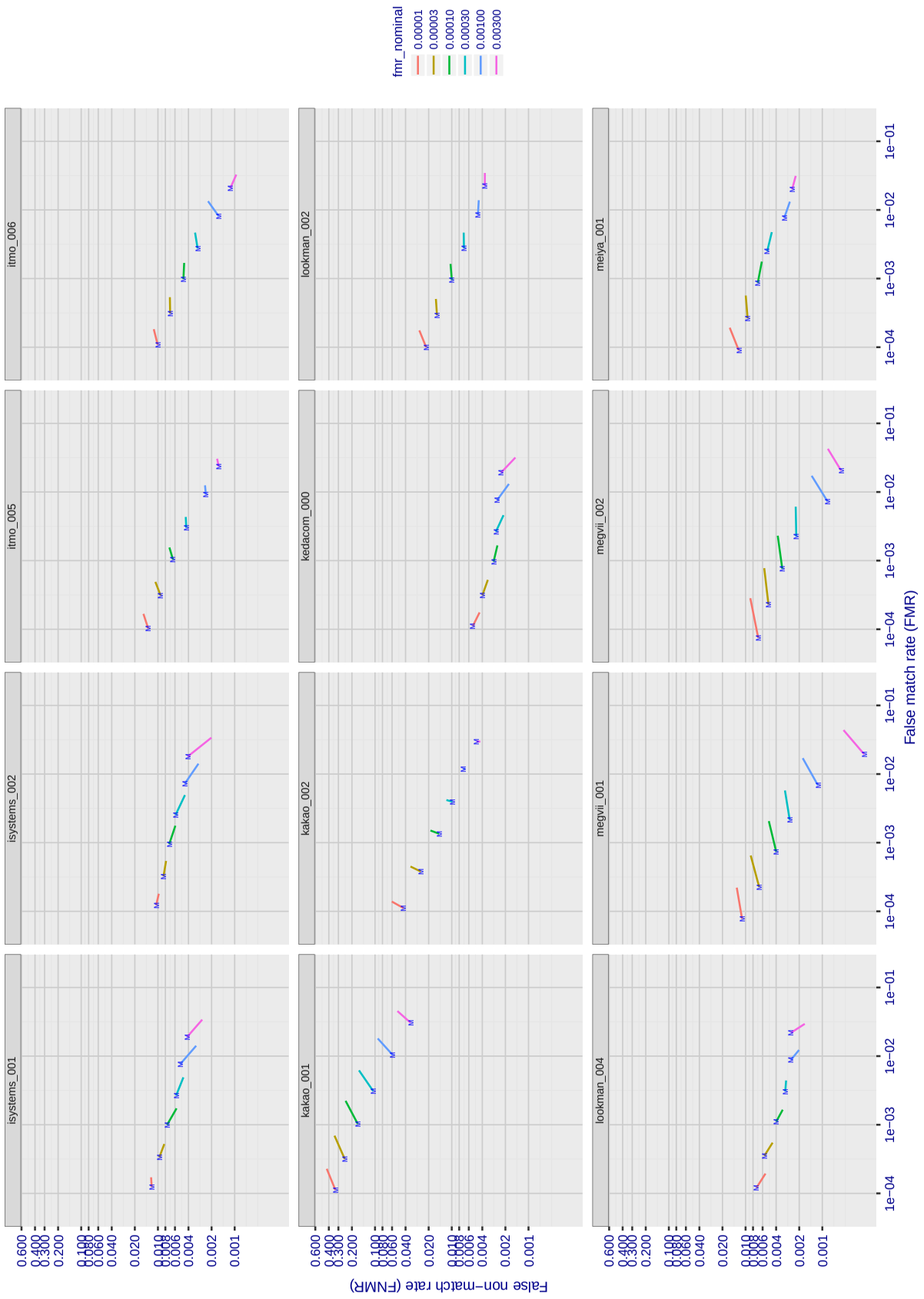

Figure 62: For the visa images, FNMR and FMR at six operating points along the DET characteristic. At each point a line is drawn between (FMR,FNMR)$_{\text{MALE}}$ and (FMR,FNMR)$_{\text{FEMALE}}$ showing how which sex has lower FMR and/or FNMR. The "M" label denotes male, the other end of the line corresponds to female. The six operating thresholds are selected to give the nominal false match rates given in the legend, and are computed over all impostor pairs regardless of age, sex, and place of birth. The plotted FMR values are broadly an order of magnitude larger than the nominal rates because FMR is computed over demographically-matched impostor pairs i.e individuals of the same sex, from the same geographic region (see section 3.6.1), and the same age group (see section 3.6.2).

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

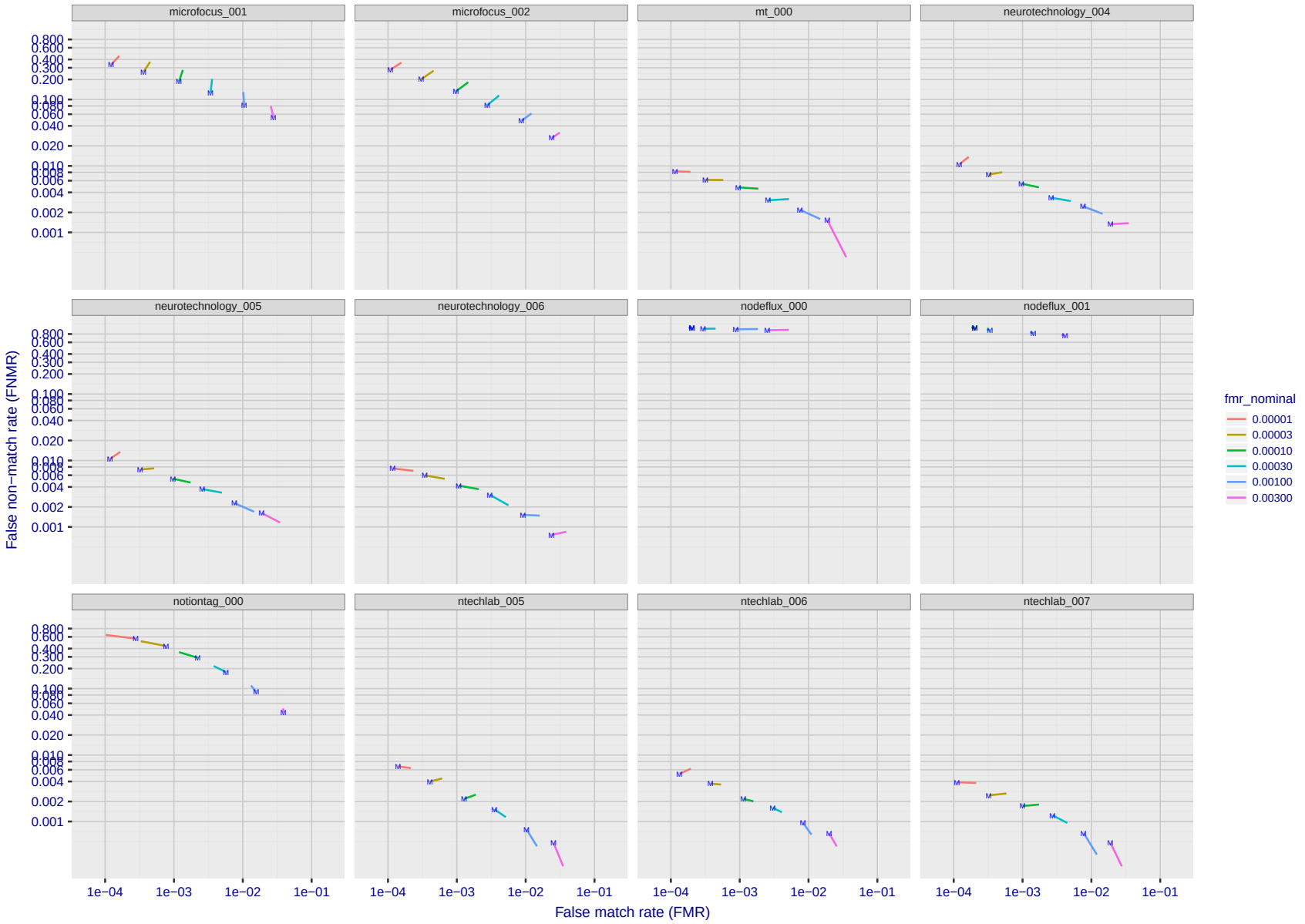

Figure 63: For the visa images, FNMR and FMR at six operating points along the DET characteristic. At each point a line is drawn between (FMR,FNMR)$_{\text{MALE}}$ and (FMR,FNMR)$_{\text{FEMALE}}$ showing how which sex has lower FMR and/or FNMR. The "M" label denotes male, the other end of the line corresponds to female. The six operating thresholds are selected to give the nominal false match rates given in the legend, and are computed over all impostor pairs regardless of age, sex, and place of birth. The plotted FMR values are broadly an order of magnitude larger than the nominal rates because FMR is computed over demographically-matched impostor pairs i.e individuals of the same sex, from the same geographic region (see section 3.6.1), and the same age group (see section 3.6.2).

2019/07/05 07:20:46
FNMR(T) "False non-match rate"
FMR(T) "False match rate"

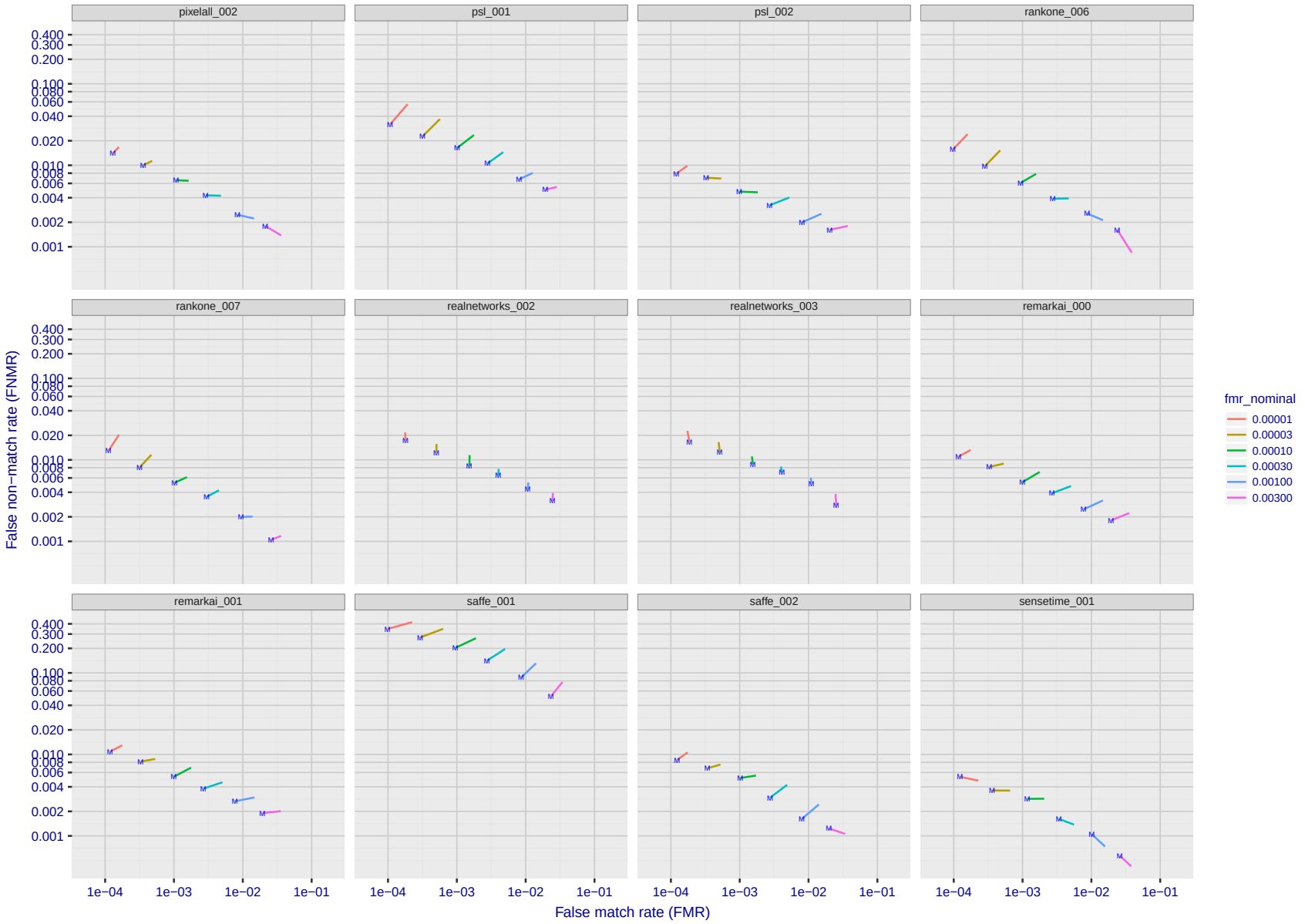

Figure 64: For the visa images, FNMR and FMR at six operating points along the DET characteristic. At each point a line is drawn between (FMR,FNMR)$_{\text{MALE}}$ and (FMR,FNMR)$_{\text{FEMALE}}$ showing how which sex has lower FMR and/or FNMR. The "M" label denotes male, the other end of the line corresponds to female. The six operating thresholds are selected to give the nominal false match rates given in the legend, and are computed over all impostor pairs regardless of age, sex, and place of birth. The plotted FMR values are broadly an order of magnitude larger than the nominal rates because FMR is computed over demographically-matched impostor pairs i.e individuals of the same sex, from the same geographic region (see section 3.6.1), and the same age group (see section 3.6.2).

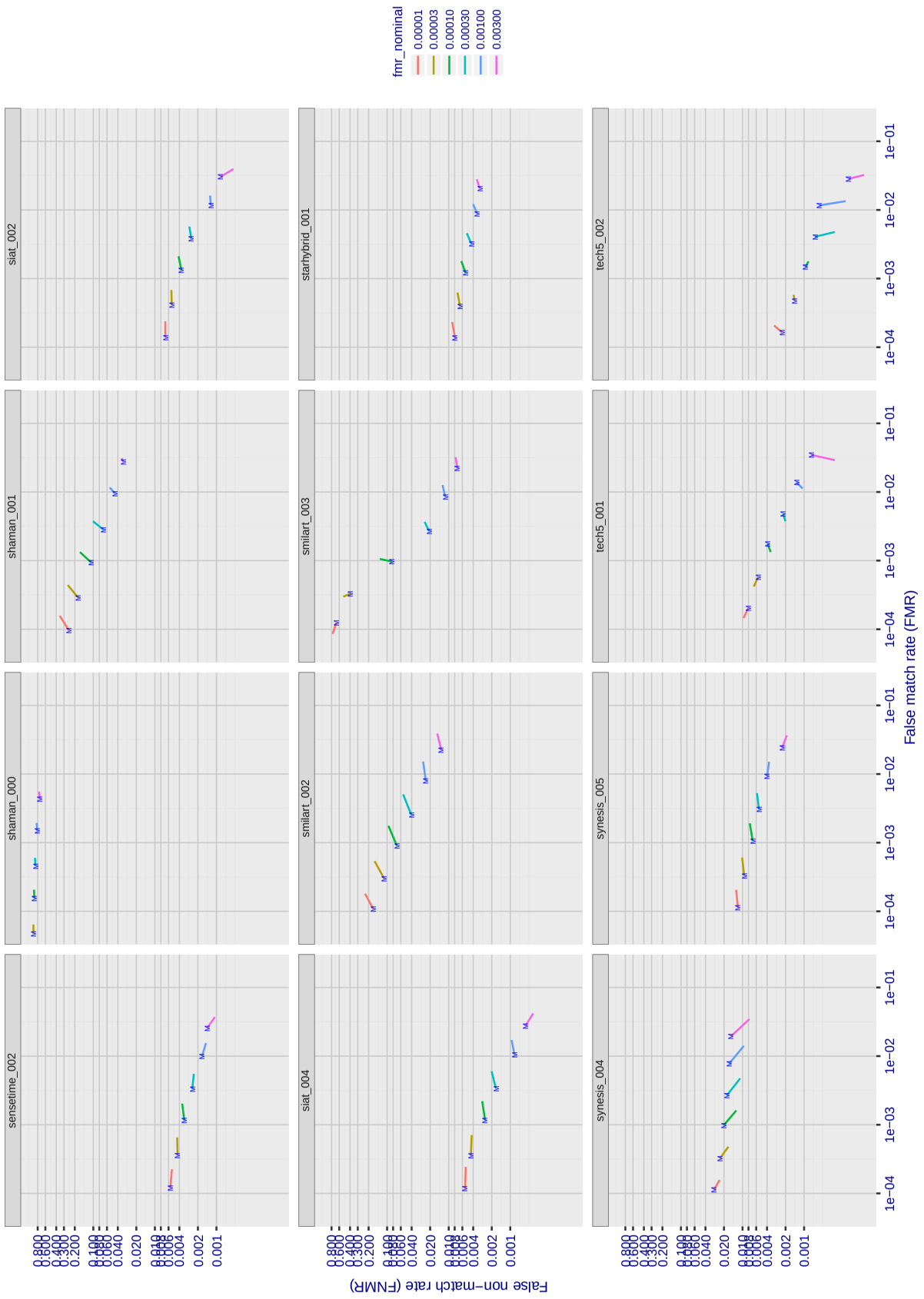

Figure 65: For the visa images, FNMR and FMR at six operating points along the DET characteristic. At each point a line is drawn between (FMR,FNMR)$_{\text{MALE}}$ and (FMR,FNMR)$_{\text{FEMALE}}$ showing how which sex has lower FMR and/or FNMR. The "M" label denotes male, the other end of the line corresponds to female. The six operating thresholds are selected to give the nominal false match rates given in the legend, and are computed over all impostor pairs regardless of age, sex, and place of birth. The plotted FMR values are broadly an order of magnitude larger than the nominal rates because FMR is computed over demographically-matched impostor pairs i.e individuals of the same sex, from the same geographic region (see section 3.6.1), and the same age group (see section 3.6.2).

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

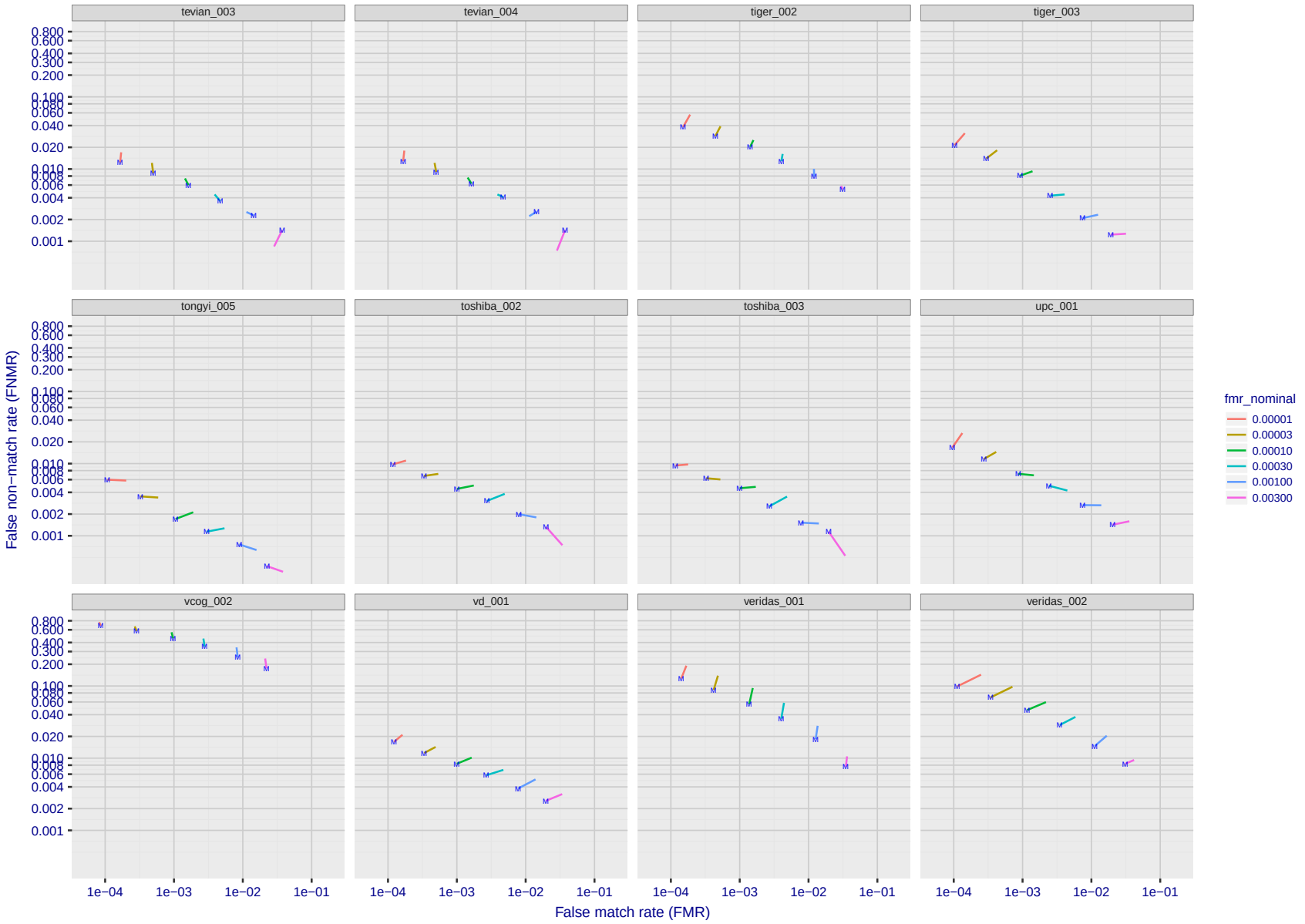

Figure 66: For the visa images, FNMR and FMR at six operating points along the DET characteristic. At each point a line is drawn between (FMR,FNMR)$_{\text{MALE}}$ and (FMR,FNMR)$_{\text{FEMALE}}$ showing how which sex has lower FMR and/or FNMR. The "M" label denotes male, the other end of the line corresponds to female. The six operating thresholds are selected to give the nominal false match rates given in the legend, and are computed over all impostor pairs regardless of age, sex, and place of birth. The plotted FMR values are broadly an order of magnitude larger than the nominal rates because FMR is computed over demographically-matched impostor pairs i.e individuals of the same sex, from the same geographic region (see section 3.6.1), and the same age group (see section 3.6.2).

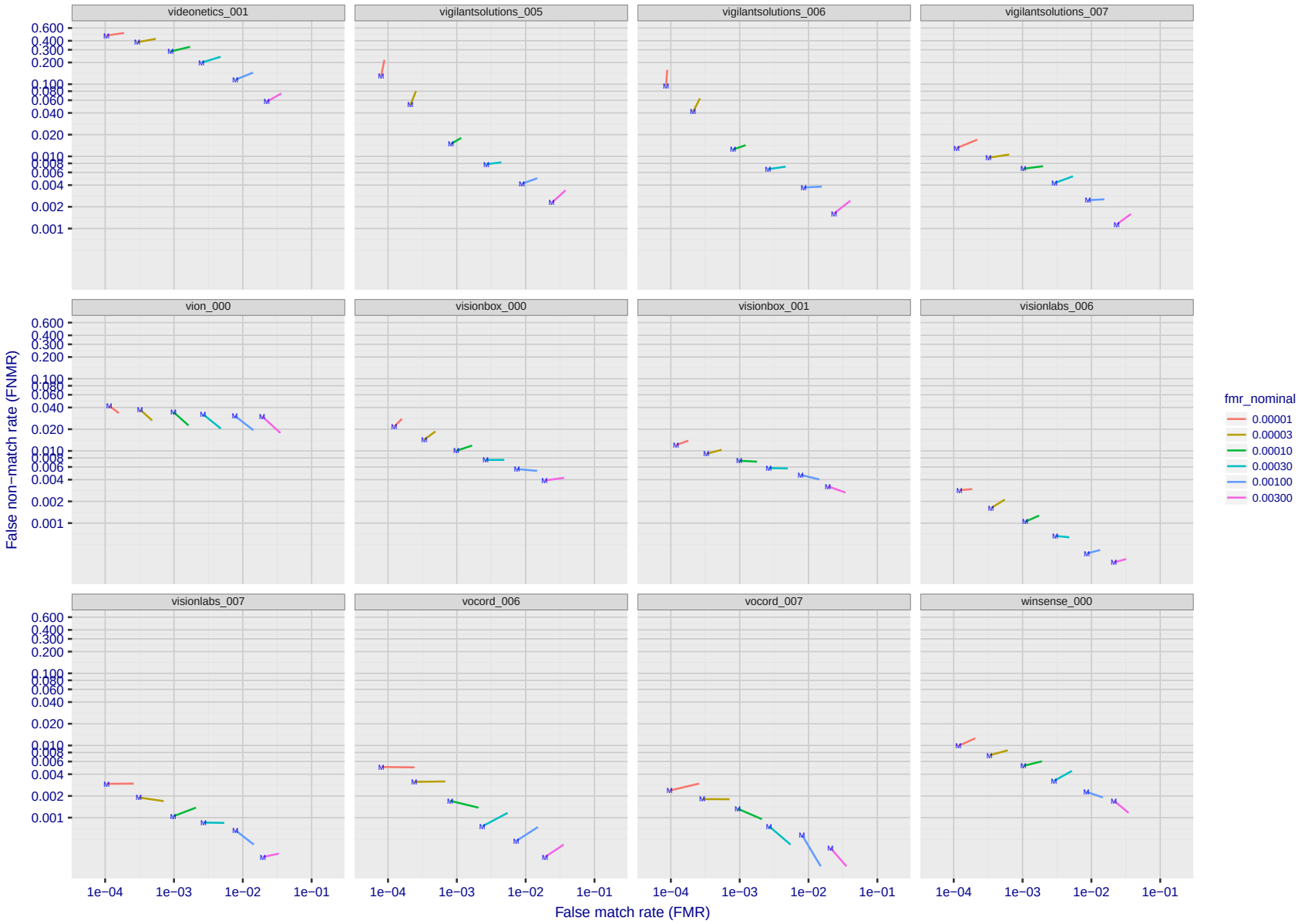

Figure 67: For the visa images, FNMR and FMR at six operating points along the DET characteristic. At each point a line is drawn between (FMR,FNMR)$_{\text{MALE}}$ and (FMR,FNMR)$_{\text{FEMALE}}$ showing how which sex has lower FMR and/or FNMR. The "M" label denotes male, the other end of the line corresponds to female. The six operating thresholds are selected to give the nominal false match rates given in the legend, and are computed over all impostor pairs regardless of age, sex, and place of birth. The plotted FMR values are broadly an order of magnitude larger than the nominal rates because FMR is computed over demographically-matched impostor pairs i.e individuals of the same sex, from the same geographic region (see section 3.6.1), and the same age group (see section 3.6.2).

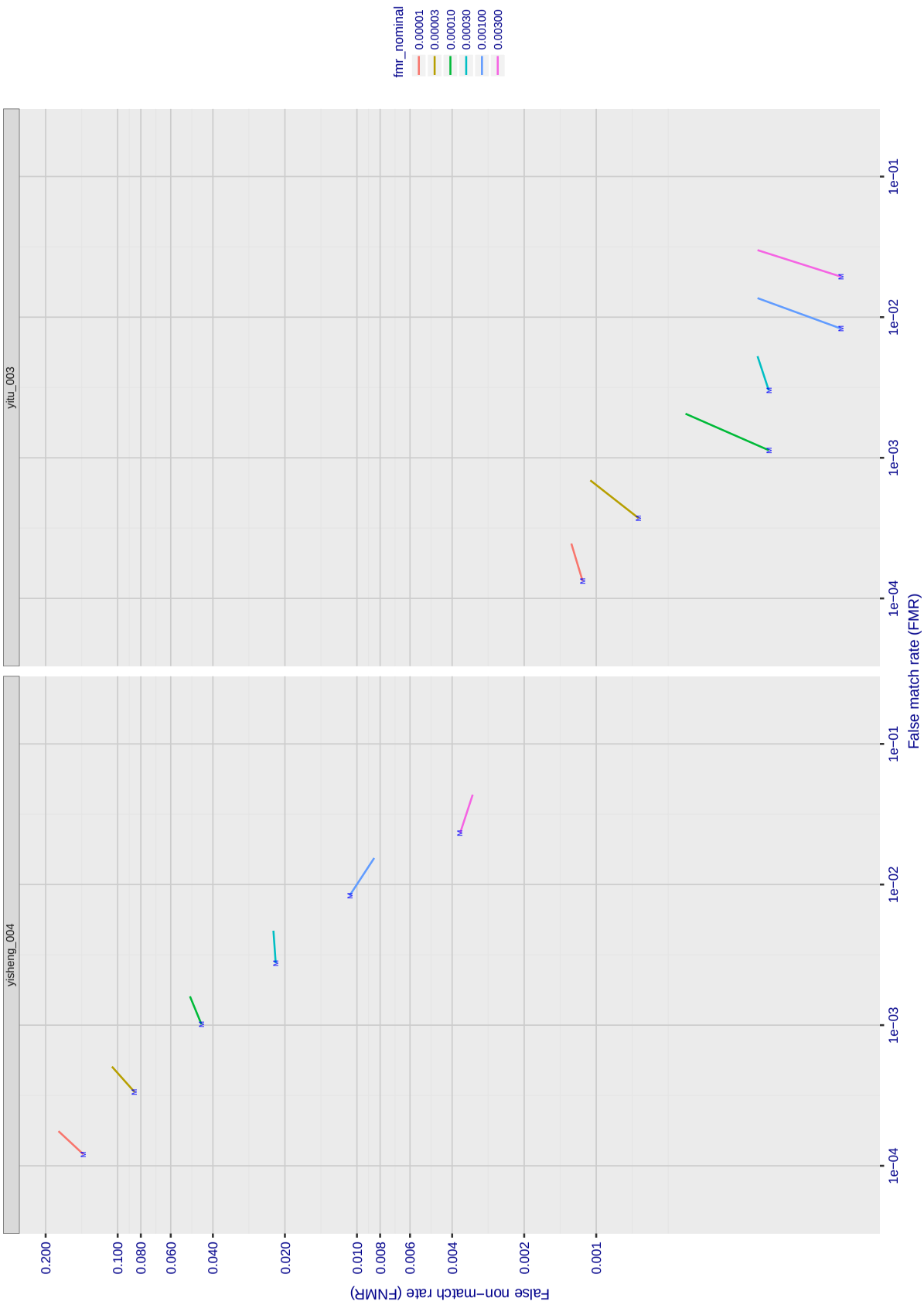

Figure 68: For the visa images, FNMR and FMR at six operating points along the DET characteristic. At each point a line is drawn between (FMR,FNMR)$_{\text{MALE}}$ and (FMR,FNMR)$_{\text{FEMALE}}$ showing how which sex has lower FMR and/or FNMR. The "M" label denotes male, the other end of the line corresponds to female. The six operating thresholds are selected to give the nominal false match rates given in the legend, and are computed over all impostor pairs regardless of age, sex, and place of birth. The plotted FMR values are broadly an order of magnitude larger than the nominal rates because FMR is computed over demographically-matched impostor pairs i.e individuals of the same sex, from the same geographic region (see section 3.6.1), and the same age group (see section 3.6.2).

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

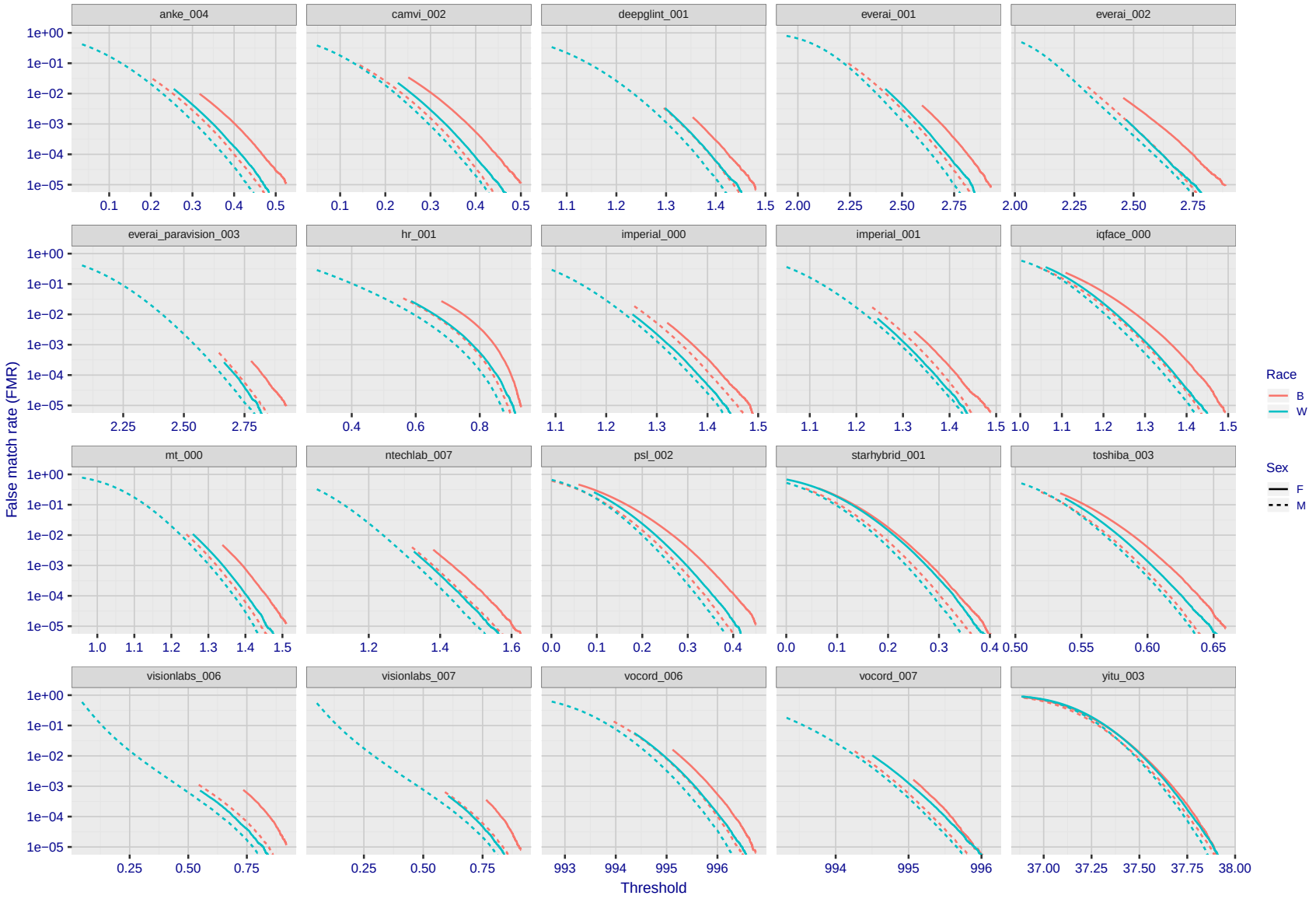

Figure 69: For the mugshot images, the false match calibration curves show false match rate vs. threshold. Separate curves appear for white females, black females, black males and white males.

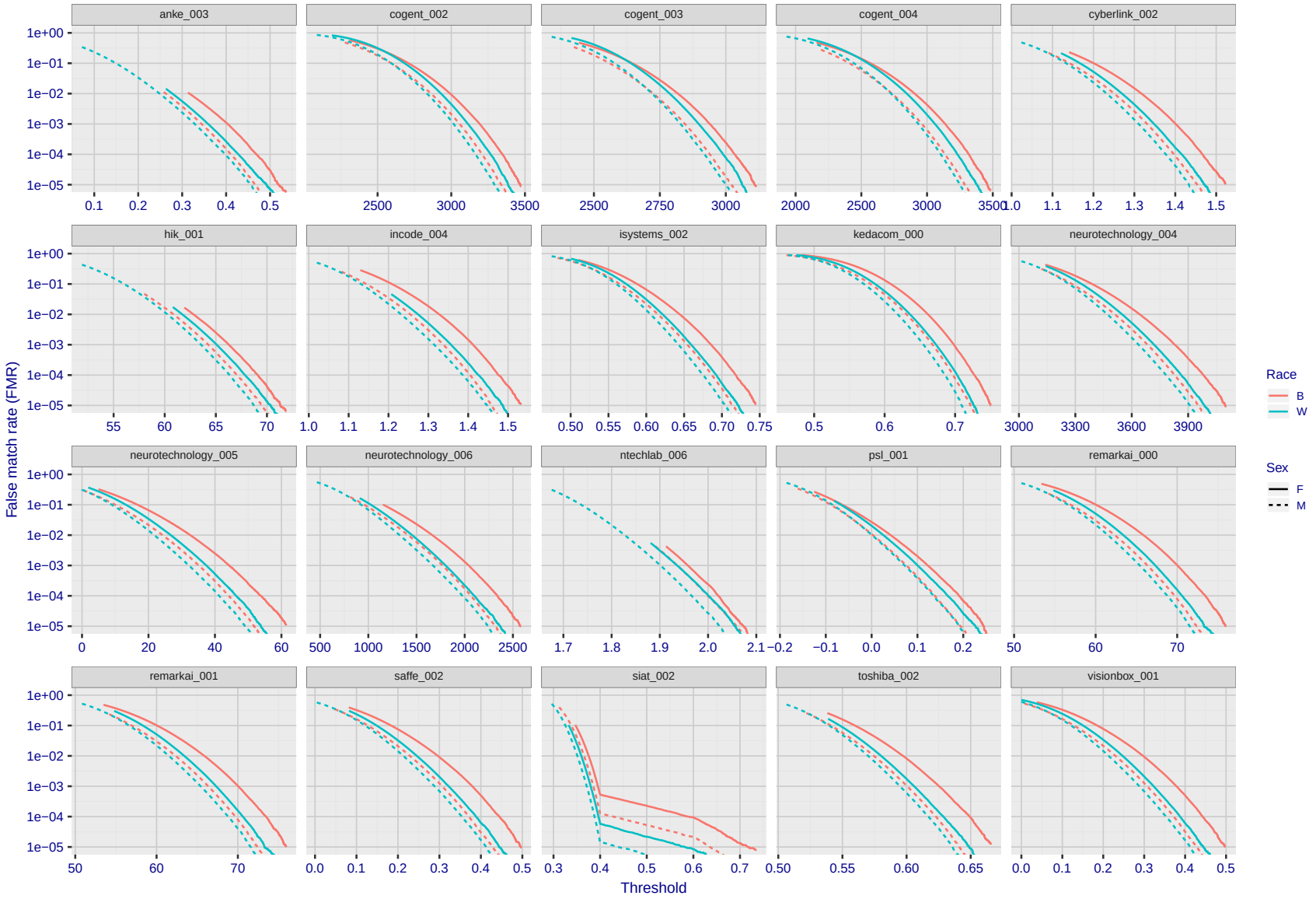

Figure 70: For the mugshot images, the false match calibration curves show false match rate vs. threshold. Separate curves appear for white females, black females, black males and white males.

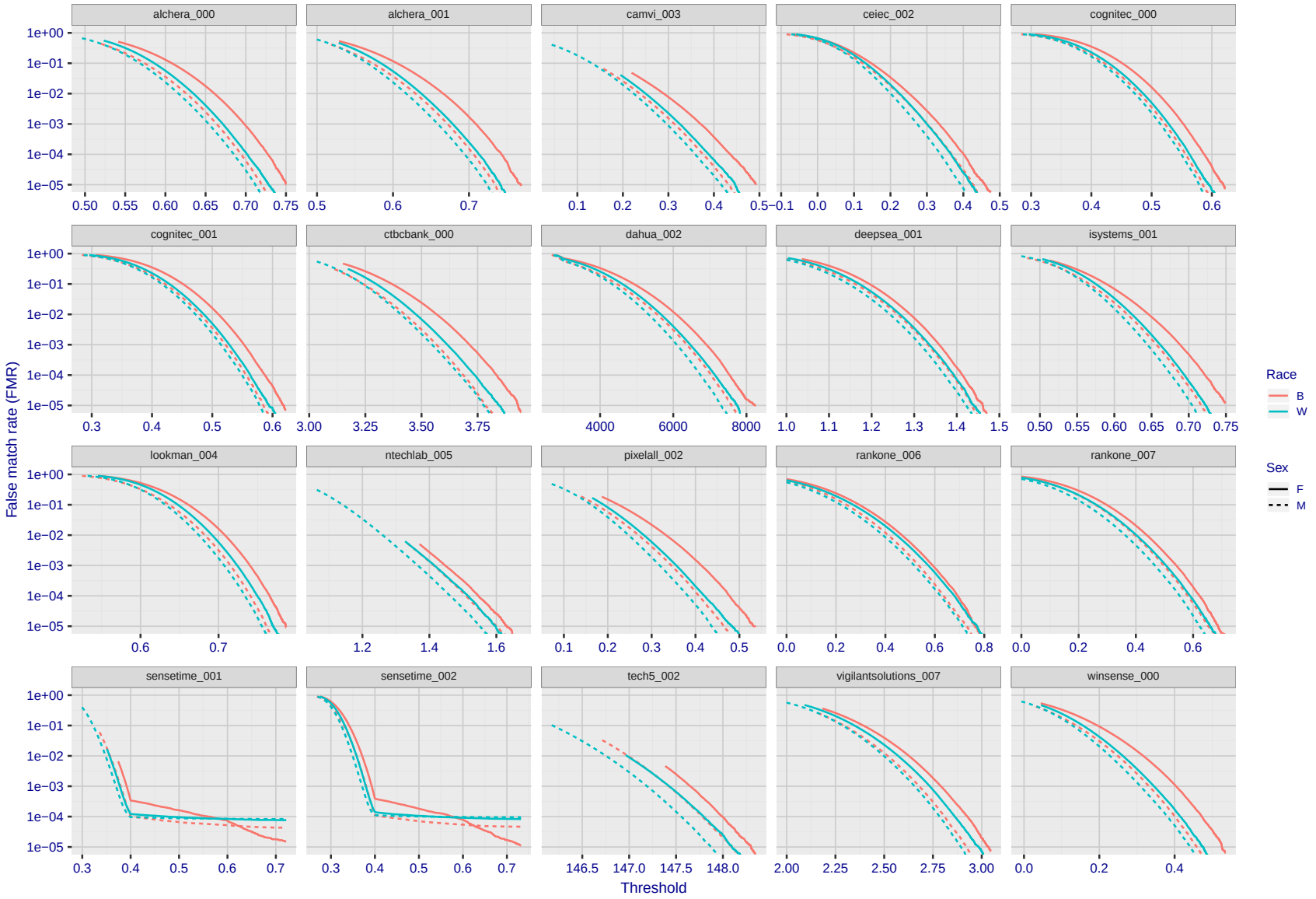

Figure 71: For the mugshot images, the false match calibration curves show false match rate vs. threshold. Separate curves appear for white females, black females, black males and white males.

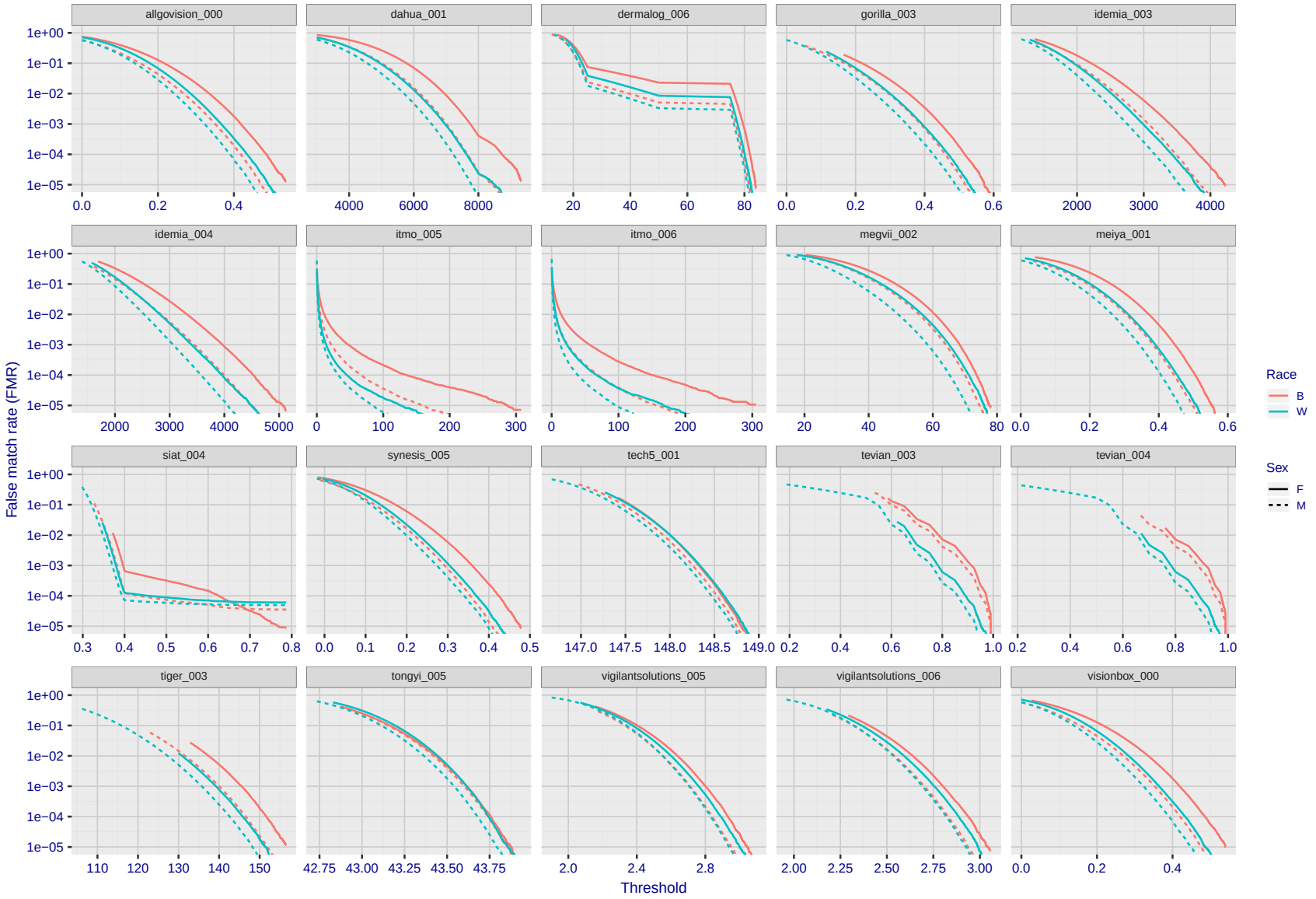

Figure 72: For the mugshot images, the false match calibration curves show false match rate vs. threshold. Separate curves appear for white females, black females, black males and white males.

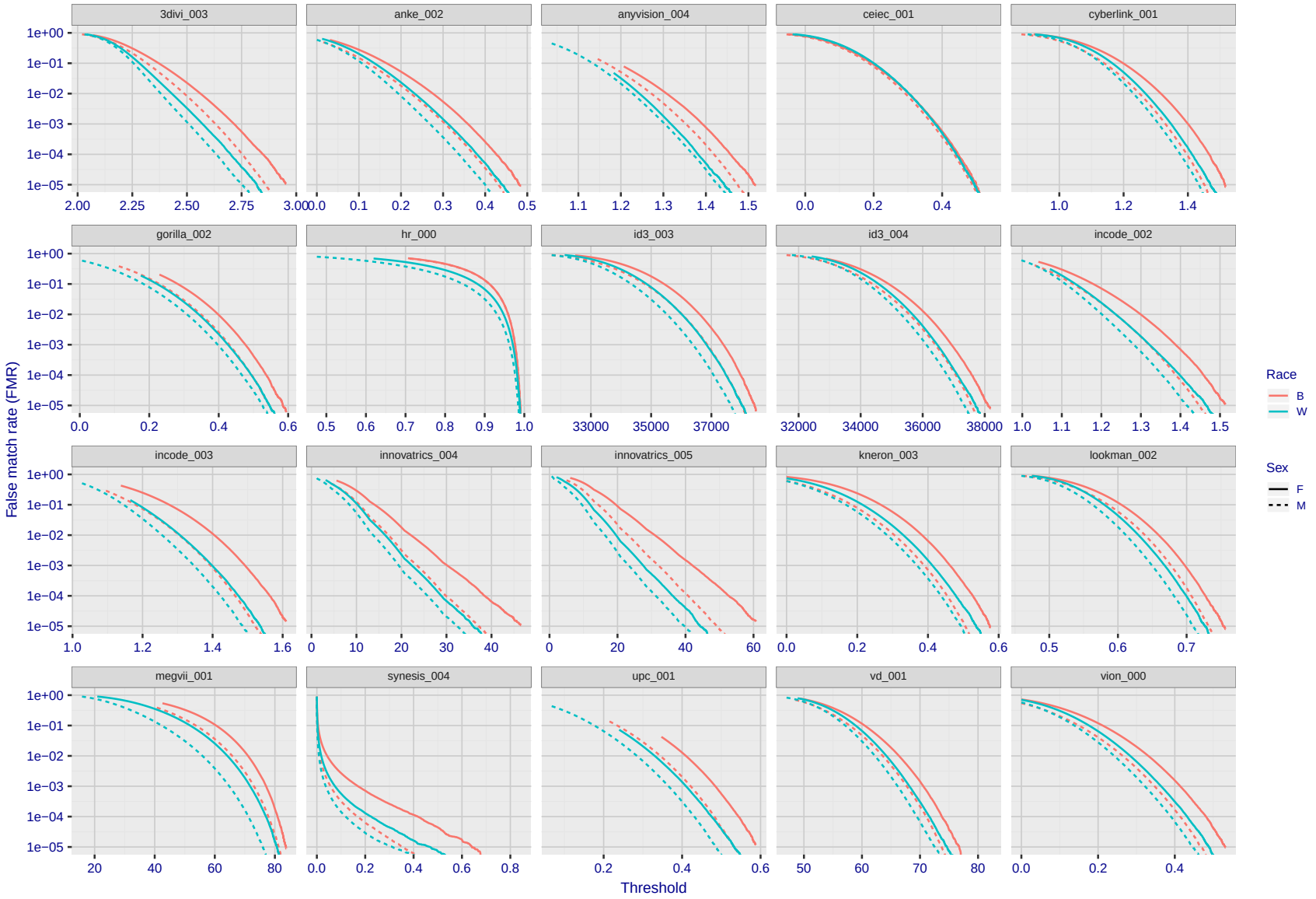

Figure 73: For the mugshot images, the false match calibration curves show false match rate vs. threshold. Separate curves appear for white females, black females, black males and white males.

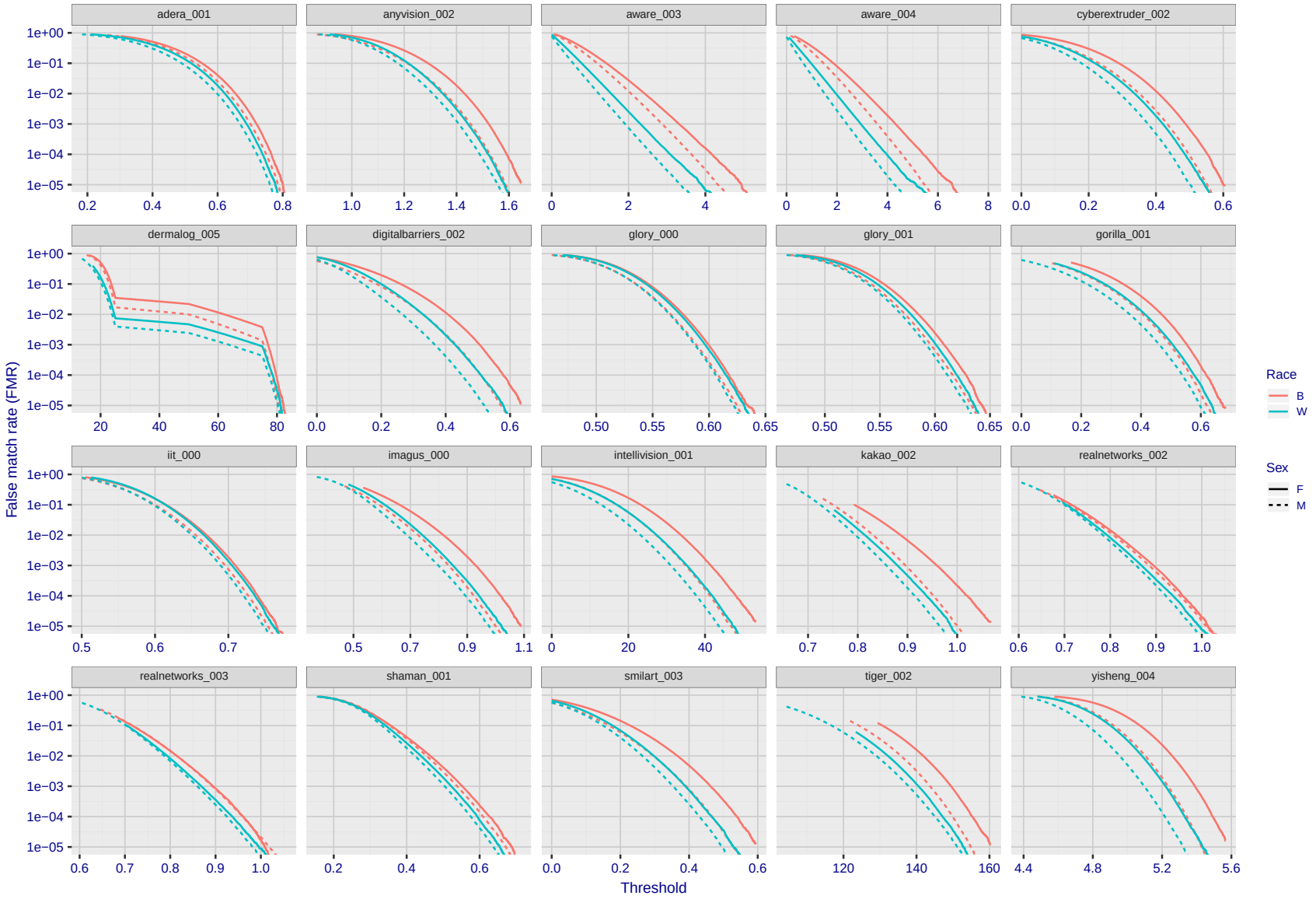

Figure 74: For the mugshot images, the false match calibration curves show false match rate vs. threshold. Separate curves appear for white females, black females, black males and white males.

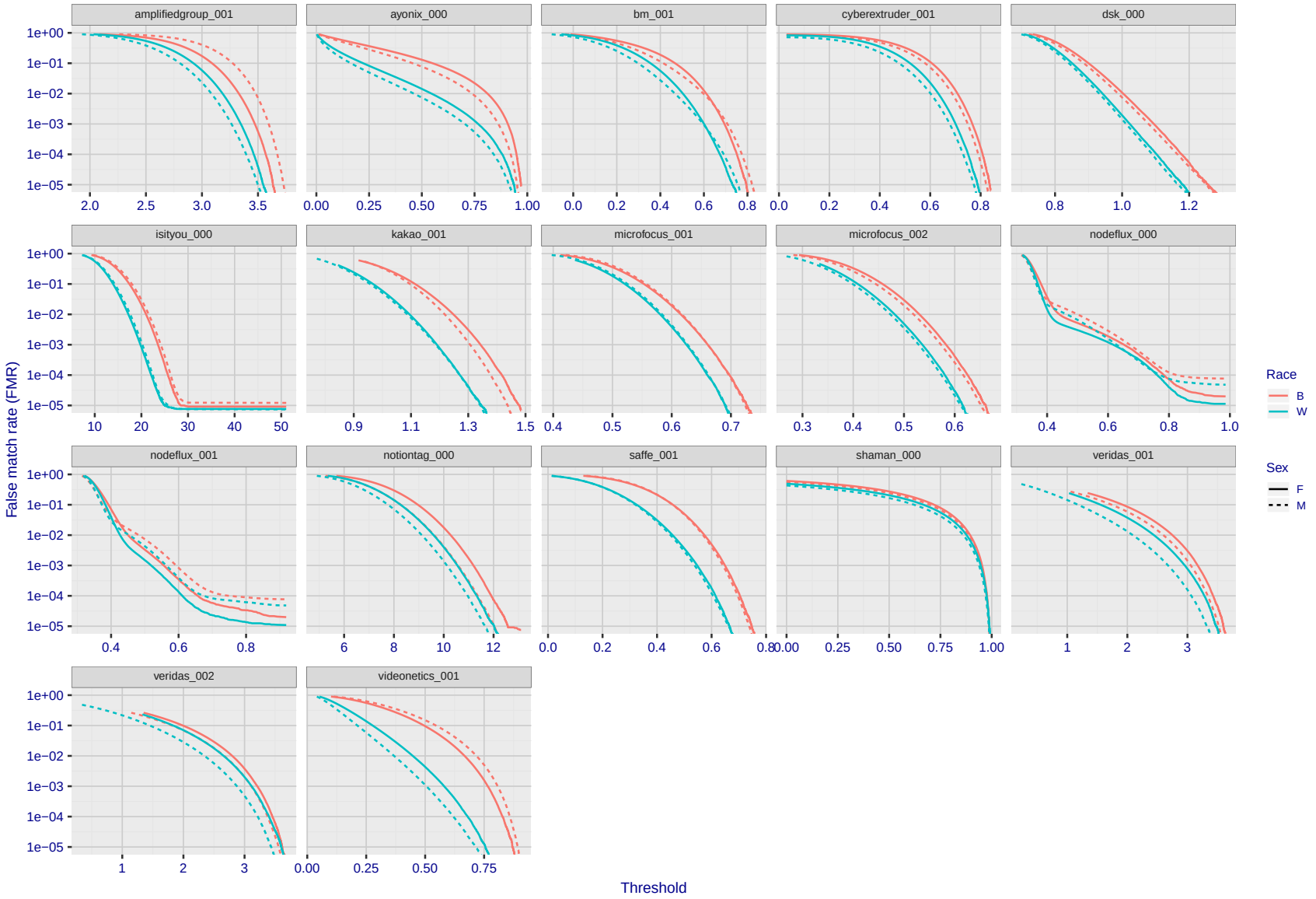

Figure 75: For the mugshot images, the false match calibration curves show false match rate vs. threshold. Separate curves appear for white females, black females, black males and white males.

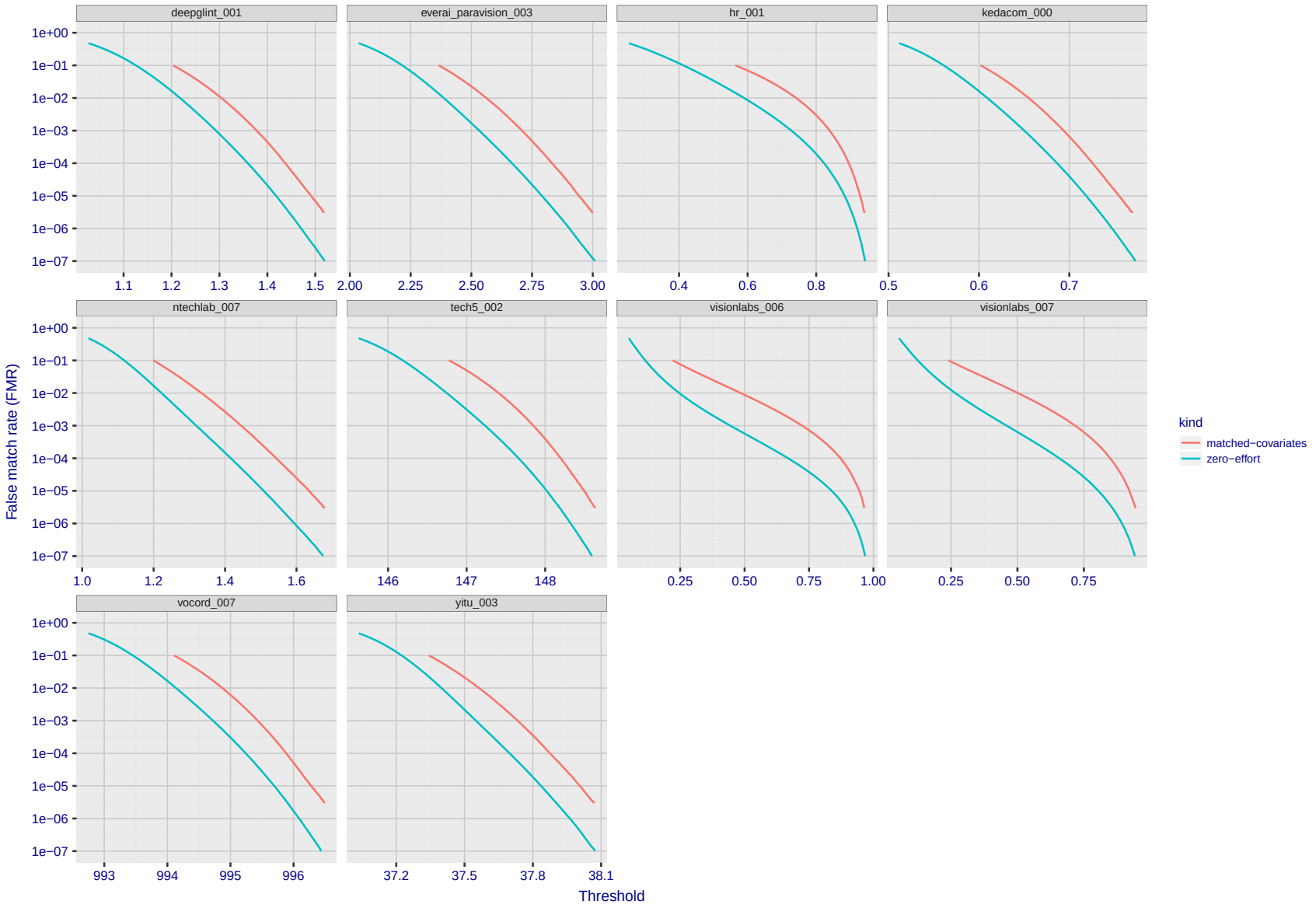

Figure 76: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

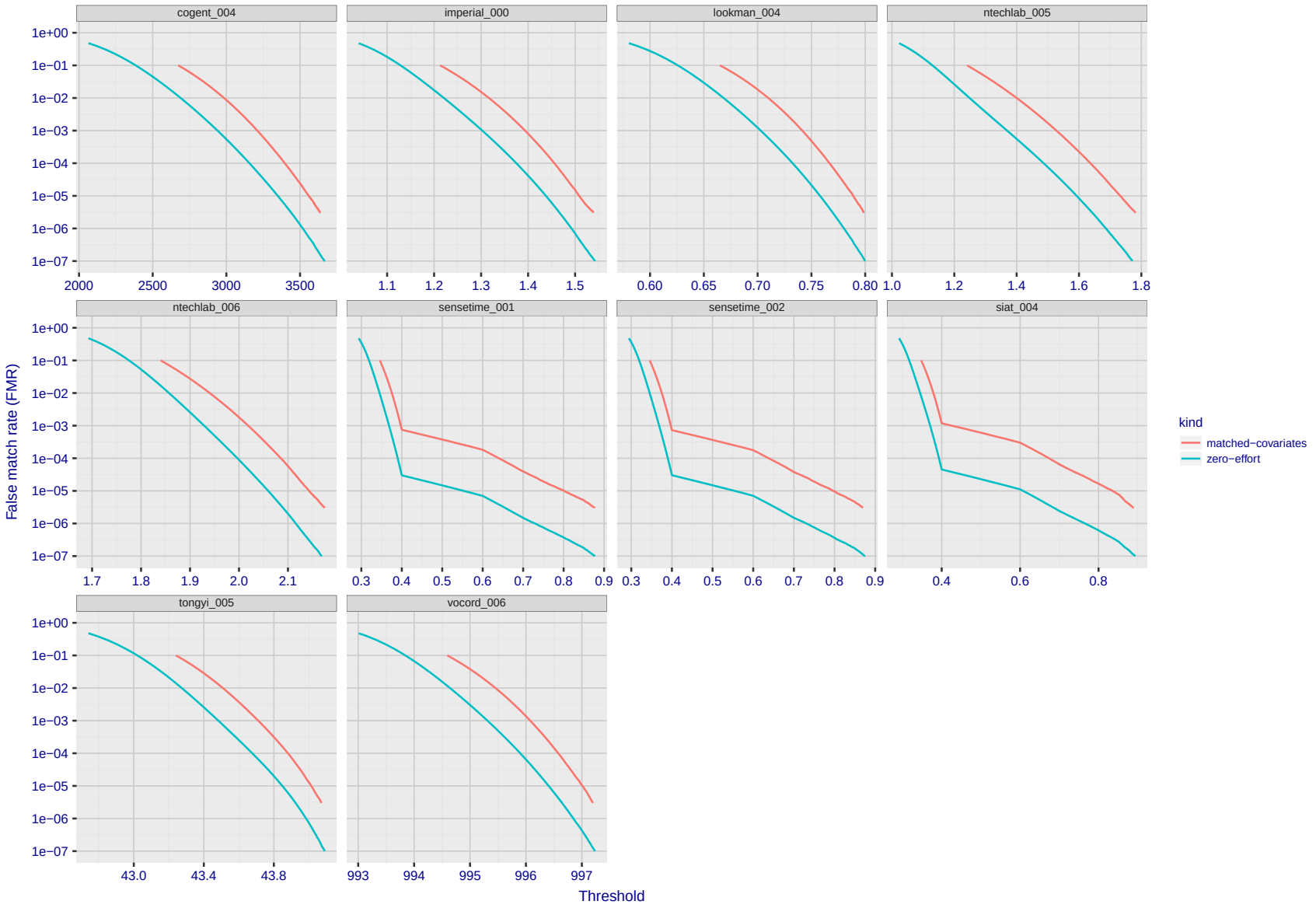

Figure 77: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

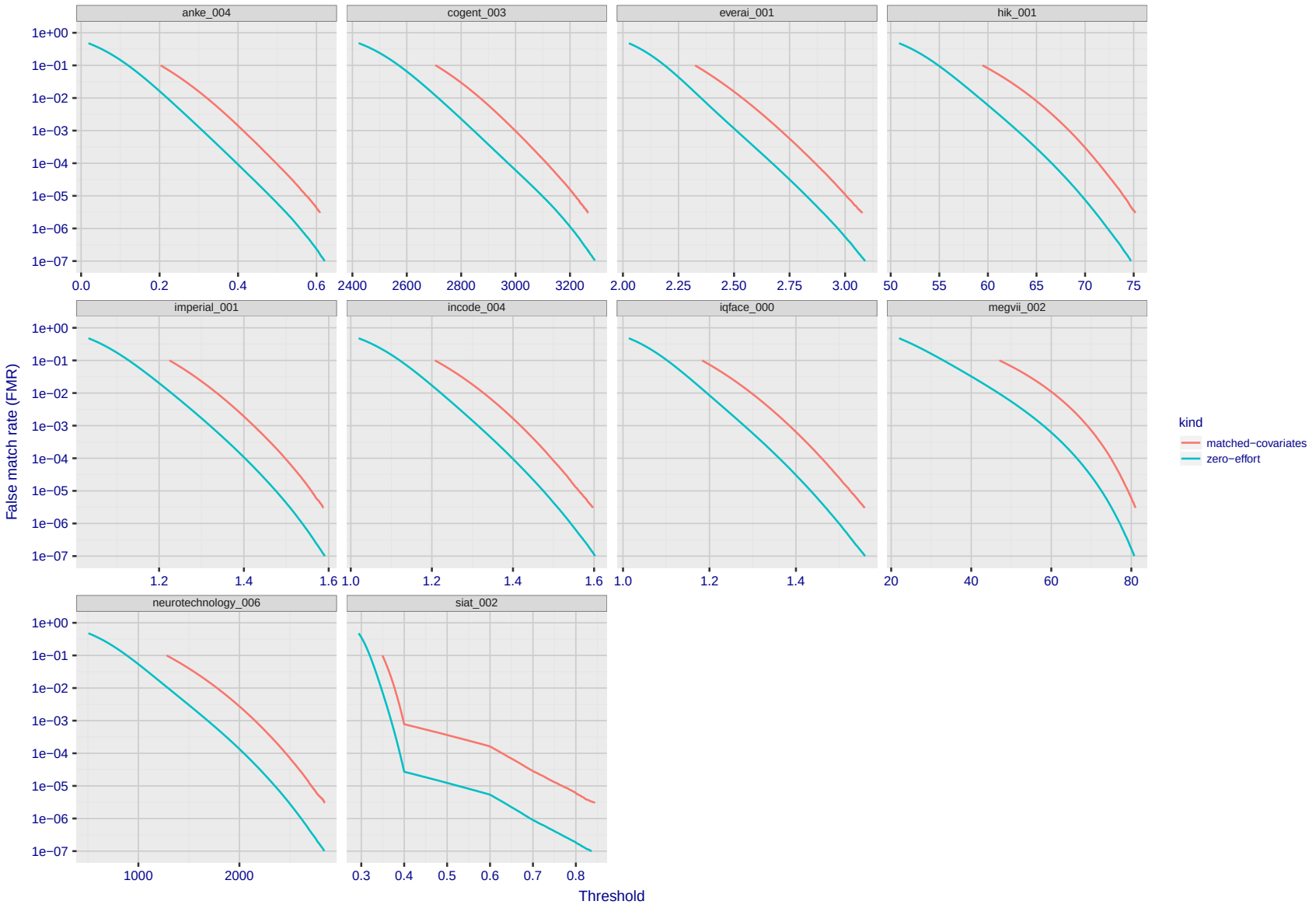

Figure 78: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

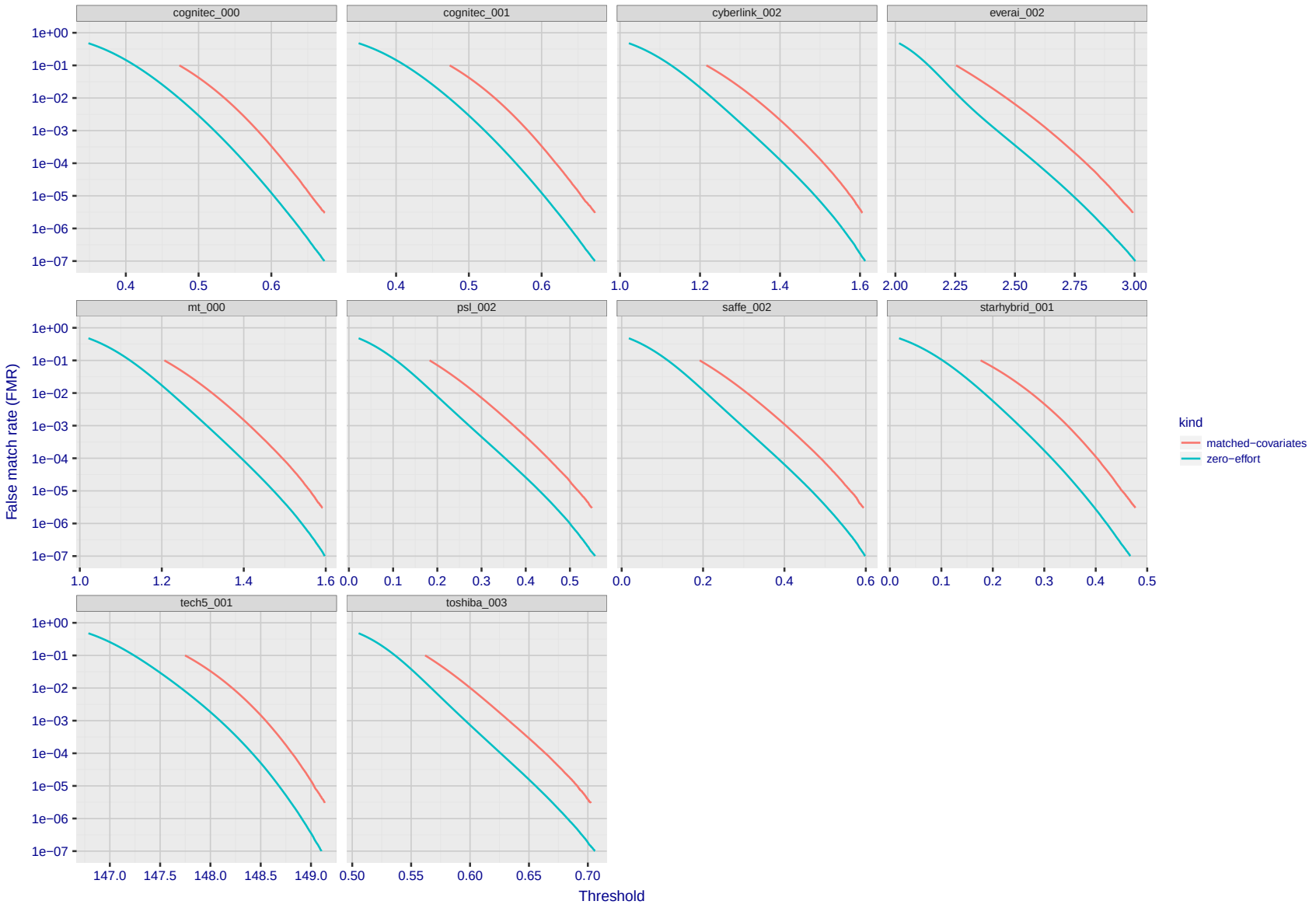

Figure 79: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

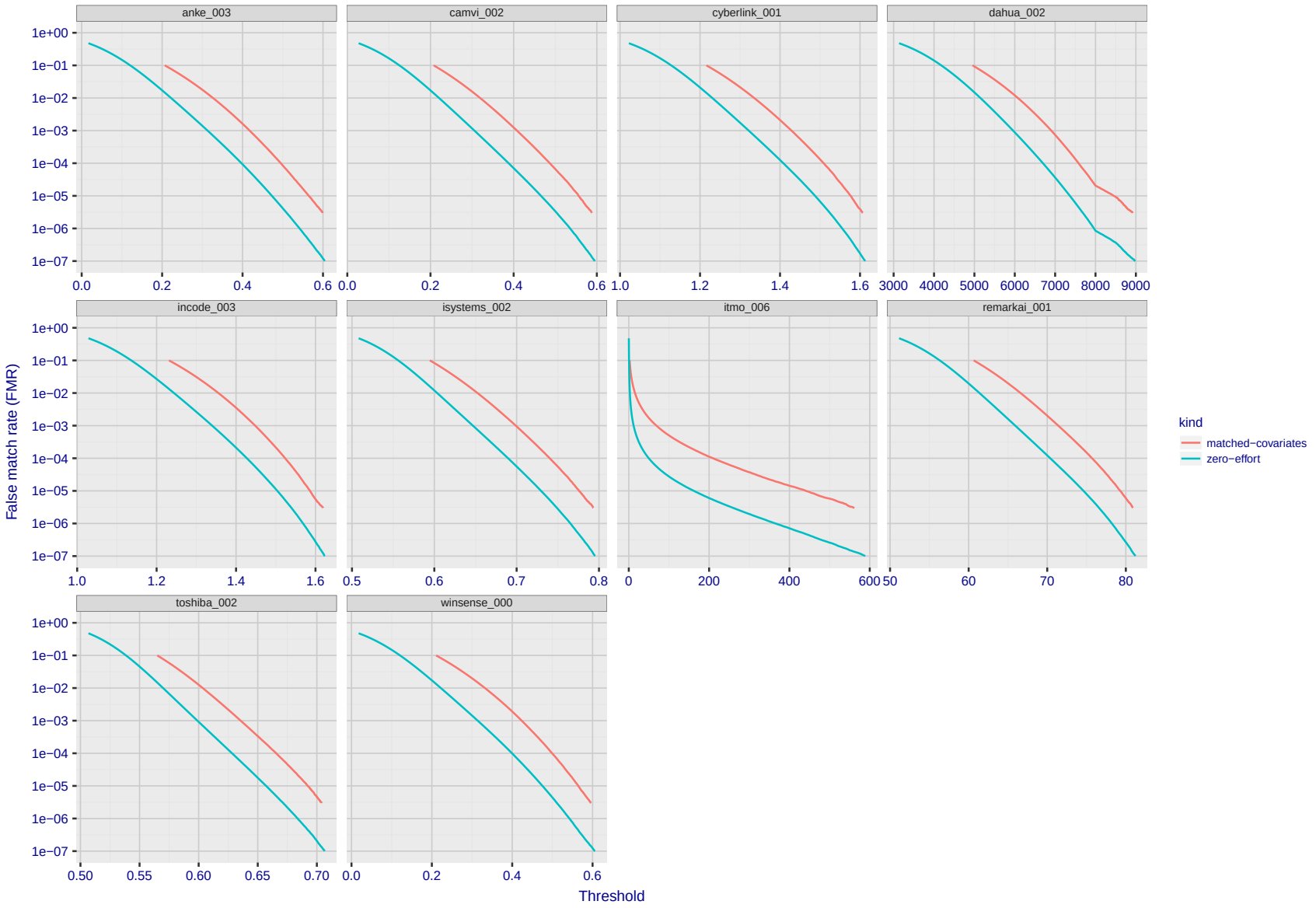

Figure 80: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

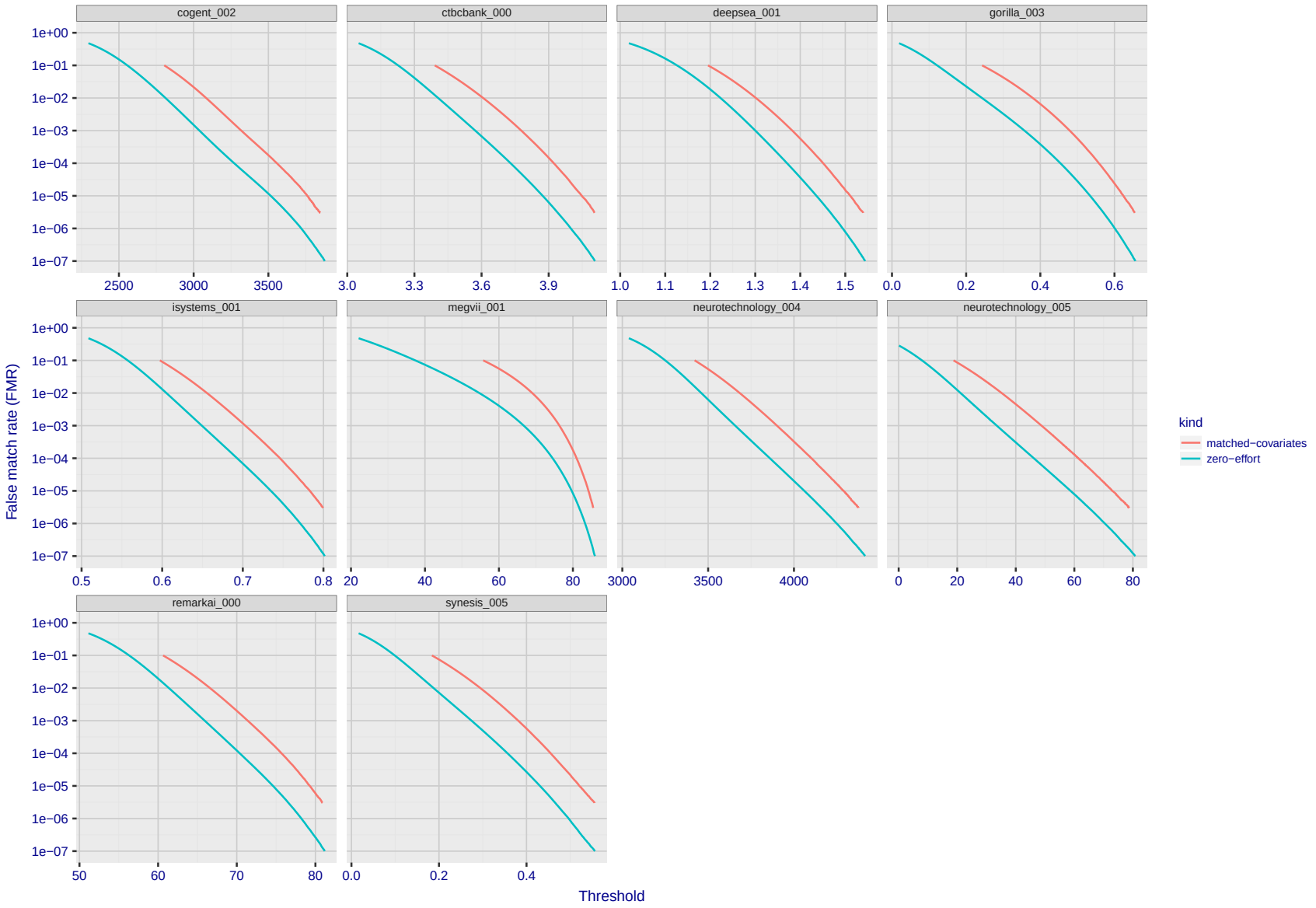

Figure 81: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

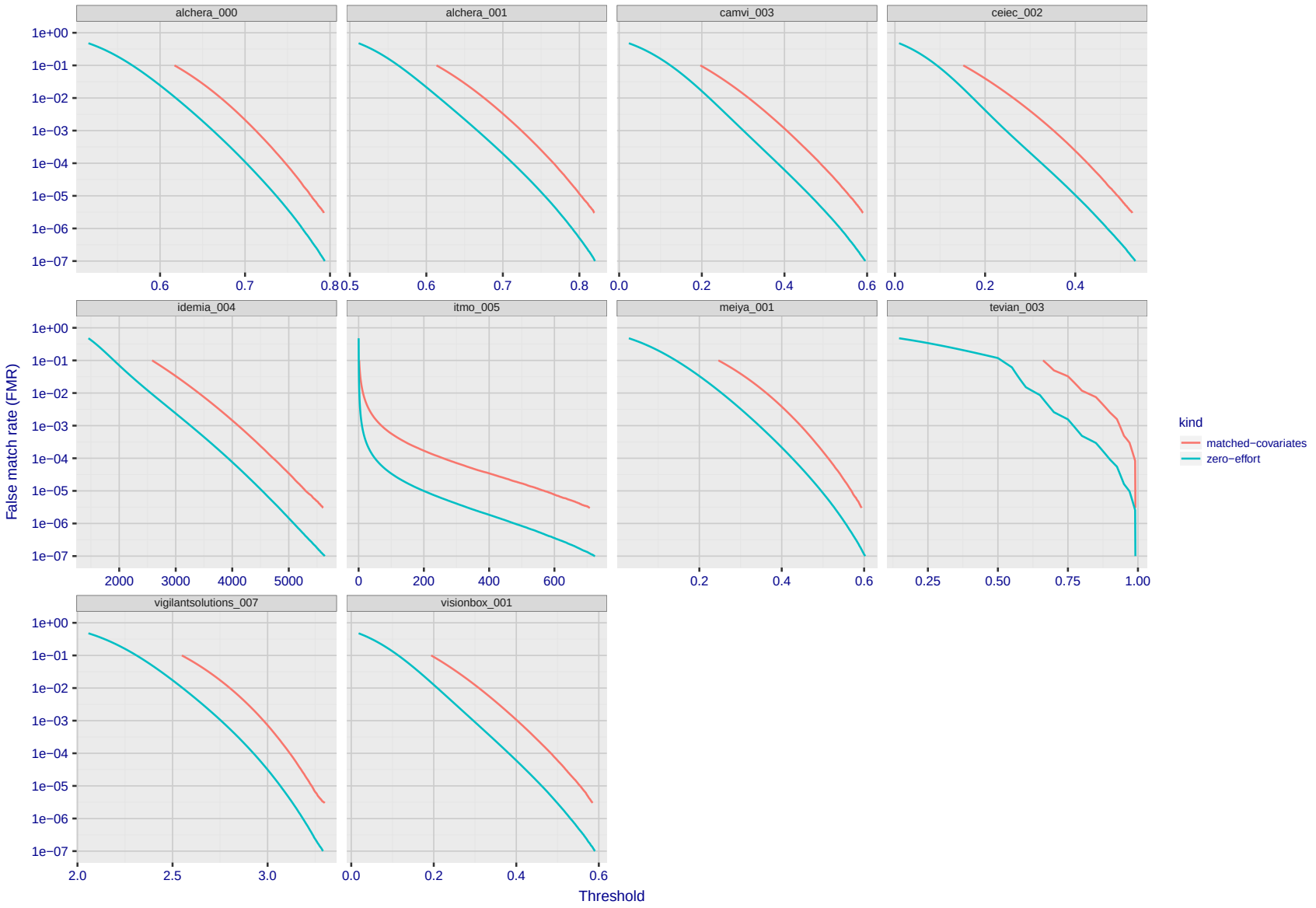

Figure 82: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

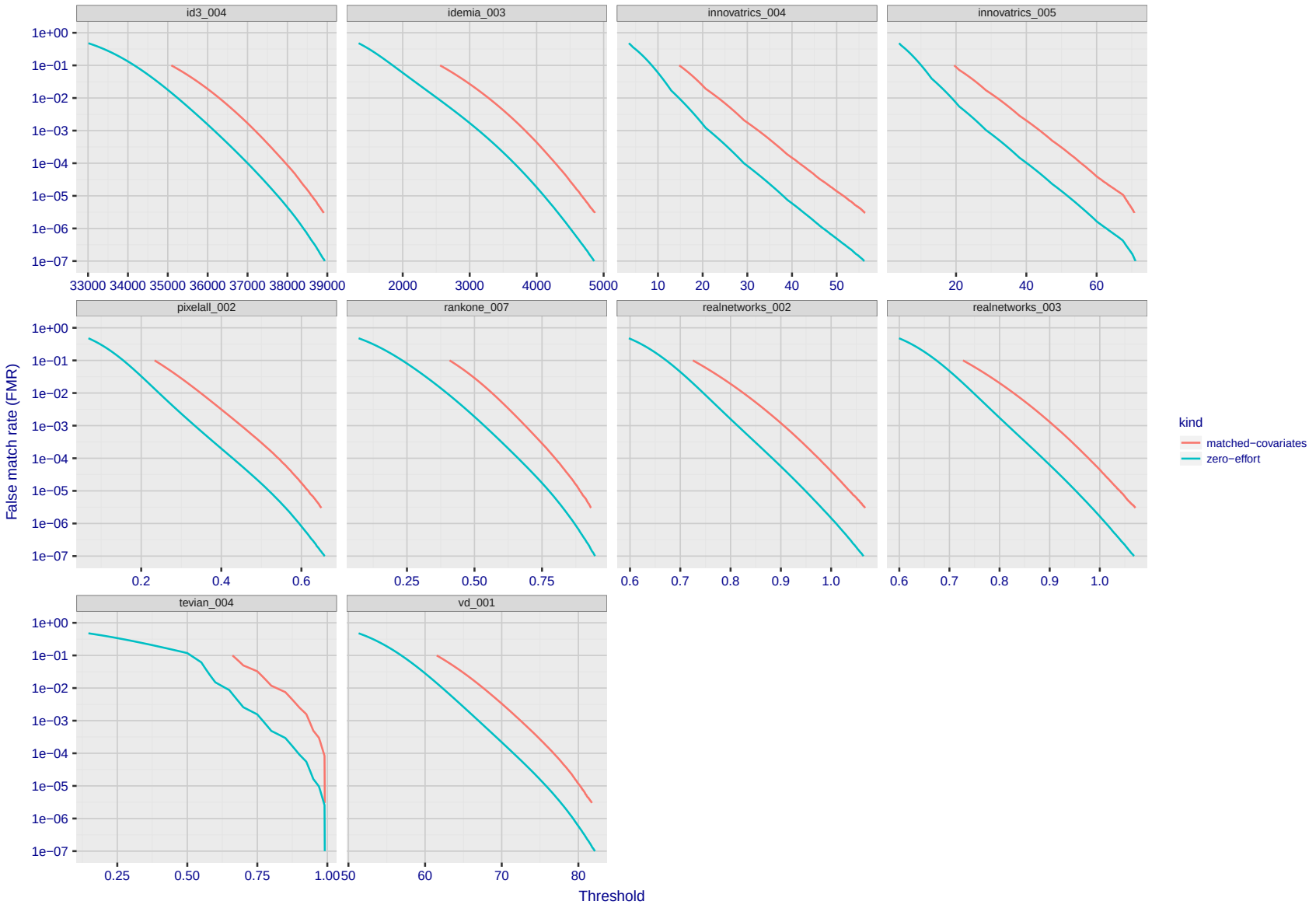

Figure 83: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

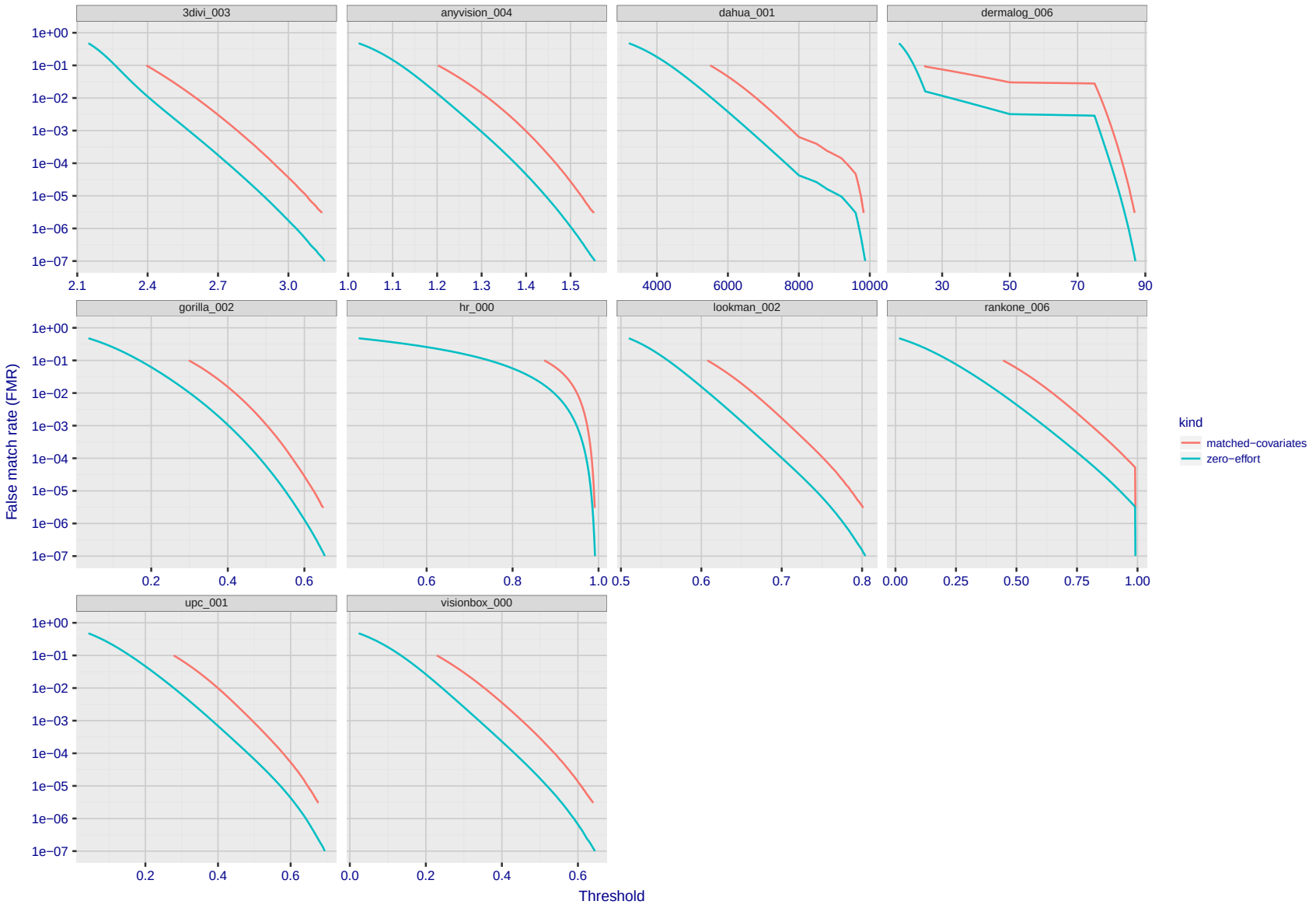

Figure 84: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

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FNMR(T) "False non-match rate"
FMR(T) "False match rate"

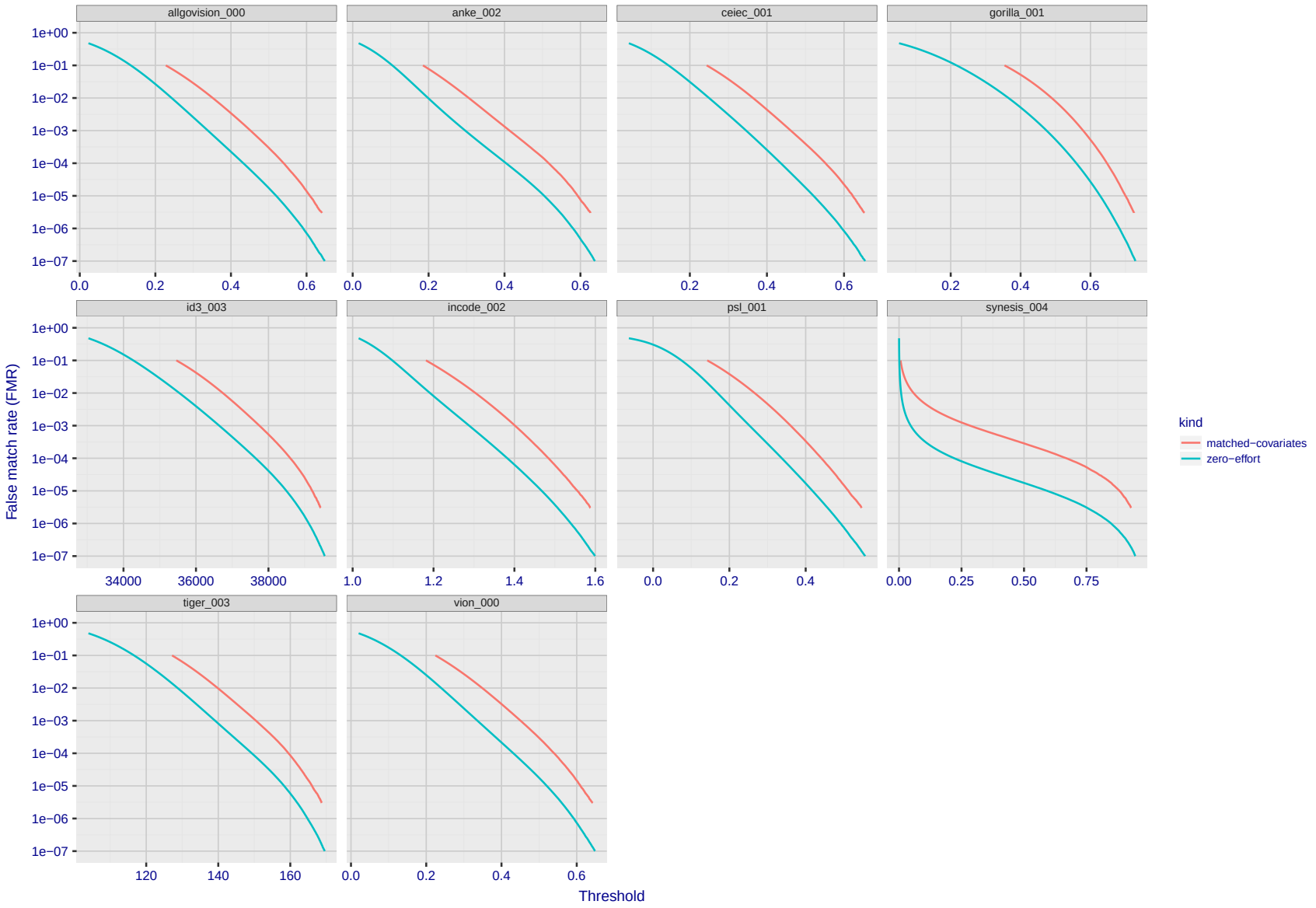

Figure 85: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

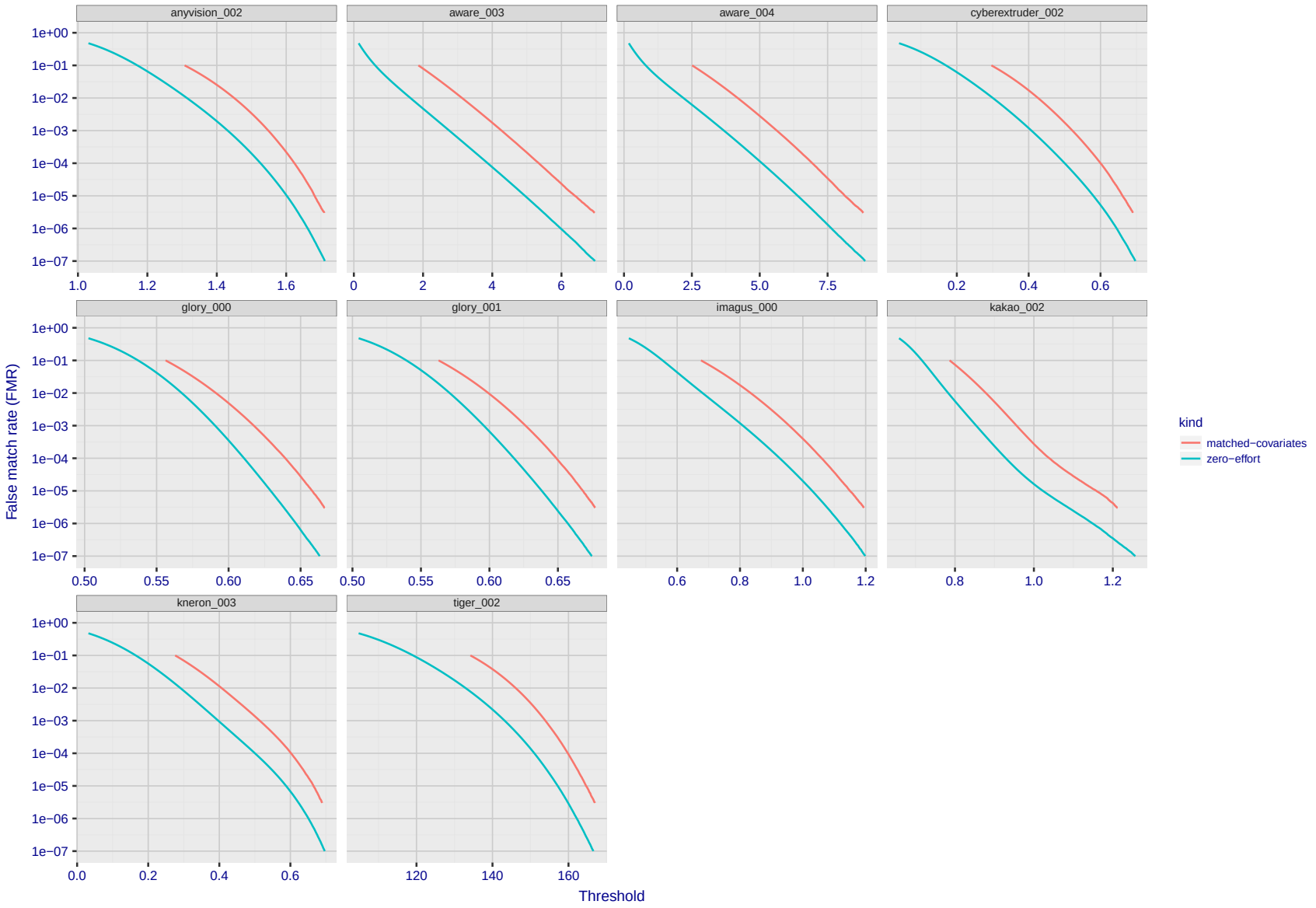

Figure 86: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

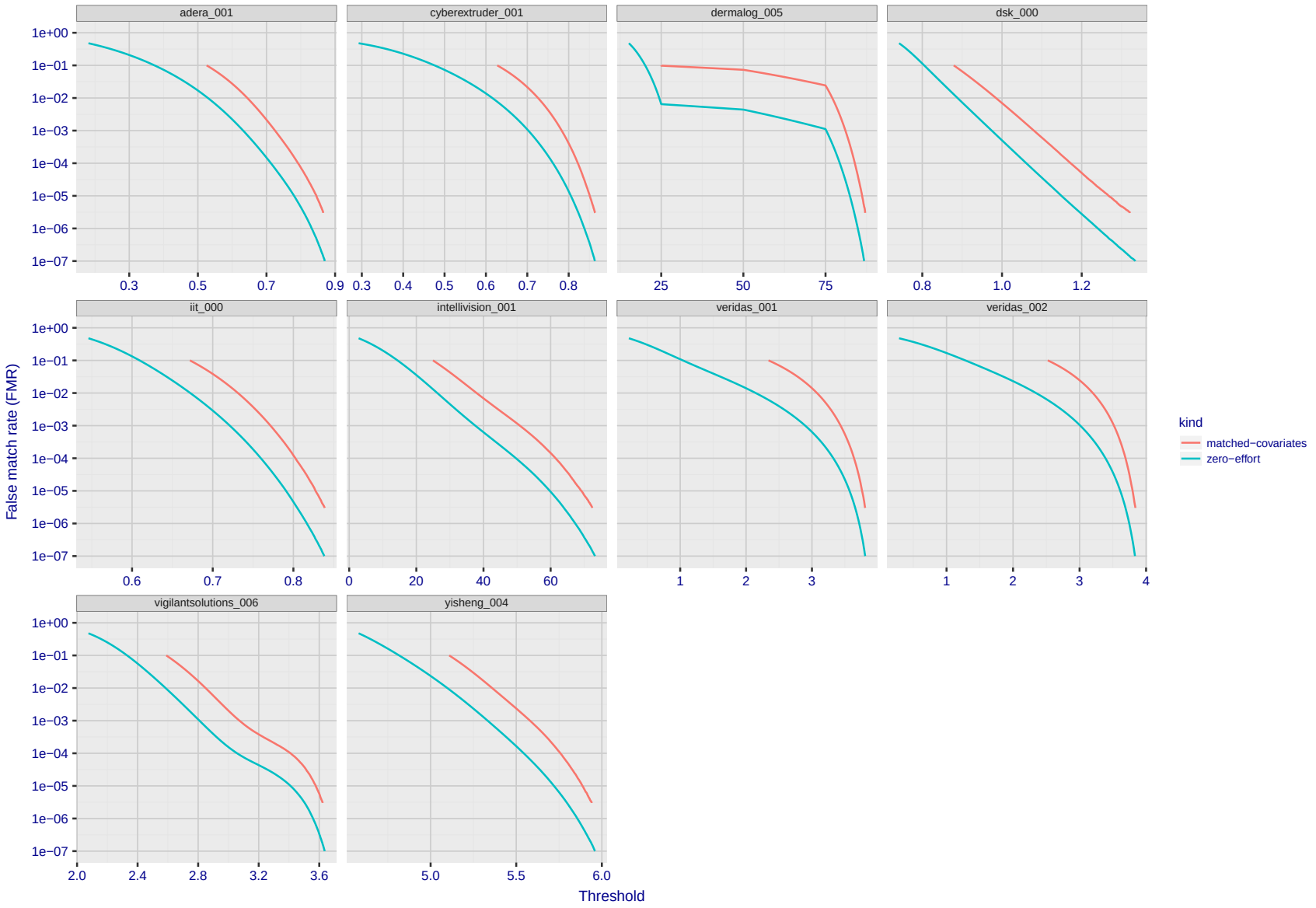

Figure 87: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

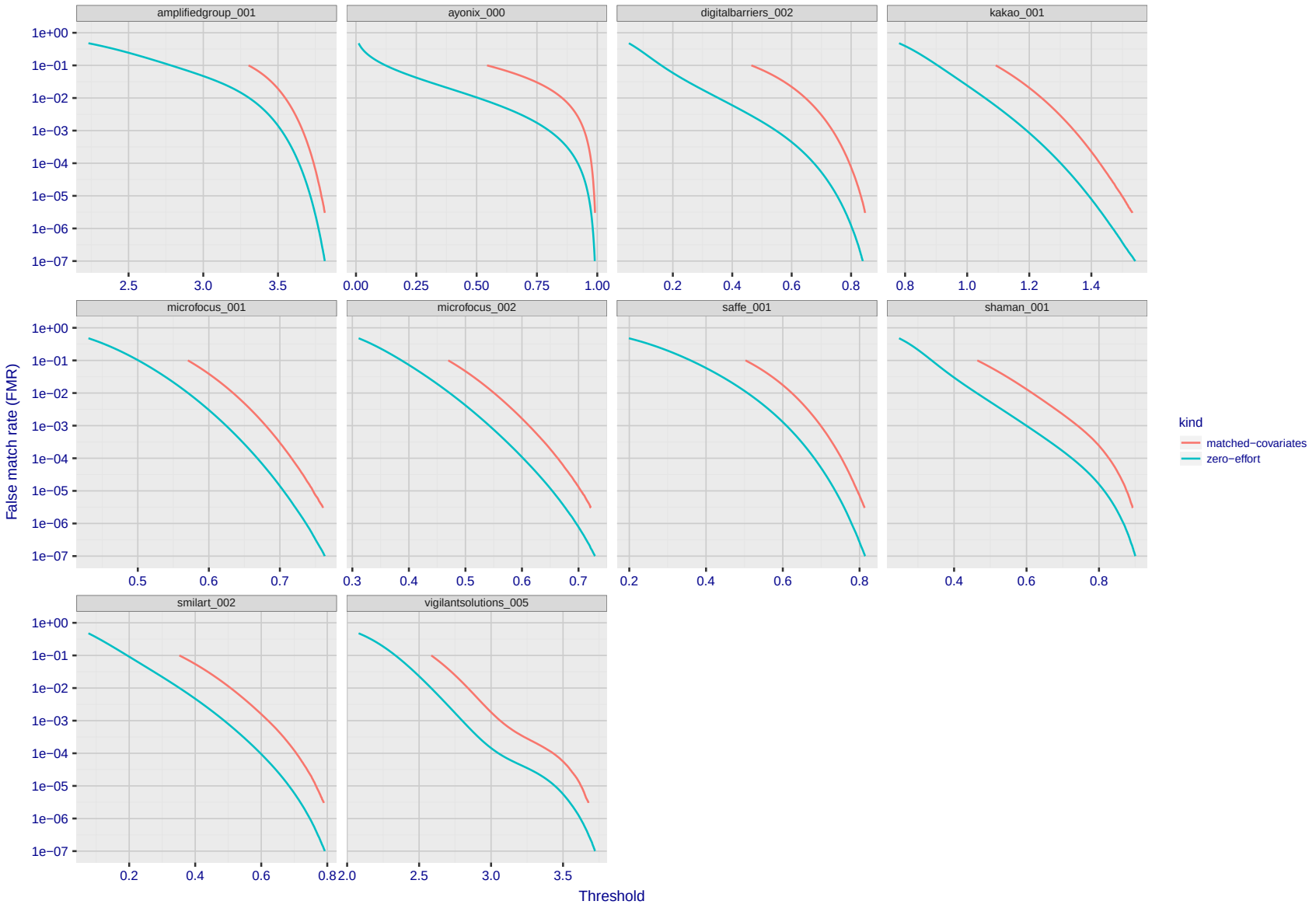

Figure 88: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

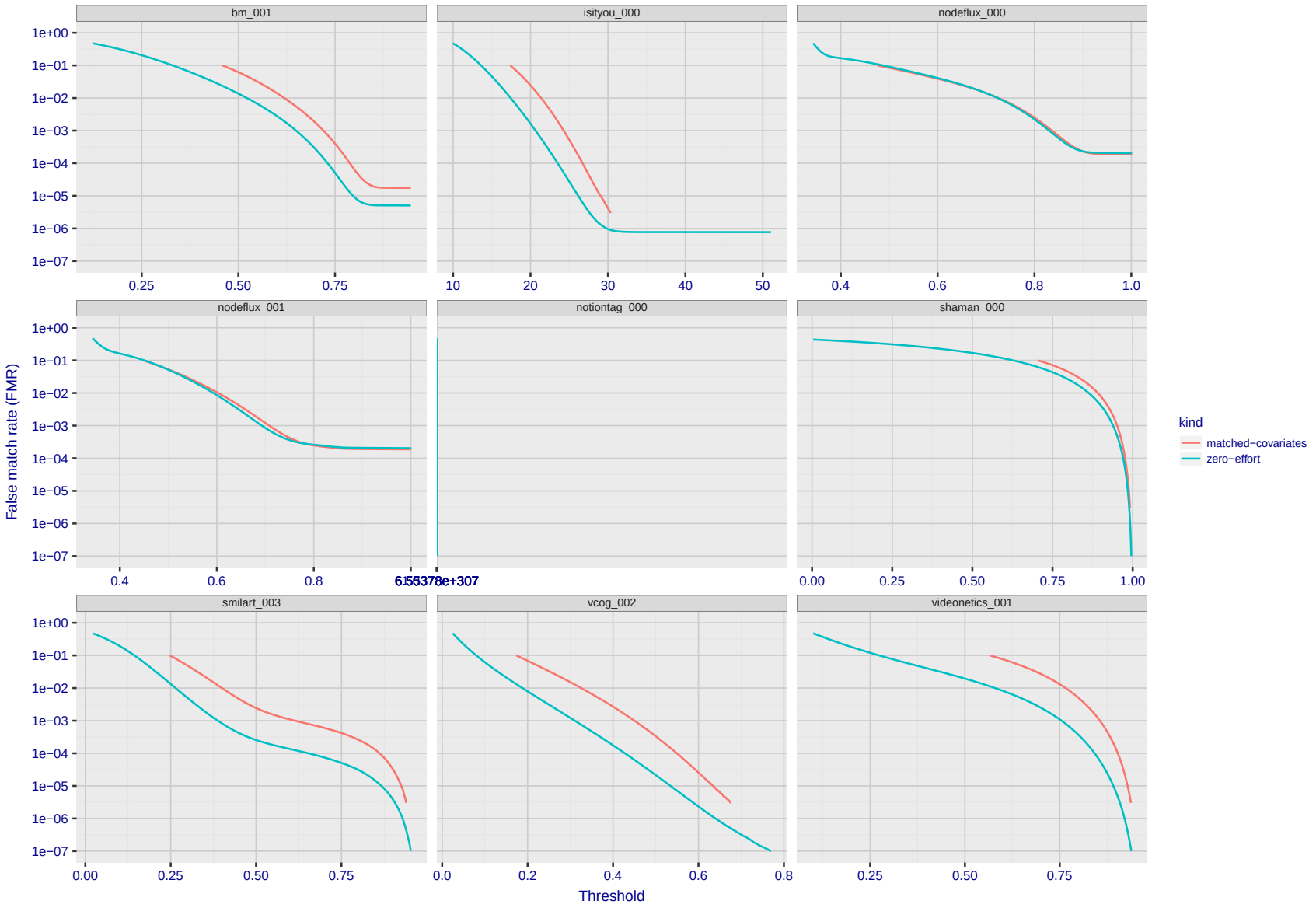

Figure 89: For the visa images, the false match calibration curves show FMR vs. threshold, T. The blue (lower) curves are for zero-effort impostors (i.e. comparing all images against all). The red (upper) curves are for persons of the same-sex, same-age, and same national-origin. This shows that FMR is underestimated (by a factor of 10 or more) by using a zero-effort impostor calculation to calibrate T. As shown later (sec. 3.6), FMR is higher for demographic-matched impostors.

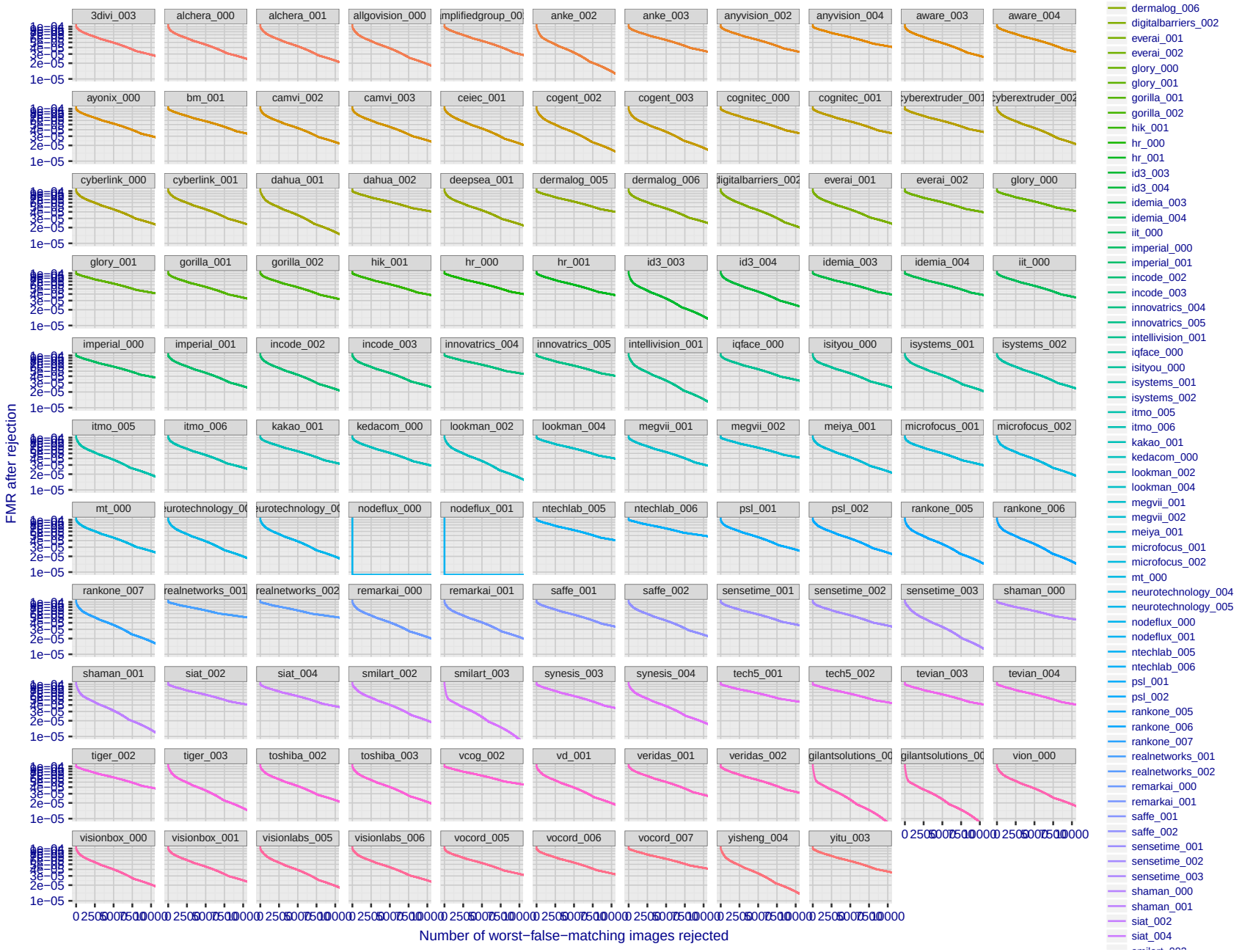

Figure 90: For the visa images, the curves show how false matches are concentrated in certain images. Specifically each line plots FMR(k) with k the number of images rejected in decreasing order of how many false matches that image was involved in. FMR$(0) = 10^{-4}$. In terms of the biometric zoo, the most "wolf-ish" images are rejected first i.e. those enrollment or verification images most often involved in false matches. A flatter response is considered superior. A steeply descending response indicates that certain kinds of images false match against others, e.g. if hypothetically images of men with particular mustaches would falsely match others.

3.5 Genuine distribution stability

3.5.1 Effect of birth place on the genuine distribution

Background: Both skin tone and bone structure vary geographically. Prior studies have reported variations in FNMR and FMR.

Goal: To measure false non-match rate (FNMR) variation with country of birth.

Methods: Thresholds are determined that give FMR = $\{0.001, 0.0001\}$ over the entire impostor set. Then FNMR is measured over 1000 bootstrap replications of the genuine scores. Only those countries with at least 140 individuals are included in the analysis.

Results: Figure 101 shows FNMR by country of birth for the two thresholds.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

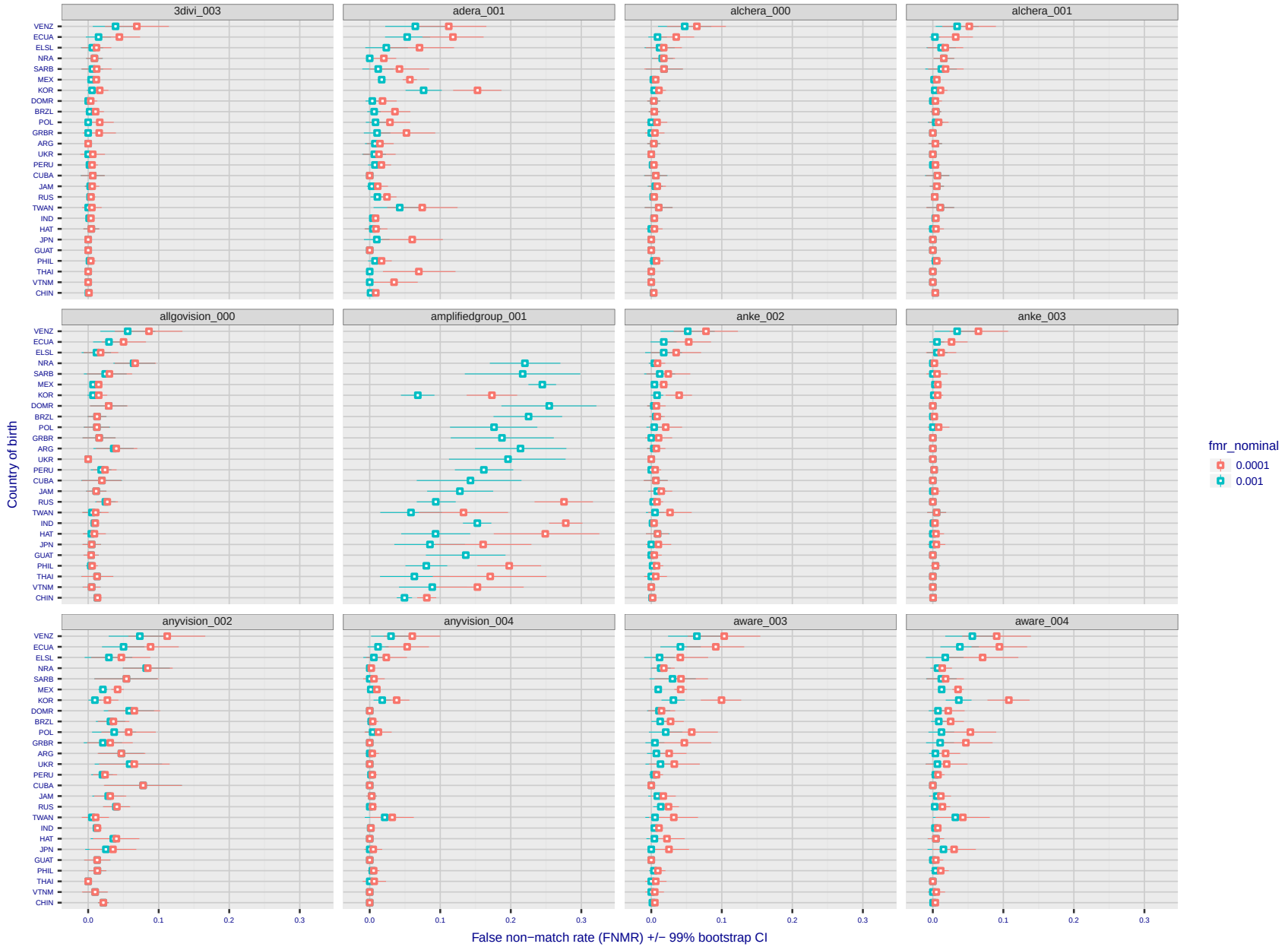

Figure 91: For the visa images, the dots show FNMR by country of birth for two globally set operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.1. The figures shows an order of magnitude variation in FNMR across country of birth; these effects are likely due quality variations, then demographics like age and race. The error rates in some cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

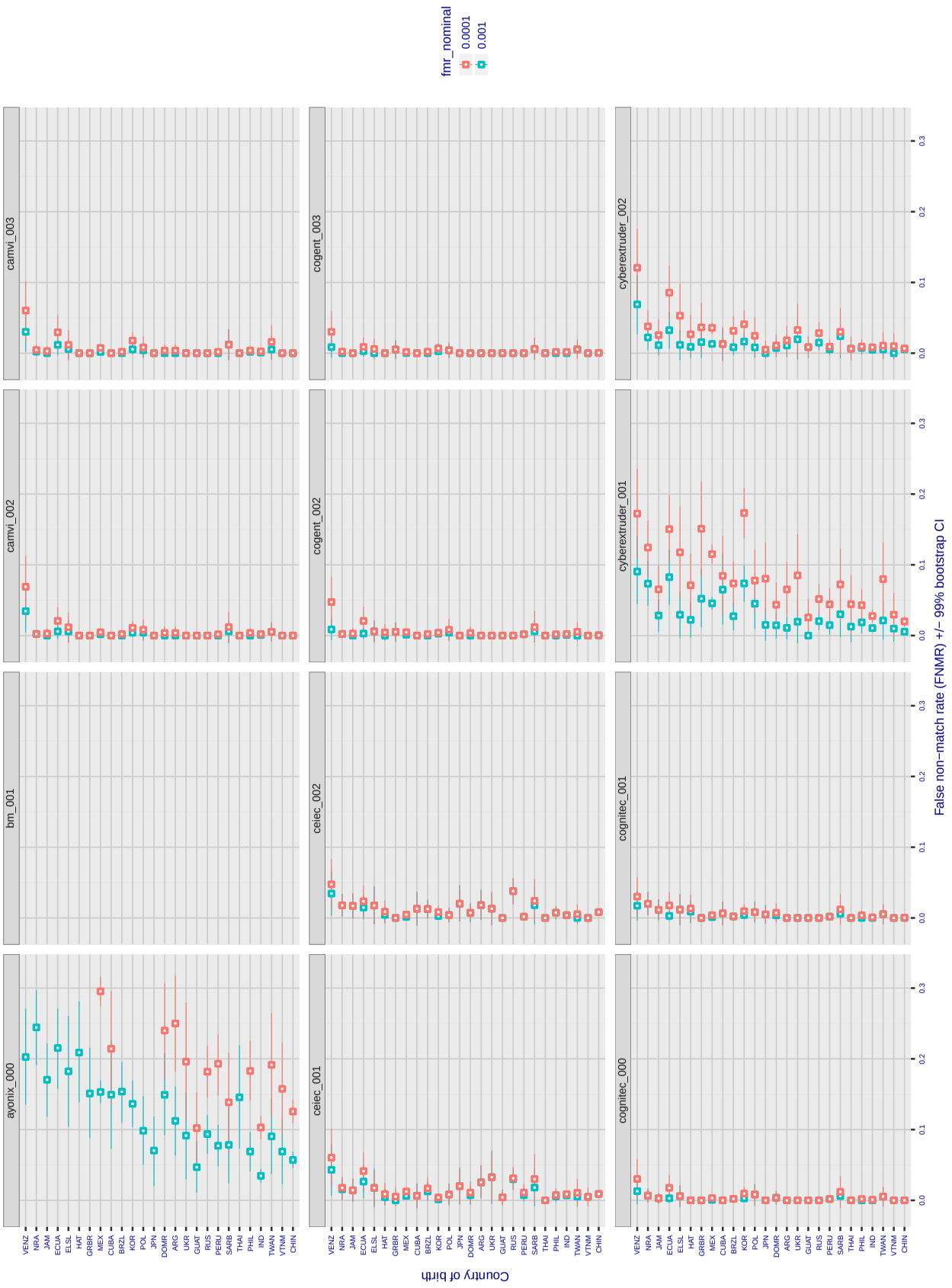

Figure 92: For the visa images, the dots show FNMR by country of birth for two globally set operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.1. The figures shows an order of magnitude variation in FNMR across country of birth; these effects are likely due quality variations, then demographics like age and race. The error rates in some cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

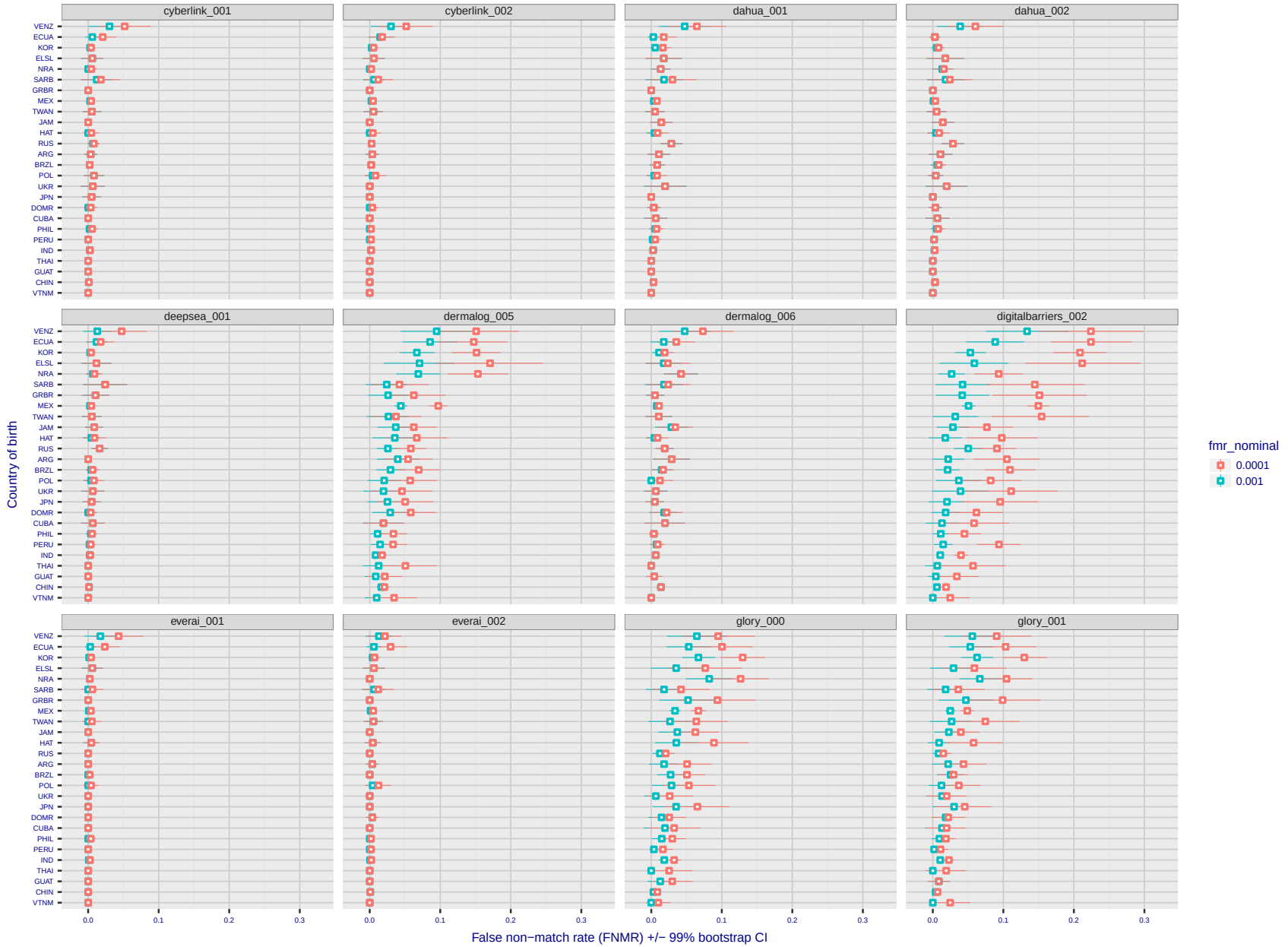

Figure 93: For the visa images, the dots show FNMR by country of birth for two globally set operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.1. The figures shows an order of magnitude variation in FNMR across country of birth; these effects are likely due quality variations, then demographics like age and race. The error rates in some cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

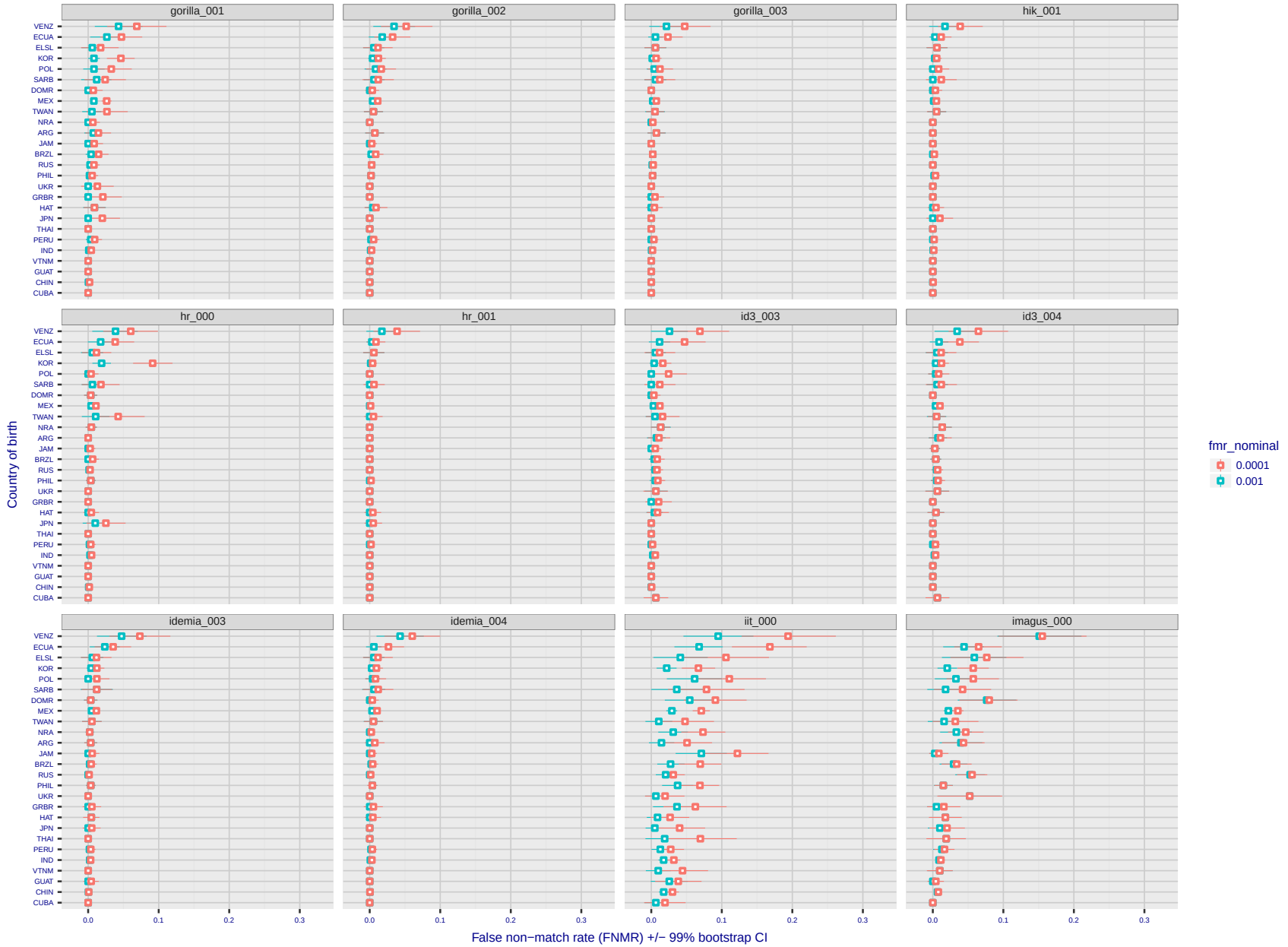

Figure 94: For the visa images, the dots show FNMR by country of birth for two globally set operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.1. The figures shows an order of magnitude variation in FNMR across country of birth; these effects are likely due quality variations, then demographics like age and race. The error rates in some cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

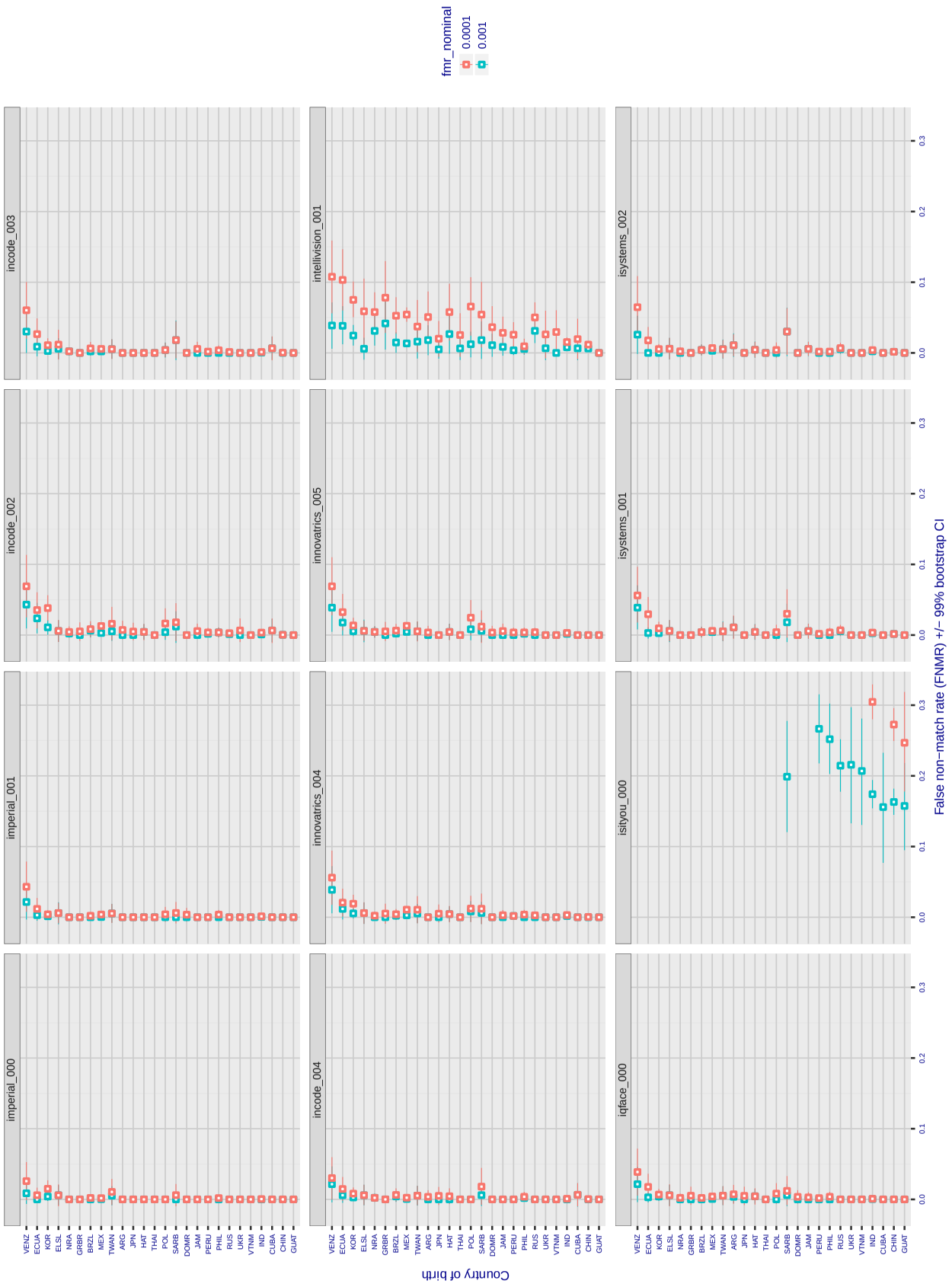

Figure 95: For the visa images, the dots show FNMR by country of birth for two globally set operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.1. The figures shows an order of magnitude variation in FNMR across country of birth; these effects are likely due quality variations, then demographics like age and race. The error rates in some cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

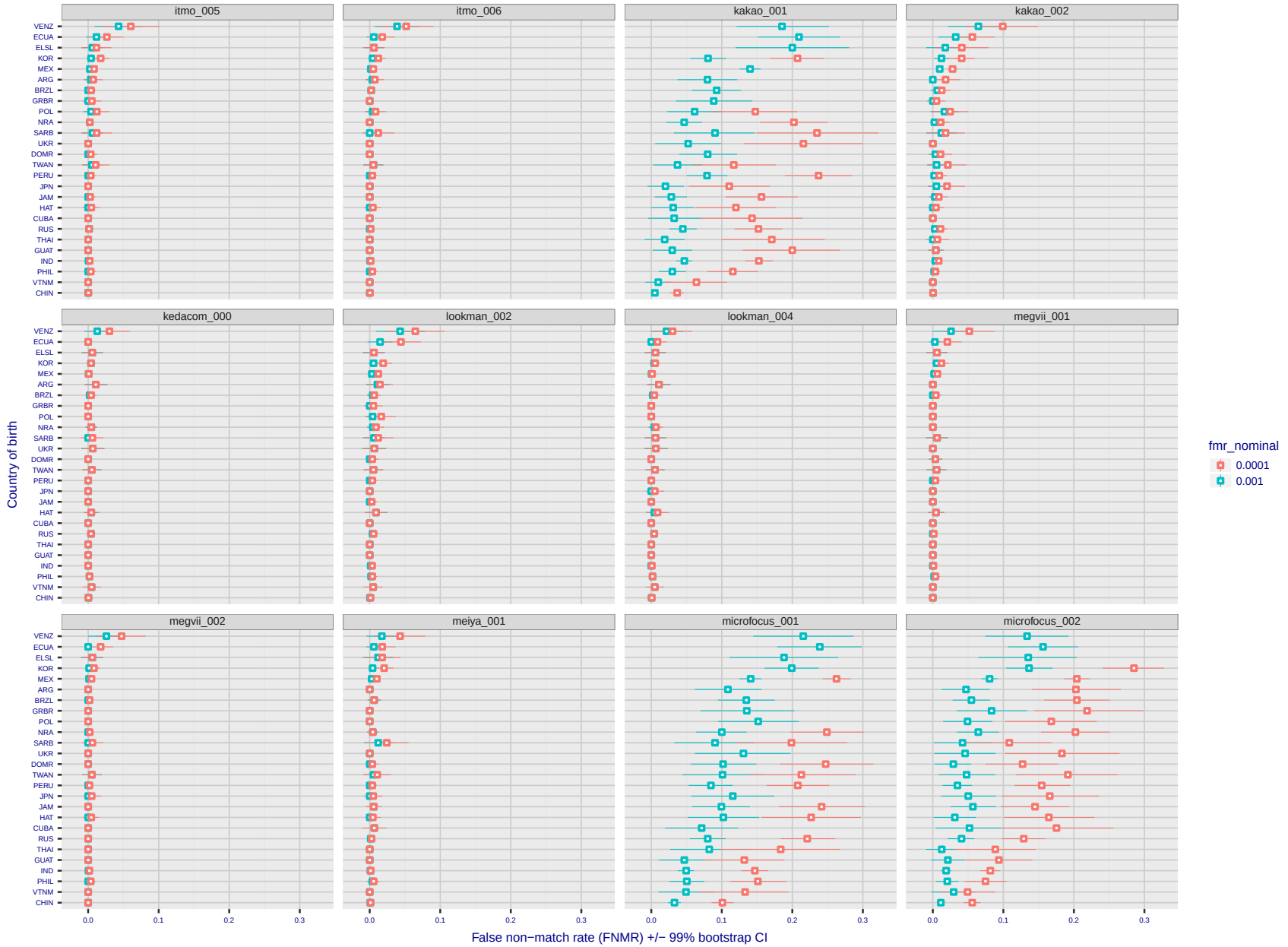

Figure 96: For the visa images, the dots show FNMR by country of birth for two globally set operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.1. The figures shows an order of magnitude variation in FNMR across country of birth; these effects are likely due quality variations, then demographics like age and race. The error rates in some cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

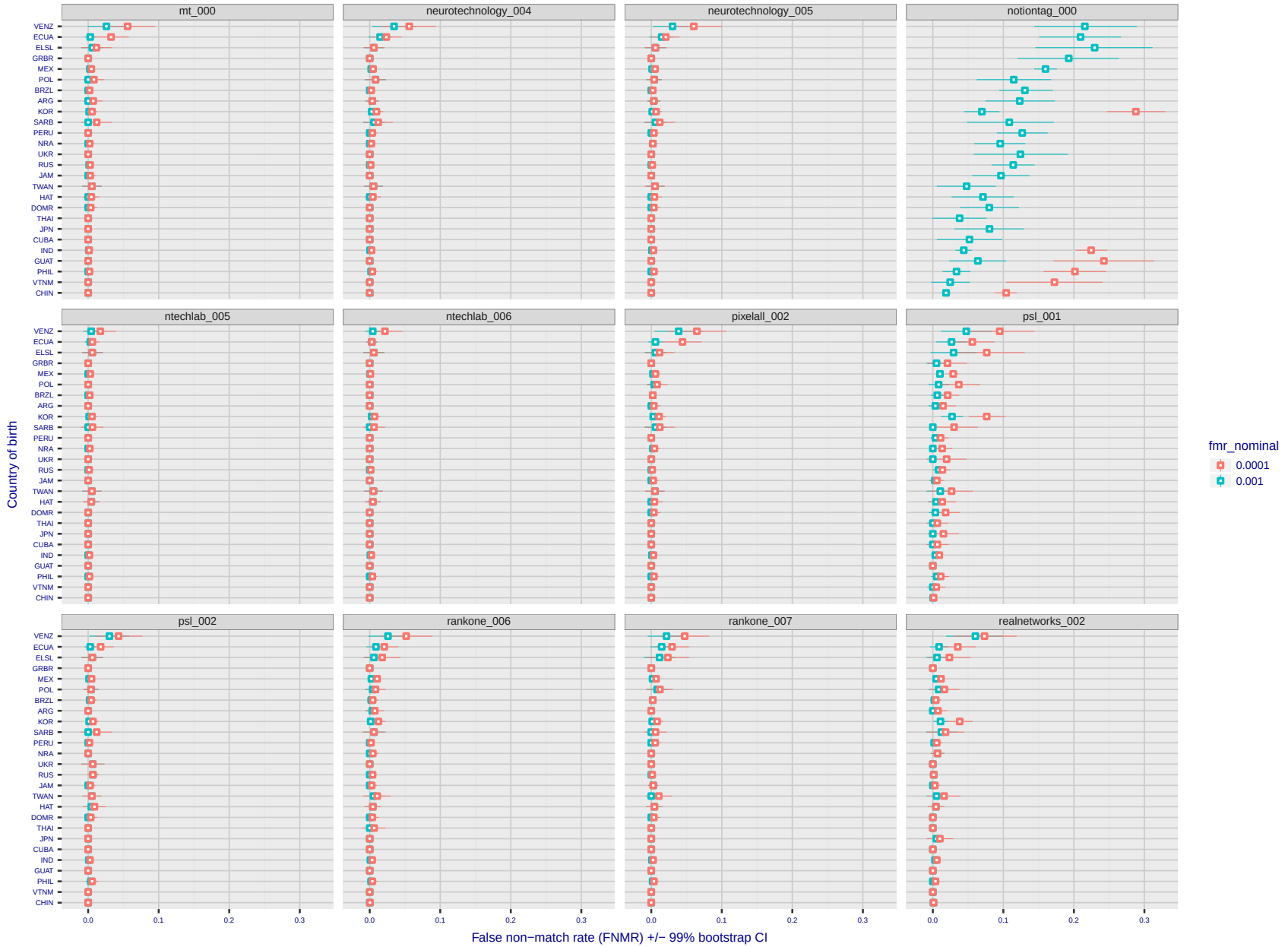

Figure 97: For the visa images, the dots show FNMR by country of birth for two globally set operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.1. The figures shows an order of magnitude variation in FNMR across country of birth; these effects are likely due quality variations, then demographics like age and race. The error rates in some cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

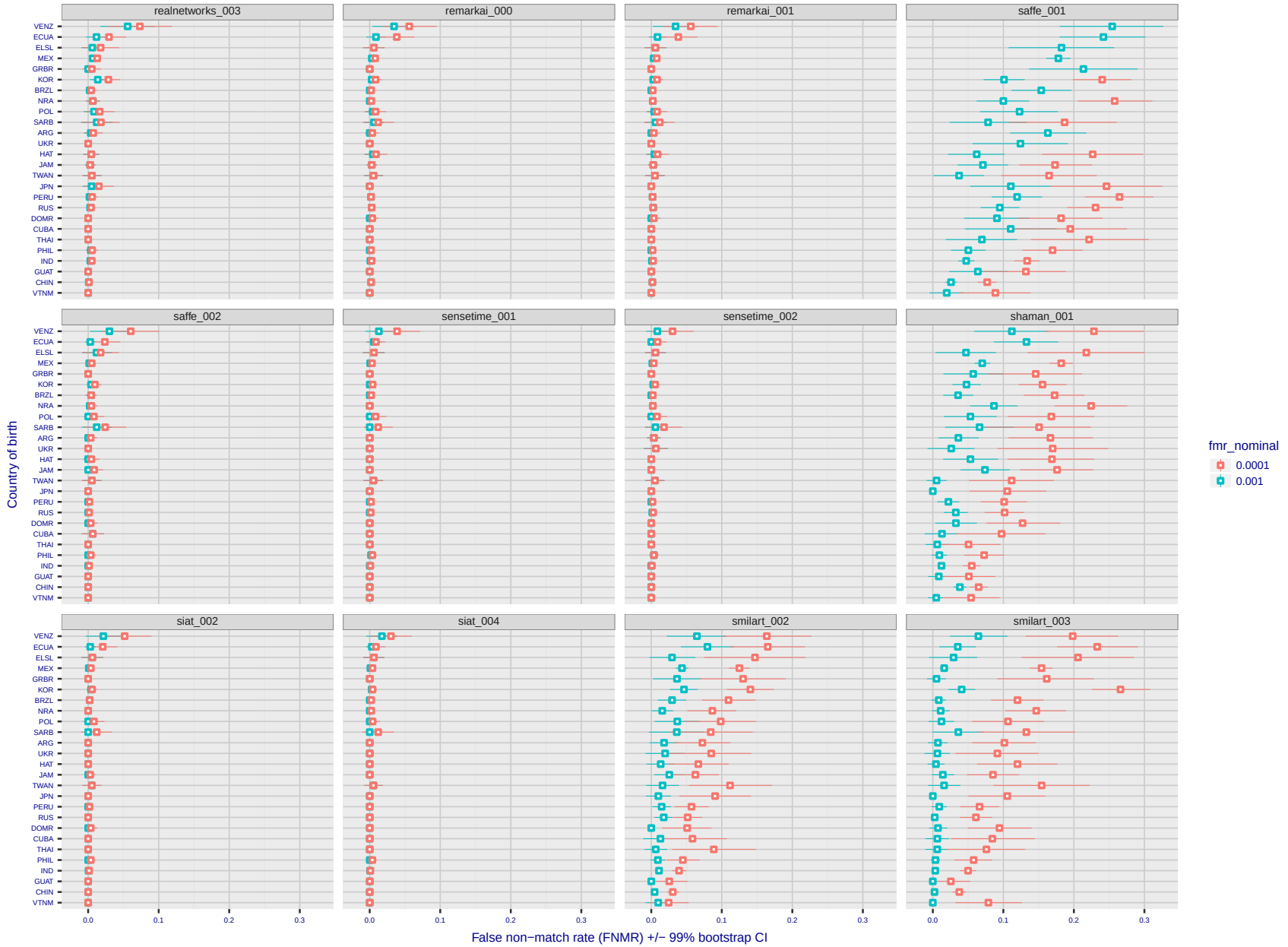

Figure 98: For the visa images, the dots show FNMR by country of birth for two globally set operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.1. The figures shows an order of magnitude variation in FNMR across country of birth; these effects are likely due quality variations, then demographics like age and race. The error rates in some cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

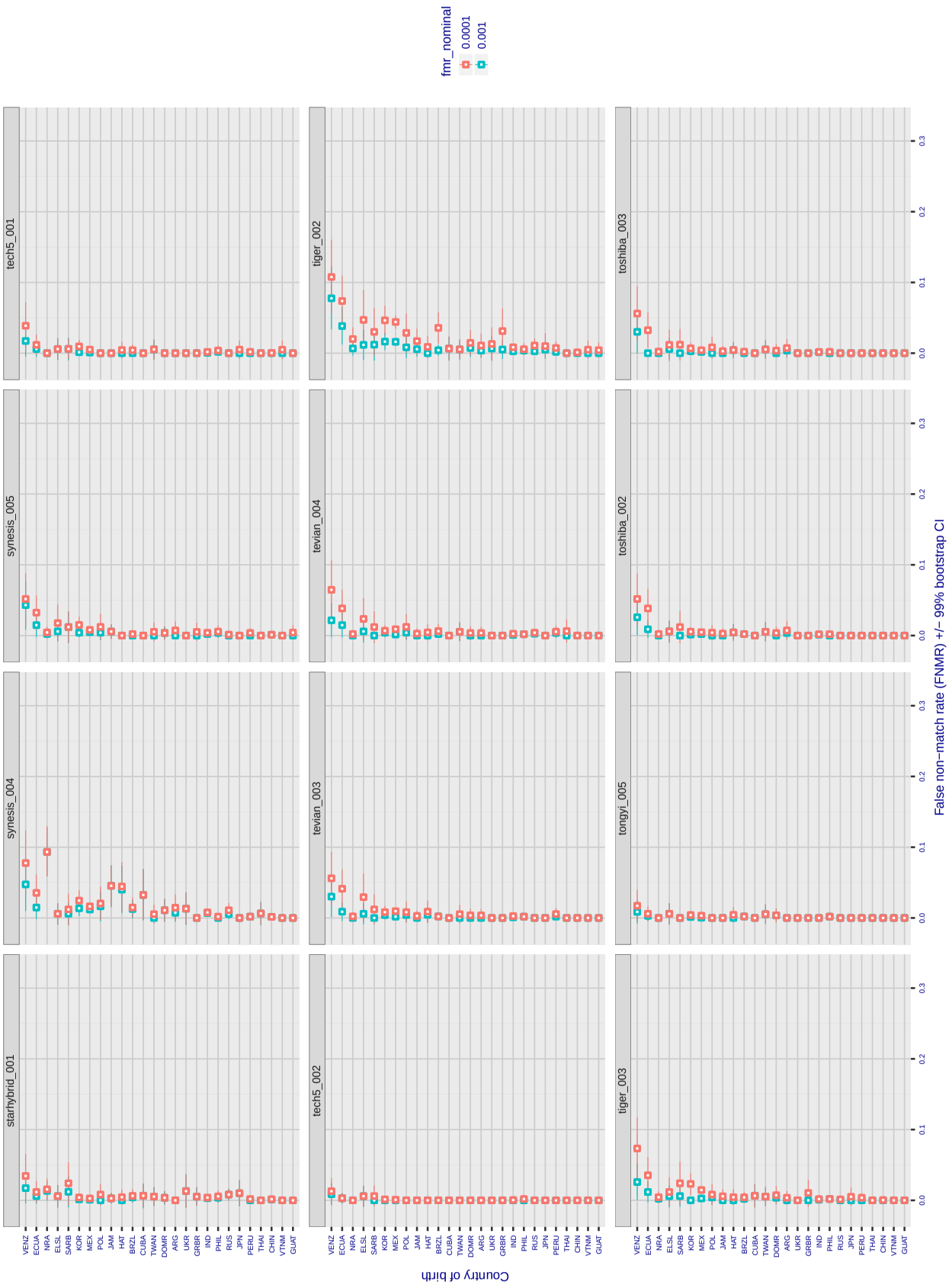

Figure 99: For the visa images, the dots show FNMR by country of birth for two globally set operating thresholds corresponding to FMR = {0.001, 0.0001} computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.1. The figures shows an order of magnitude variation in FNMR across country of birth; these effects are likely due quality variations, then demographics like age and race. The error rates in some cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

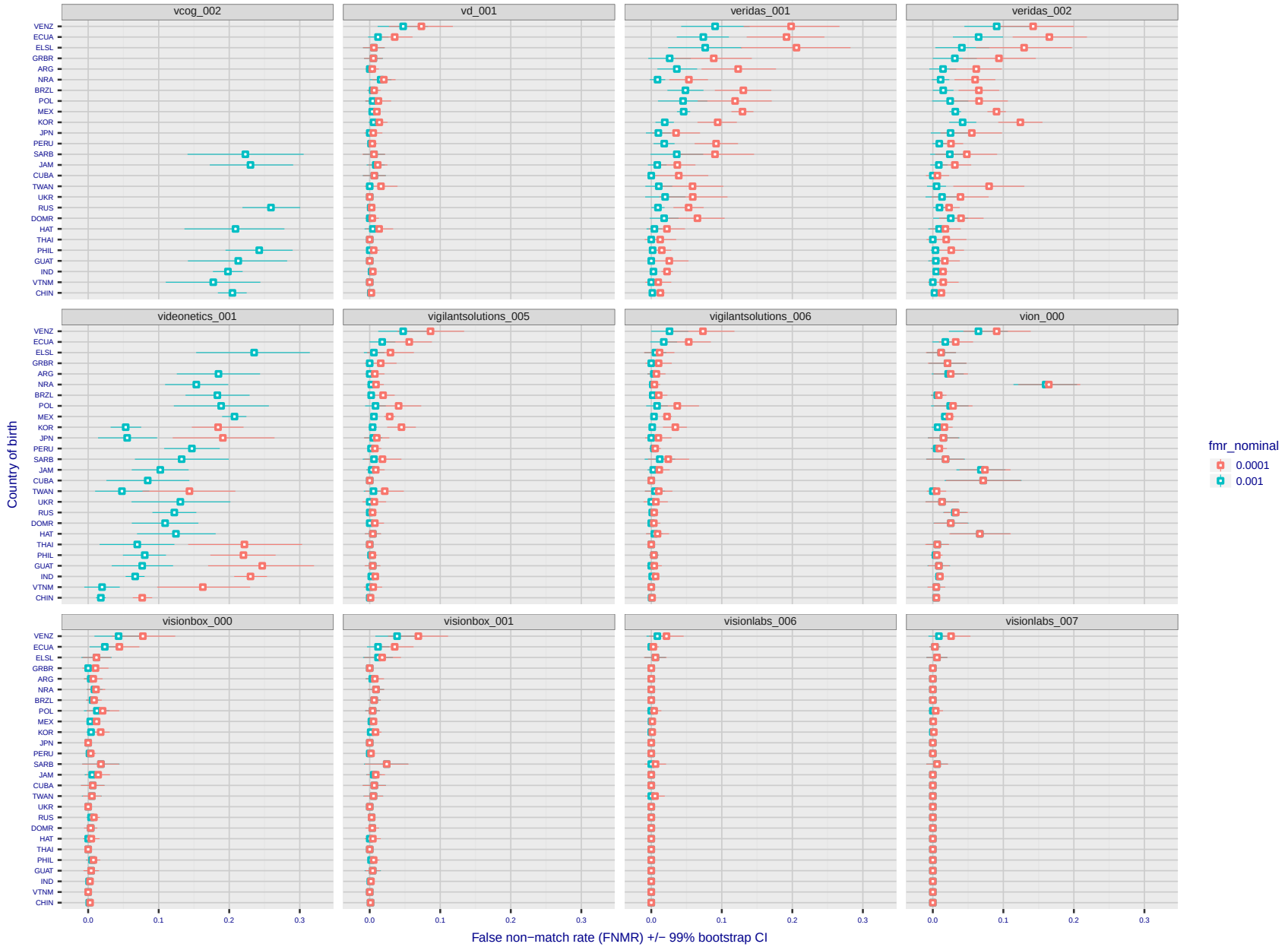

Figure 100: For the visa images, the dots show FNMR by country of birth for two globally set operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.1. The figures shows an order of magnitude variation in FNMR across country of birth; these effects are likely due quality variations, then demographics like age and race. The error rates in some cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

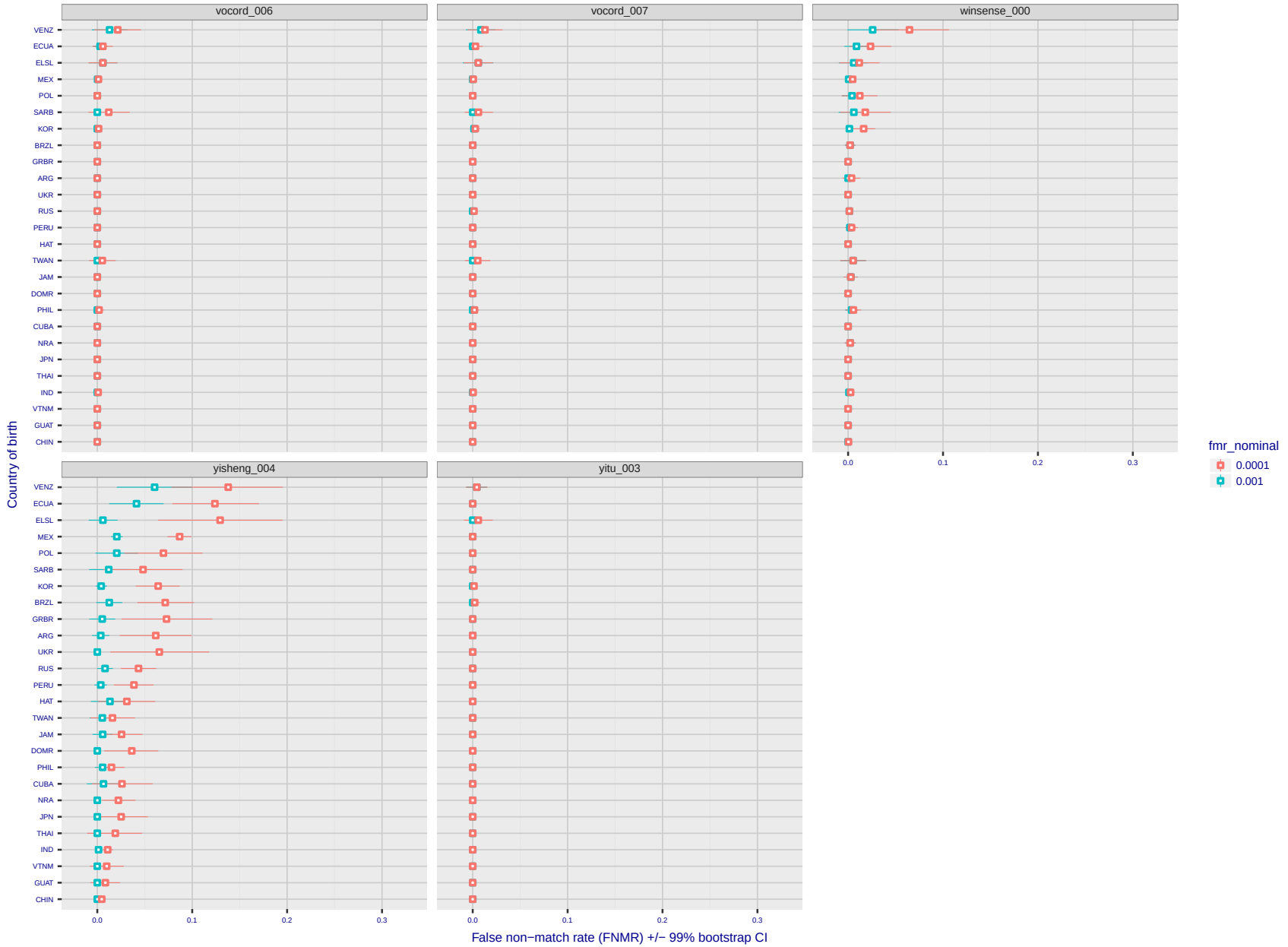

Figure 101: For the visa images, the dots show FNMR by country of birth for two globally set operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.1. The figures shows an order of magnitude variation in FNMR across country of birth; these effects are likely due quality variations, then demographics like age and race. The error rates in some cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

Caveats: The results may not relate to subject-specific properties. Instead they could reflect image-specific quality differences, which could occur due to collection protocol or software processing variations.

3.5.2 Effect of ageing

Background: Faces change appearance throughout life. This change gradually reduces similarity of a new image to an earlier image. Face recognition algorithms give reduced similarity scores and more frequent false rejections.

Goal: To quantify false non-match rates (FNMR) as a function of elapsed time in an adult population.

Methods: Using the mugshot images, a threshold is set to give FMR = 0.00001 over the entire impostor set. Then FNMR is measured over 1000 bootstrap replications of the genuine scores.

Results: For the visa images, Figure 110 shows how false non-match rates for genuine users, as a function of age group.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

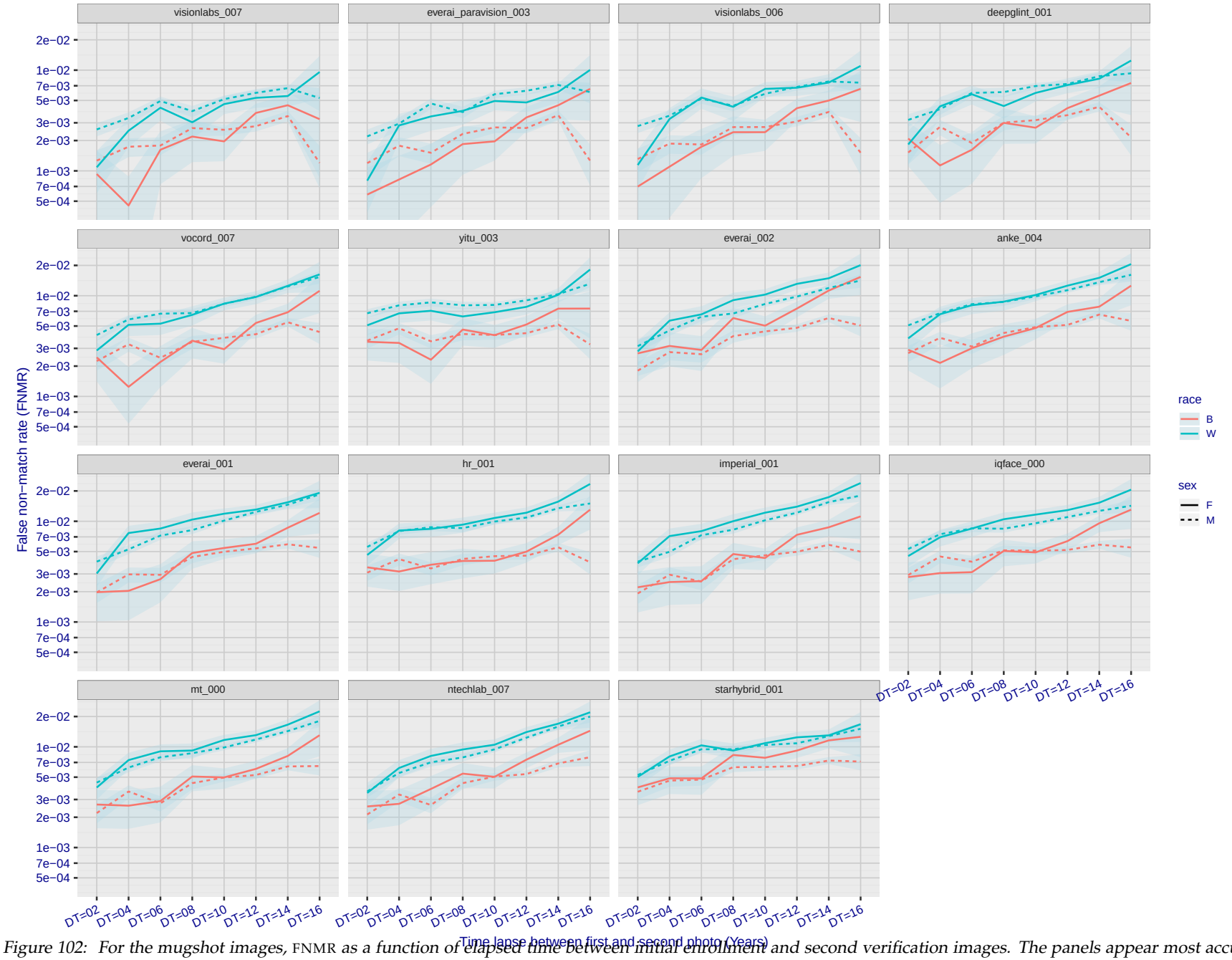

Figure 102: For the mugshot images, FNMR *as a function of elapsed time between initial enrollment and second verification images. The panels appear most accurate first, and vertical scale changes on each page. The four traces correspond to images annotated with codes for black female, black male, white female, white male. The threshold is fixed for each algorithm to give FMR = 0.00001 over all (10^8) impostor comparisons. For short time-lapses, the most accurate algorithms give very few errors (FNMR < 0.001) so that the uncertainty estimates are high.*

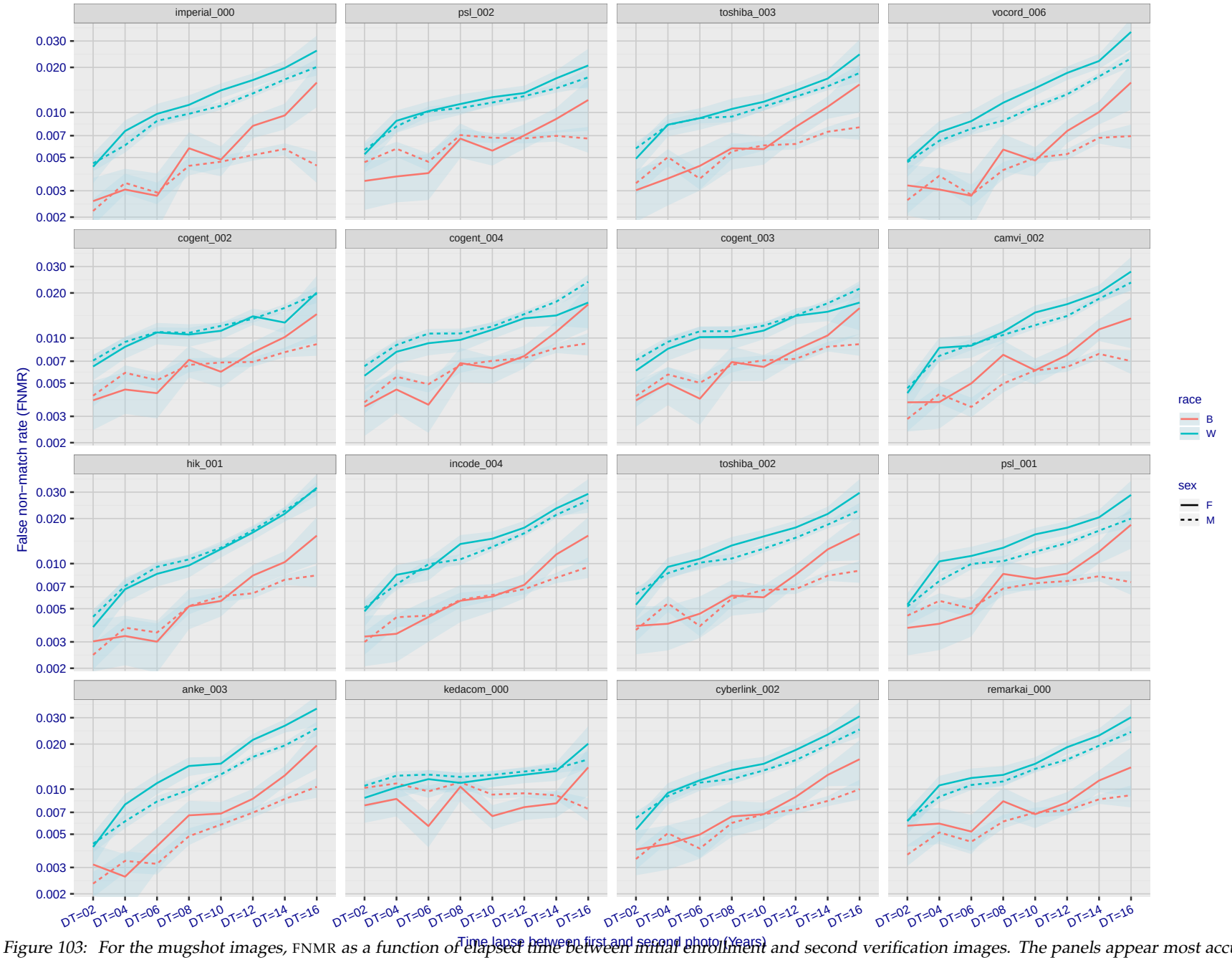

Figure 103: For the mugshot images, FNMR *as a function of elapsed time between initial enrollment and second verification images. The panels appear most accurate first, and vertical scale changes on each page. The four traces correspond to images annotated with codes for black female, black male, white female, white male. The threshold is fixed for each algorithm to give FMR = 0.00001 over all (10^8) impostor comparisons. For short time-lapses, the most accurate algorithms give very few errors (FNMR < 0.001) so that the uncertainty estimates are high.*

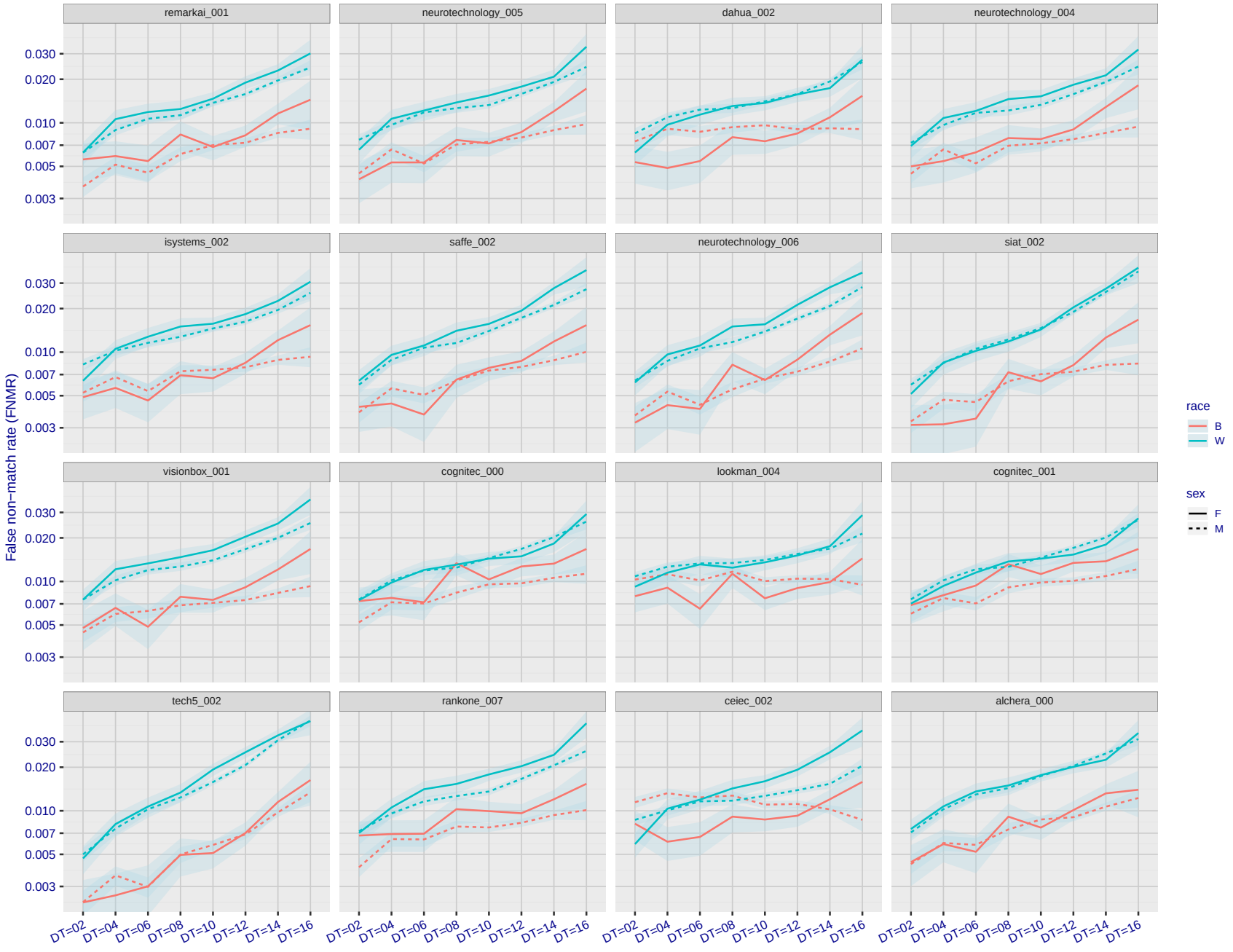

Figure 104: For the mugshot images, FNMR *as a function of elapsed time between initial enrollment and second verification images. The panels appear most accurate first, and vertical scale changes on each page. The four traces correspond to images annotated with codes for black female, black male, white female, white male. The threshold is fixed for each algorithm to give FMR = 0.00001 over all (10^8) impostor comparisons. For short time-lapses, the most accurate algorithms give very few errors (FNMR < 0.001) so that the uncertainty estimates are high.*

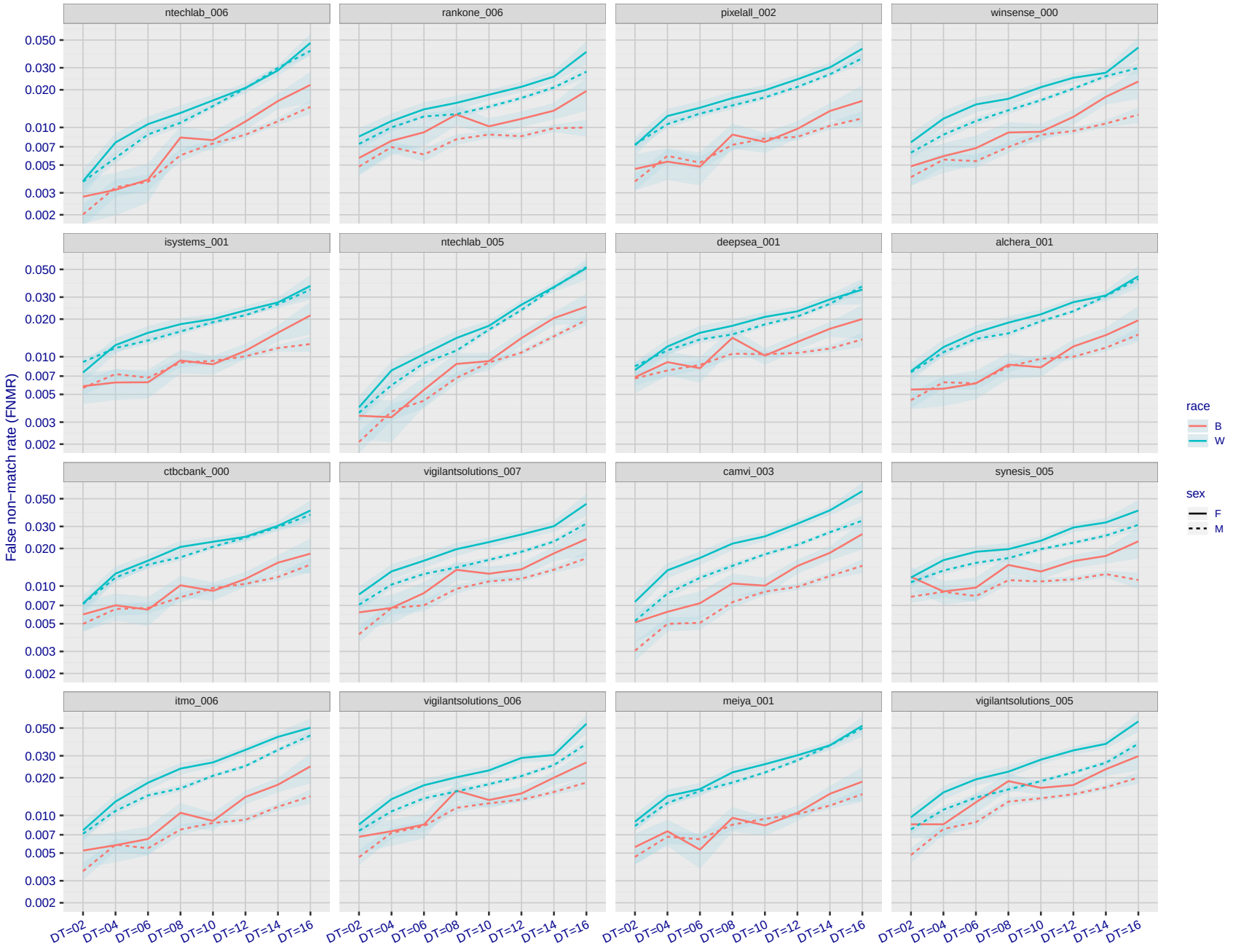

Figure 105: For the mugshot images, FNMR *as a function of elapsed time between initial enrollment and second verification images. The panels appear most accurate first, and vertical scale changes on each page. The four traces correspond to images annotated with codes for black female, black male, white female, white male. The threshold is fixed for each algorithm to give FMR = 0.00001 over all ($\tilde{10}^8$) impostor comparisons. For short time-lapses, the most accurate algorithms give very few errors (FNMR < 0.001) so that the uncertainty estimates are high.*

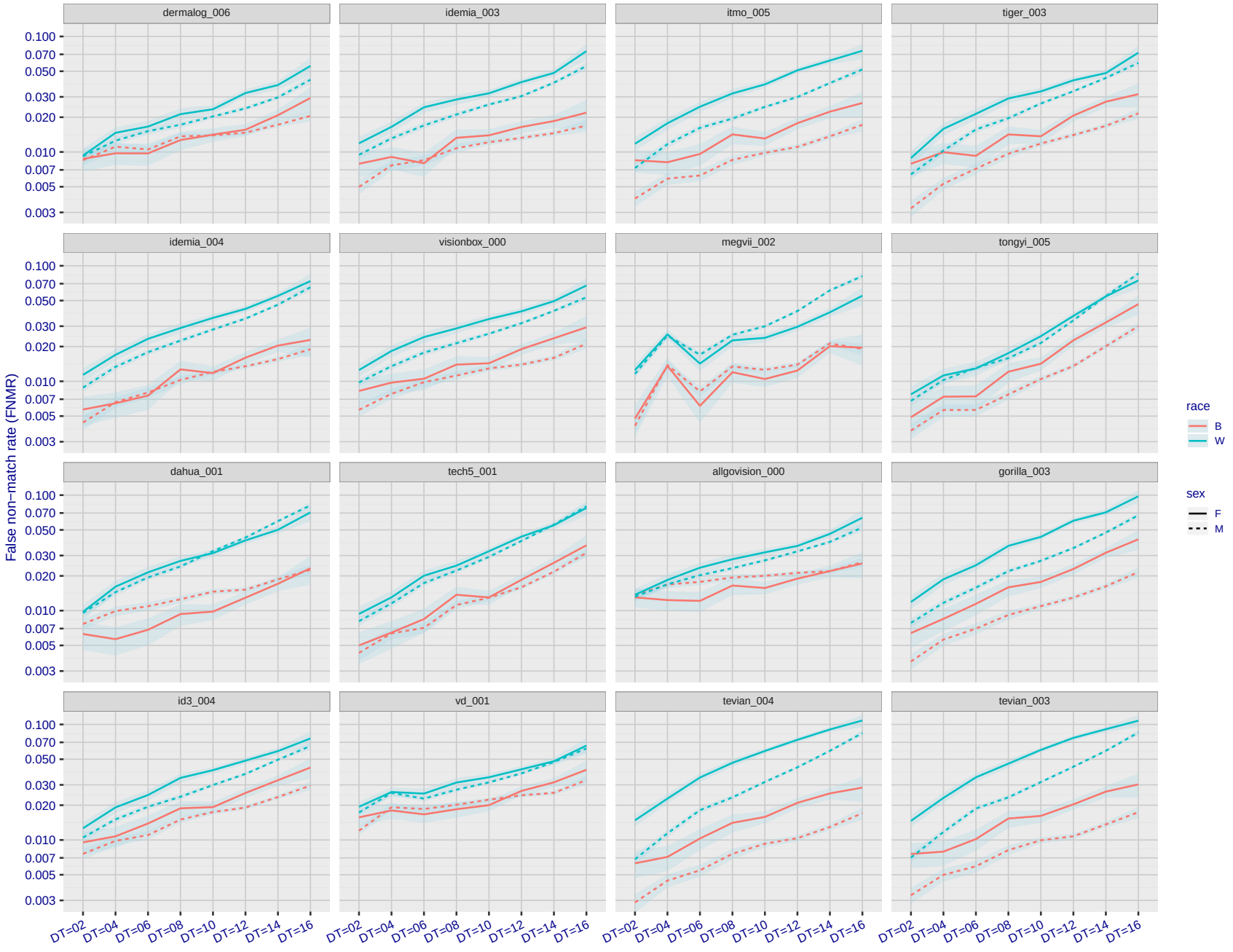

Figure 106: For the mugshot images, FNMR *as a function of elapsed time between initial enrollment and second verification images. The panels appear most accurate first, and vertical scale changes on each page. The four traces correspond to images annotated with codes for black female, black male, white female, white male. The threshold is fixed for each algorithm to give FMR = 0.00001 over all (10^8) impostor comparisons. For short time-lapses, the most accurate algorithms give very few errors (FNMR < 0.001) so that the uncertainty estimates are high.*

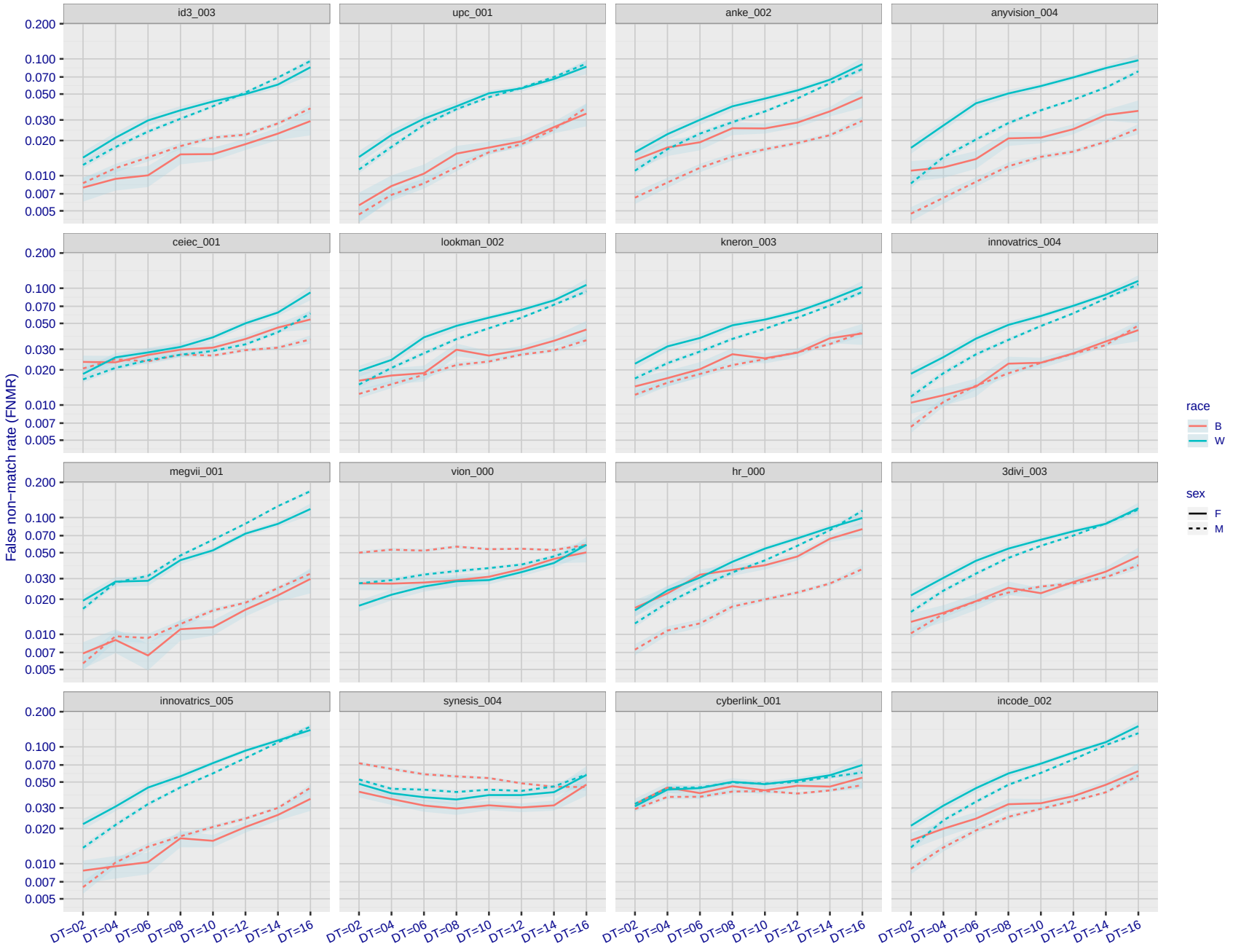

Figure 107: For the mugshot images, FNMR *as a function of elapsed time between initial enrollment and second verification images. The panels appear most accurate first, and vertical scale changes on each page. The four traces correspond to images annotated with codes for black female, black male, white female, white male. The threshold is fixed for each algorithm to give FMR = 0.00001 over all (10^8) impostor comparisons. For short time-lapses, the most accurate algorithms give very few errors (FNMR < 0.001) so that the uncertainty estimates are high.*

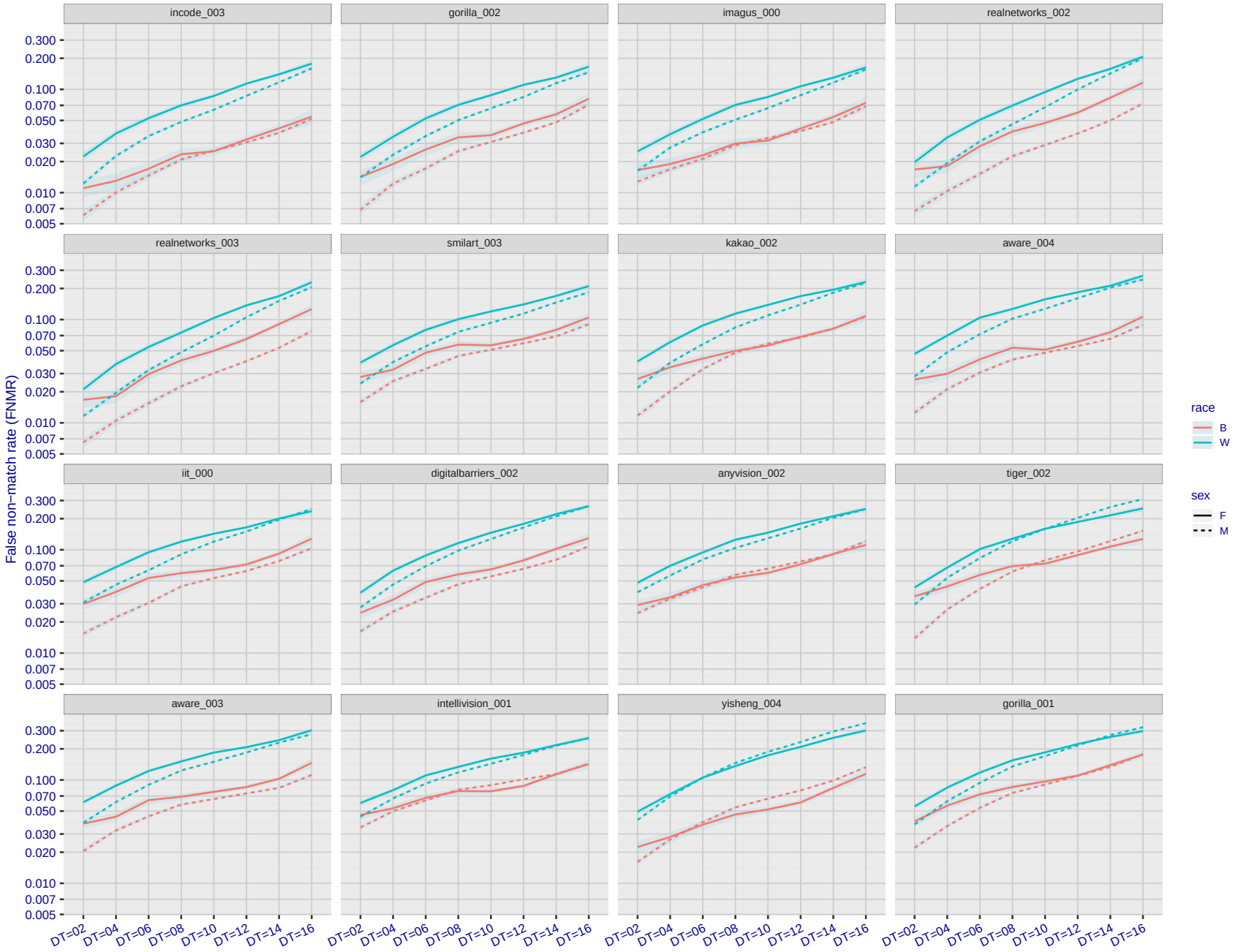

Figure 108: For the mugshot images, FNMR *as a function of elapsed time between initial enrollment and second verification images. The panels appear most accurate first, and vertical scale changes on each page. The four traces correspond to images annotated with codes for black female, black male, white female, white male. The threshold is fixed for each algorithm to give FMR = 0.00001 over all (10^8) impostor comparisons. For short time-lapses, the most accurate algorithms give very few errors (FNMR < 0.001) so that the uncertainty estimates are high.*

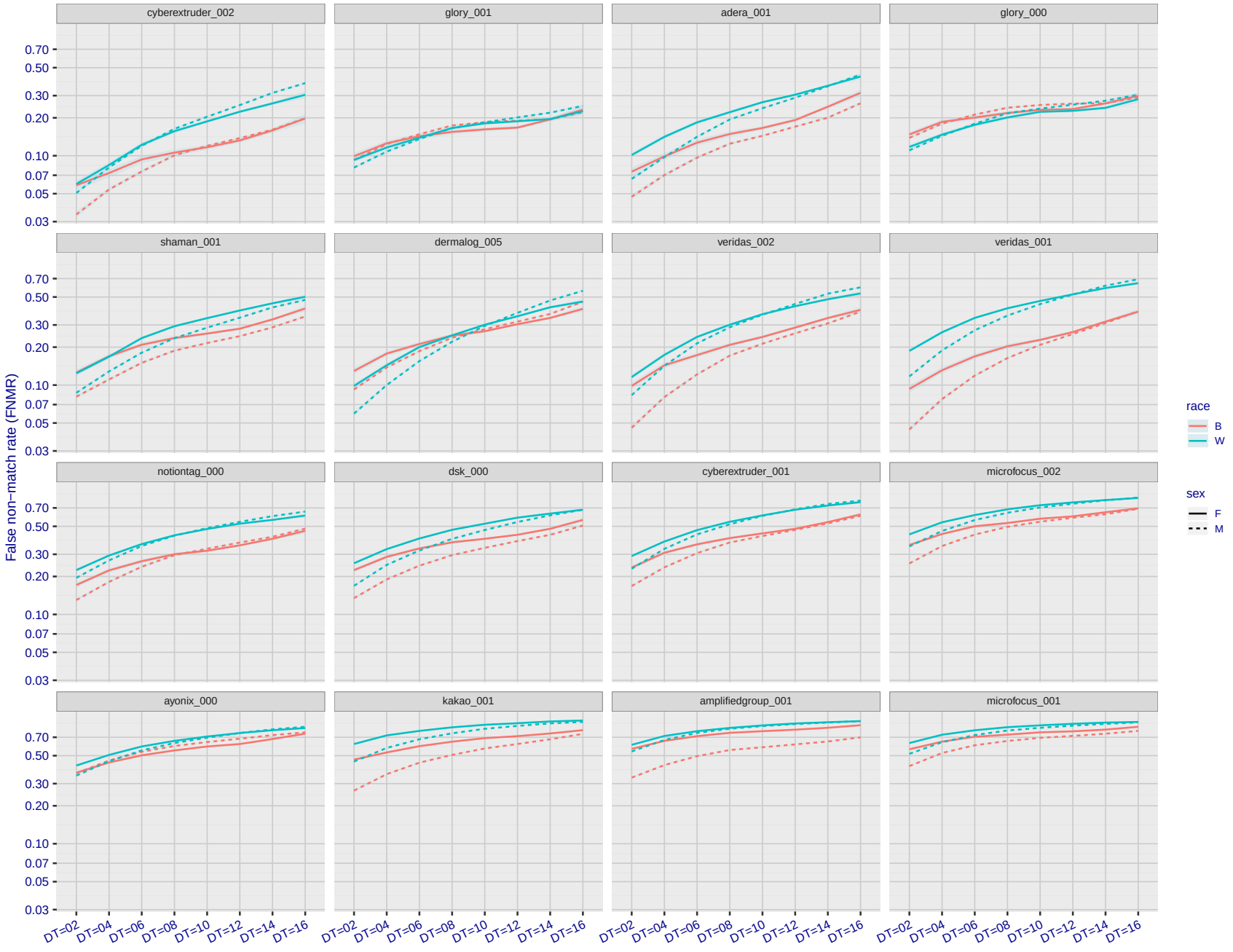

Figure 109: For the mugshot images, FNMR *as a function of elapsed time between initial enrollment and second verification images. The panels appear most accurate first, and vertical scale changes on each page. The four traces correspond to images annotated with codes for black female, black male, white female, white male. The threshold is fixed for each algorithm to give FMR = 0.00001 over all (10^8) impostor comparisons. For short time-lapses, the most accurate algorithms give very few errors (FNMR < 0.001) so that the uncertainty estimates are high.*

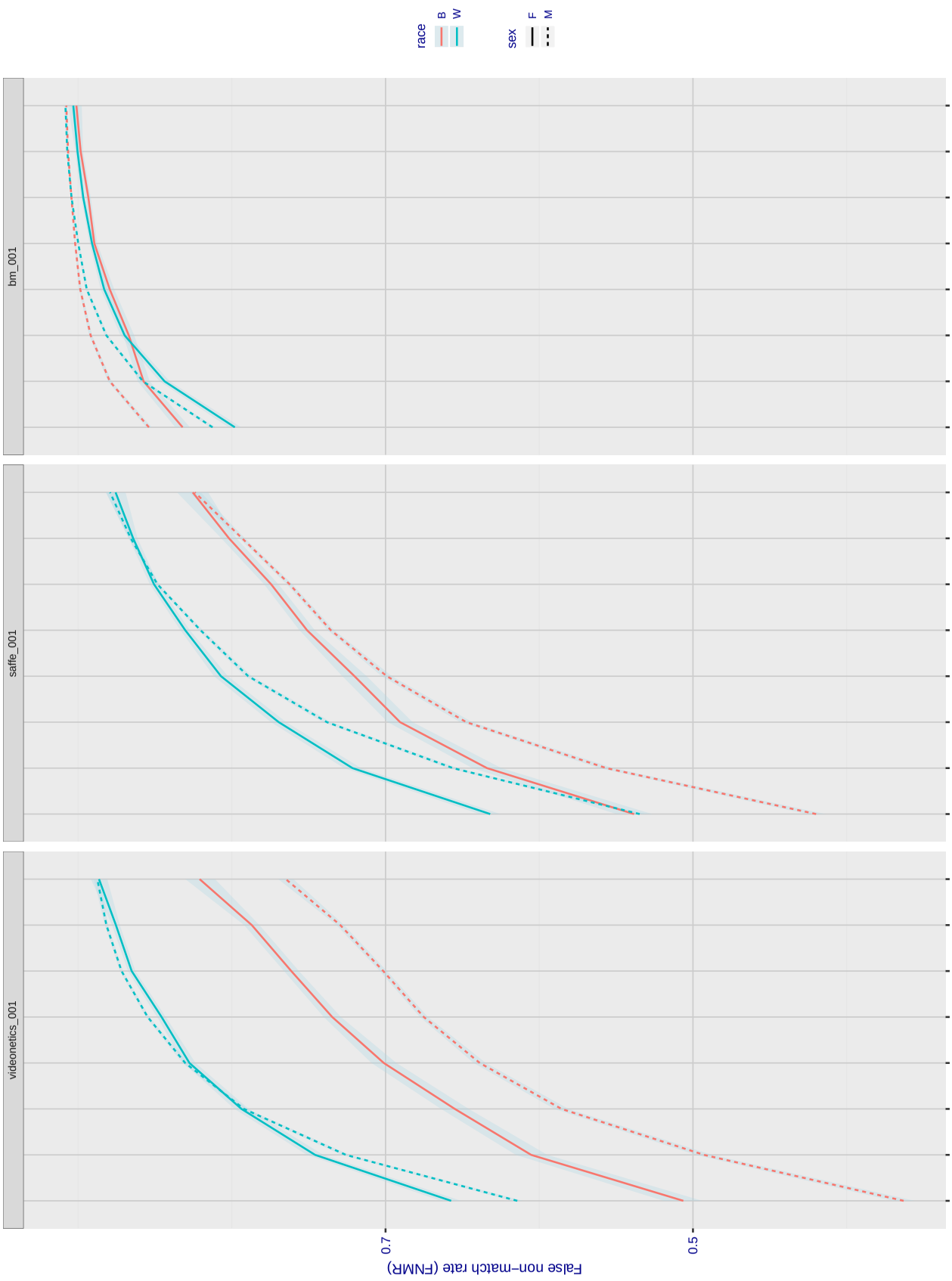

Figure 110: For the mugshot images, FNMR *as a function of elapsed time between initial enrollment and second verification images. The panels appear most accurate first, and vertical scale changes on each page. The four traces correspond to images annotated with codes for black female, black male, white female, white male. The threshold is fixed for each algorithm to give FMR = 0.00001 over all* (10^8) *impostor comparisons. For short time-lapses, the most accurate algorithms give very few errors (FNMR* < 0.001*) so that the uncertainty estimates are high.*

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

3.5.3 Effect of age on genuine subjects

Background: Faces change appearance throughout life. Face recognition algorithms have previously beeen reported to give better accuracy on older individuals (See NIST IR 8009).

Goal: To quantify false non-match rates (FNMR) as a function of age, without an ageing component.

Methods: Using the visa images, which span fewer than five years, thresholds are determined that give FMR = 0.001 and 0.0001 over the entire impostor set. Then FNMR is measured over 1000 bootstrap replications of the genuine scores.

Results: For the visa images, Figure 122 shows how false non-match rates for genuine users, as a function of age group.

The notable aspects are:

- Younger subjects give considerably higher FNMR. This is likely due to rapid growth and change in facial appearance.
- FNMR trends down throughout life. The last bin, AGE $>$ 72, contains fewer than 140 mated pairs, and may be affected by small sample size.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

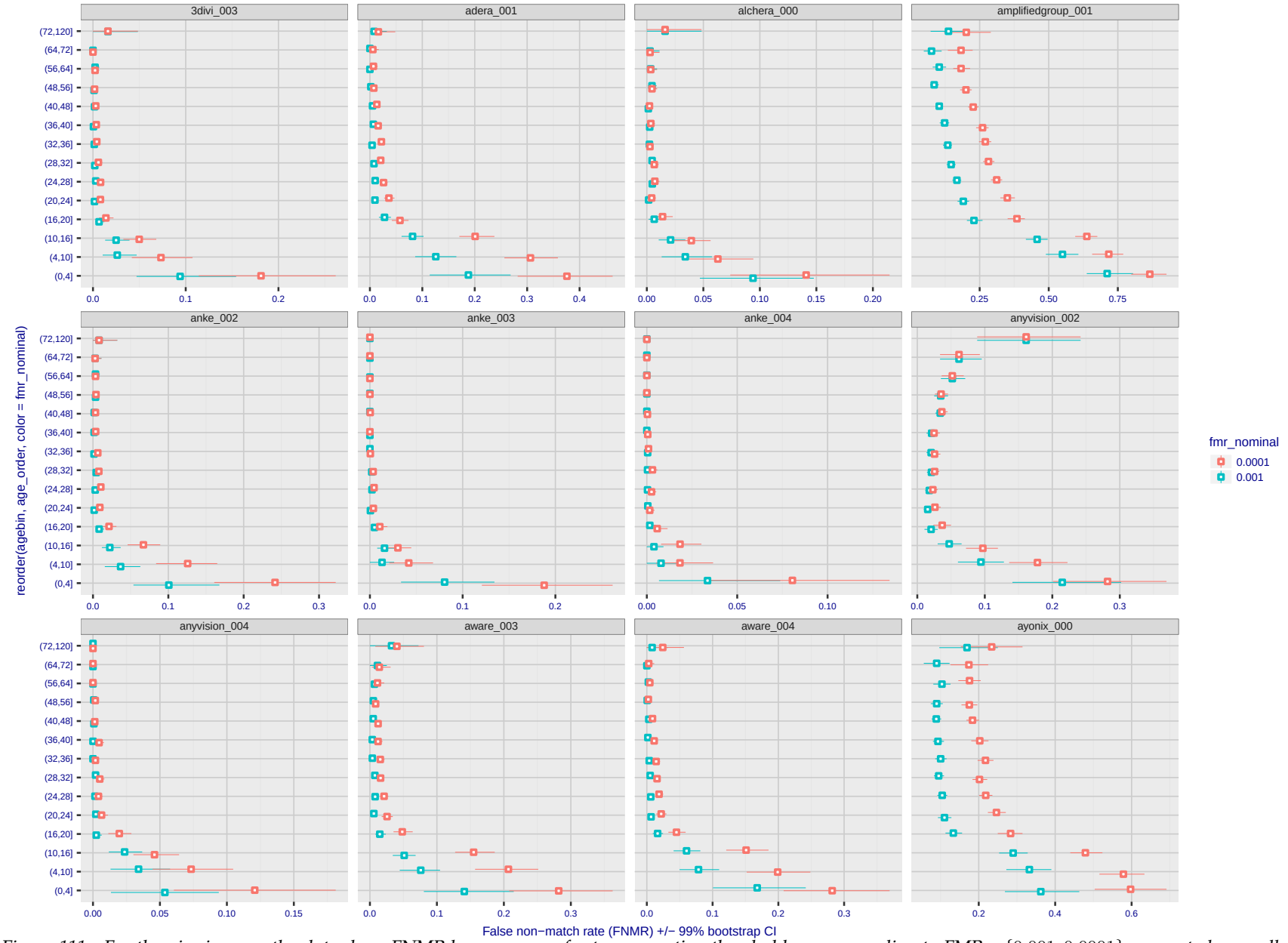

Figure 111: For the visa images, the dots show FNMR by age group for two operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.2. Given a pair of face images taken at different times, we assign the comparison to the bin that is the arithmetic average of the subject's ages. This plot shows only the effect of age, not ageing. The number of comparisons in each bin is generally in the thousands, however the first and last bins are computed over 149 and 124 respectively. The error rates in some (adult) cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

Figure 112: For the visa images, the dots show FNMR by age group for two operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.2. Given a pair of face images taken at different times, we assign the comparison to the bin that is the arithmetic average of the subject's ages. This plot shows only the effect of age, not ageing. The number of comparisons in each bin is generally in the thousands, however the first and last bins are computed over 149 and 124 respectively. The error rates in some (adult) cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

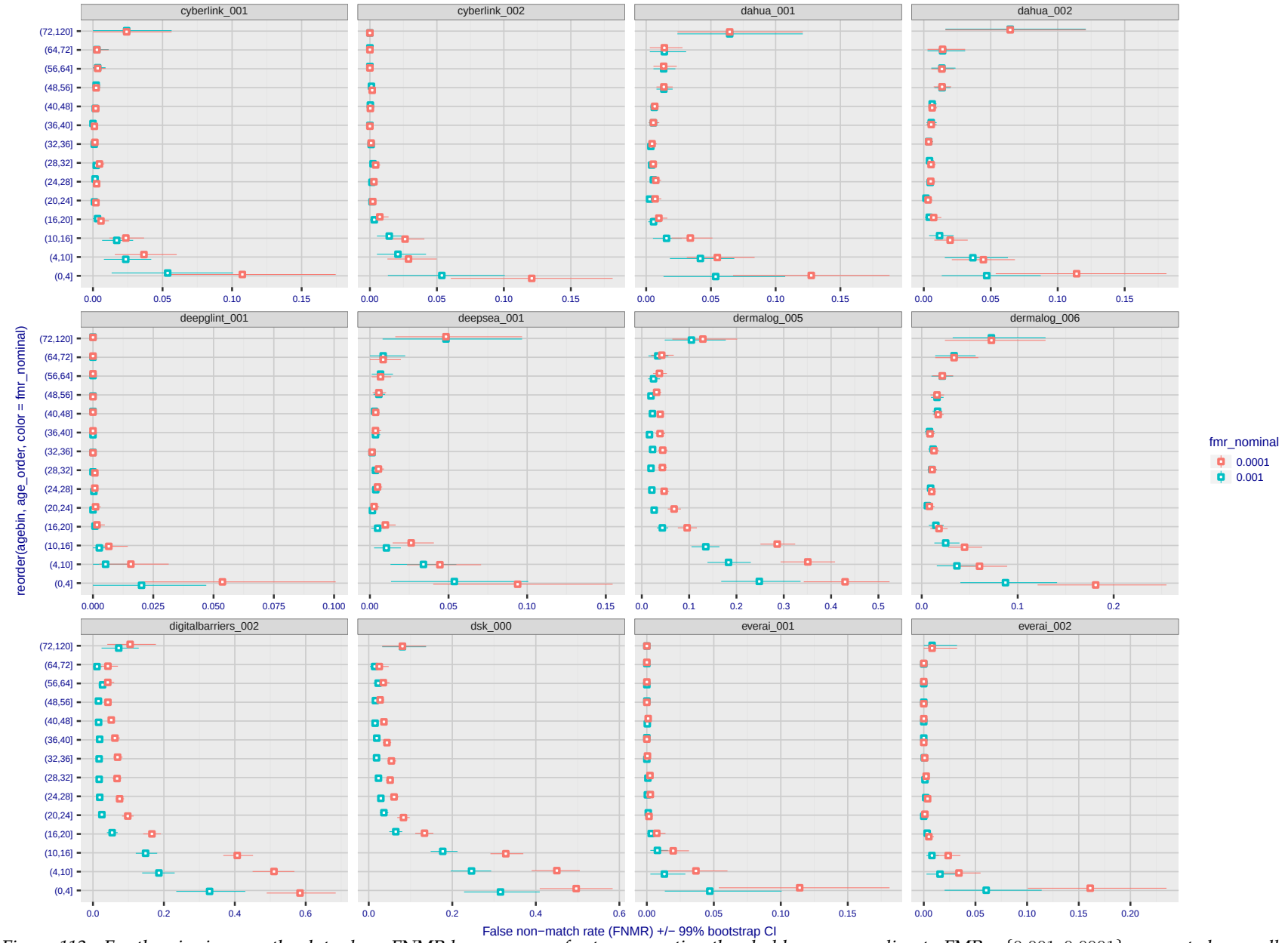

Figure 113: For the visa images, the dots show FNMR by age group for two operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.2. Given a pair of face images taken at different times, we assign the comparison to the bin that is the arithmetic average of the subject's ages. This plot shows only the effect of age, not ageing. The number of comparisons in each bin is generally in the thousands, however the first and last bins are computed over 149 and 124 respectively. The error rates in some (adult) cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

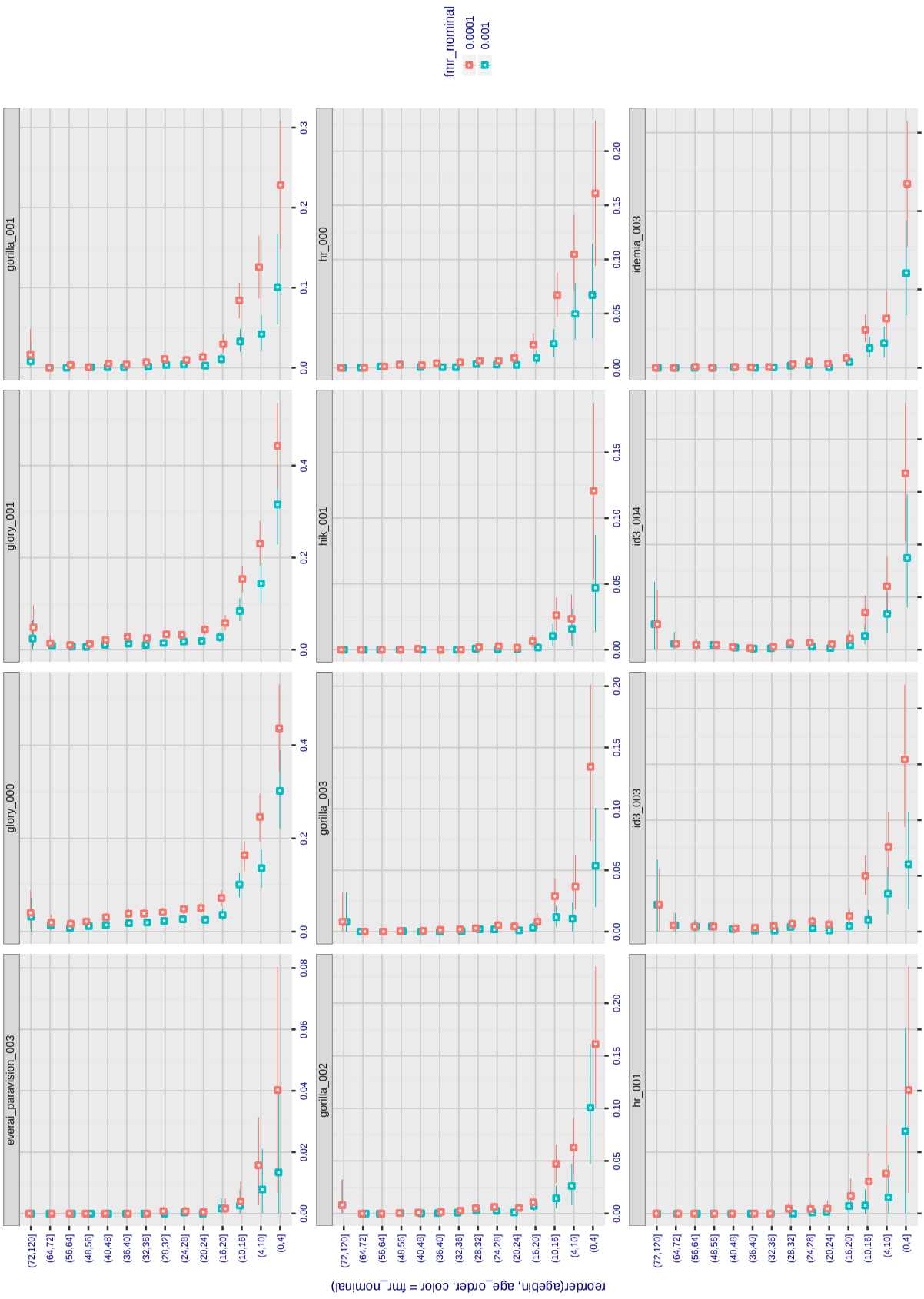

Figure 114: For the visa images, the dots show FNMR by age group for two operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.2. Given a pair of face images taken at different times, we assign the comparison to the bin that is the arithmetic average of the subject's ages. This plot shows only the effect of age, not ageing. The number of comparisons in each bin is generally in the thousands, however the first and last bins are computed over 149 and 124 respectively. The error rates in some (adult) cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

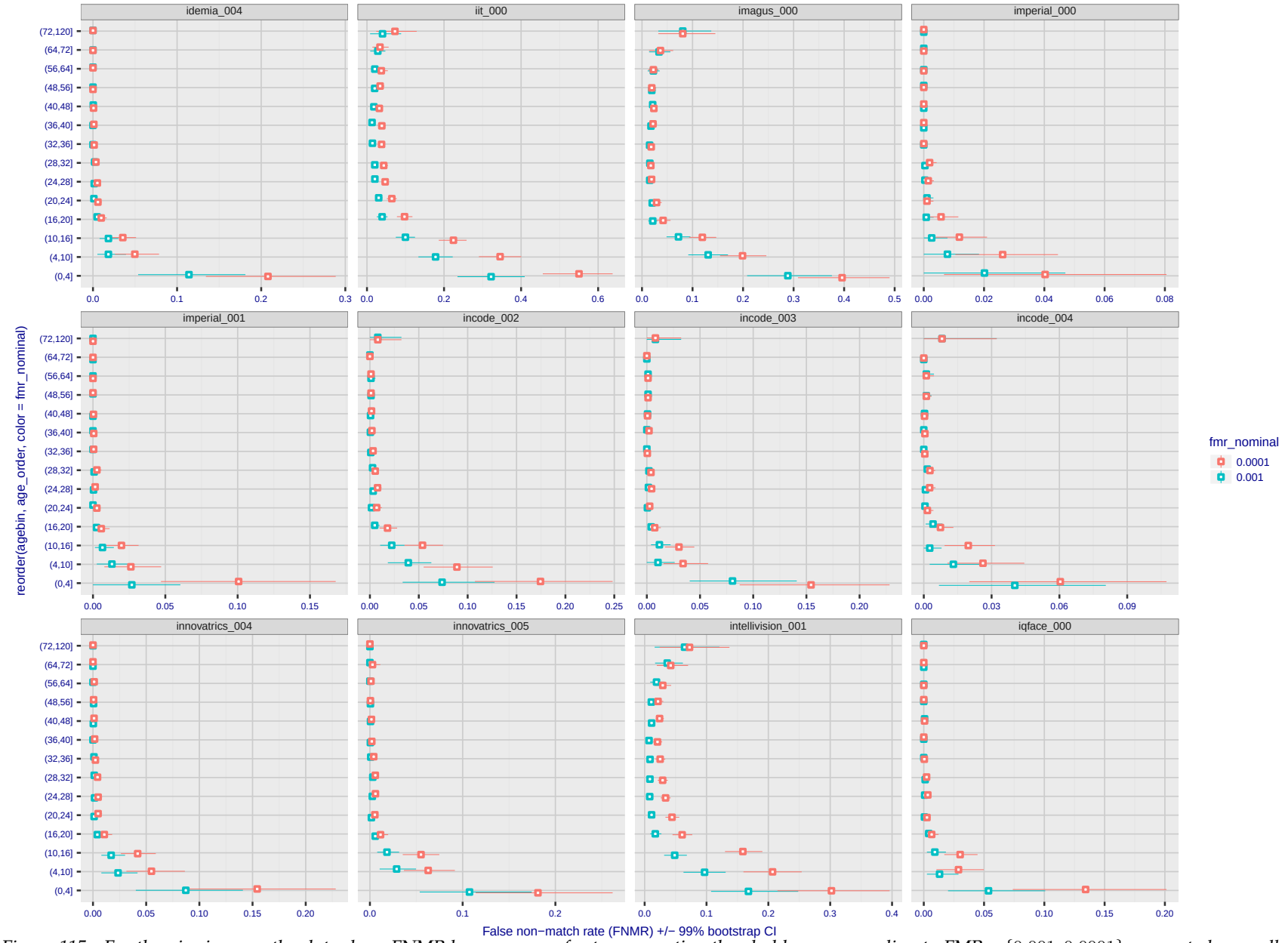

Figure 115: For the visa images, the dots show FNMR by age group for two operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.2. Given a pair of face images taken at different times, we assign the comparison to the bin that is the arithmetic average of the subject's ages. This plot shows only the effect of age, not ageing. The number of comparisons in each bin is generally in the thousands, however the first and last bins are computed over 149 and 124 respectively. The error rates in some (adult) cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

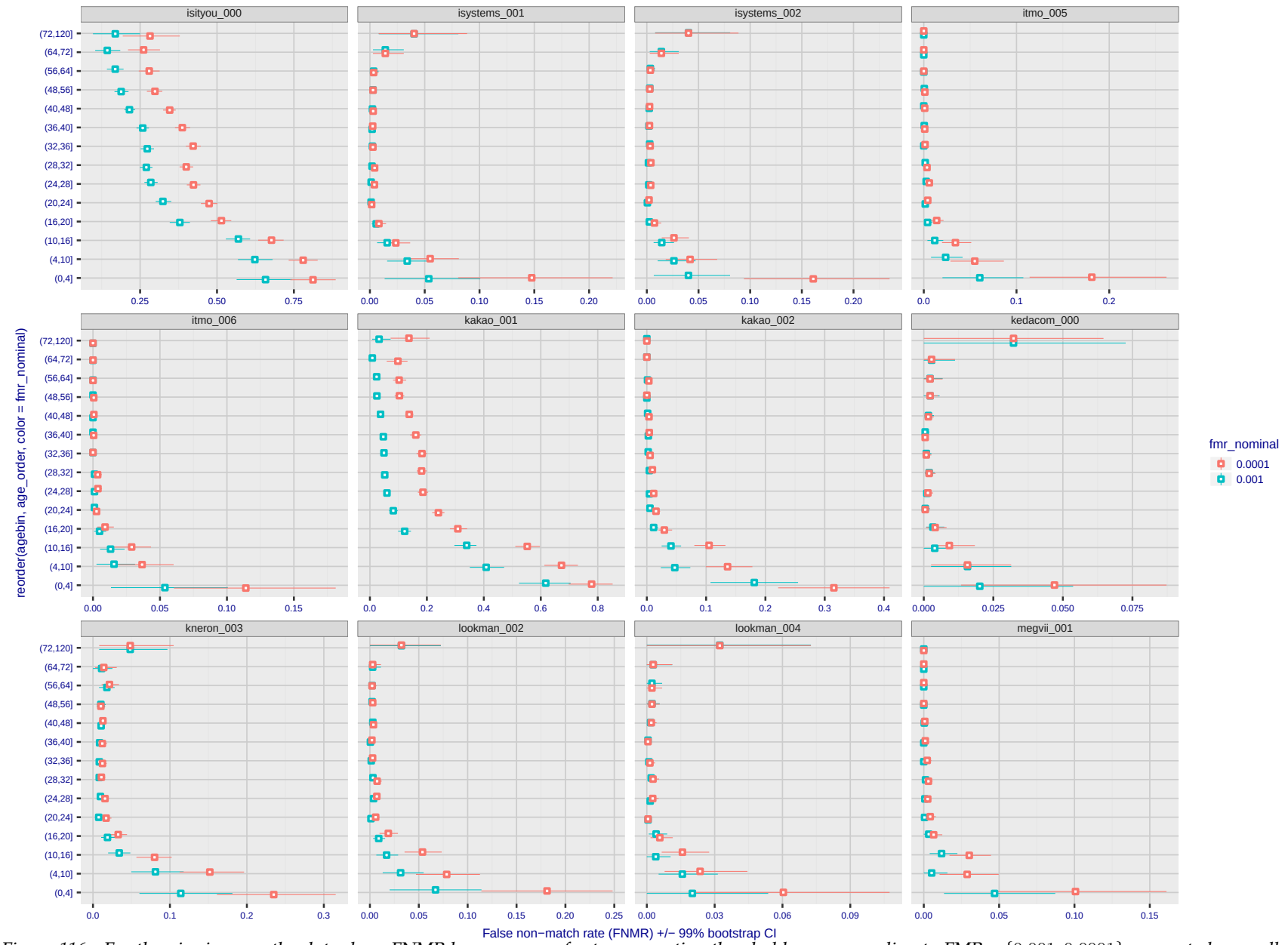

Figure 116: For the visa images, the dots show FNMR by age group for two operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.2. Given a pair of face images taken at different times, we assign the comparison to the bin that is the arithmetic average of the subject's ages. This plot shows only the effect of age, not ageing. The number of comparisons in each bin is generally in the thousands, however the first and last bins are computed over 149 and 124 respectively. The error rates in some (adult) cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

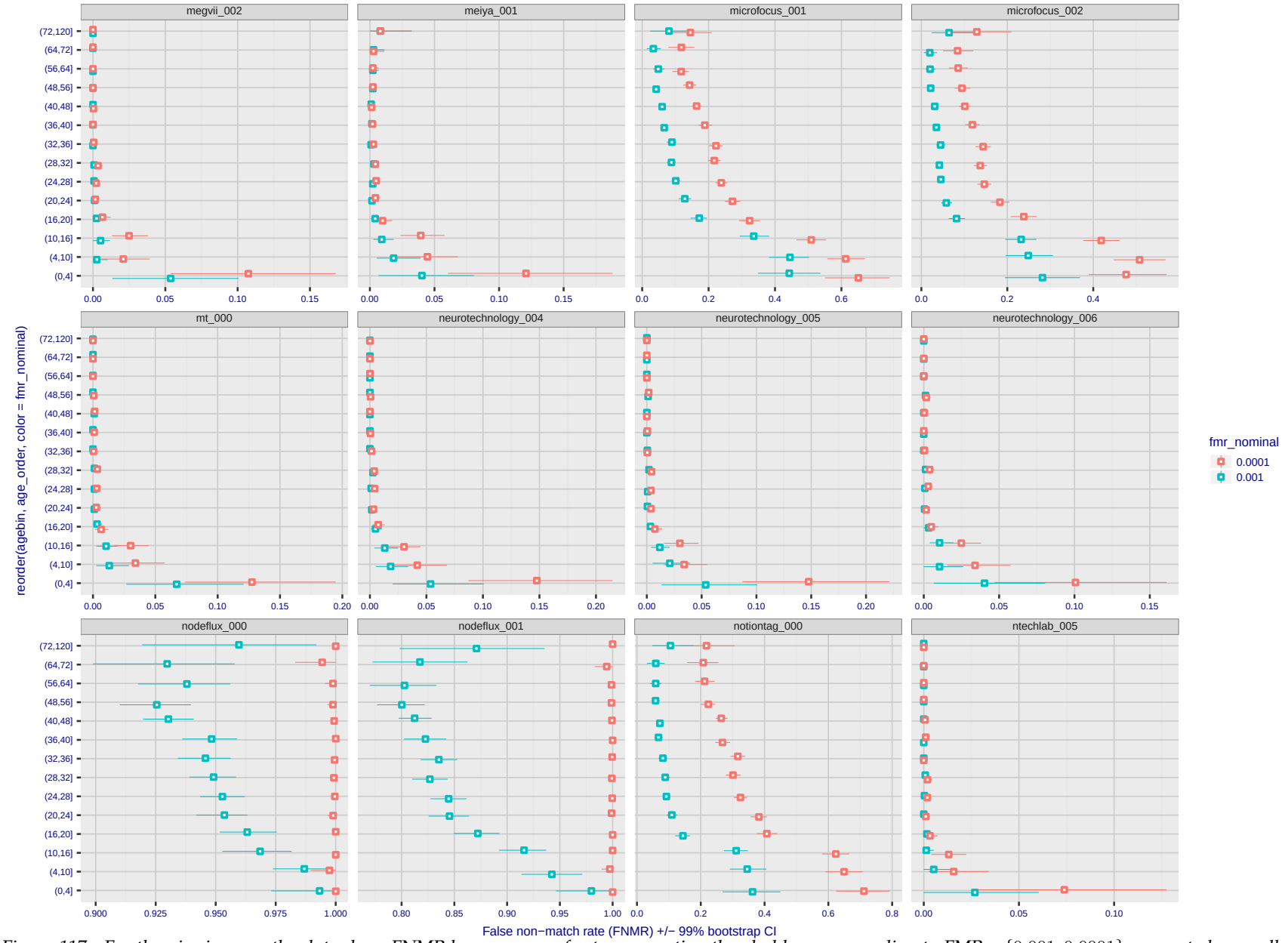

Figure 117: For the visa images, the dots show FNMR by age group for two operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.2. Given a pair of face images taken at different times, we assign the comparison to the bin that is the arithmetic average of the subject's ages. This plot shows only the effect of age, not ageing. The number of comparisons in each bin is generally in the thousands, however the first and last bins are computed over 149 and 124 respectively. The error rates in some (adult) cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

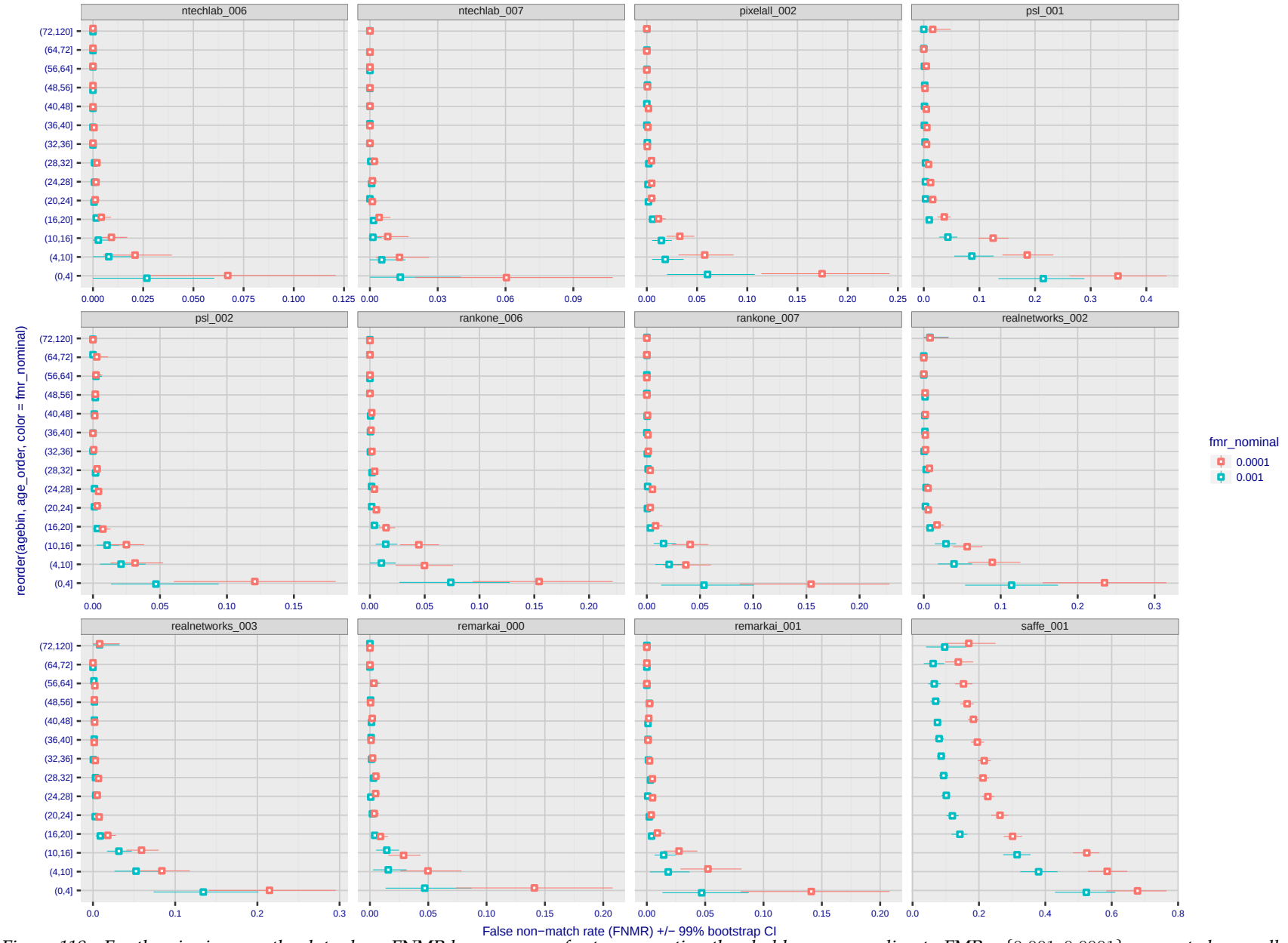

Figure 118: For the visa images, the dots show FNMR by age group for two operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.2. Given a pair of face images taken at different times, we assign the comparison to the bin that is the arithmetic average of the subject's ages. This plot shows only the effect of age, not ageing. The number of comparisons in each bin is generally in the thousands, however the first and last bins are computed over 149 and 124 respectively. The error rates in some (adult) cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

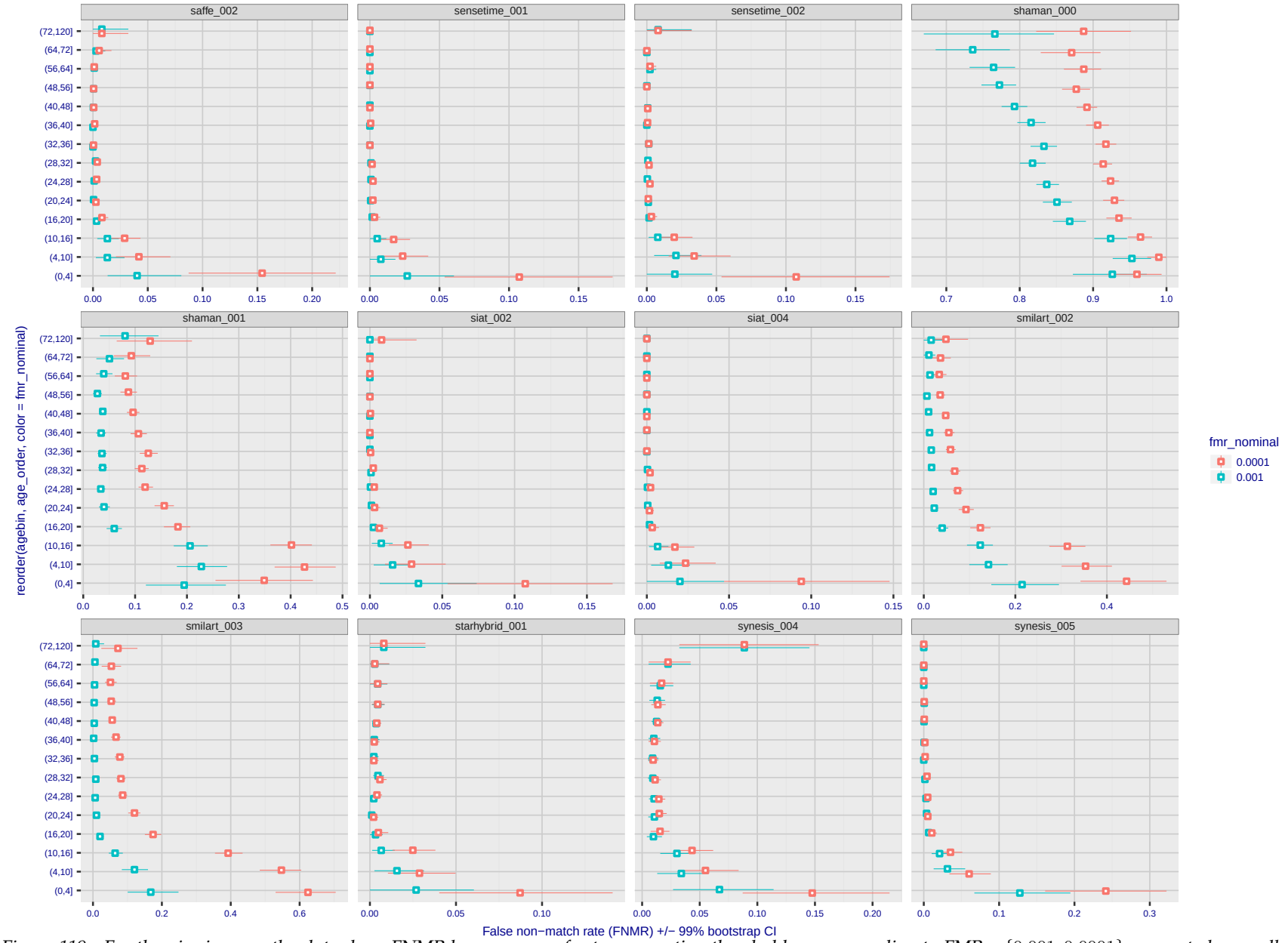

Figure 119: For the visa images, the dots show FNMR by age group for two operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.2. Given a pair of face images taken at different times, we assign the comparison to the bin that is the arithmetic average of the subject's ages. This plot shows only the effect of age, not ageing. The number of comparisons in each bin is generally in the thousands, however the first and last bins are computed over 149 and 124 respectively. The error rates in some (adult) cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

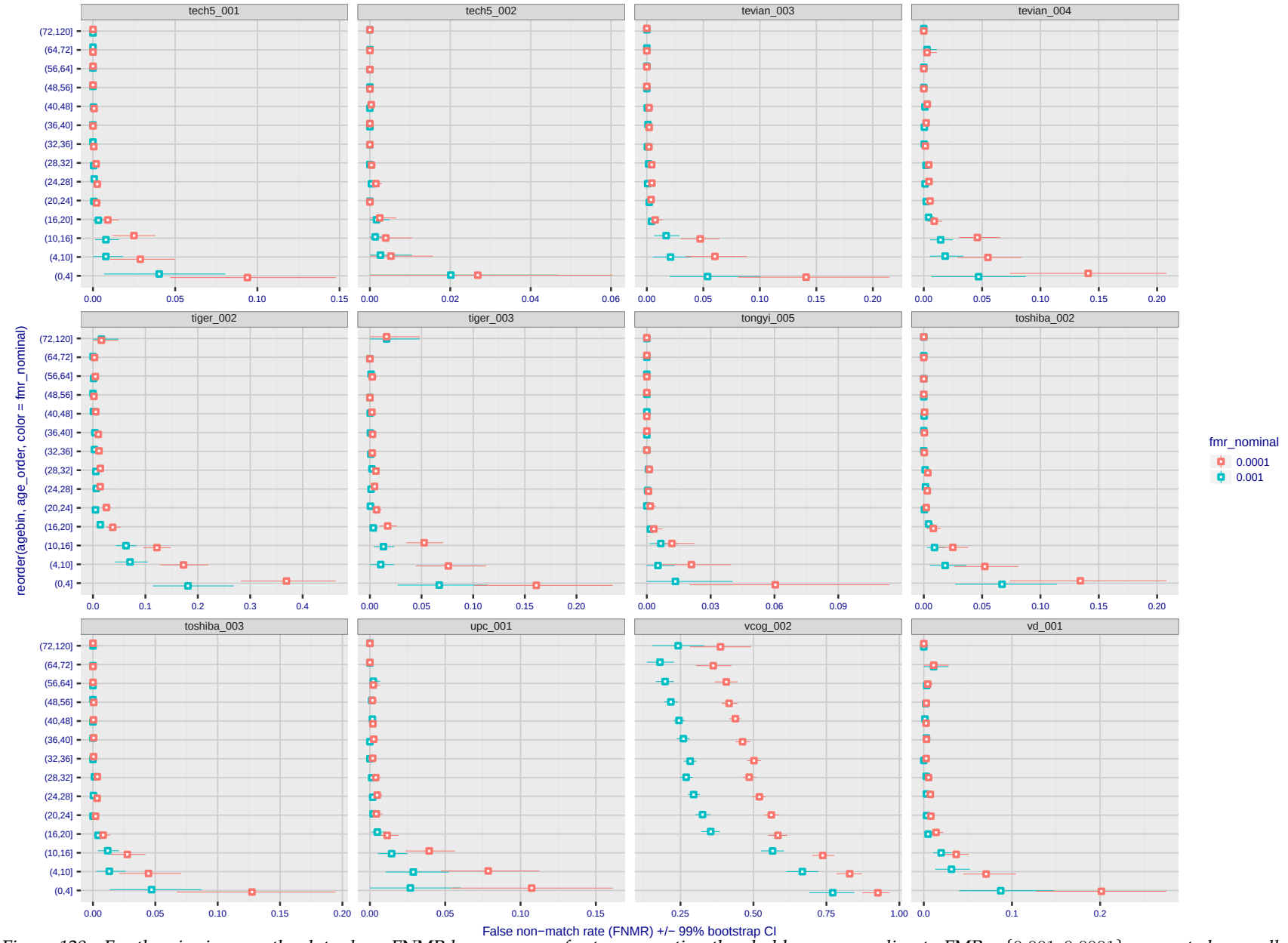

Figure 120: For the visa images, the dots show FNMR by age group for two operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.2. Given a pair of face images taken at different times, we assign the comparison to the bin that is the arithmetic average of the subject's ages. This plot shows only the effect of age, not ageing. The number of comparisons in each bin is generally in the thousands, however the first and last bins are computed over 149 and 124 respectively. The error rates in some (adult) cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

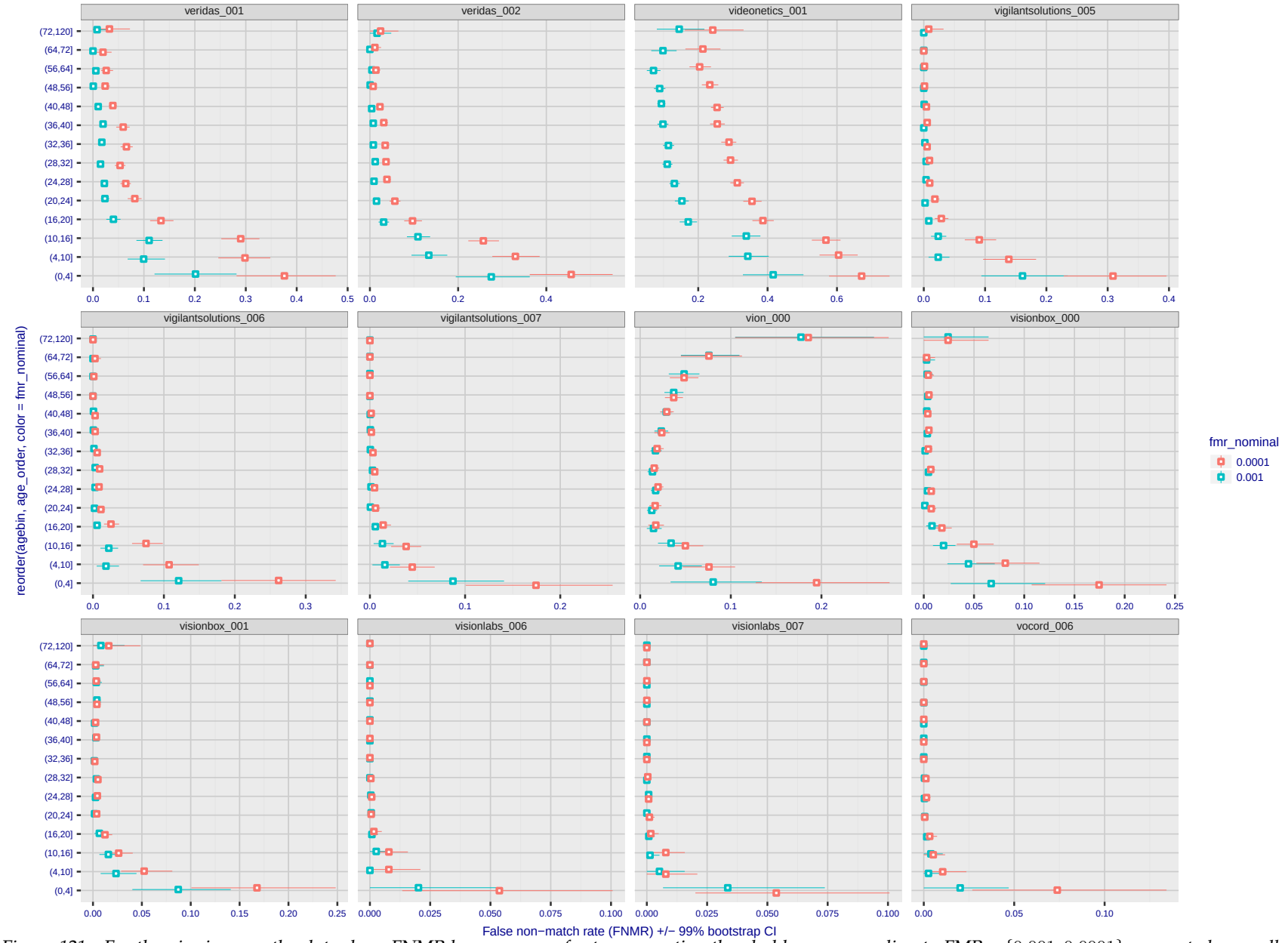

Figure 121: For the visa images, the dots show FNMR by age group for two operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.2. Given a pair of face images taken at different times, we assign the comparison to the bin that is the arithmetic average of the subject's ages. This plot shows only the effect of age, not ageing. The number of comparisons in each bin is generally in the thousands, however the first and last bins are computed over 149 and 124 respectively. The error rates in some (adult) cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

Figure 122: For the visa images, the dots show FNMR by age group for two operating thresholds corresponding to FMR = $\{0.001, 0.0001\}$ computed over all on the order of 10^{10} impostor scores. The FMR in each bin will vary also - see subsequent impostor heatmaps in sec. 3.6.2. Given a pair of face images taken at different times, we assign the comparison to the bin that is the arithmetic average of the subject's ages. This plot shows only the effect of age, not ageing. The number of comparisons in each bin is generally in the thousands, however the first and last bins are computed over 149 and 124 respectively. The error rates in some (adult) cases are zero, and in others the DET is flat so the error rates at the two thresholds are identical. The lines span 1% and 99% of boostrap replicated FNMR estimates.

Caveats: None.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

3.6 Impostor distribution stability

3.6.1 Effect of birth place on the impostor distribution

Background: Facial appearance varies geographically, both in terms of skin tone, cranio-facial structure and size. This section addresses whether false match rates vary intra- and inter-regionally.

Goals:

- ▷ To show the effect of birth region of the impostor and enrollee on false match rates.
- ▷ To determine whether some algorithms give better impostor distribution stability.

Methods:

- ▷ For the visa images, NIST defined 10 regions: Sub-Saharan Africa, South Asia, Polynesia, North Africa, Middle East, Europe, East Asia, Central and South America, Central Asia, and the Caribbean.
- ▷ For the visa images, NIST mapped each country of birth to a region. There is some arbitrariness to this. For example, Egypt could reasonably be assigned to the Middle East instead of North Africa. An alternative methodology could, for example, assign the Philippines to *both* Polynesia and East Asia.
- ▷ FMR is computed for cases where all face images of impostors born in region r_2 are compared with enrolled face images of persons born in region r_1.

$$\text{FMR}(r_1, r_2, T) = \frac{\sum_{i=1}^{N_{r_1,r_2}} H(s_i - T)}{N_{r_1,r_2}} \tag{5}$$

  where the same threshold, T, is used in all cells, and H is the unit step function. The threshold is set to give FMR(T) = 0.001 over the entire set of visa image impostor comparisons.
- ▷ This analysis is then repeated by country-pair, but only for those country pairs where both have at least 1000 images available. The countries[1] appear in the axes of graphs that follow.
- ▷ The mean number of impostor scores in any cross-region bin is 33 million. The smallest number of impostor scores in any bin is 135000, for Central Asia - North Africa. While these counts are large enough to support reasonable significance, the number of individual faces is much smaller, on the order of $N^{0.5}$.
- ▷ The numbers of impostor scores in any cross-country bin is shown in Figure 350.

Results: Subsequent figures show heatmaps that use color to represent the base-10 logarithm of the false match rate. Red colors indicate high (bad) false match rates. Dark colors indicate benign false match rates. There are two series of graphs corresponding to aggregated geographical regions, and to countries. The notable observations are:

- ▷ The on-diagonal elements correspond to within-region impostors. FMR is generally above the nominal value of FMR = 0.001. Particularly there is usually higher FMR in, Sub-Saharan Africa, South Asia, and the Caribbean. Europe and Central Asia, on the other hand, usually give FMR closer to the nominal value.
- ▷ The off-diagonal elements correspond to across-region impostors. The highest FMR is produced between the Caribbean and Sub-Saharan Africa.
- ▷ Algorithms vary.

[1] These are Argentina, Australia, Brazil, Chile, China, Costa Rica, Cuba, Czech Republic, Dominican Republic, Ecuador, Egypt, El Salvador, Germany, Ghana, Great Britain, Greece, Guatamala, Haiti, Hong Kong, Honduras, Indonesia, India, Israel, Jamaica, Japan, Kenya, Korea, Lebanon, Mexico, Malaysia, Nepal, Nigeria, Peru, Philippines, Pakistan, Poland, Romania, Russia, South Africa, Saudi Arabia, Thailand, Trinidad, Turkey, Taiwan, Ukraine, Venezuela, and Vietnam.

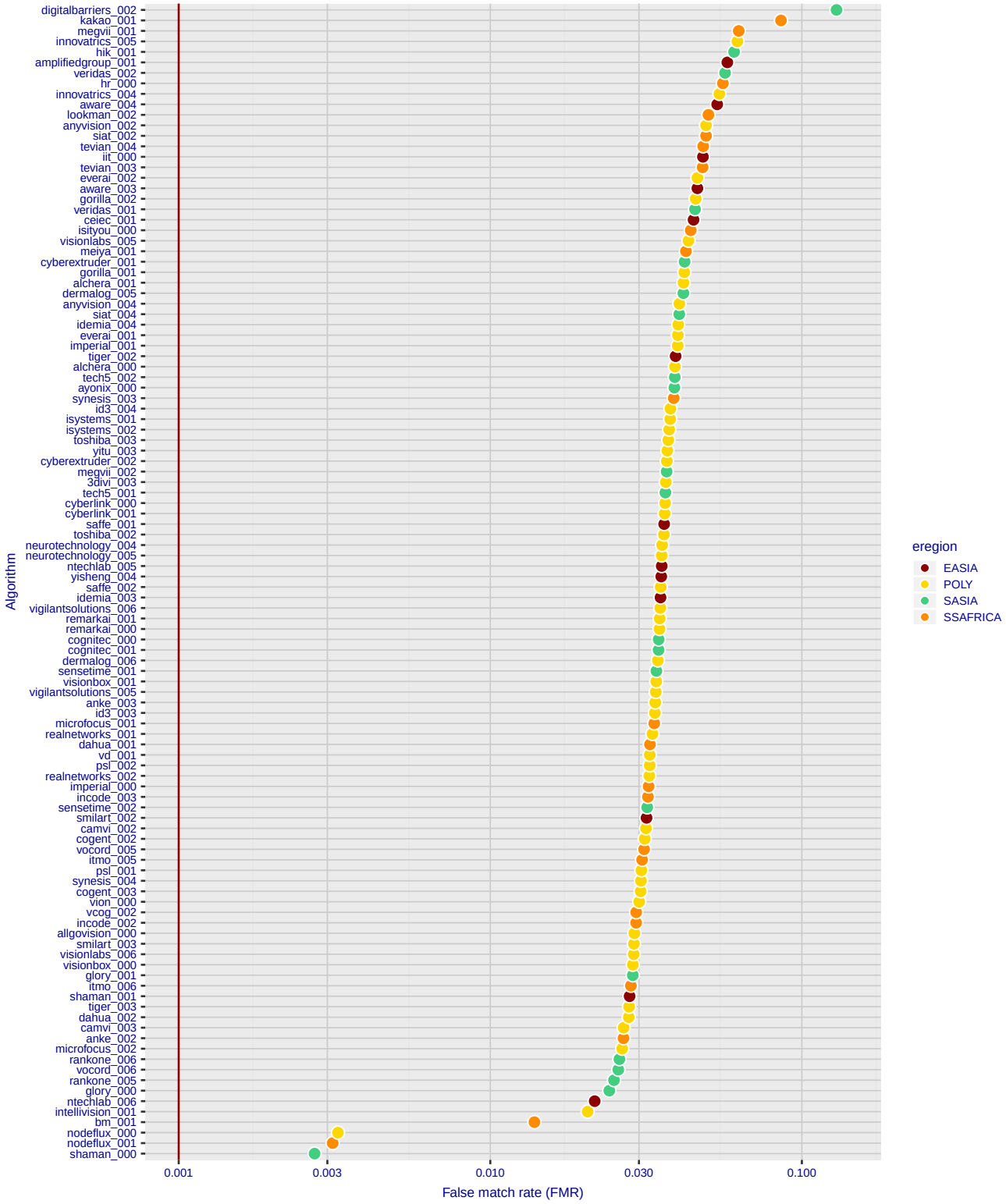

Figure 123: For the visa images, the dots show FMR for impostor comparisons of individuals of the same sex and same age group for the region of the world that gives the worst (highest) FMR when the threshold is set to give FMR = 0.001 (red vertical line) over all on the order of 10^{10} impostor scores i.e. zero-effort. The shift of the dots to right shows massive increases in FMR when impostors have the same sex, age, and region of birth. The color code indicates which region gives the worst case FMR. If the observed variation is due to the prevalence of one kind of images in the training imagery, then algorithms developed on one kind of data might be expected to give higher FMR on other kinds.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

▷ We computed the same quantities for a global FMR = 0.0001. The effects are similar.

Caveats:

▷ The effects of variable impostor rates on one-to-many identification systems may well differ from what's implied by these one-to-one verification results. Two reasons for this are a) the enrollment galleries are usually imbalanced across countries of birth, age and sex; b) one-to-many identification algorithms often implement techniques aimed at stabilizing the impostor distribution. Further research is necessary.

▷ In principle, the effects seen in this subsection could be due to differences in the image capture process. We consider this unlikely since the effects are maintained across geography - e.g. Caribbean vs. Africa, or Japan vs. China.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

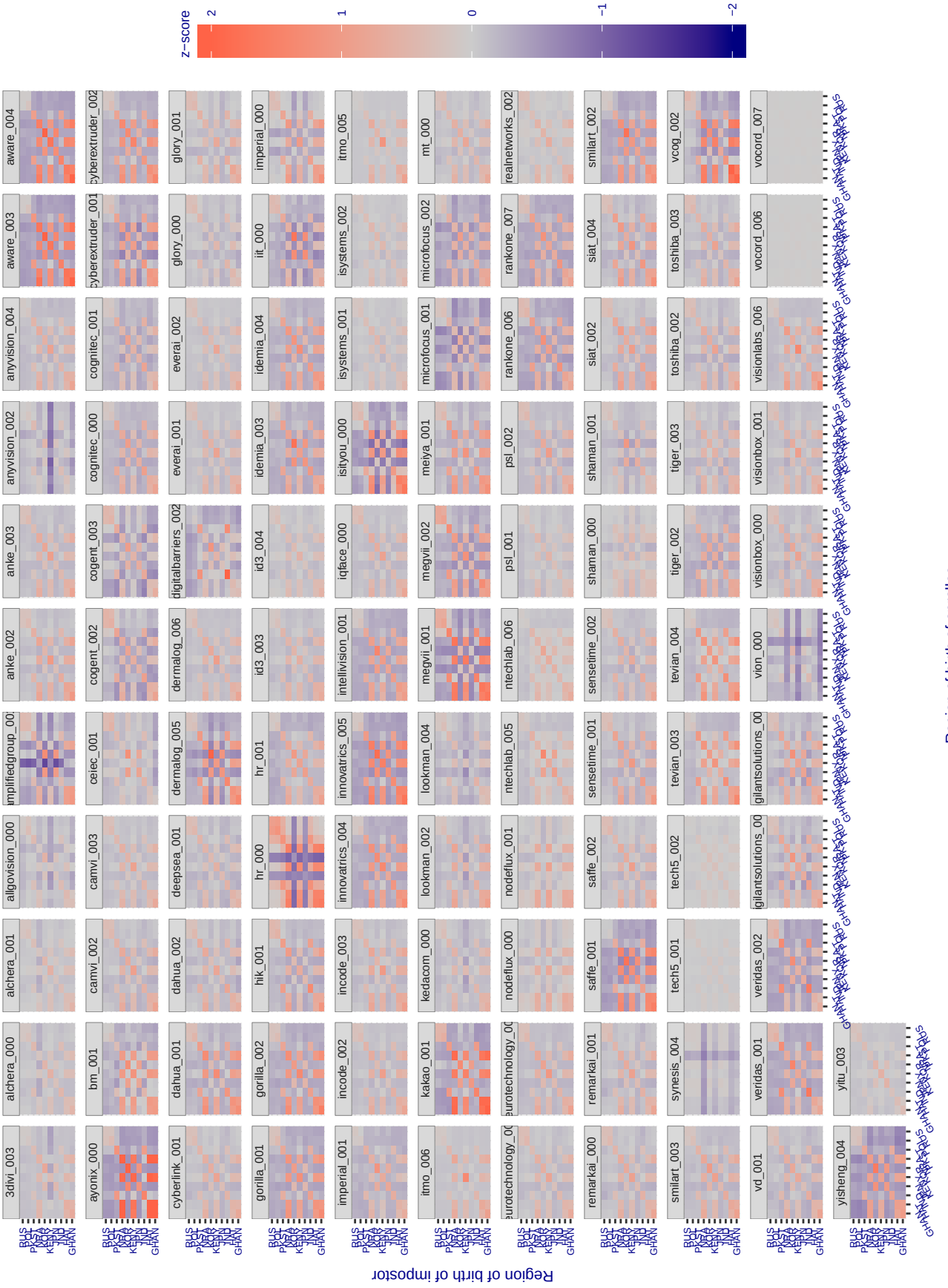

Figure 124: For visa images, the heatmap shows how the mean of the impostor distribution for the country pair (a,b) is shifted relative to the mean of the global impostor distribution, expressed as a number of standard deviations of the global impostor distribution. This statistic is designed to show shifts in the entire impostor distribution, not just tail effects that manifest as the anomalously high (or low) false match rates that appear in the subsequent figures. The countries are chosen to show that skin tone alone does not explain impostor distribution shifts. The reduced shift in Asian populations with the Yitu and TongYiTrans algorithms, is accompanied by positive shifts in the European populations. This reversal relative to most other algorithms, may derive from use of nationally weighted training sets. The Visionlabs algorithm appears most insensitive to country effects. The figure is computed from same-sex and same-age impostor pairs.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

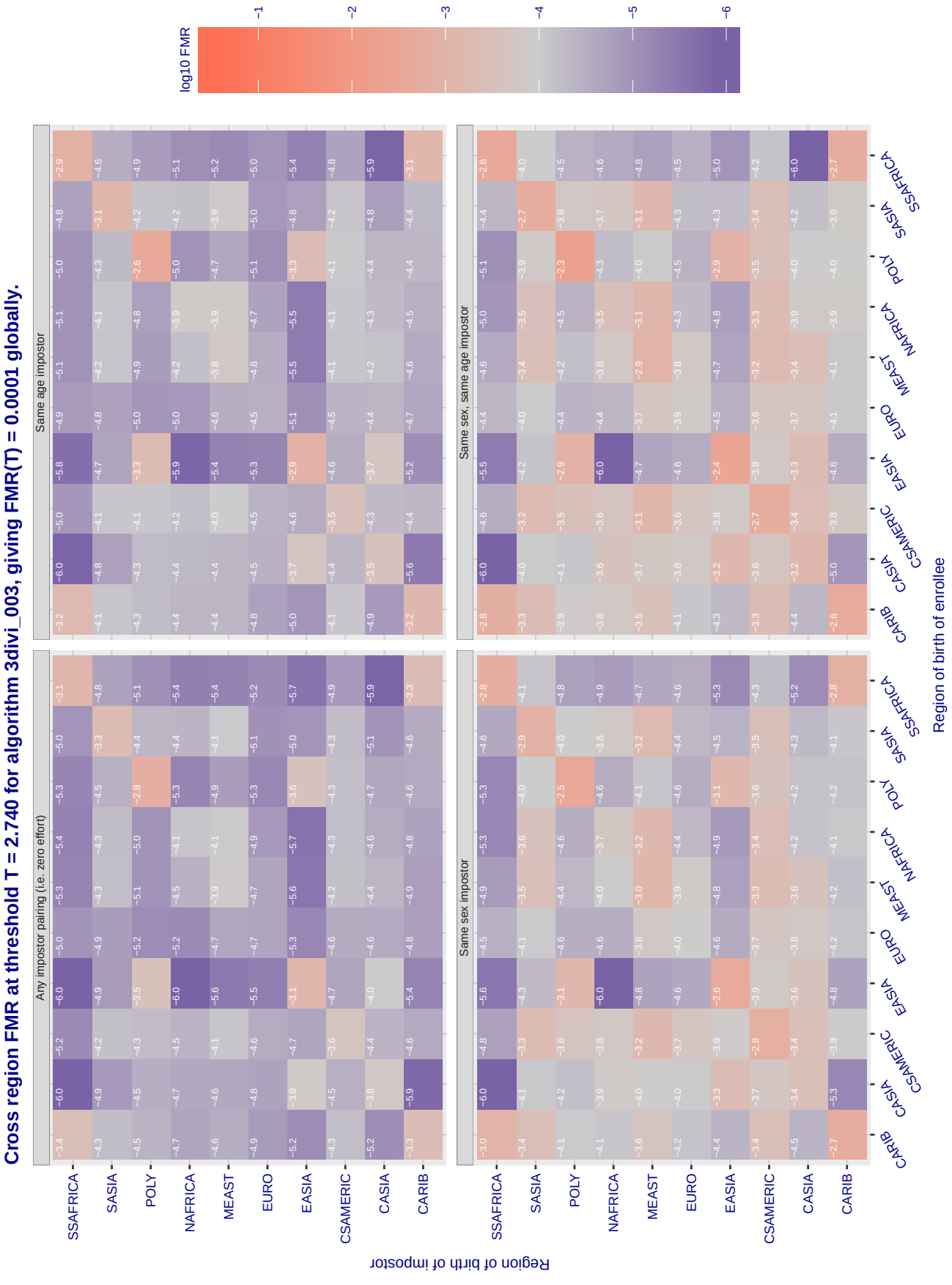

Figure 125: For algorithm 3divi-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

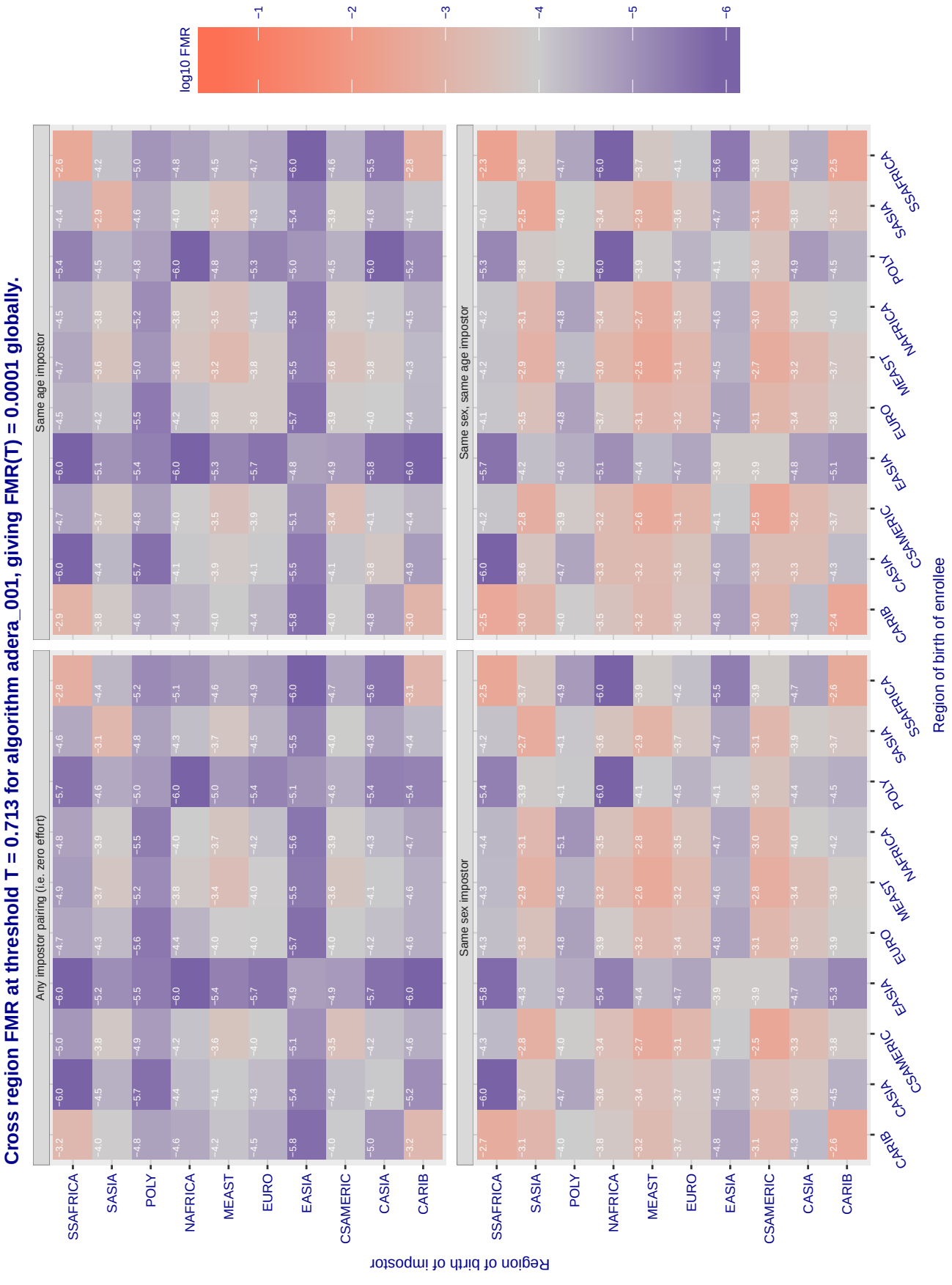

Figure 126: For algorithm adera-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

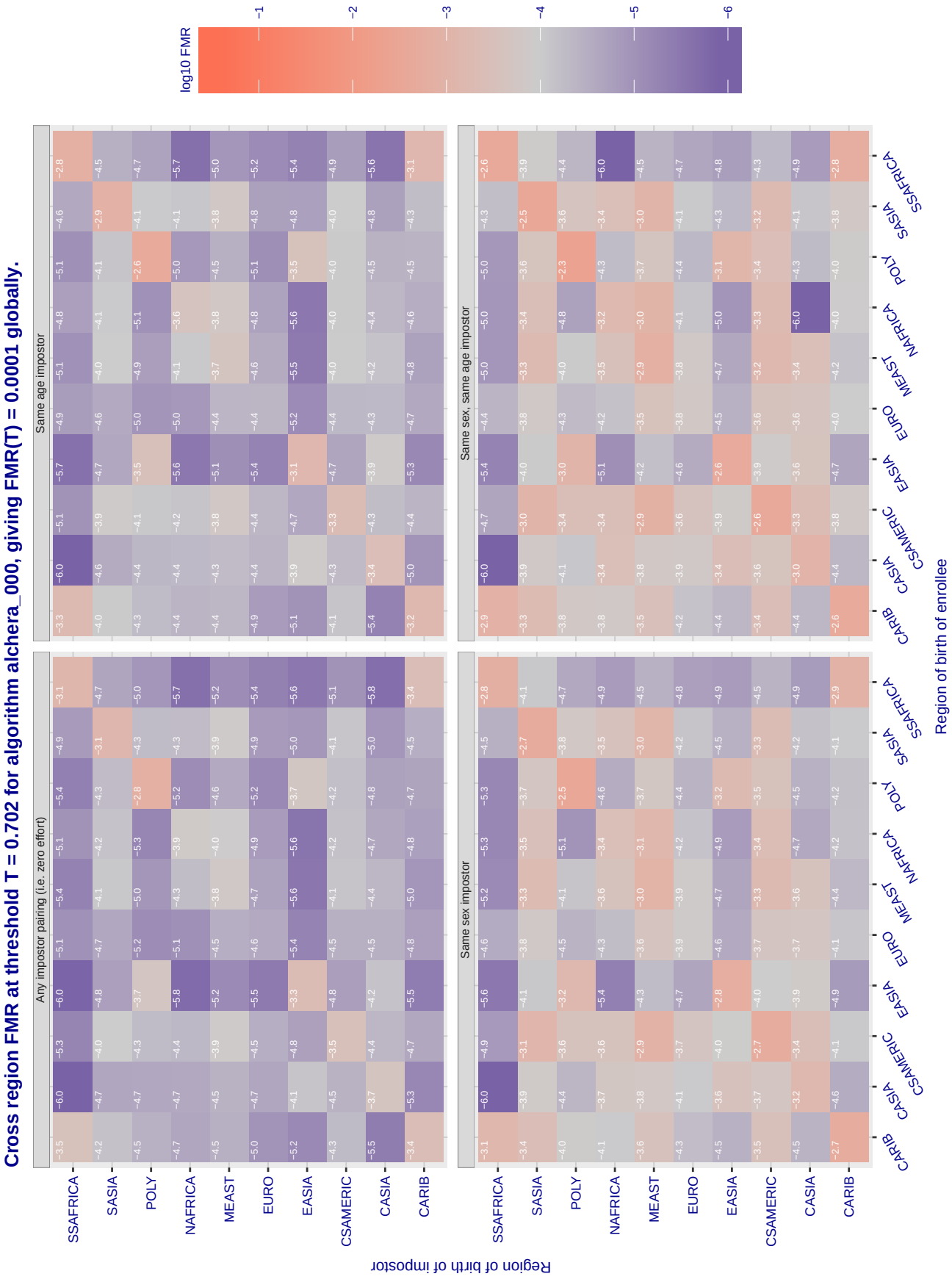

Figure 127: For algorithm alchera-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

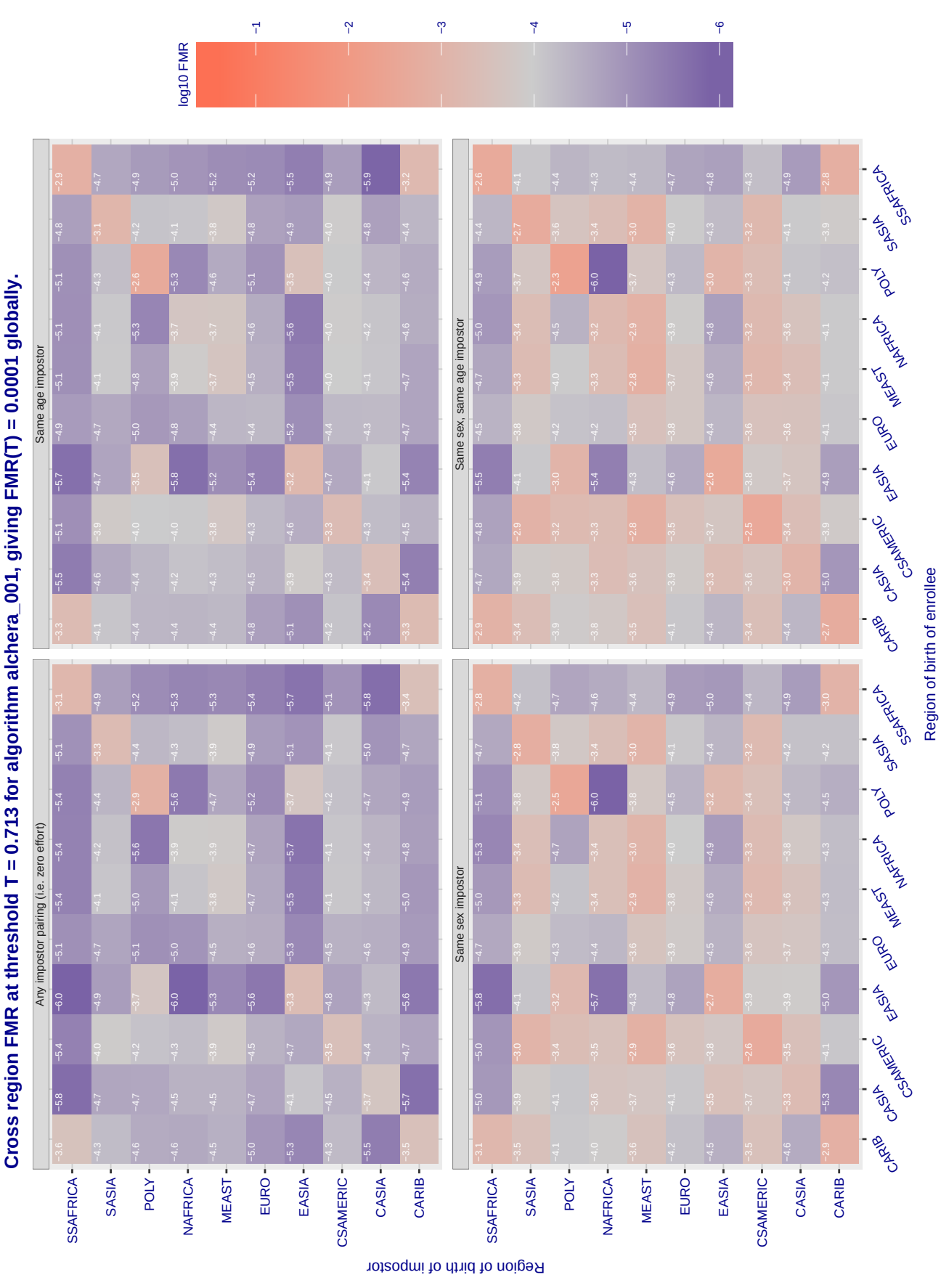

Figure 128: For algorithm alchera-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
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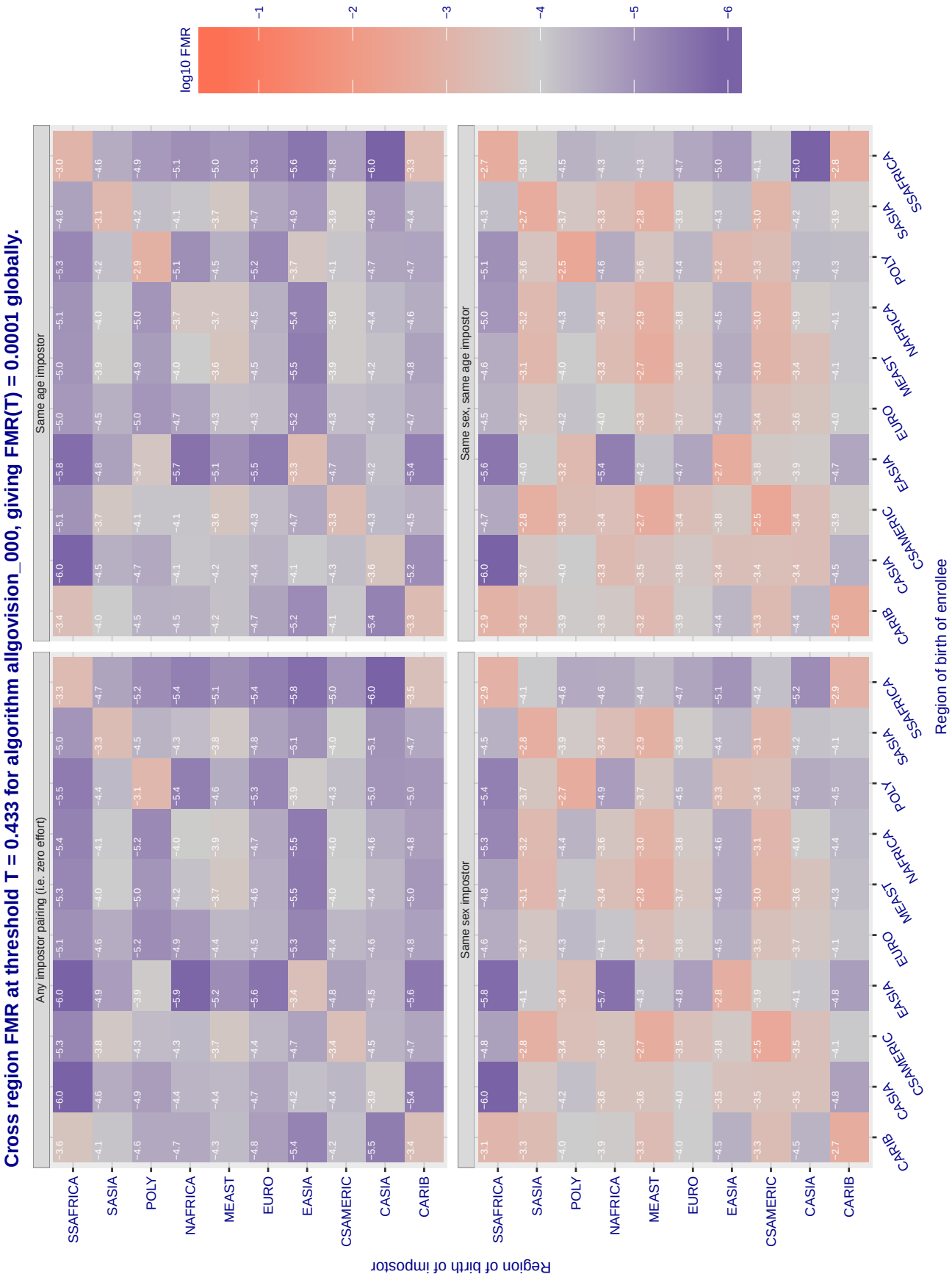


Figure 129: For algorithm allgovision-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

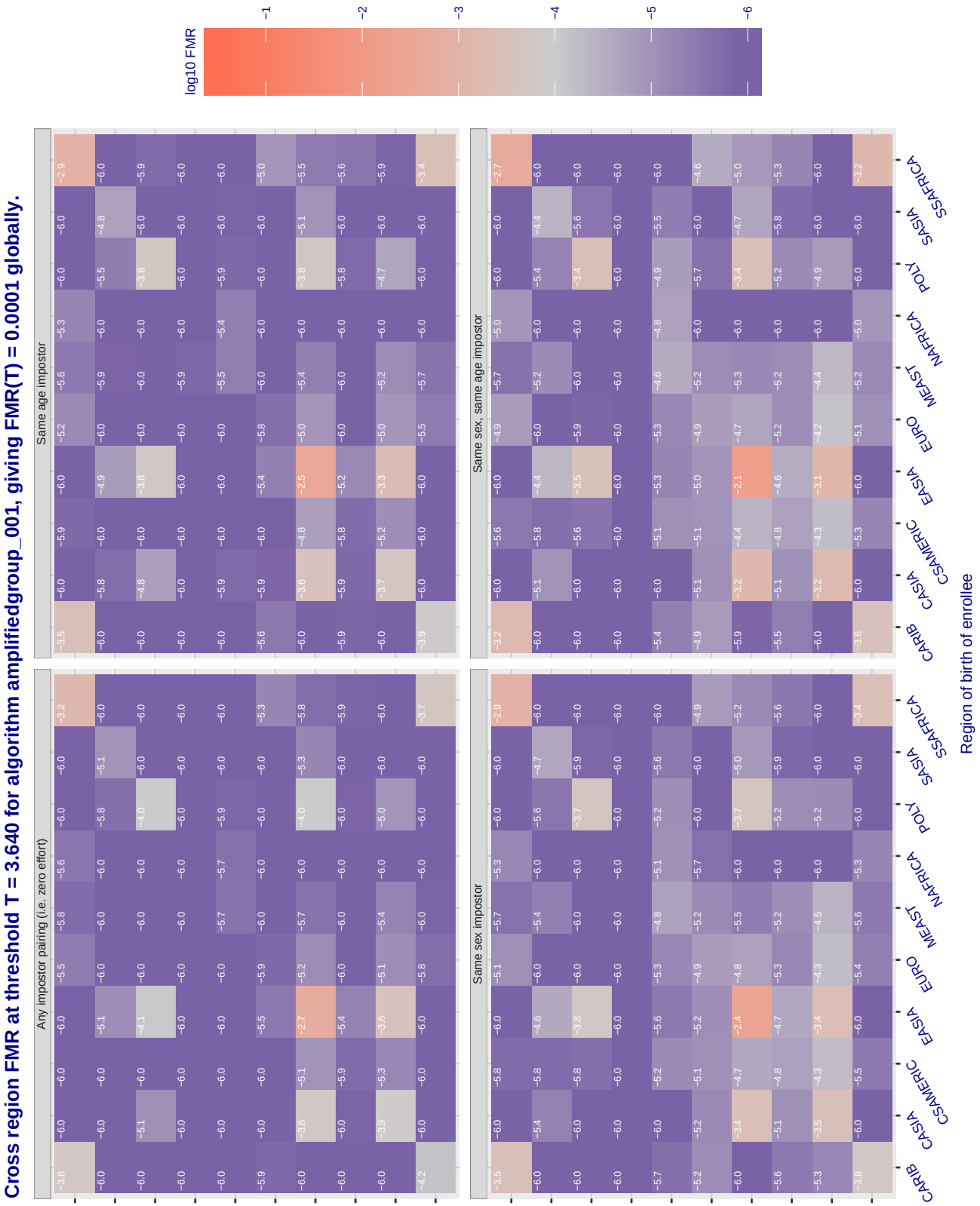


Figure 130: For algorithm amplifiedgroup-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

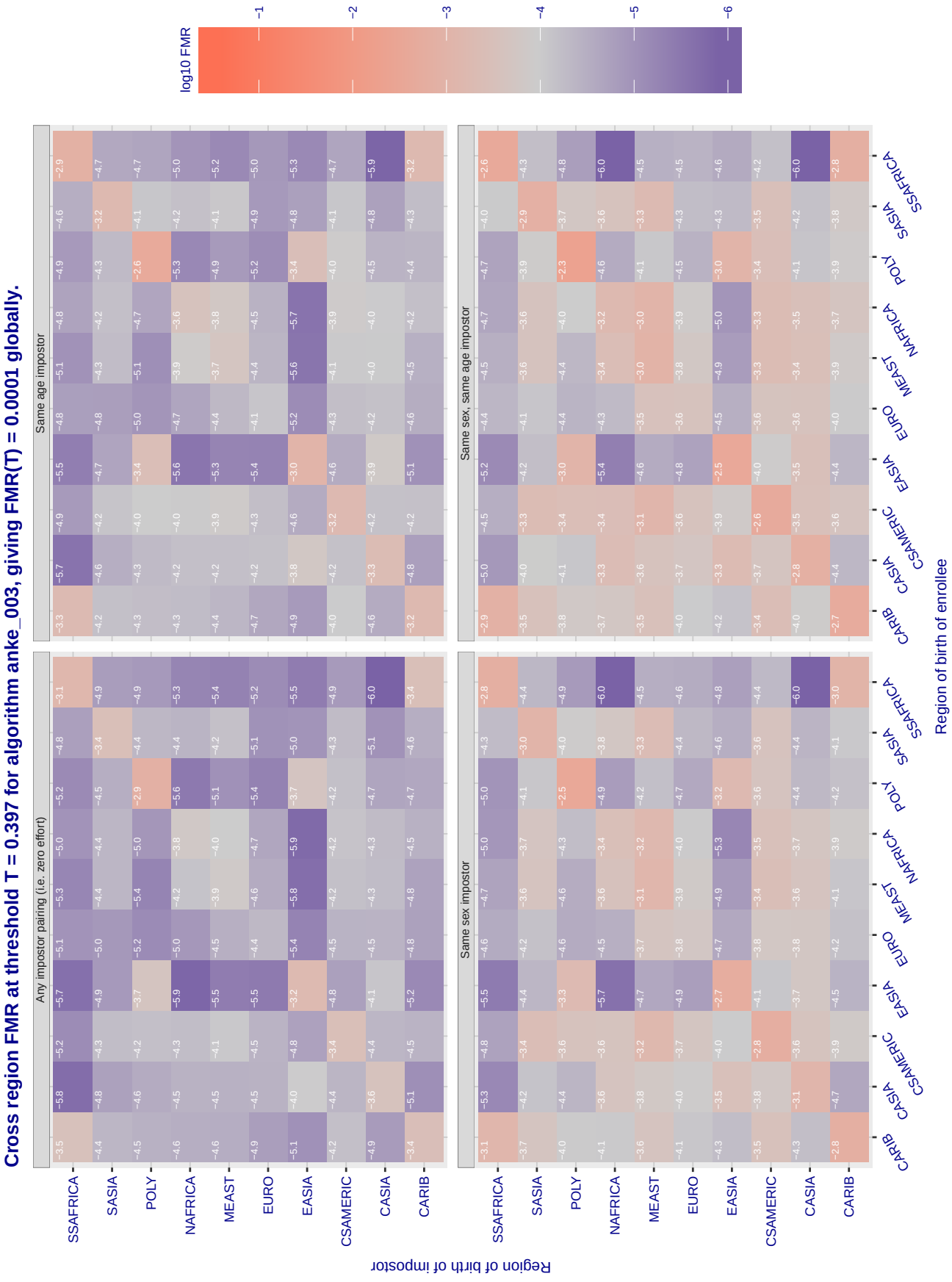


Figure 131: For algorithm anke-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

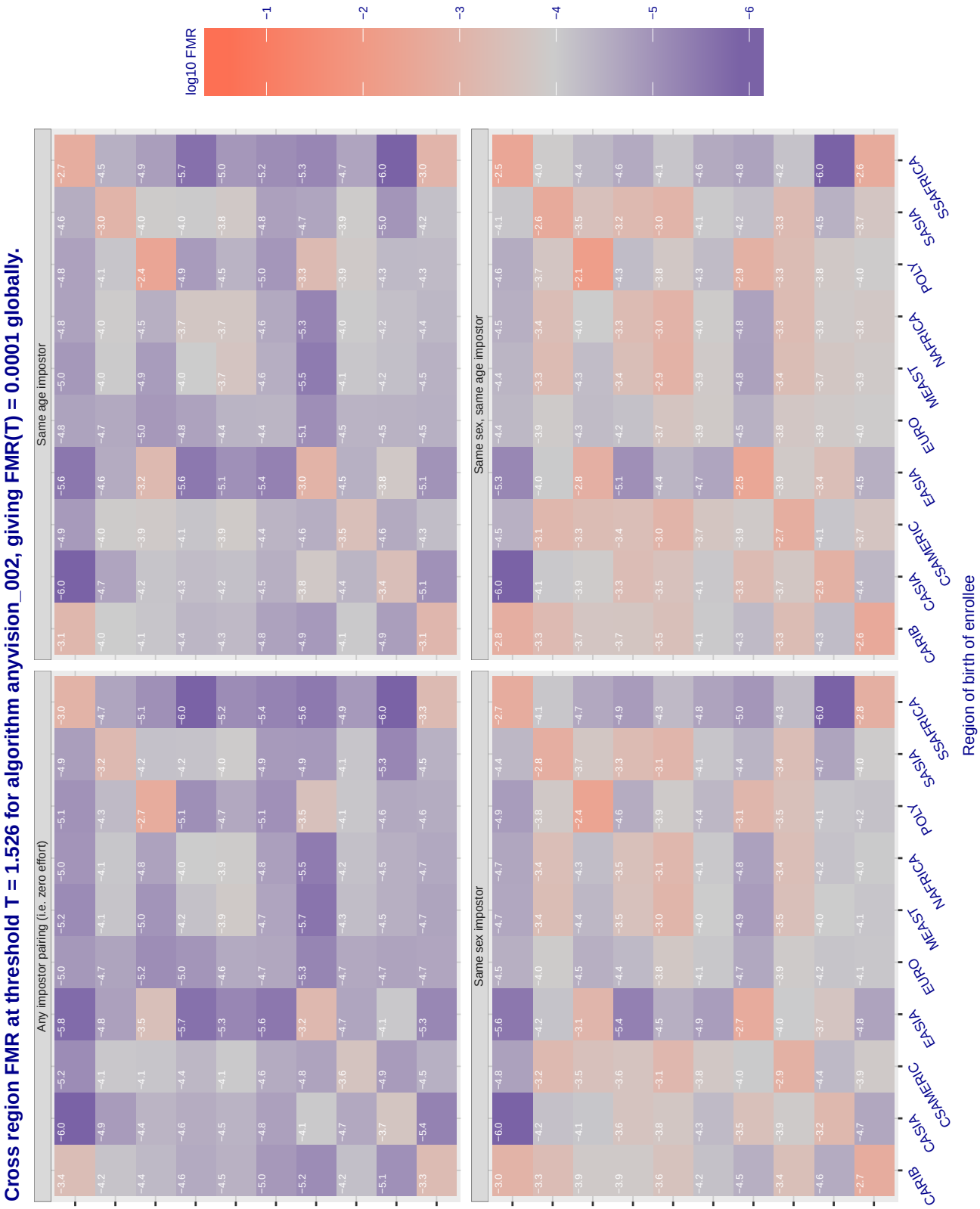


Figure 132: For algorithm anyvision-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

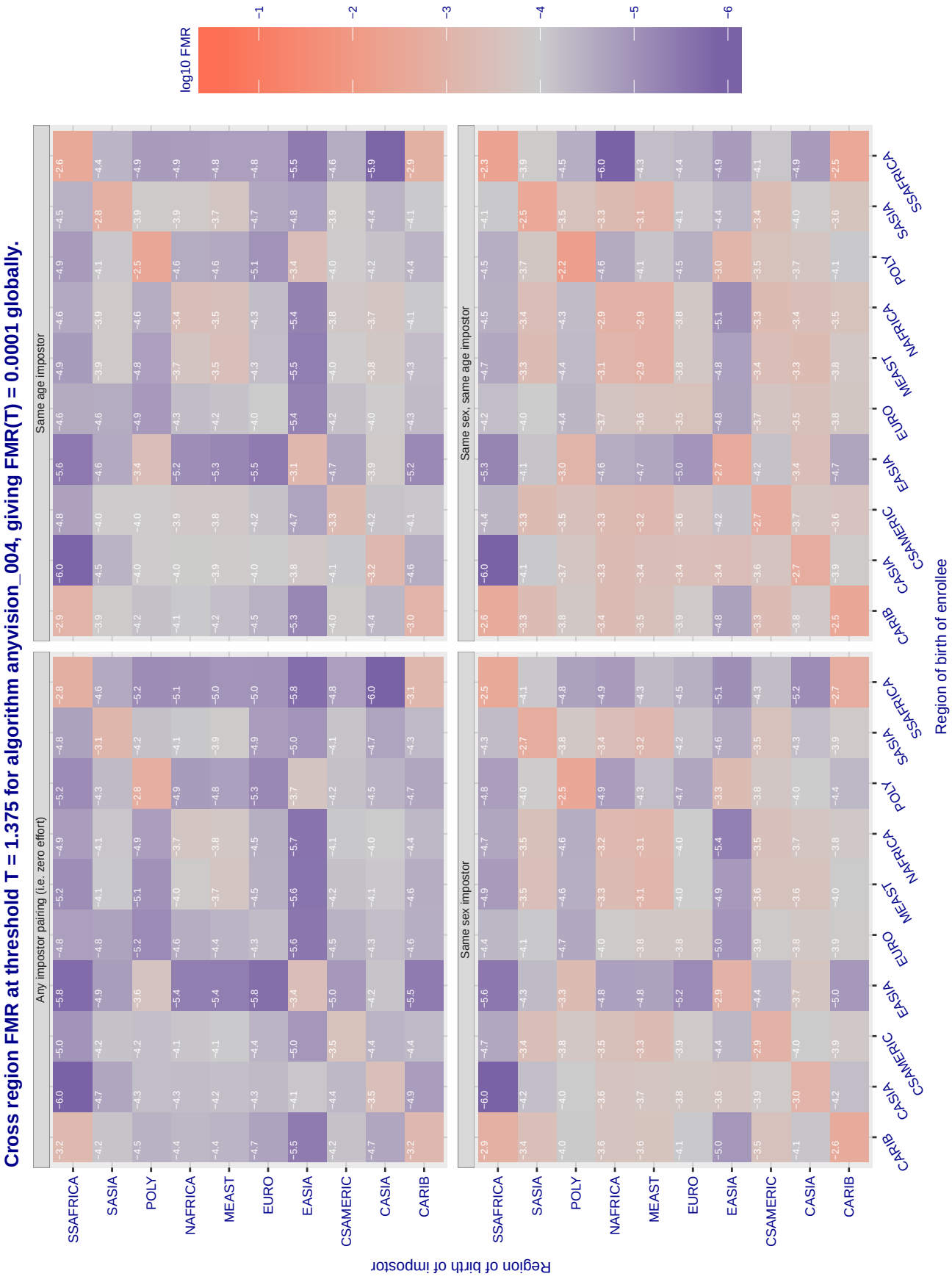


Figure 133: For algorithm anyvision-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

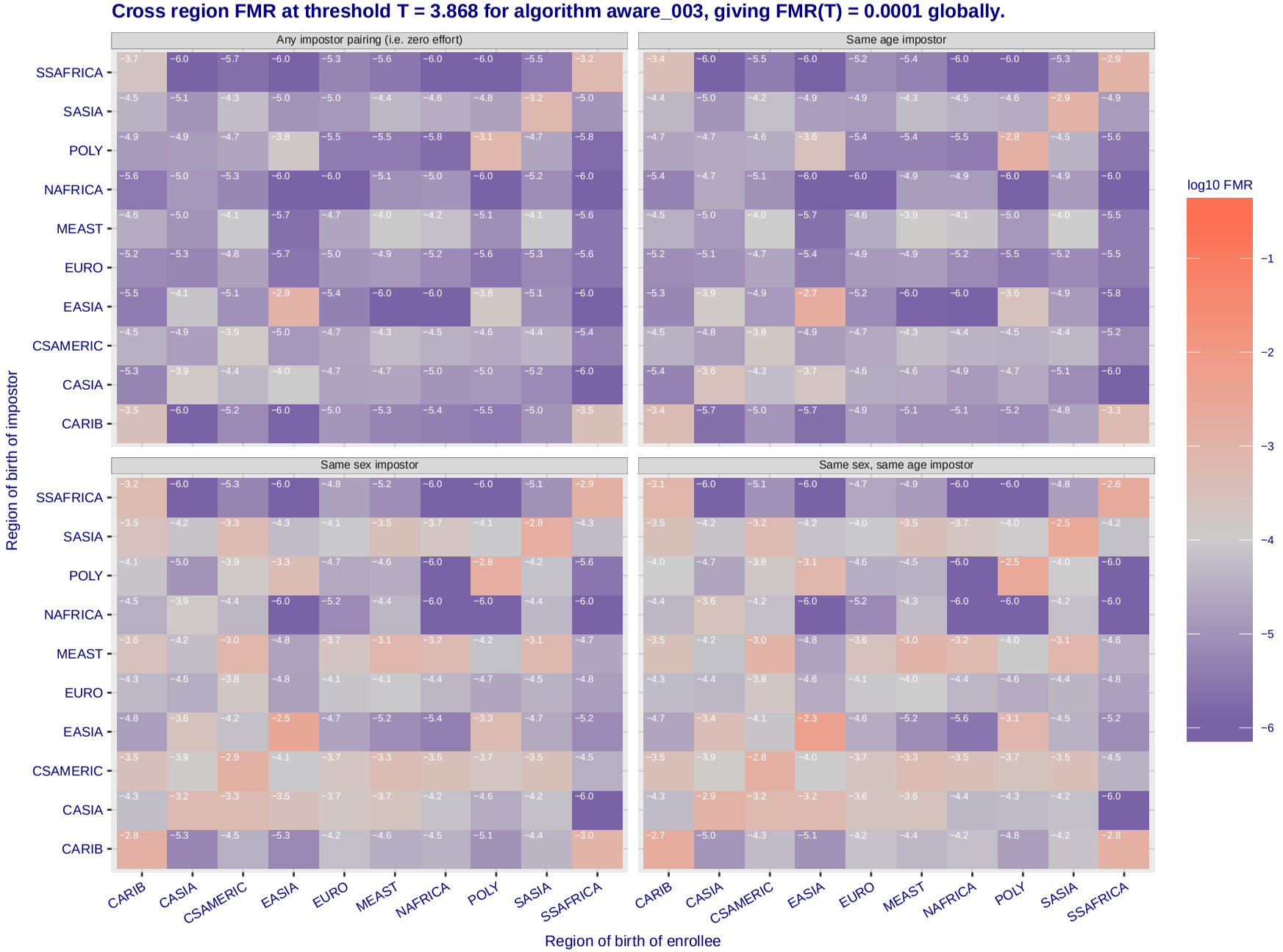


Figure 134: For algorithm aware-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

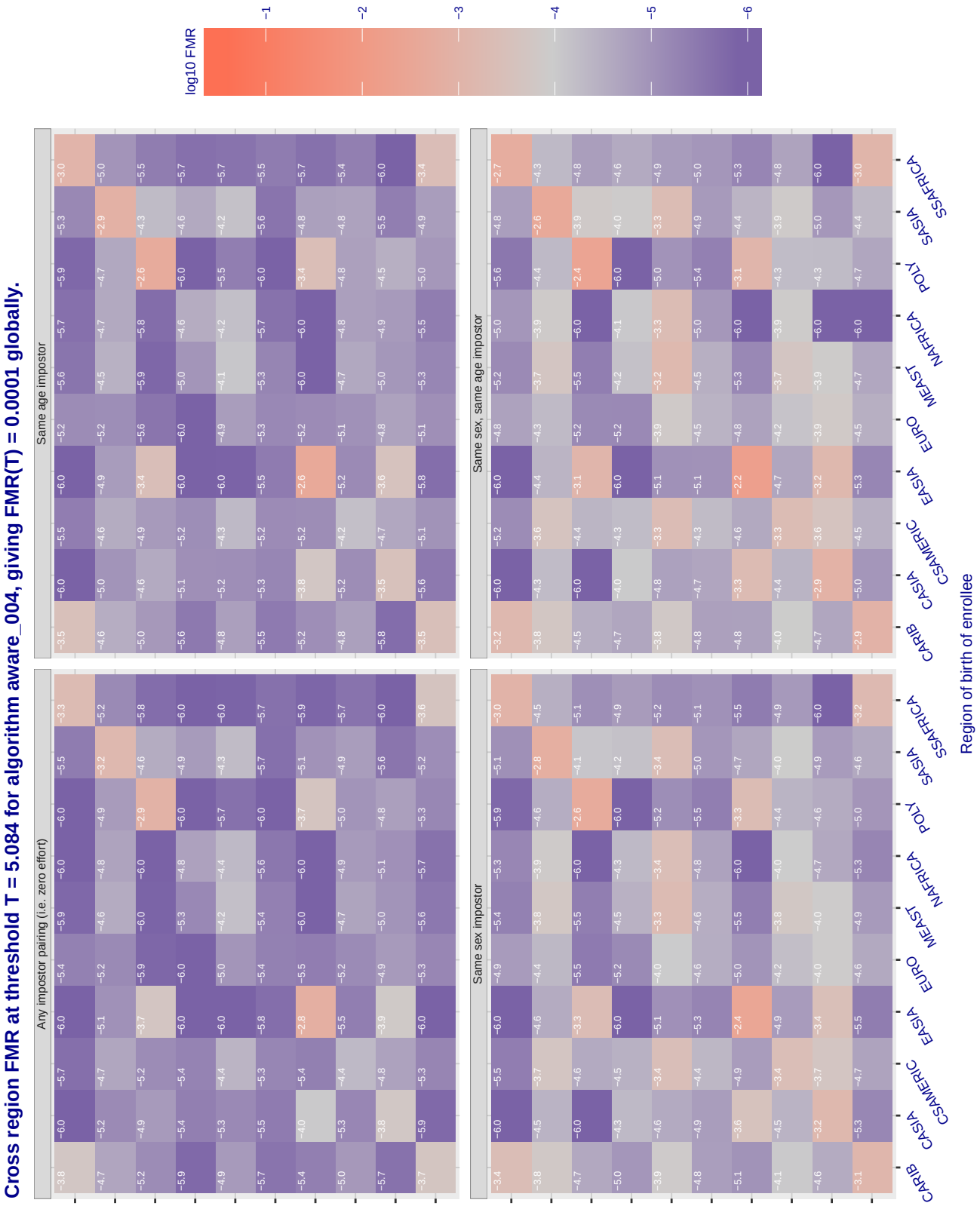


Figure 135: For algorithm aware-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

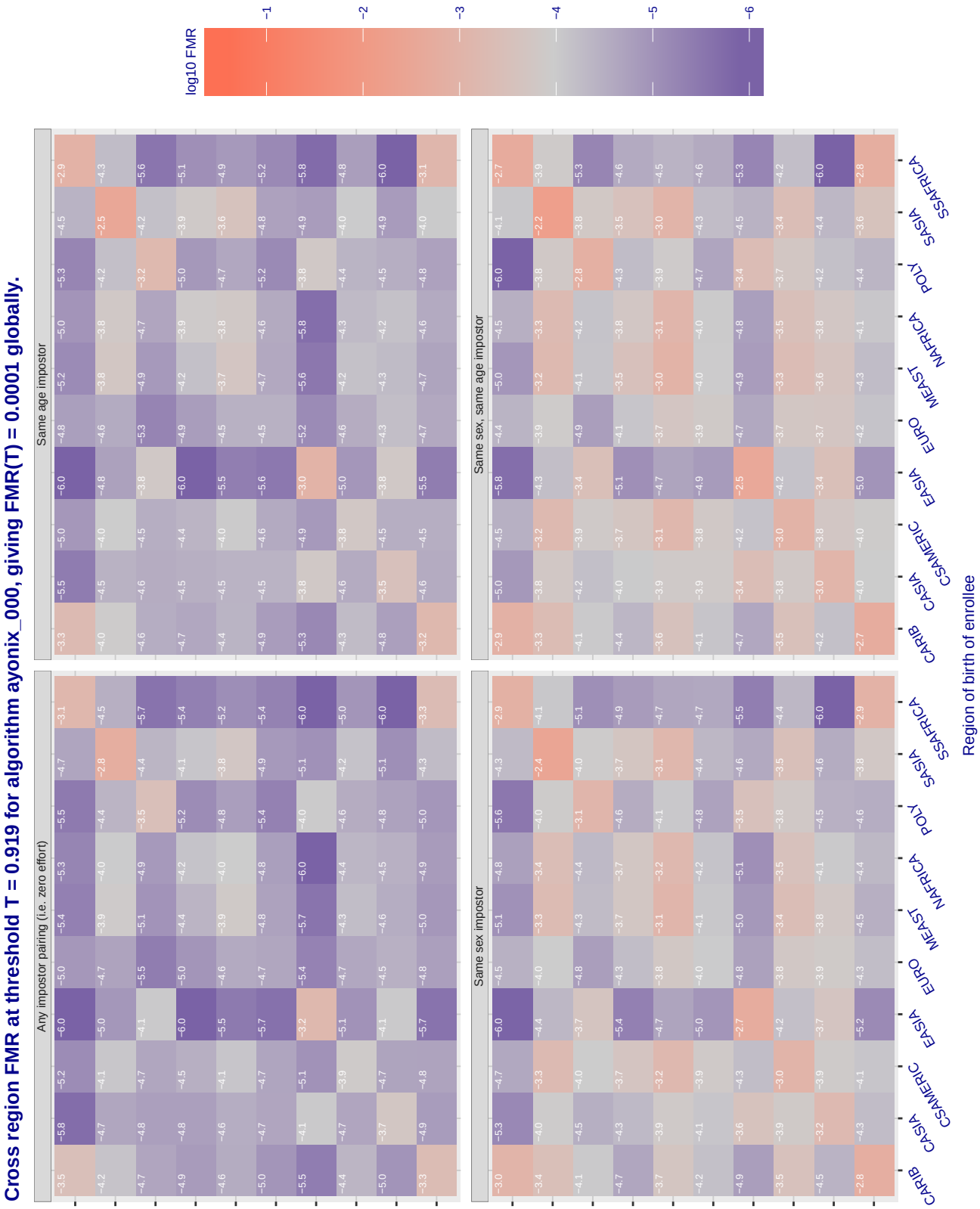


Figure 136: For algorithm ayonix-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

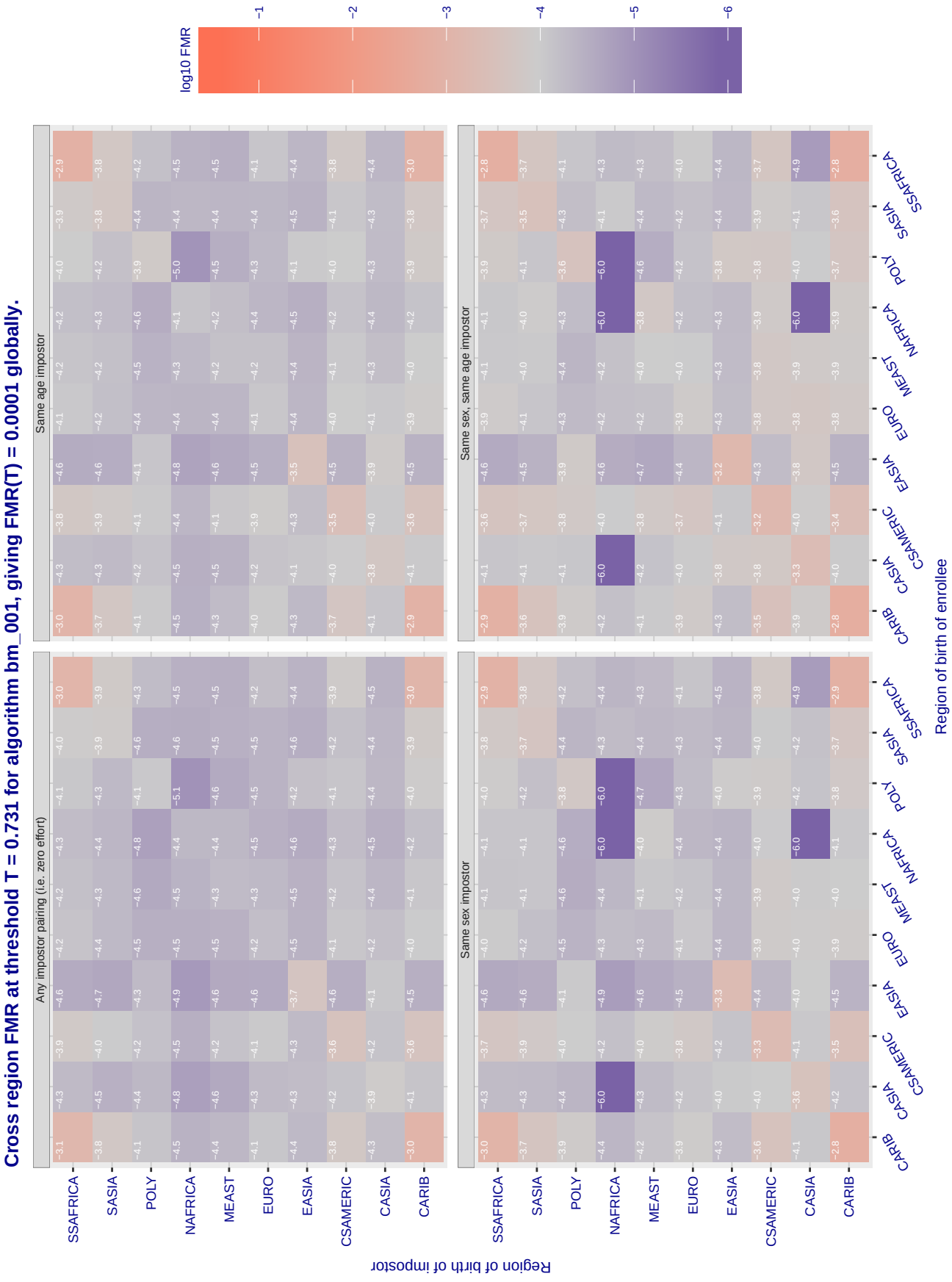


Figure 137: For algorithm bm-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

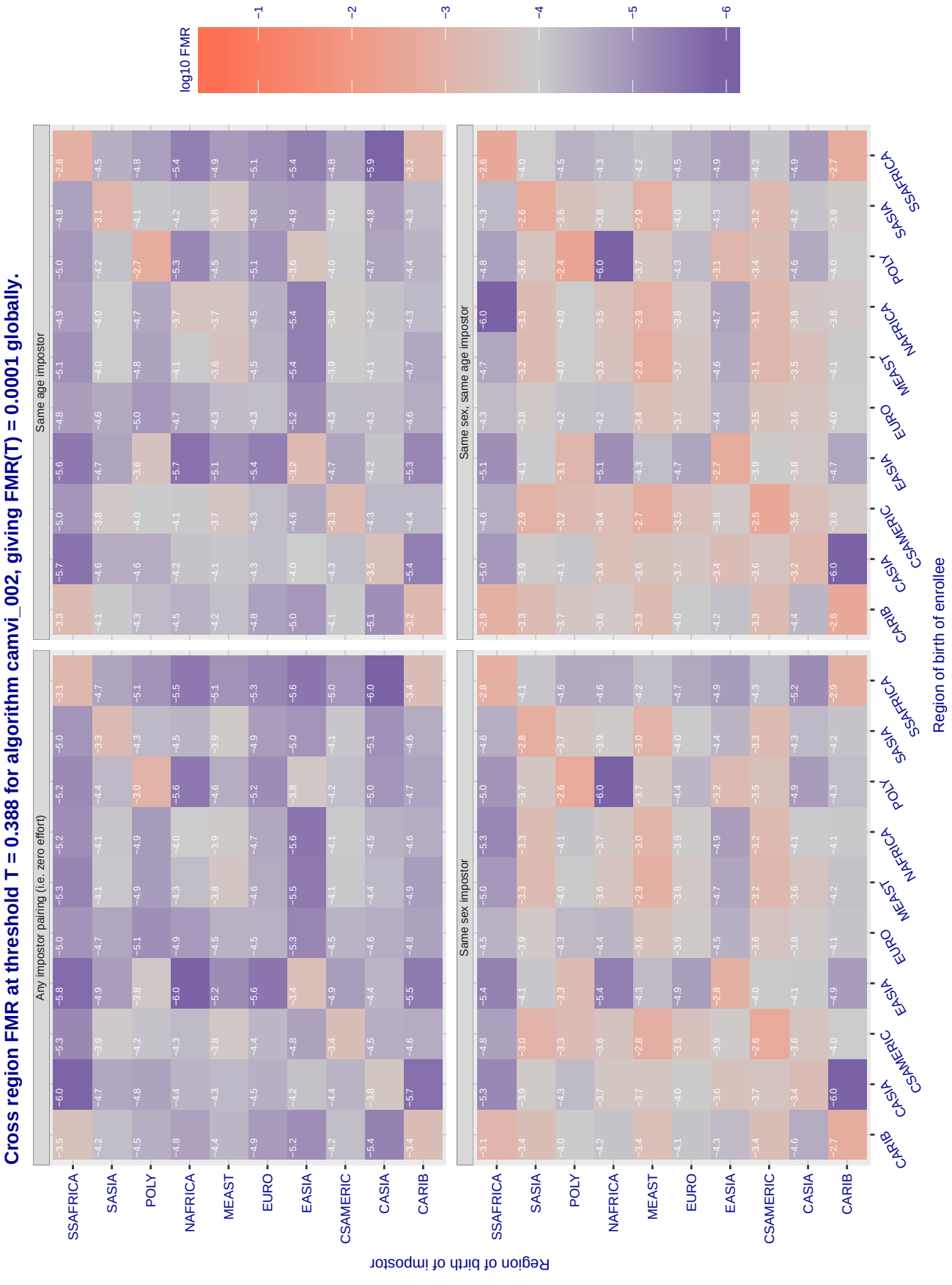


Figure 138: For algorithm camvi-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

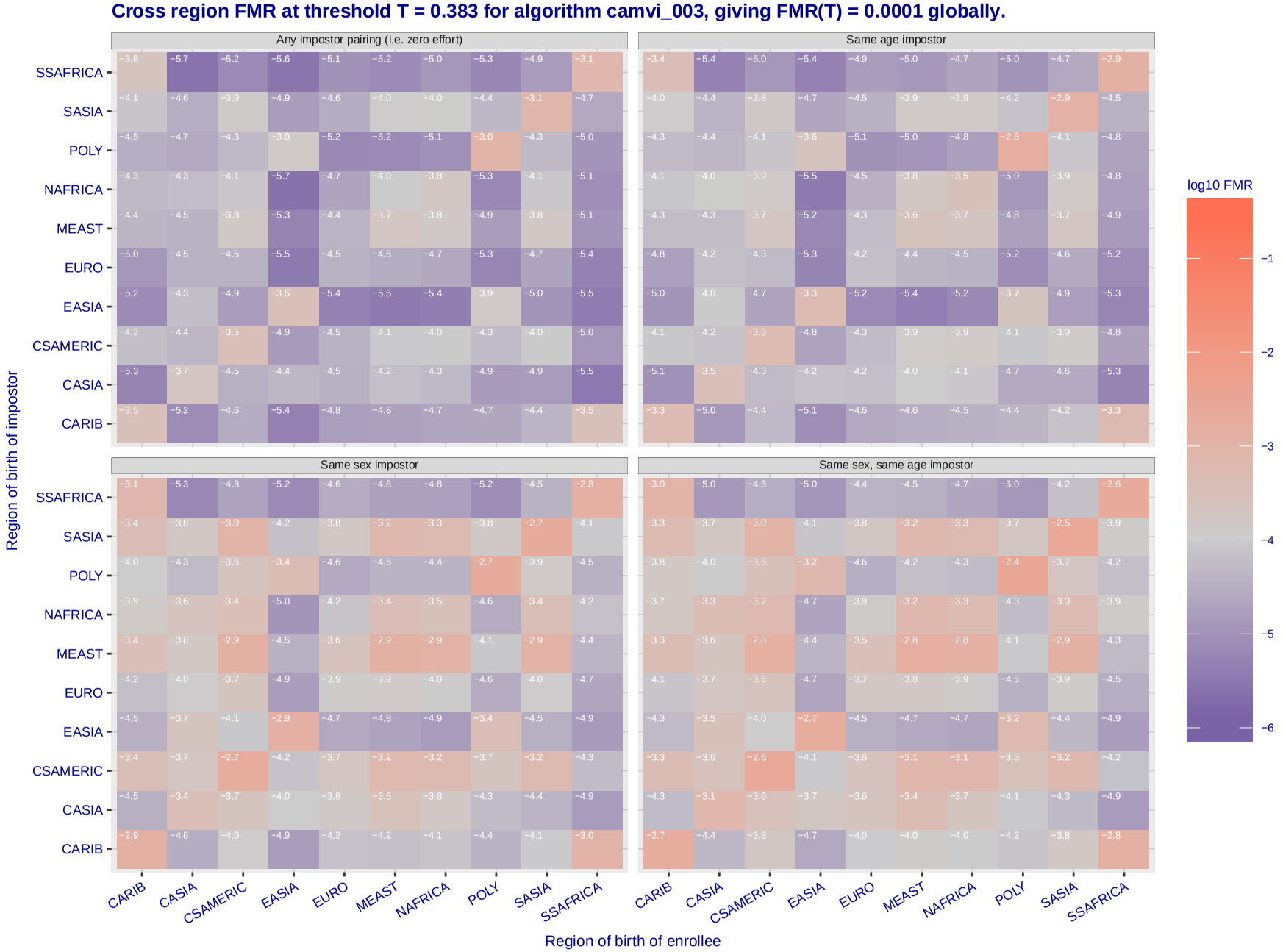


Figure 139: For algorithm camvi-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

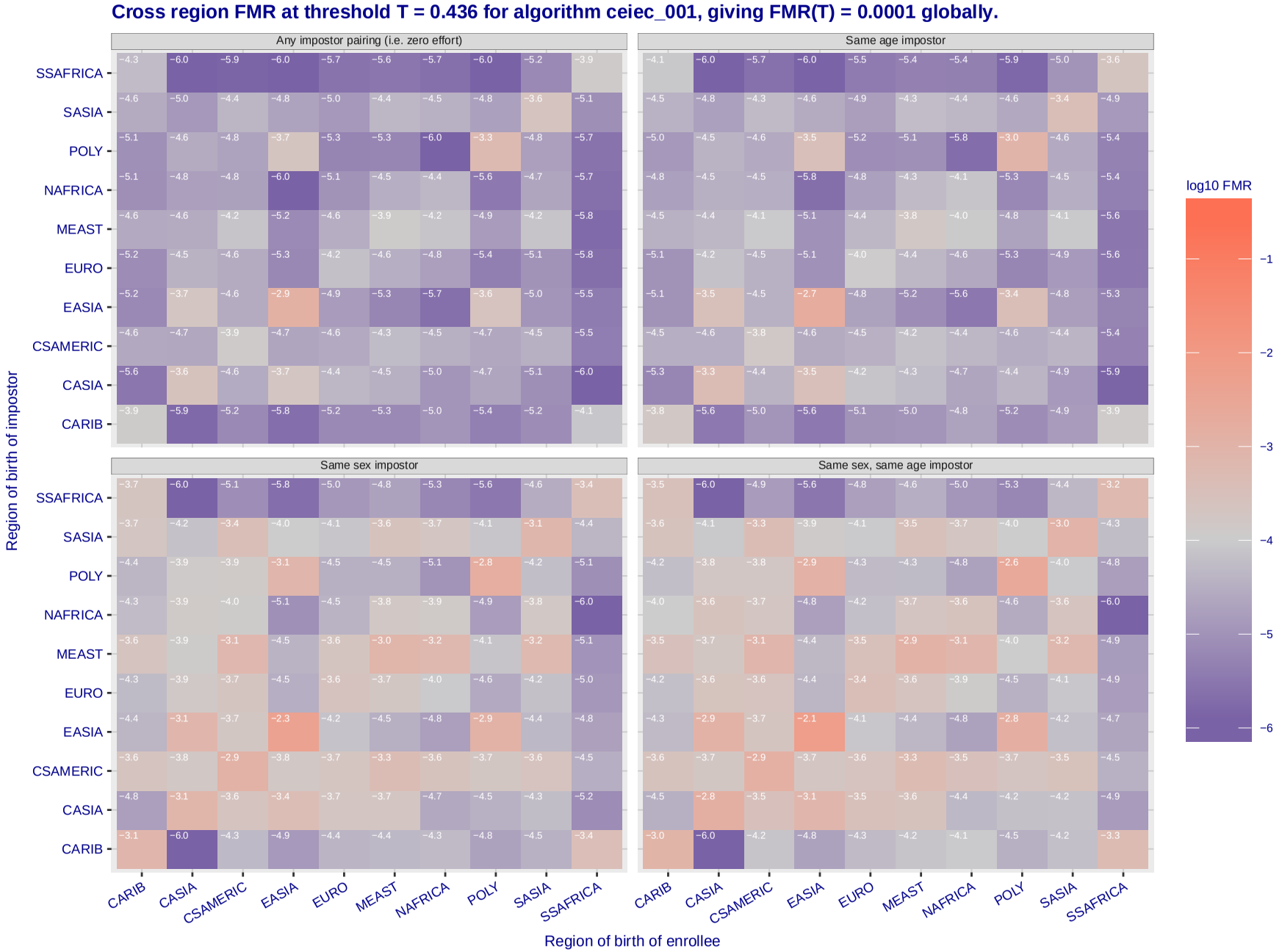


Figure 140: For algorithm ceiec-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

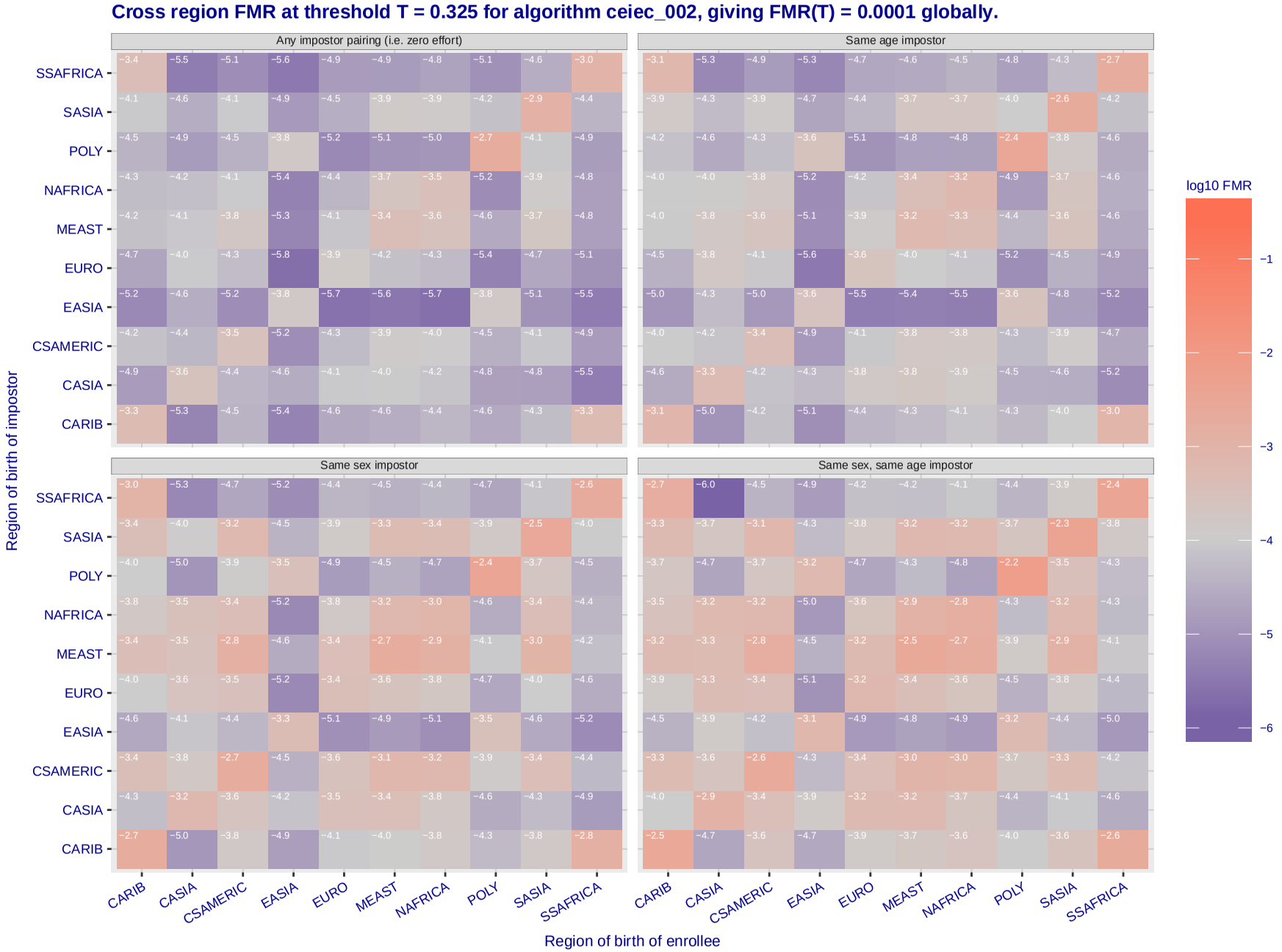


Figure 141: For algorithm ceiec-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

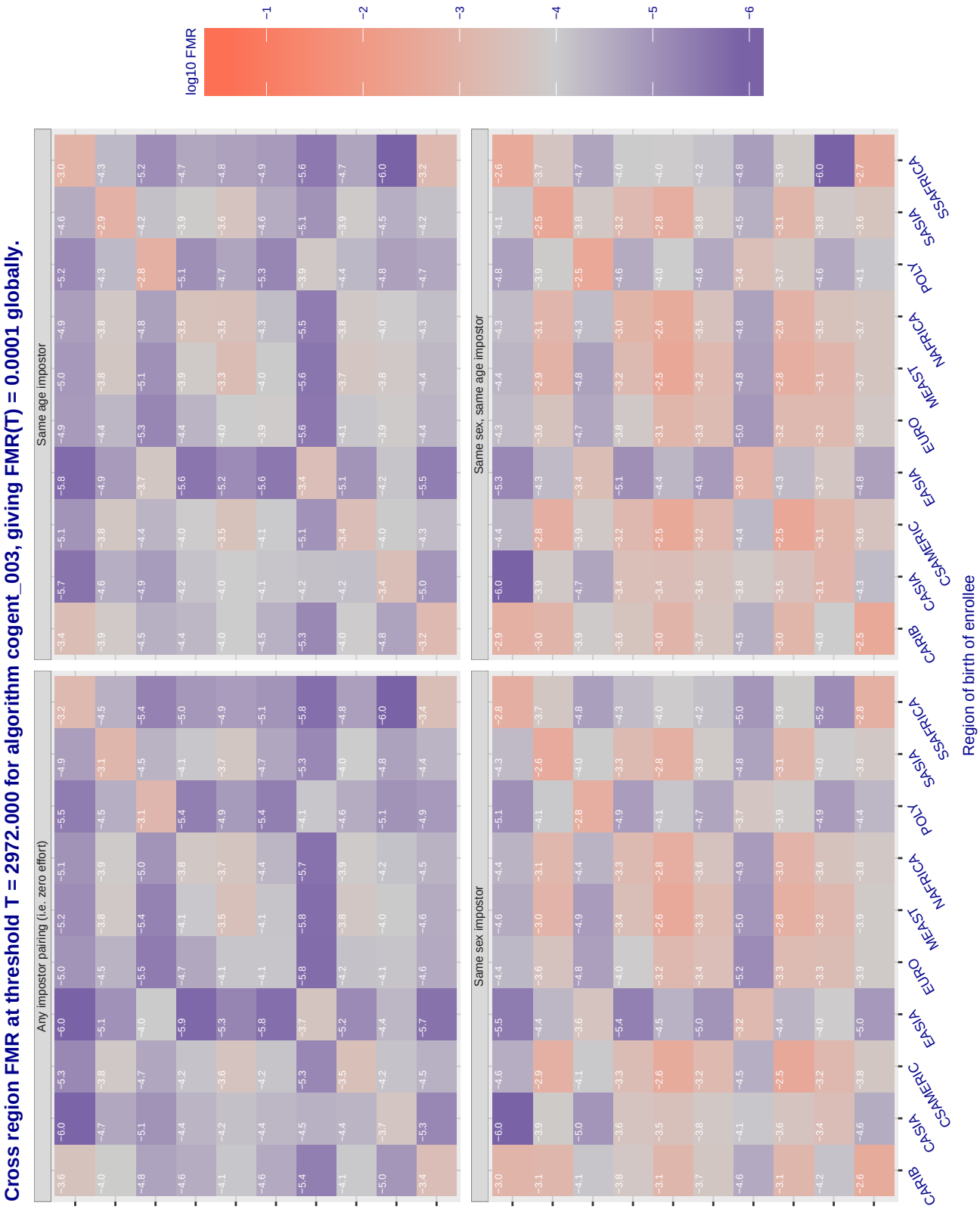


Figure 142: For algorithm cogent-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

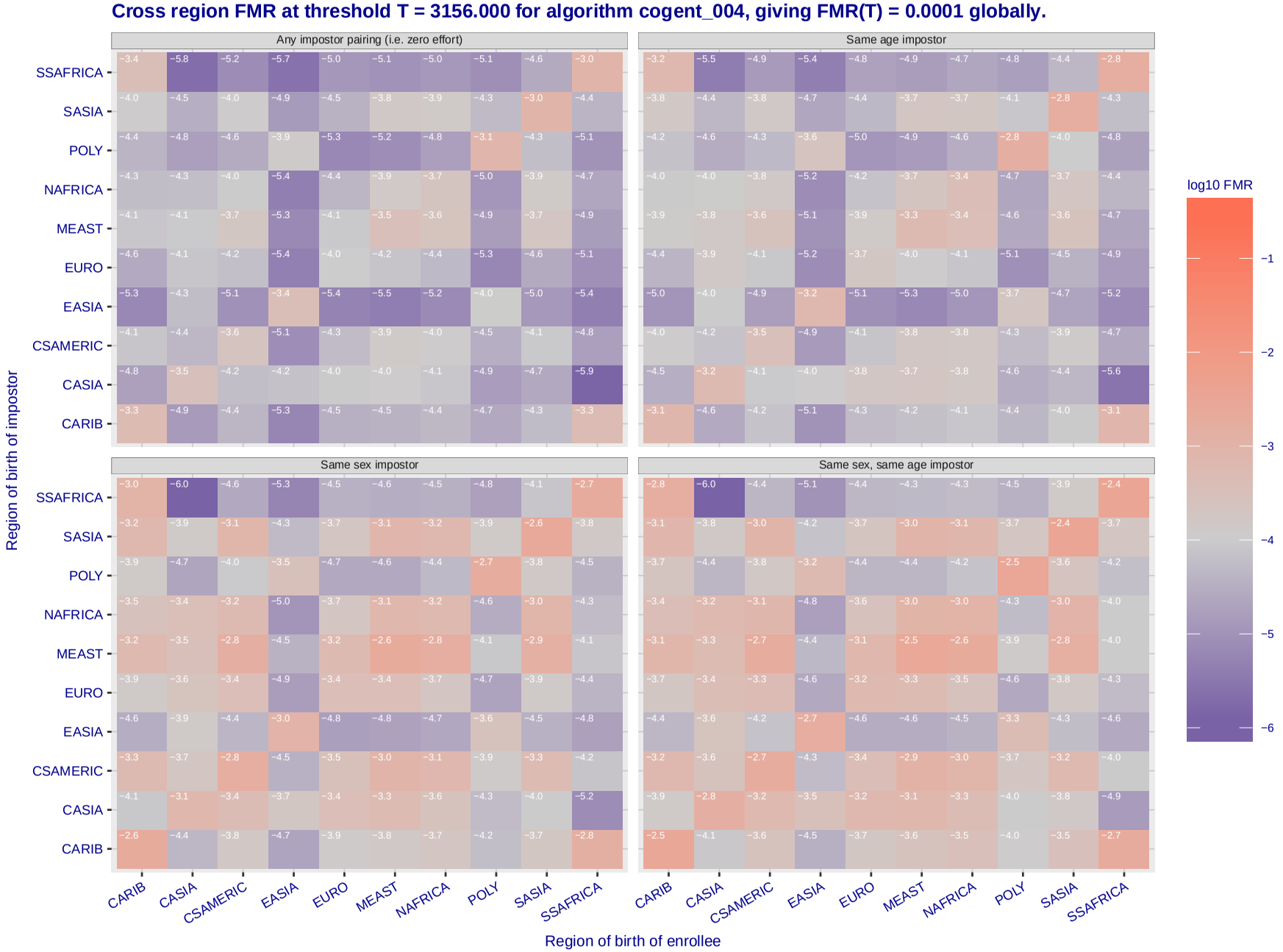


Figure 143: For algorithm cogent-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

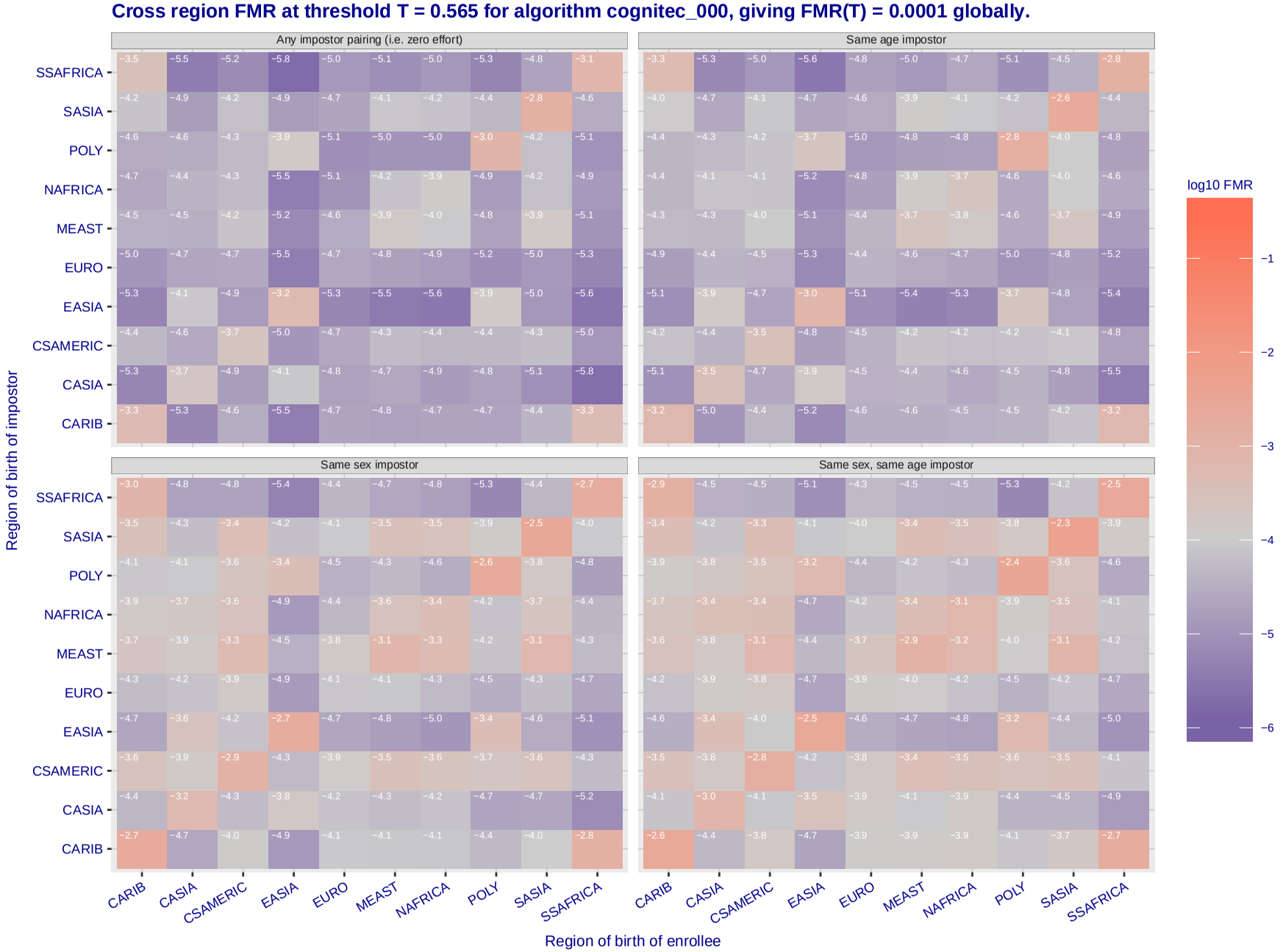


Figure 144: For algorithm cognitec-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

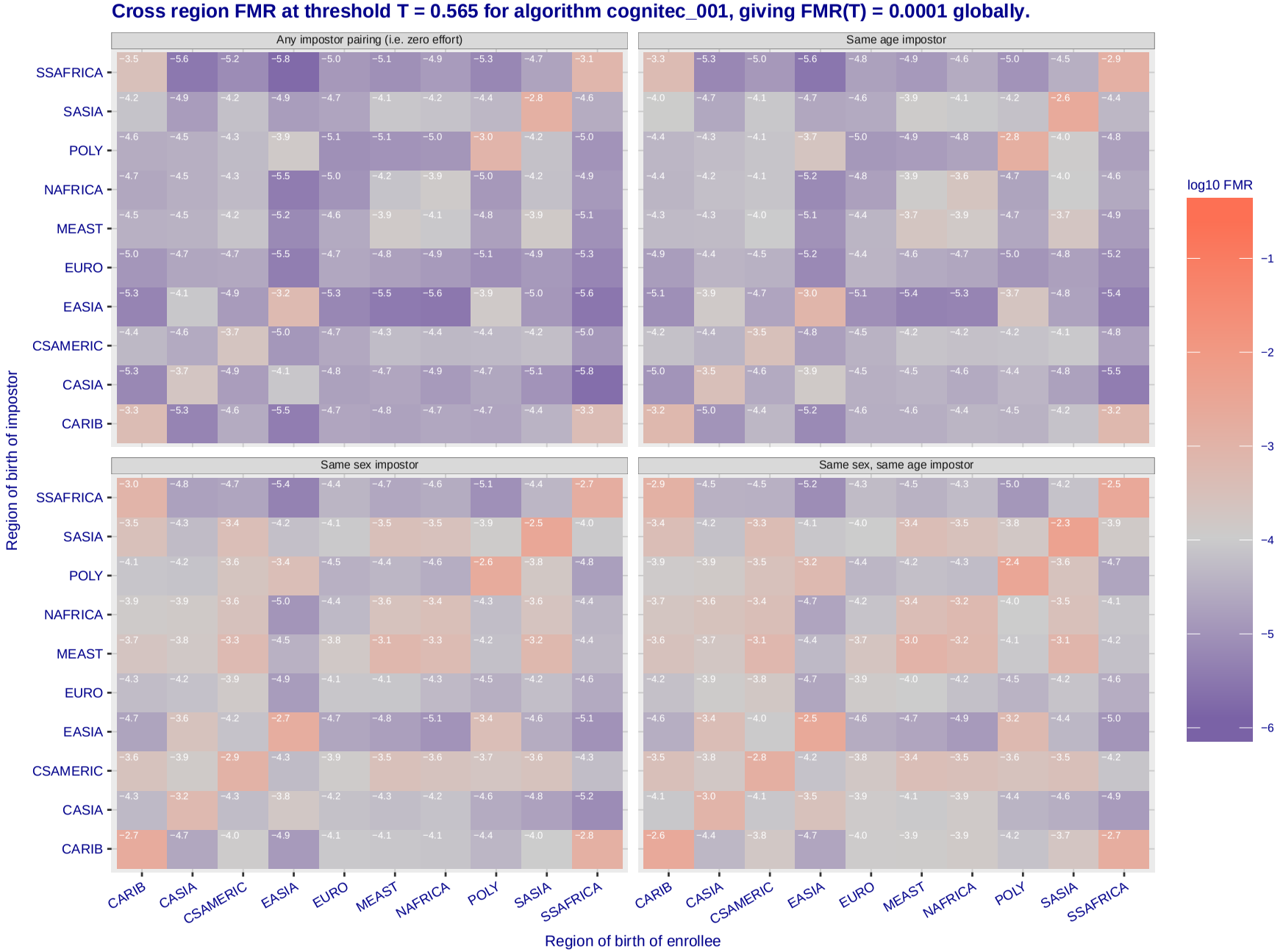


Figure 145: For algorithm cognitec-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

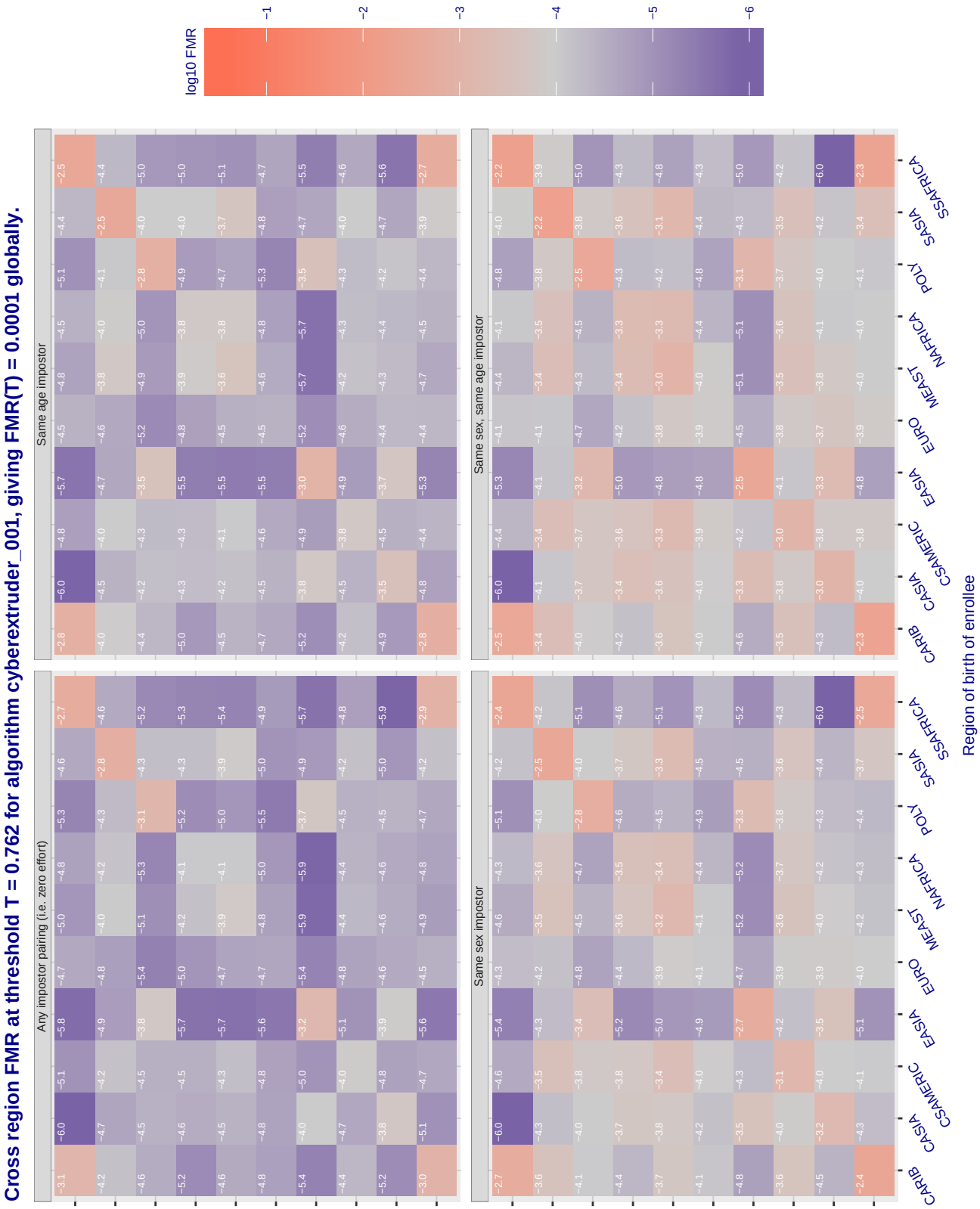


Figure 146: For algorithm cyberextruder-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

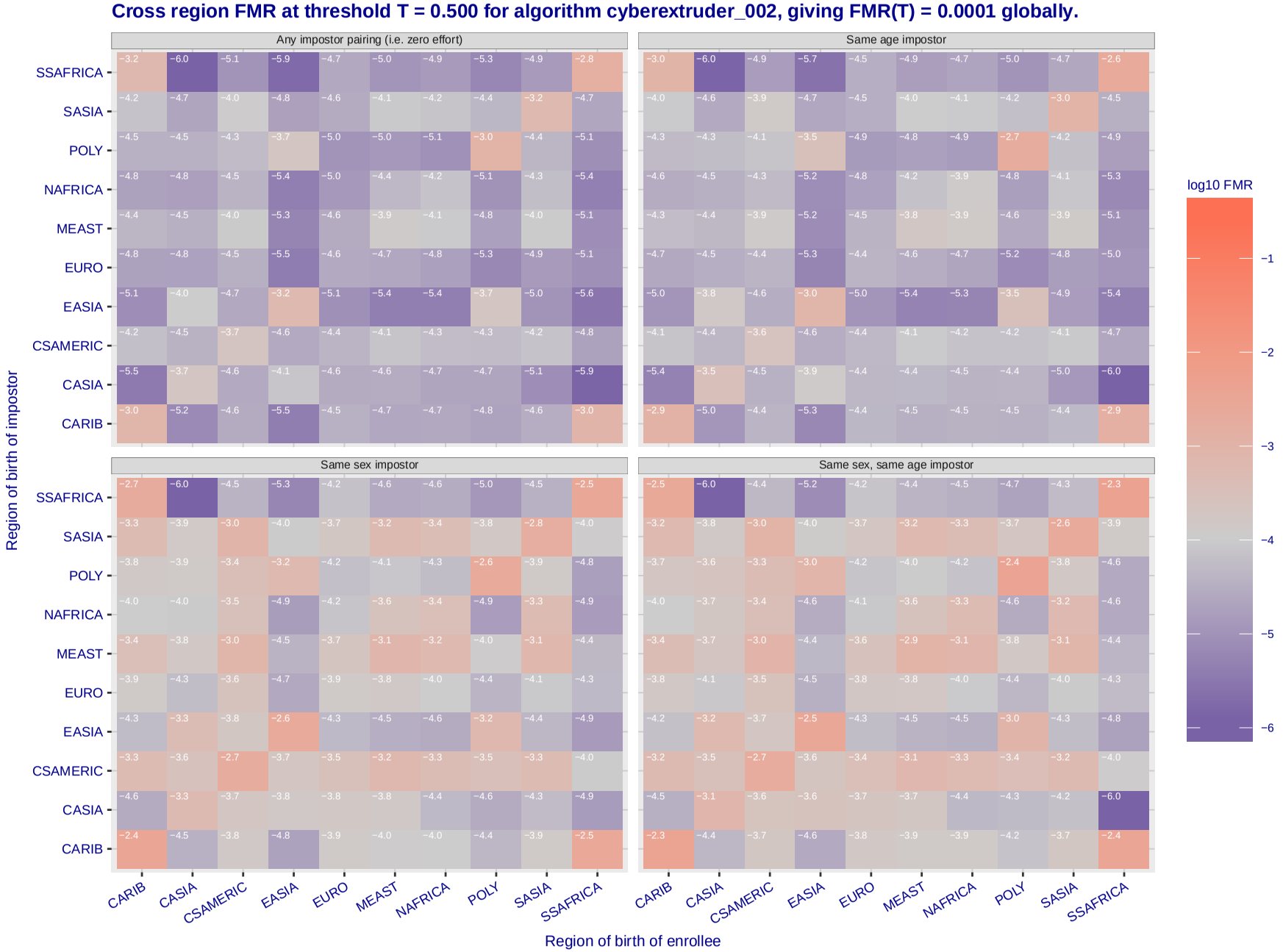


Figure 147: For algorithm cyberextruder-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

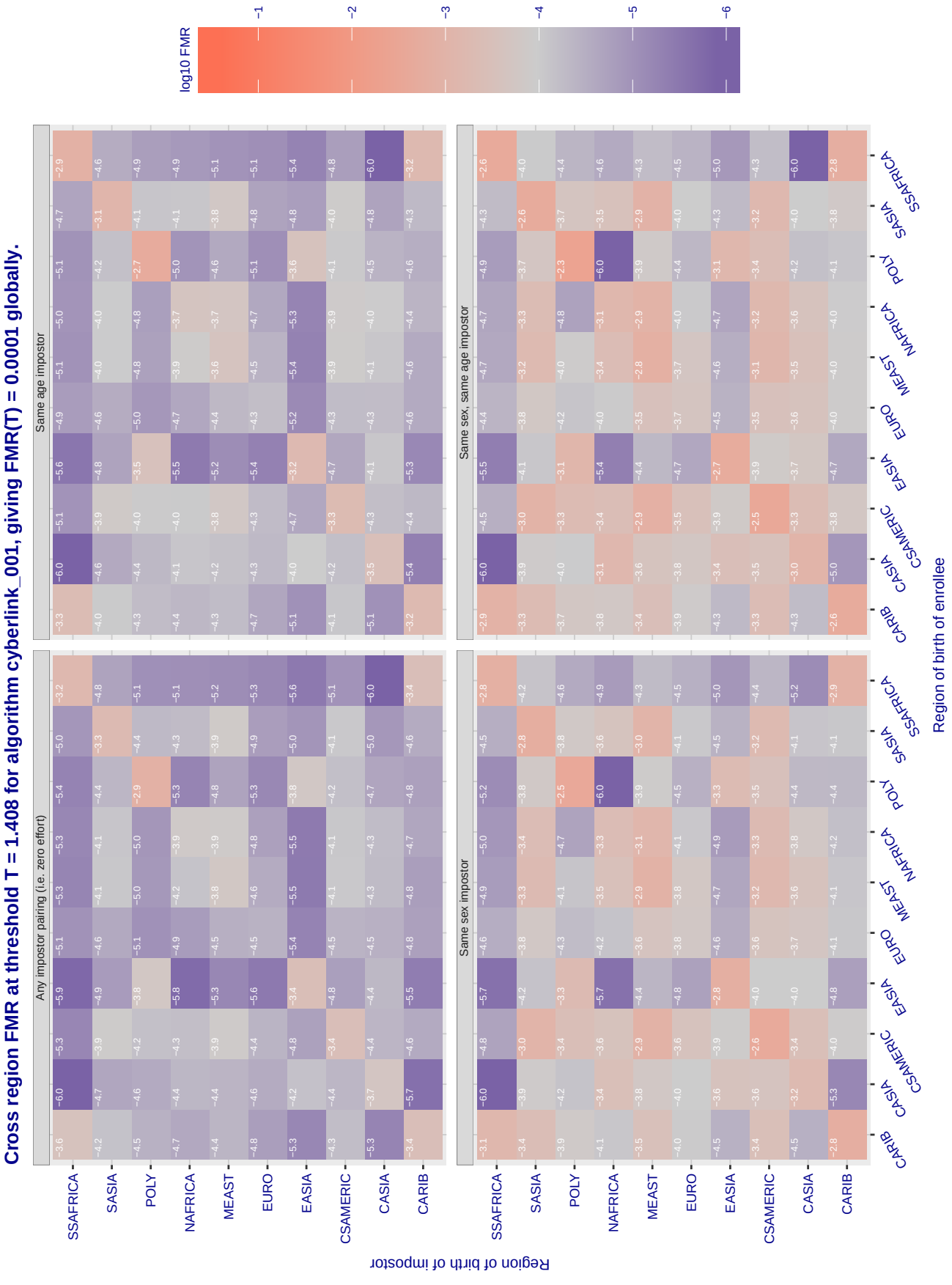


Figure 148: For algorithm cyberlink-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

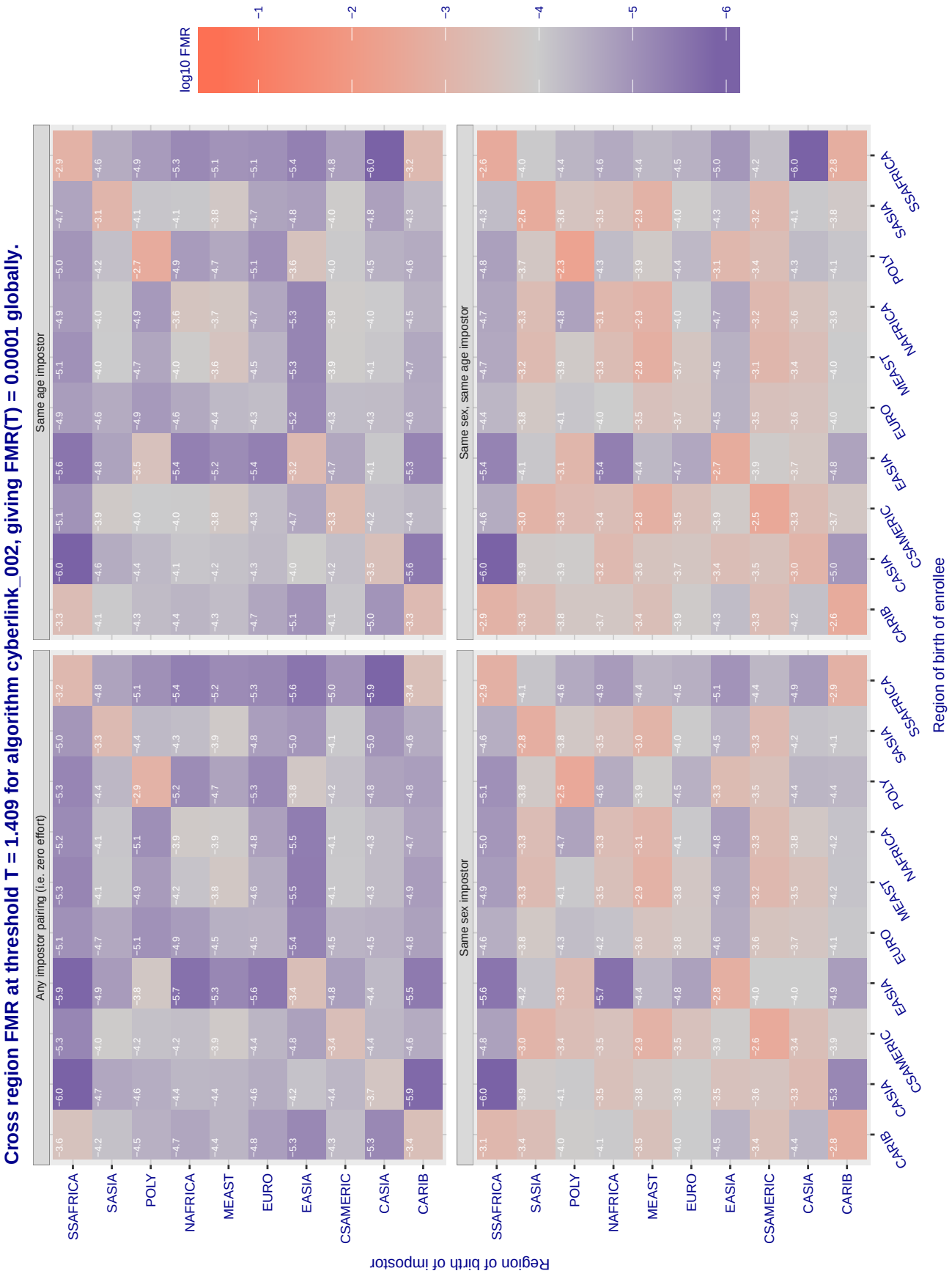


Figure 149: For algorithm cyberlink-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

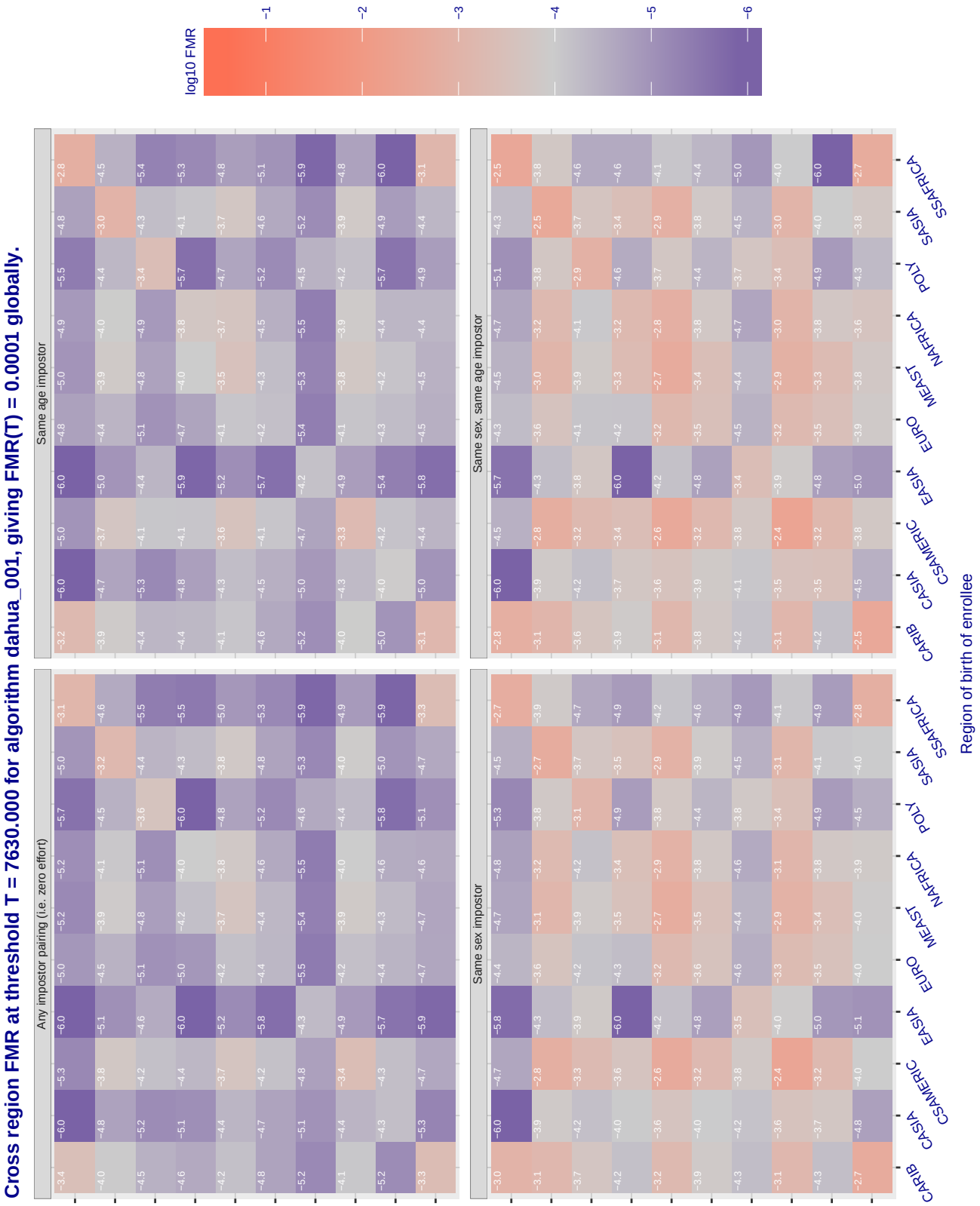


Figure 150: For algorithm dahua-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

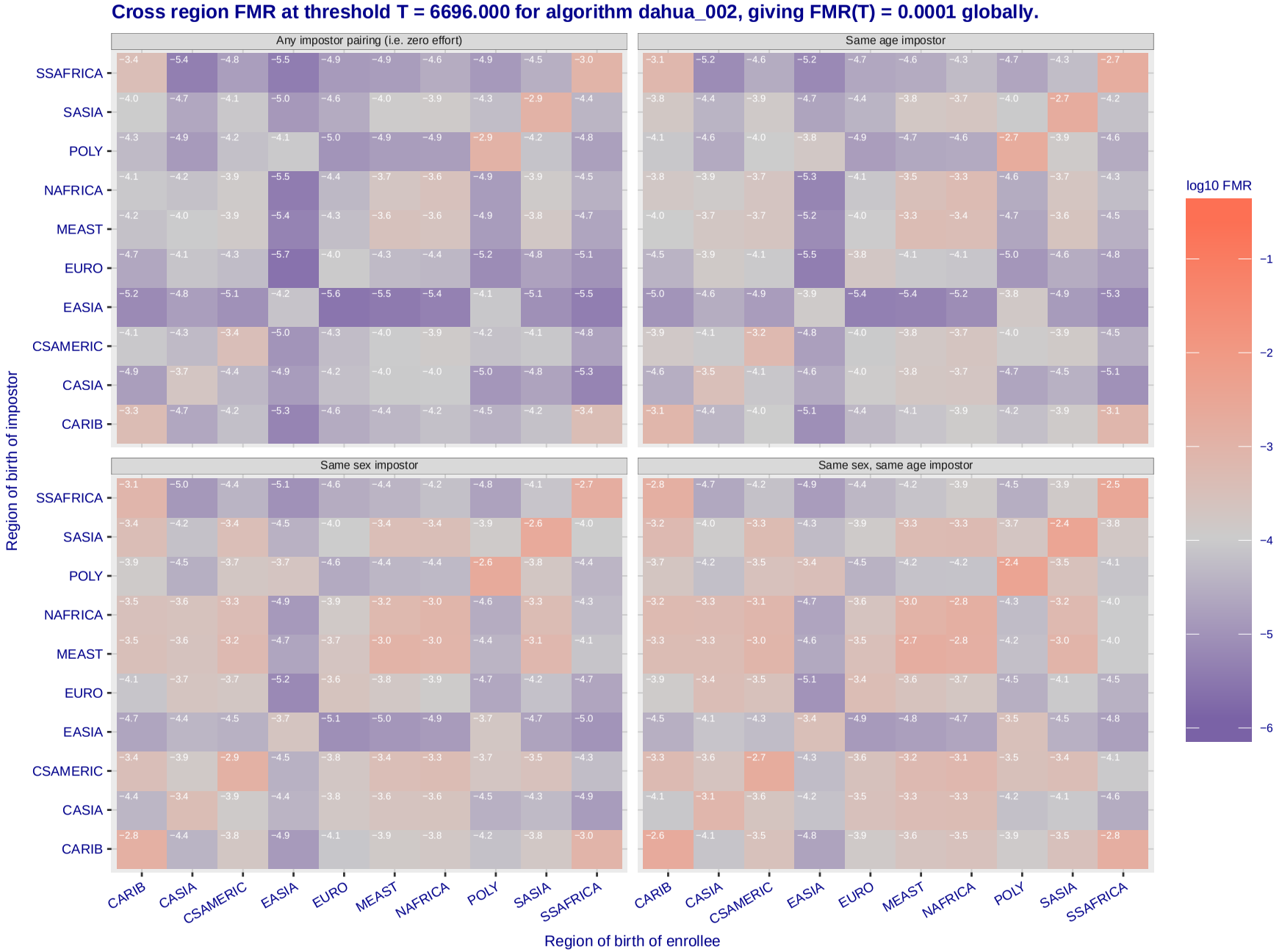


Figure 151: For algorithm dahua-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

Figure 152: For algorithm deepglint-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

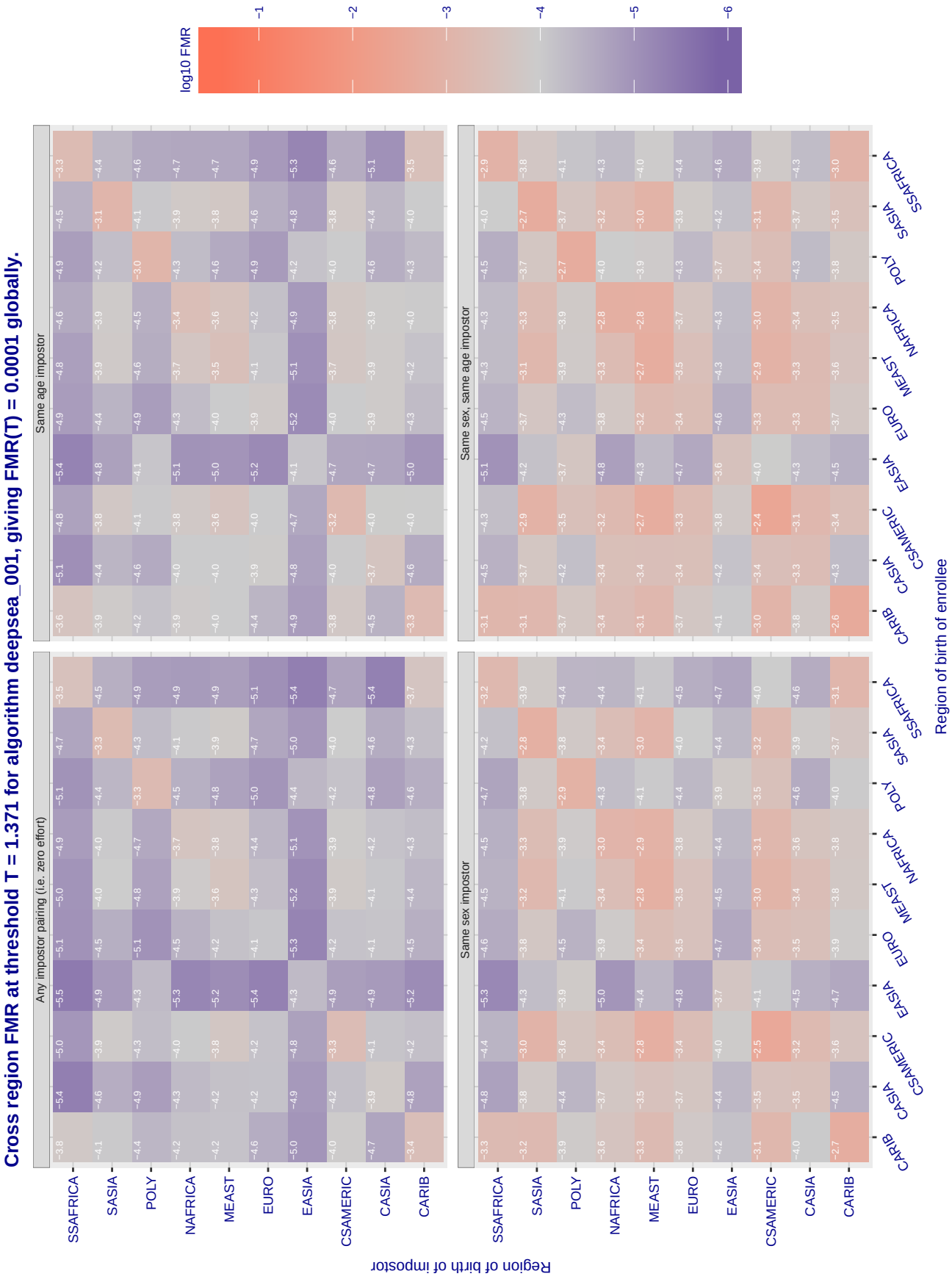


Figure 153: For algorithm deepsea-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

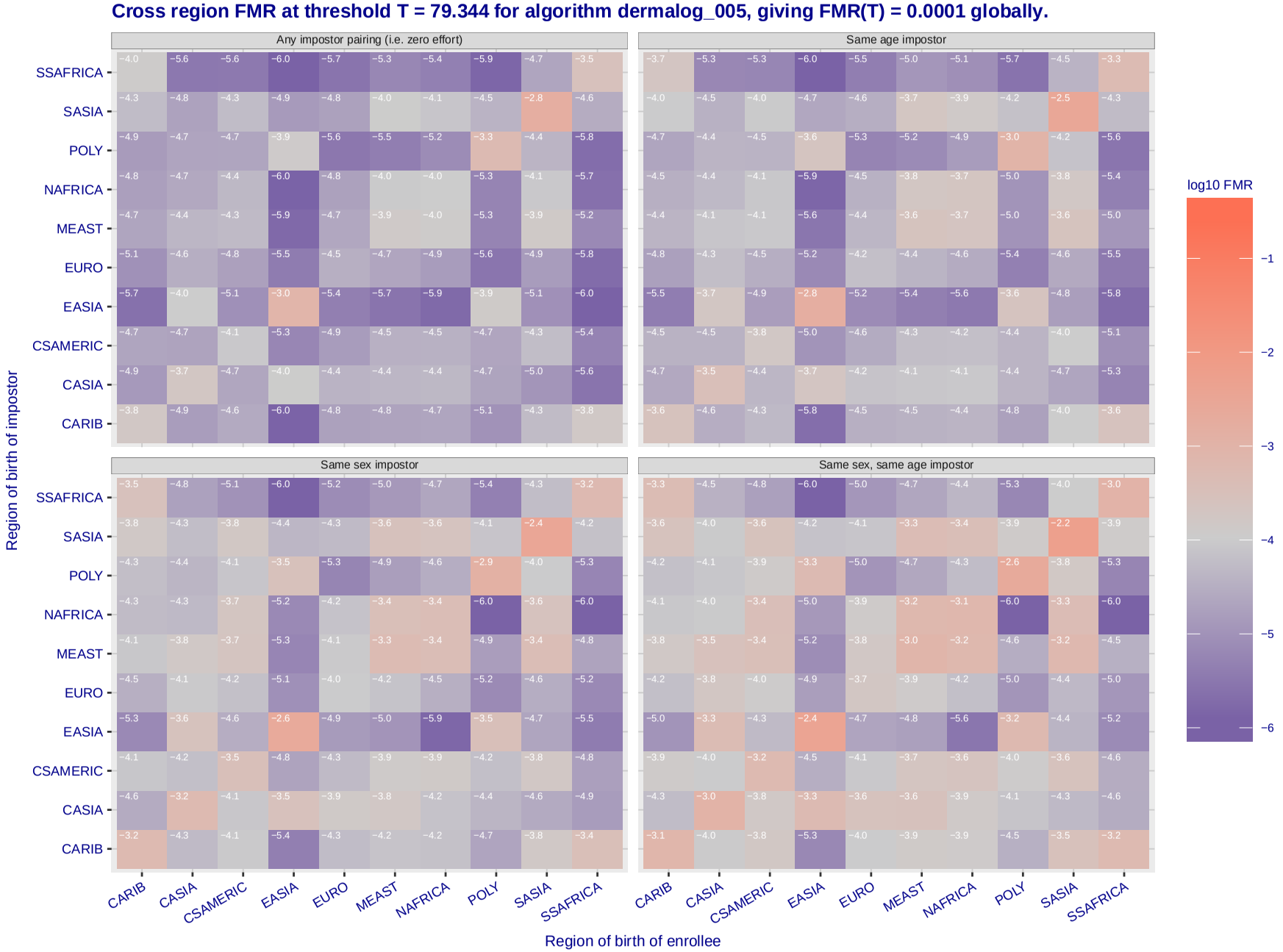


Figure 154: For algorithm dermalog-005 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

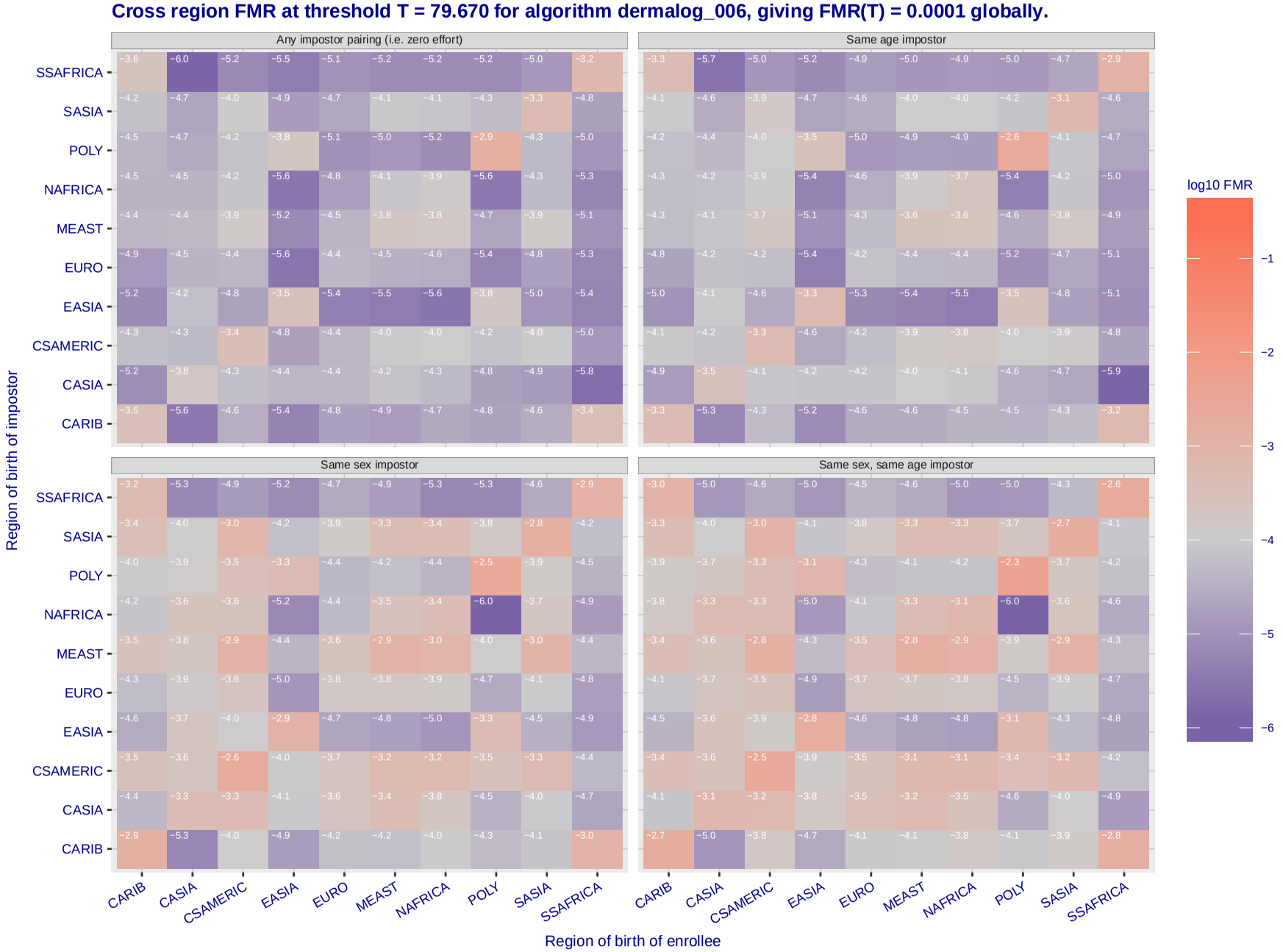


Figure 155: For algorithm dermalog-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

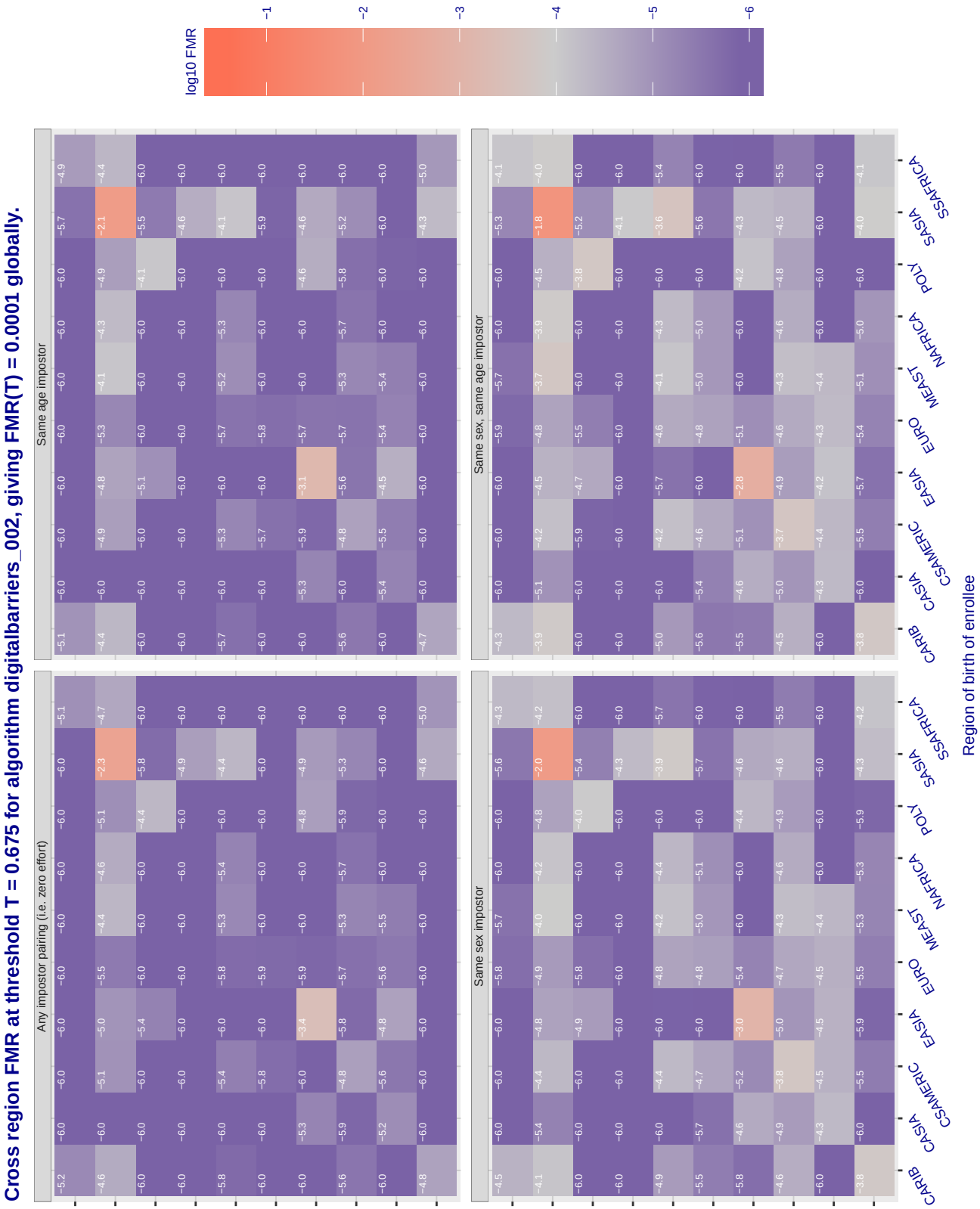


Figure 156: For algorithm digitalbarriers-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

Figure 157: For algorithm everai-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

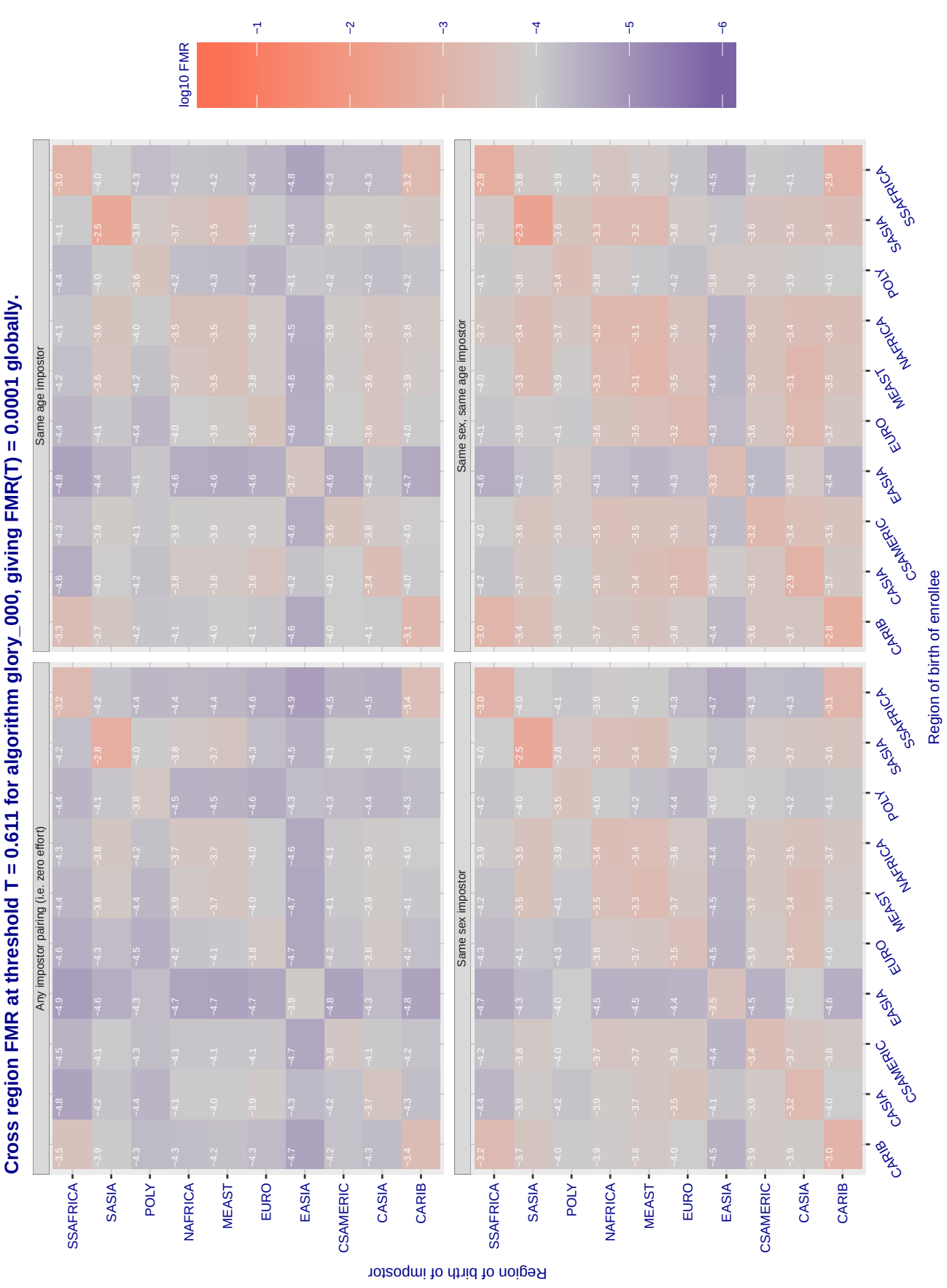


Figure 158: For algorithm glory-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

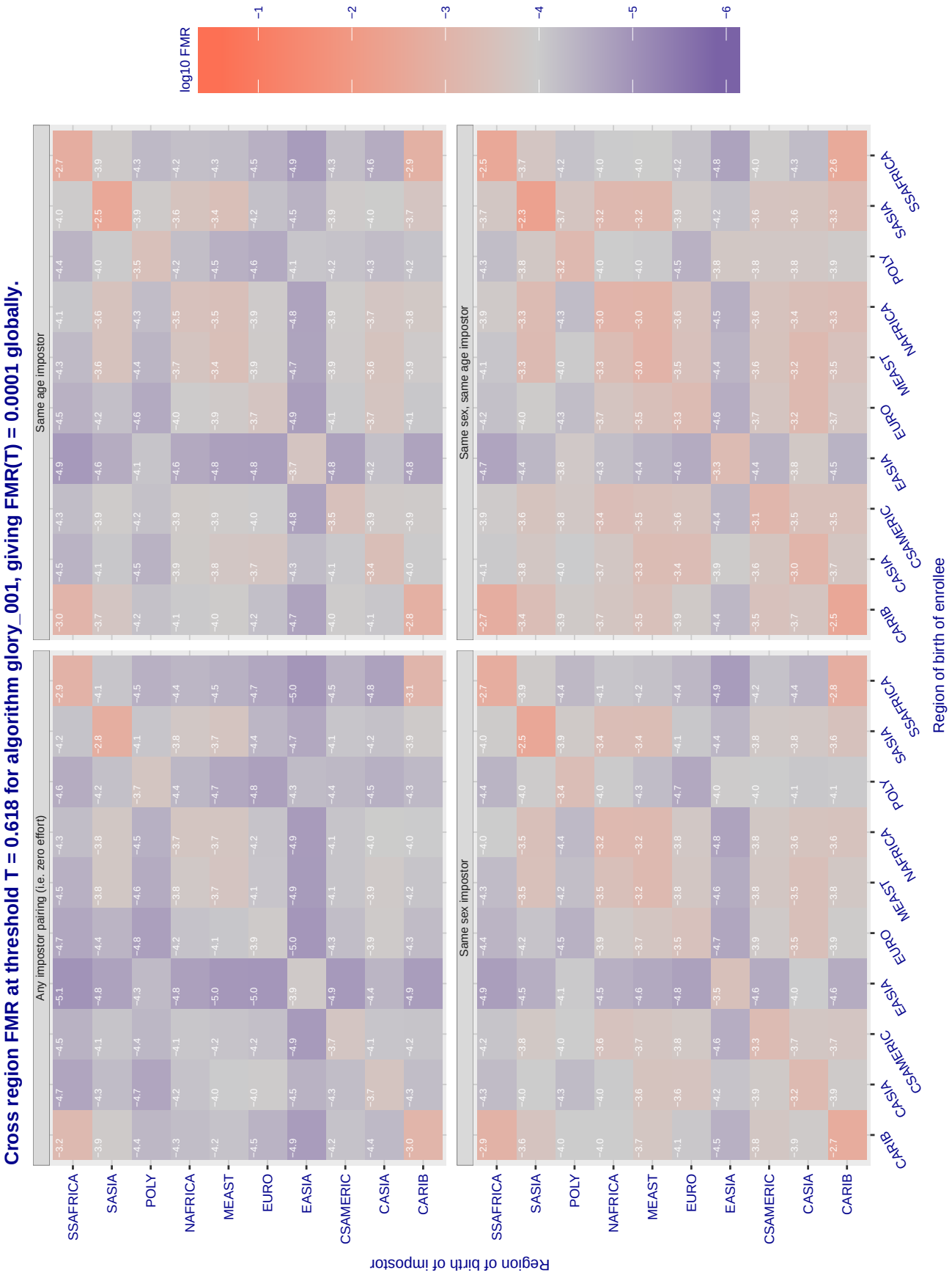


Figure 159: For algorithm glory-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

Figure 160: For algorithm gorilla-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

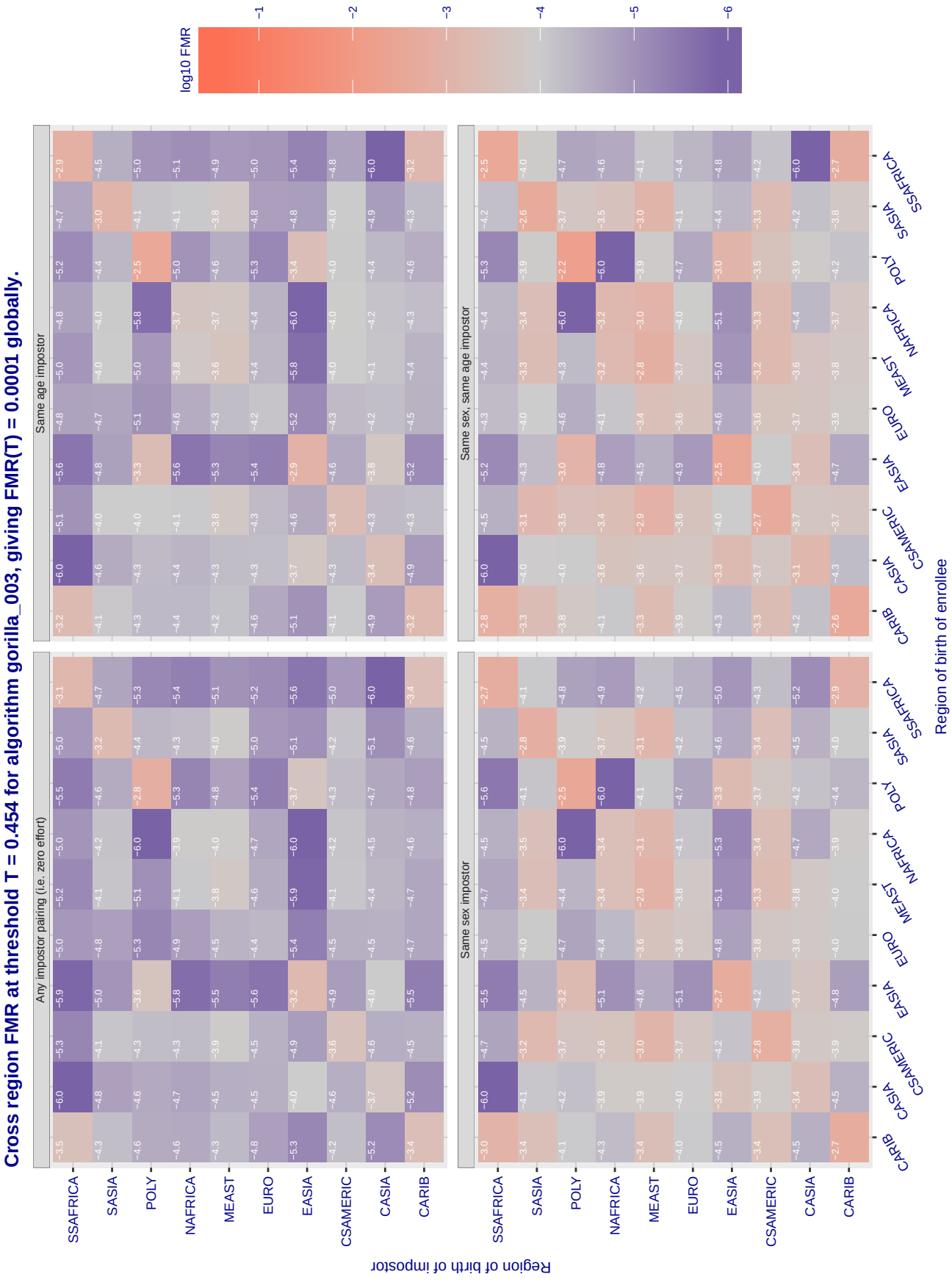


Figure 161: For algorithm gorilla-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

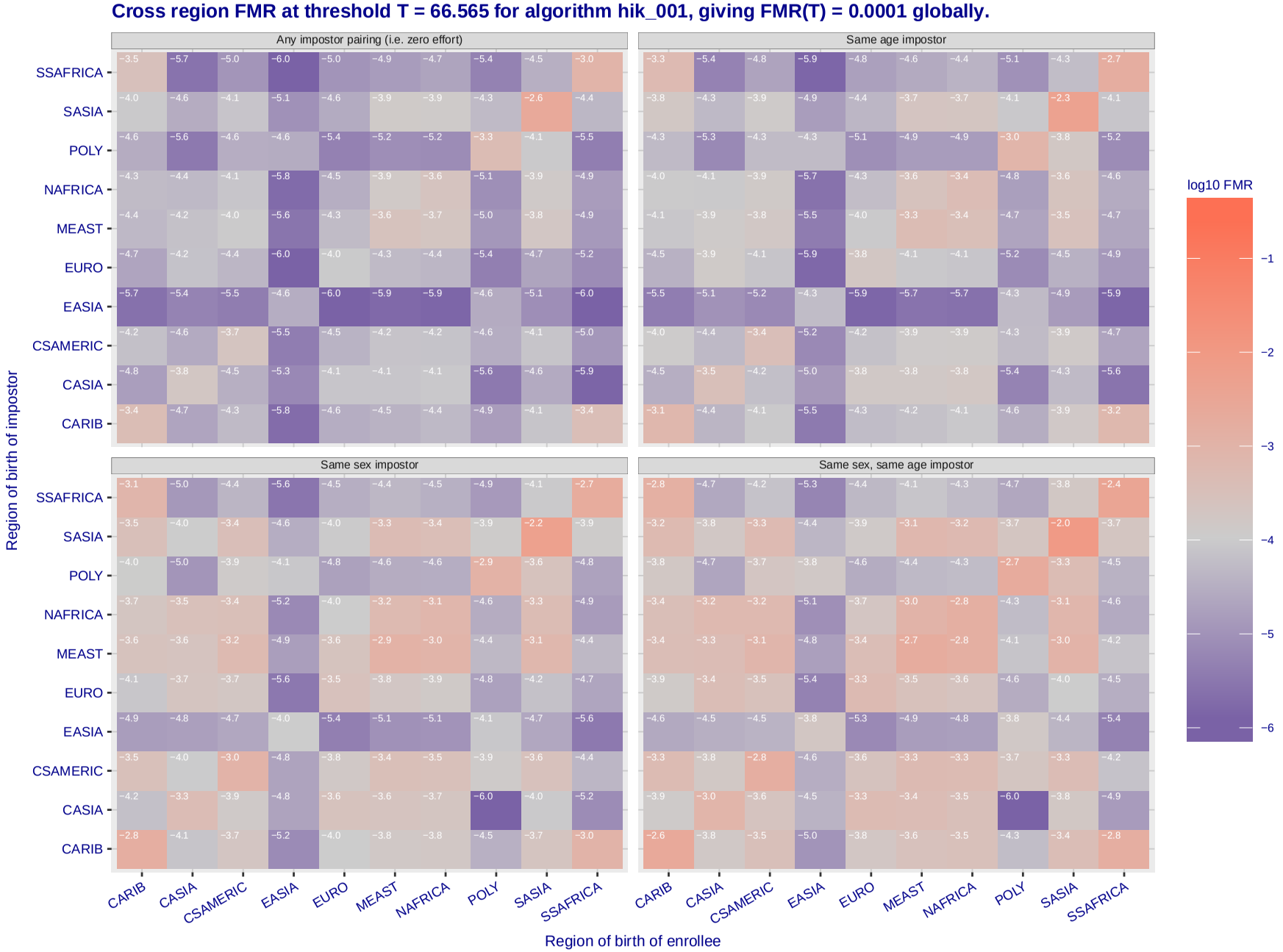


Figure 162: For algorithm hik-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

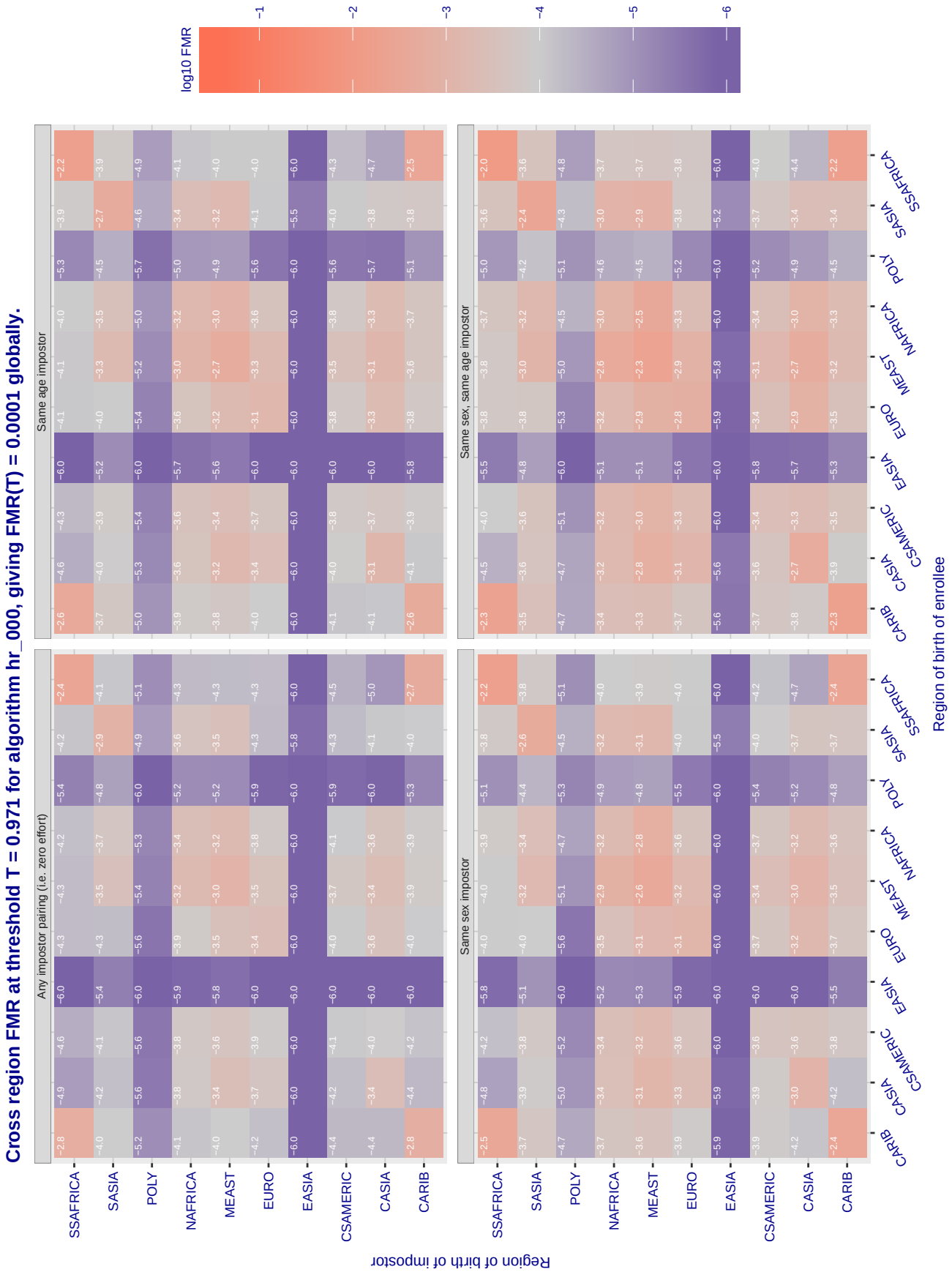


Figure 163: For algorithm hr-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

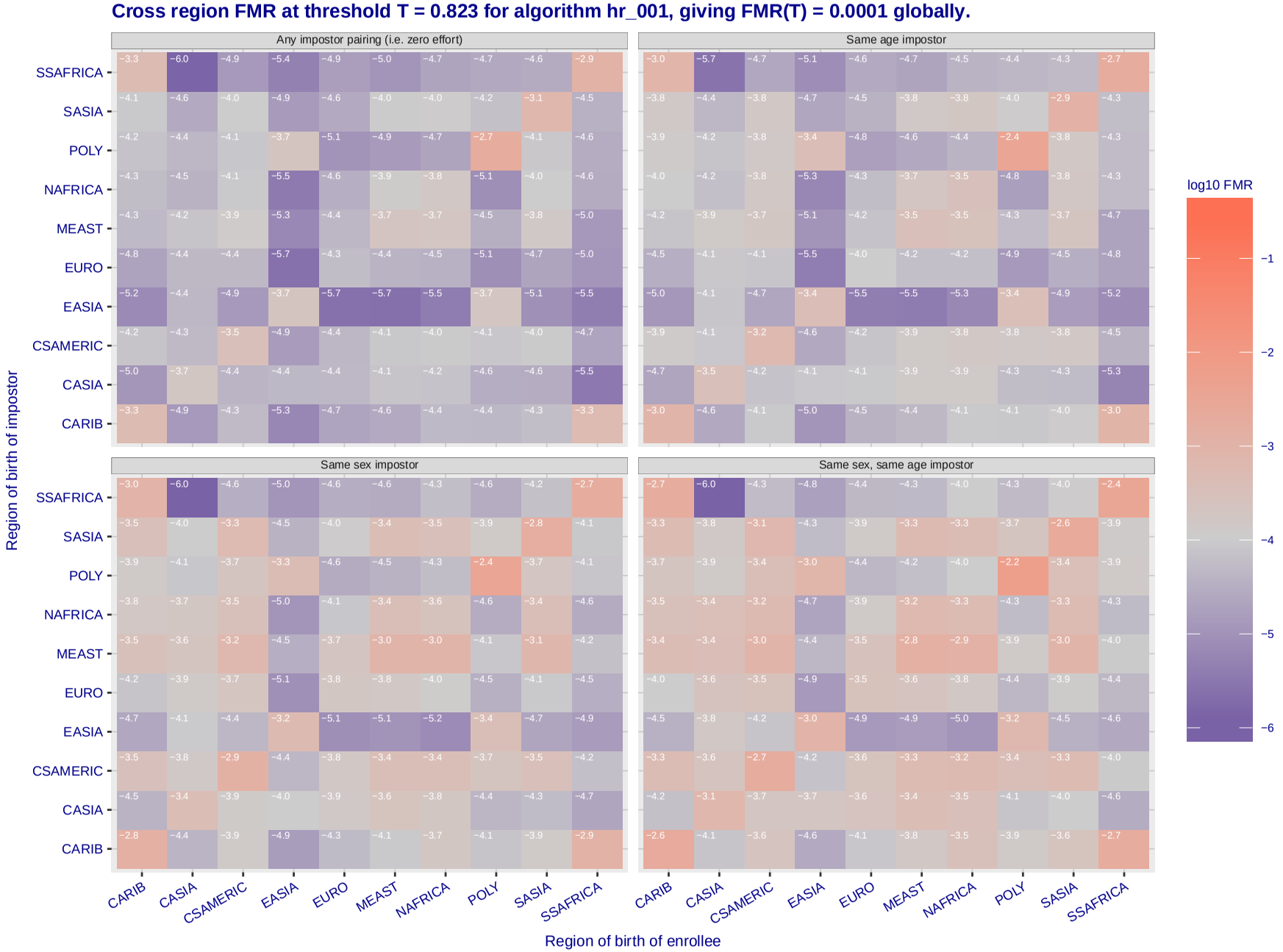


Figure 164: For algorithm hr-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

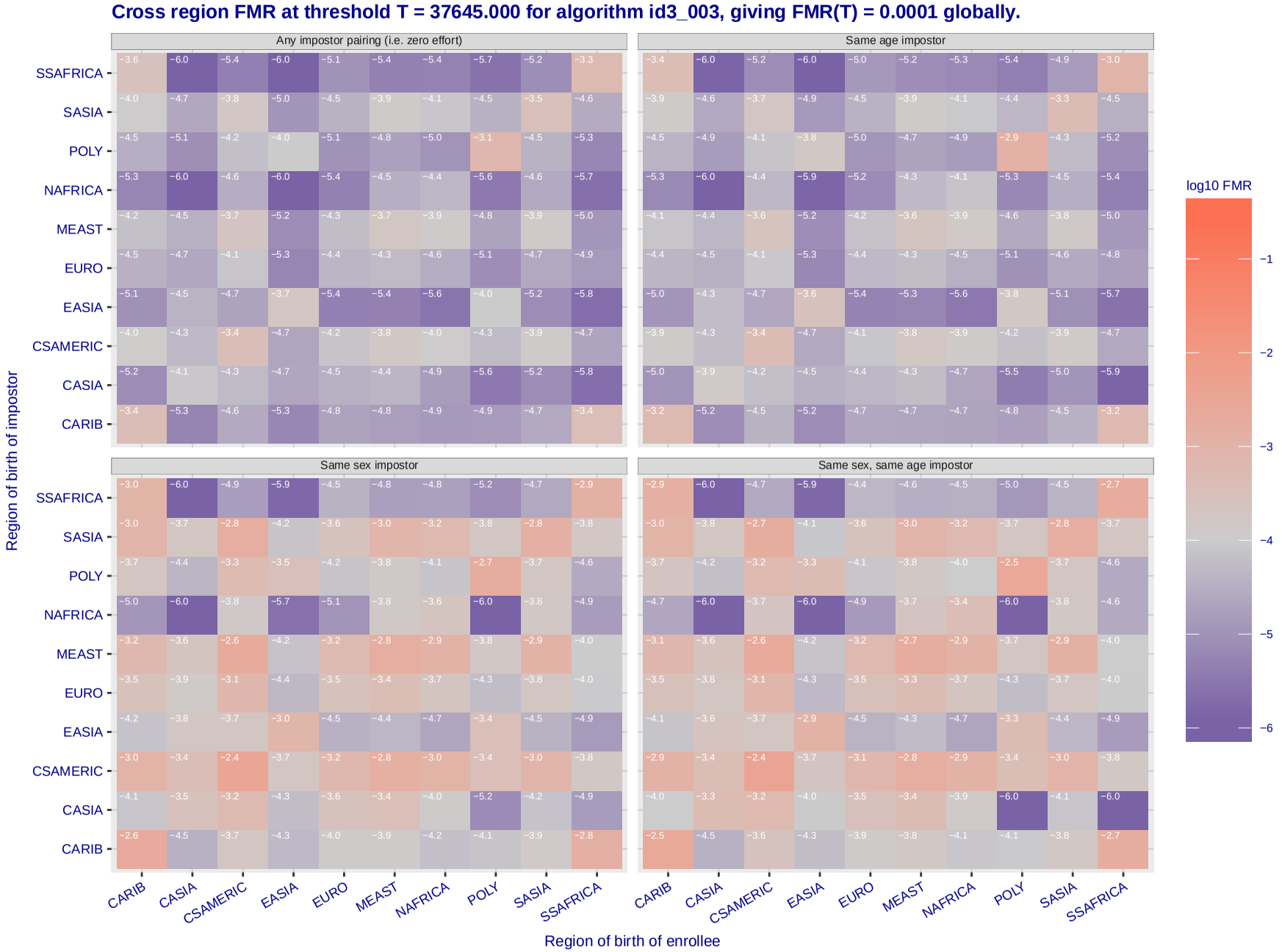


Figure 165: For algorithm id3-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

Figure 166: For algorithm id3-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

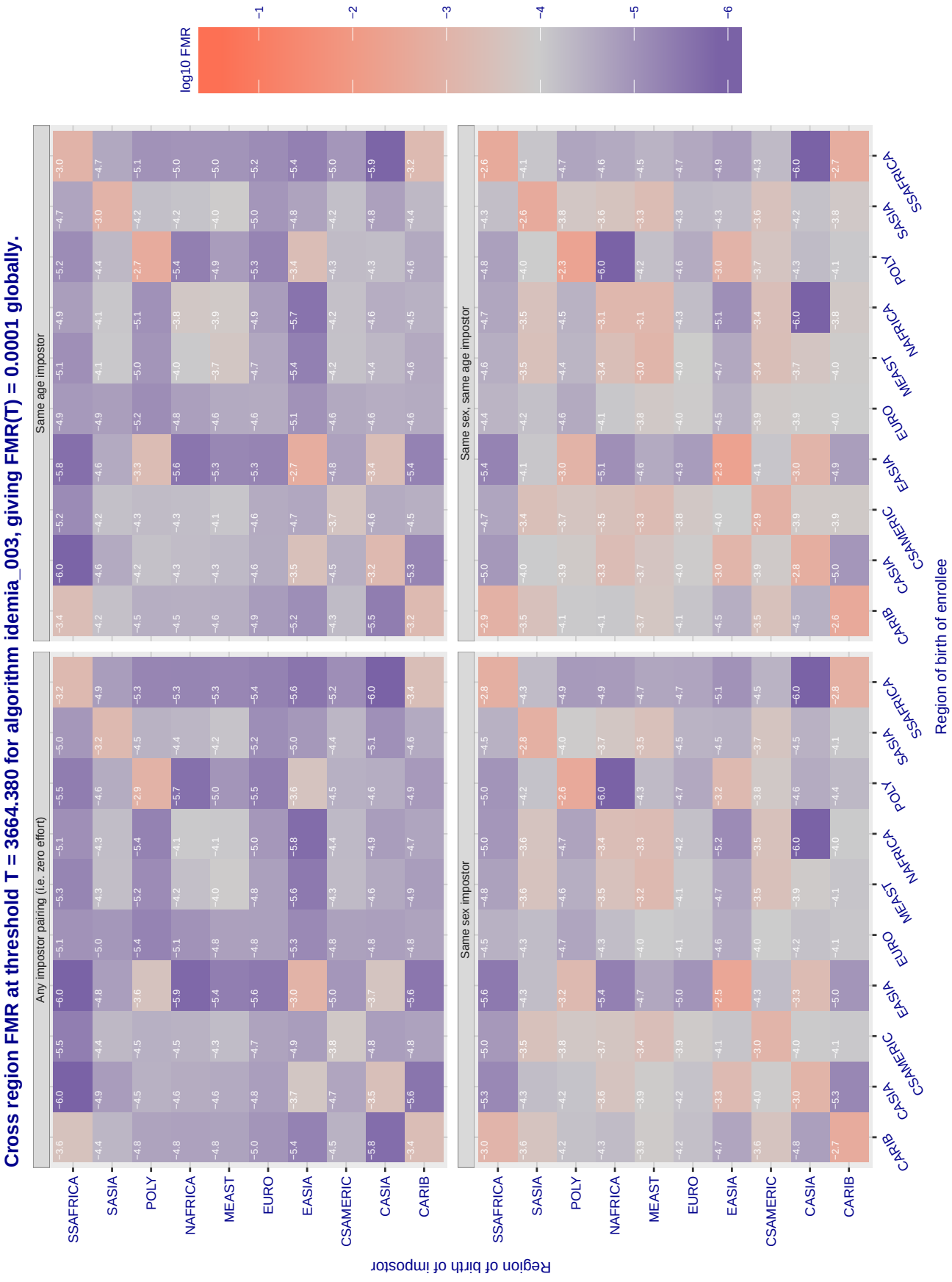


Figure 167: For algorithm idemia-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

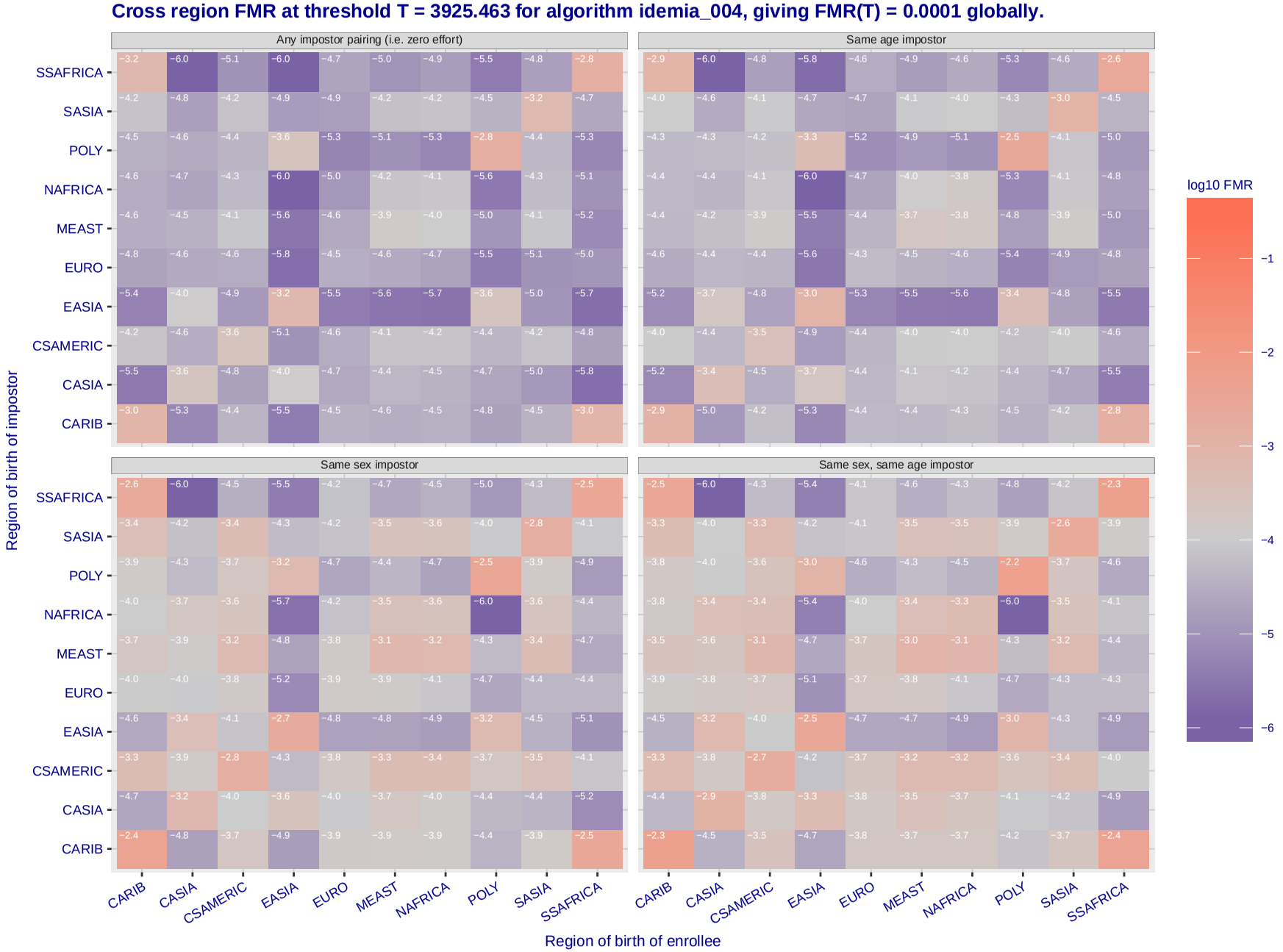


Figure 168: For algorithm idemia-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

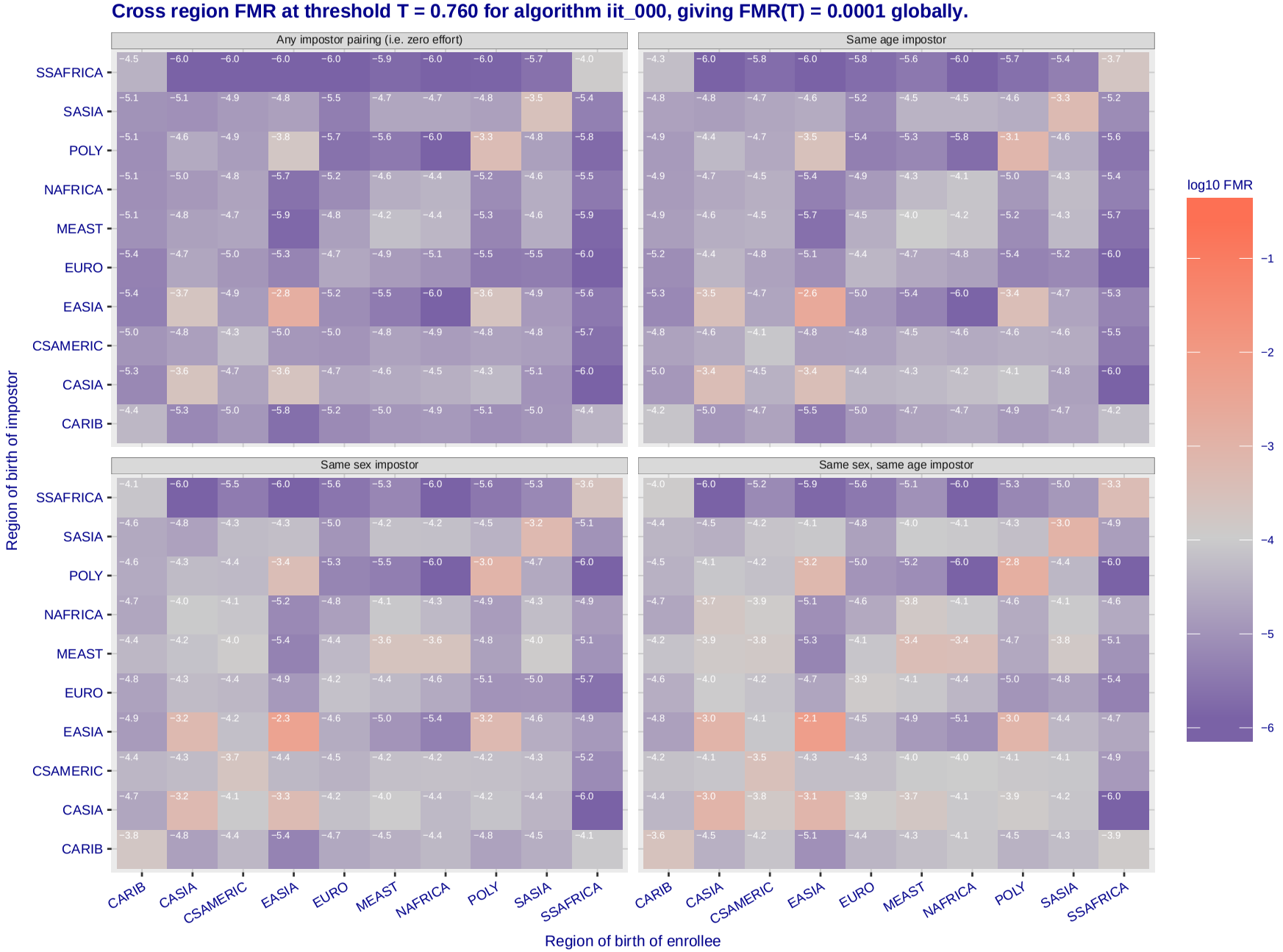


Figure 169: For algorithm iit-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

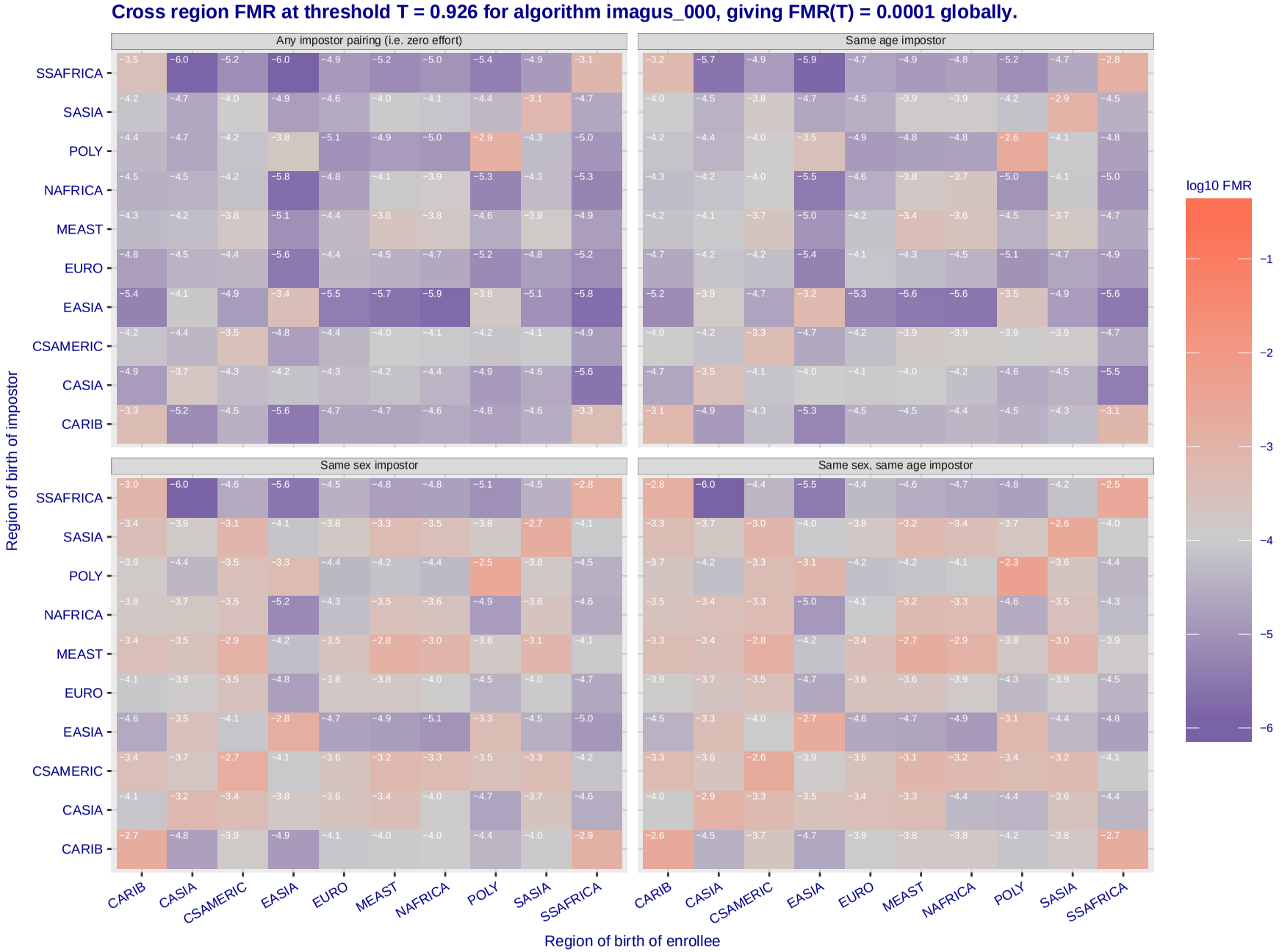


Figure 170: For algorithm imagus-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

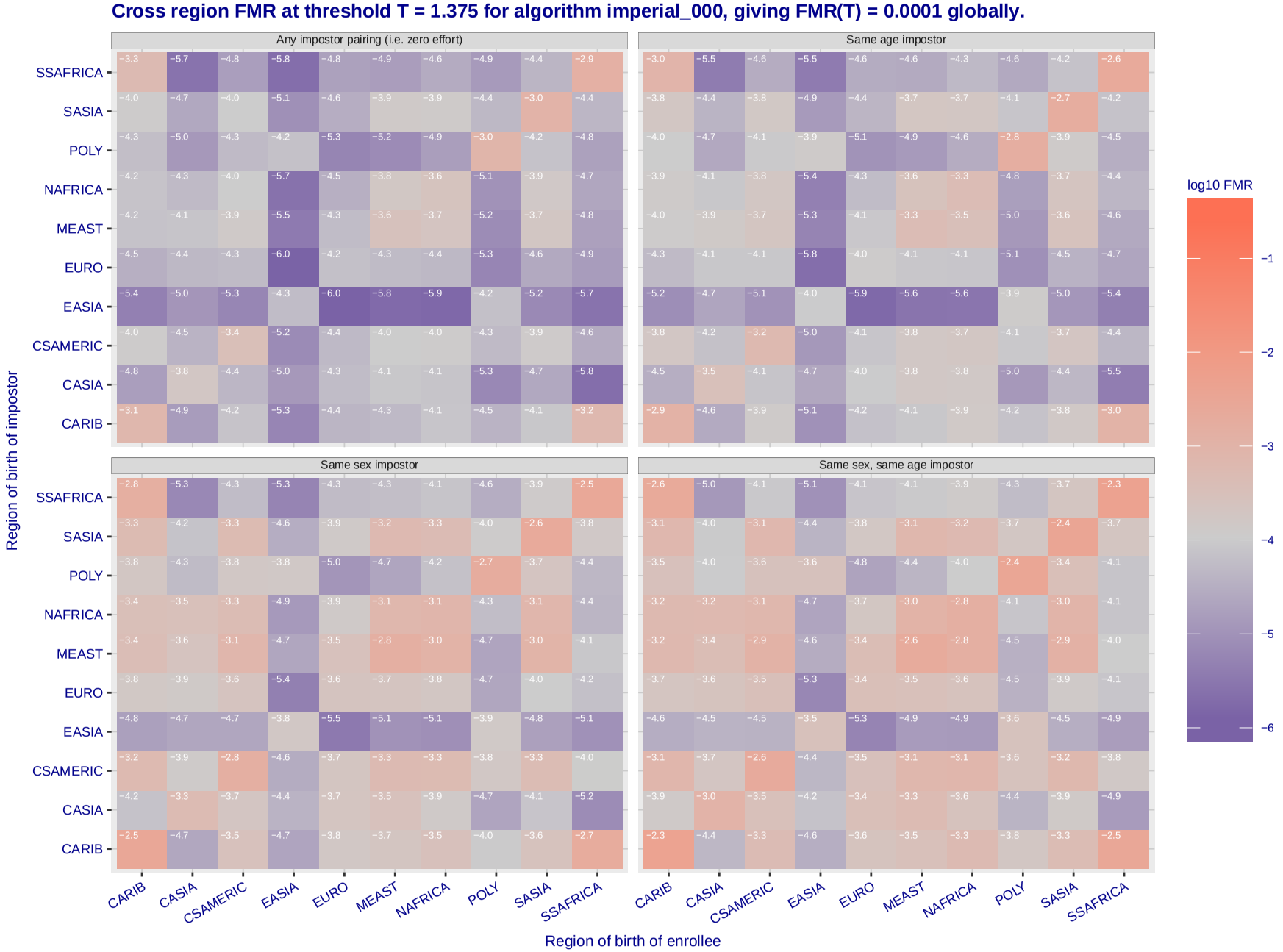


Figure 171: For algorithm imperial-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

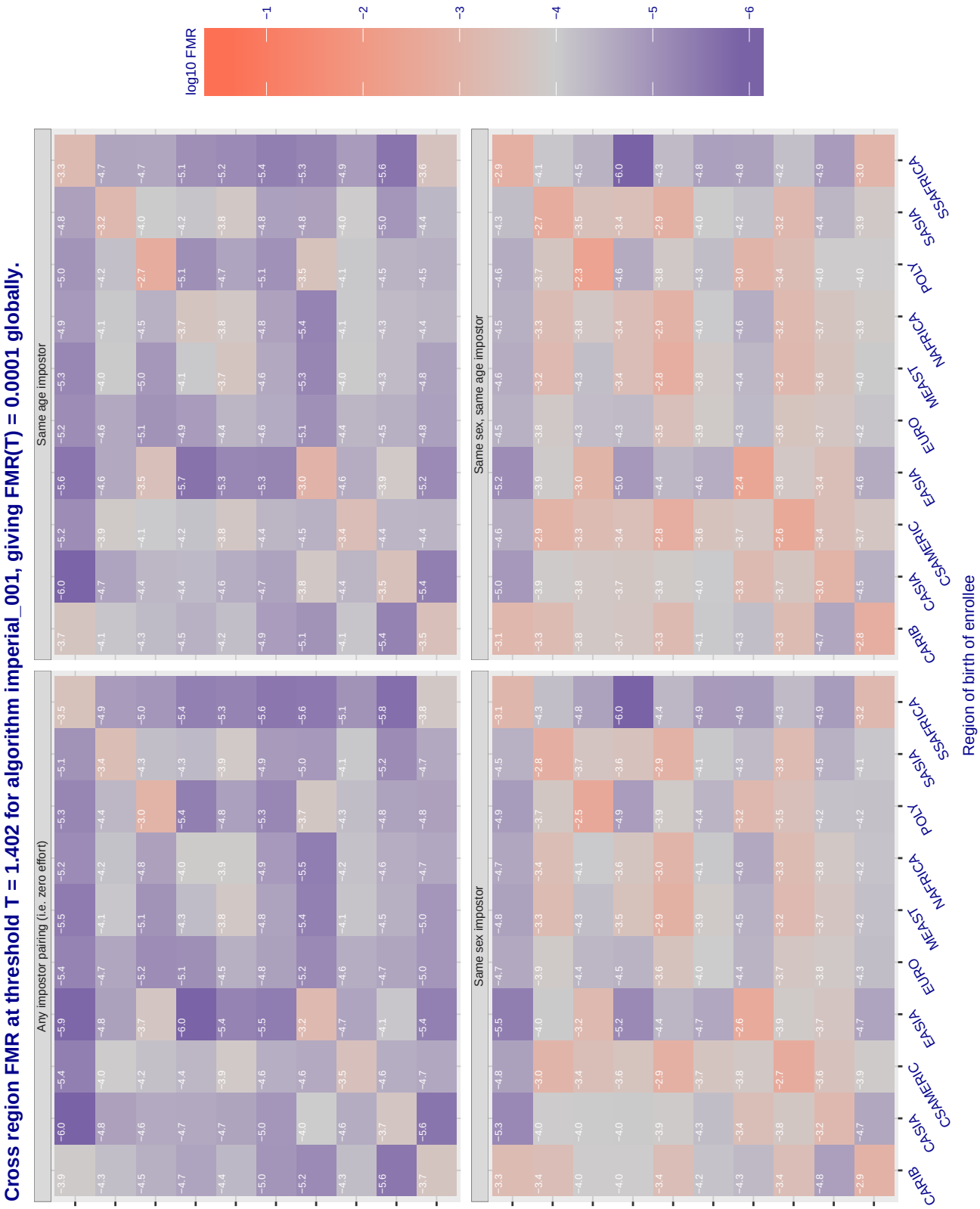


Figure 172: For algorithm imperial-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

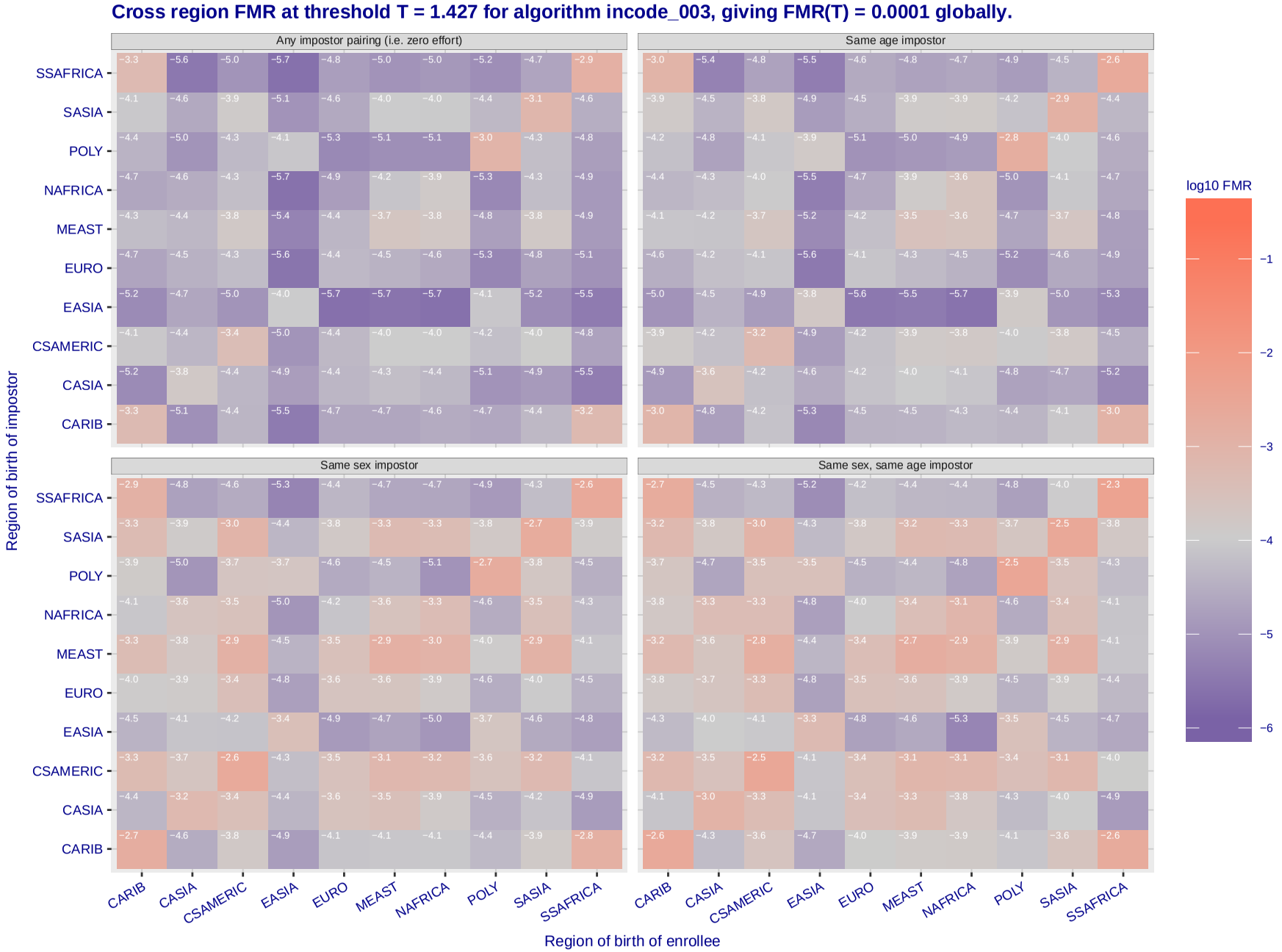


Figure 173: For algorithm incode-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

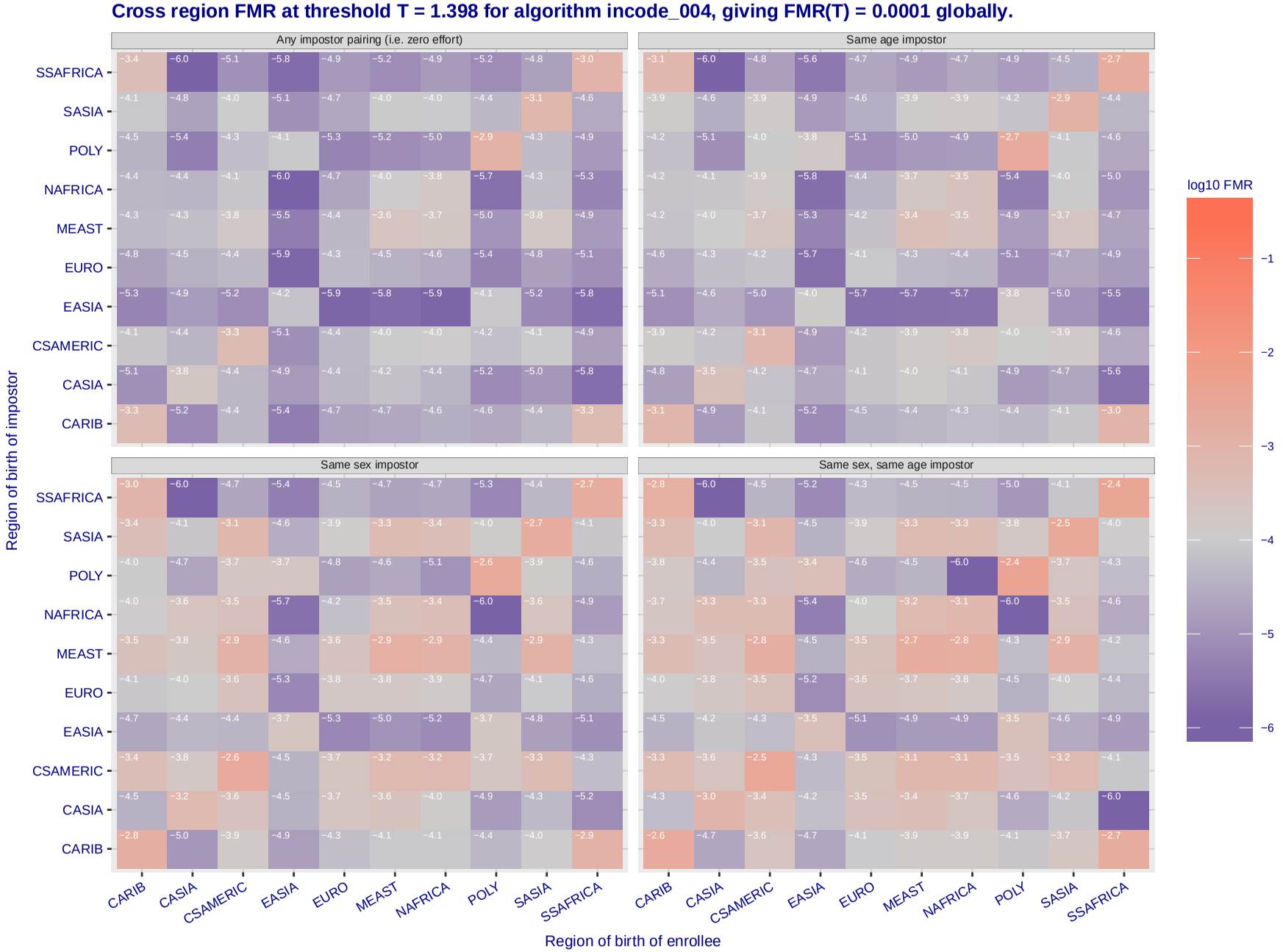


Figure 174: For algorithm incode-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

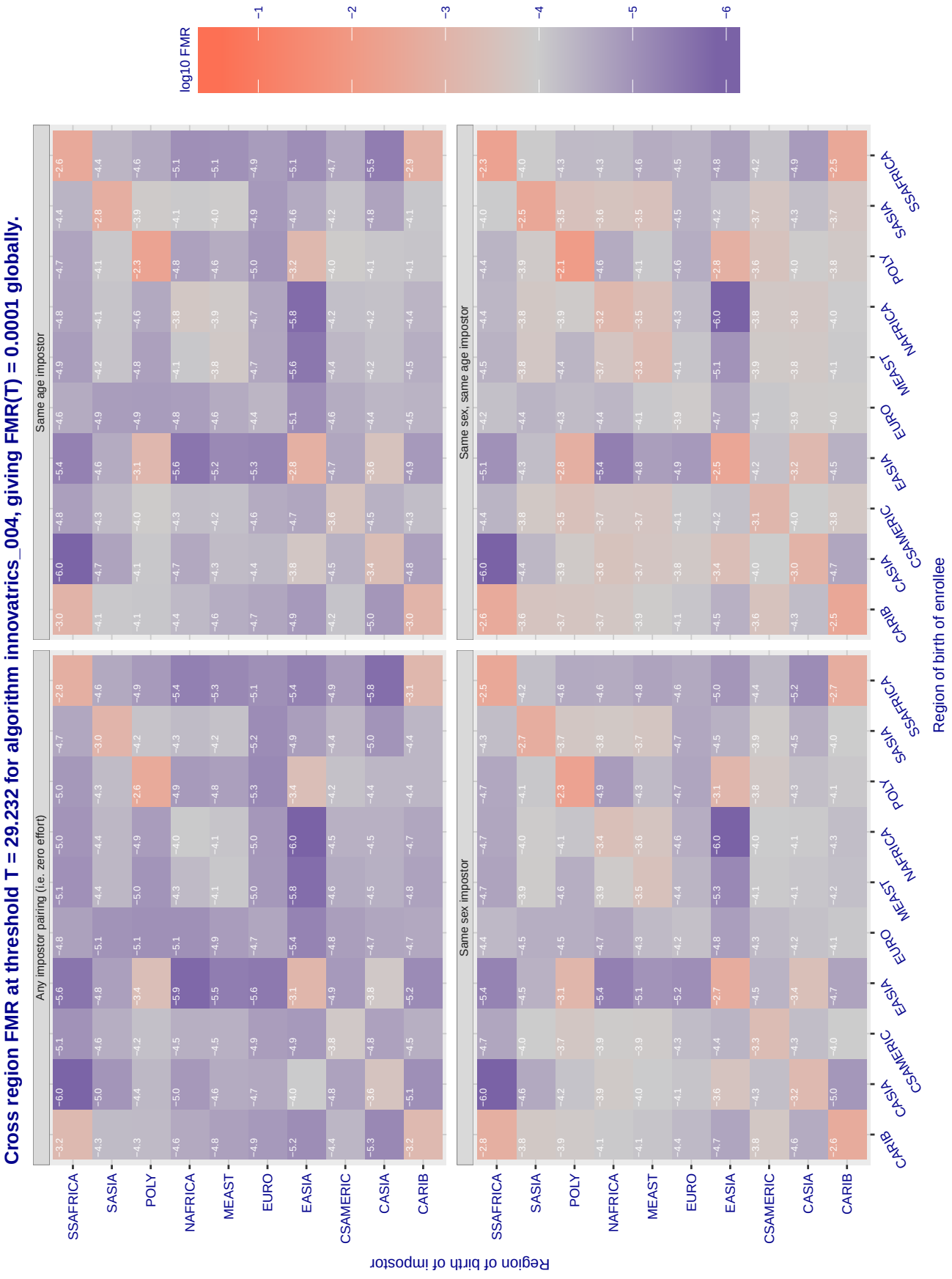


Figure 175: For algorithm innovatrics-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

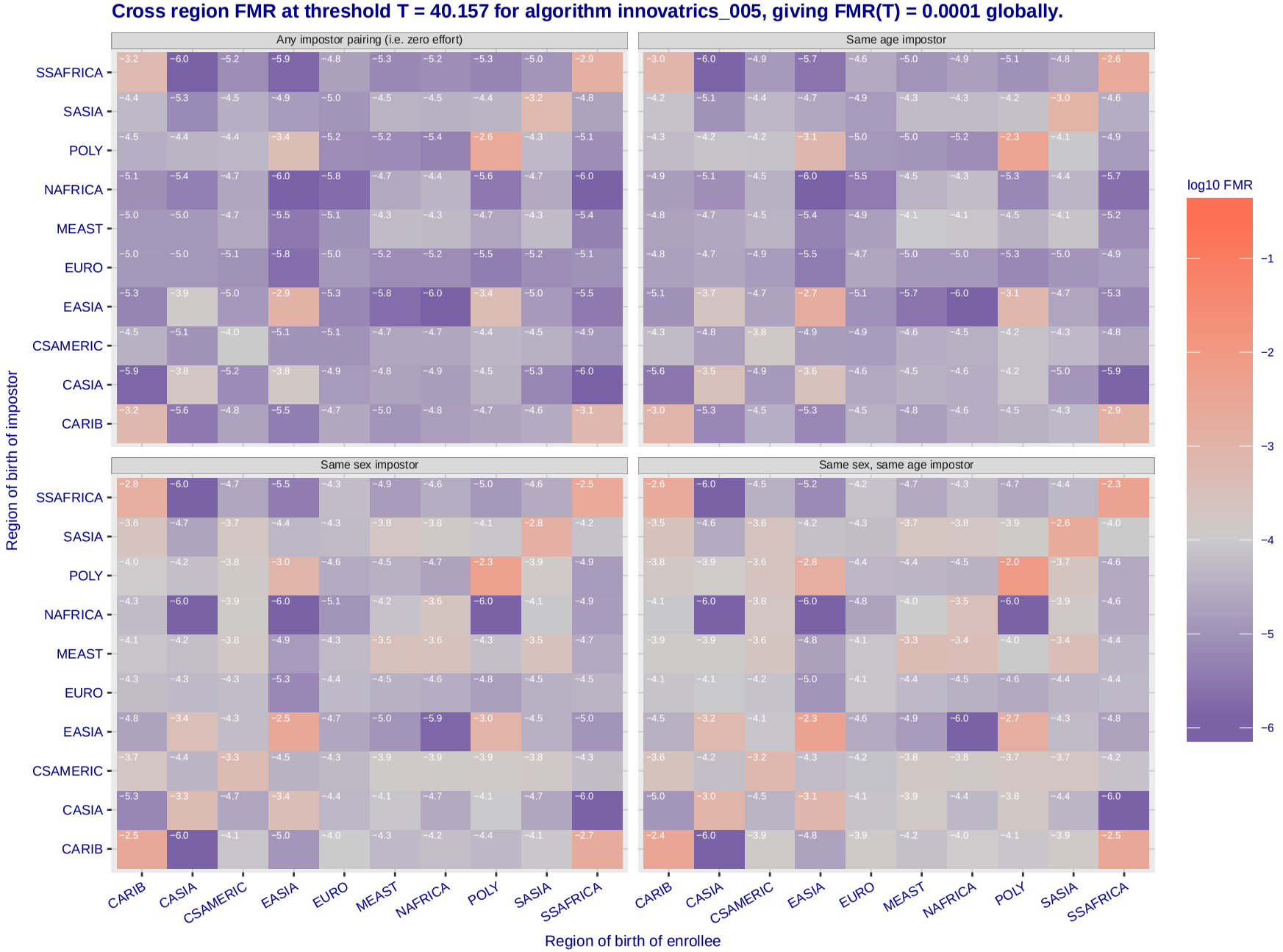


Figure 176: For algorithm innovatrics-005 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

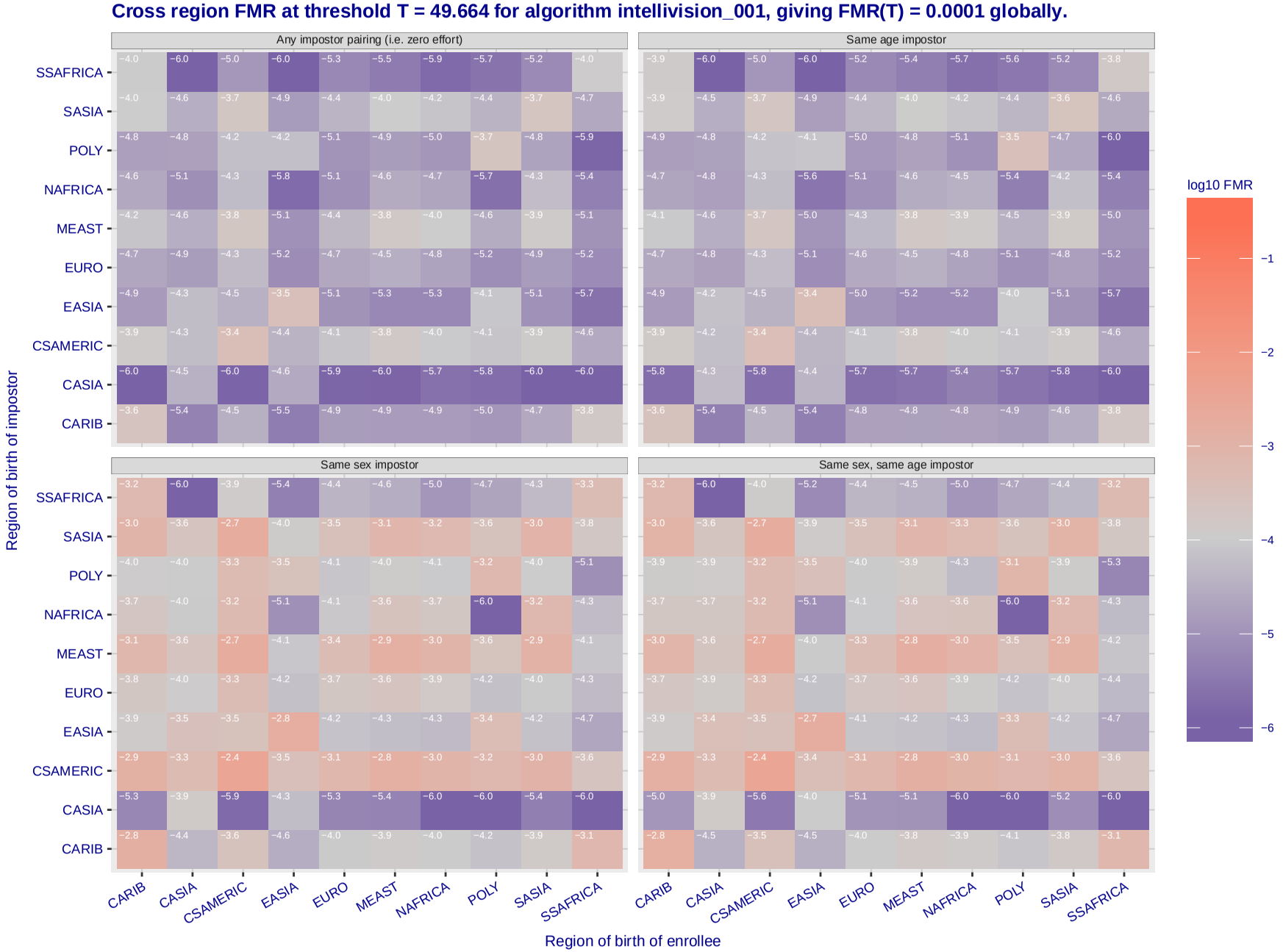


Figure 177: For algorithm intellivision-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

Figure 178: For algorithm iqface-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

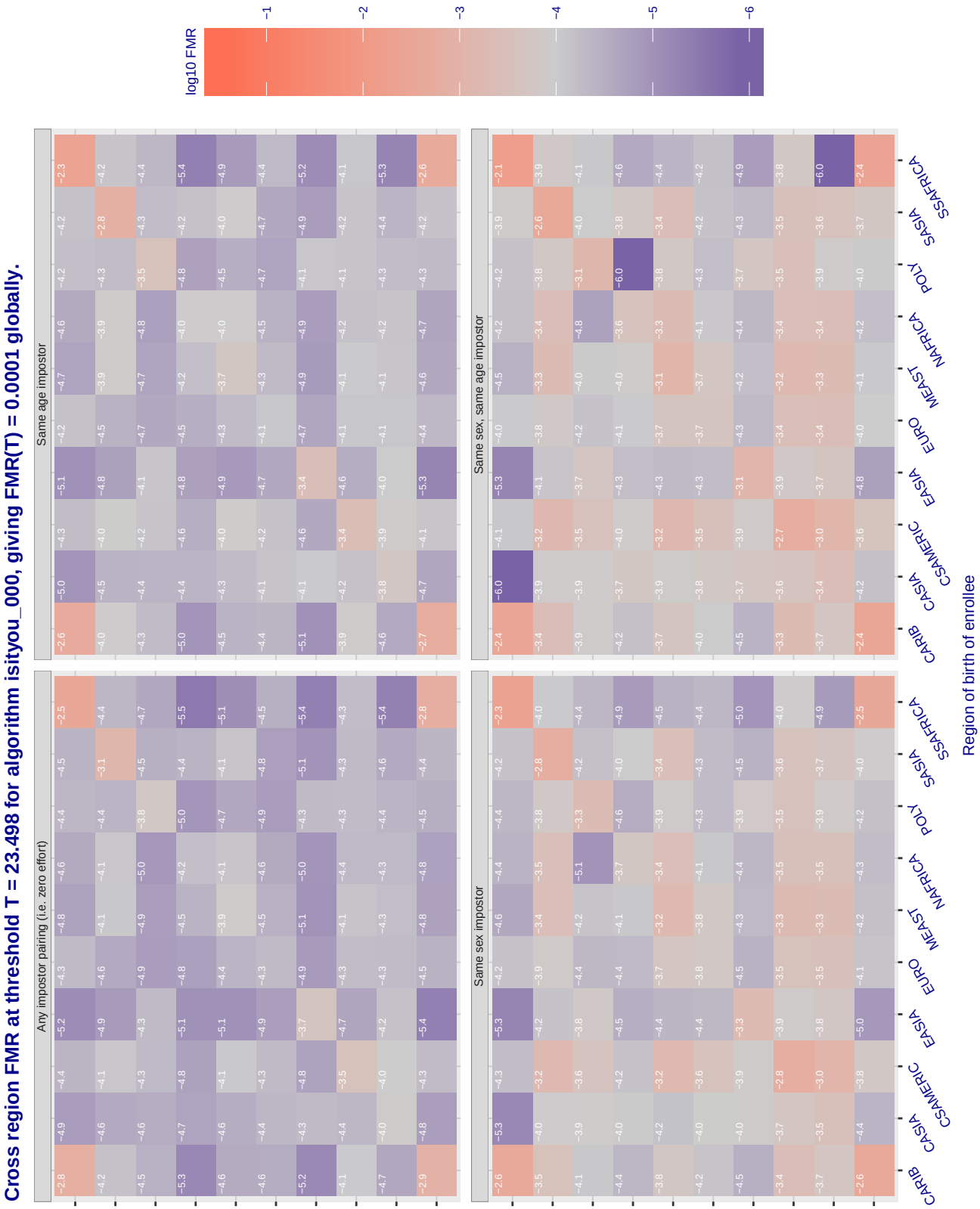


Figure 179: For algorithm isityou-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

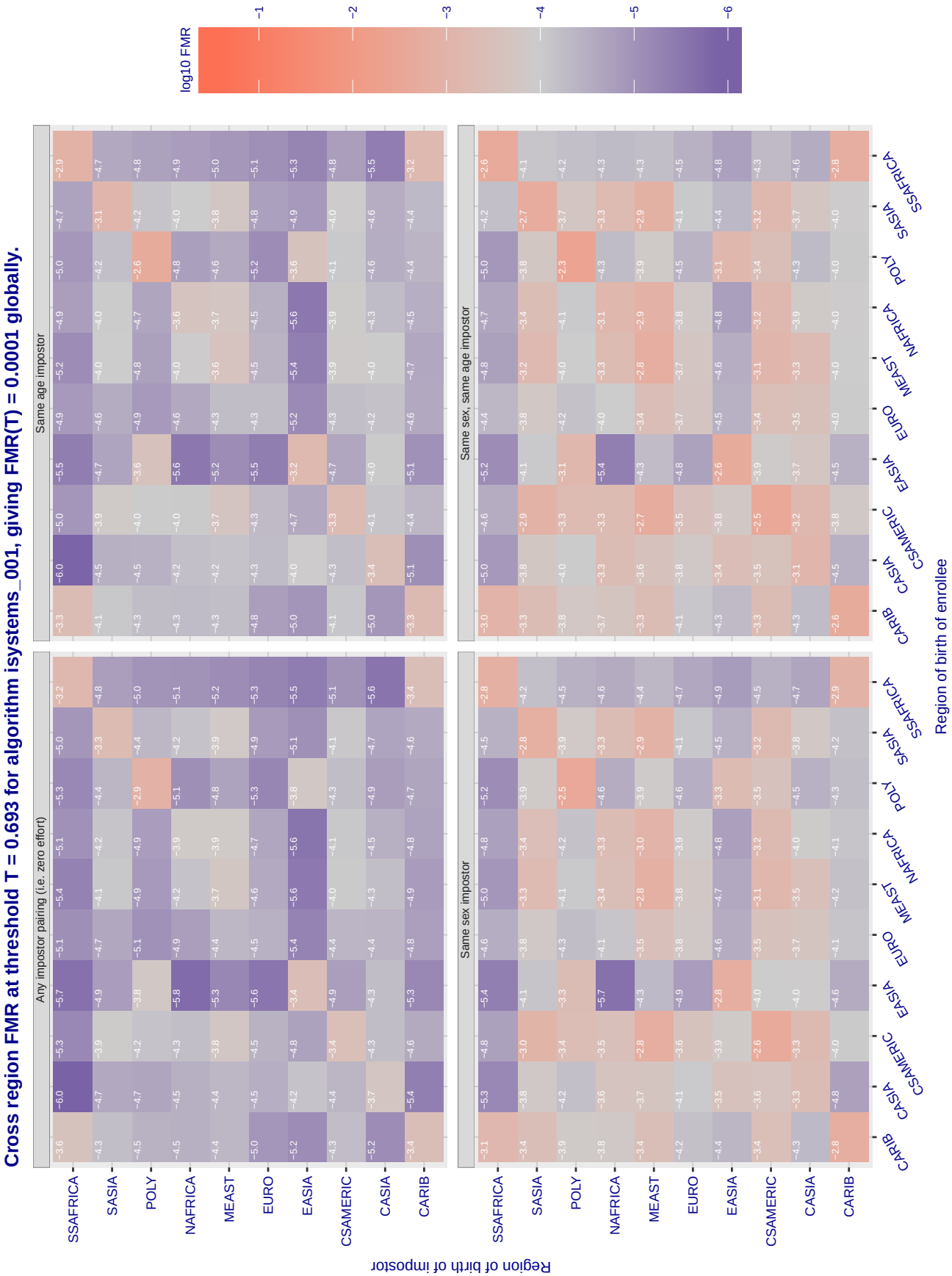


Figure 180: For algorithm isystems-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

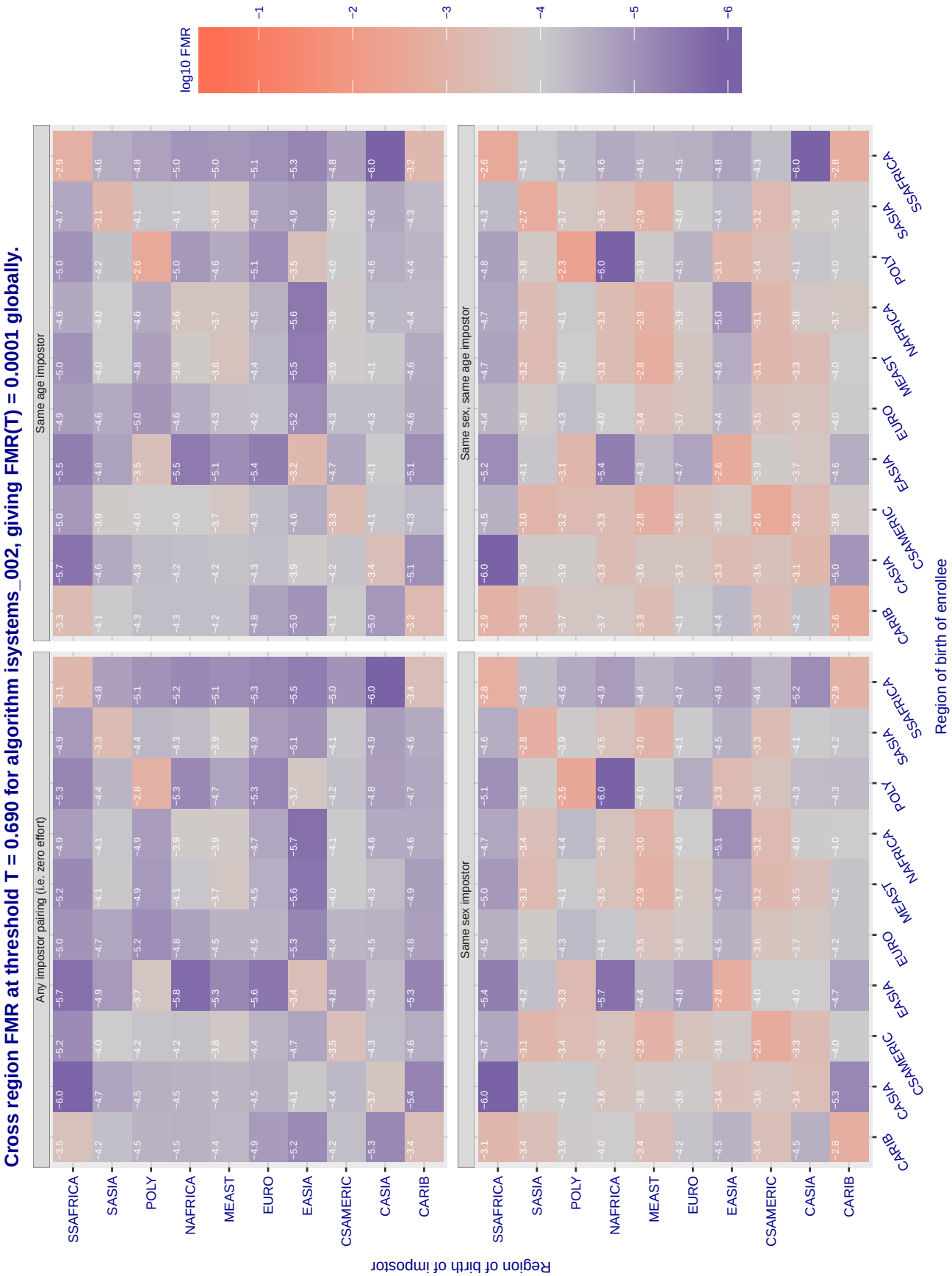


Figure 181: For algorithm isystems-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

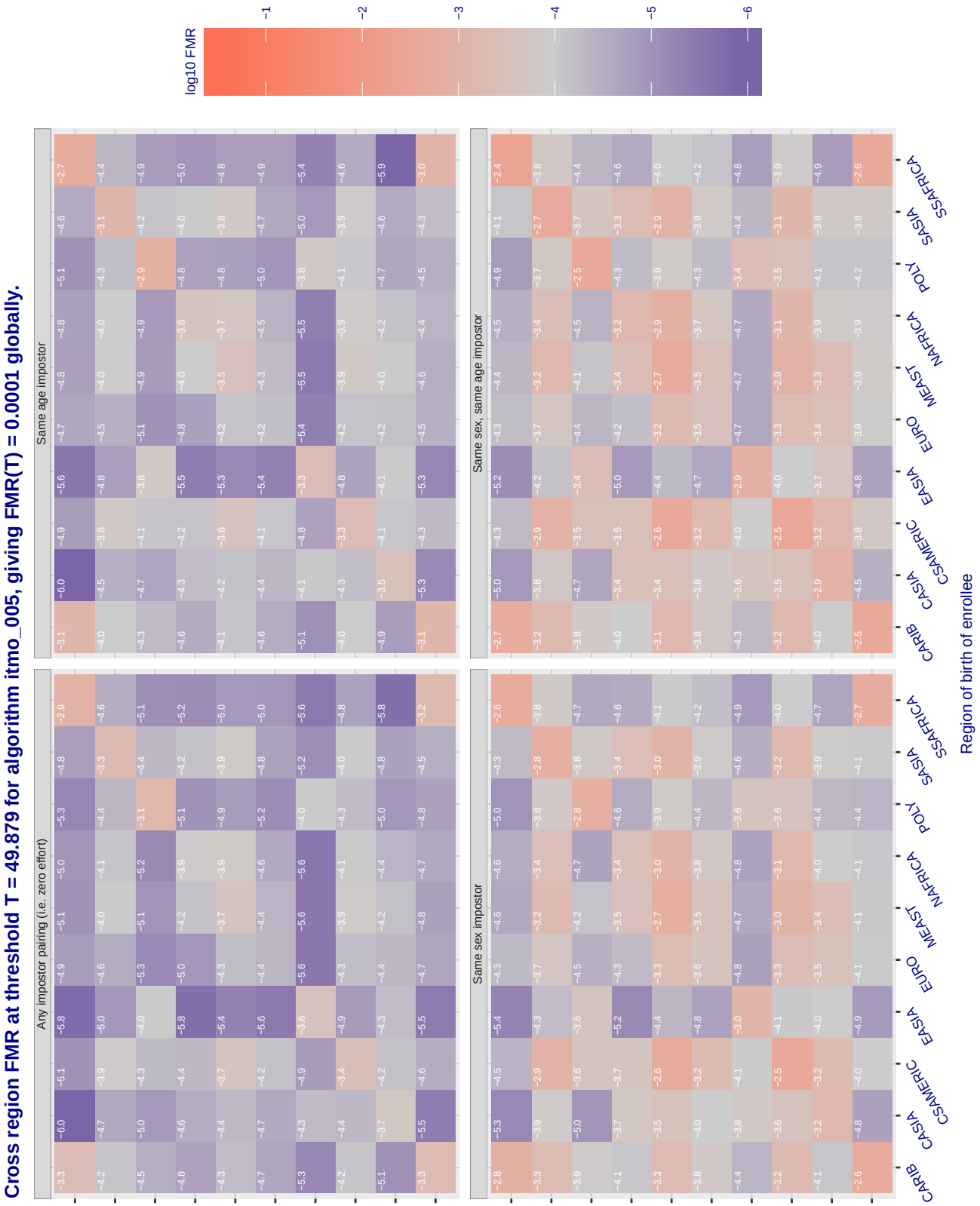


Figure 182: For algorithm itmo-005 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

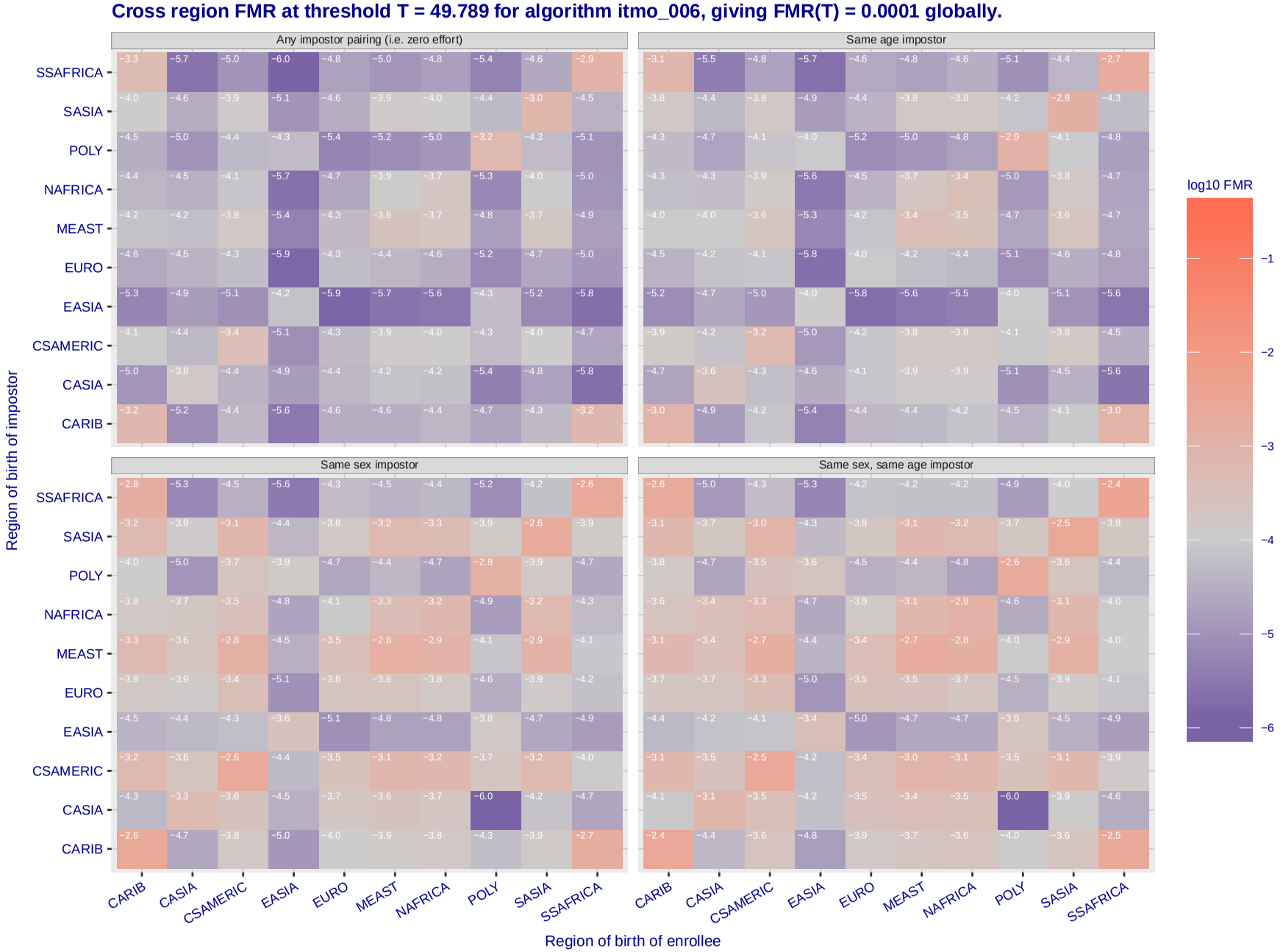


Figure 183: For algorithm itmo-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

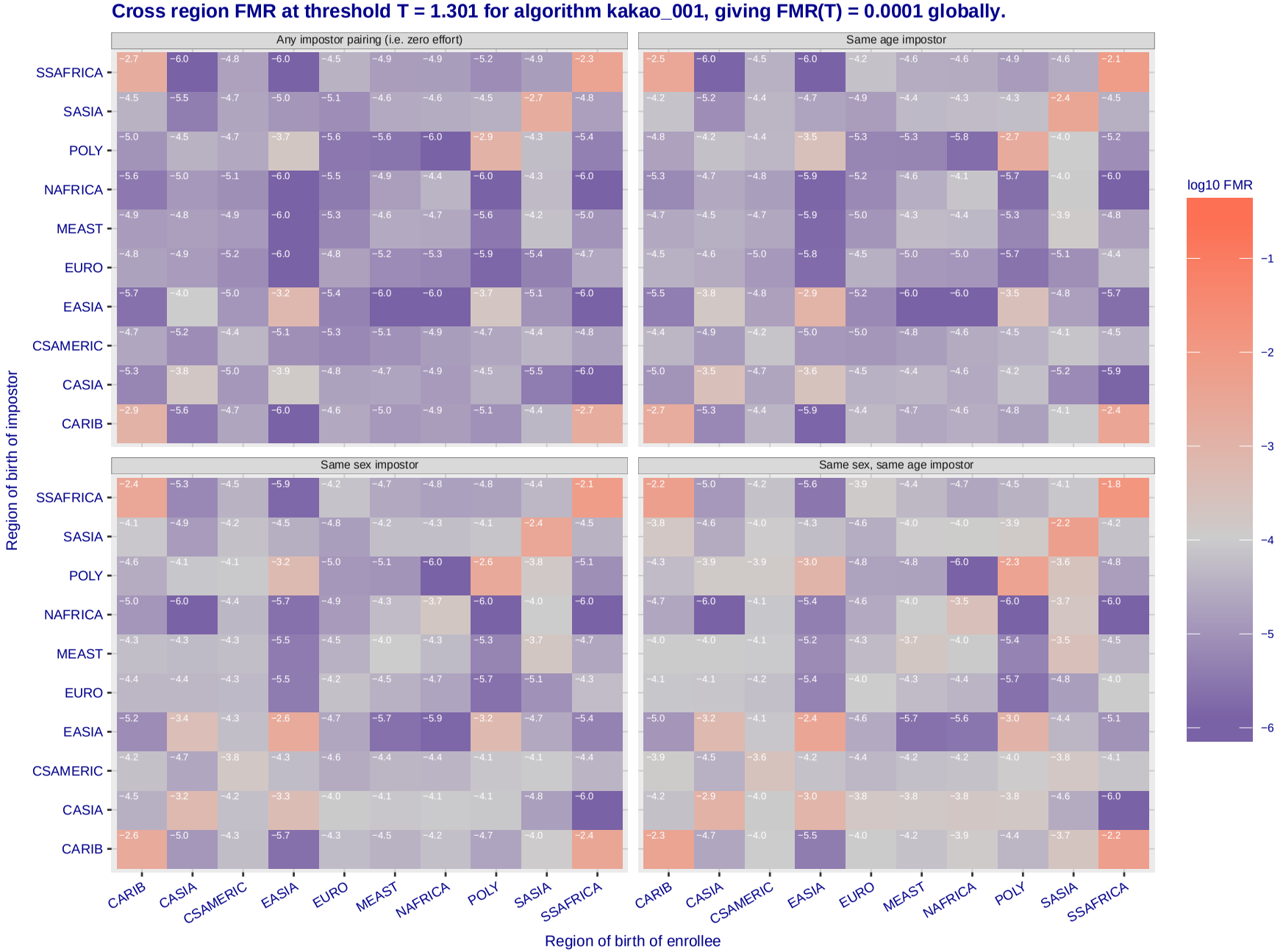


Figure 184: For algorithm kakao-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

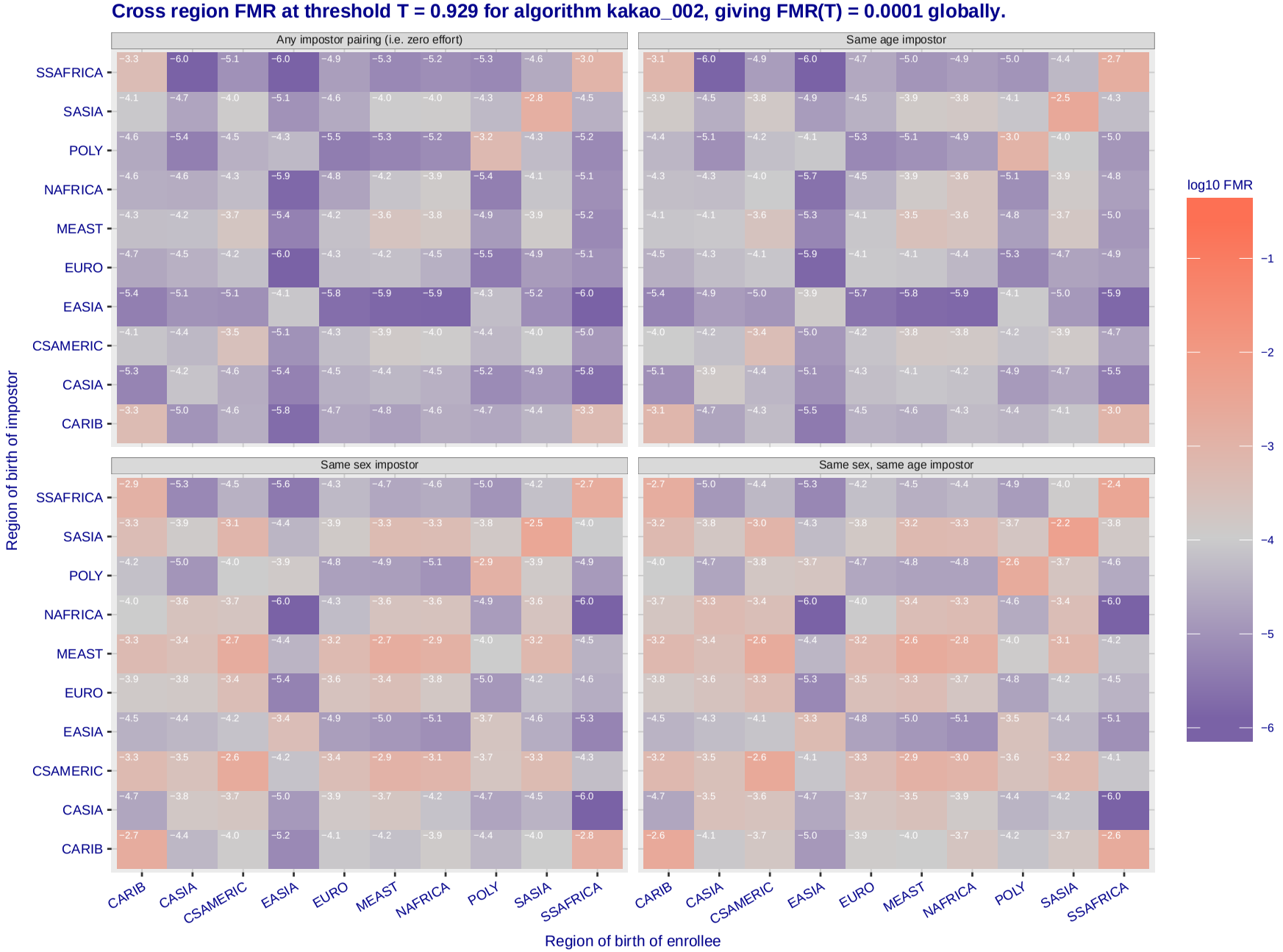


Figure 185: For algorithm kakao-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

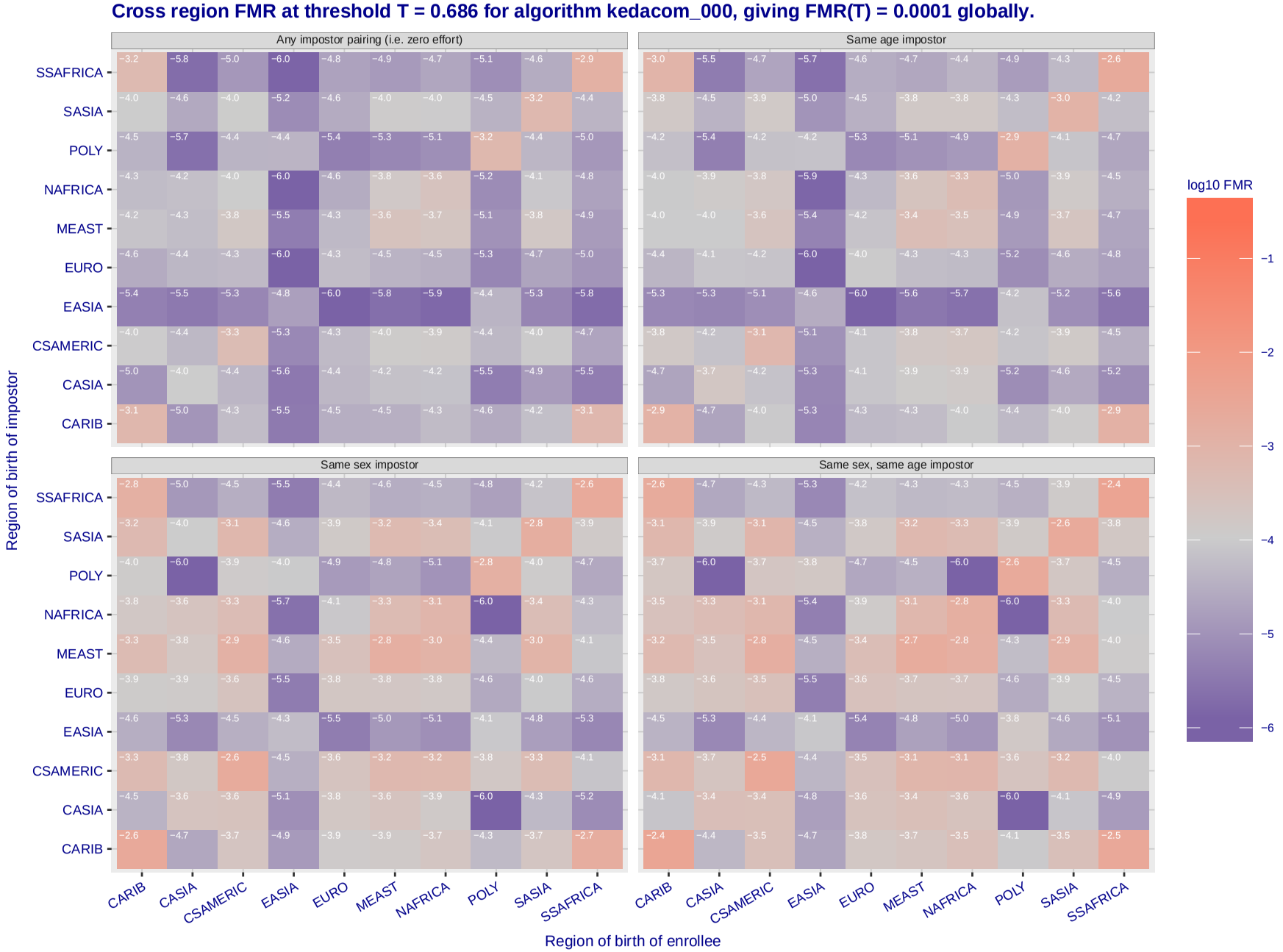


Figure 186: For algorithm kedacom-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

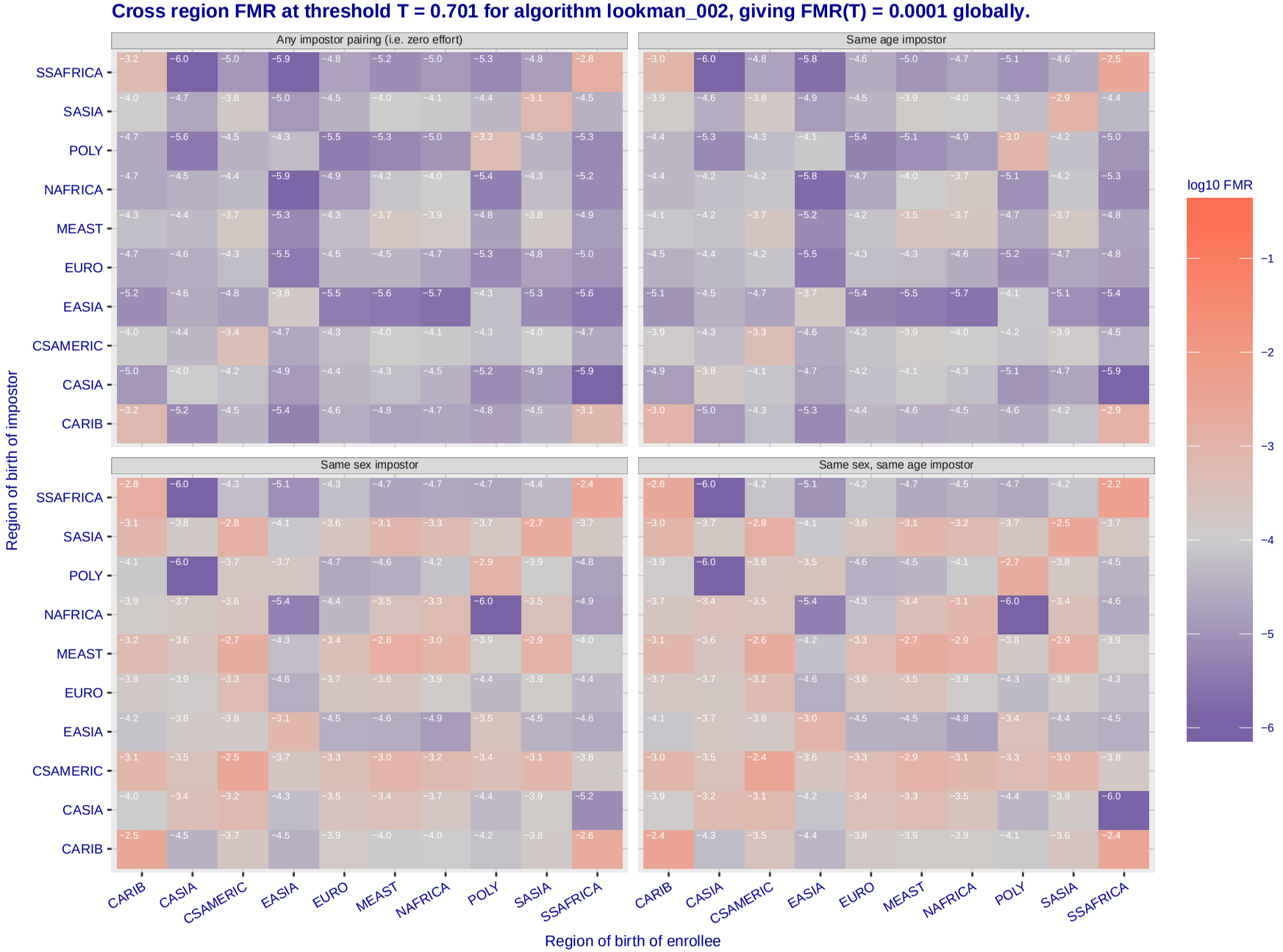


Figure 187: For algorithm lookman-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

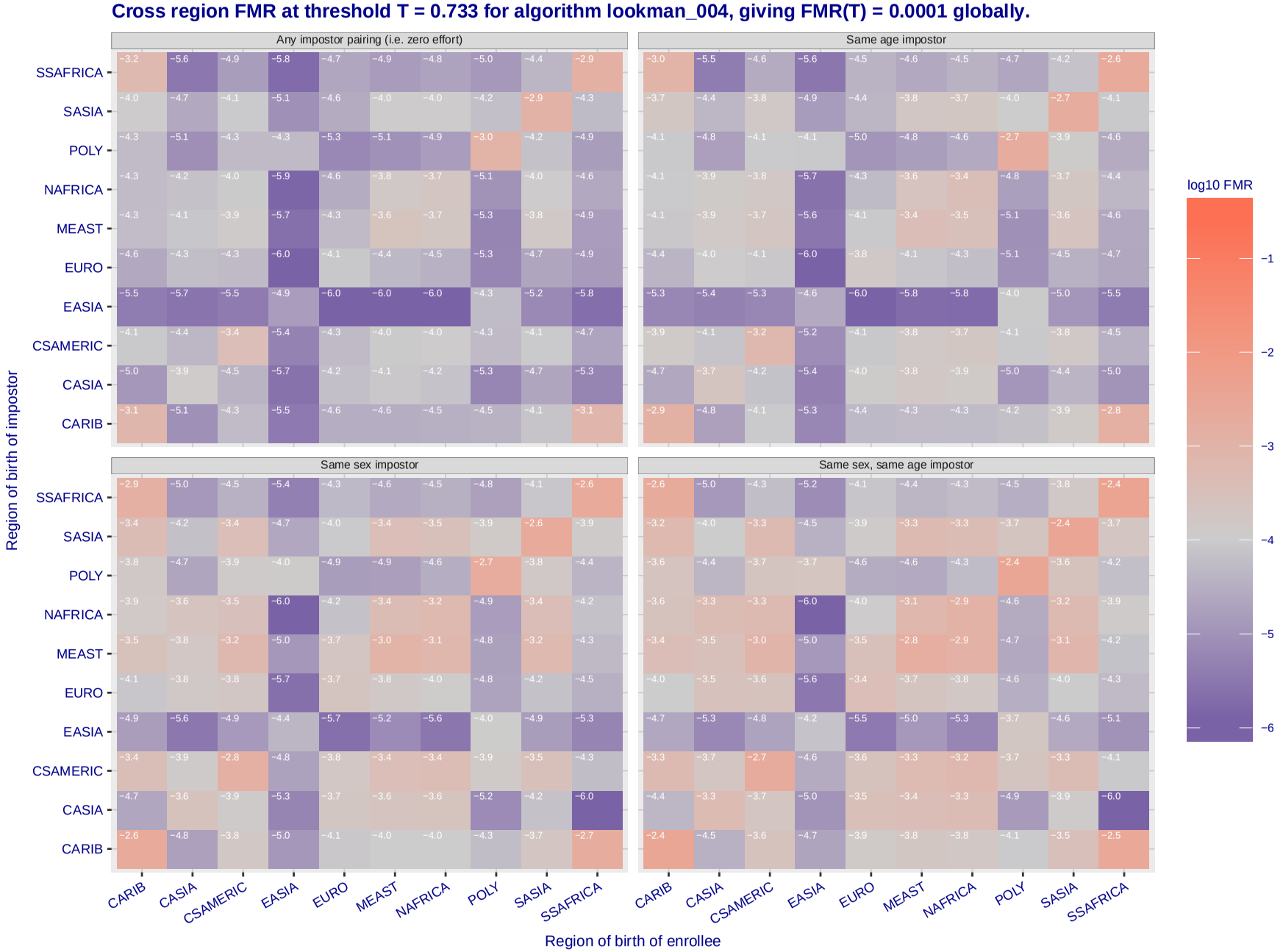


Figure 188: For algorithm lookman-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

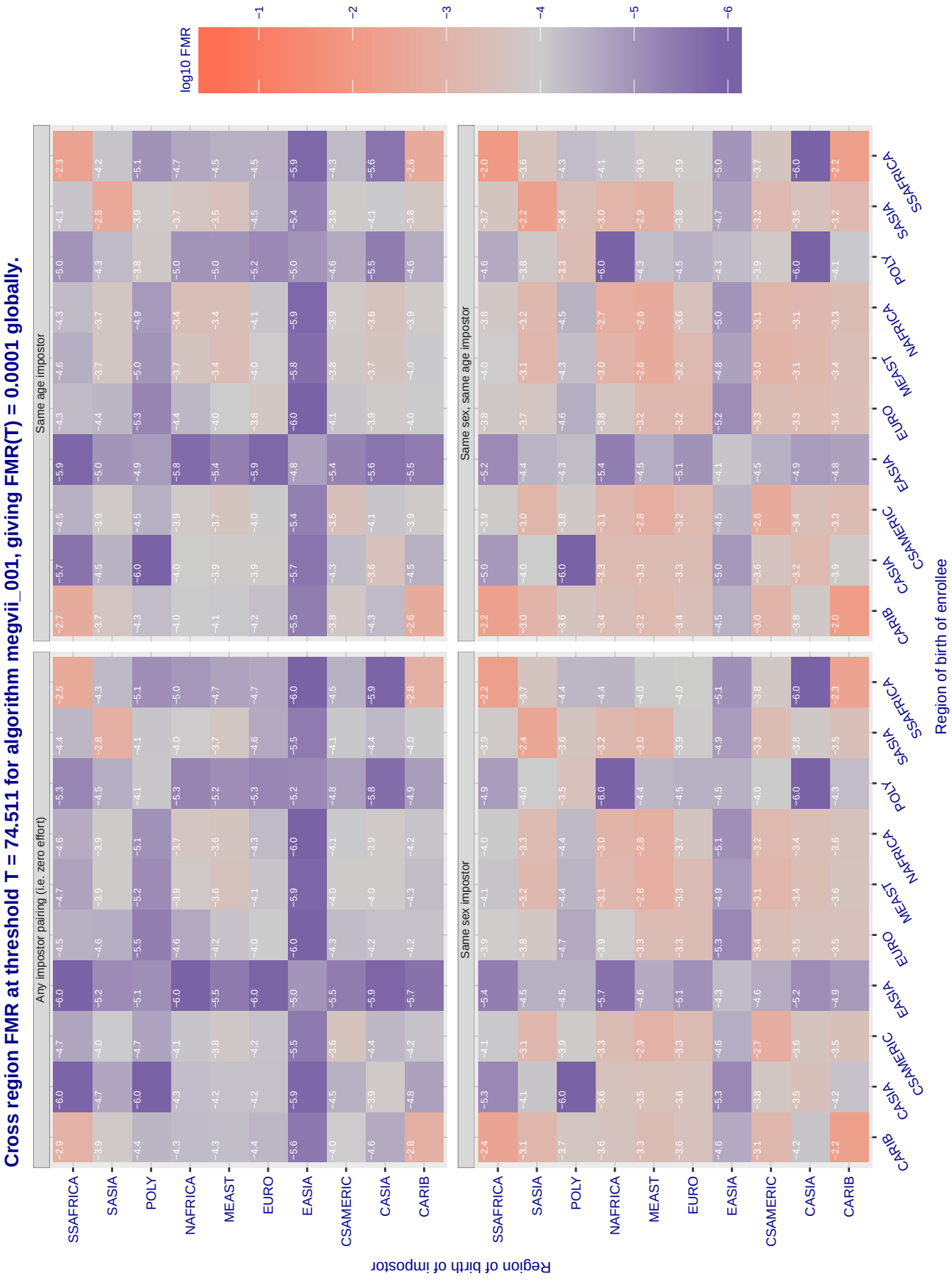


Figure 189: For algorithm megvii-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

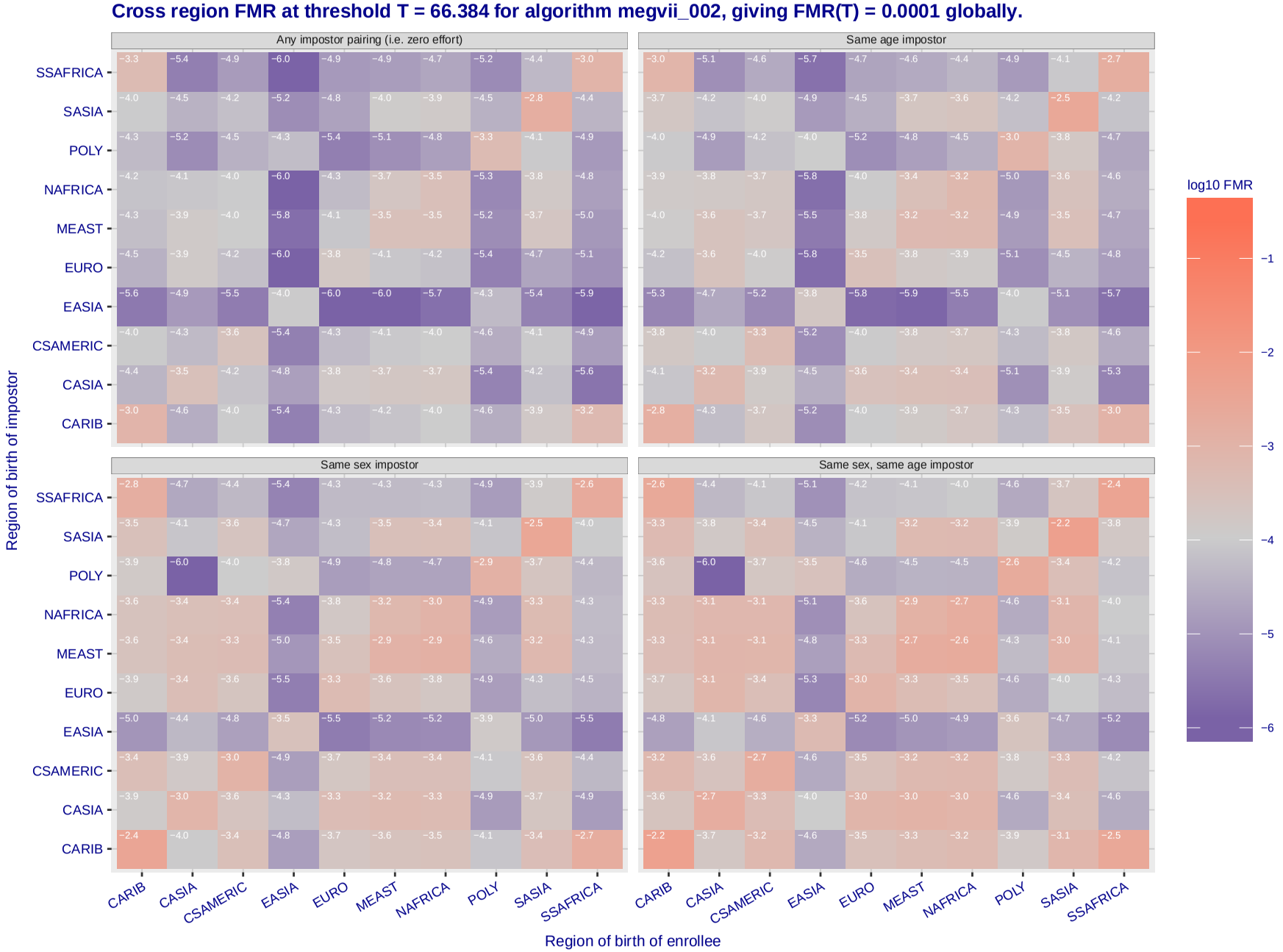


Figure 190: For algorithm megvii-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

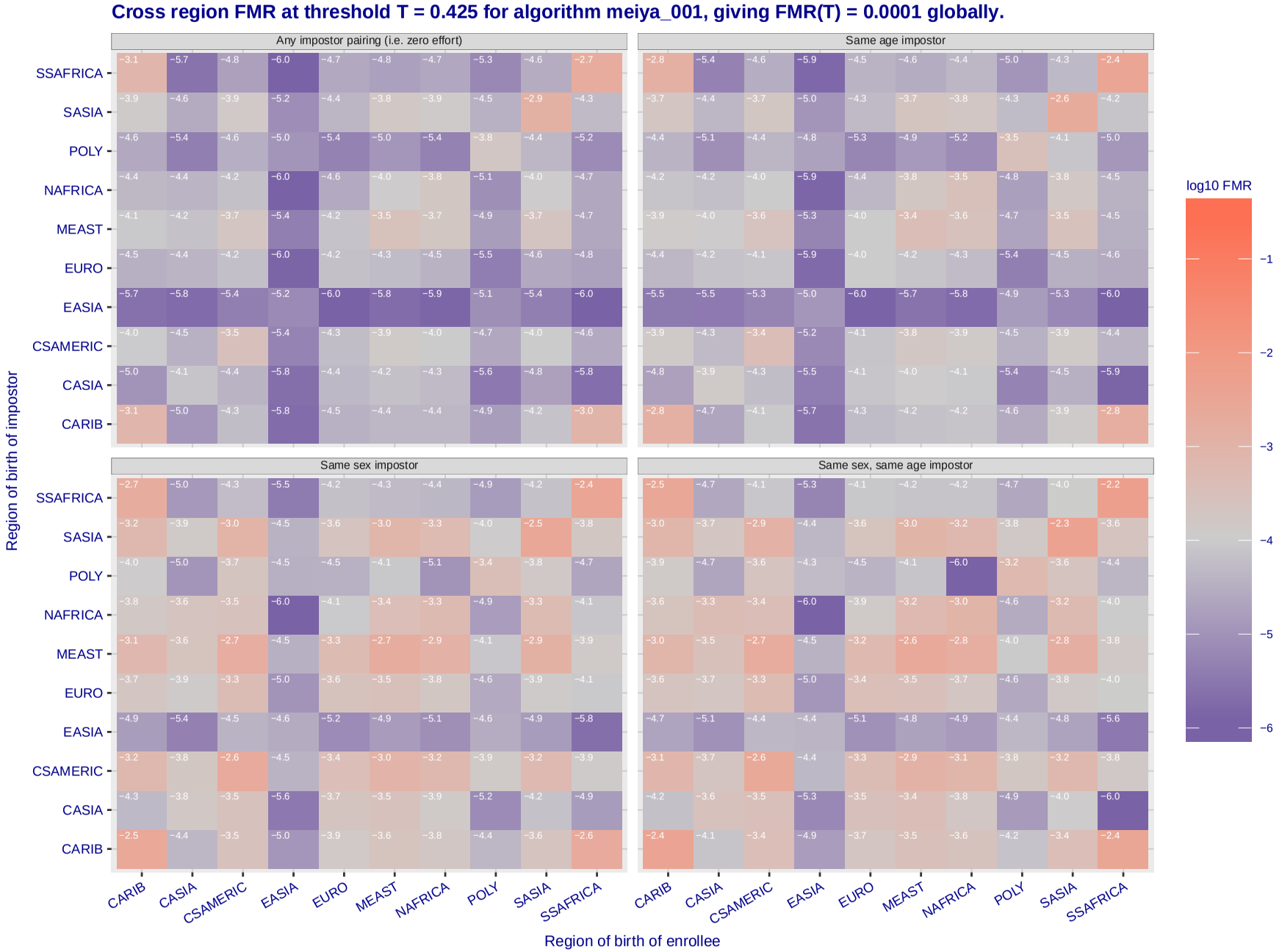


Figure 191: For algorithm meiya-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

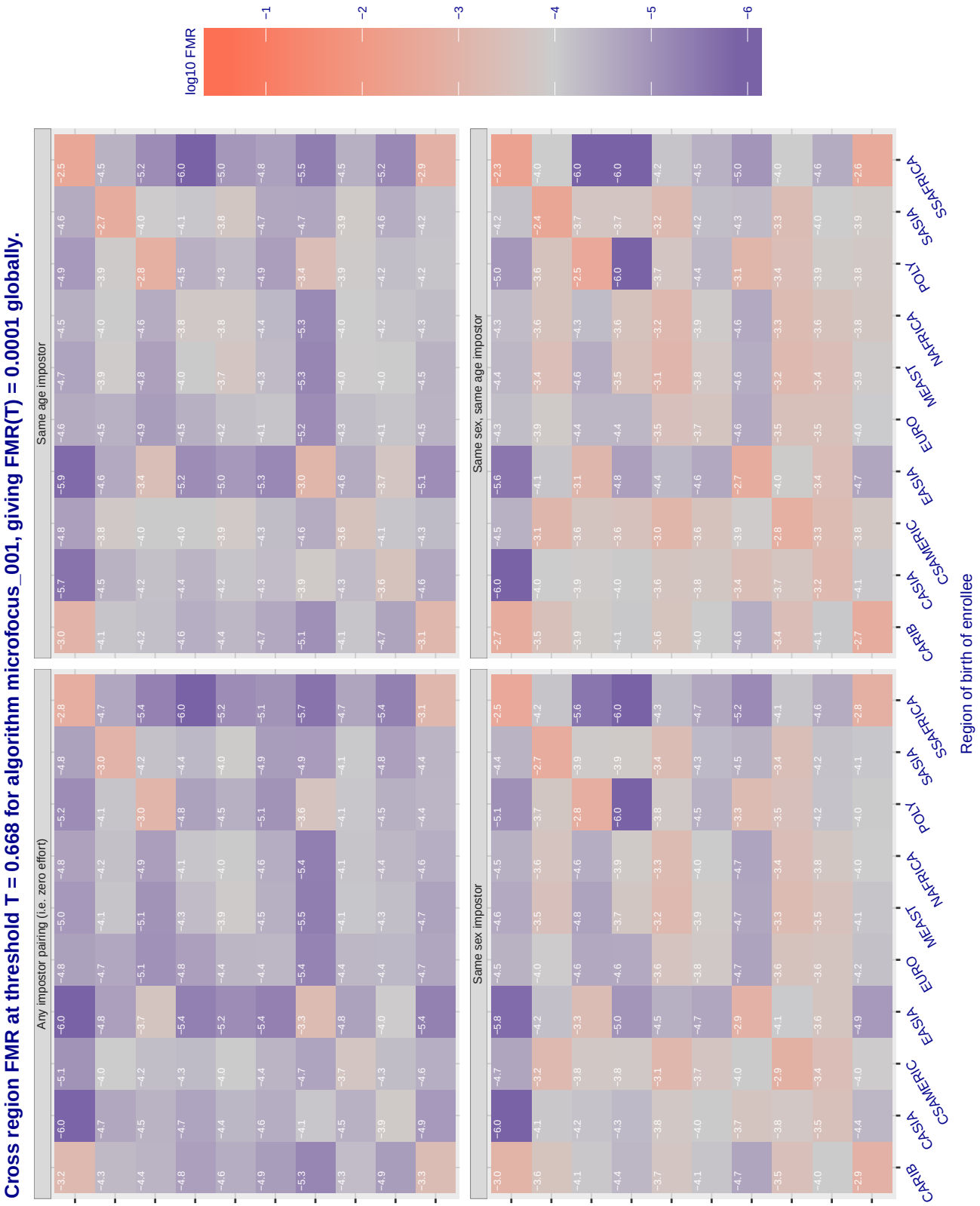


Figure 192: For algorithm microfocus-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

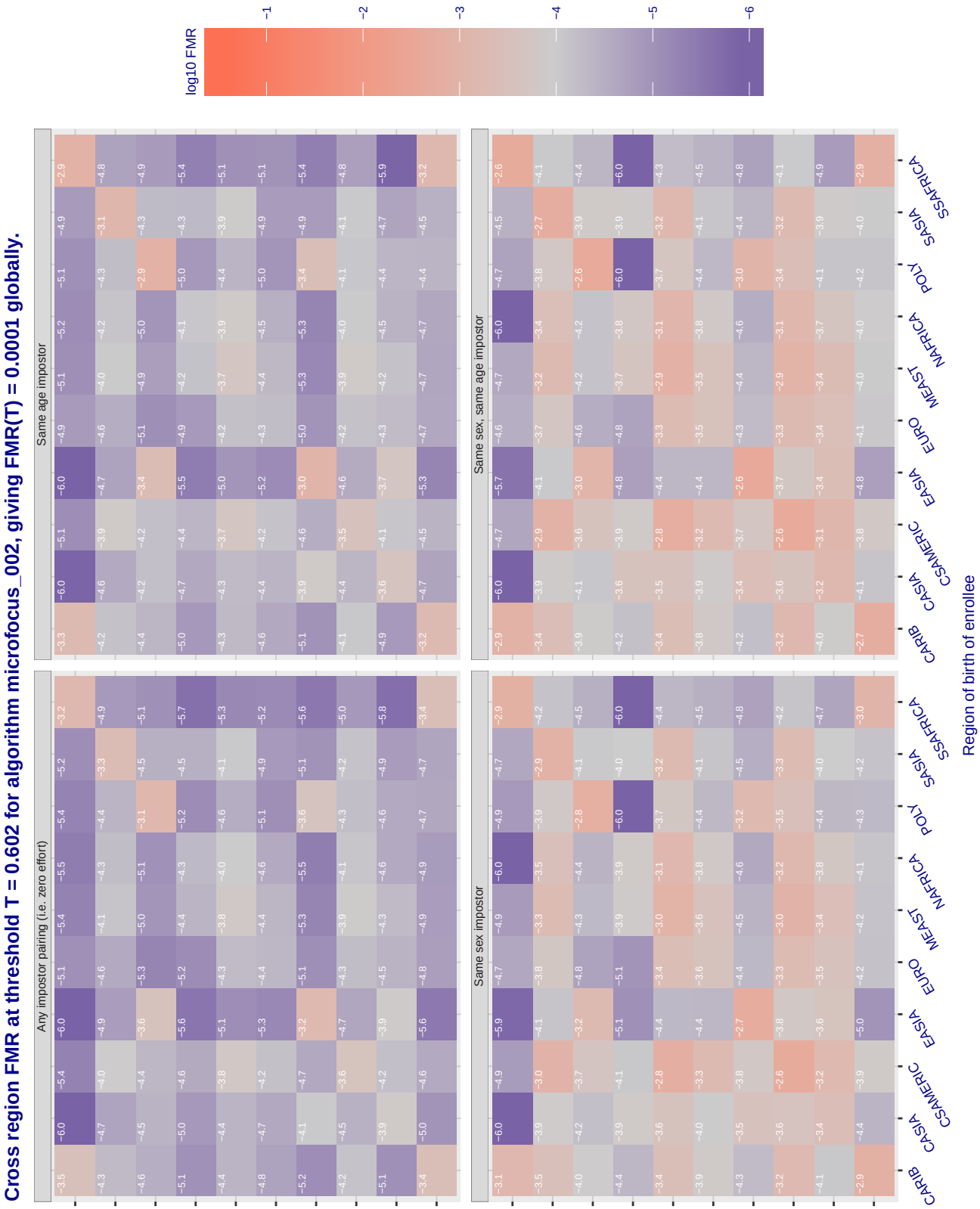


Figure 193: For algorithm microfocus-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

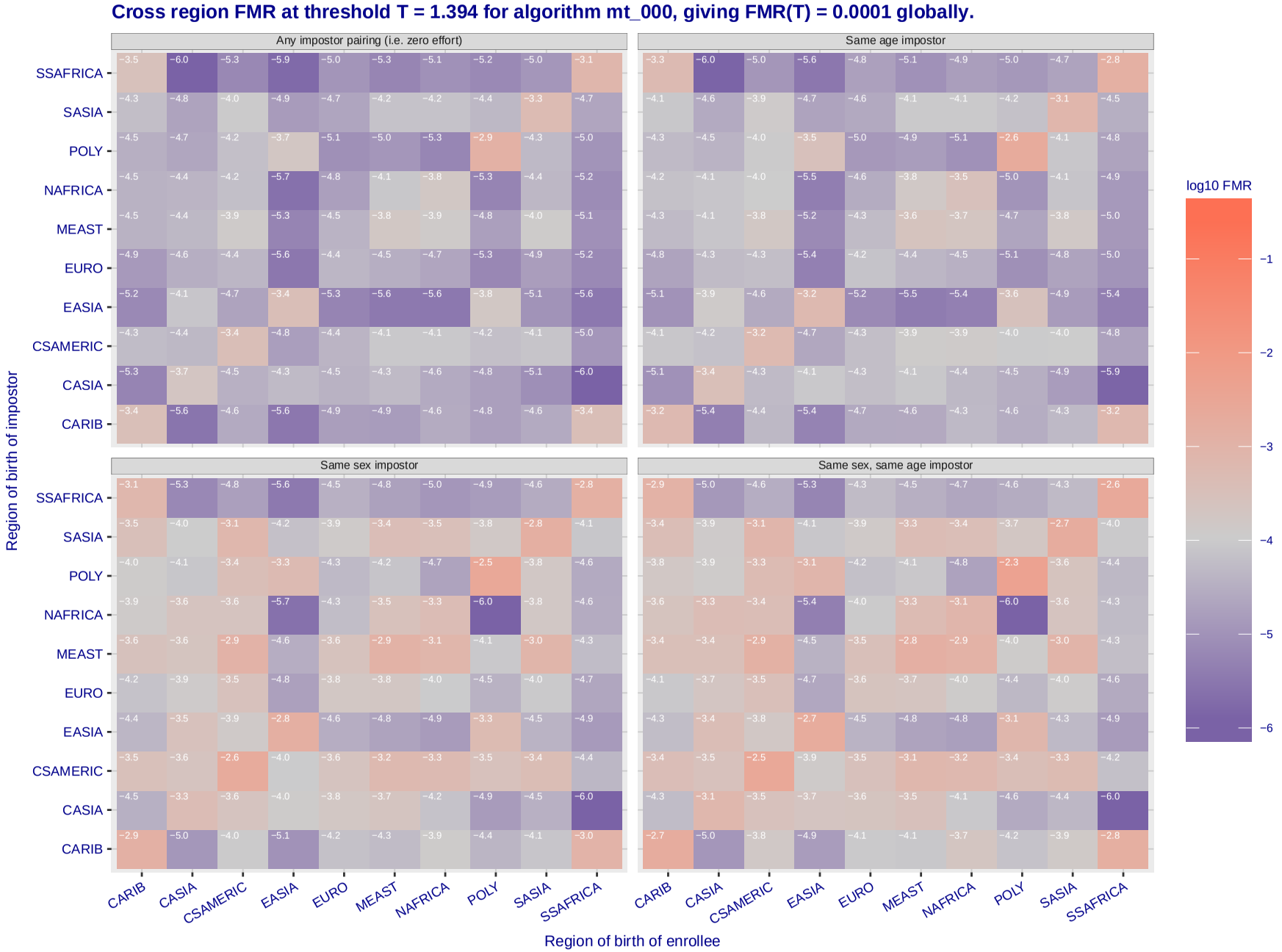


Figure 194: For algorithm mt-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

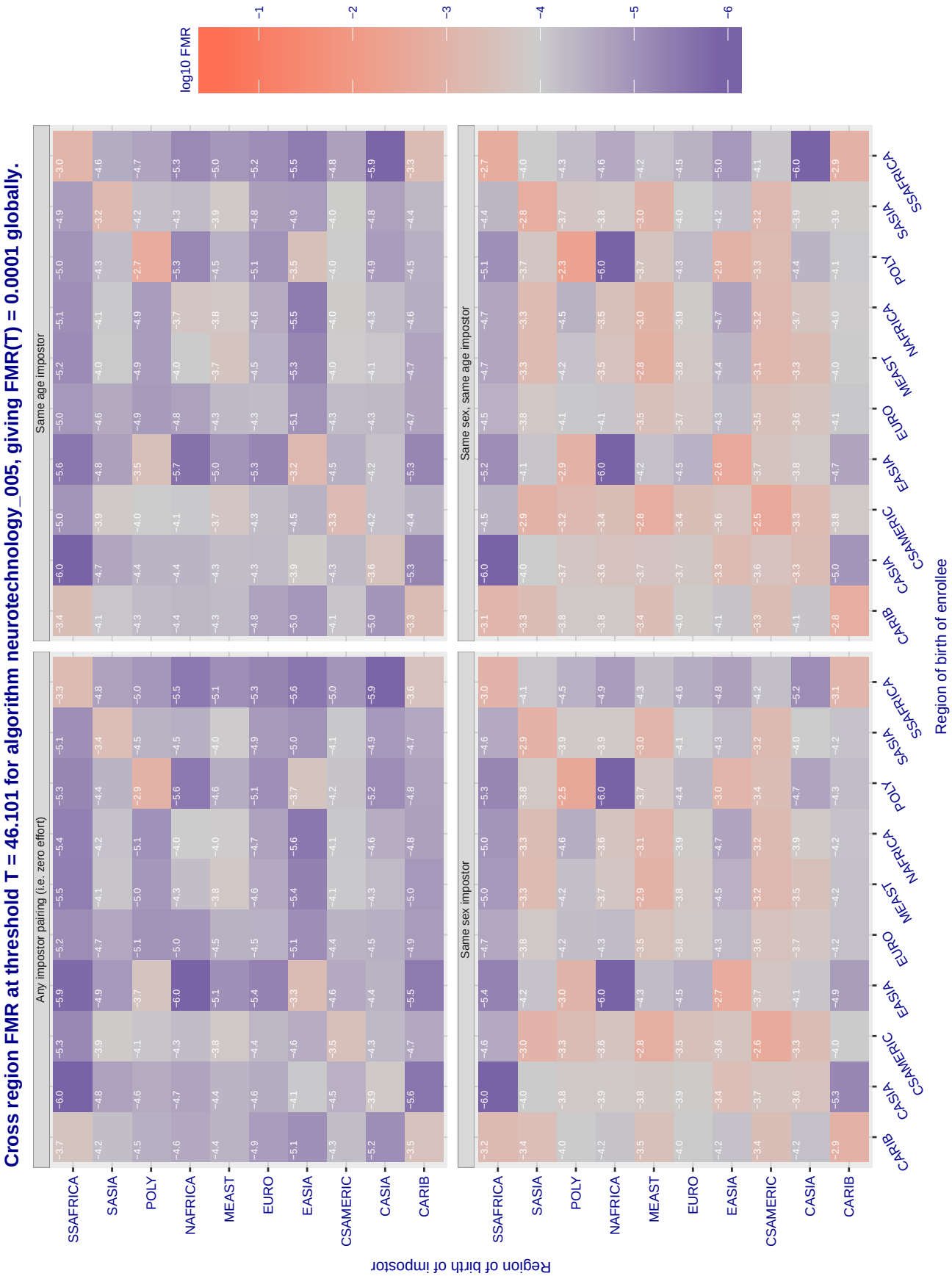


Figure 195: For algorithm neurotechnology-005 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

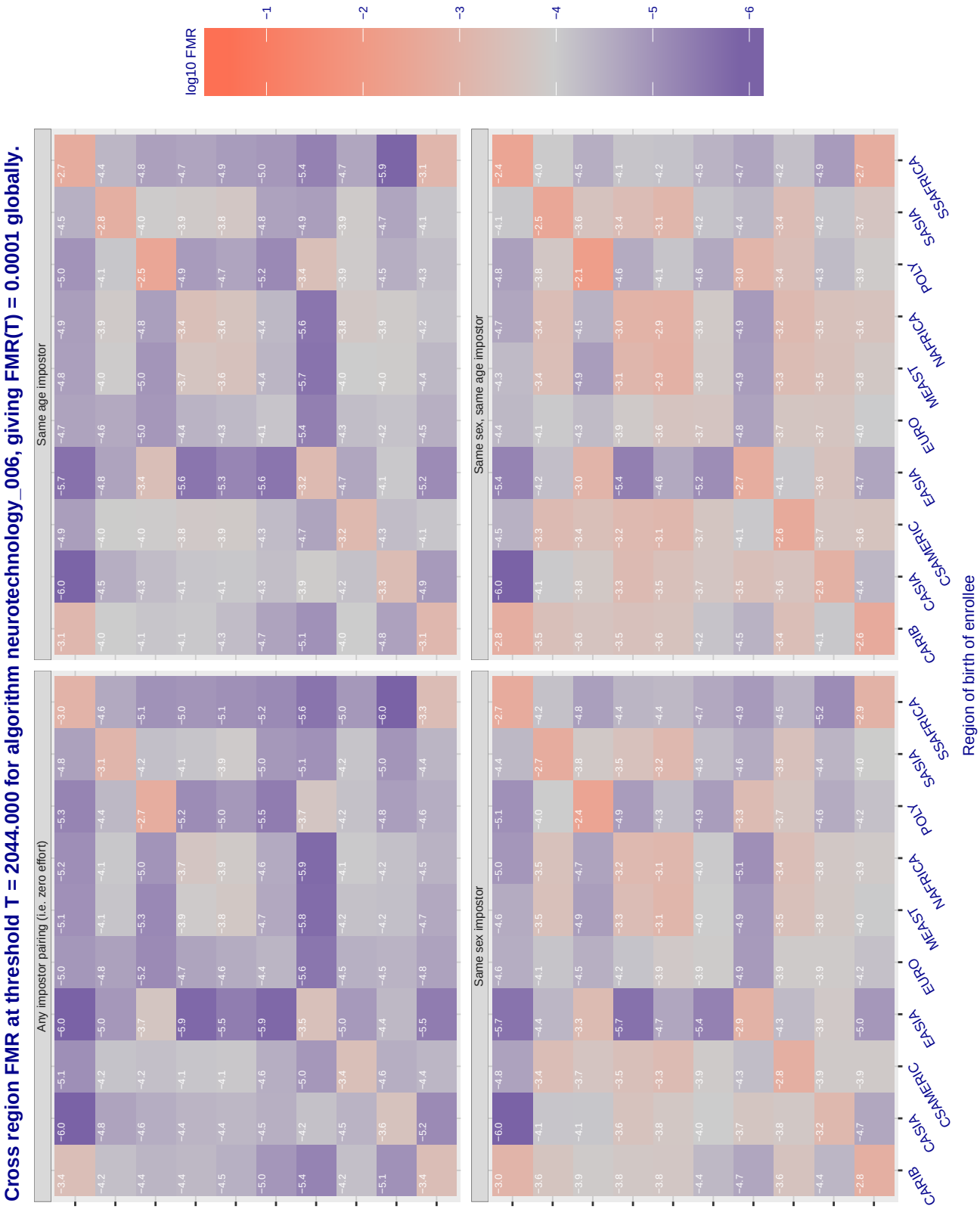


Figure 196: For algorithm neurotechnology-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

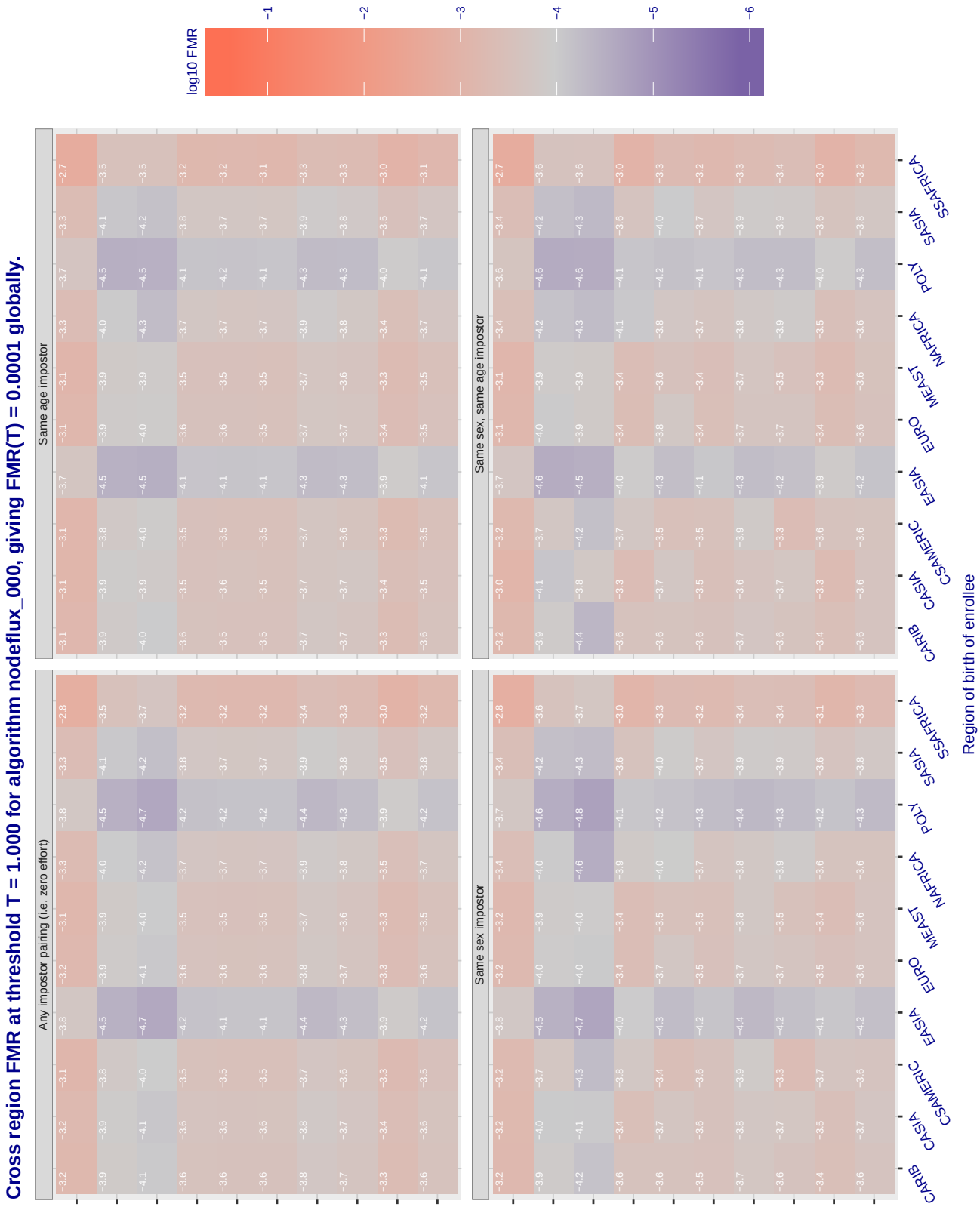


Figure 197: For algorithm nodeflux-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

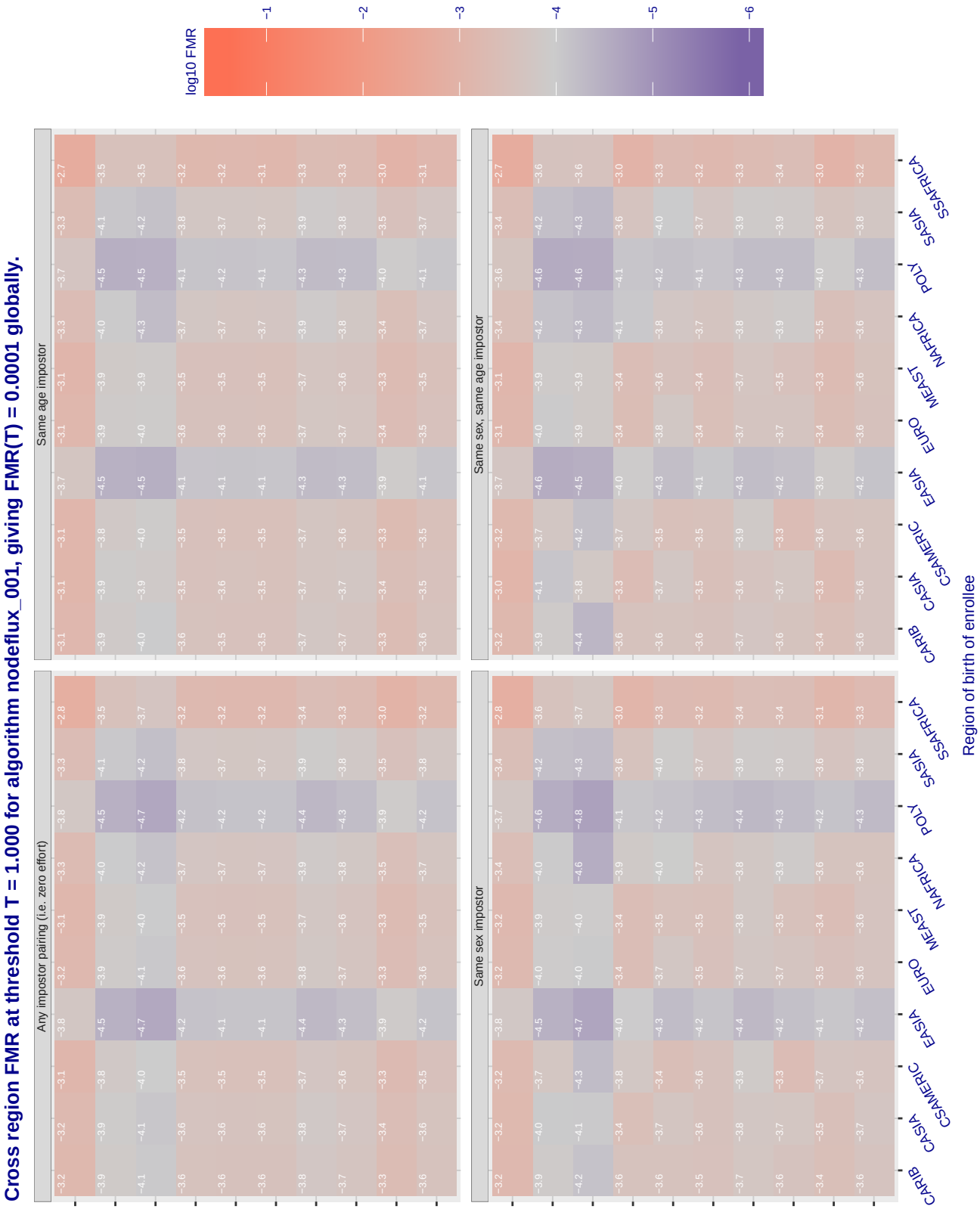


Figure 198: For algorithm nodeflux-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

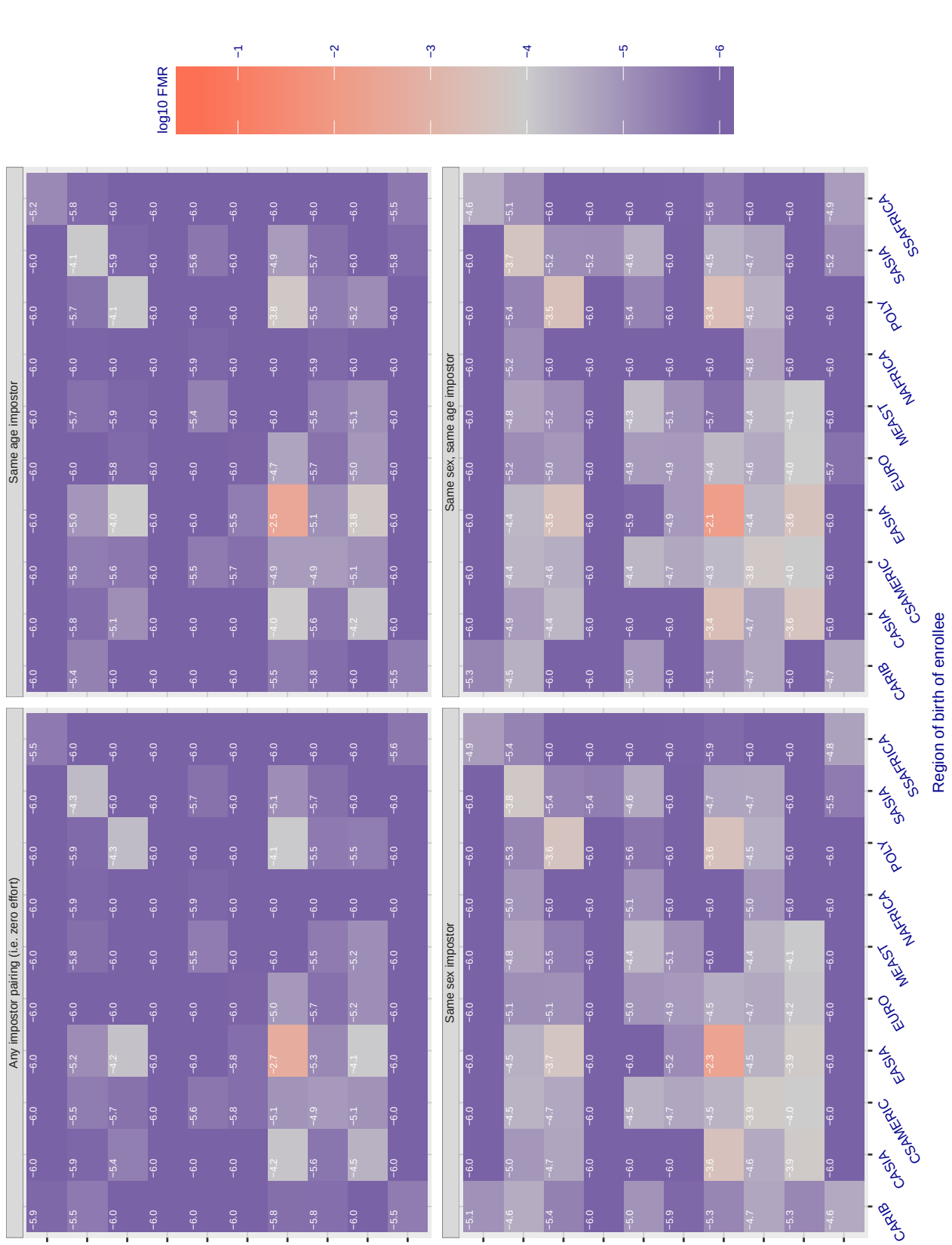


Figure 199: For algorithm notiontag-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

Figure 200: For algorithm ntechlab-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

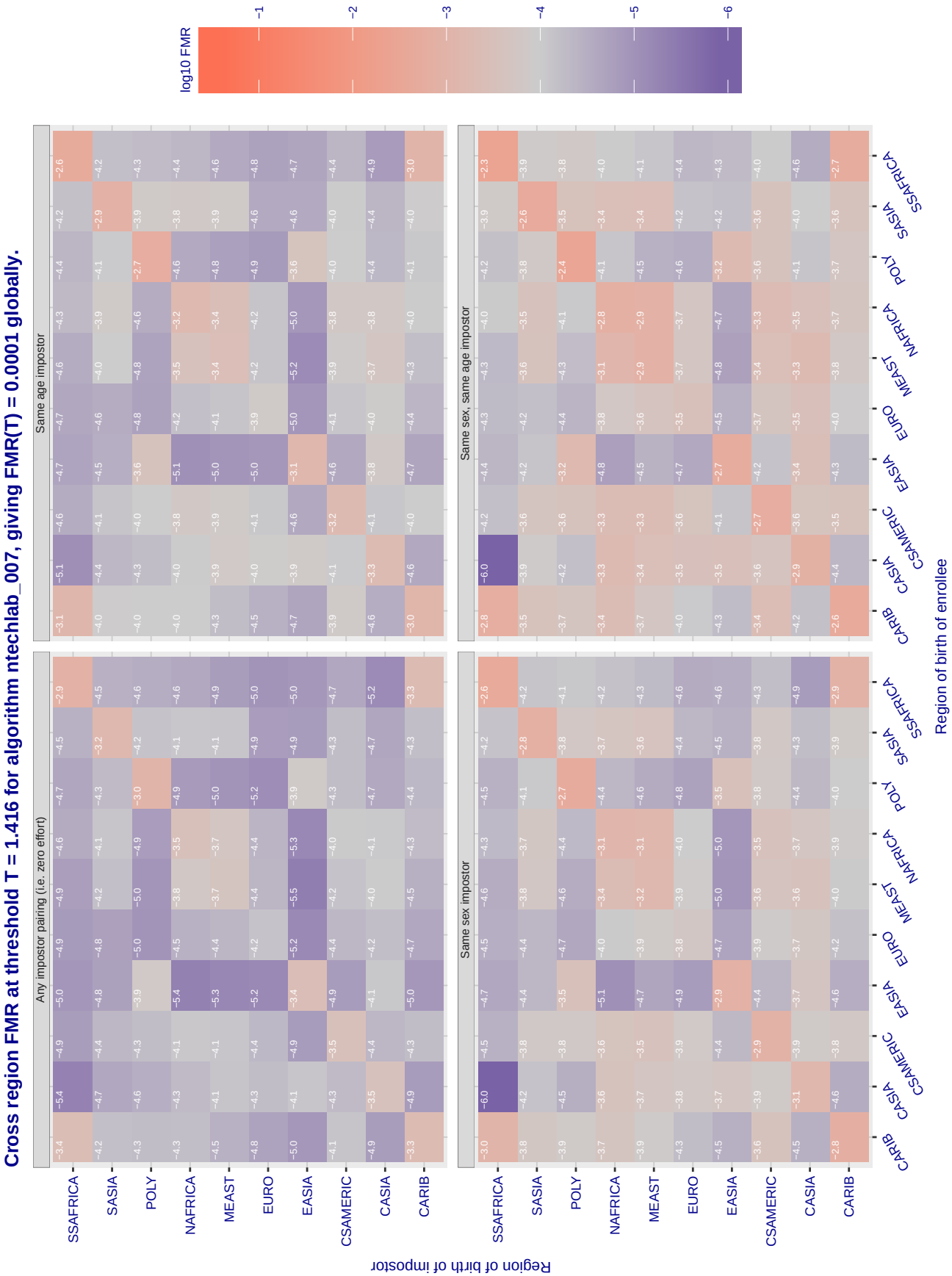


Figure 201: For algorithm ntechlab-007 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

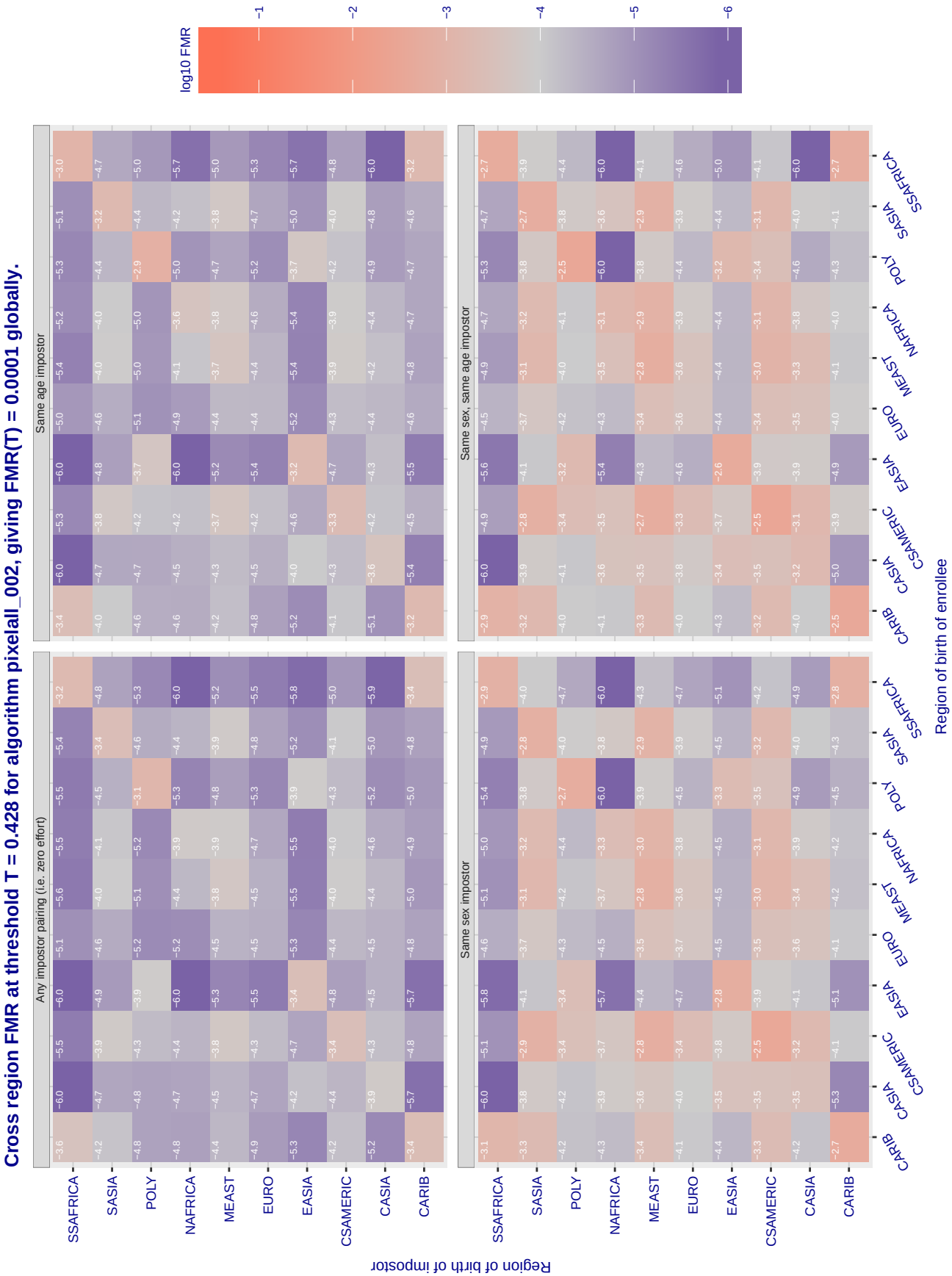


Figure 202: For algorithm pixelall-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

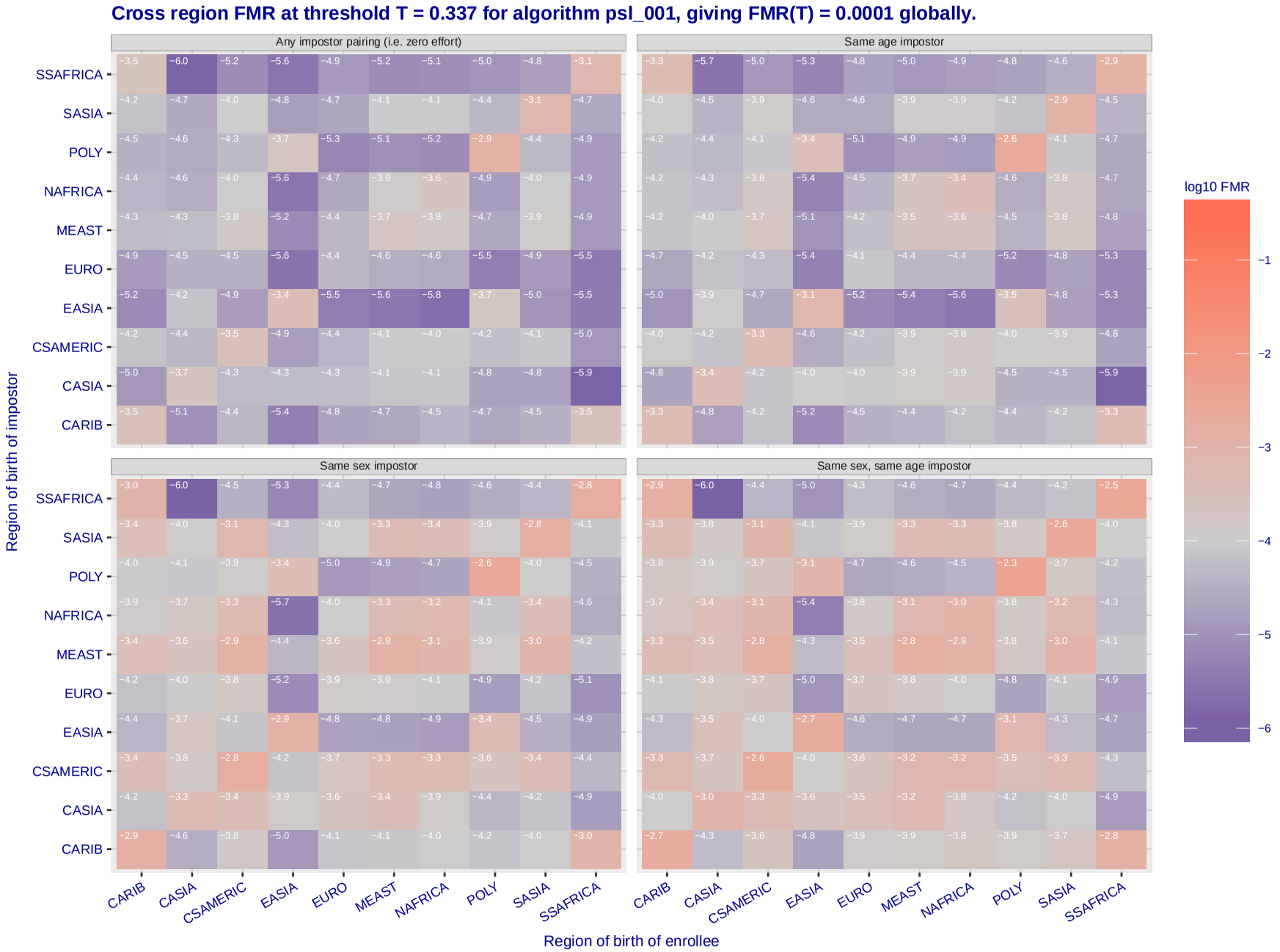


Figure 203: For algorithm psl-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

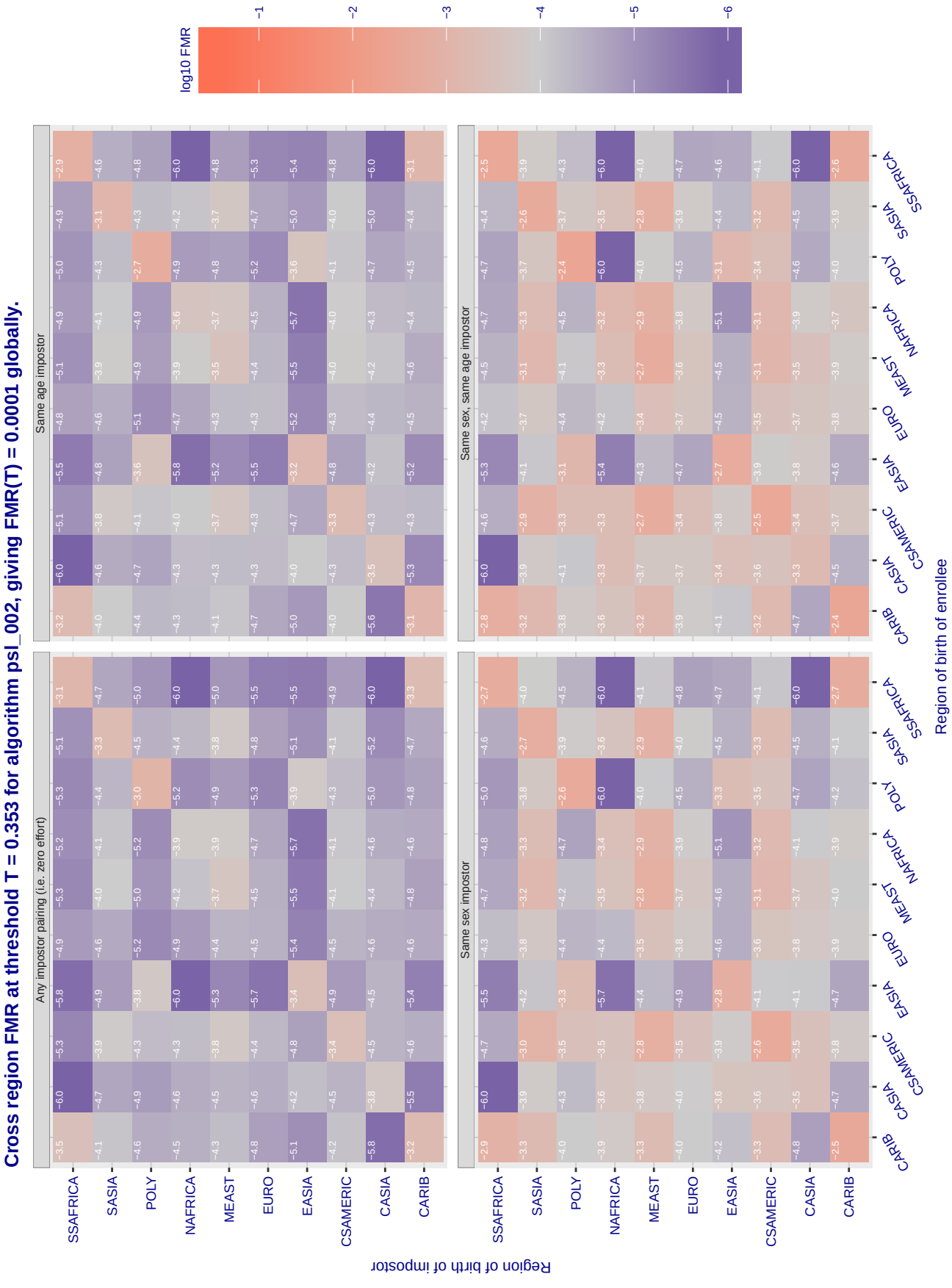


Figure 204: For algorithm psl-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

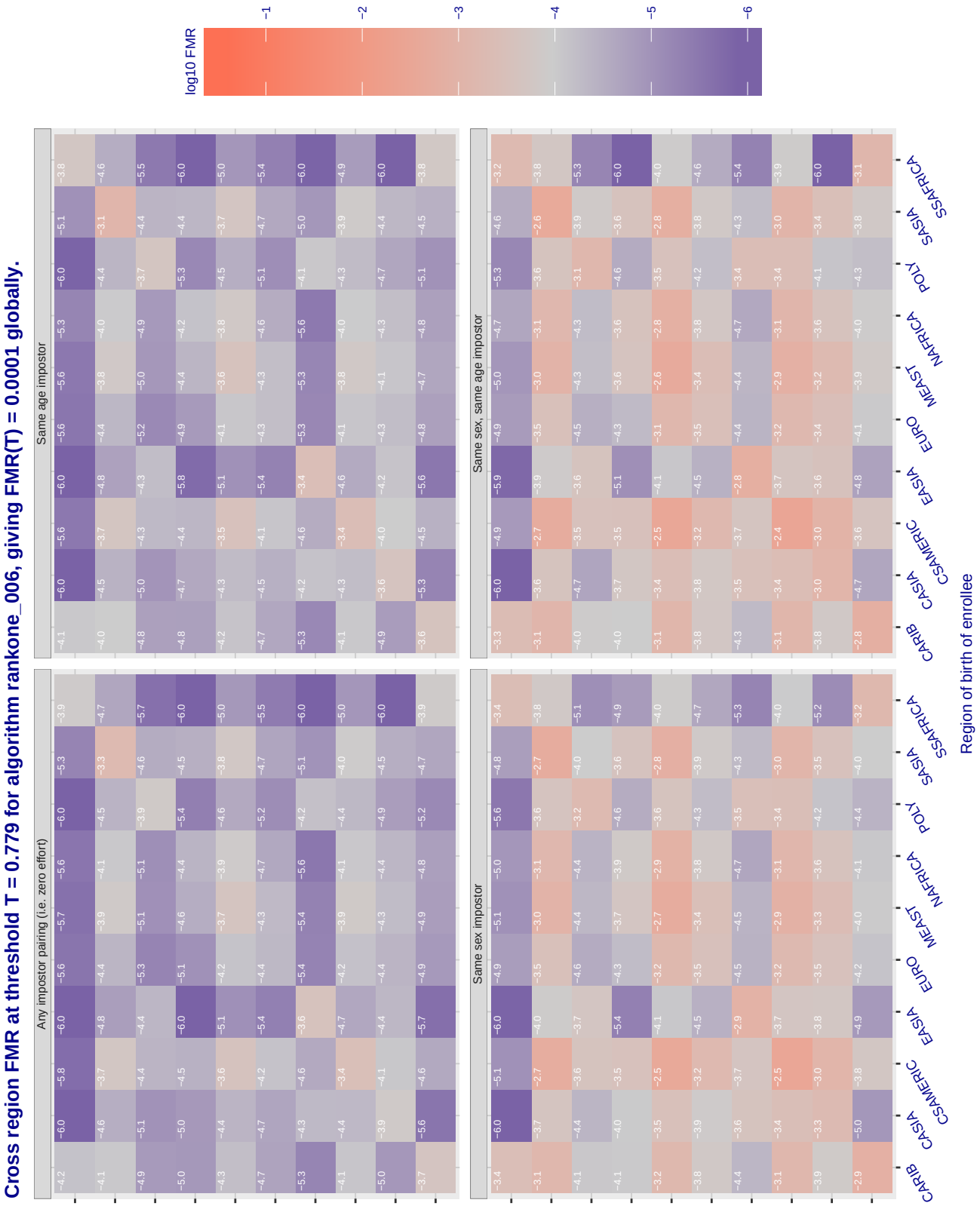


Figure 205: For algorithm rankone-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

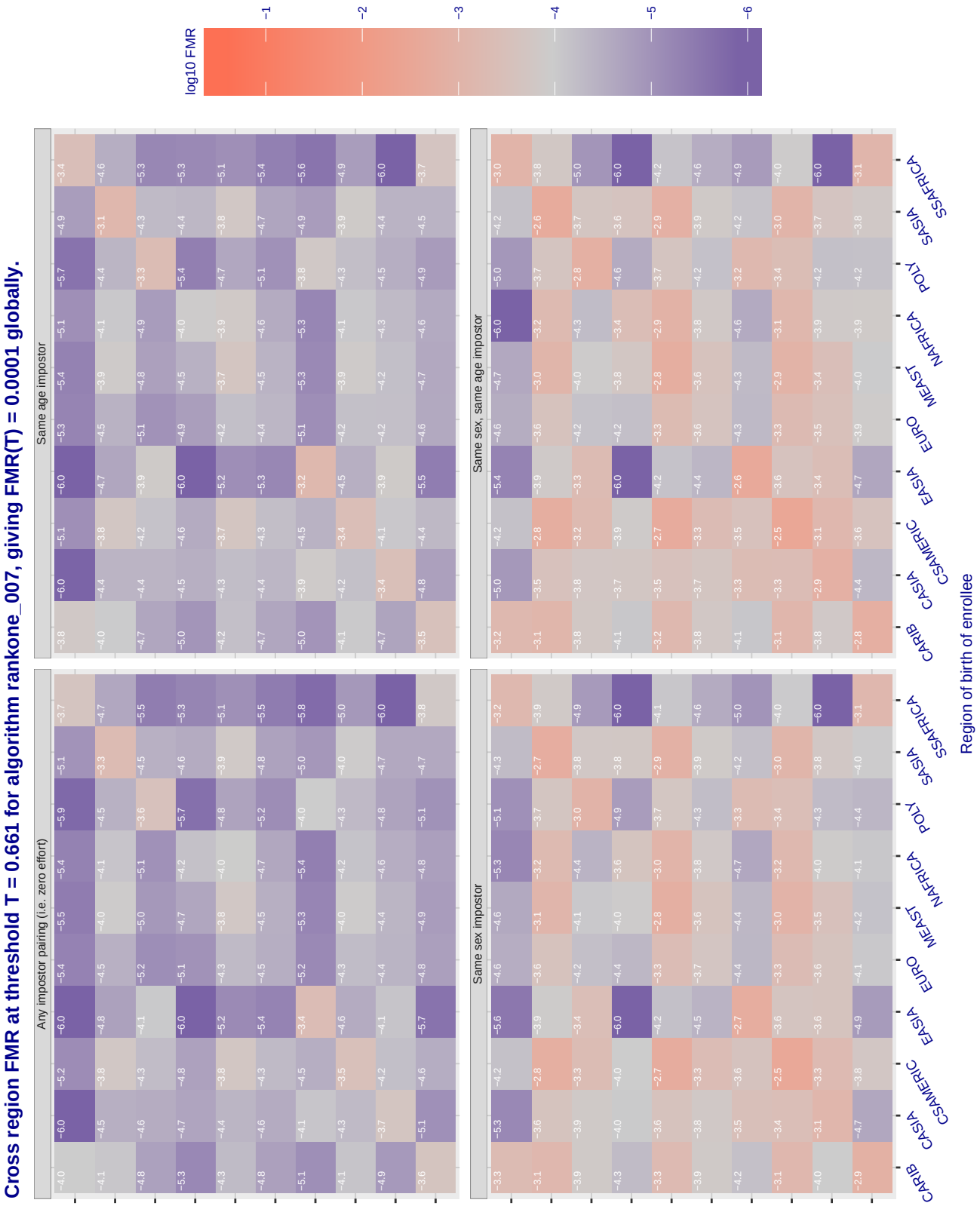


Figure 206: For algorithm rankone-007 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

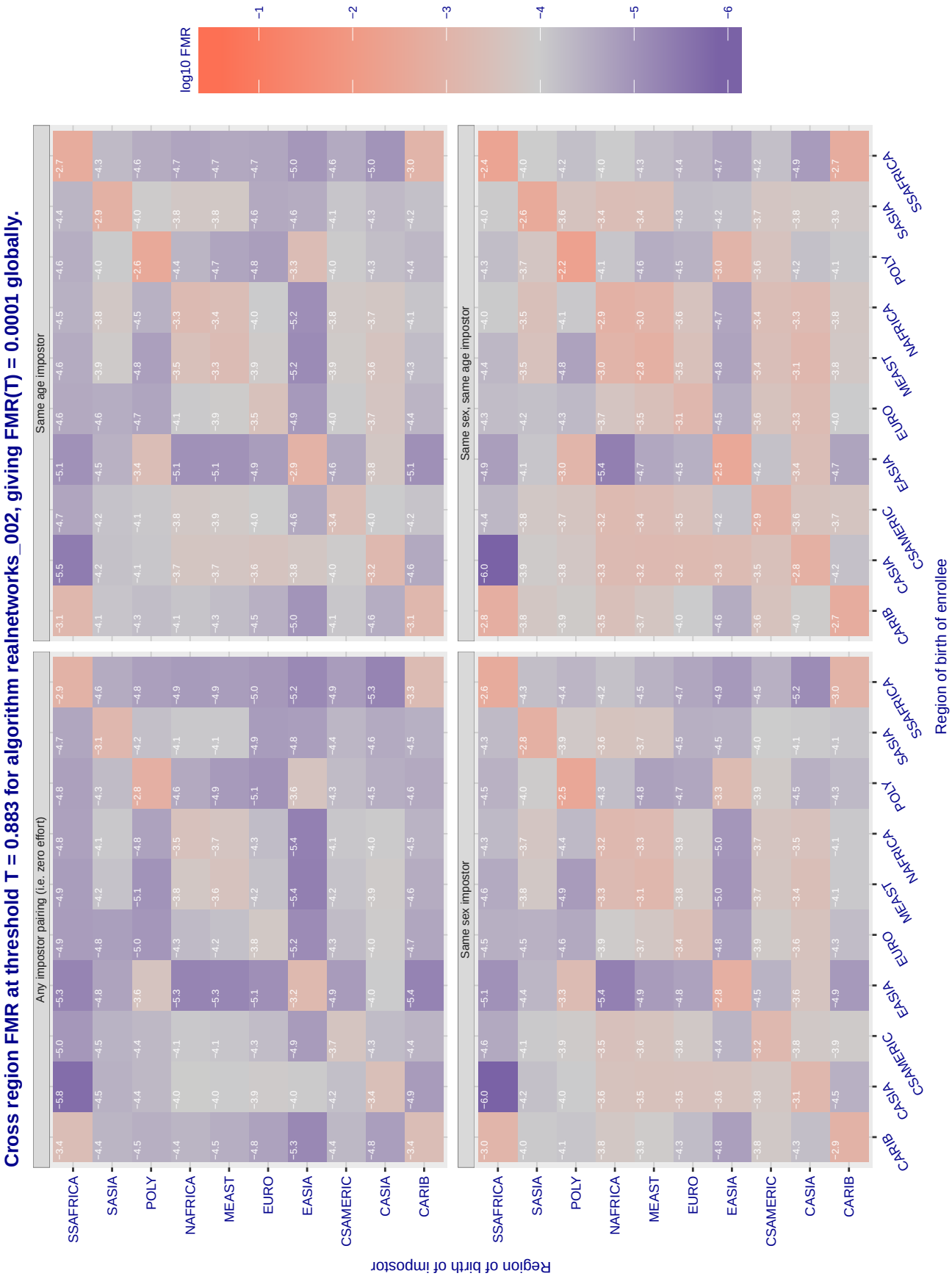


Figure 207: For algorithm realnetworks-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

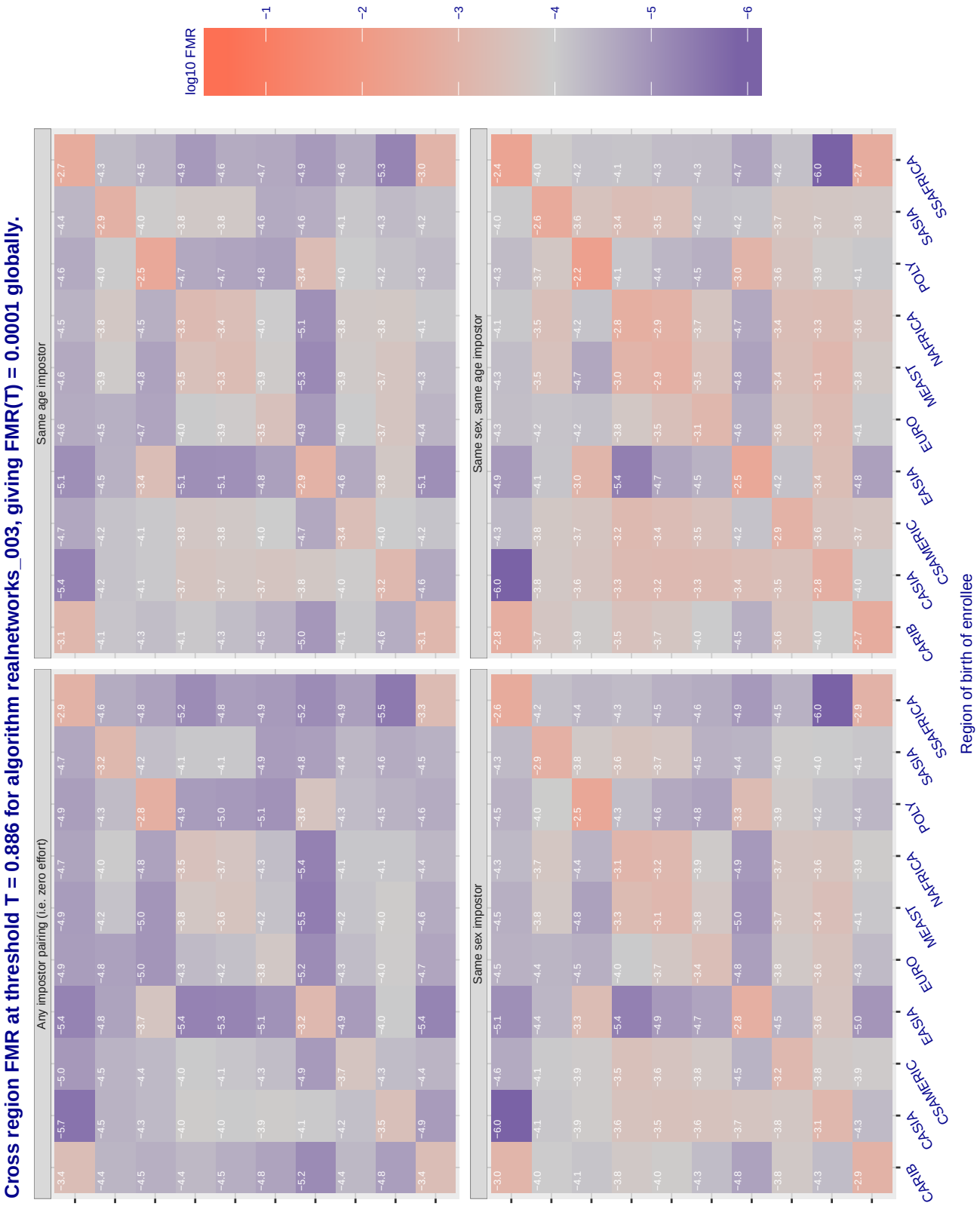


Figure 208: For algorithm realnetworks-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

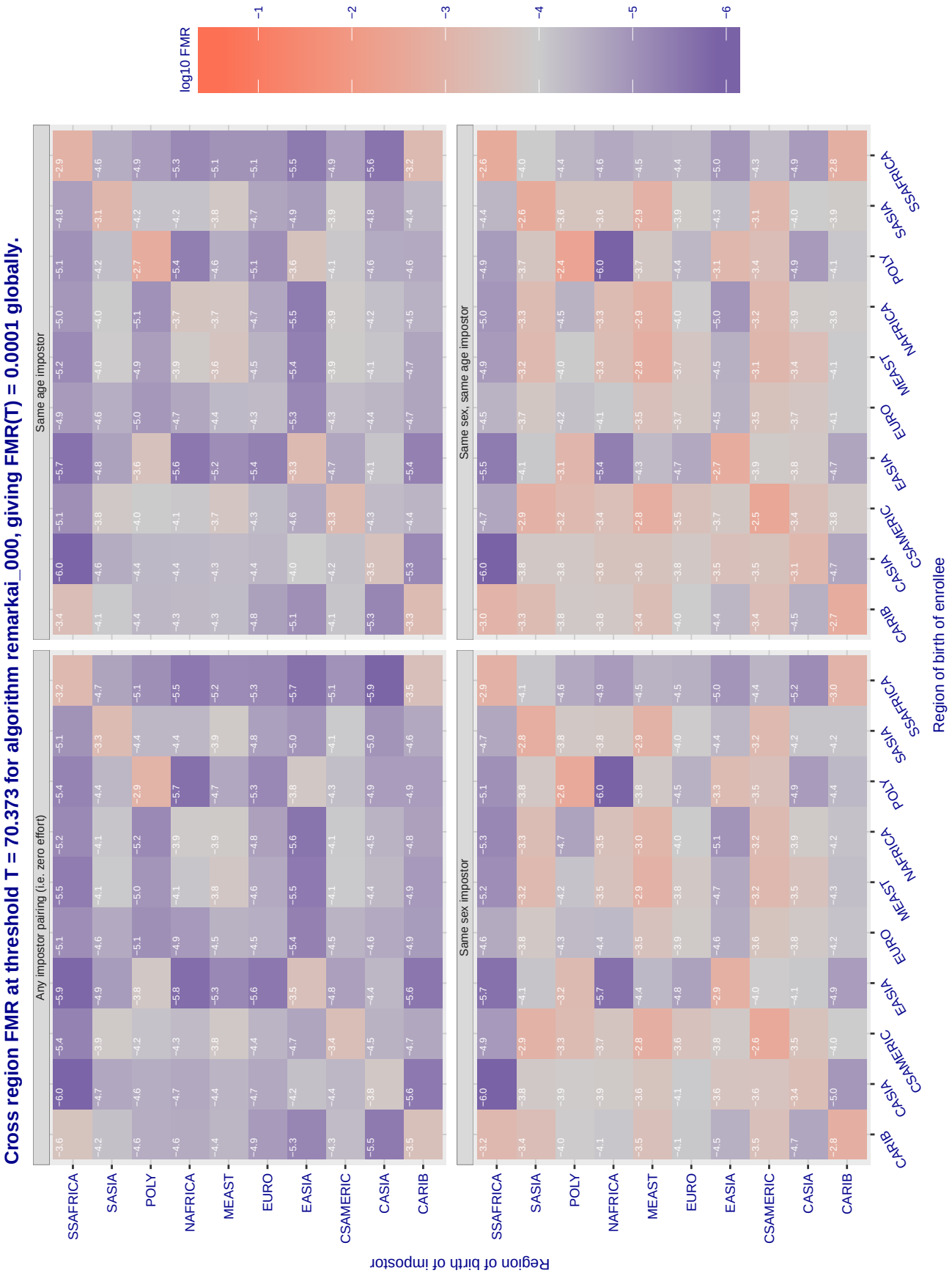


Figure 209: For algorithm remarkai-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

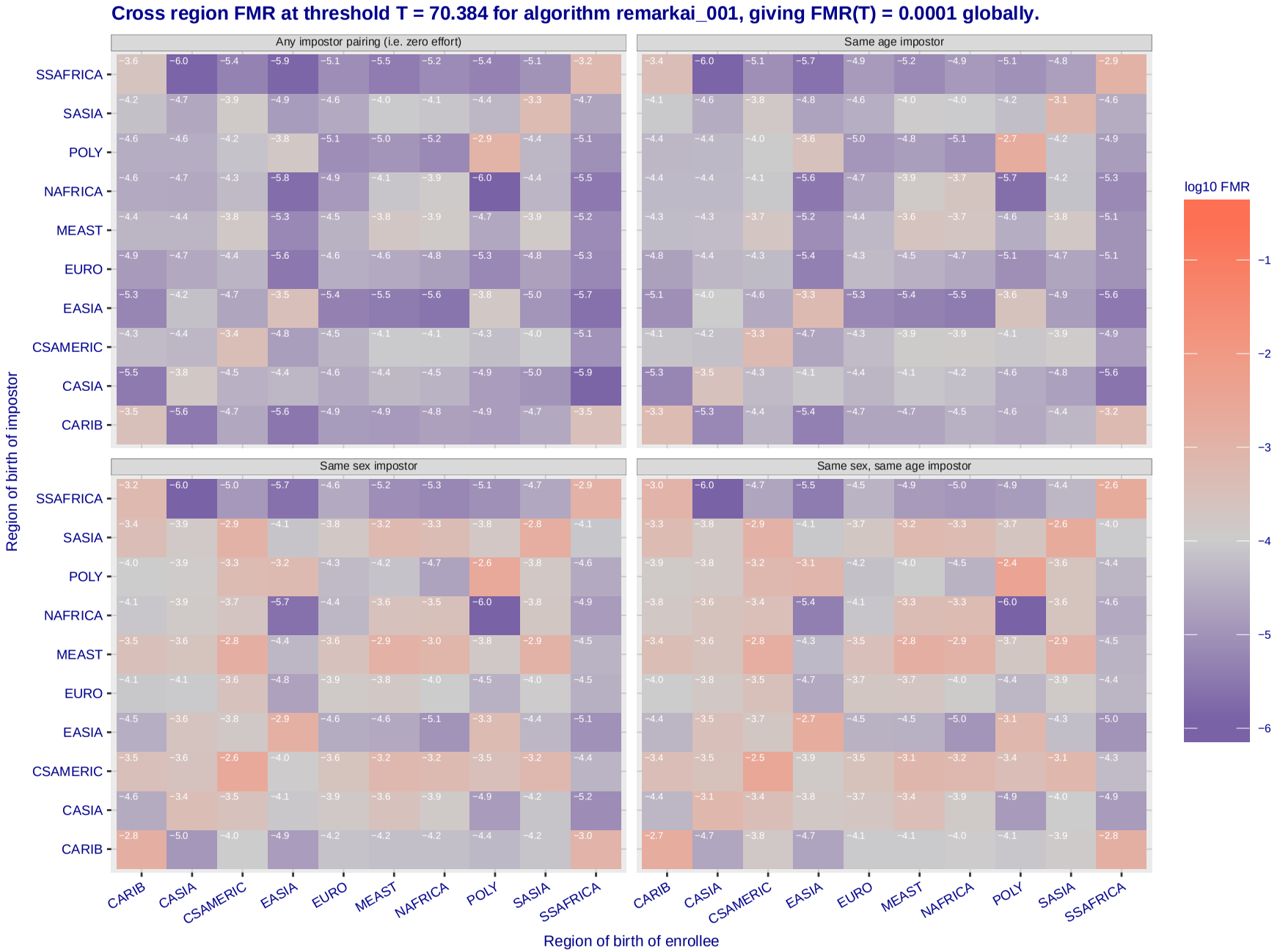


Figure 210: For algorithm remarkai-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

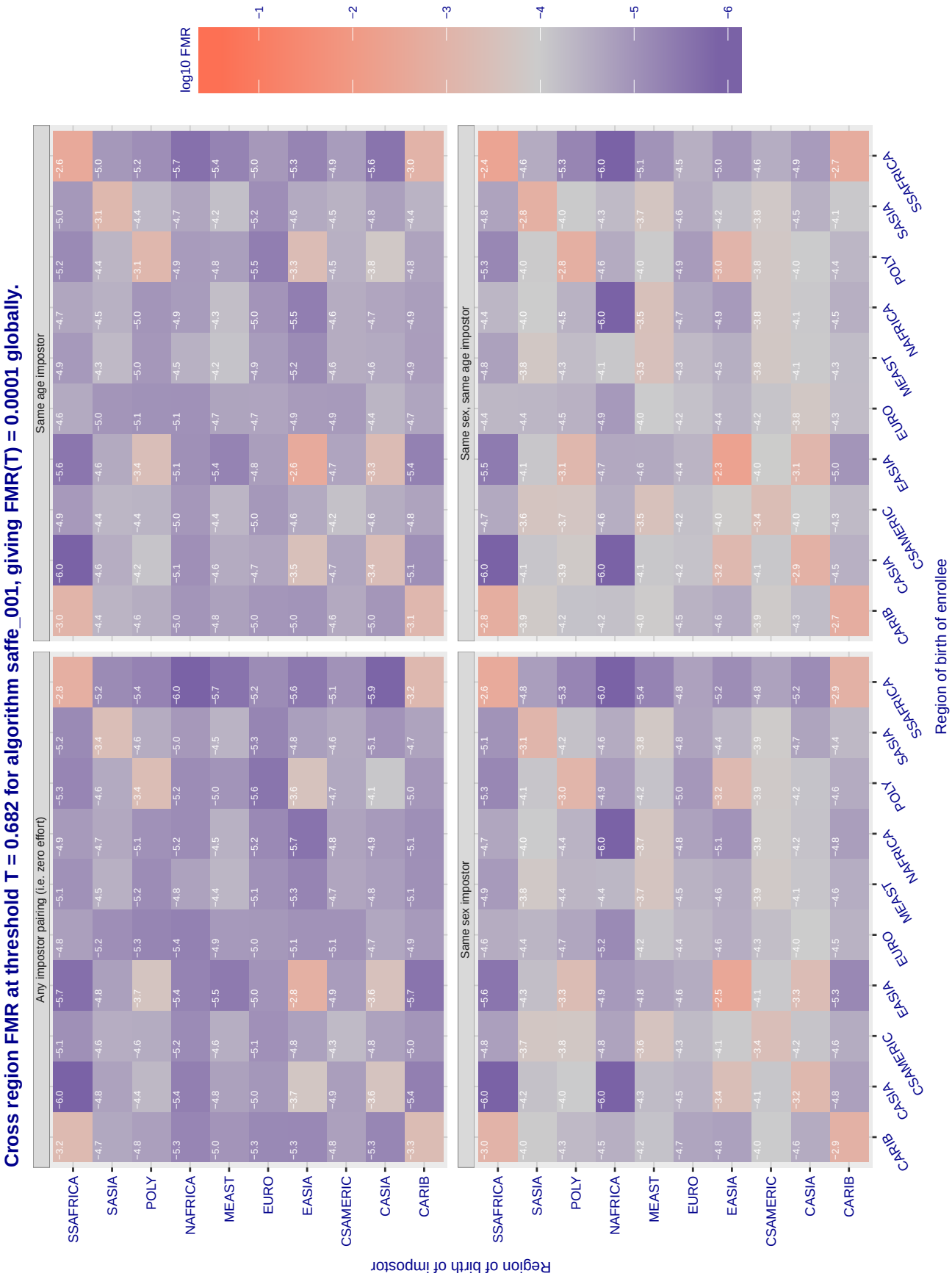


Figure 211: For algorithm saffe-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

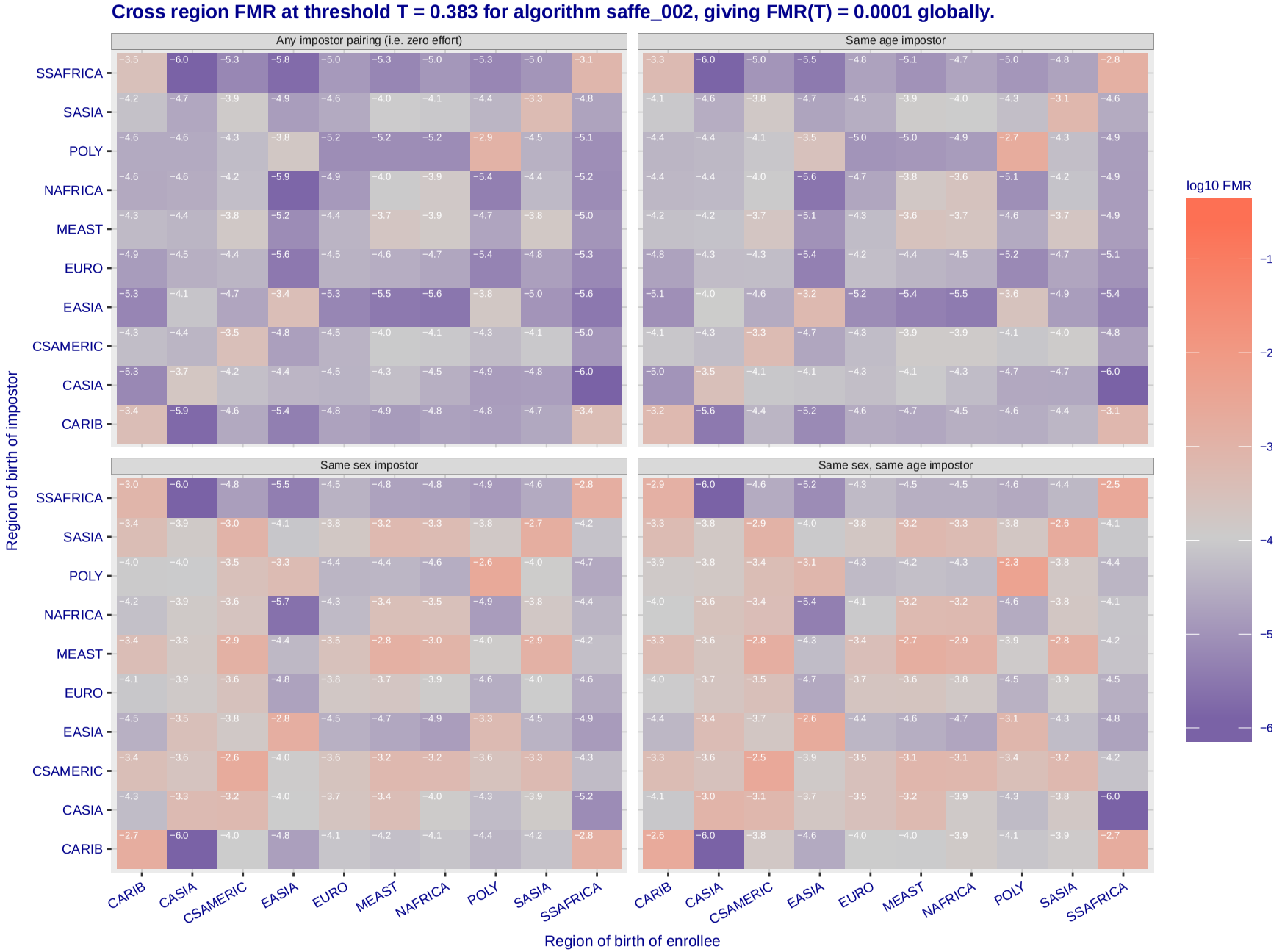


Figure 212: For algorithm saffe-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

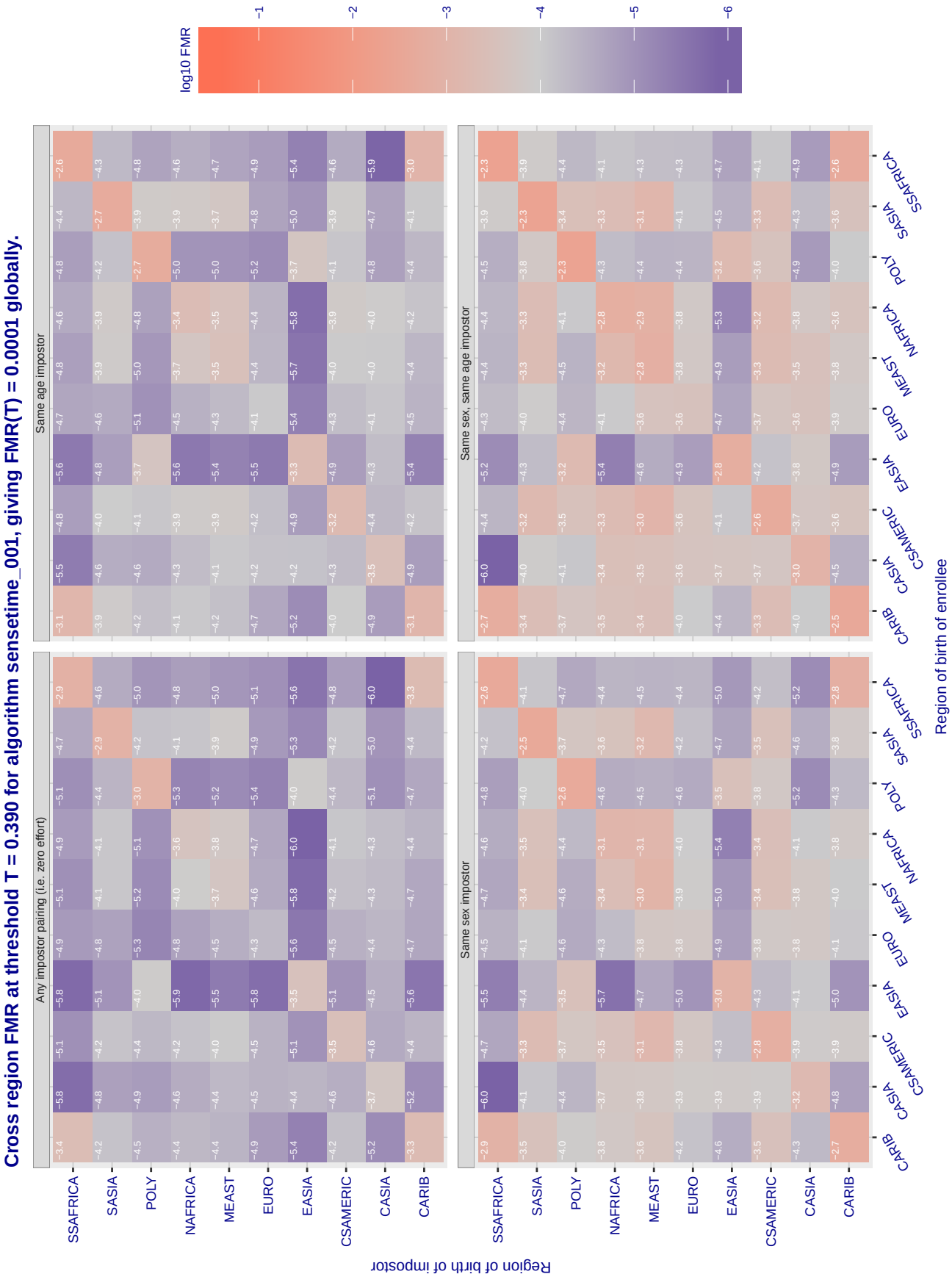


Figure 213: For algorithm sensetime-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

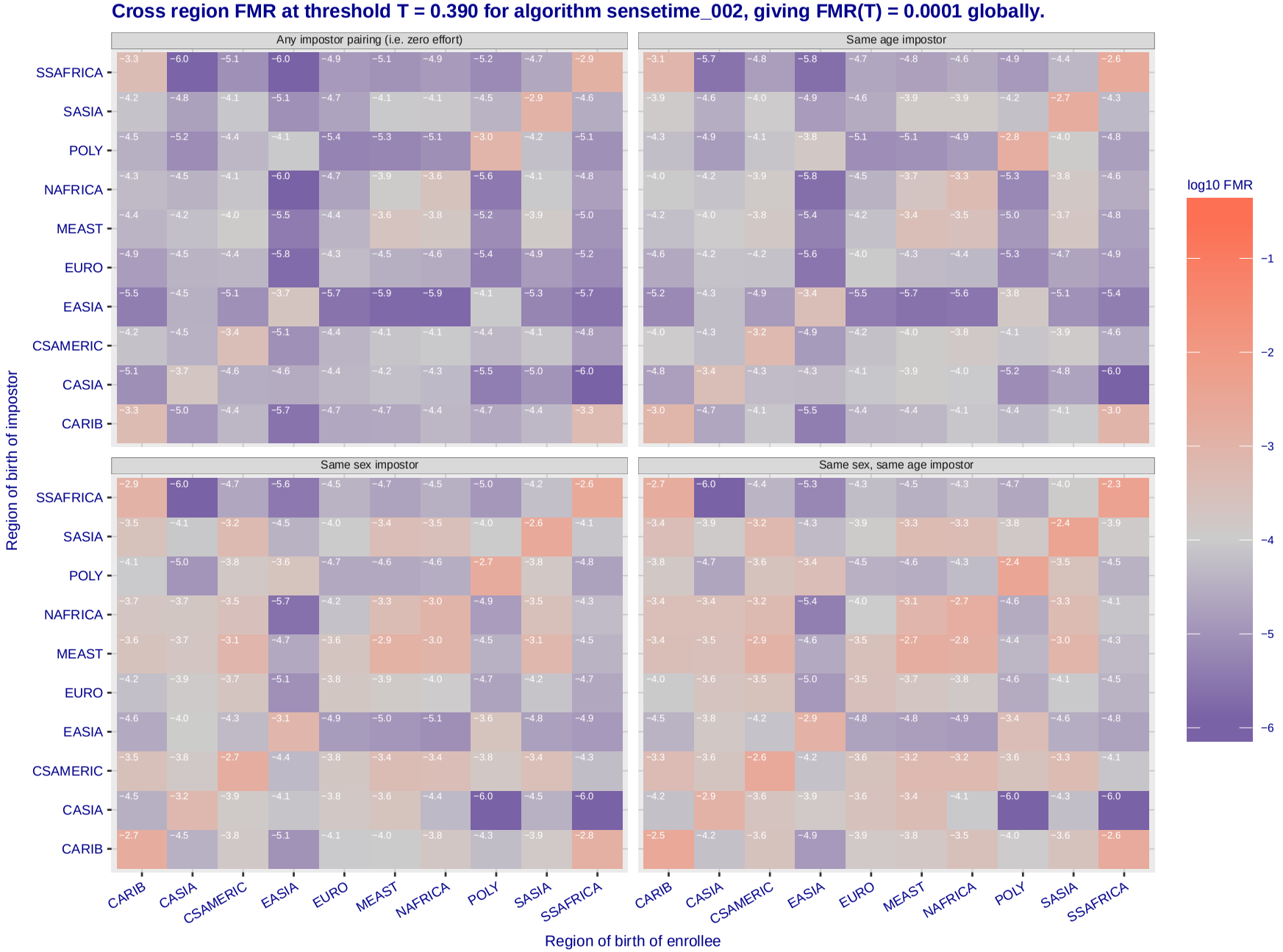


Figure 214: For algorithm sensetime-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

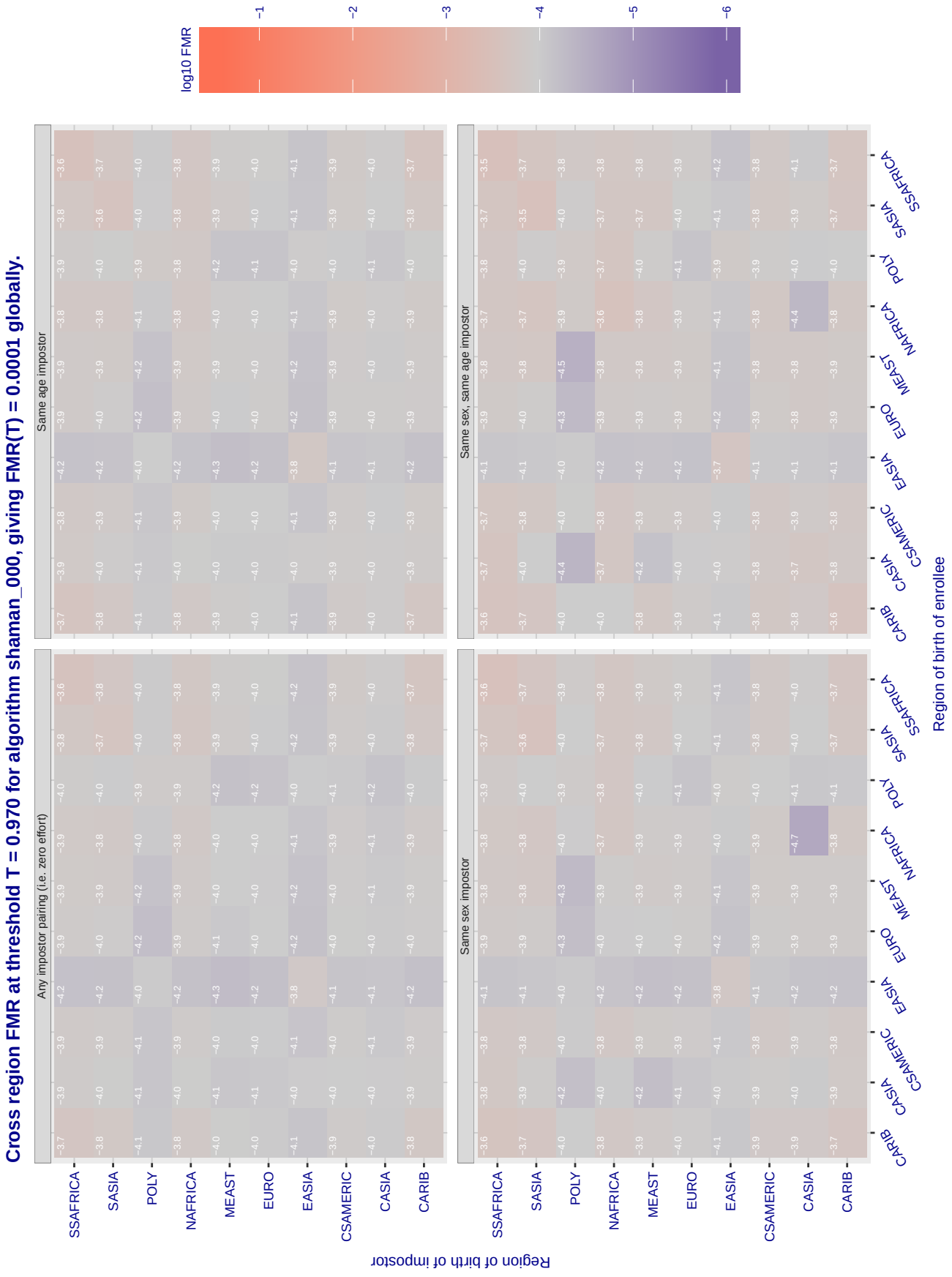


Figure 215: For algorithm shaman-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

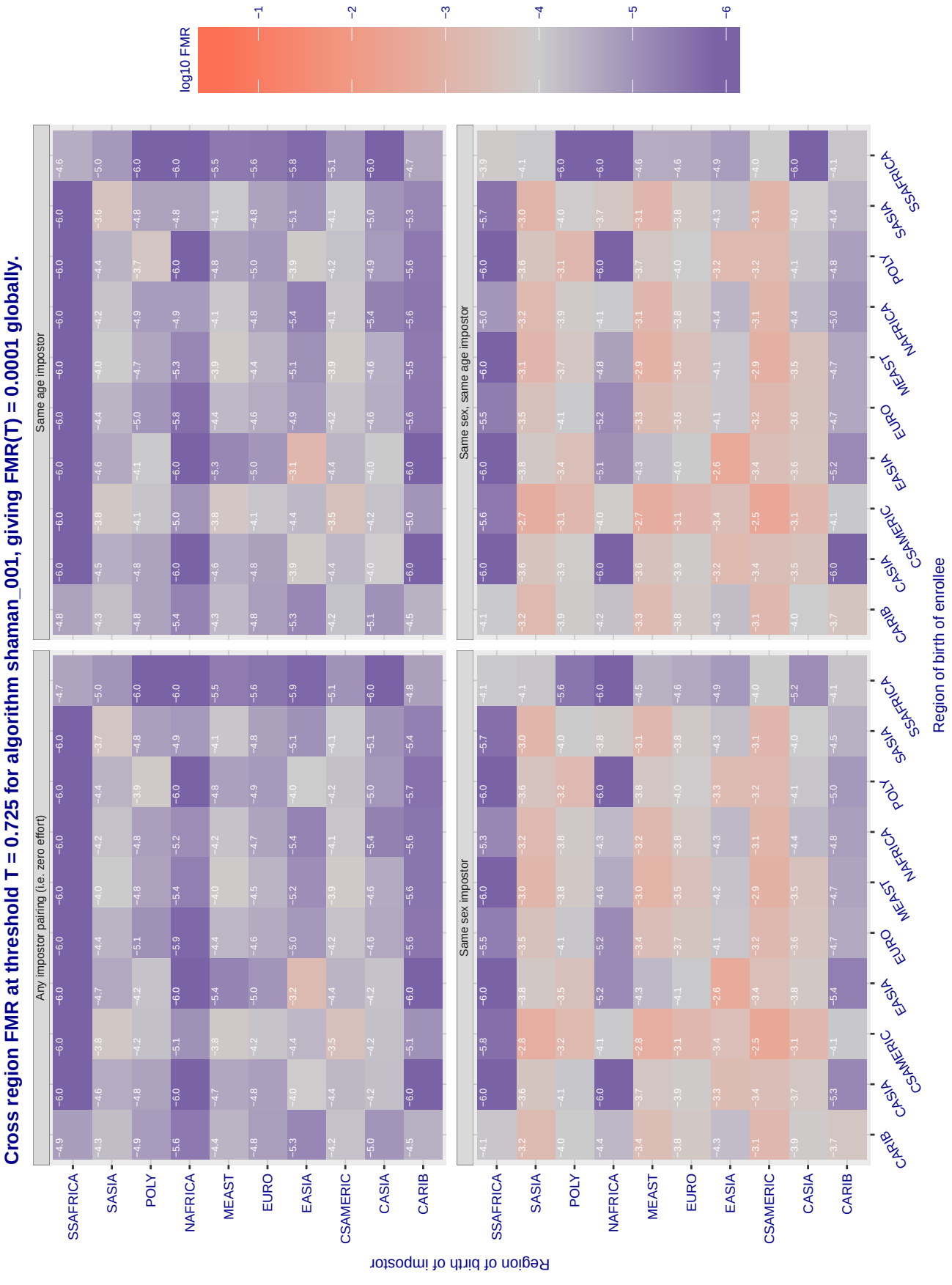


Figure 216: For algorithm shaman-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

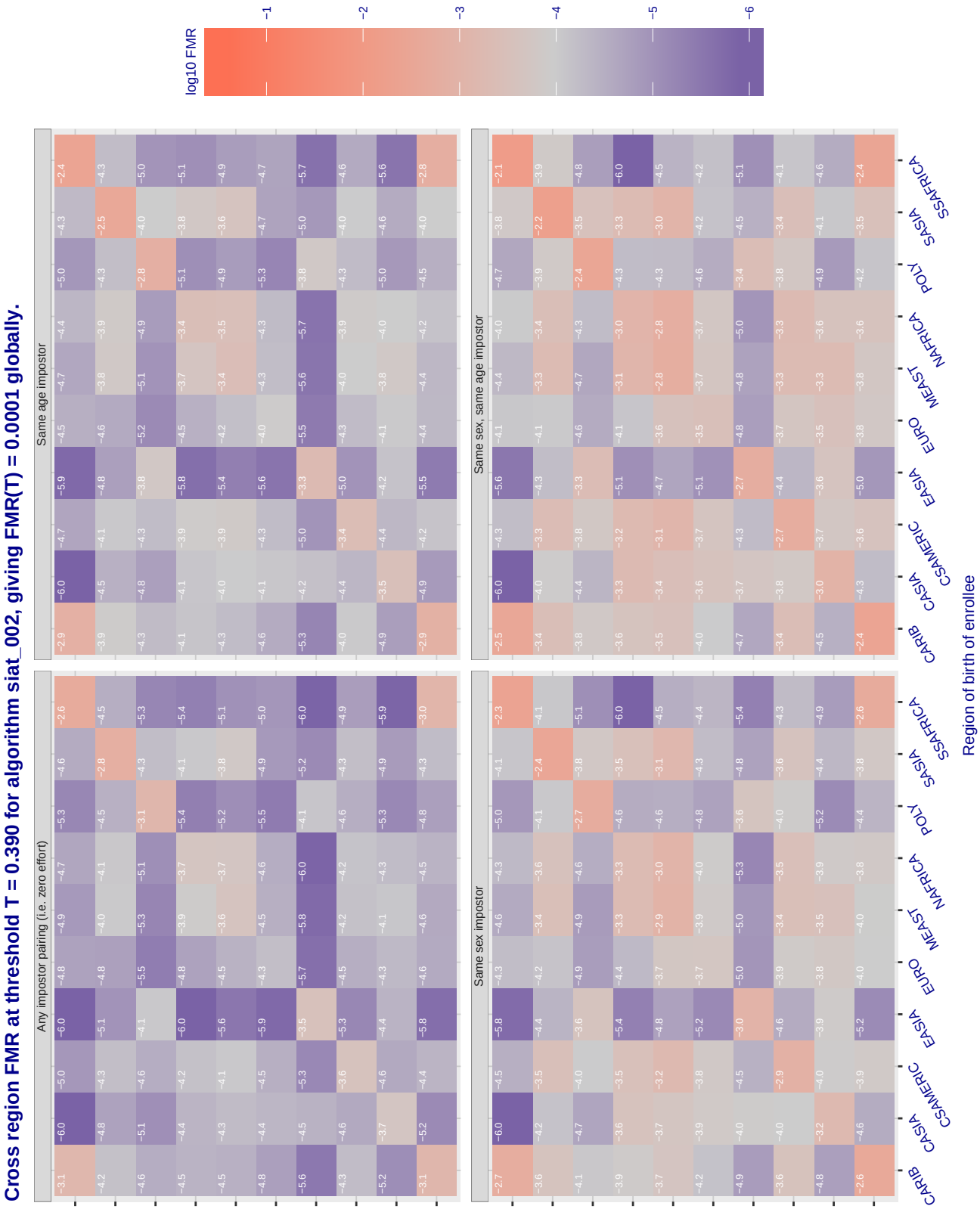


Figure 217: For algorithm siat-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

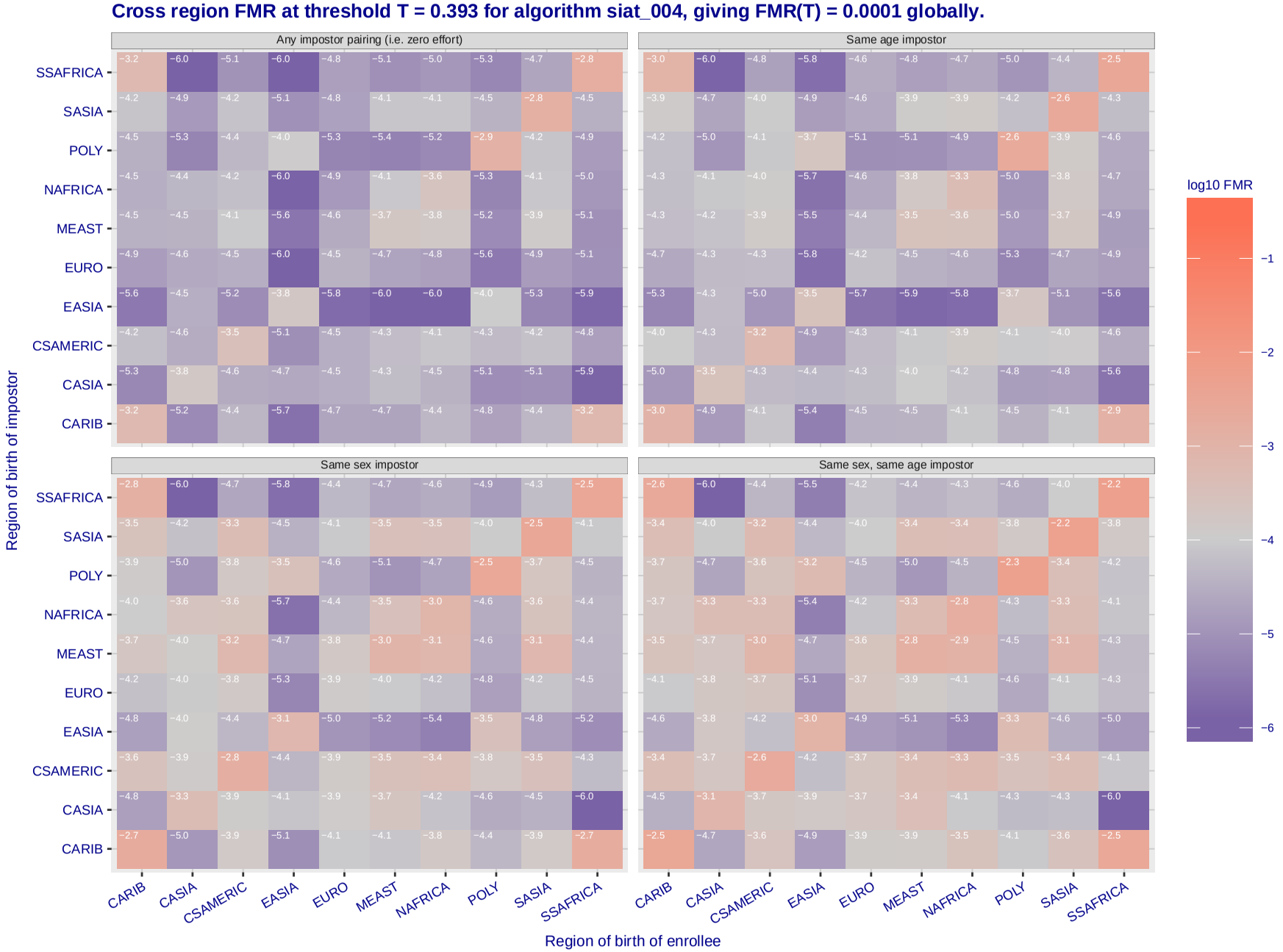


Figure 218: For algorithm siat-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

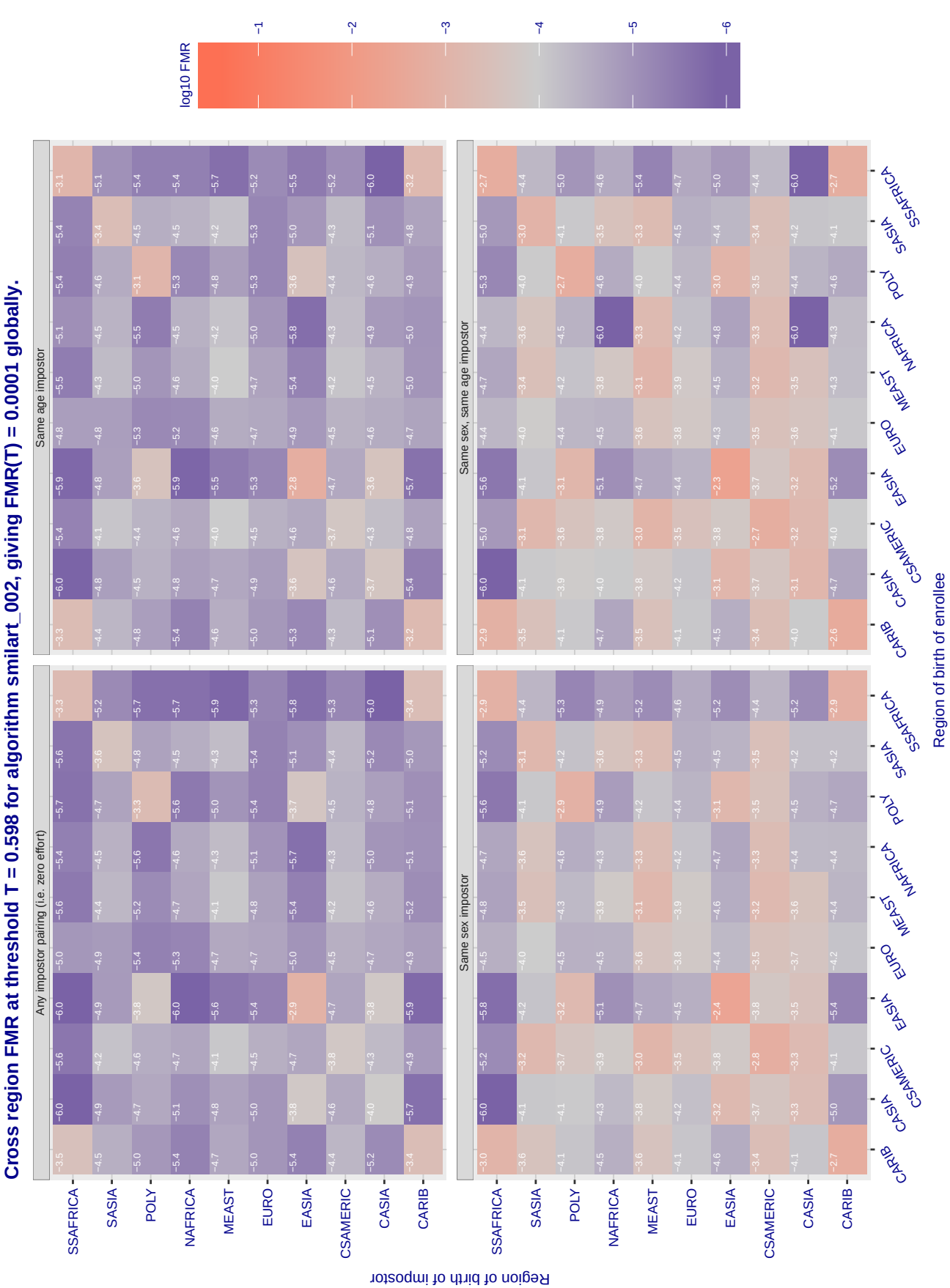


Figure 219: For algorithm smilart-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

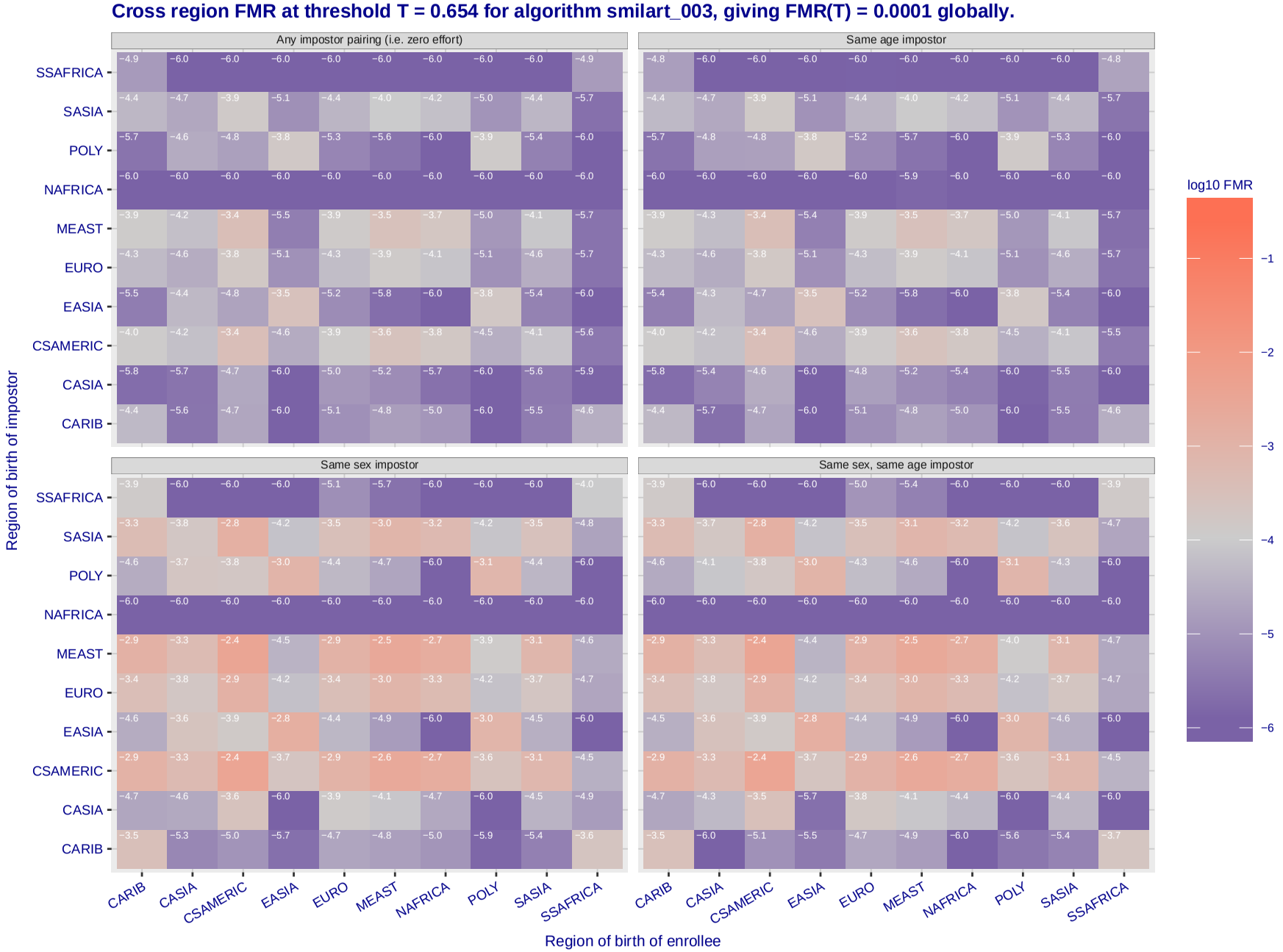


Figure 220: For algorithm smilart-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

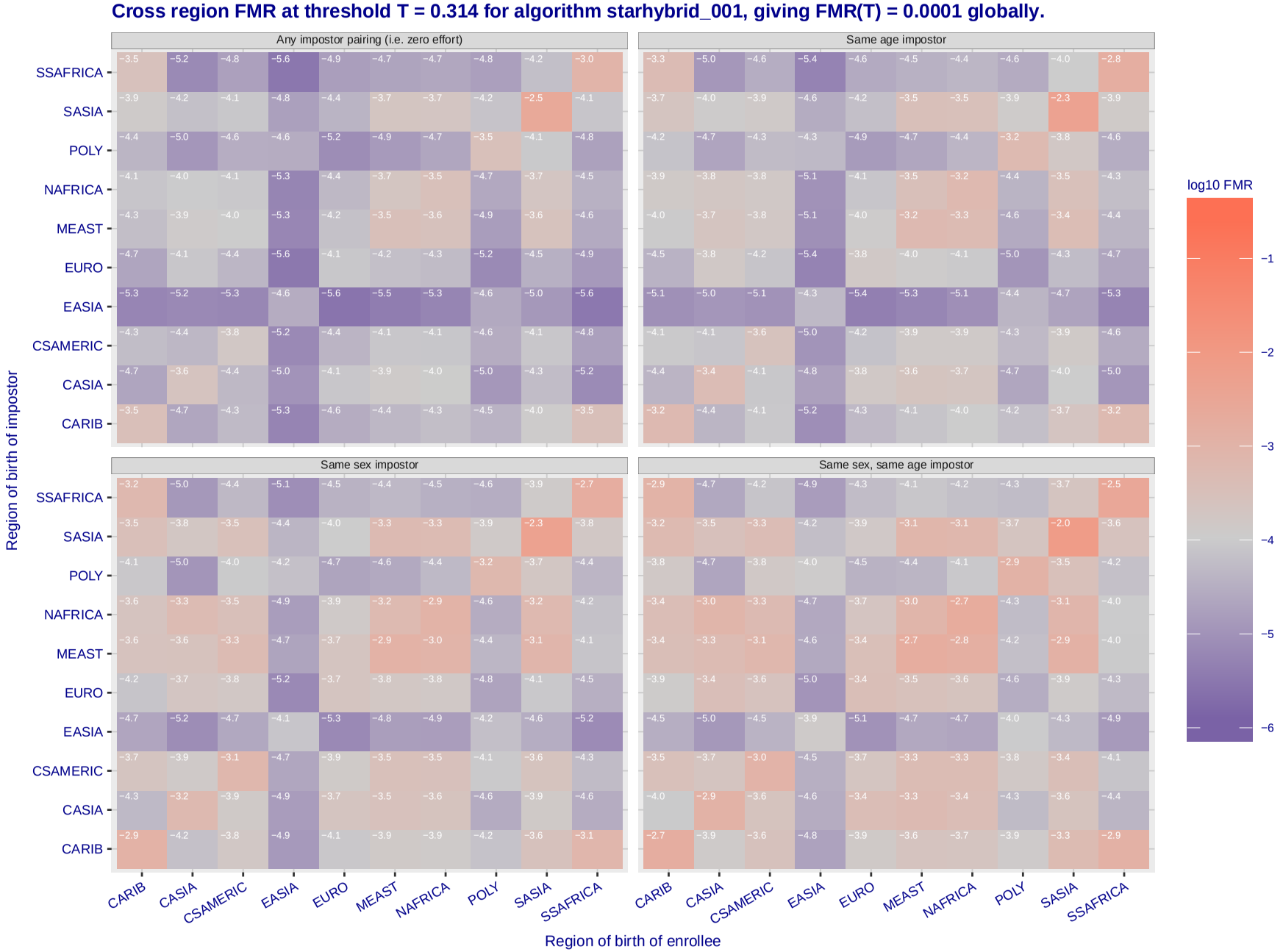


Figure 221: For algorithm starhybrid-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

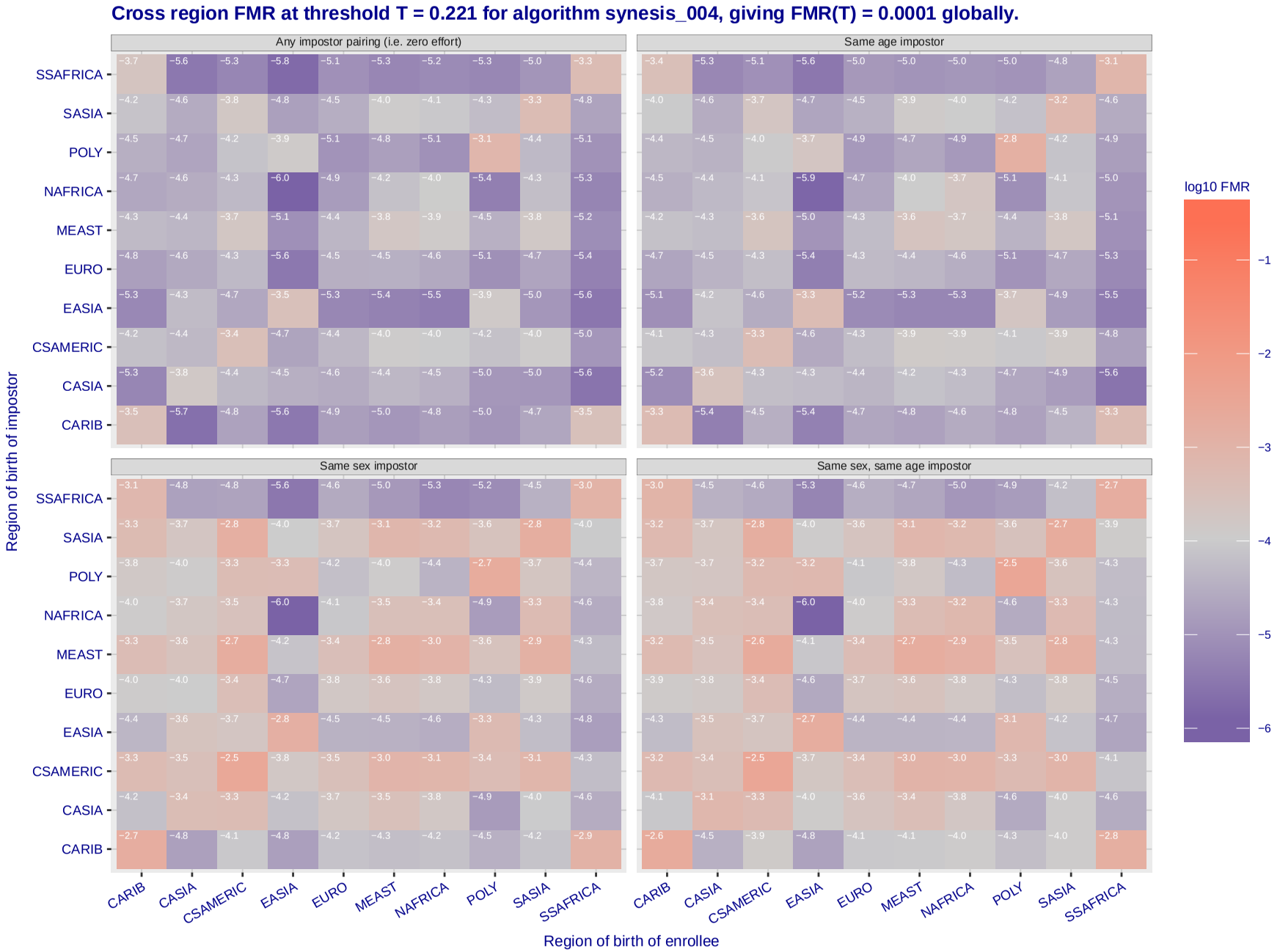


Figure 222: For algorithm synesis-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

Figure 223: For algorithm synesis-005 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

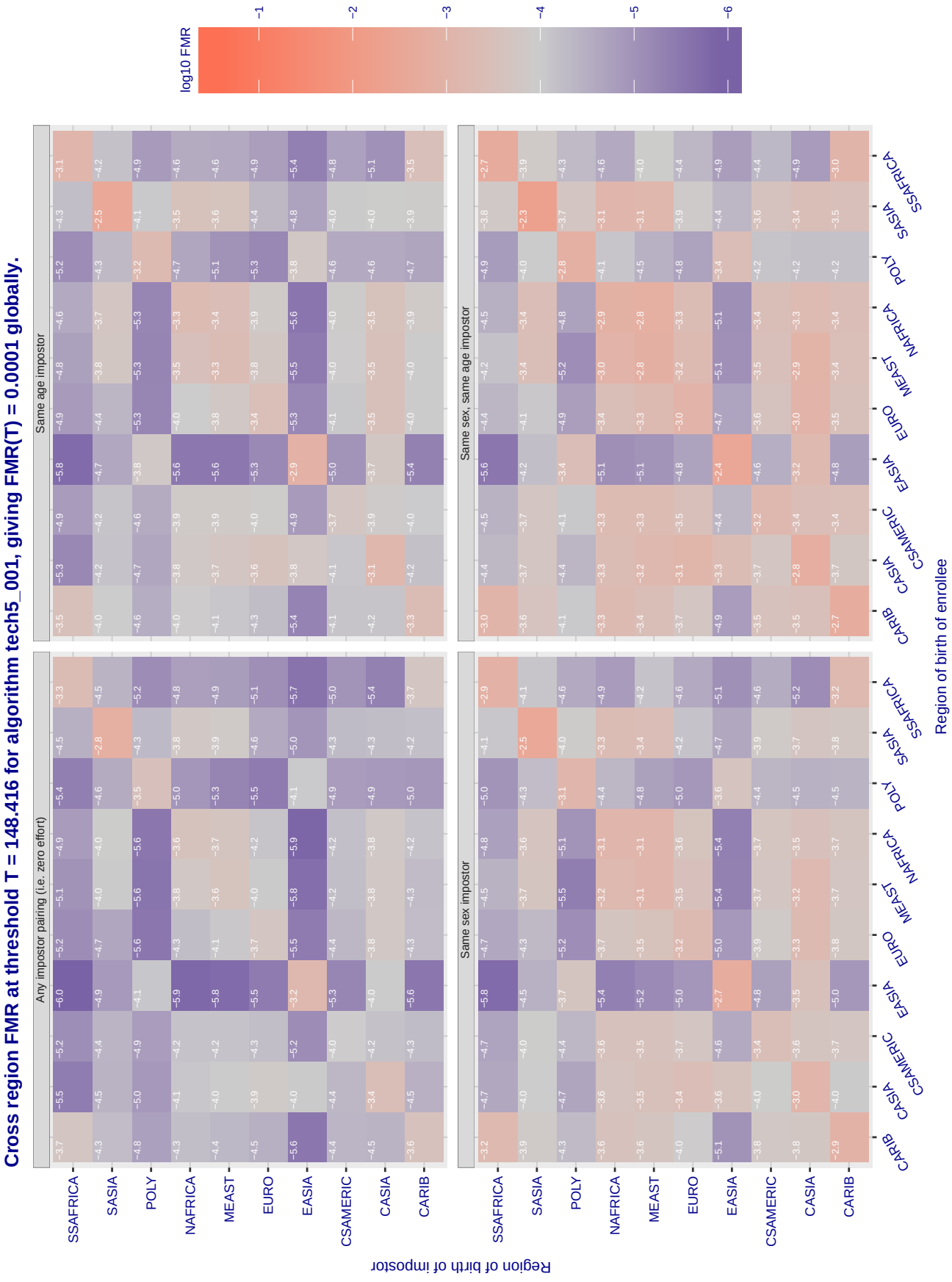


Figure 224: For algorithm tech5-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

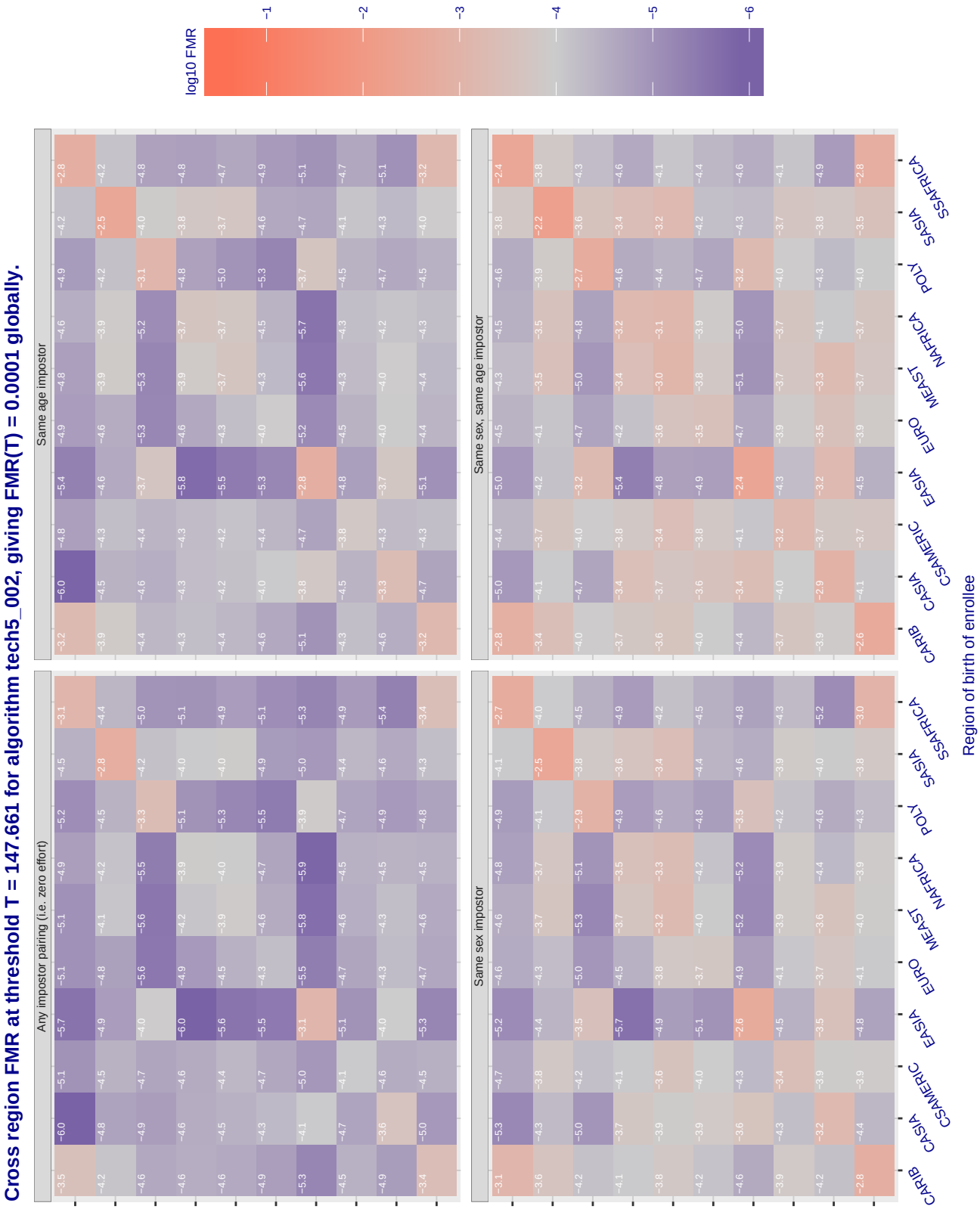


Figure 225: For algorithm tech5-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

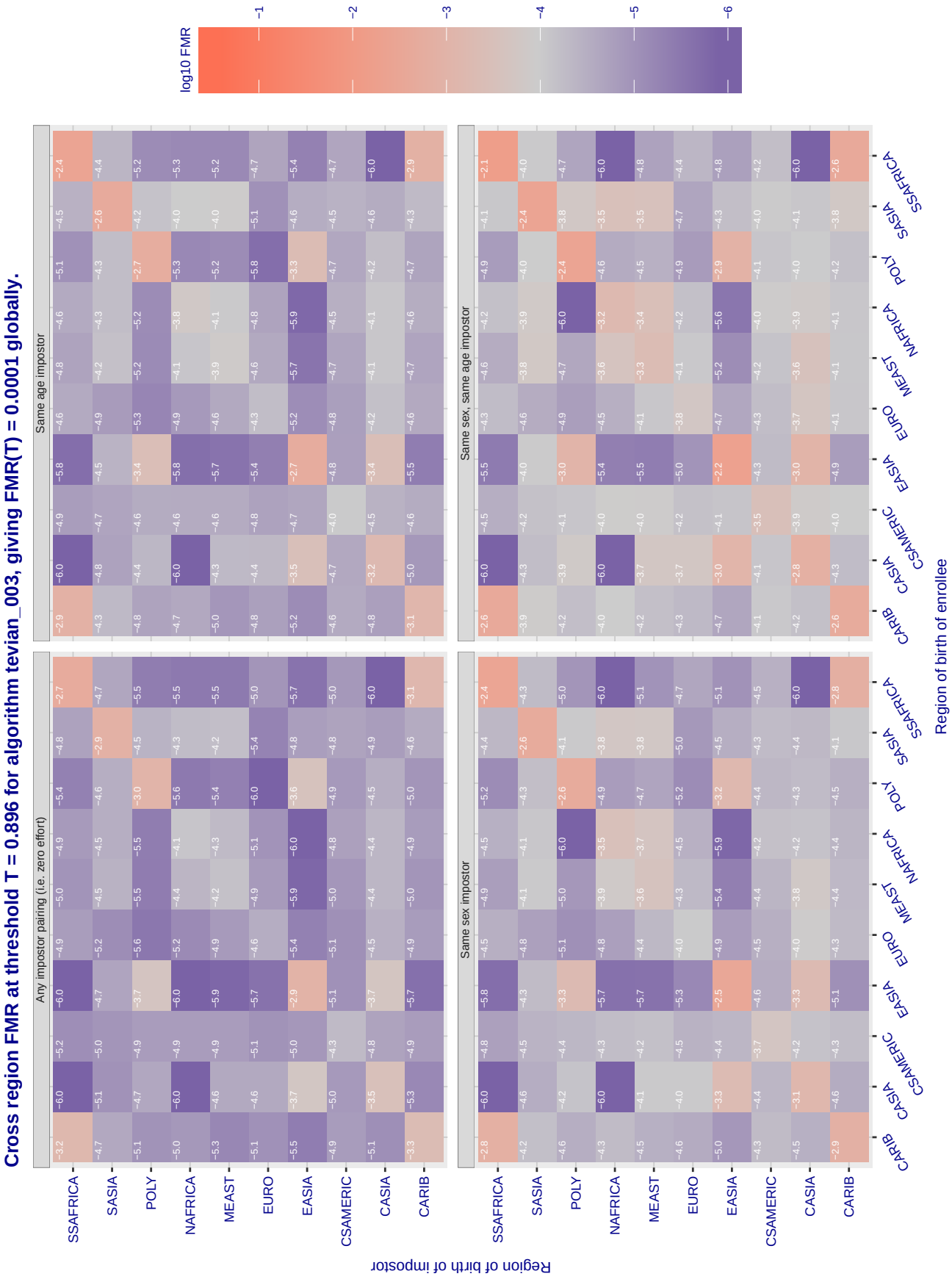


Figure 226: For algorithm tevian-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

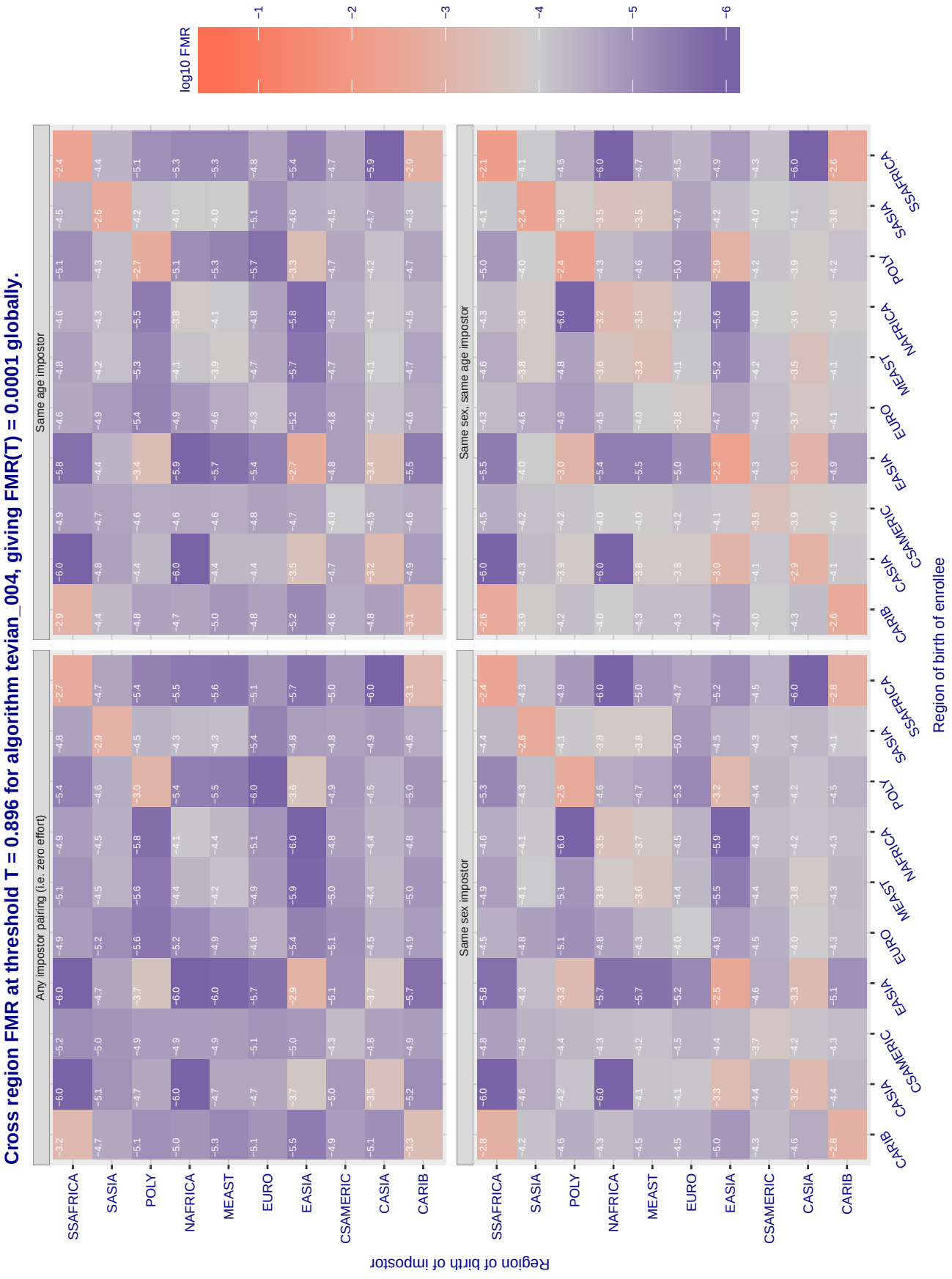


Figure 227: For algorithm tevian-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

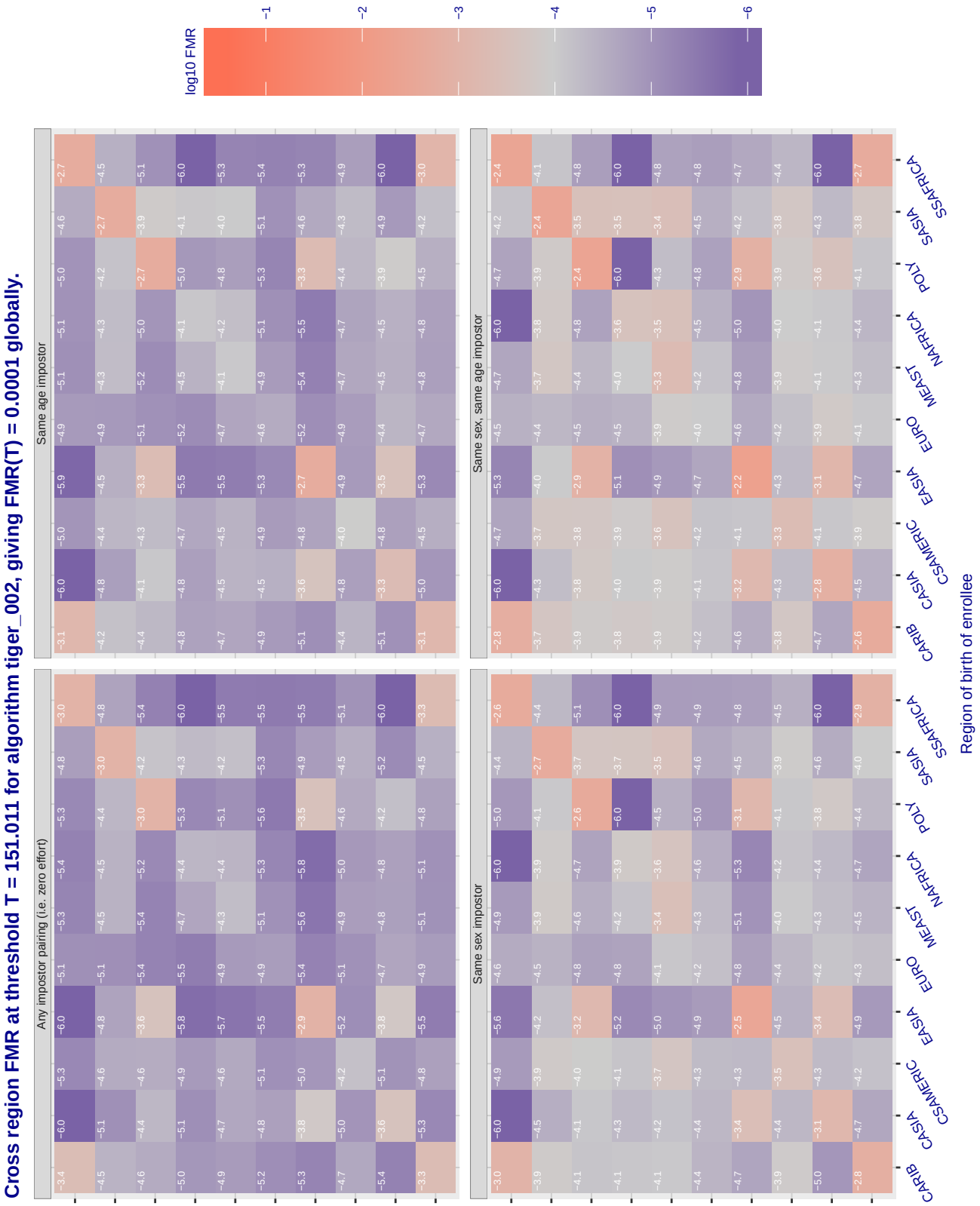


Figure 228: For algorithm tiger-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

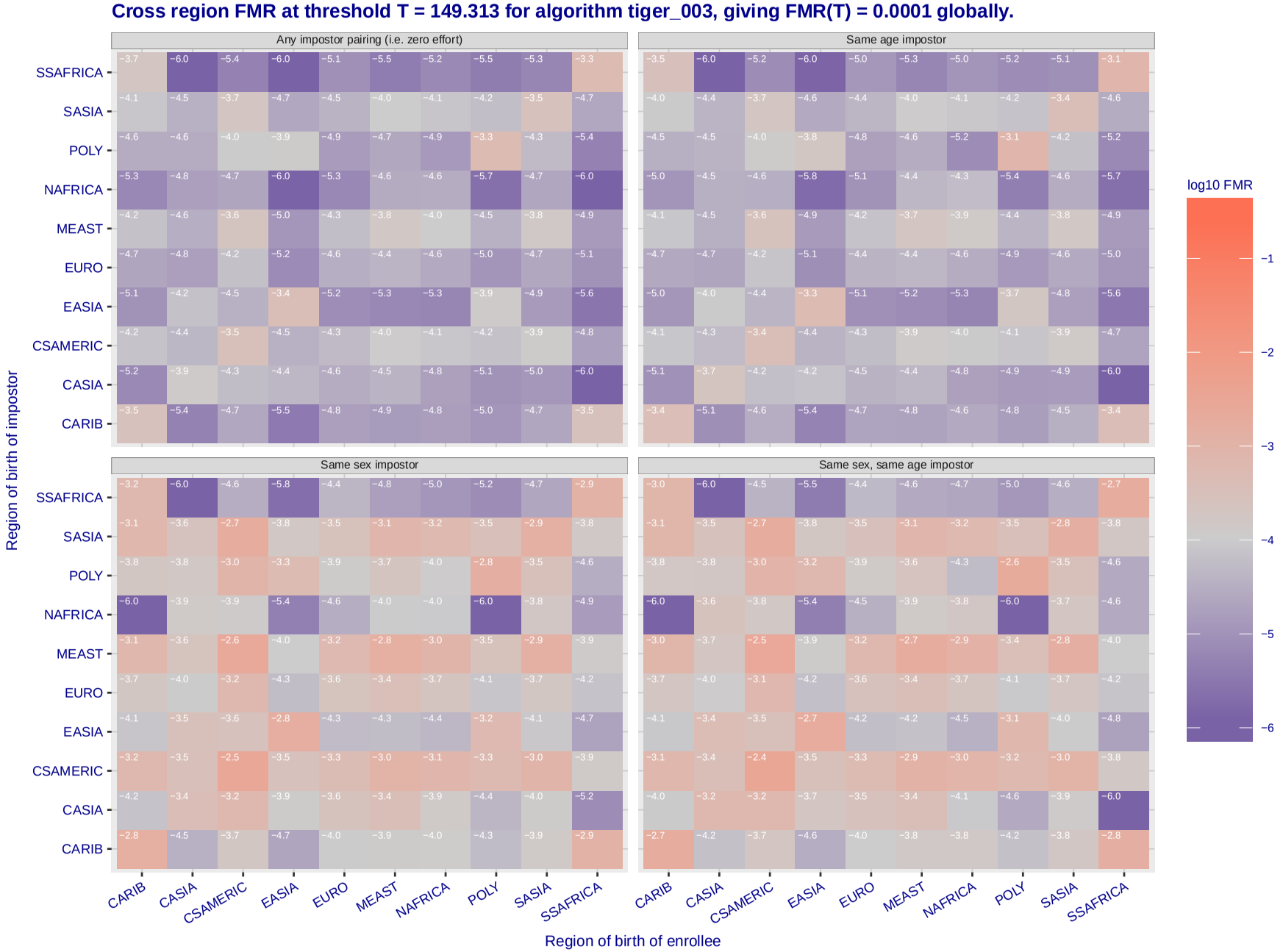


Figure 229: For algorithm tiger-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

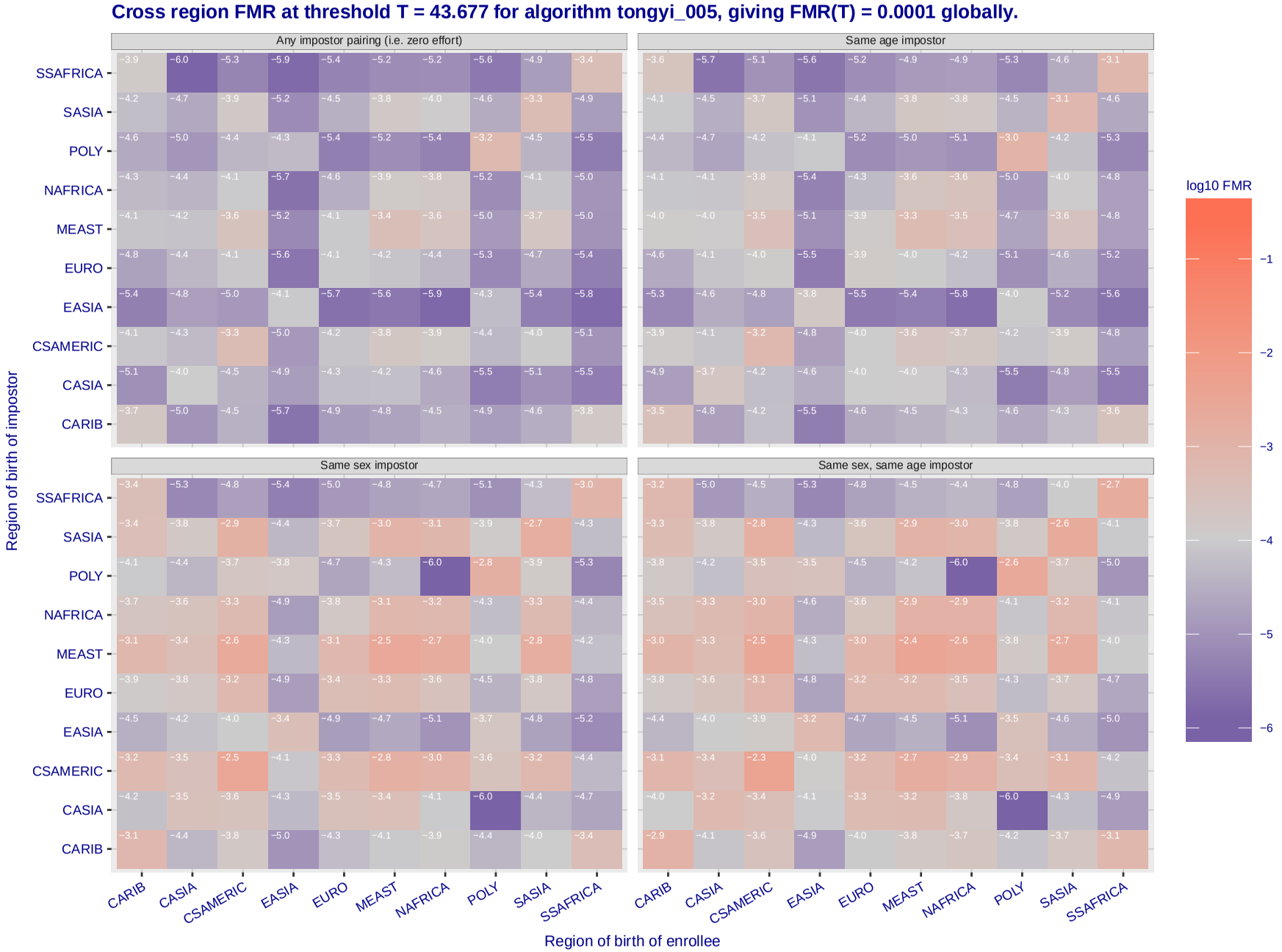


Figure 230: For algorithm tongyi-005 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

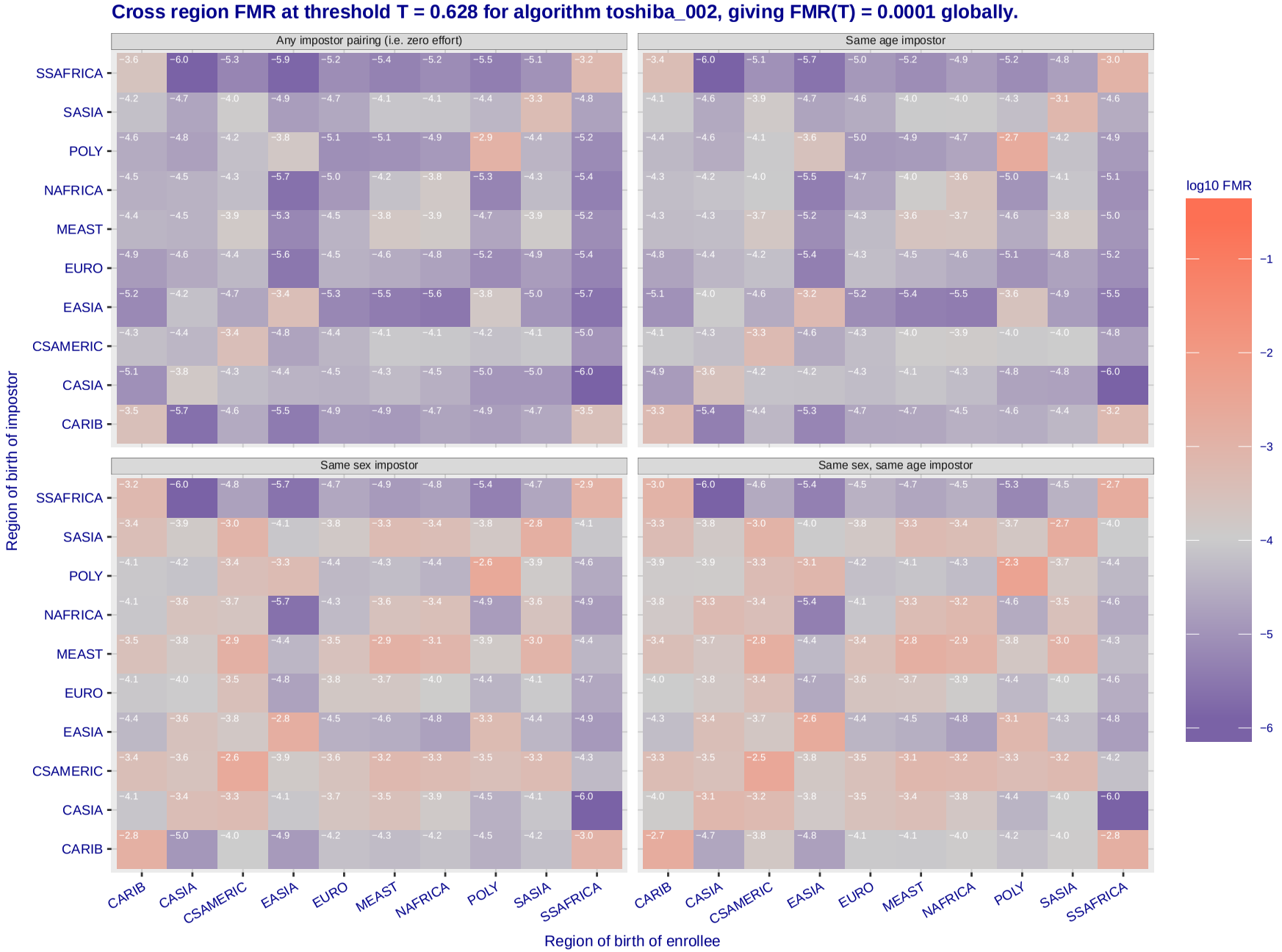


Figure 231: For algorithm toshiba-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

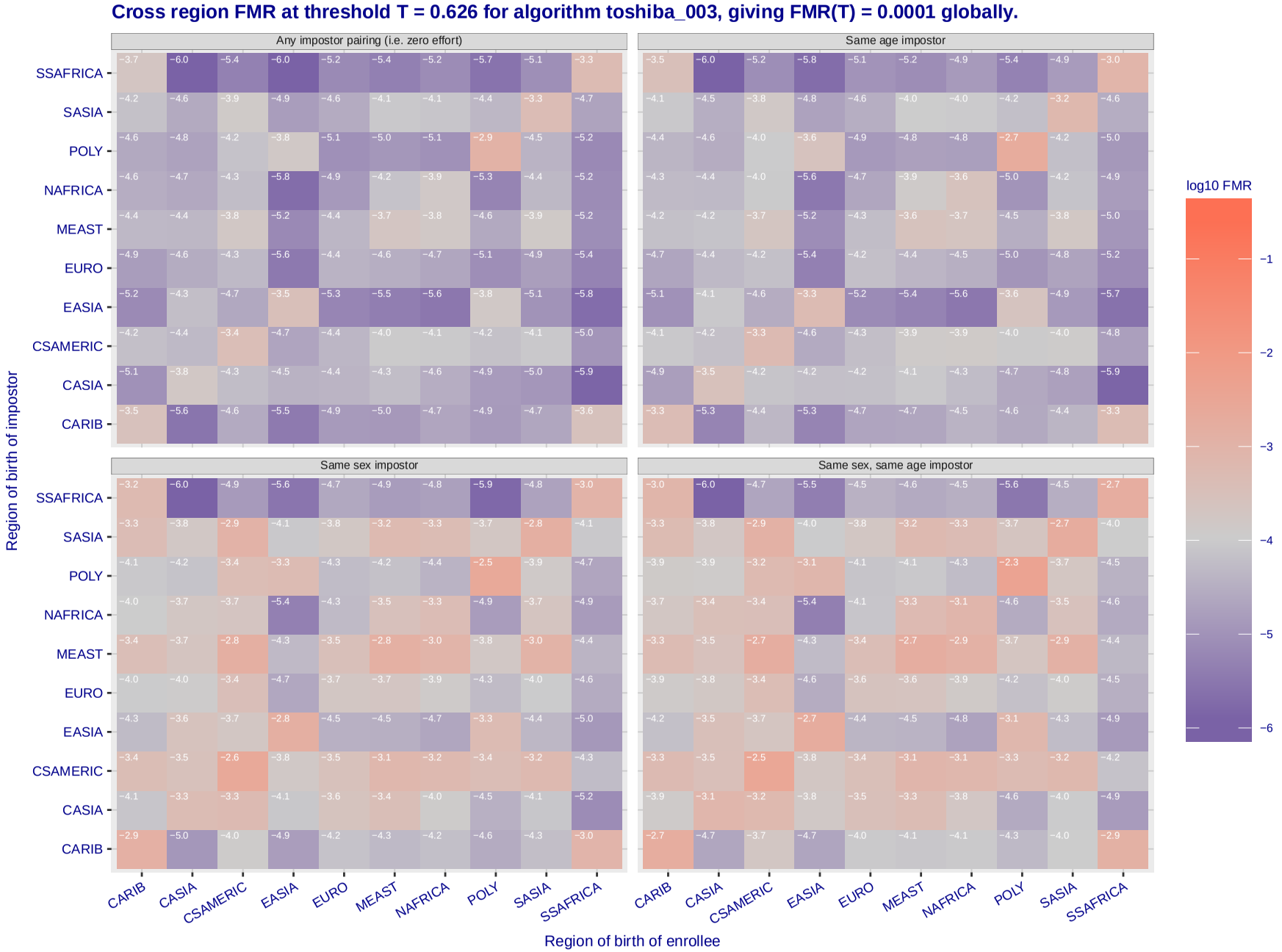


Figure 232: For algorithm toshiba-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

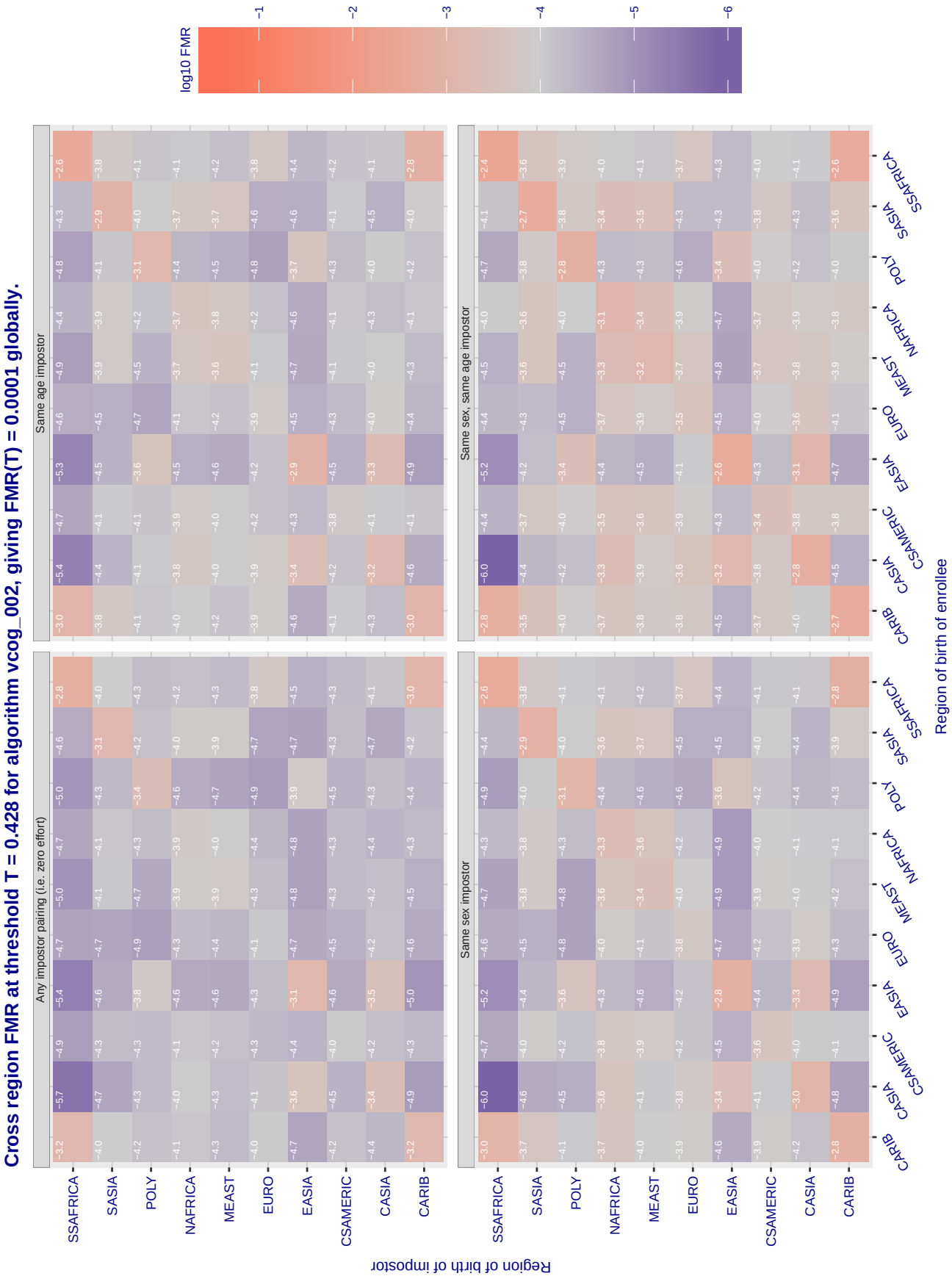


Figure 233: For algorithm vcog-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

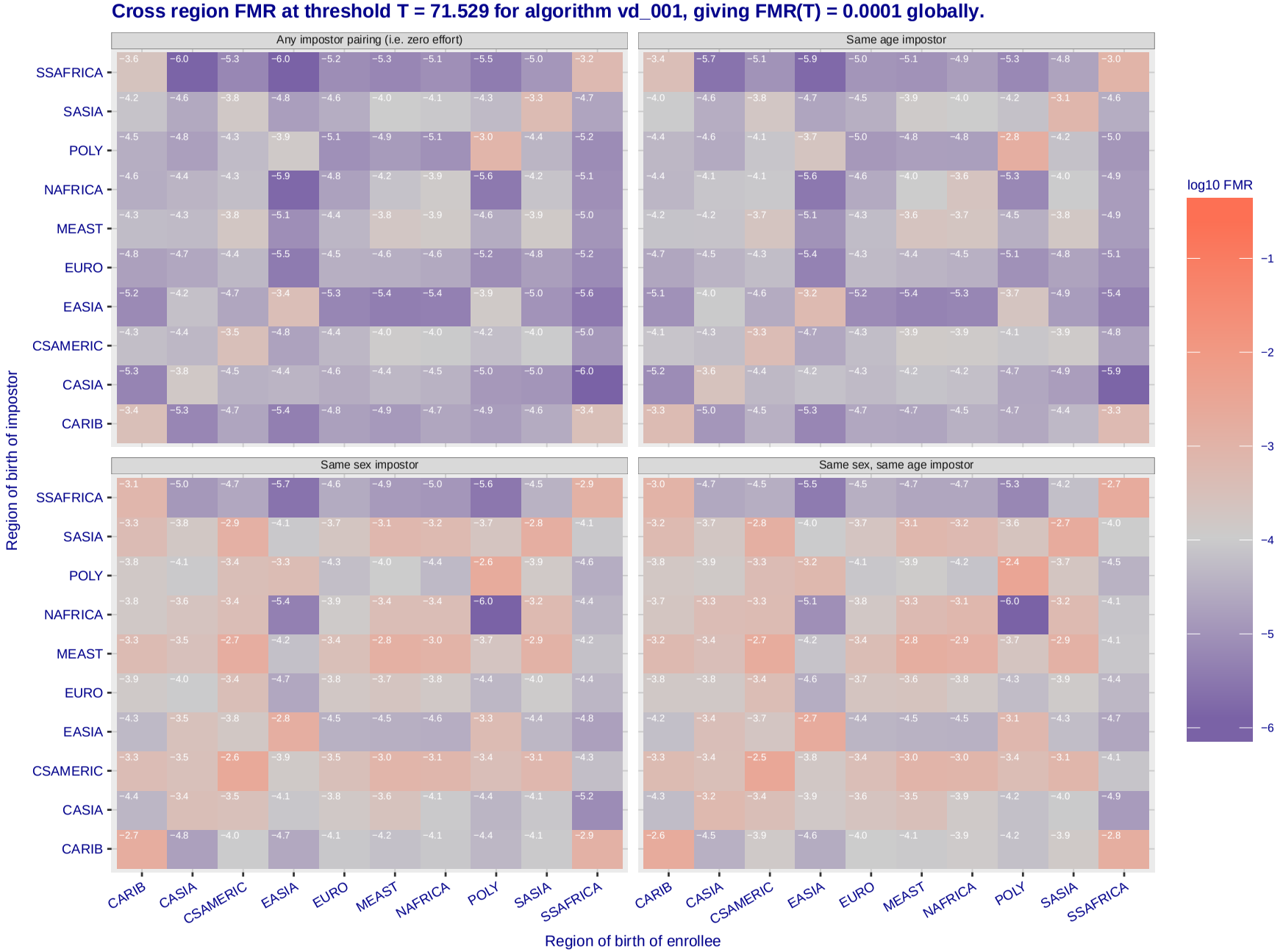


Figure 234: For algorithm vd-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

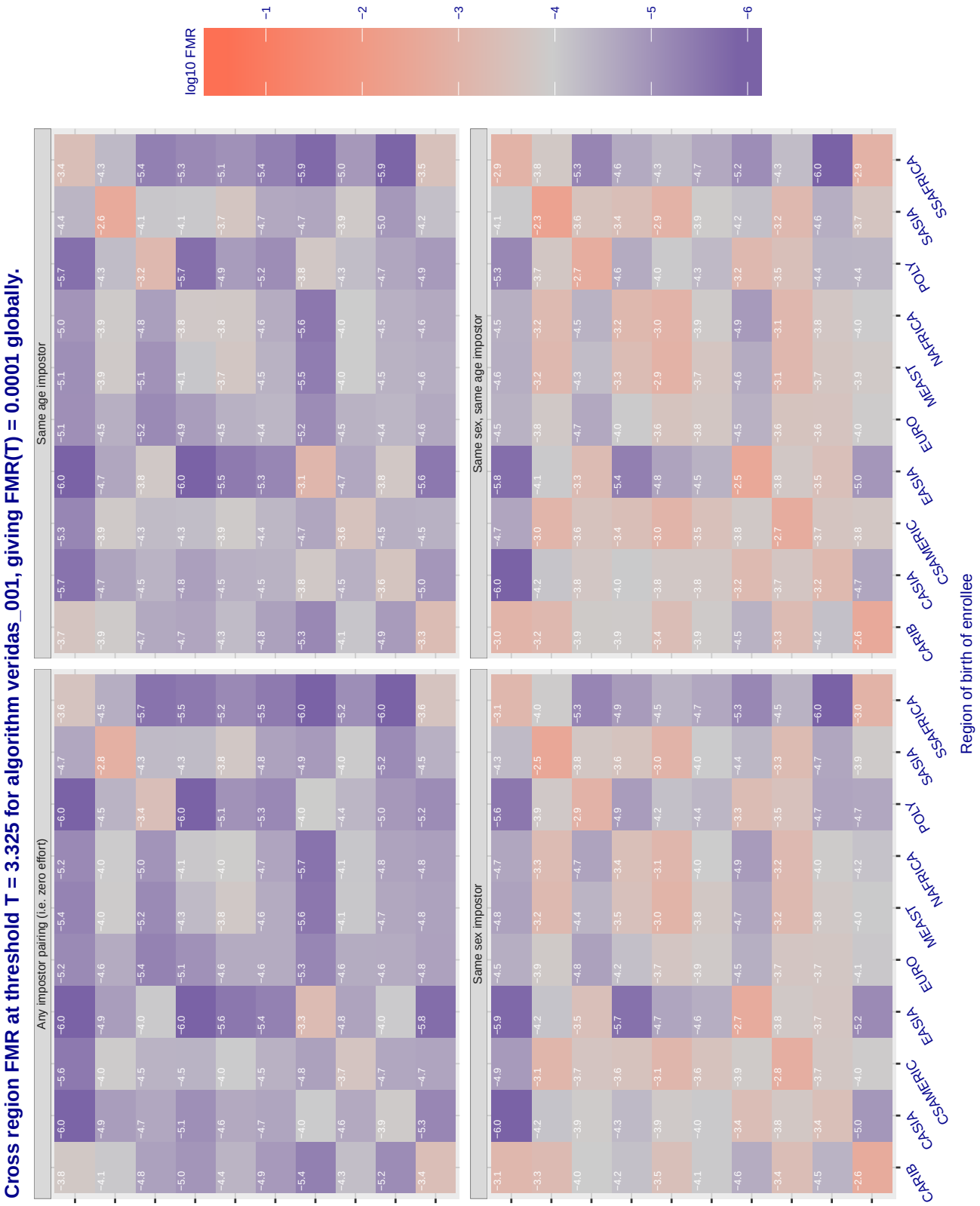


Figure 235: For algorithm veridas-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

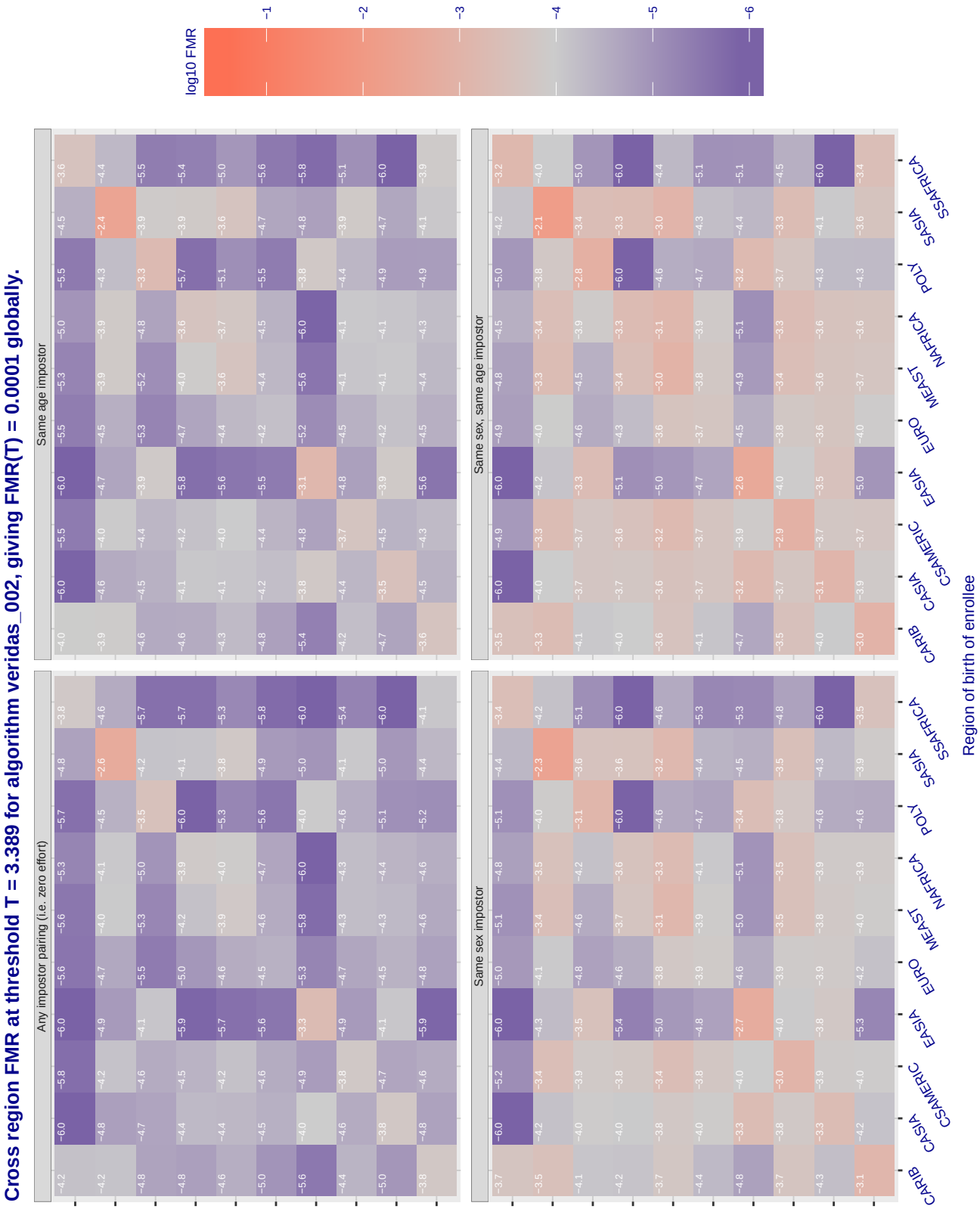


Figure 236: For algorithm veridas-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

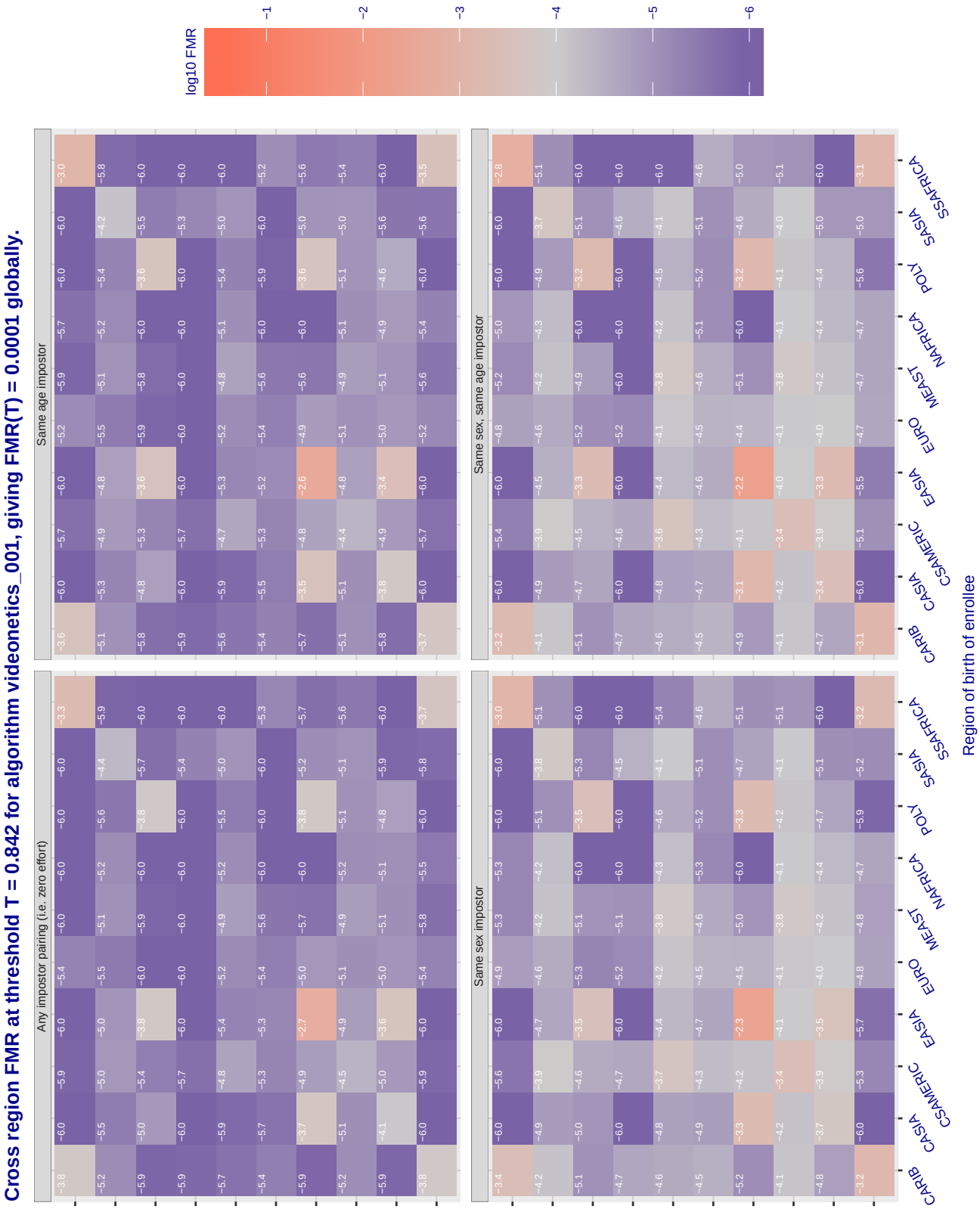


Figure 237: For algorithm videonetics-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

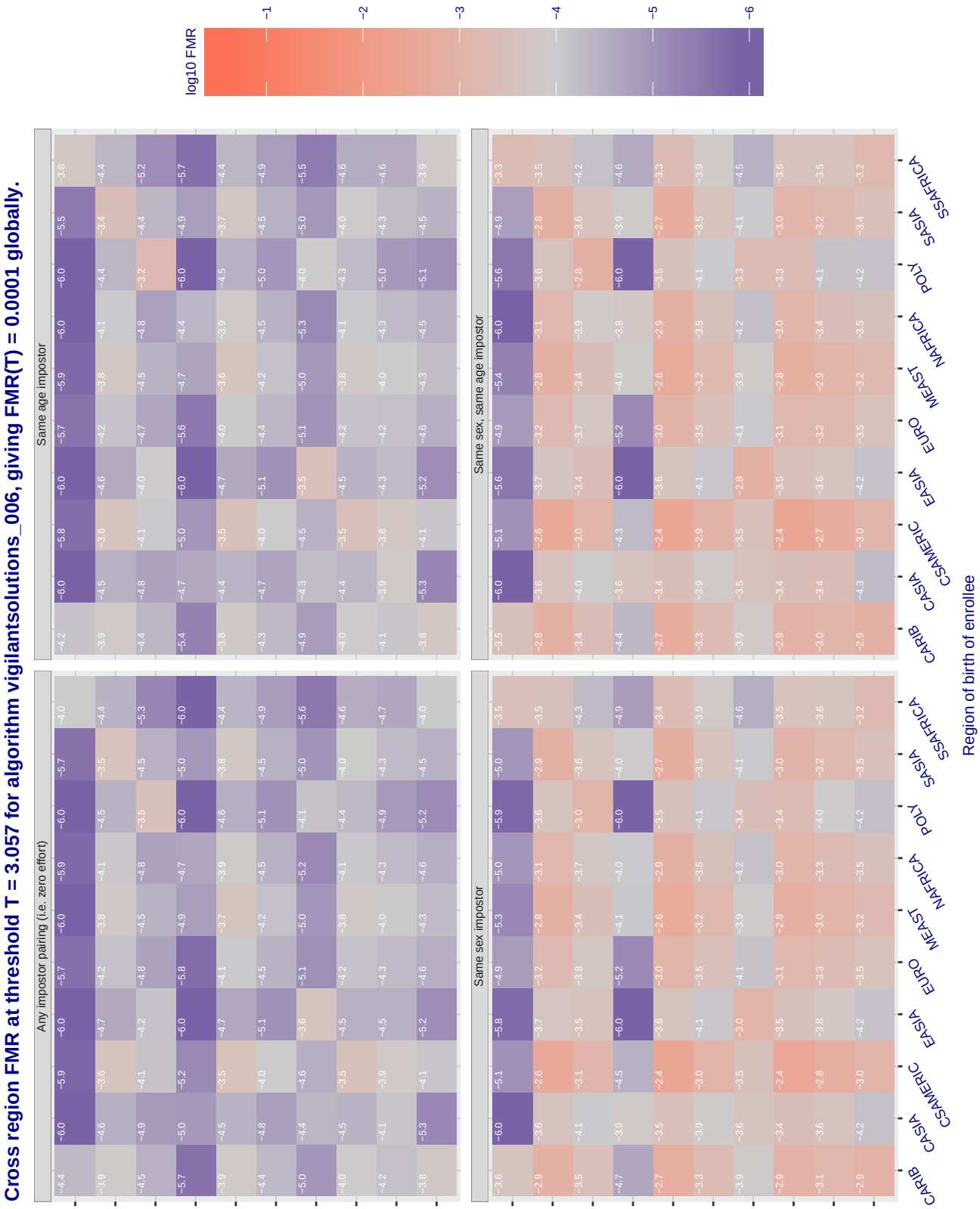


Figure 238: For algorithm vigilantsolutions-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

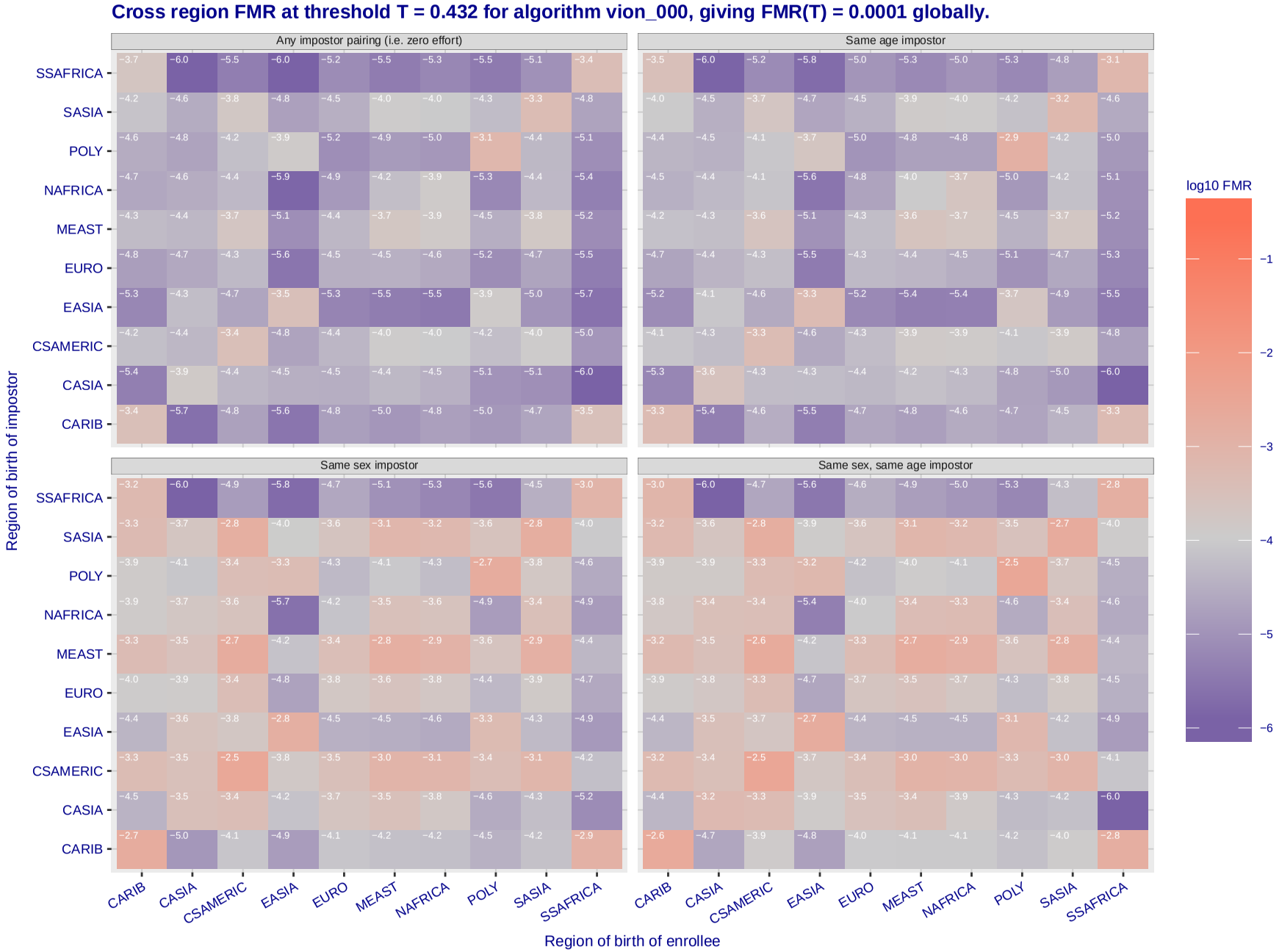


Figure 239: For algorithm vion-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

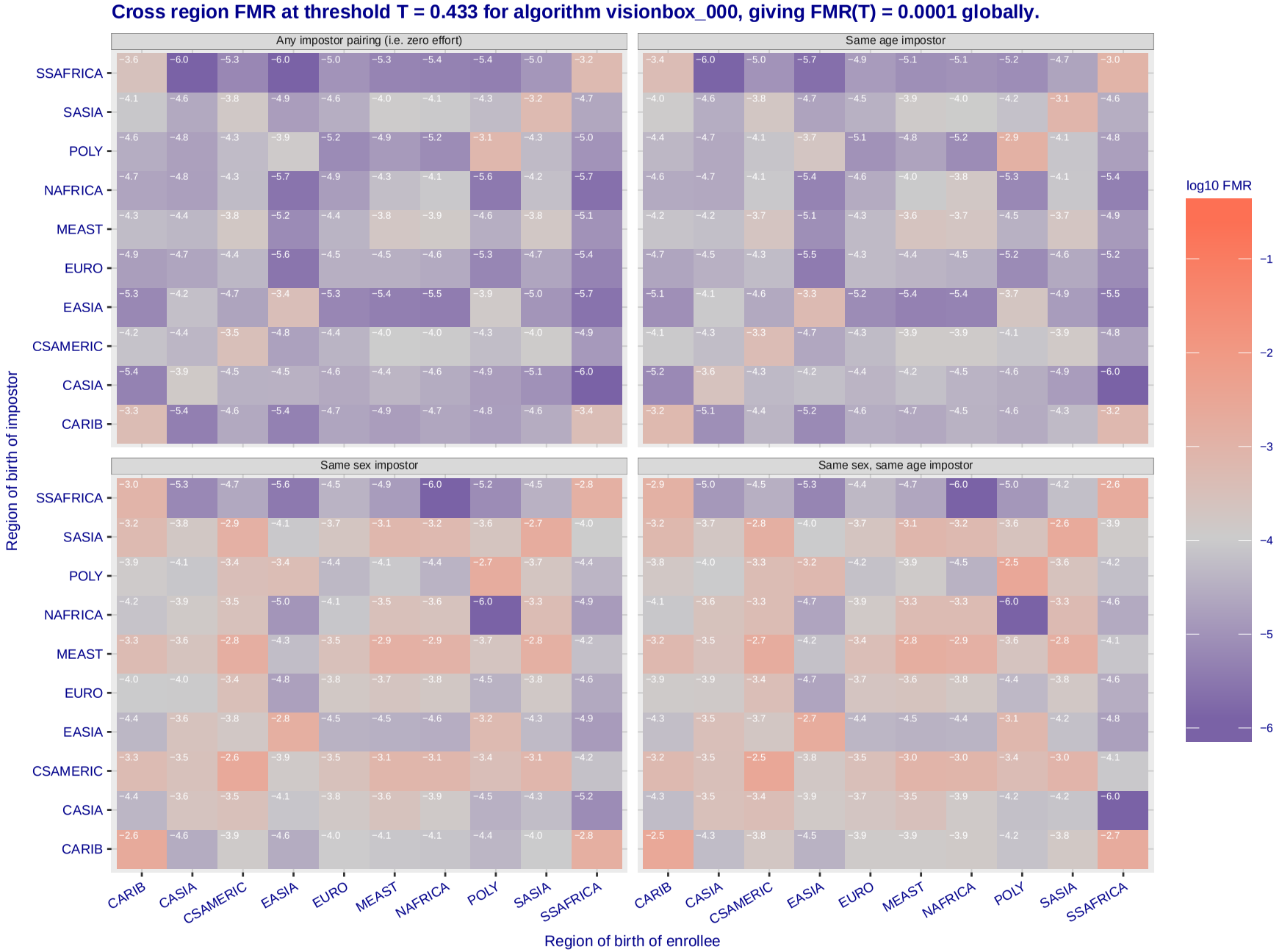


Figure 240: For algorithm visionbox-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

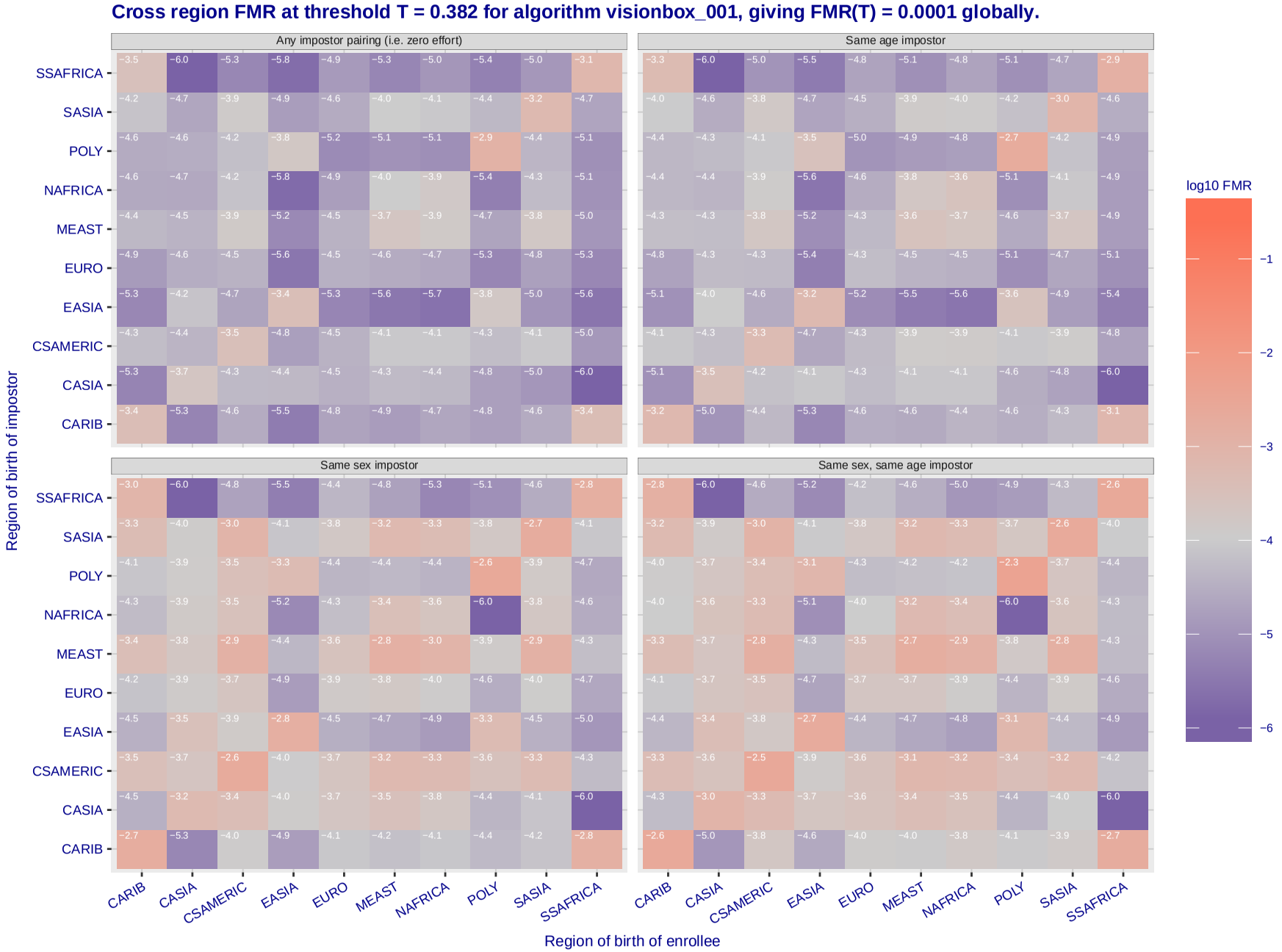


Figure 241: For algorithm visionbox-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

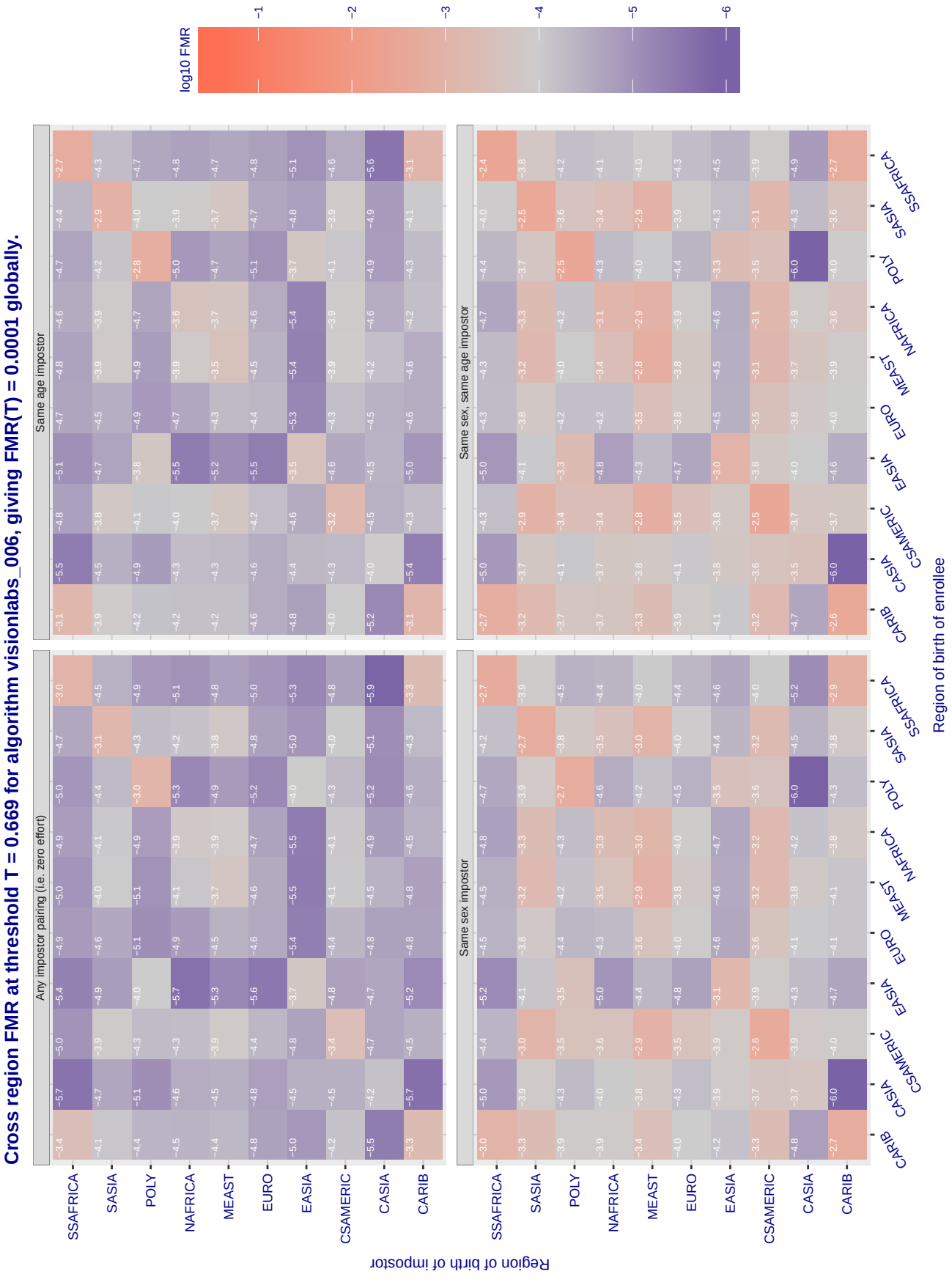


Figure 242: For algorithm visionlabs-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

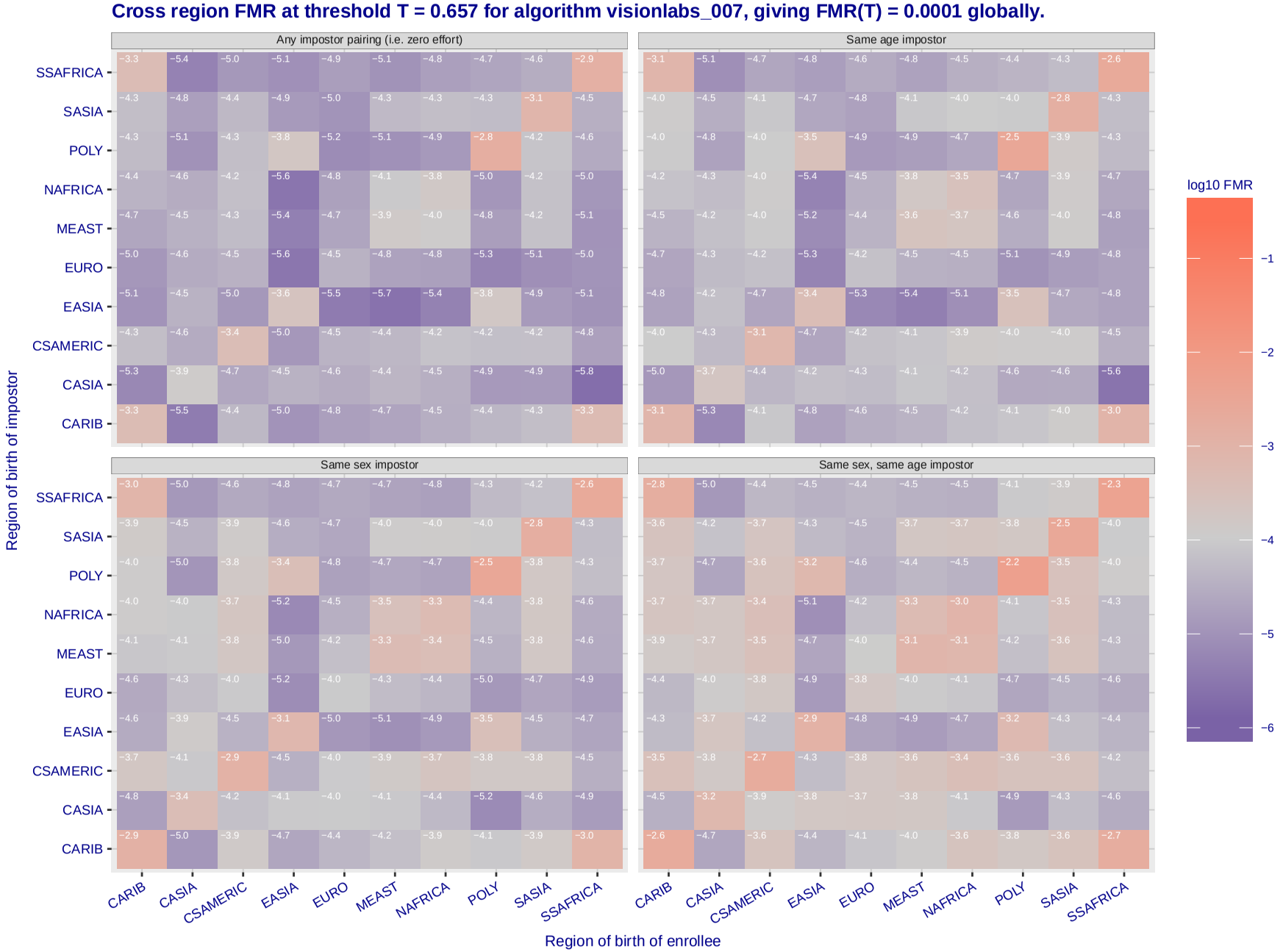


Figure 243: For algorithm visionlabs-007 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

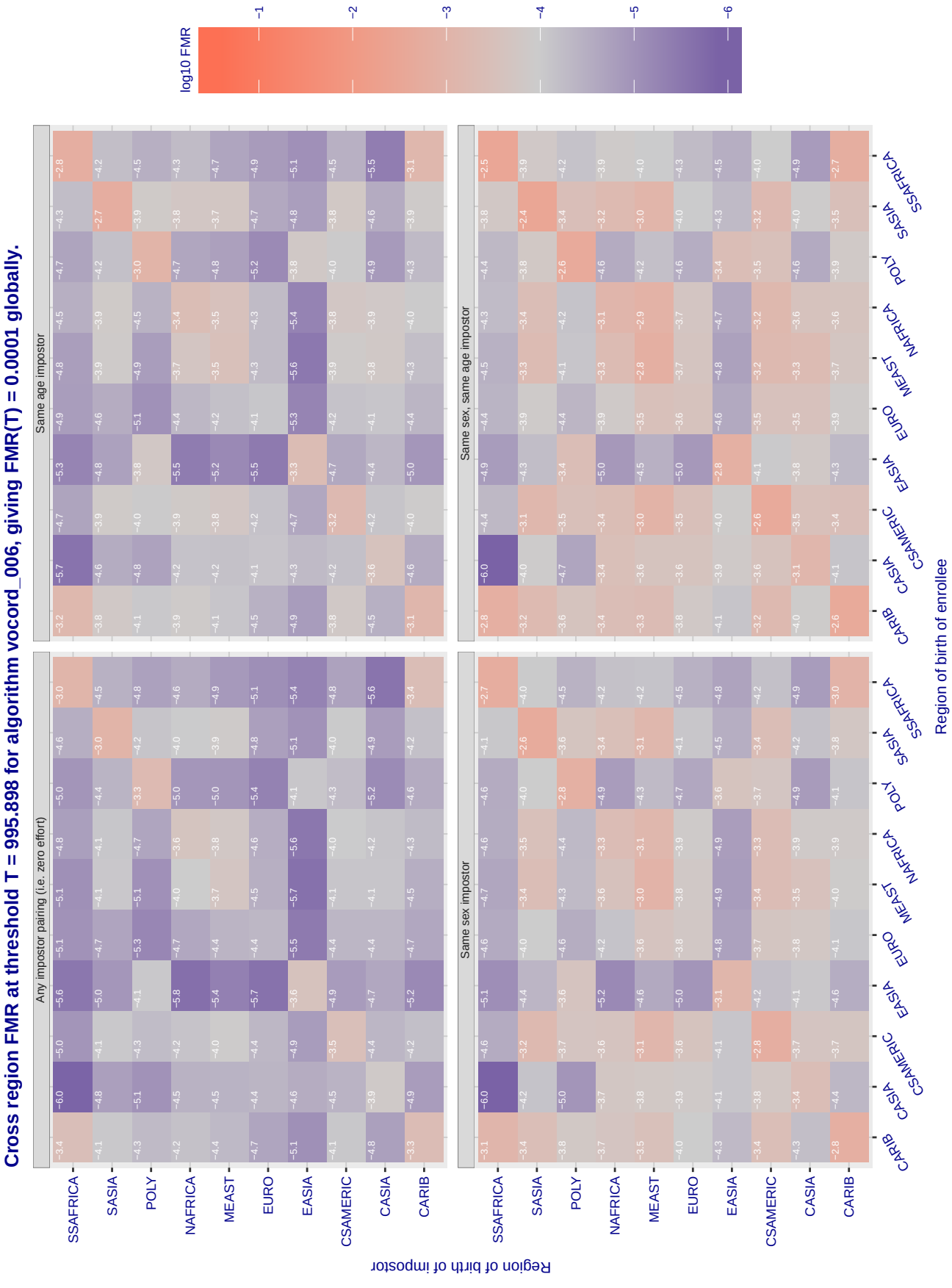


Figure 244: For algorithm vocord-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

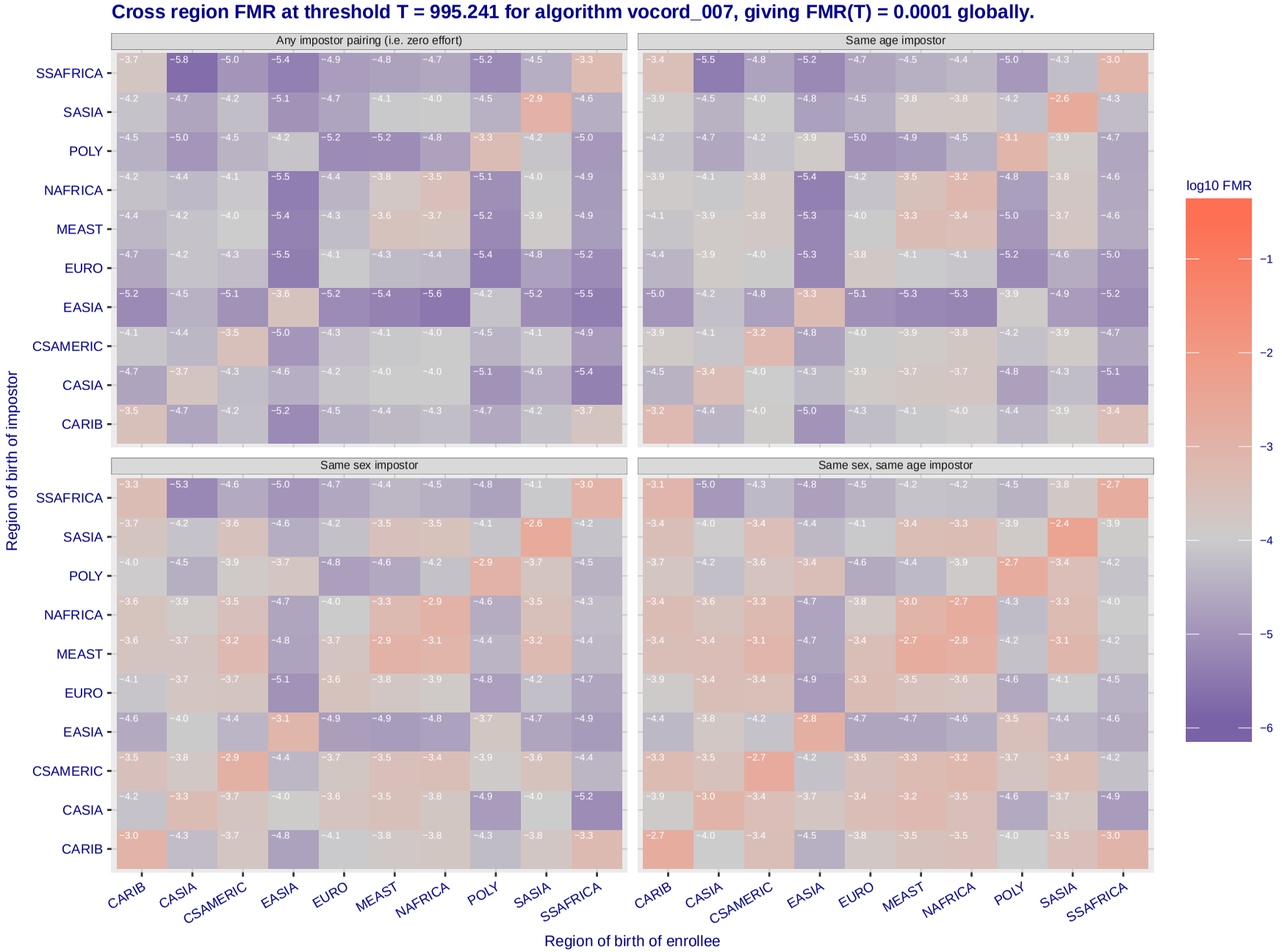


Figure 245: For algorithm vocord-007 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

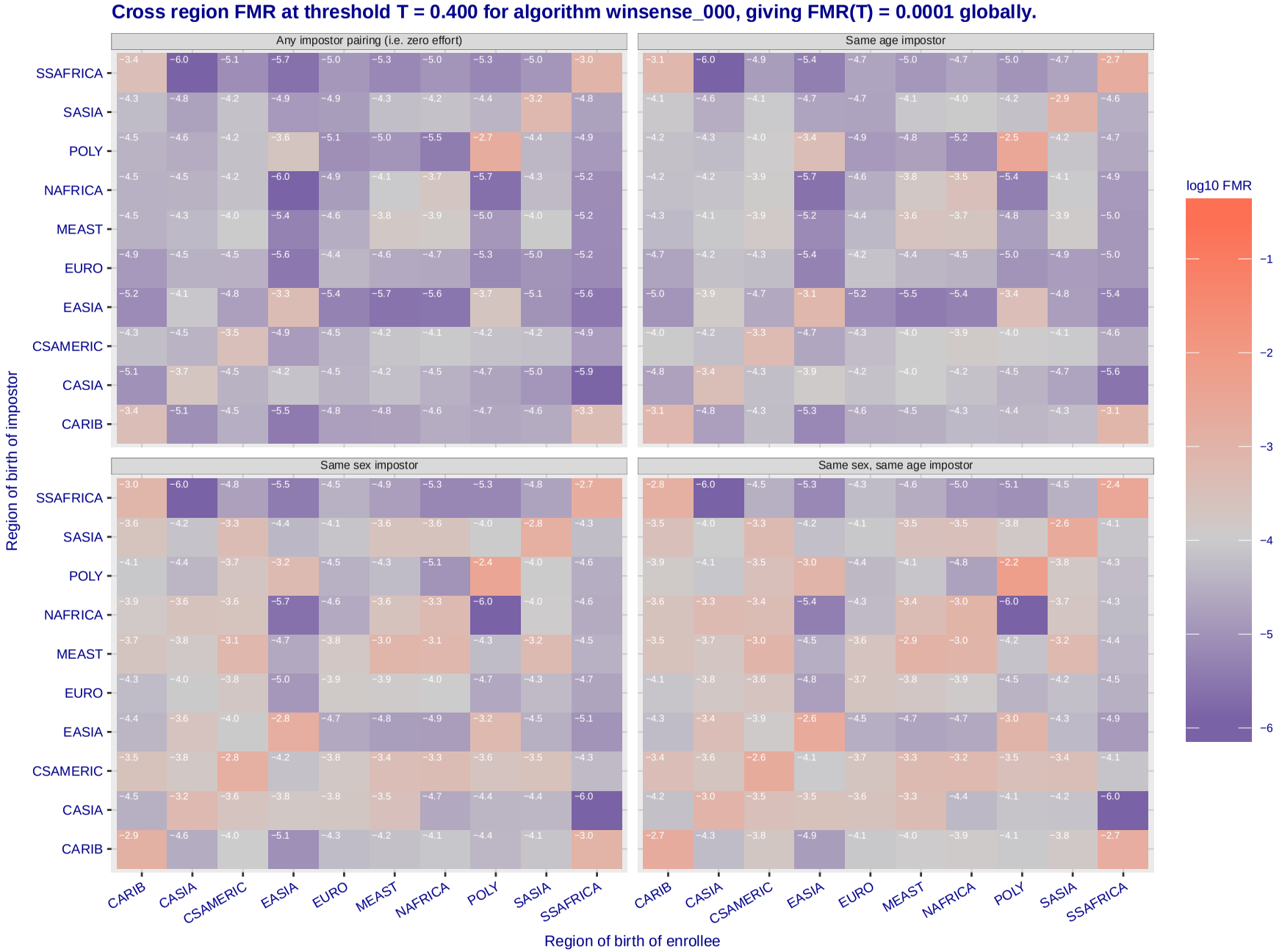


Figure 246: For algorithm winsense-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

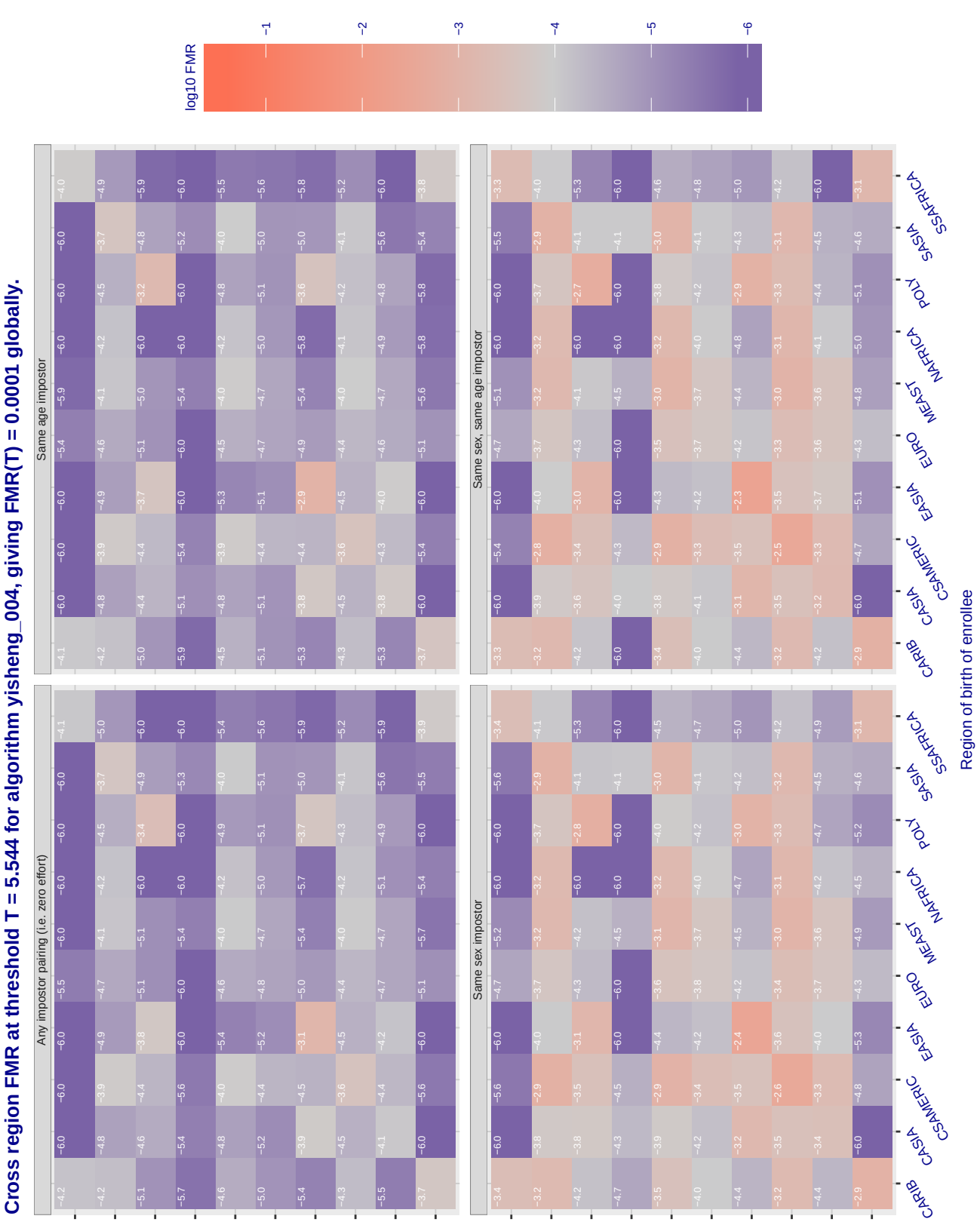


Figure 247: For algorithm yisheng-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

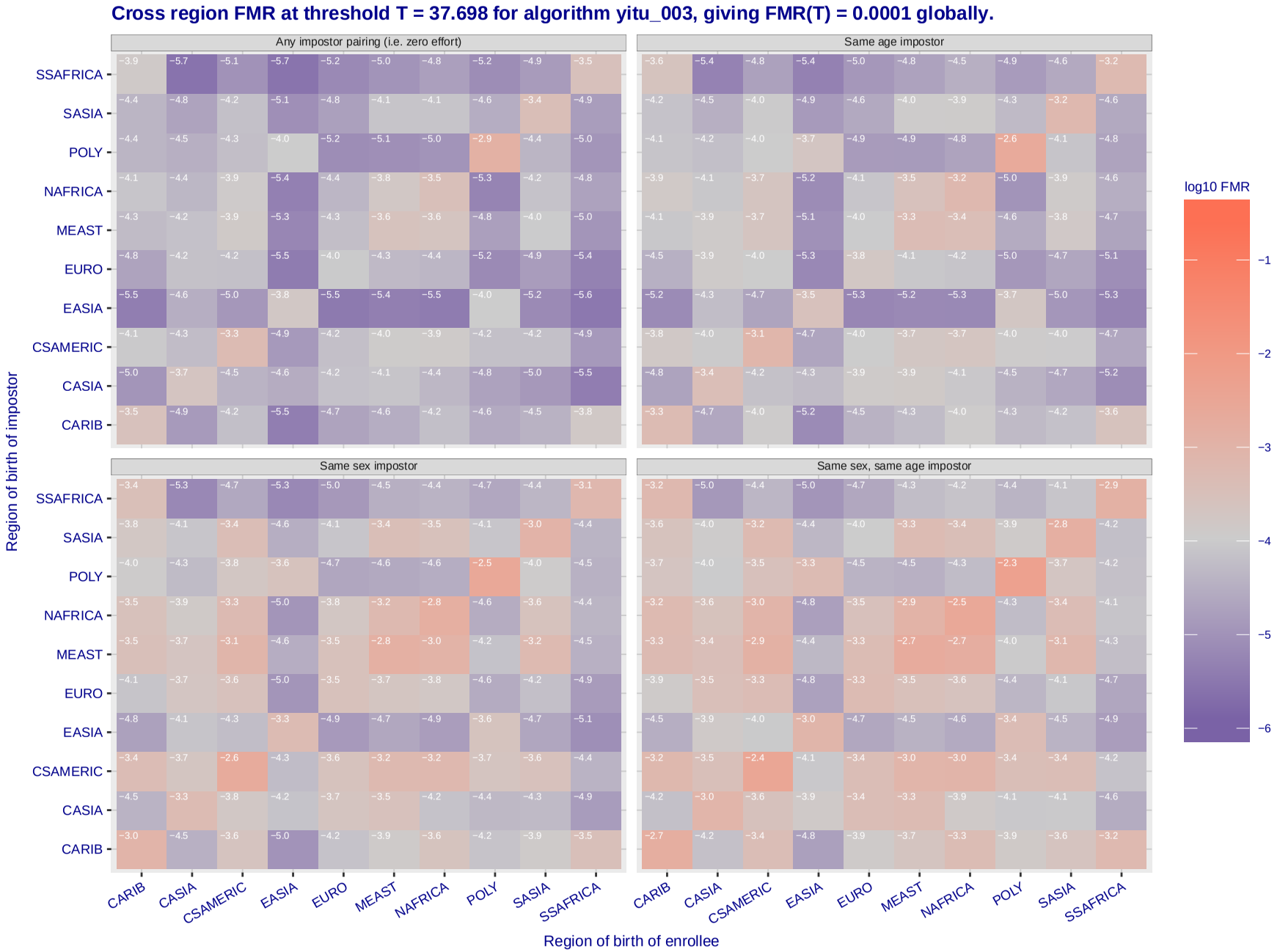


Figure 248: For algorithm yitu-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given region pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

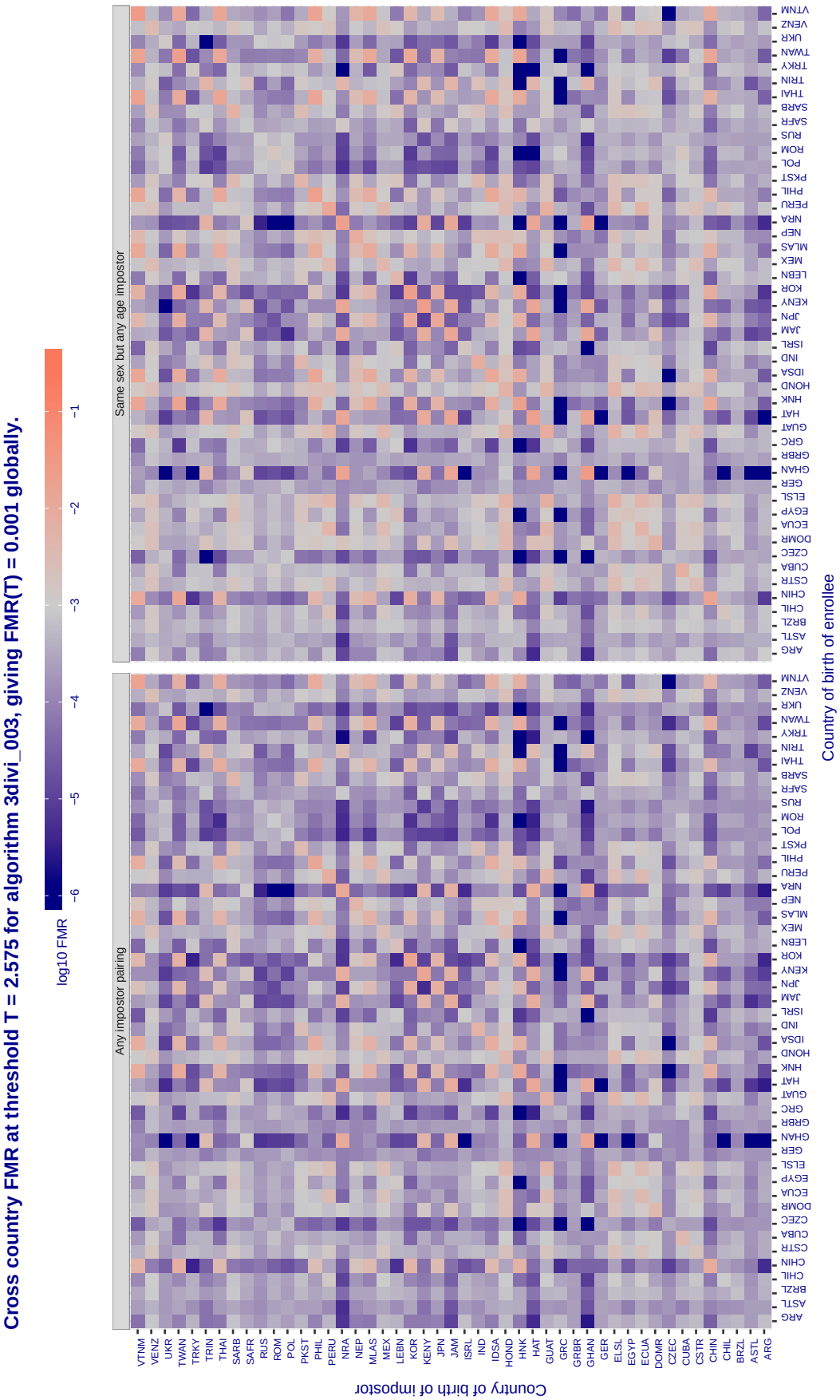


Figure 249: For algorithm 3divi-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

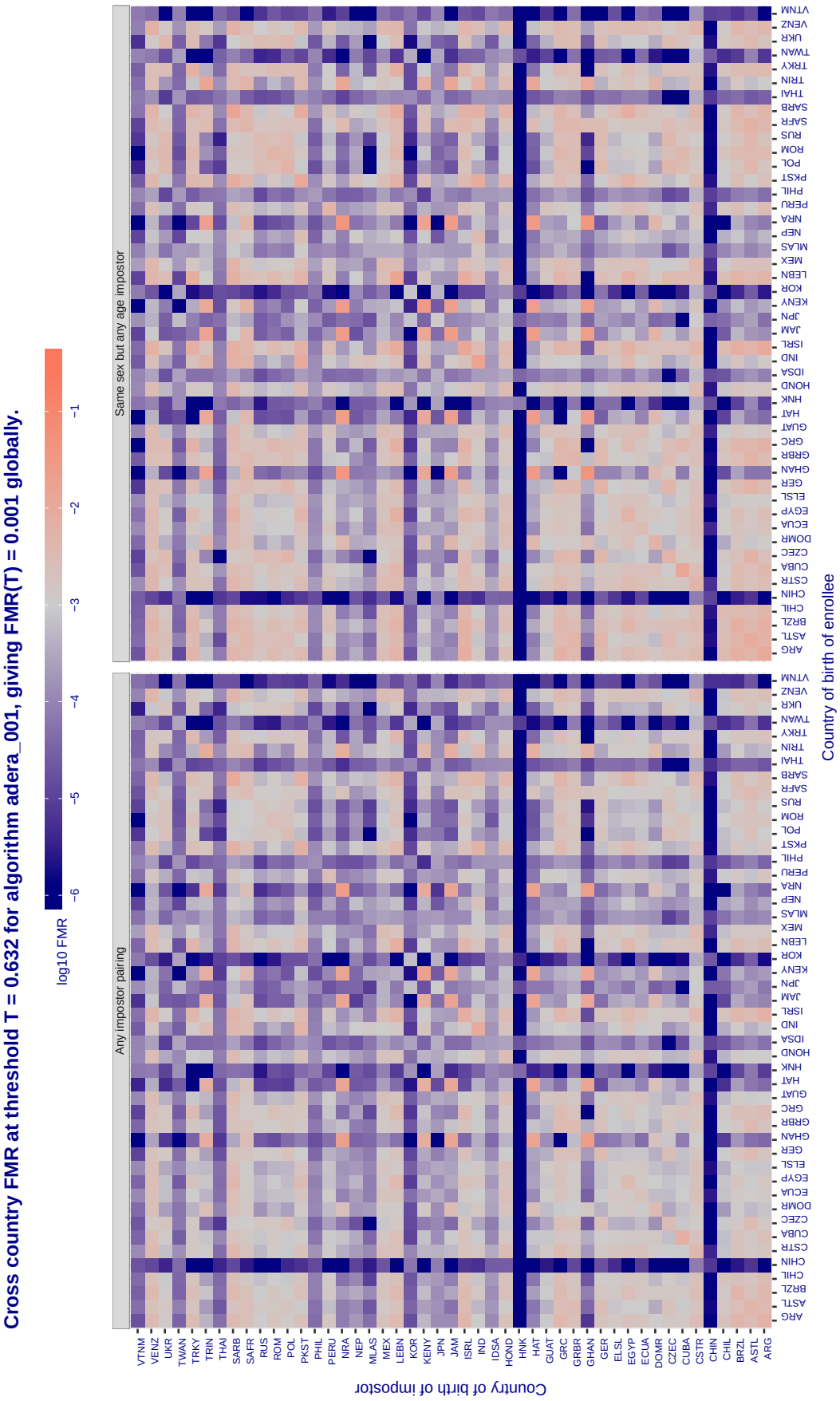


Figure 250: For algorithm adera-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

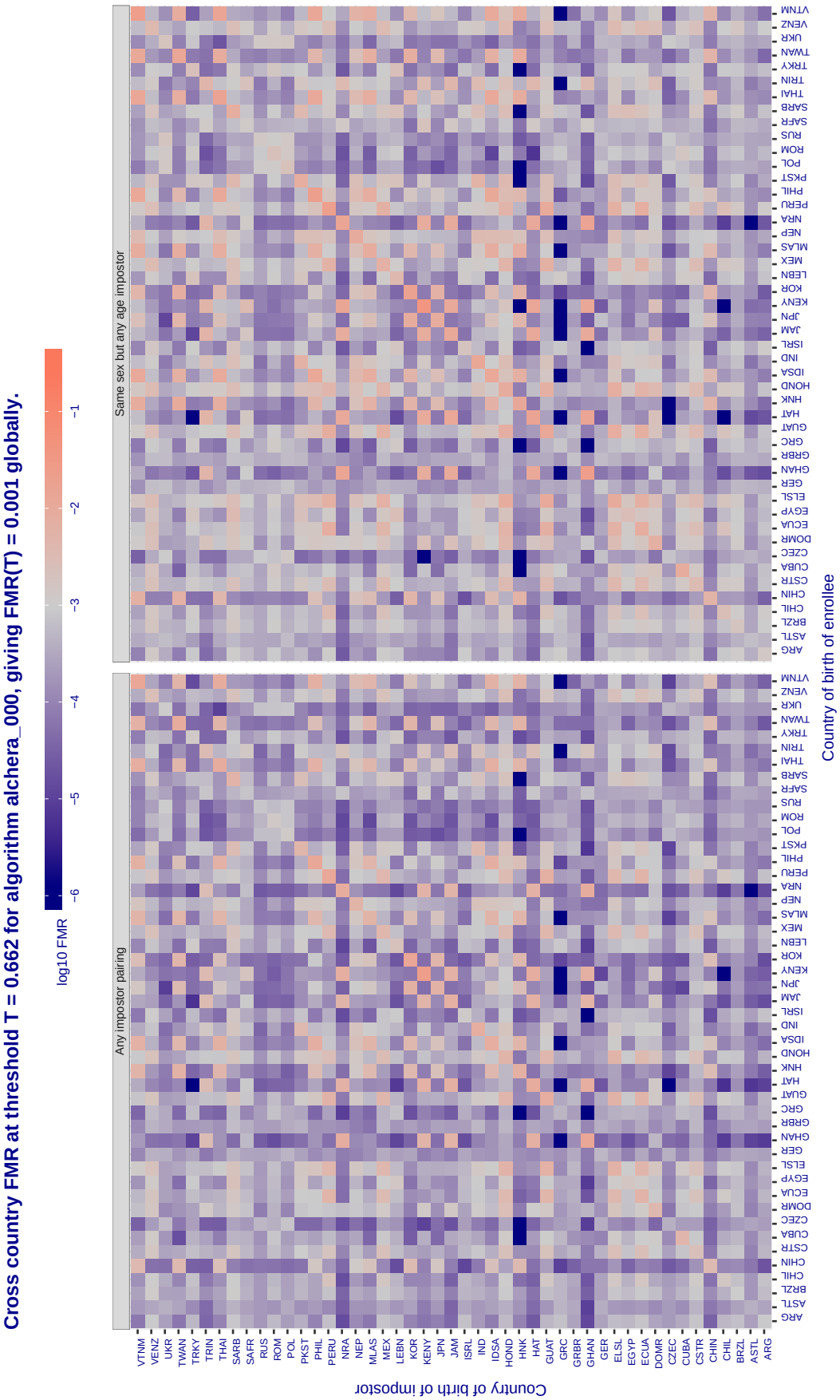


Figure 251: For algorithm alchera-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

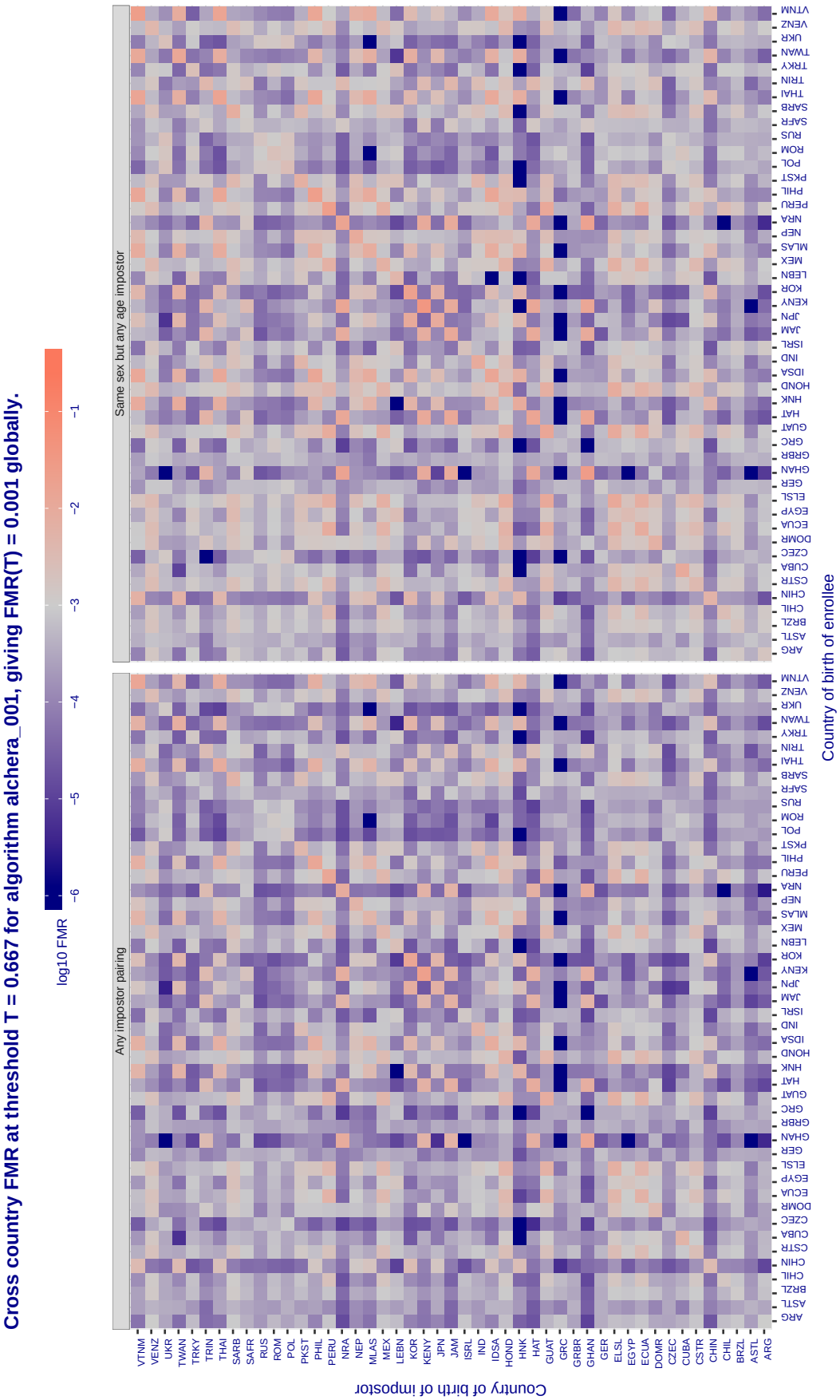


Figure 252: For algorithm alchera-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

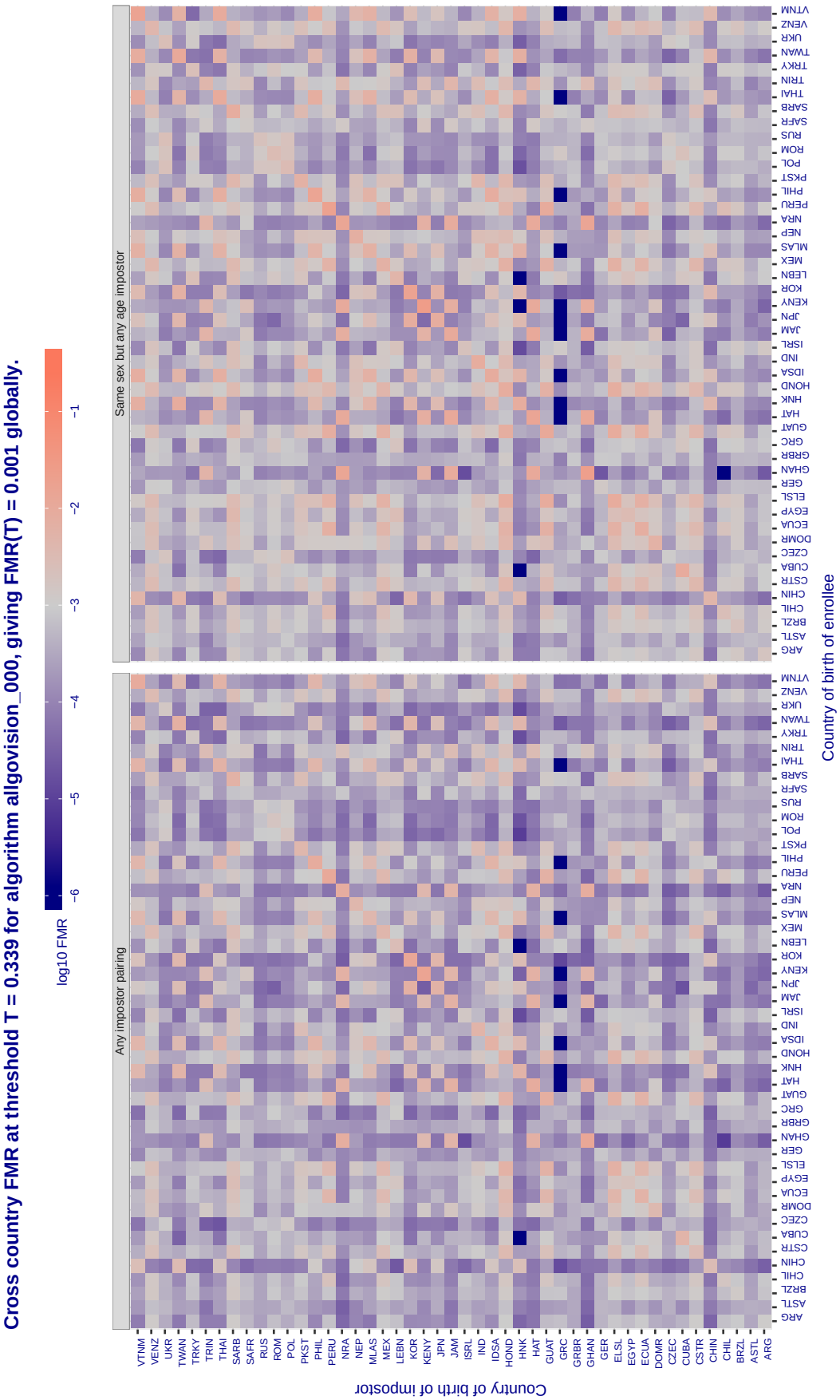


Figure 253: For algorithm allgovision-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

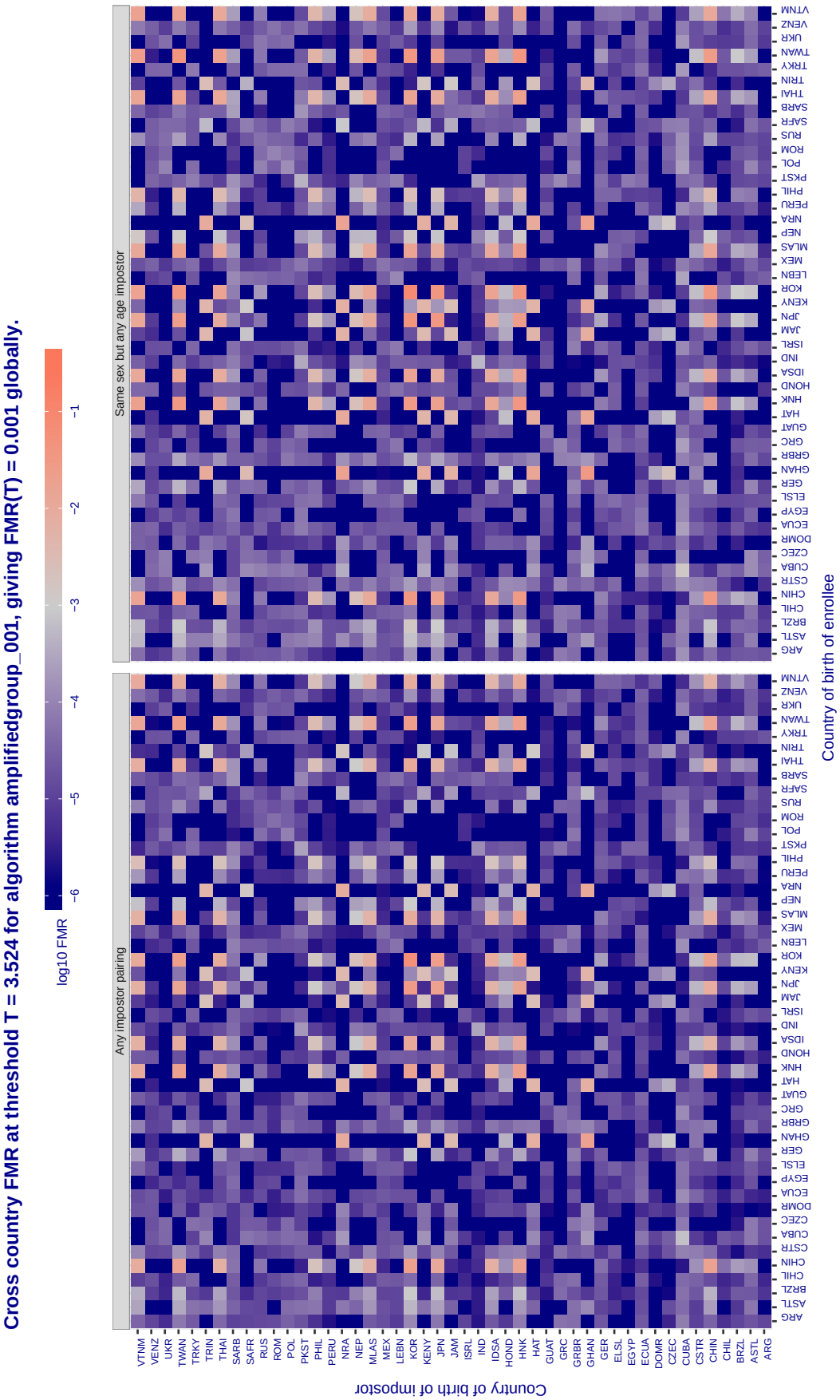


Figure 254: For algorithm amplifiedgroup-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

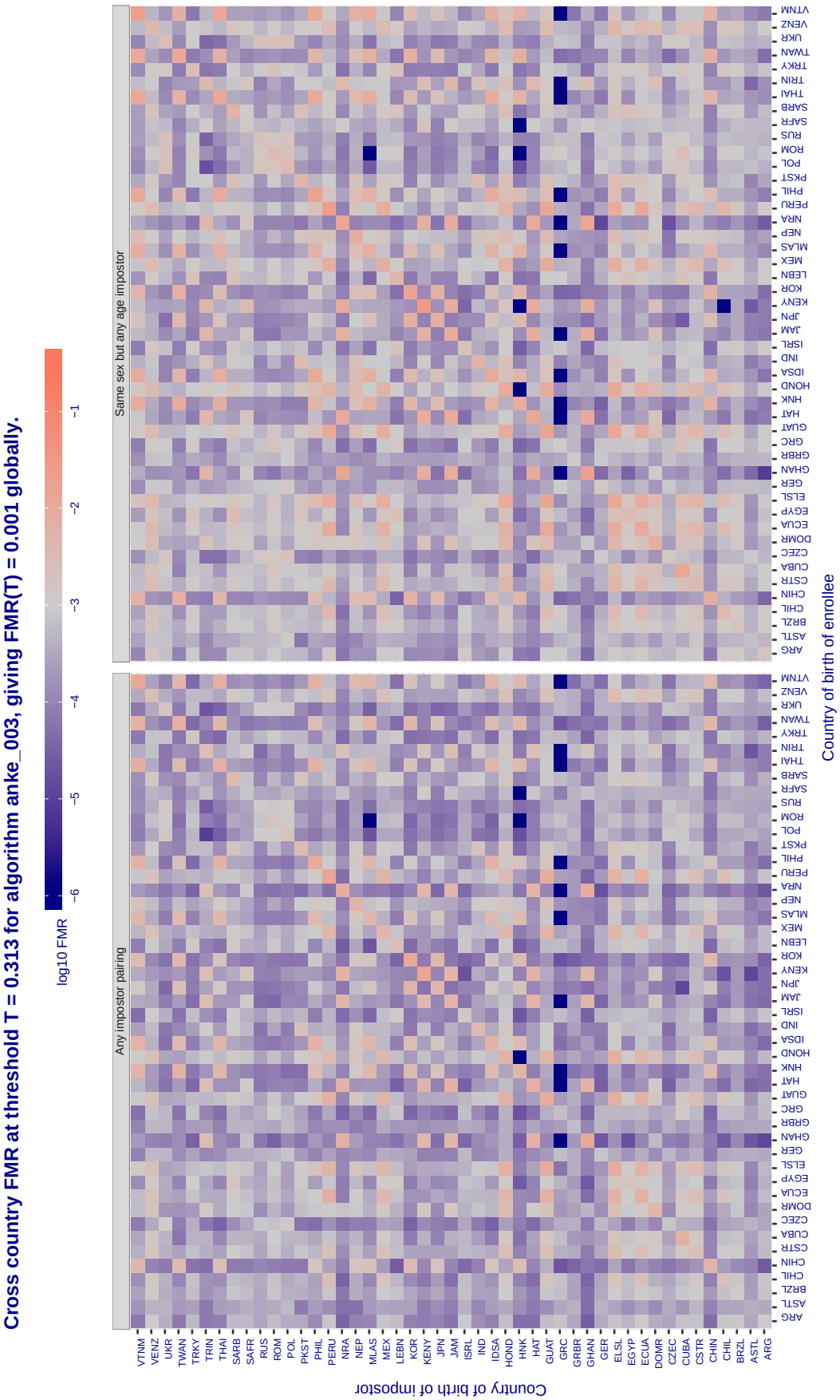


Figure 255: For algorithm anke-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

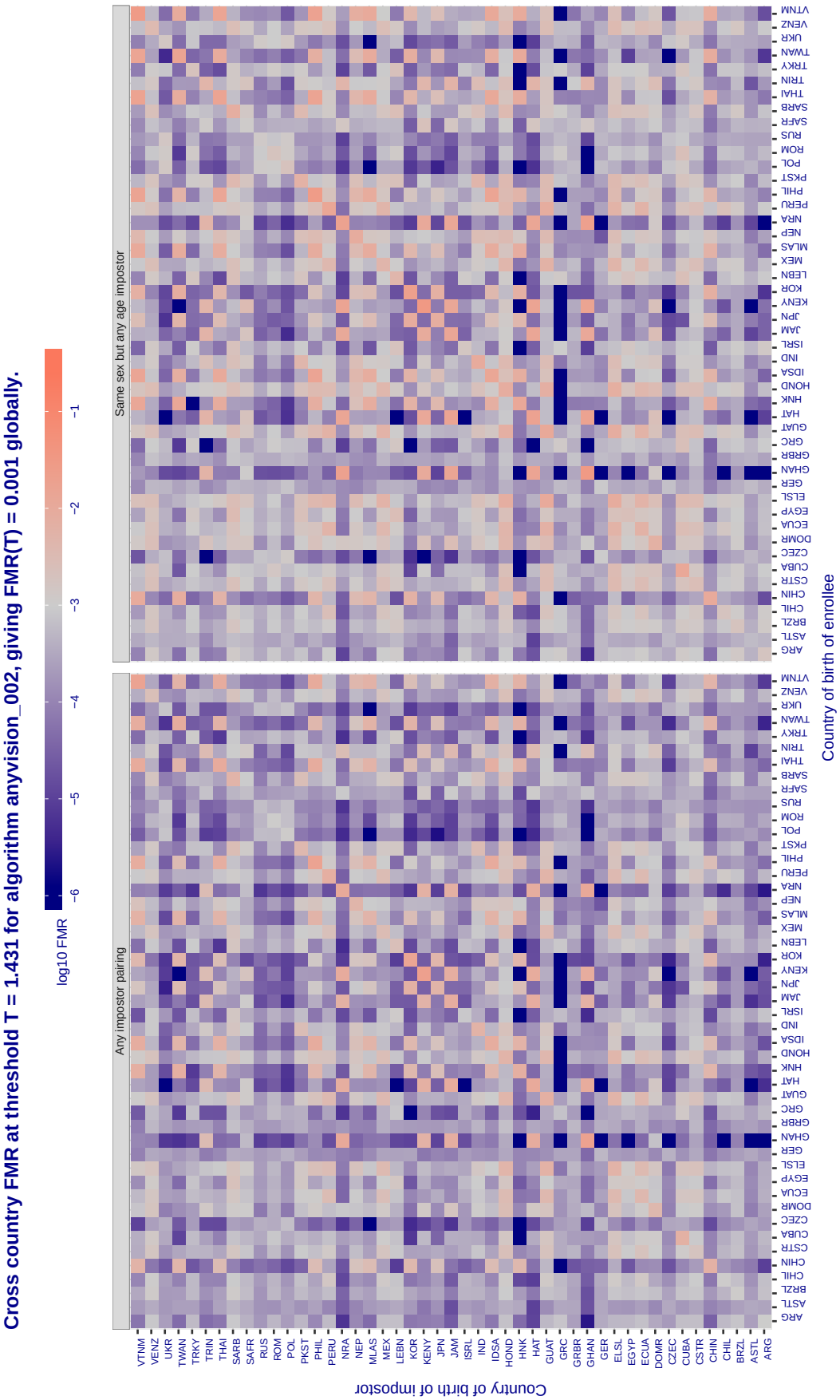


Figure 256: For algorithm anyvision-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

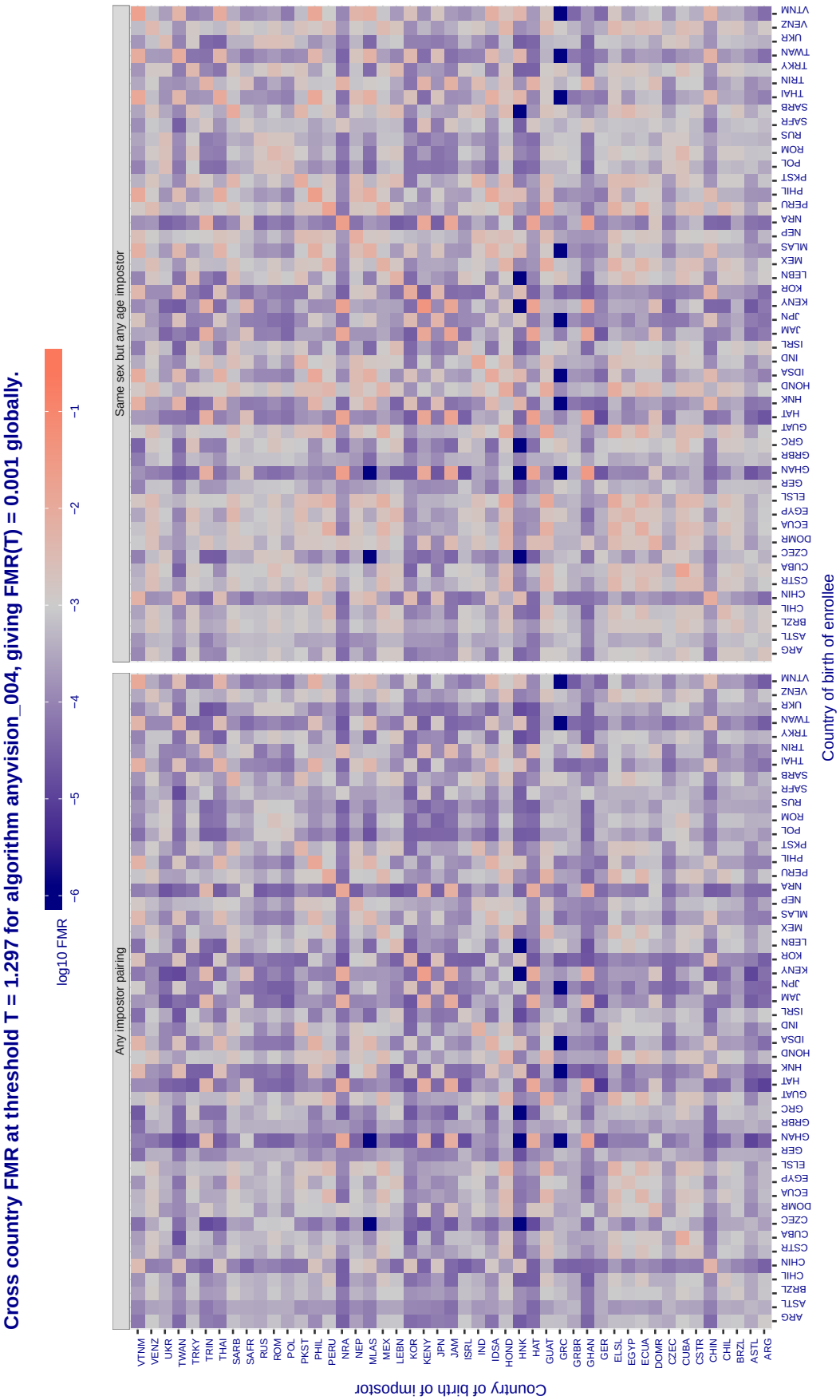


Figure 257: For algorithm anyvision-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

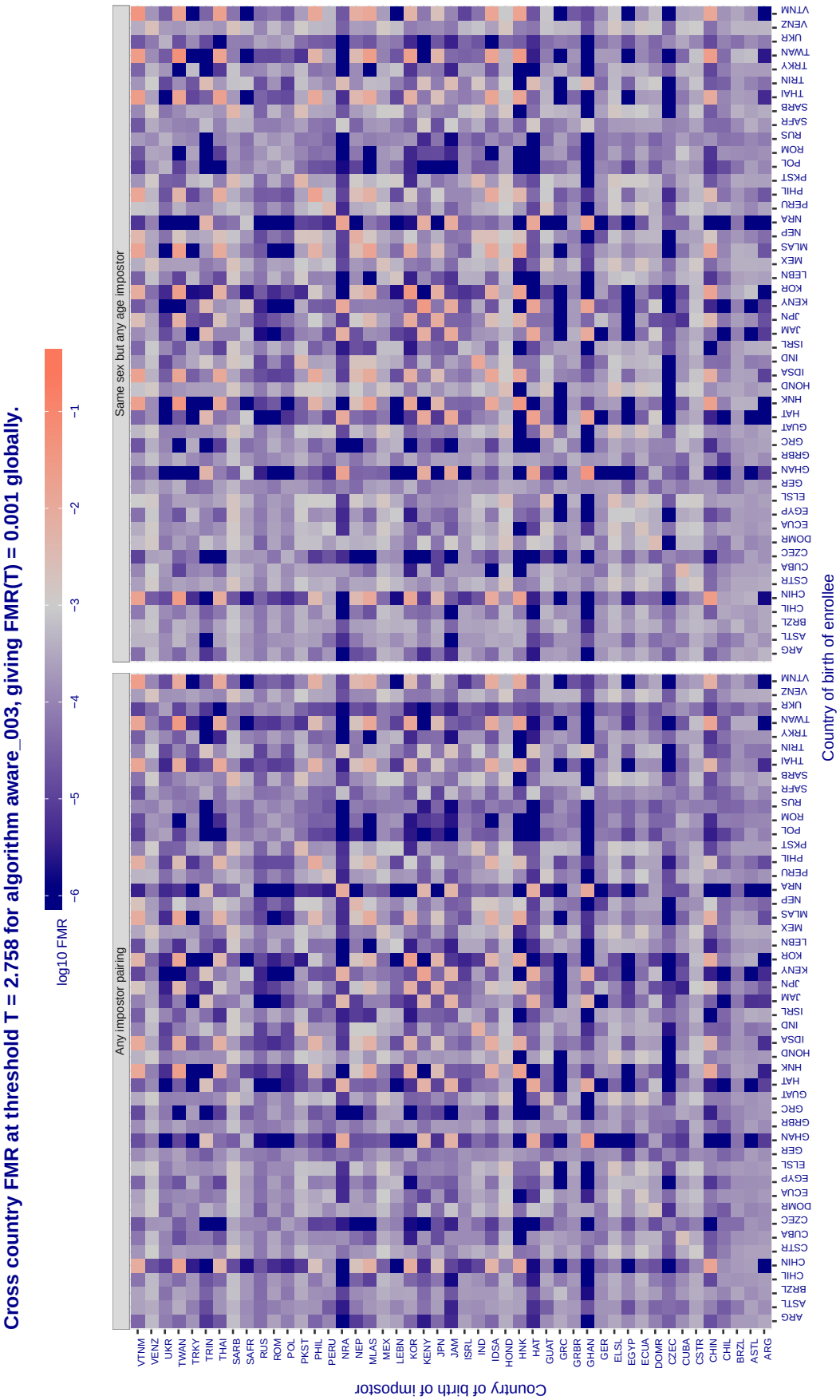


Figure 258: For algorithm aware-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

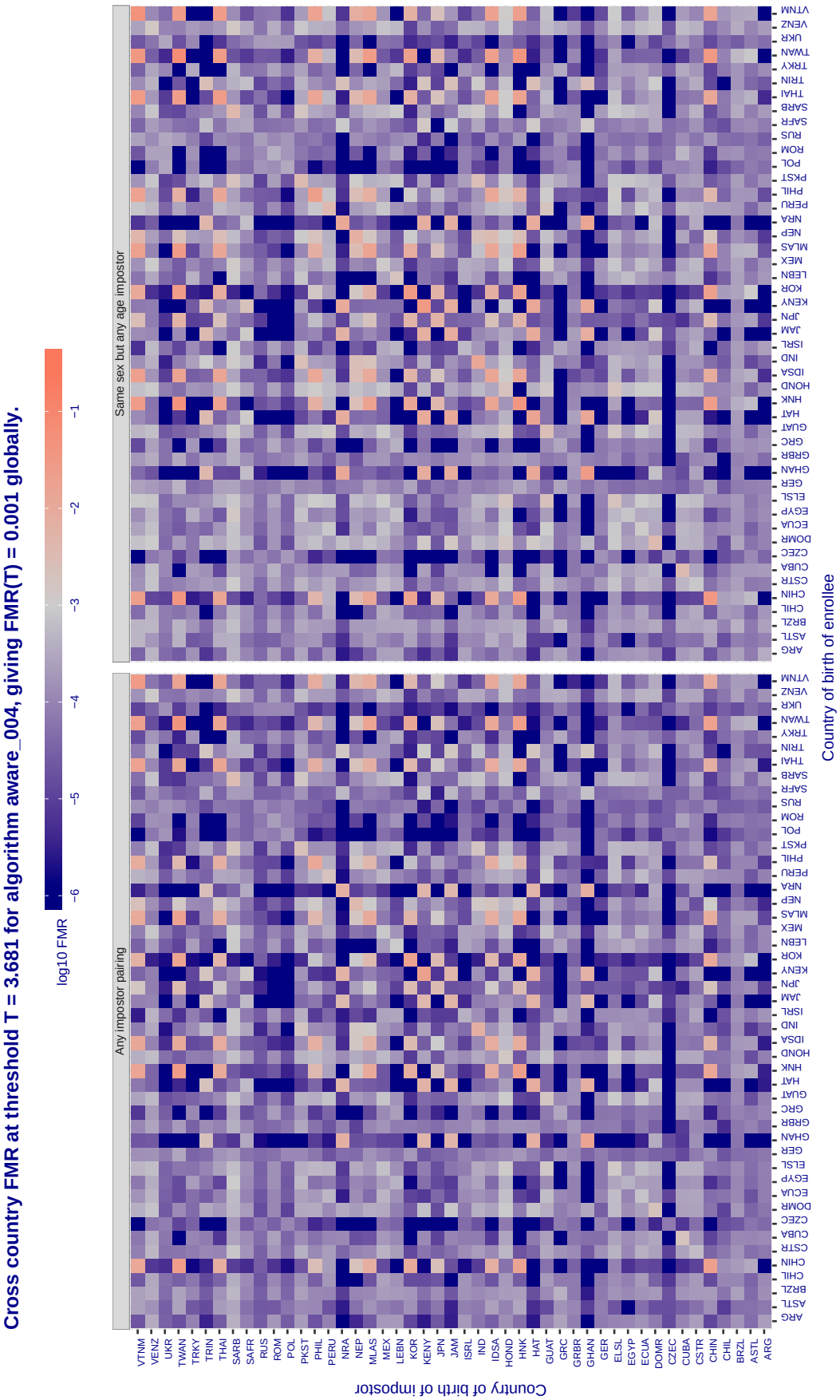


Figure 259: For algorithm aware-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

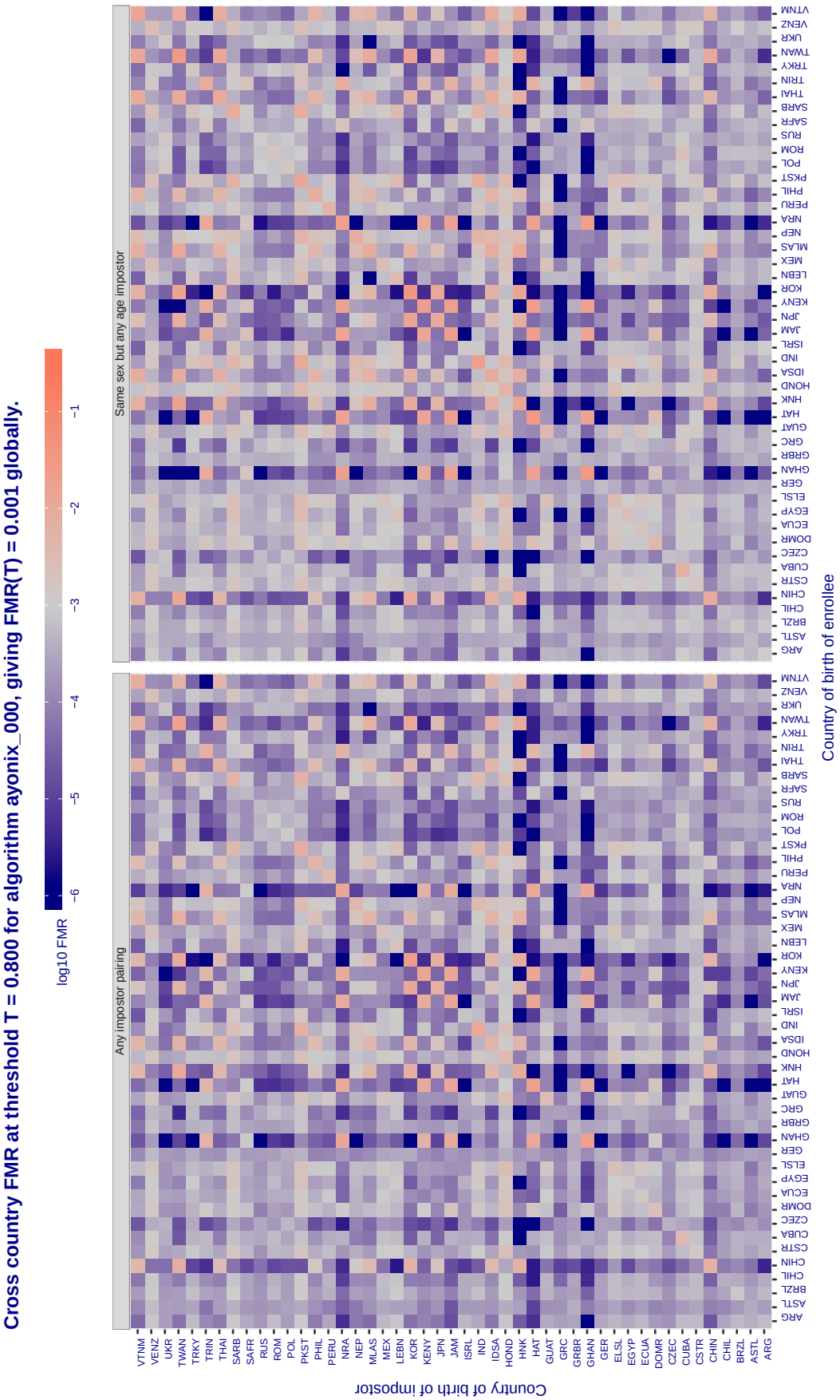


Figure 260: For algorithm ayonix-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

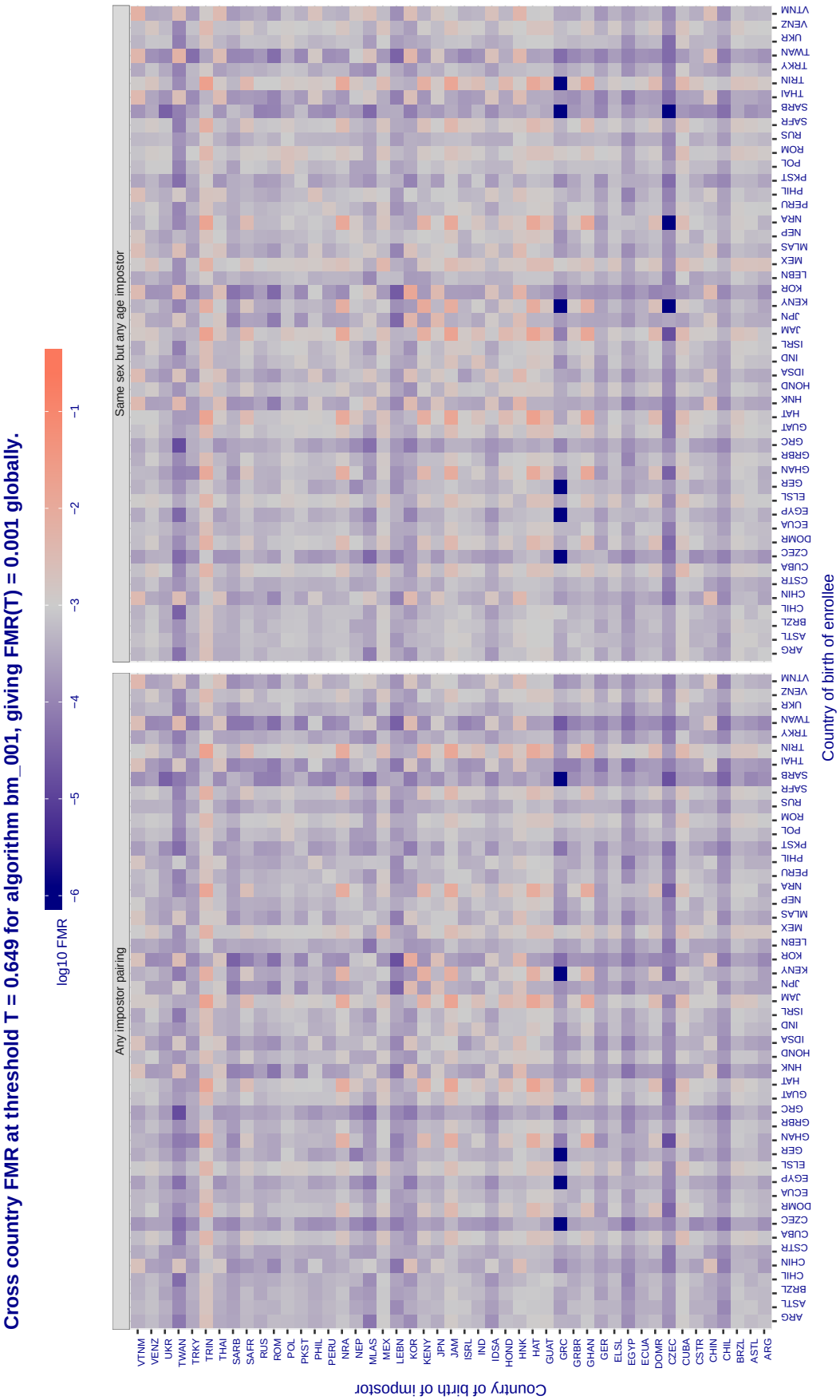


Figure 261: For algorithm bm-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

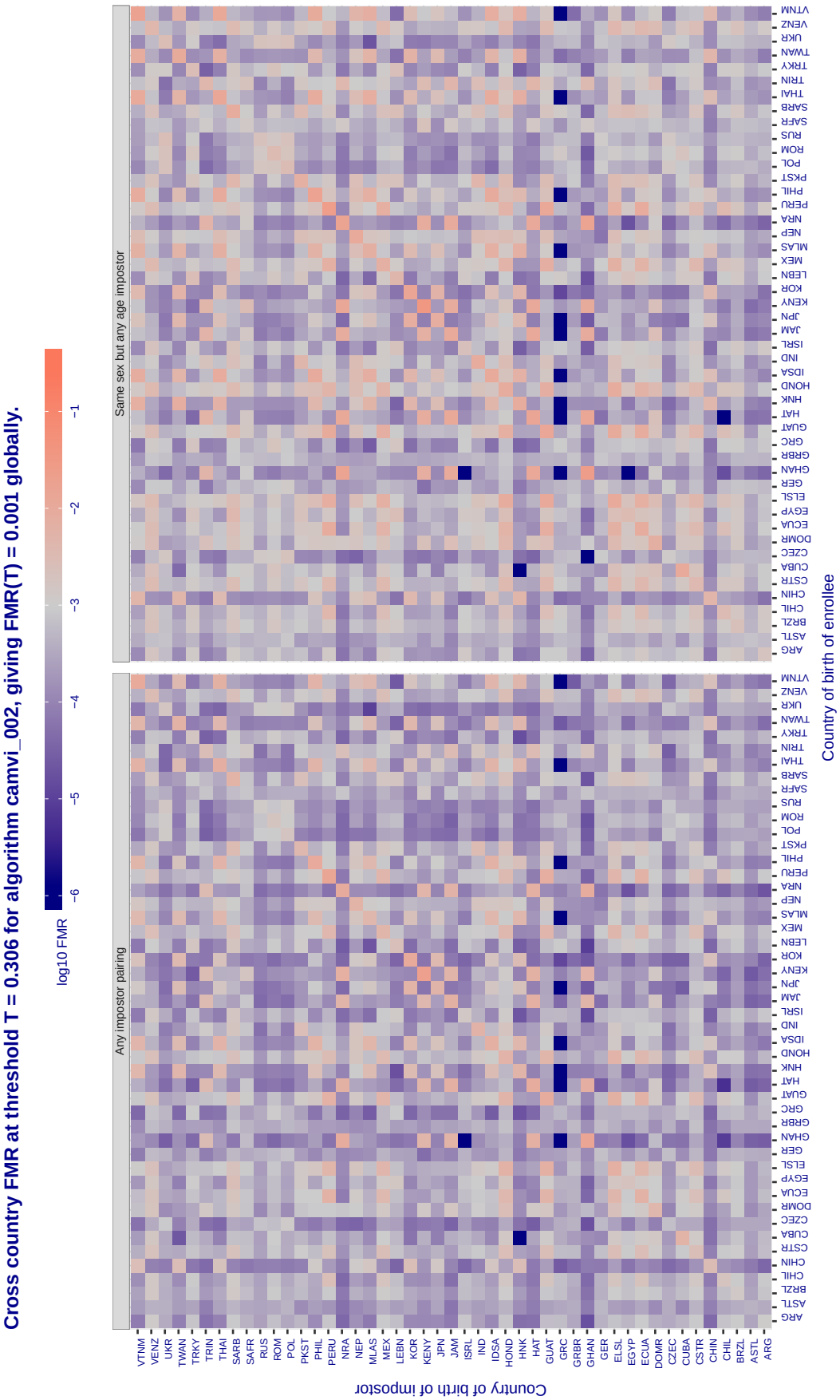


Figure 262: For algorithm camvi-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

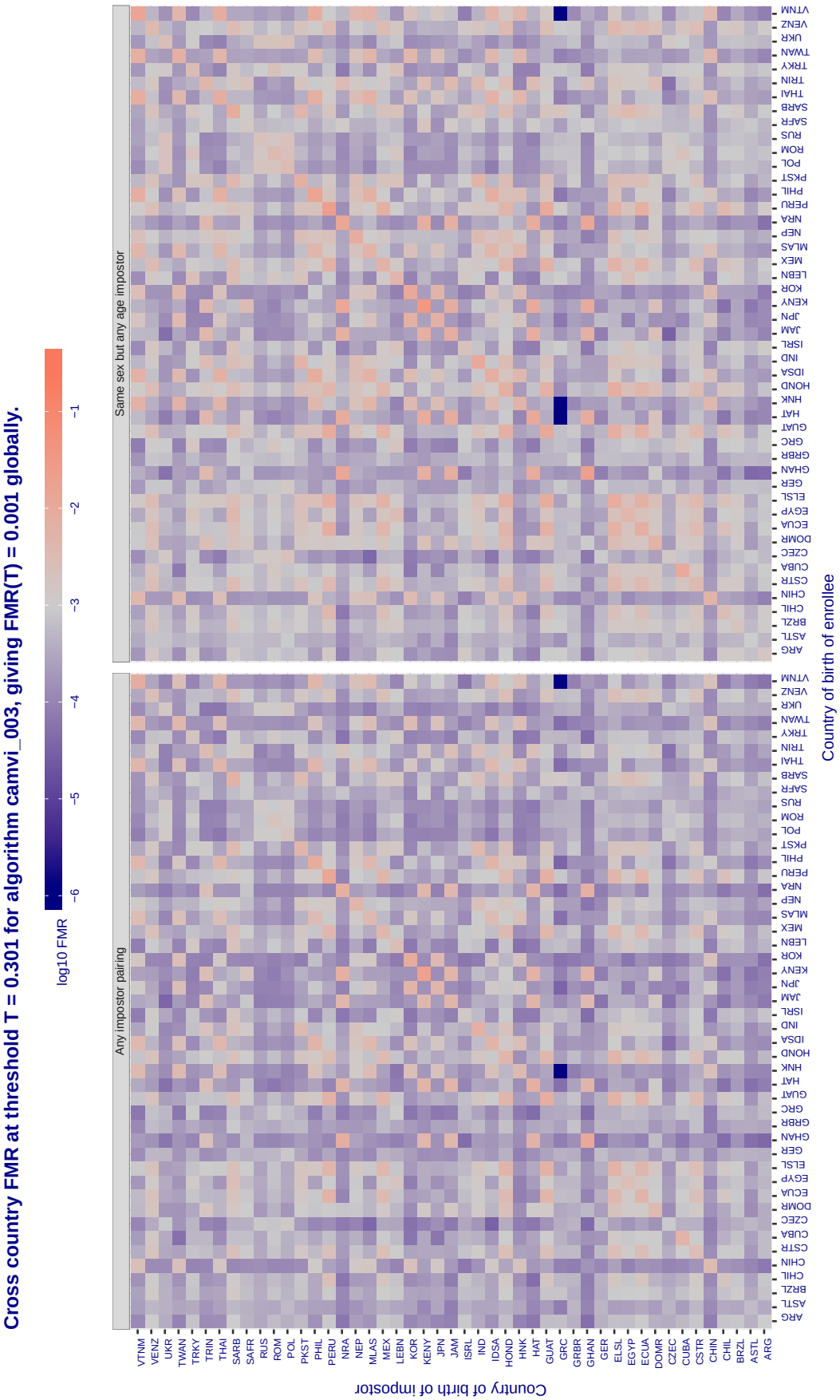


Figure 263: For algorithm camvi-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

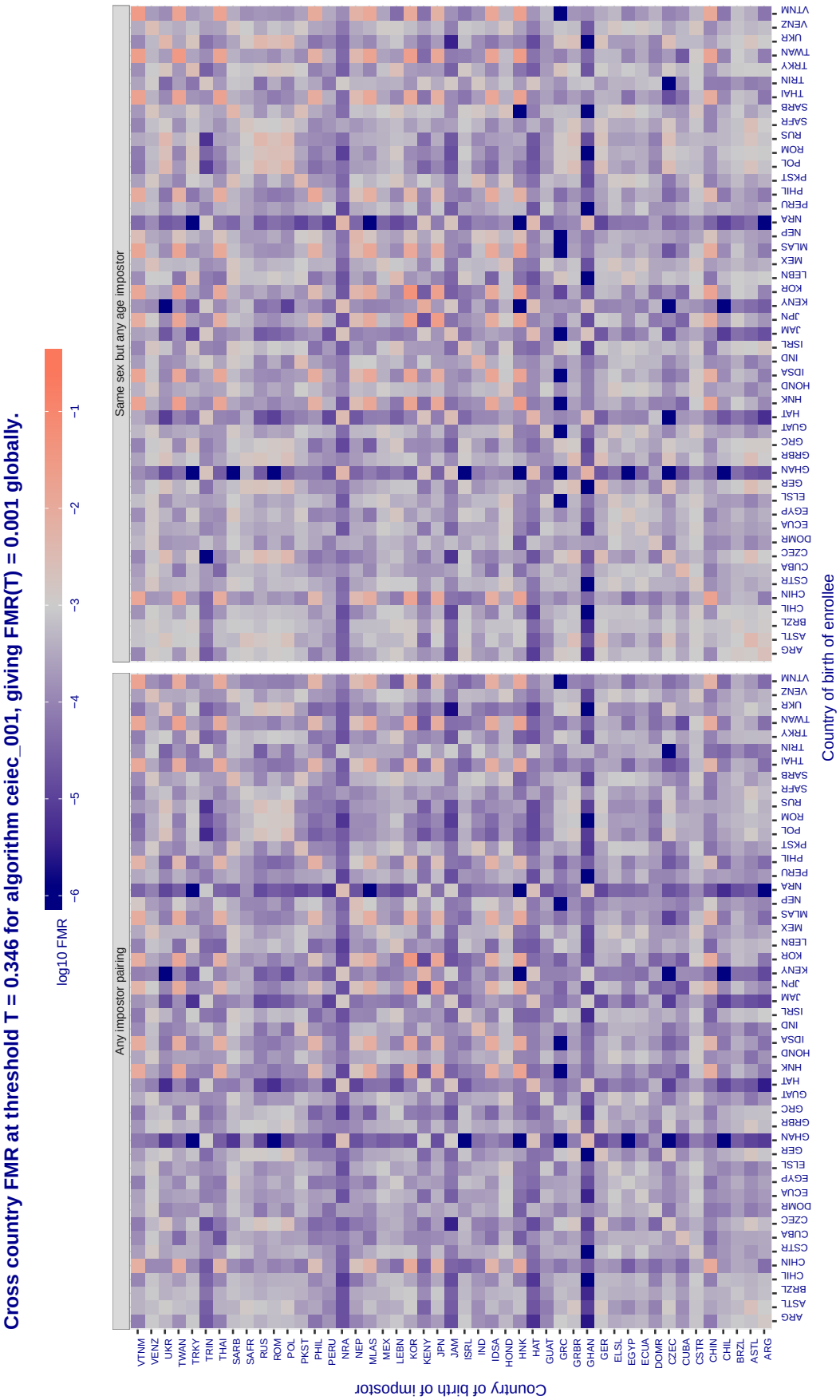


Figure 264: For algorithm ceiec-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

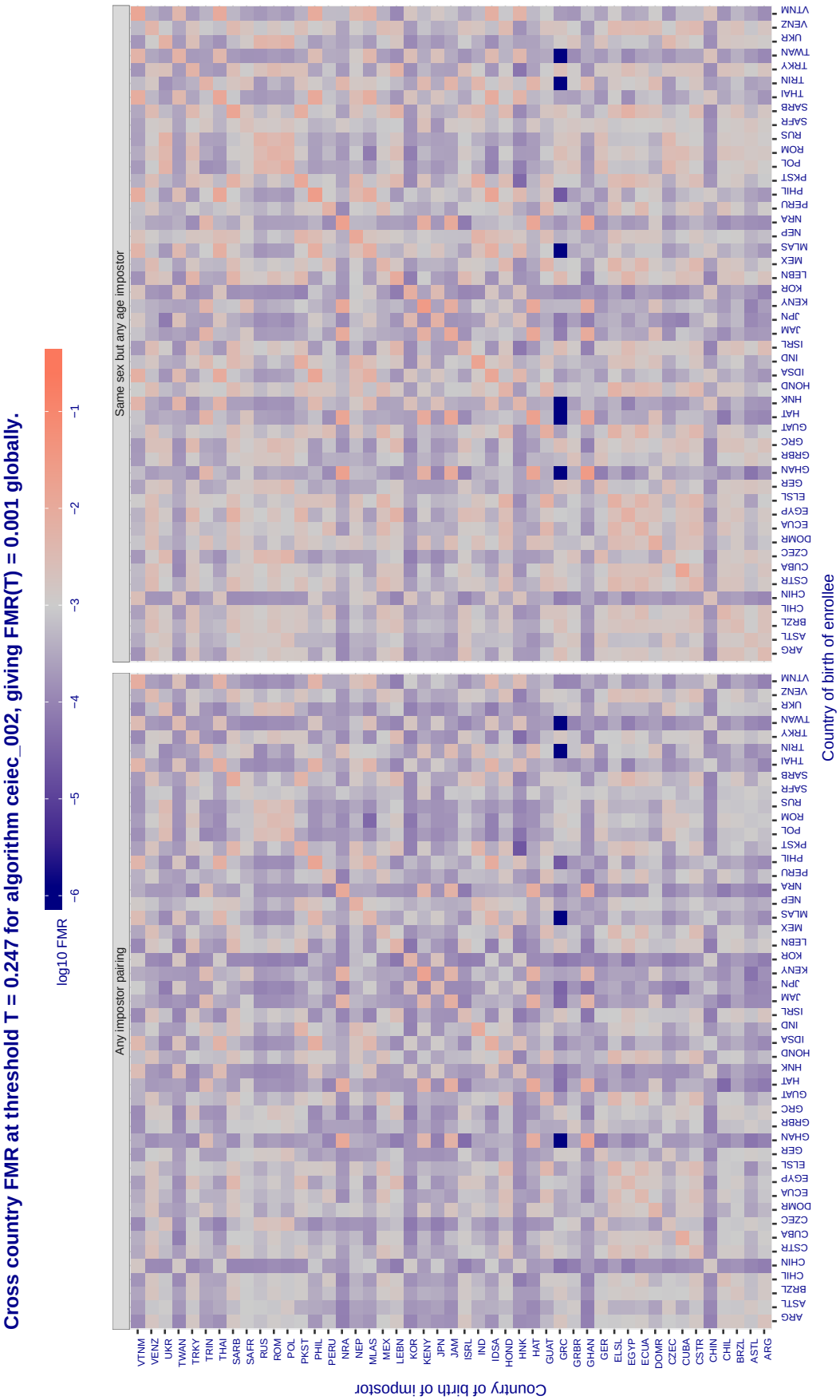


Figure 265: For algorithm ceiec-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

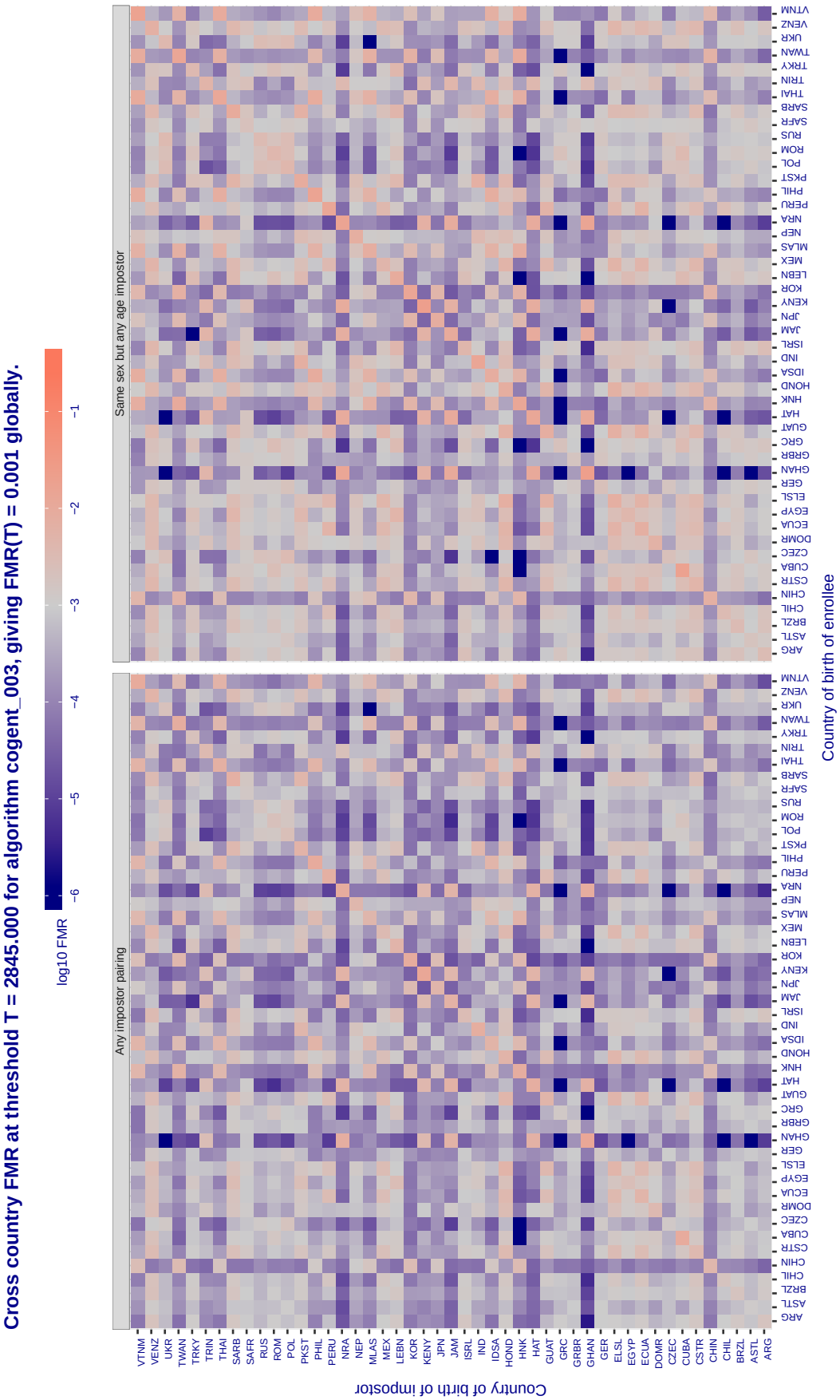


Figure 266: For algorithm cogent-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

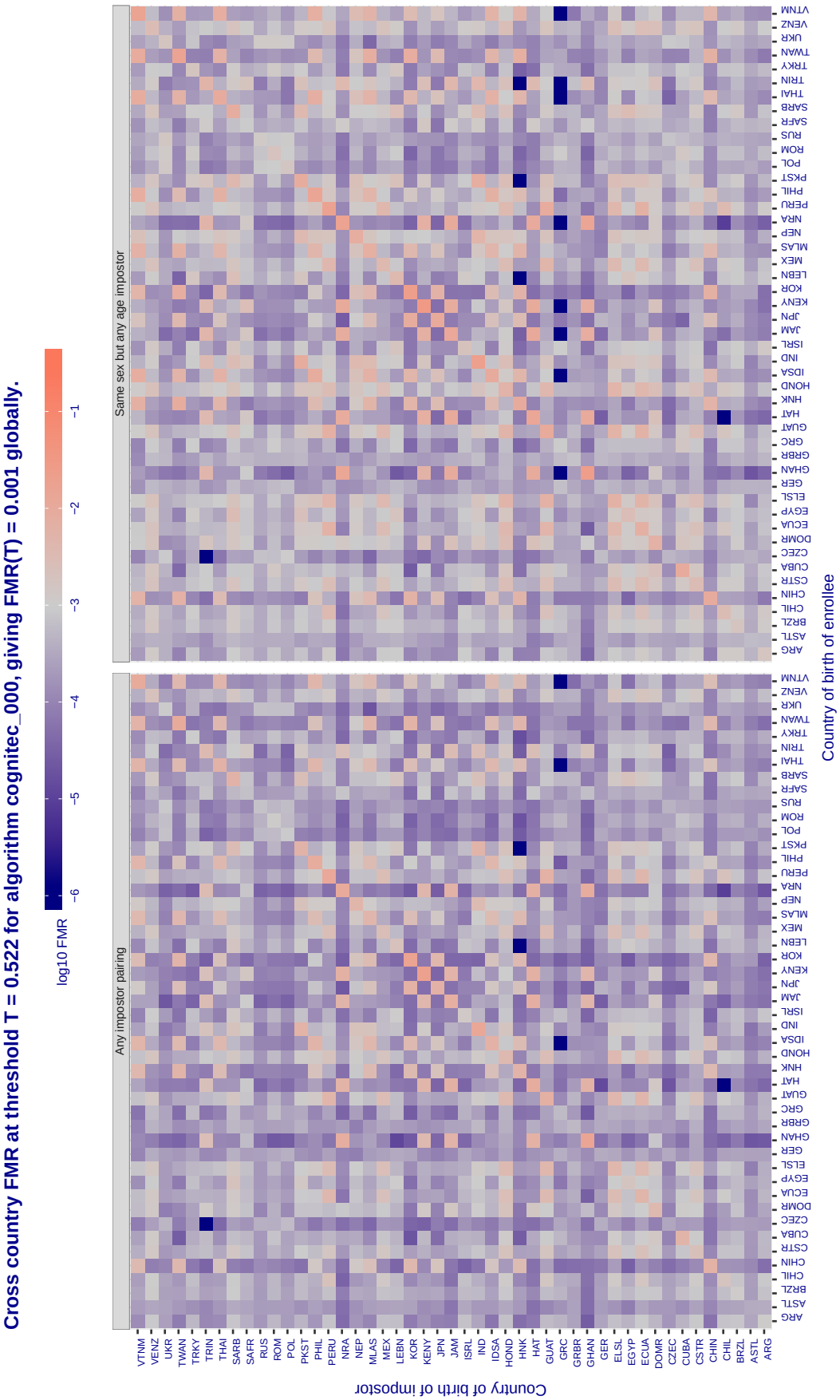


Figure 267: For algorithm cognitec-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

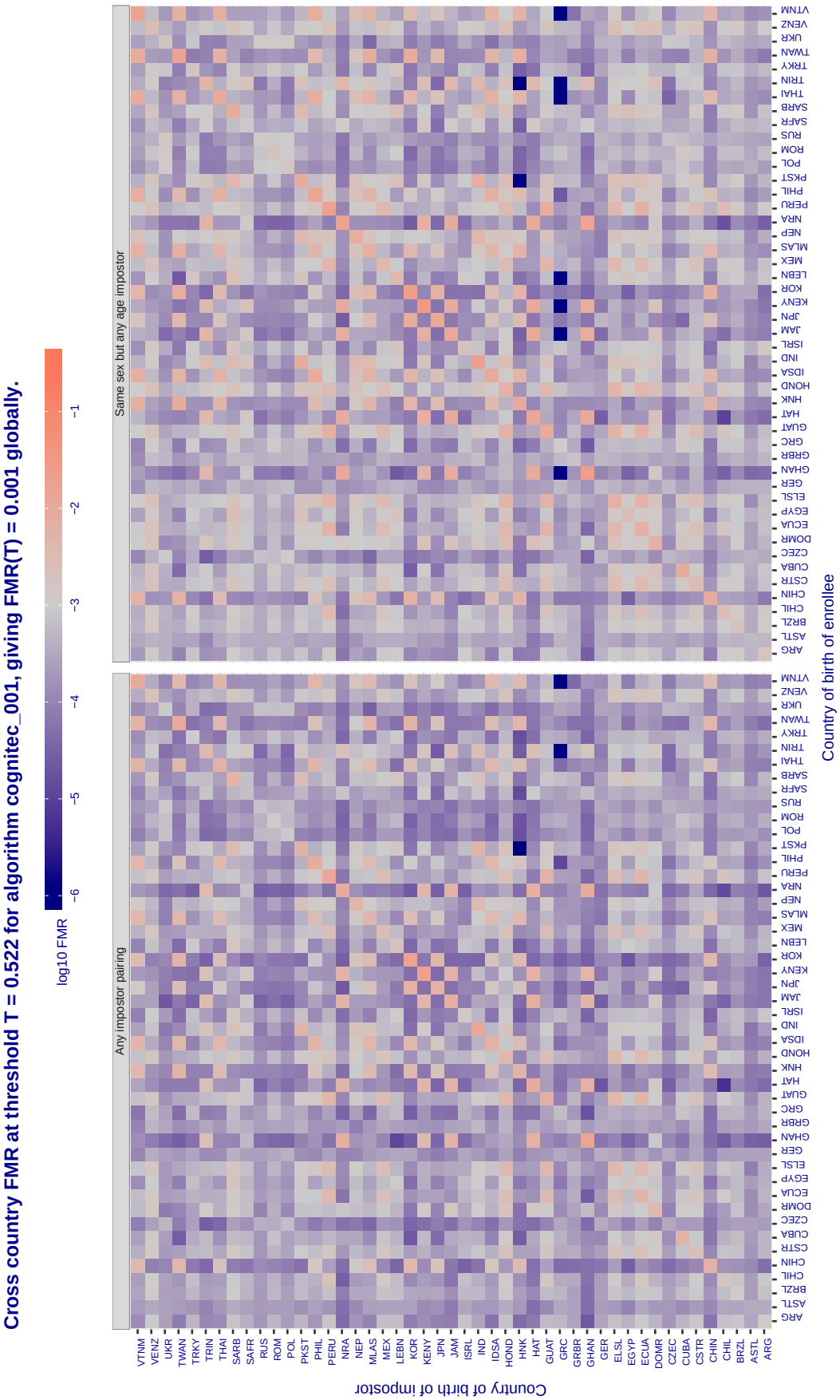


Figure 268: For algorithm cognitec-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

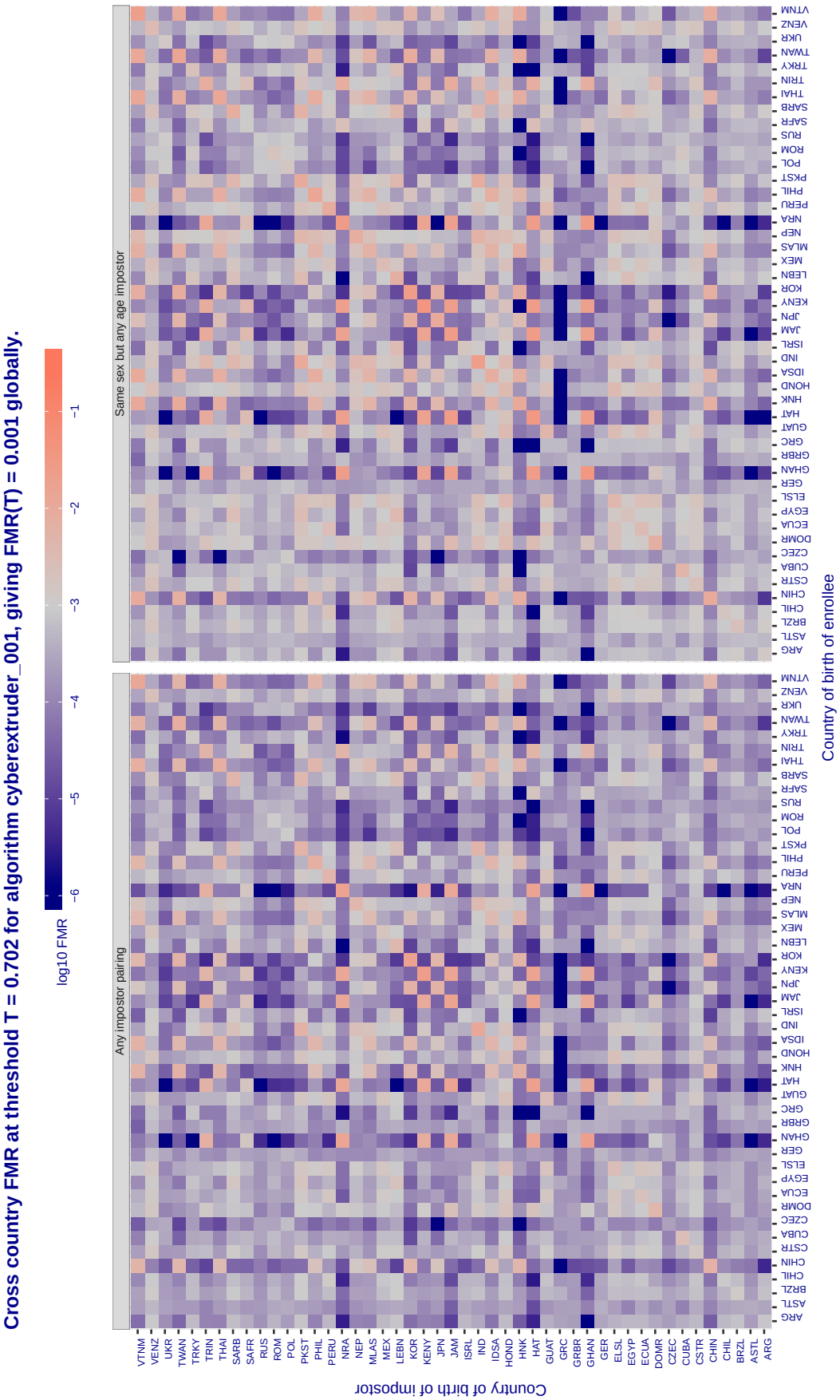


Figure 269: For algorithm cyberextruder-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

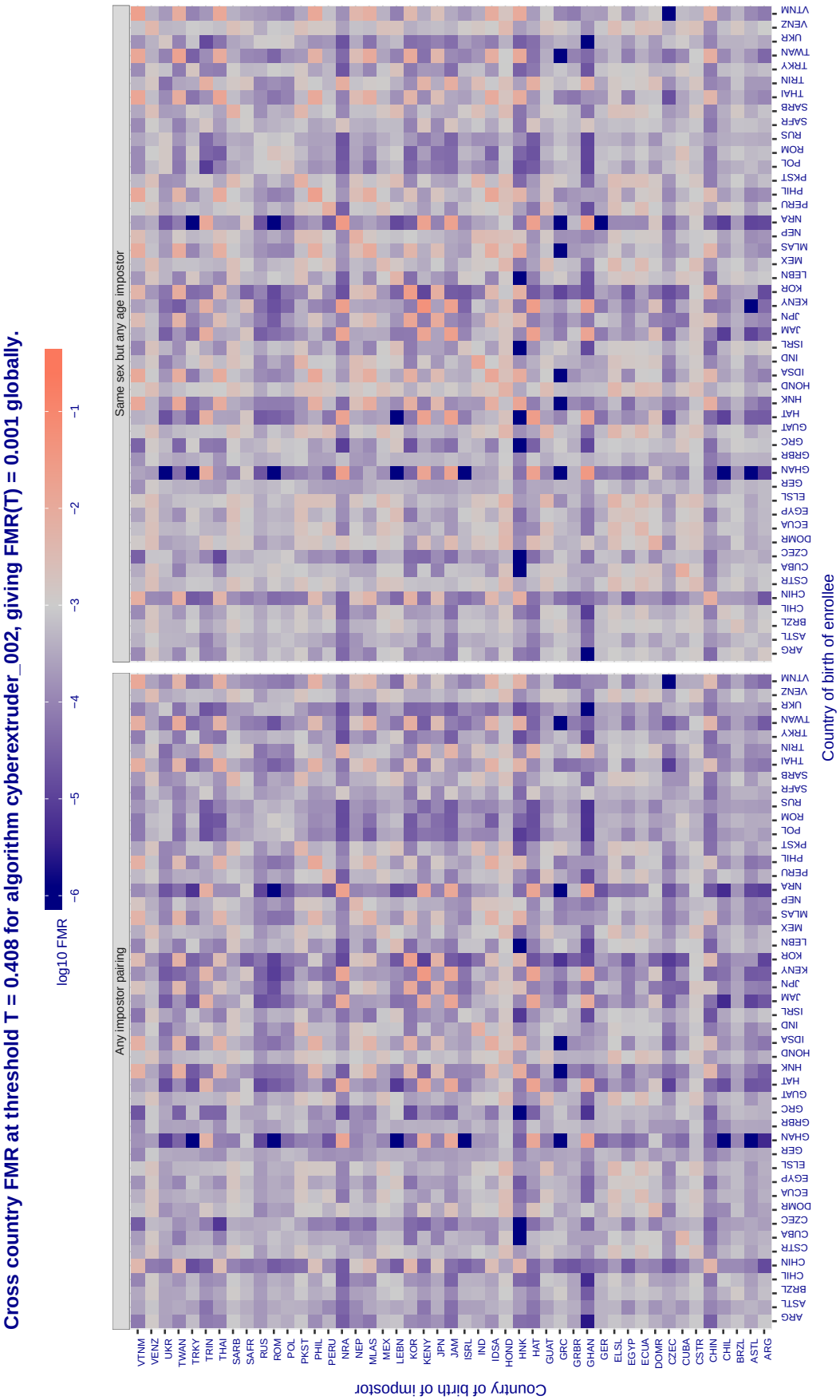


Figure 270: For algorithm cyberextruder-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

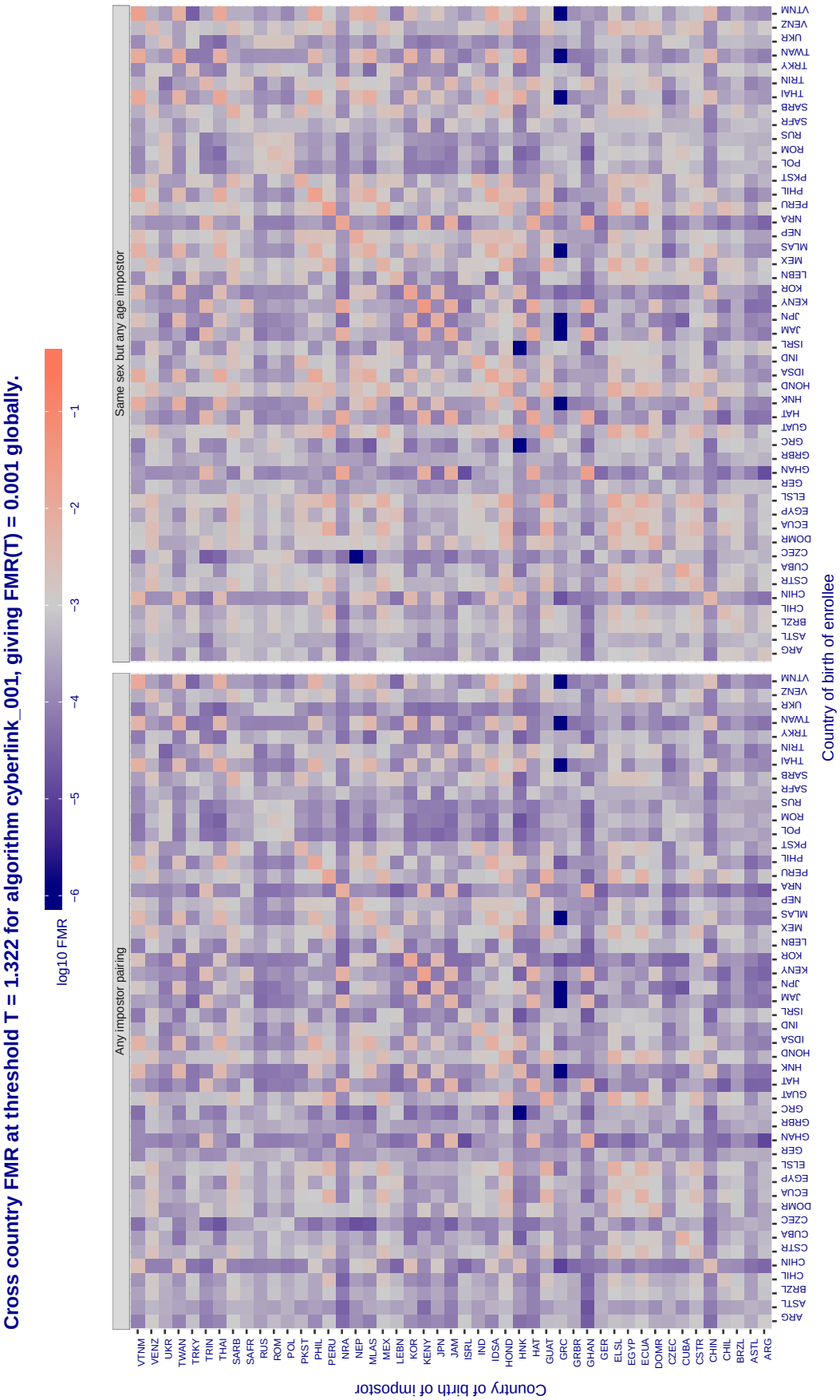


Figure 271: For algorithm cyberlink-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

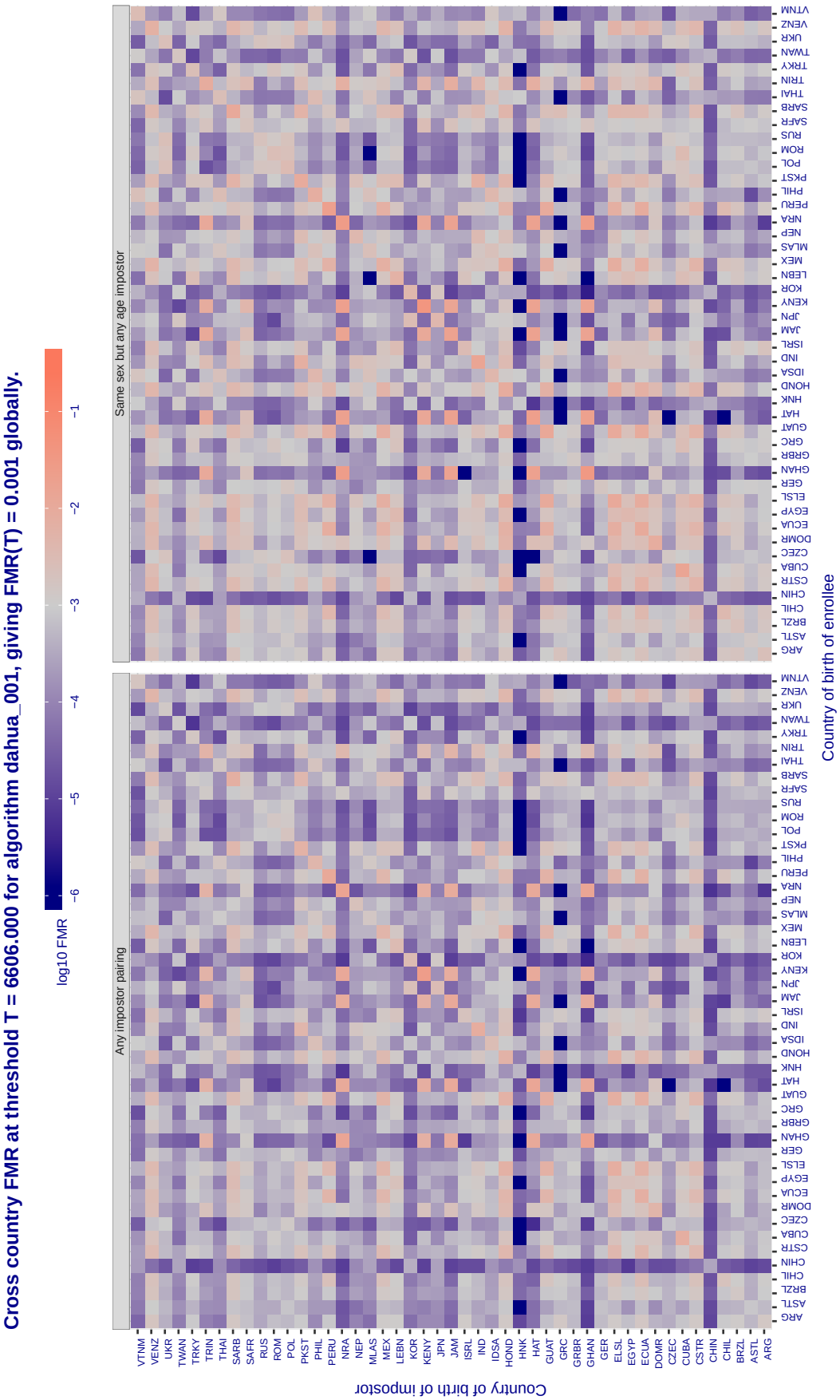


Figure 272: For algorithm dahua-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

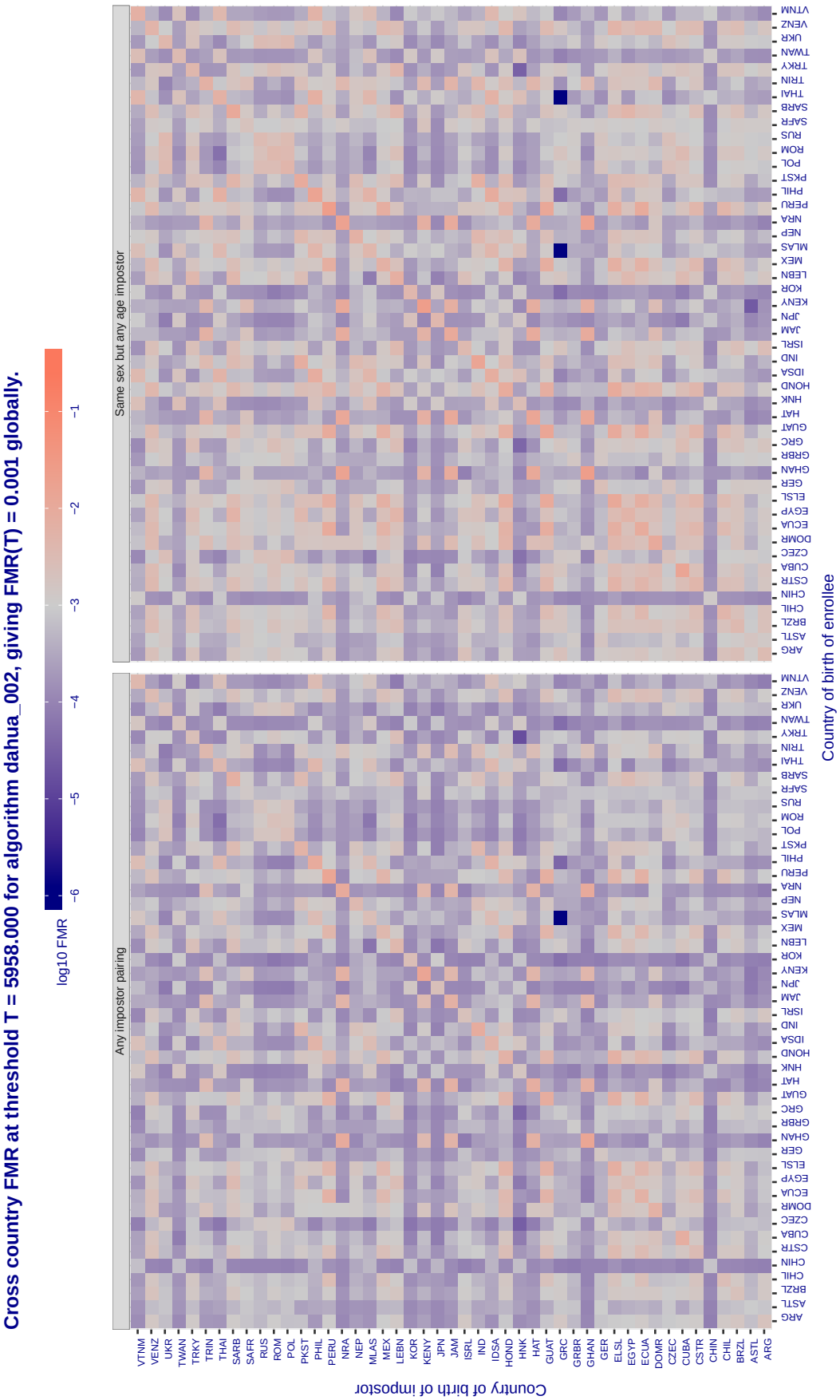


Figure 273: For algorithm dahua-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

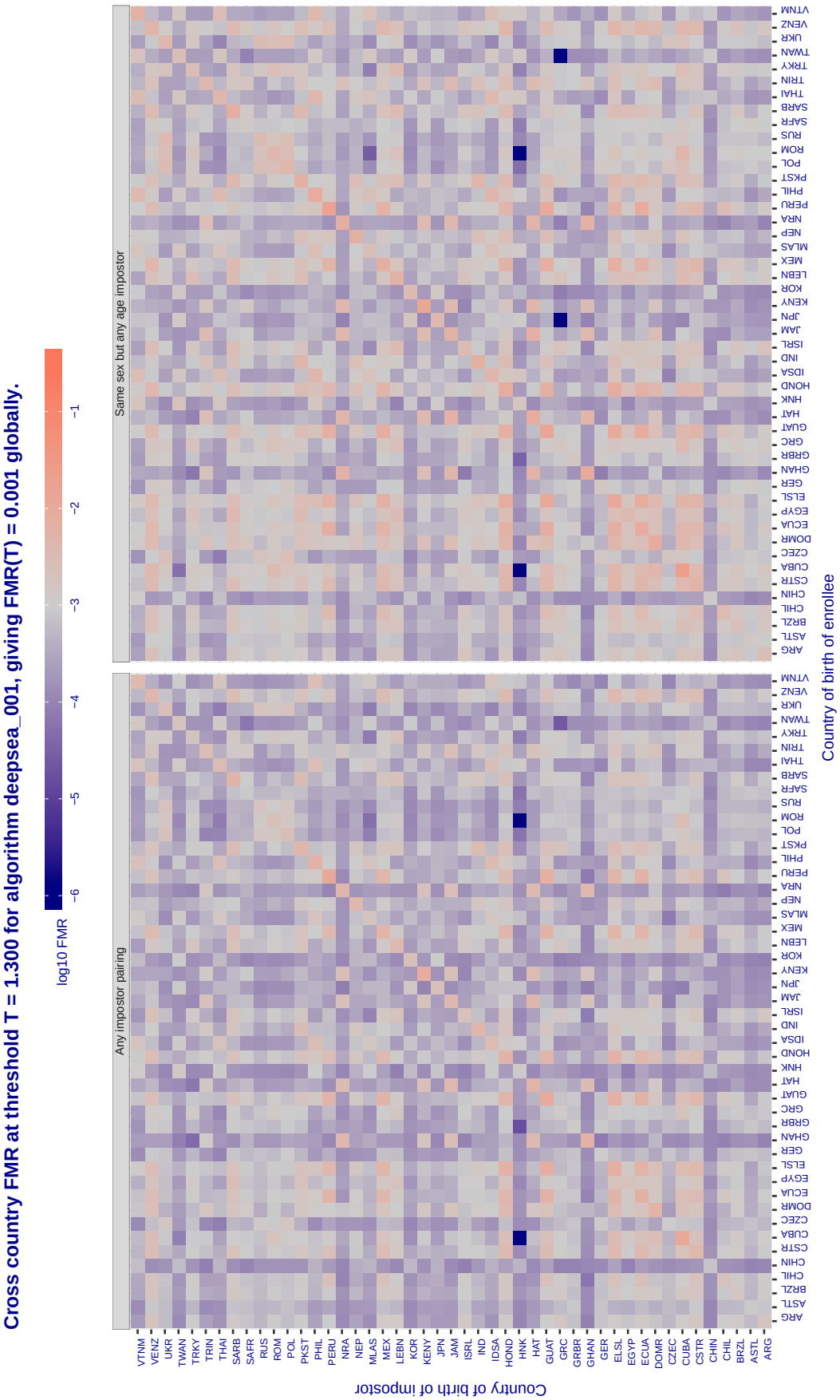


Figure 274: For algorithm deepsea-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

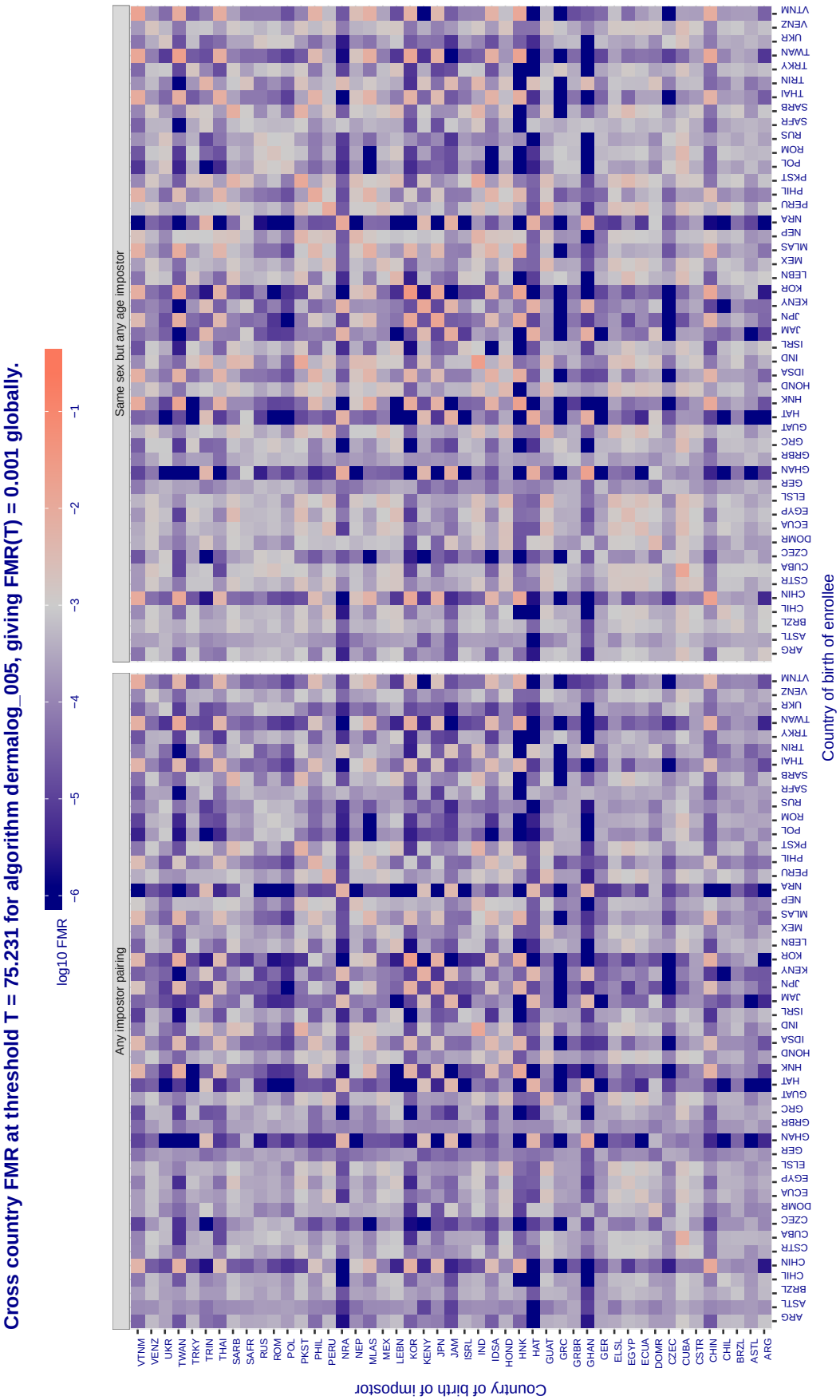


Figure 275: For algorithm dermalog-005 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

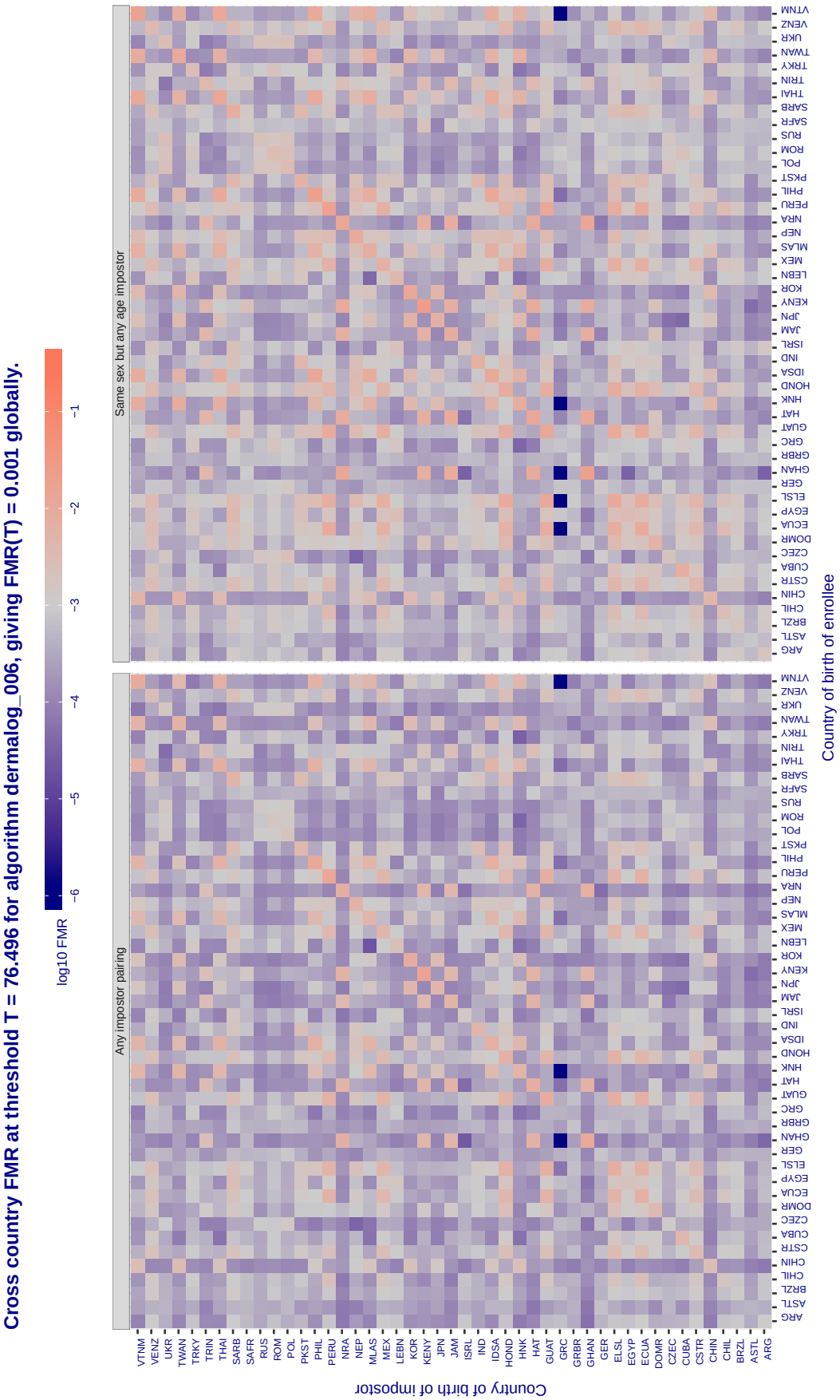


Figure 276: For algorithm dermalog-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

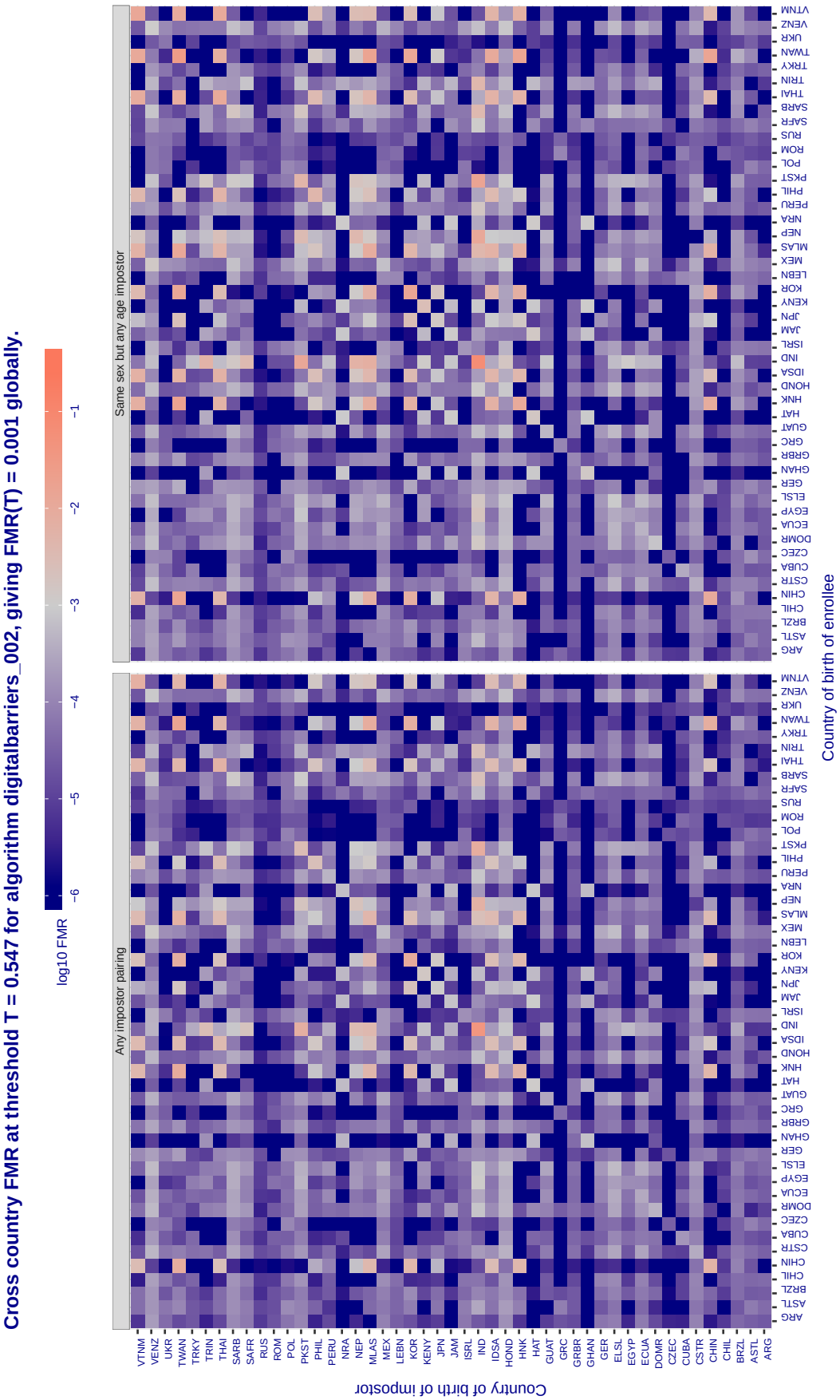


Figure 277: For algorithm digitalbarriers-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

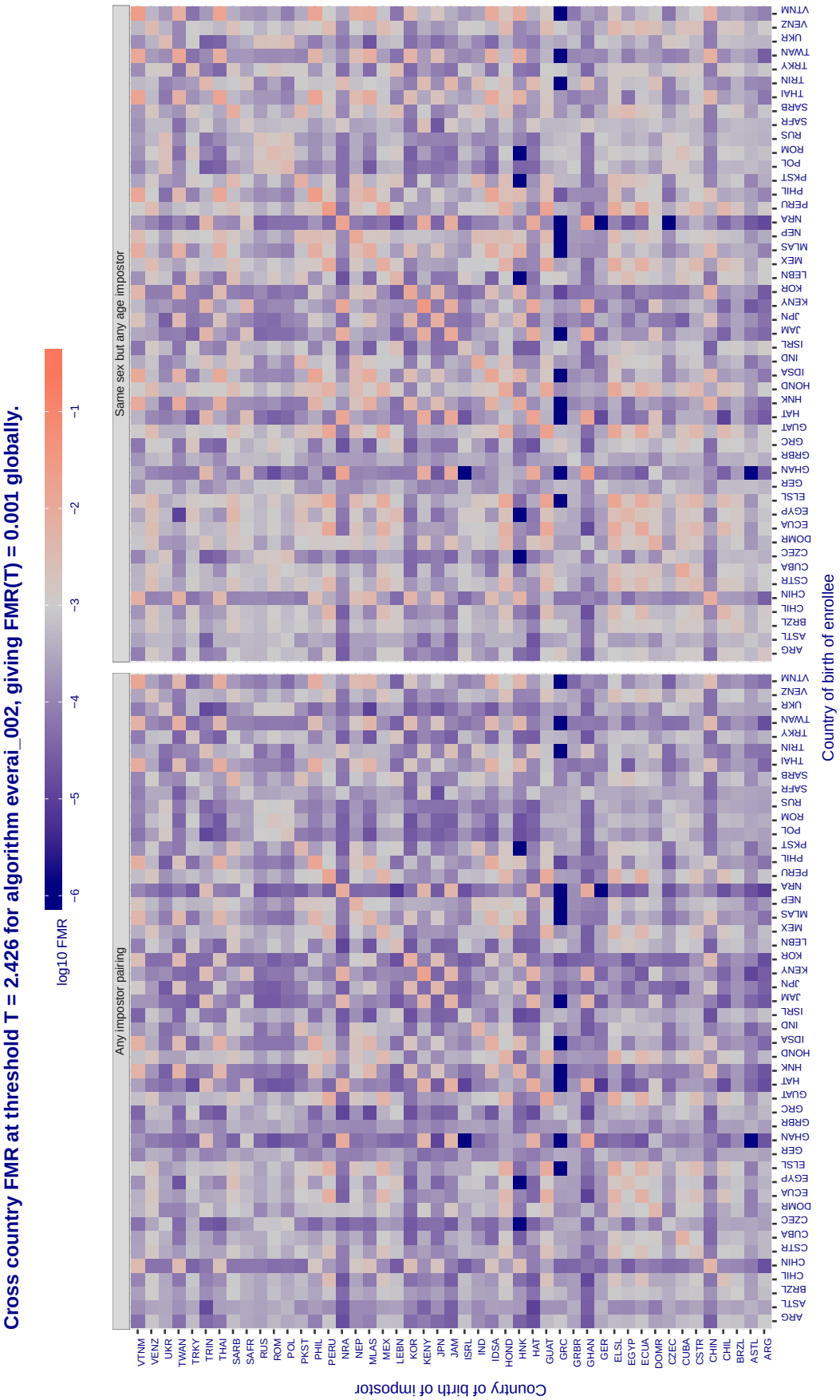


Figure 278: For algorithm everai-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

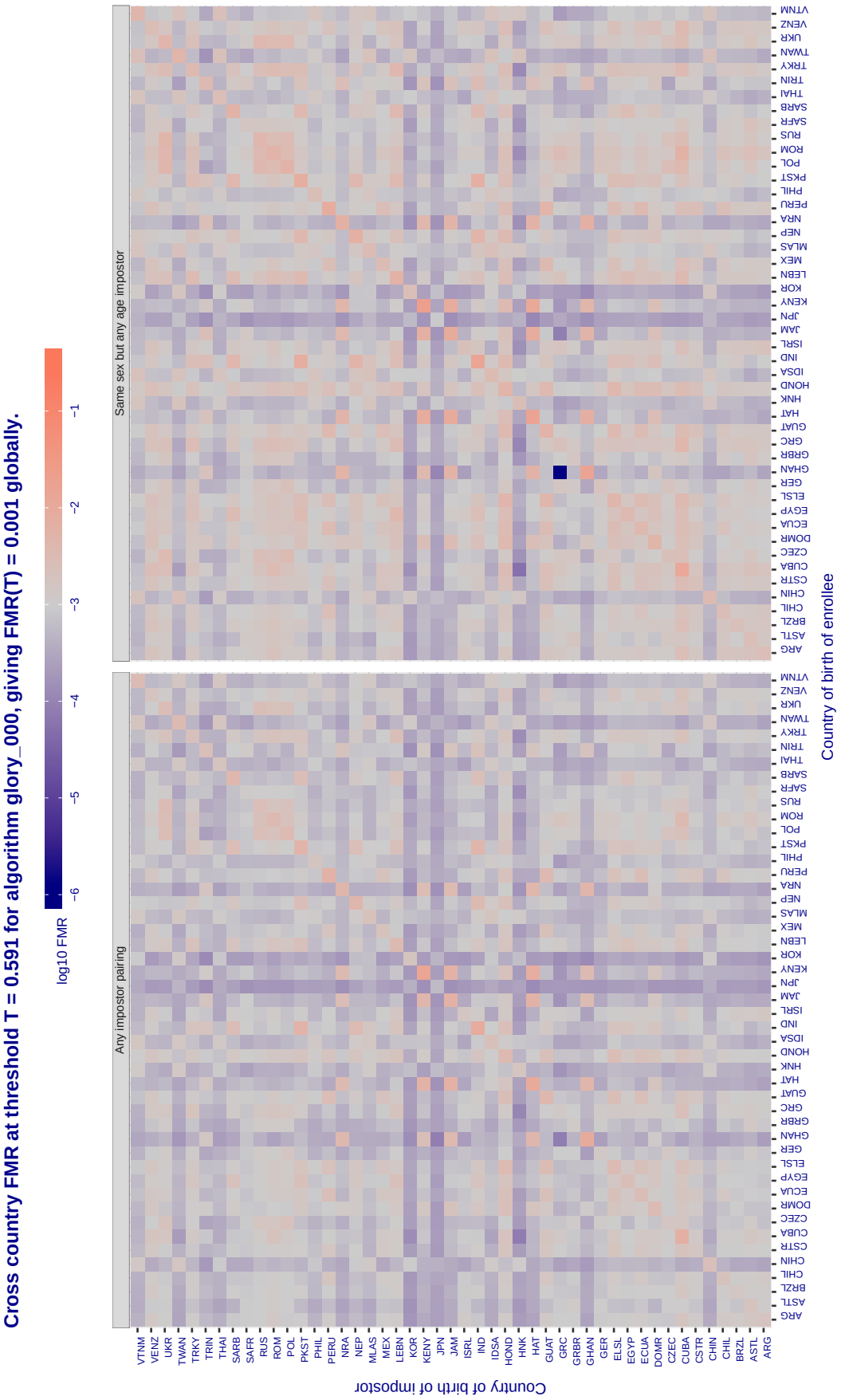


Figure 279: For algorithm glory-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

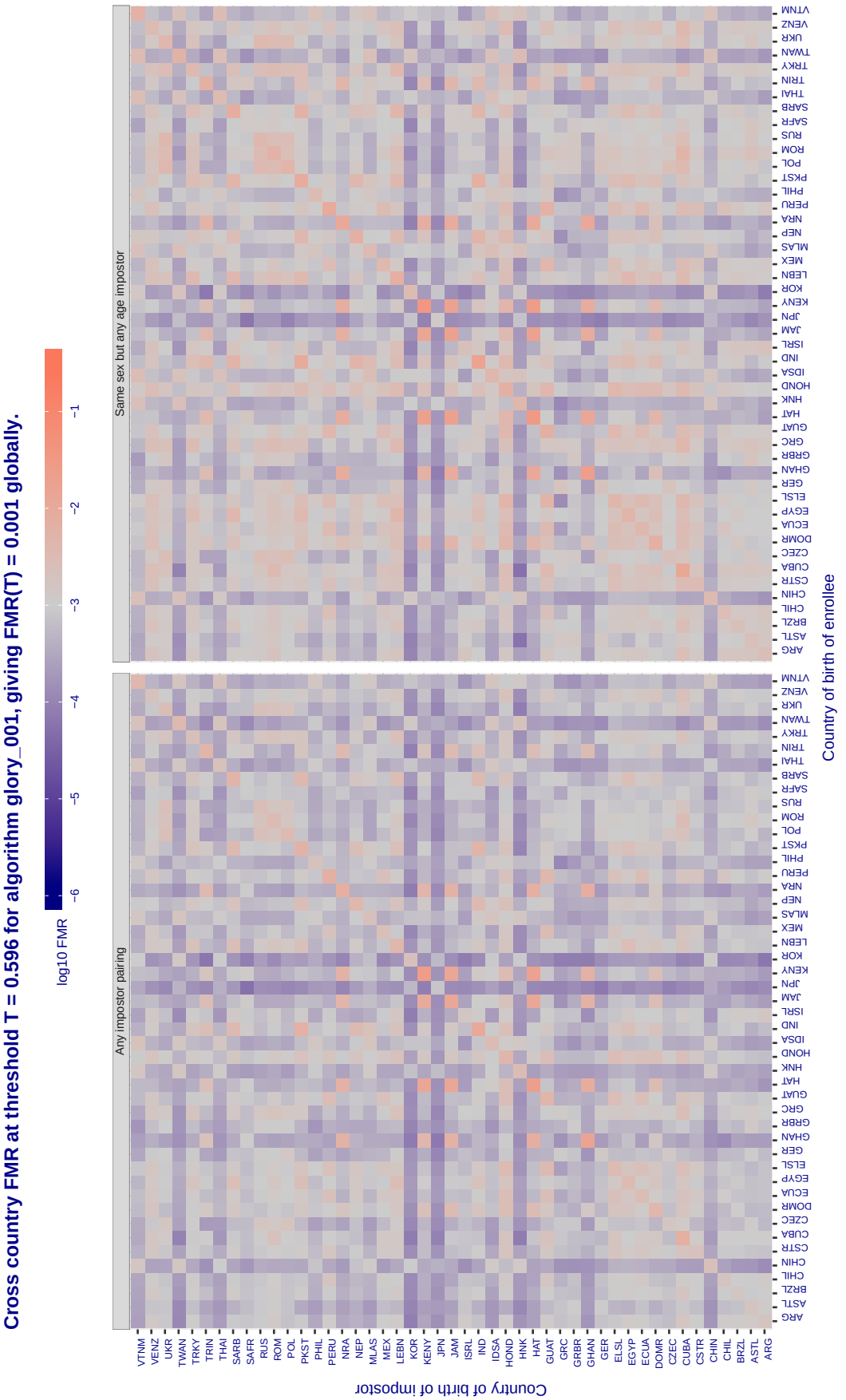


Figure 280: For algorithm glory-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

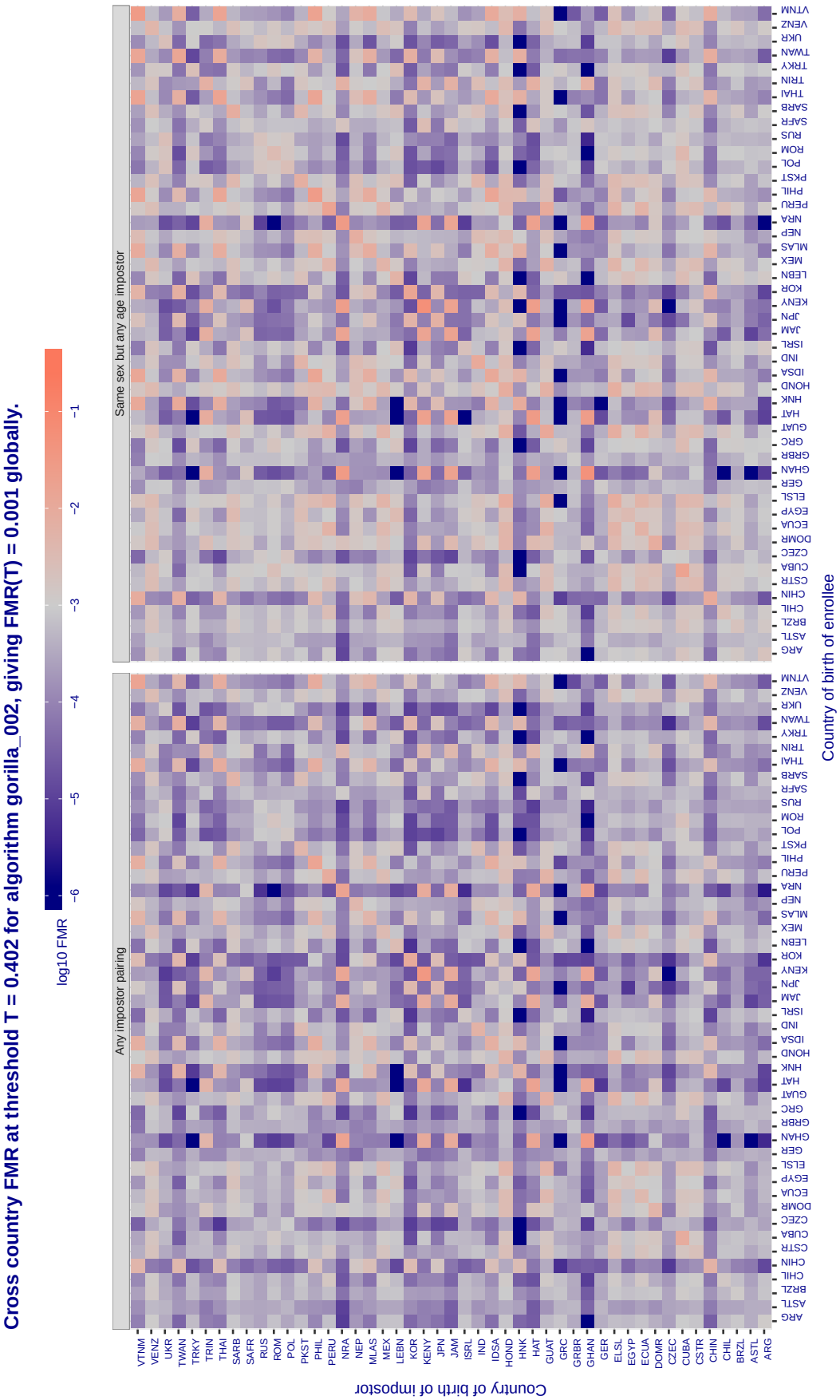


Figure 281: For algorithm gorilla-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

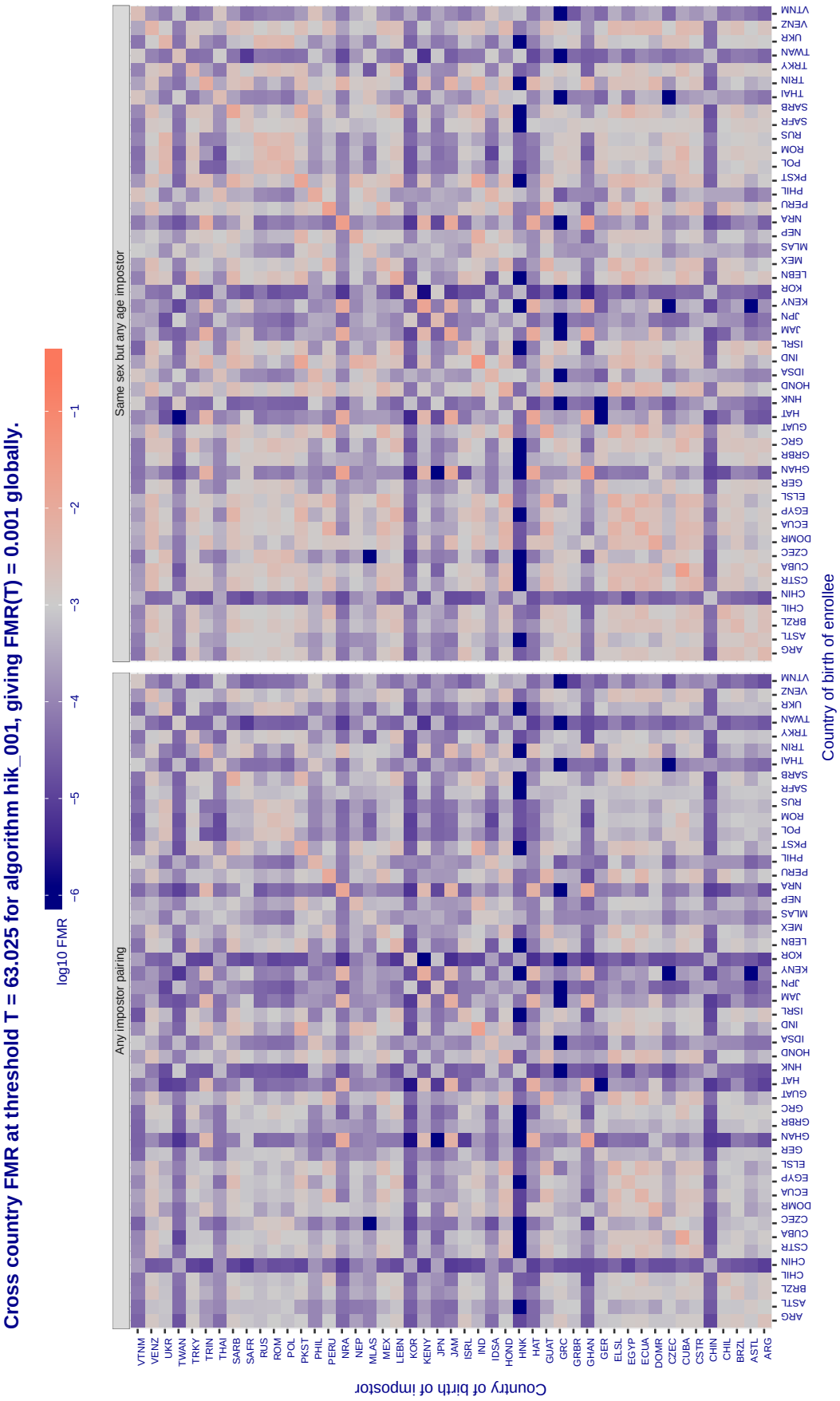


Figure 282: For algorithm hik-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

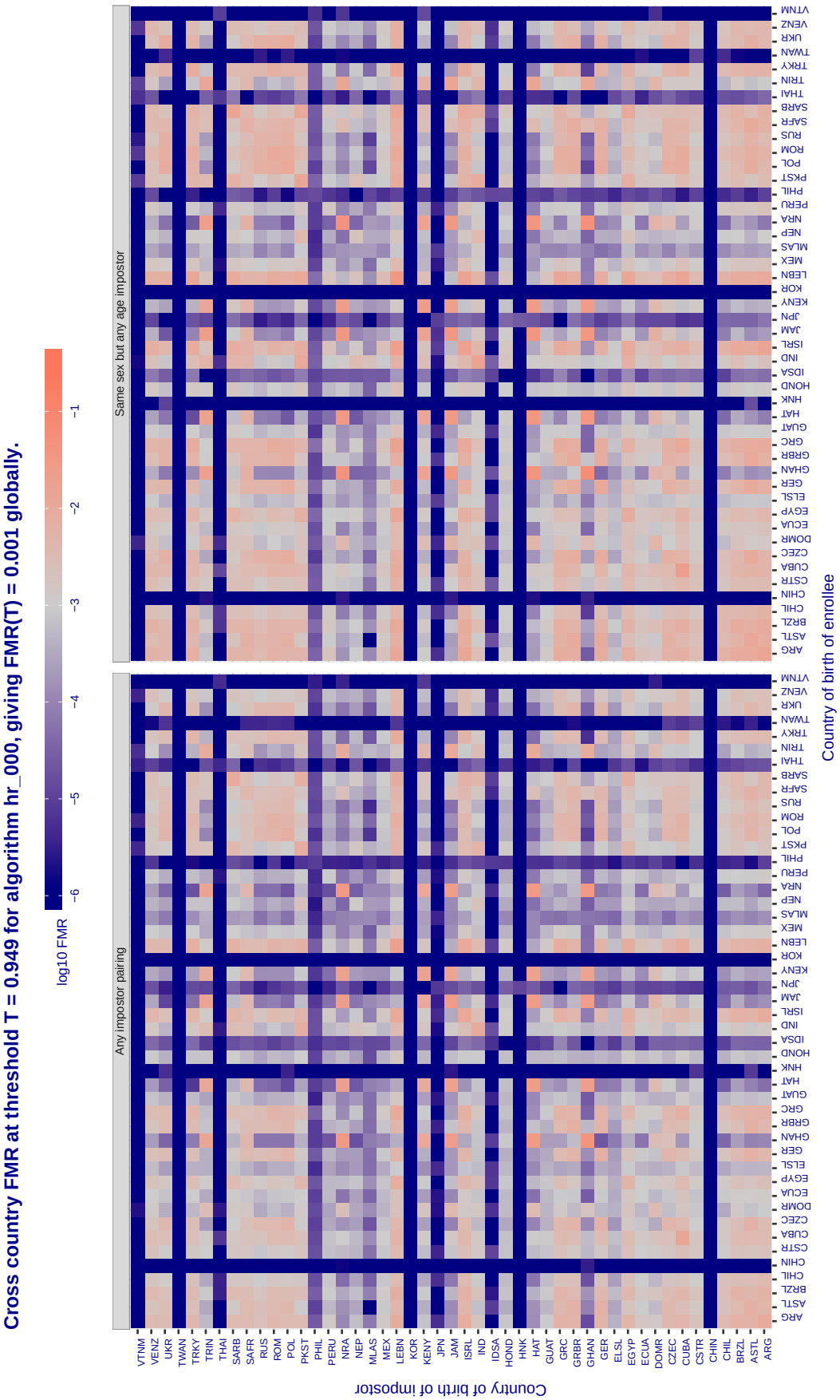


Figure 283: For algorithm hr-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

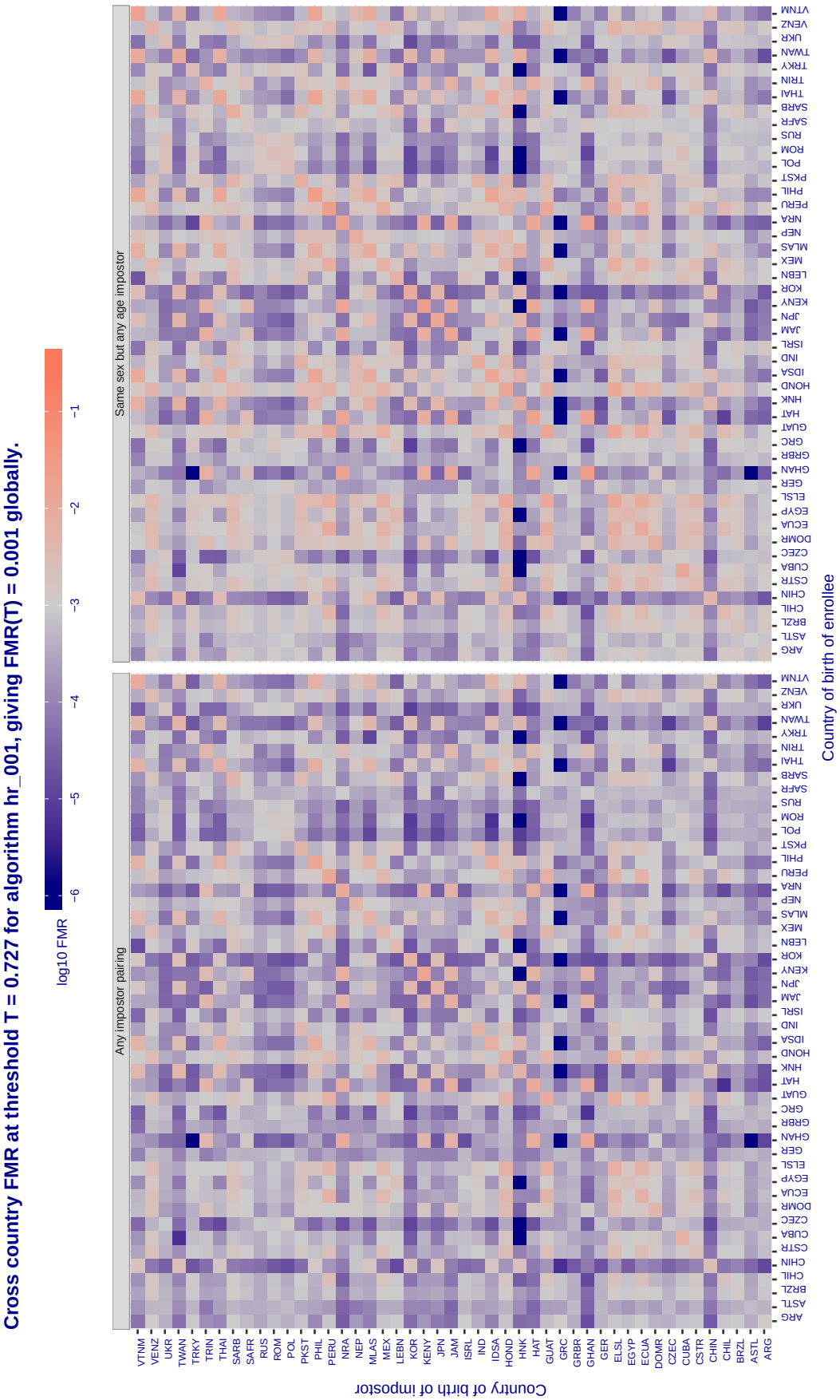


Figure 284: For algorithm hr-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

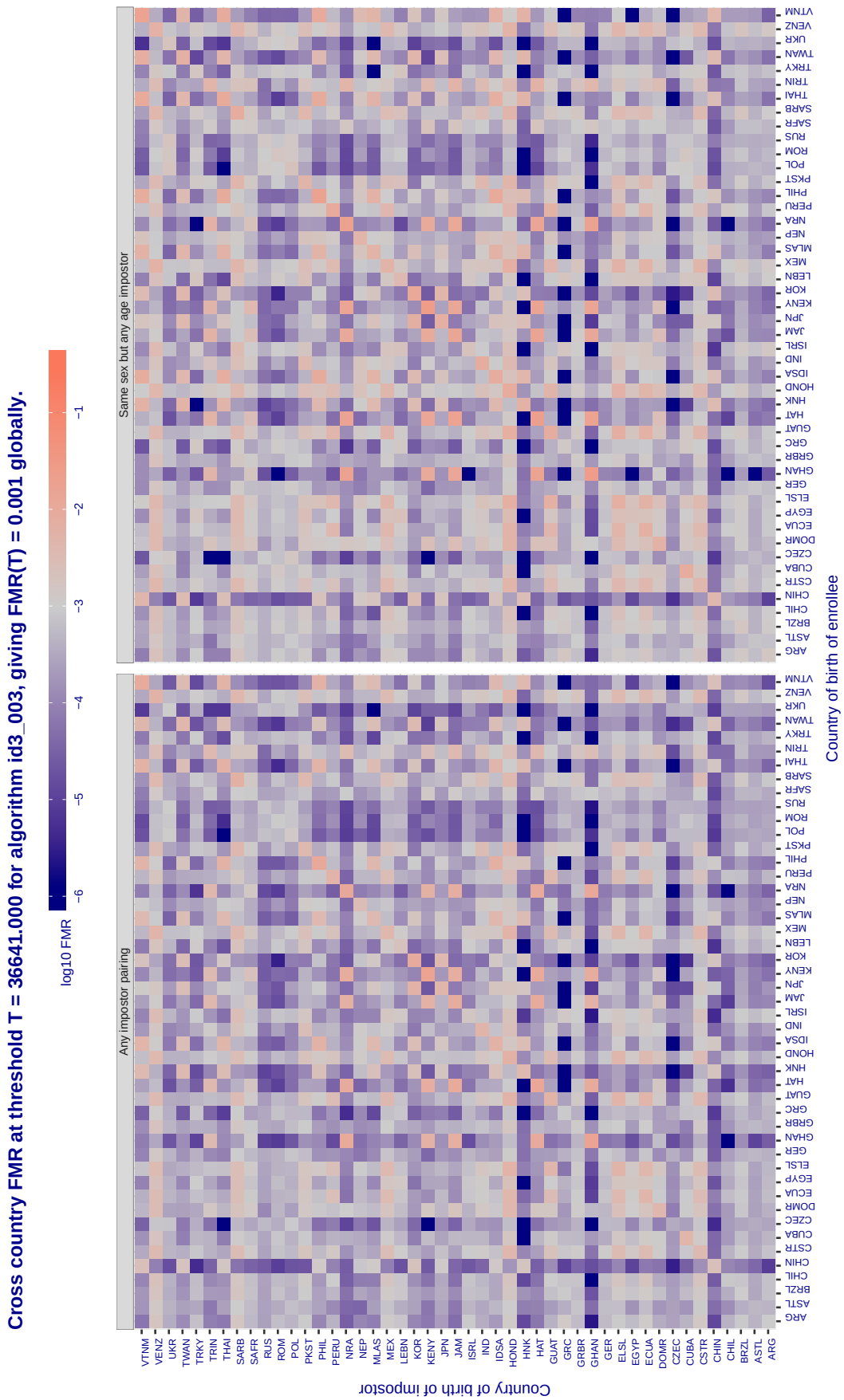


Figure 285: For algorithm id3-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

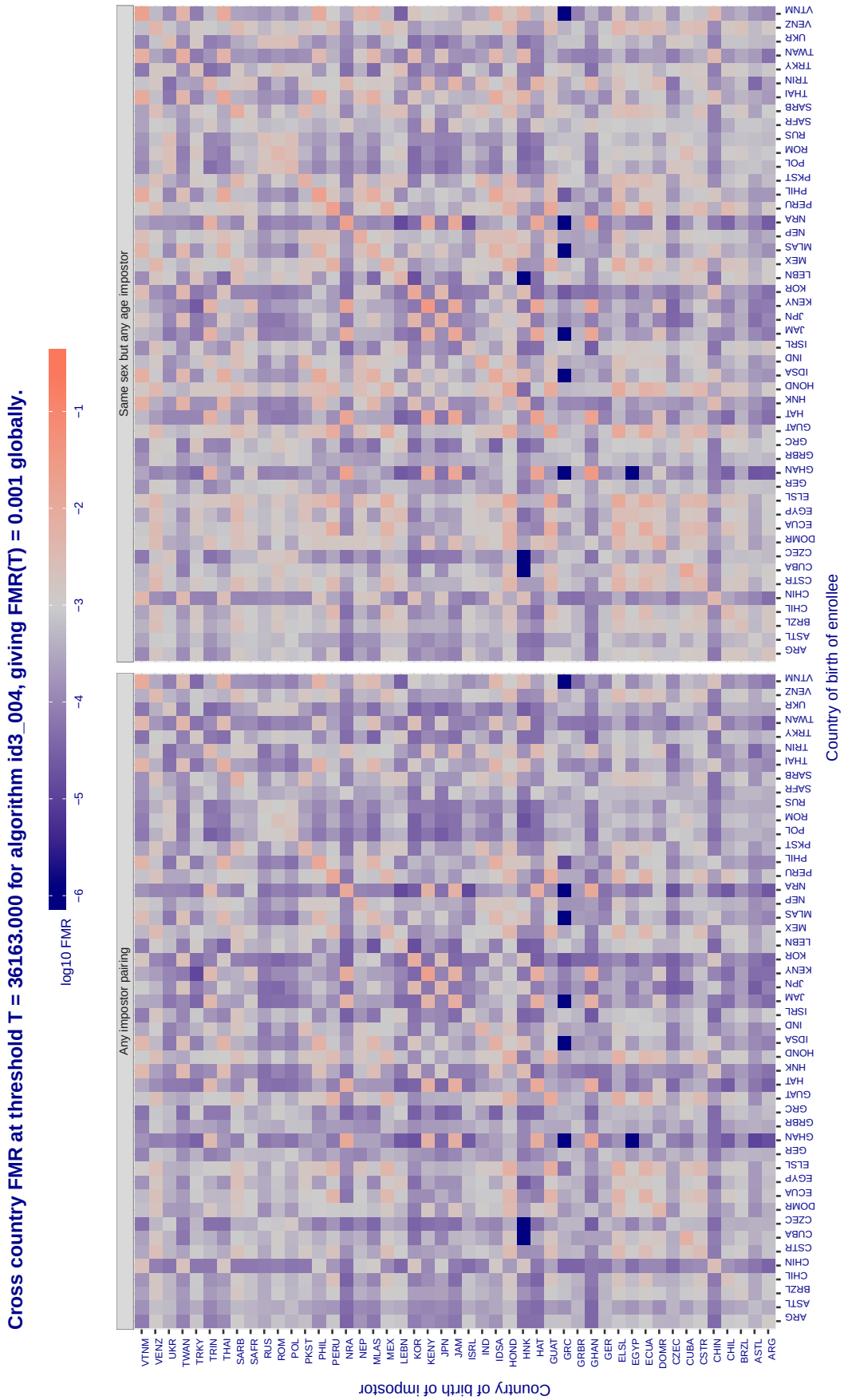


Figure 286: For algorithm id3-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

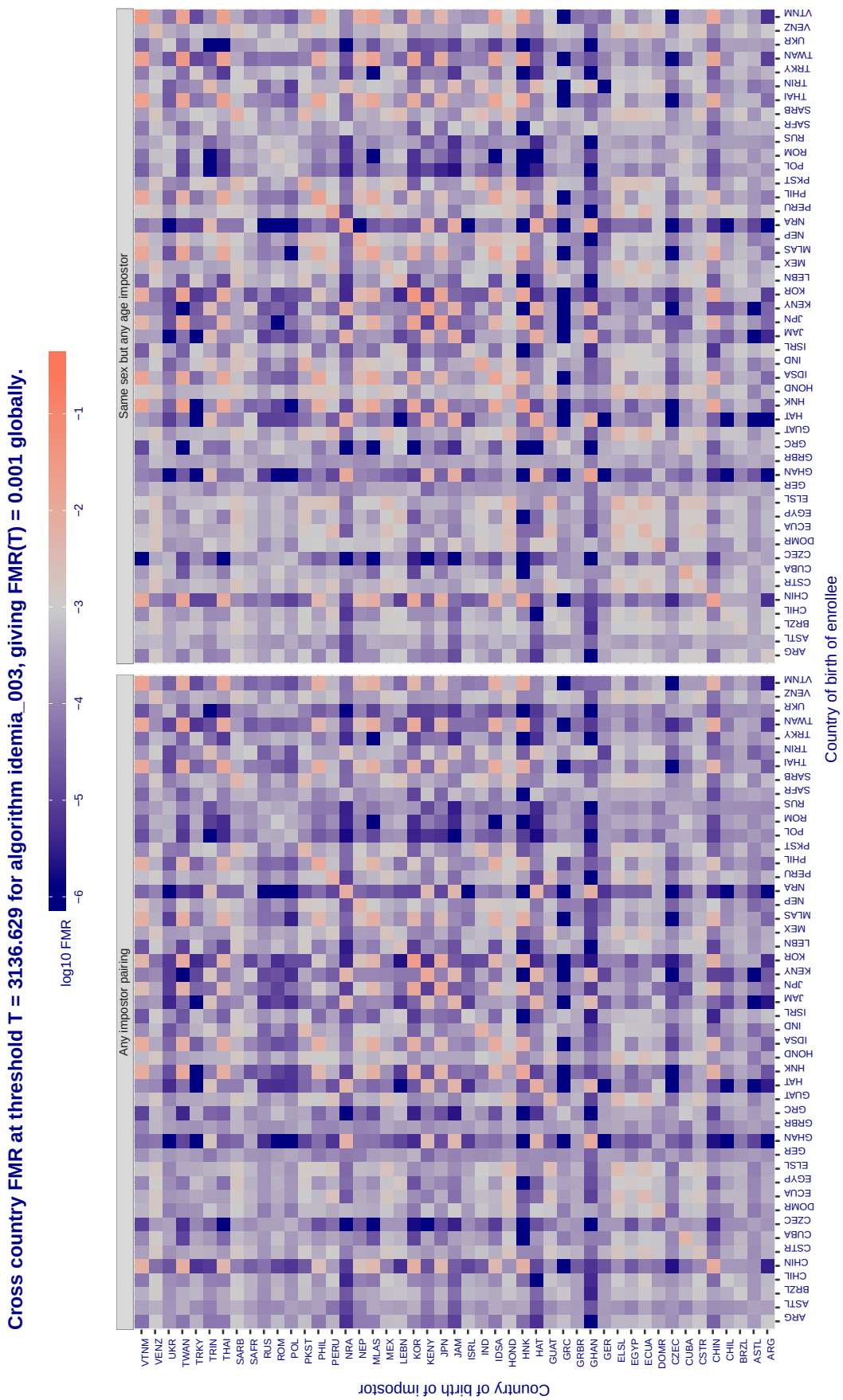


Figure 287: For algorithm idemia-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

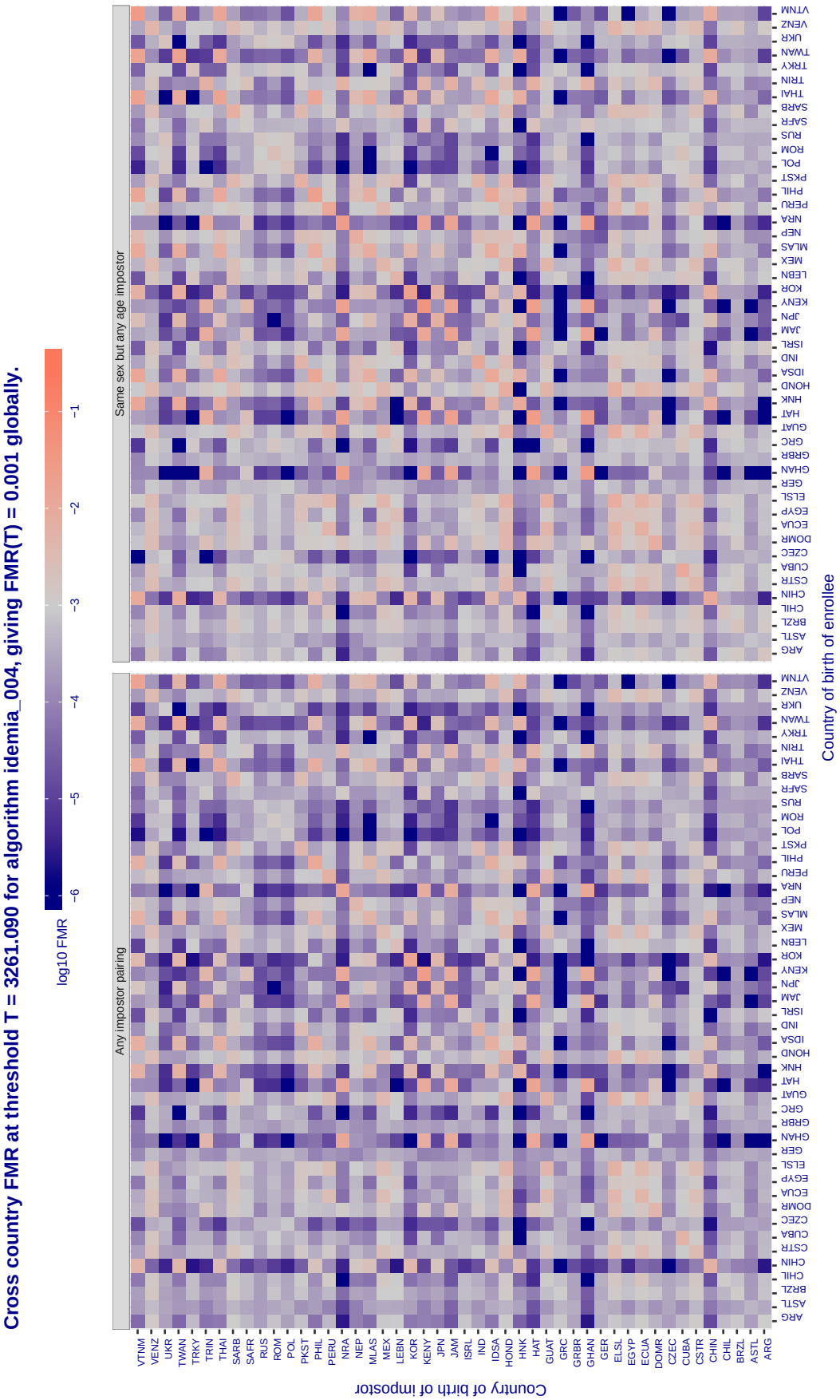


Figure 288: For algorithm idemia-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

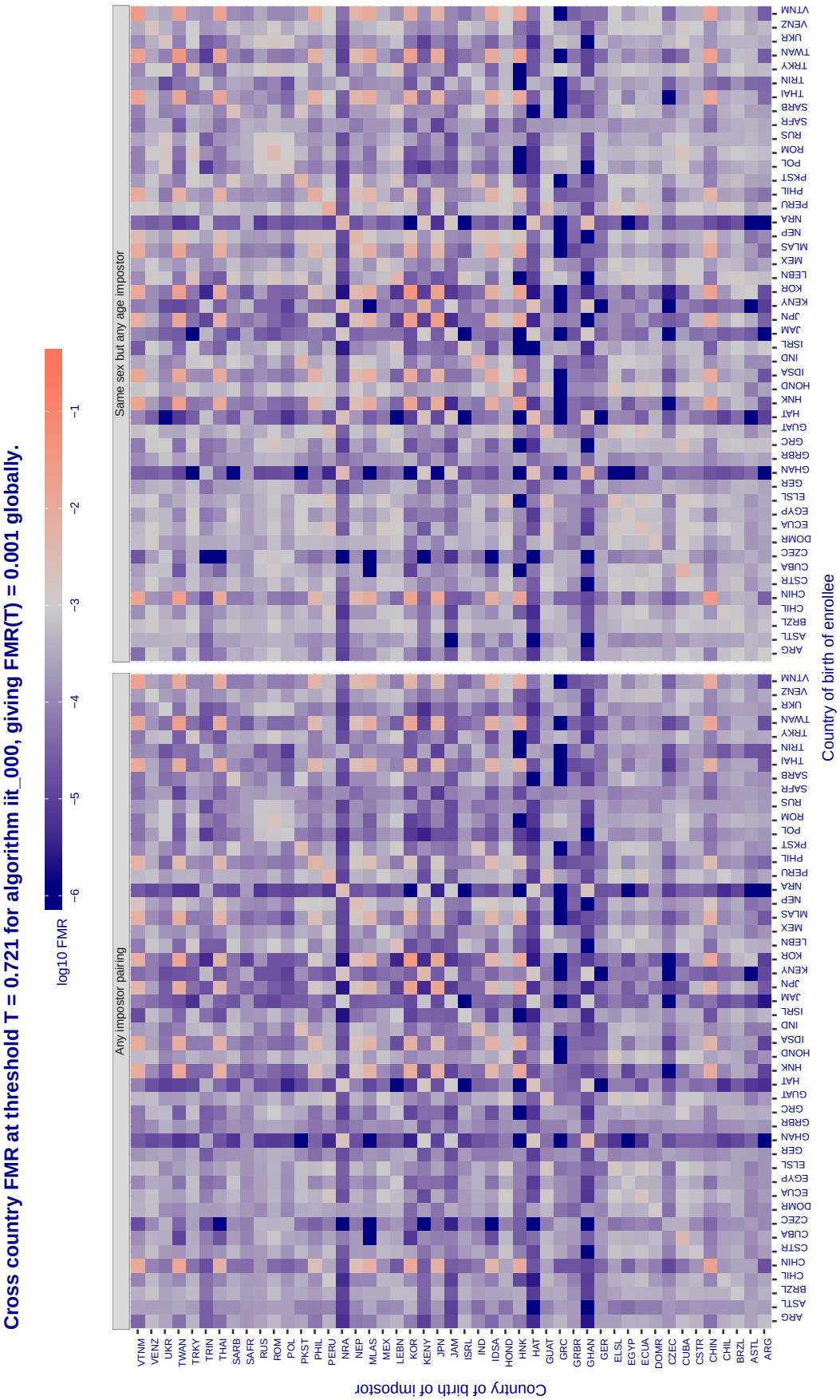


Figure 289: For algorithm iit-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

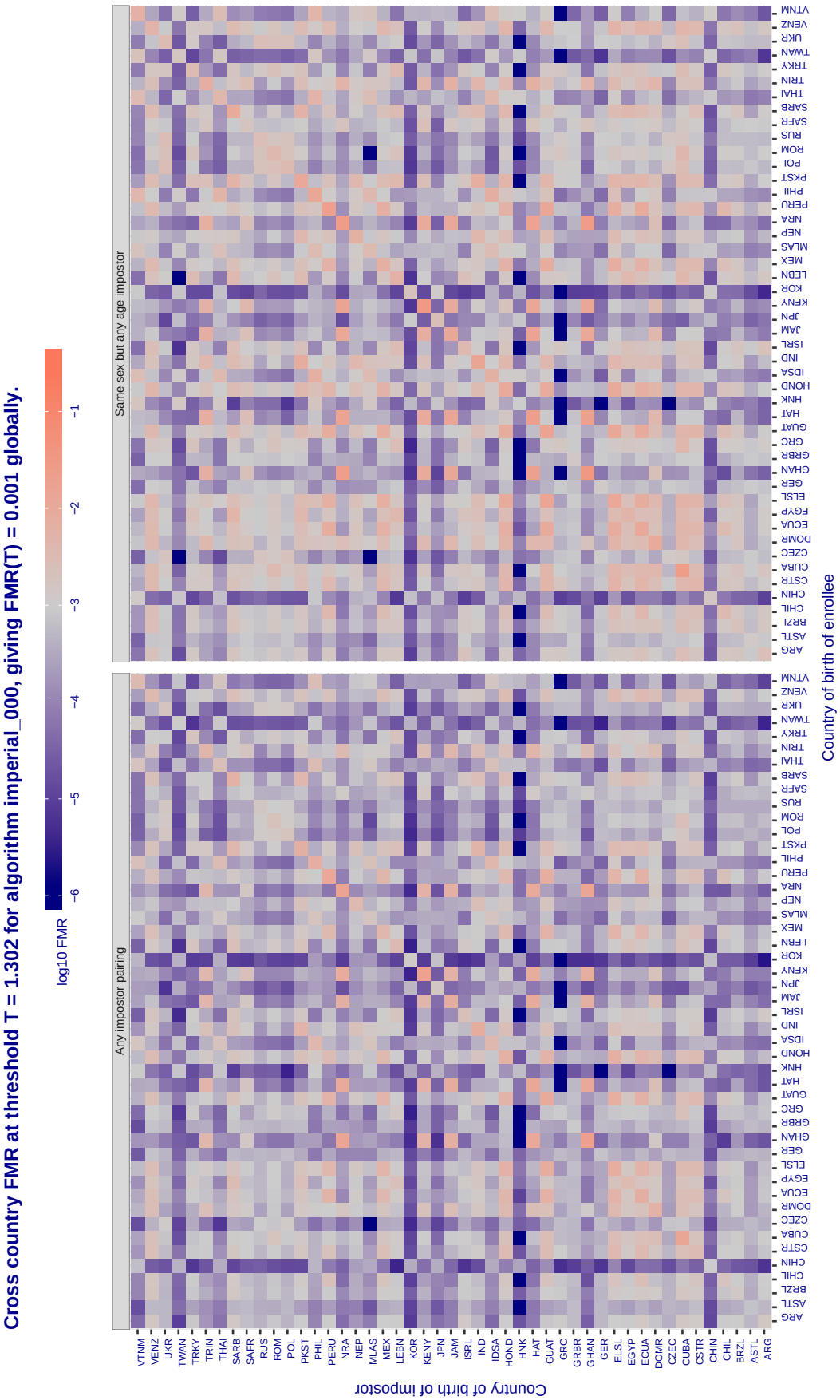


Figure 290: For algorithm imperial-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

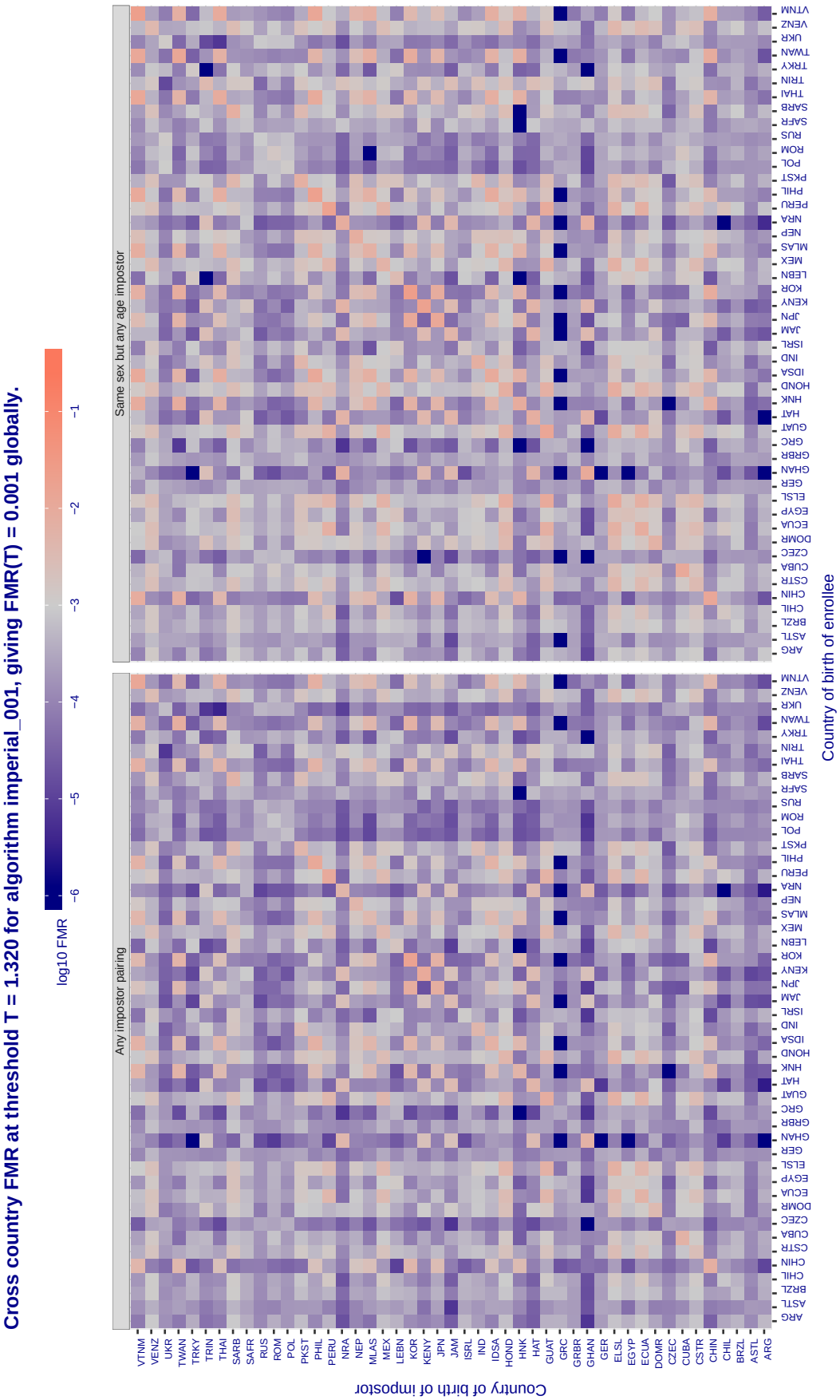


Figure 291: For algorithm imperial-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

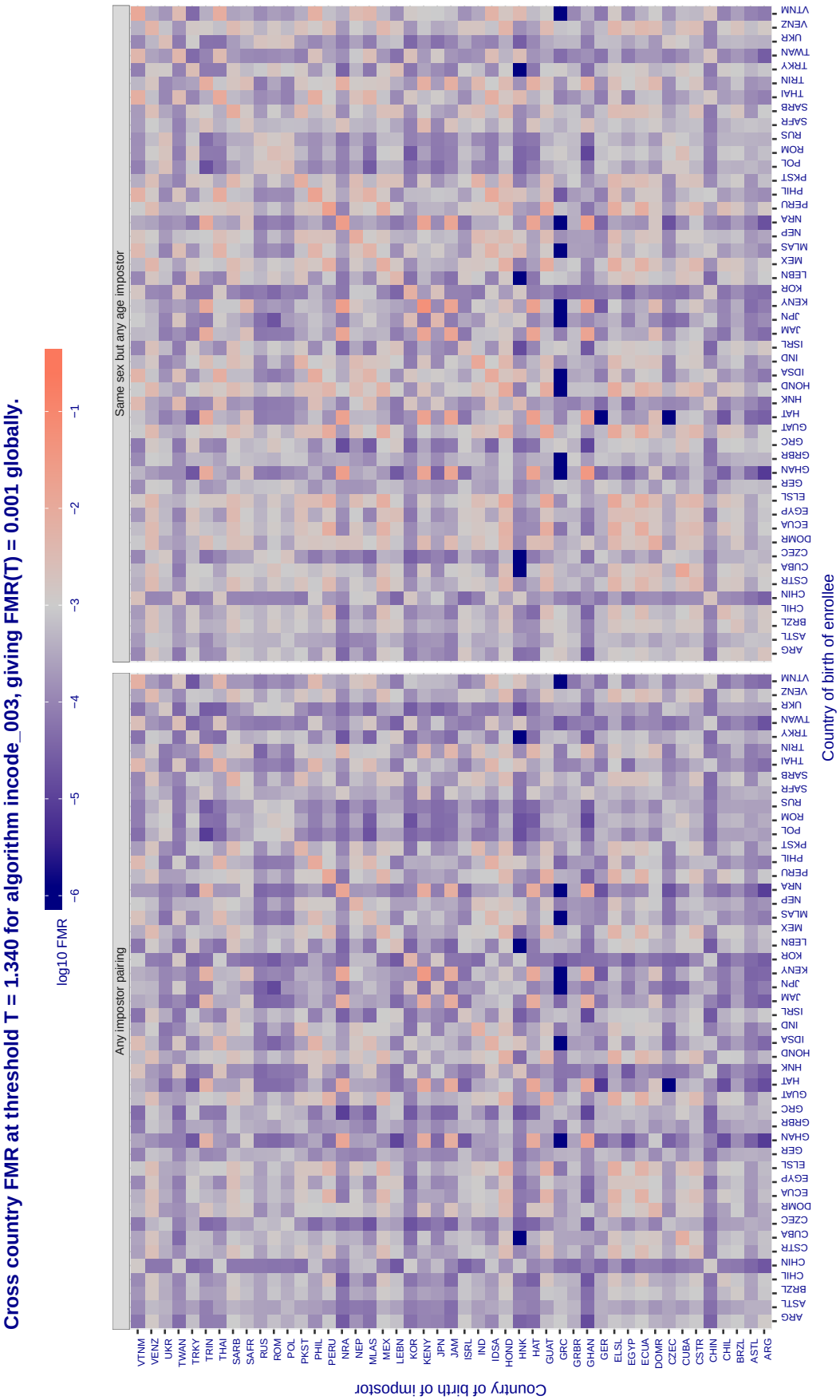


Figure 292: For algorithm incode-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

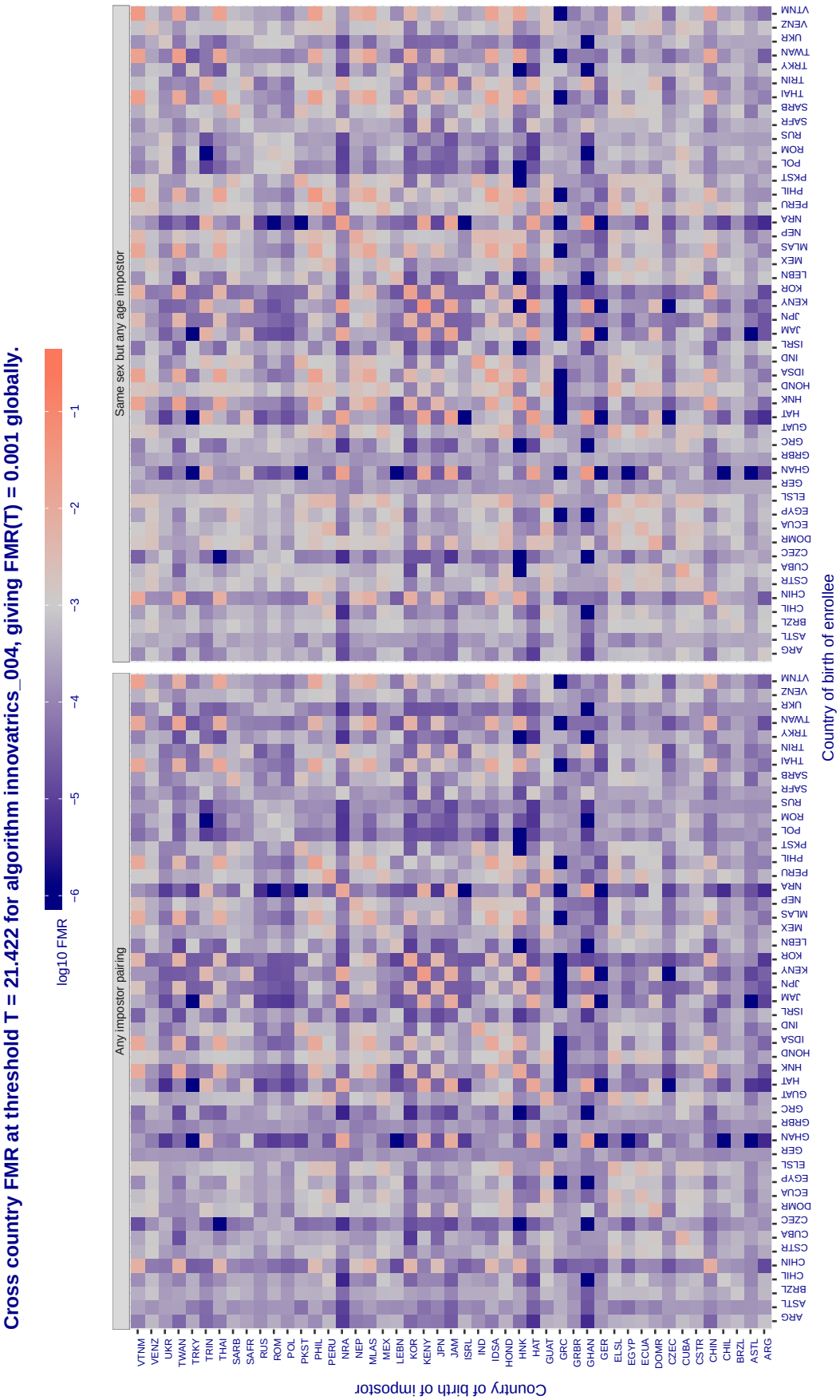


Figure 293: For algorithm innovatrics-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

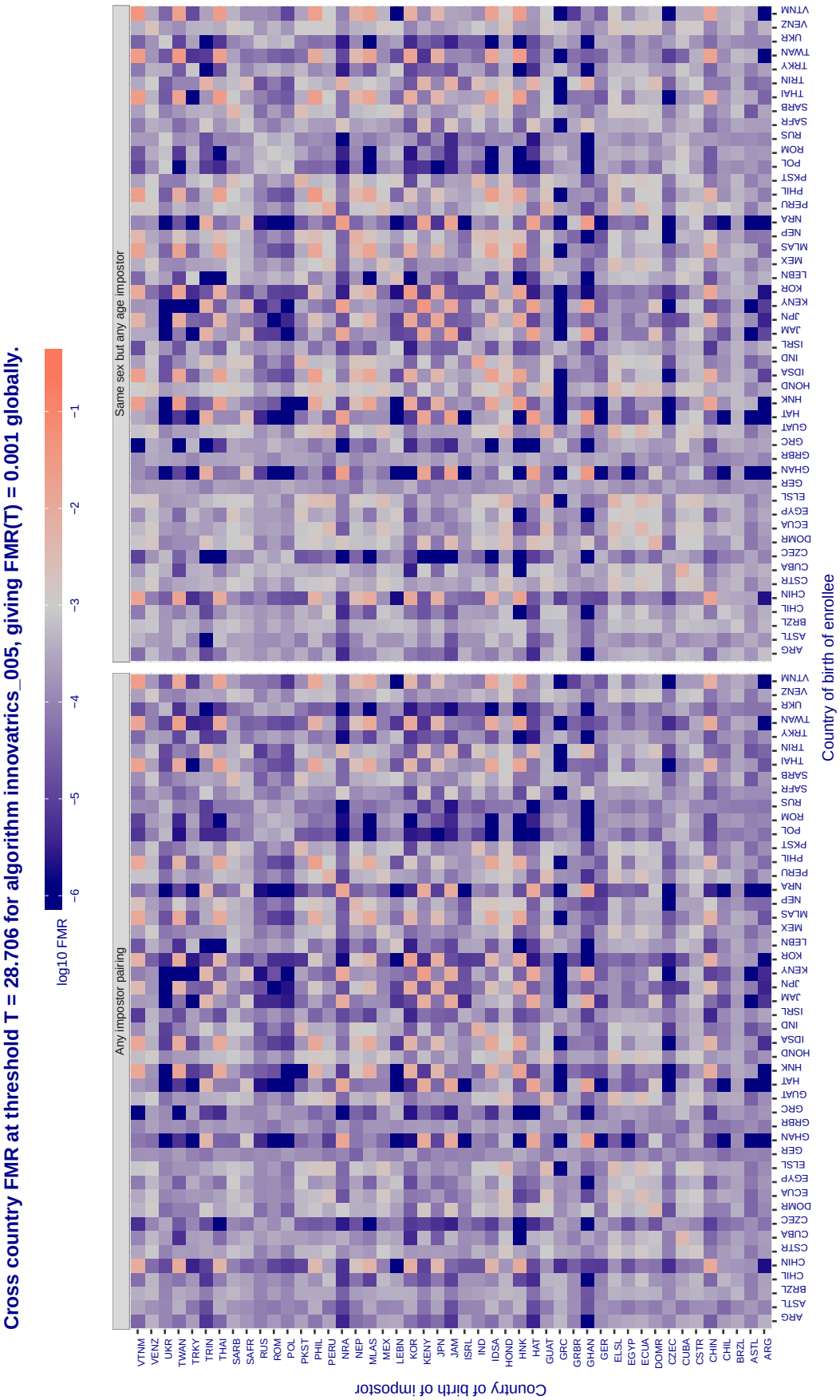


Figure 294: For algorithm innovatrics-005 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

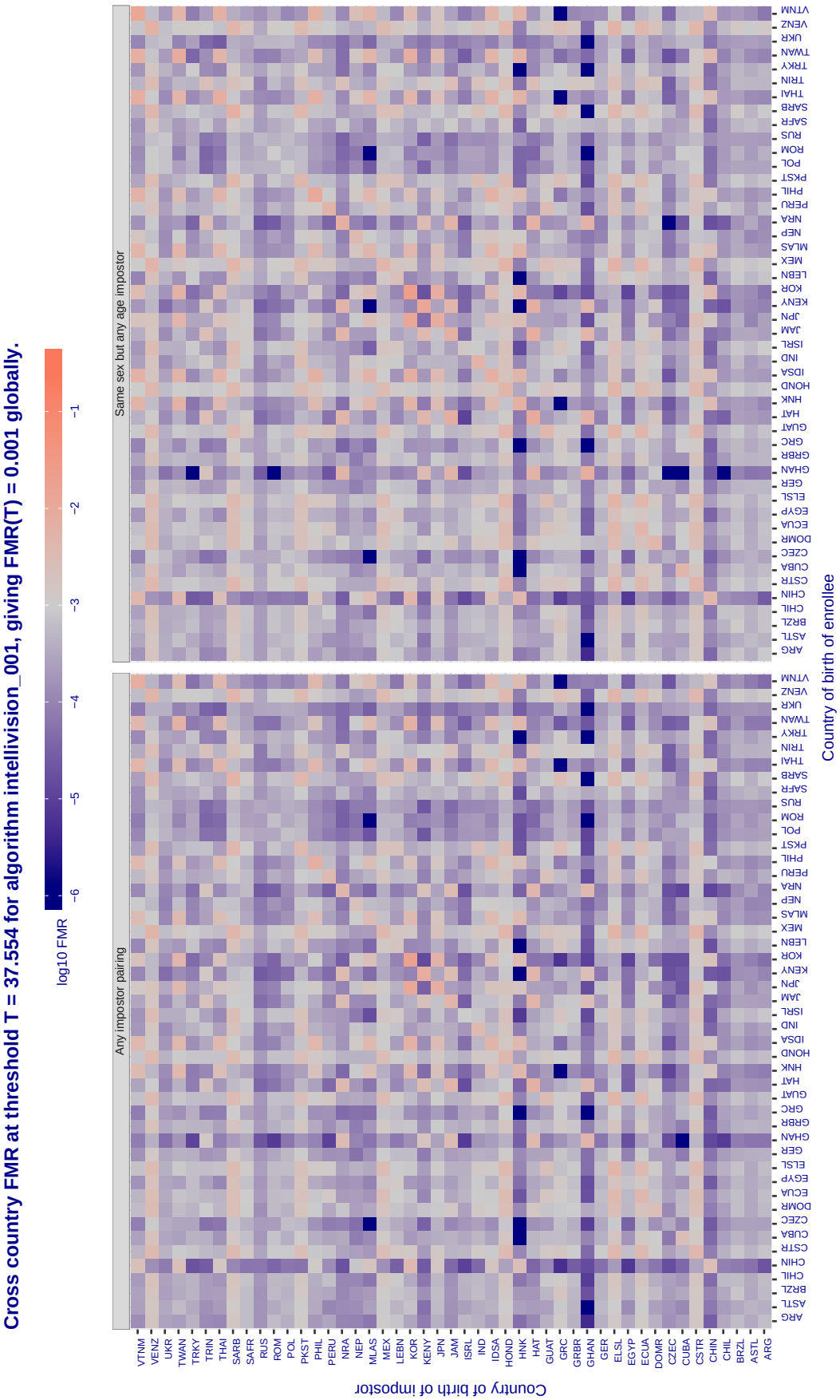


Figure 295: For algorithm intellivision-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

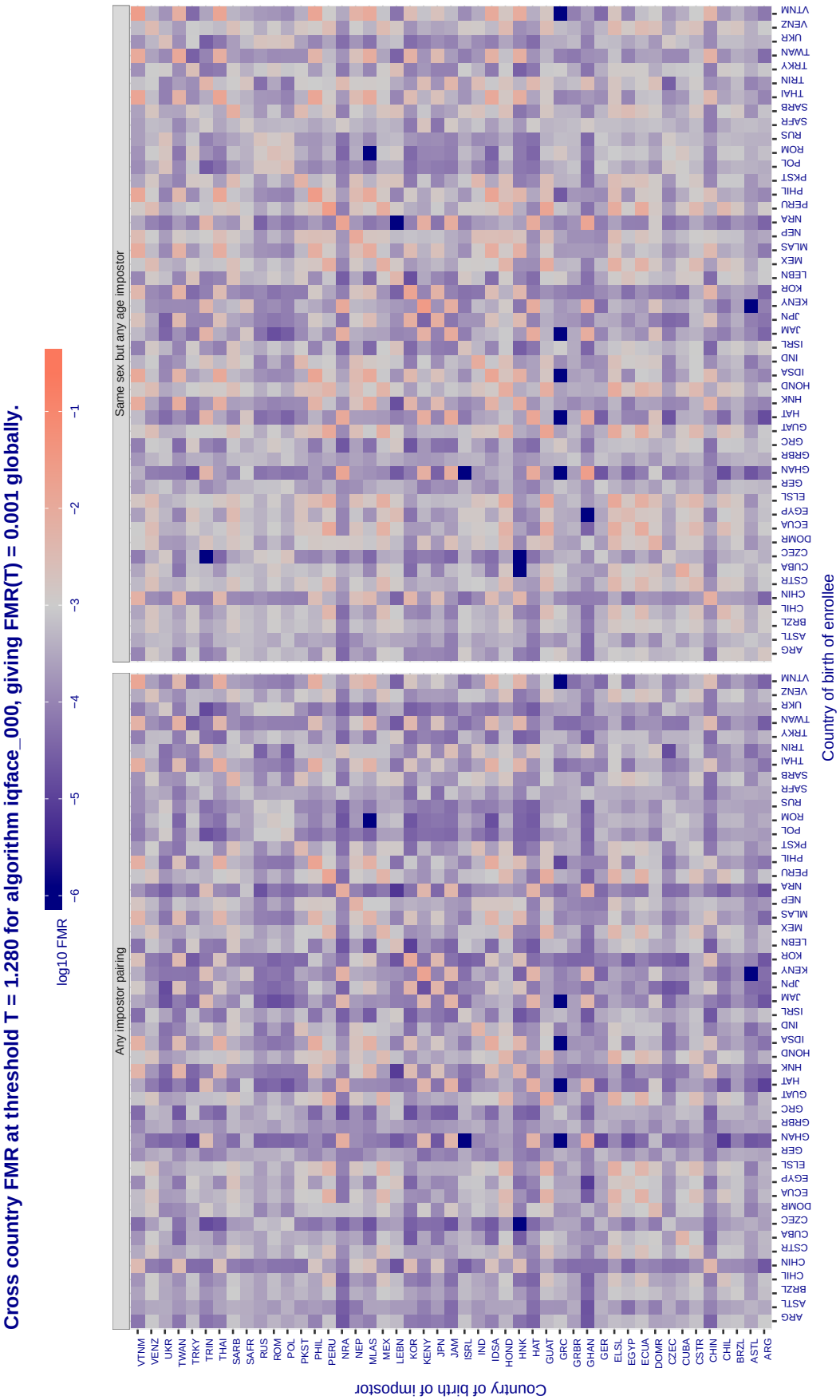


Figure 296: For algorithm iqface-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

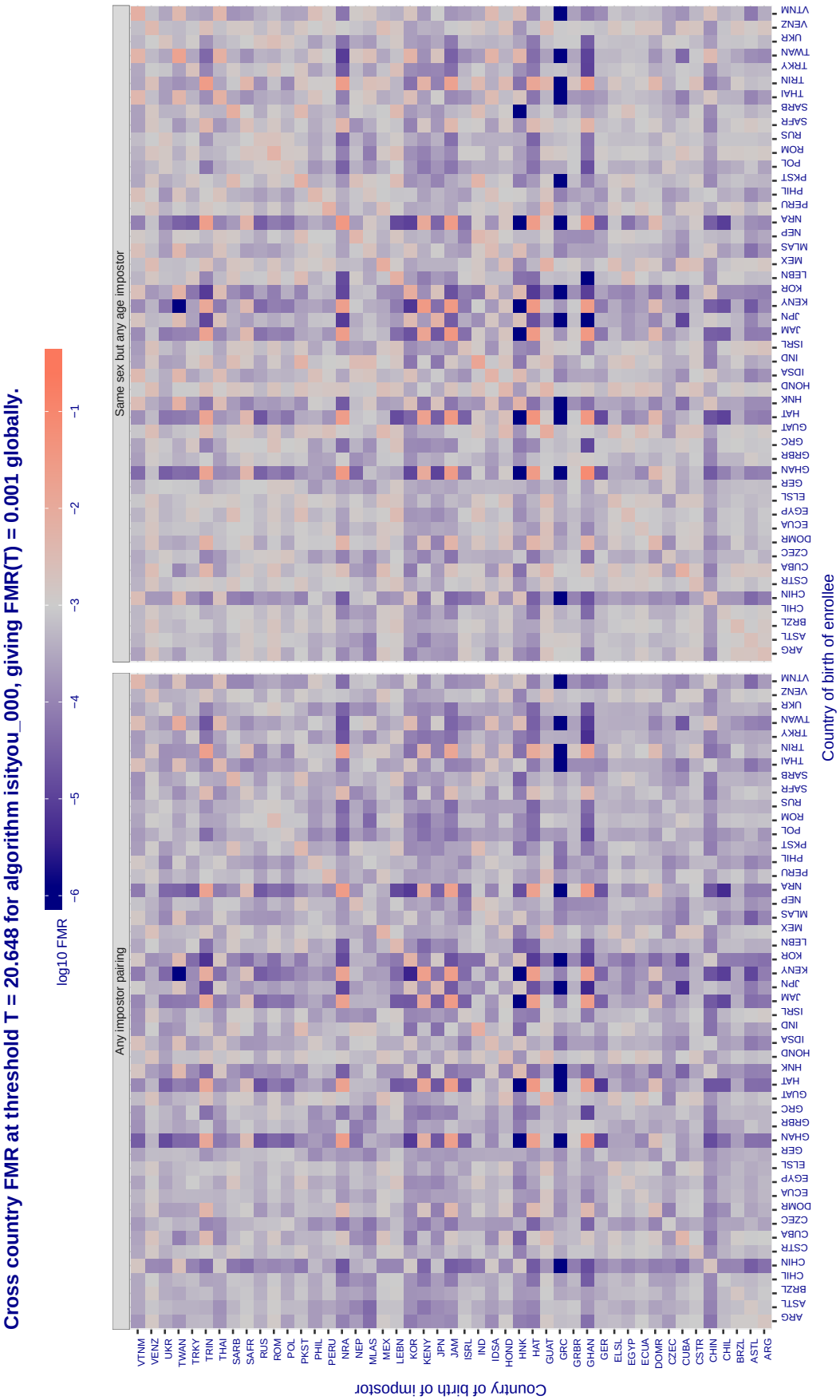


Figure 297: For algorithm isityou-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

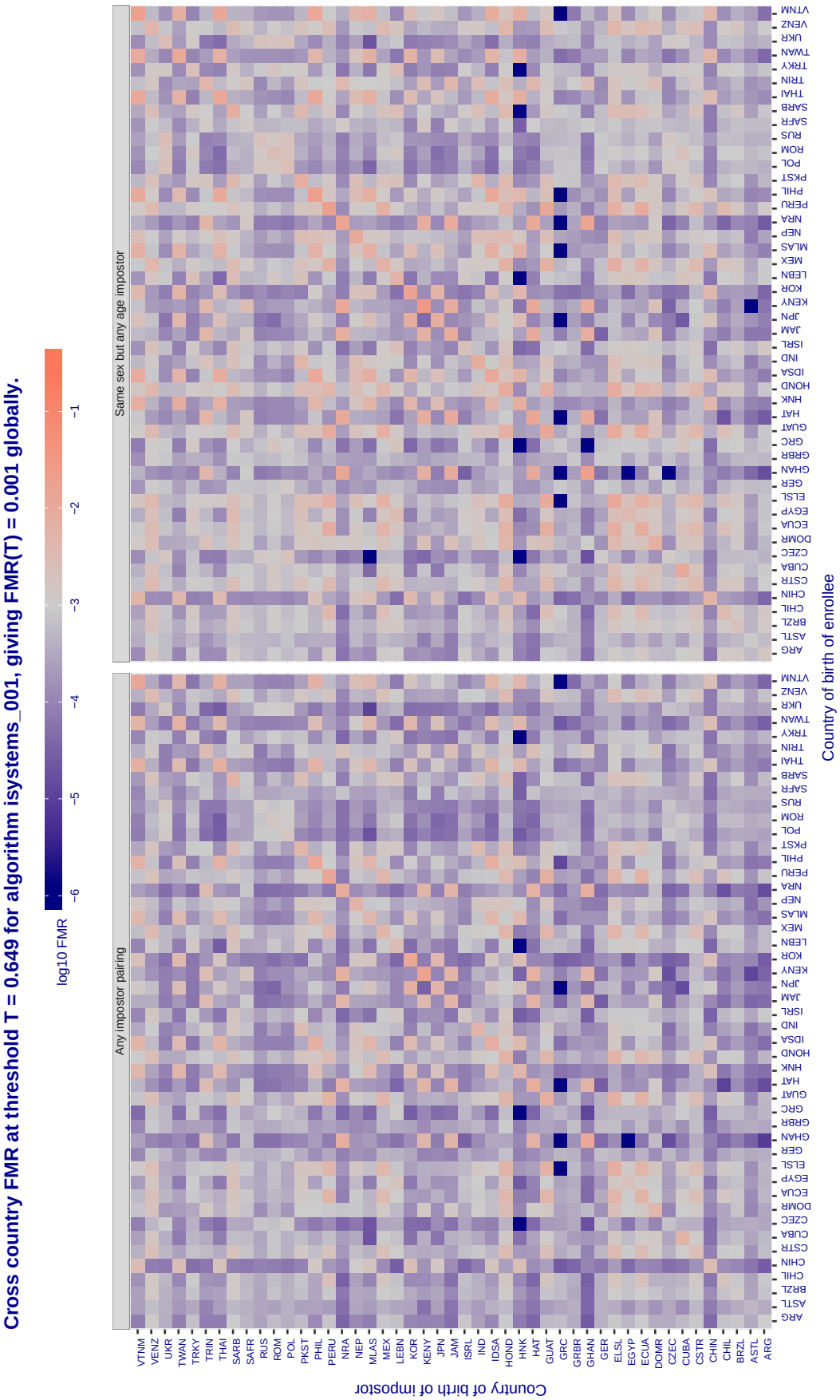


Figure 298: For algorithm isystems-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

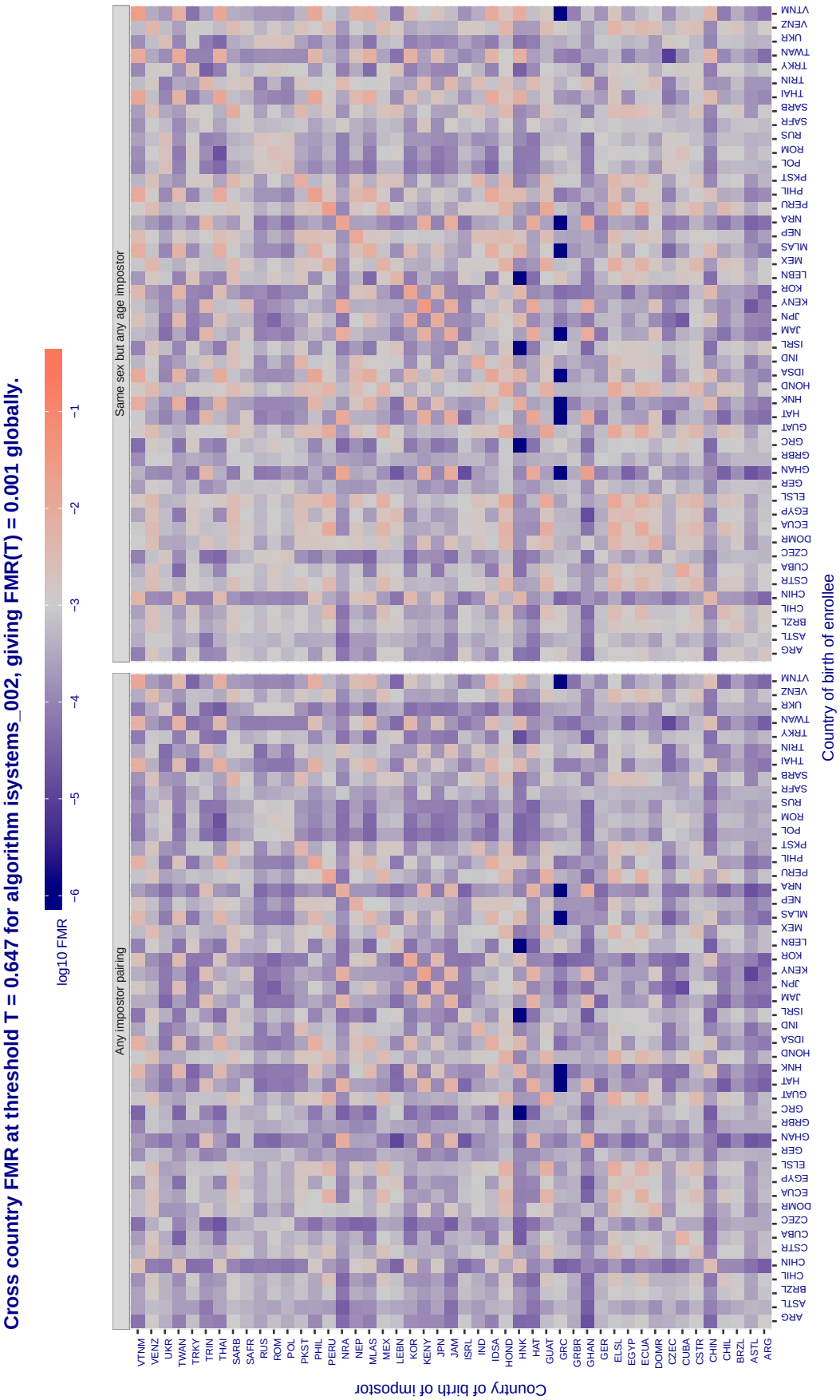


Figure 299: For algorithm isystems-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

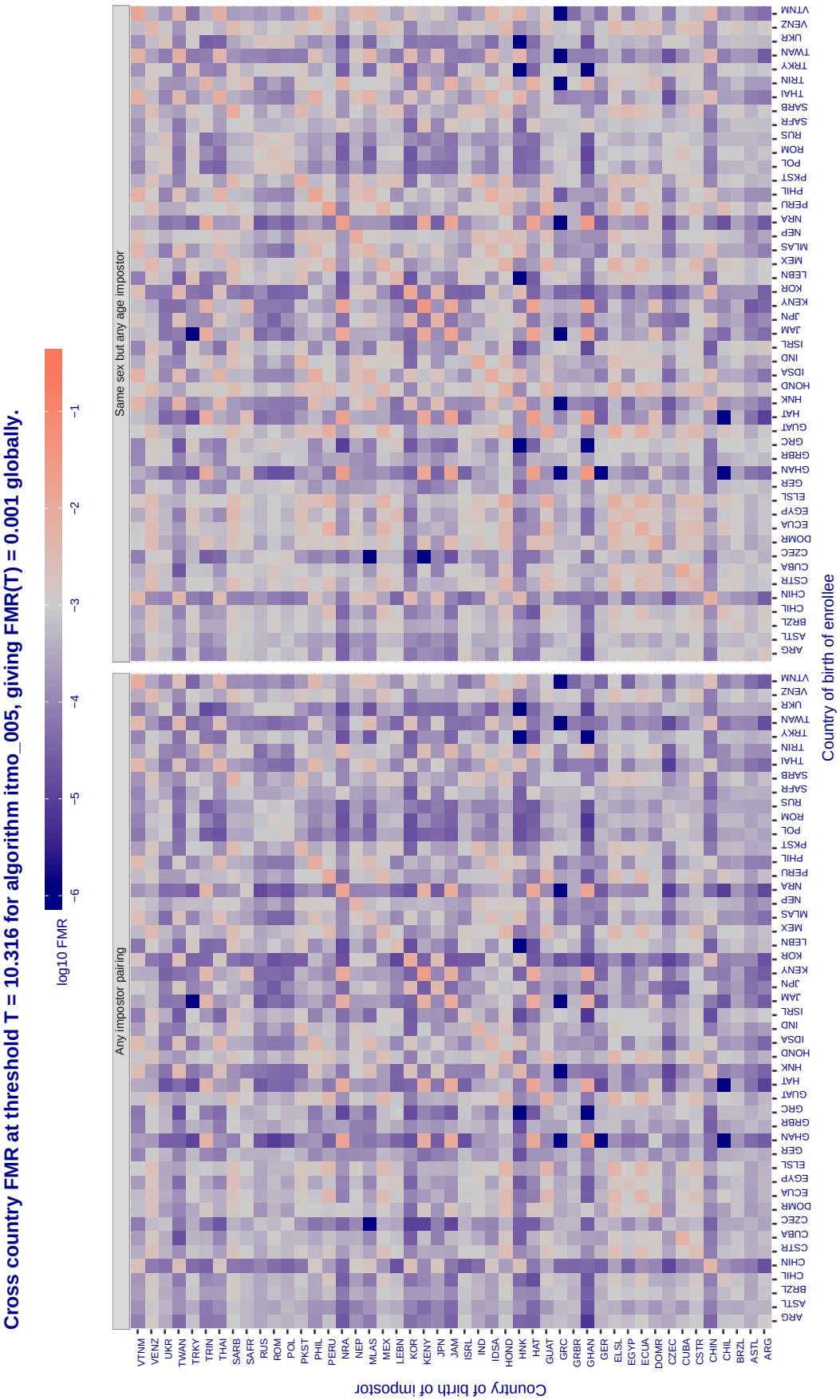


Figure 300: For algorithm itmo-005 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

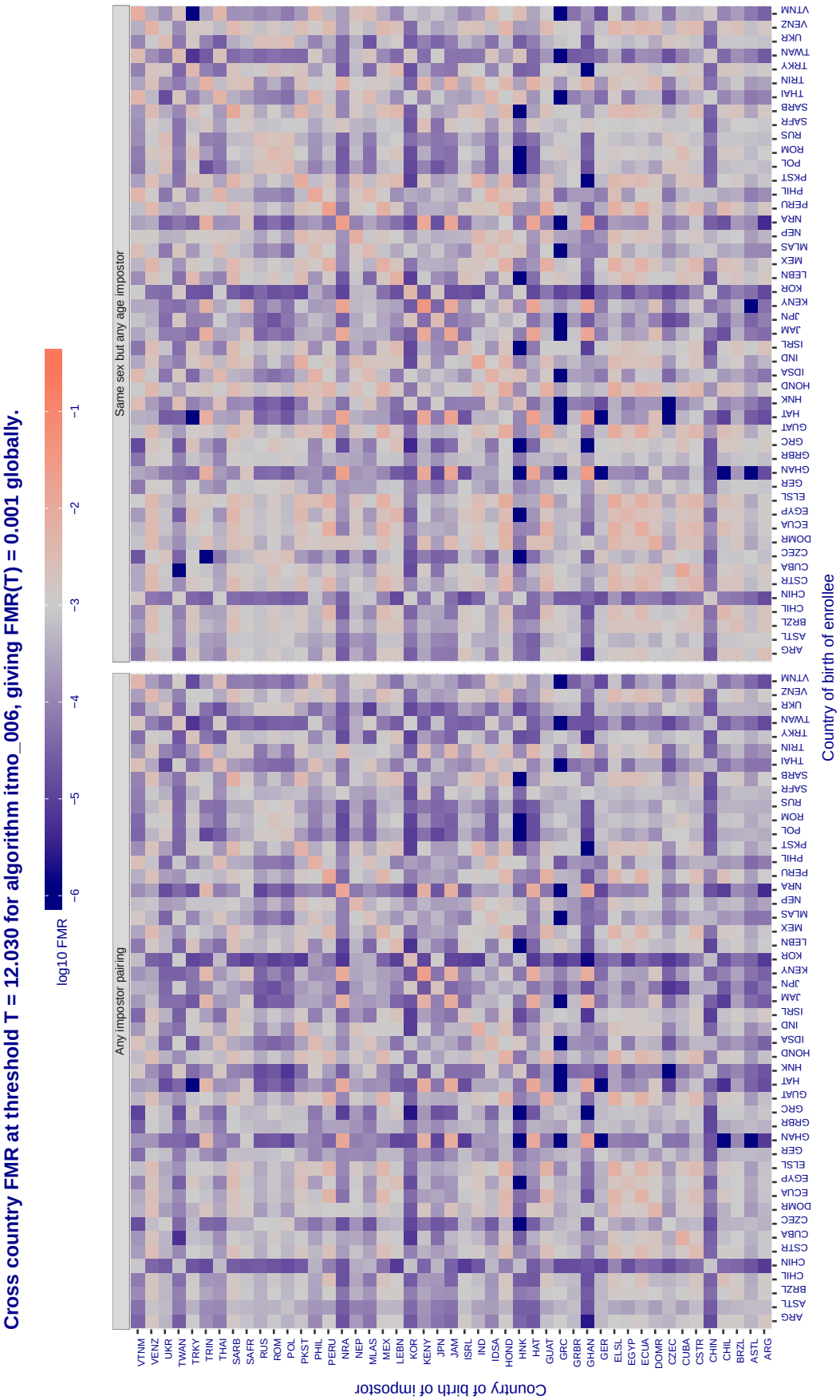


Figure 301: For algorithm itmo-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

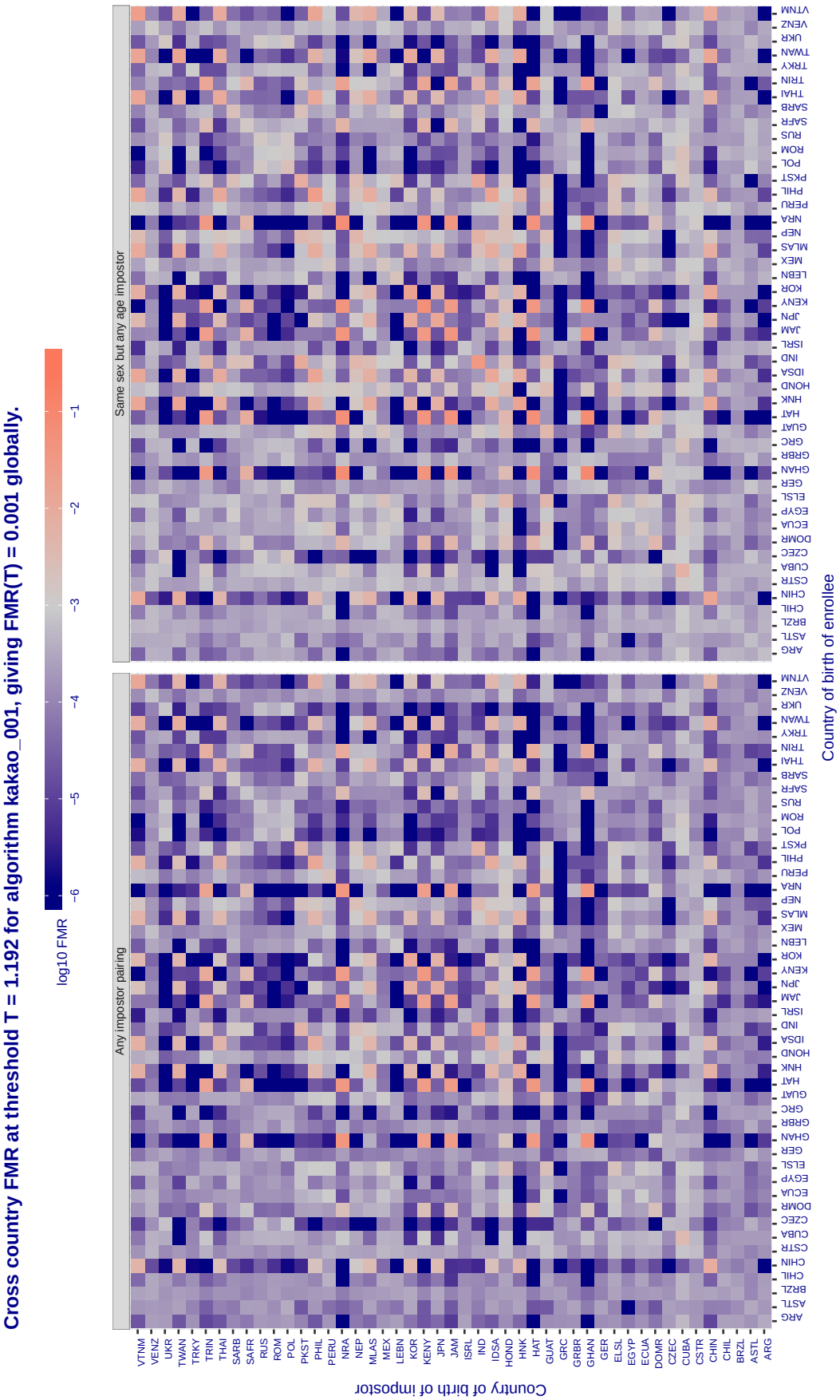


Figure 302: For algorithm kakao-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

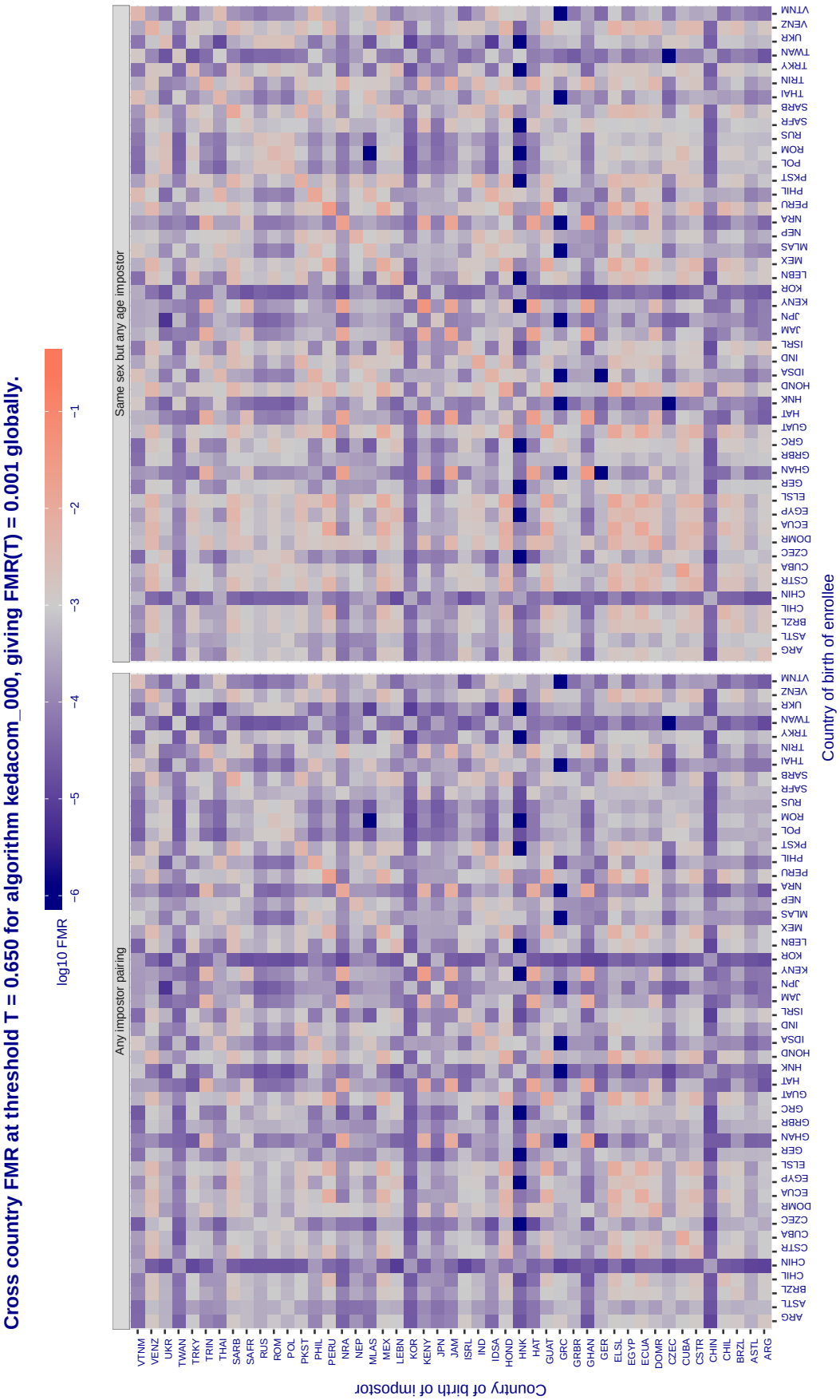


Figure 303: For algorithm kedacom-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

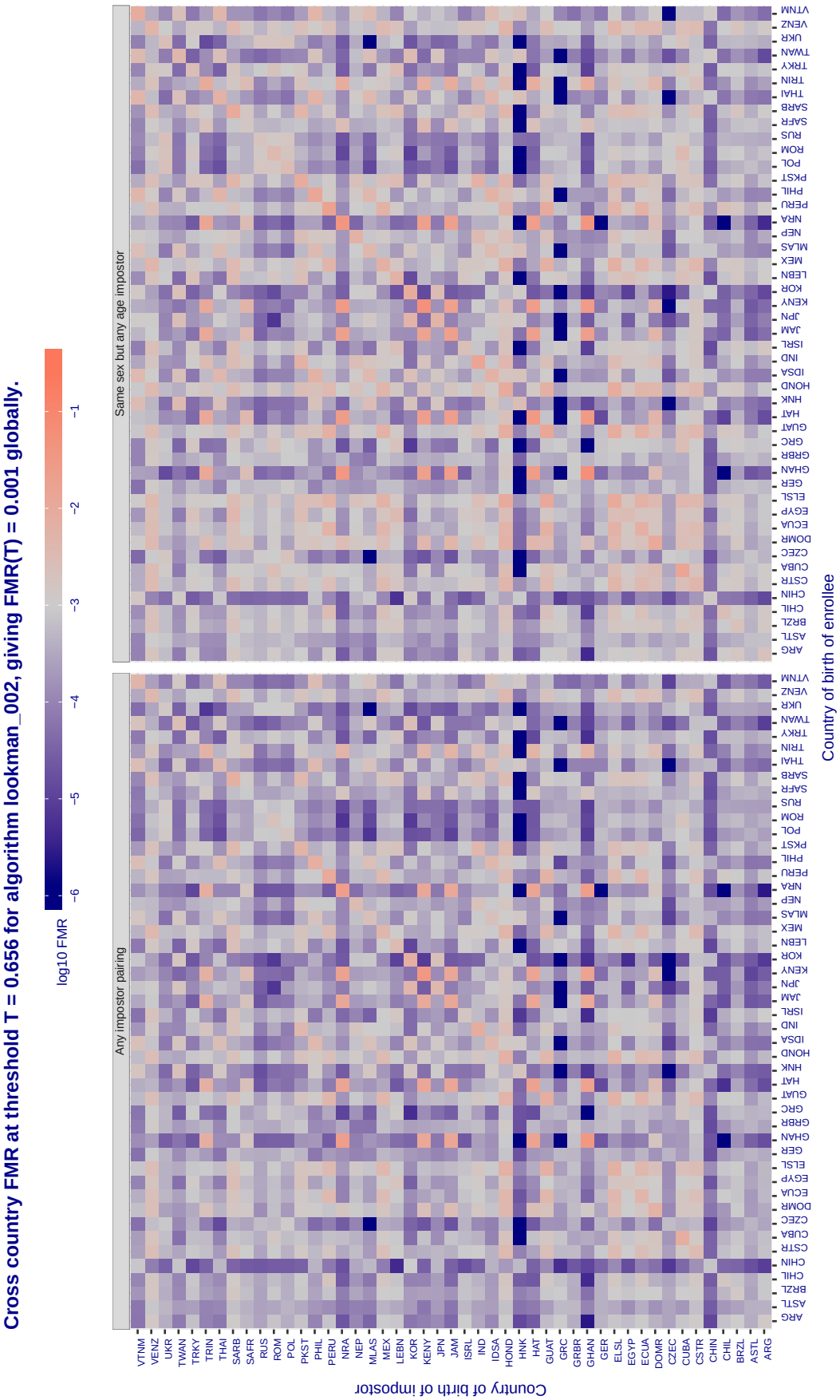


Figure 304: For algorithm lookman-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

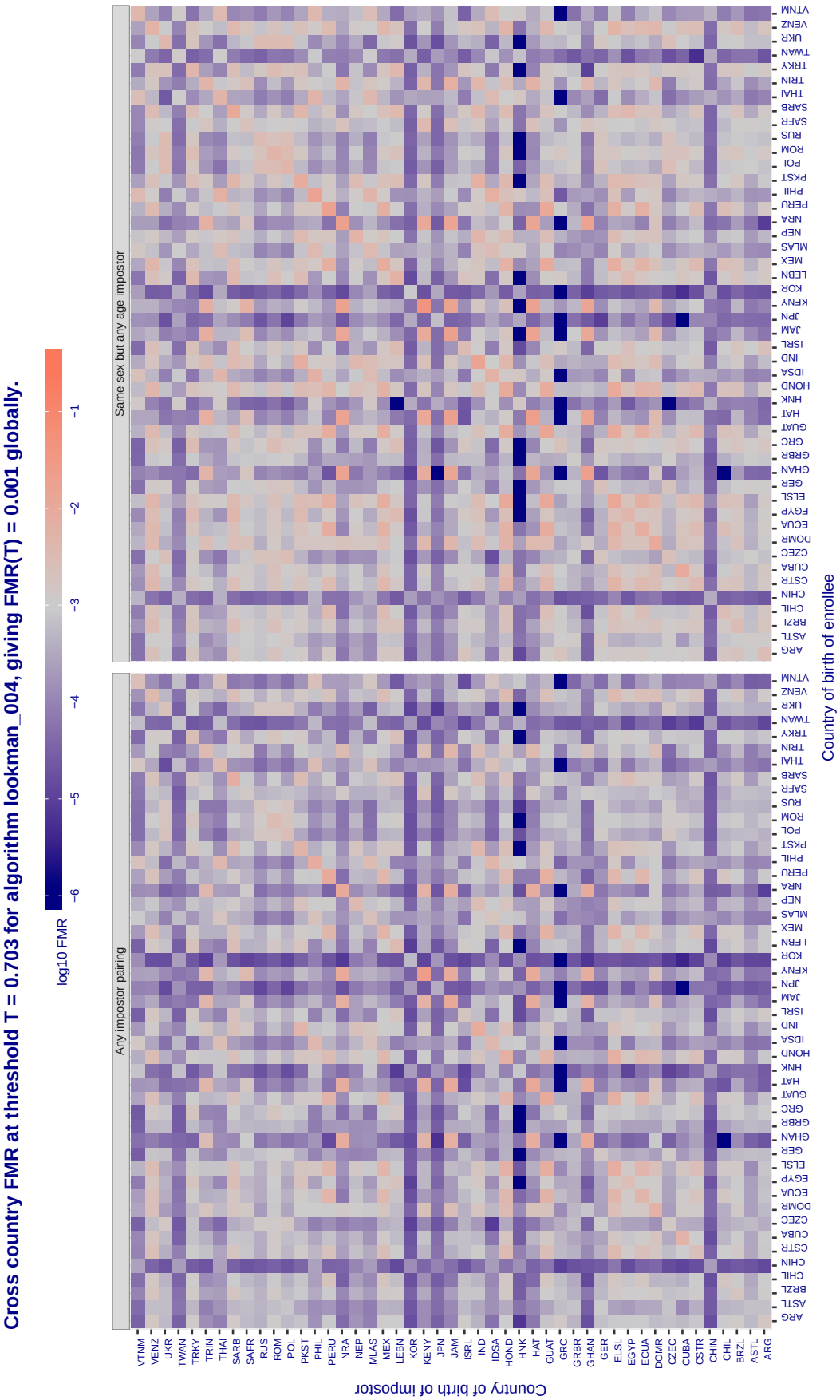


Figure 305: For algorithm lookman-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

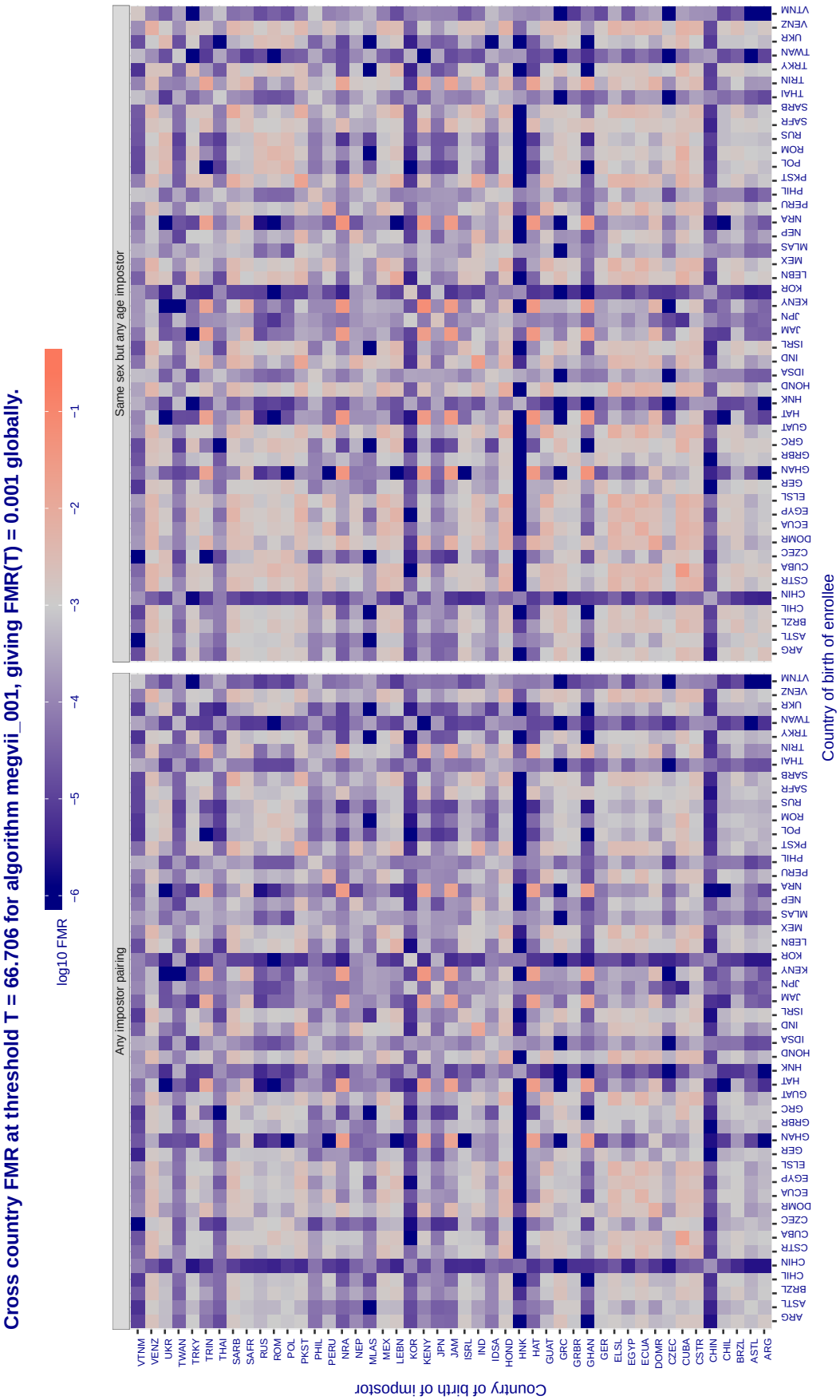


Figure 306: For algorithm megvii-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

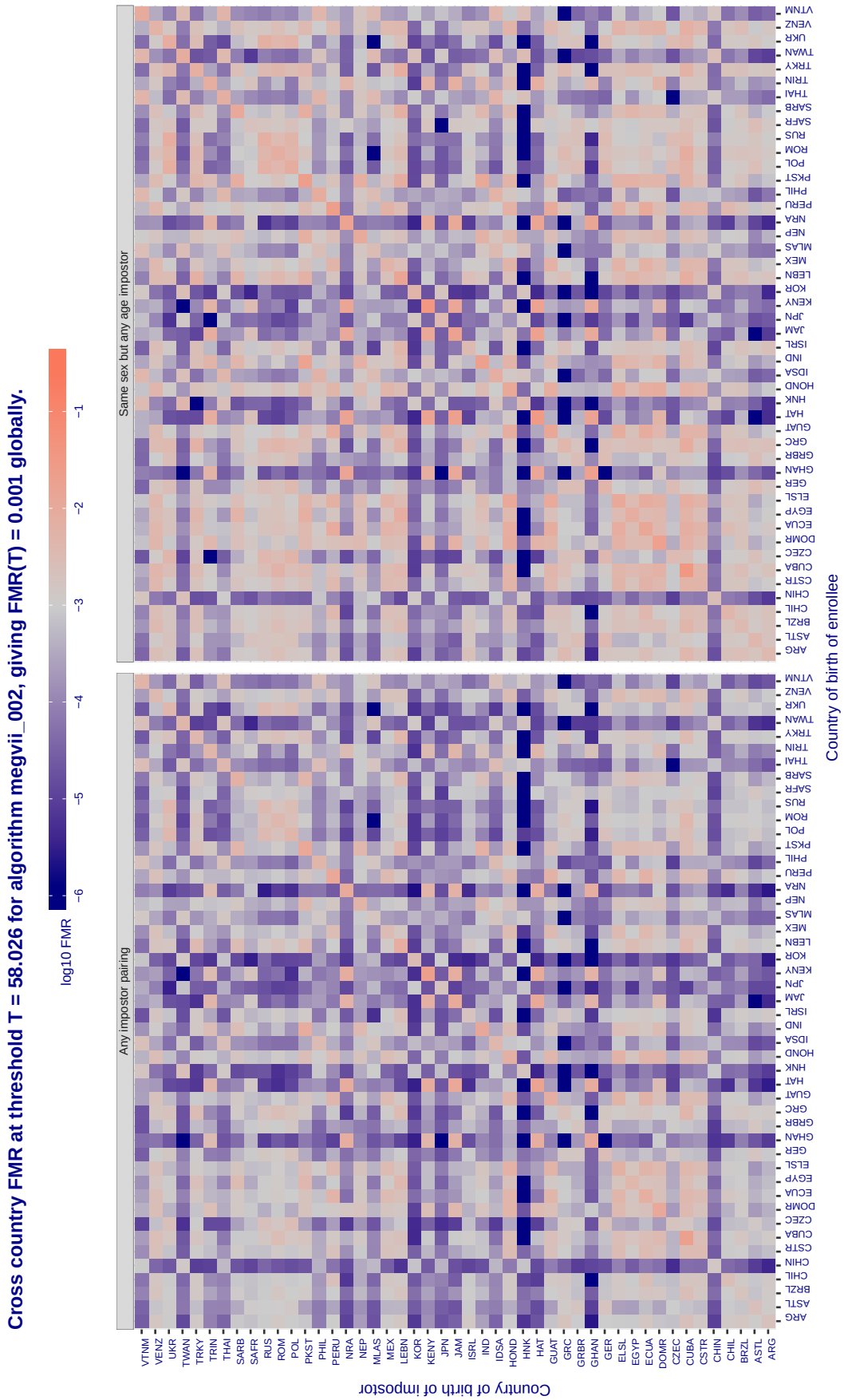


Figure 307: For algorithm megvii-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

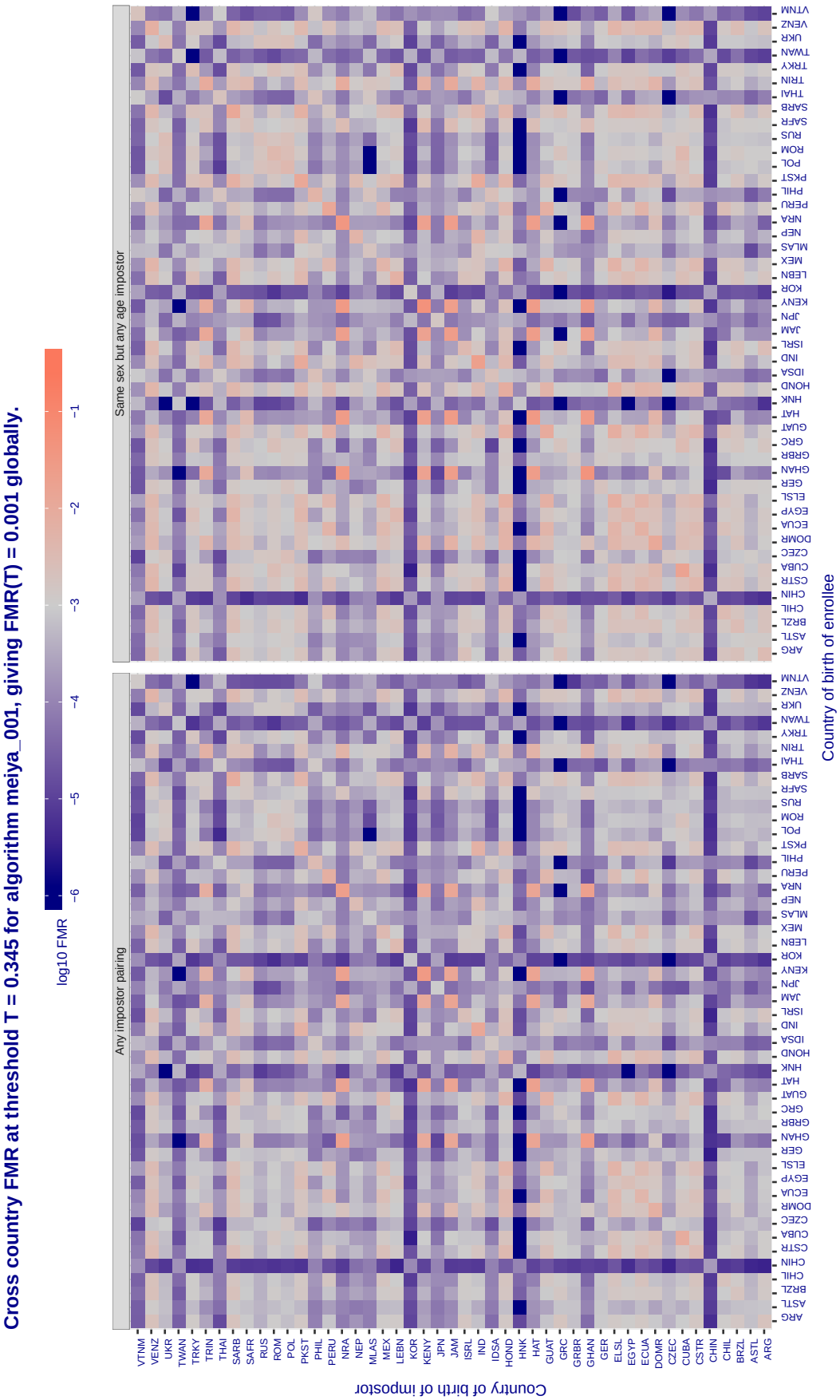


Figure 308: For algorithm meiya-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

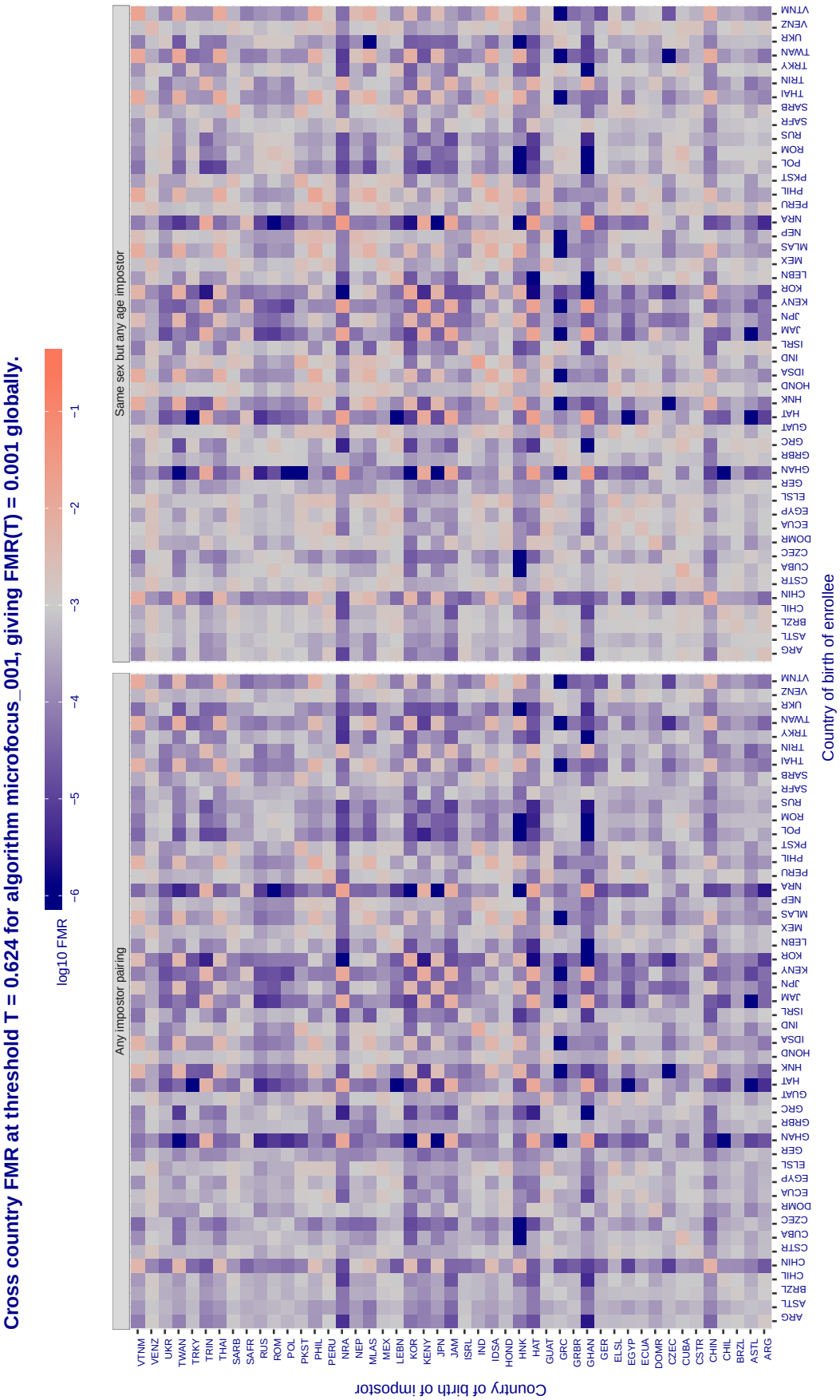


Figure 309: For algorithm microfocus-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

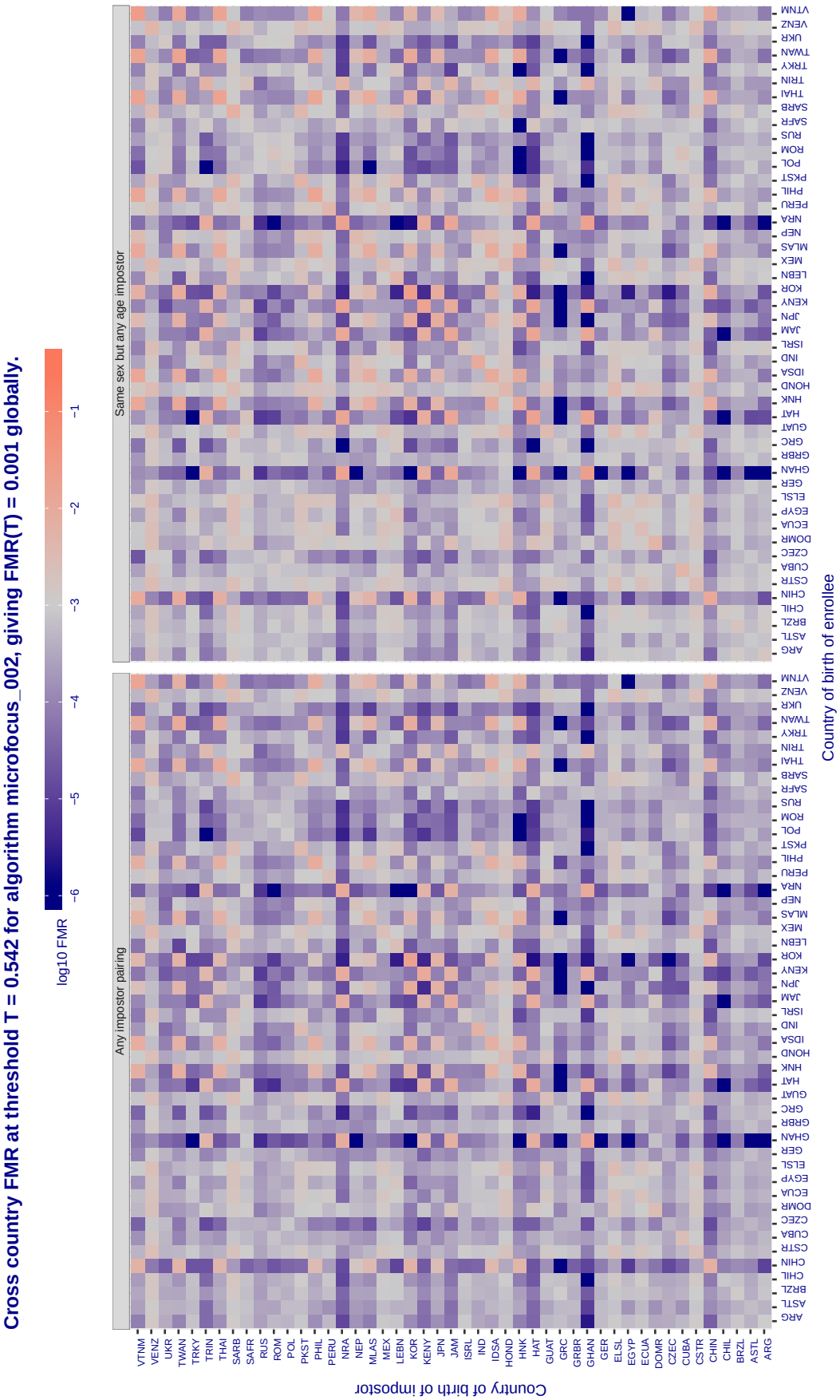


Figure 310: For algorithm microfocus-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

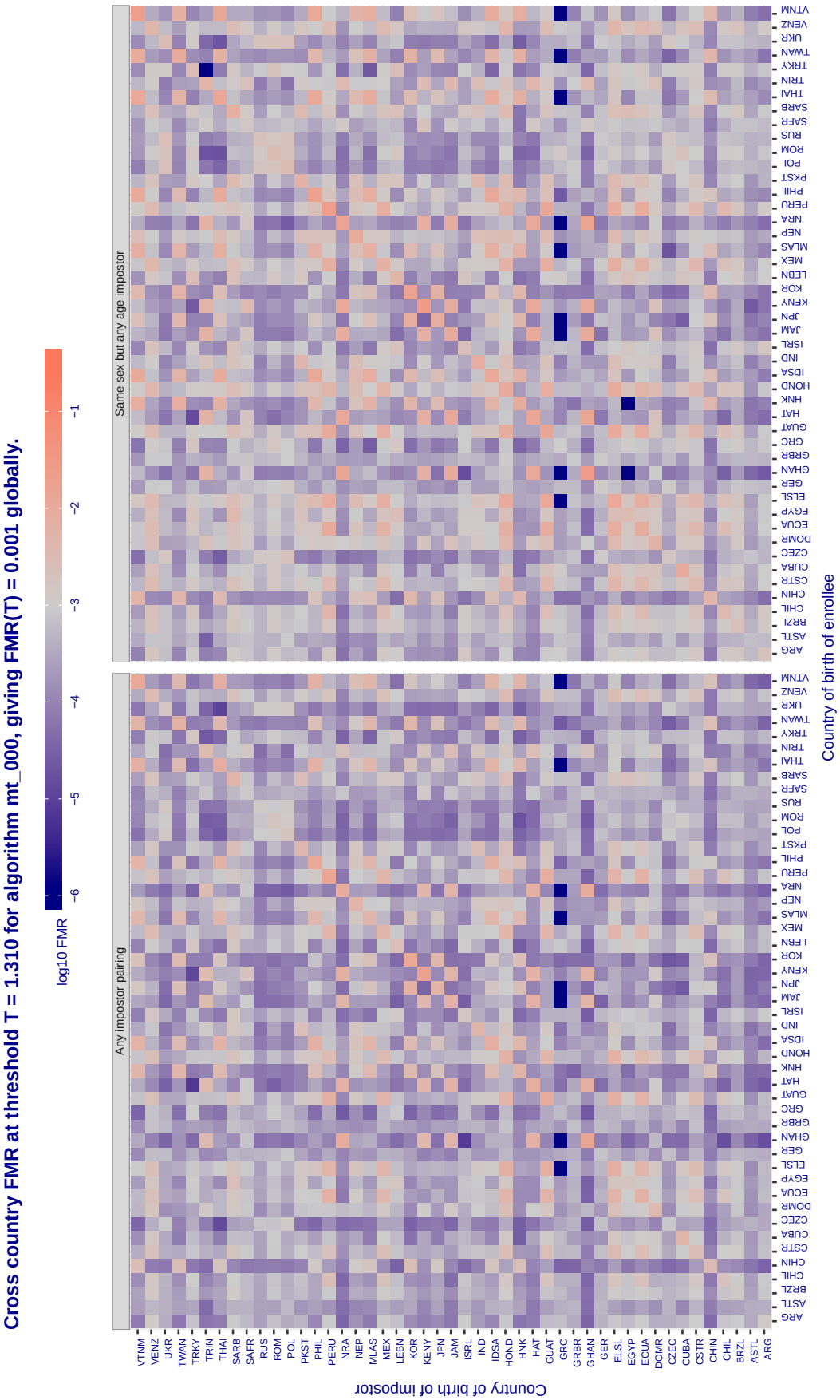


Figure 311: For algorithm mt-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

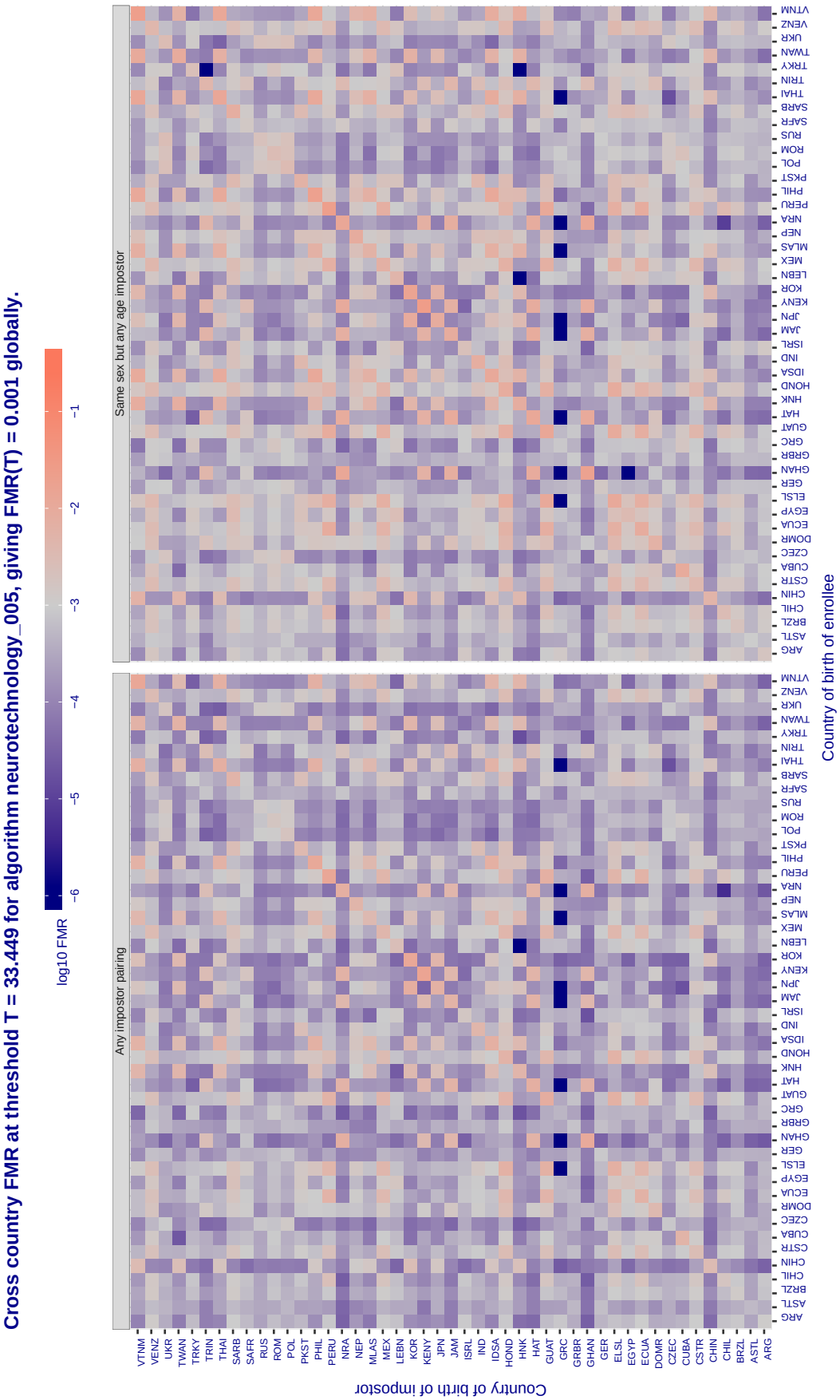


Figure 312: For algorithm neurotechnology-005 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

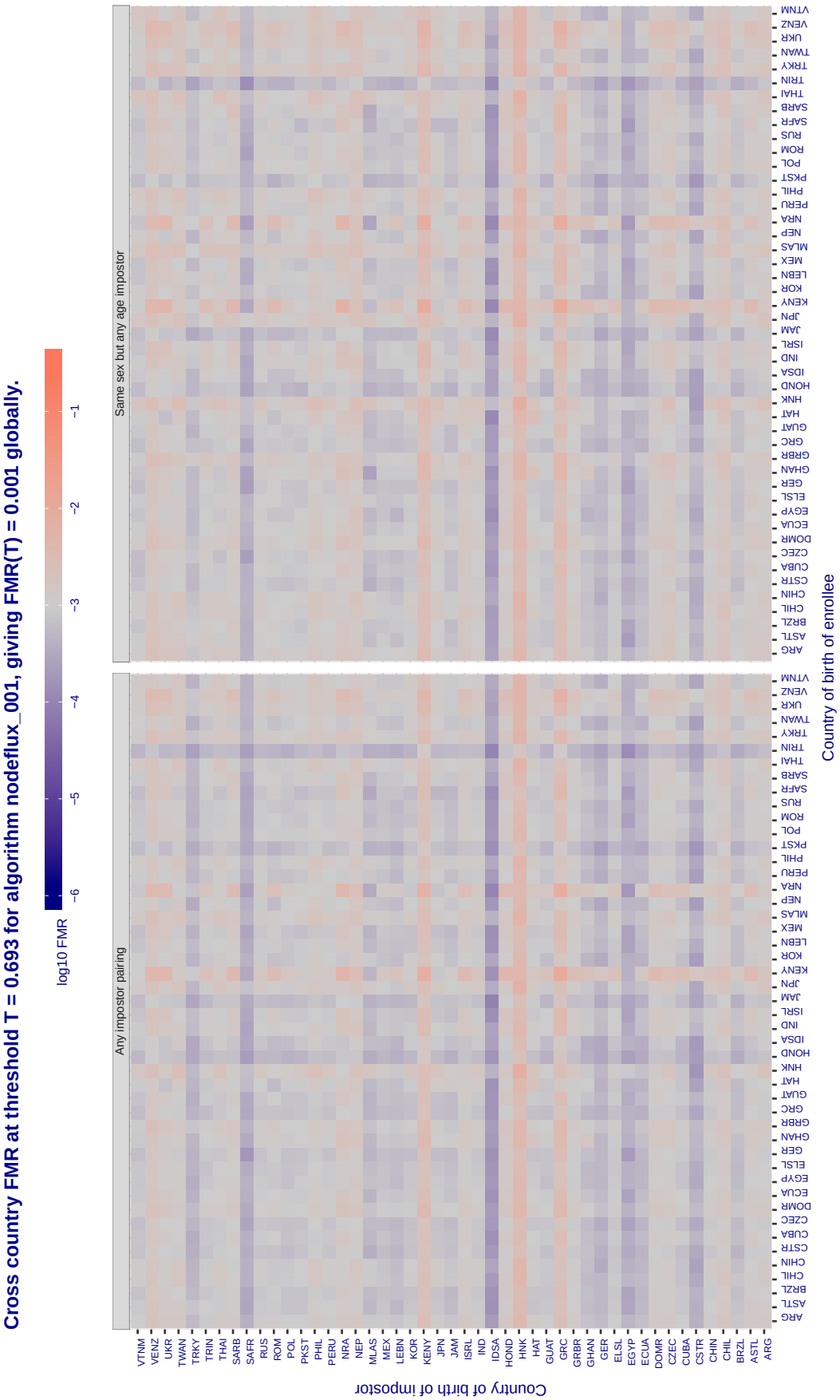


Figure 313: For algorithm nodeflux-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

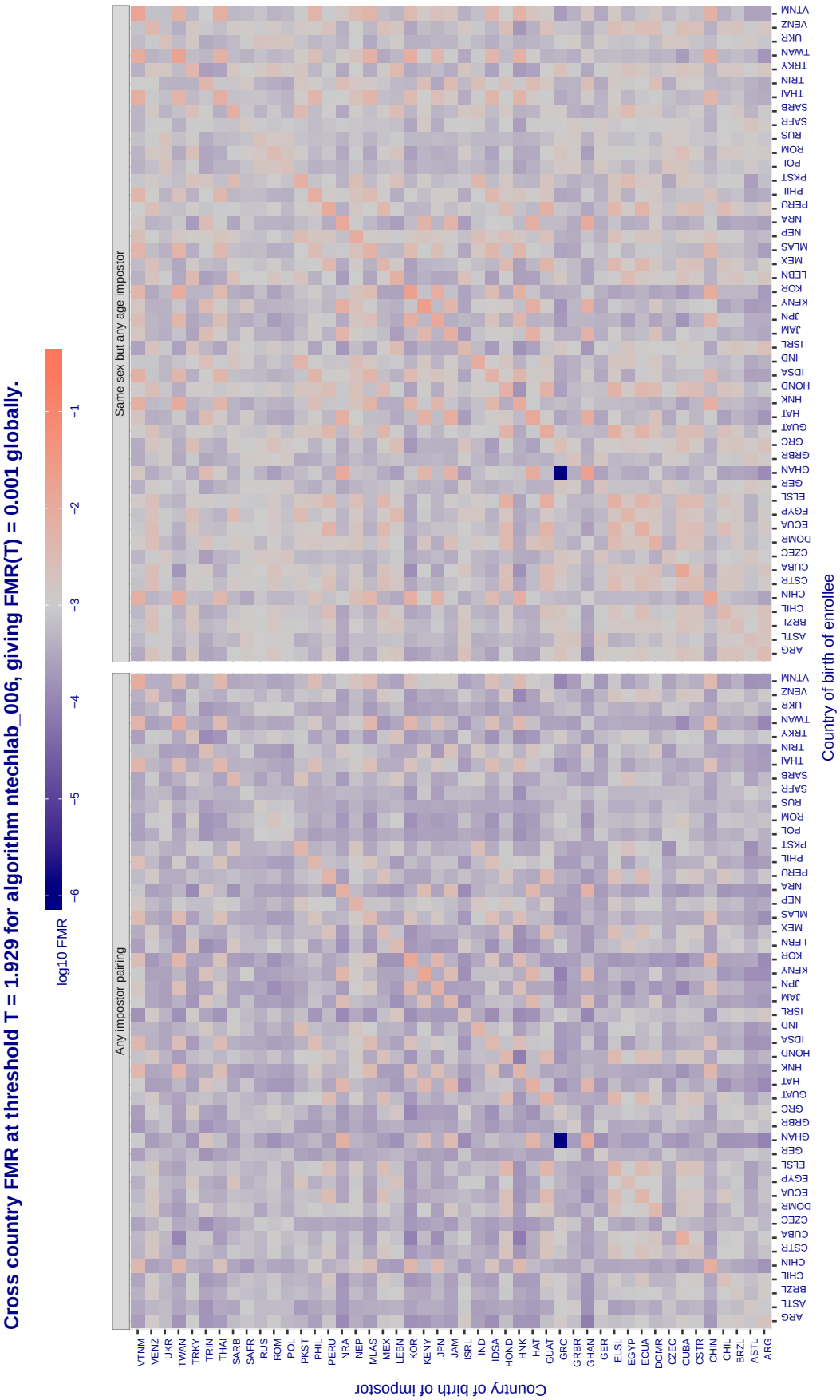


Figure 314: For algorithm ntechlab-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

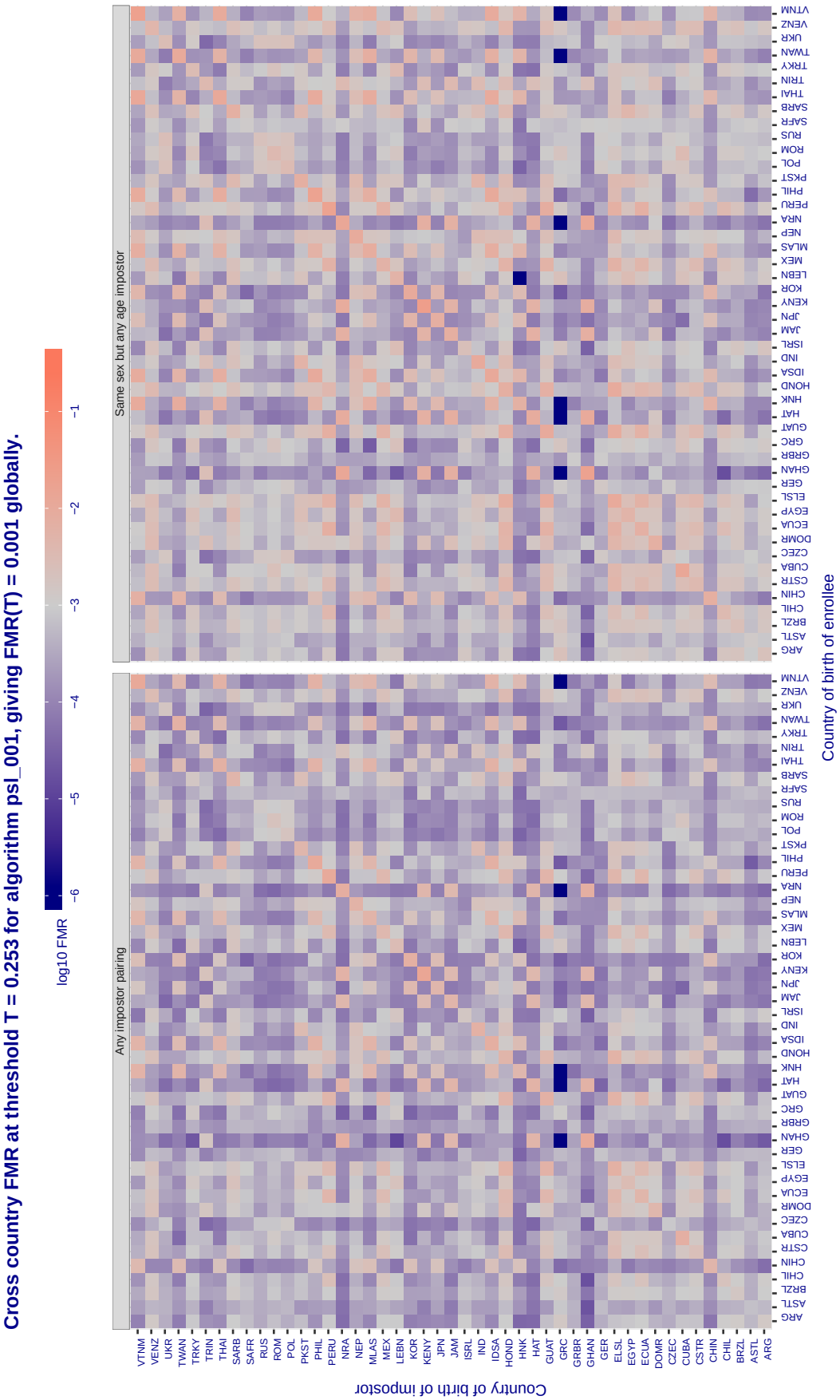


Figure 315: For algorithm psl-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

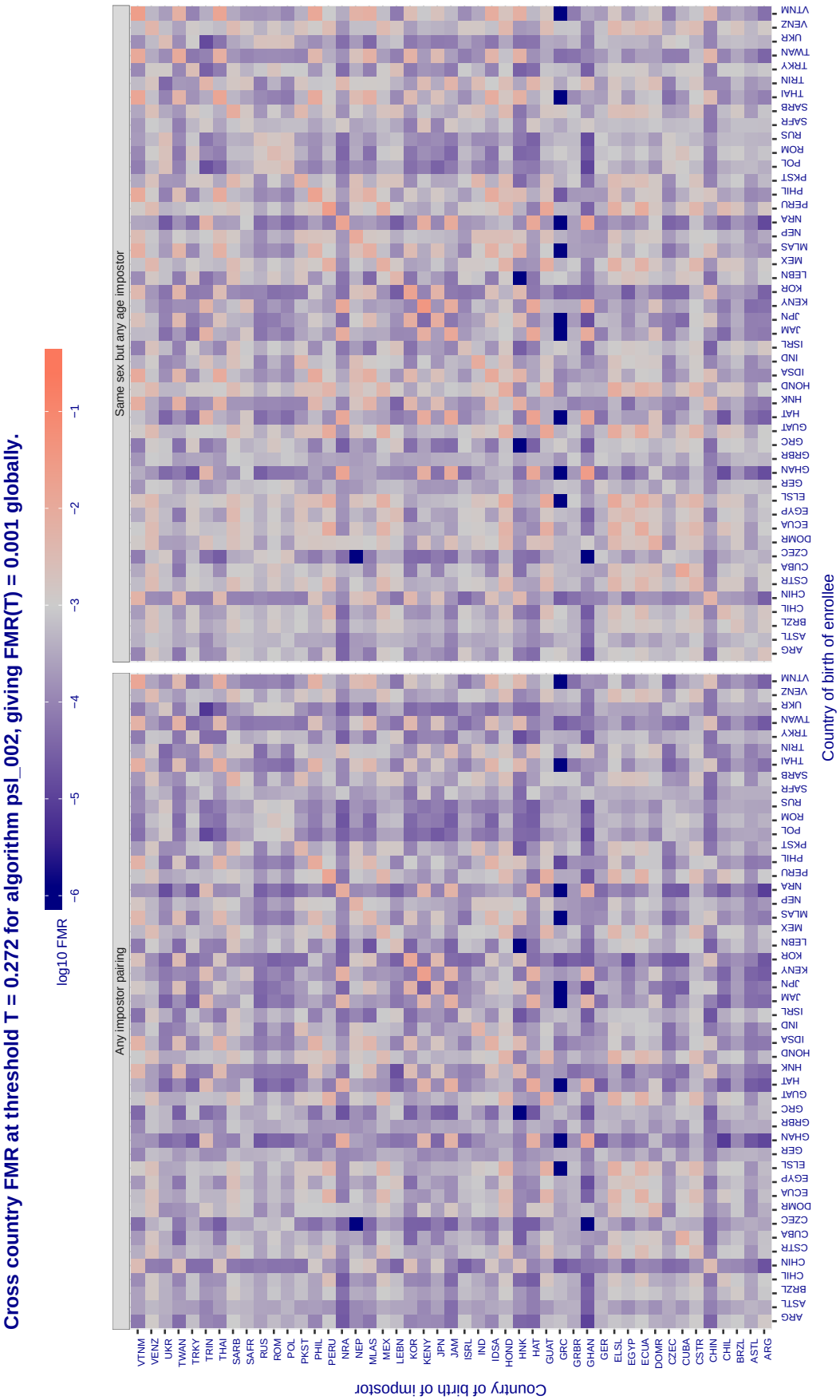


Figure 316: For algorithm psl-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

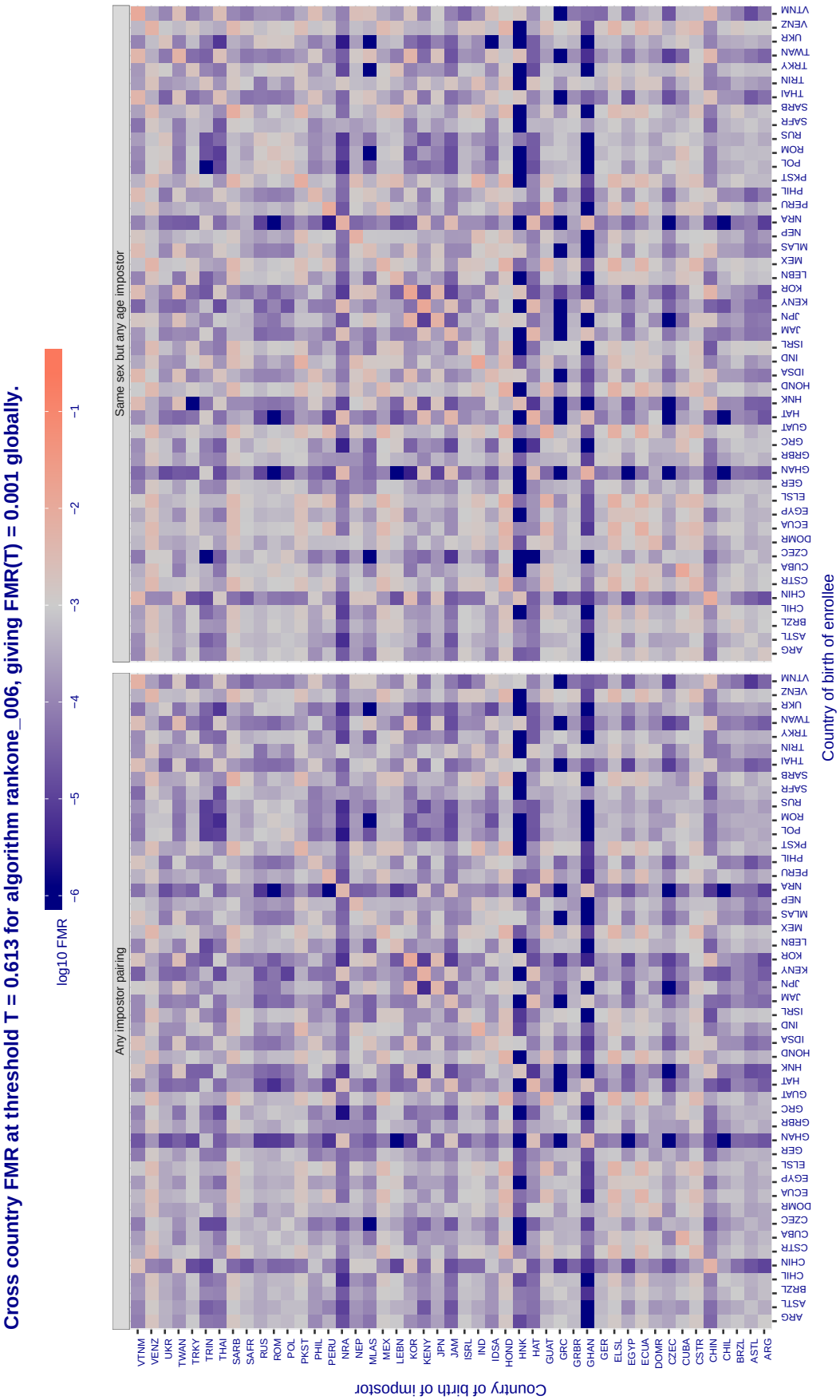


Figure 317: For algorithm rankone-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

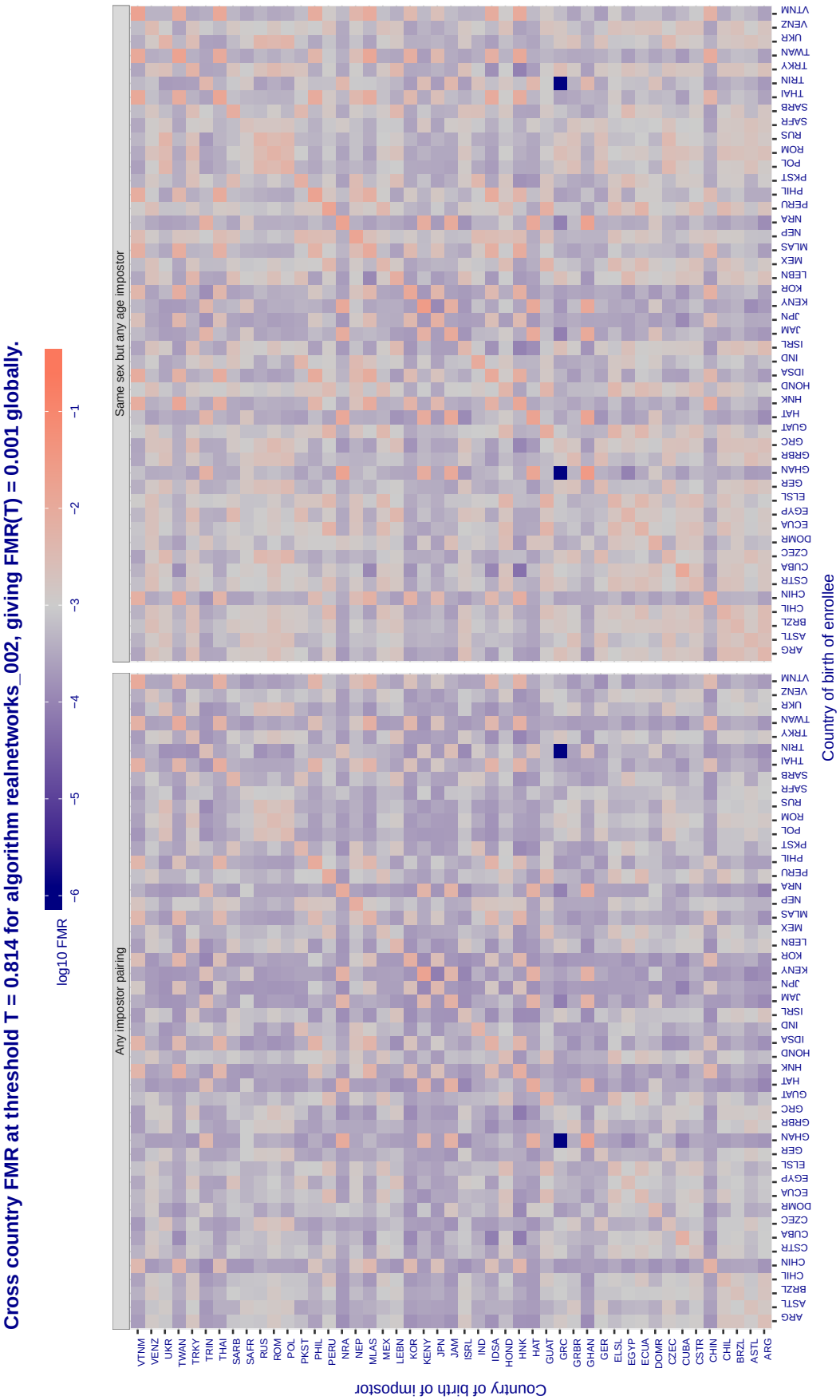


Figure 318: For algorithm realnetworks-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

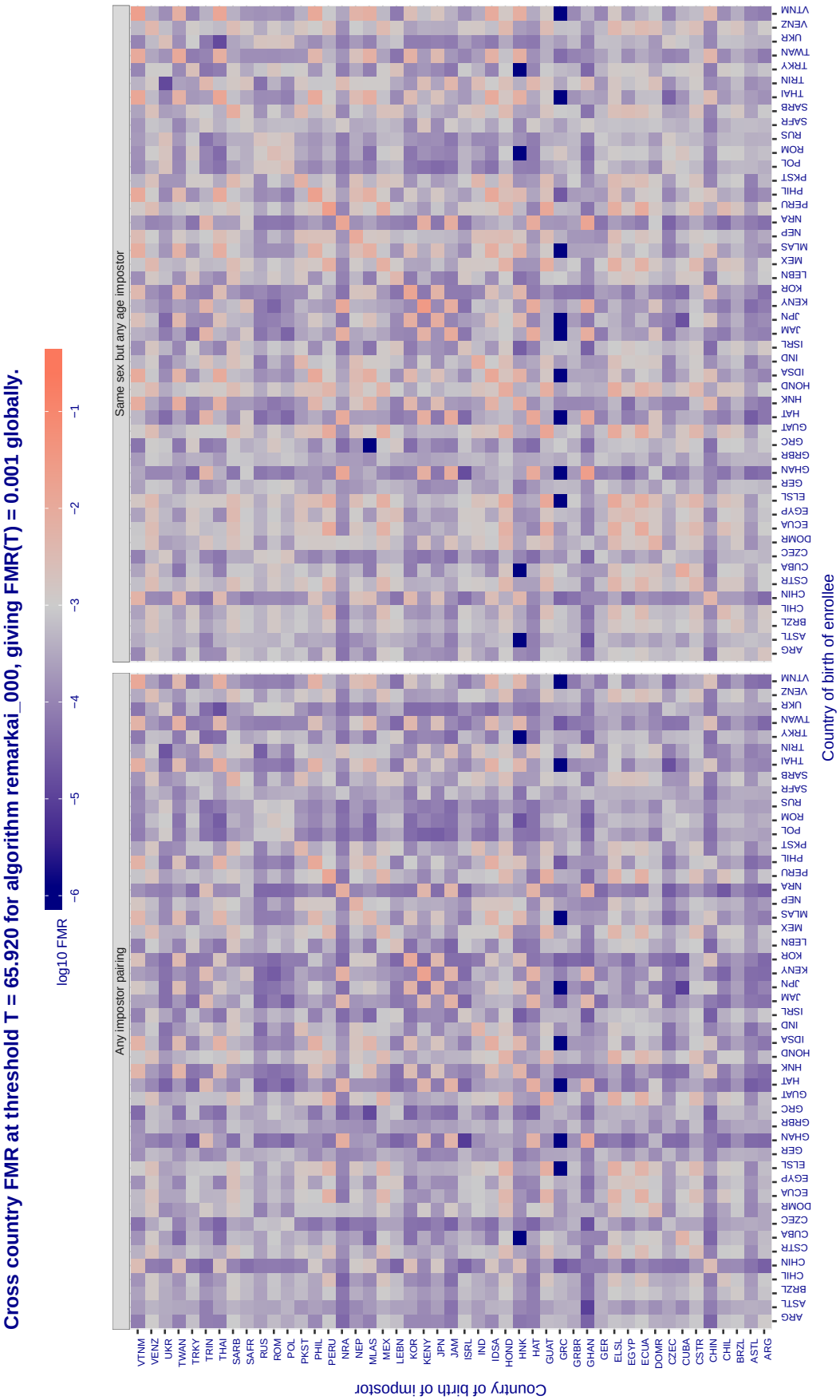


Figure 319: For algorithm remarkai-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

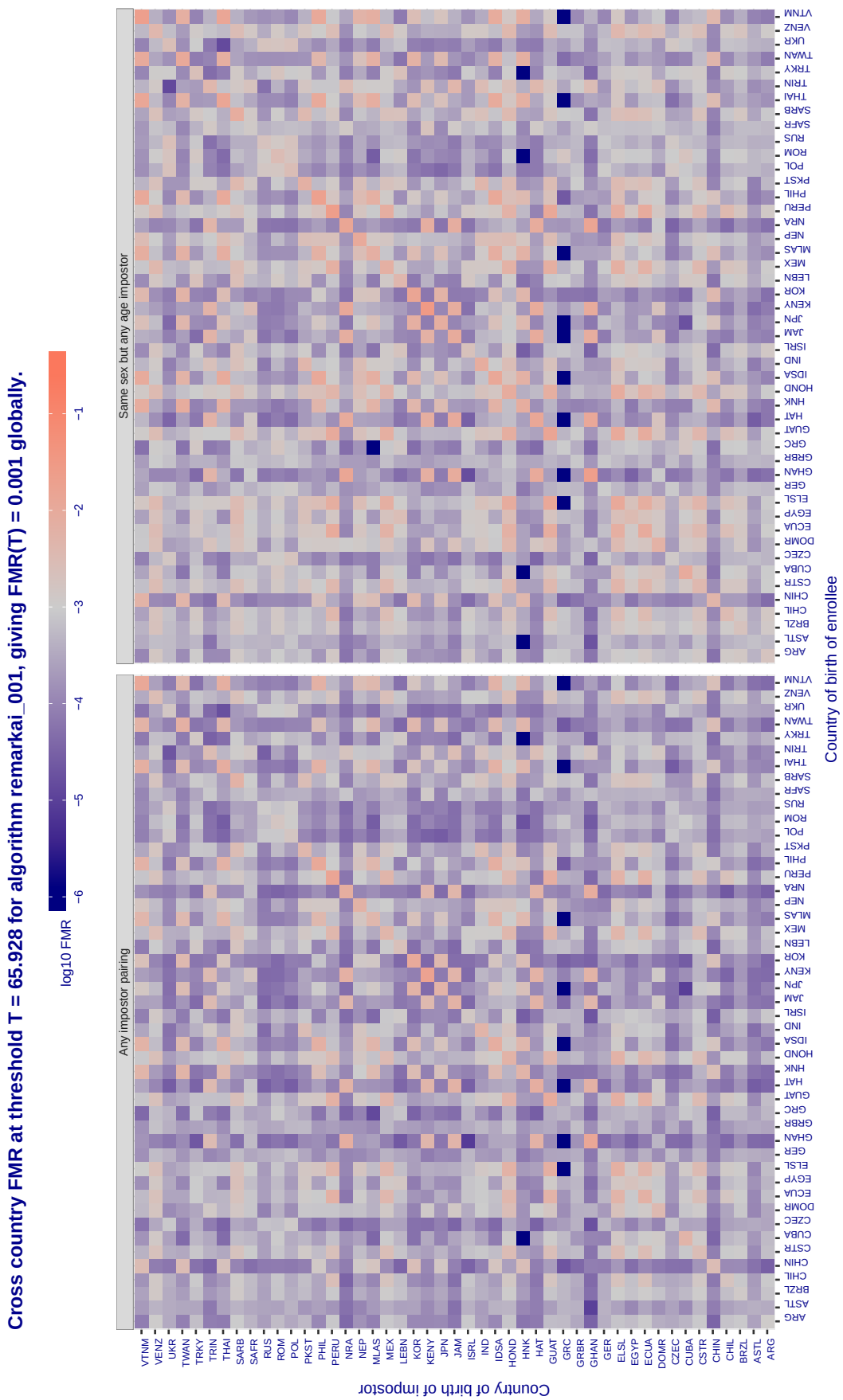


Figure 320: For algorithm remarkai-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

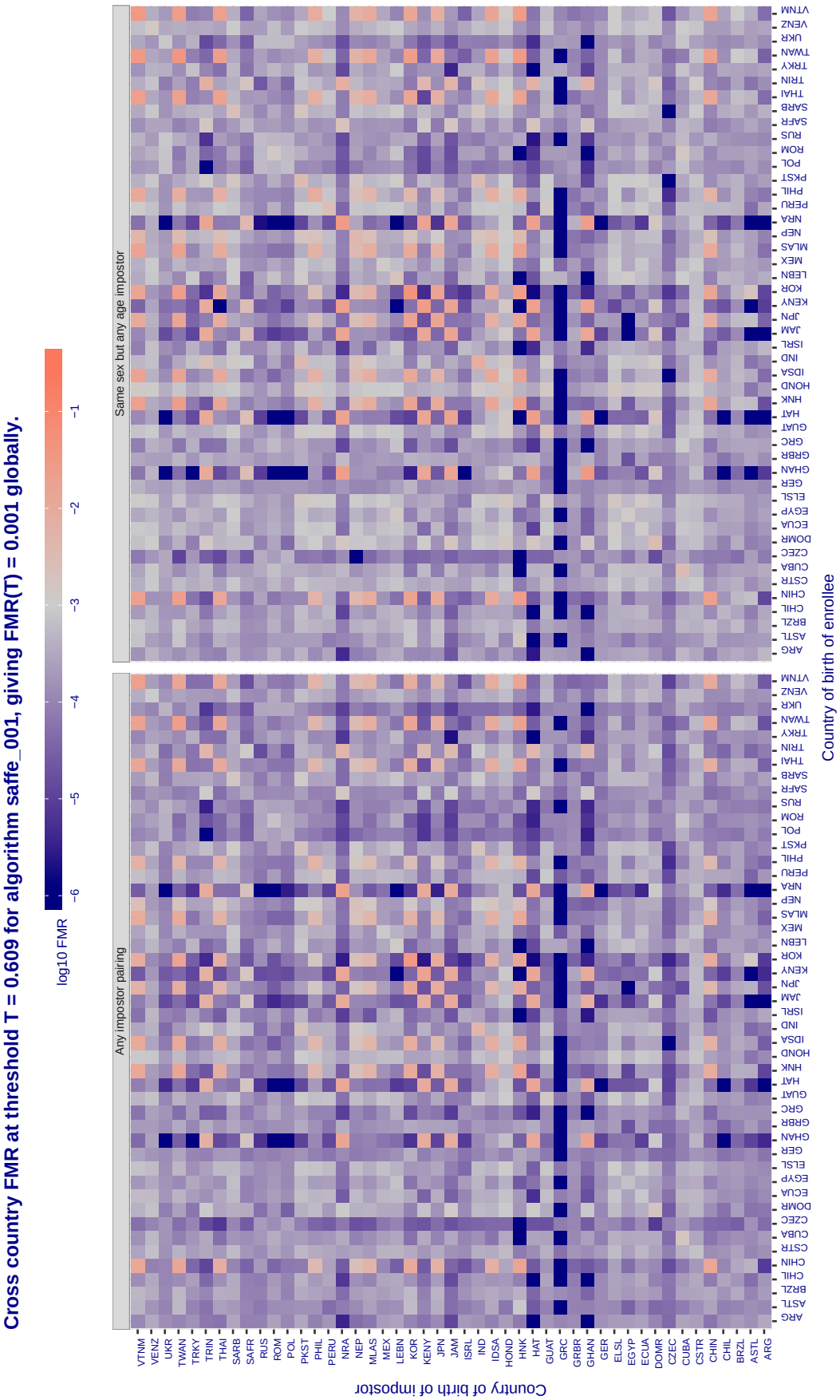


Figure 321: For algorithm saffe-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

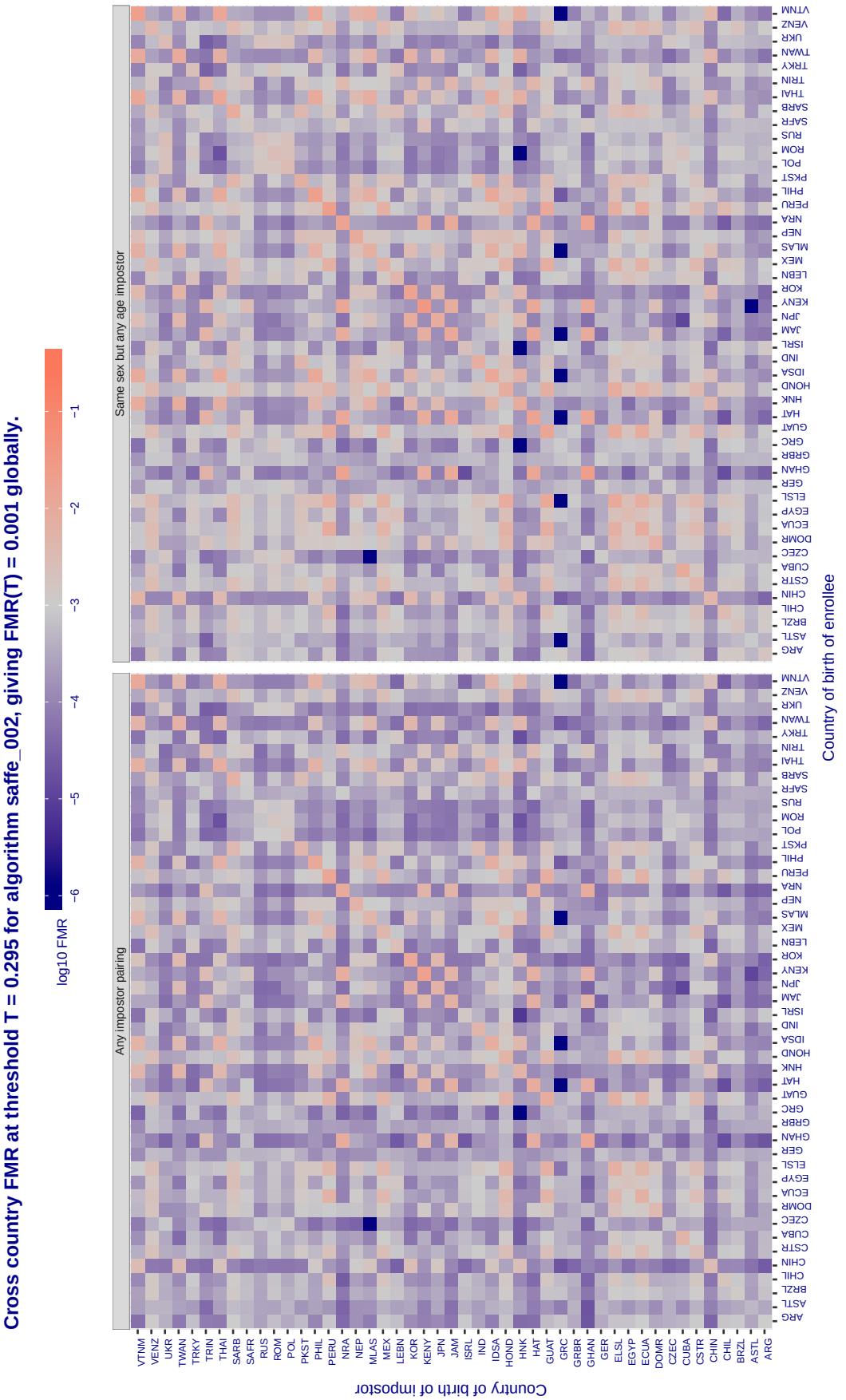


Figure 322: For algorithm saffe-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

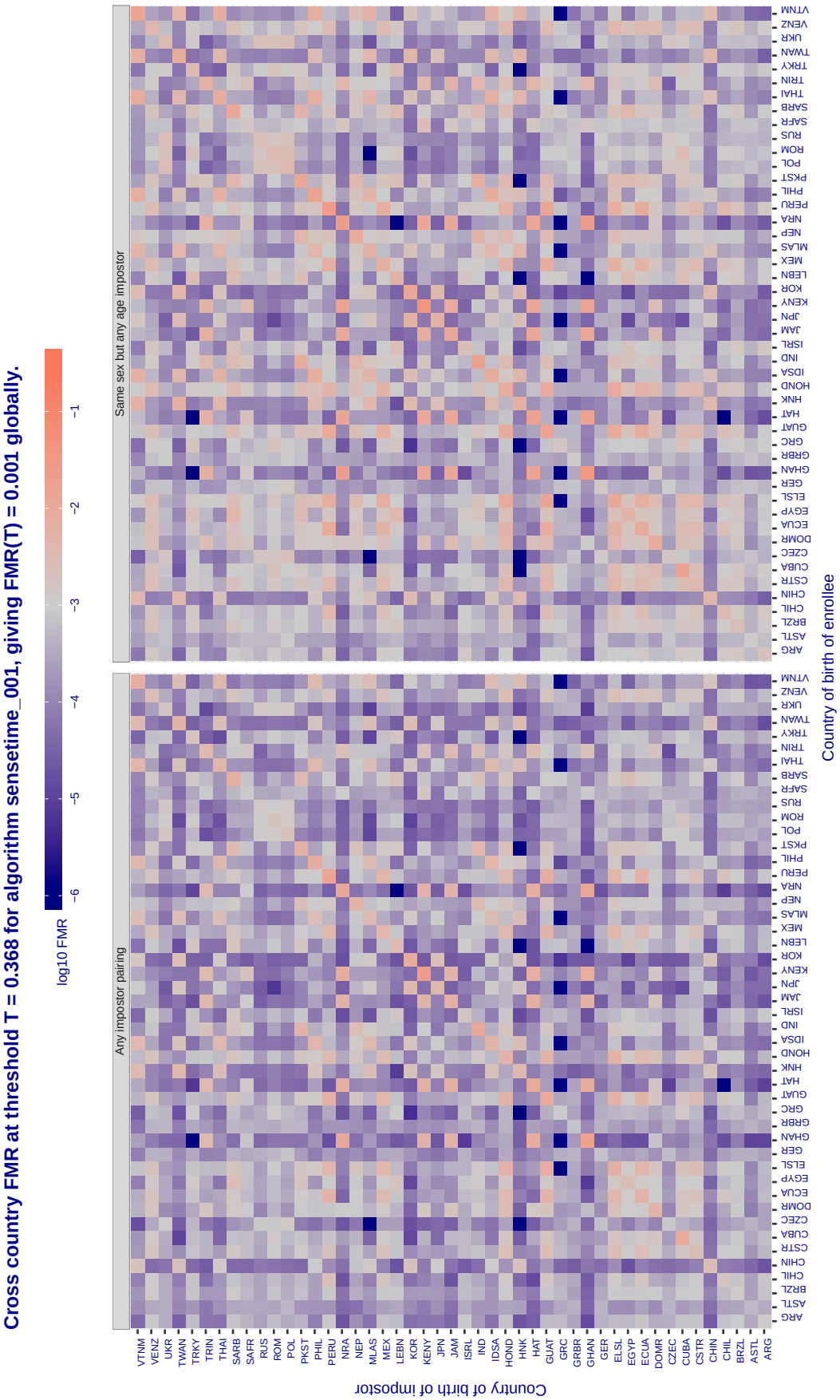


Figure 323: For algorithm sensetime-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

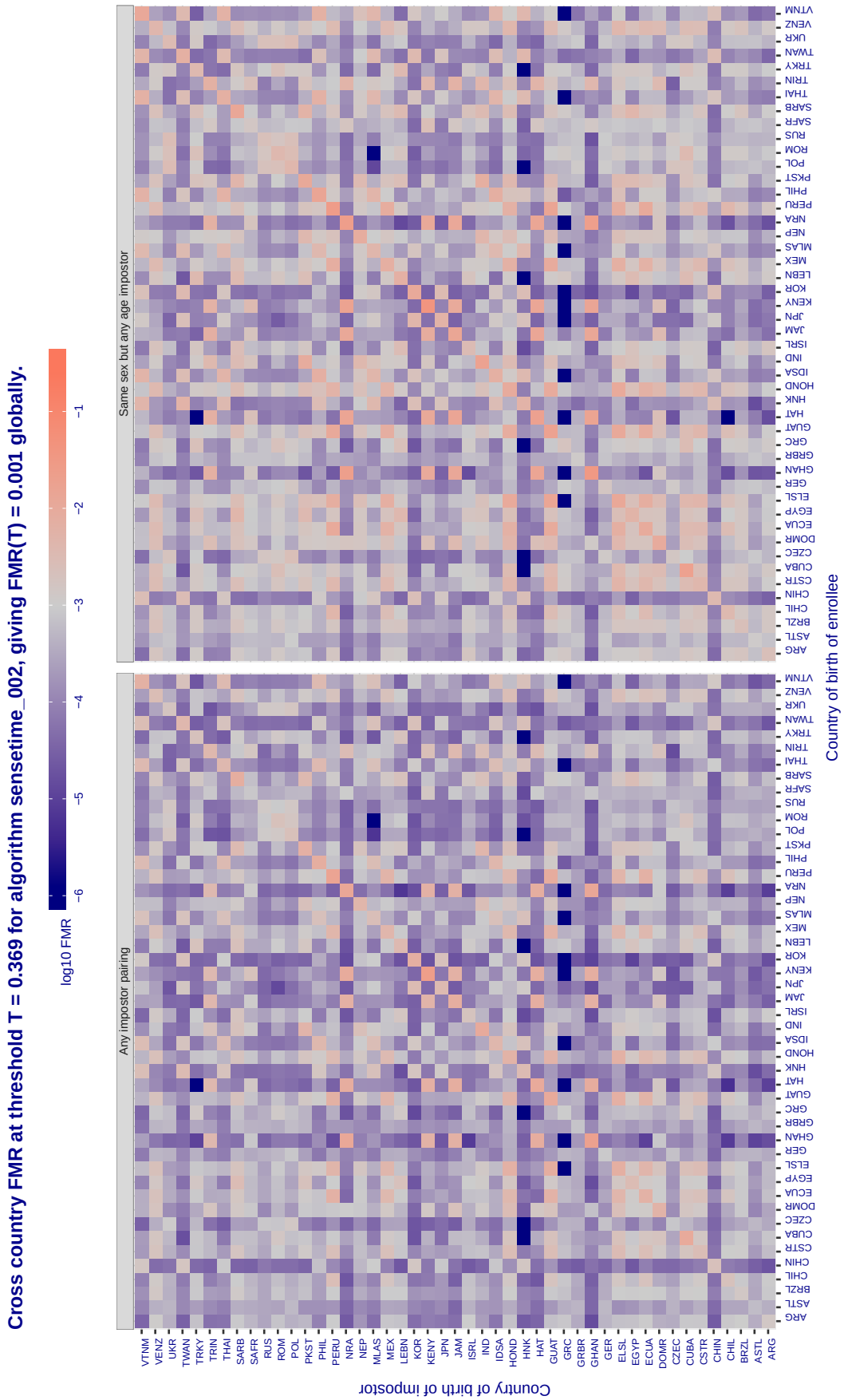


Figure 324: For algorithm sensetime-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

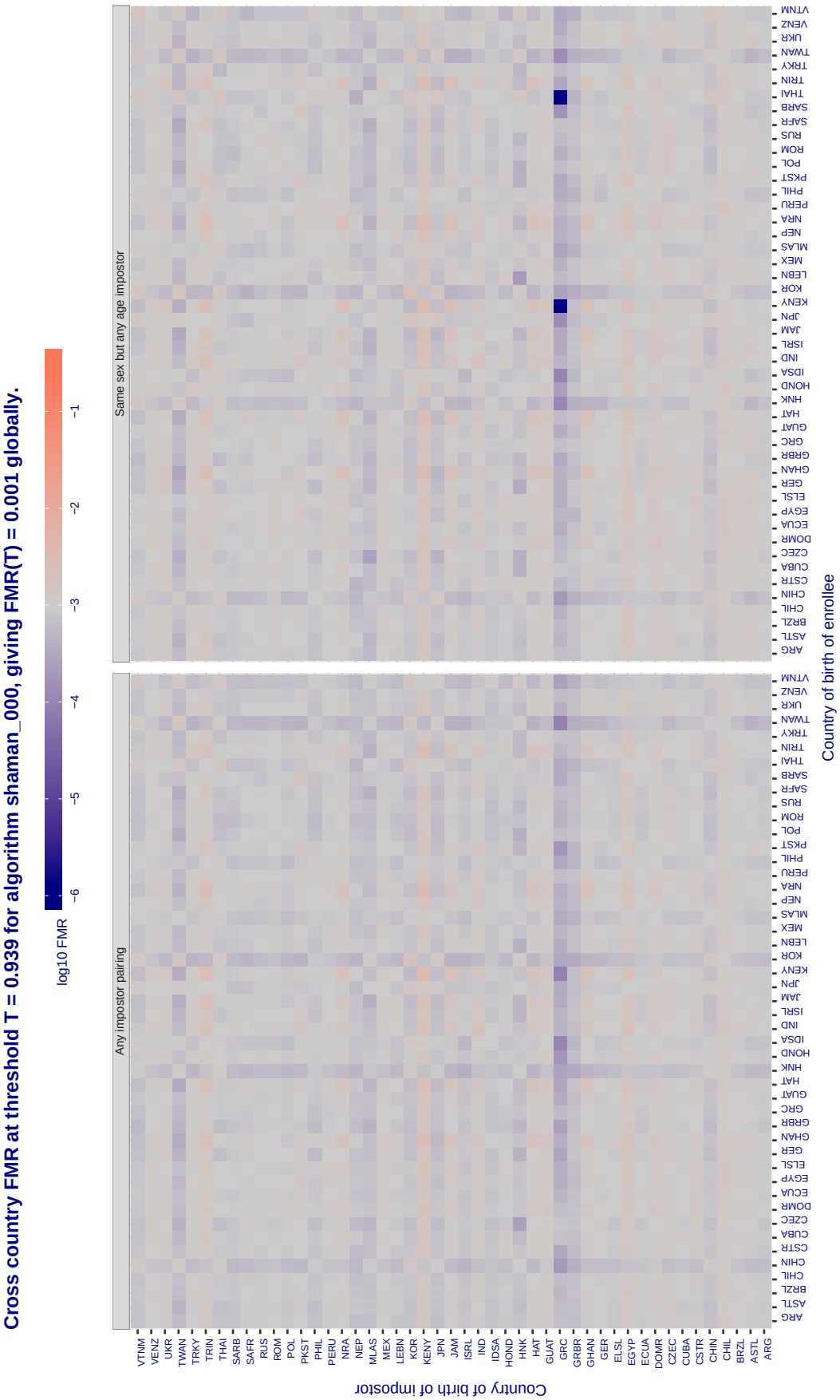


Figure 325: For algorithm shaman-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

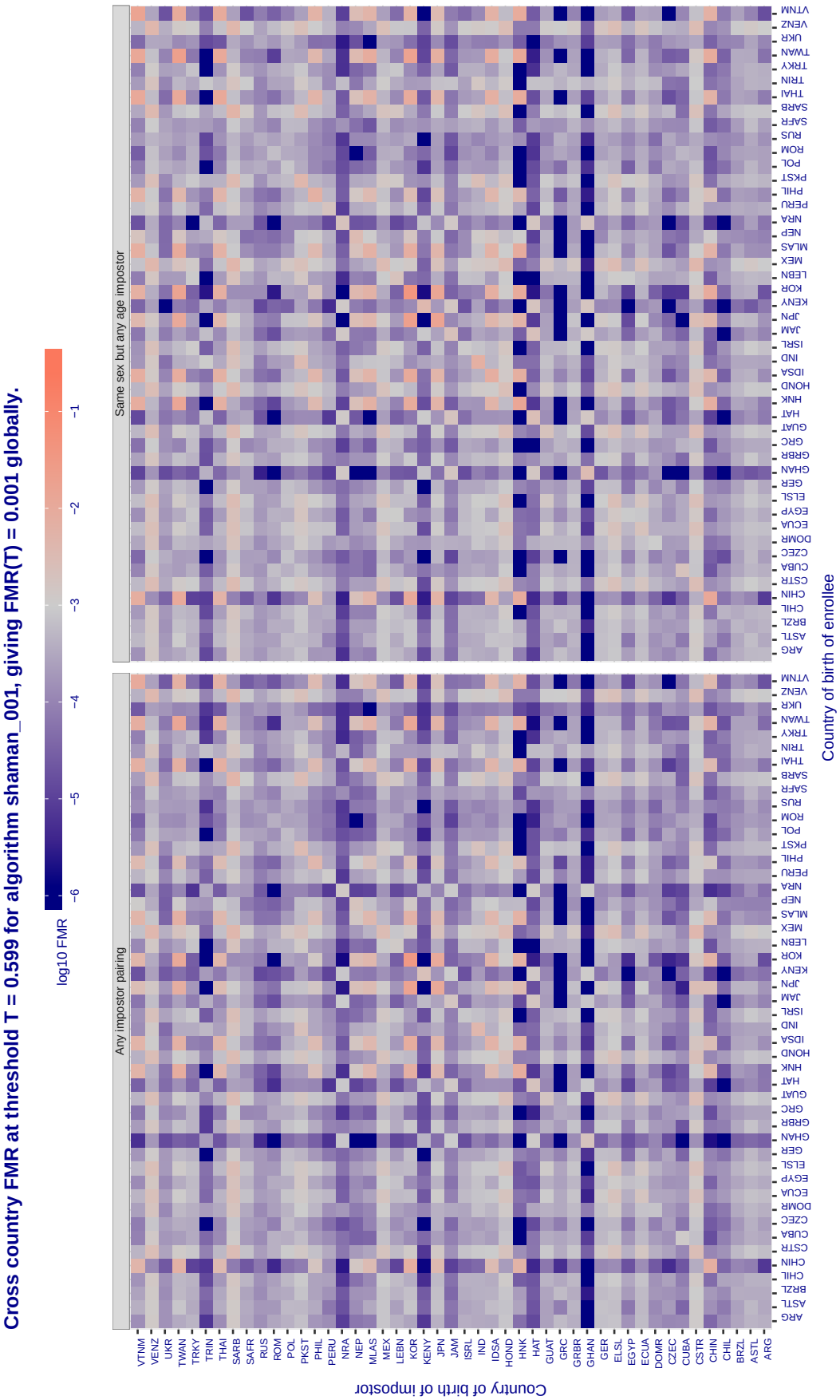


Figure 326: For algorithm shaman-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

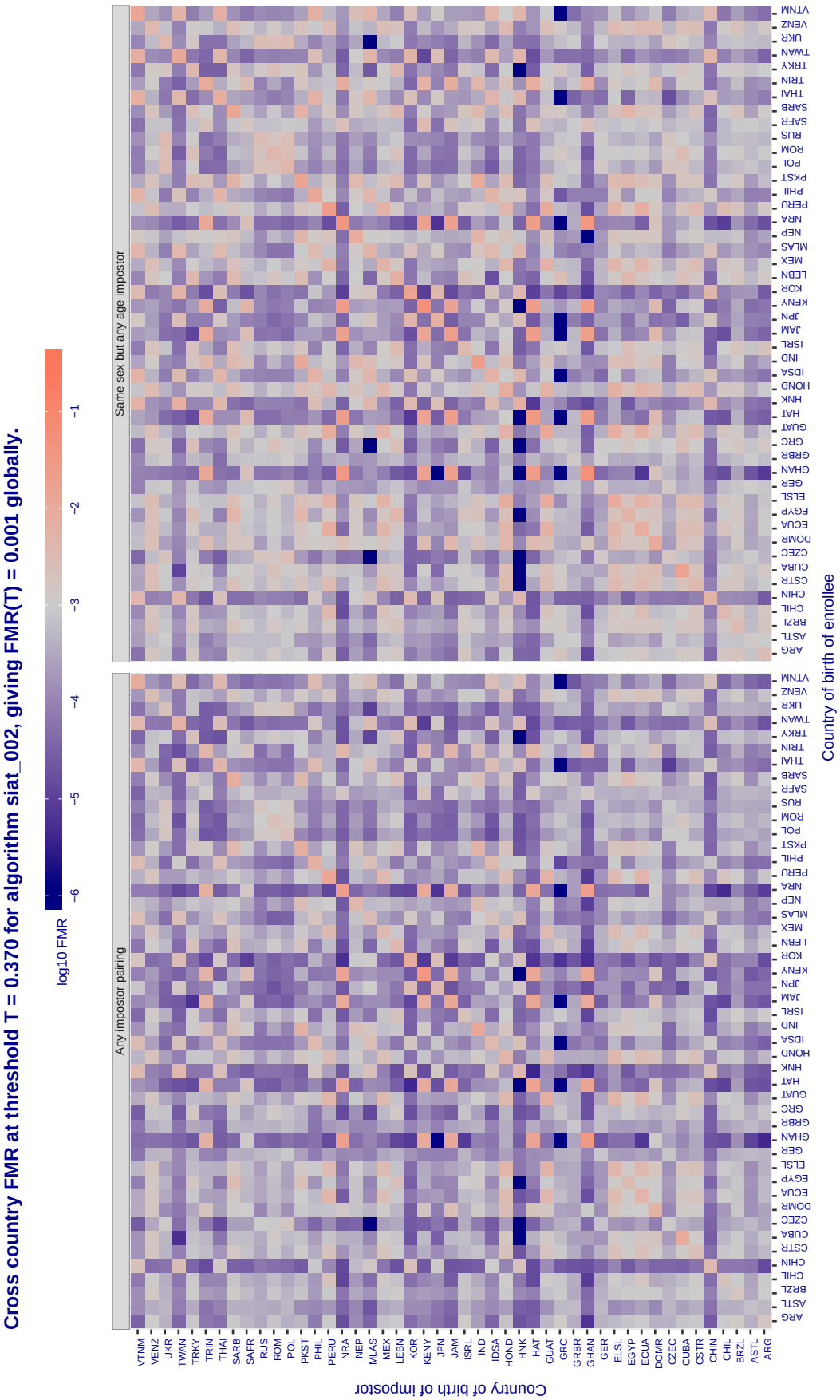


Figure 327: For algorithm siat-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

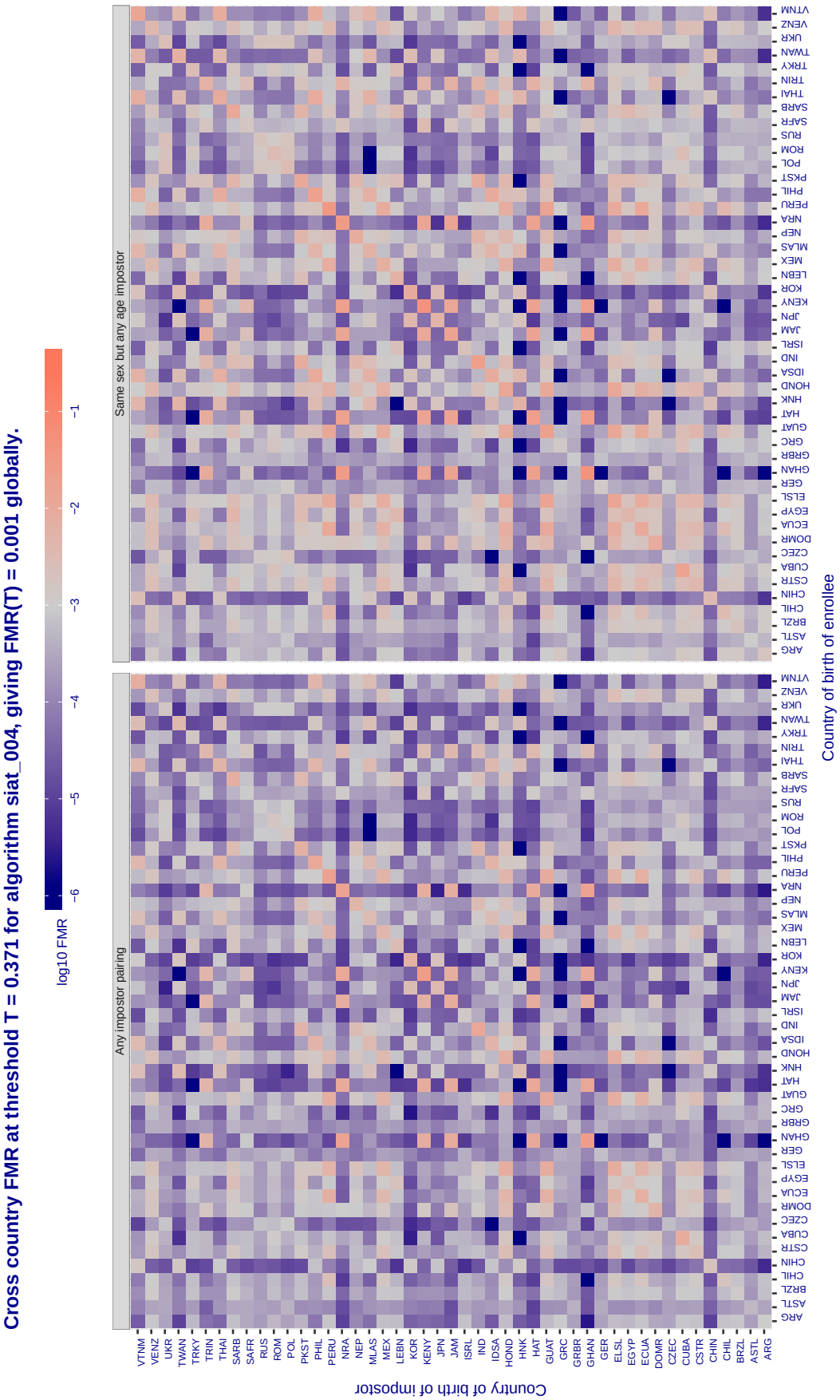


Figure 328: For algorithm siat-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

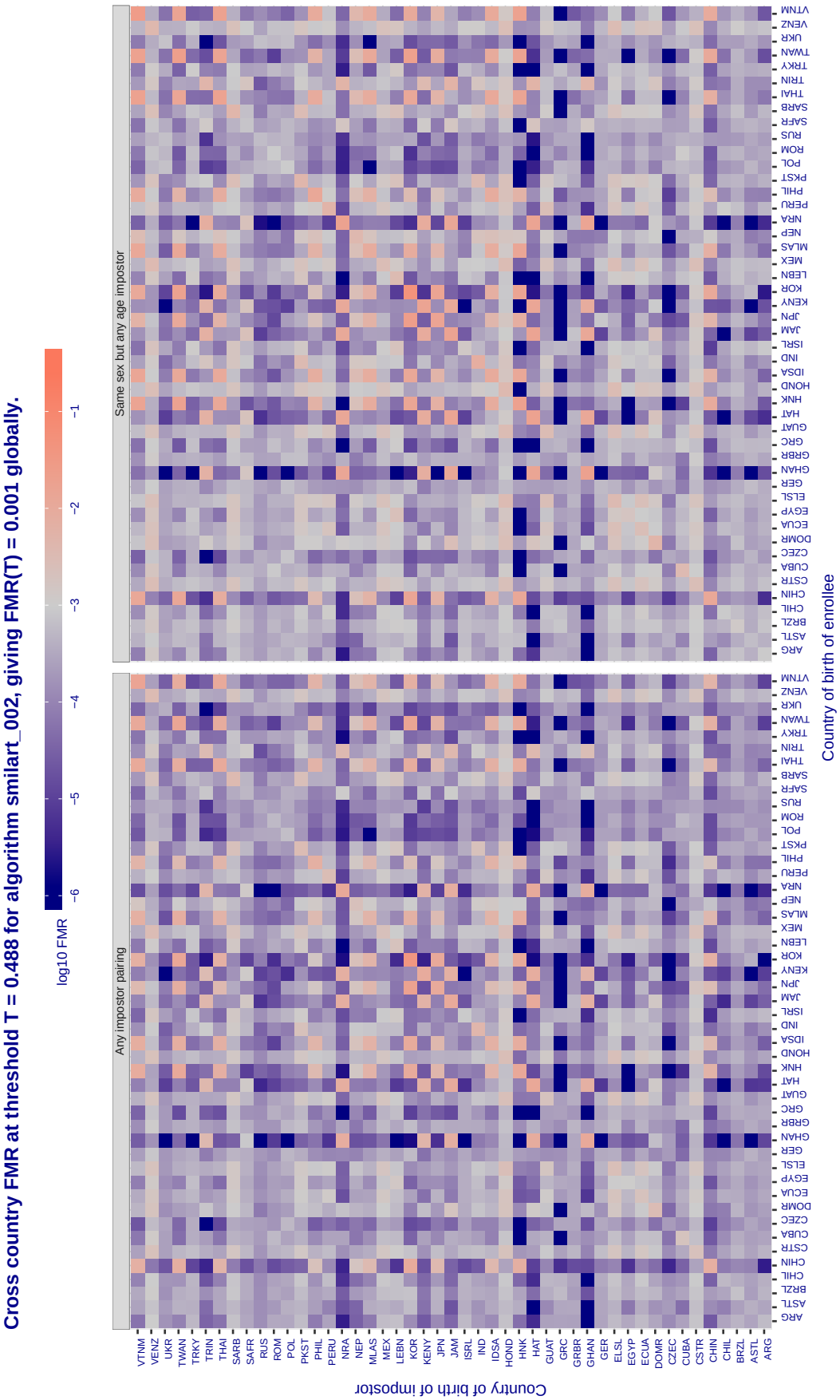


Figure 329: For algorithm smilart-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

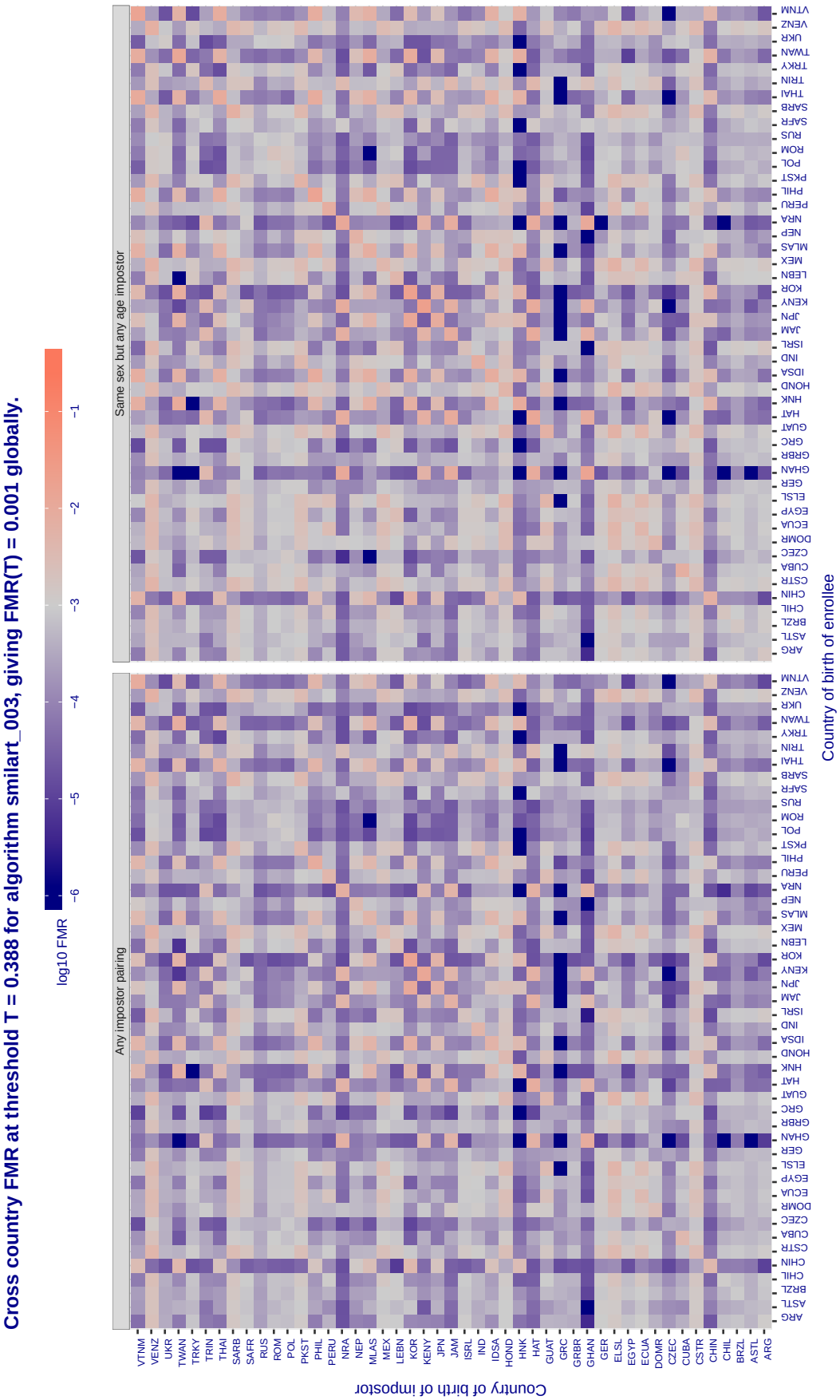


Figure 330: For algorithm smilart-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

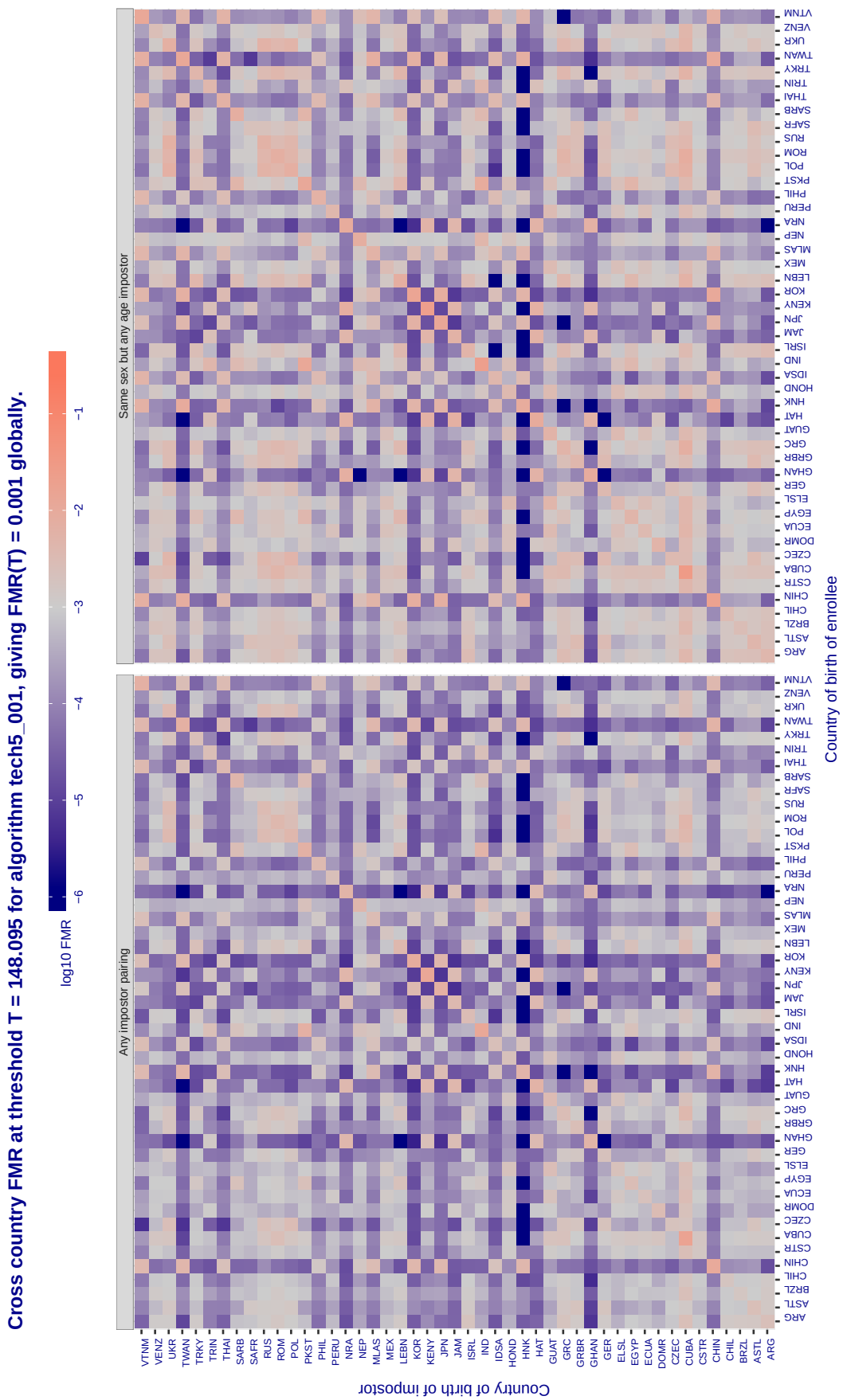


Figure 331: For algorithm tech5-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

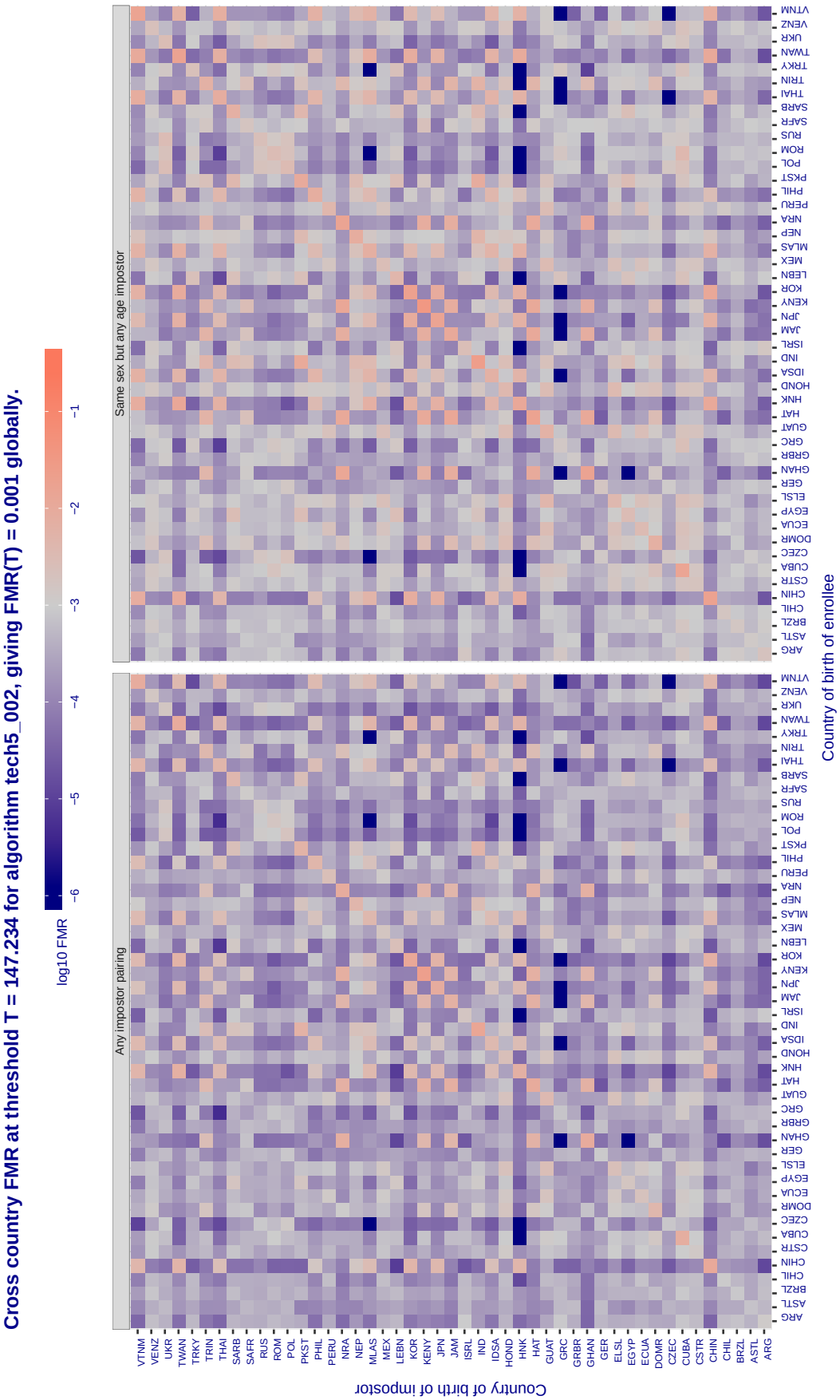


Figure 332: For algorithm tech5-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

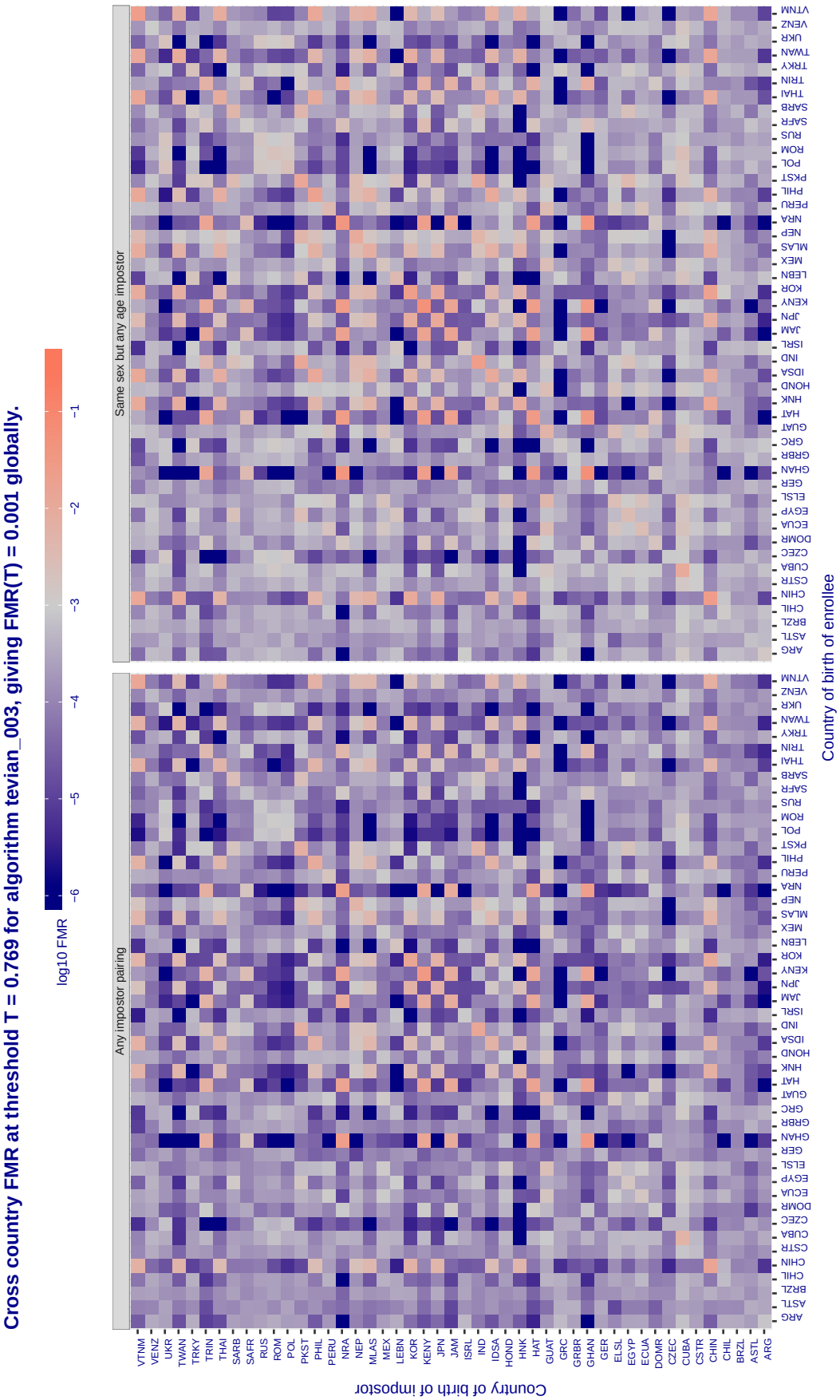


Figure 333: For algorithm tevian-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

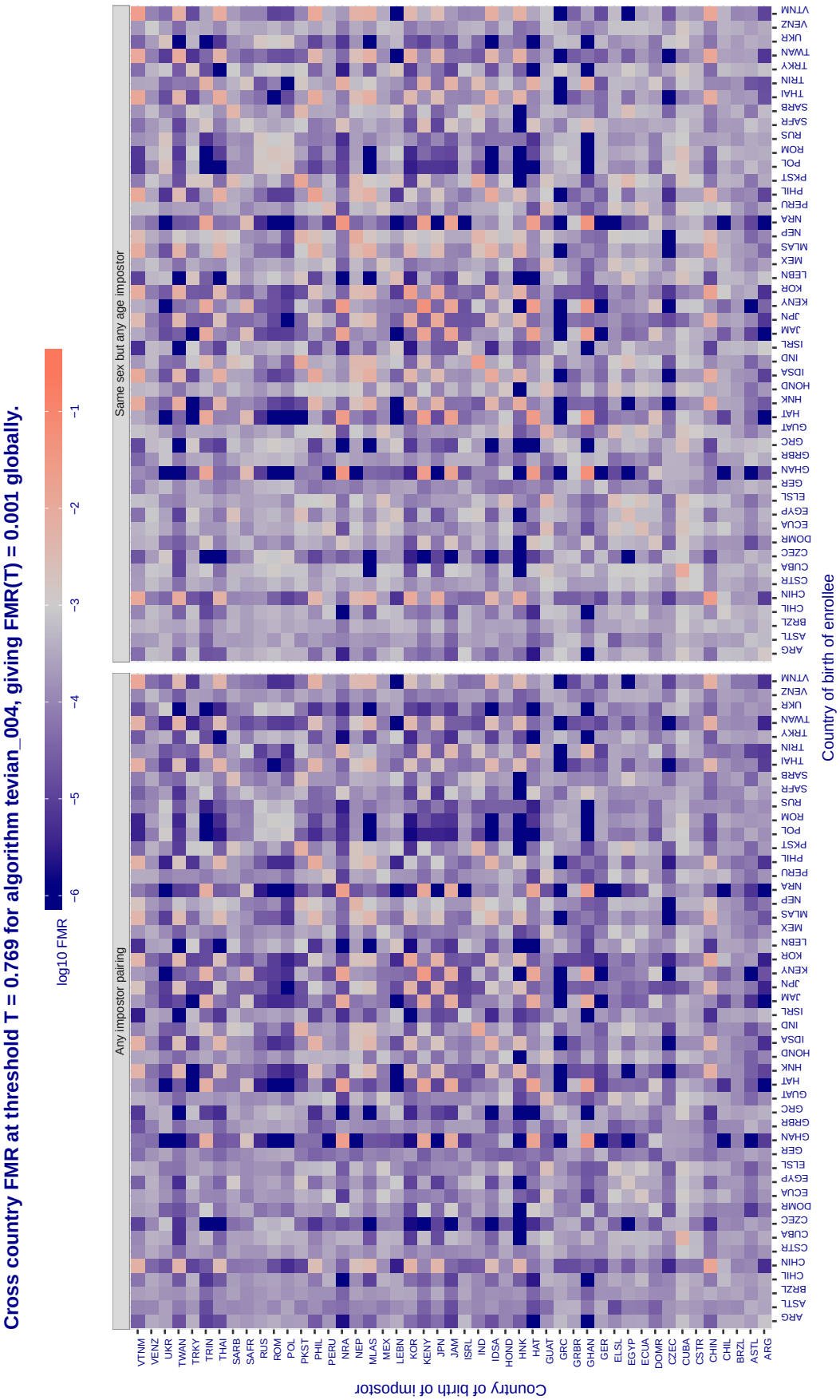


Figure 334: For algorithm tevian-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

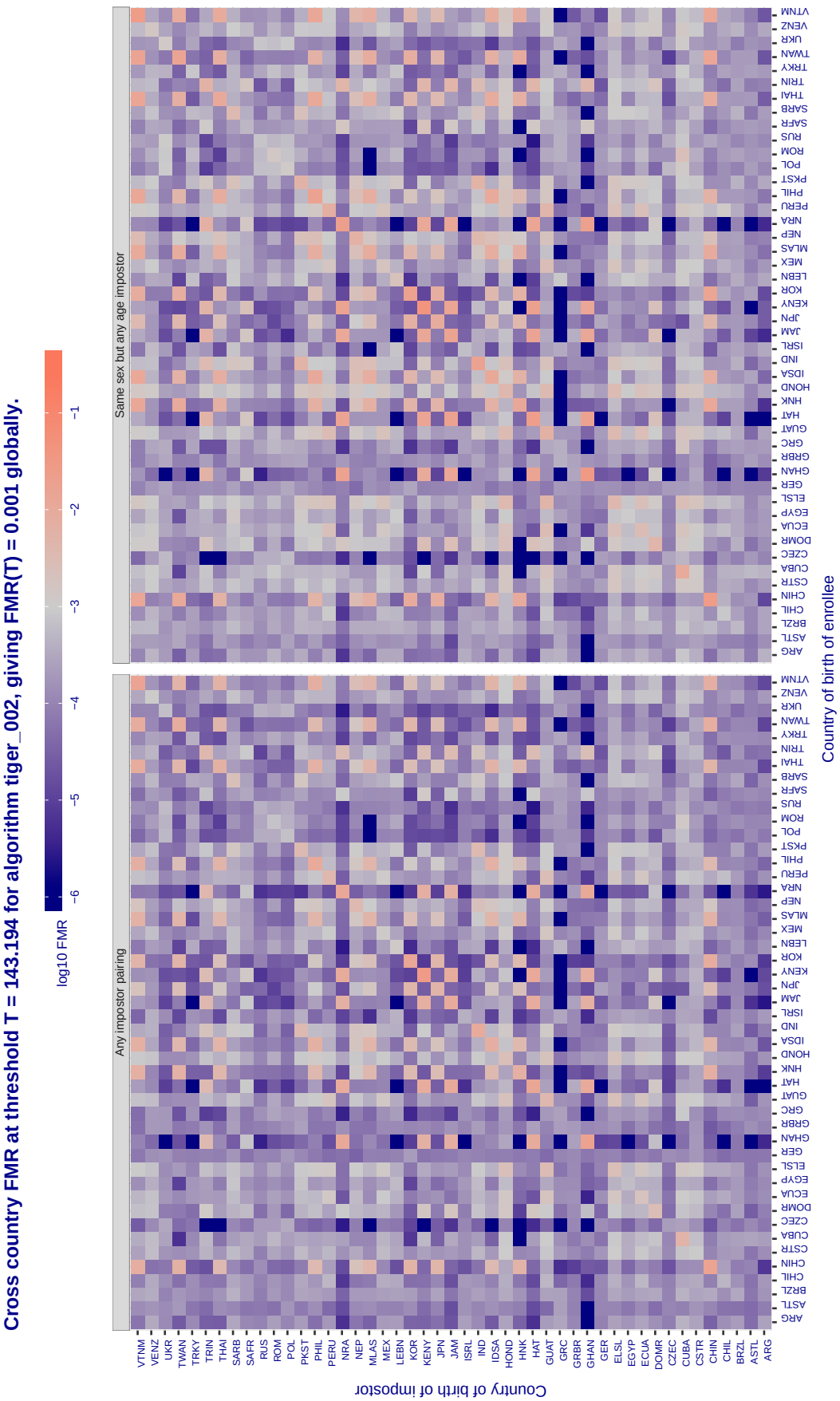


Figure 335: For algorithm tiger-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

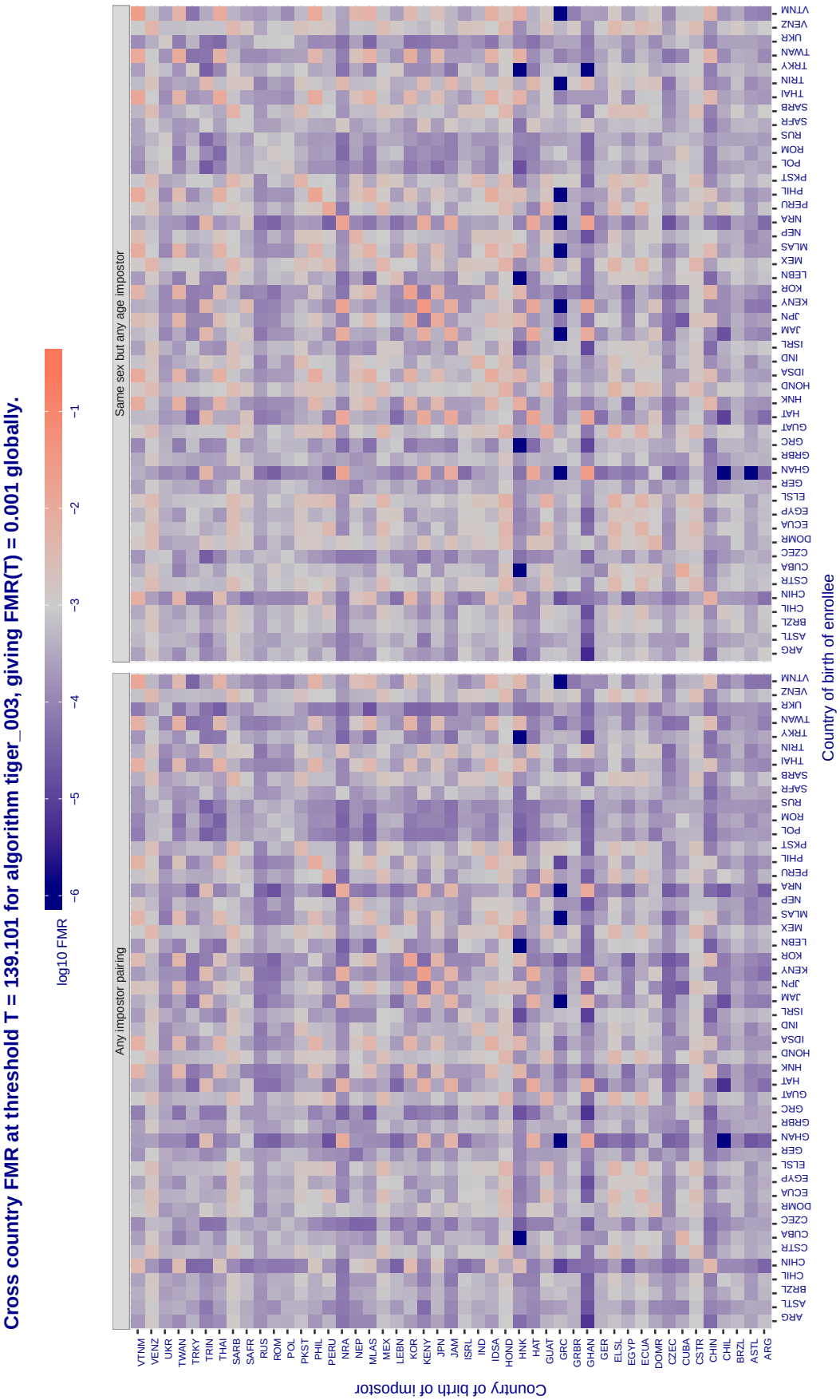


Figure 336: For algorithm tiger-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

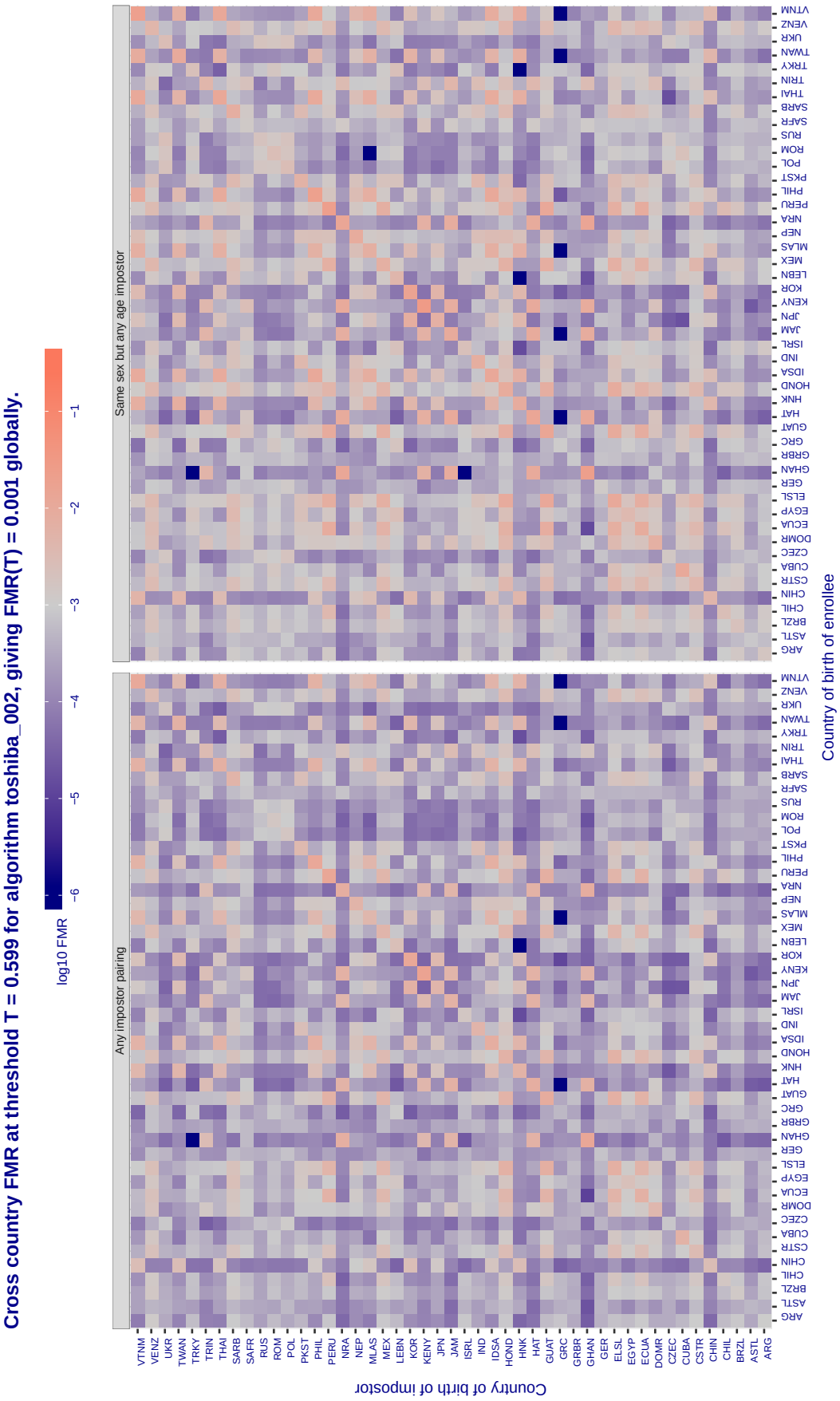


Figure 337: For algorithm toshiba-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

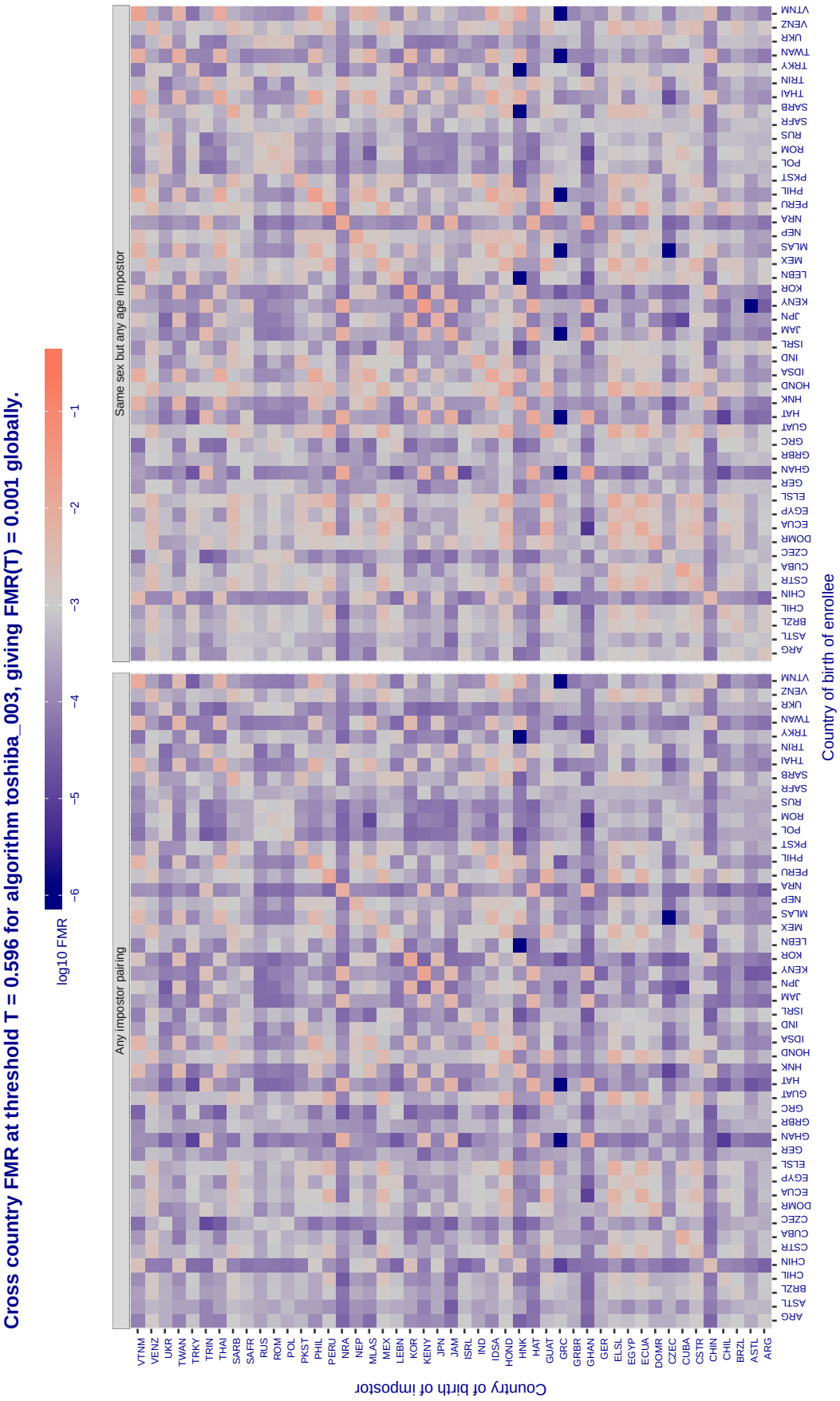


Figure 338: For algorithm toshiba-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

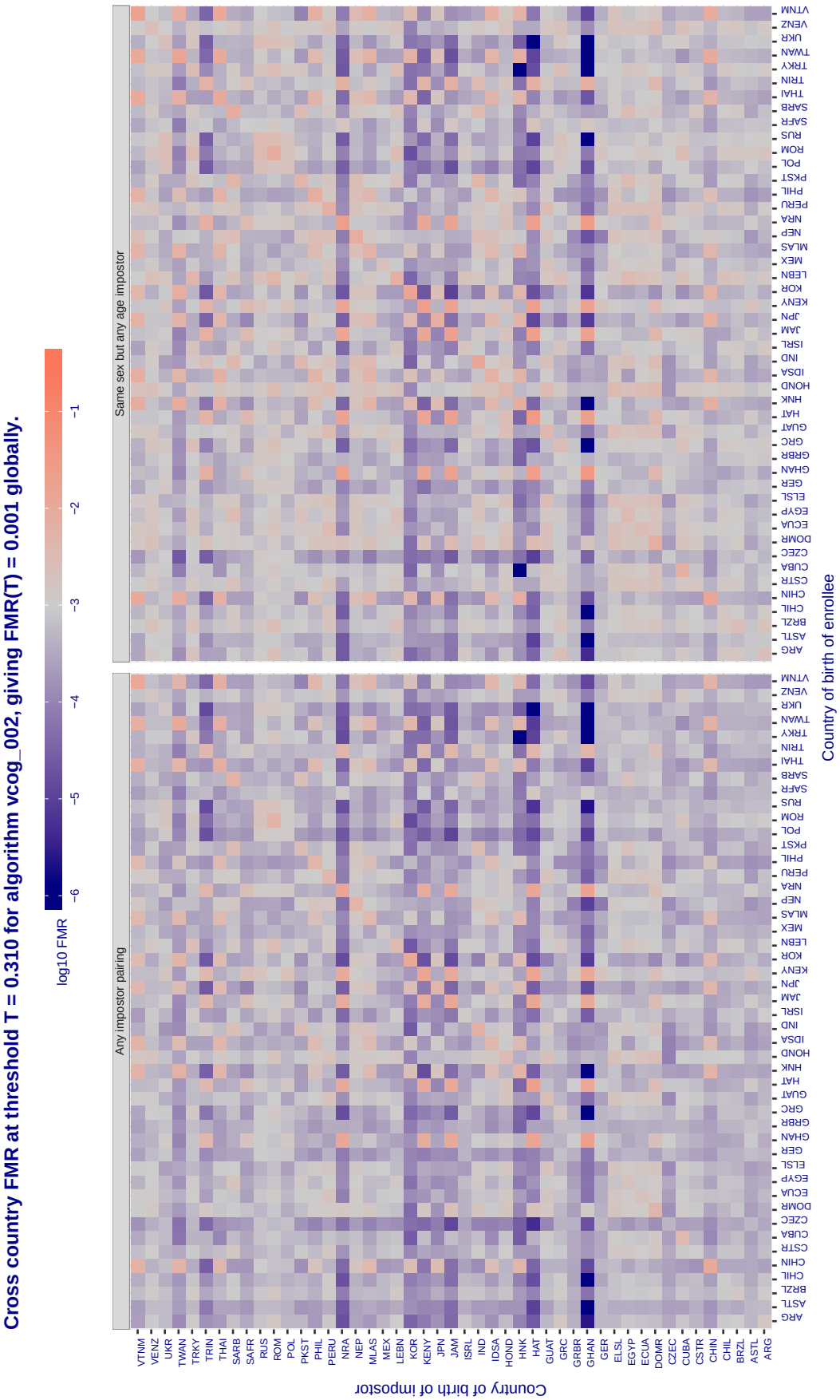


Figure 339: For algorithm vcog-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

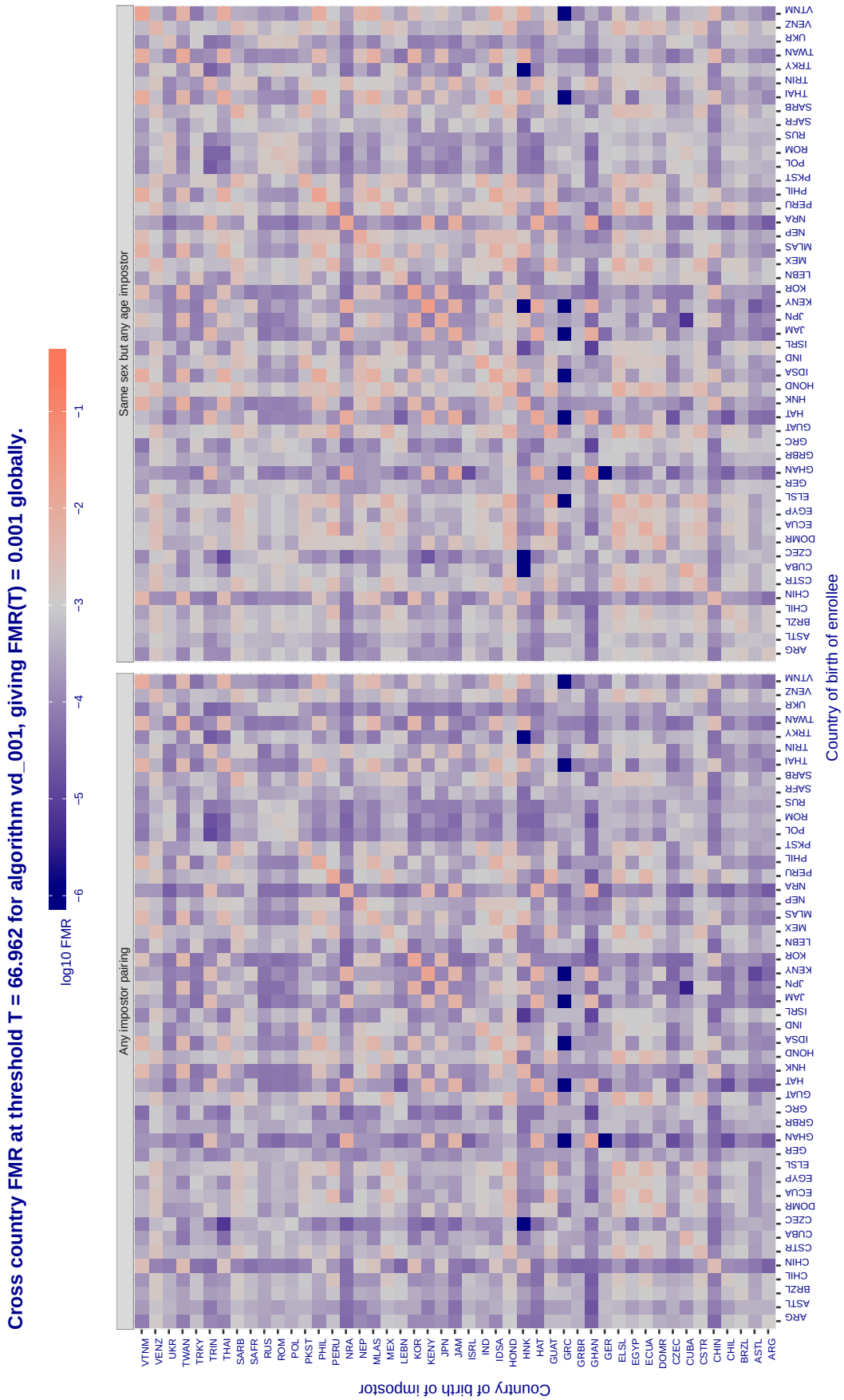


Figure 340: For algorithm vd-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

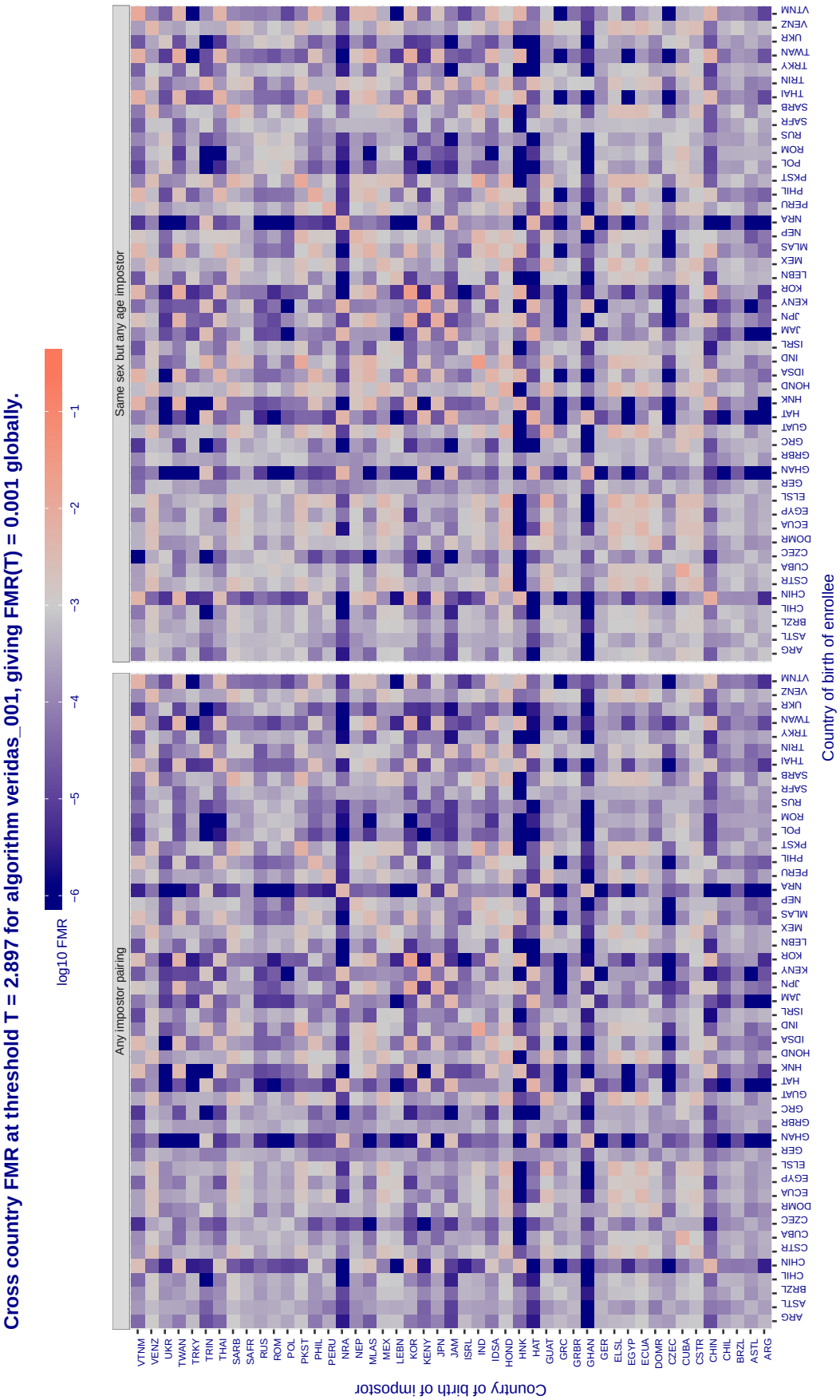


Figure 341: For algorithm veridas-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

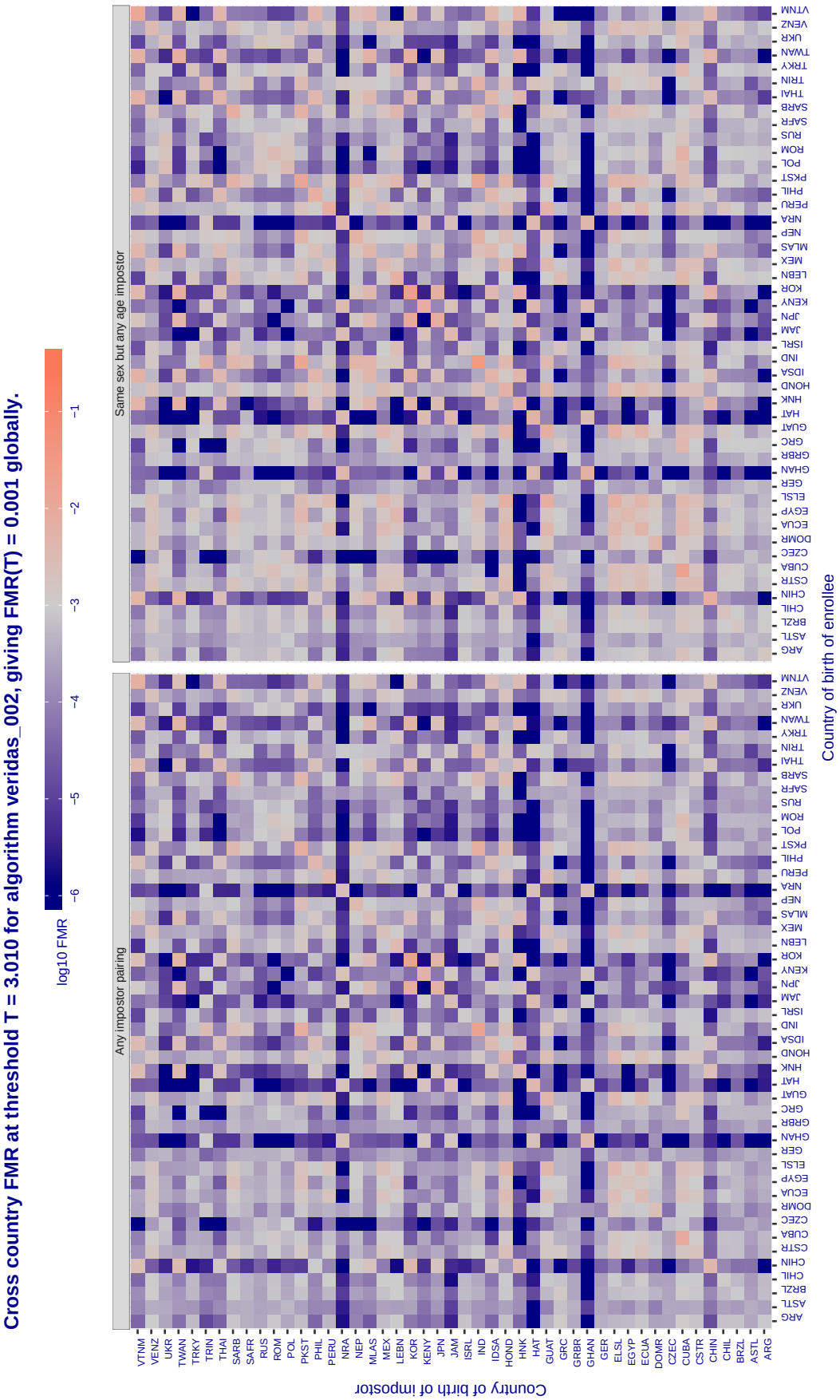


Figure 342: For algorithm veridas-002 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

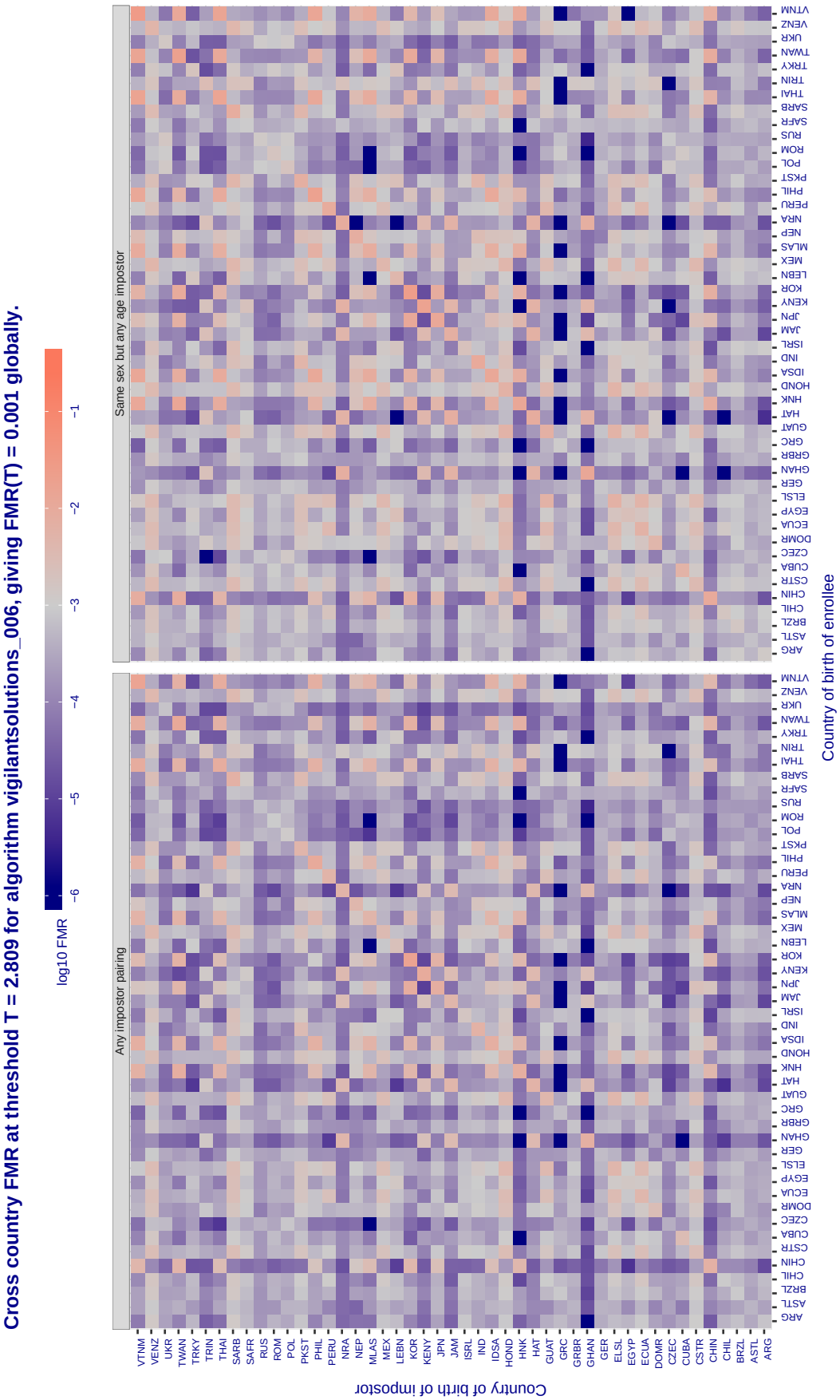


Figure 343: For algorithm vigilantsolutions-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

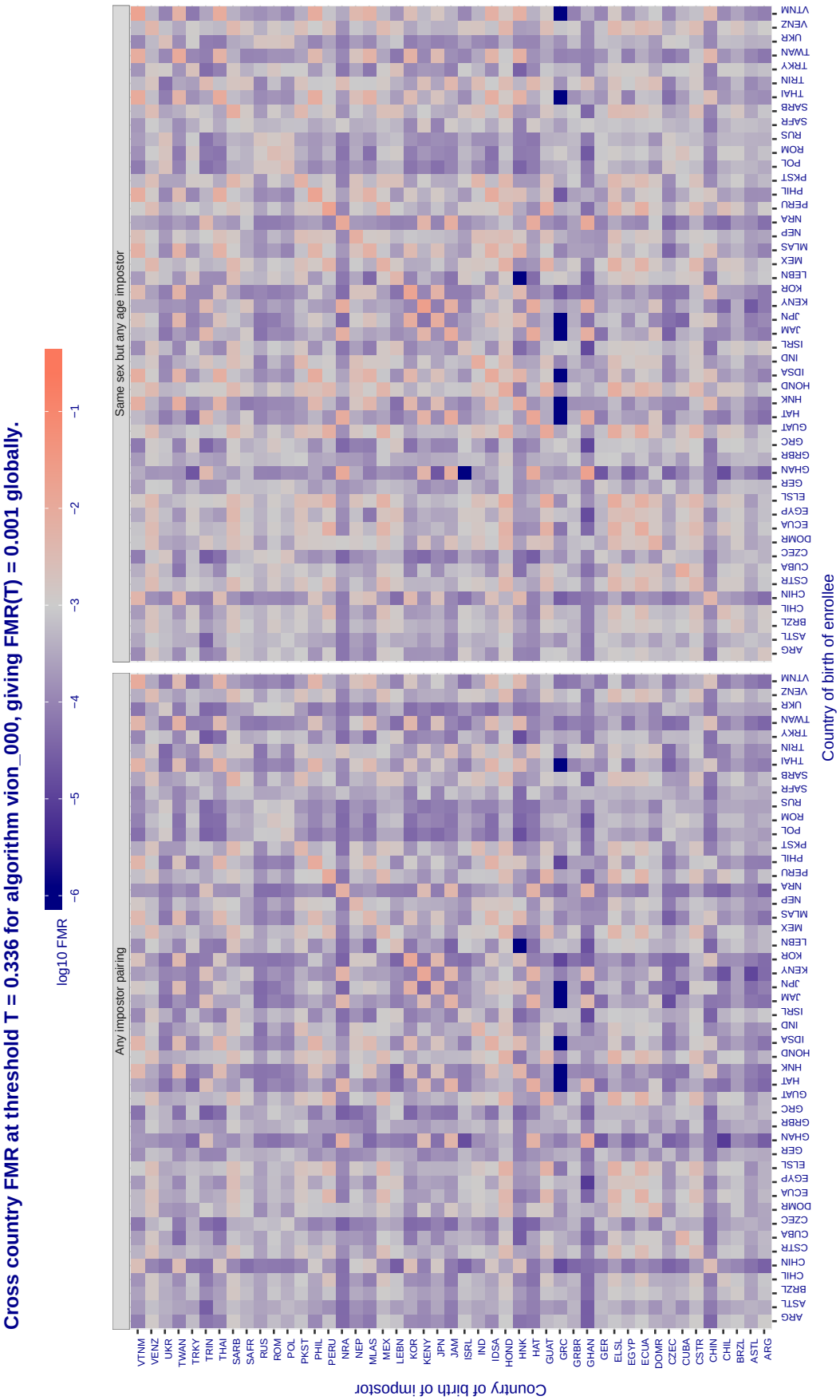


Figure 344: For algorithm vion-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

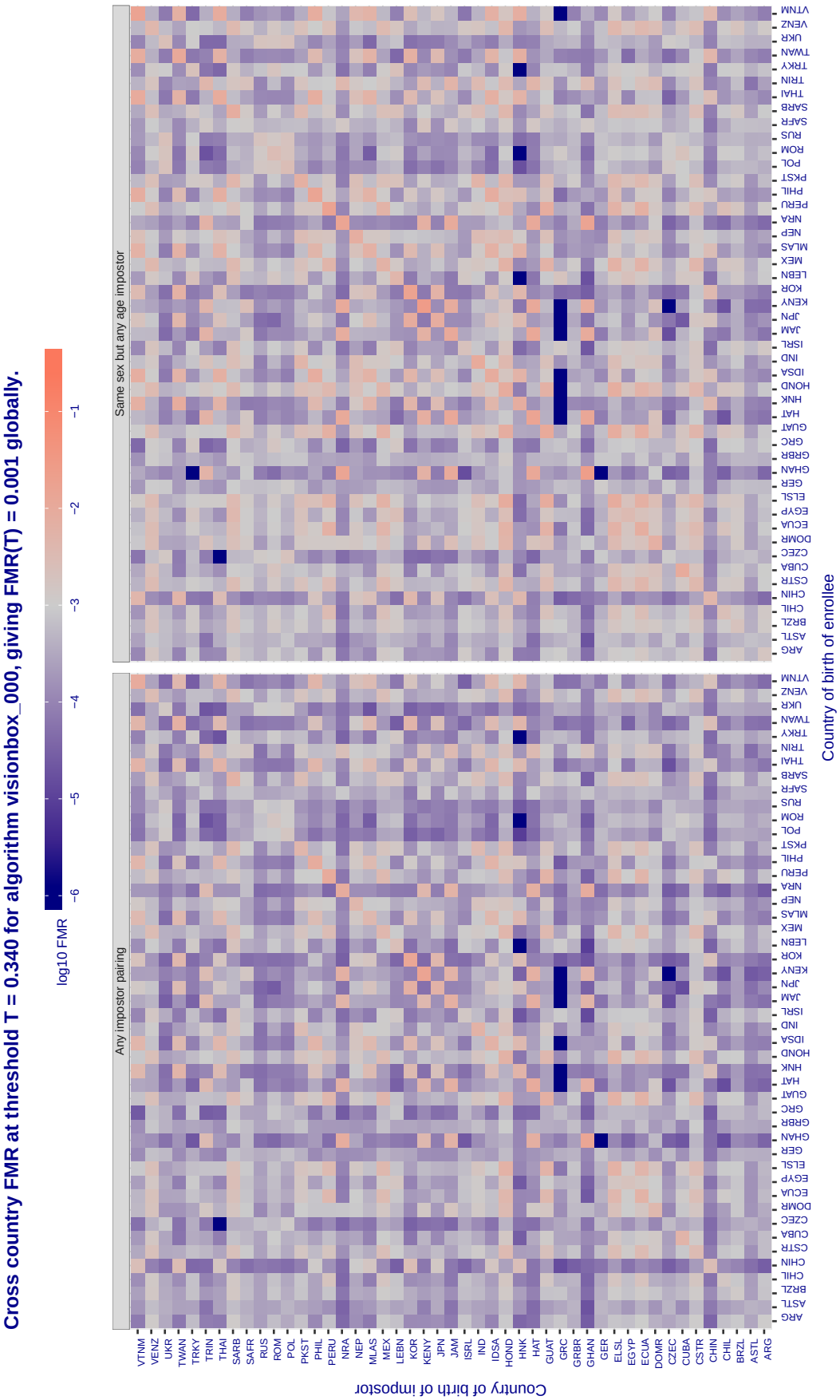


Figure 345: For algorithm visionbox-000 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

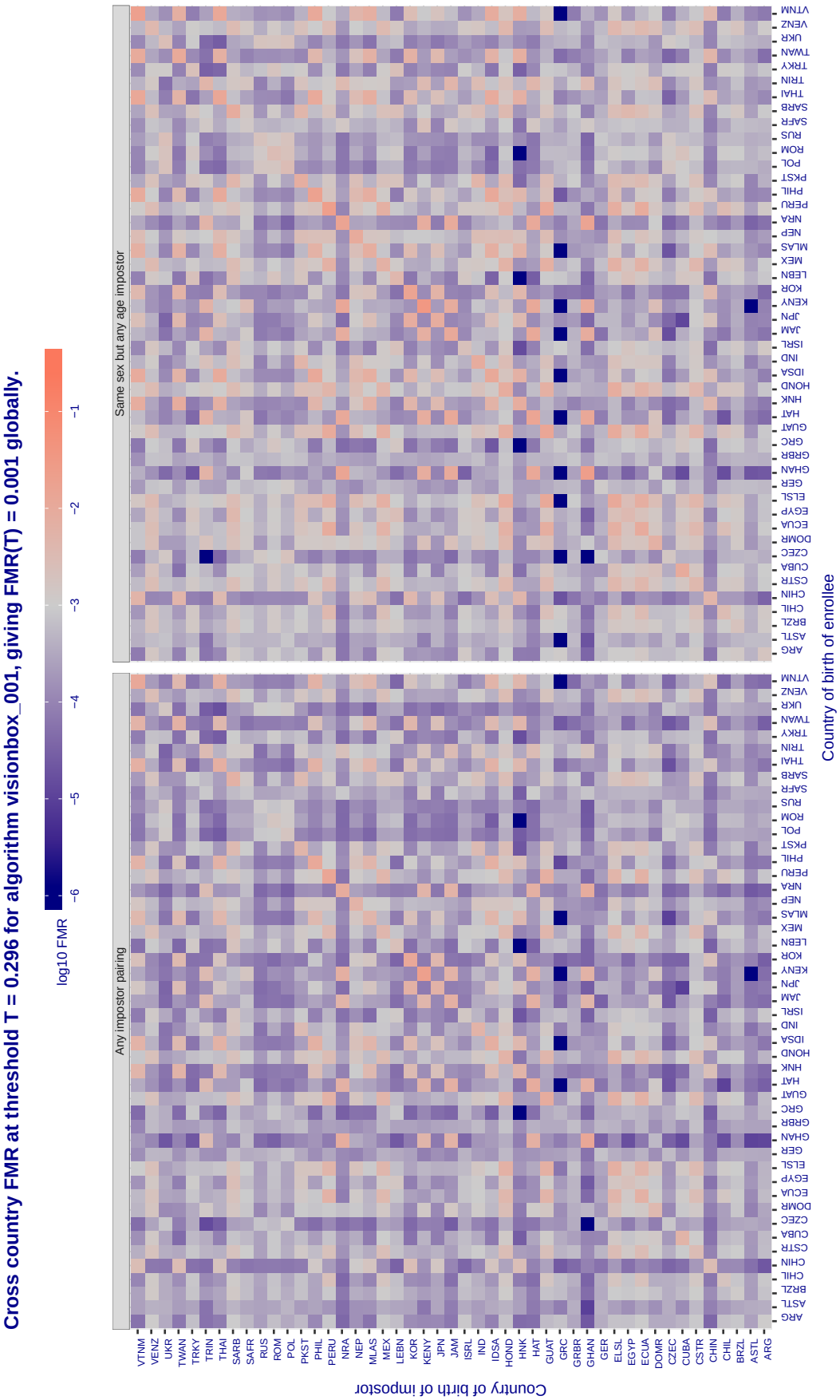


Figure 346: For algorithm visionbox-001 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

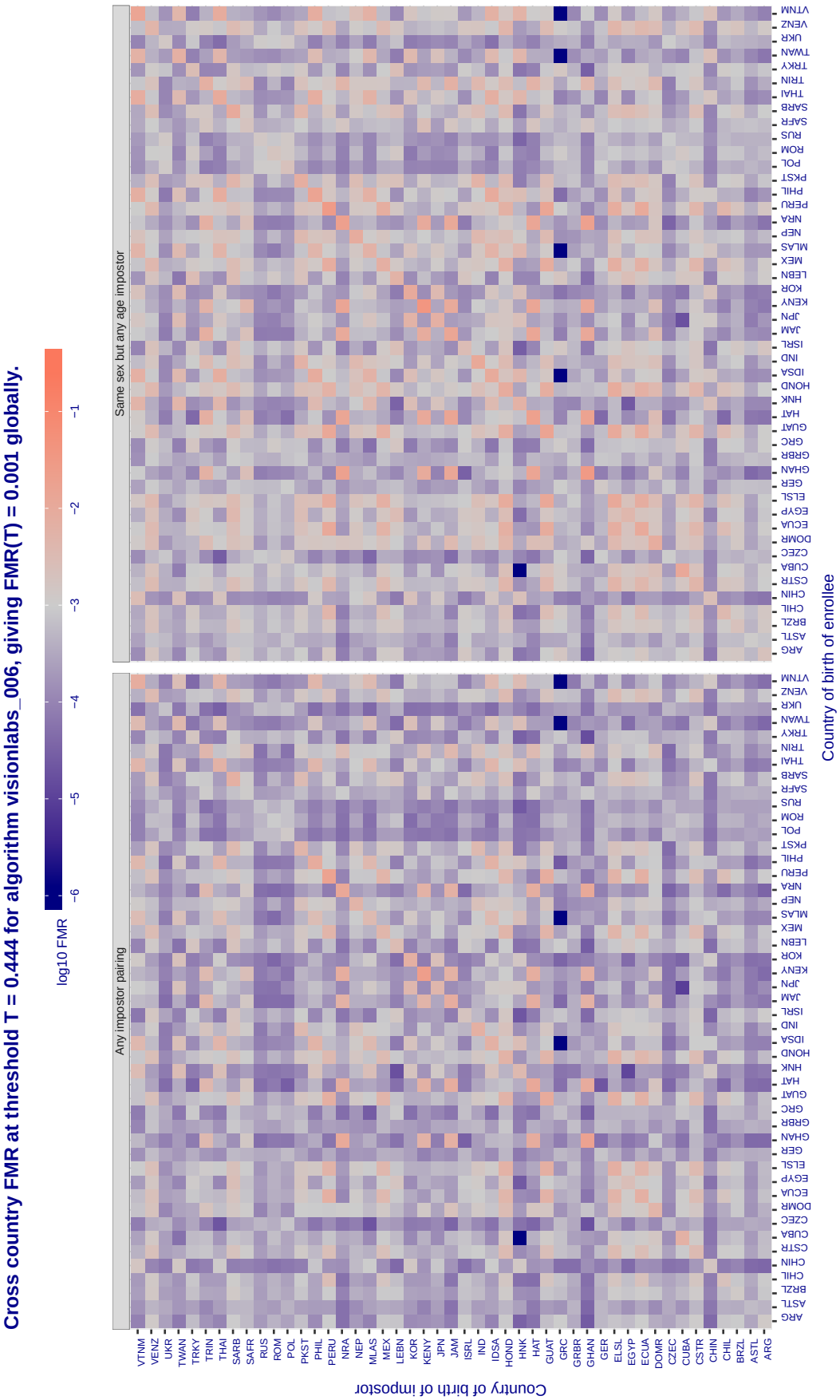


Figure 347: For algorithm visionlabs-006 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

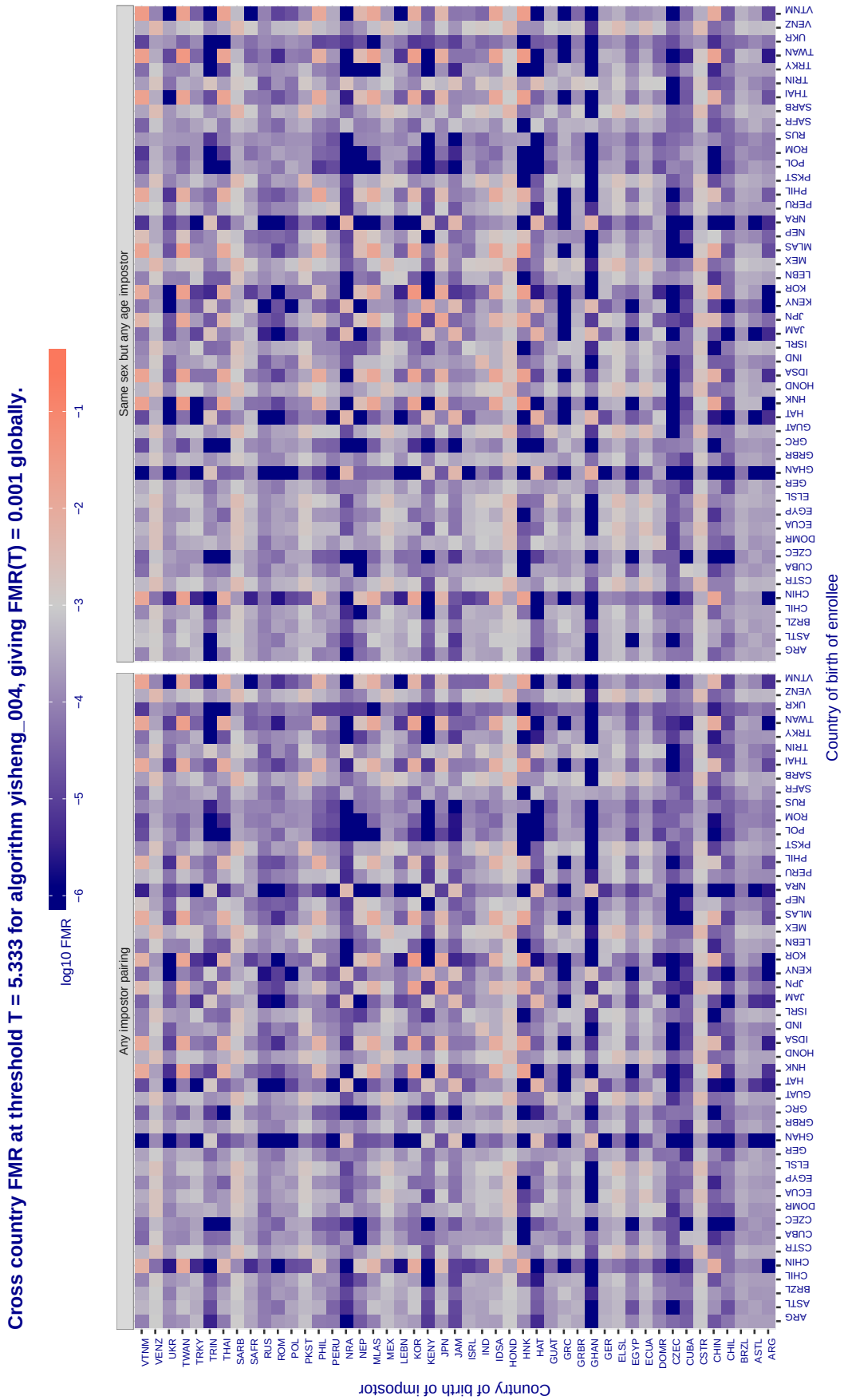


Figure 348: For algorithm yisheng-004 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

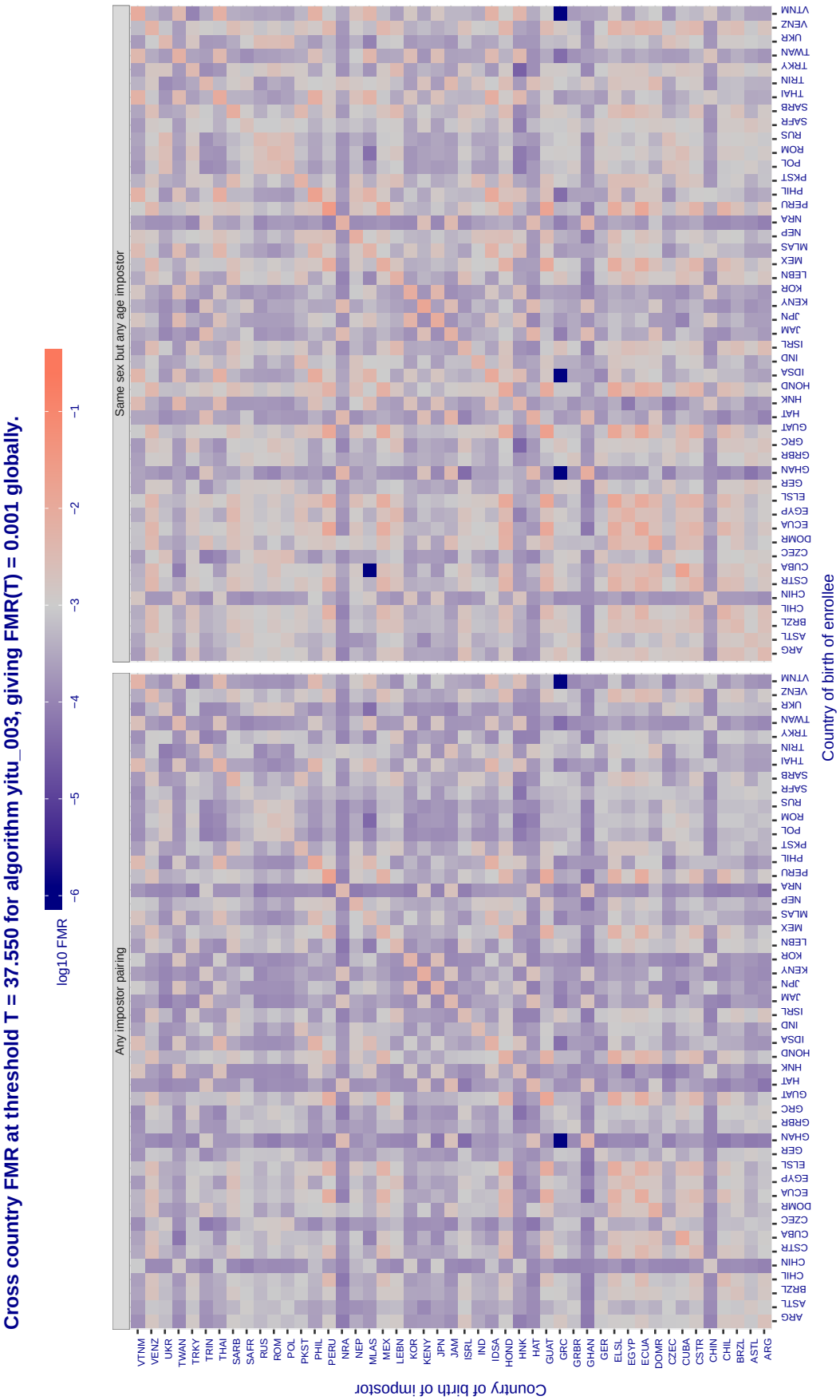


Figure 349: For algorithm yitu-003 operating on visa images, the heatmap shows false match rates observed over impostor comparisons of faces from different individuals who were born in the given country pair. False matches are counted against a recognition threshold fixed globally to give the target FMR in the plot title, computed over all on the order of 10^{10} impostor comparisons. If text appears in each box it give the same quantity as that coded by the color. Grey indicates FMR is at the intended FMR target level. Light red colors present a security vulnerability to, for example, a passport gate. Each +1 increase in log10 FMR corresponds to a factor of 10 increase in FMR. The matrix is not quite symmetric because images in the enrollment and verification sets are different.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

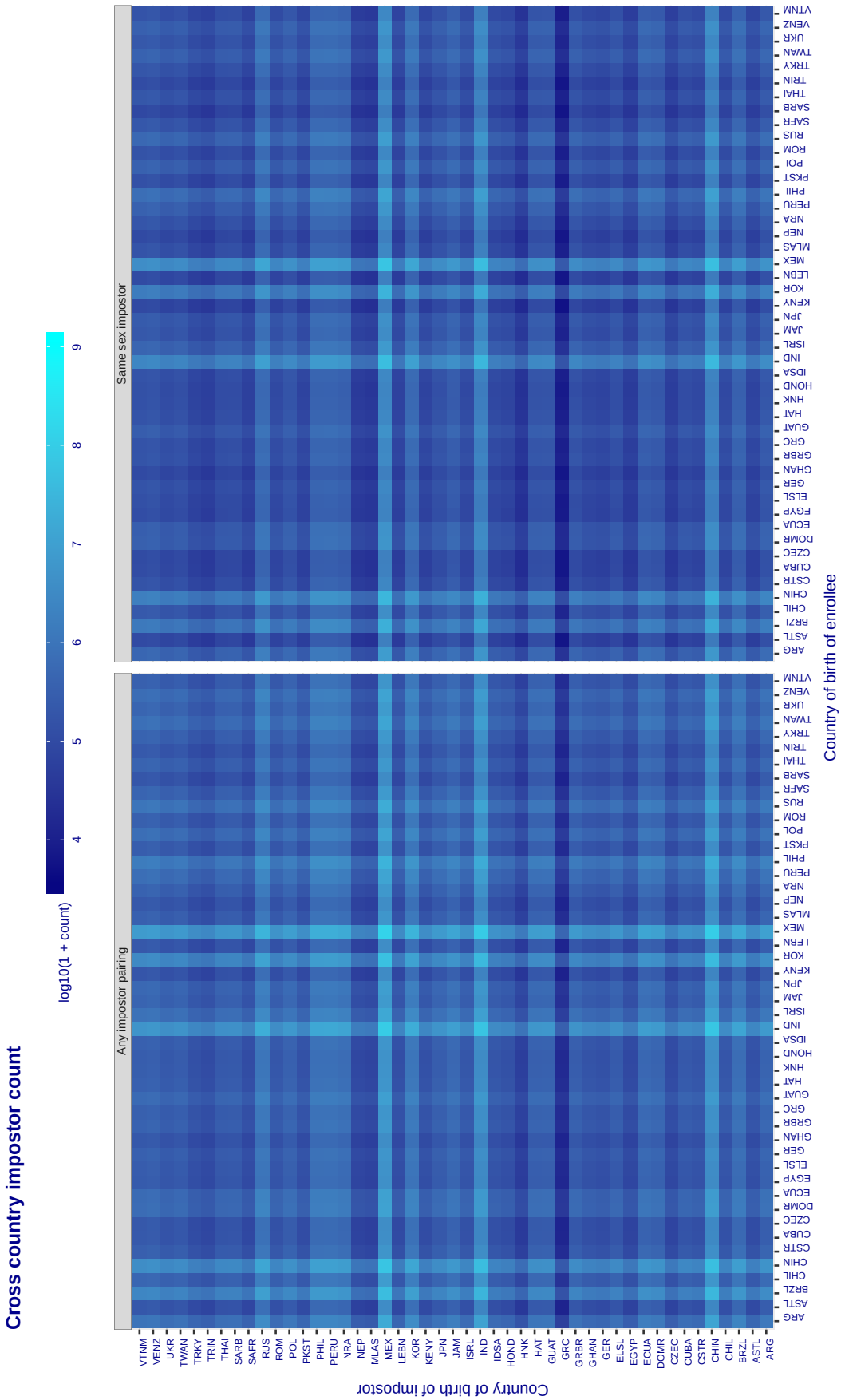


Figure 350: For visa images, the heatmap shows the count of impostor comparisons of faces from different individuals who were born in the given country pair.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

3.6.2 Effect of age on impostors

Background: This section shows the effect of age on the impostor distribution. The ideal behaviour is that the age of the enrollee and the impostor would not affect impostor scores. This would support FMR stability over sub-populations.

Goals:

- ▷ To show the effect of relative ages of the impostor and enrollee on false match rates.
- ▷ To determine whether some algorithms have better impostor distribution stability.

Methods:

- ▷ Define 14 age group bins, spanning 0 to over 100 years old.
- ▷ Compute FMR over all impostor comparisons for which the subjects in the enrollee and impostor images have ages in two bins.
- ▷ Compute FMR over all impostor comparisons for which the subjects are additionally of the same sex, and born in the same geographic region.

Results:

The notable aspects are:

- ▷ Diagonal dominance: Impostors are more likely to be matched against their same age group.
- ▷ Same sex and same region impostors are more successful. On the diagonal, an impostor is more likely to succeed by posing as someone of the same sex. If $\Delta \log_{10}$ FMR $= 0.2$, then same-sex same-region FMR exceeds the all-pairs FMR by factor of $10^{0.2} = 1.6$.
- ▷ Young children impostors give elevated FMR against young children. Older adult impostor give elevated FMR against older adults. These effects are quite large, for example if $\Delta \log_{10}$ FMR $= 1.0$ larger than a 32 year old, then these groups have higher FMR by a factor of $10^1 = 10$. This would imply an FMR above 0.01 for a nominal (global) FMR = 0.001.
- ▷ Algorithms vary.
- ▷ We computed the same quantities for a global FMR = 0.0001. The effects are similar.

Note the calculations in this section include impostors paired across all countries of birth.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

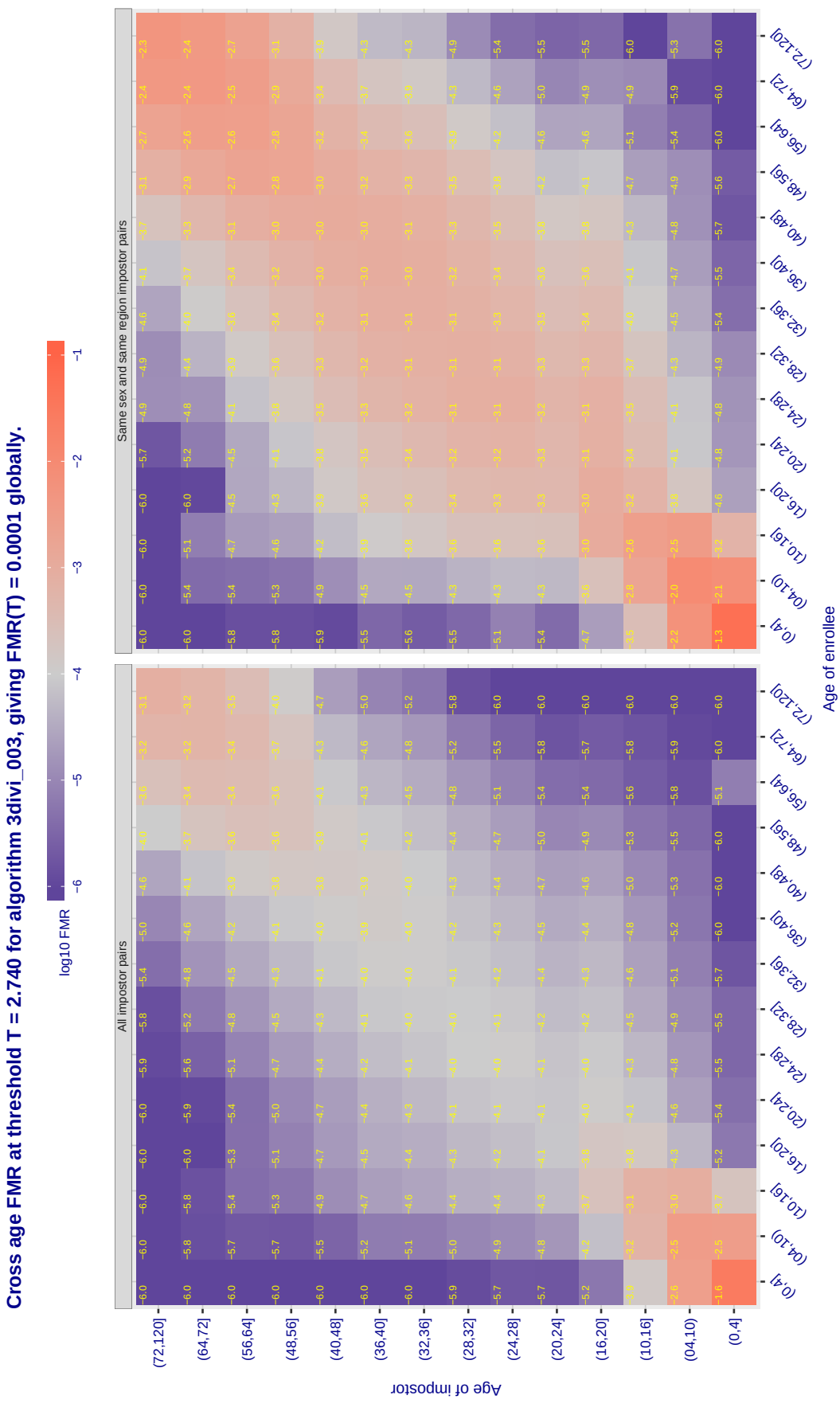


Figure 351: For algorithm 3divi-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

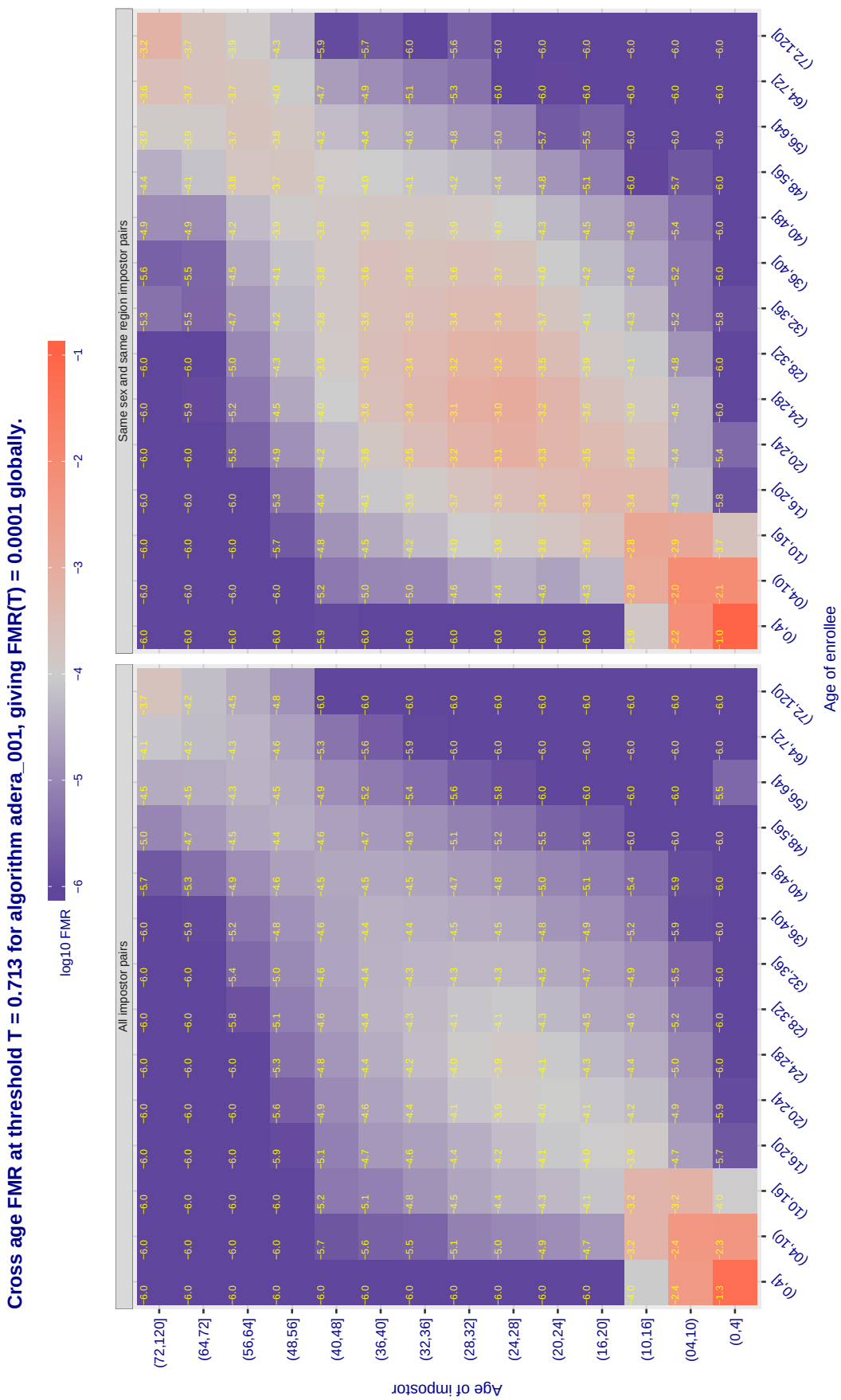


Figure 352: For algorithm adera-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

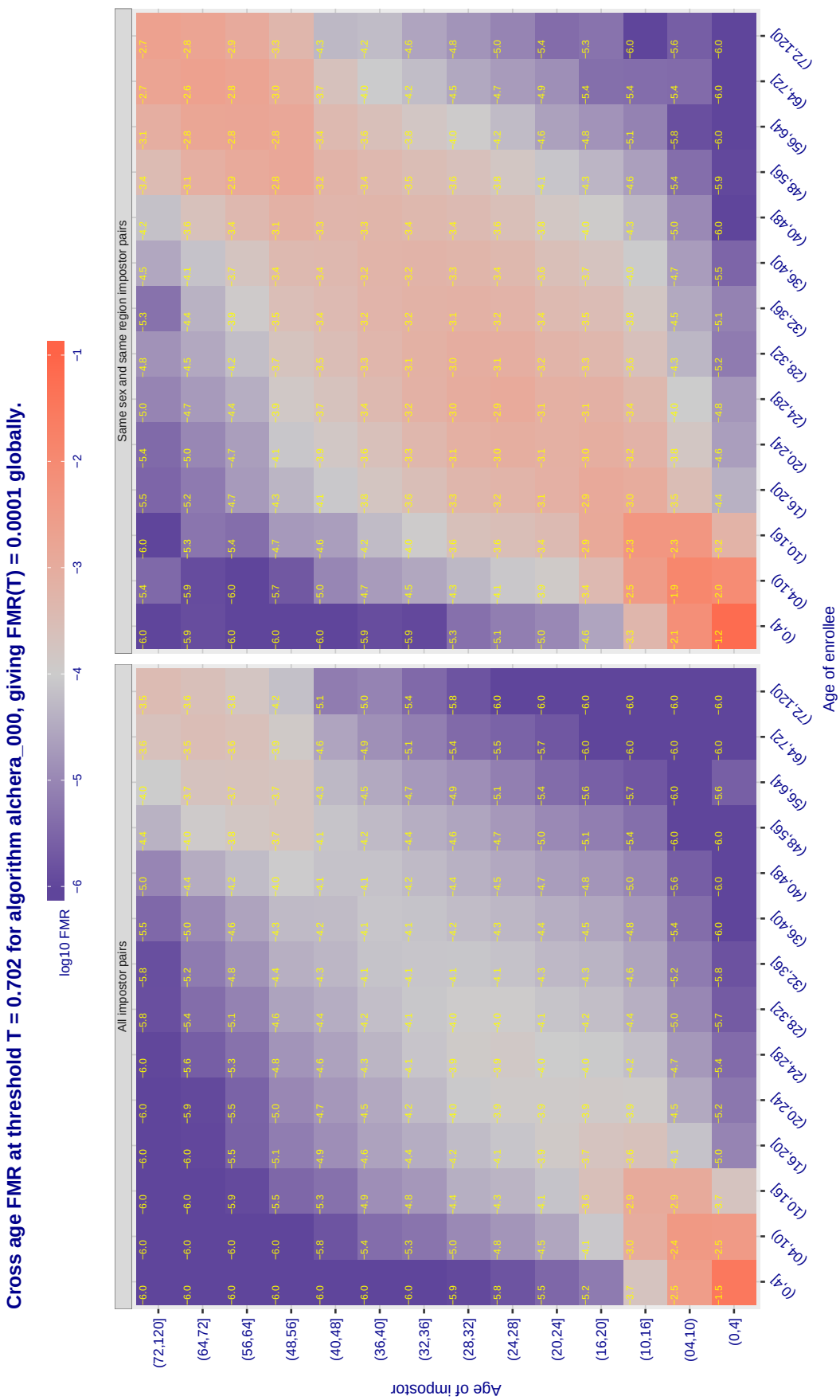


Figure 353: For algorithm alchera-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

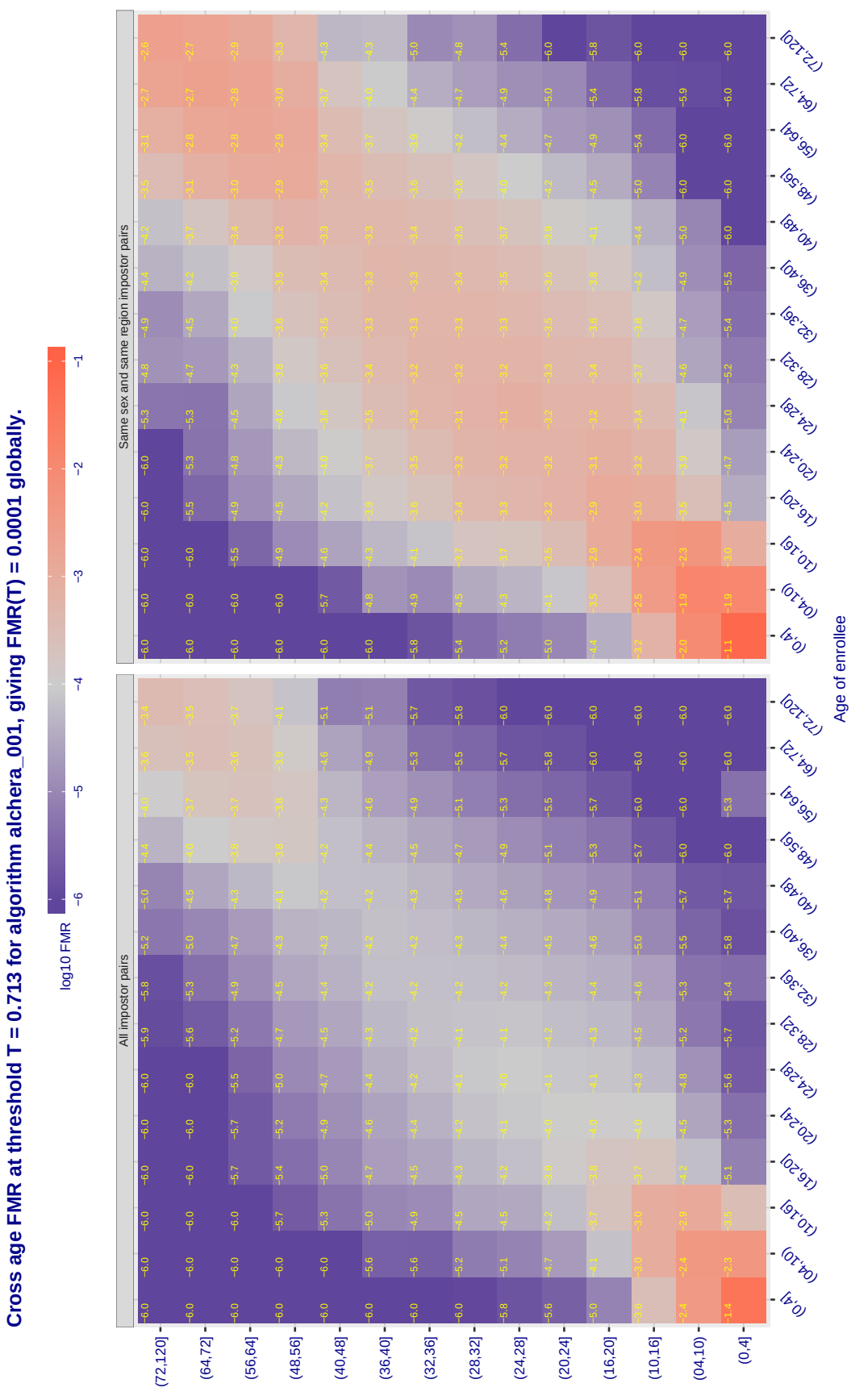


Figure 354: For algorithm alchera-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

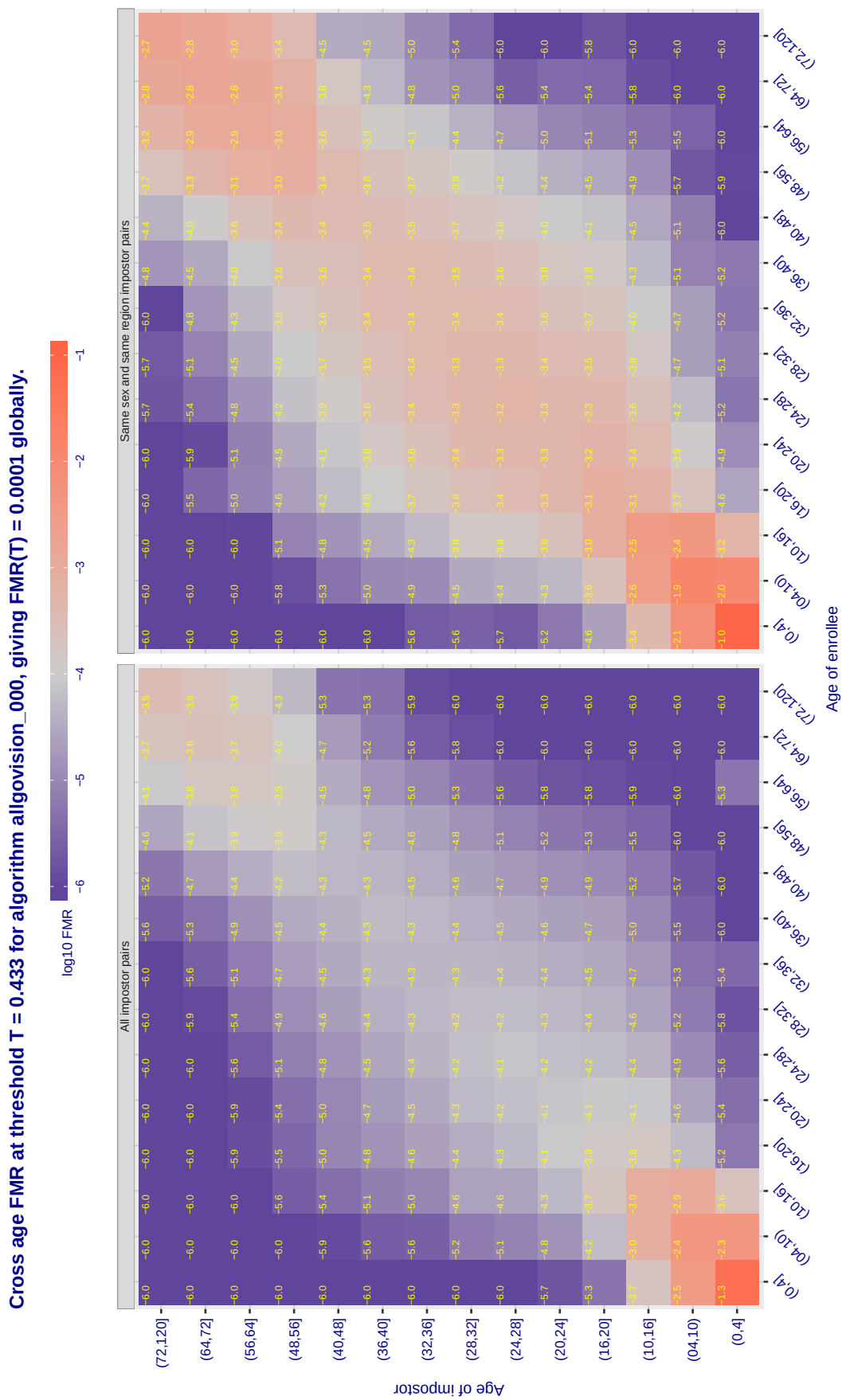


Figure 355: For algorithm allgovision-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

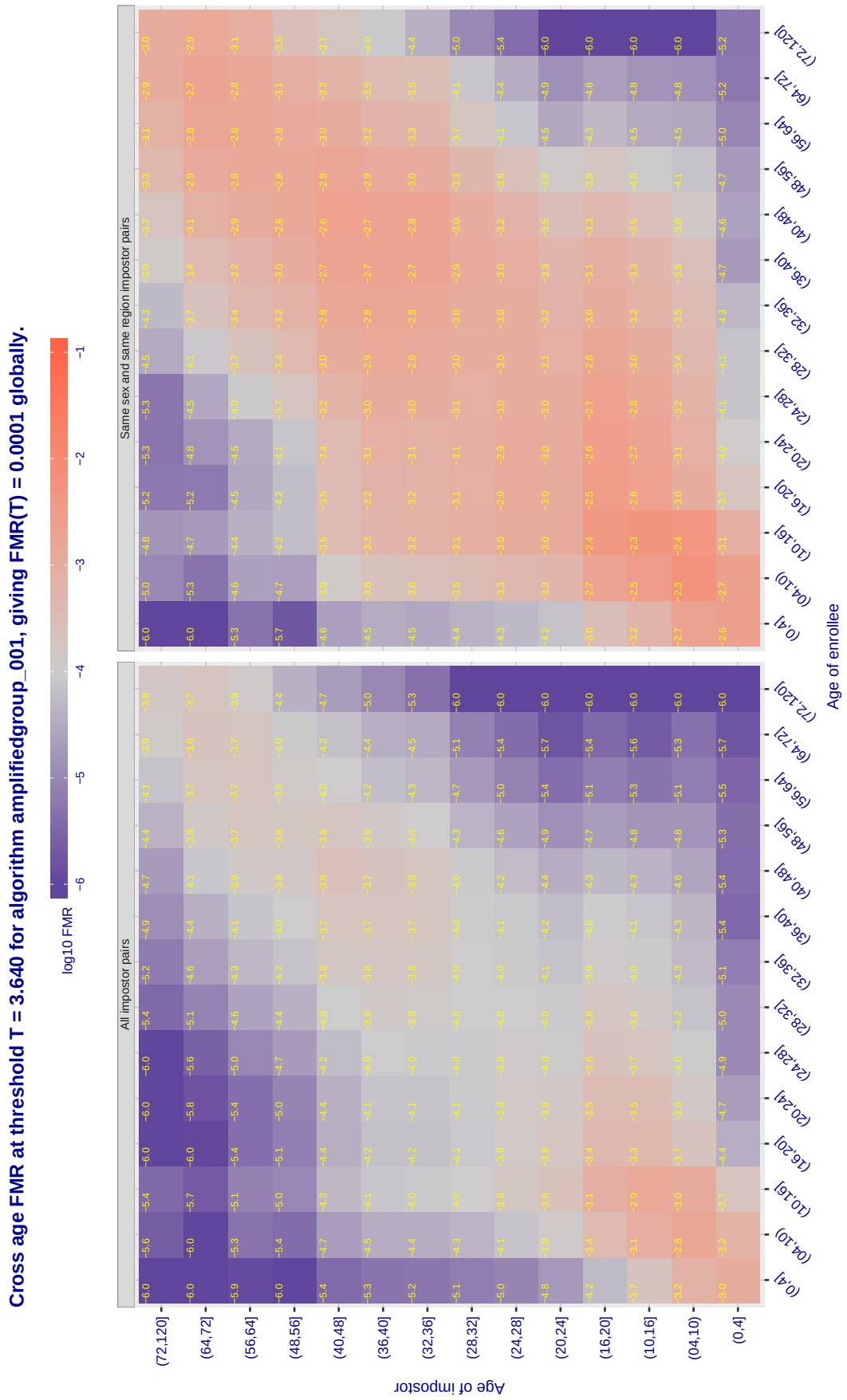


Figure 356: For algorithm amplifiedgroup-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

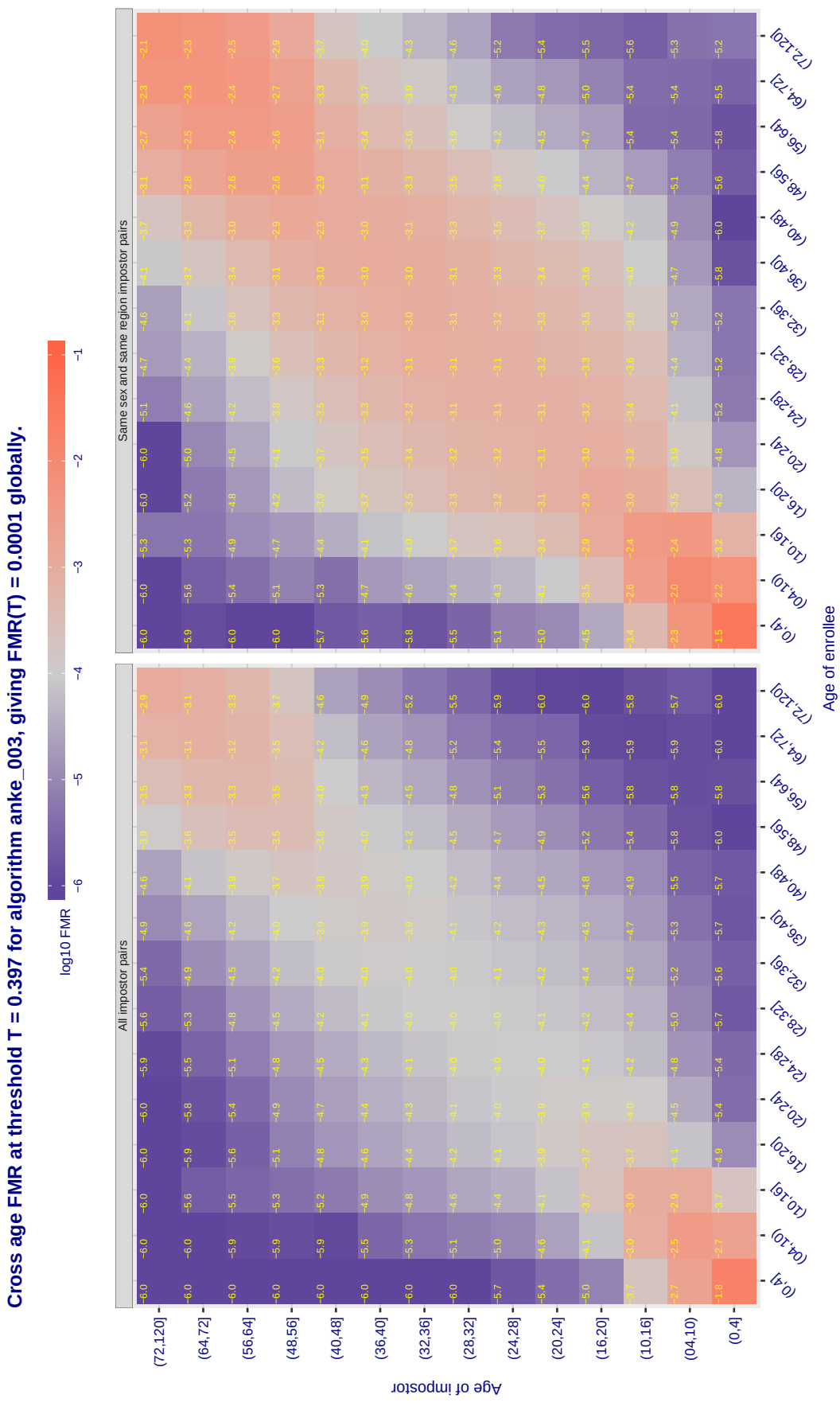


Figure 357: For algorithm anke-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

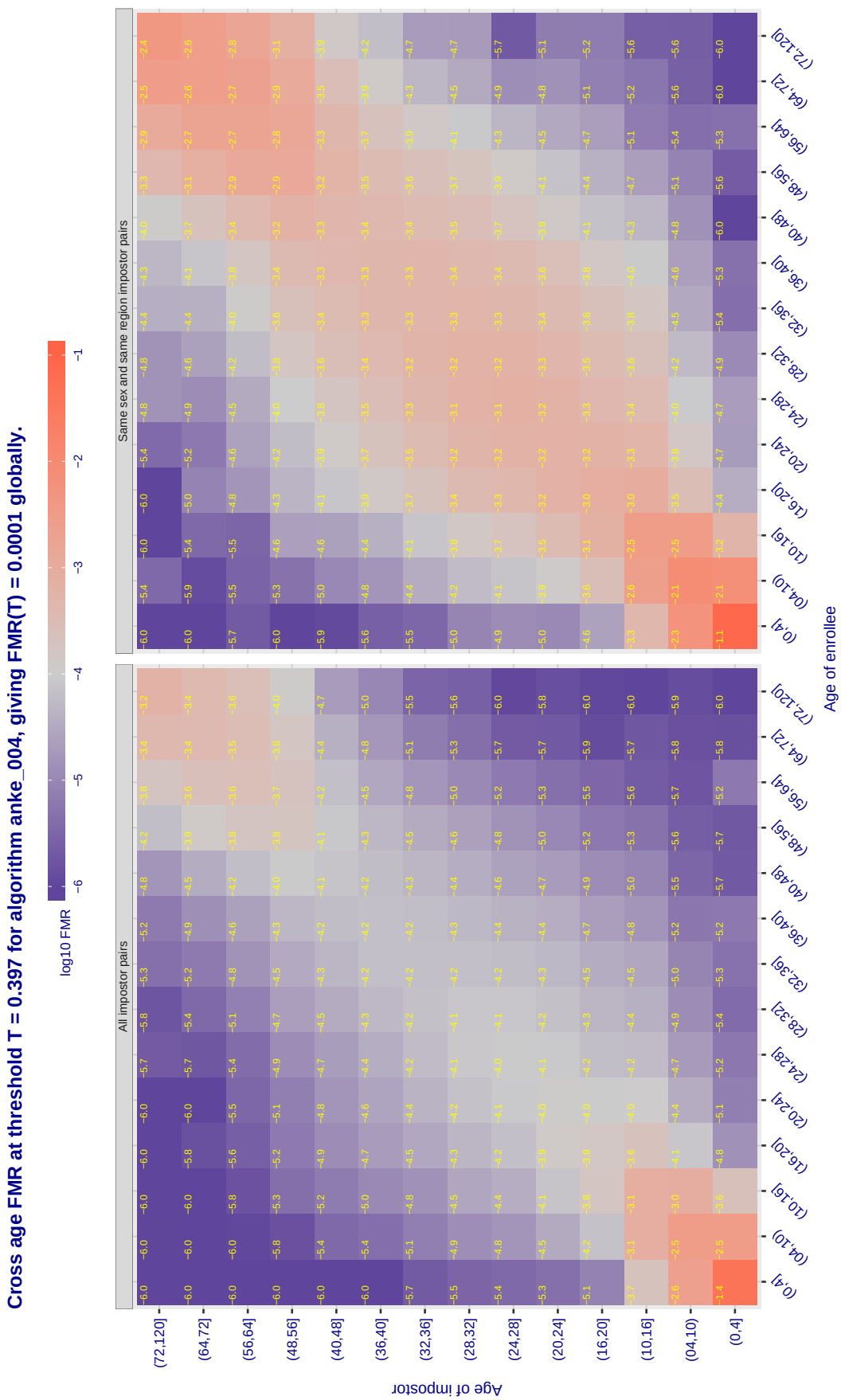


Figure 358: For algorithm anke-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

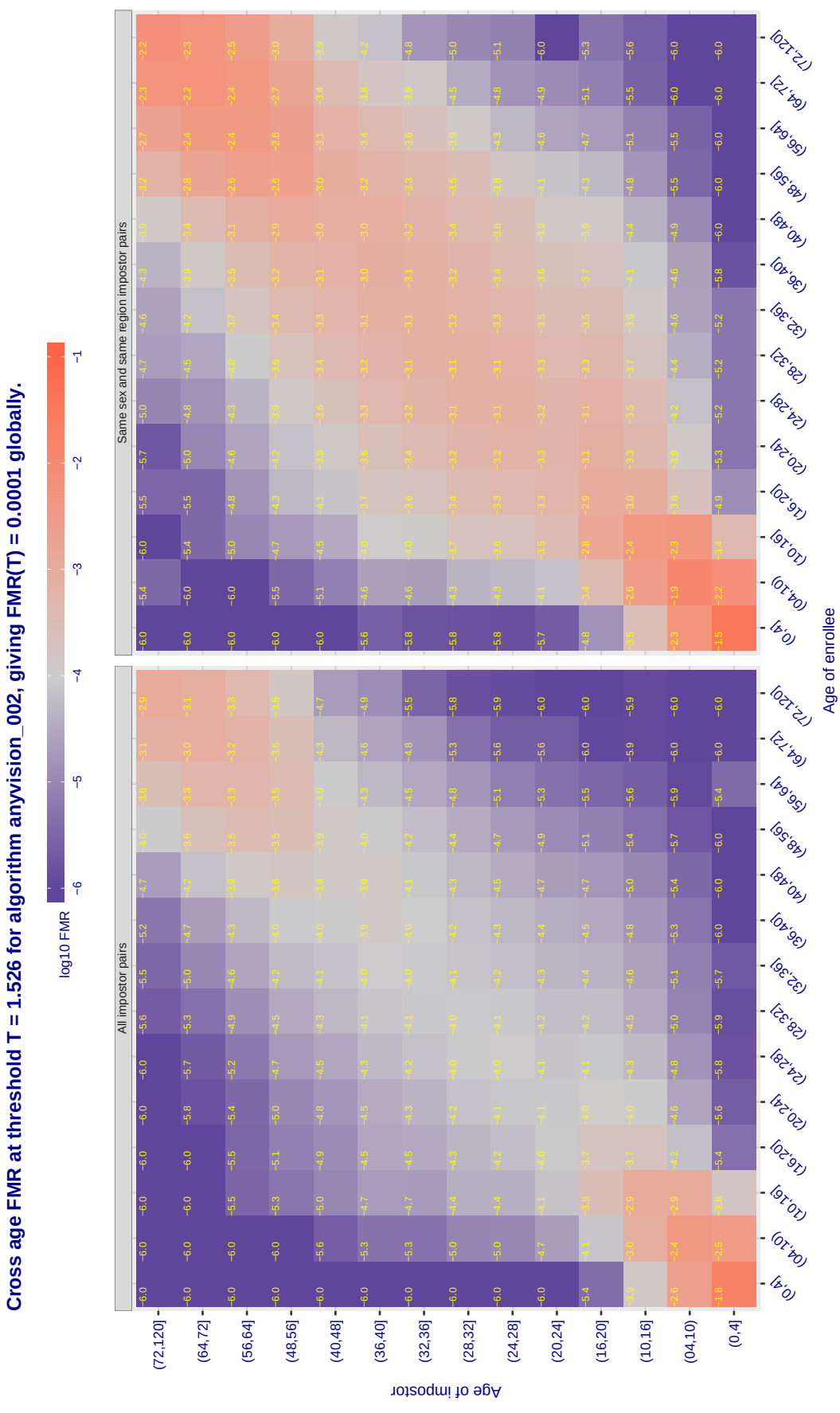


Figure 359: For algorithm anyvision-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

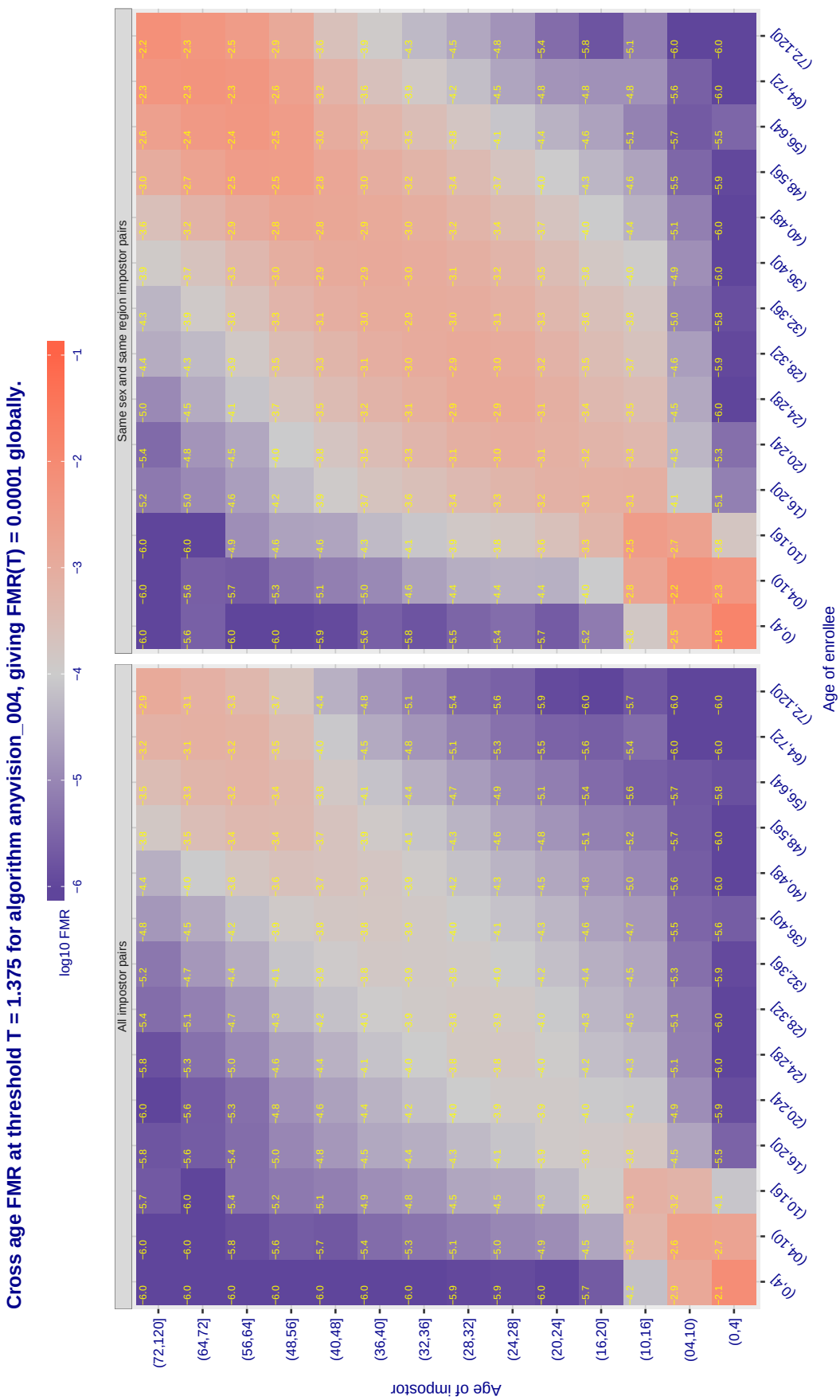


Figure 360: For algorithm anyvision-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

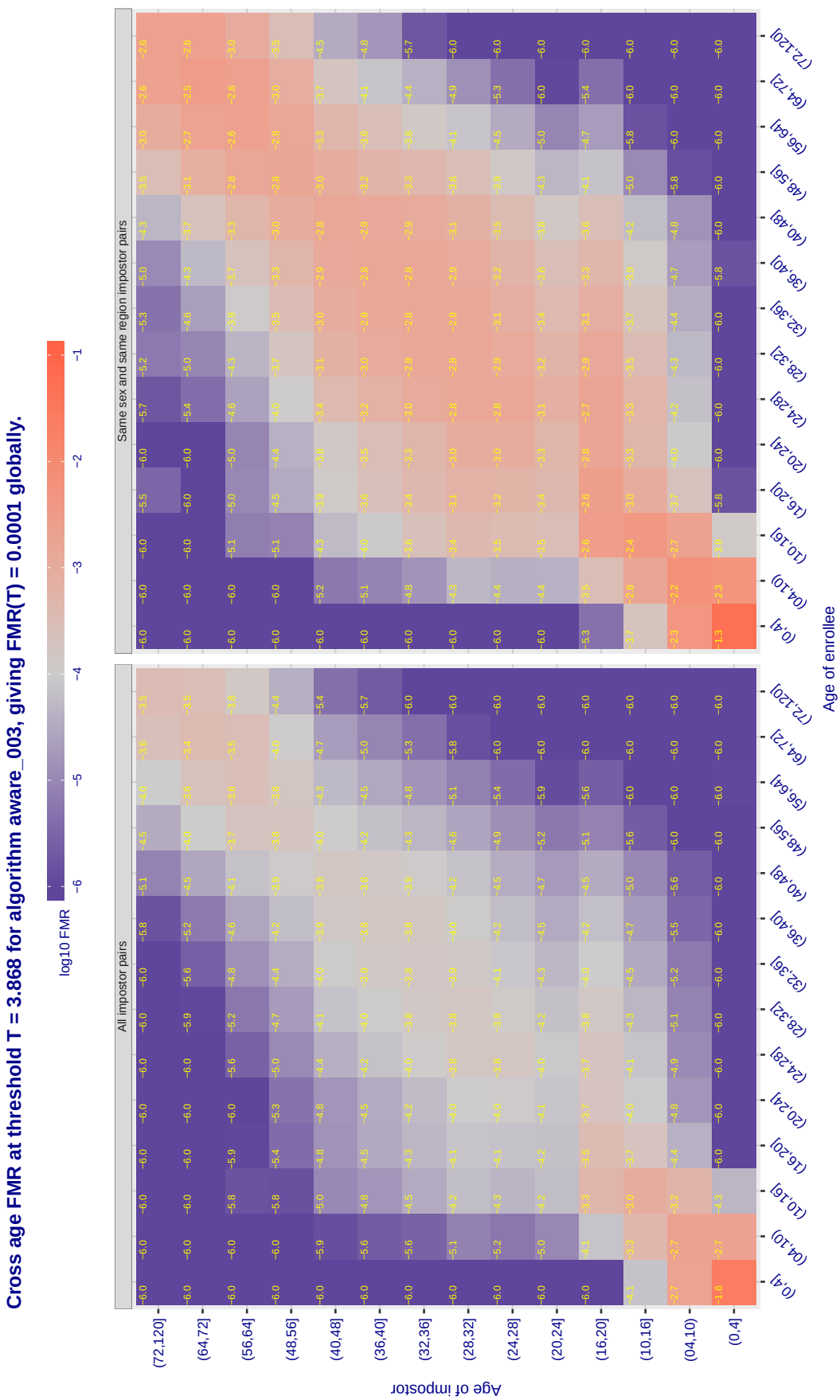


Figure 361: For algorithm aware-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

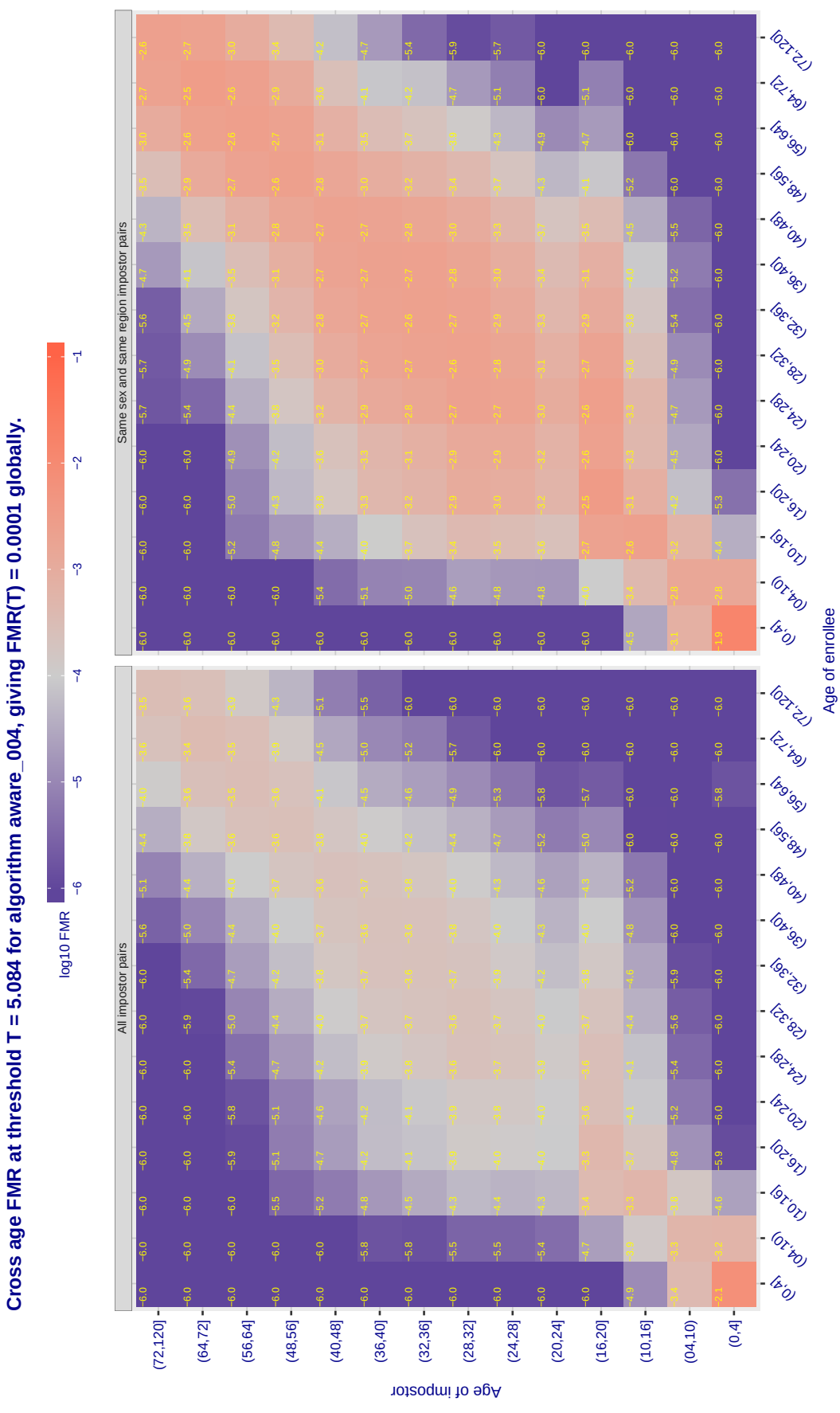


Figure 362: For algorithm aware-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

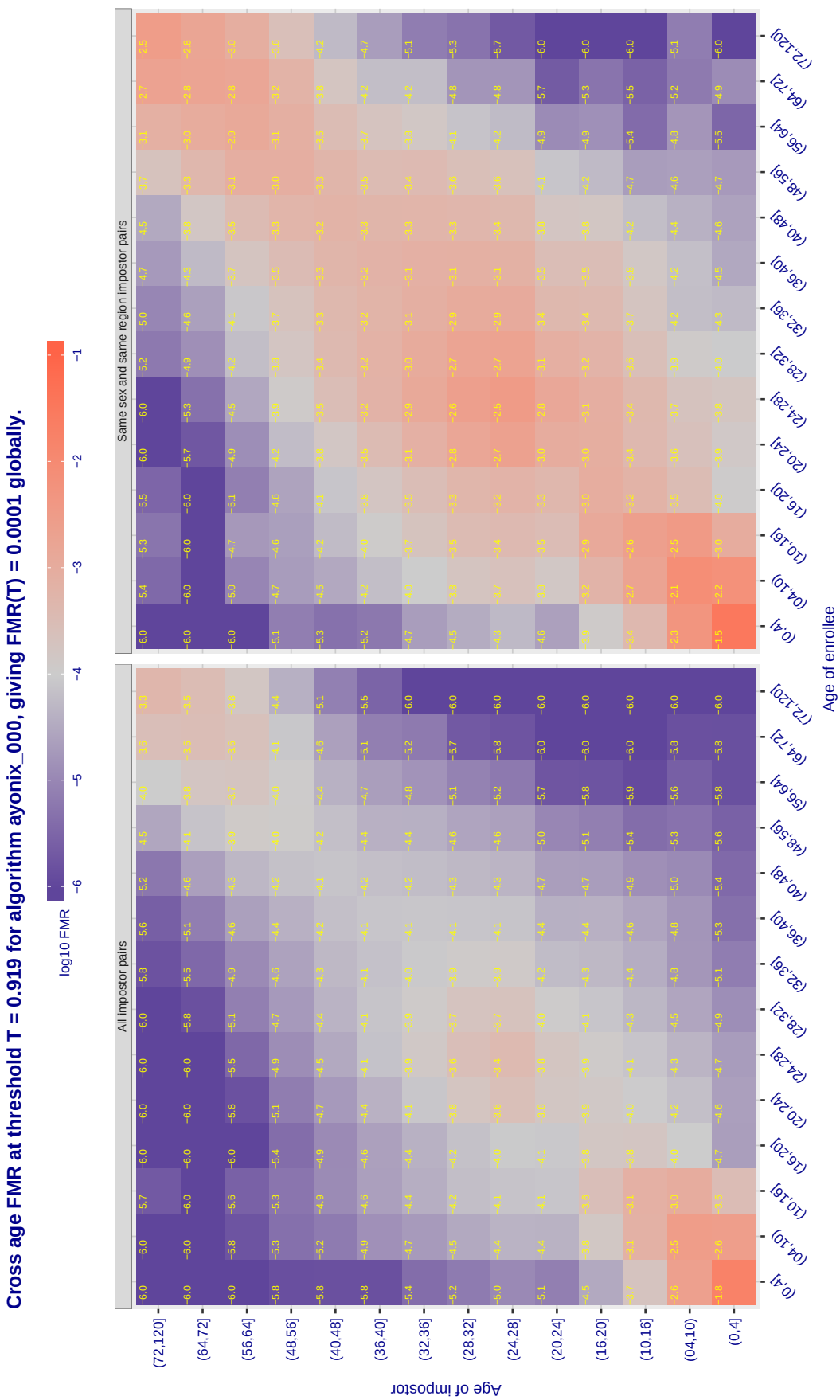


Figure 363: For algorithm ayonix-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

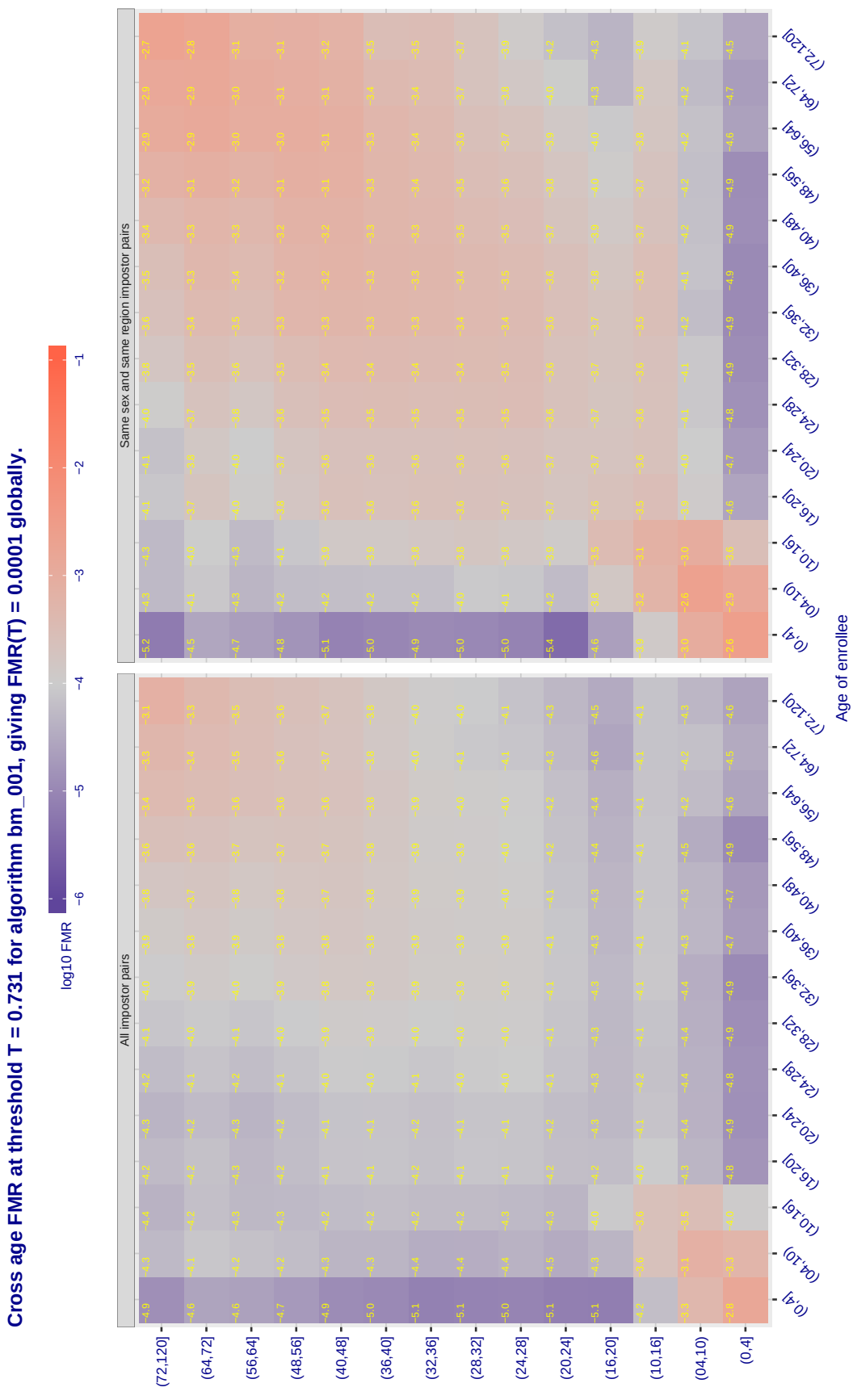


Figure 364: For algorithm bm-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

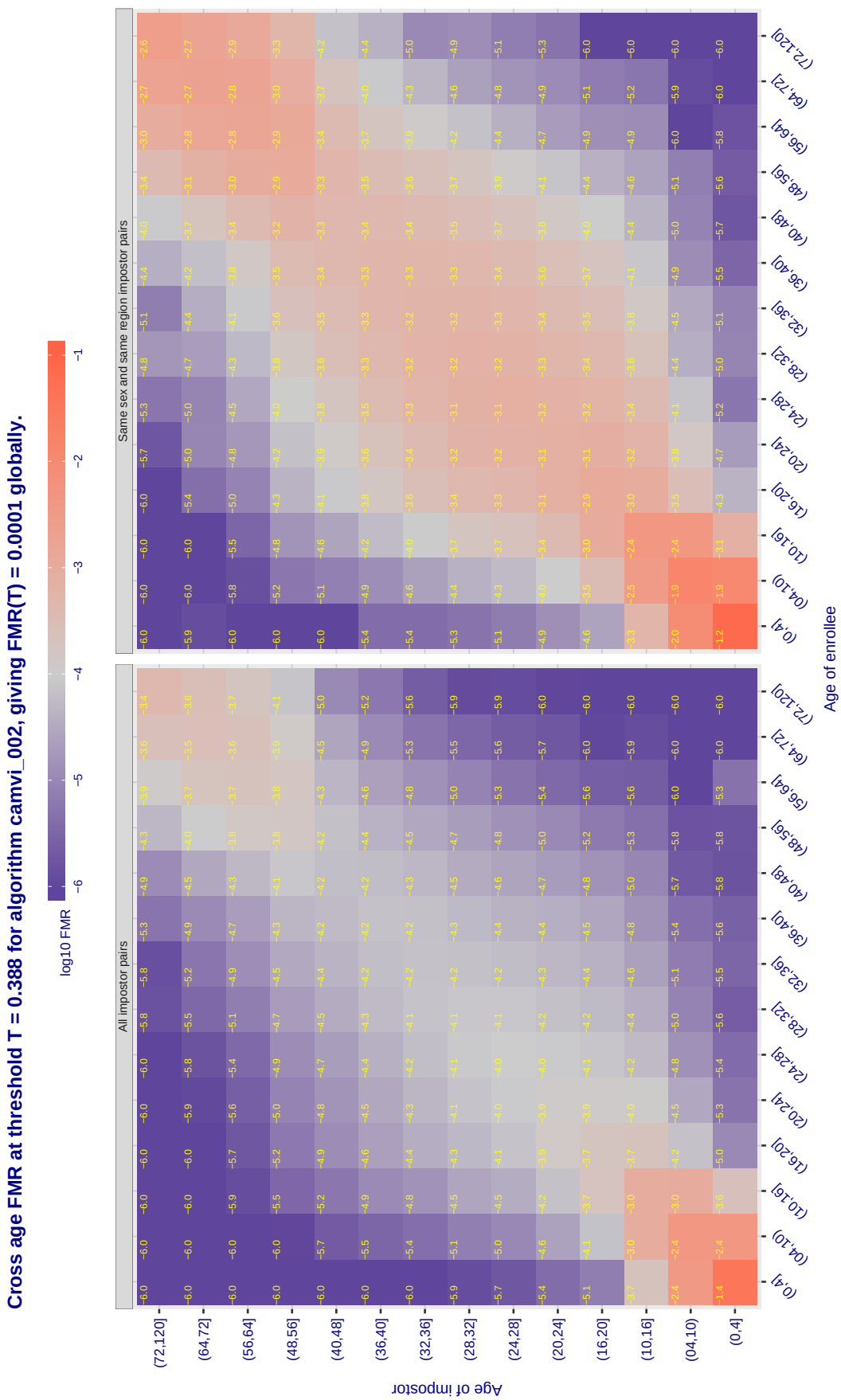


Figure 365: For algorithm camvi-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

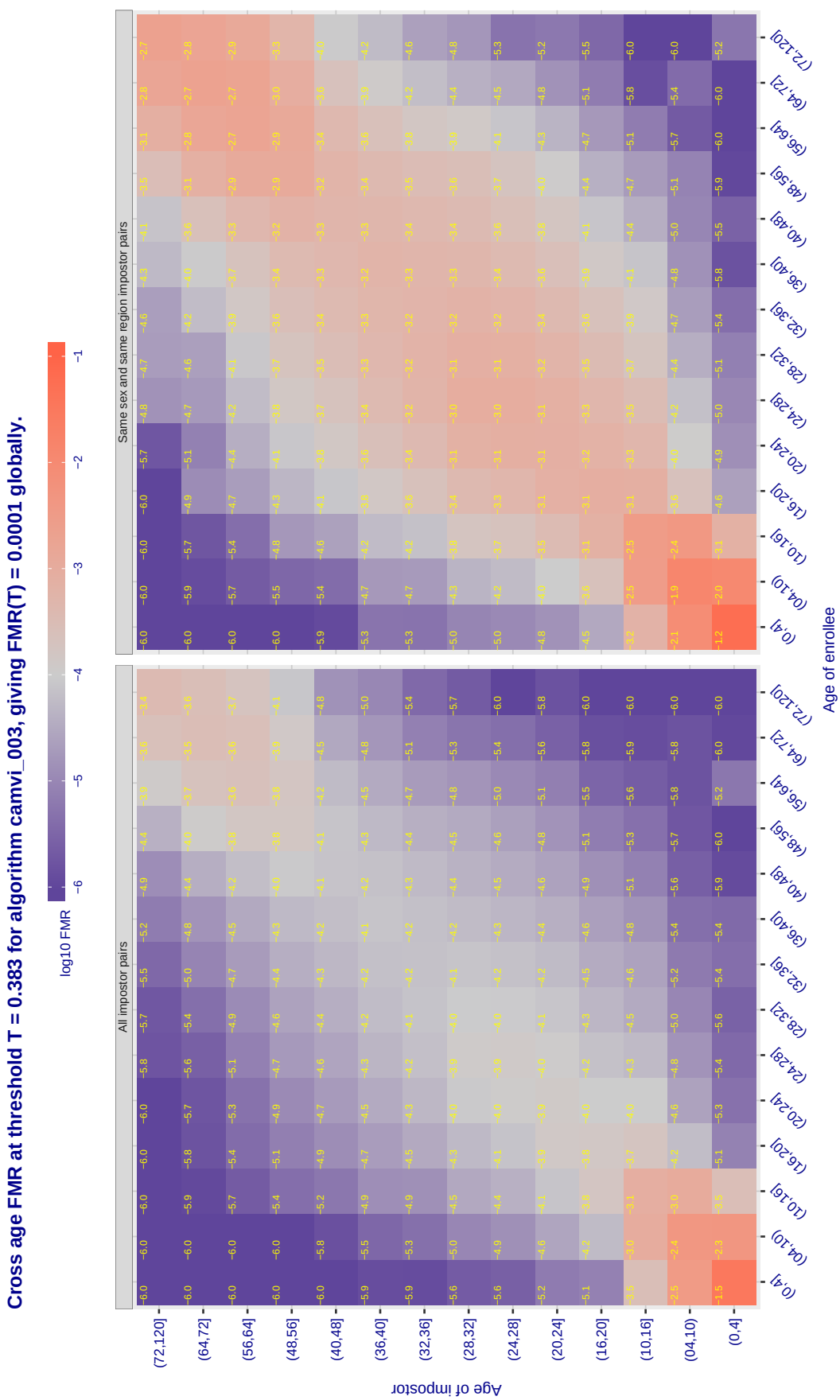


Figure 366: For algorithm camvi-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

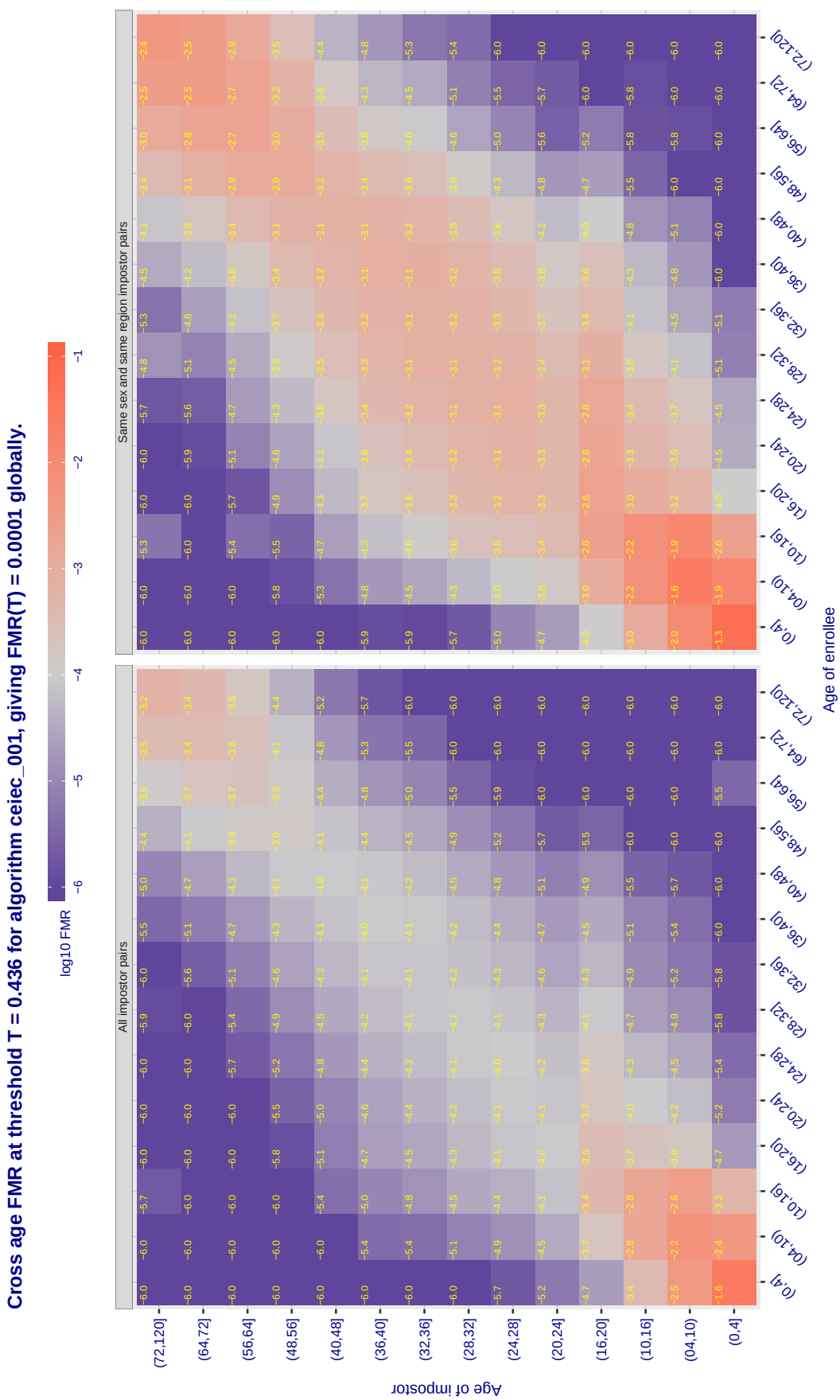


Figure 367: For algorithm ceiec-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

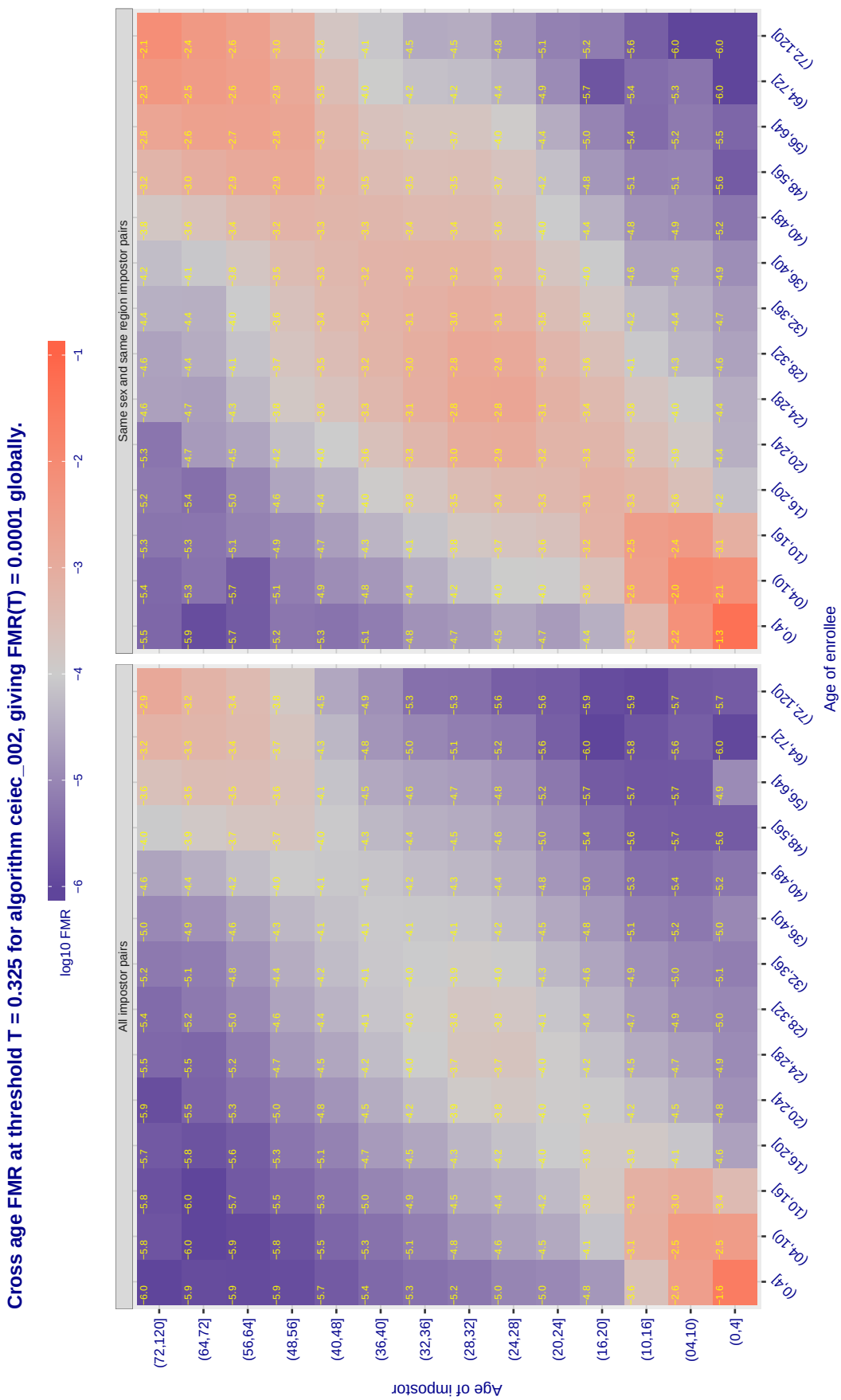


Figure 368: For algorithm ceiec-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

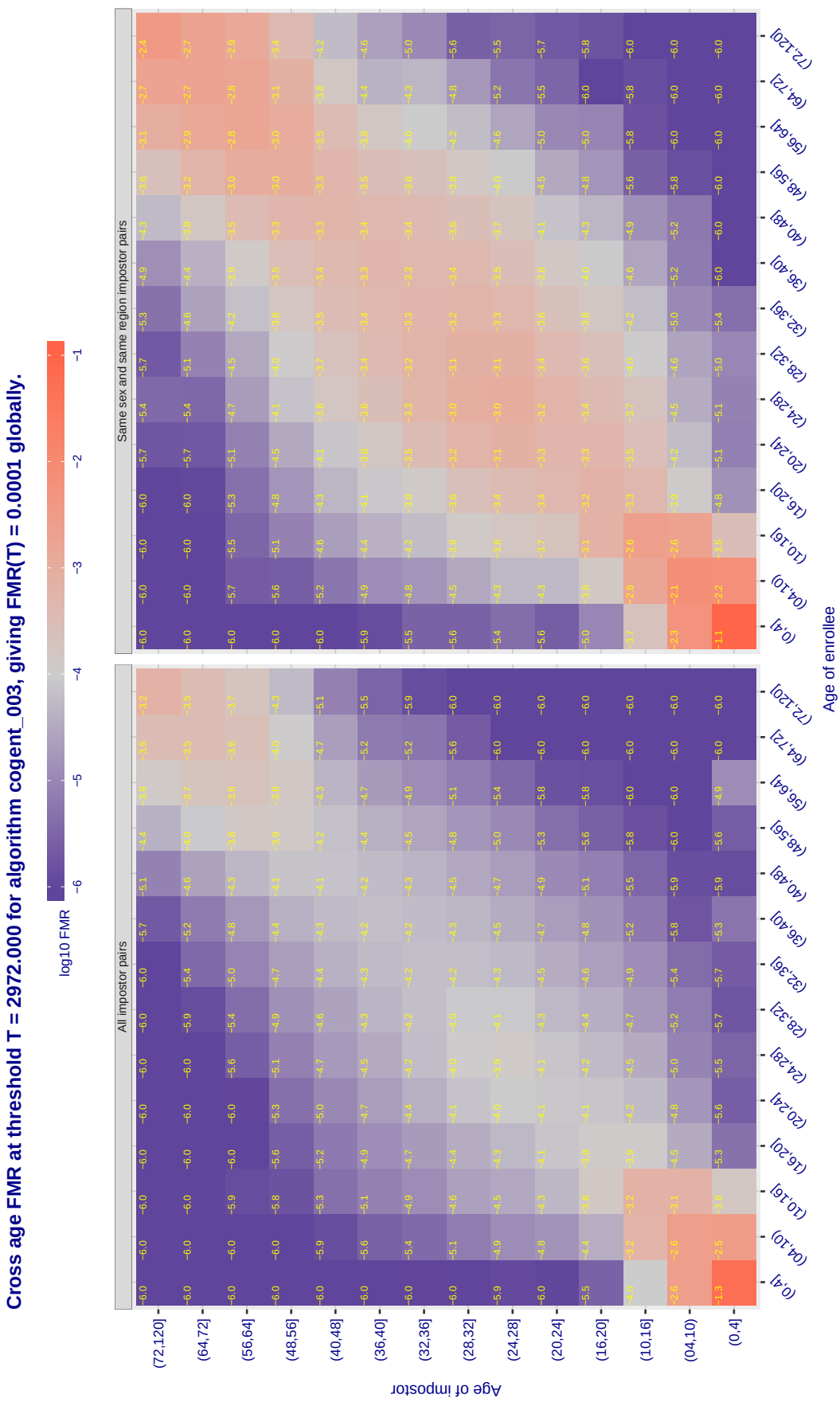


Figure 369: For algorithm cogent-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

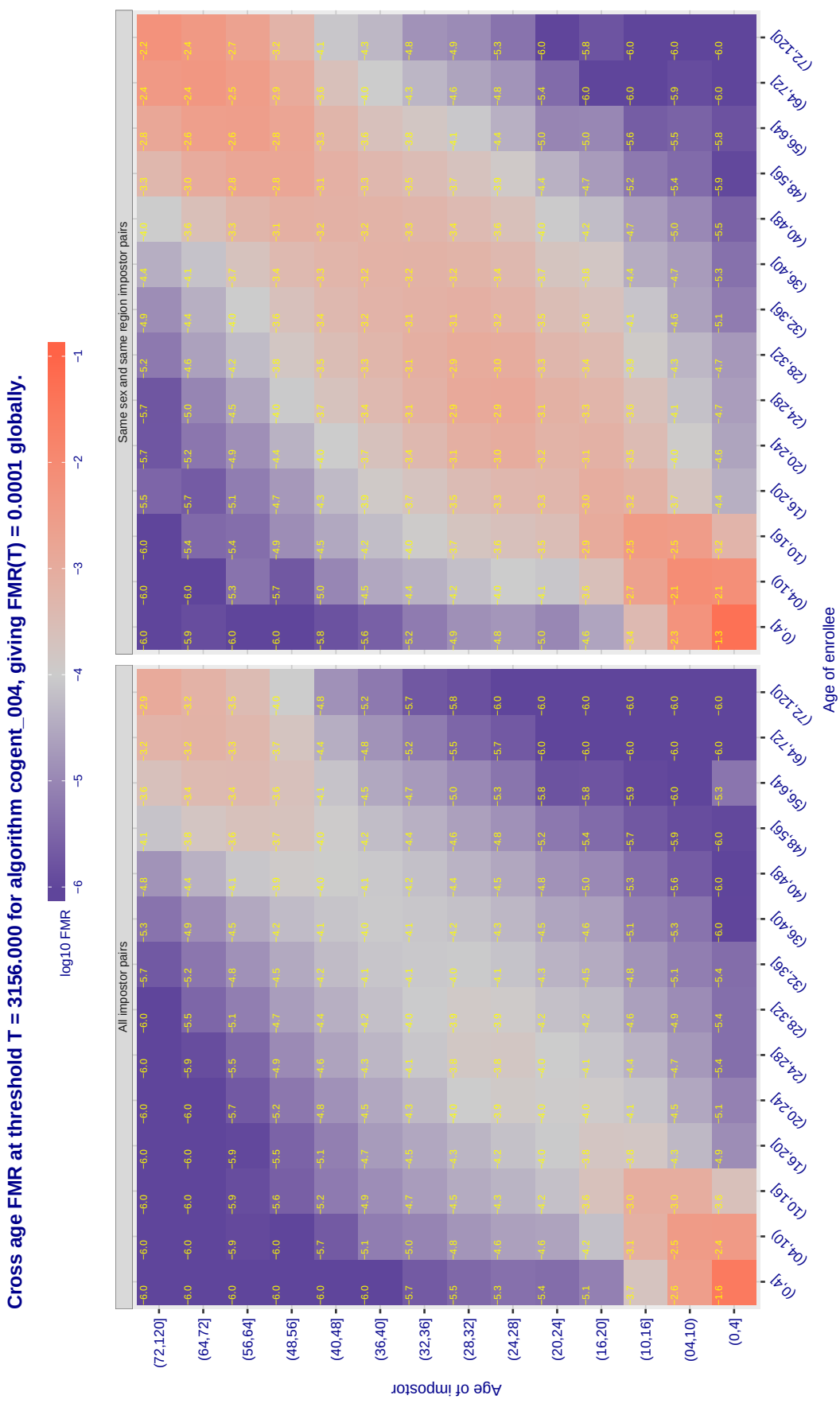


Figure 370: For algorithm cogent-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

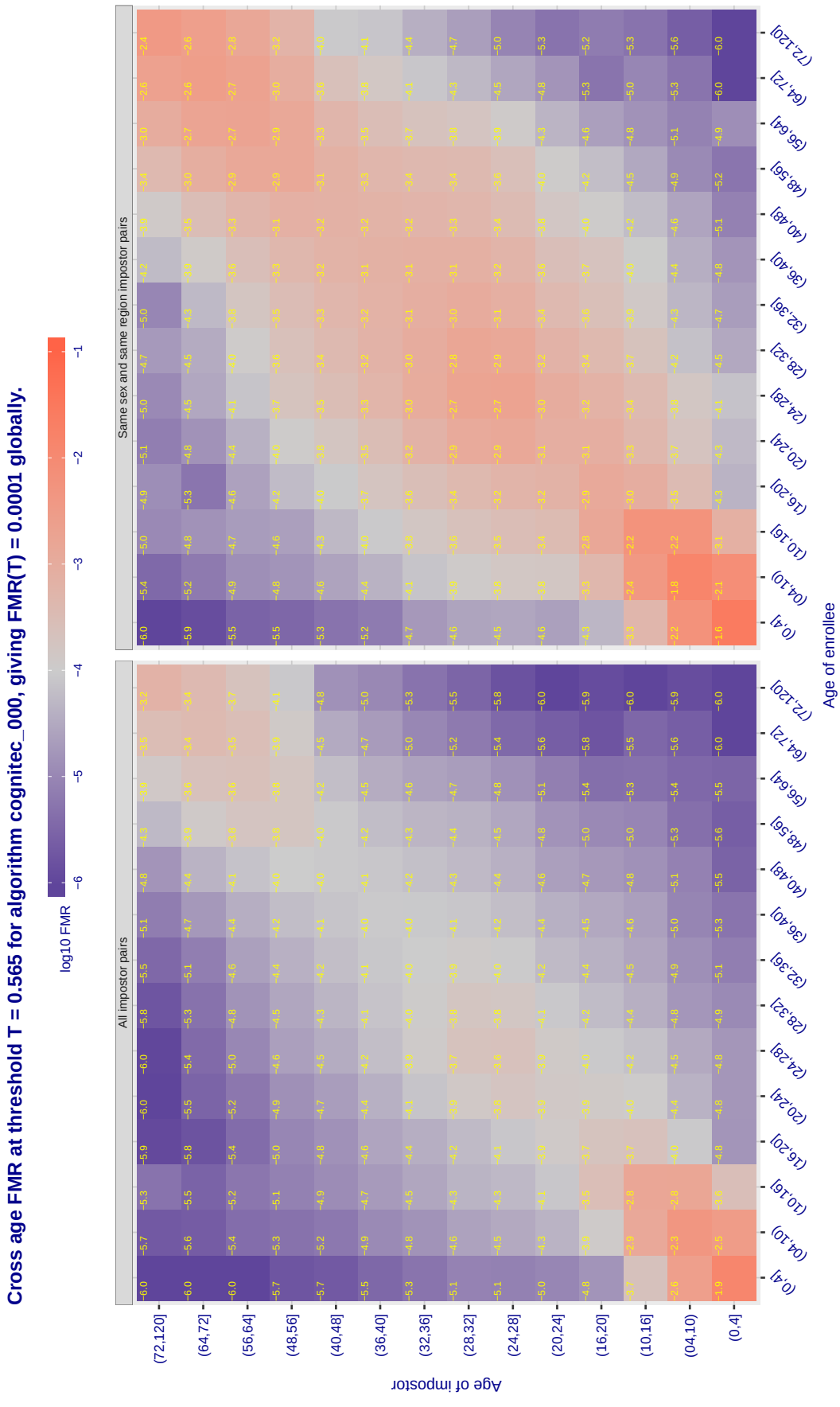


Figure 371: For algorithm cognitec-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

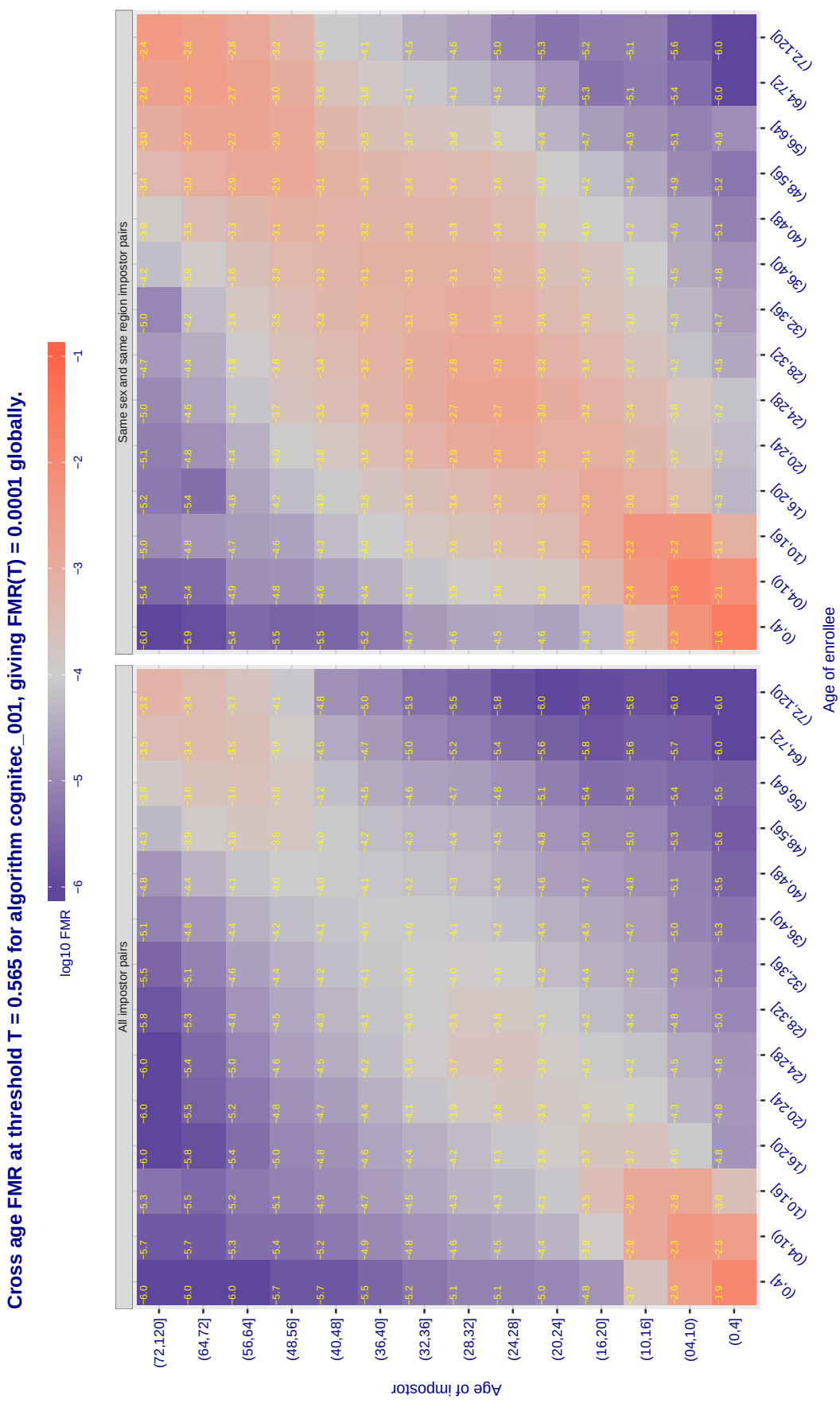


Figure 372: For algorithm cognitec-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

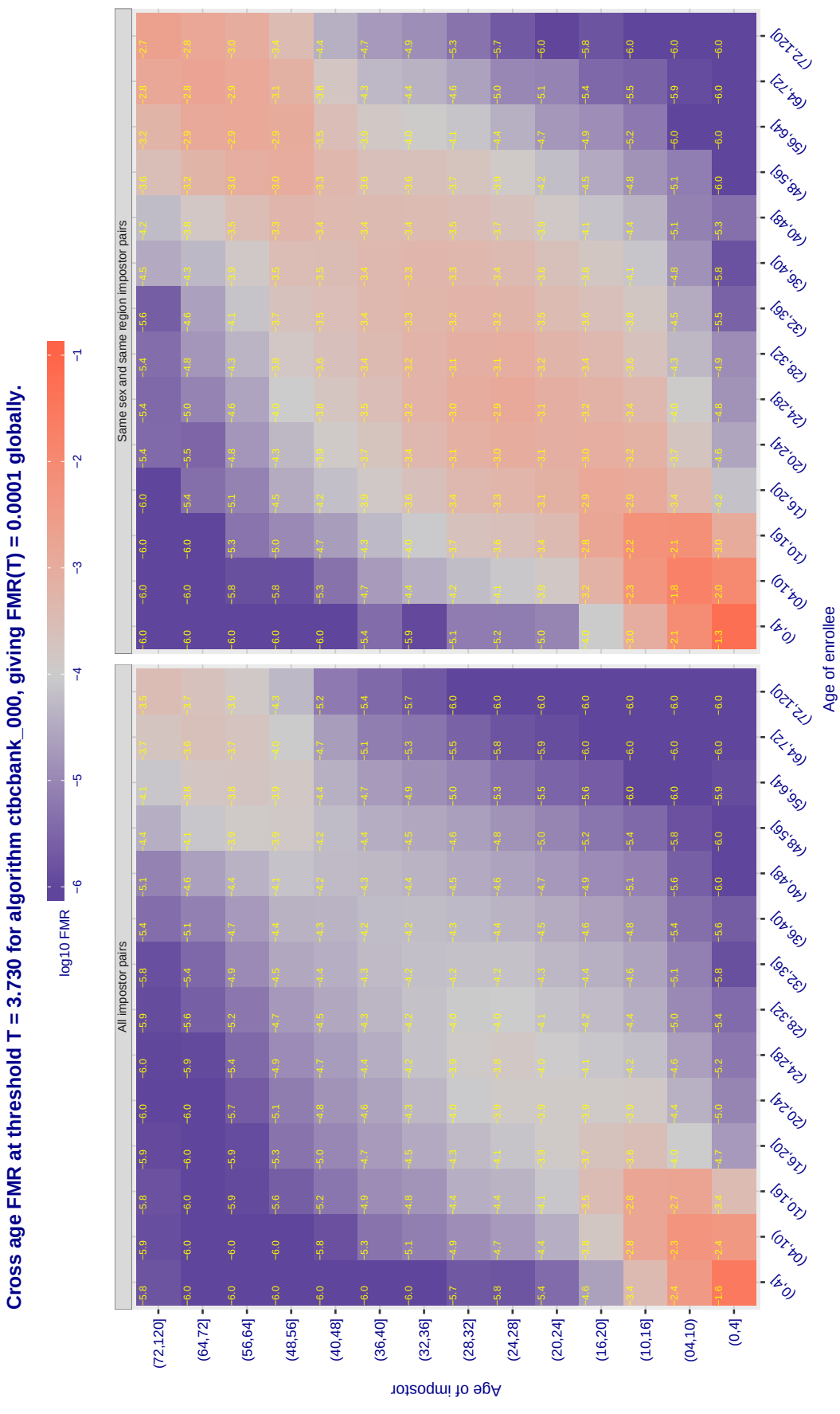


Figure 373: For algorithm ctbcbank-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

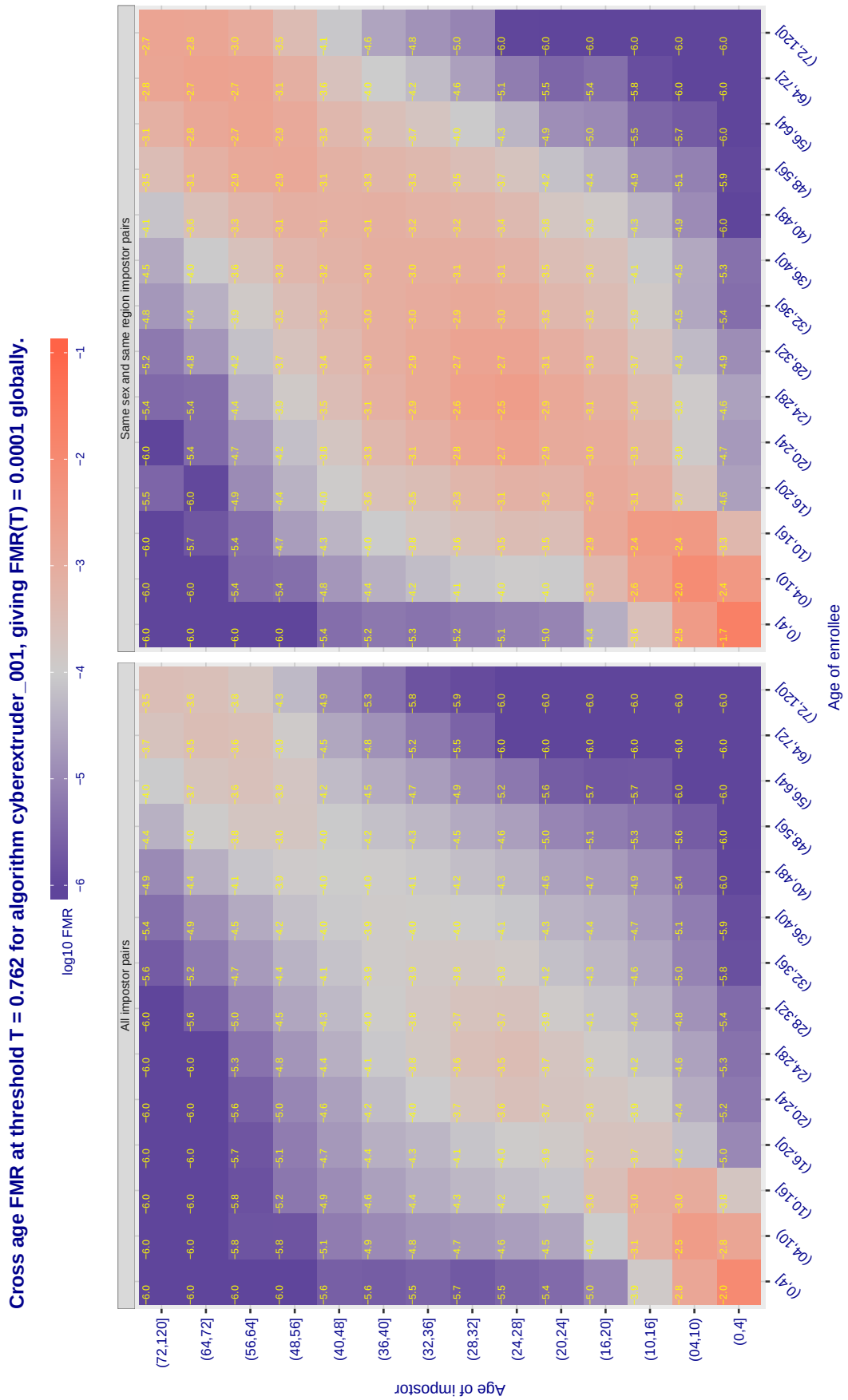


Figure 374: For algorithm cyberextruder-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

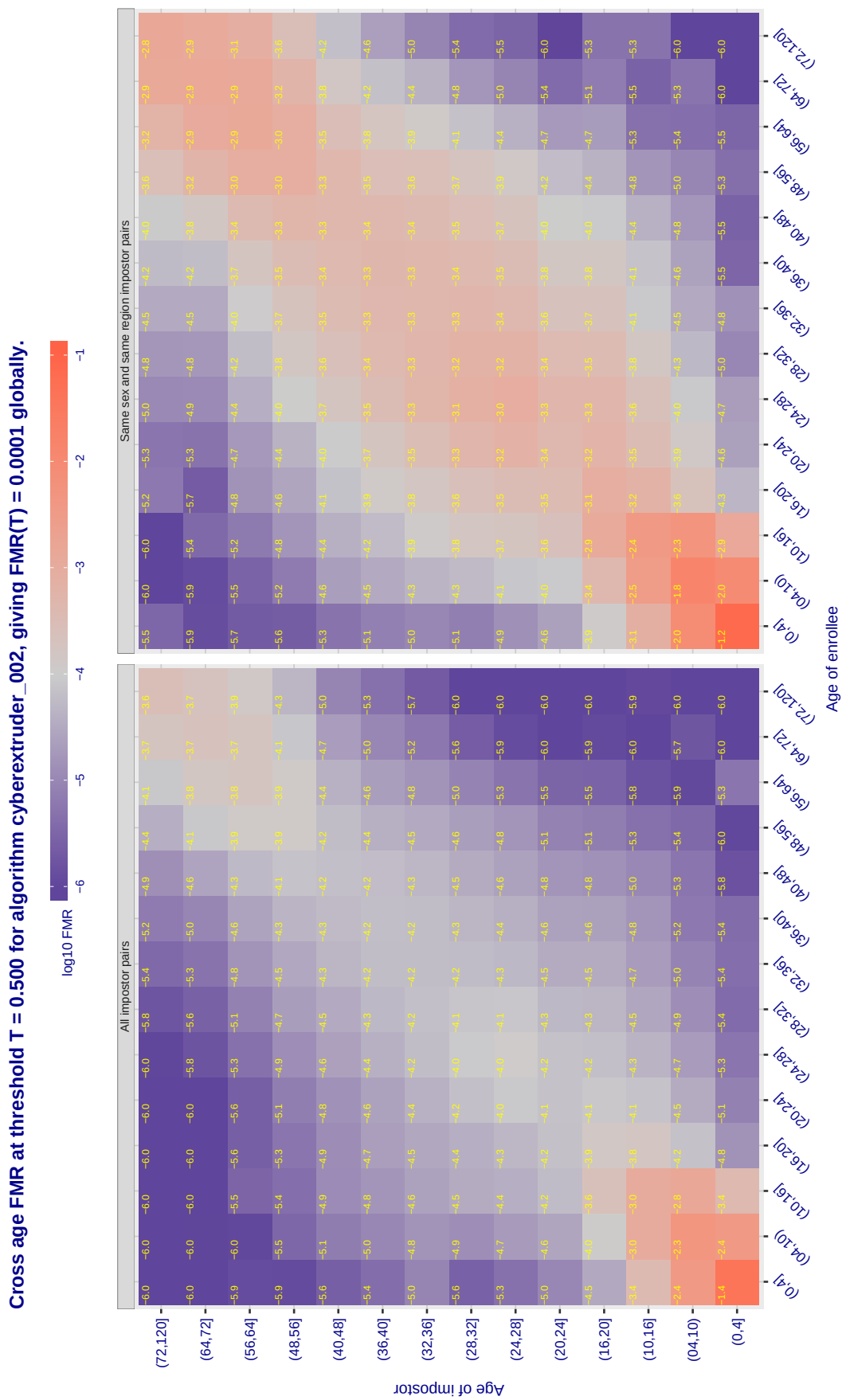


Figure 375: For algorithm cyberextruder-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

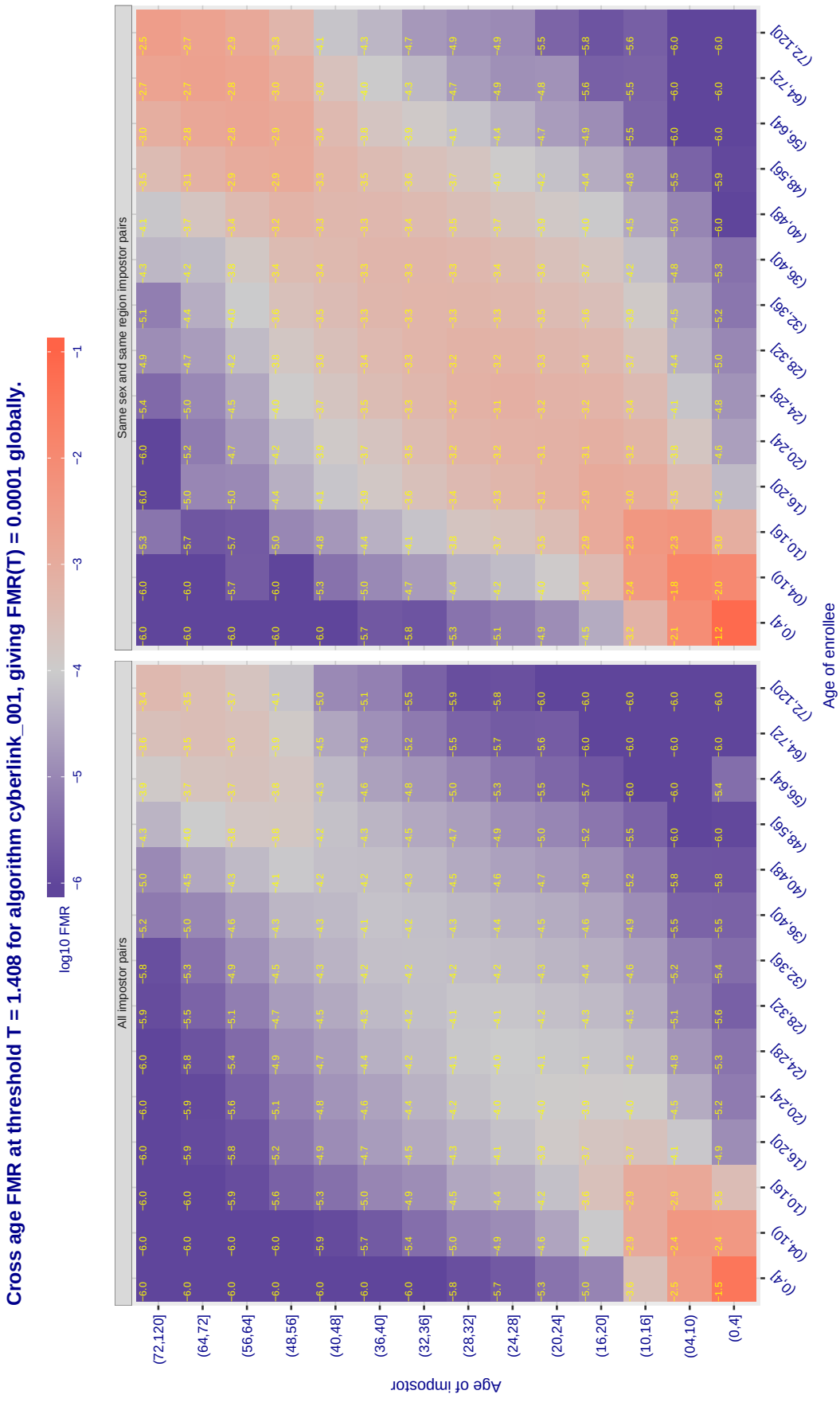


Figure 376: For algorithm cyberlink-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

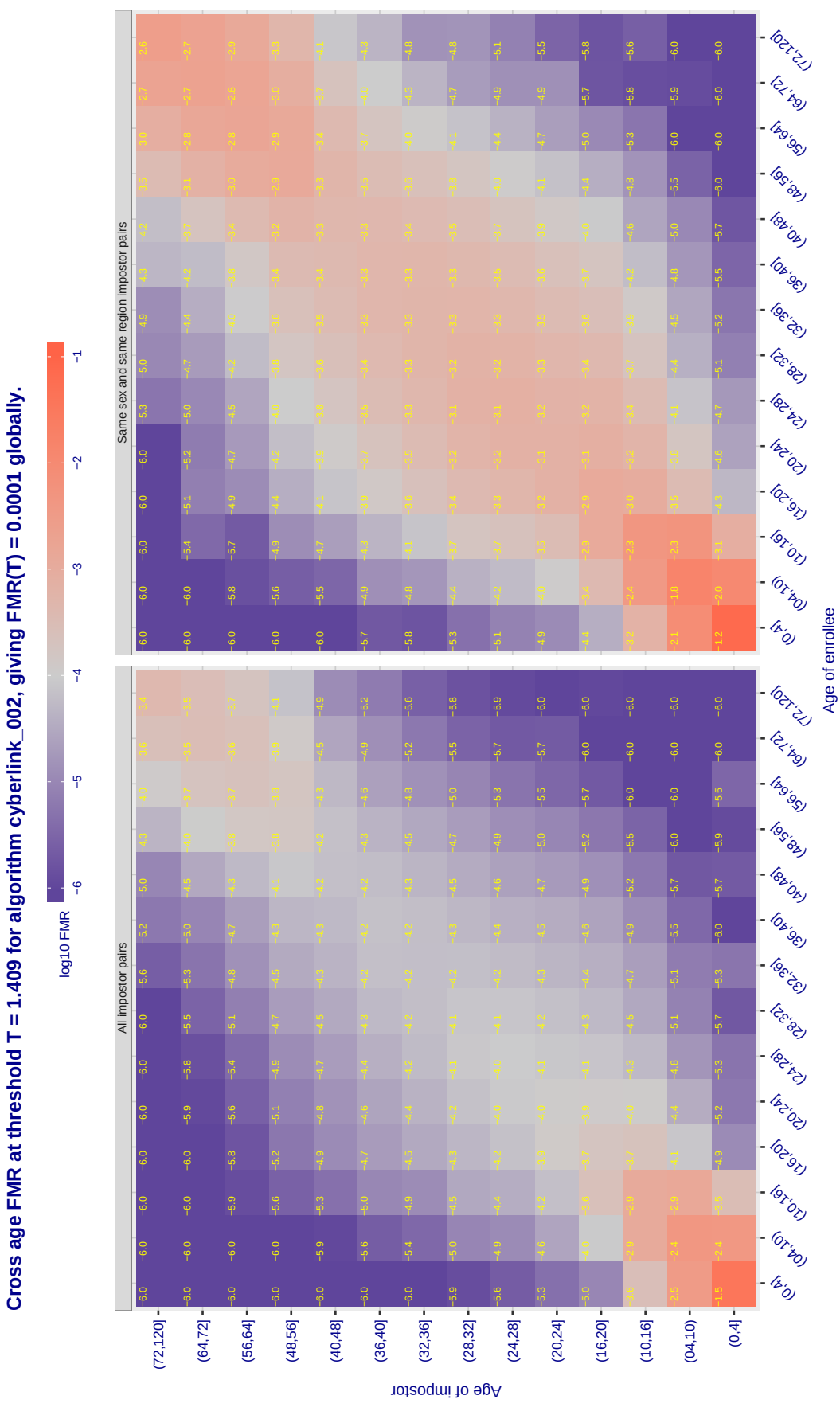


Figure 377: For algorithm cyberlink-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

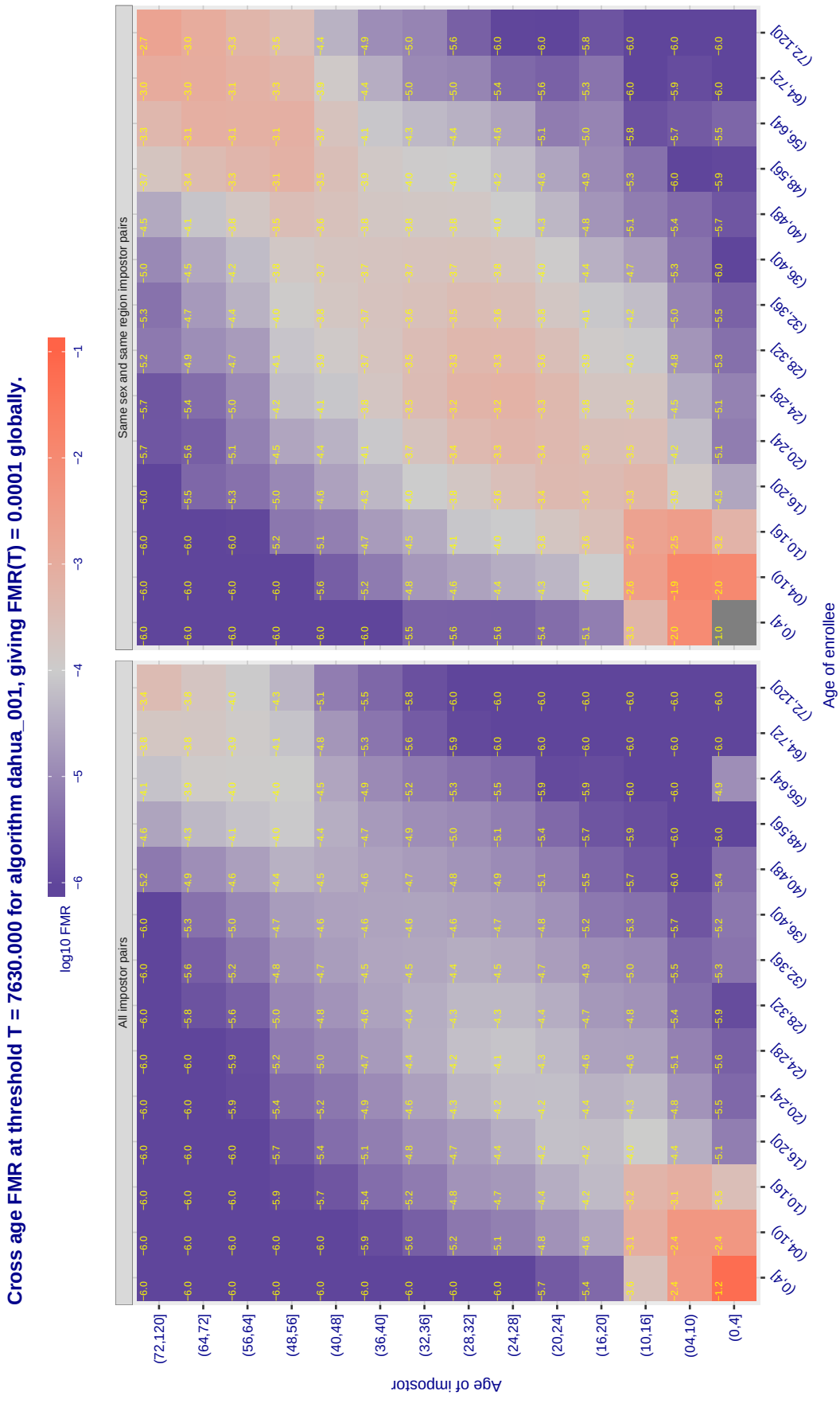


Figure 378: For algorithm dahua-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

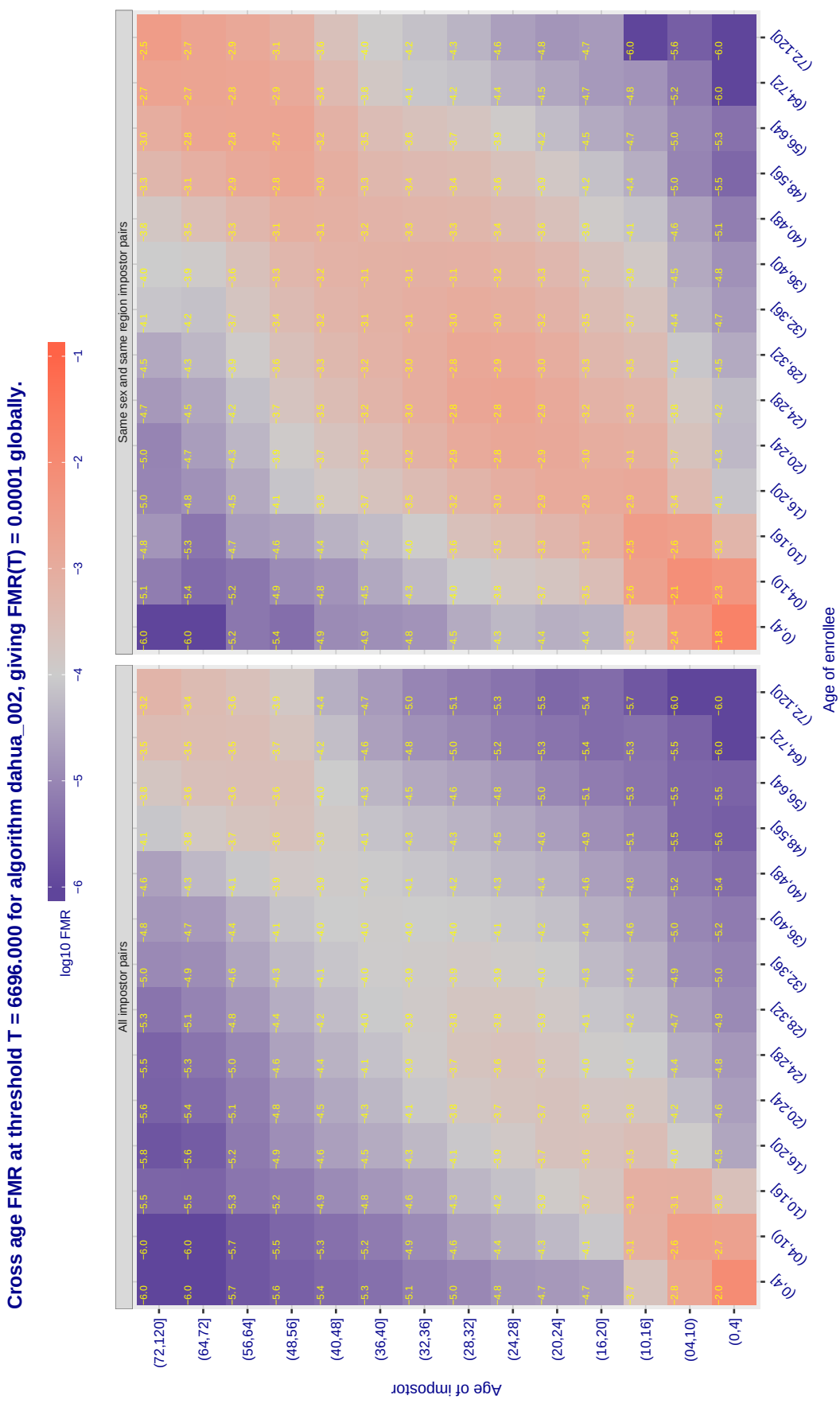


Figure 379: For algorithm dahua-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

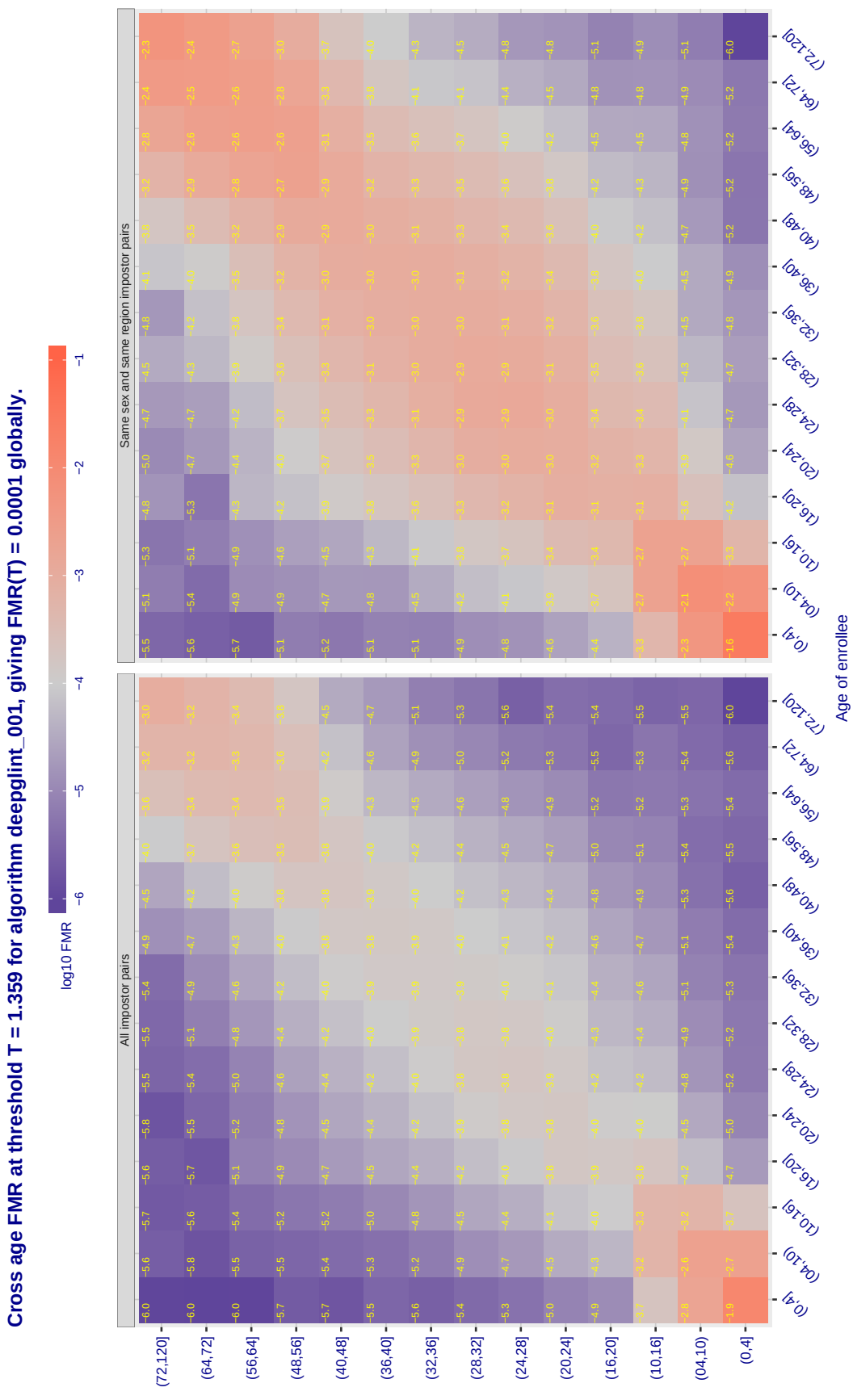


Figure 380: For algorithm deepglint-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

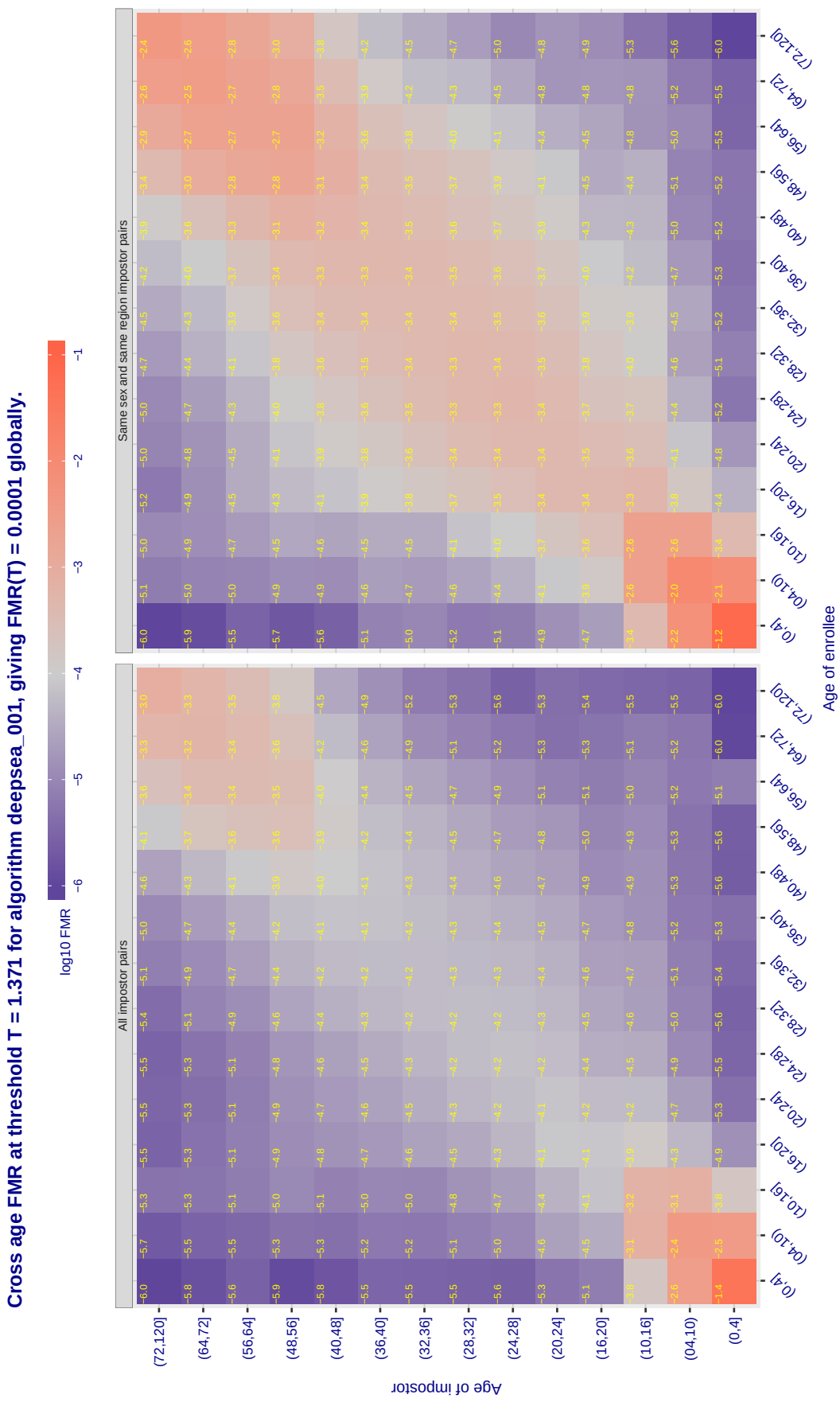


Figure 381: For algorithm deepsea-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

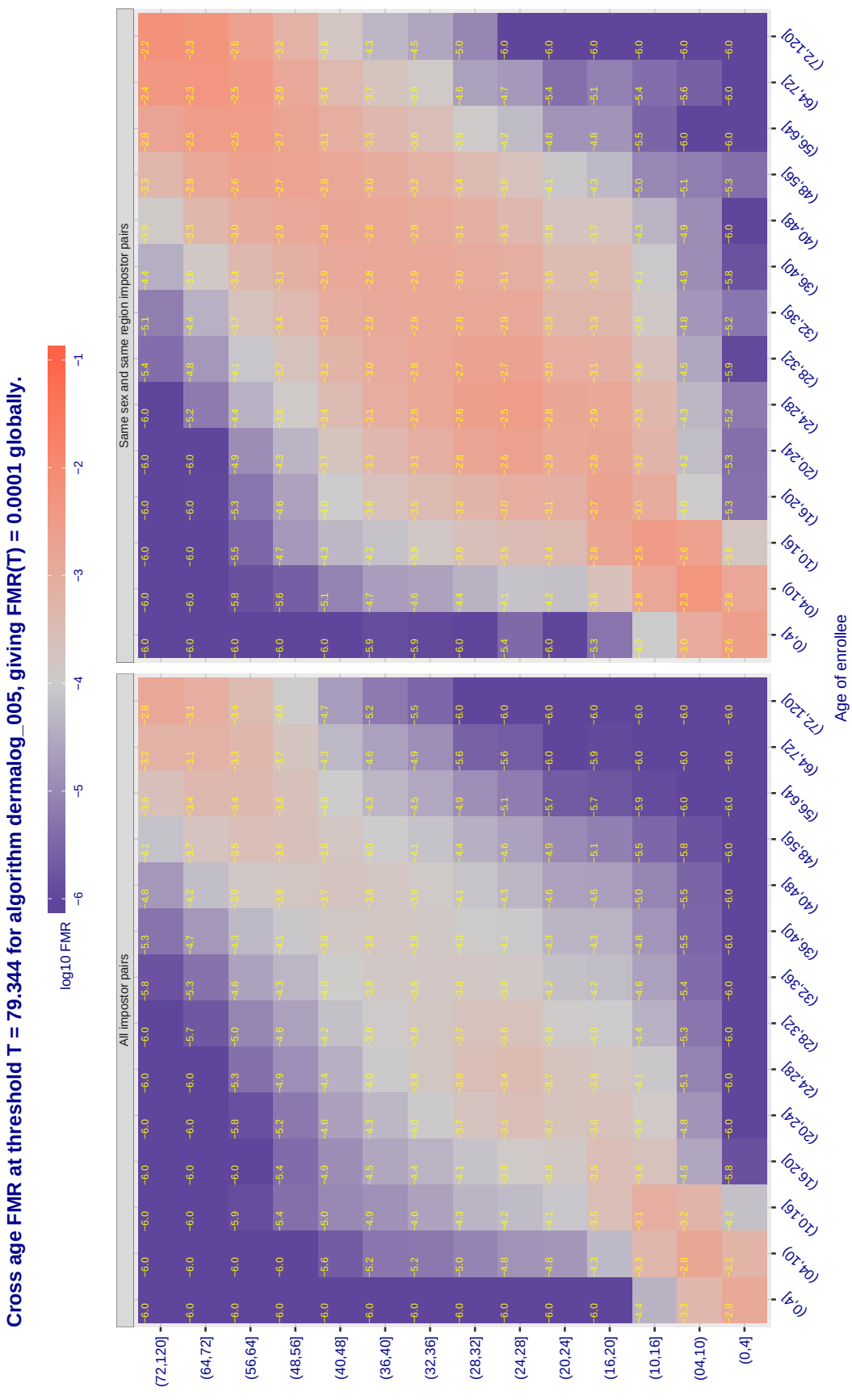


Figure 382: For algorithm dermalog-005 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

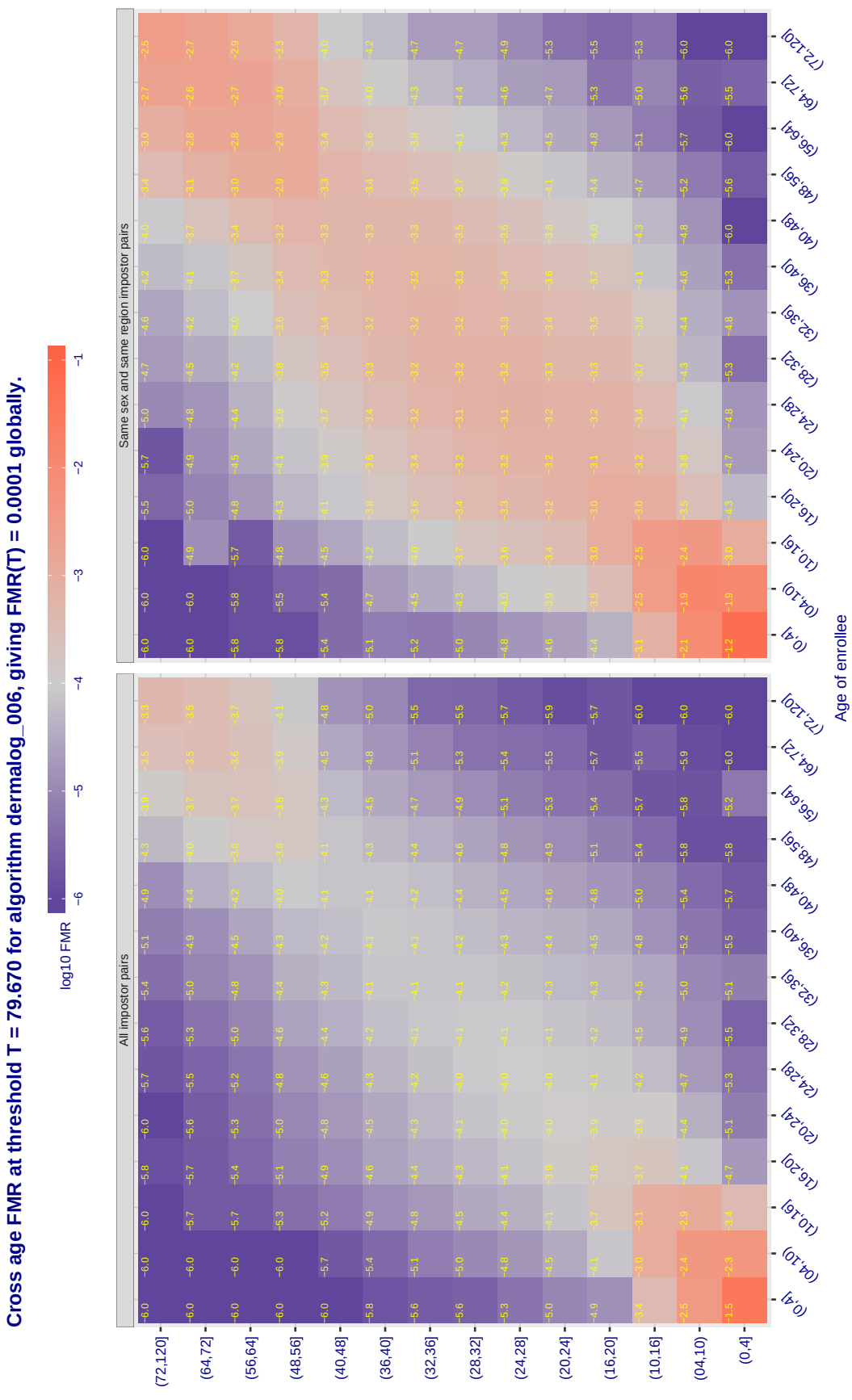


Figure 383: For algorithm dermalog-006 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

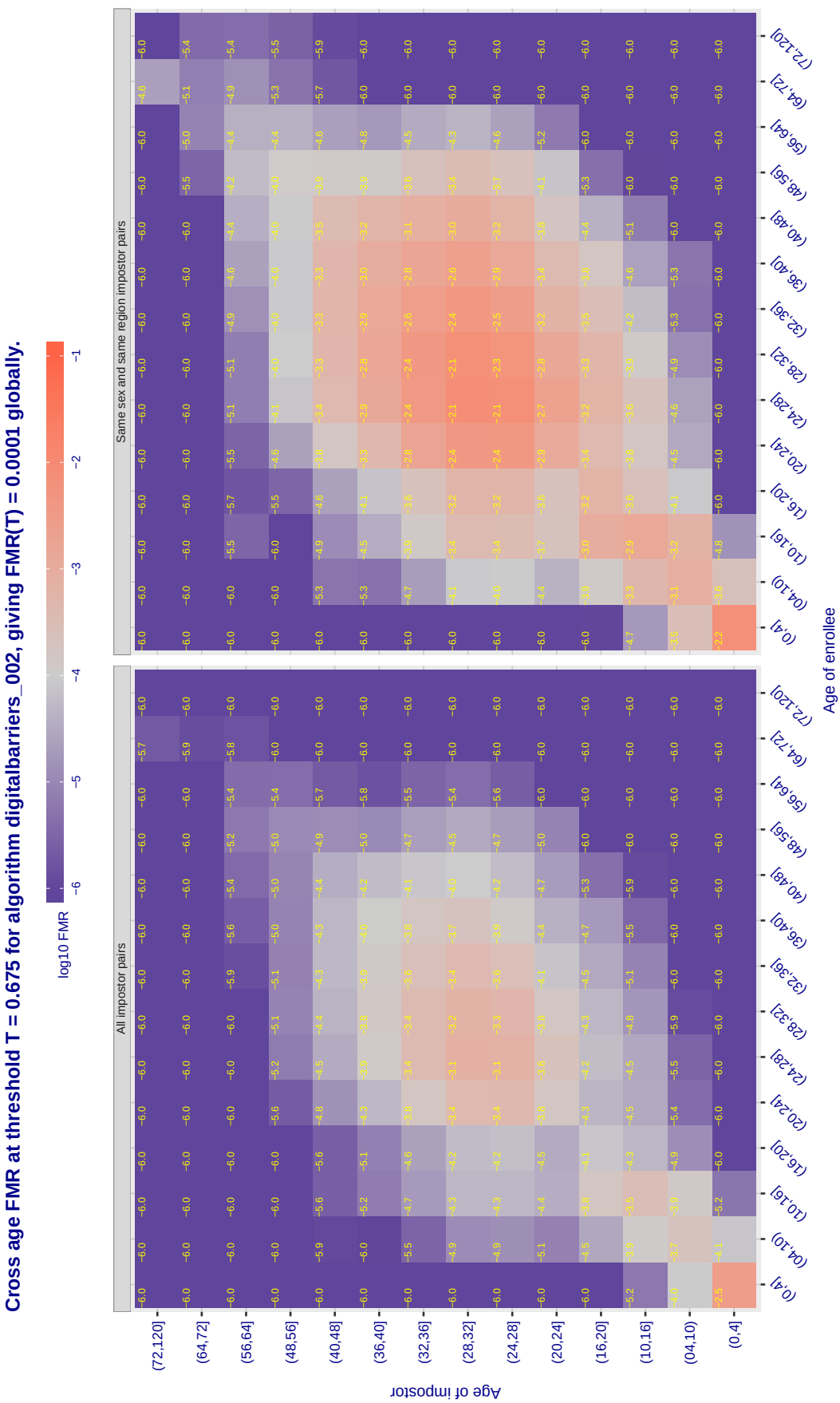


Figure 384: For algorithm digitalbarriers-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

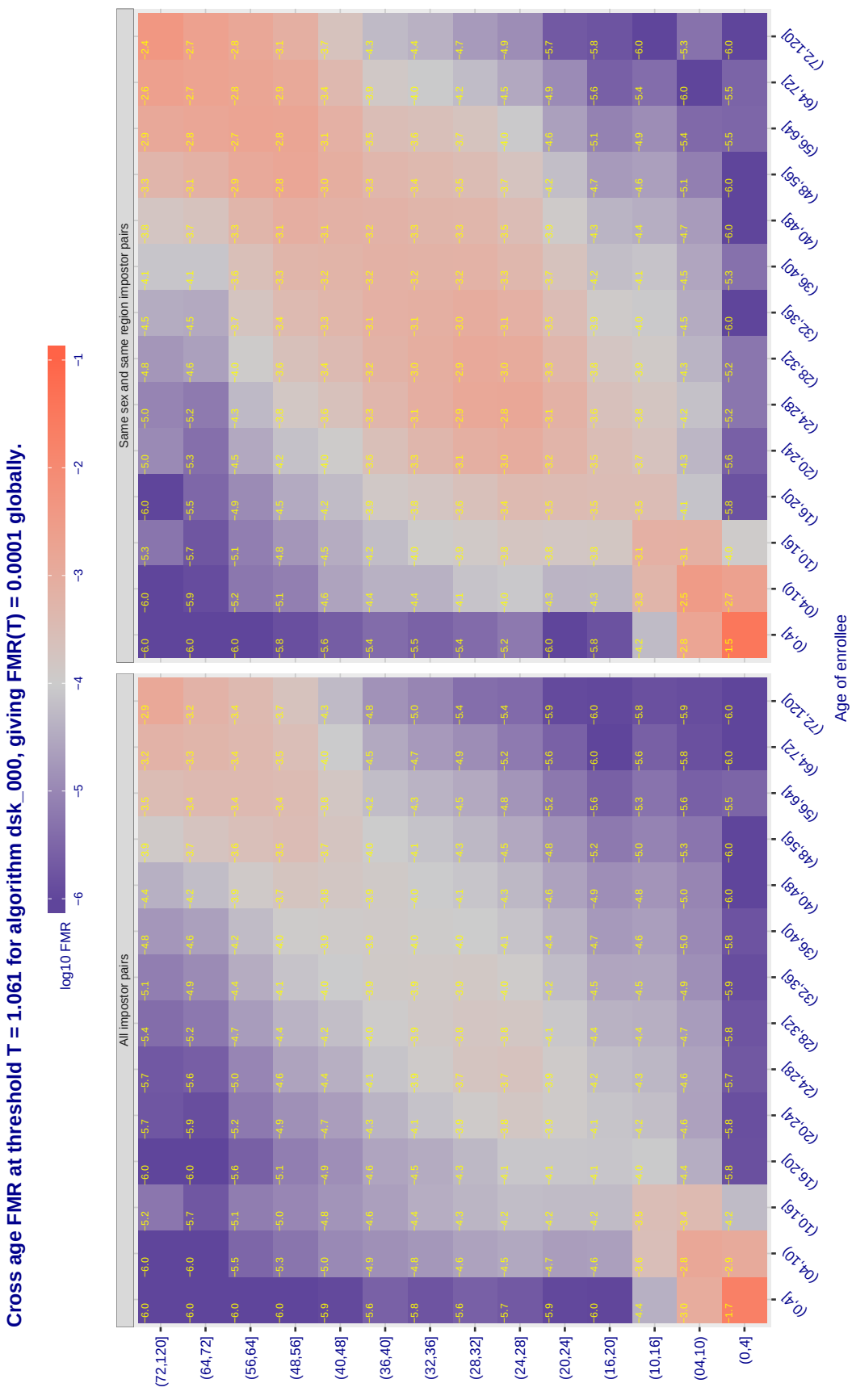


Figure 385: For algorithm dsk-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

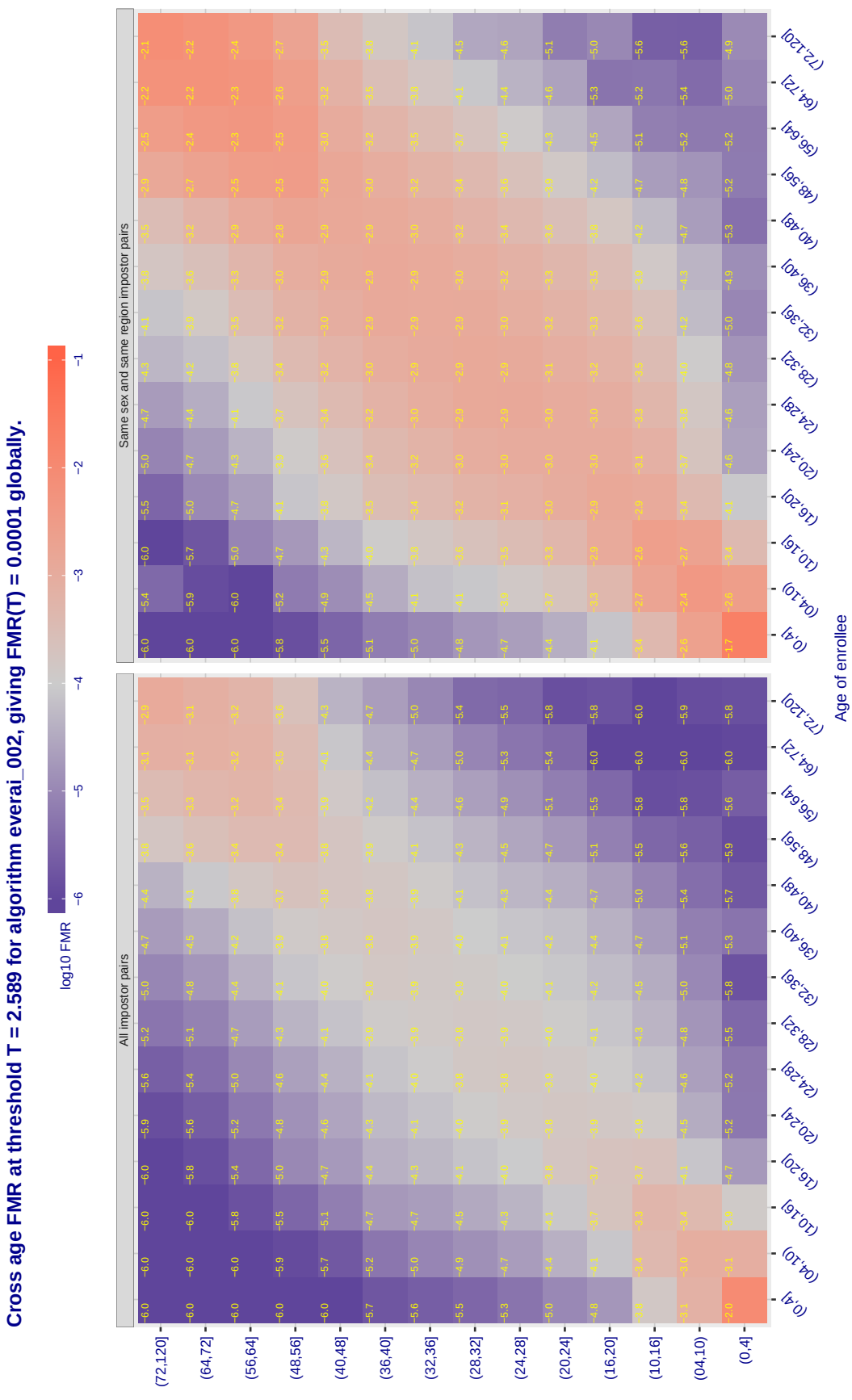


Figure 386: For algorithm everai-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

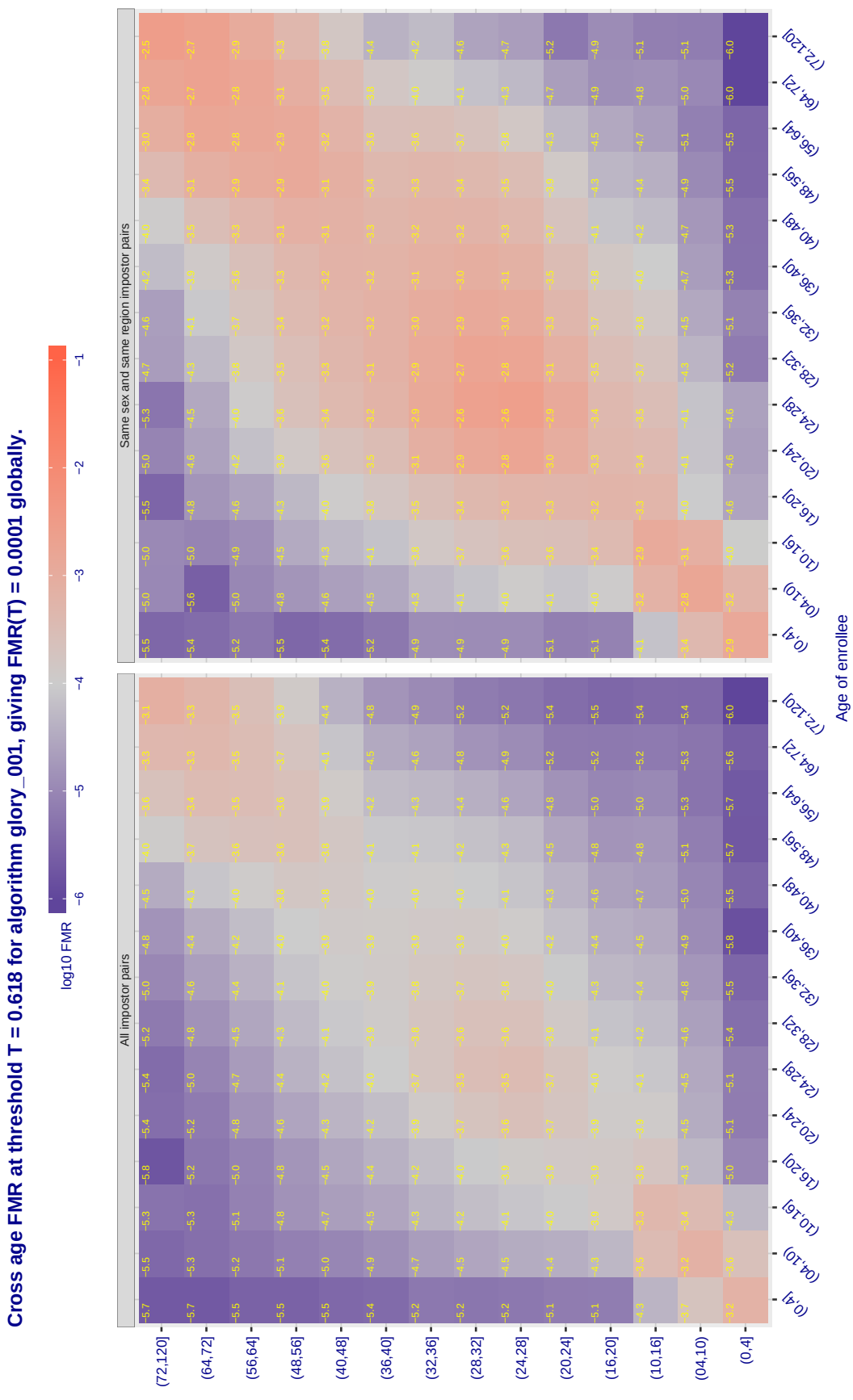


Figure 387: For algorithm glory-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

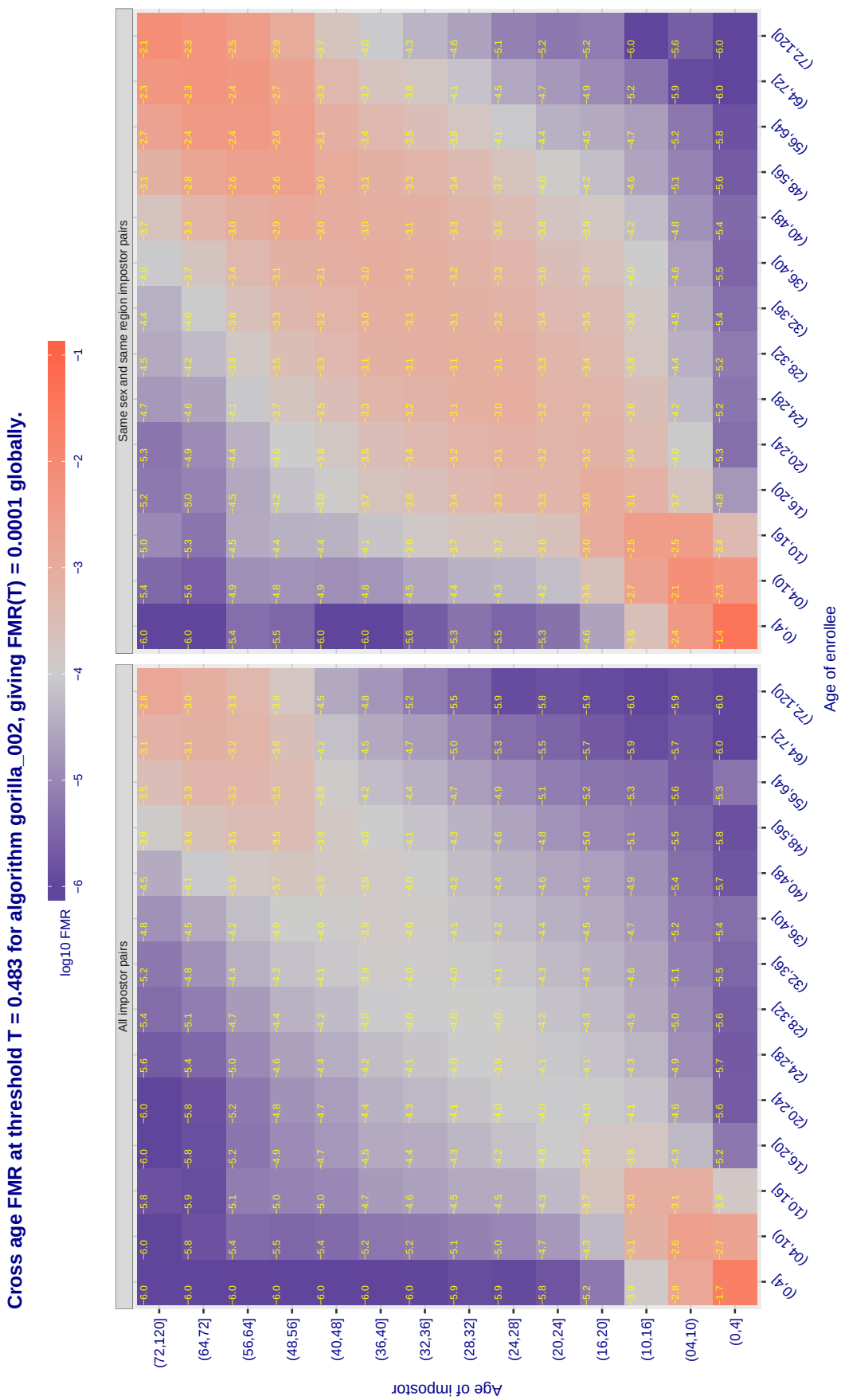


Figure 388: For algorithm gorilla-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

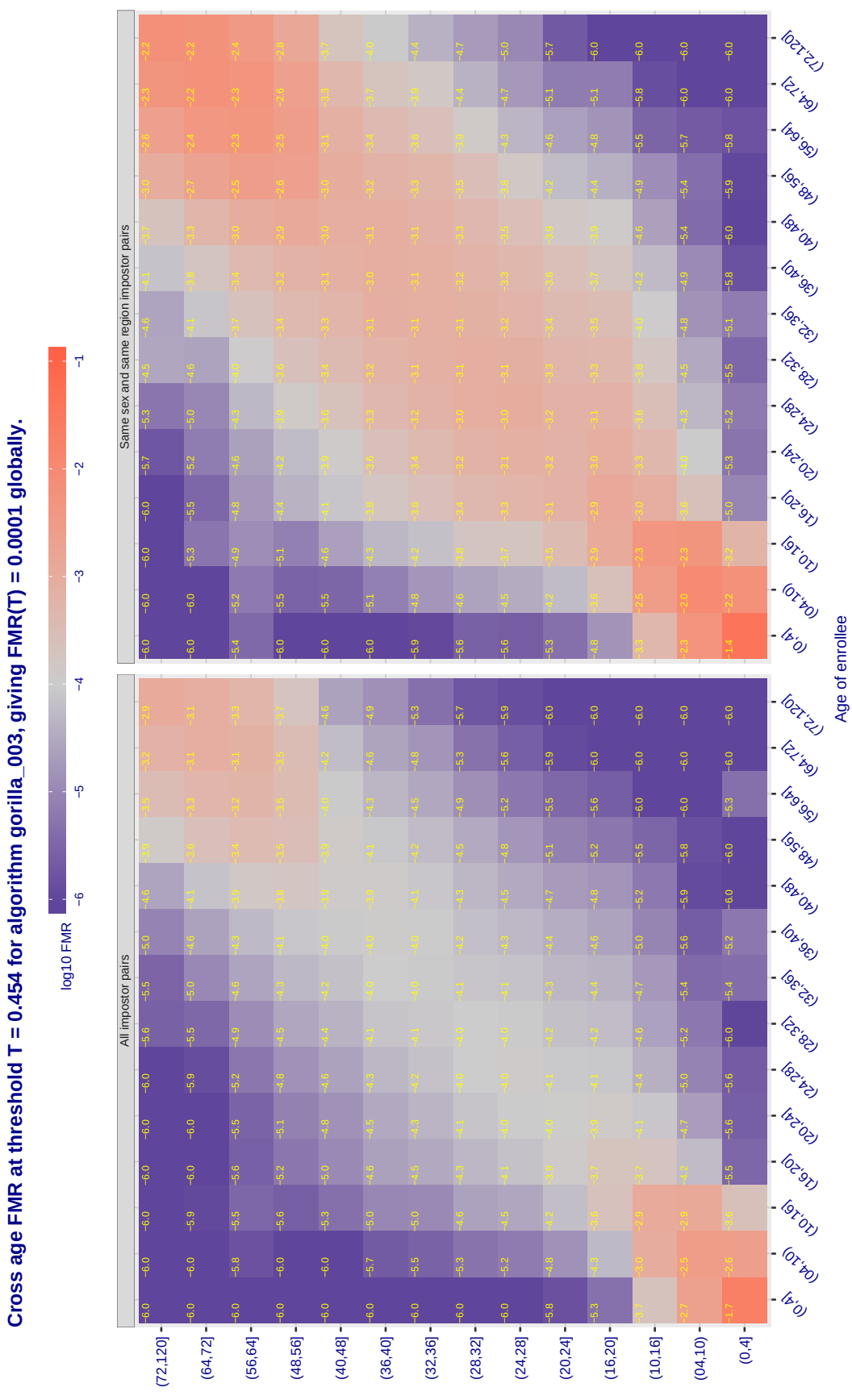


Figure 389: For algorithm gorilla-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

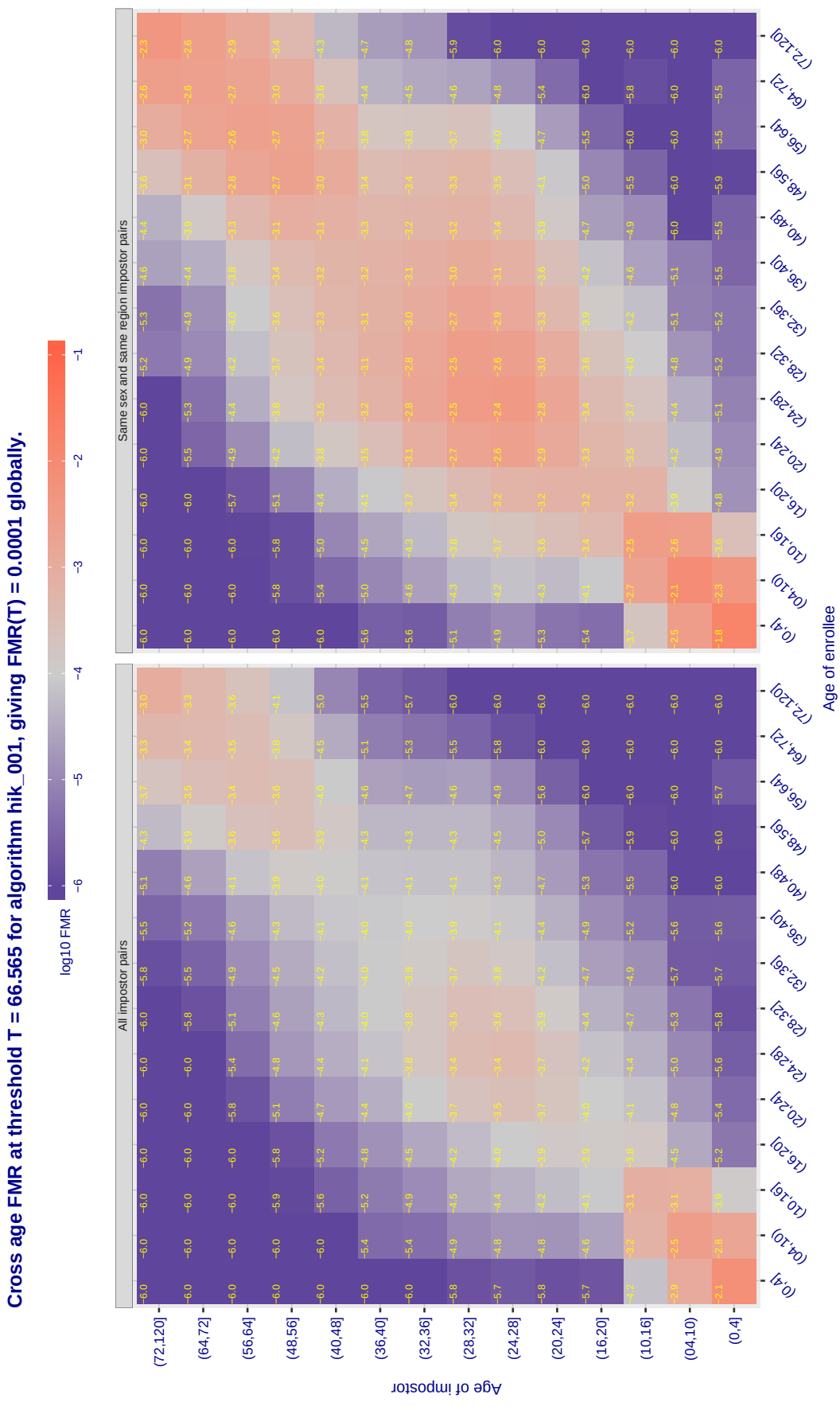


Figure 390: For algorithm hik-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

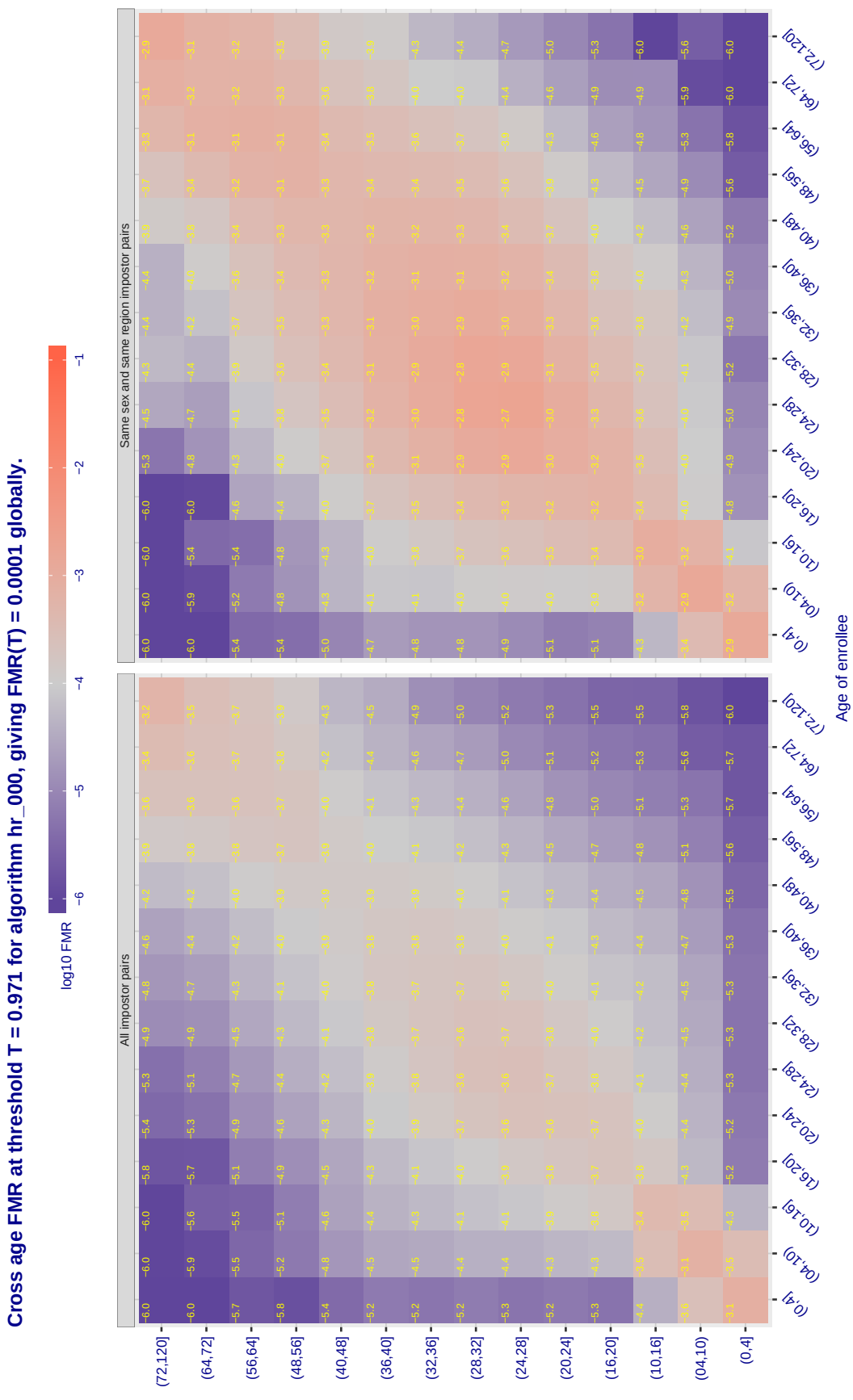


Figure 391: For algorithm hr-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

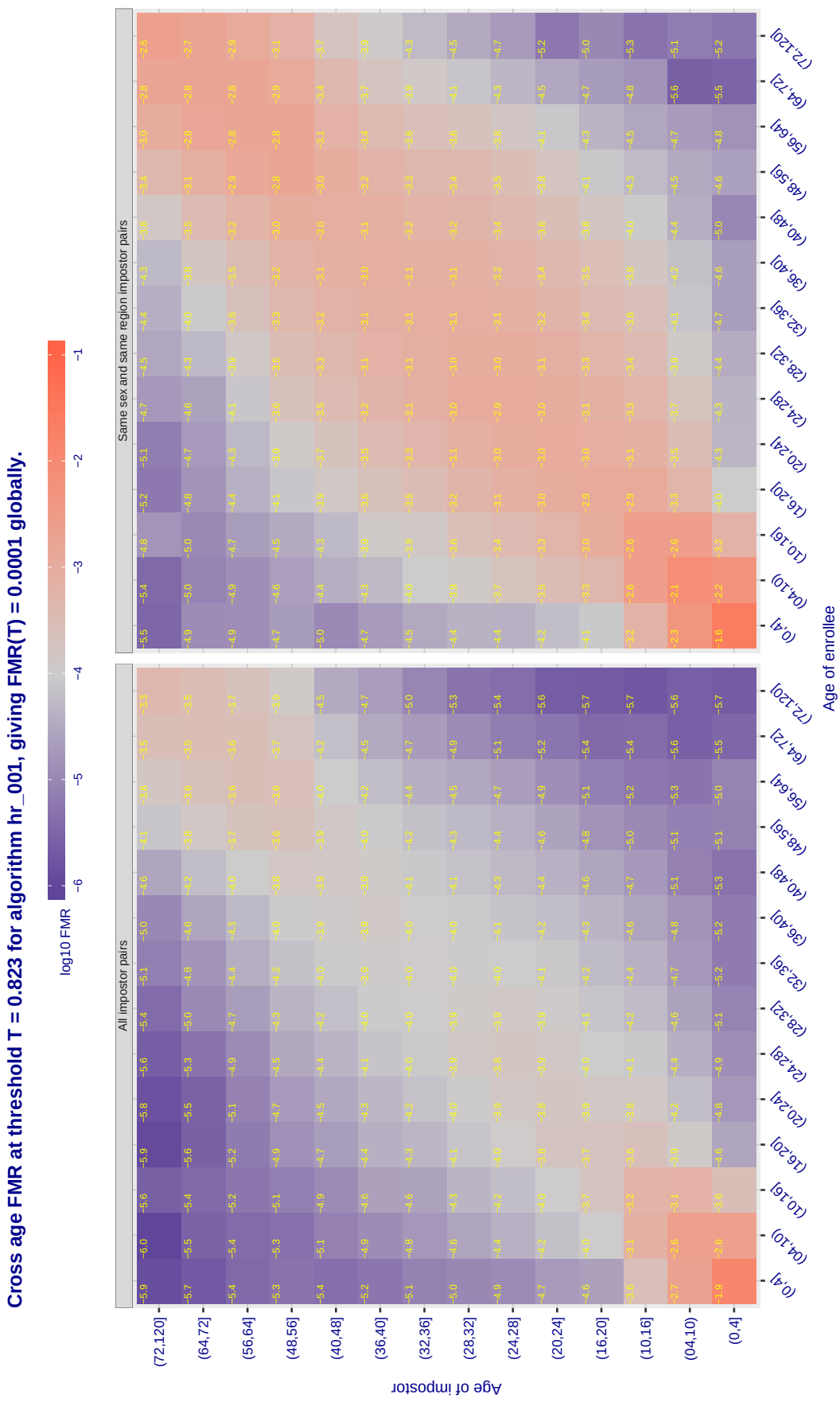


Figure 392: For algorithm hr-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

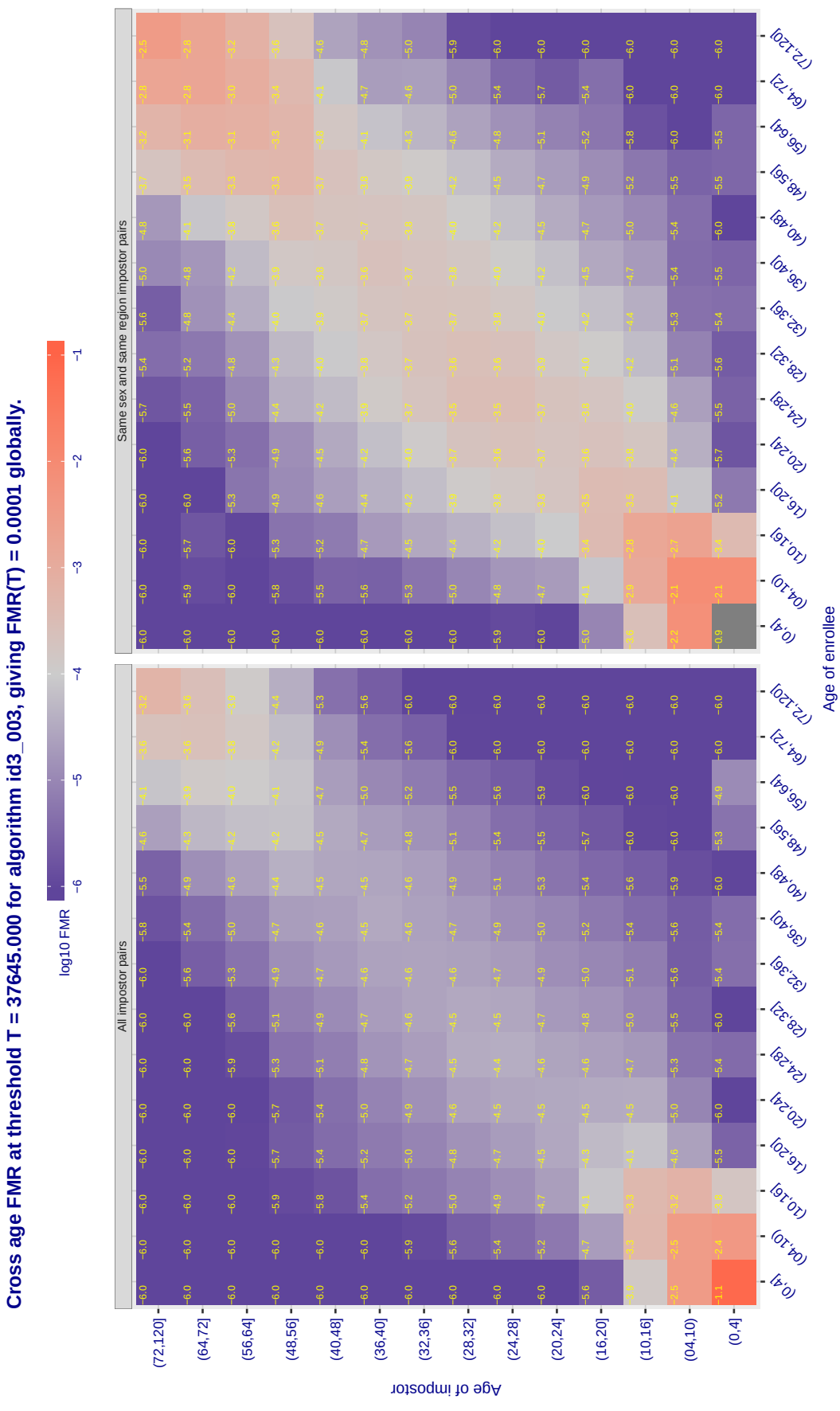


Figure 393: For algorithm id3-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

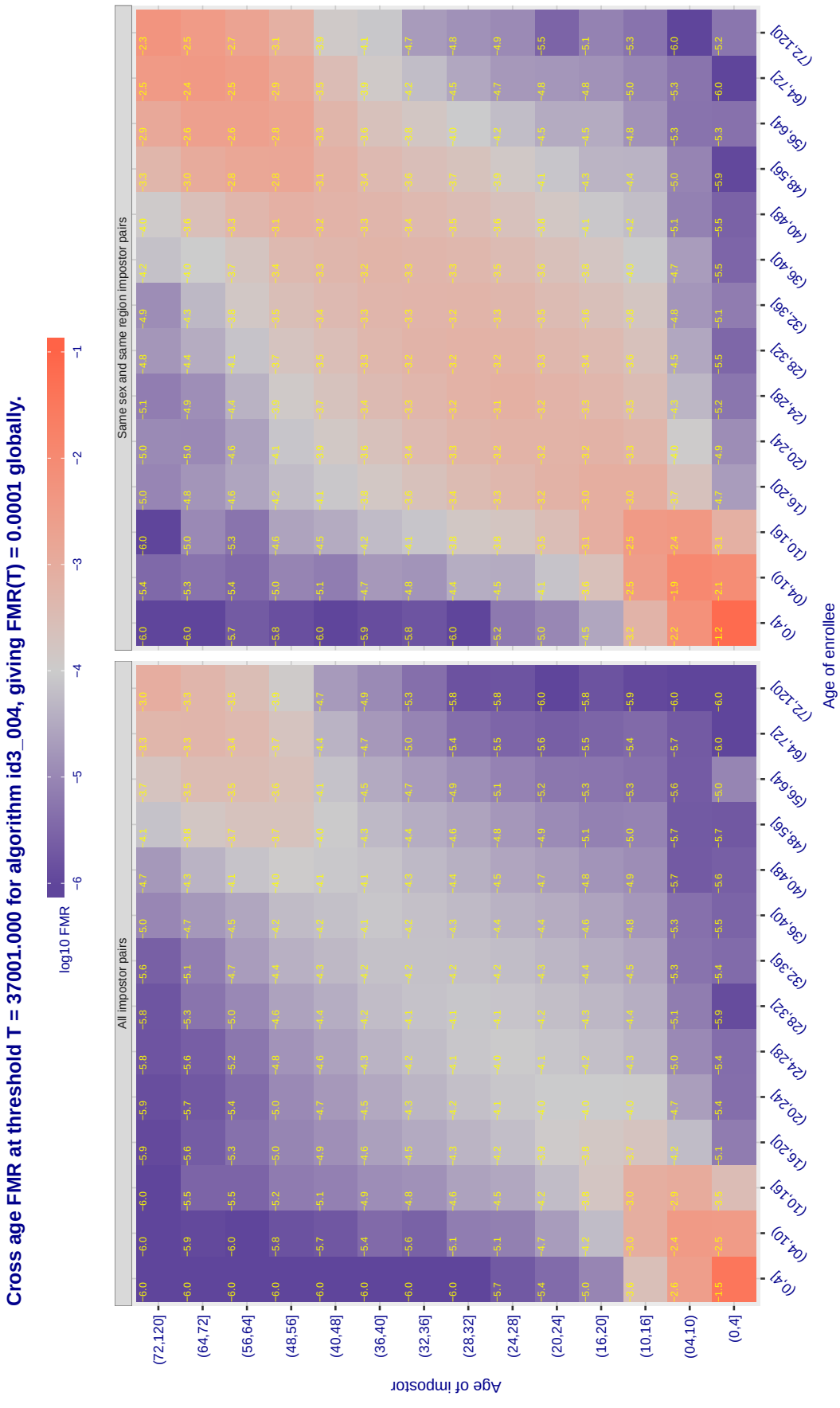


Figure 394: For algorithm id3-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

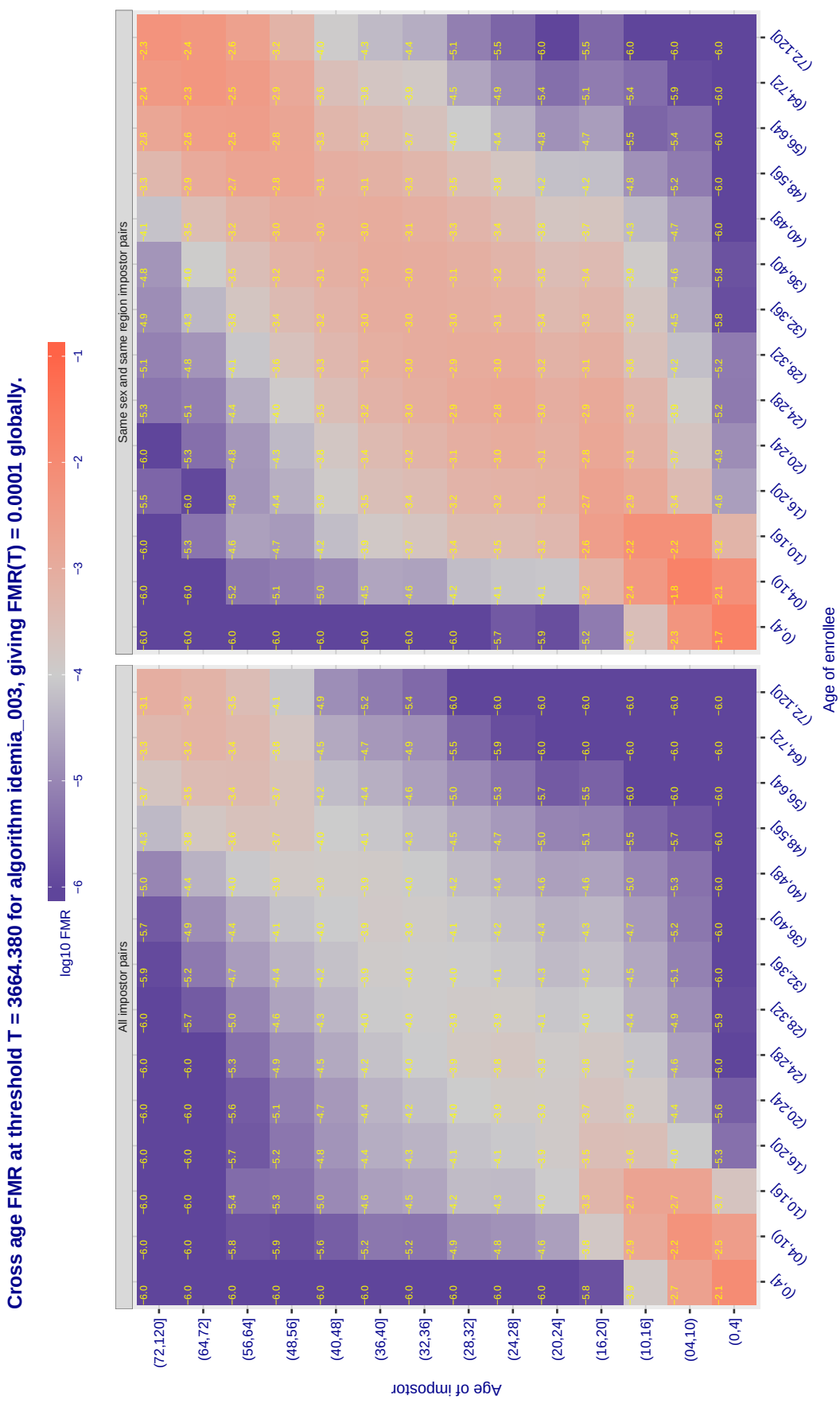


Figure 395: For algorithm idemia-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

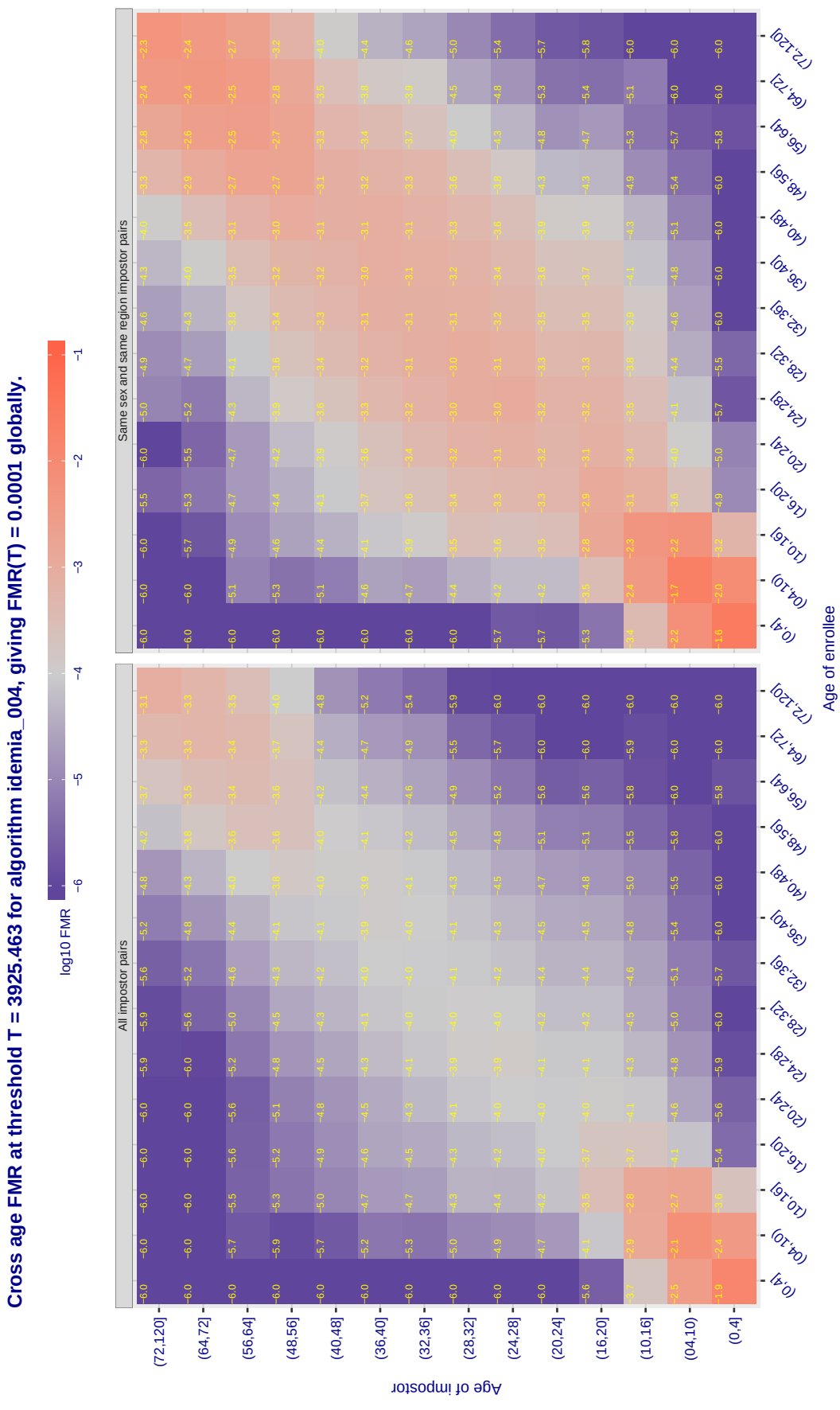


Figure 396: For algorithm idemia-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

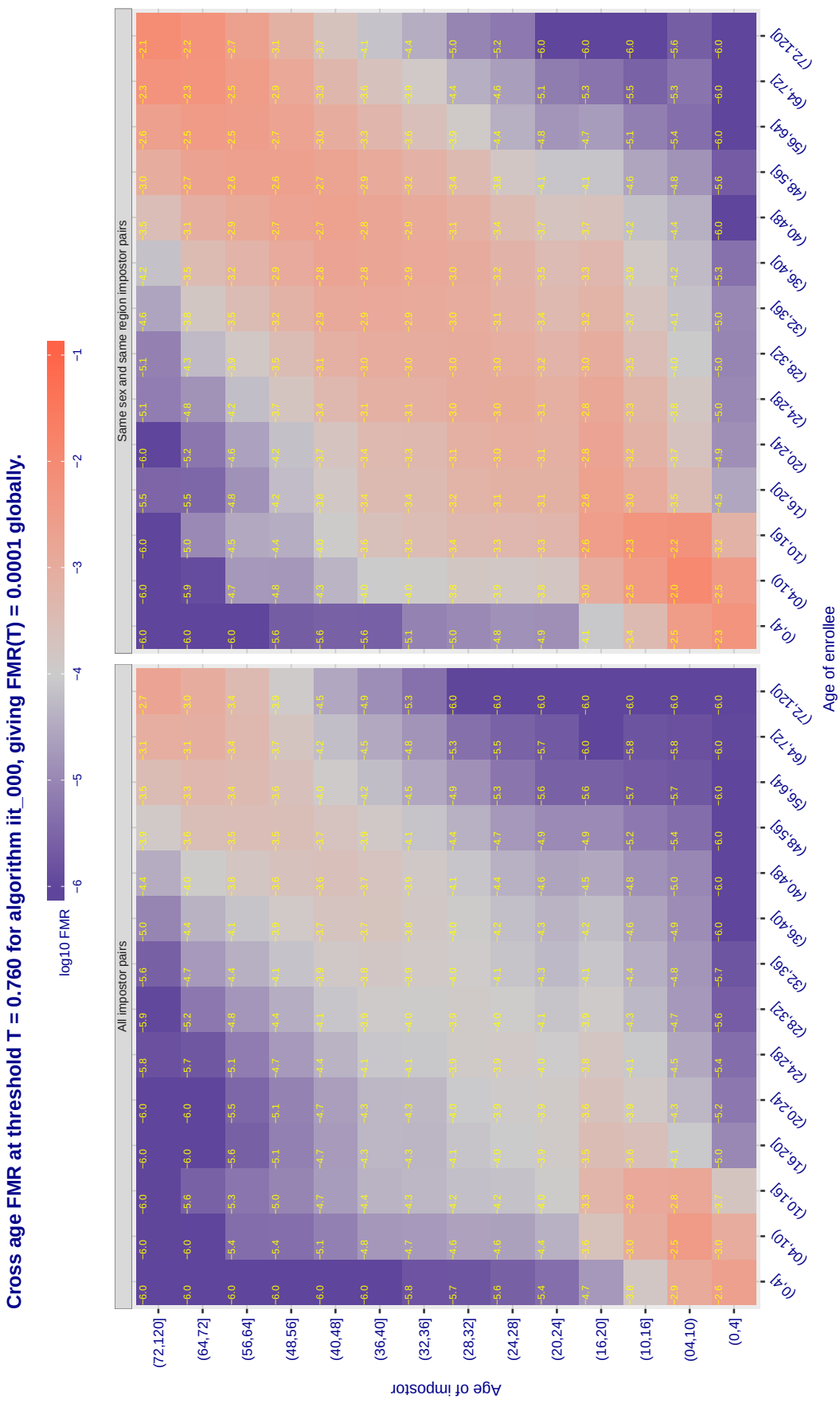


Figure 397: For algorithm iit-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

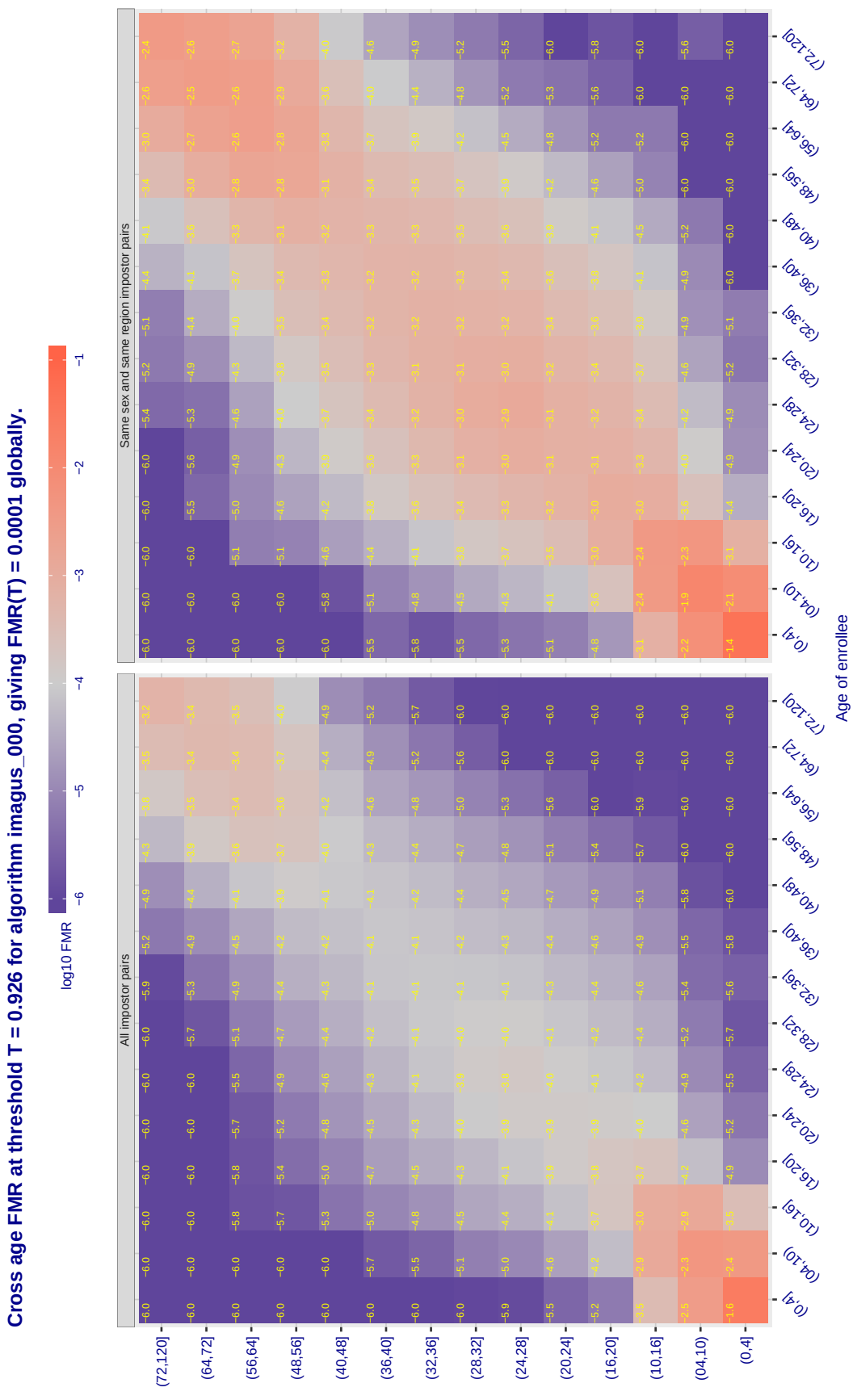


Figure 398: For algorithm imagus-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

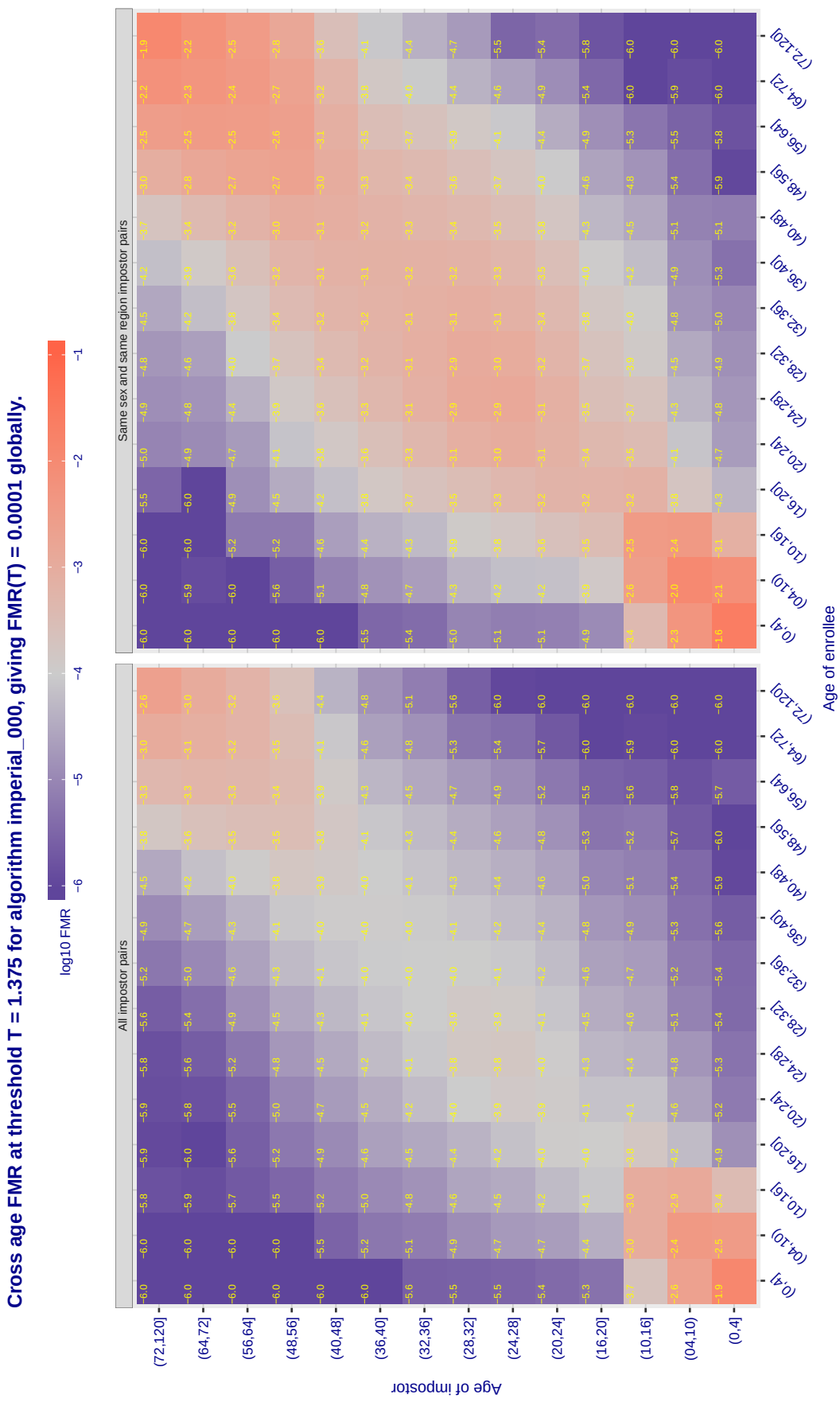


Figure 399: For algorithm imperial-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

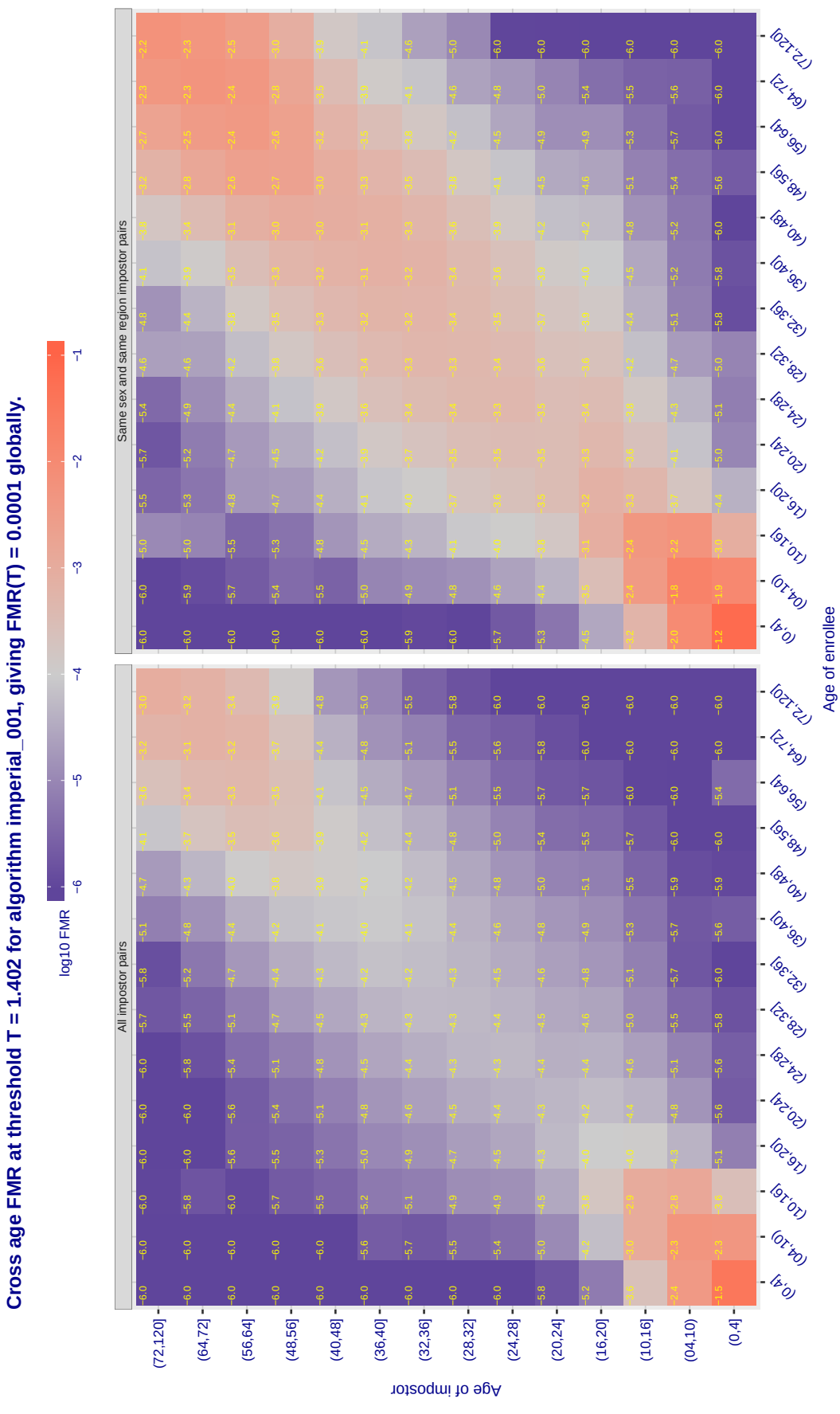


Figure 400: For algorithm imperial-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

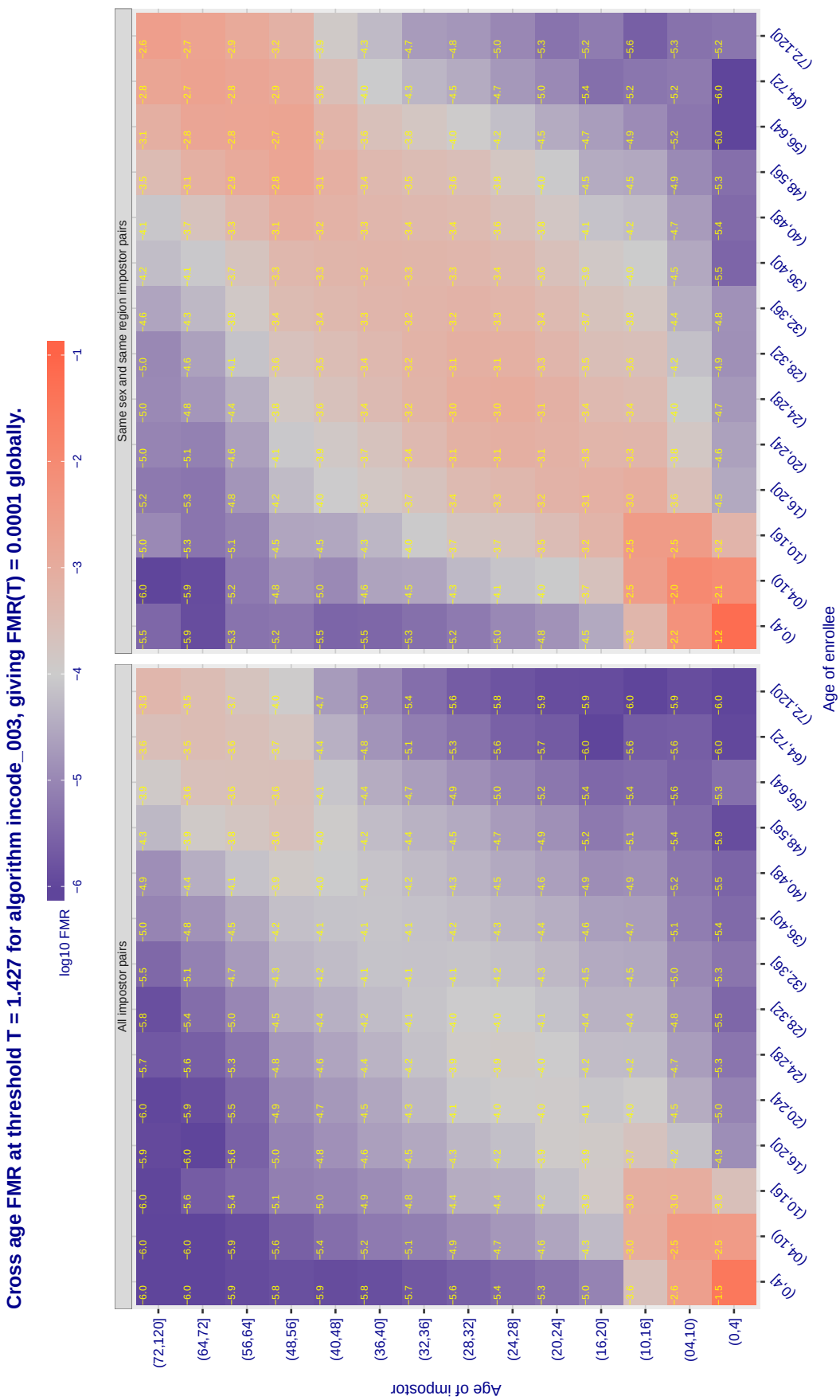


Figure 401: For algorithm incode-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

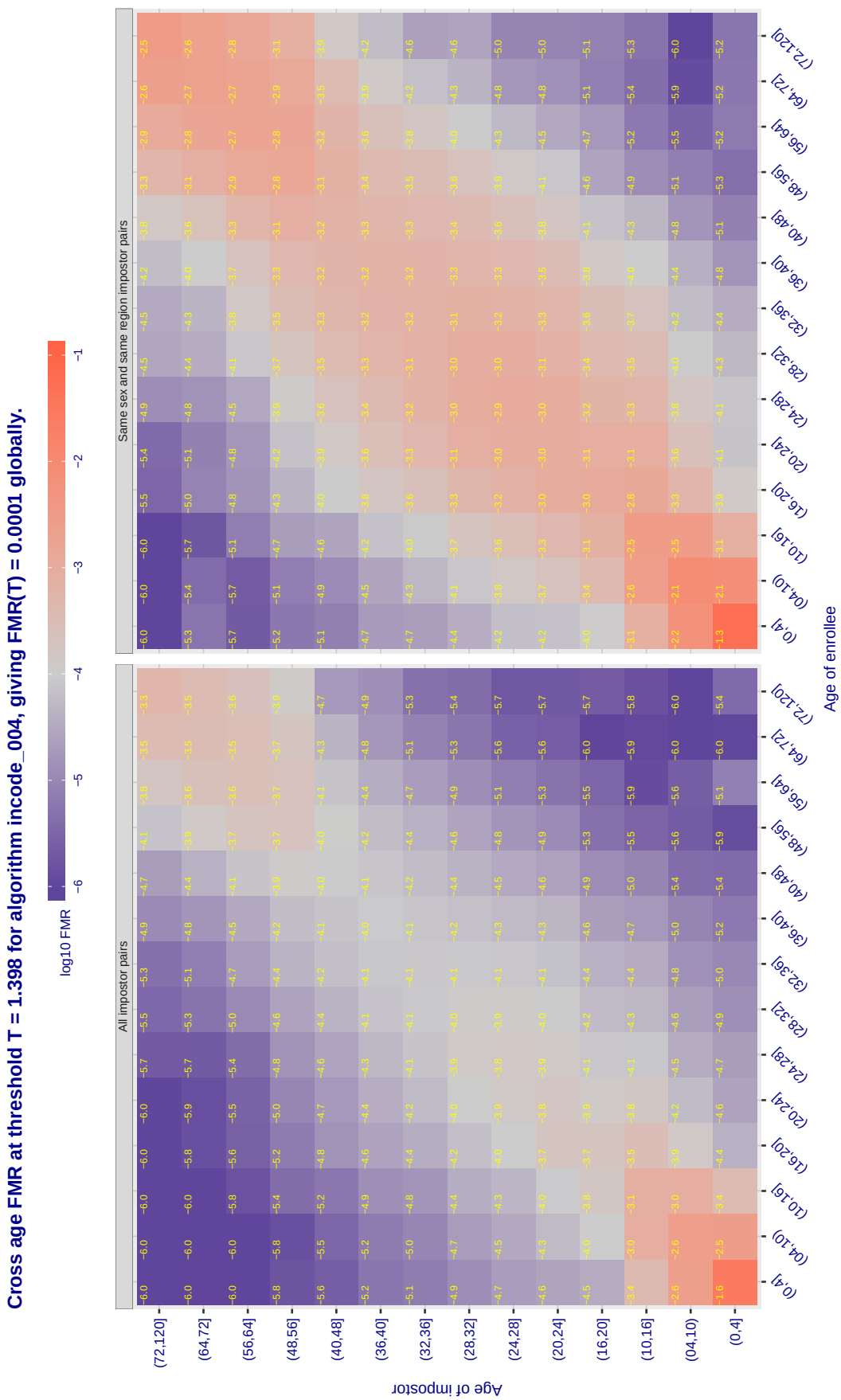


Figure 402: For algorithm incode-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

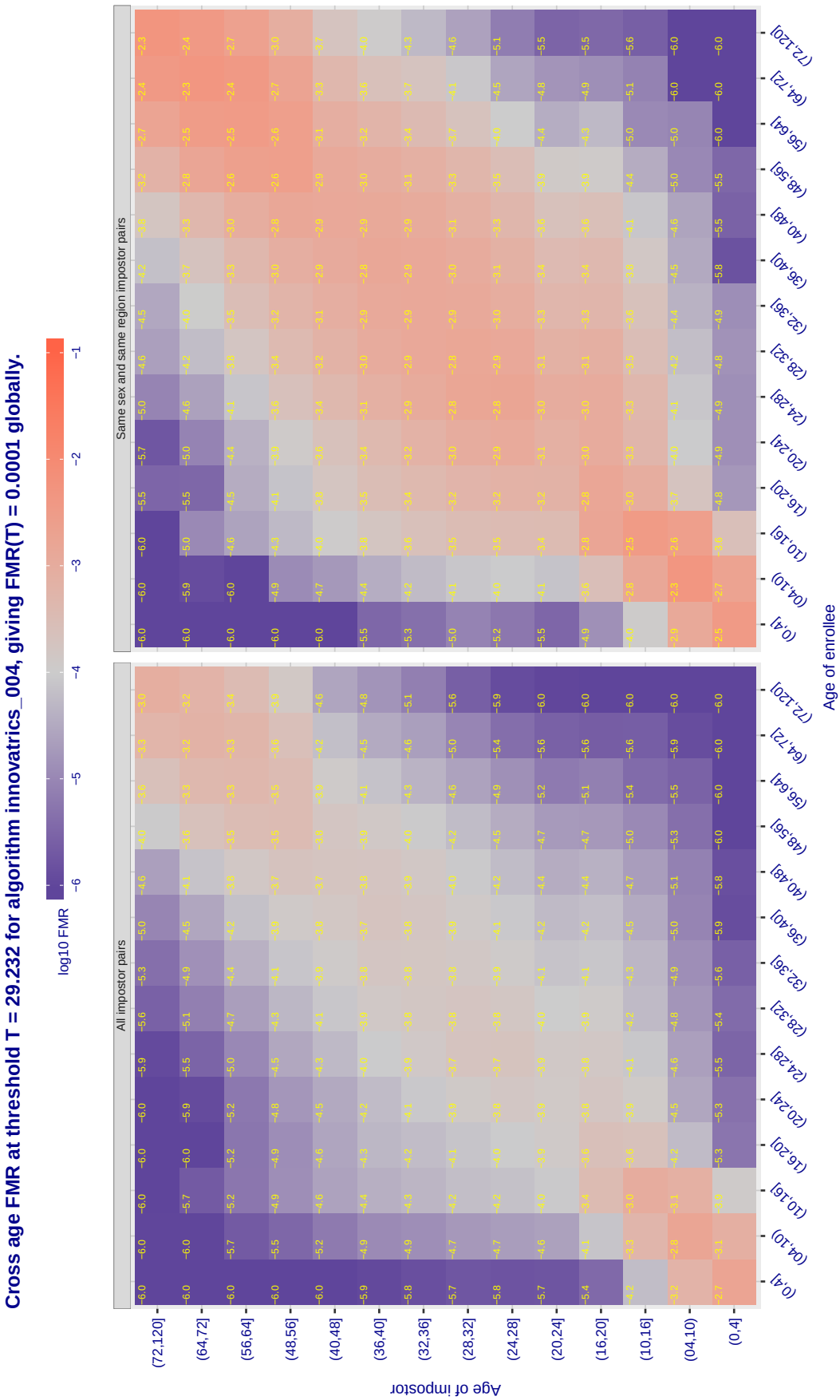


Figure 403: For algorithm innovatrics-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

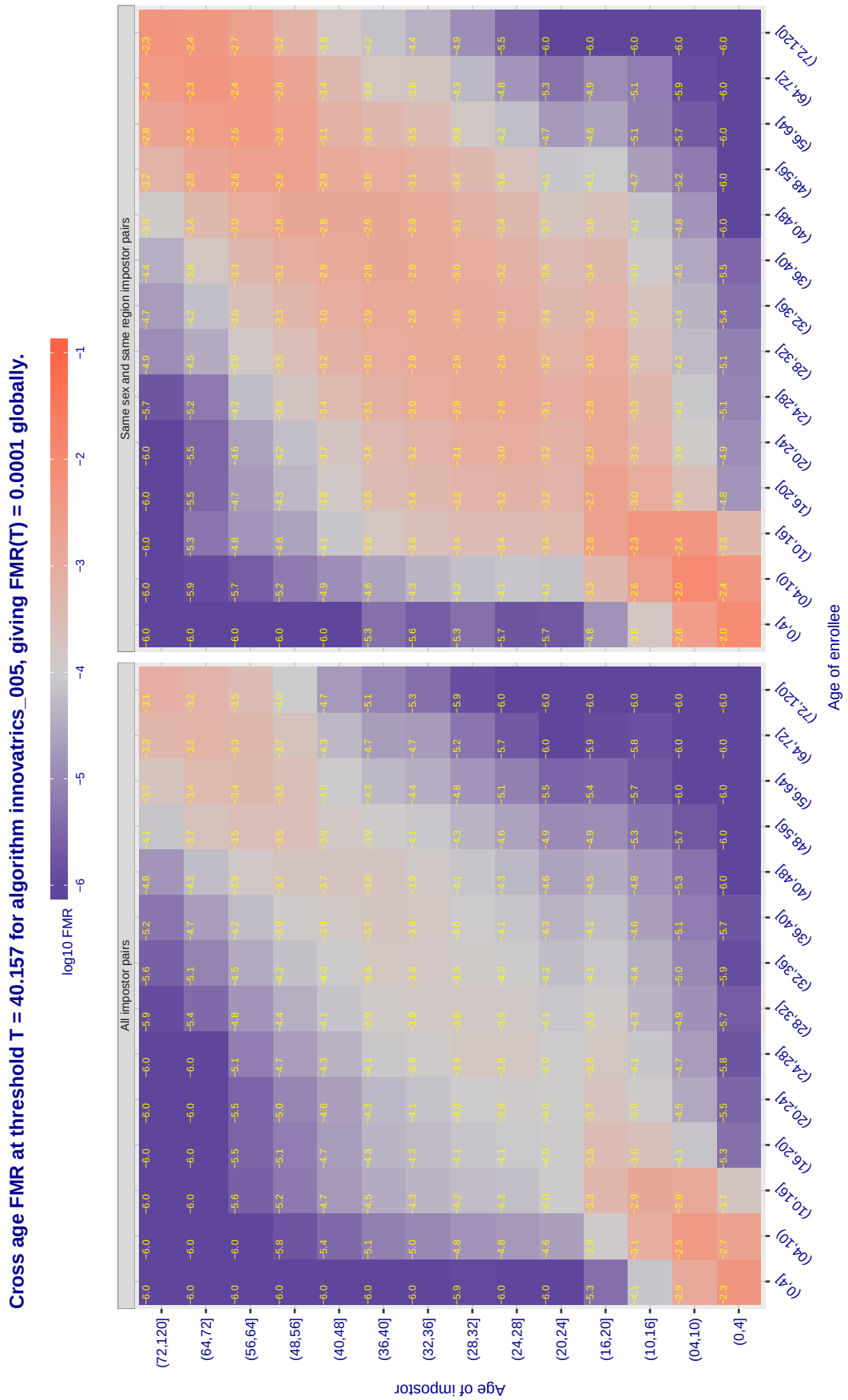


Figure 404: For algorithm innovatrics-005 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

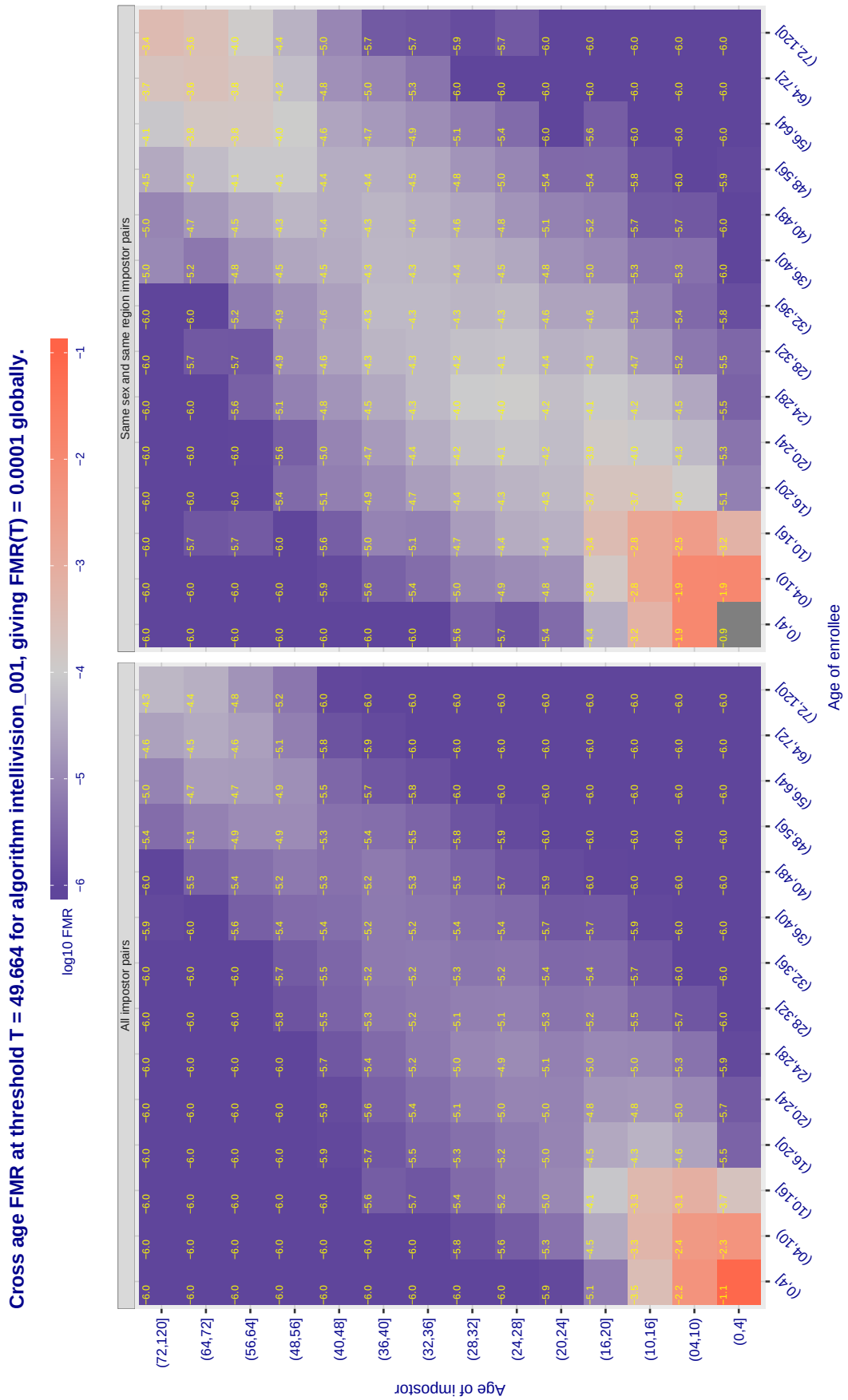


Figure 405: For algorithm intellivision-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

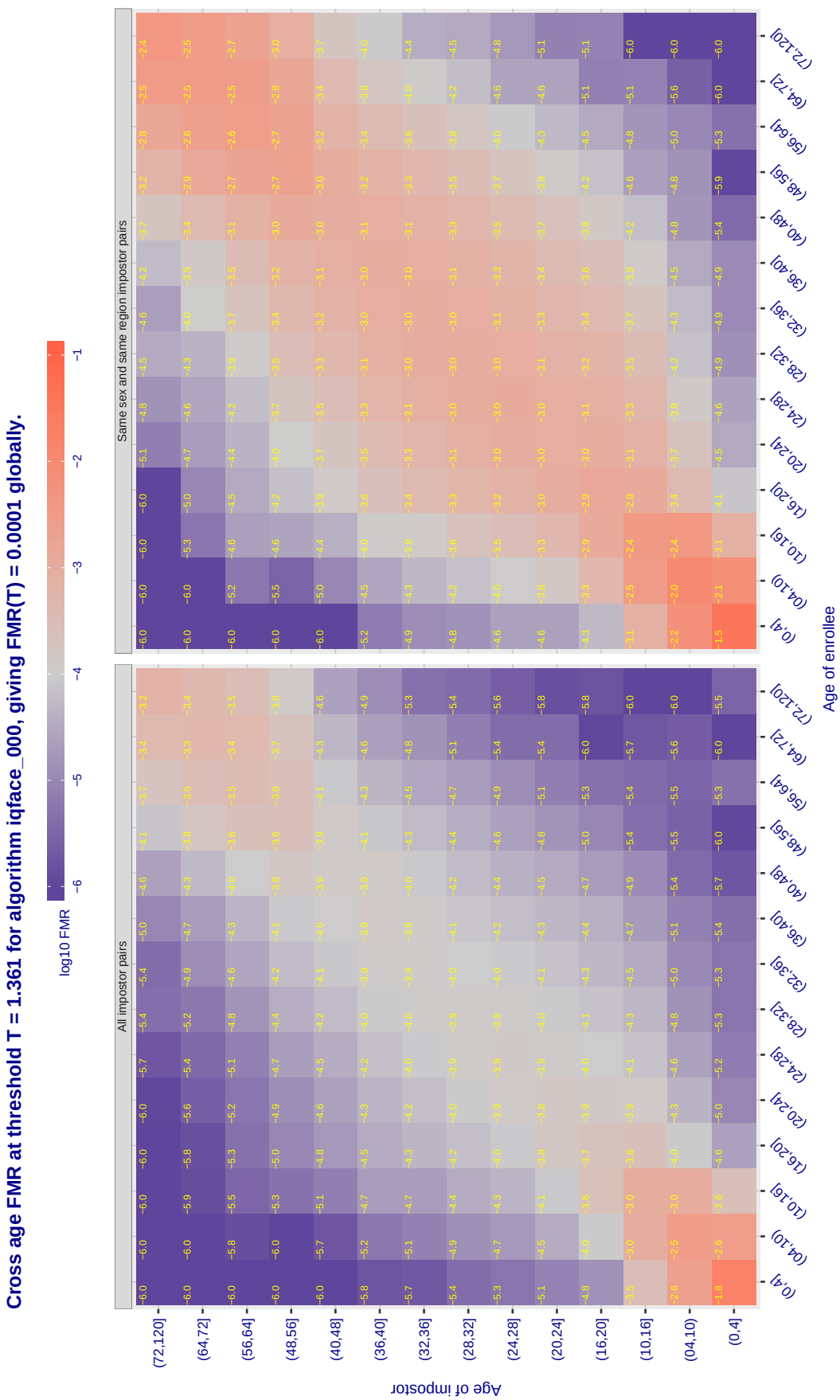


Figure 406: For algorithm iqface-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

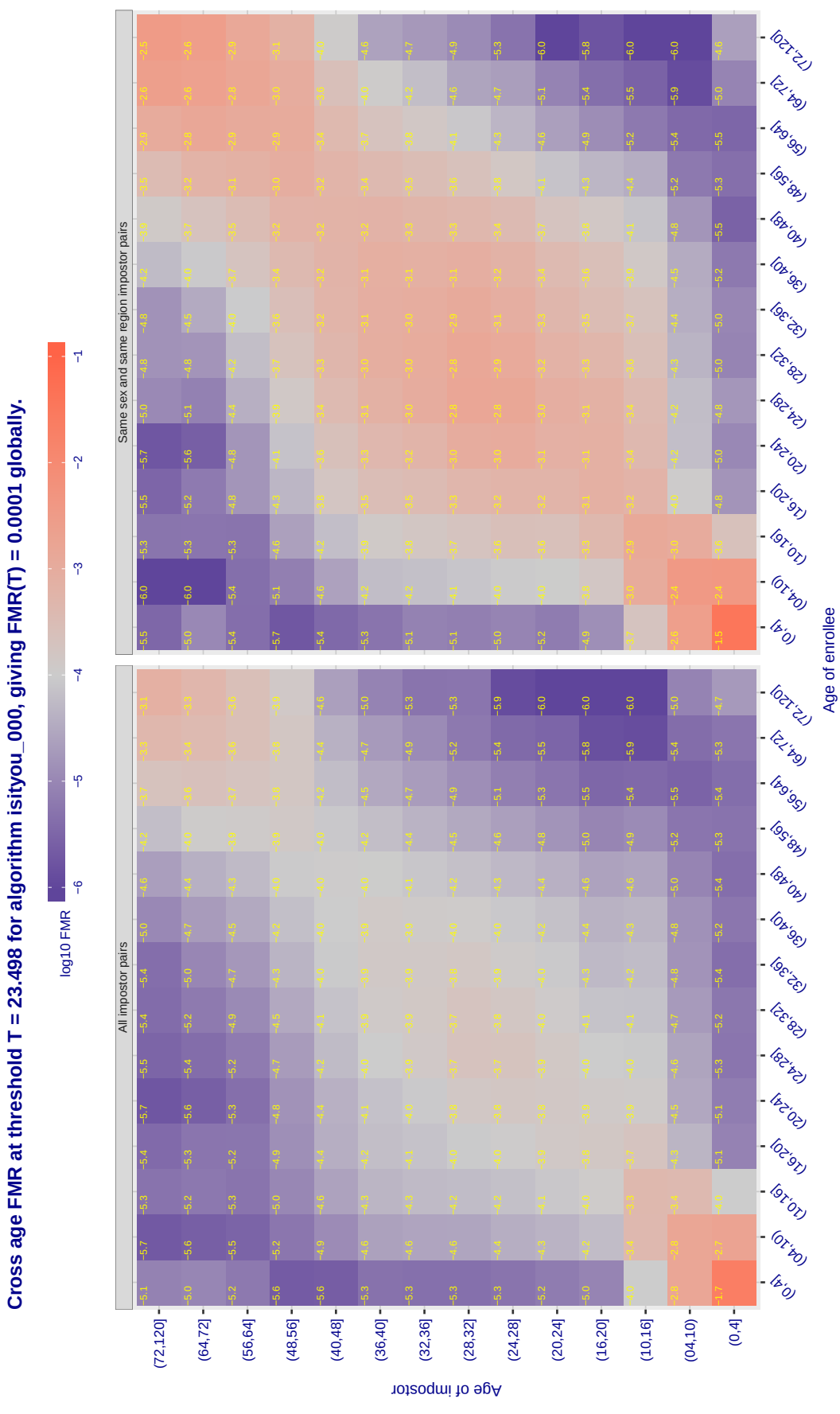


Figure 407: For algorithm isityou-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

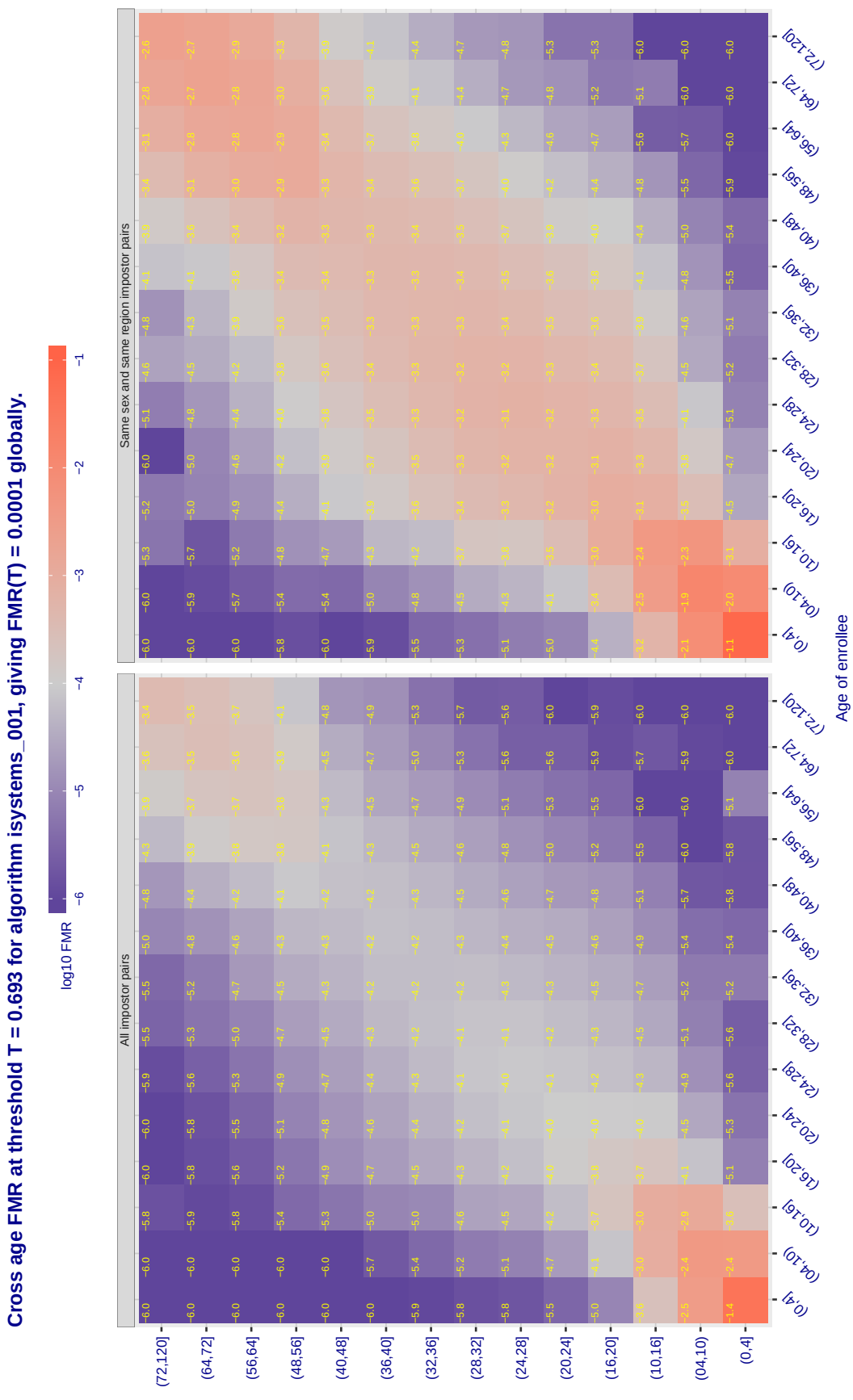


Figure 408: For algorithm isystems-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

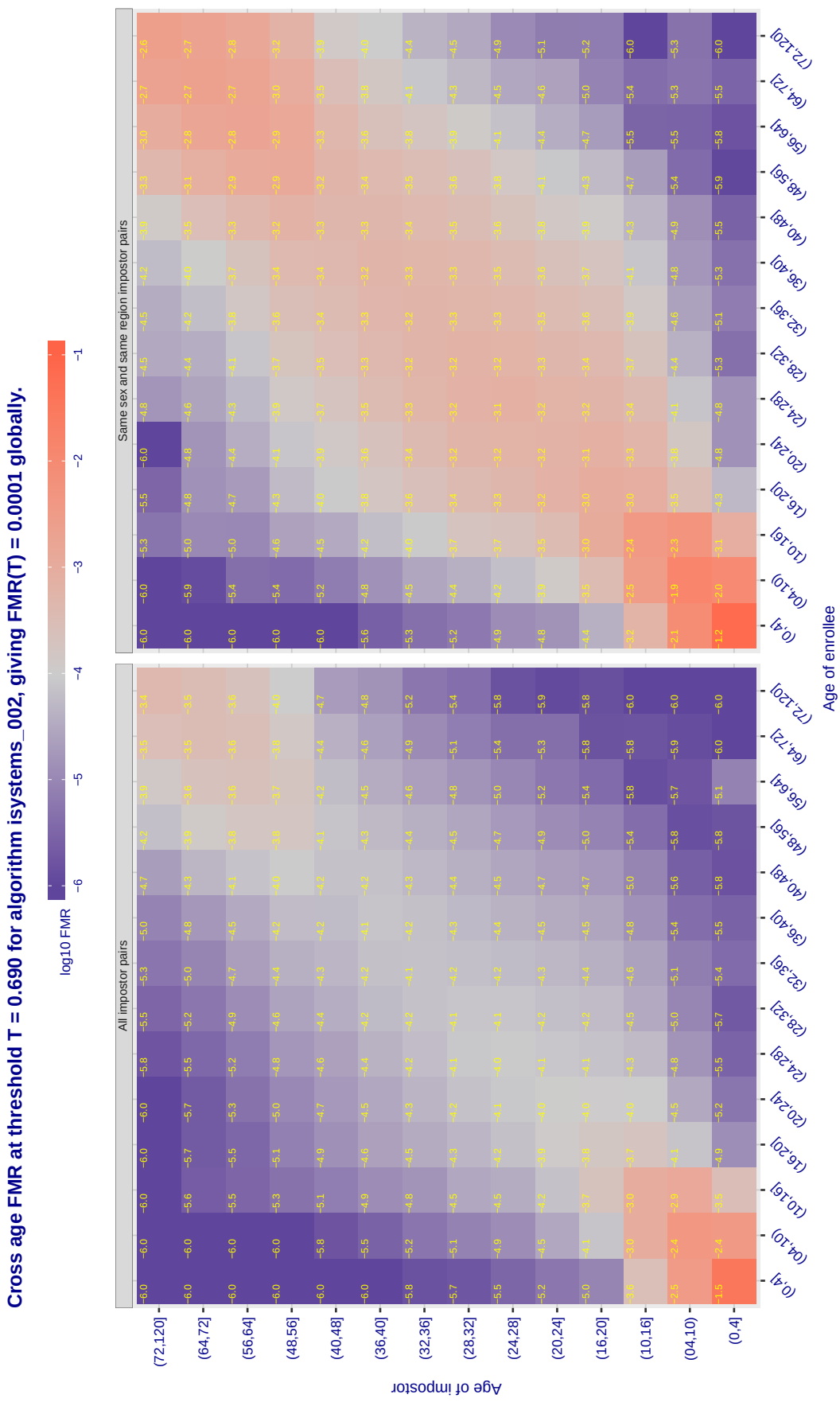


Figure 409: For algorithm isystems-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

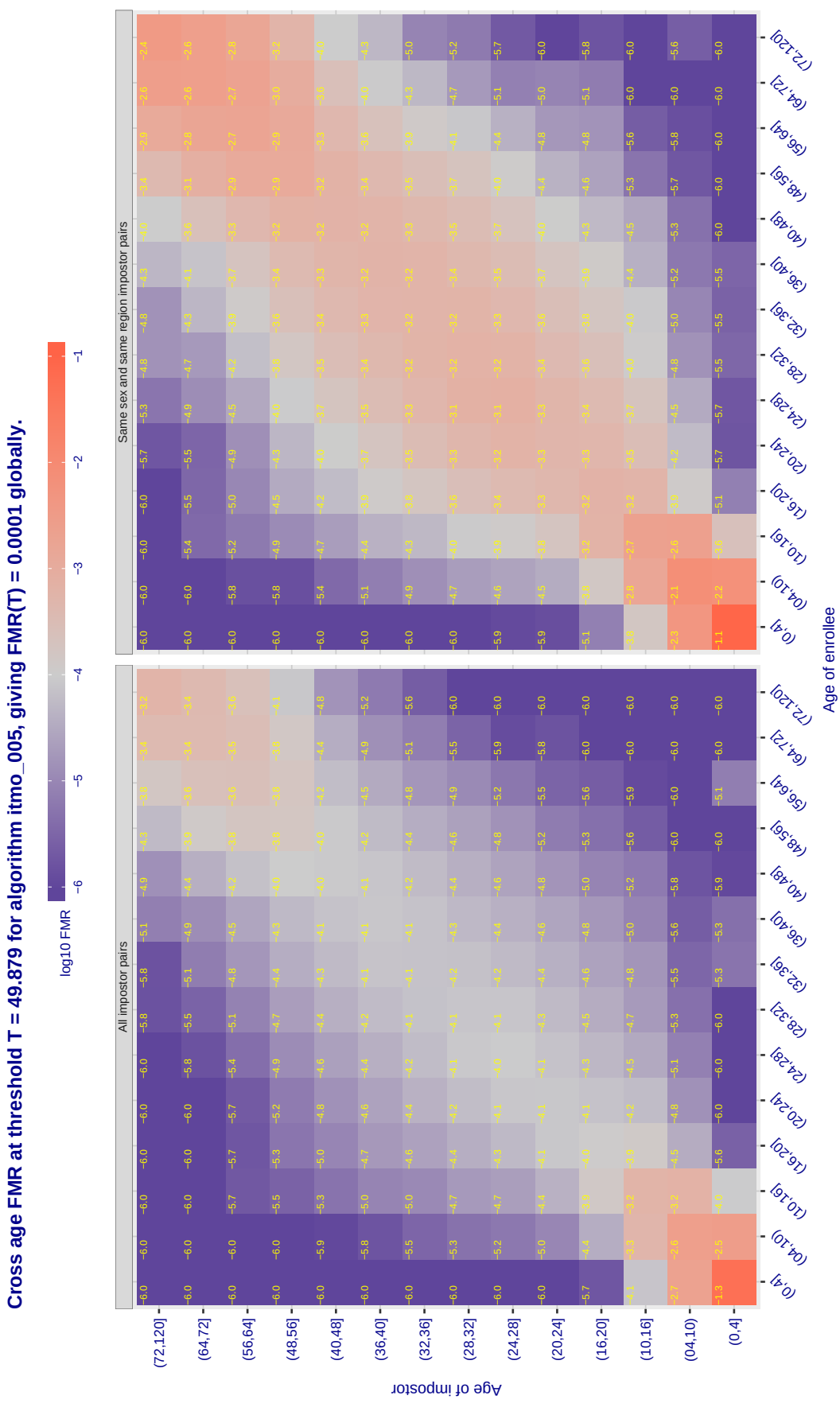


Figure 410: For algorithm itmo-005 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

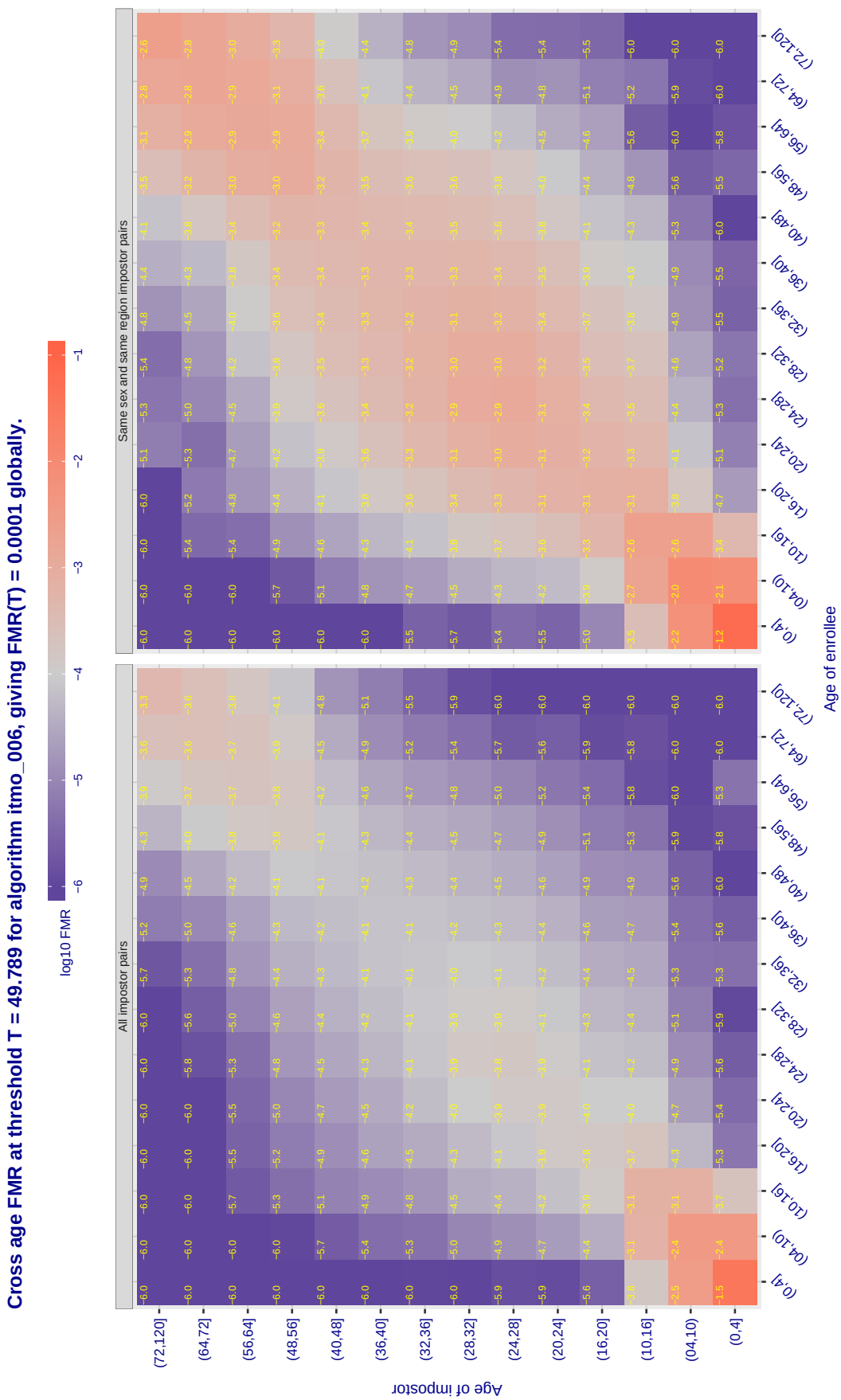


Figure 411: For algorithm itmo-006 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

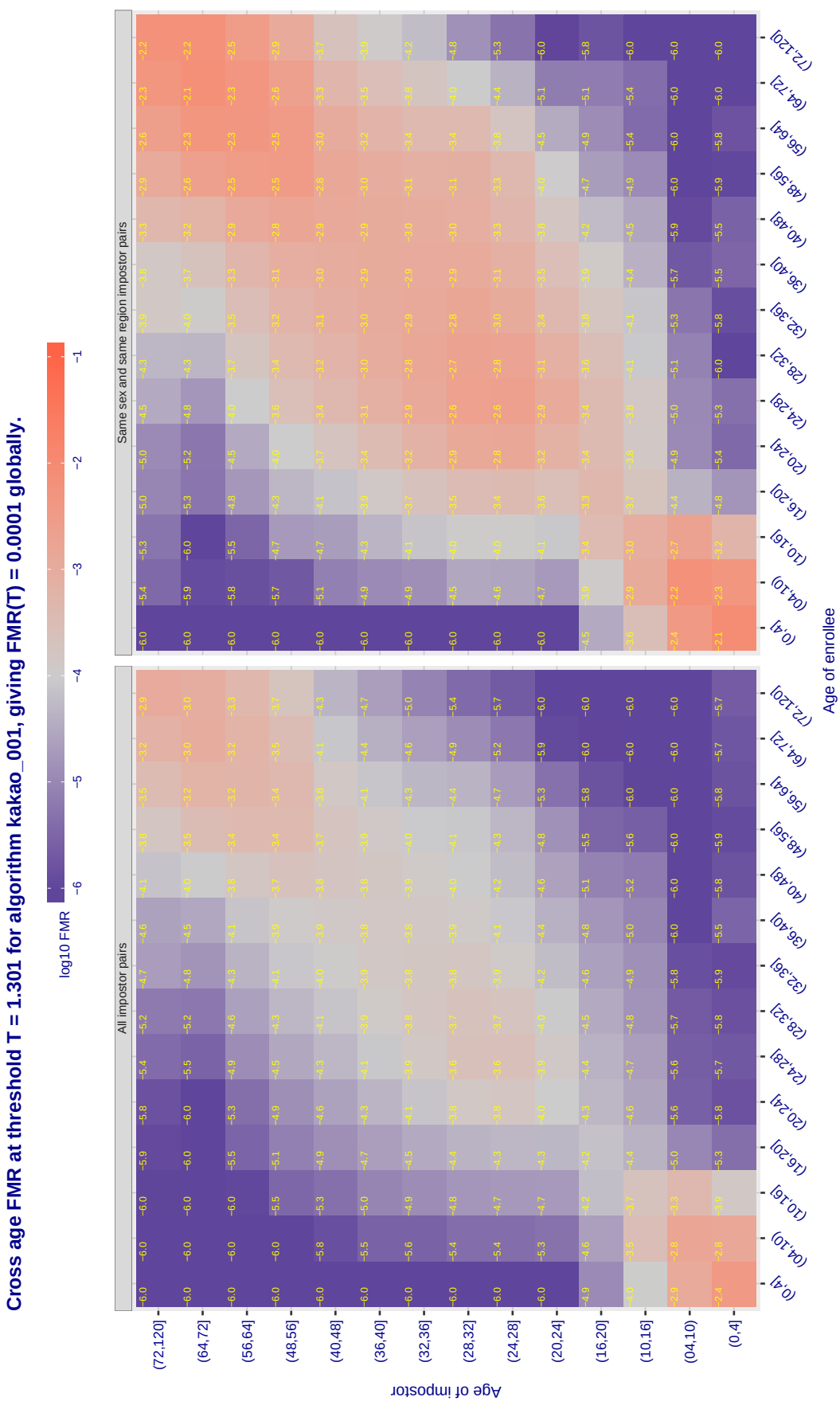


Figure 412: For algorithm kakao-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

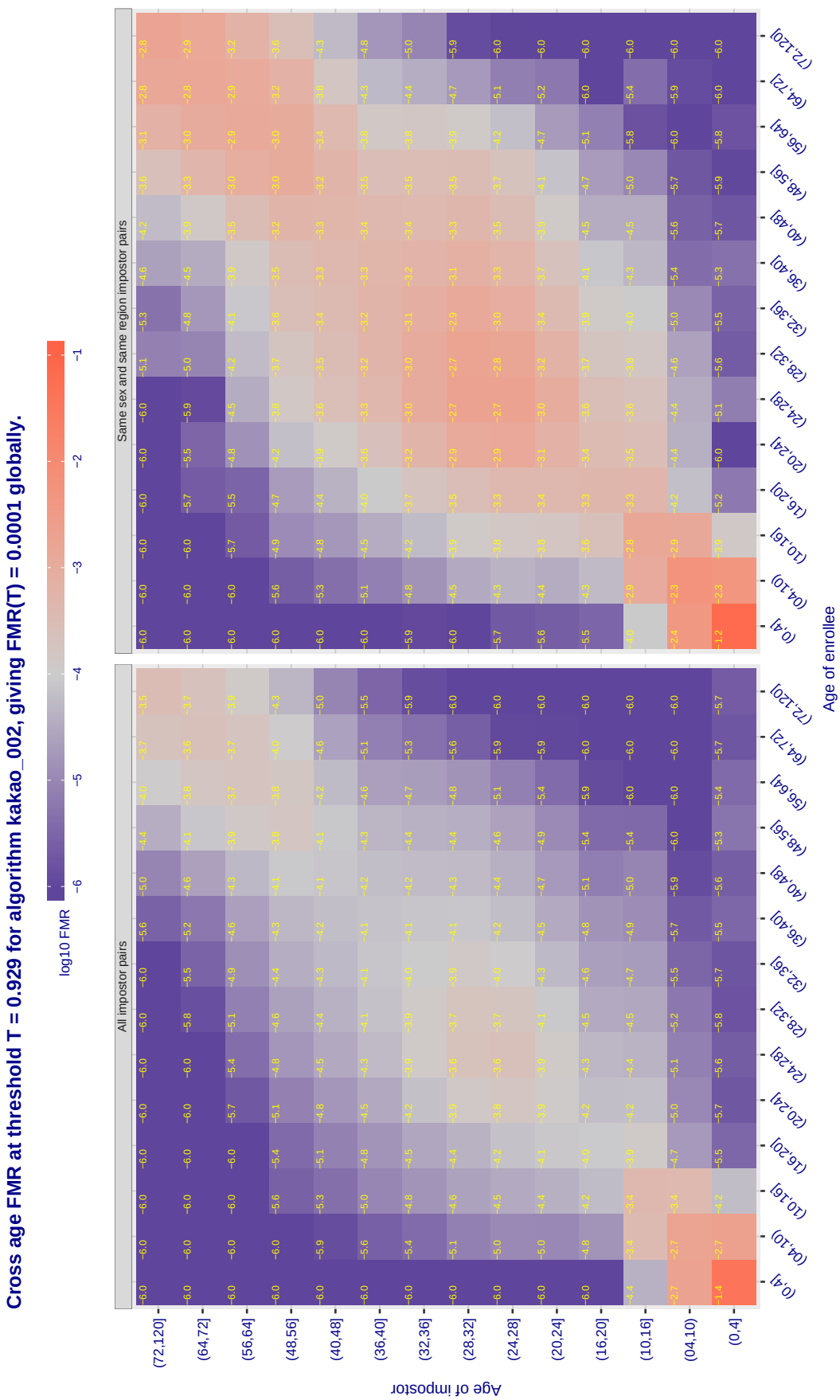


Figure 413: For algorithm kakao-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

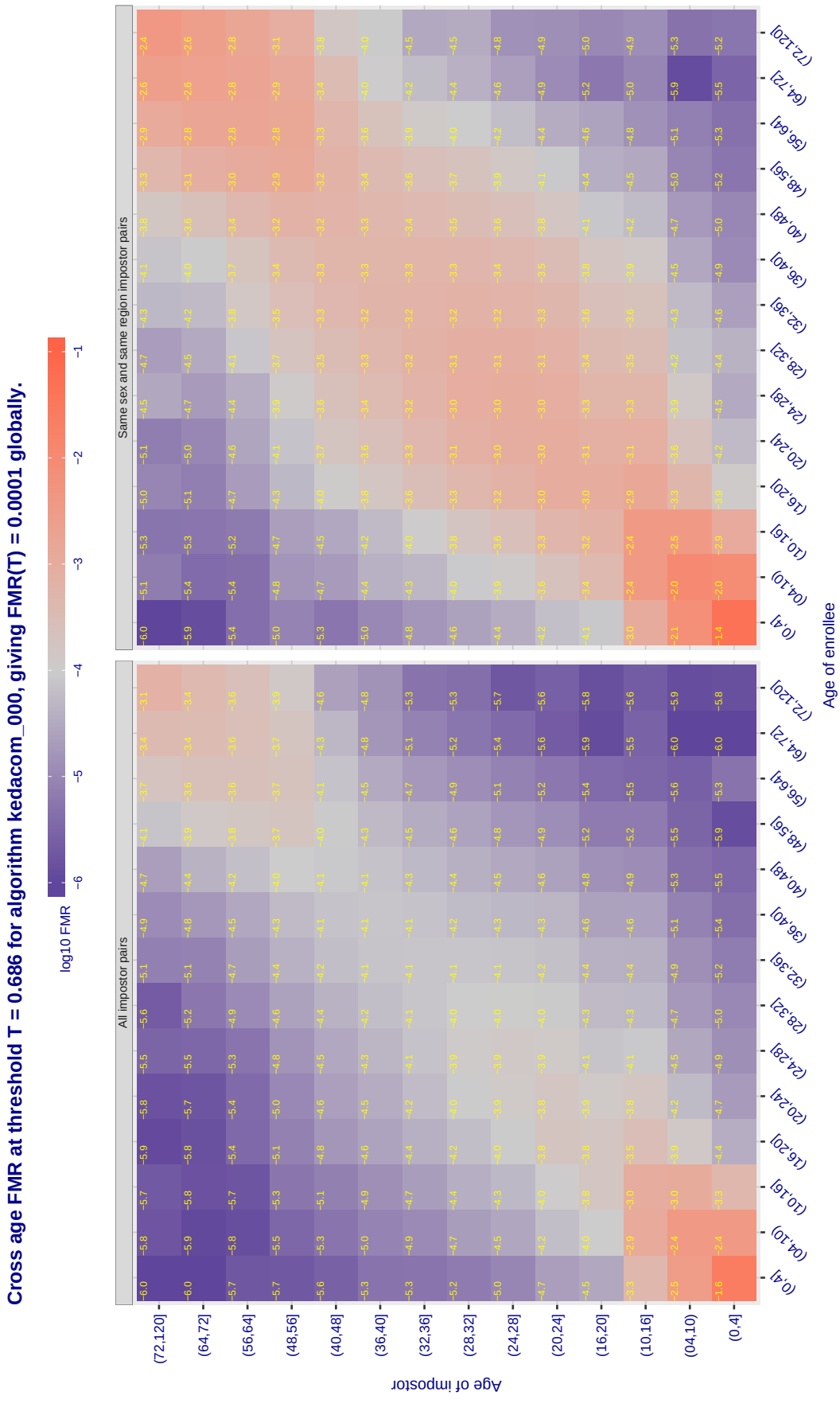


Figure 414: For algorithm kedacom-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

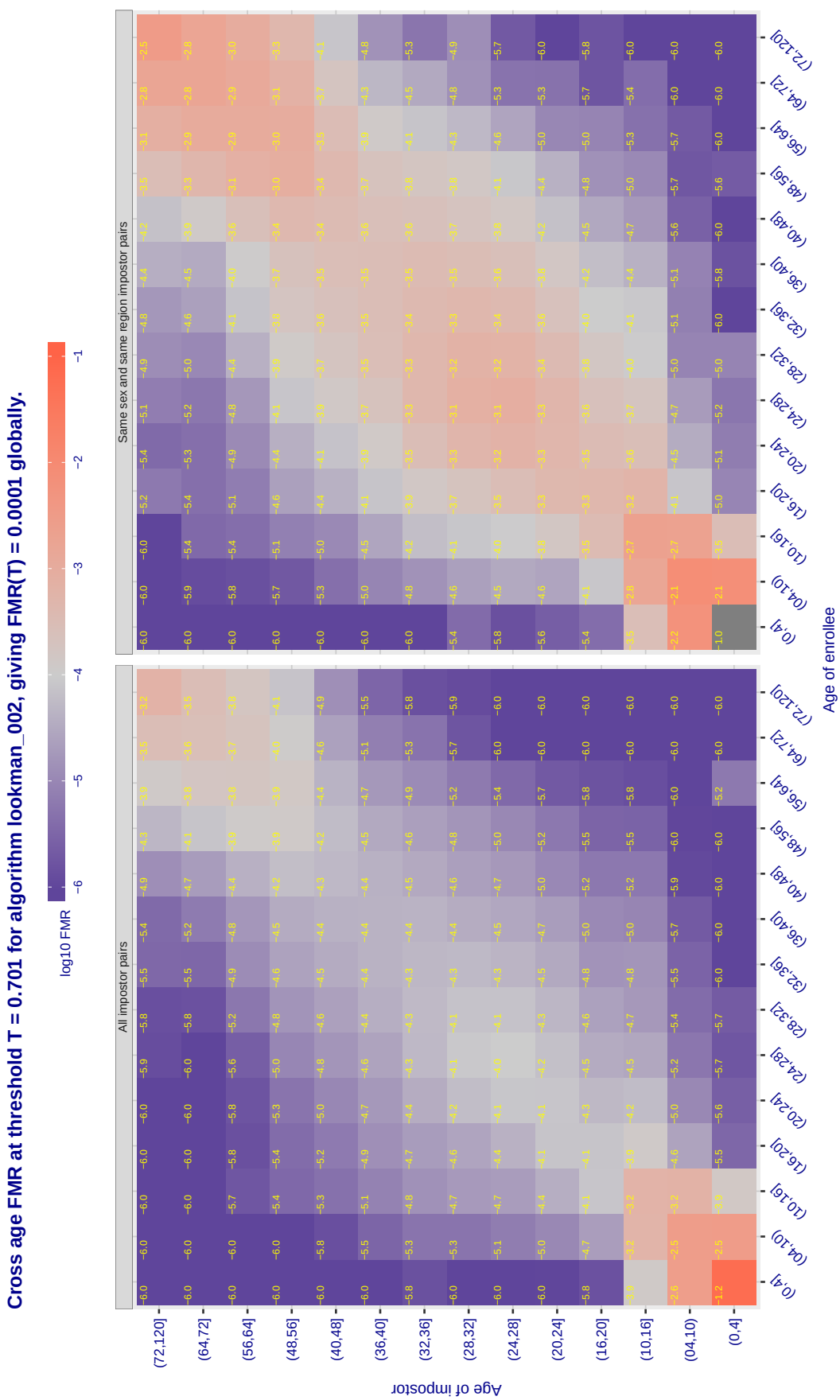


Figure 415: For algorithm lookman-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

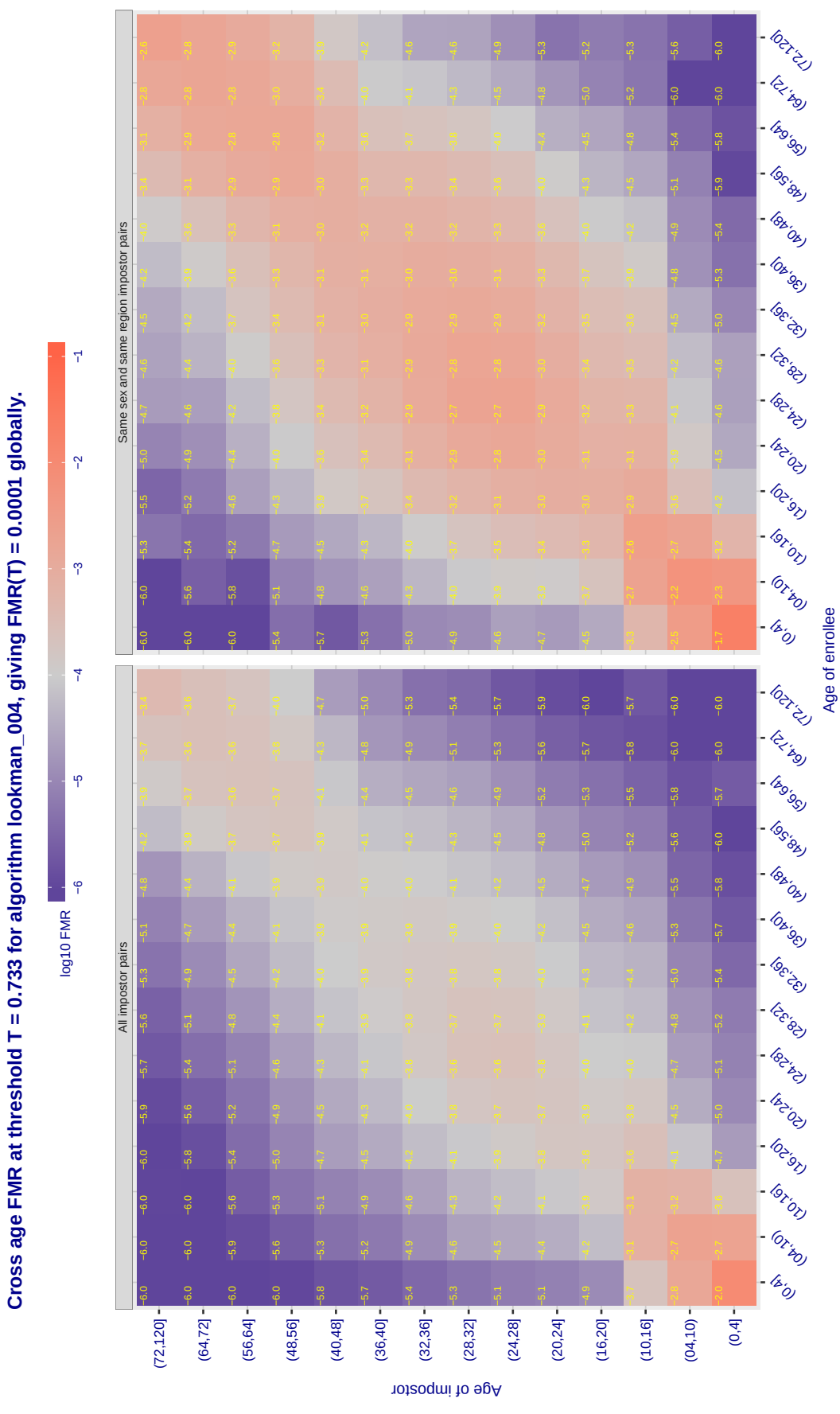


Figure 416: For algorithm lookman-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

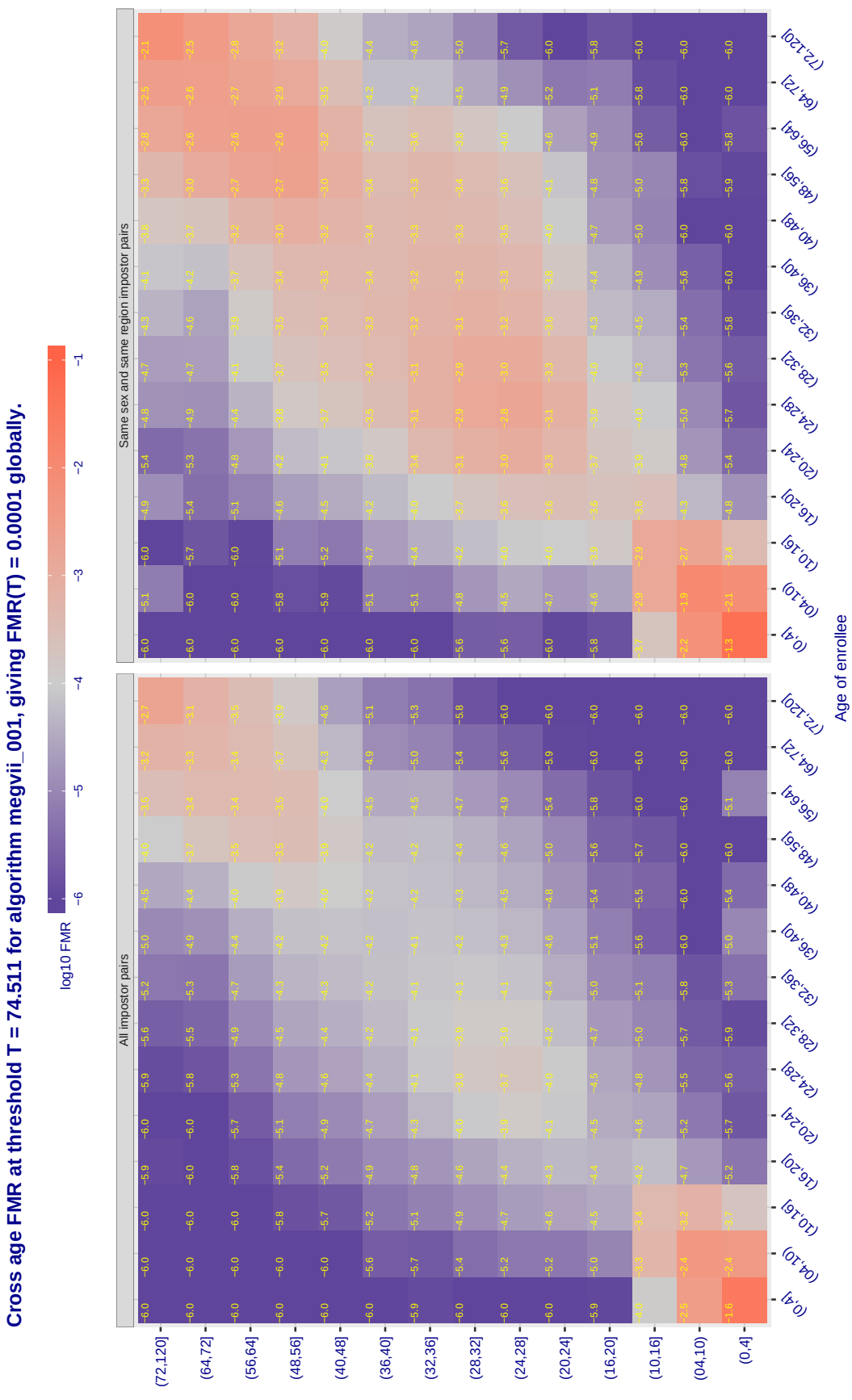


Figure 417: For algorithm megvii-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

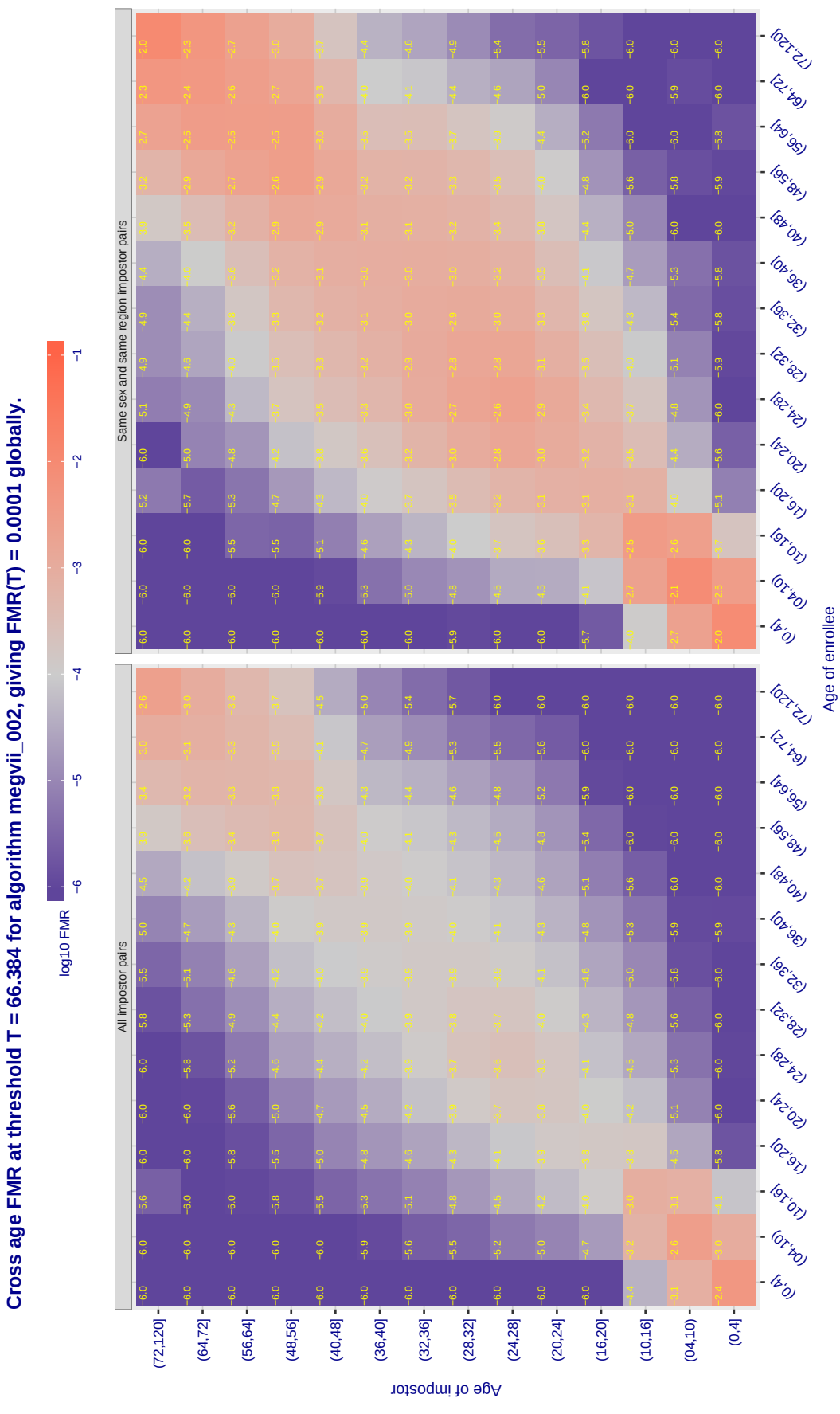


Figure 418: For algorithm megvii-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

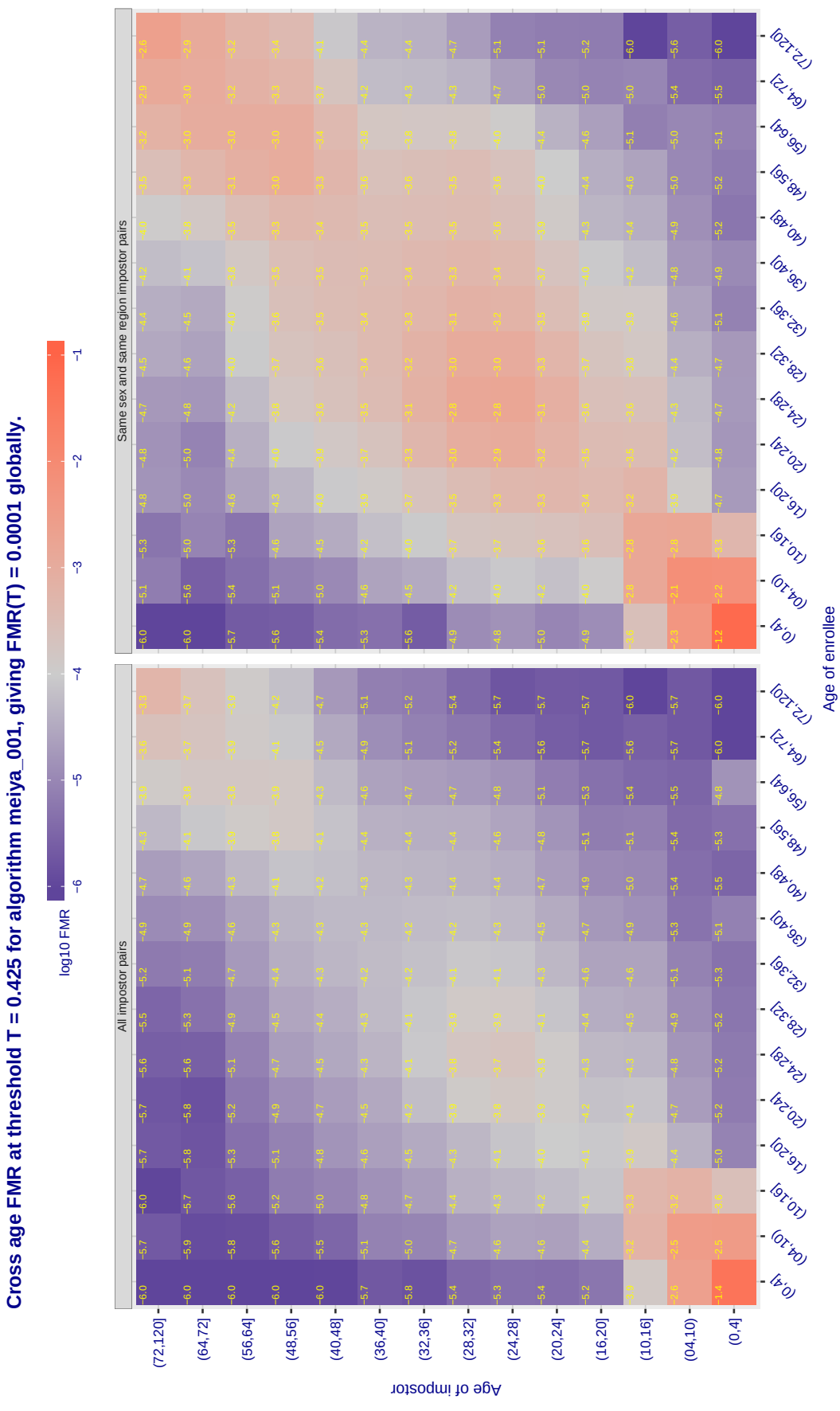


Figure 419: For algorithm meiya-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

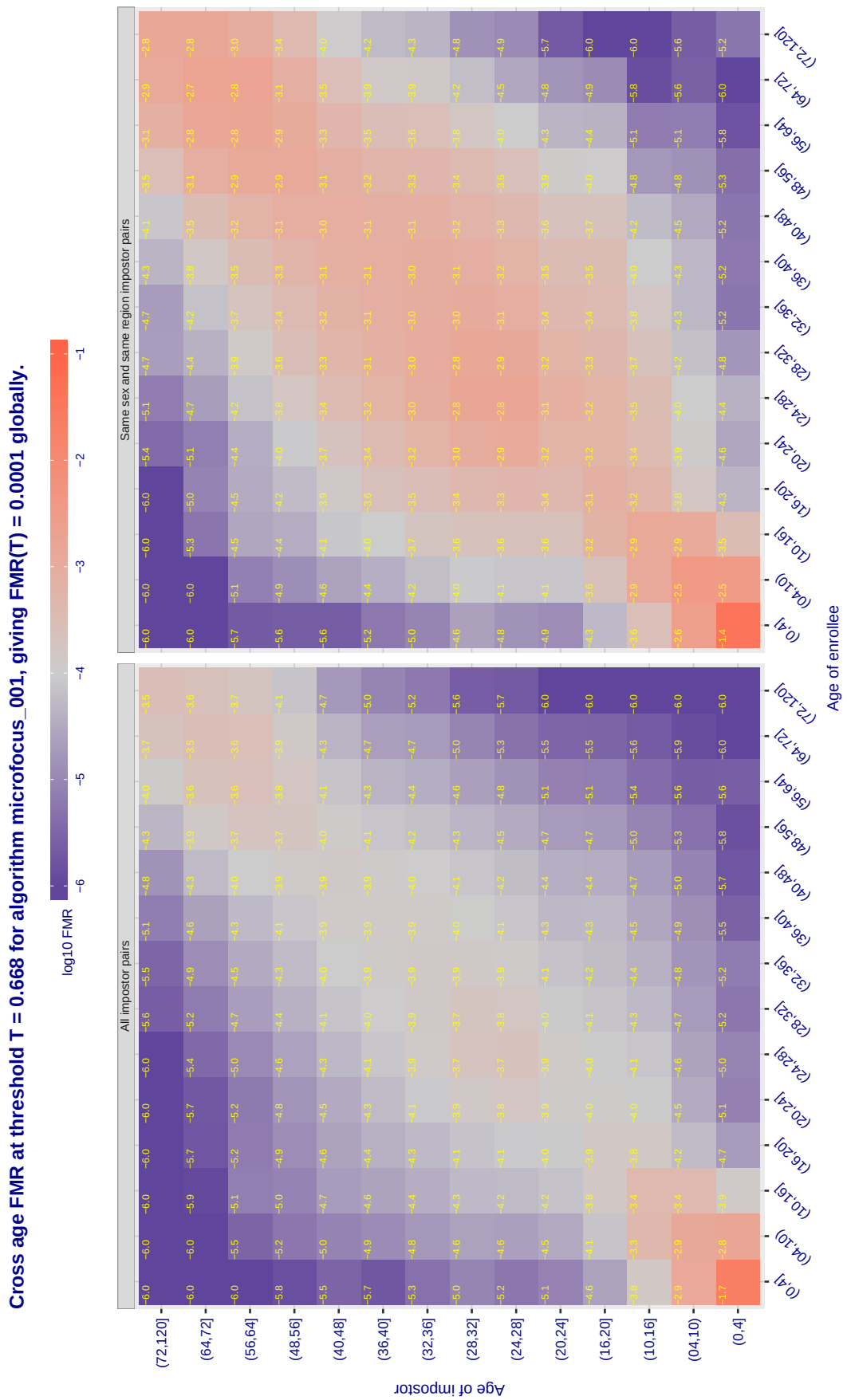


Figure 420: For algorithm microfocus-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

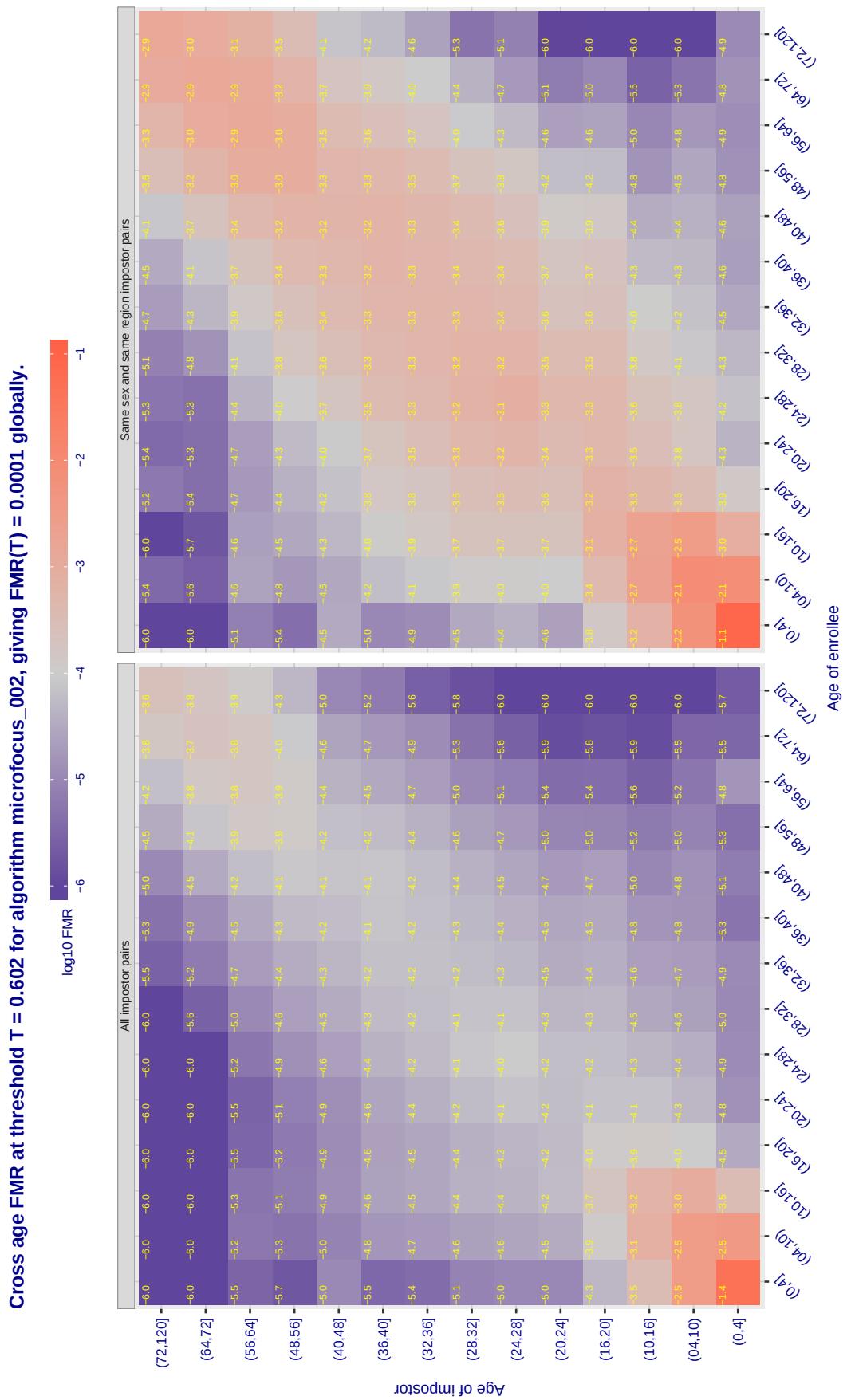


Figure 421: For algorithm microfocus-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

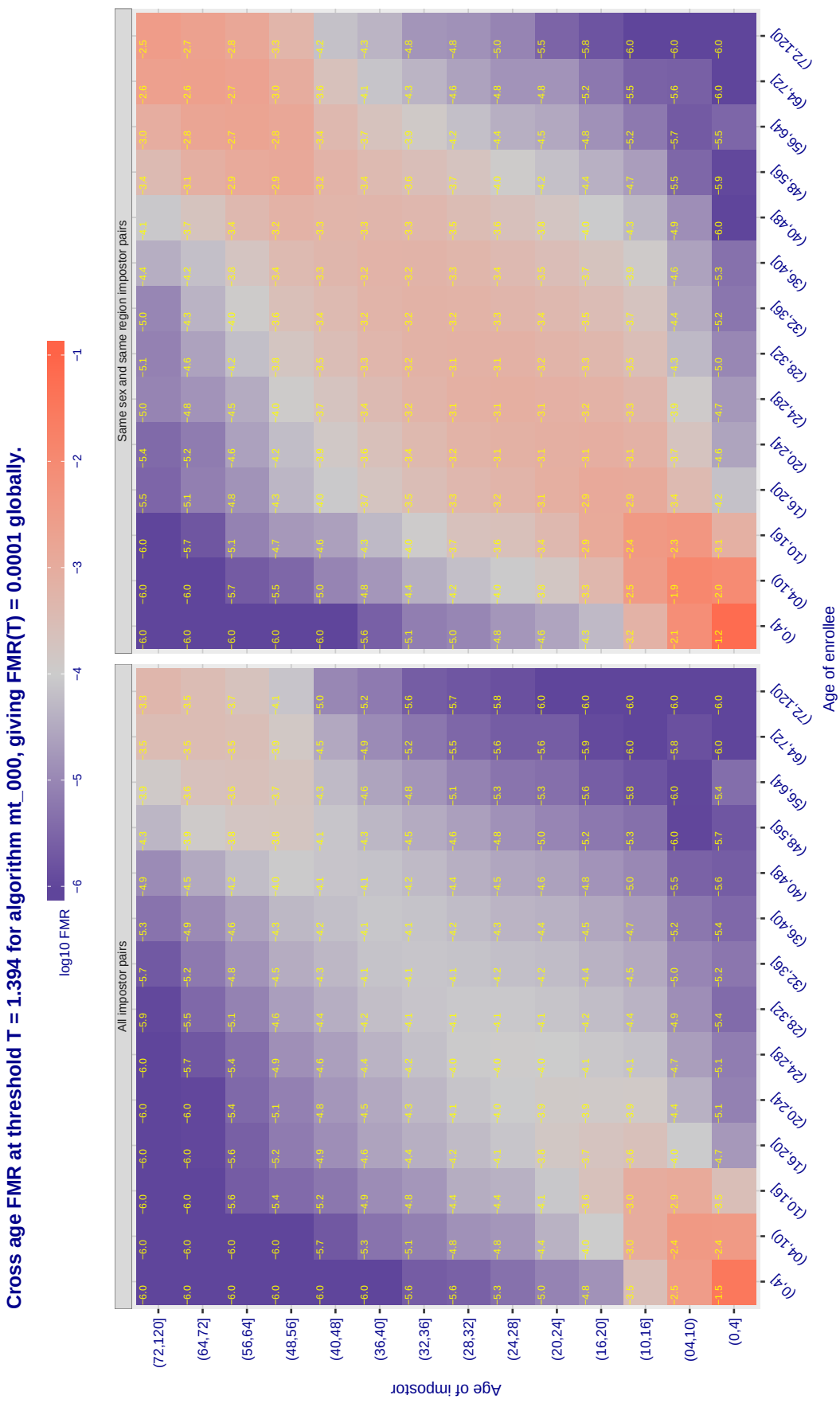


Figure 422: For algorithm mt-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

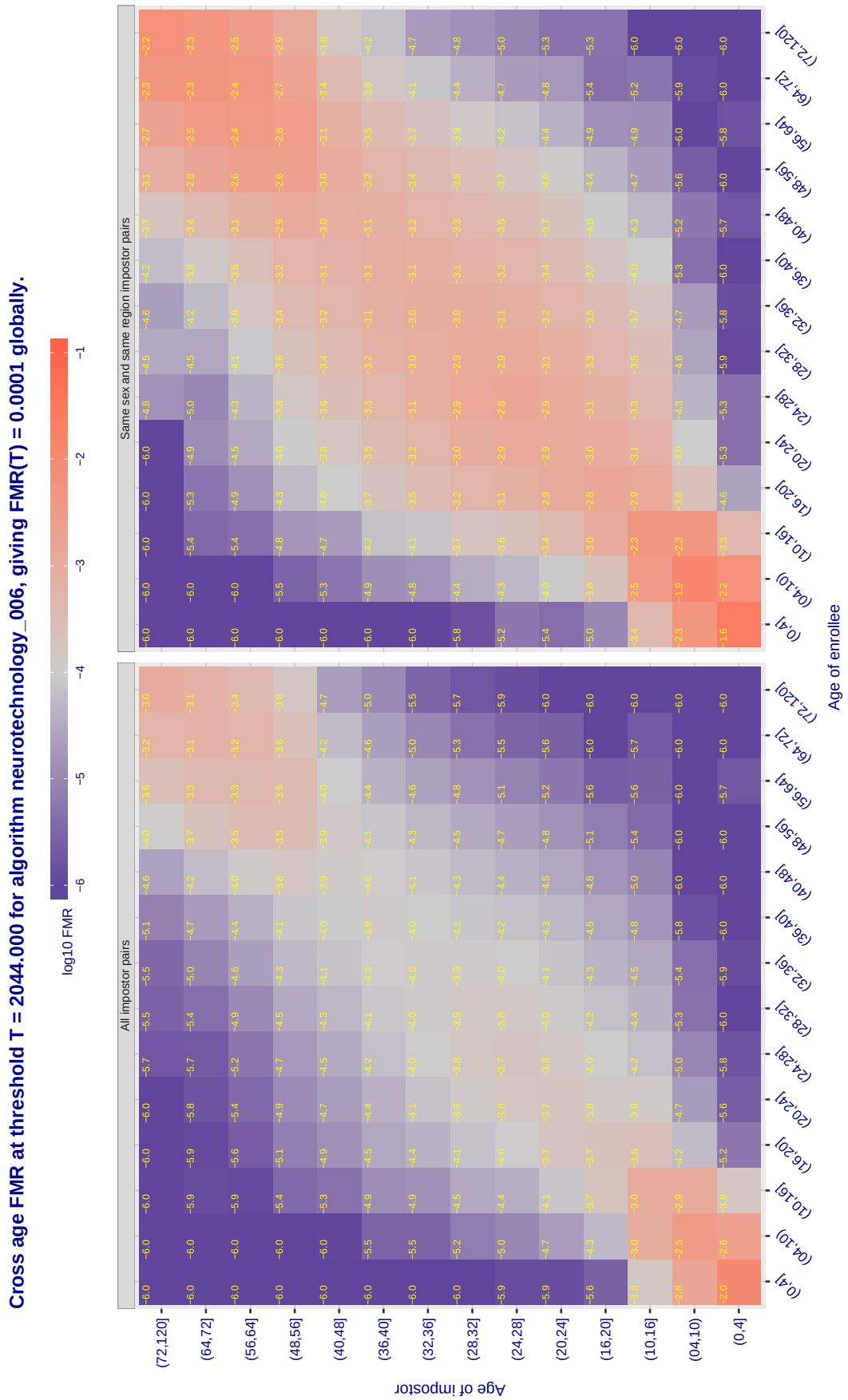


Figure 423: For algorithm neurotechnology-006 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

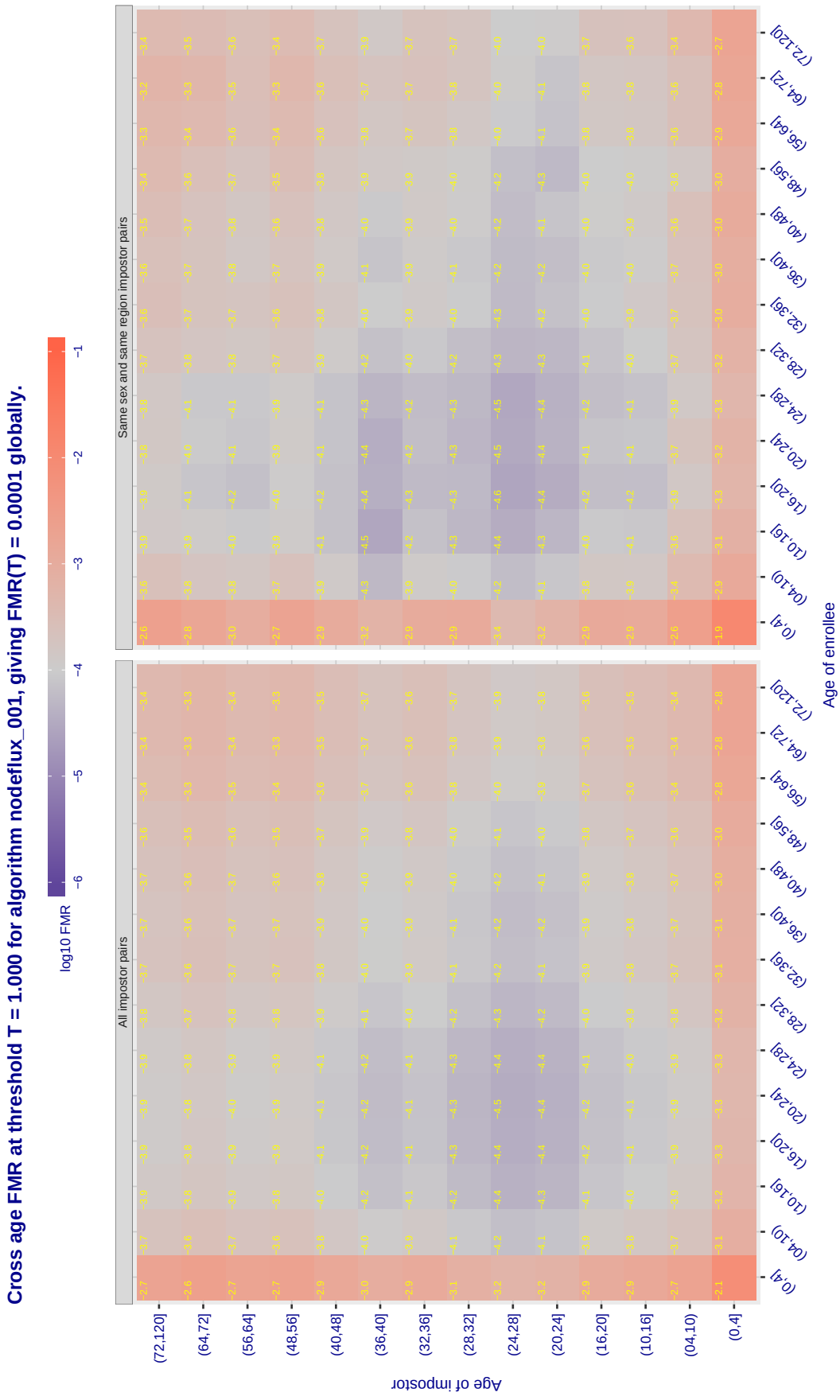


Figure 424: For algorithm nodeflux-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

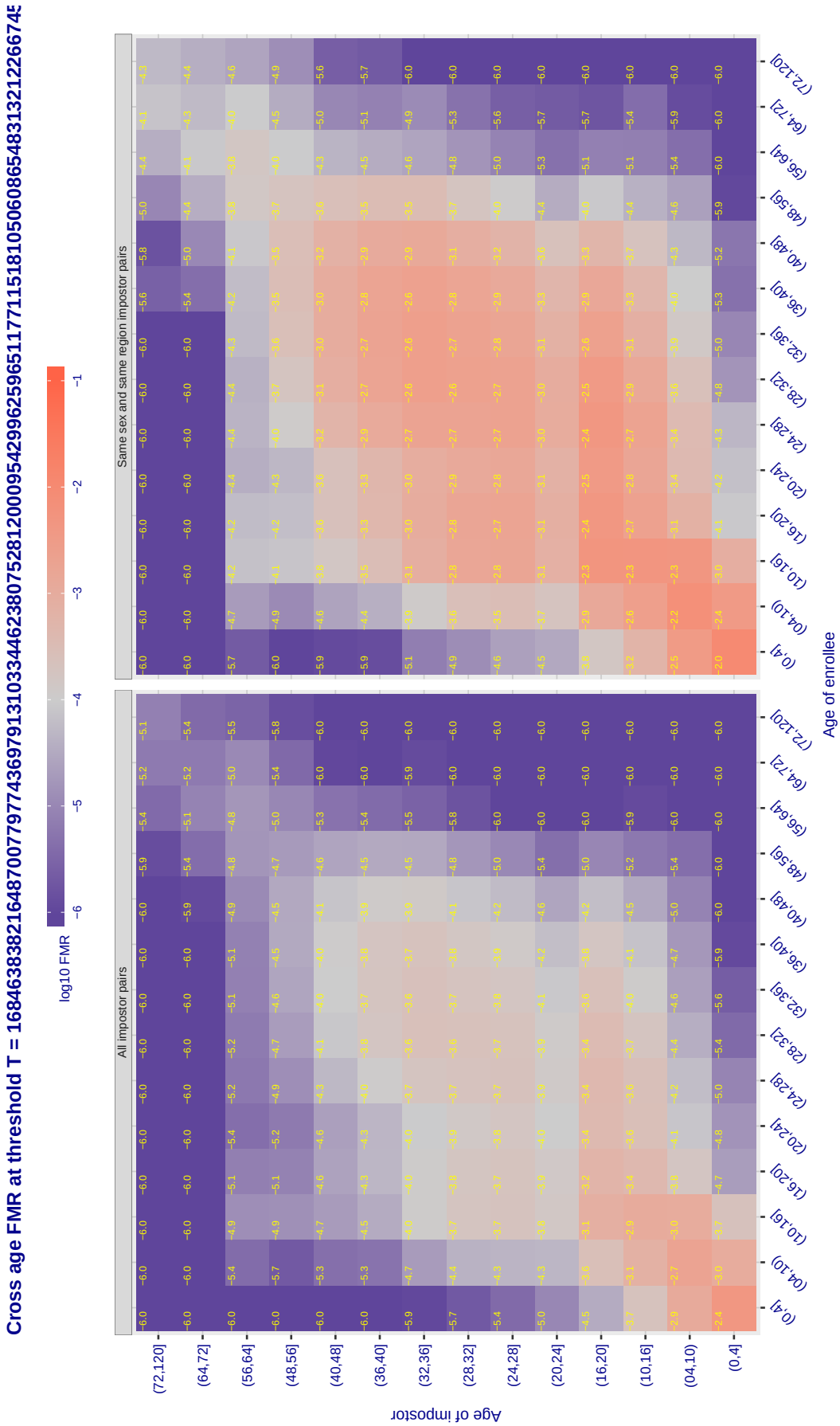


Figure 425: For algorithm notiontag-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

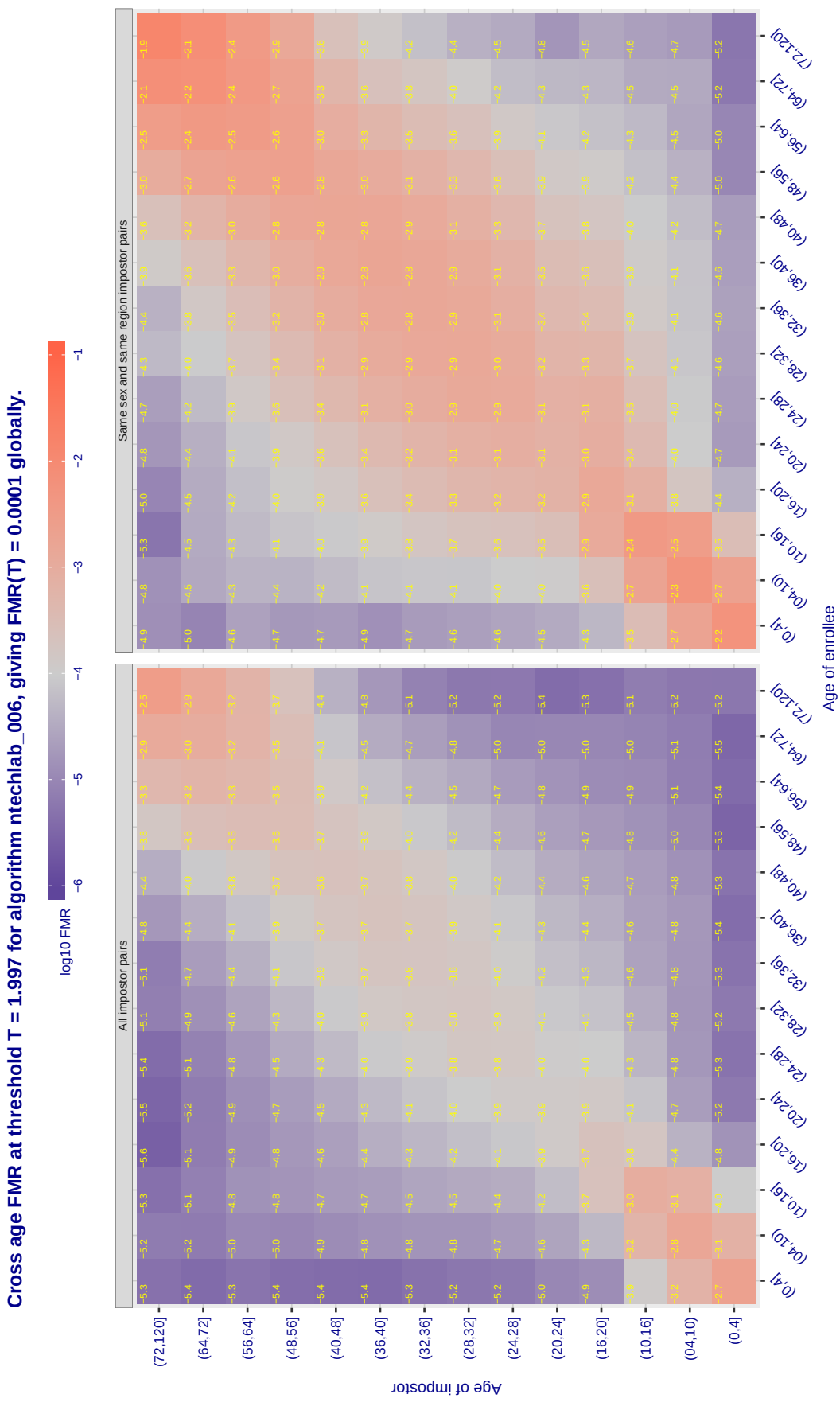


Figure 426: For algorithm ntechlab-006 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

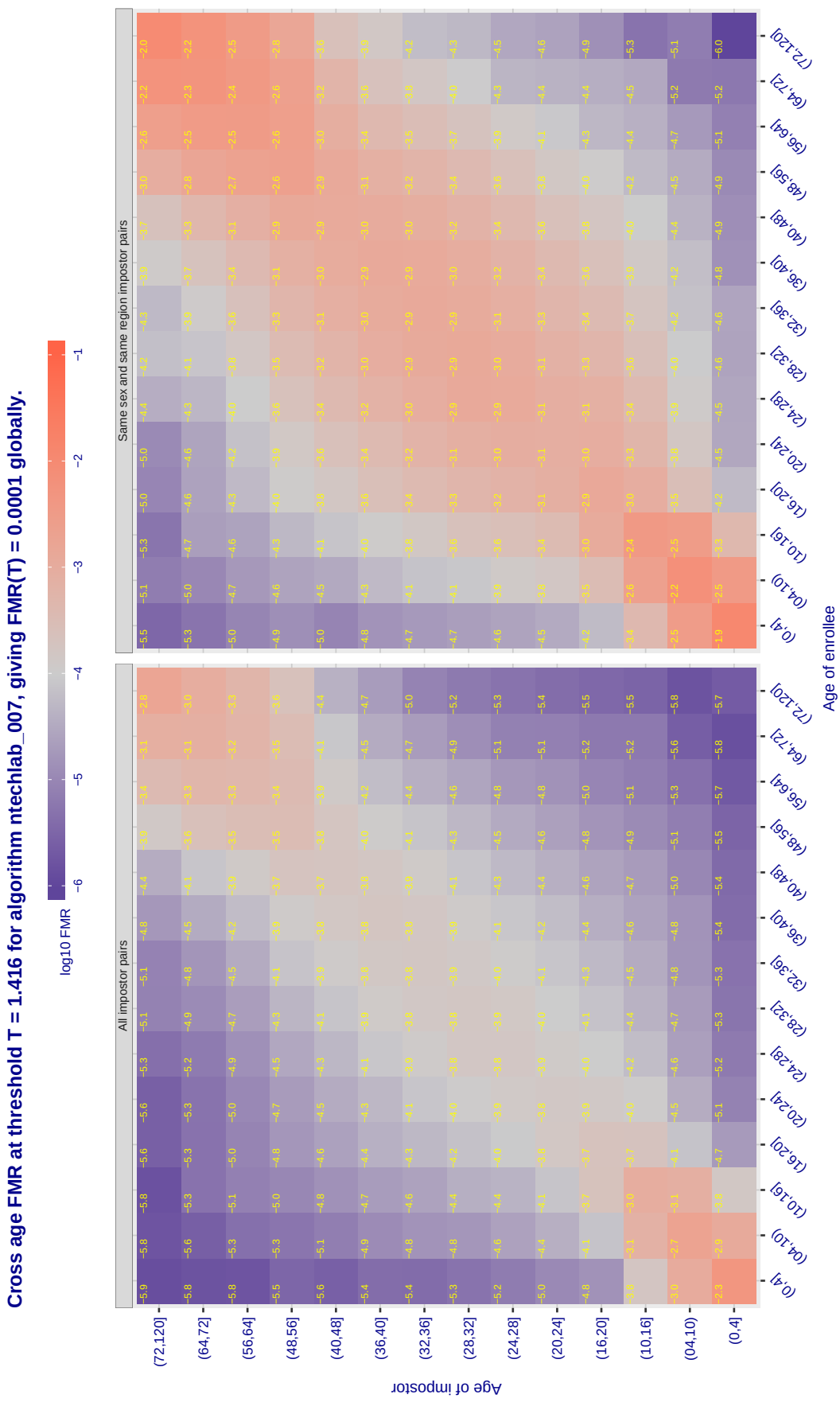


Figure 427: For algorithm ntechlab-007 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

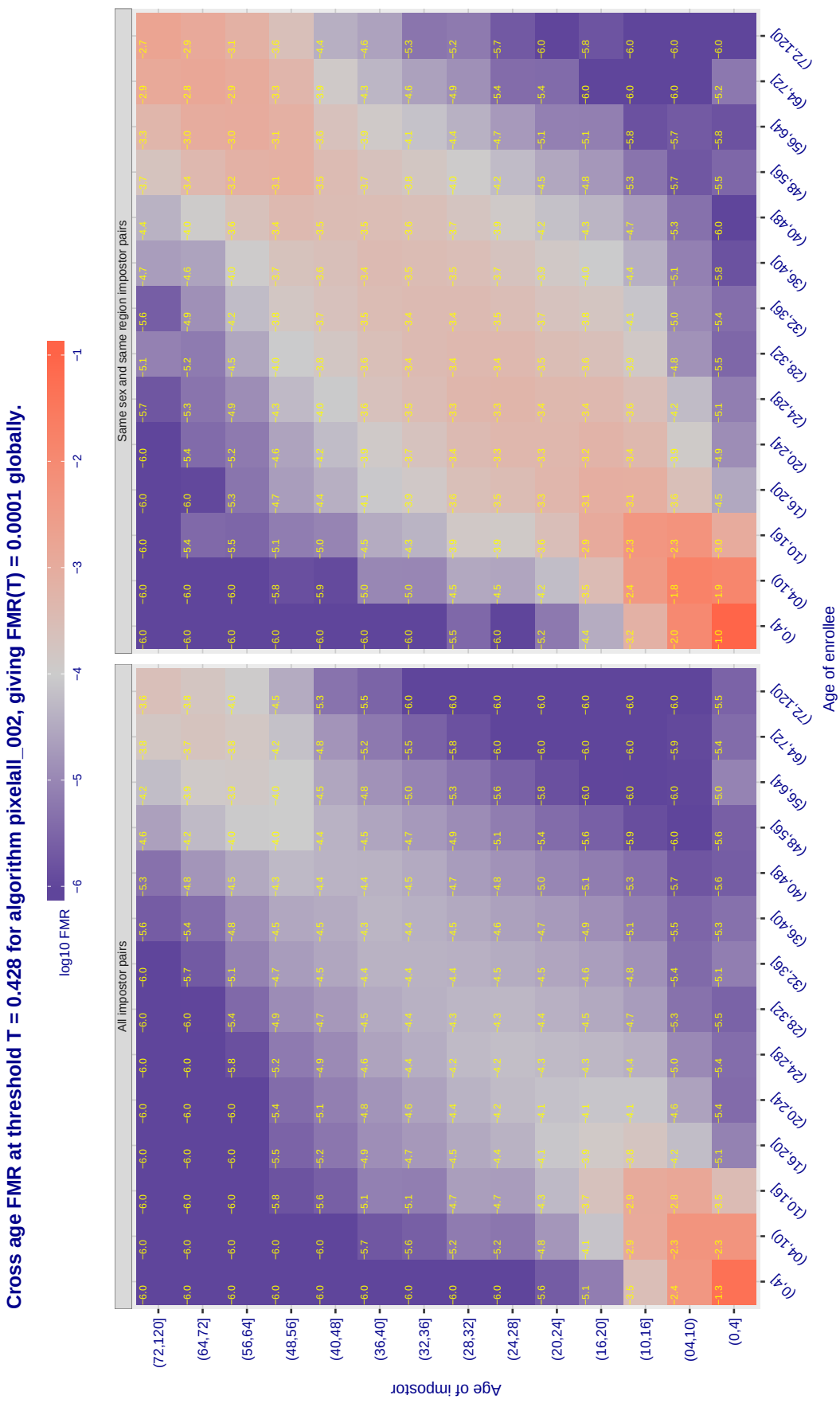


Figure 428: For algorithm pixelall-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

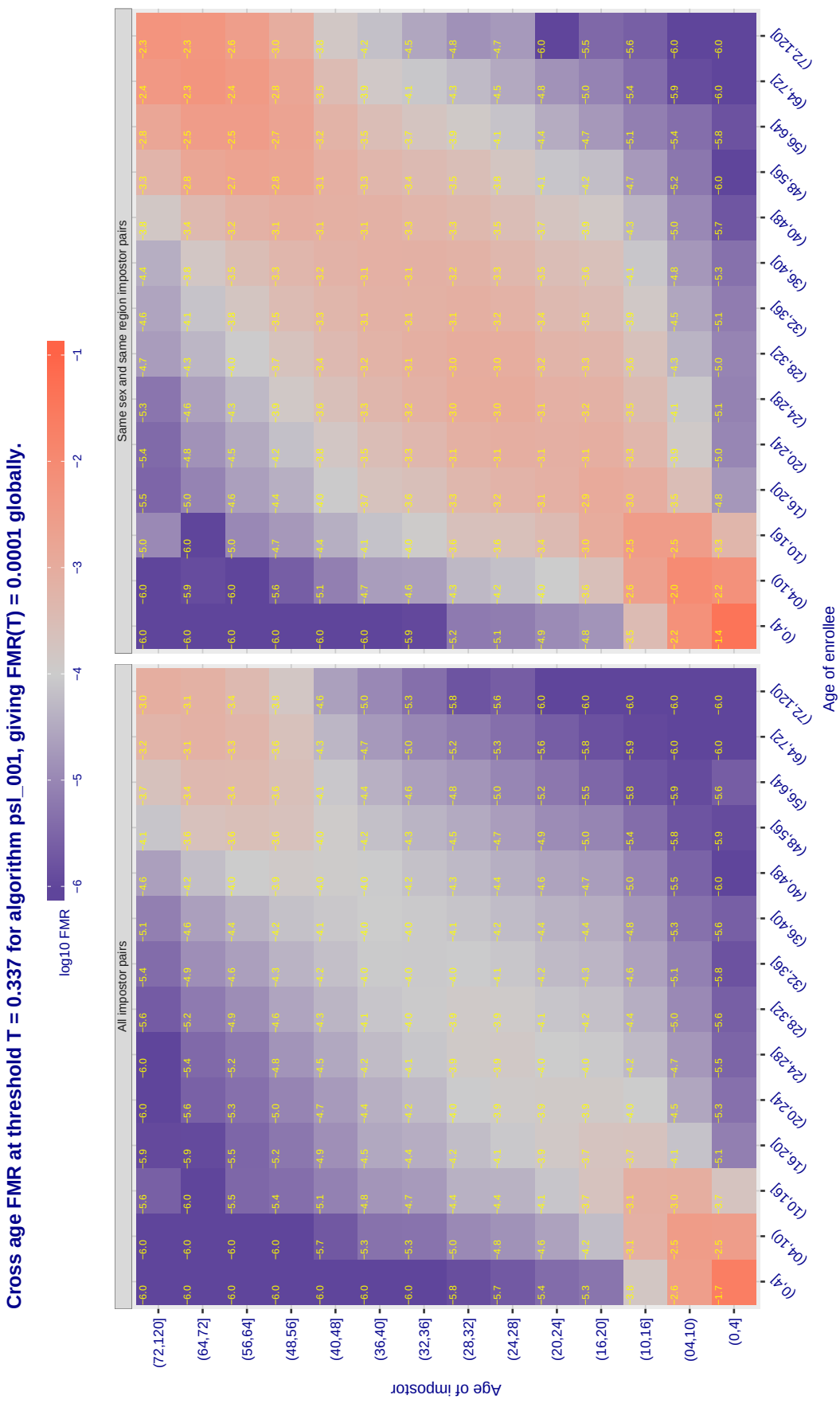


Figure 429: For algorithm psl-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

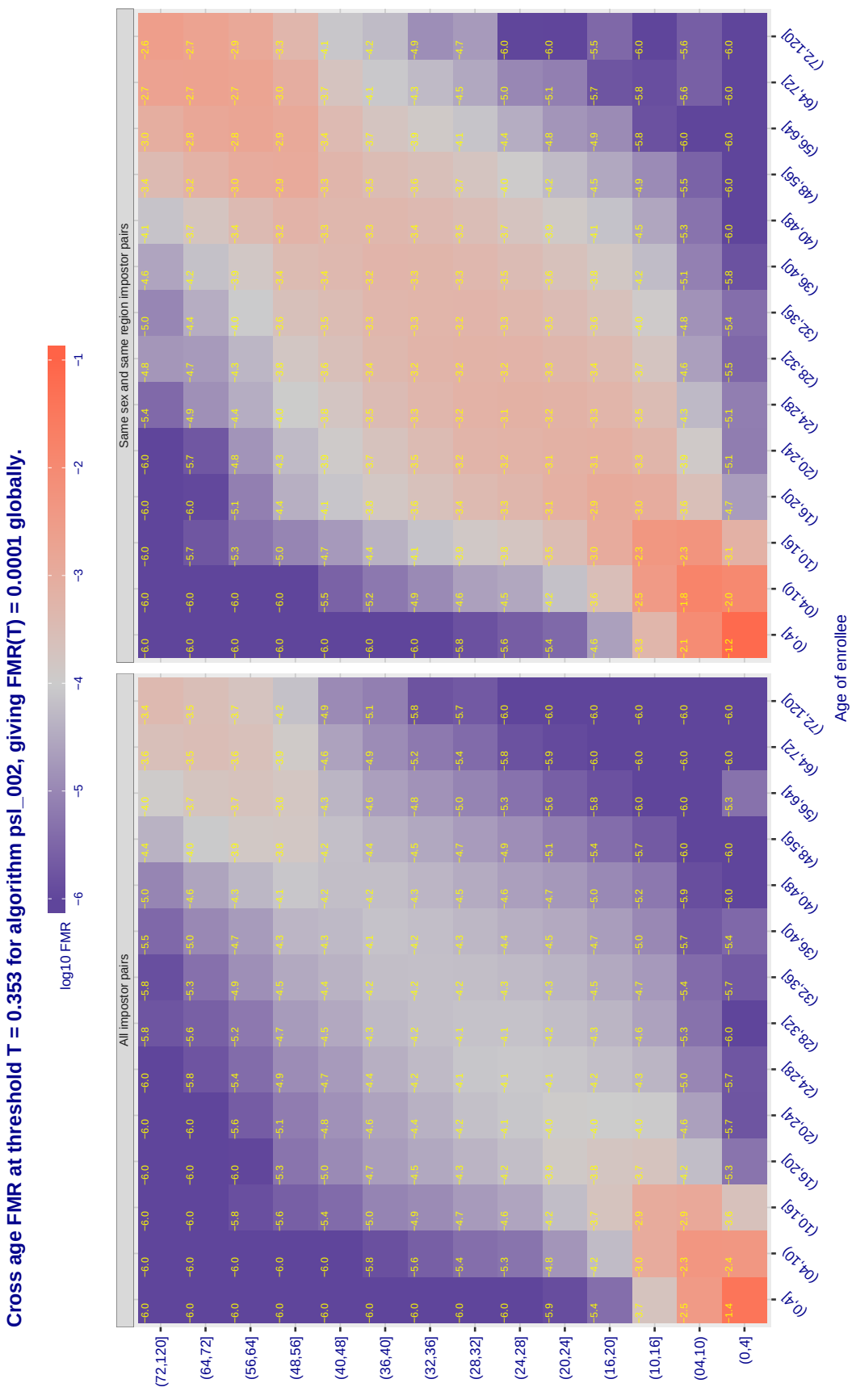


Figure 430: For algorithm psl-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

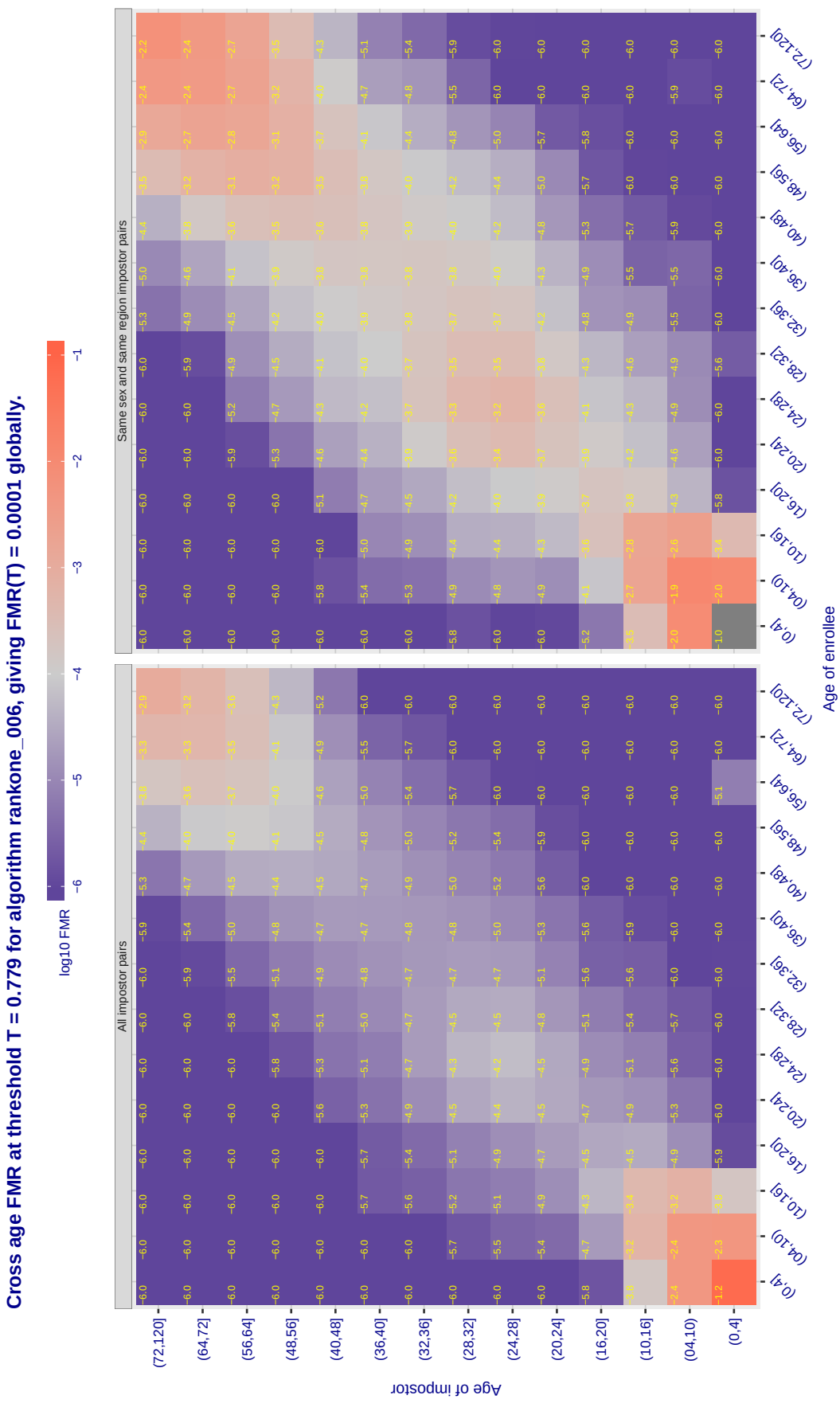


Figure 431: For algorithm rankone-006 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

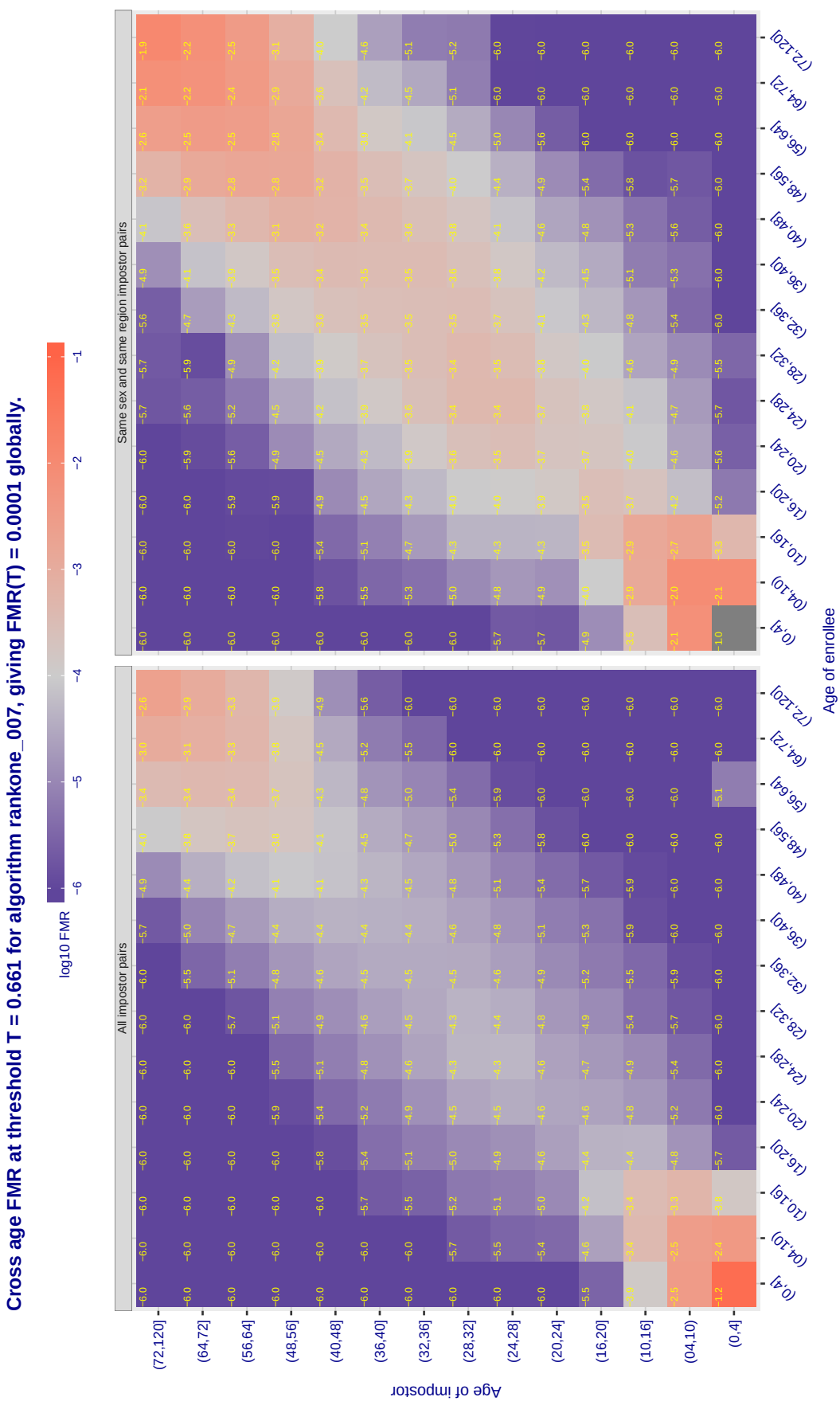


Figure 432: For algorithm rankone-007 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

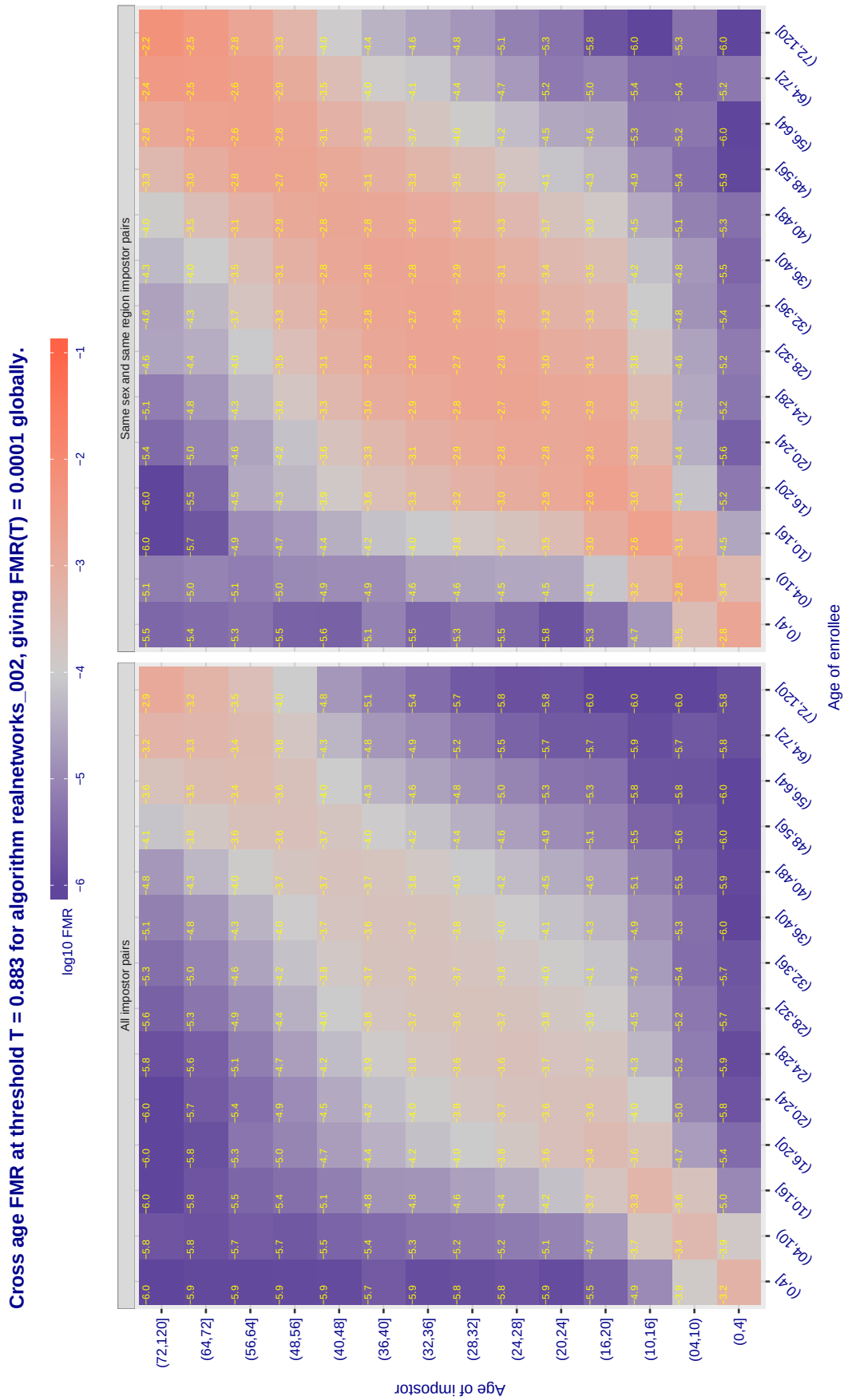


Figure 433: For algorithm realnetworks-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

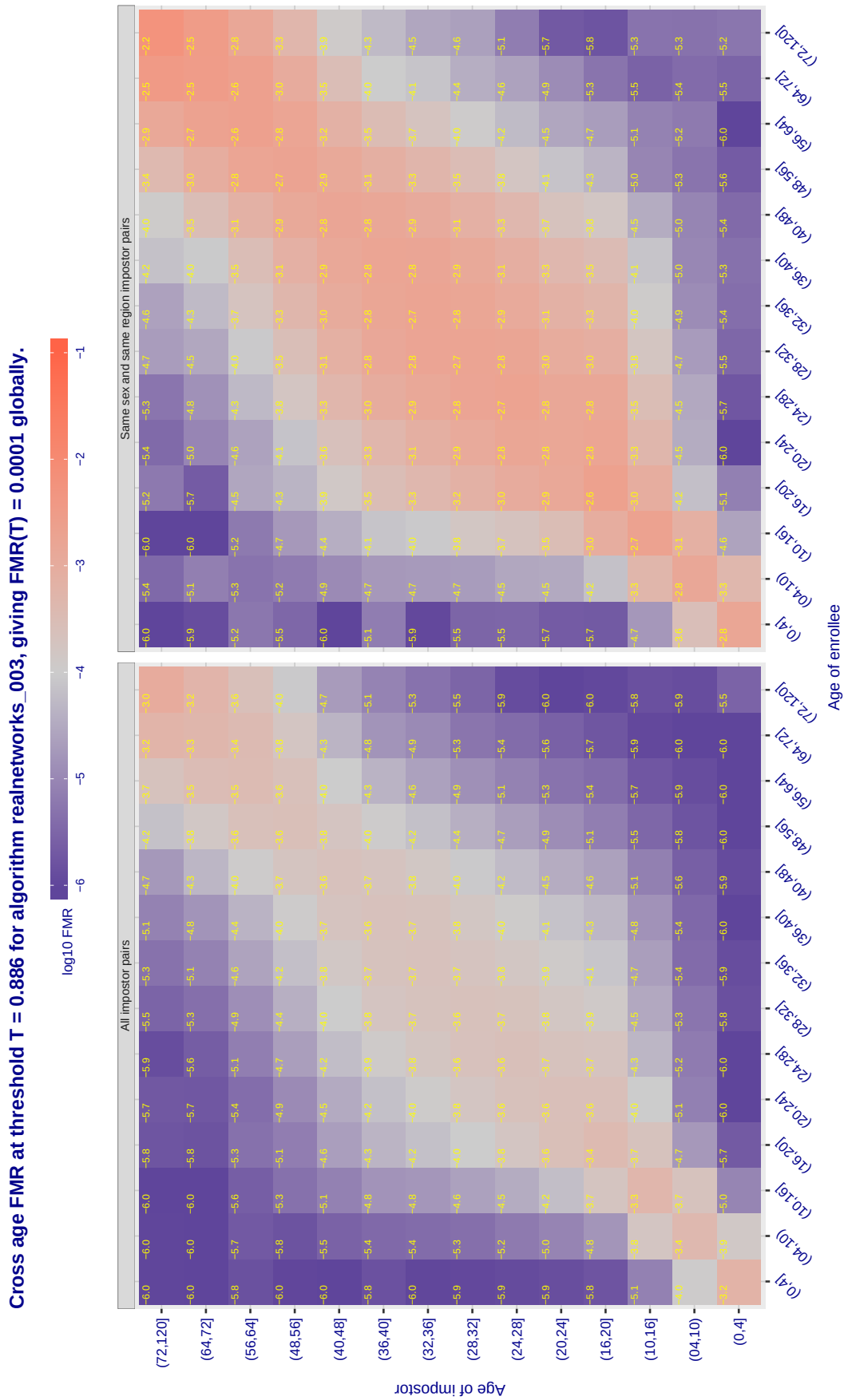


Figure 434: For algorithm realnetworks-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

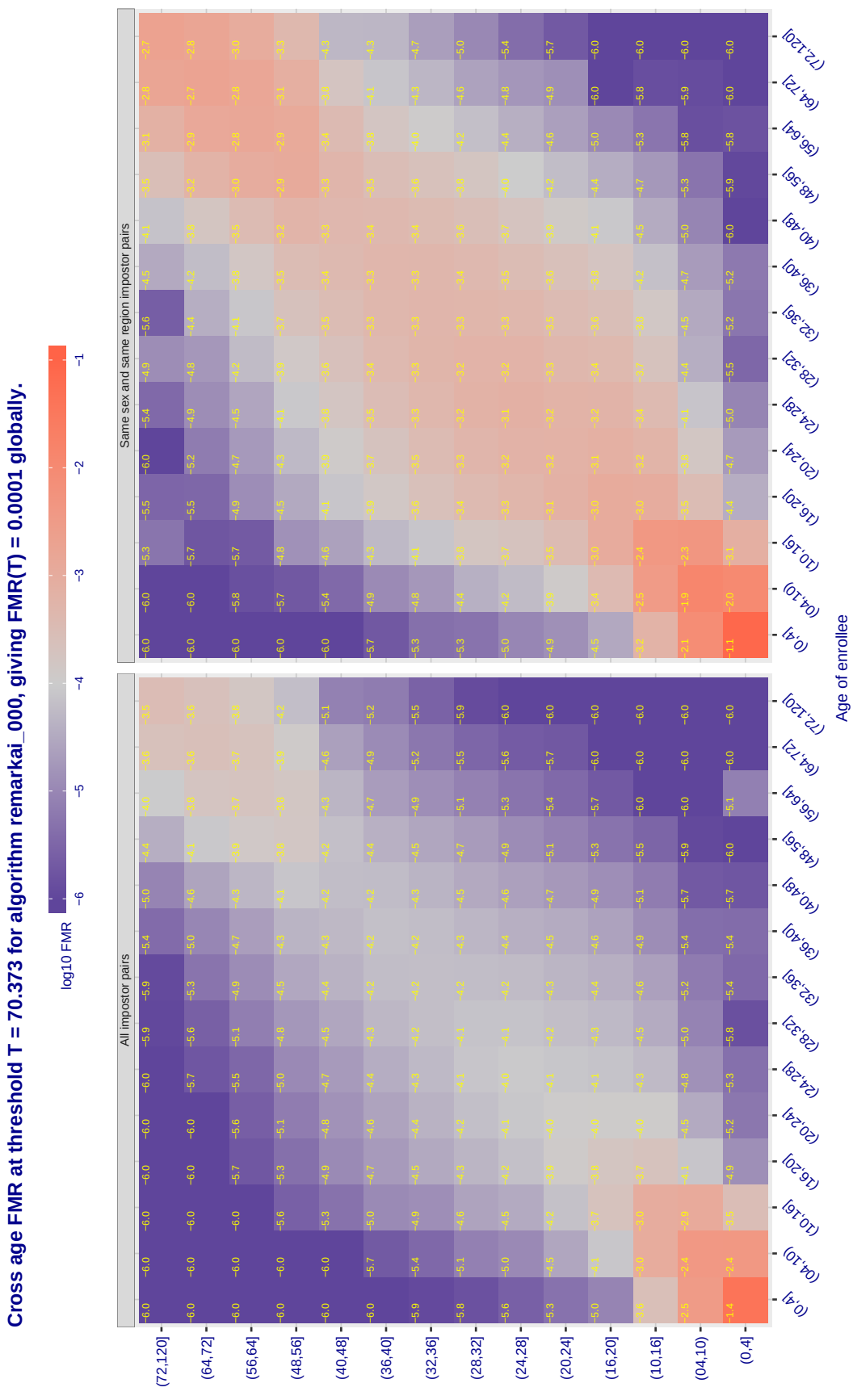


Figure 435: For algorithm remarkai-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

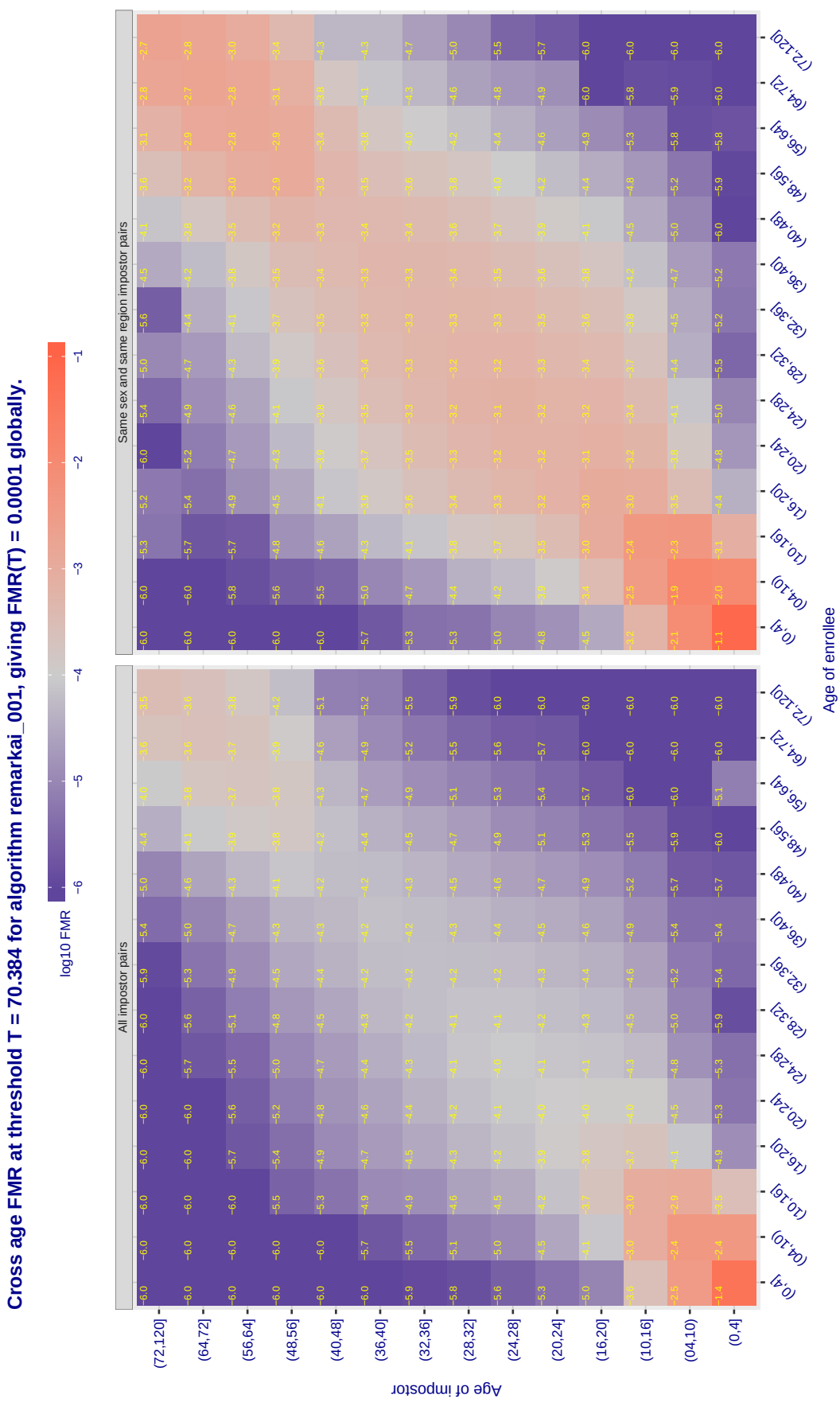


Figure 436: For algorithm remarkai-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

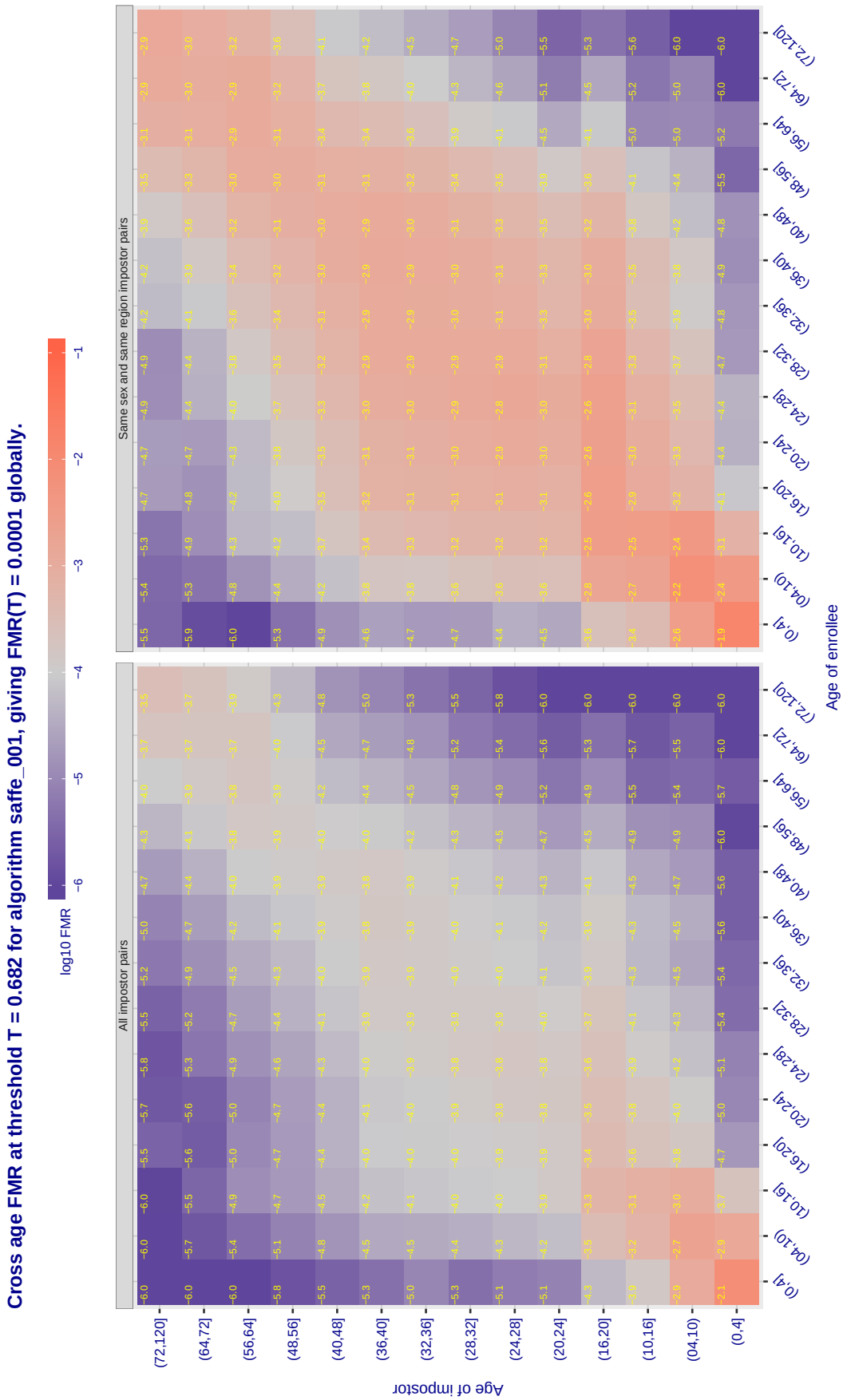


Figure 437: For algorithm saffe-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

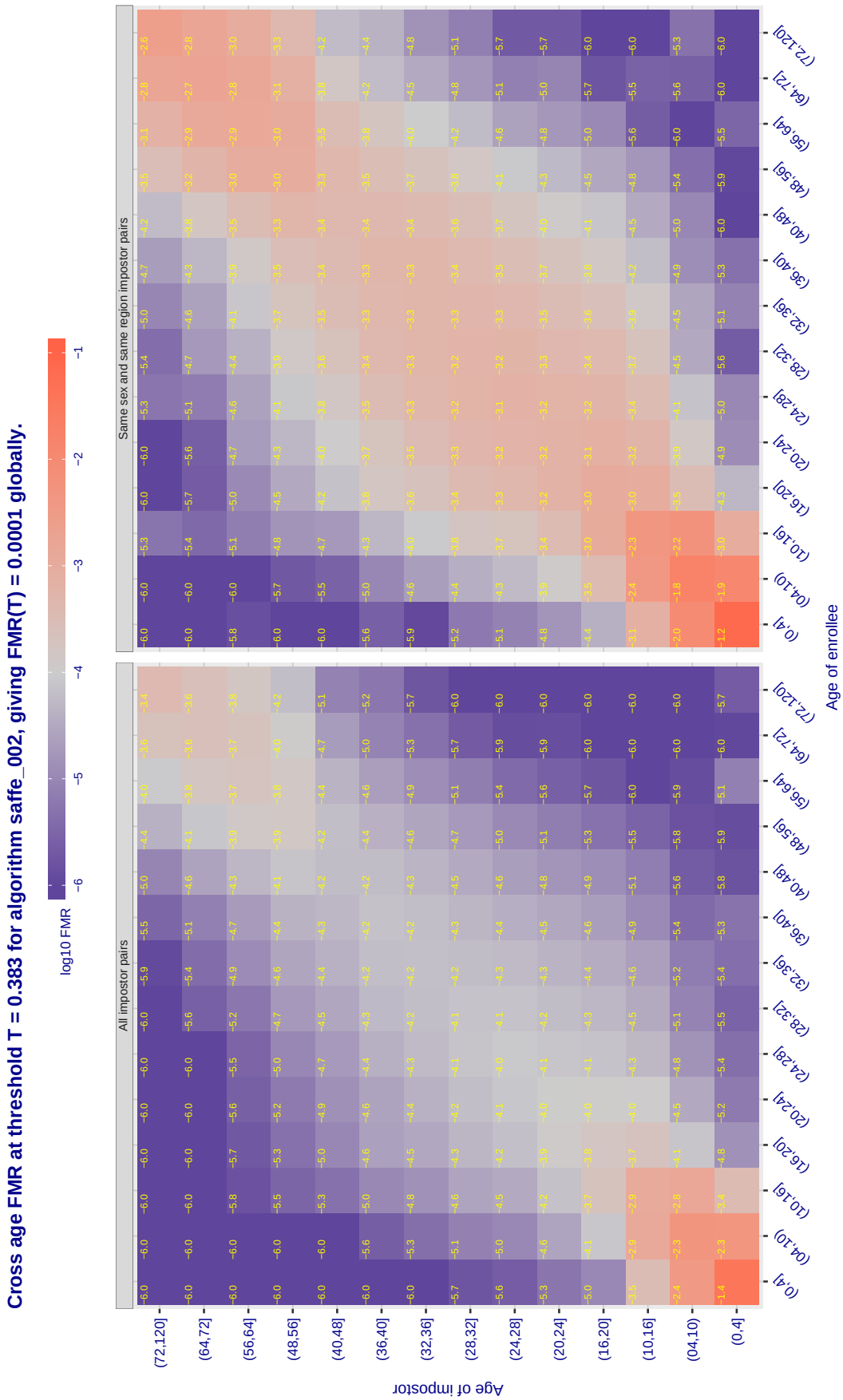


Figure 438: For algorithm saffe-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

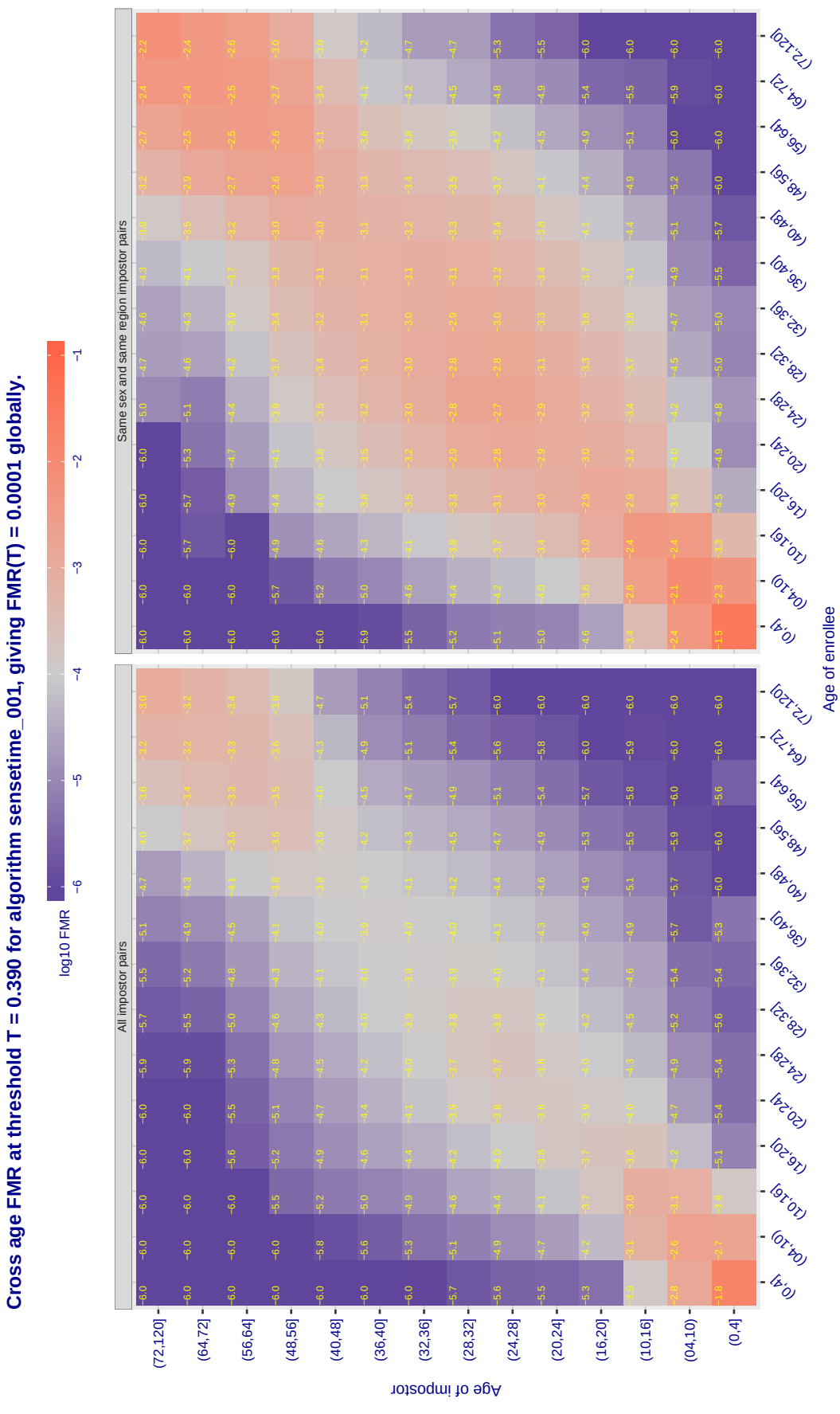


Figure 439: For algorithm sensetime-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

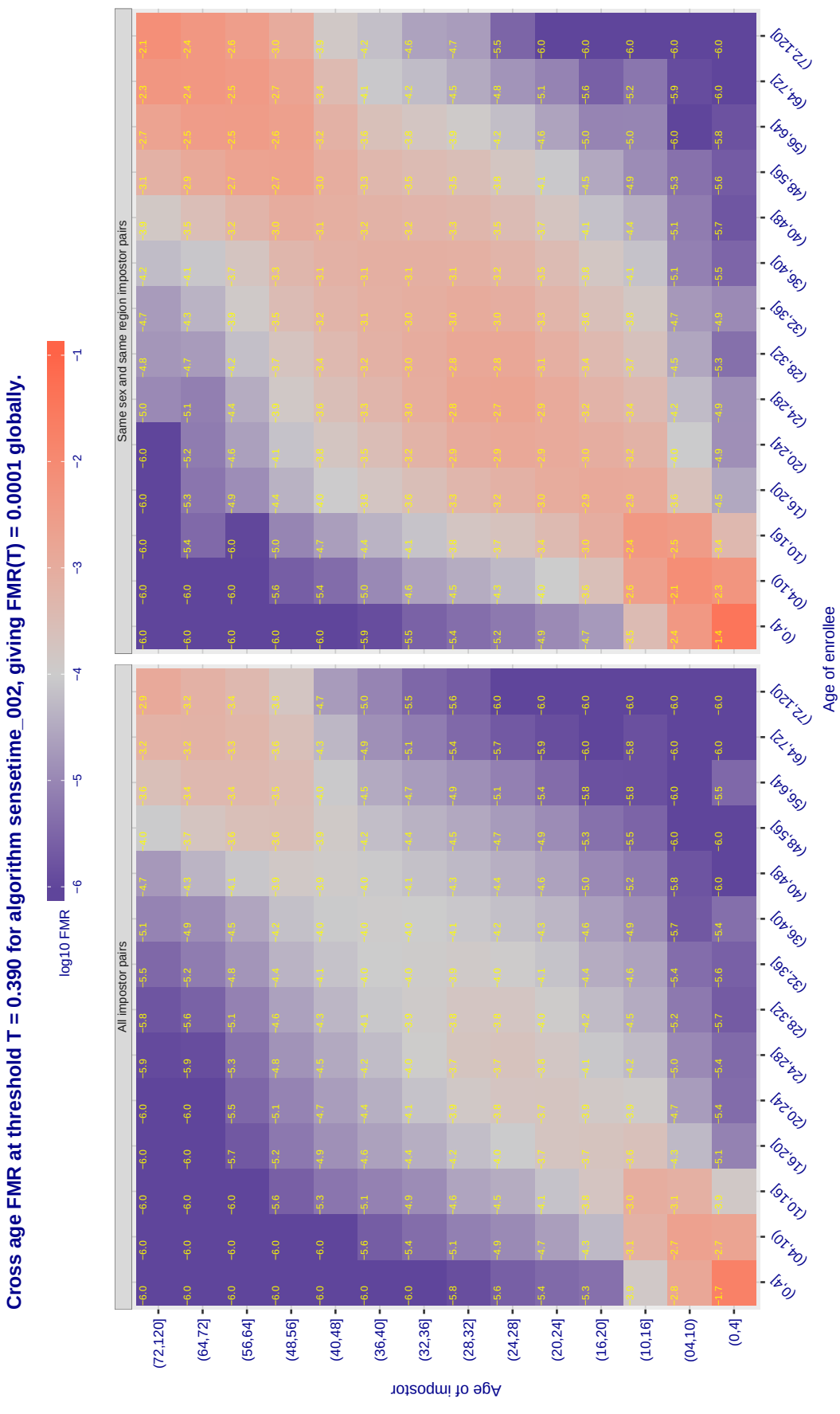


Figure 440: For algorithm sensetime-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

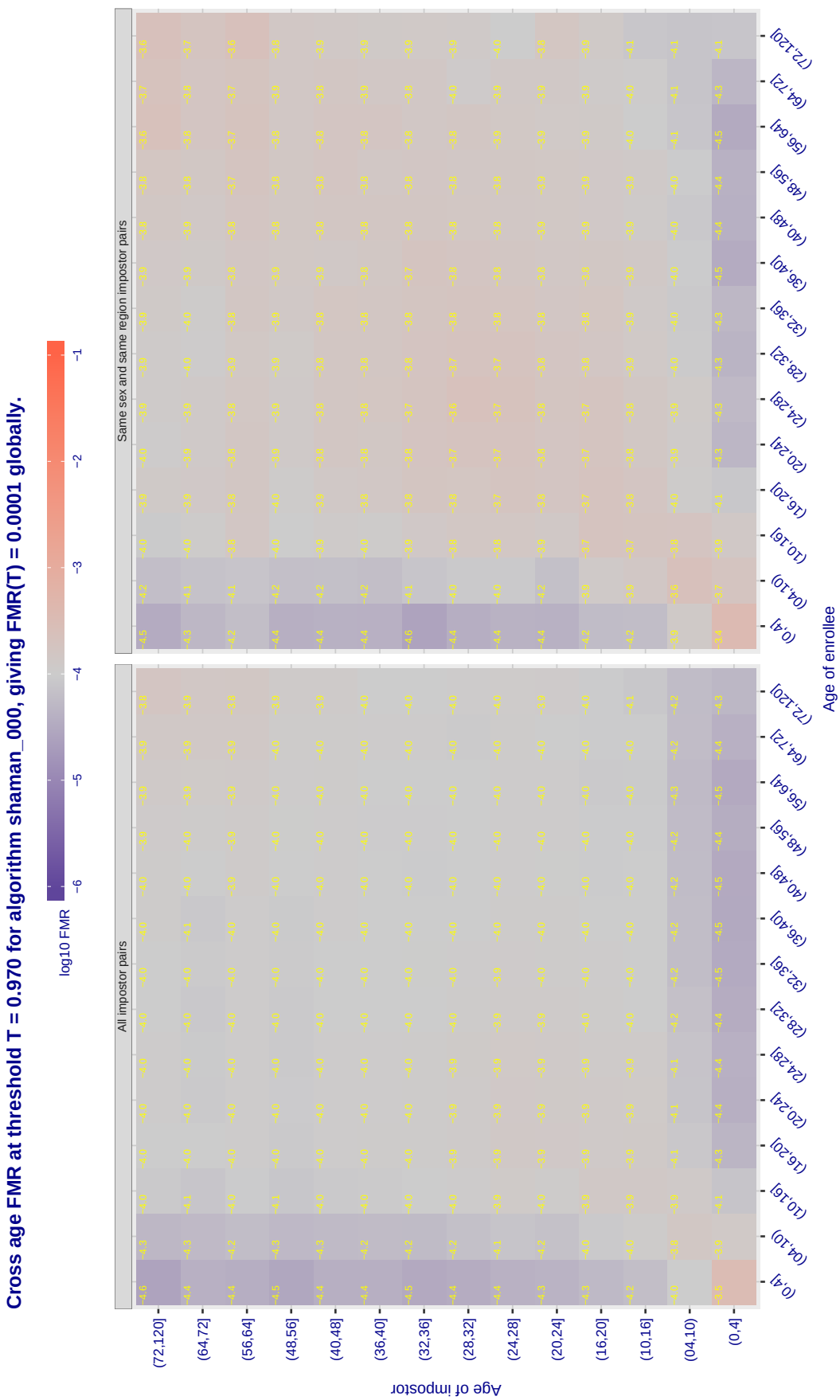


Figure 441: For algorithm shaman-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

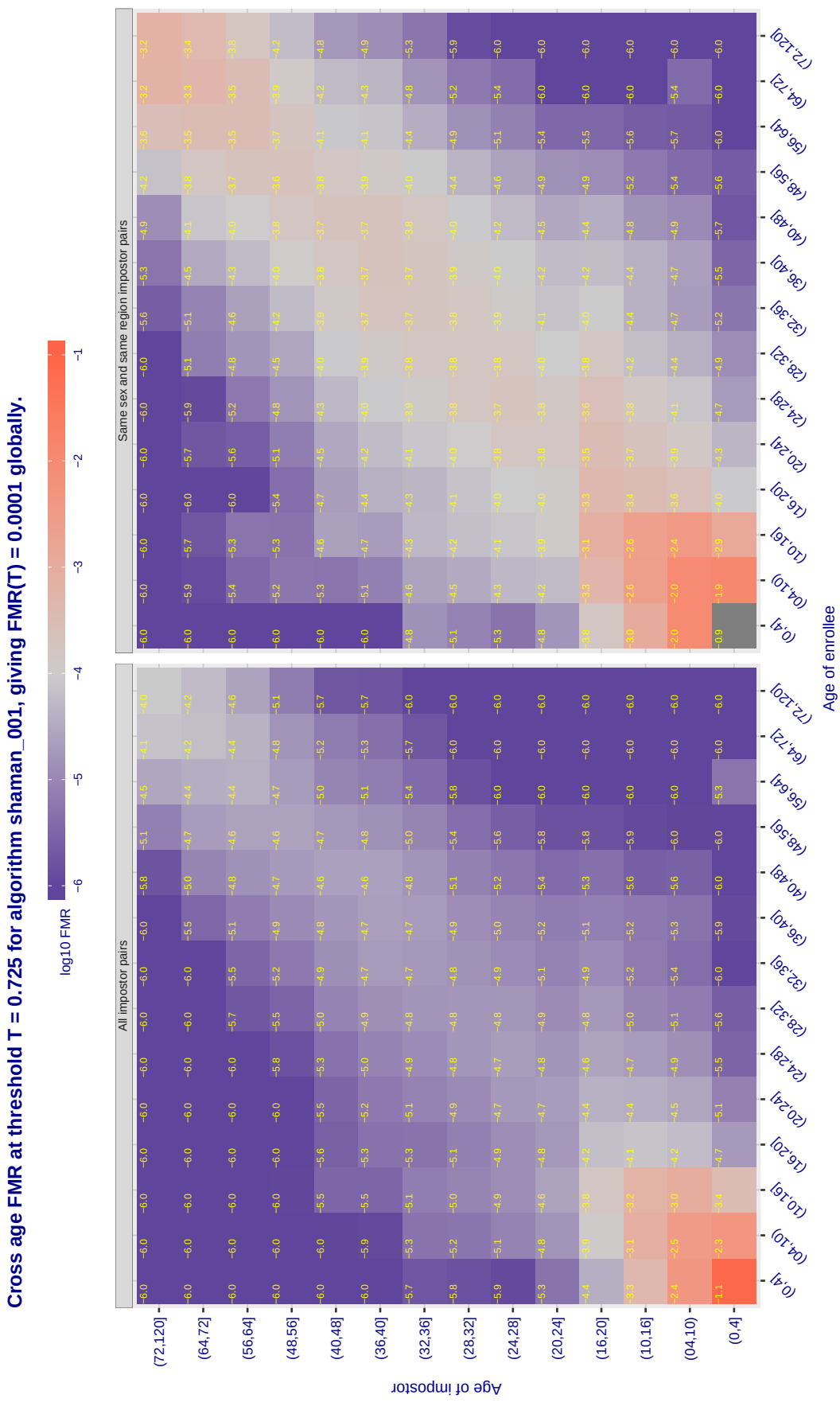


Figure 442: For algorithm shaman-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

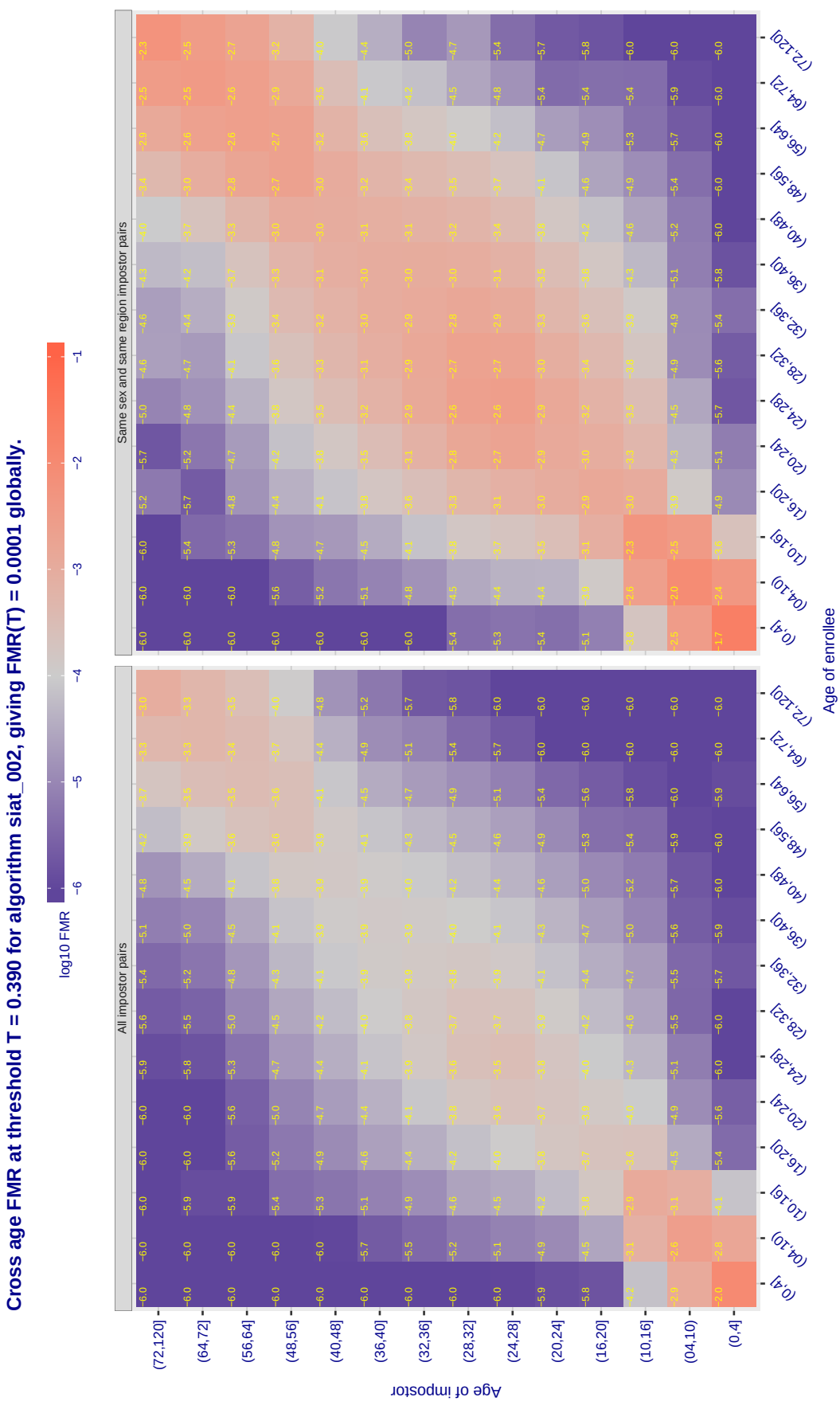


Figure 443: For algorithm siat-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

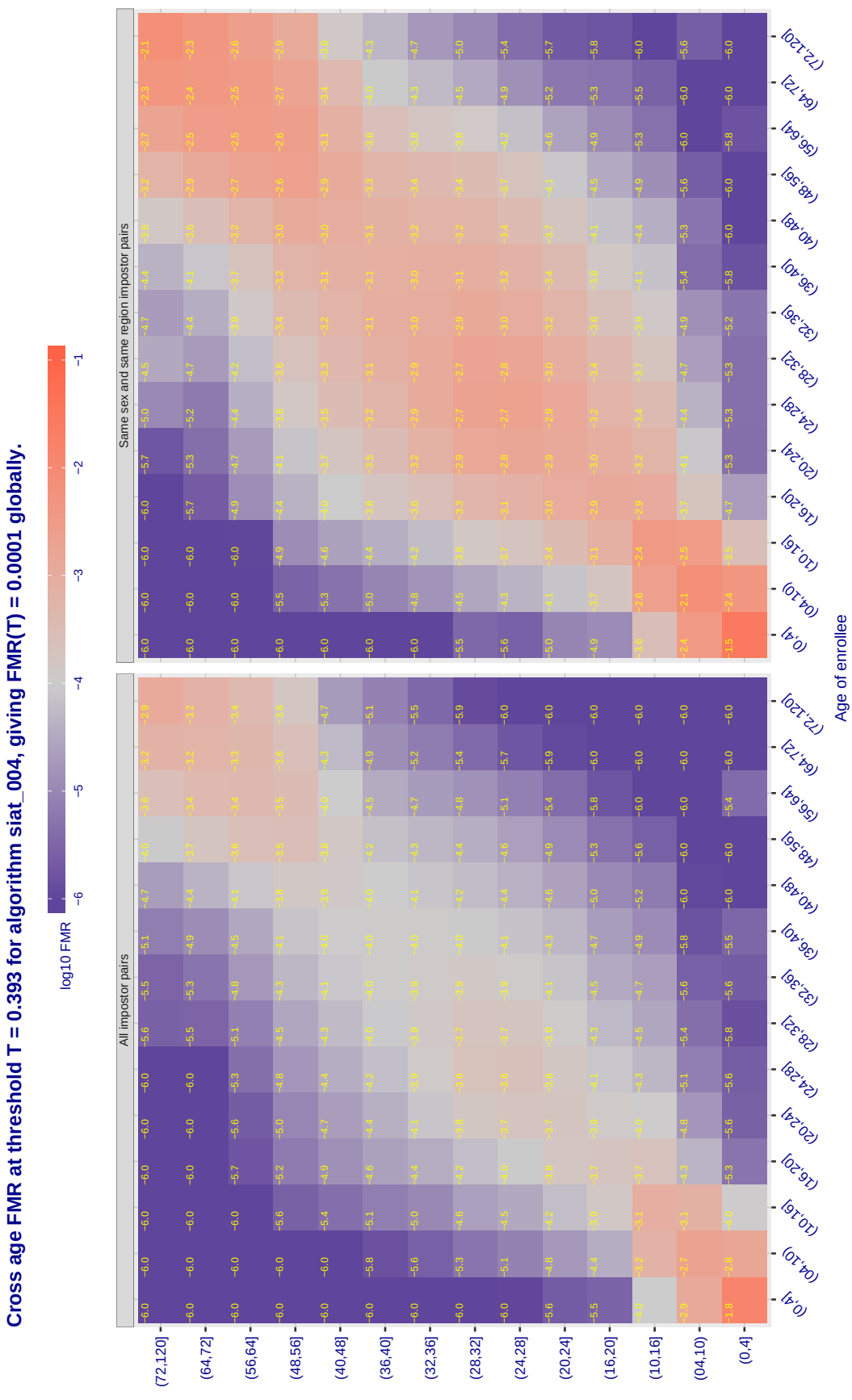


Figure 444: For algorithm siat-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

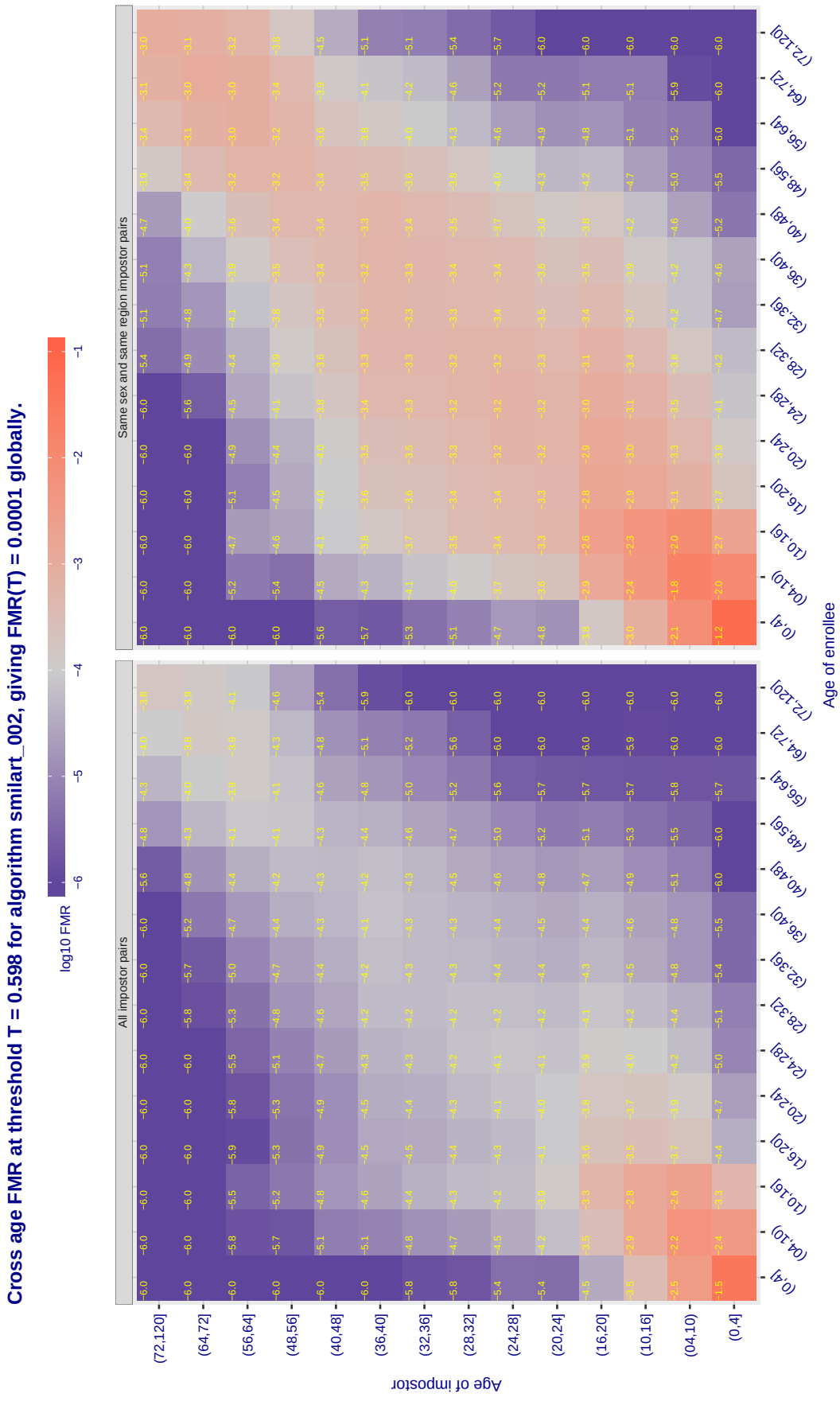


Figure 445: For algorithm smilart-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

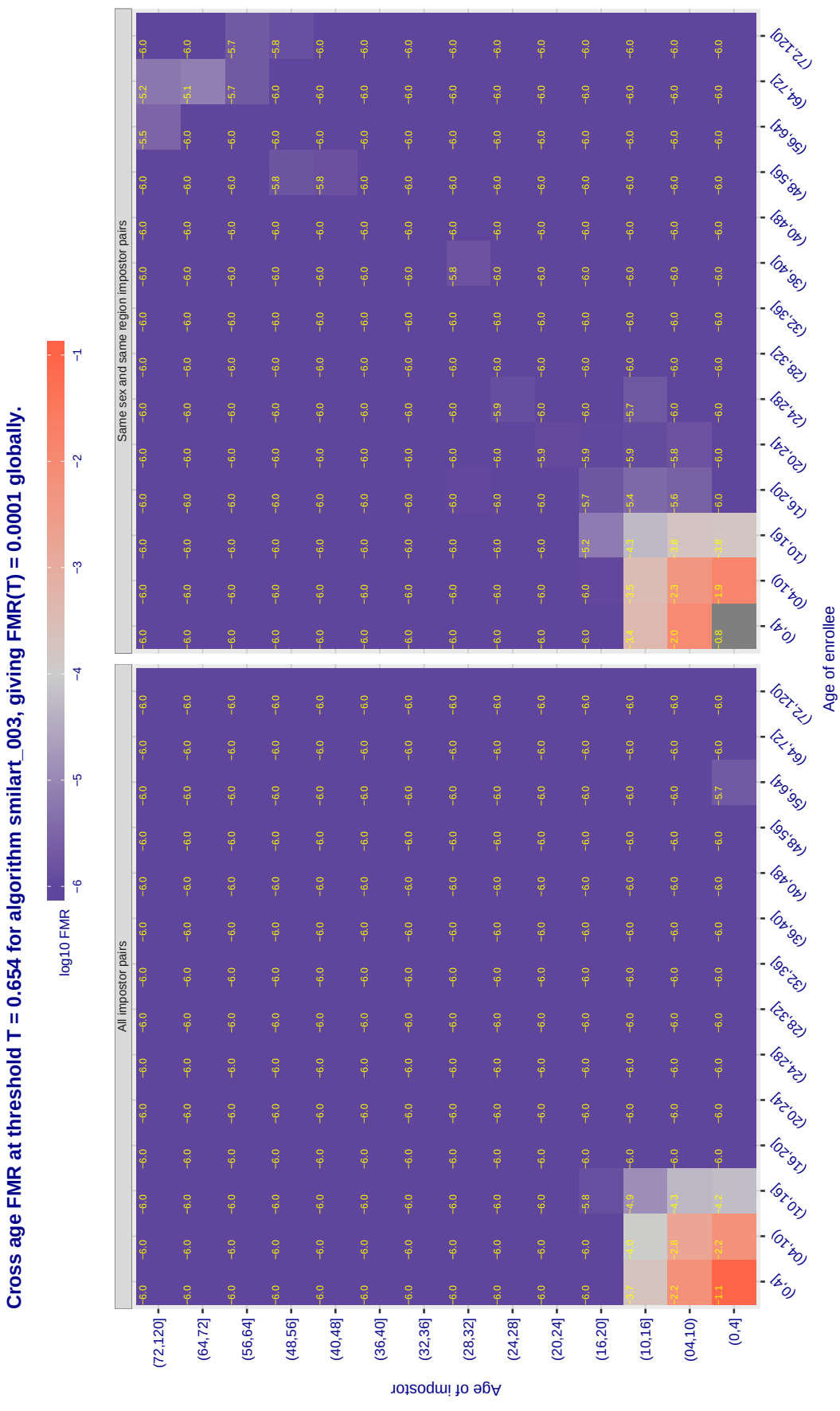


Figure 446: For algorithm smilart-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

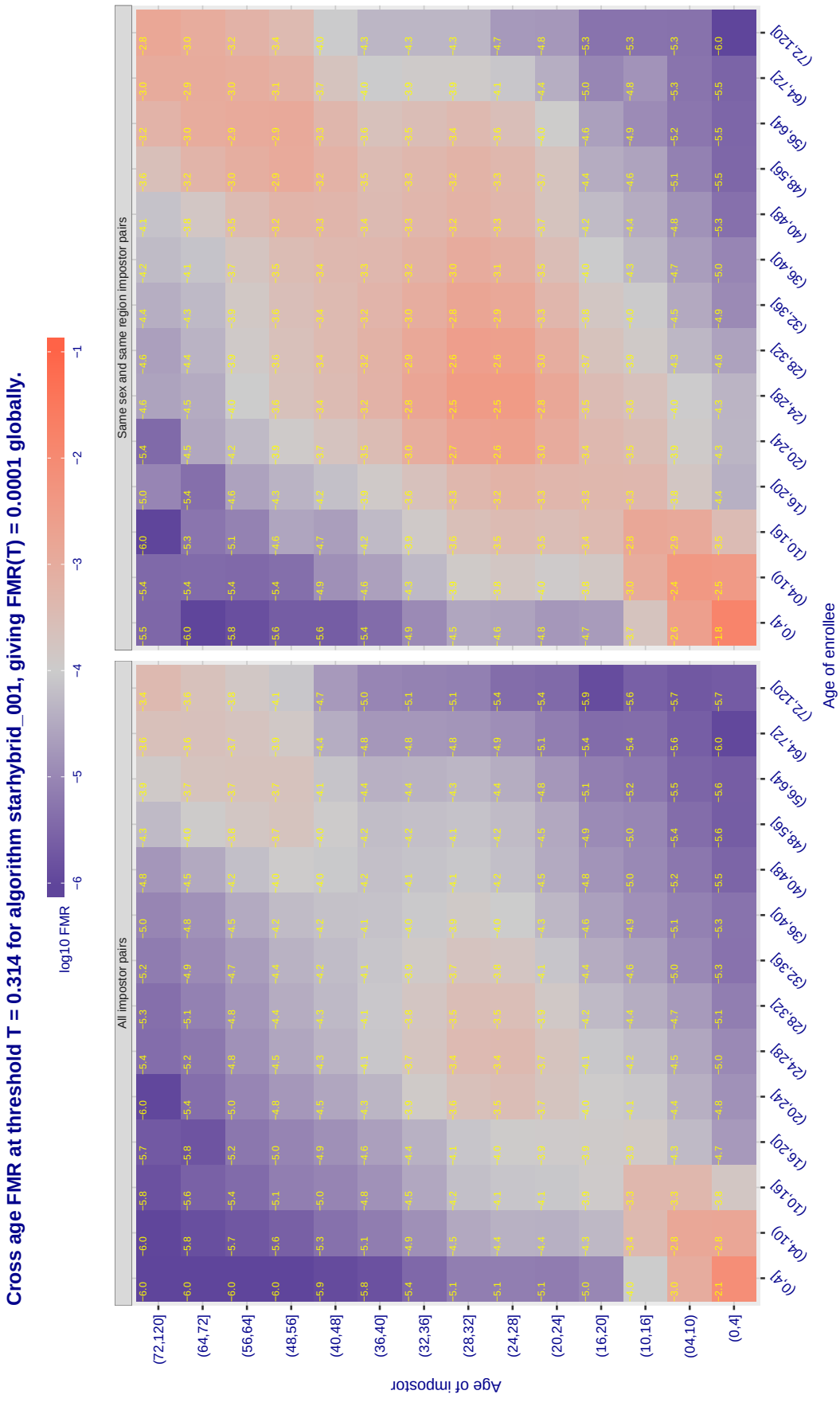


Figure 447: For algorithm starhybrid-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

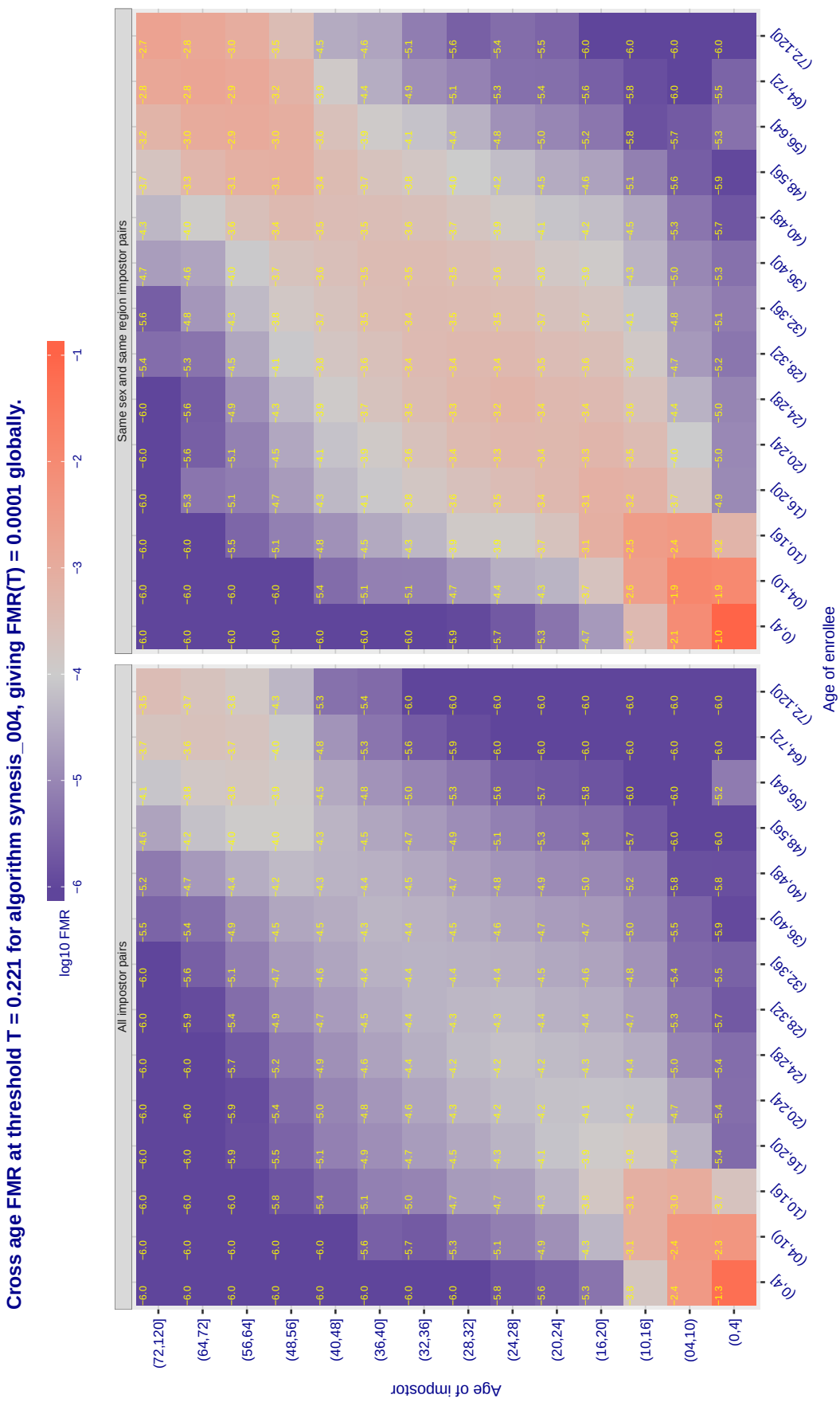


Figure 448: For algorithm synesis-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

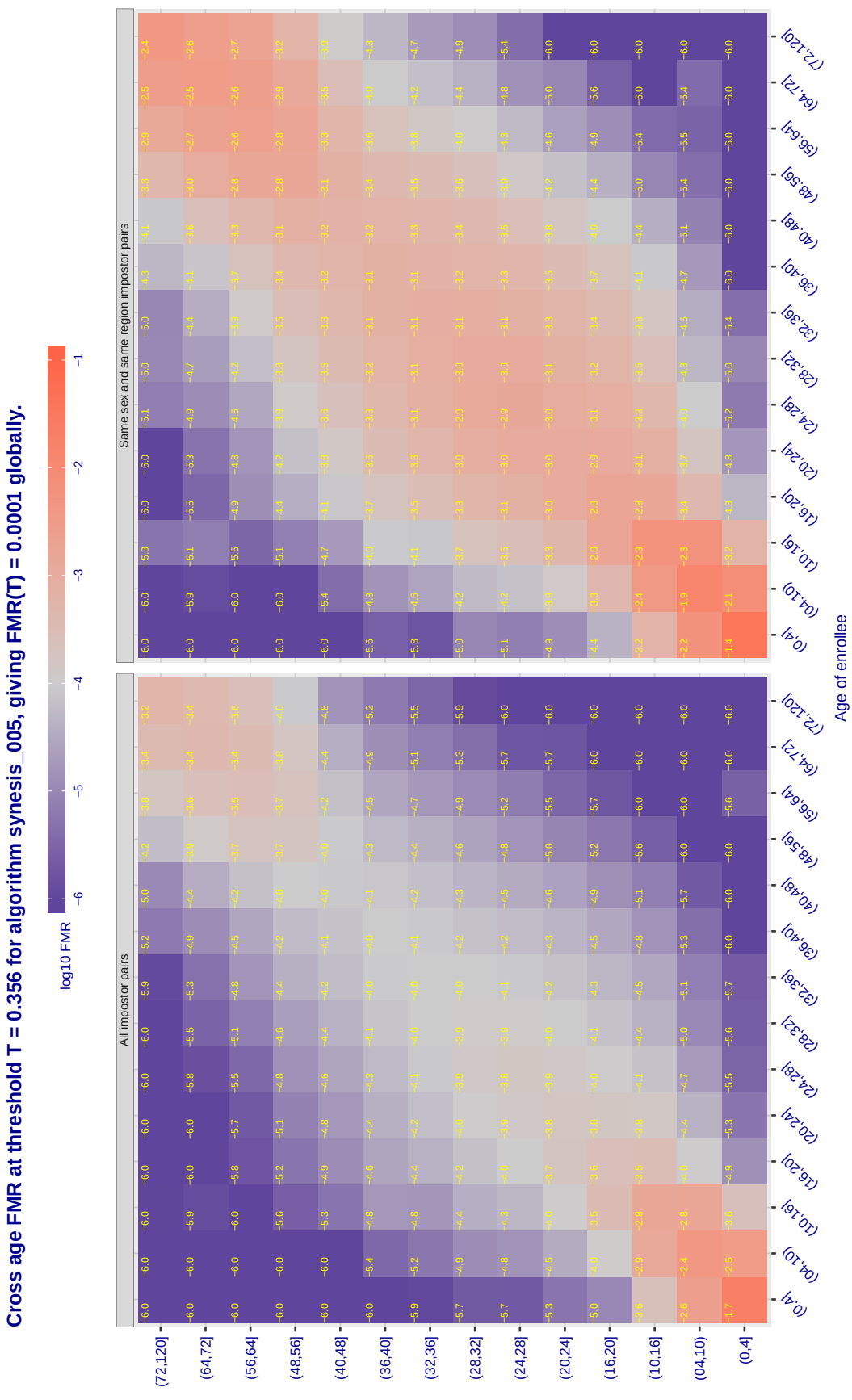


Figure 449: For algorithm synesis-005 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

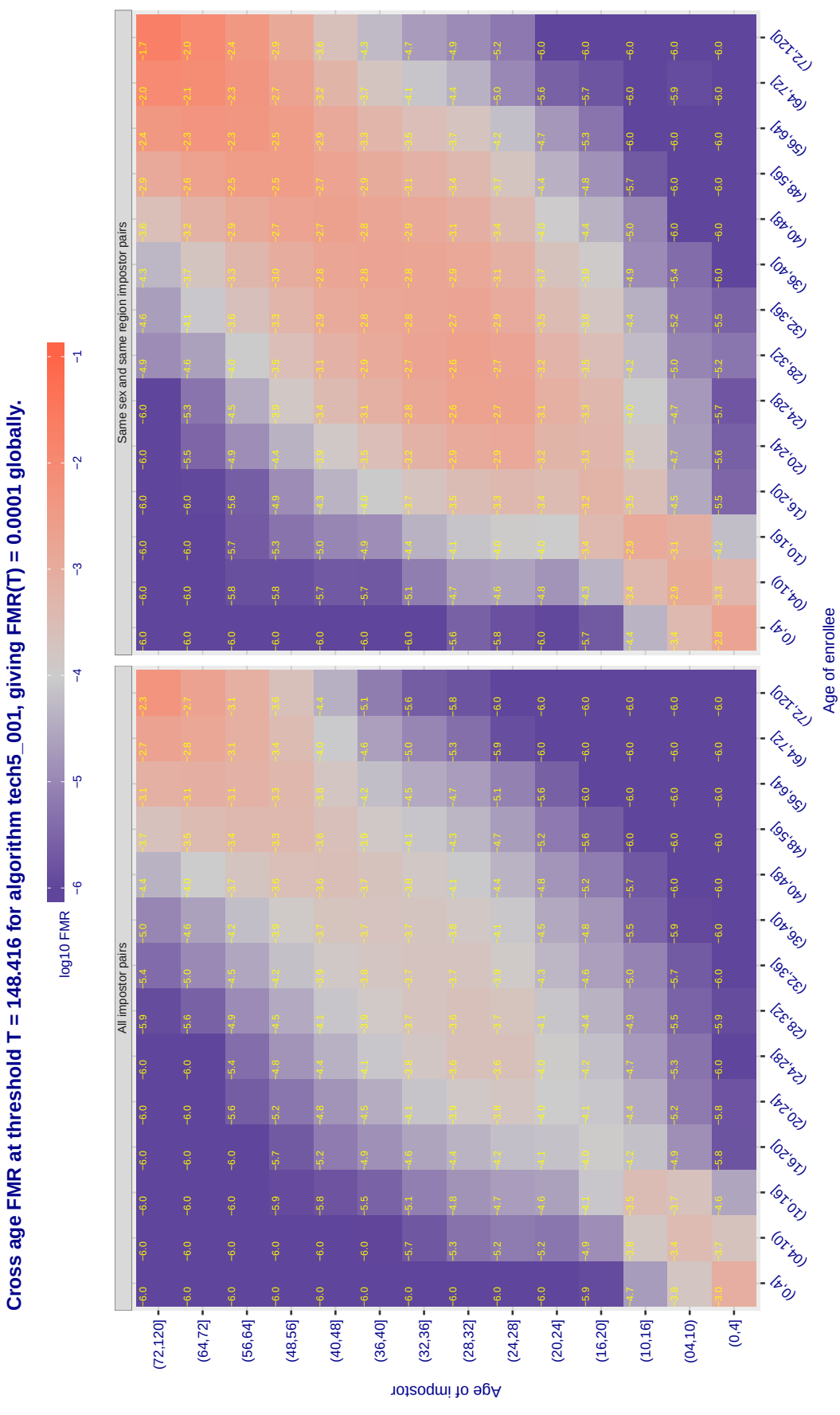


Figure 450: For algorithm tech5-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

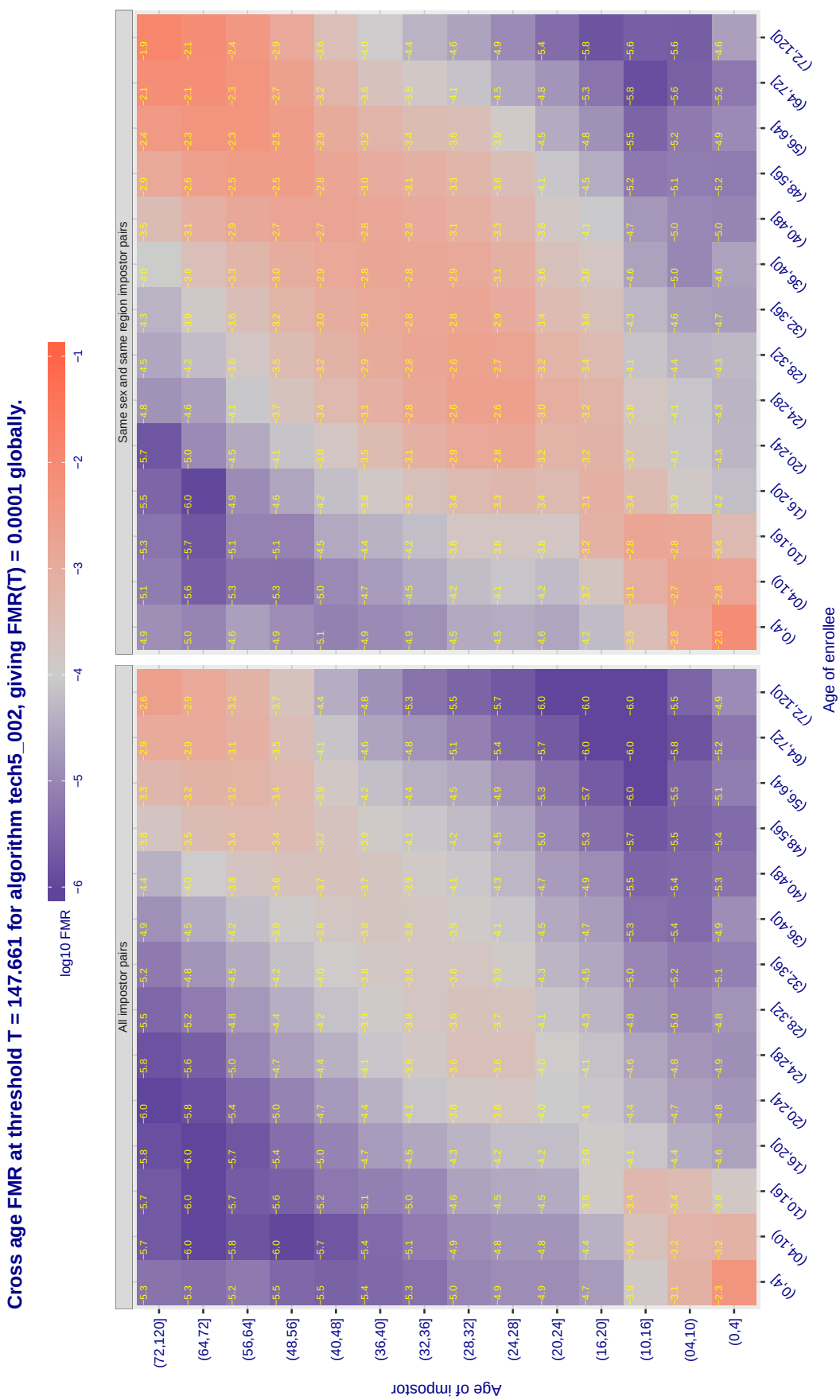


Figure 451: For algorithm tech5-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

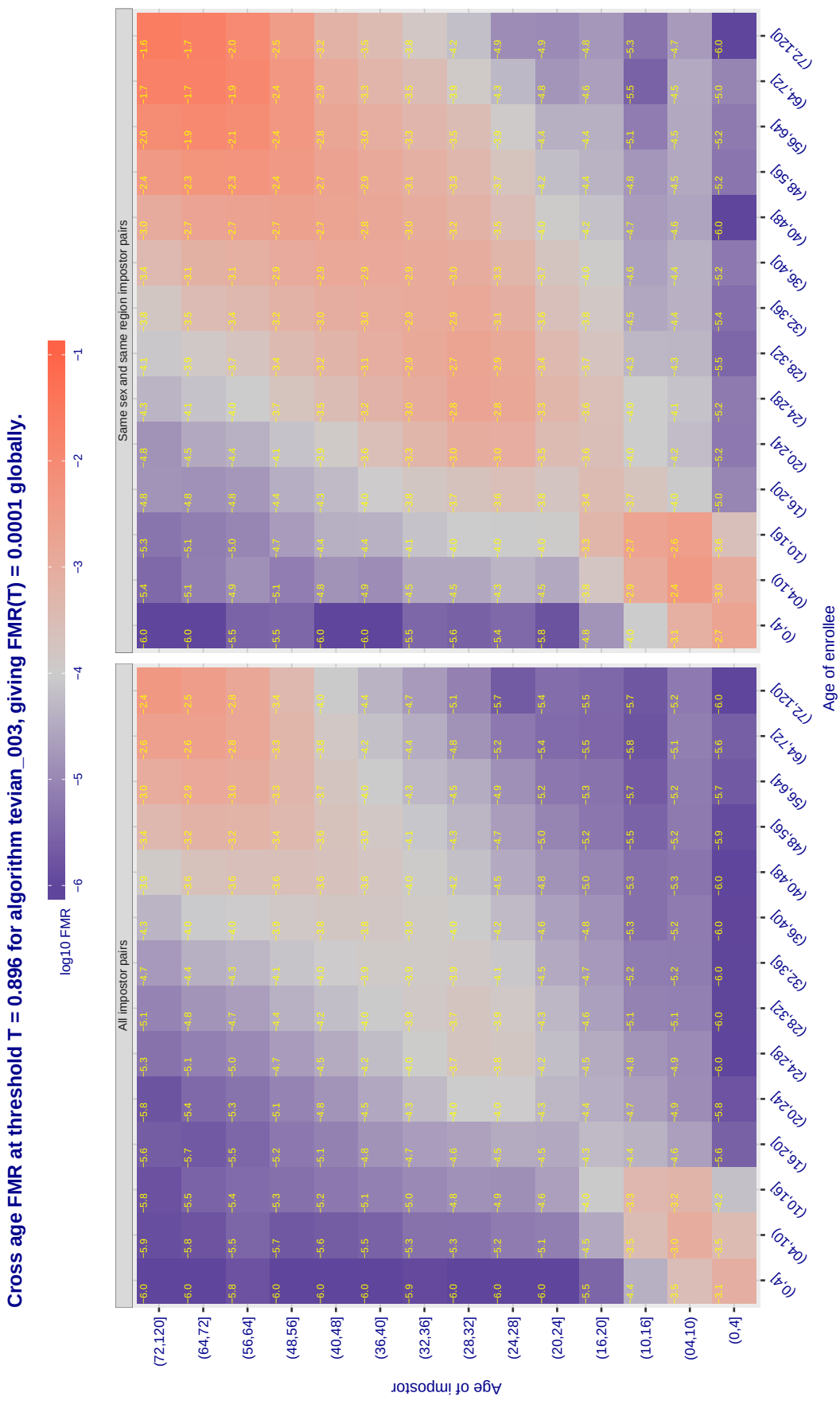


Figure 452: For algorithm tevian-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

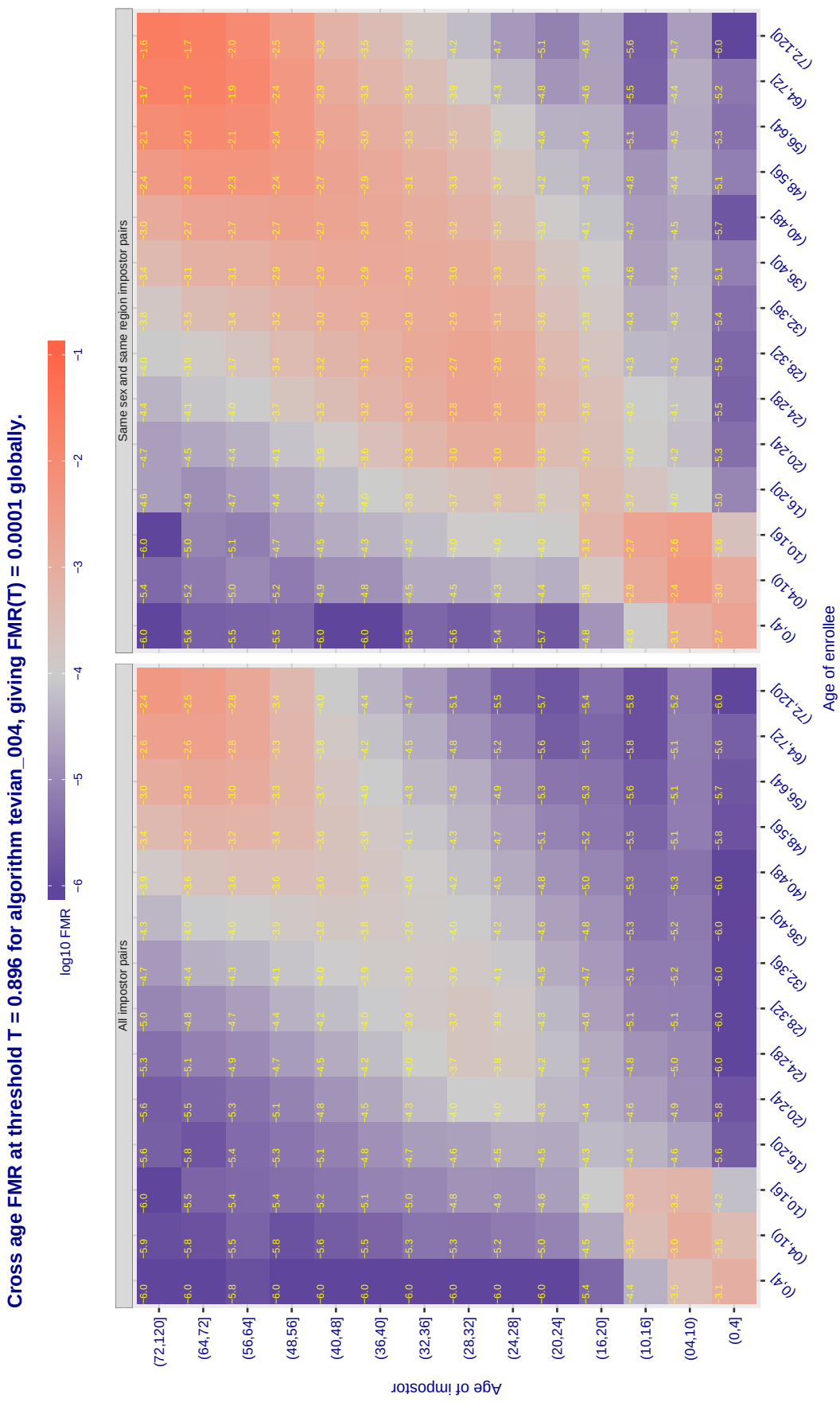


Figure 453: For algorithm tevian-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

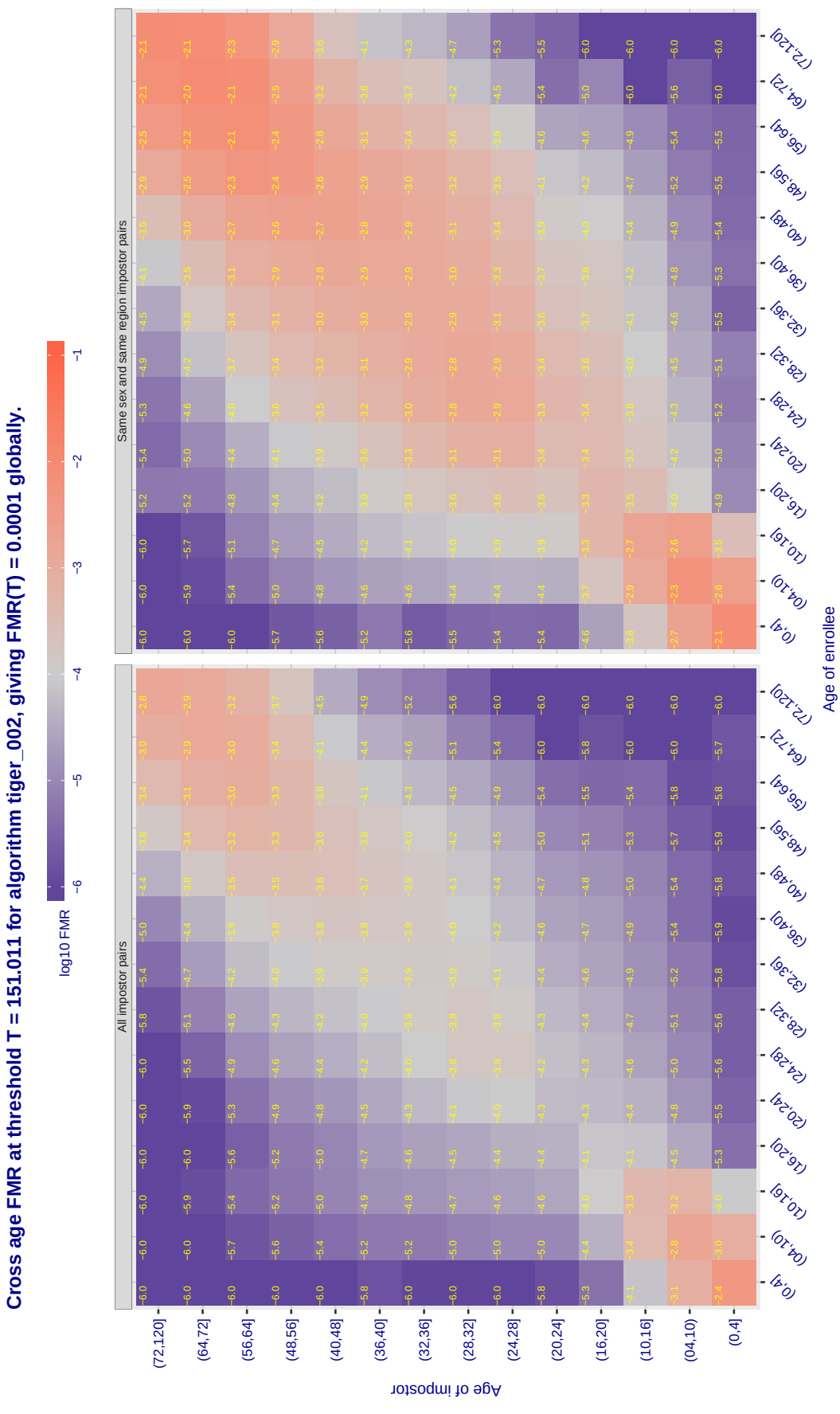


Figure 454: For algorithm tiger-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

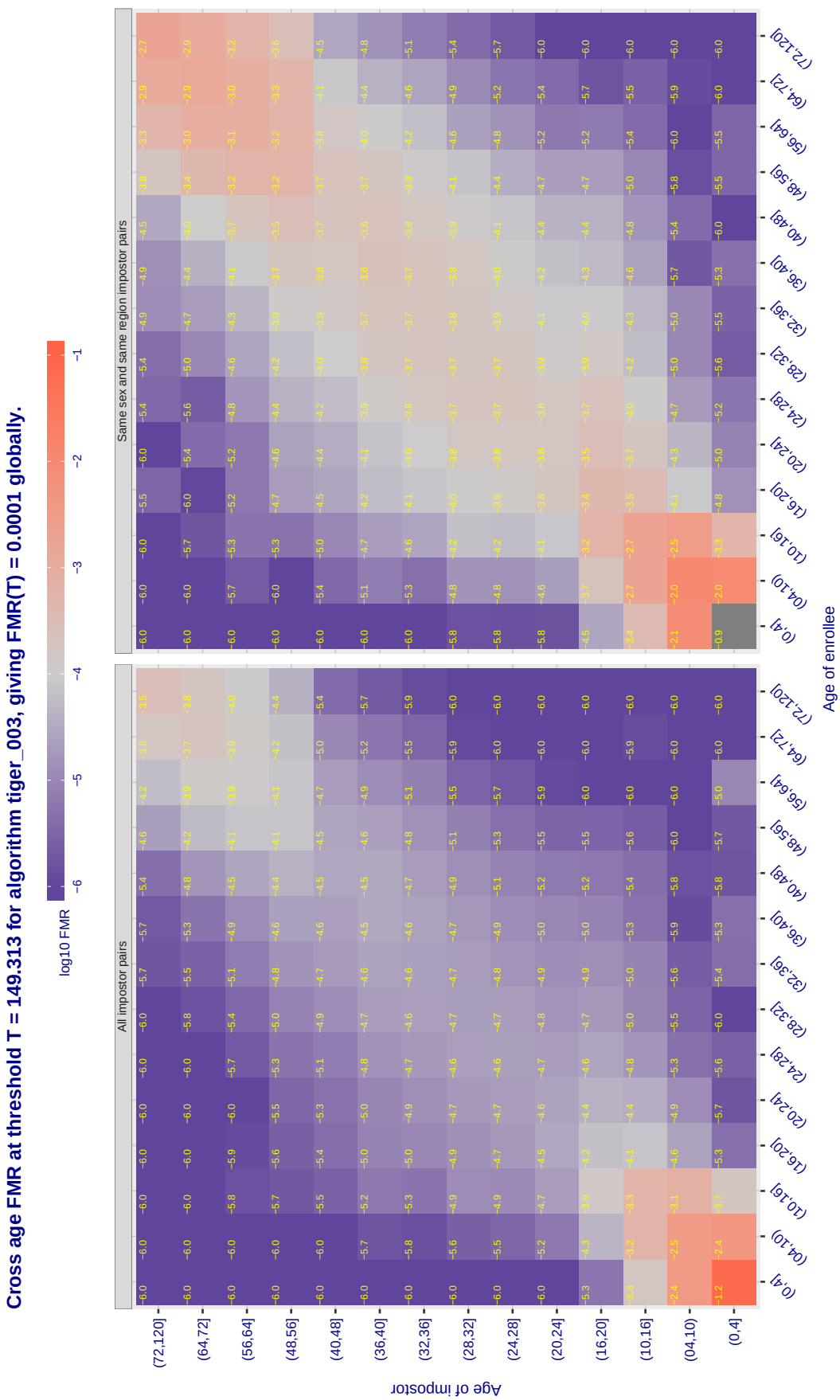


Figure 455: For algorithm tiger-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

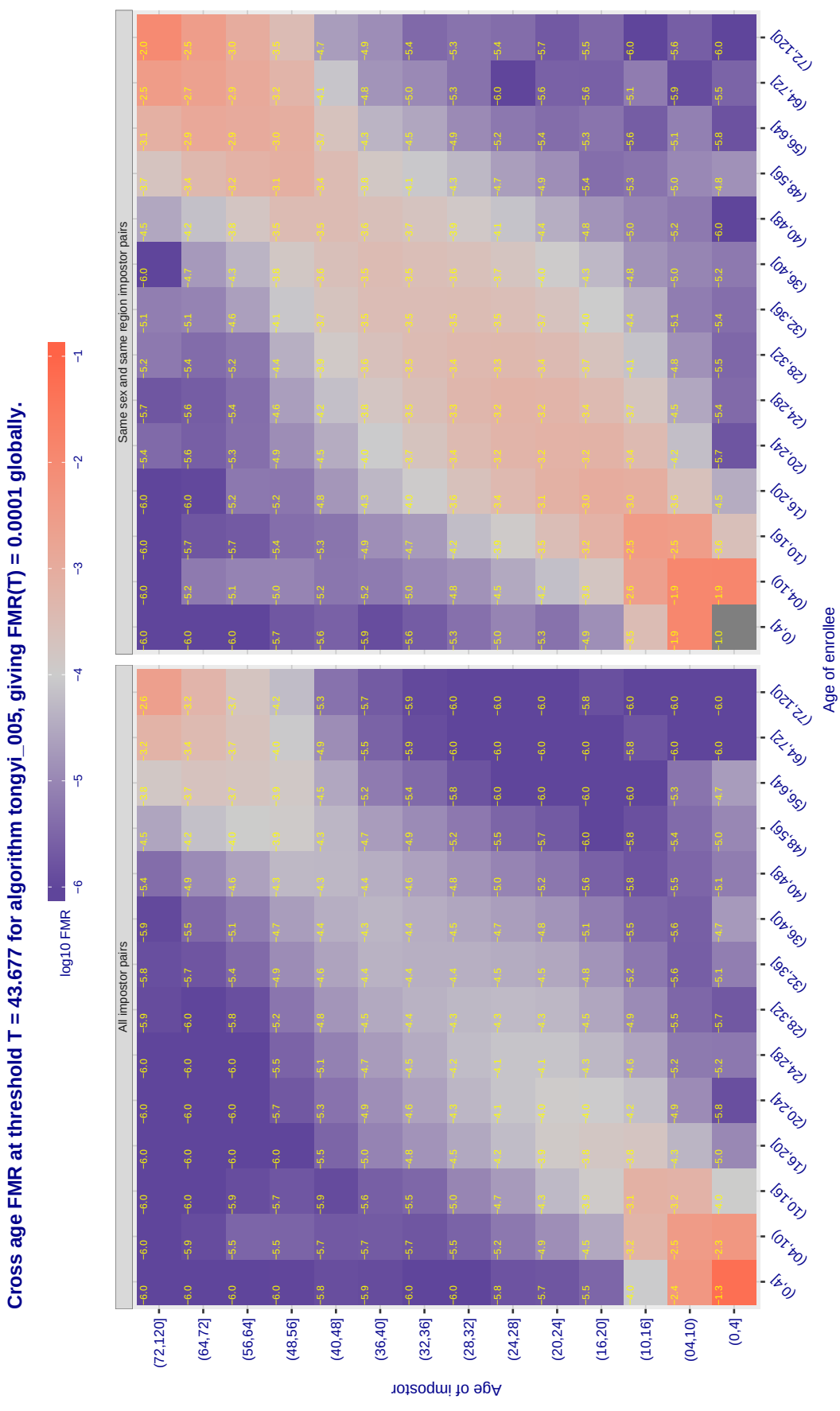


Figure 456: For algorithm tongyi-005 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

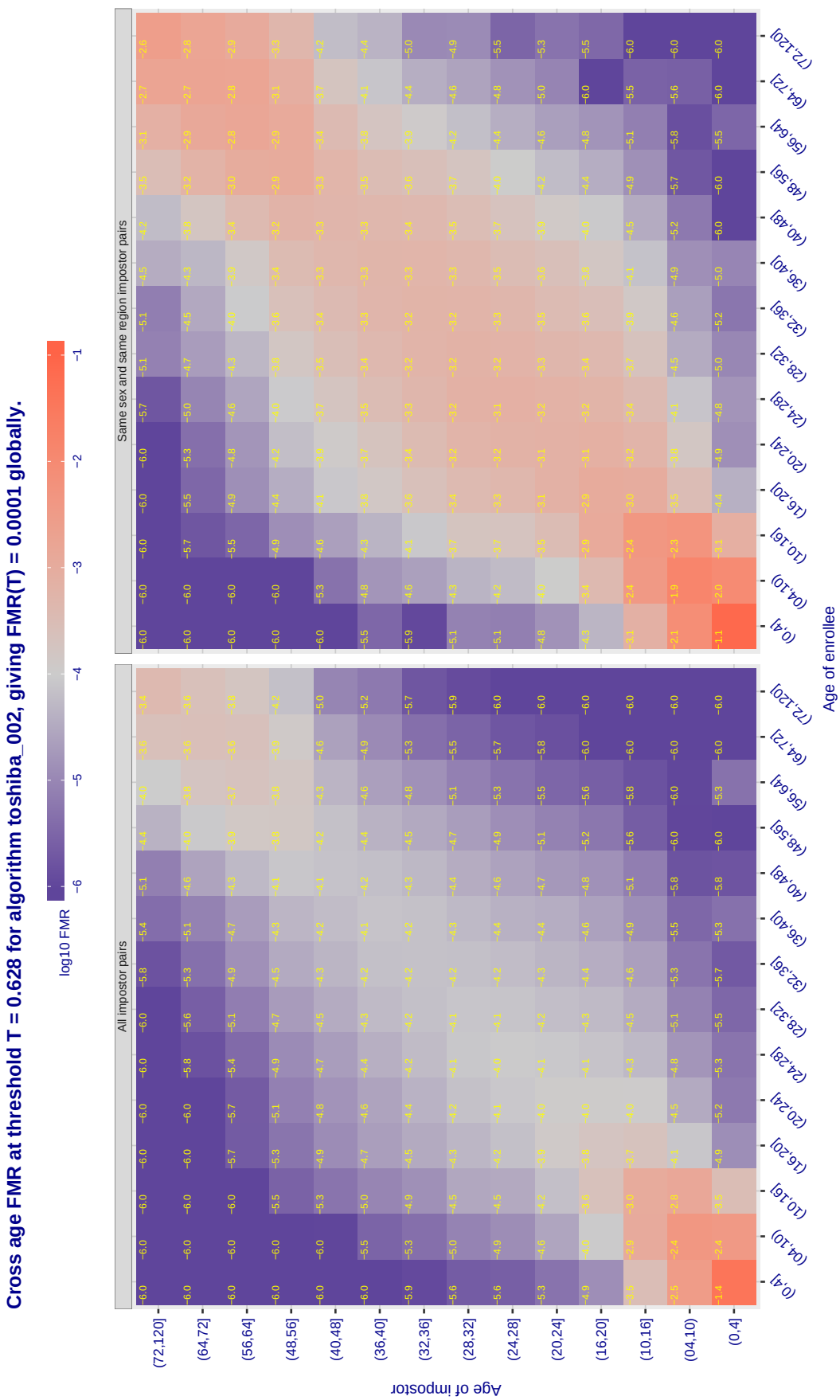


Figure 457: For algorithm toshiba-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

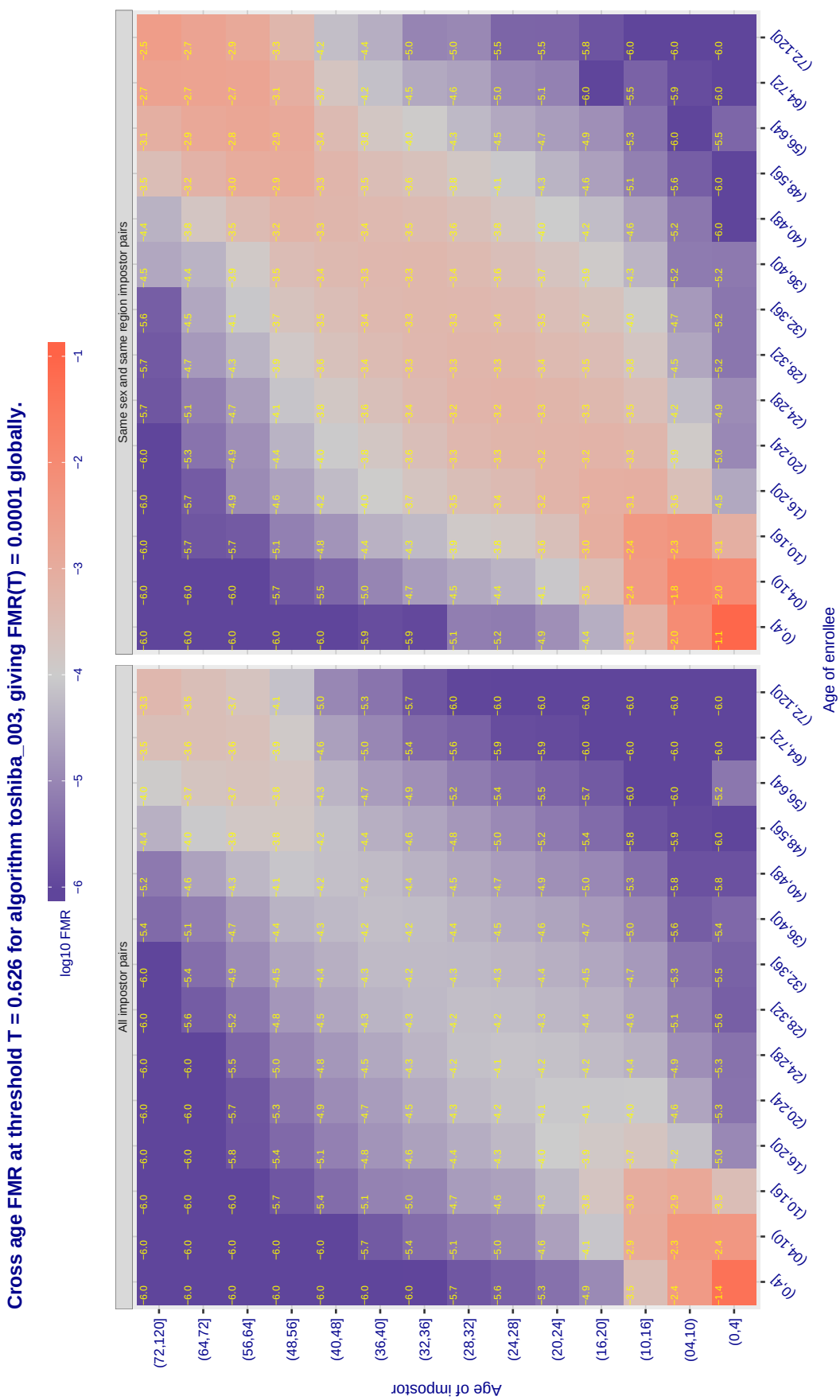


Figure 458: For algorithm toshiba-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

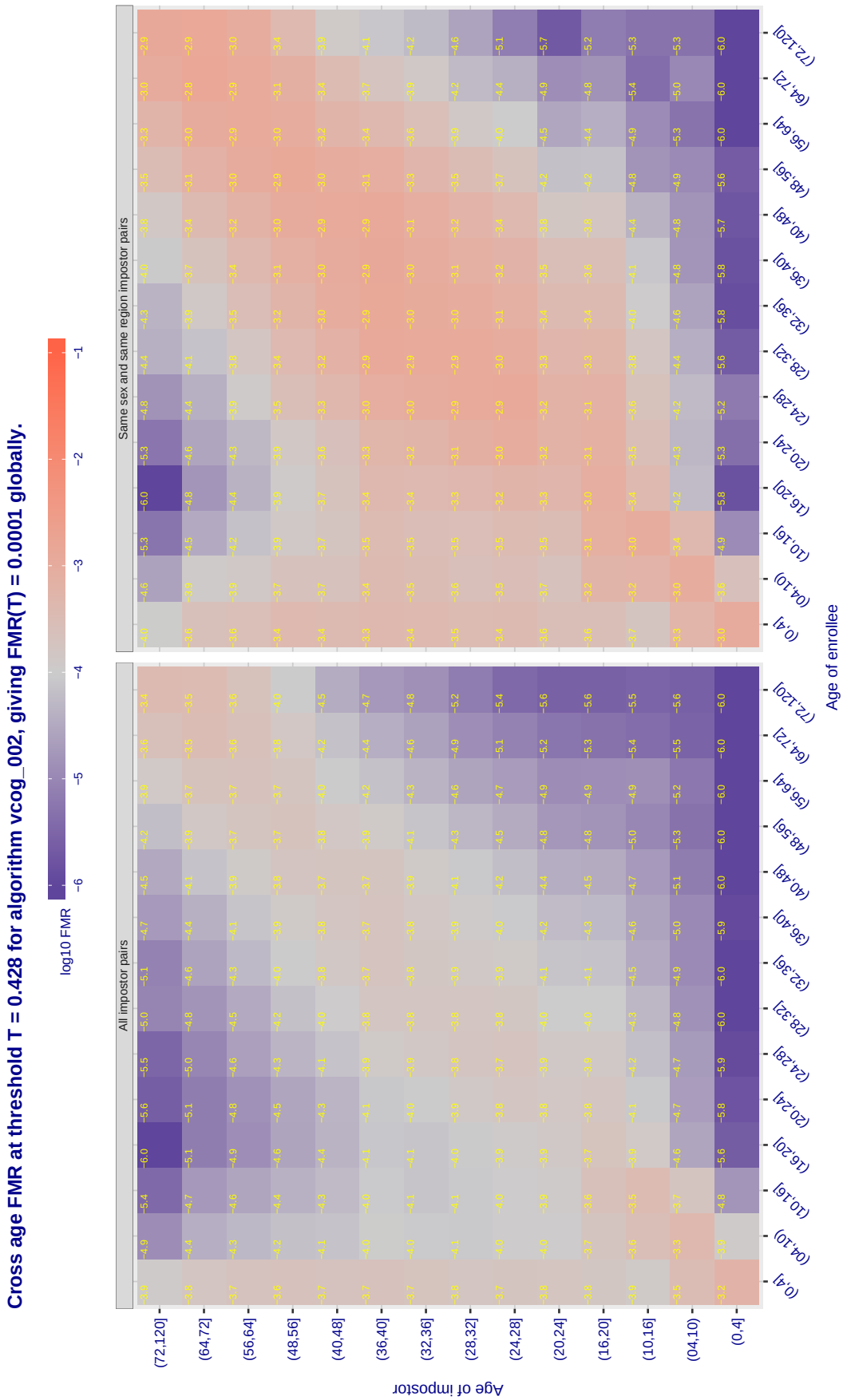


Figure 459: For algorithm vcog-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

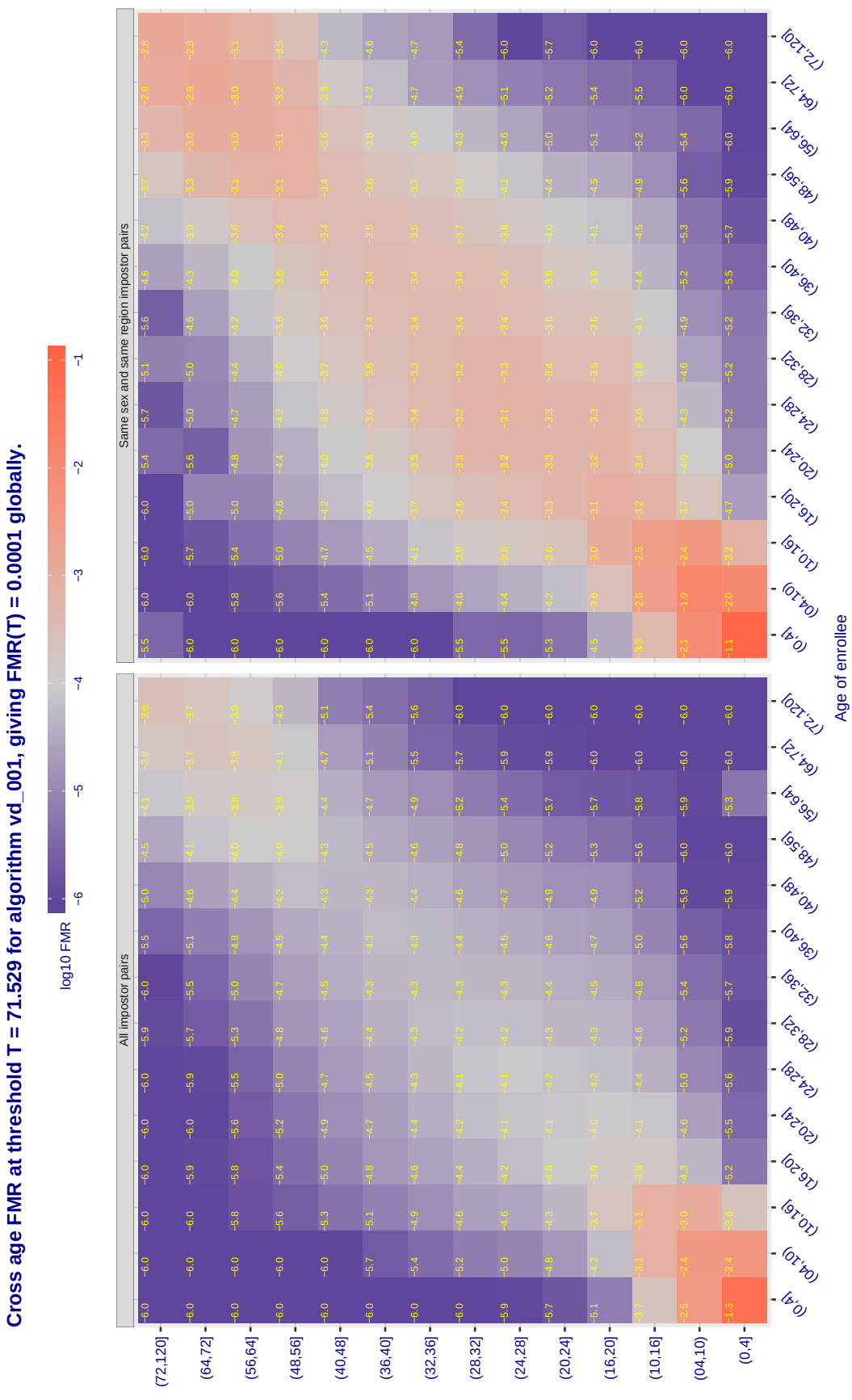


Figure 460: For algorithm vd-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

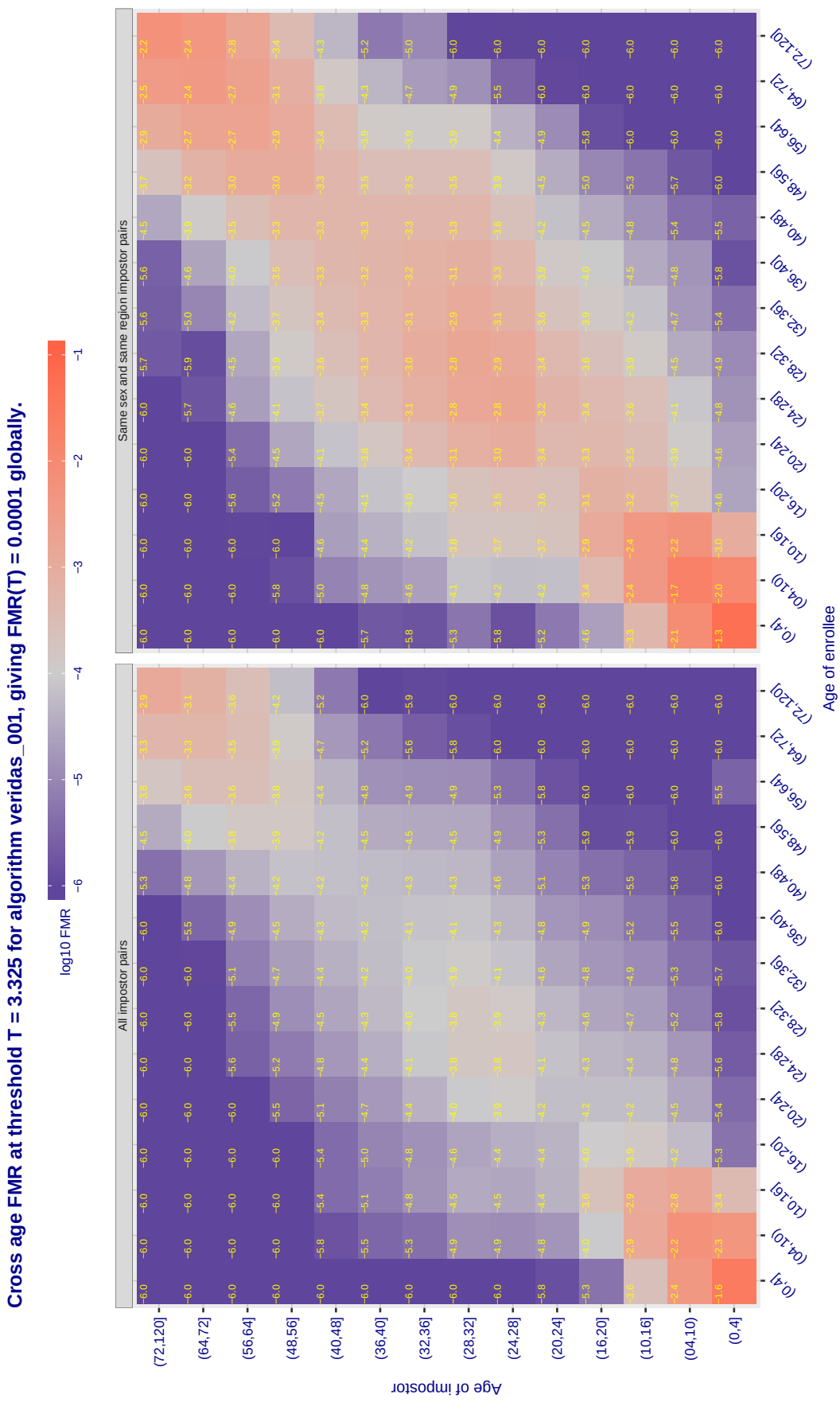


Figure 461: For algorithm veridas-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

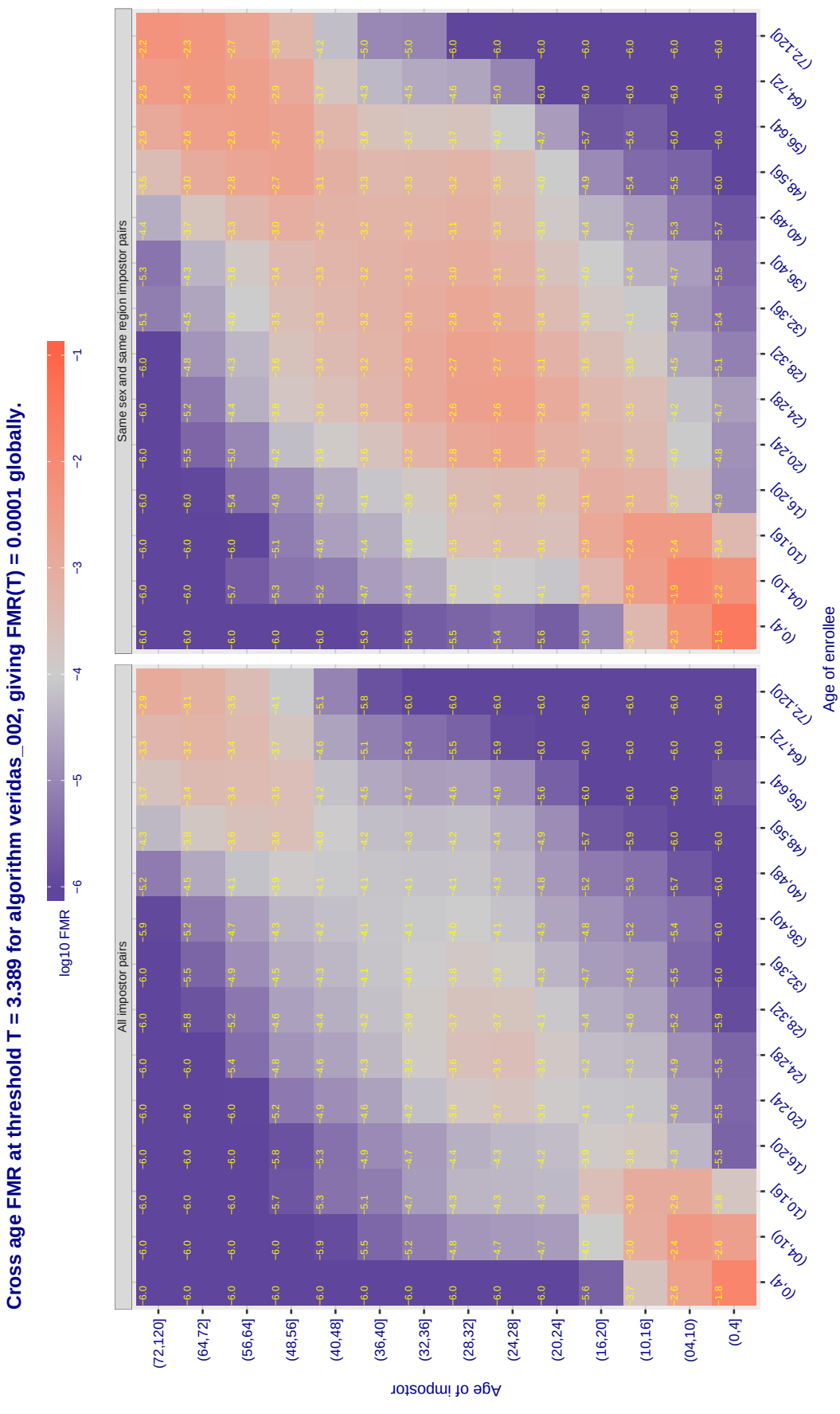


Figure 462: For algorithm veridas-002 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

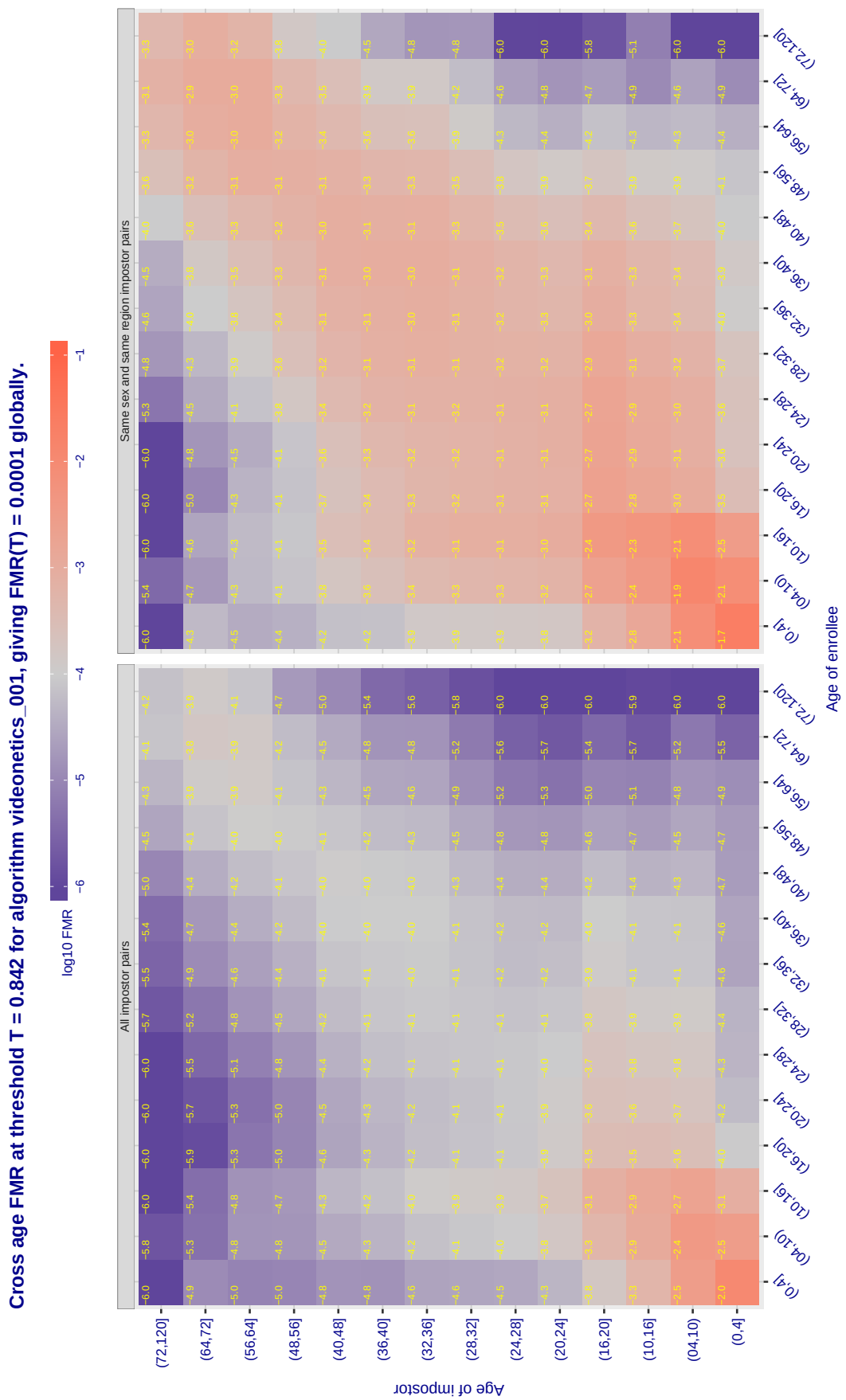


Figure 463: For algorithm videonetics-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

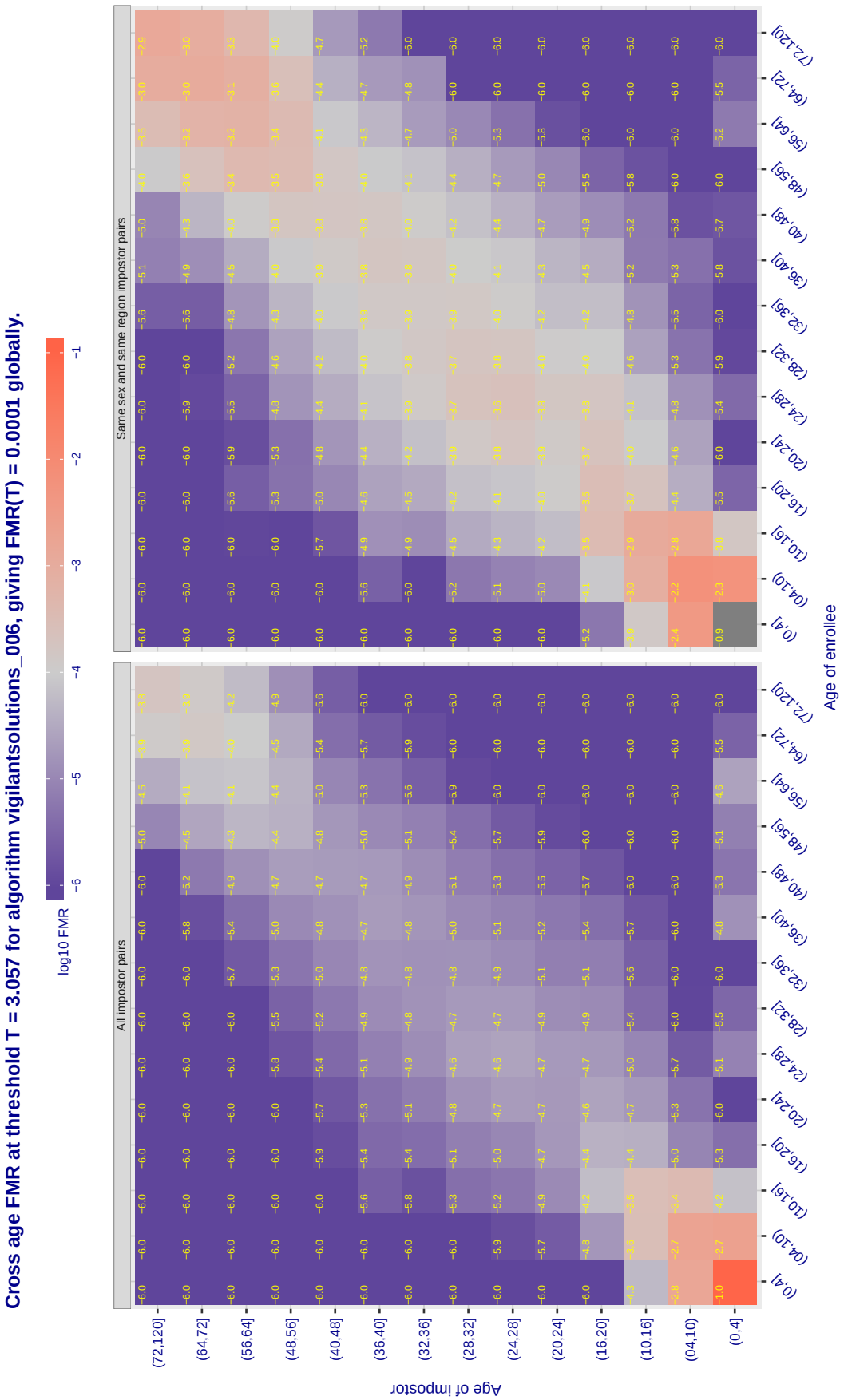


Figure 464: For algorithm vigilantsolutions-006 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

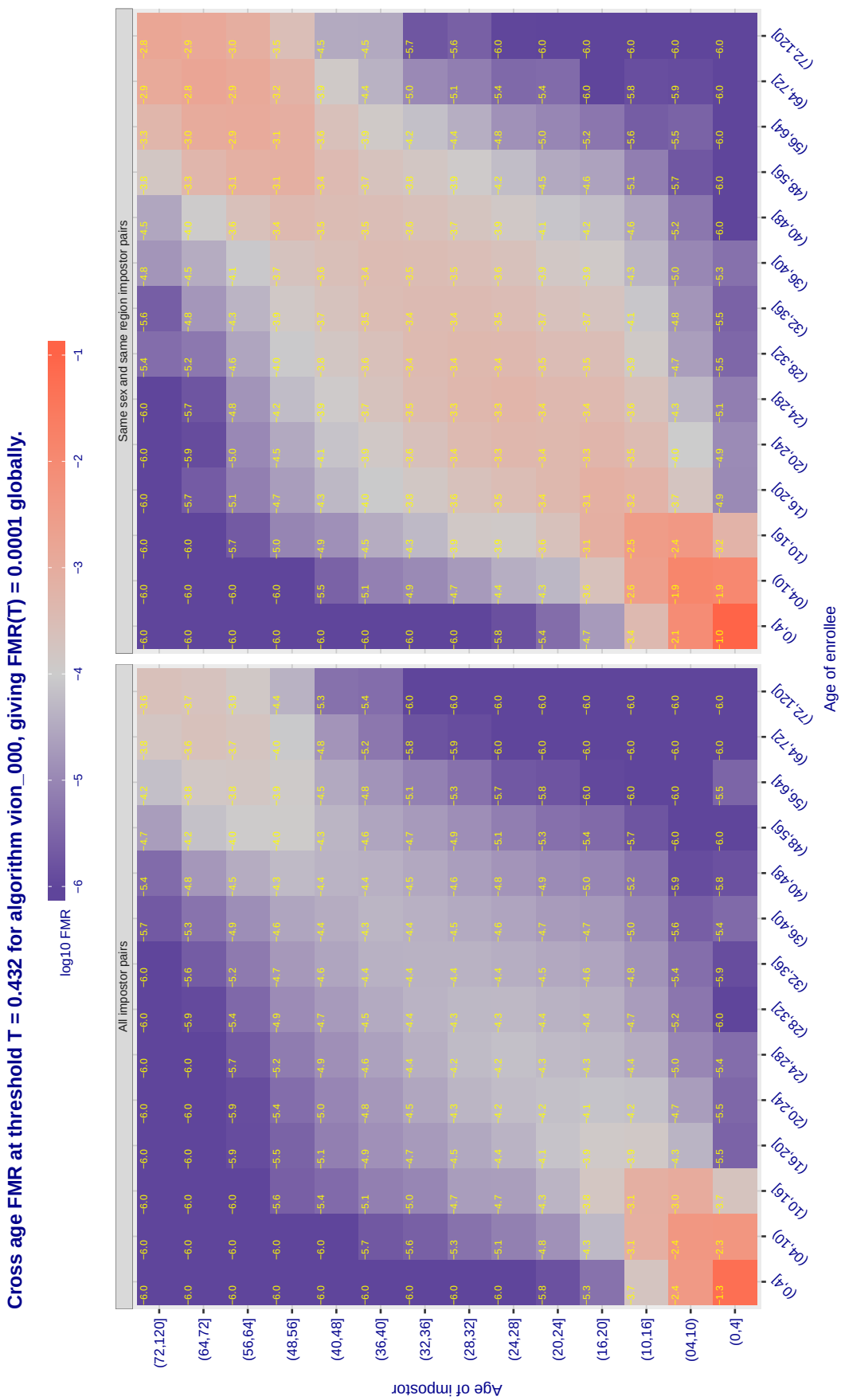


Figure 465: For algorithm vion-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

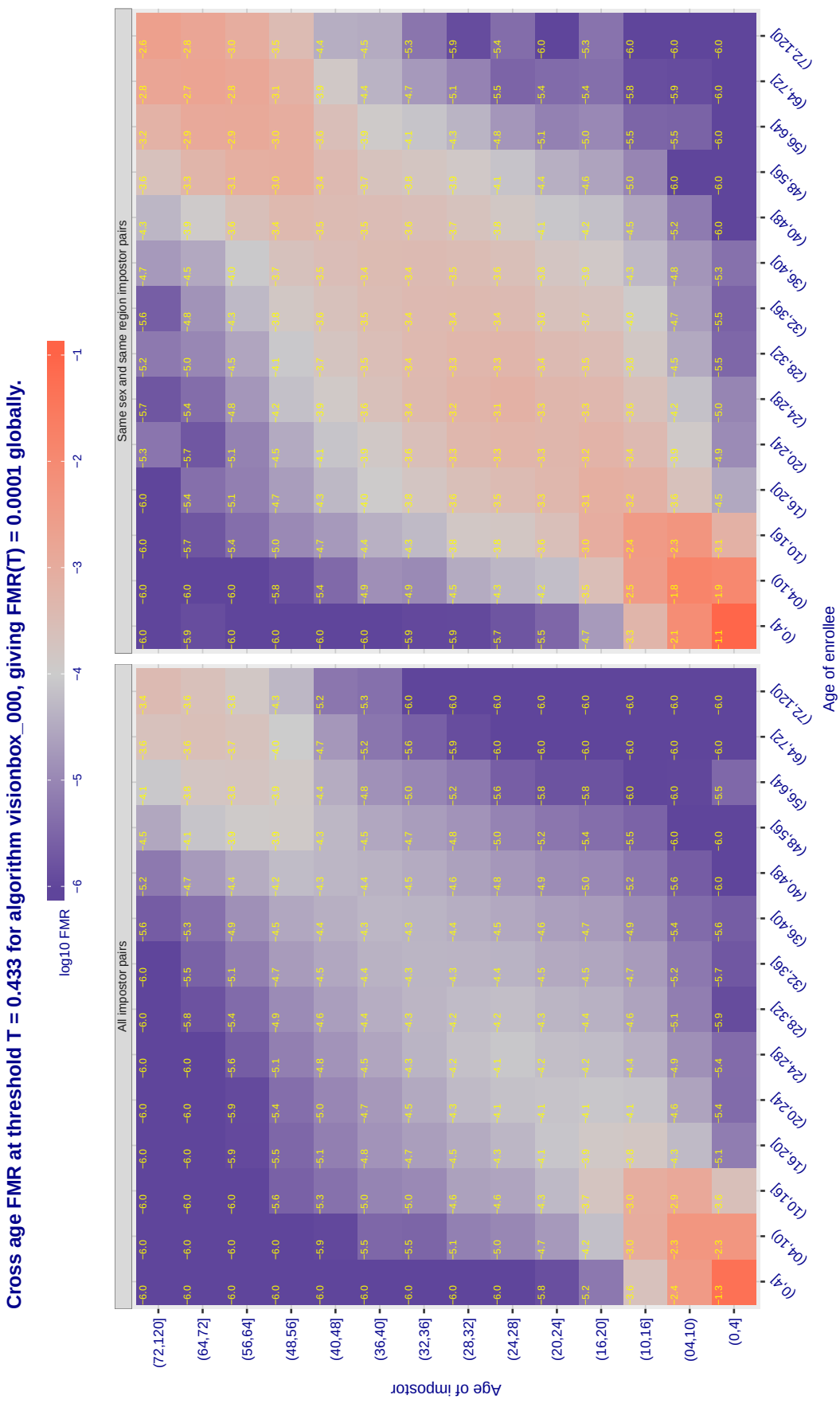


Figure 466: For algorithm visionbox-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

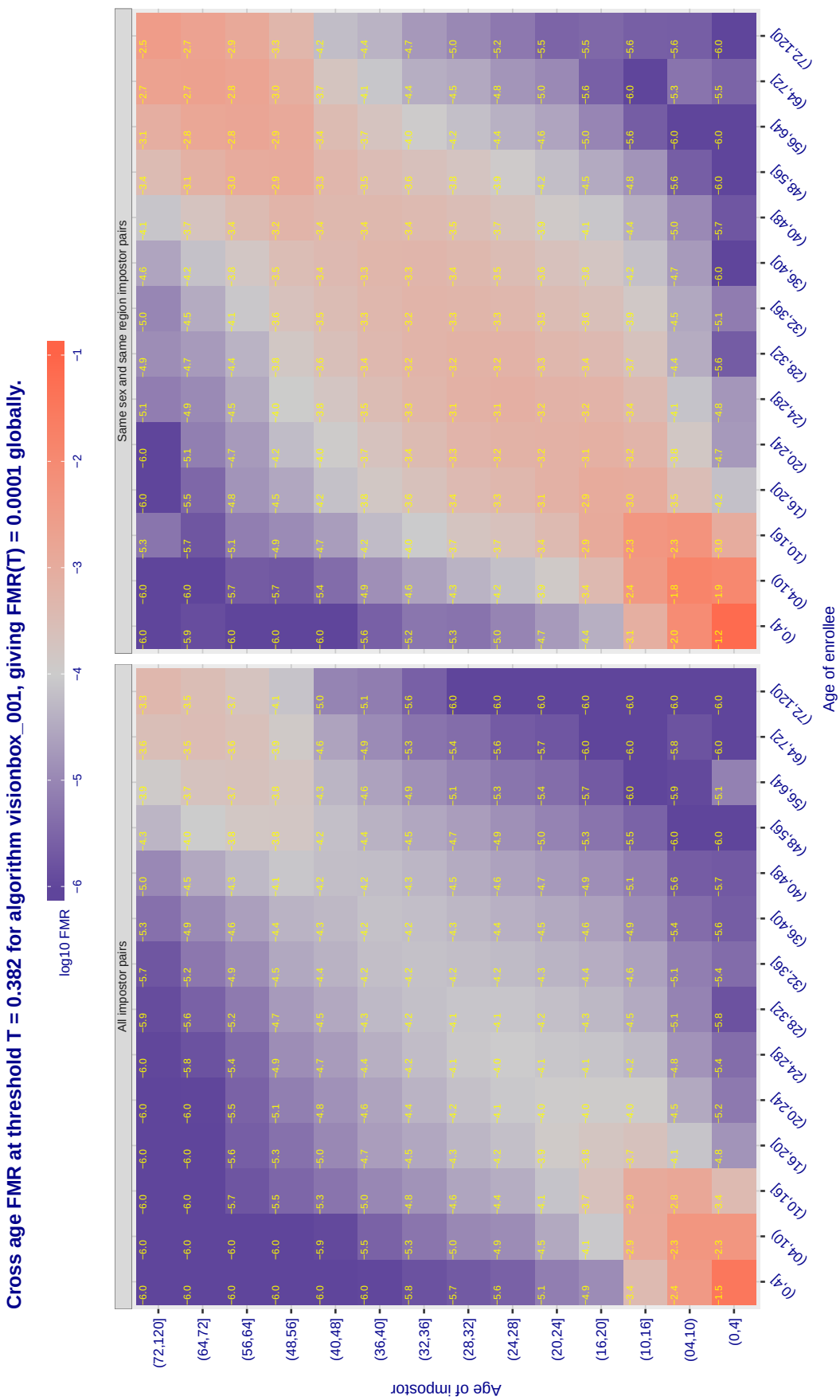


Figure 467: For algorithm visionbox-001 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

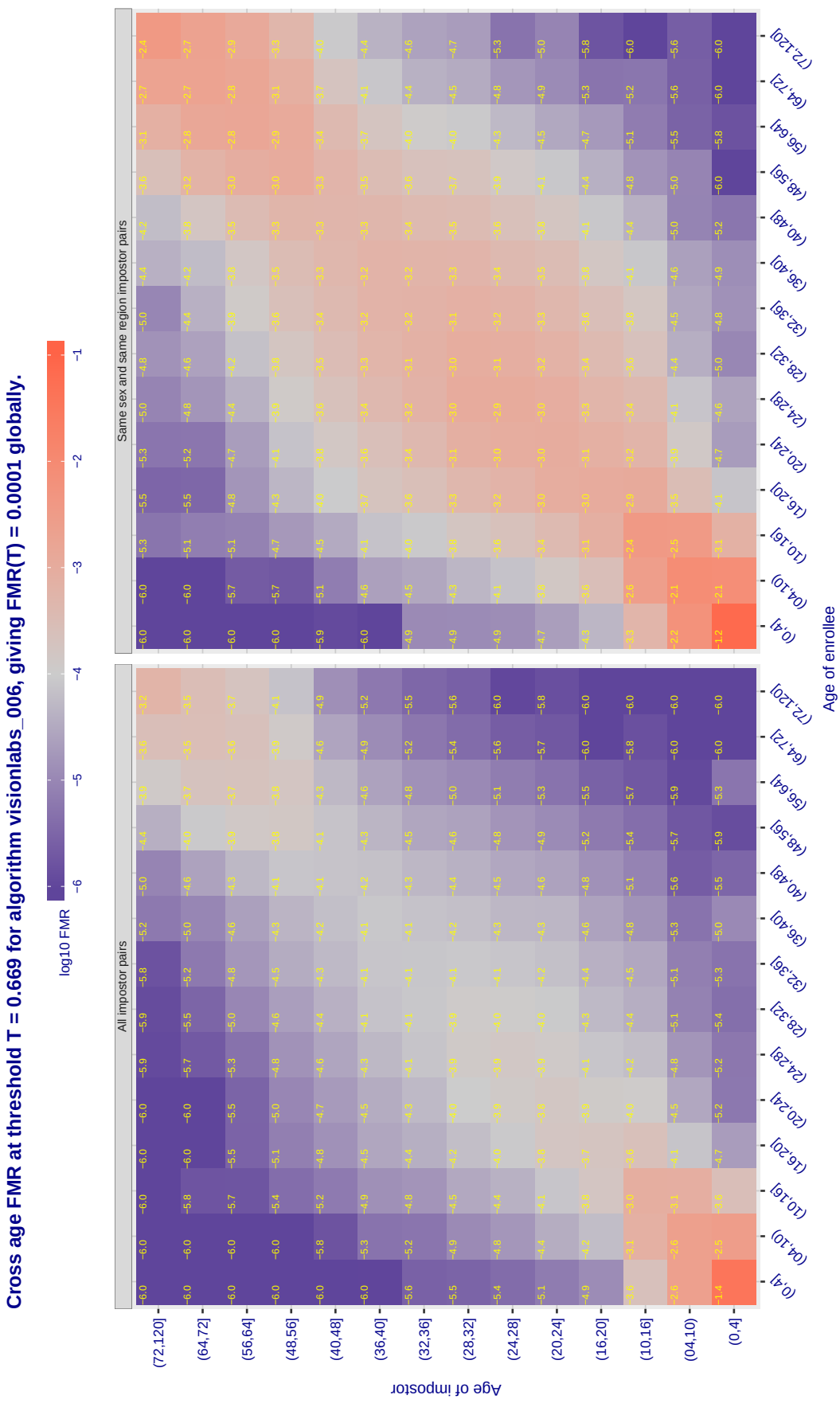


Figure 468: For algorithm visionlabs-006 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

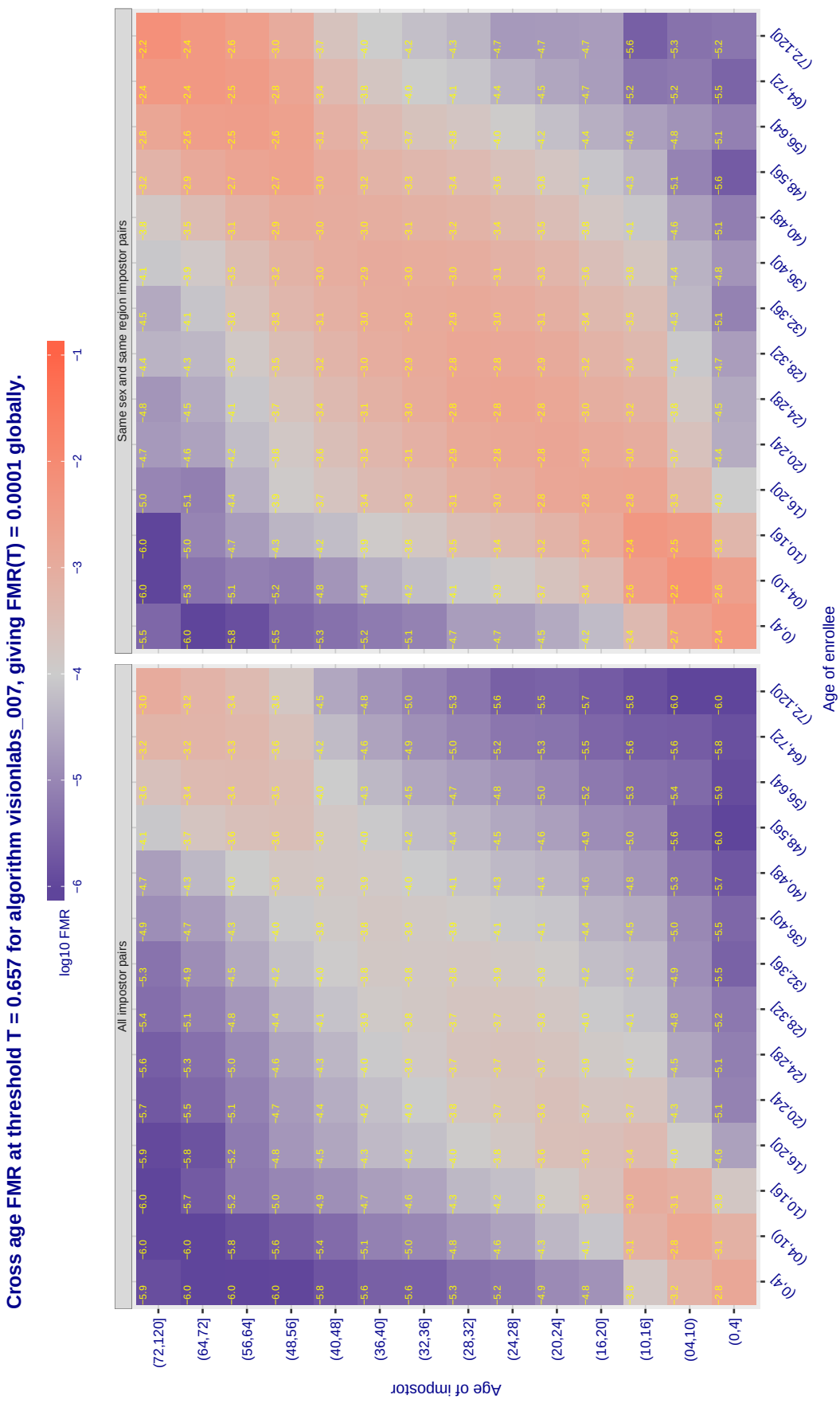


Figure 469: For algorithm visionlabs-007 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

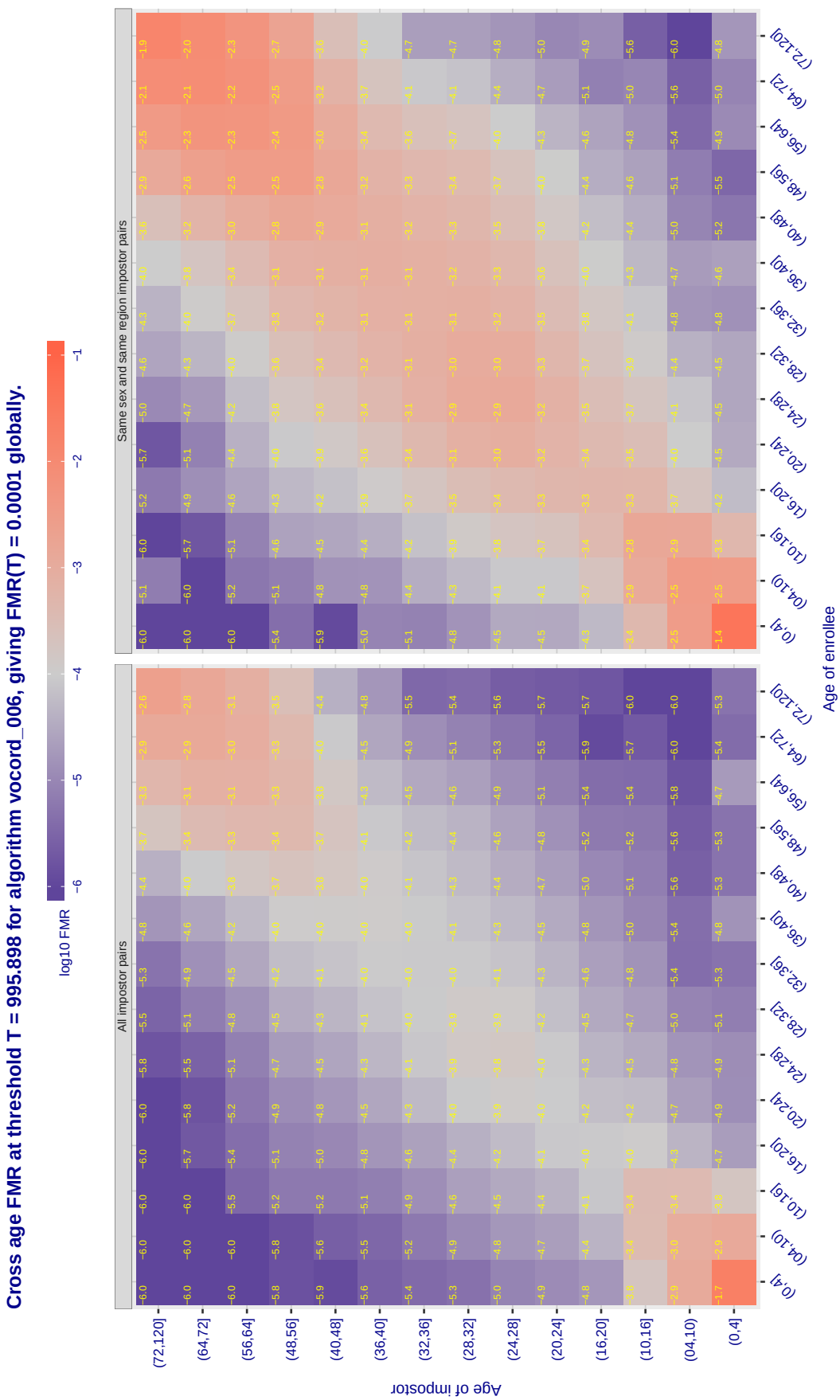


Figure 470: For algorithm vocord-006 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

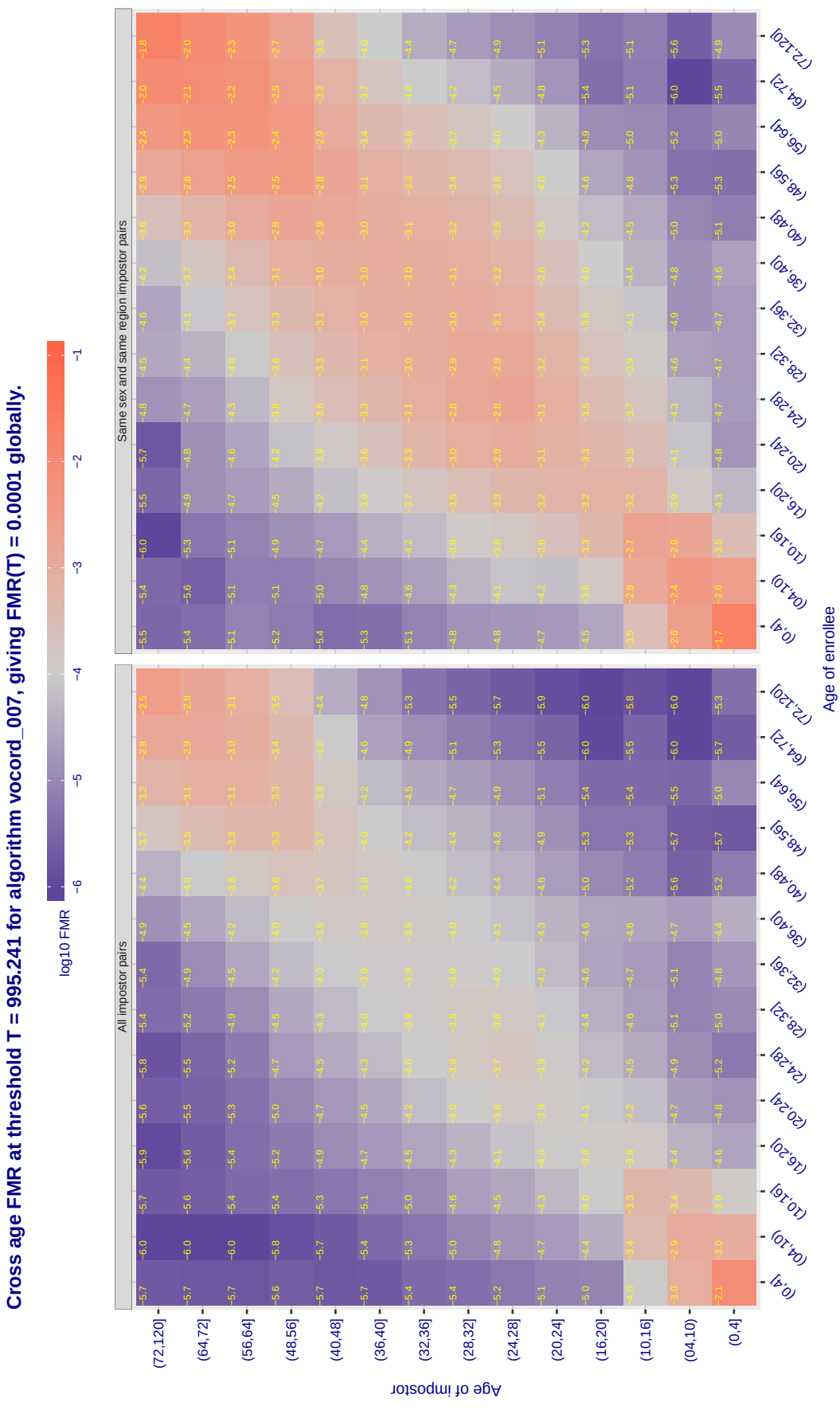


Figure 471: For algorithm vocord-007 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

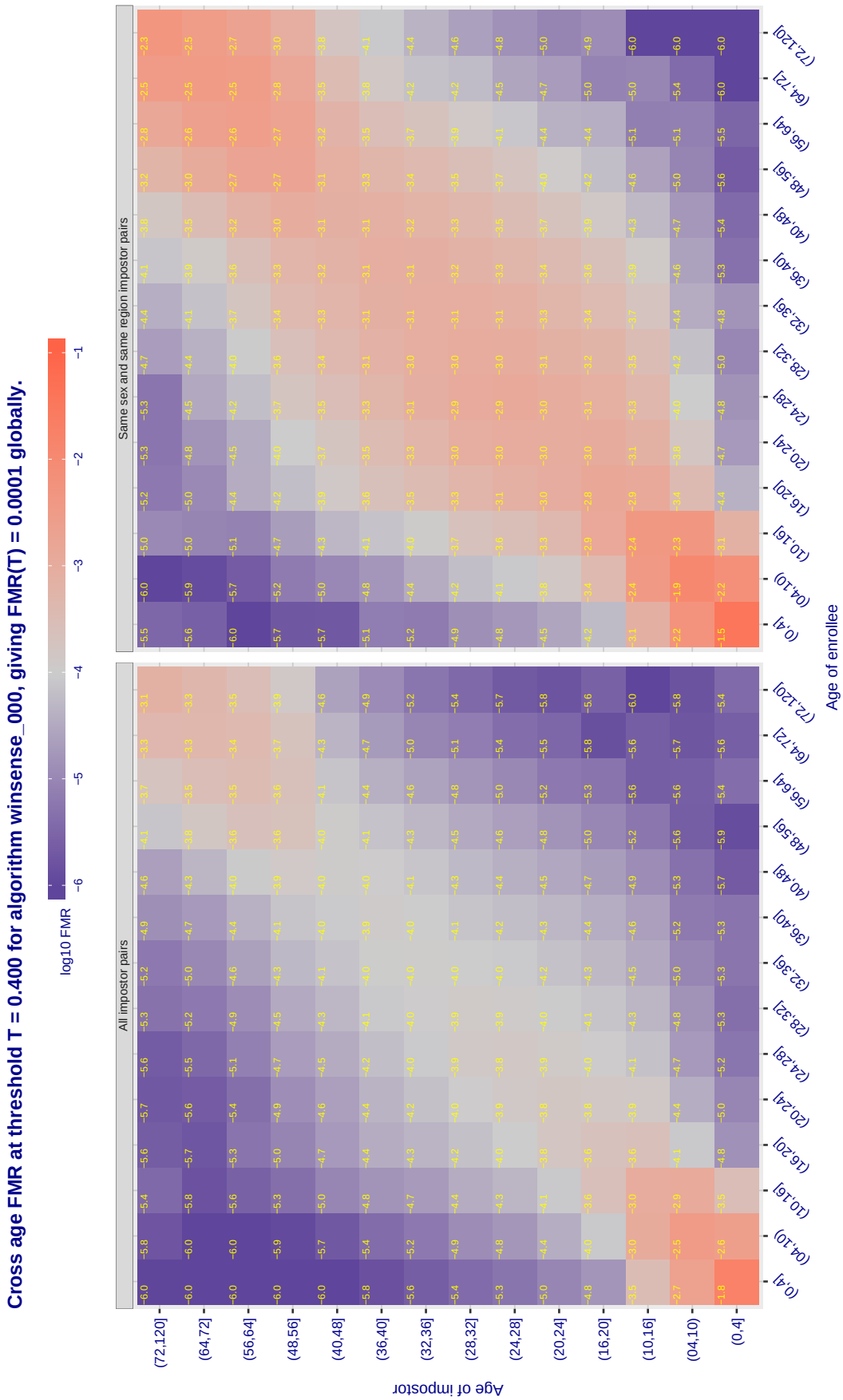


Figure 472: For algorithm winsense-000 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

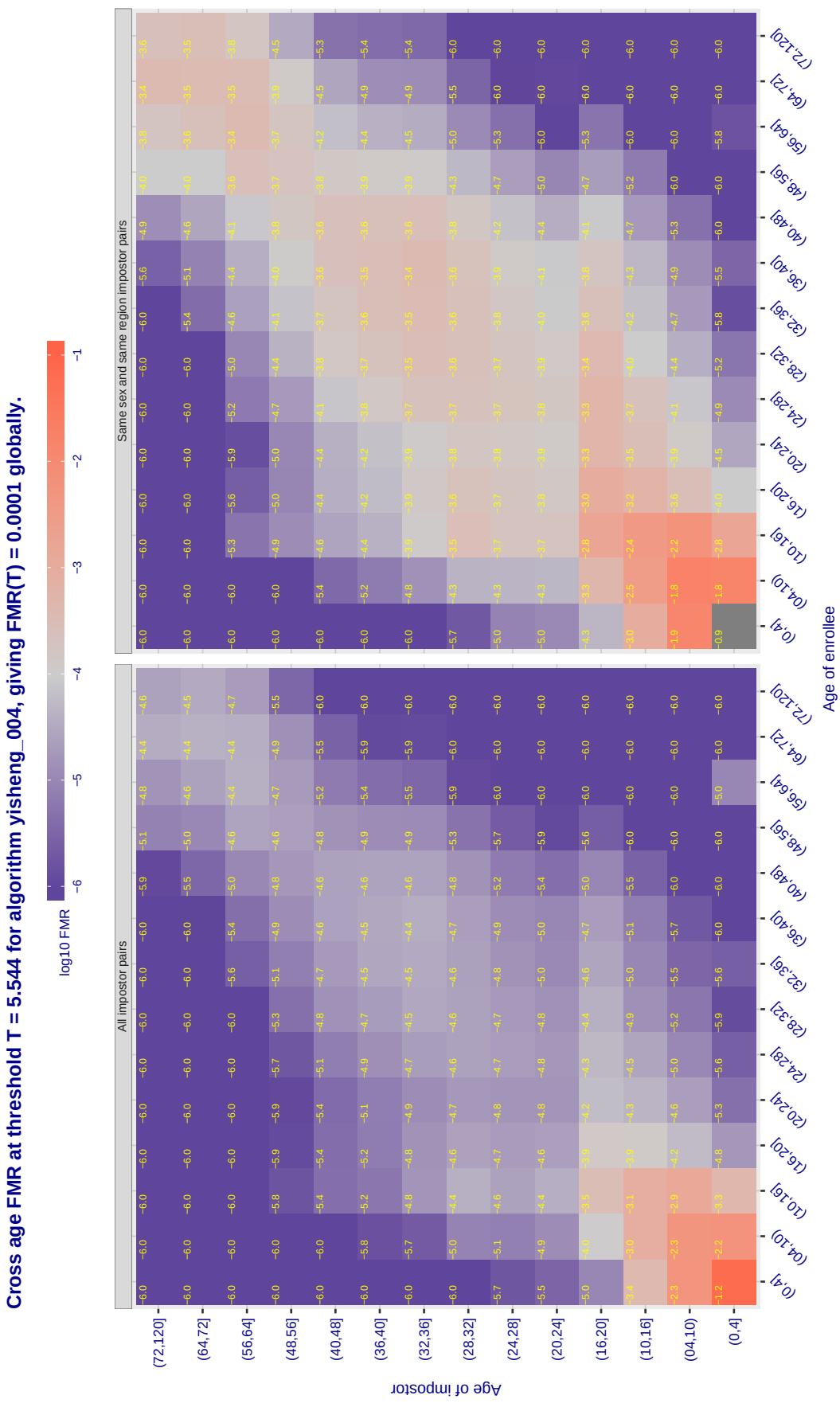


Figure 473: For algorithm yisheng-004 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

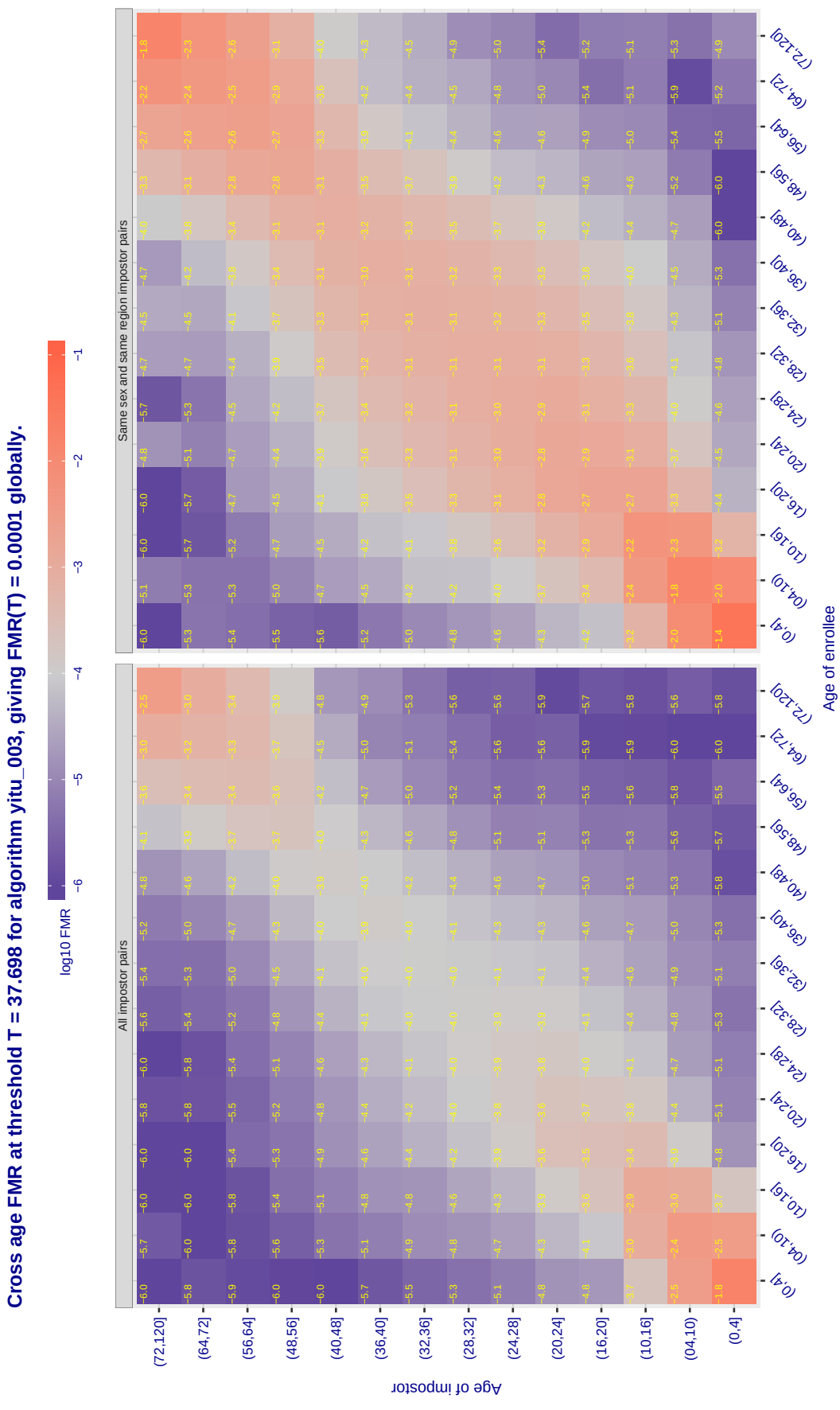


Figure 474: For algorithm yitu-003 operating on visa images, the heatmap shows false match observed over impostor comparisons of faces from different individuals who have the given age pair. False matches are counted against a recognition threshold fixed globally to give FMR = 0.001 over all on the order of 10^{10} impostor comparisons. The text in each box gives the same quantity as that coded by the color. Light colors present a security vulnerability to, for example, a passport gate.

FNMR(T) "False non-match rate"
FMR(T) "False match rate"

Accuracy Terms + Definitions

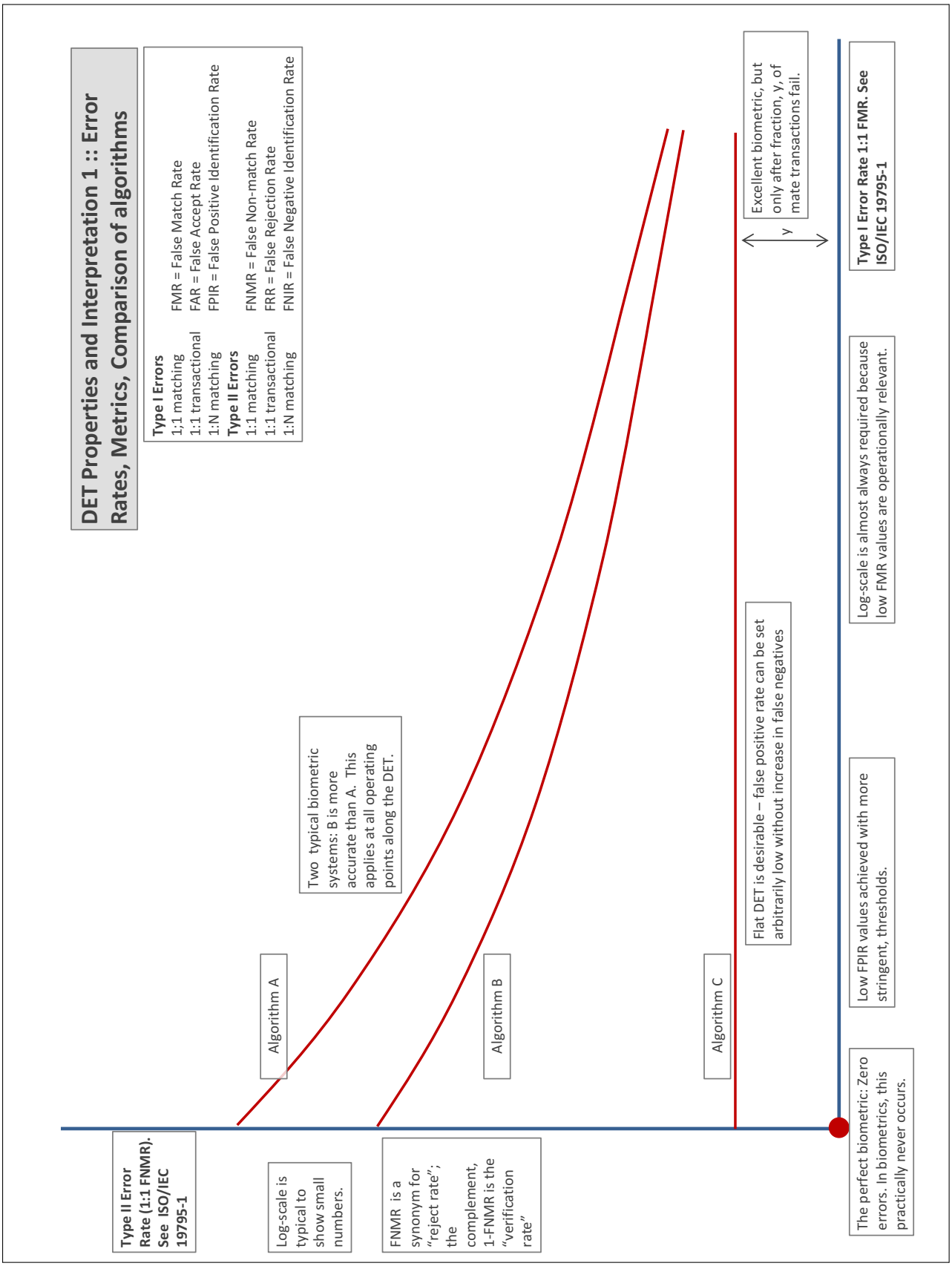
In biometrics, Type II errors occur when two samples of one person do not match – this is called a **false negative**. Correspondingly, Type I errors occur when samples from two persons do match – this is called a **false positive**. Matches are declared by a biometric system when the native comparison score from the recognition algorithm meets some **threshold**. Comparison scores can be either **similarity scores**, in which case higher values indicate that the samples are more likely to come from the same person, or **dissimilarity scores**, in which case higher values indicate different people. Similarity scores are traditionally computed by **fingerprint** and **face** recognition algorithms, while dissimilarities are used in **iris recognition**. In some cases, the dissimilarity score is a distance; this applies only when **metric** properties are obeyed. In any case, scores can be either **mate** scores, coming from a comparison of one person's samples, or **nonmate** scores, coming from comparison of different persons' samples. The words **genuine** or **authentic** are synonyms for mate, and the word **impostor** is used a synonym for nonmate. The words mate and nonmate are traditionally used in identification applications (such as law enforcement search, or background checks) while genuine and impostor are used in verification applications (such as access control).

A **error tradeoff** characteristic represents the tradeoff between Type II and Type I classification errors. For verification this plots false non-match rate (FNMR) vs. false match rate (FMR) parametrically with T.

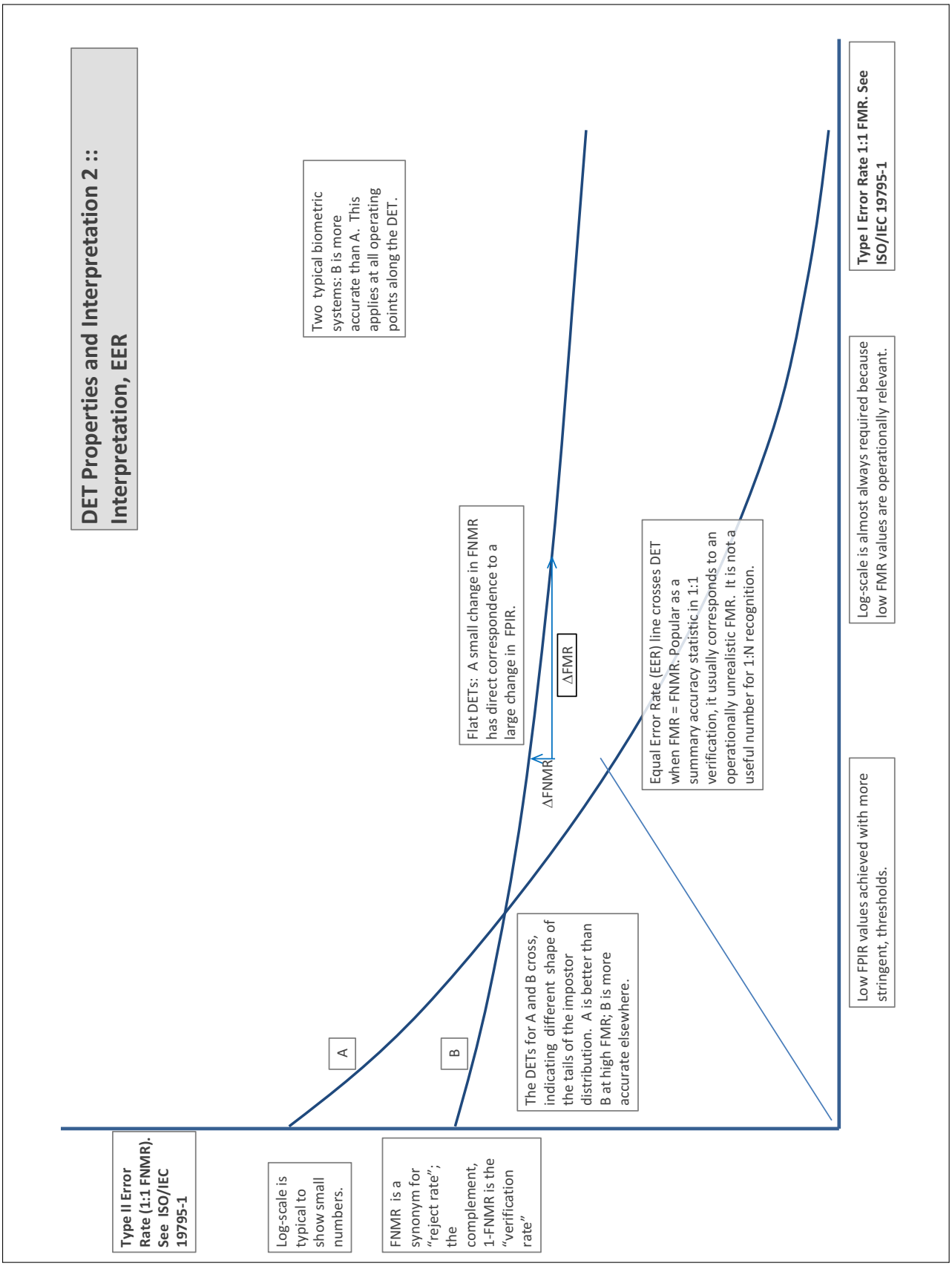
The error tradeoff plots are often called **detection error tradeoff (DET)** characteristics or **receiver operating characteristic** (ROC). These serve the same function but differ, for example, in plotting the complement of an error rate (e.g. TMR = 1 – FNMR) and in transforming the axes most commonly using logarithms, to show multiple decades of FMR. More rarely, the function might be the inverse Gaussian function.

More detail and generality is provided in formal biometrics testing standards, see the various parts of ISO/IEC 19795 Biometrics Testing and Reporting. More terms, including and beyond those to do with accuracy, see ISO/IEC 2382-37 Information technology -- Vocabulary -- Part 37: Harmonized biometric vocabulary

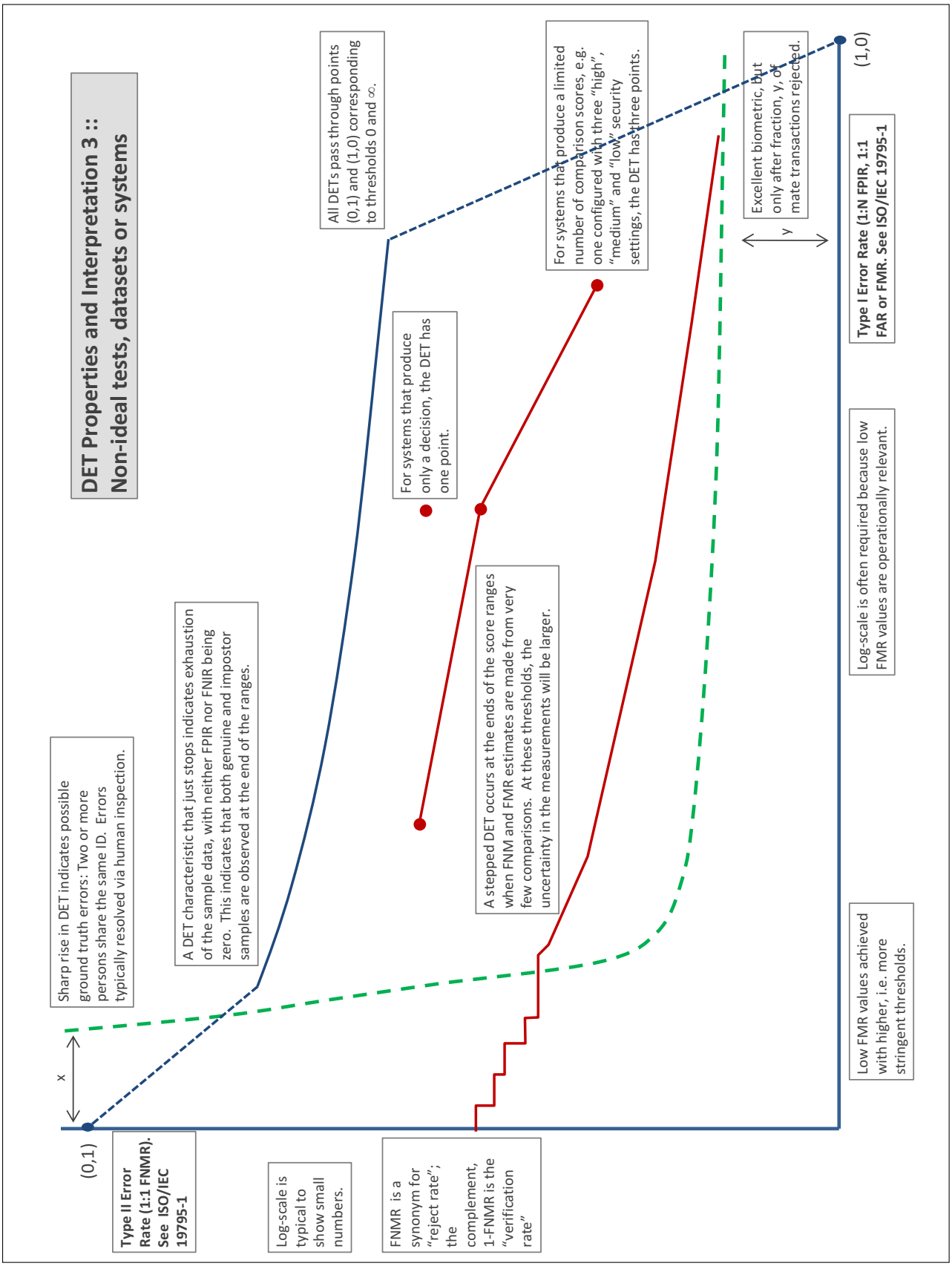
FNMR(T) "False non-match rate"
FMR(T) "False match rate"



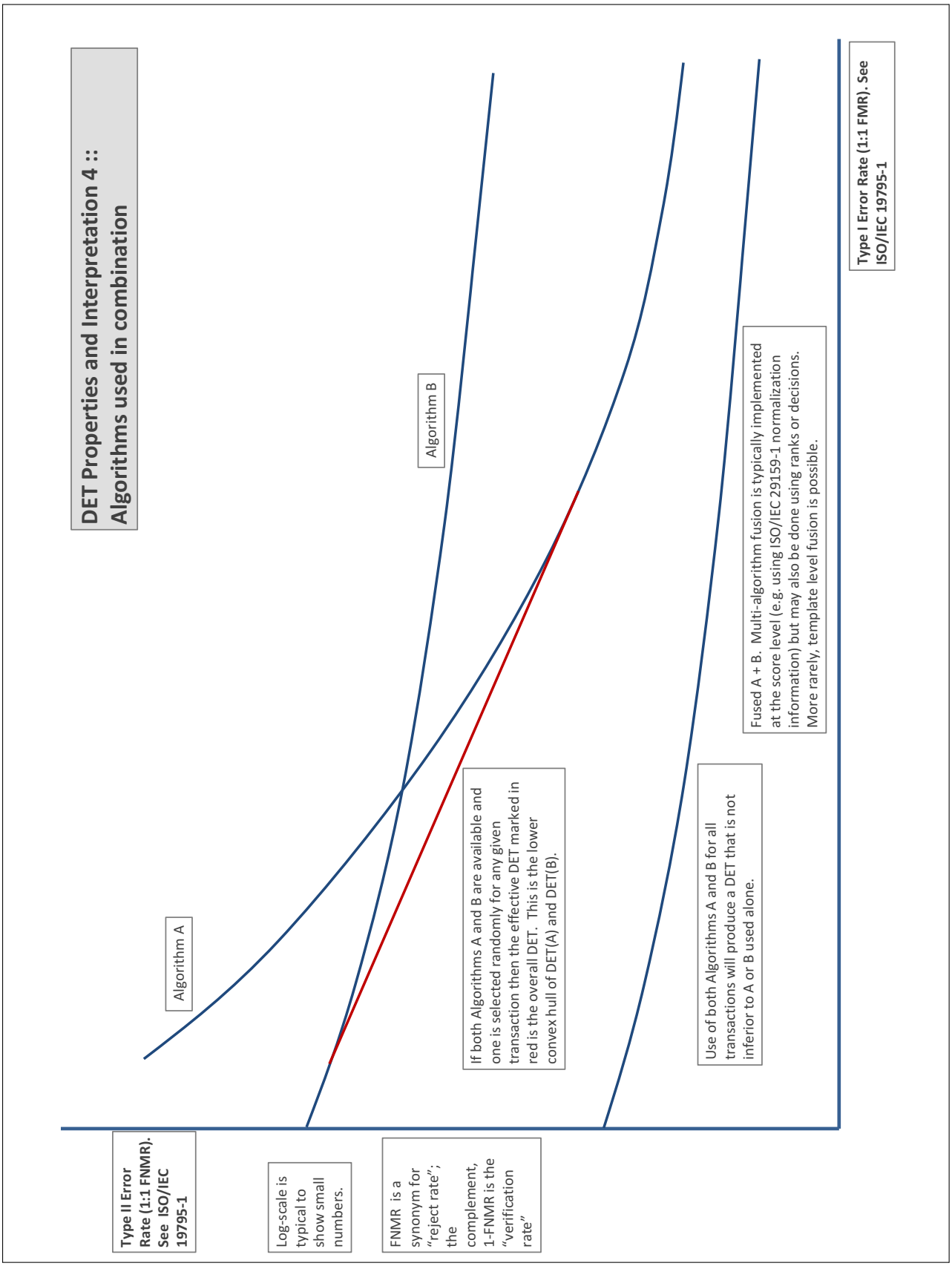
FNMR(T) "False non-match rate"
FMR(T) "False match rate"



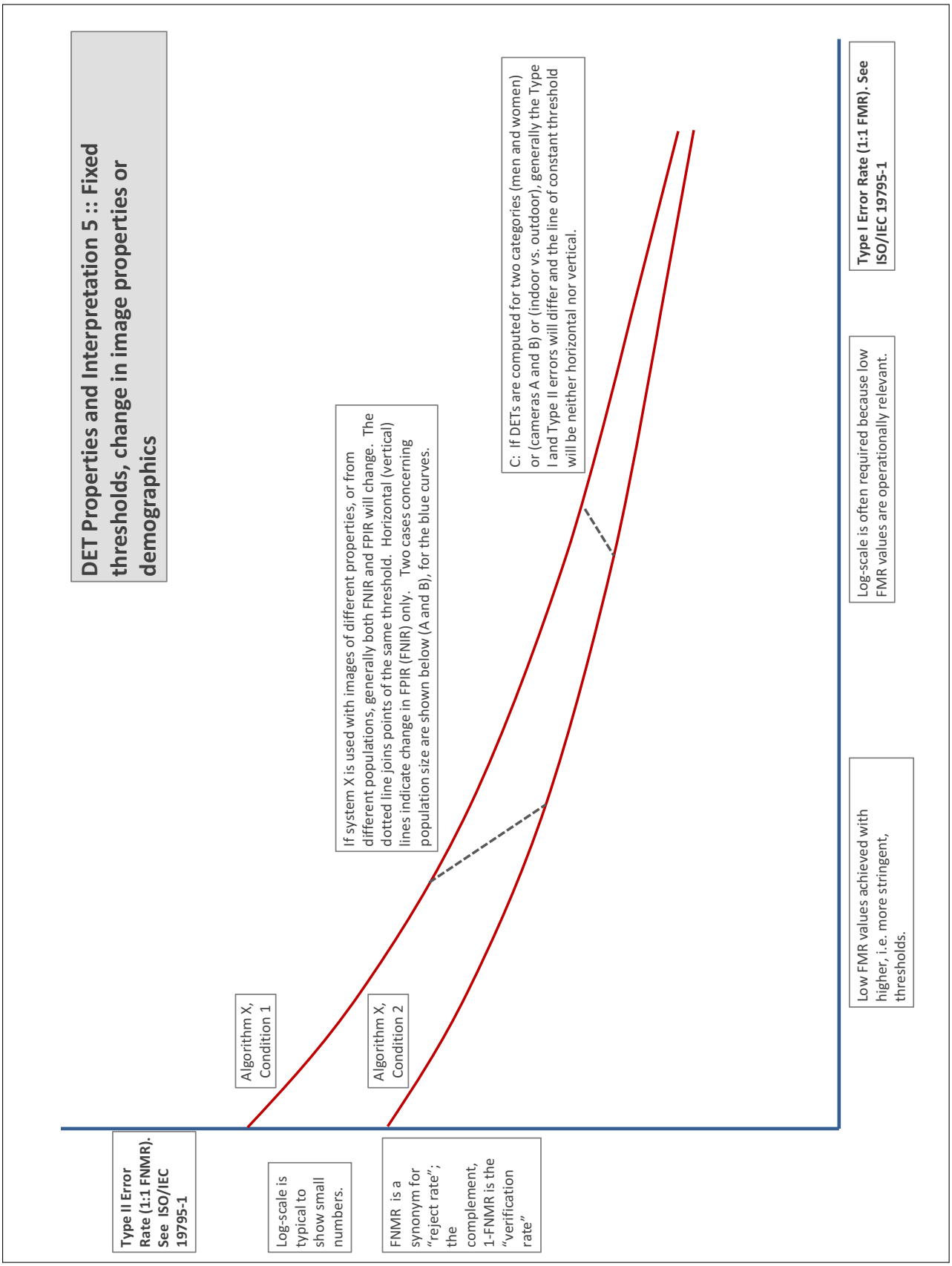
FNMR(T) "False non-match rate"
FMR(T) "False match rate"



FNMR(T) "False non-match rate"
FMR(T) "False match rate"



FNMR(T) "False non-match rate"
FMR(T) "False match rate"



FNMR(T) "False non-match rate"
FMR(T) "False match rate"

References

[1] P. Jonathon Phillips, Amy N. Yates, Ying Hu, Carina A. Hahn, Eilidh Noyes, Kelsey Jackson, Jacqueline G. Cavazos, Géraldine Jeckeln, Rajeev Ranjan, Swami Sankaranarayanan, Jun-Cheng Chen, Carlos D. Castillo, Rama Chellappa, David White, and Alice J. O'Toole. Face recognition accuracy of forensic examiners, superrecognizers, and face recognition algorithms. *Proceedings of the National Academy of Sciences*, 115(24):6171–6176, 2018.