

The VoicePrivacy 2020 Challenge

Odyssey 2020

Objective evaluation-ZEBRA

Presenter: Andreas Nautsch

Natalia Tomashenko¹

Brij M.L. Srivastava²

Xin Wang³

Emmanuel Vincent⁴

Andreas Nautsch⁵

Junichi Yamagishi^{3,6}

Nicholas Evans⁵

Jose Patino⁵

Jean-François Bonastre¹

Paul-Gauthier Noé¹

Massimiliano Todisco⁵

Mohamed Maouche²

Benjamin O'Brien⁷

Anais Chanclu¹

¹ LIA – University of Avignon – France

² Inria – France

³ NII – Tokyo – Japan

⁴ Inria – France

⁵ Audio Security and Privacy Group, EURECOM – France

⁶ University of Edinburgh – UK

⁷ Aix-Marseille University – France

4th November 2020



Inria



EURECOM
Sophia Antipolis



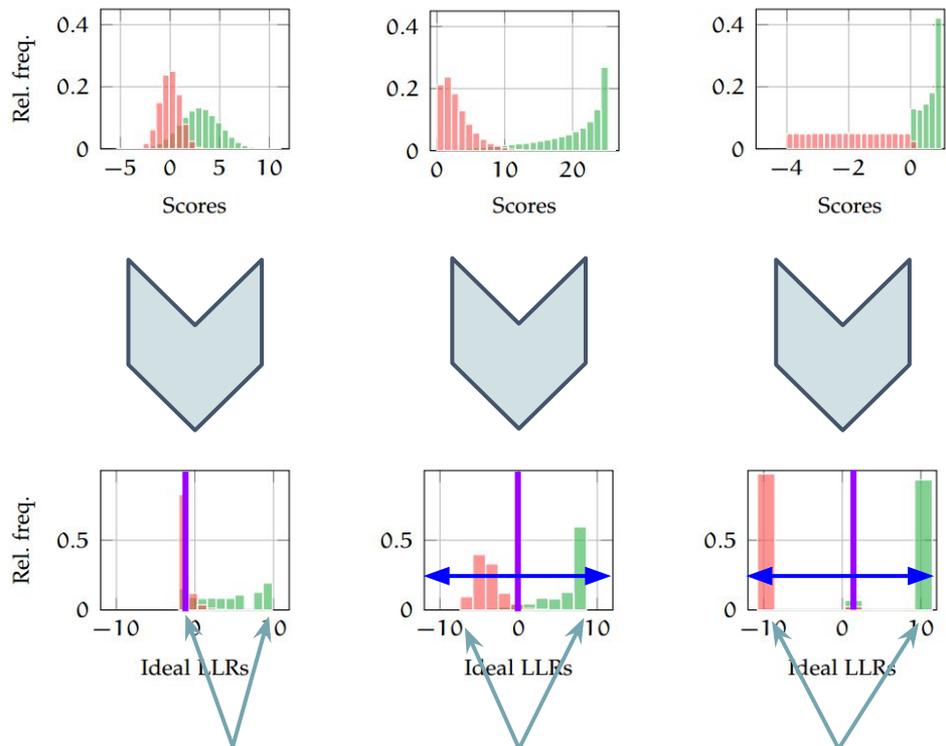
JST Japan Science and
Technology Agency



THE UNIVERSITY
of EDINBURGH

Aix-Marseille
université
Initiative d'excellence

Recap: EER, min Cllr & ZEBRA's "worst case"



ZEBRA worst-case:
 $\max(\text{abs}(\text{LLR}))$

Ideal score calibration:

1. identify bins with same ratios of errors
2. map scores to unified scale

EER: one threshold, varies on "unified scale"

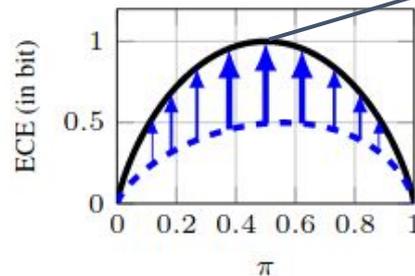
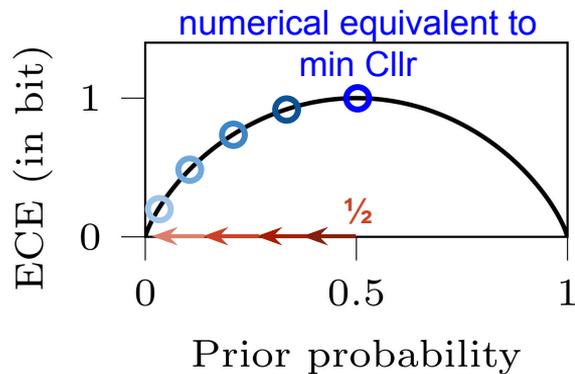
min Cllr: generalised class discrimination

Recap: min Cllr & ZEBRA's "expectation"

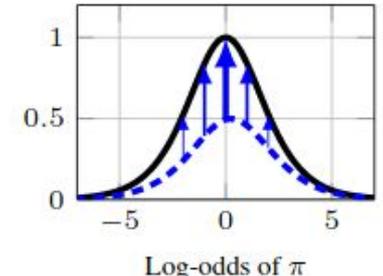
$$\frac{\pi}{|\mathcal{S}_A|} \sum_{a \in \mathcal{S}_A} \log_2 \left(1 + \frac{1-\pi}{a\pi} \right) + \frac{1-\pi}{|\mathcal{S}_B|} \sum_{b \in \mathcal{S}_B} \log_2 \left(1 + \frac{b\pi}{1-\pi} \right)$$

If perfect privacy, then must:

- a) min Cllr is upper bound
- b) profile is symmetric



(a) ZEBRA idea



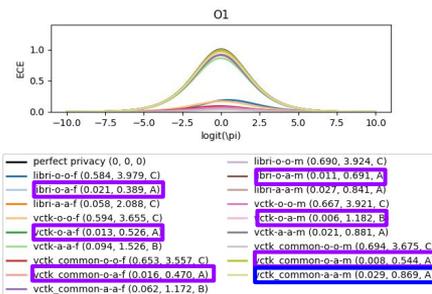
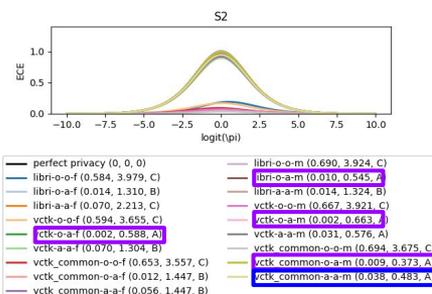
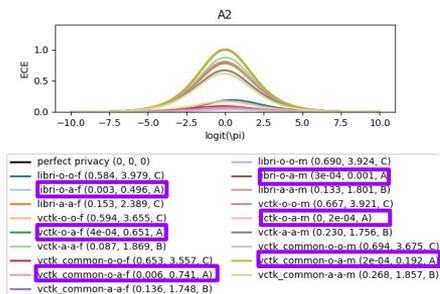
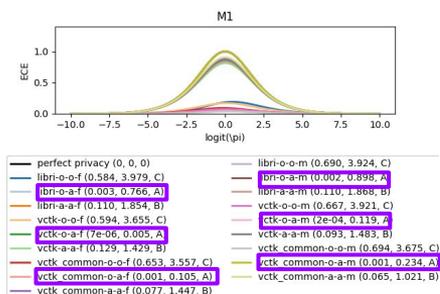
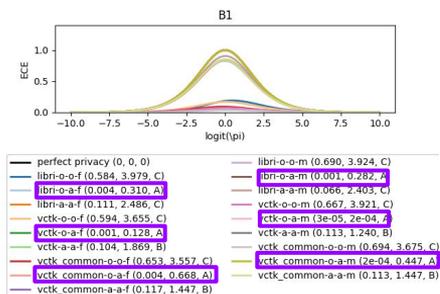
(b) ECE plot

Prior: chosen by adversary
 \Rightarrow *inaccessible to us,*
 but we can simulate :)

Empirical observations:

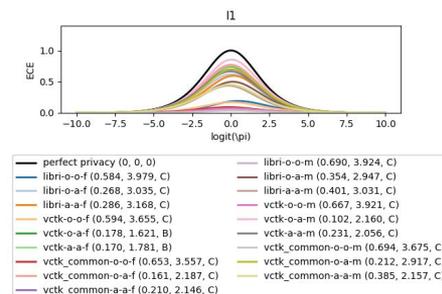
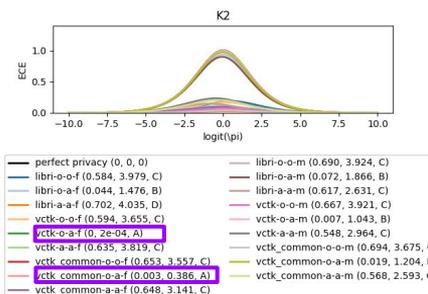
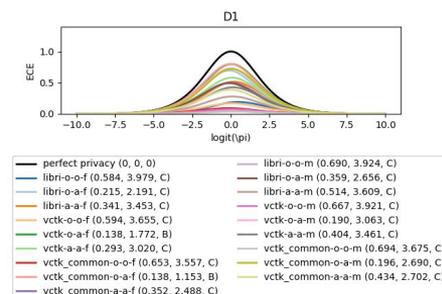
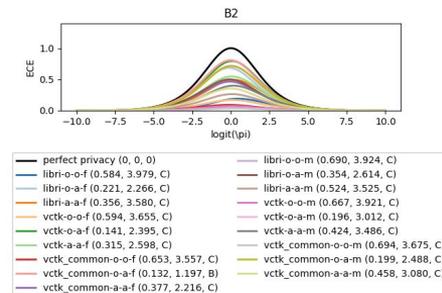
- i) min Cllr often close to upper bound
- ii) lots of symmetries

ZEBRA: by system for all VoicePrivacy test data sets (primary)

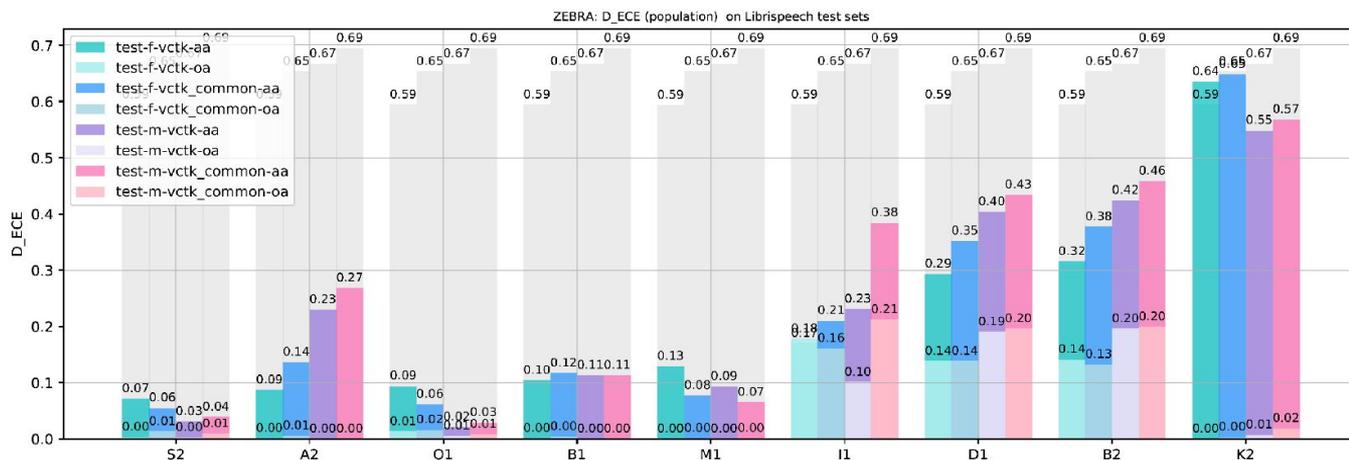


Categorical tags of worst-case privacy disclosure

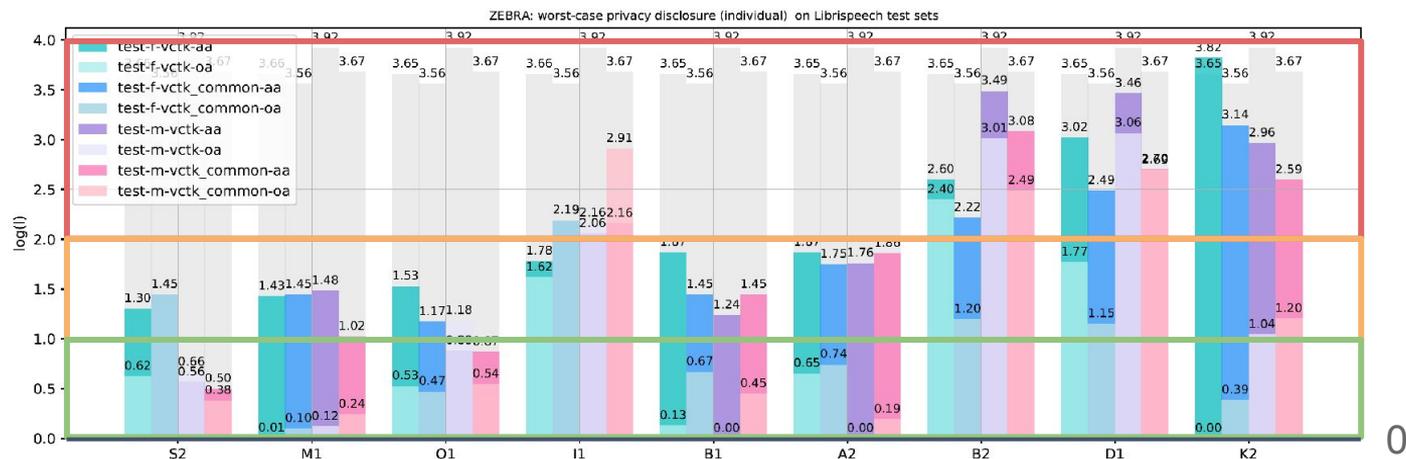
Tag	Category	Posterior odds ratio (flat prior)
0	$l = 1 = 10^0$	50 : 50 (flat posterior)
A	$10^0 < l < 10^1$	more disclosure than 50 : 50
B	$10^1 \leq l < 10^2$	one wrong in 10 to 100
C	$10^2 \leq l < 10^3$	one wrong in 100 to 1000
D	$10^3 \leq l < 10^4$	one wrong in 1000 to 10000
E	$10^4 \leq l < 10^5$	one wrong in 10000 to 100000
F	$10^5 \leq l < 10^6$	one wrong in 100000 to 1000000
	$10^6 \leq l$	one wrong in at least 1000000



ZEBRA: D_ECE (population) on VCTK-test



ZEBRA: worst-case privacy disclosure (individual) on VCTK-test



C

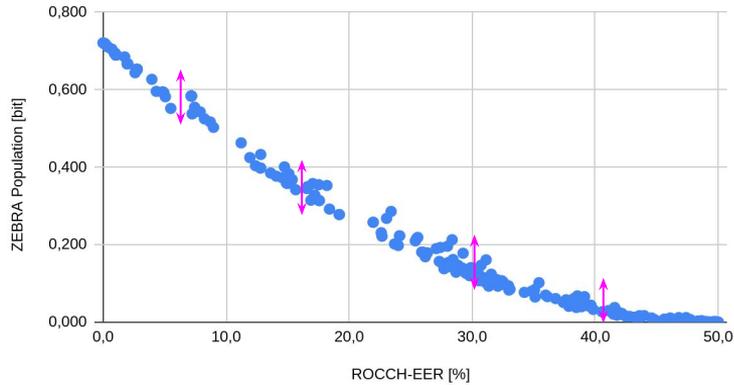
B

A

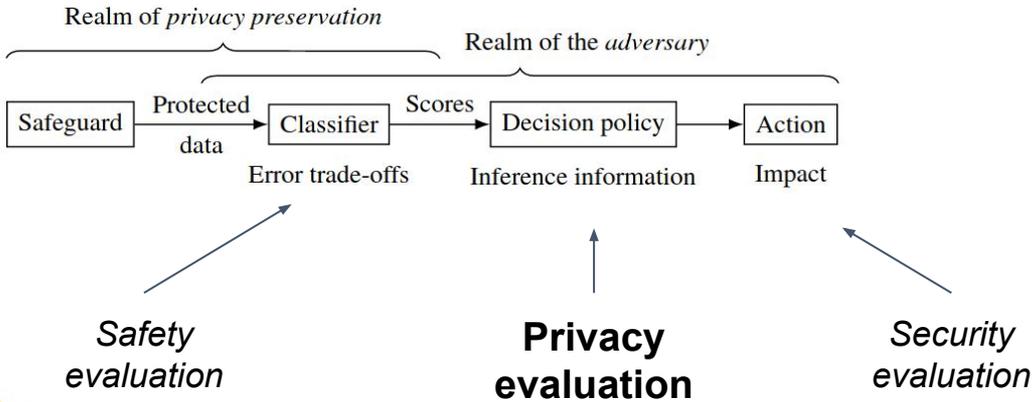
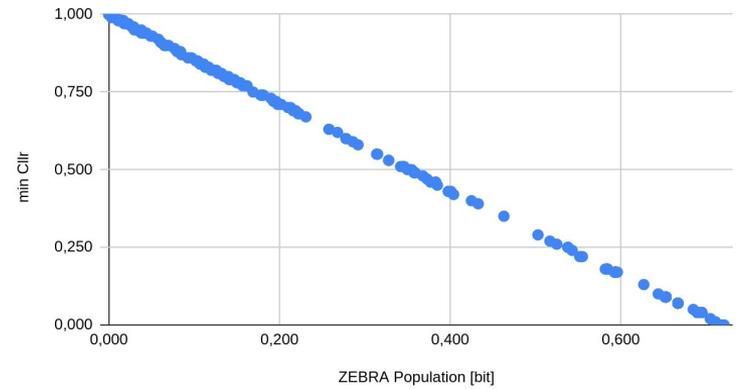
0

Metric correlation — NOT CAUSALITY

ZEBRA Population [bit] vs. ROCCH-EER [%]



ZEBRA Population [bit] vs. min Cllr

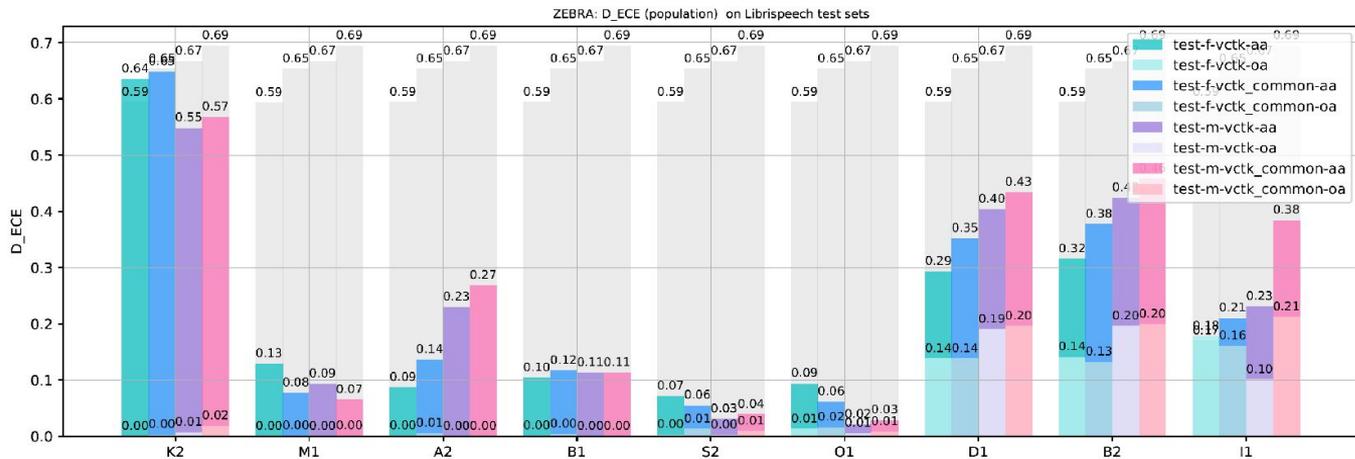


ZEBRA expected disclosure [bit] vs. worst-case disclosure

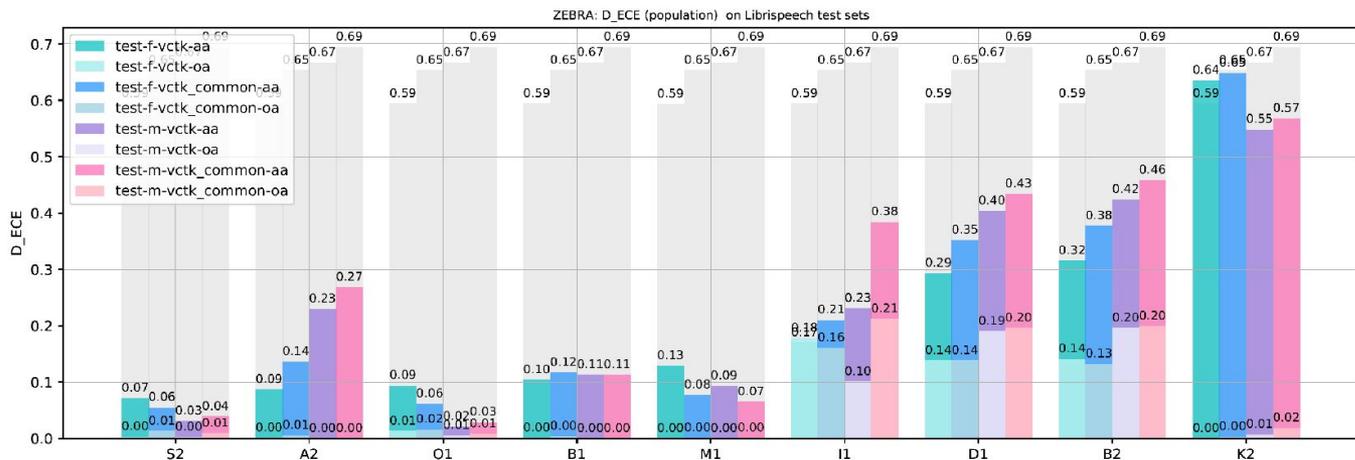




ZEBRA: D_ECE (population) on VCTK-test

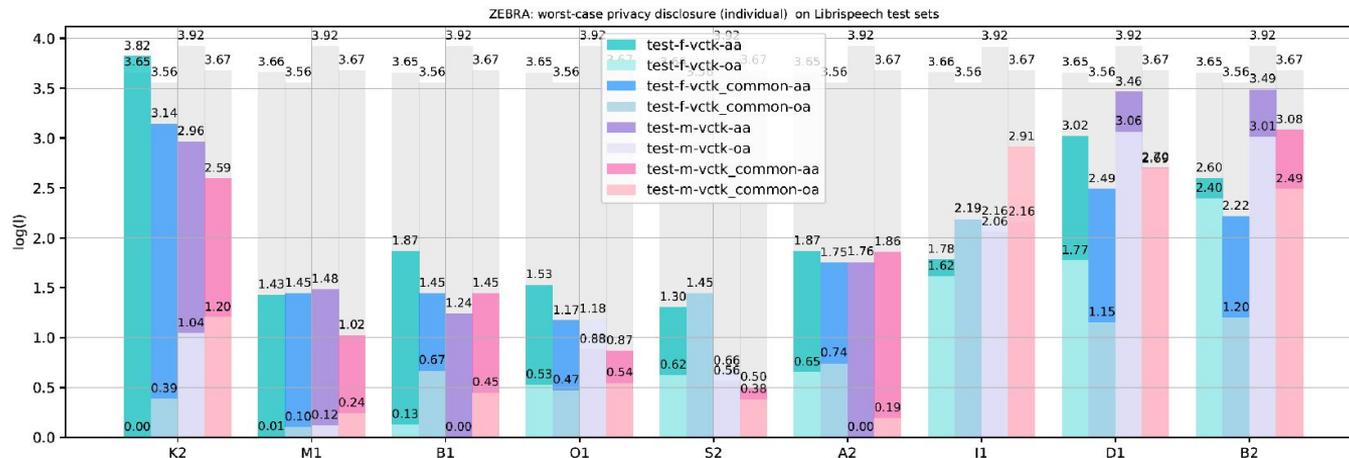


Sorted by oa f-test-vctk

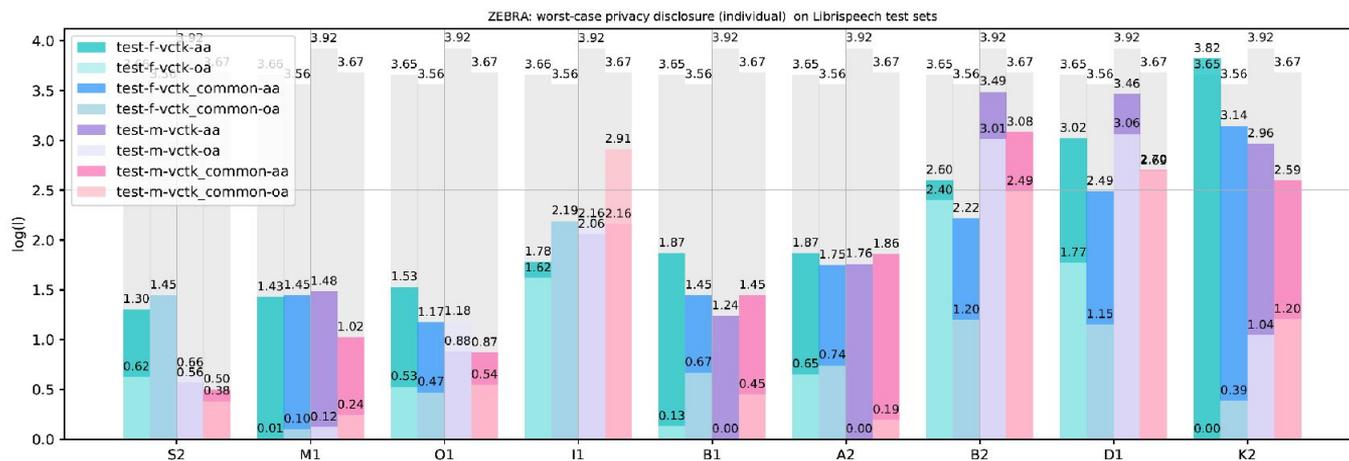


Sorted by aa f-test-vctk

ZEBRA: worst-case privacy disclosure (individual) on VCTK-test

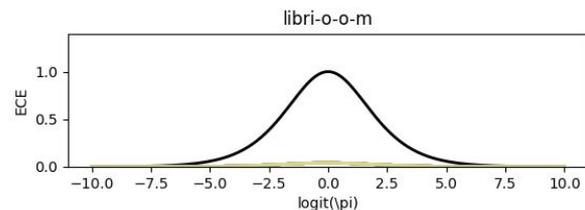


Sorted by oa f-test-vctk

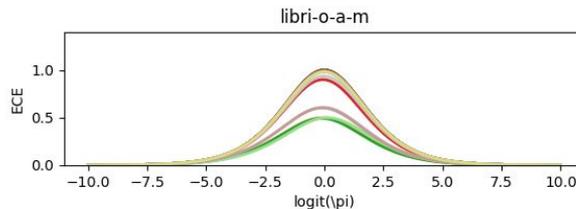


Sorted by aa f-test-vctk

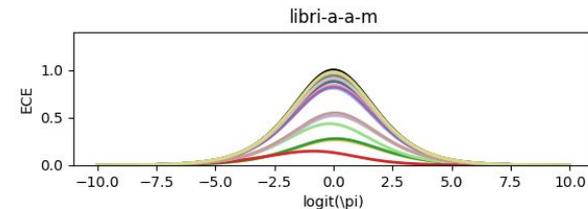
ZEBRA: LibriSpeech (all systems)



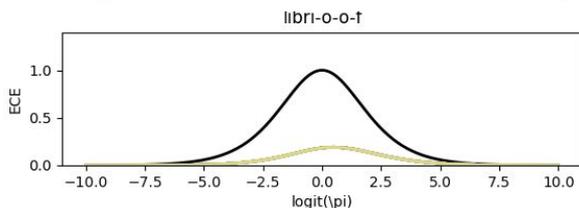
perfect privacy (0, 0, 0)	M1c2 (0.690, 3.924, C)
A1 (0.690, 3.924, C)	M1c3 (0.690, 3.924, C)
A2 (0.690, 3.924, C)	M1c4 (0.690, 3.924, C)
B1 (0.690, 3.924, C)	O1 (0.690, 3.924, C)
B2 (0.690, 3.924, C)	O1c1 (0.690, 3.924, C)
D1 (0.690, 3.924, C)	S1 (0.690, 3.924, C)
I1 (0.690, 3.924, C)	S1c1 (0.690, 3.924, C)
K2 (0.690, 3.924, C)	S2 (0.690, 3.924, C)
M1 (0.690, 3.924, C)	S2c1 (0.690, 3.924, C)
M1c1 (0.690, 3.924, C)	



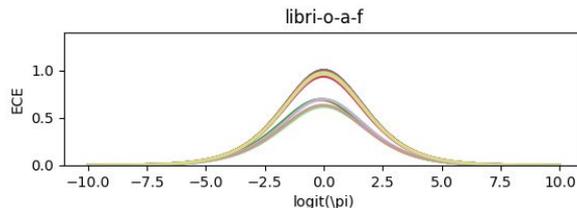
perfect privacy (0, 0, 0)	M1c2 (0.273, 1.969, B)
A1 (0.002, 0.202, A)	M1c3 (0.001, 0.263, A)
A2 (3e-04, 0.001, A)	M1c4 (0.277, 1.909, B)
B1 (0.001, 0.282, A)	O1 (0.011, 0.691, A)
B2 (0.354, 2.614, C)	O1c1 (0.012, 1.022, B)
D1 (0.359, 2.656, C)	S1 (0.012, 0.710, A)
I1 (0.354, 2.947, C)	S1c1 (0.045, 1.230, B)
K2 (0.072, 1.866, B)	S2 (0.010, 0.545, A)
M1 (0.002, 0.898, A)	S2c1 (0.013, 0.675, A)
M1c1 (0.001, 0.670, A)	



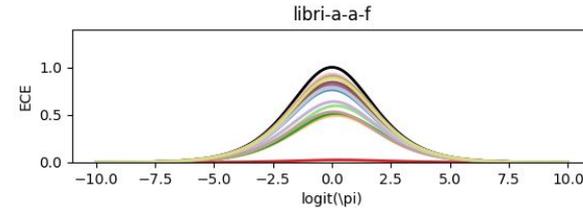
perfect privacy (0, 0, 0)	M1c2 (0.335, 2.936, C)
A1 (0.084, 2.169, C)	M1c3 (0.070, 2.102, C)
A2 (0.133, 1.801, B)	M1c4 (0.314, 2.829, C)
B1 (0.066, 2.403, C)	O1 (0.027, 0.841, A)
B2 (0.524, 3.525, C)	O1c1 (0.023, 0.546, A)
D1 (0.514, 3.609, C)	S1 (0.042, 1.659, B)
I1 (0.401, 3.031, C)	S1c1 (0.061, 1.721, B)
K2 (0.617, 2.631, C)	S2 (0.014, 1.324, B)
M1 (0.110, 1.868, B)	S2c1 (0.015, 1.022, B)
M1c1 (0.124, 2.022, C)	



perfect privacy (0, 0, 0)	M1c2 (0.584, 3.979, C)
A1 (0.584, 3.979, C)	M1c3 (0.584, 3.979, C)
A2 (0.584, 3.979, C)	M1c4 (0.584, 3.979, C)
B1 (0.584, 3.979, C)	O1 (0.584, 3.979, C)
B2 (0.584, 3.979, C)	O1c1 (0.584, 3.979, C)
D1 (0.584, 3.979, C)	S1 (0.584, 3.979, C)
I1 (0.584, 3.979, C)	S1c1 (0.584, 3.979, C)
K2 (0.584, 3.979, C)	S2 (0.584, 3.979, C)
M1 (0.584, 3.979, C)	S2c1 (0.584, 3.979, C)
M1c1 (0.584, 3.979, C)	



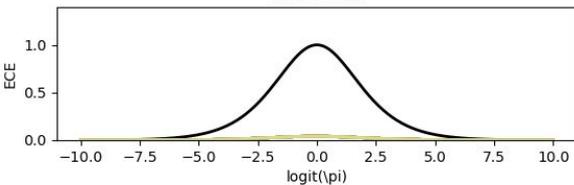
perfect privacy (0, 0, 0)	M1c2 (0.214, 2.265, C)
A1 (0.004, 0.486, A)	M1c3 (0.009, 0.959, A)
A2 (0.003, 0.496, A)	M1c4 (0.258, 2.265, C)
B1 (0.004, 0.310, A)	O1 (0.021, 0.389, A)
B2 (0.221, 2.266, C)	O1c1 (0.018, 0.399, A)
D1 (0.215, 2.191, C)	S1 (0.017, 0.823, A)
I1 (0.268, 3.035, C)	S1c1 (0.031, 0.804, A)
K2 (0.044, 1.476, B)	S2 (0.014, 1.310, B)
M1 (0.003, 0.766, A)	S2c1 (0.019, 0.708, A)
M1c1 (0.002, 0.682, A)	



perfect privacy (0, 0, 0)	M1c2 (0.251, 1.912, B)
A1 (0.162, 2.310, C)	M1c3 (0.107, 1.155, B)
A2 (0.153, 2.389, C)	M1c4 (0.328, 3.130, C)
B1 (0.111, 2.486, C)	O1 (0.058, 2.088, C)
B2 (0.356, 3.580, C)	O1c1 (0.049, 1.912, B)
D1 (0.341, 3.453, C)	S1 (0.068, 2.310, C)
I1 (0.286, 3.168, C)	S1c1 (0.147, 2.802, C)
K2 (0.702, 4.035, D)	S2 (0.070, 2.213, C)
M1 (0.110, 1.854, B)	S2c1 (0.078, 2.265, C)
M1c1 (0.128, 2.051, C)	

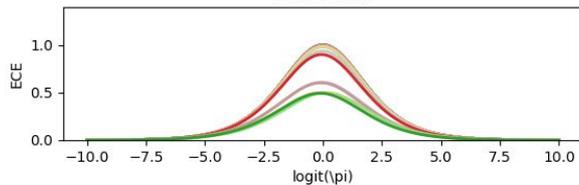
ZEBRA: LibriSpeech (all systems) ordered by performance

libri-o-o-m



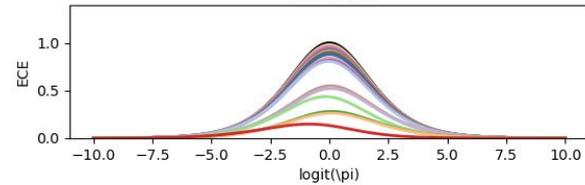
perfect privacy (0, 0, 0)	M1 (0.690, 3.924, C)
A1 (0.690, 3.924, C)	K2 (0.690, 3.924, C)
S1c1 (0.690, 3.924, C)	I1 (0.690, 3.924, C)
S1 (0.690, 3.924, C)	D1 (0.690, 3.924, C)
O1c1 (0.690, 3.924, C)	B2 (0.690, 3.924, C)
O1 (0.690, 3.924, C)	B1 (0.690, 3.924, C)
M1c4 (0.690, 3.924, C)	A2 (0.690, 3.924, C)
M1c3 (0.690, 3.924, C)	S2 (0.690, 3.924, C)
M1c2 (0.690, 3.924, C)	S2c1 (0.690, 3.924, C)
M1c1 (0.690, 3.924, C)	

libri-o-a-m



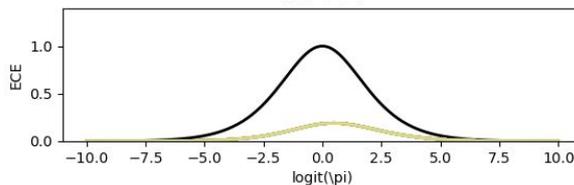
perfect privacy (0, 0, 0)	O1c1 (0.012, 1.022, B)
A2 (3e-04, 0.001, A)	S2c1 (0.013, 0.675, A)
M1c1 (0.001, 0.670, A)	S1c1 (0.045, 1.230, B)
M1c3 (0.001, 0.263, A)	K2 (0.072, 1.866, B)
B1 (0.001, 0.282, A)	M1c2 (0.273, 1.969, B)
A1 (0.002, 0.202, A)	M1c4 (0.277, 1.909, B)
M1 (0.002, 0.898, A)	I1 (0.354, 2.947, C)
S2 (0.010, 0.545, A)	B2 (0.354, 2.614, C)
O1 (0.011, 0.691, A)	D1 (0.359, 2.656, C)
S1 (0.012, 0.710, A)	

libri-a-a-m



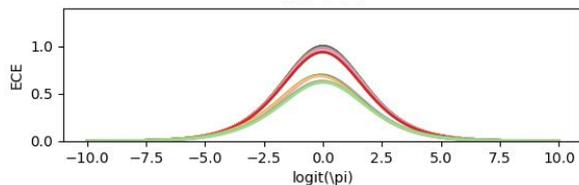
perfect privacy (0, 0, 0)	M1 (0.110, 1.868, B)
S2 (0.014, 1.324, B)	M1c1 (0.124, 2.022, C)
S2c1 (0.015, 1.022, B)	A2 (0.133, 1.801, B)
O1c1 (0.023, 0.546, A)	M1c4 (0.314, 2.829, C)
O1 (0.027, 0.841, A)	M1c2 (0.335, 2.936, C)
S1 (0.042, 1.659, B)	I1 (0.401, 3.031, C)
S1c1 (0.061, 1.721, B)	D1 (0.514, 3.609, C)
B1 (0.066, 2.403, C)	B2 (0.524, 3.525, C)
M1c3 (0.070, 2.102, C)	K2 (0.617, 2.631, C)
A1 (0.084, 2.169, C)	

libri-o-o-f



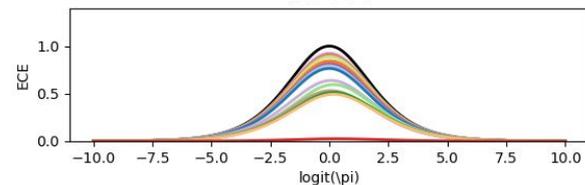
perfect privacy (0, 0, 0)	M1c1 (0.584, 3.979, C)
K2 (0.584, 3.979, C)	M1 (0.584, 3.979, C)
M1c2 (0.584, 3.979, C)	I1 (0.584, 3.979, C)
A1 (0.584, 3.979, C)	D1 (0.584, 3.979, C)
S1c1 (0.584, 3.979, C)	B2 (0.584, 3.979, C)
S1 (0.584, 3.979, C)	B1 (0.584, 3.979, C)
O1c1 (0.584, 3.979, C)	A2 (0.584, 3.979, C)
O1 (0.584, 3.979, C)	S2 (0.584, 3.979, C)
M1c4 (0.584, 3.979, C)	S2c1 (0.584, 3.979, C)
M1c3 (0.584, 3.979, C)	

libri-o-a-f



perfect privacy (0, 0, 0)	S2c1 (0.019, 0.708, A)
M1c1 (0.002, 0.682, A)	O1 (0.021, 0.389, A)
M1 (0.003, 0.766, A)	S1c1 (0.031, 0.804, A)
A2 (0.003, 0.496, A)	K2 (0.044, 1.476, B)
B1 (0.004, 0.310, A)	M1c2 (0.214, 2.265, C)
A1 (0.004, 0.486, A)	D1 (0.215, 2.191, C)
M1c3 (0.009, 0.959, A)	B2 (0.221, 2.266, C)
S2 (0.014, 1.310, B)	M1c4 (0.258, 2.265, C)
S1 (0.017, 0.823, A)	I1 (0.268, 3.035, C)
O1c1 (0.018, 0.399, A)	

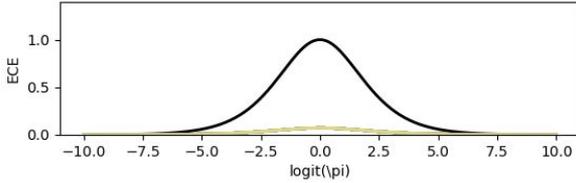
libri-a-a-f



perfect privacy (0, 0, 0)	S1c1 (0.147, 2.802, C)
O1c1 (0.049, 1.912, B)	A2 (0.153, 2.389, C)
O1 (0.058, 2.088, C)	A1 (0.162, 2.310, C)
S1 (0.068, 2.310, C)	M1c2 (0.251, 1.912, B)
S2 (0.070, 2.213, C)	I1 (0.286, 3.168, C)
S2c1 (0.078, 2.265, C)	M1c4 (0.328, 3.130, C)
M1c3 (0.107, 1.155, B)	D1 (0.341, 3.453, C)
M1 (0.110, 1.854, B)	B2 (0.356, 3.580, C)
B1 (0.111, 2.486, C)	K2 (0.702, 4.035, D)
M1c1 (0.128, 2.051, C)	

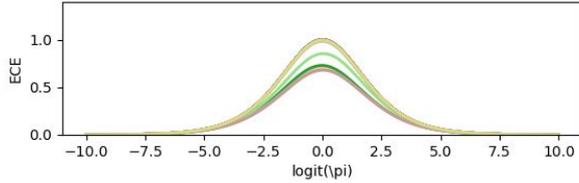
ZEBRA: VCTK-different (all systems)

vctk-o-o-m



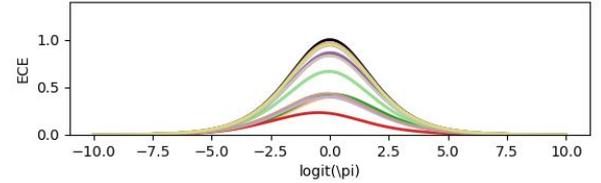
perfect privacy (0, 0, 0)	M1c2 (0.667, 3.921, C)
A1 (0.667, 3.921, C)	M1c3 (0.667, 3.921, C)
A2 (0.667, 3.921, C)	M1c4 (0.667, 3.921, C)
B1 (0.667, 3.921, C)	O1 (0.667, 3.921, C)
B2 (0.667, 3.921, C)	O1c1 (0.667, 3.921, C)
D1 (0.667, 3.921, C)	S1 (0.667, 3.921, C)
I1 (0.667, 3.921, C)	S1c1 (0.667, 3.921, C)
K2 (0.667, 3.921, C)	S2 (0.667, 3.921, C)
M1 (0.667, 3.921, C)	S2c1 (0.667, 3.921, C)
M1c1 (0.667, 3.921, C)	

vctk-o-a-m



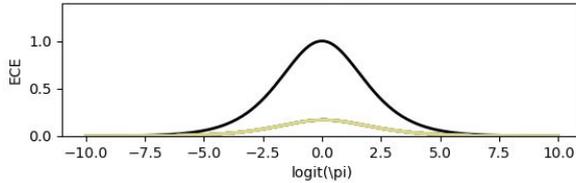
perfect privacy (0, 0, 0)	M1c2 (0.217, 2.373, C)
A1 (3e-05, 2e-04, A)	M1c3 (8e-05, 2e-04, A)
A2 (0, 2e-04, A)	M1c4 (0.223, 2.313, C)
B1 (3e-05, 2e-04, A)	O1 (0.006, 1.182, B)
B2 (0.196, 3.012, C)	O1c1 (0.006, 1.182, B)
D1 (0.190, 3.063, C)	S1 (0.003, 0.140, A)
I1 (0.102, 2.160, C)	S1c1 (0.012, 0.566, A)
K2 (0.007, 1.043, B)	S2 (0.002, 0.663, A)
M1 (2e-04, 0.119, A)	S2c1 (0.003, 0.663, A)
M1c1 (7e-05, 0.073, A)	

vctk-a-a-m



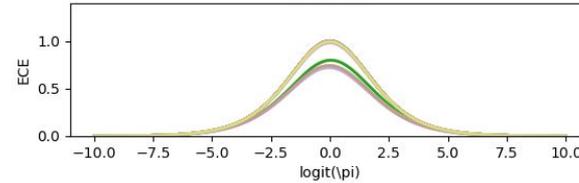
perfect privacy (0, 0, 0)	M1c2 (0.424, 2.627, C)
A1 (0.103, 1.124, B)	M1c3 (0.108, 1.337, B)
A2 (0.230, 1.756, B)	M1c4 (0.398, 2.373, C)
B1 (0.113, 1.240, B)	O1 (0.021, 0.881, A)
B2 (0.424, 3.486, C)	O1c1 (0.023, 0.685, A)
D1 (0.404, 3.461, C)	S1 (0.038, 1.359, B)
I1 (0.231, 2.056, C)	S1c1 (0.114, 1.480, B)
K2 (0.548, 2.964, C)	S2 (0.031, 0.576, A)
M1 (0.093, 1.483, B)	S2c1 (0.035, 1.182, B)
M1c1 (0.093, 1.359, B)	

vctk-o-o-f



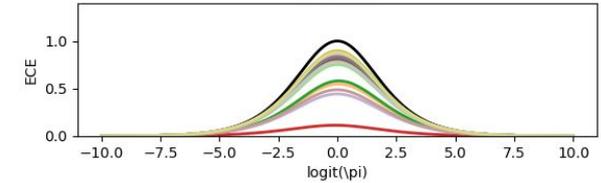
perfect privacy (0, 0, 0)	M1c2 (0.594, 3.655, C)
A1 (0.594, 3.655, C)	M1c3 (0.594, 3.655, C)
A2 (0.594, 3.655, C)	M1c4 (0.594, 3.655, C)
B1 (0.594, 3.655, C)	O1 (0.594, 3.655, C)
B2 (0.594, 3.655, C)	O1c1 (0.594, 3.655, C)
D1 (0.594, 3.655, C)	S1 (0.594, 3.655, C)
I1 (0.594, 3.655, C)	S1c1 (0.594, 3.655, C)
K2 (0.594, 3.655, C)	S2 (0.594, 3.655, C)
M1 (0.594, 3.655, C)	S2c1 (0.594, 3.655, C)
M1c1 (0.594, 3.655, C)	

vctk-o-a-f



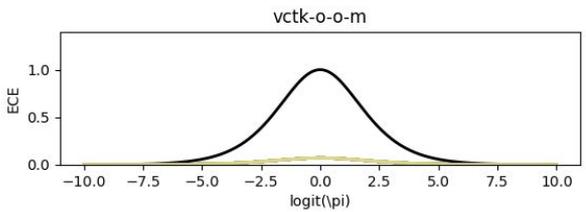
perfect privacy (0, 0, 0)	M1c2 (0.196, 2.304, C)
A1 (3e-04, 0.371, A)	M1c3 (0.005, 0.128, A)
A2 (4e-04, 0.651, A)	M1c4 (0.179, 2.258, C)
B1 (0.001, 0.128, A)	O1 (0.013, 0.526, A)
B2 (0.141, 2.395, C)	O1c1 (0.015, 0.371, A)
D1 (0.138, 1.772, B)	S1 (0.005, 0.485, A)
I1 (0.178, 1.621, B)	S1c1 (0.011, 0.859, A)
K2 (0, 2e-04, A)	S2 (0.002, 0.588, A)
M1 (7e-06, 0.005, A)	S2c1 (0.002, 0.827, A)
M1c1 (4e-04, 0.287, A)	

vctk-a-a-f

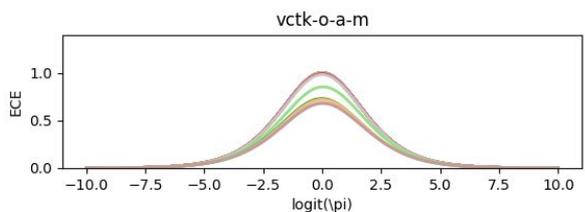


perfect privacy (0, 0, 0)	M1c2 (0.390, 2.318, C)
A1 (0.107, 1.429, B)	M1c3 (0.134, 1.672, B)
A2 (0.087, 1.869, B)	M1c4 (0.359, 2.196, C)
B1 (0.104, 1.869, B)	O1 (0.094, 1.526, B)
B2 (0.315, 2.598, C)	O1c1 (0.096, 1.781, B)
D1 (0.293, 3.020, C)	S1 (0.111, 1.429, B)
I1 (0.170, 1.781, B)	S1c1 (0.150, 1.702, B)
K2 (0.635, 3.819, C)	S2 (0.070, 1.304, B)
M1 (0.129, 1.429, B)	S2c1 (0.080, 1.128, B)
M1c1 (0.120, 1.827, B)	

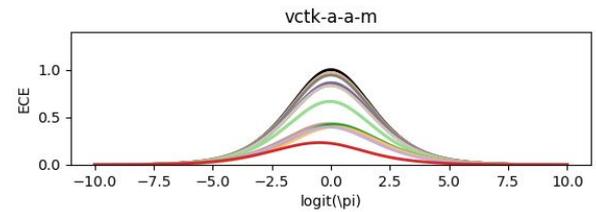
ZEBRA: VCTK-different (all systems) ordered by performance



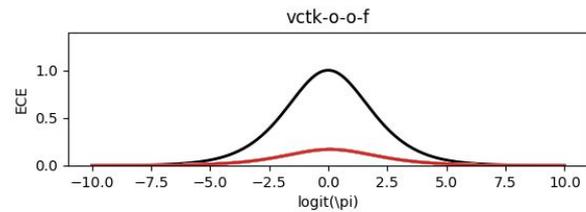
perfect privacy (0, 0, 0)	M1c1 (0.667, 3.921, C)
K2 (0.667, 3.921, C)	M1 (0.667, 3.921, C)
M1c2 (0.667, 3.921, C)	I1 (0.667, 3.921, C)
A1 (0.667, 3.921, C)	D1 (0.667, 3.921, C)
S1c1 (0.667, 3.921, C)	B2 (0.667, 3.921, C)
S1 (0.667, 3.921, C)	B1 (0.667, 3.921, C)
O1c1 (0.667, 3.921, C)	A2 (0.667, 3.921, C)
O1 (0.667, 3.921, C)	S2 (0.667, 3.921, C)
M1c4 (0.667, 3.921, C)	S2c1 (0.667, 3.921, C)
M1c3 (0.667, 3.921, C)	



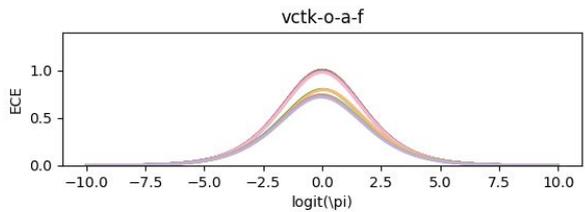
perfect privacy (0, 0, 0)	O1 (0.006, 1.182, B)
A2 (0, 2e-04, A)	O1c1 (0.006, 1.182, B)
B1 (3e-05, 2e-04, A)	K2 (0.007, 1.043, B)
A1 (3e-05, 2e-04, A)	S1c1 (0.012, 0.566, A)
M1c1 (7e-05, 0.073, A)	I1 (0.102, 2.160, C)
M1c3 (8e-05, 2e-04, A)	D1 (0.190, 3.063, C)
M1 (2e-04, 0.119, A)	B2 (0.196, 3.012, C)
S2 (0.002, 0.663, A)	M1c2 (0.217, 2.373, C)
S1 (0.003, 0.140, A)	M1c4 (0.223, 2.313, C)
S2c1 (0.003, 0.663, A)	



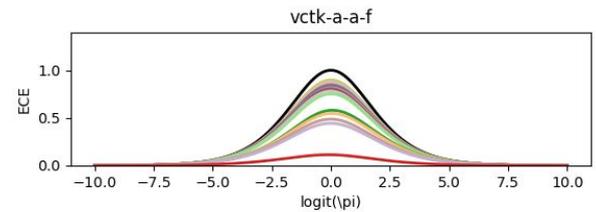
perfect privacy (0, 0, 0)	B1 (0.113, 1.240, B)
O1 (0.021, 0.881, A)	S1c1 (0.114, 1.480, B)
O1c1 (0.023, 0.685, A)	A2 (0.230, 1.756, B)
S2 (0.031, 0.576, A)	I1 (0.231, 2.056, C)
S2c1 (0.035, 1.182, B)	M1c4 (0.398, 2.373, C)
S1 (0.038, 1.359, B)	D1 (0.404, 3.461, C)
M1 (0.093, 1.483, B)	B2 (0.424, 3.486, C)
M1c1 (0.093, 1.359, B)	M1c2 (0.424, 2.627, C)
A1 (0.103, 1.124, B)	K2 (0.548, 2.964, C)
M1c3 (0.108, 1.337, B)	



perfect privacy (0, 0, 0)	I1 (0.594, 3.655, C)
A1 (0.594, 3.655, C)	D1 (0.594, 3.655, C)
S1c1 (0.594, 3.655, C)	B2 (0.594, 3.655, C)
S1 (0.594, 3.655, C)	B1 (0.594, 3.655, C)
O1c1 (0.594, 3.655, C)	A2 (0.594, 3.655, C)
O1 (0.594, 3.655, C)	M1 (0.594, 3.655, C)
M1c4 (0.594, 3.655, C)	S2c1 (0.594, 3.655, C)
M1c3 (0.594, 3.655, C)	M1c2 (0.594, 3.655, C)
S2 (0.594, 3.655, C)	K2 (0.594, 3.655, C)
M1c1 (0.594, 3.655, C)	



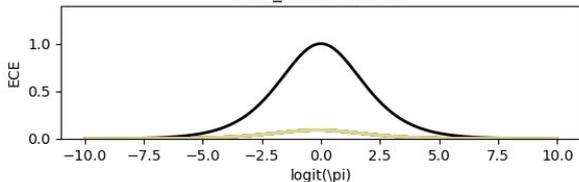
perfect privacy (0, 0, 0)	S1 (0.005, 0.485, A)
K2 (0, 2e-04, A)	S1c1 (0.011, 0.859, A)
M1 (7e-06, 0.005, A)	O1 (0.013, 0.526, A)
A1 (3e-04, 0.371, A)	O1c1 (0.015, 0.371, A)
M1c1 (4e-04, 0.287, A)	D1 (0.138, 1.772, B)
A2 (4e-04, 0.651, A)	B2 (0.141, 2.395, C)
B1 (0.001, 0.128, A)	I1 (0.178, 1.621, B)
S2c1 (0.002, 0.827, A)	M1c4 (0.179, 2.258, C)
S2 (0.002, 0.588, A)	M1c2 (0.196, 2.304, C)
M1c3 (0.005, 0.128, A)	



perfect privacy (0, 0, 0)	M1 (0.129, 1.429, B)
S2 (0.070, 1.304, B)	M1c3 (0.134, 1.672, B)
S2c1 (0.080, 1.128, B)	S1c1 (0.150, 1.702, B)
A2 (0.087, 1.869, B)	I1 (0.170, 1.781, B)
O1 (0.094, 1.526, B)	D1 (0.293, 3.020, C)
O1c1 (0.096, 1.781, B)	B2 (0.315, 2.598, C)
B1 (0.104, 1.869, B)	M1c4 (0.359, 2.196, C)
A1 (0.107, 1.429, B)	M1c2 (0.390, 2.318, C)
S1 (0.111, 1.429, B)	K2 (0.635, 3.819, C)
M1c1 (0.120, 1.827, B)	

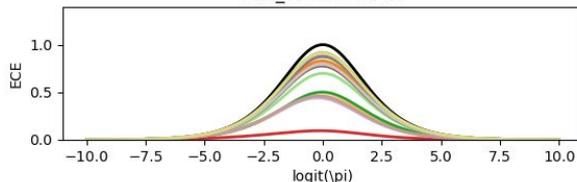
ZEBRA: VCTK-common (all systems)

vctk_common-o-o-f



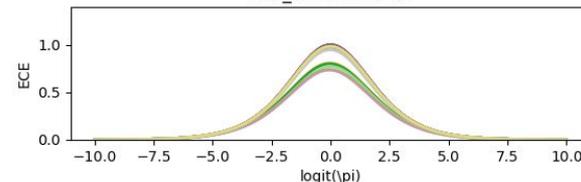
perfect privacy (0, 0, 0)	M1c2 (0.653, 3.557, C)
A1 (0.653, 3.557, C)	M1c3 (0.653, 3.557, C)
A2 (0.653, 3.557, C)	M1c4 (0.653, 3.557, C)
B1 (0.653, 3.557, C)	O1 (0.653, 3.557, C)
B2 (0.653, 3.557, C)	O1c1 (0.653, 3.557, C)
D1 (0.653, 3.557, C)	S1 (0.653, 3.557, C)
I1 (0.653, 3.557, C)	S1c1 (0.653, 3.557, C)
K2 (0.653, 3.557, C)	S2 (0.653, 3.557, C)
M1 (0.653, 3.557, C)	S2c1 (0.653, 3.557, C)
M1c1 (0.653, 3.557, C)	

vctk_common-a-a-f



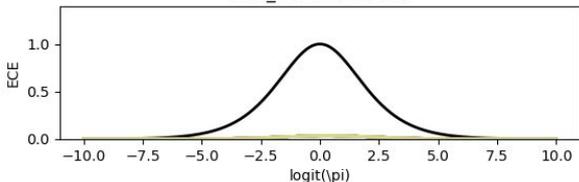
perfect privacy (0, 0, 0)	M1c2 (0.397, 2.266, C)
A1 (0.149, 1.447, B)	M1c3 (0.154, 1.748, B)
A2 (0.136, 1.748, B)	M1c4 (0.383, 2.269, C)
B1 (0.117, 1.447, B)	O1 (0.062, 1.172, B)
B2 (0.377, 2.216, C)	O1c1 (0.067, 1.208, B)
D1 (0.352, 2.488, C)	S1 (0.085, 0.845, A)
I1 (0.210, 2.146, C)	S1c1 (0.142, 1.227, B)
K2 (0.648, 3.141, C)	S2 (0.056, 1.447, B)
M1 (0.077, 1.447, B)	S2c1 (0.059, 1.447, B)
M1c1 (0.083, 1.172, B)	

vctk_common-o-a-f



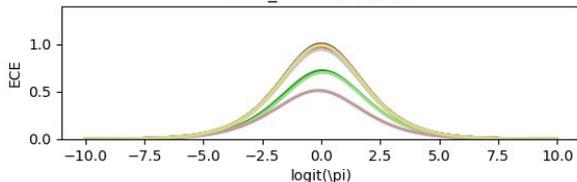
perfect privacy (0, 0, 0)	M1c2 (0.186, 2.187, C)
A1 (0.007, 0.423, A)	M1c3 (0.007, 0.367, A)
A2 (0.006, 0.741, A)	M1c4 (0.181, 2.100, C)
B1 (0.004, 0.668, A)	O1 (0.016, 0.470, A)
B2 (0.132, 1.197, B)	O1c1 (0.015, 0.559, A)
D1 (0.138, 1.153, B)	S1 (0.017, 0.706, A)
I1 (0.161, 2.187, C)	S1c1 (0.037, 1.124, B)
K2 (0.003, 0.386, A)	S2 (0.012, 1.447, B)
M1 (0.001, 0.105, A)	S2c1 (0.012, 1.146, B)
M1c1 (0.001, 0.098, A)	

vctk_common-o-o-m



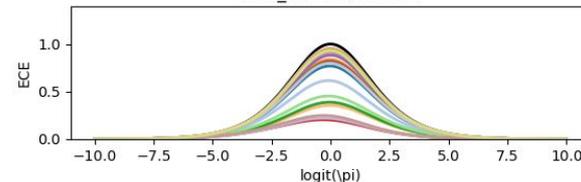
perfect privacy (0, 0, 0)	M1c2 (0.694, 3.675, C)
A1 (0.694, 3.675, C)	M1c3 (0.694, 3.675, C)
A2 (0.694, 3.675, C)	M1c4 (0.694, 3.675, C)
B1 (0.694, 3.675, C)	O1 (0.694, 3.675, C)
B2 (0.694, 3.675, C)	O1c1 (0.694, 3.675, C)
D1 (0.694, 3.675, C)	S1 (0.694, 3.675, C)
I1 (0.694, 3.675, C)	S1c1 (0.694, 3.675, C)
K2 (0.694, 3.675, C)	S2 (0.694, 3.675, C)
M1 (0.694, 3.675, C)	S2c1 (0.694, 3.675, C)
M1c1 (0.694, 3.675, C)	

vctk_common-o-a-m



perfect privacy (0, 0, 0)	M1c2 (0.342, 2.468, C)
A1 (0.001, 0.447, A)	M1c3 (3e-04, 0.544, A)
A2 (2e-04, 0.192, A)	M1c4 (0.346, 2.376, C)
B1 (2e-04, 0.447, A)	O1 (0.008, 0.544, A)
B2 (0.199, 2.488, C)	O1c1 (0.009, 1.146, B)
D1 (0.196, 2.690, C)	S1 (0.007, 0.669, A)
I1 (0.212, 2.917, C)	S1c1 (0.040, 0.778, A)
K2 (0.019, 1.204, B)	S2 (0.009, 0.373, A)
M1 (0.001, 0.234, A)	S2c1 (0.010, 0.392, A)
M1c1 (0.001, 0.171, A)	

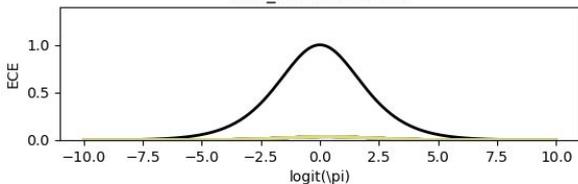
vctk_common-a-a-m



perfect privacy (0, 0, 0)	M1c2 (0.558, 2.909, C)
A1 (0.159, 1.447, B)	M1c3 (0.126, 1.176, B)
A2 (0.268, 1.857, B)	M1c4 (0.538, 2.561, C)
B1 (0.113, 1.447, B)	O1 (0.029, 0.869, A)
B2 (0.458, 3.080, C)	O1c1 (0.027, 1.146, B)
D1 (0.434, 2.702, C)	S1 (0.053, 1.146, B)
I1 (0.385, 2.157, C)	S1c1 (0.138, 1.447, B)
K2 (0.568, 2.593, C)	S2 (0.038, 0.483, A)
M1 (0.065, 1.021, B)	S2c1 (0.049, 0.614, A)
M1c1 (0.080, 1.447, B)	

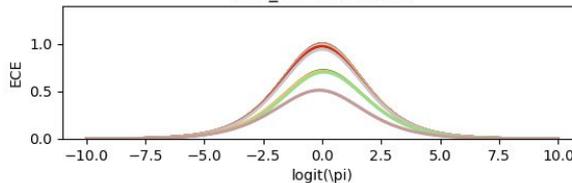
ZEBRA: VCTK-common (all systems) ordered by performance

vctk_common-o-o-m



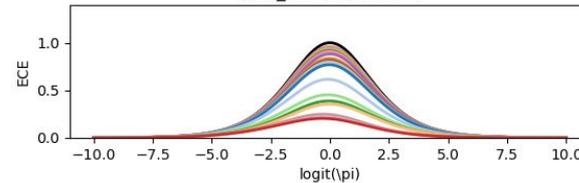
perfect privacy (0, 0, 0)	M1 (0.694, 3.675, C)
A1 (0.694, 3.675, C)	K2 (0.694, 3.675, C)
S1c1 (0.694, 3.675, C)	I1 (0.694, 3.675, C)
S1 (0.694, 3.675, C)	D1 (0.694, 3.675, C)
O1c1 (0.694, 3.675, C)	B2 (0.694, 3.675, C)
O1 (0.694, 3.675, C)	B1 (0.694, 3.675, C)
M1c4 (0.694, 3.675, C)	A2 (0.694, 3.675, C)
M1c3 (0.694, 3.675, C)	S2 (0.694, 3.675, C)
M1c2 (0.694, 3.675, C)	S2c1 (0.694, 3.675, C)
M1c1 (0.694, 3.675, C)	

vctk_common-o-a-m



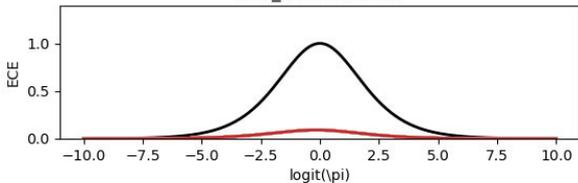
perfect privacy (0, 0, 0)	S2 (0.009, 0.373, A)
A2 (2e-04, 0.192, A)	S2c1 (0.010, 0.392, A)
B1 (2e-04, 0.447, A)	K2 (0.019, 1.204, B)
M1c3 (3e-04, 0.544, A)	S1c1 (0.040, 0.778, A)
A1 (0.001, 0.447, A)	D1 (0.196, 2.690, C)
M1c1 (0.001, 0.171, A)	B2 (0.199, 2.488, C)
M1 (0.001, 0.234, A)	I1 (0.212, 2.917, C)
S1 (0.007, 0.669, A)	M1c2 (0.342, 2.468, C)
O1 (0.008, 0.544, A)	M1c4 (0.346, 2.376, C)
O1c1 (0.009, 1.146, B)	

vctk_common-a-a-m



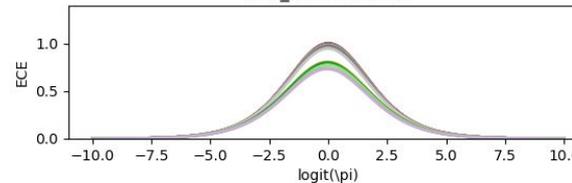
perfect privacy (0, 0, 0)	S1c1 (0.138, 1.447, B)
O1c1 (0.027, 1.146, B)	A1 (0.159, 1.447, B)
O1 (0.029, 0.869, A)	A2 (0.268, 1.857, B)
S2 (0.038, 0.483, A)	I1 (0.385, 2.157, C)
S2c1 (0.049, 0.614, A)	D1 (0.434, 2.702, C)
S1 (0.053, 1.146, B)	B2 (0.458, 3.080, C)
M1 (0.065, 1.021, B)	M1c4 (0.538, 2.561, C)
M1c1 (0.080, 1.447, B)	M1c2 (0.558, 2.909, C)
B1 (0.113, 1.447, B)	K2 (0.568, 2.593, C)
M1c3 (0.126, 1.176, B)	

vctk_common-o-o-f



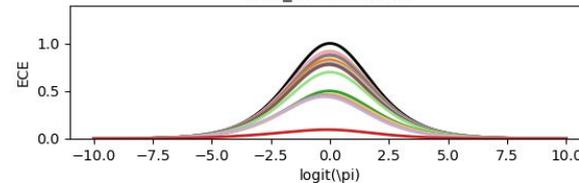
perfect privacy (0, 0, 0)	I1 (0.653, 3.557, C)
A1 (0.653, 3.557, C)	D1 (0.653, 3.557, C)
S1c1 (0.653, 3.557, C)	B2 (0.653, 3.557, C)
S1 (0.653, 3.557, C)	B1 (0.653, 3.557, C)
O1c1 (0.653, 3.557, C)	A2 (0.653, 3.557, C)
O1 (0.653, 3.557, C)	M1 (0.653, 3.557, C)
M1c4 (0.653, 3.557, C)	S2c1 (0.653, 3.557, C)
M1c3 (0.653, 3.557, C)	M1c2 (0.653, 3.557, C)
S2 (0.653, 3.557, C)	K2 (0.653, 3.557, C)
M1c1 (0.653, 3.557, C)	

vctk_common-o-a-f



perfect privacy (0, 0, 0)	O1c1 (0.015, 0.559, A)
M1 (0.001, 0.105, A)	O1 (0.016, 0.470, A)
M1c1 (0.001, 0.098, A)	S1 (0.017, 0.706, A)
K2 (0.003, 0.386, A)	S1c1 (0.037, 1.124, B)
B1 (0.004, 0.668, A)	B2 (0.132, 1.197, B)
A2 (0.006, 0.741, A)	D1 (0.138, 1.153, B)
M1c3 (0.007, 0.367, A)	I1 (0.161, 2.187, C)
A1 (0.007, 0.423, A)	M1c4 (0.181, 2.100, C)
S2c1 (0.012, 1.146, B)	M1c2 (0.186, 2.187, C)
S2 (0.012, 1.447, B)	

vctk_common-a-a-f



perfect privacy (0, 0, 0)	S1c1 (0.142, 1.227, B)
S2 (0.056, 1.447, B)	A1 (0.149, 1.447, B)
S2c1 (0.059, 1.447, B)	M1c3 (0.154, 1.748, B)
O1 (0.062, 1.172, B)	I1 (0.210, 2.146, C)
O1c1 (0.067, 1.208, B)	D1 (0.352, 2.488, C)
M1 (0.077, 1.447, B)	B2 (0.377, 2.216, C)
M1c1 (0.083, 1.172, B)	M1c4 (0.383, 2.269, C)
S1 (0.085, 0.845, A)	M1c2 (0.397, 2.266, C)
B1 (0.117, 1.447, B)	K2 (0.648, 3.141, C)
A2 (0.136, 1.748, B)	