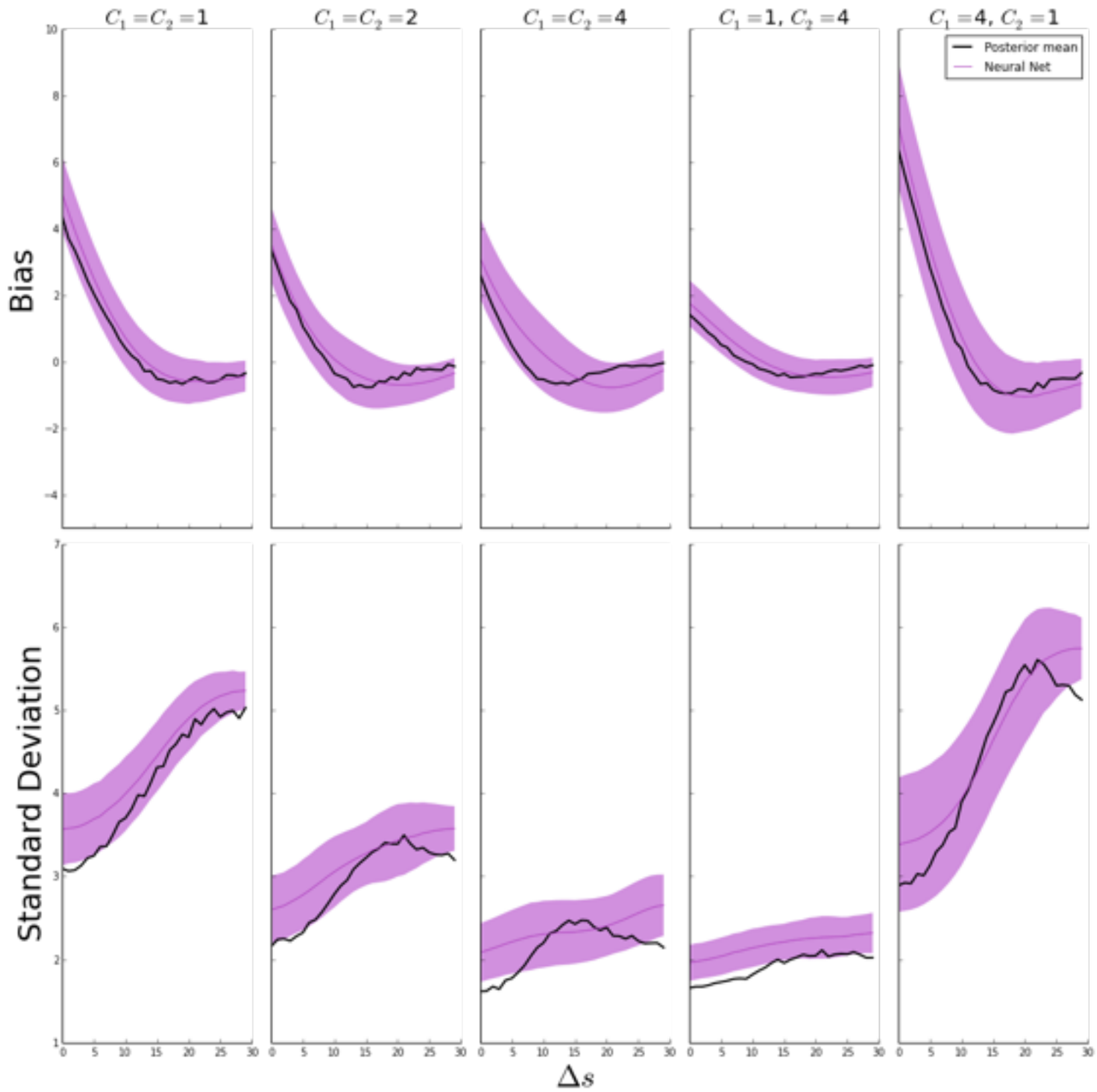
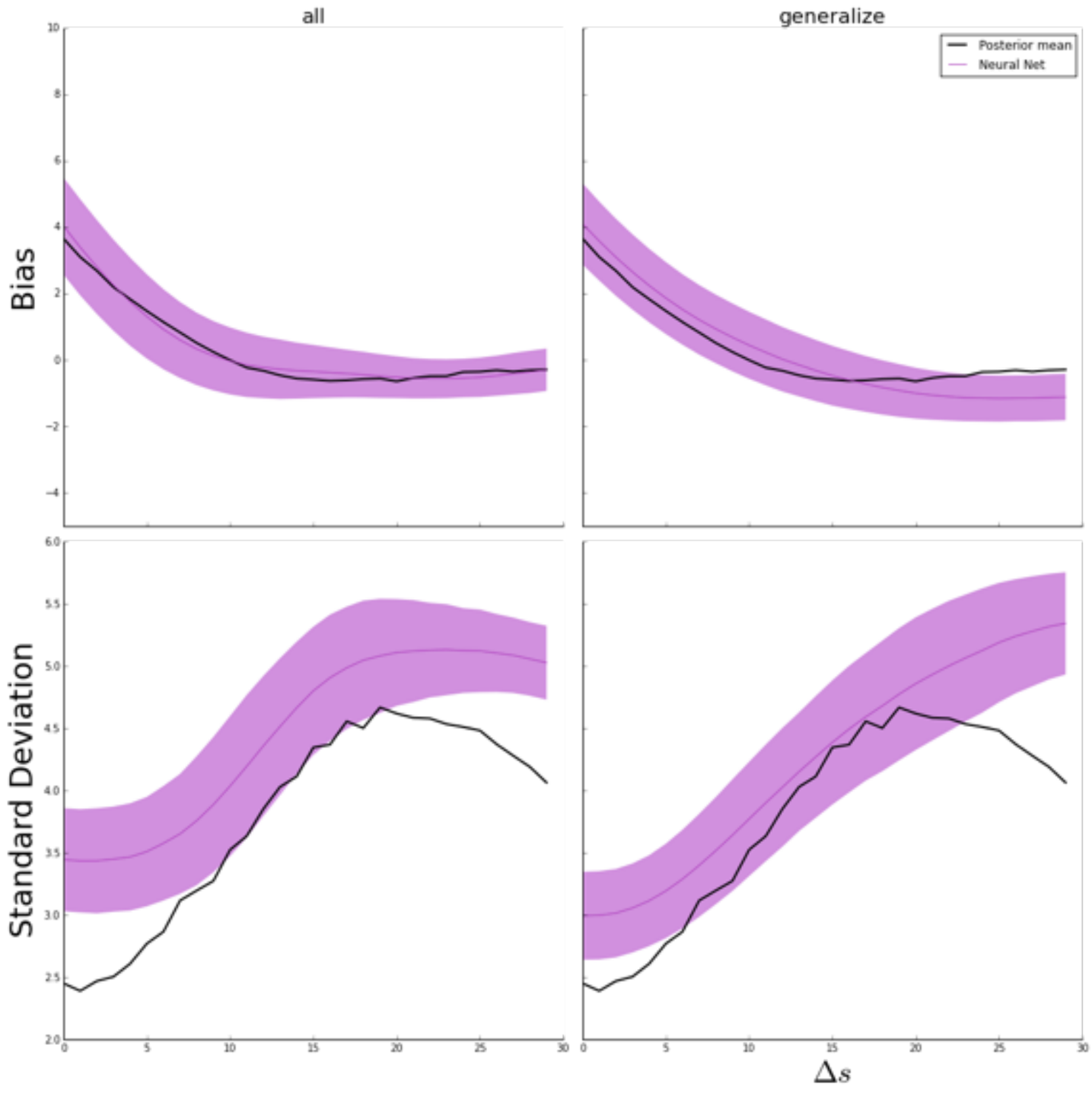
Equal known contrasts

Trained 200 neural networks
for each and averaged

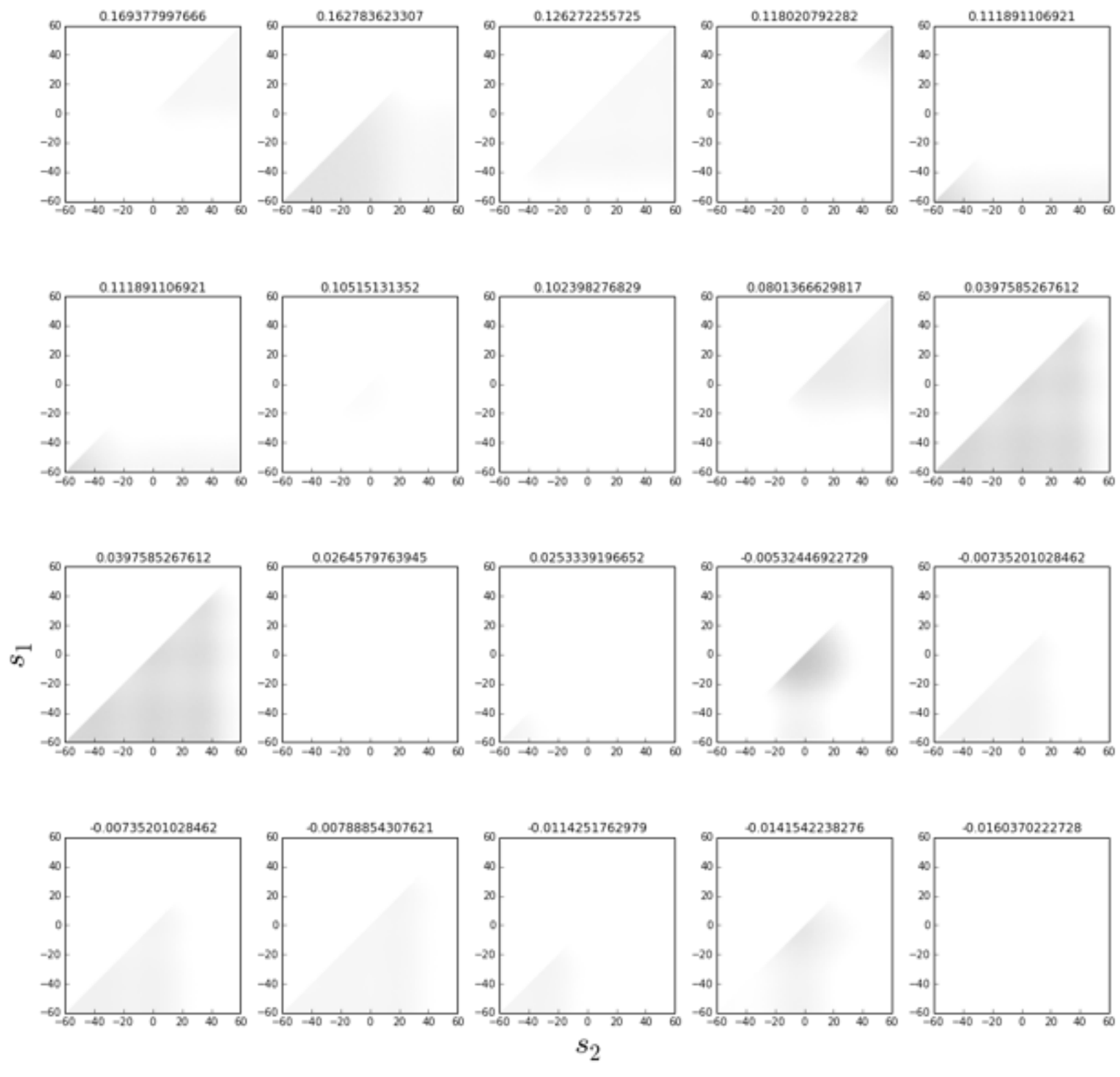
Neural networks parameters
learning_rate=0.0001, n_epochs=100, rho=.9,
mu=.99, nesterov=True, hidden_units = 100
with 270,000 training trials


$C_1 = C_2 = 1$
$C_1 = C_2 = 2$
$C_1 = C_2 = 4$
$C_1 = 1, C_2 = 4$
$C_1 = 4, C_2 = 1$
Posterior mean
Neural Net
Bias
Standard Deviation
Δs

All was trained on all combinations of [1, 2, 4]
Generalize only saw [1, 1] and [4, 4]


all
generalize
Posterior mean
Neural Net
Bias
Standard Deviation
Δs

s_1 estimate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0.162783623307
0.126272255725
0.118020792282
0.111891106921
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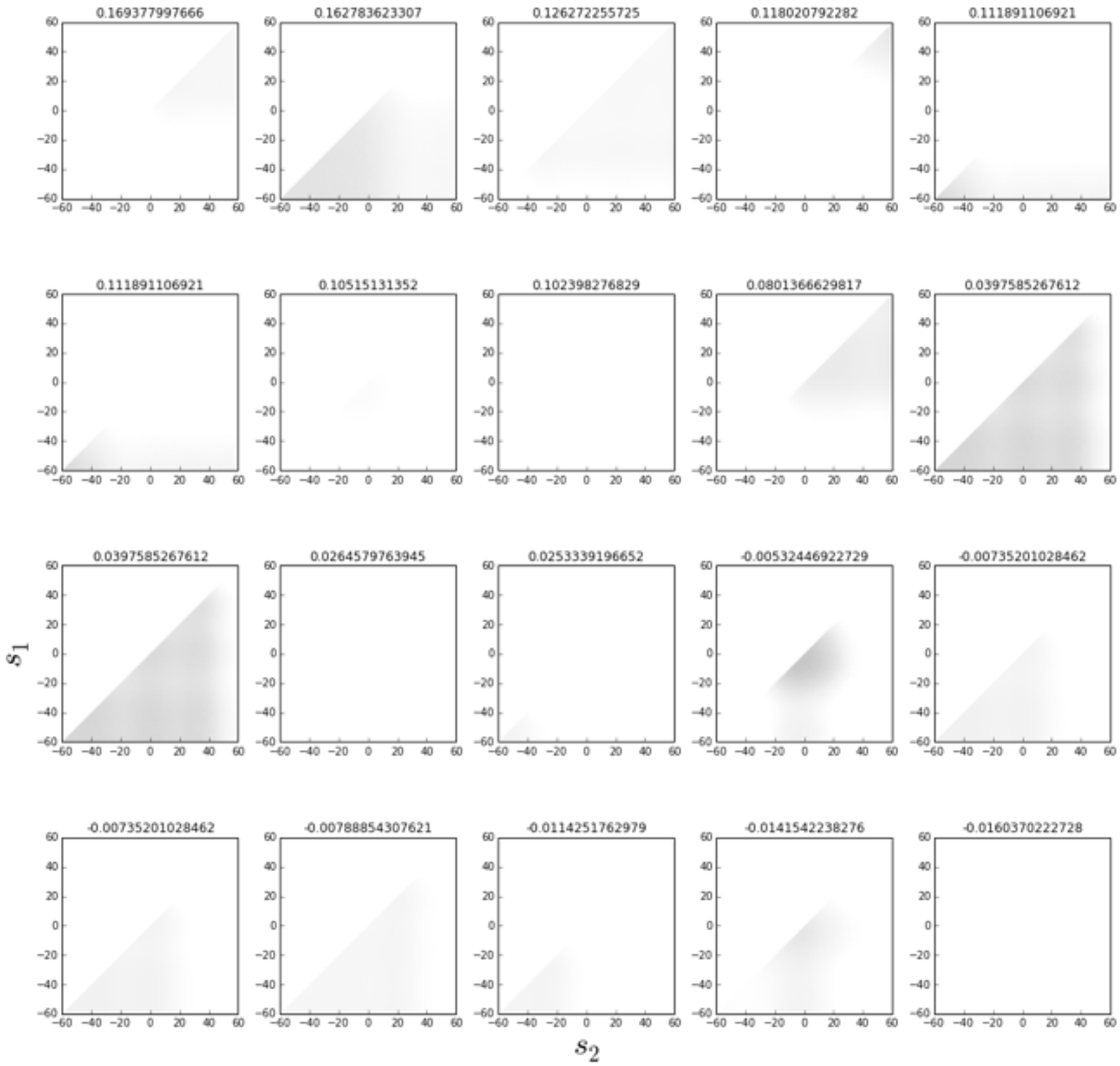
0.10515131352
0.102398276829
0.0801366629817
0.0397585267612
0.0397585267612
0.0264579763945
0.0253339196652
-0.00532446922729
-0.00735201028462
-0.00735201028462
-0.00788854307621
-0.0114251762979
-0.0141542238276
-0.0160370222728
s_1
s_2

s_2 estimate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0.0801366629817
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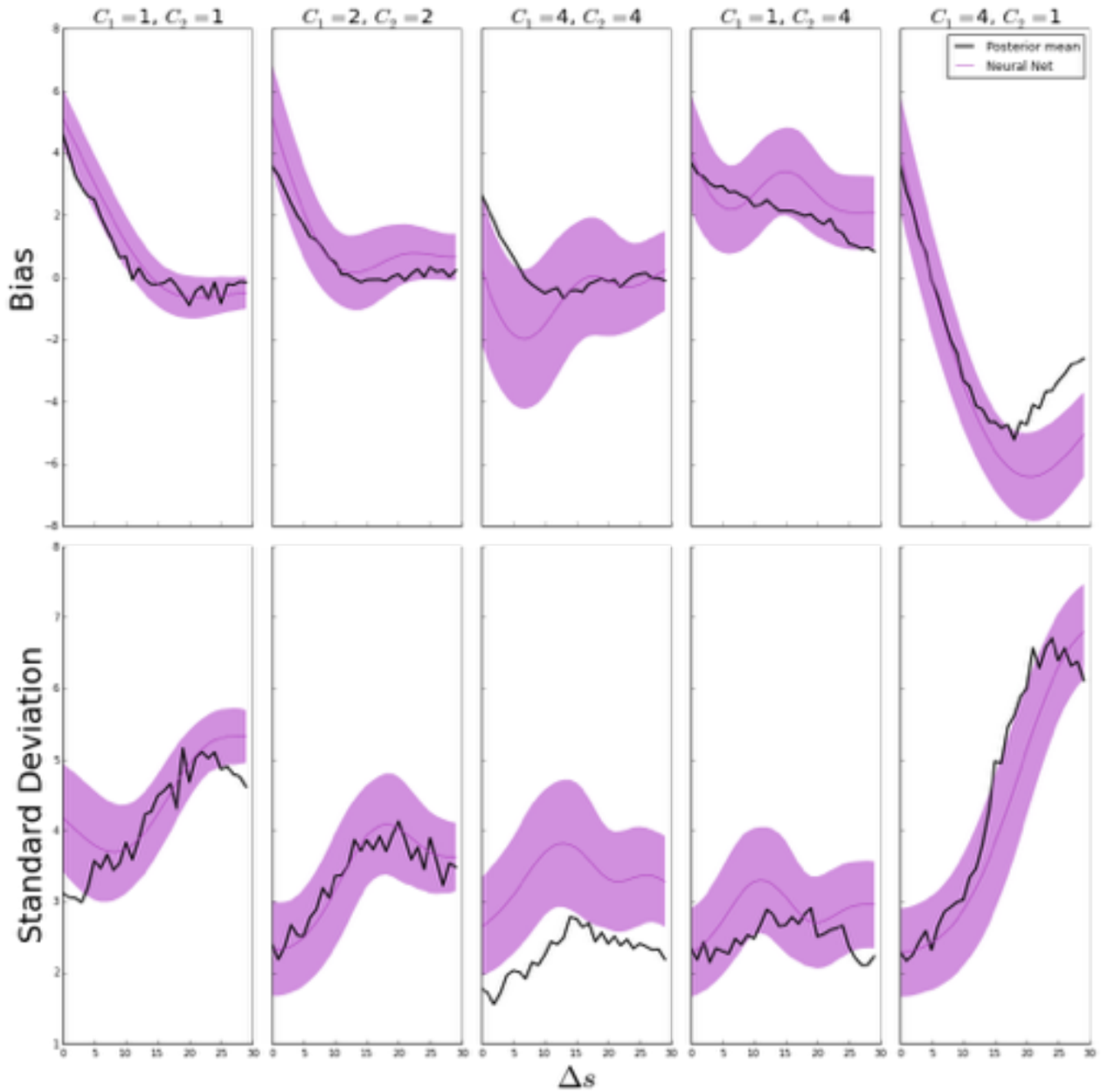
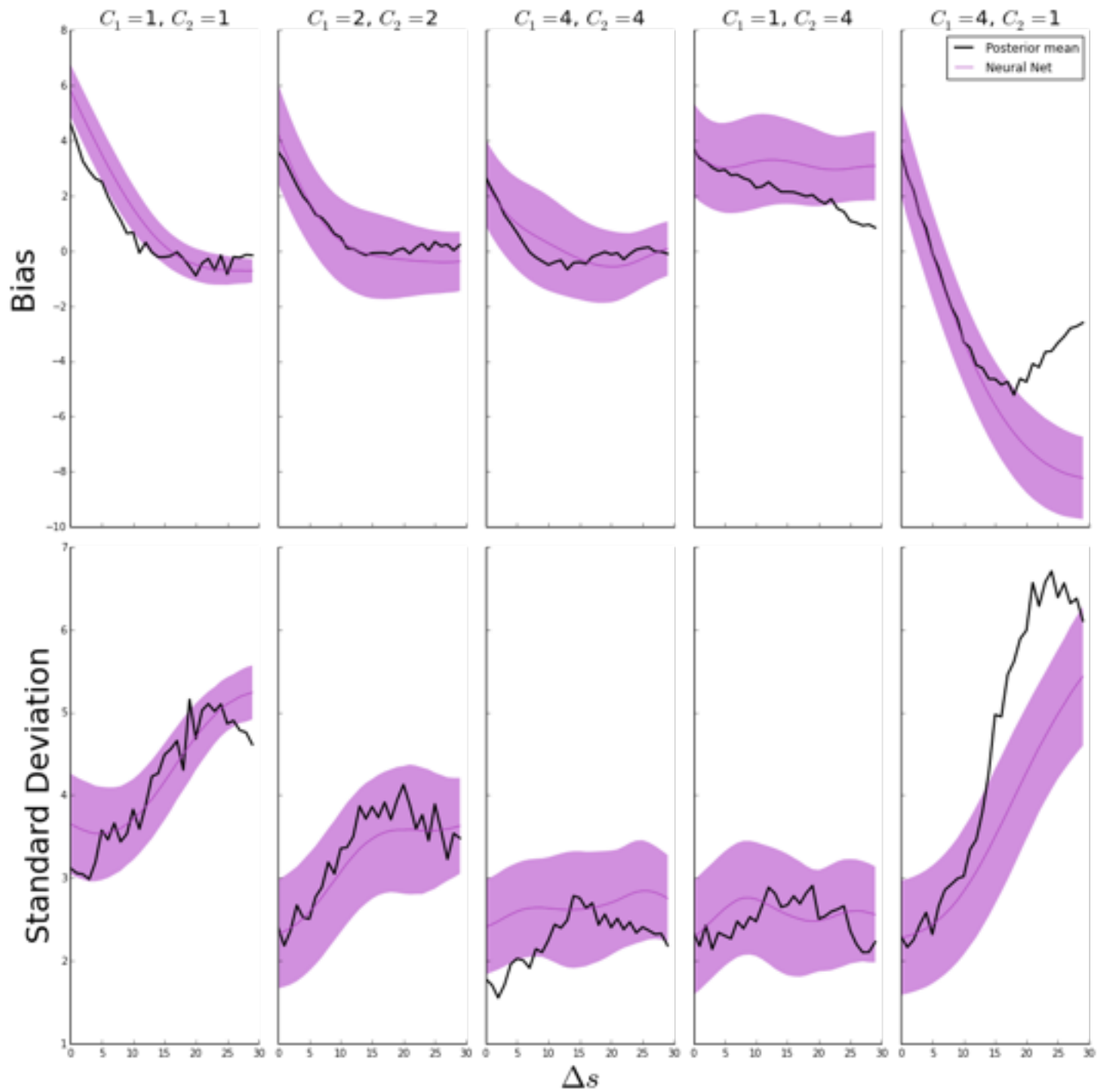
0.0397585267612
0.0264579763945
0.0253339196652
-0.00532446922729
-0.00735201028462
-0.00735201028462
-0.00788854307621
-0.0114251762979
-0.0141542238276
-0.0160370222728
s_1
s_2

Split by gains

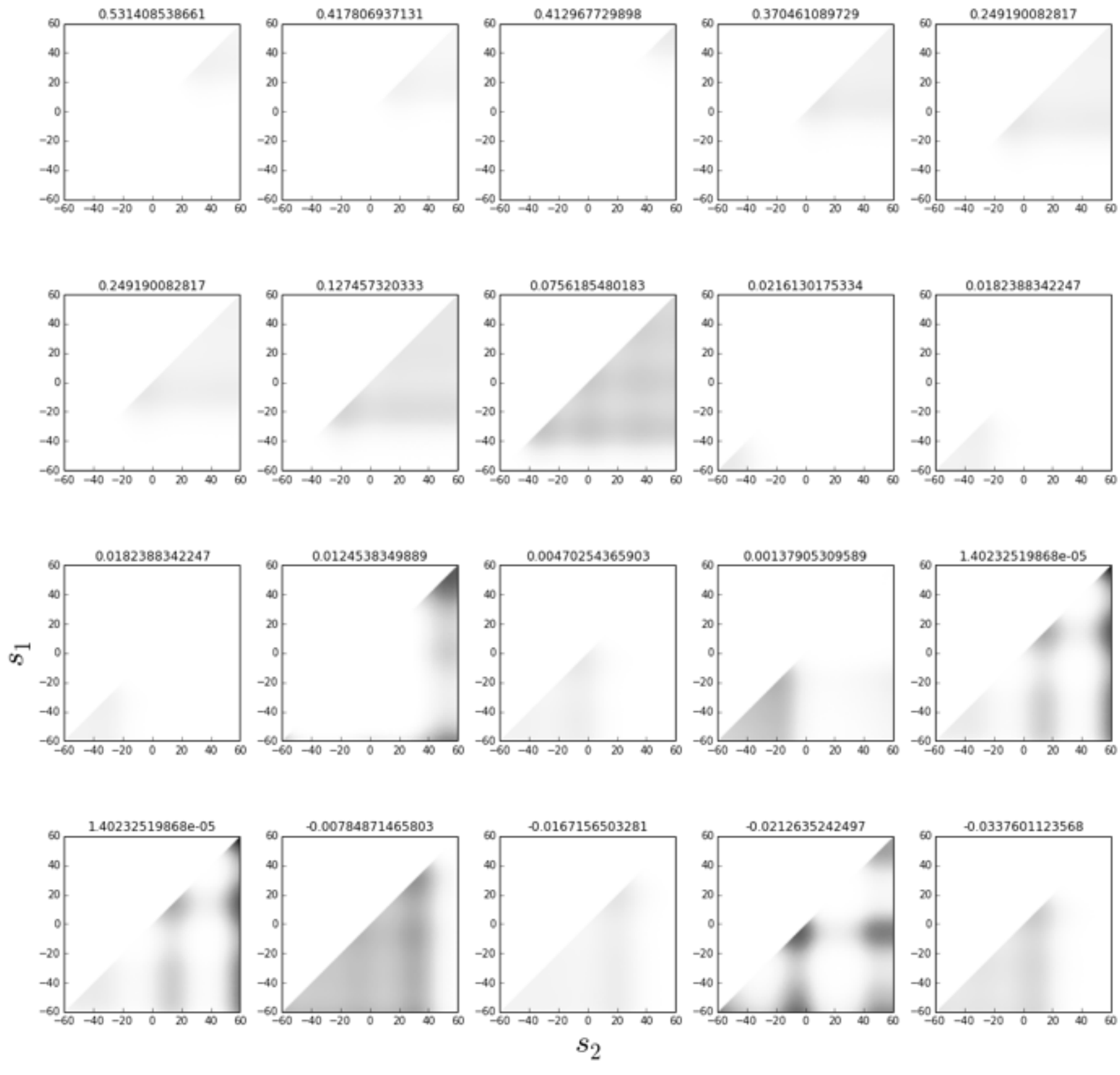
Train all, test all



Generalize


$C_1 = 1, C_2 = 1$
$C_1 = 2, C_2 = 2$
$C_1 = 4, C_2 = 4$
$C_1 = 1, C_2 = 4$
$C_1 = 4, C_2 = 1$
Posterior mean
Neural Net
Bias
Standard Deviation
Δs

s_1 estimate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1.40232519868e-05
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-0.0167156503281
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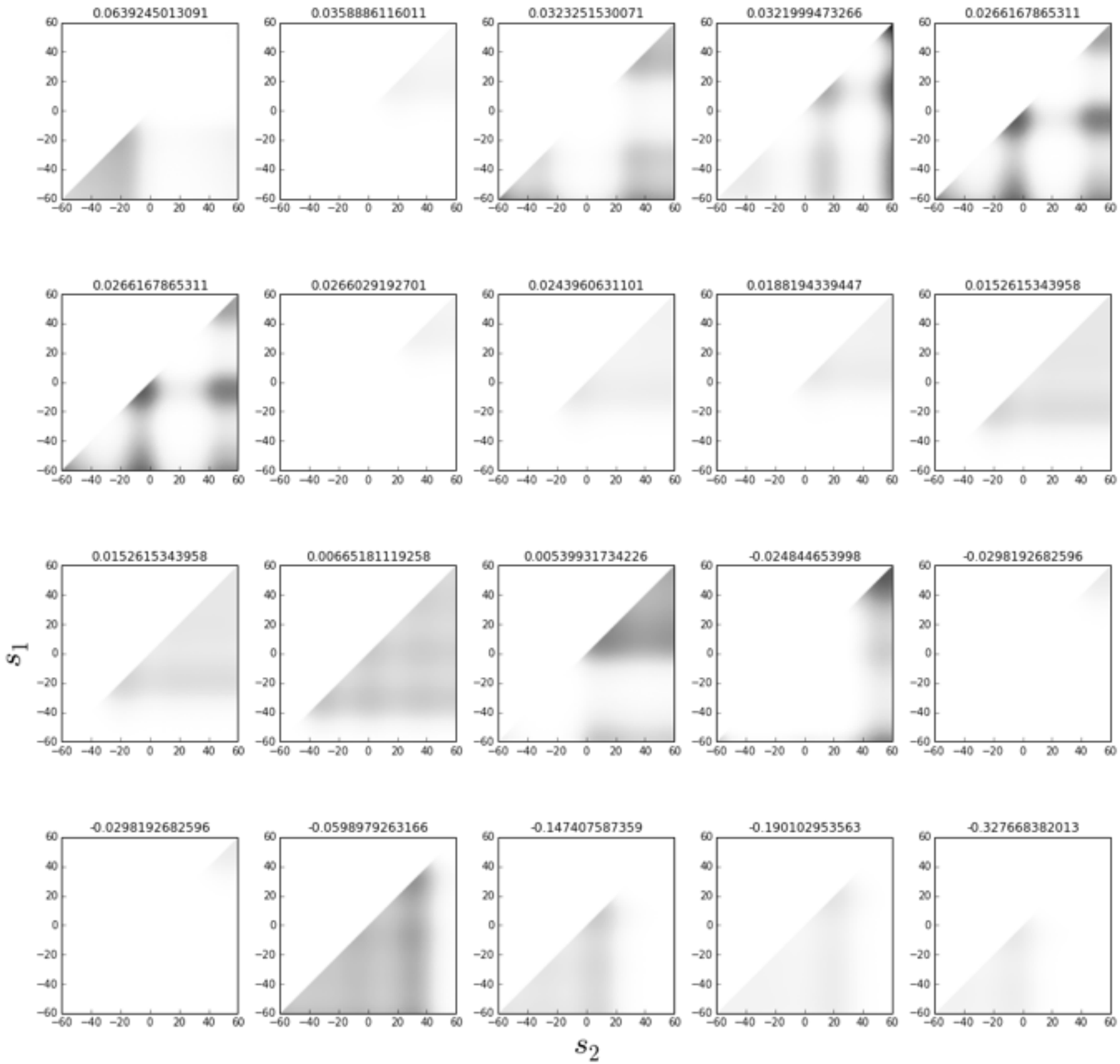
-0.0337601123568
s_1
s_2

s_2 estimate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0.0243960631101
0.0188194339447
0.0152615343958
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0.00539931734226
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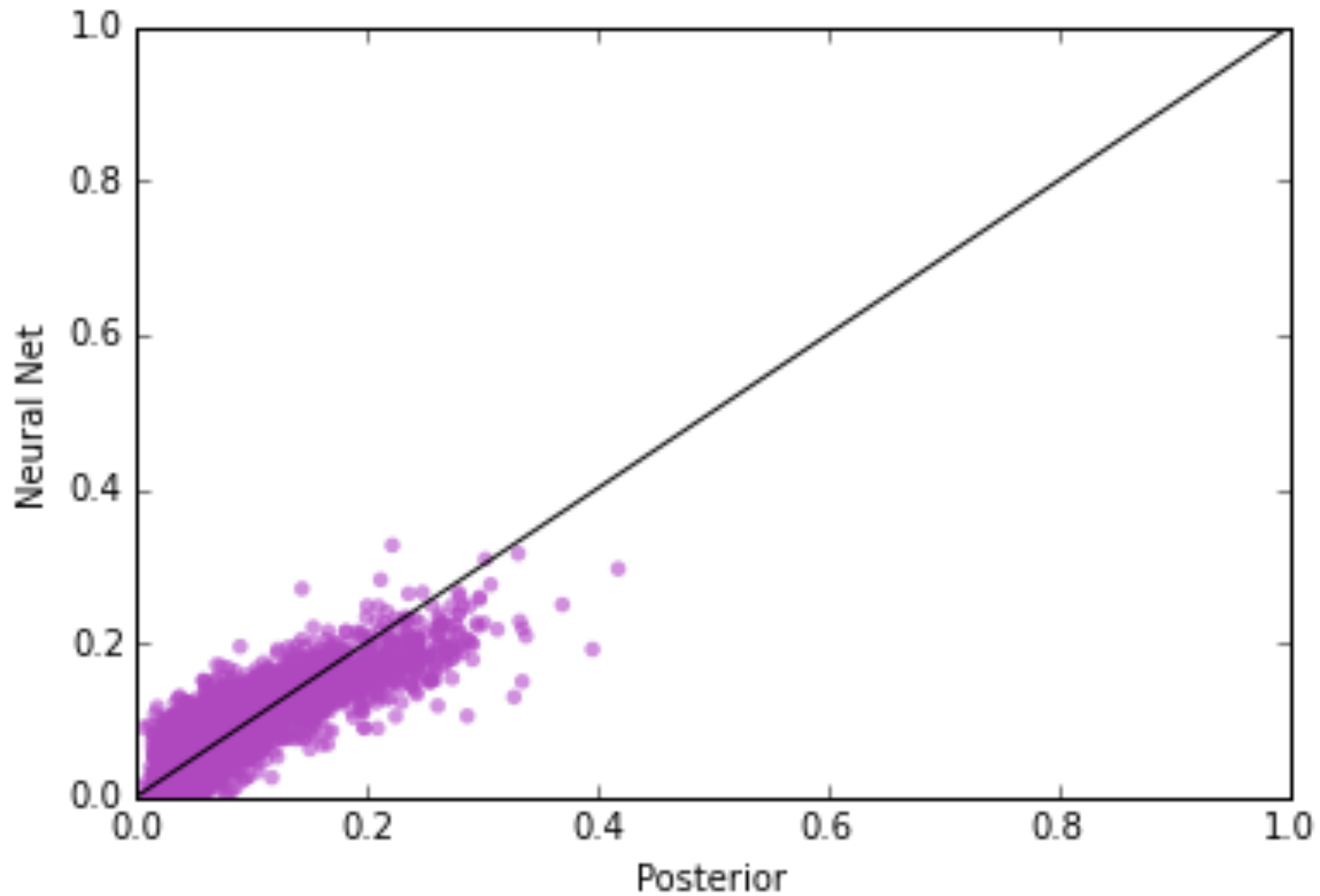
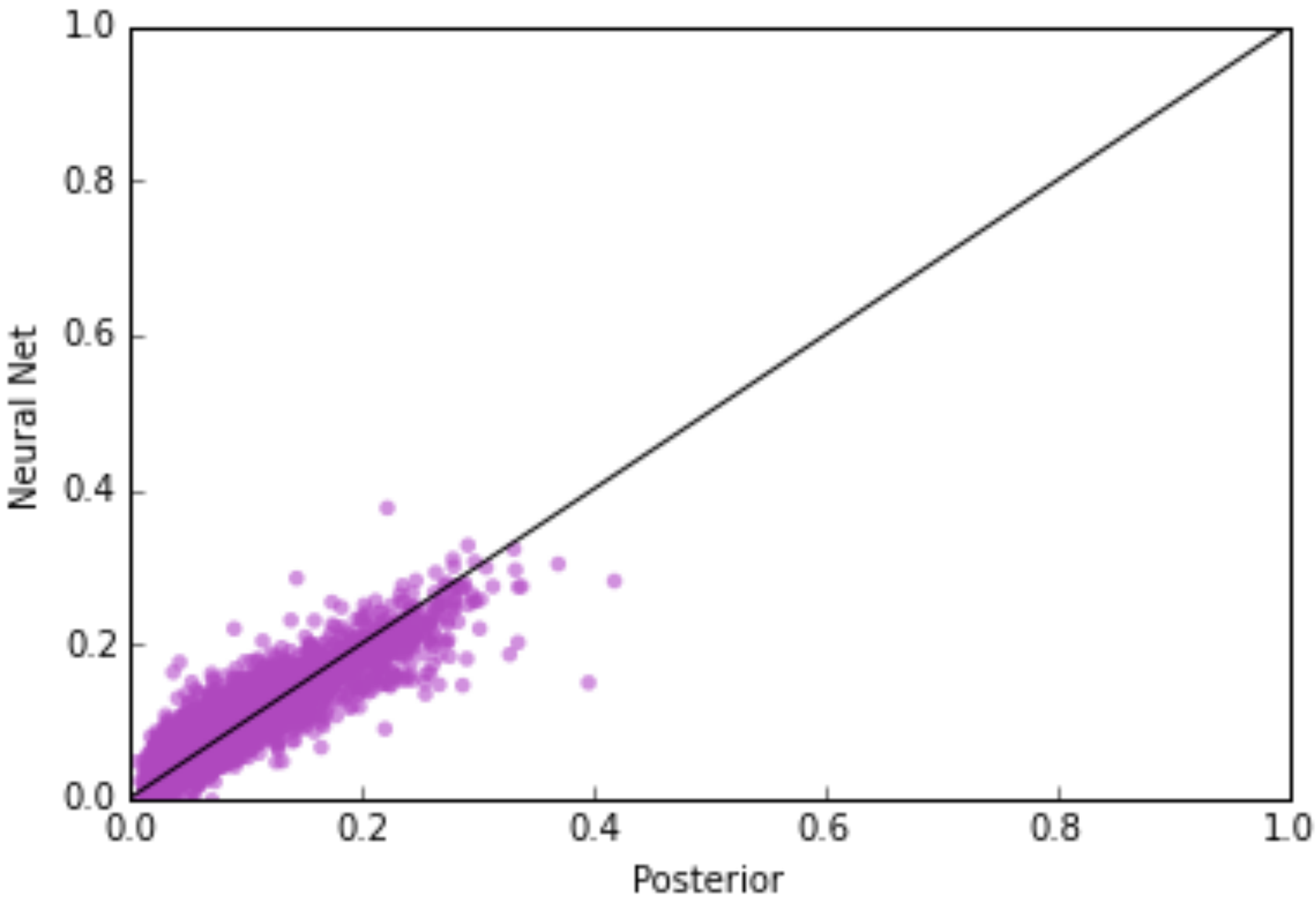
-0.0298192682596
-0.0598979263166
-0.147407587359
-0.190102953563
-0.327668382013
s_1
s_2

Reading out posterior precision from hidden units

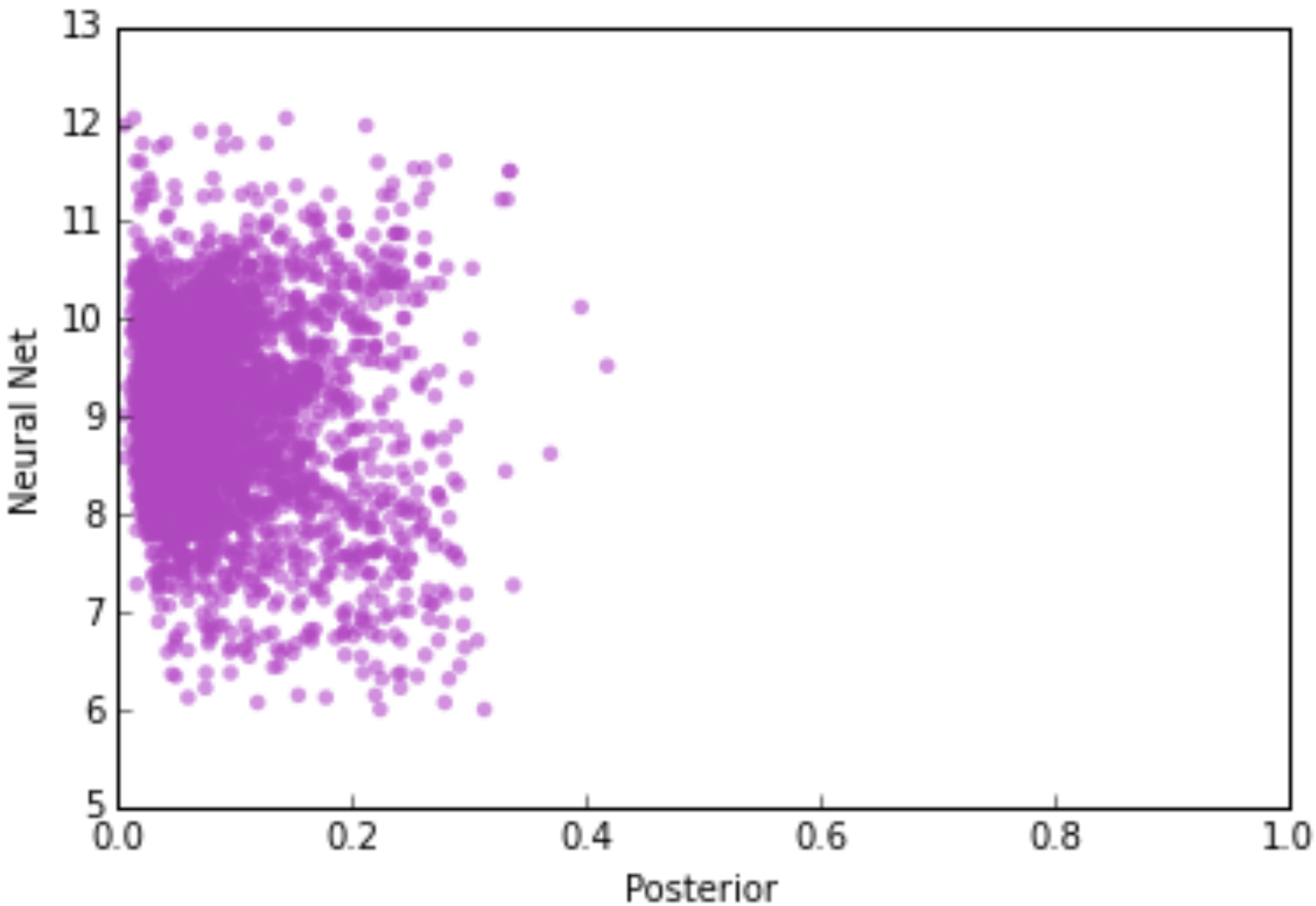
Linear readout
Correlation = 0.83



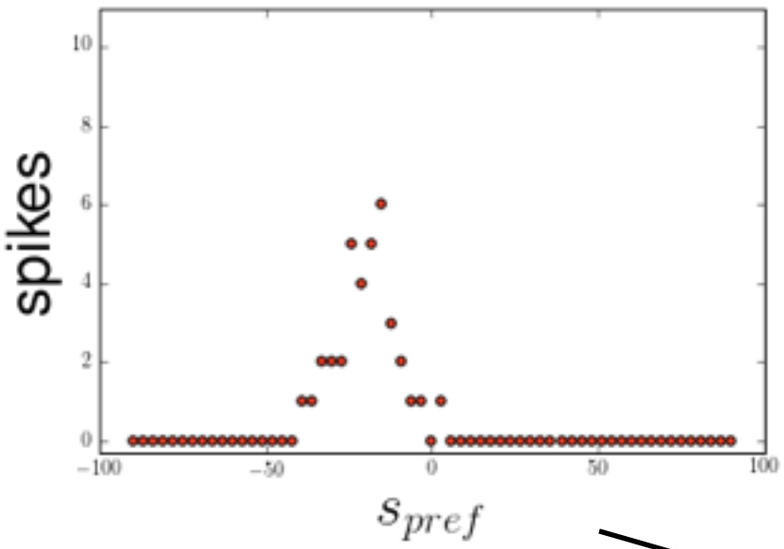
Trained network
Correlation = 0.89

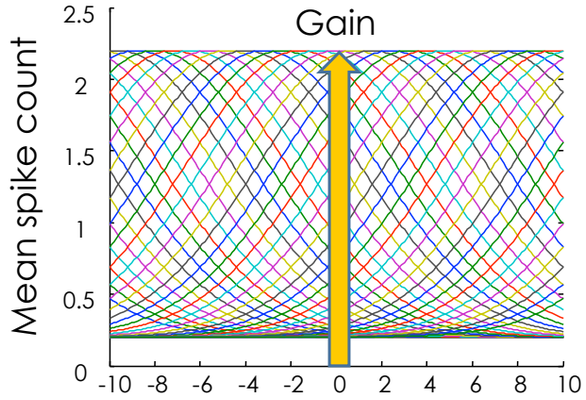


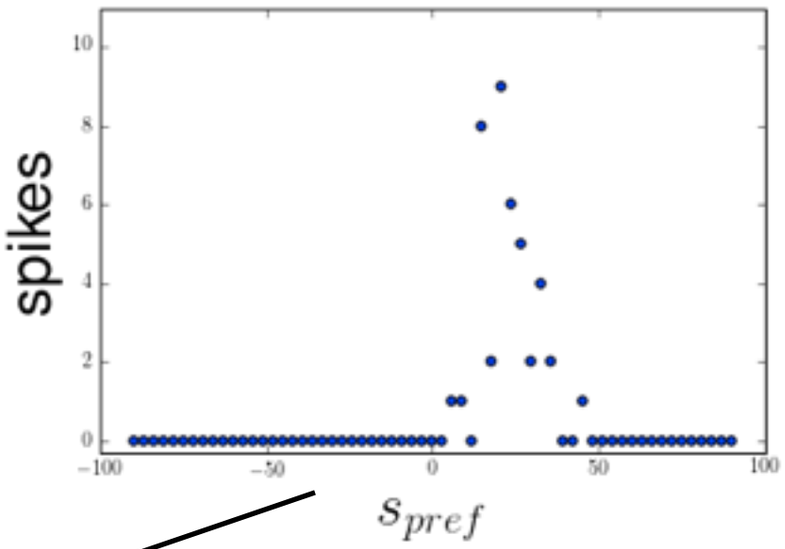
Sum of hidden units
Correlation = -.09

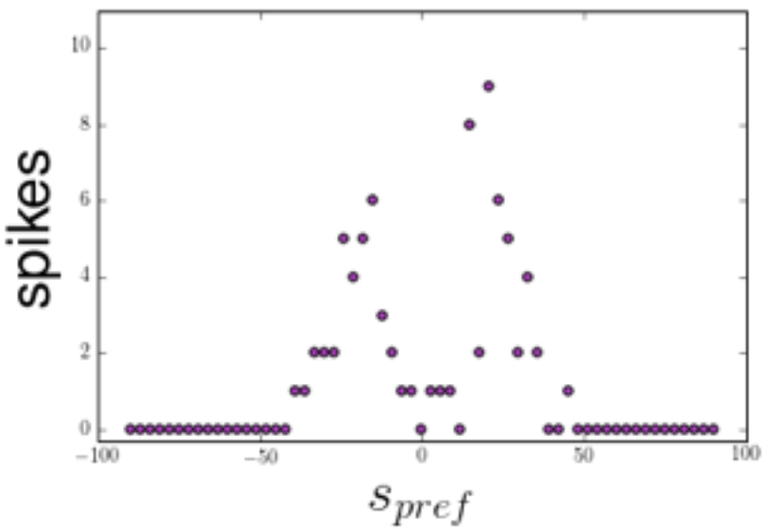


Presentation Figures


spikes
s_{pref}


Gain
Mean spike count
Stimulus s


spikes
s_{pref}


spikes
s_{pref}

A Harder One (15, 20)