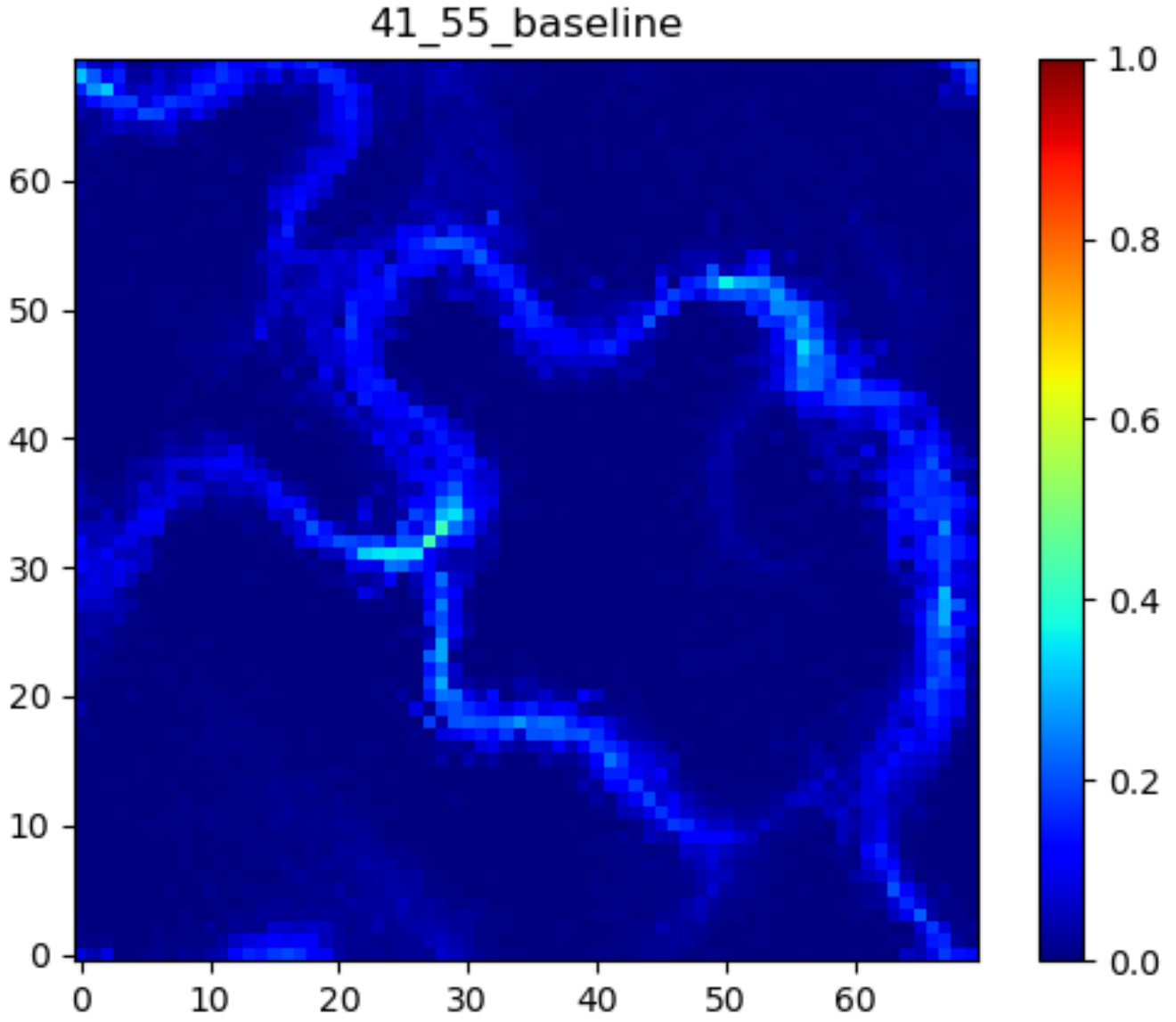
Dopamine arithmetics

Configuration:

- Perlin size: 4 (base/seed: 1), sig_{EE}=5, sig_{II}=5
- J=2, g=6.5, ext. drive=20+-20
- Nrows=70, p=20%, seed=912
- Transfer function: steepness=0.5, x0=50

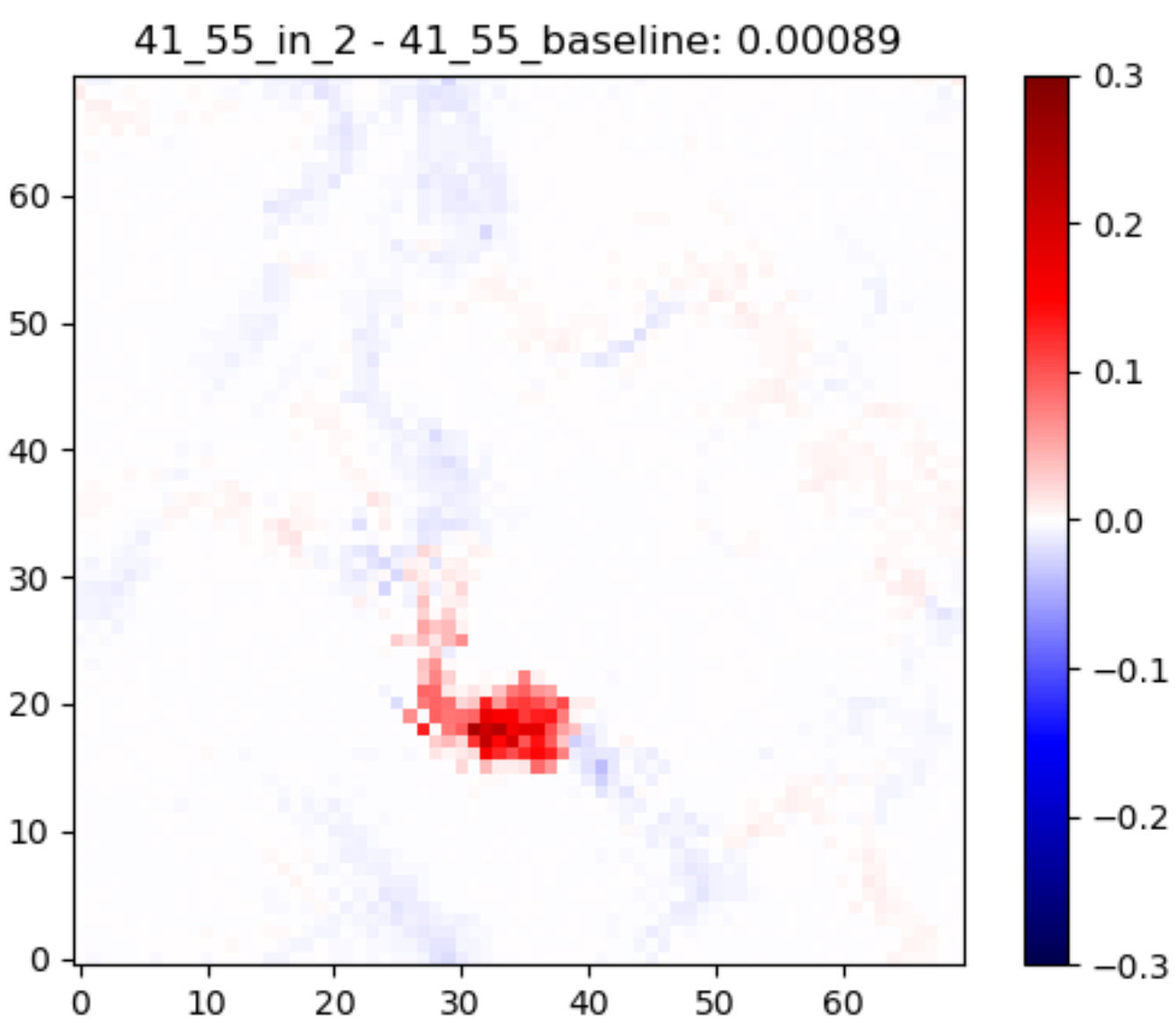
- Baseline simulation
- Most sequences go from right to left.
- Diverging at (20, 50) and (58, 14)
- Converging at (30, 30) and (68, 30)
- Fading at (26, 30), (18, 50), and (55, 14)



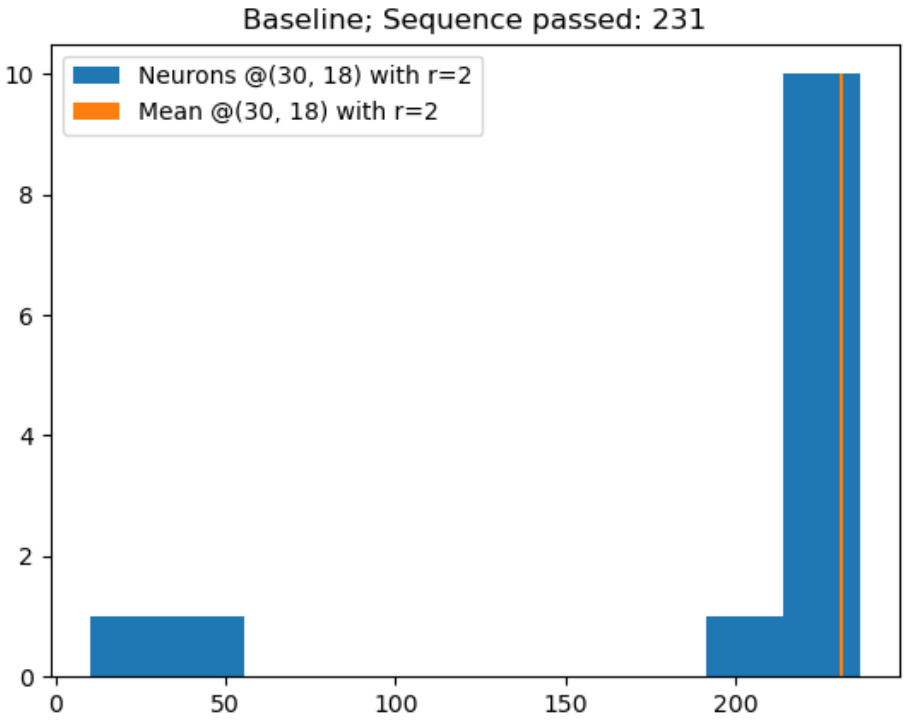
Patch placed orthogonal to STAS direction

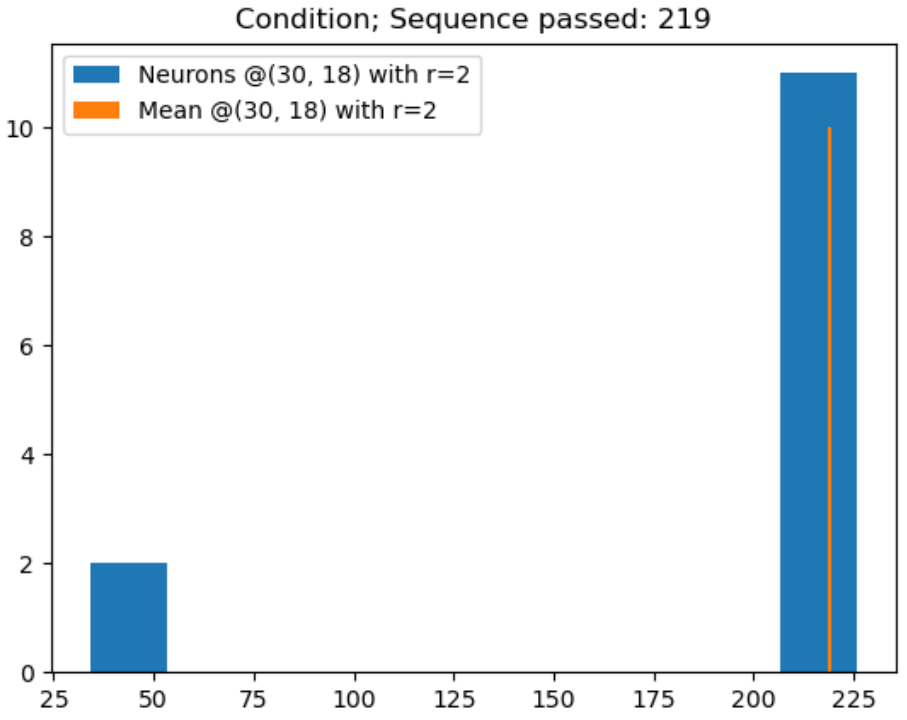
In-, edge-, and out- patch
Interestingly, the second set (my first idea) lead to quite interesting result, acquiring a new path. Thus the PCA also gives exciting results here.

- In patch @(35, 18), r=4
- Increasing the (avg.) activation in and past the patch
- Reducing the avg. activation prior to the patch

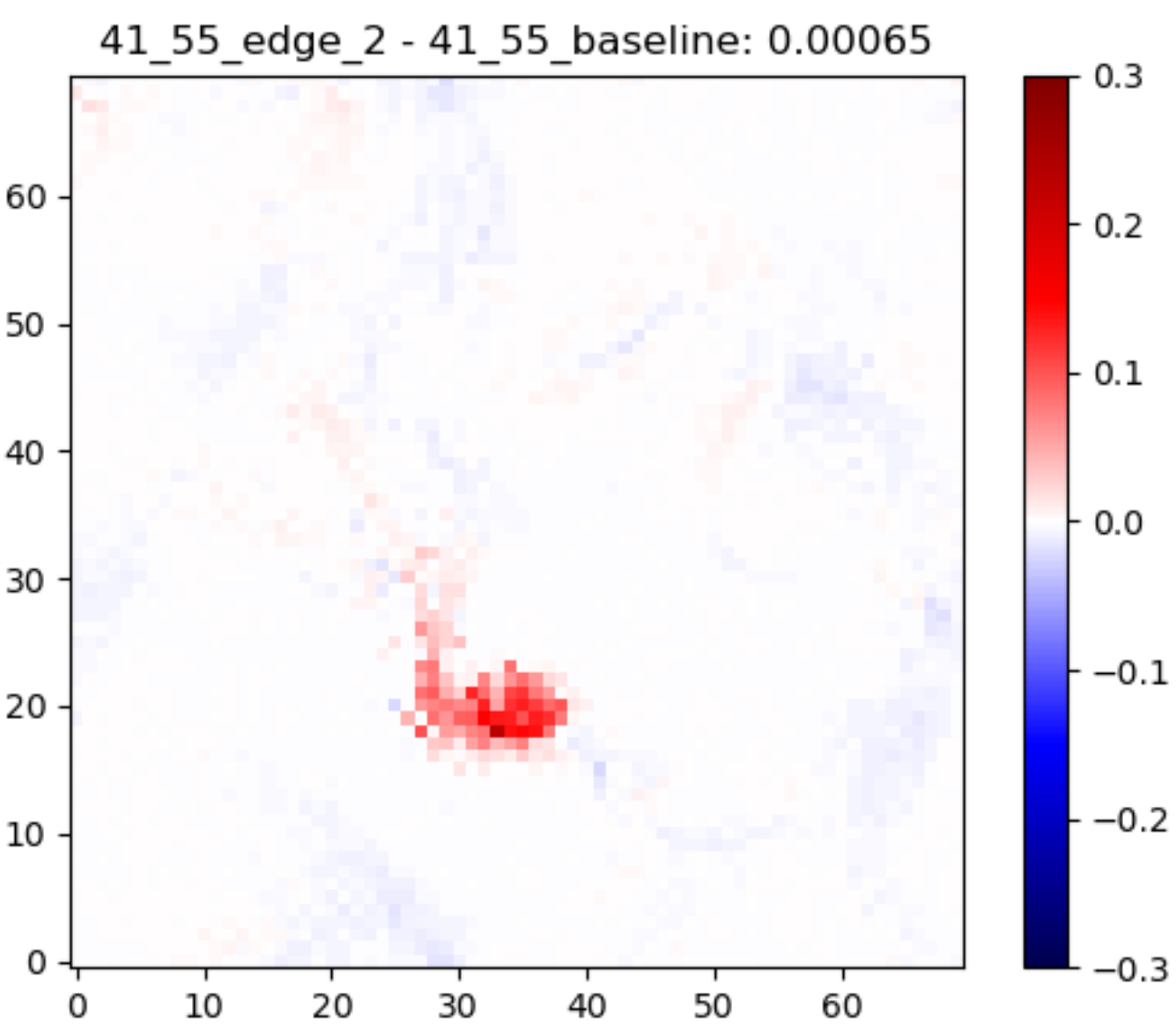


Sequence passing by

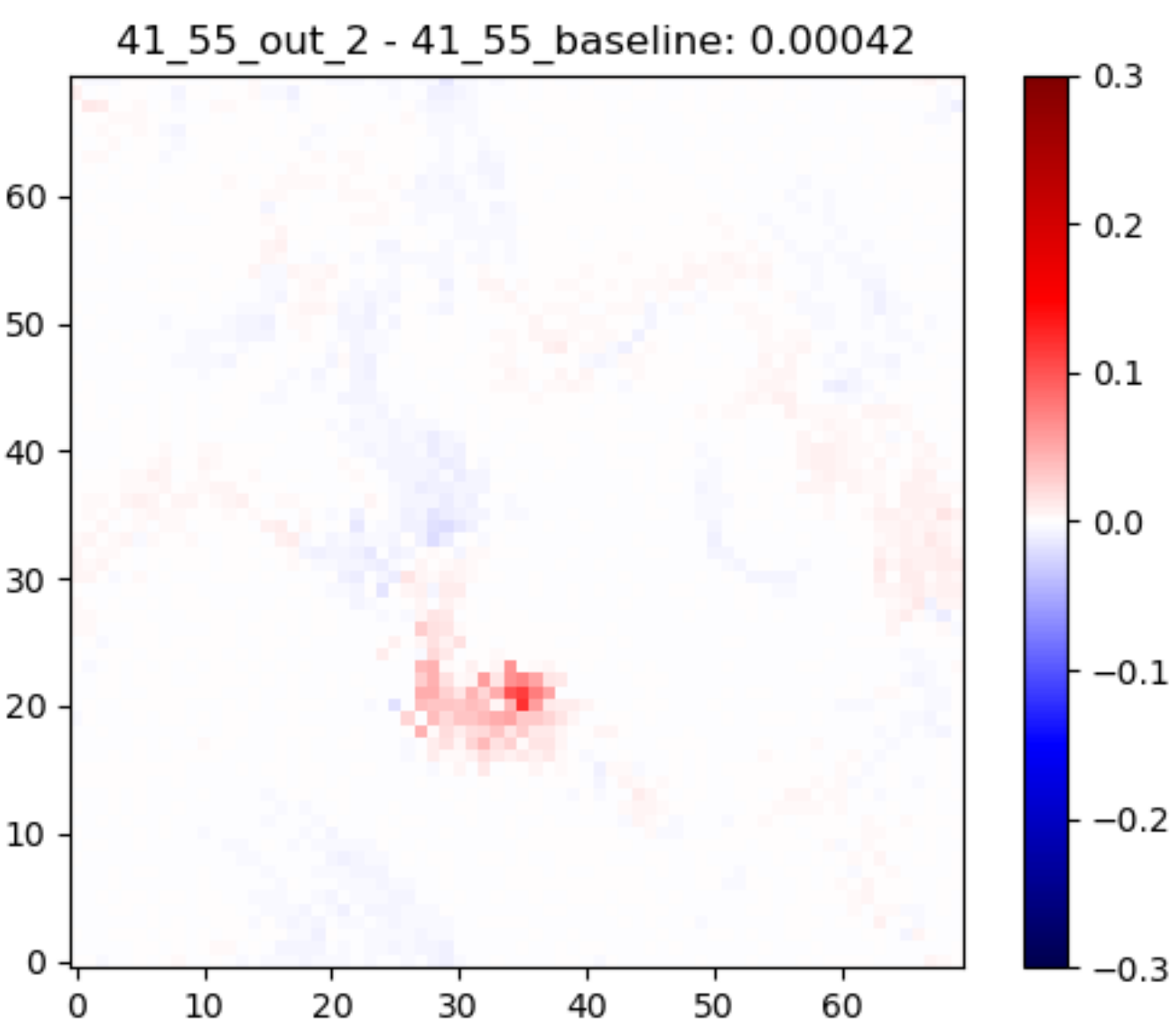




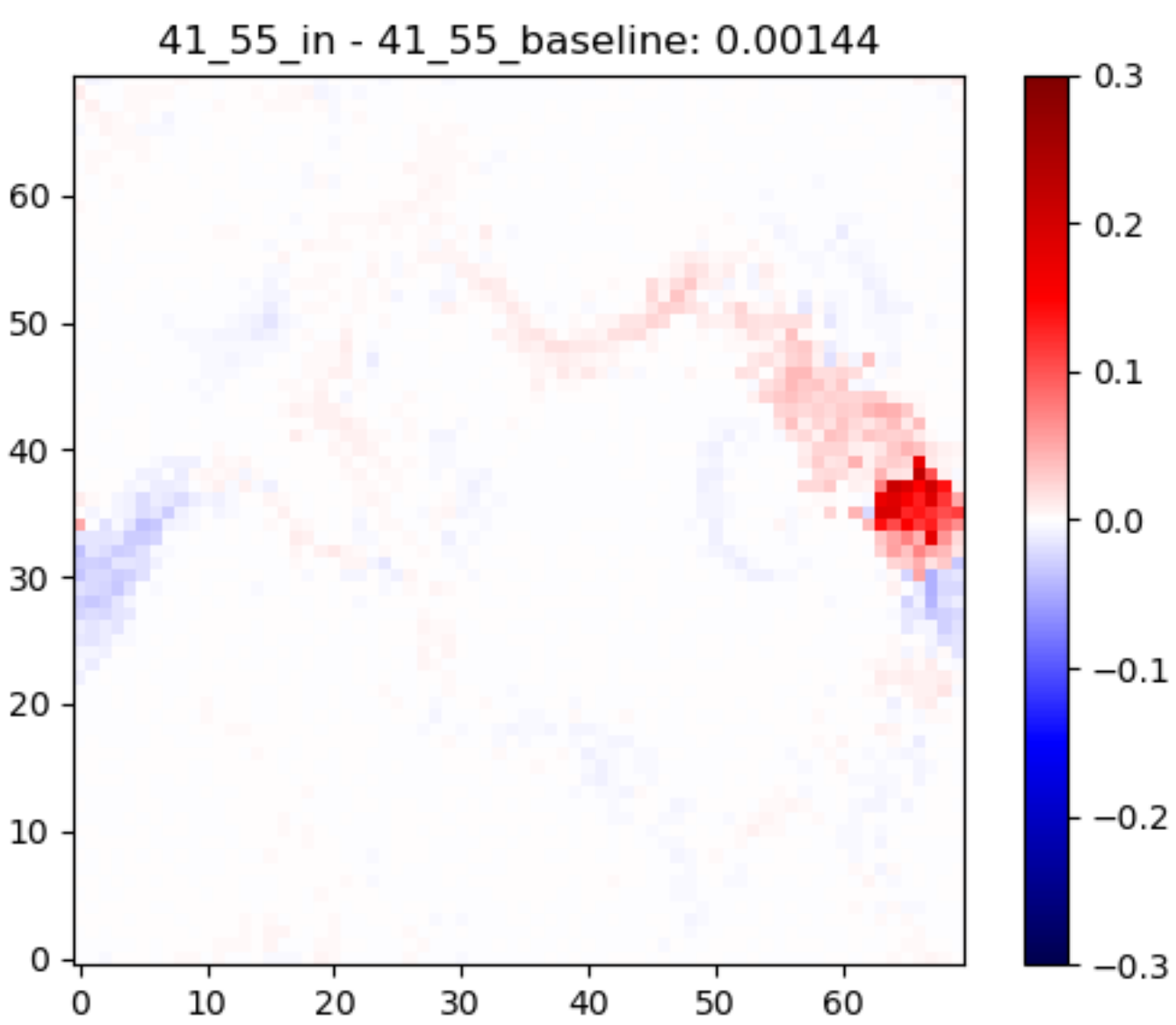
- edge patch @(35, 21), r=4
- Increasing the (avg.) activation in and past the patch
- Reducing the avg. activation prior to the patch
- Effect is smaller compared to the in-patch
- No. of sequence analysis need to be done.



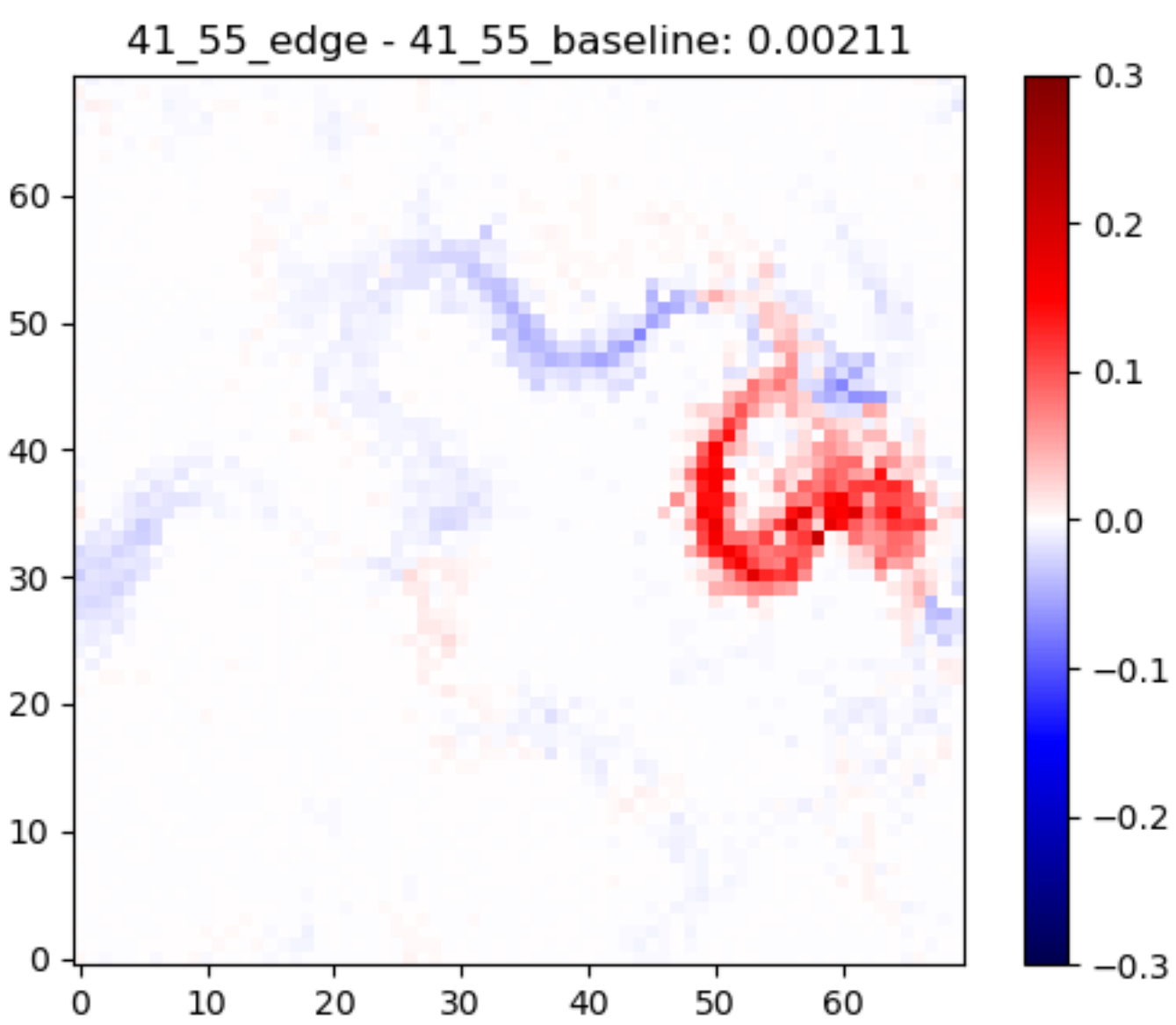
- out patch @(35, 24), r=4
- Increasing the (avg.) activation in and past the patch
- Reducing the avg. activation prior to the patch
- Effect is smaller compared to the in-patch and edge-patch
- No. of sequence analysis need to be done.



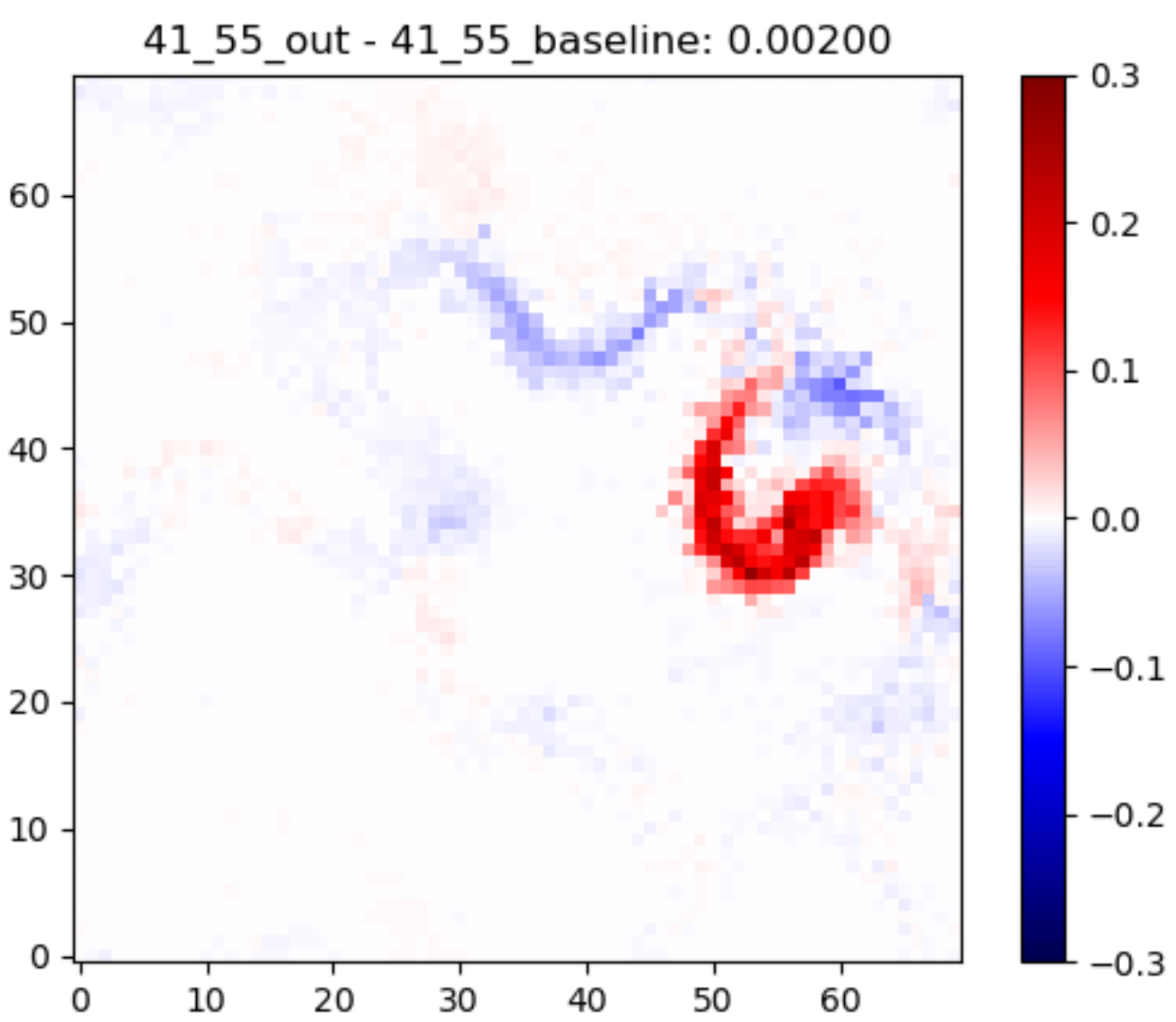
- in patch @(66, 34), r=4
- Increasing the (avg.) activation in and past the patch
- Reducing the avg. activation prior to the patch
- No. of sequence analysis need to be done.



- edge patch @(63, 34), r=4
- A new path is acquired
- Complex changes along the paths
- No. of sequence analysis need to be done.



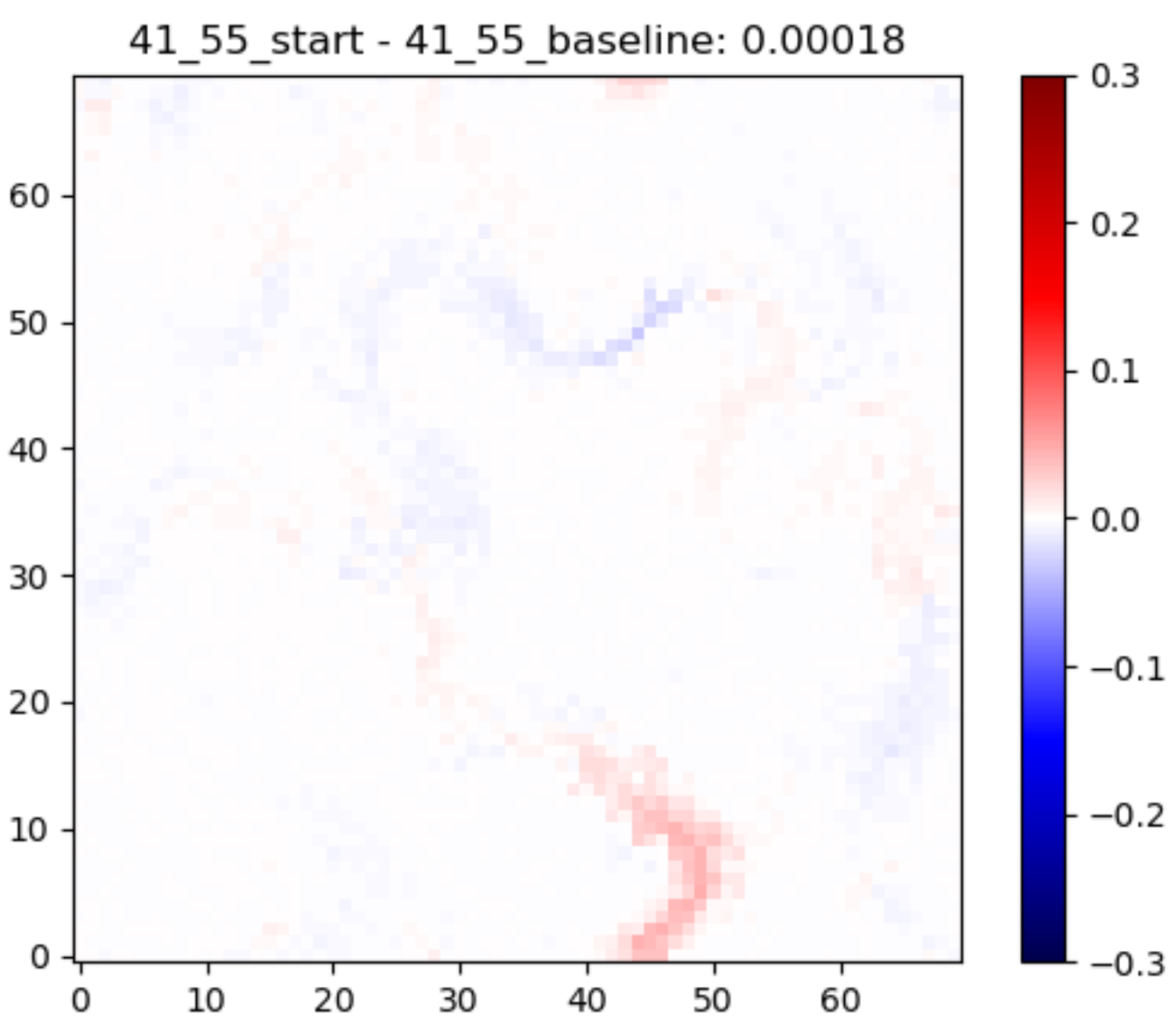
- out patch @(59, 34), r=4
- A new path is acquired
- Complex changes along the paths
- No. of sequence analysis need to be done.



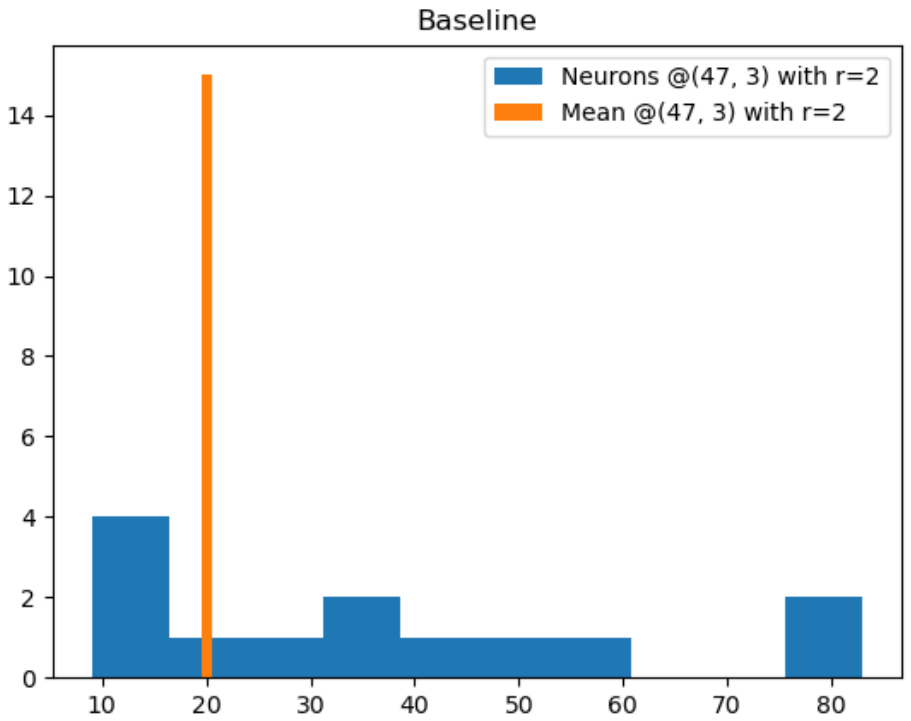
Patch locations along the sequence

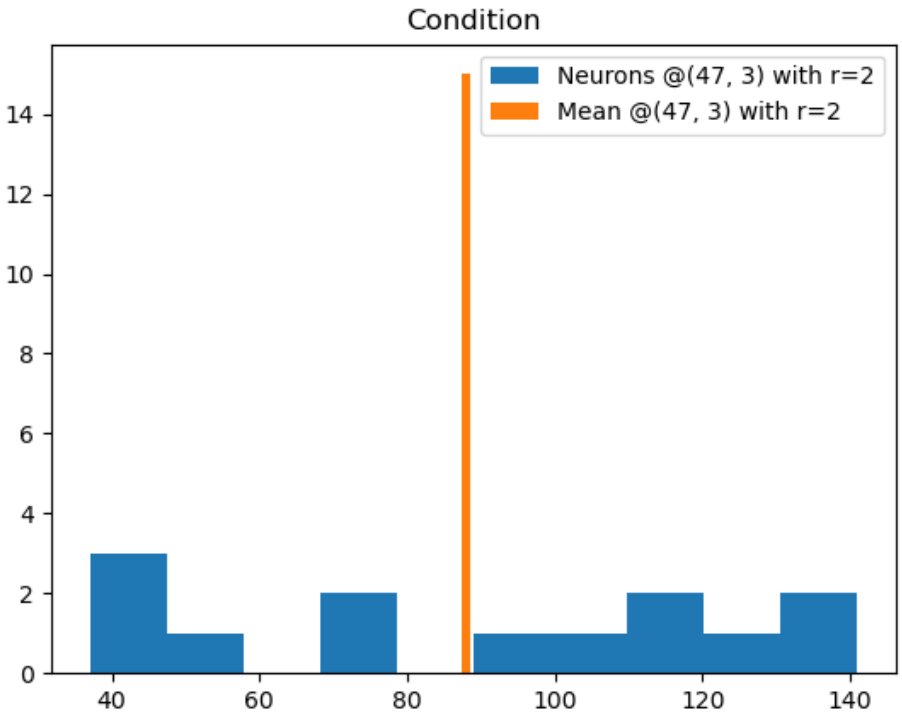
Starter patch
Repeater patch
Linker patch
Effectively changing the sequence pattern occurring in the network. Thus, the combination of the patches allows for arithmetics of sequences. Simple binary operations are possible.

- starter patch @(43, 68), r=4
- Increasing the (avg.) activation in and past the patch (see the red pixels on the bottom)
- No. of sequence analysis need to be done.

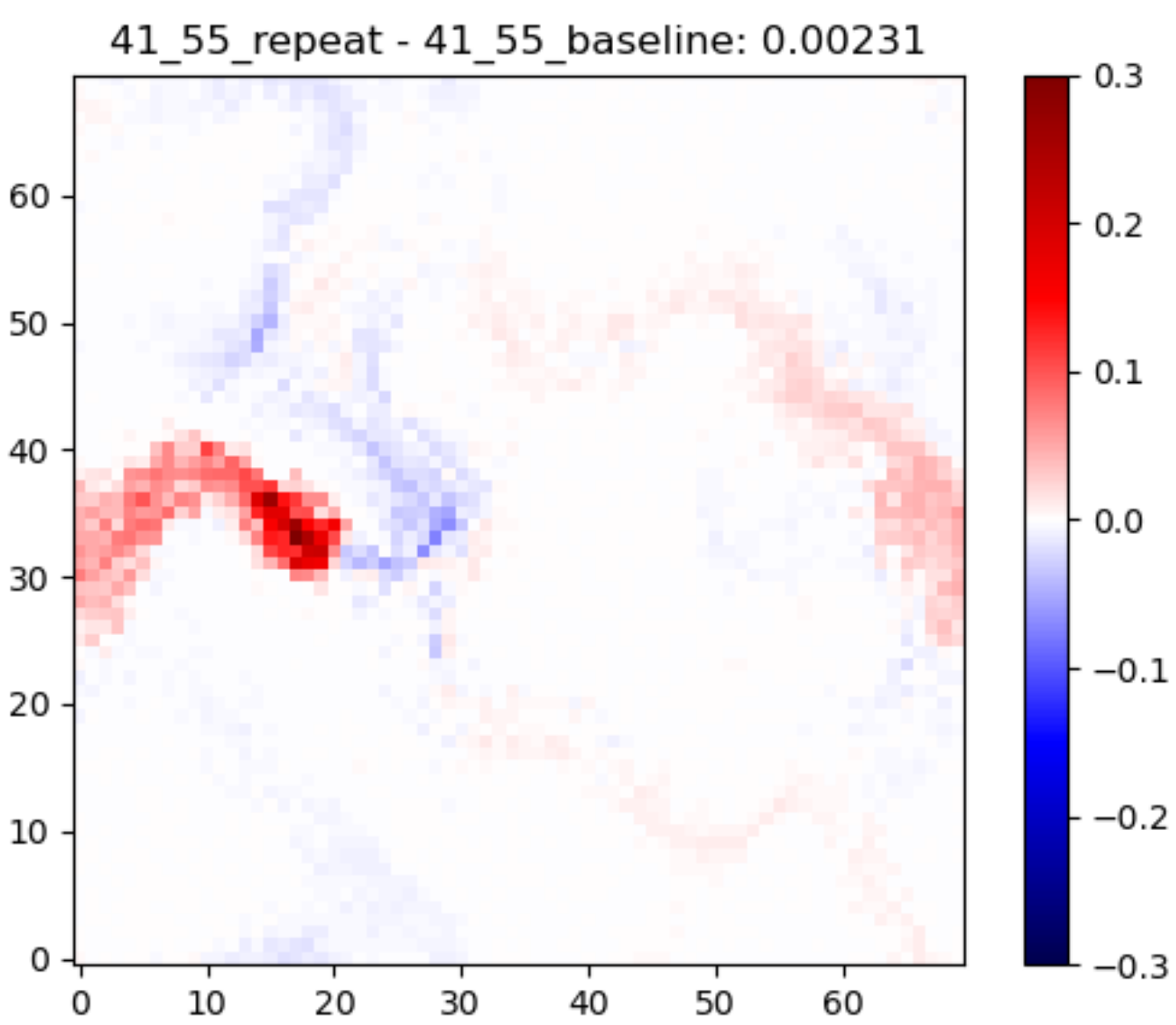


Sequence passing by

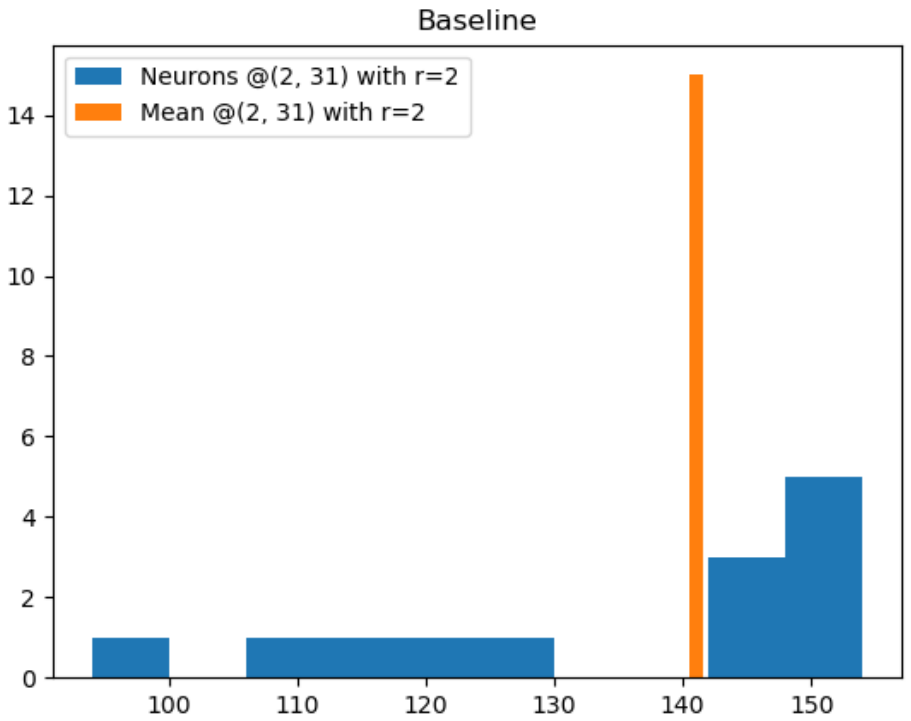


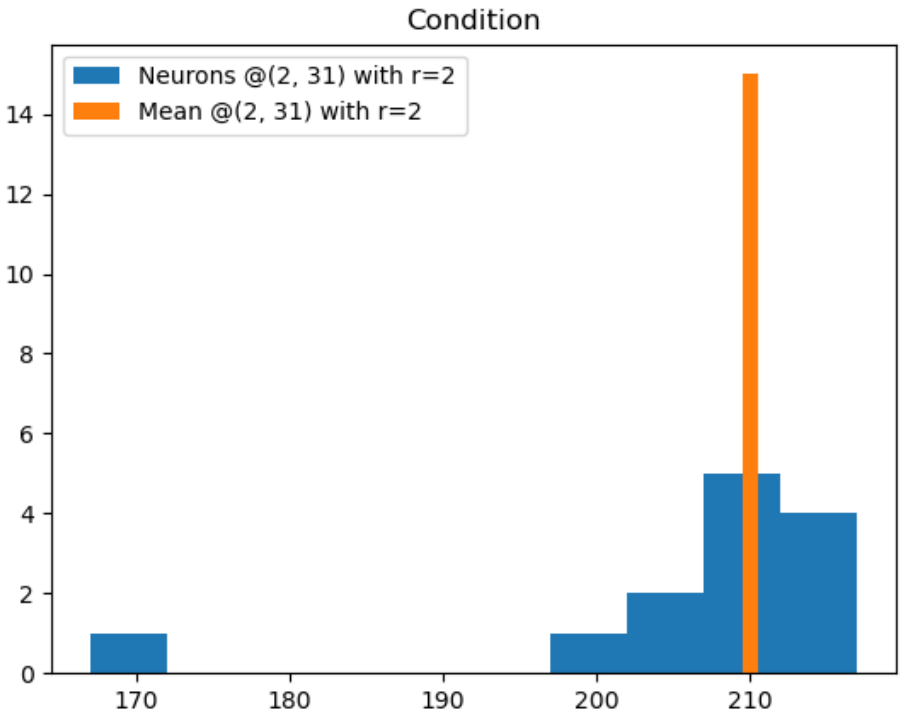


- repeater patch @(17, 34), r=4
- Increasing the (avg.) activation in and past the patch
- Alters other sequences (see upper one)
- No. of sequence analysis need to be done.

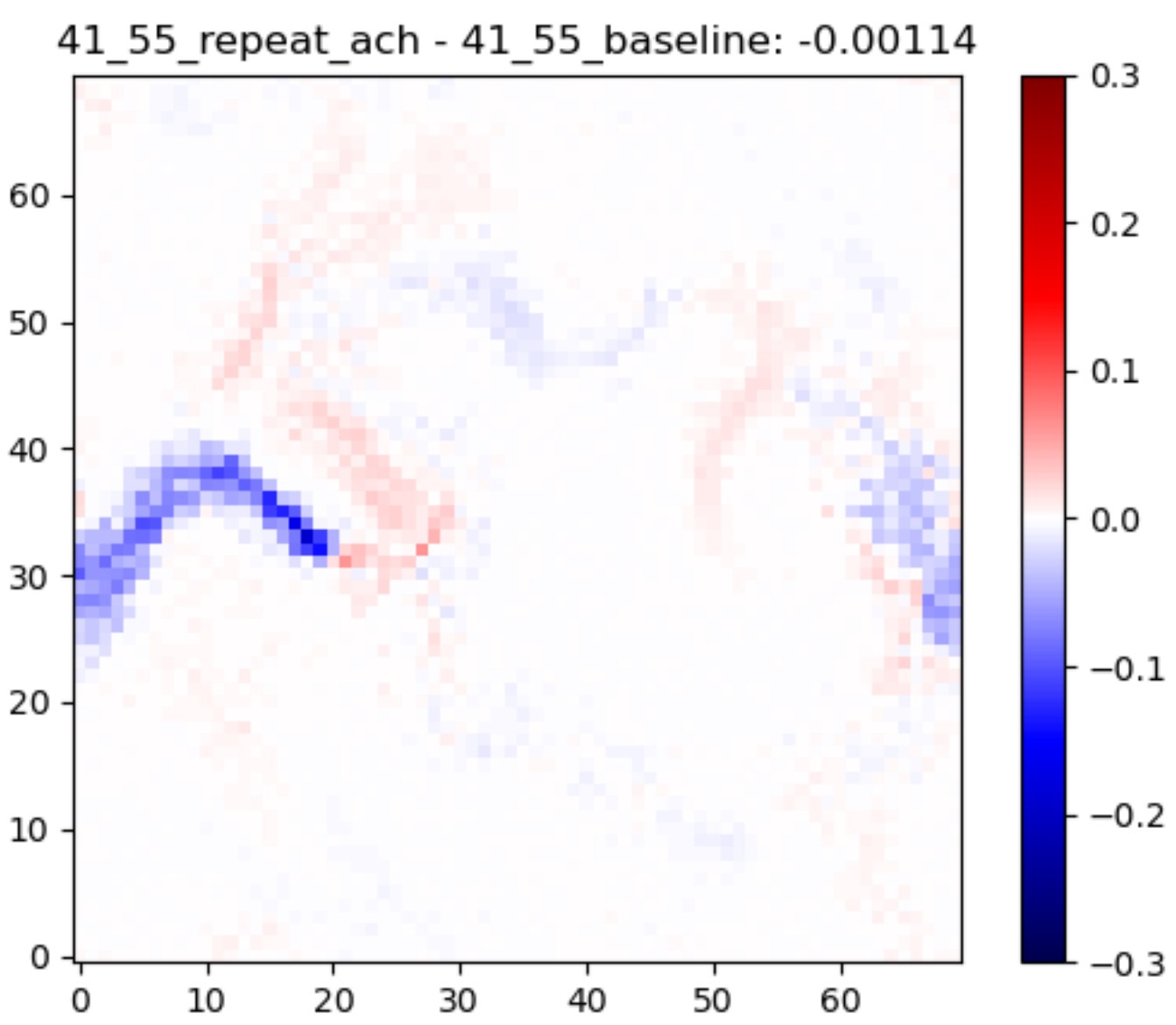


Sequence passing by

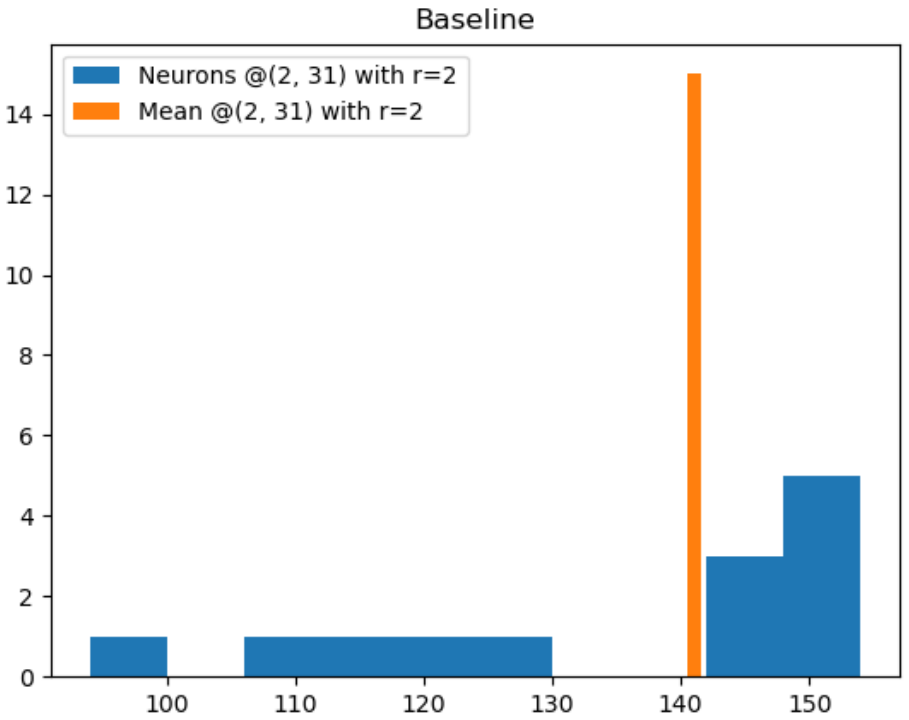


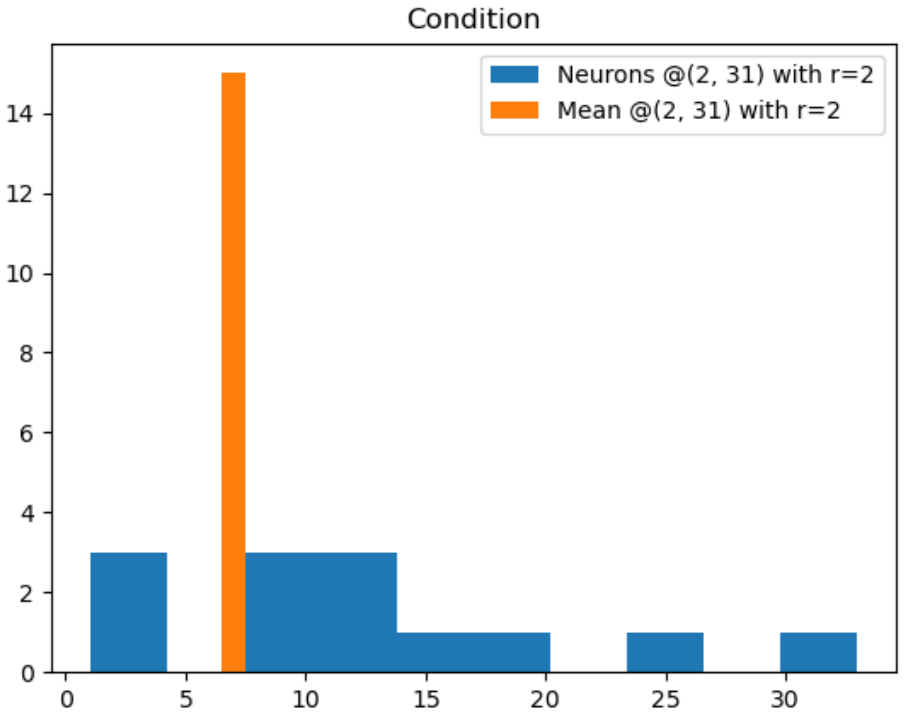


- repeater patch (ACh) @(17, 34), r=4
- Decreasing the (avg.) activation in and past the patch
- Alters other sequences (see upper one)
- No. of sequence analysis need to be done.

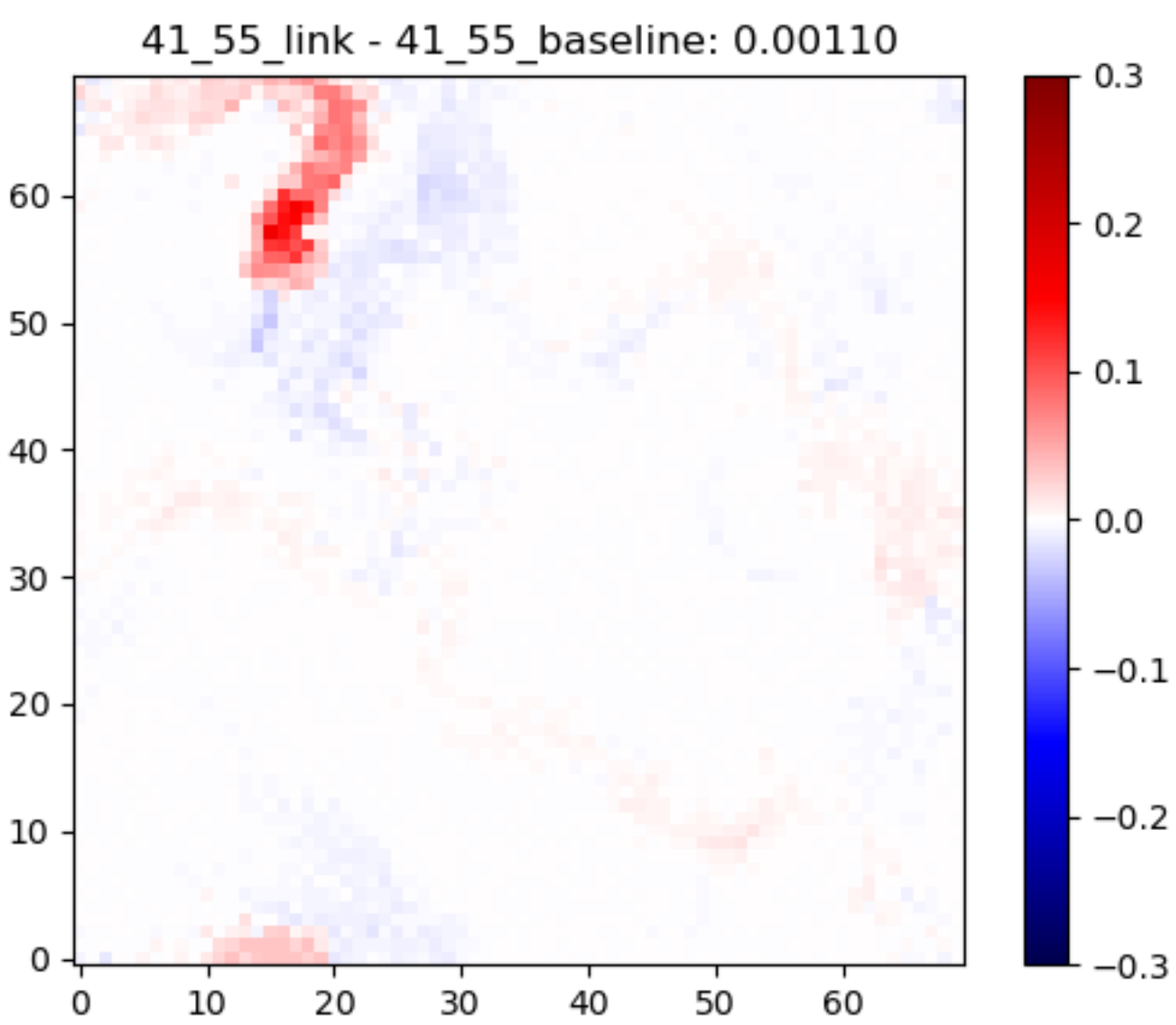


Sequence passing by

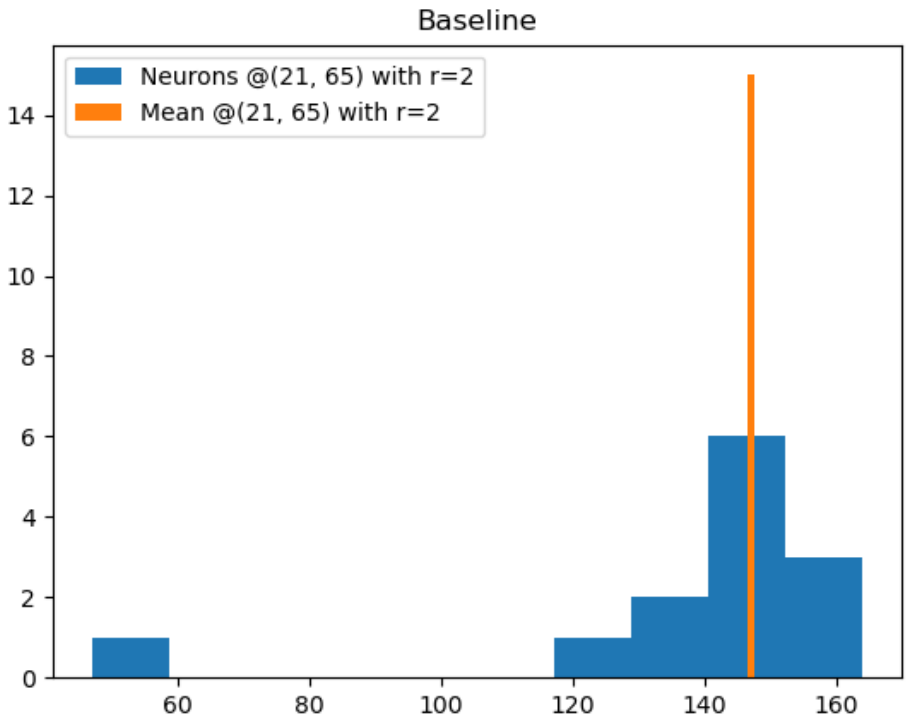


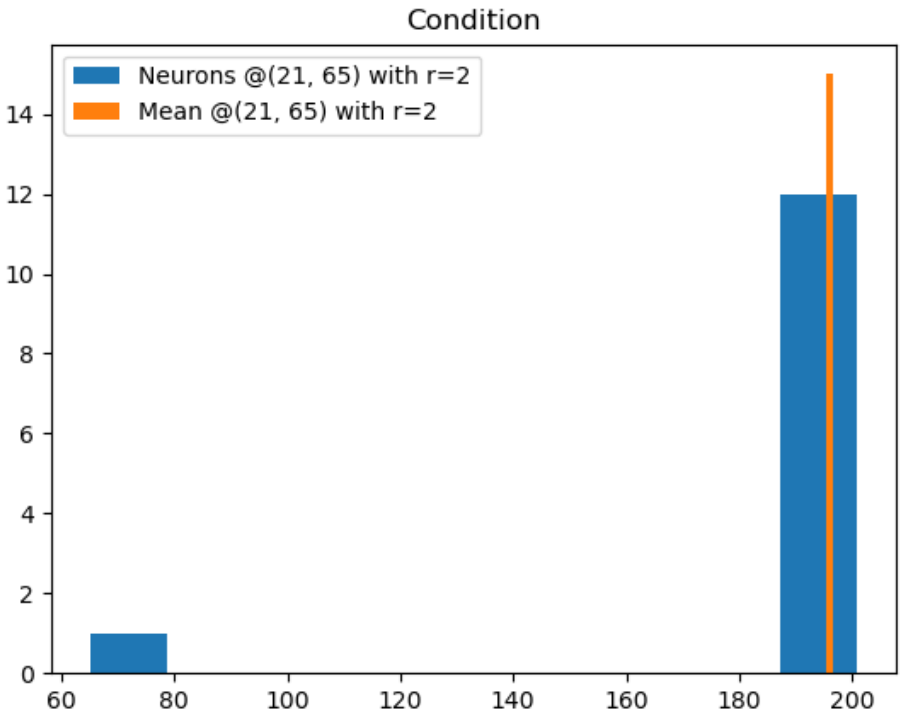


- linker patch @(16, 56), r=4
- Increasing the (avg.) activation in and past the patch
- Alters other sequences (see right beside it)
- No. of sequence analysis need to be done.

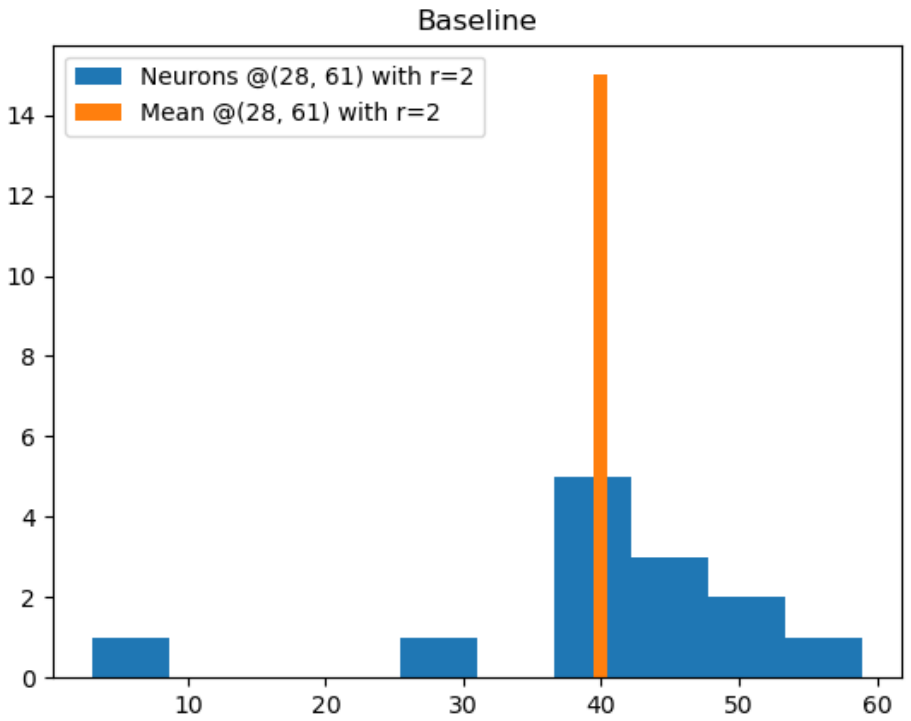


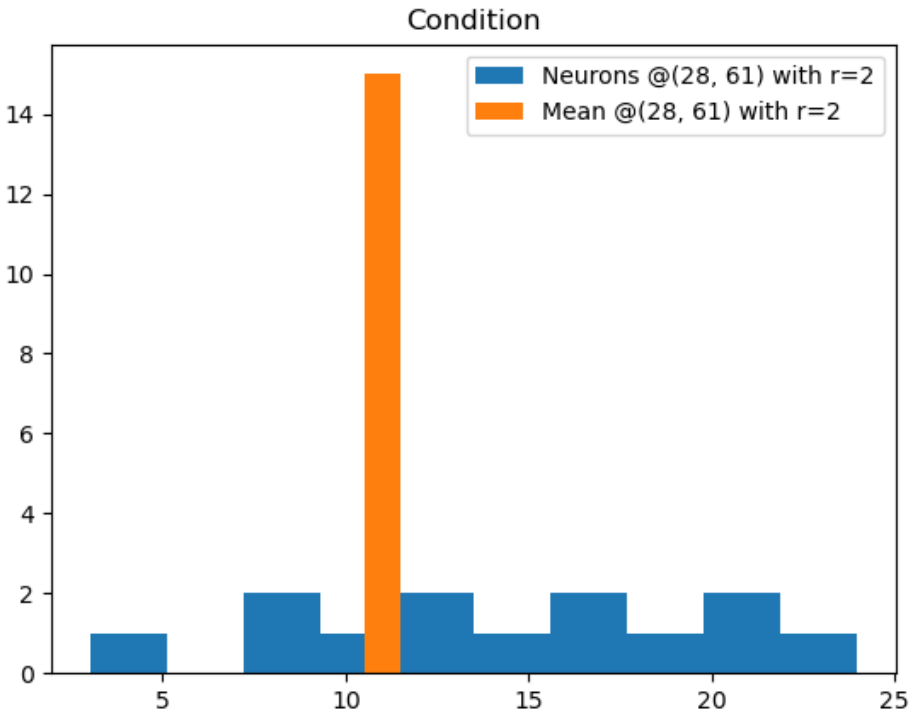
Sequence passing by



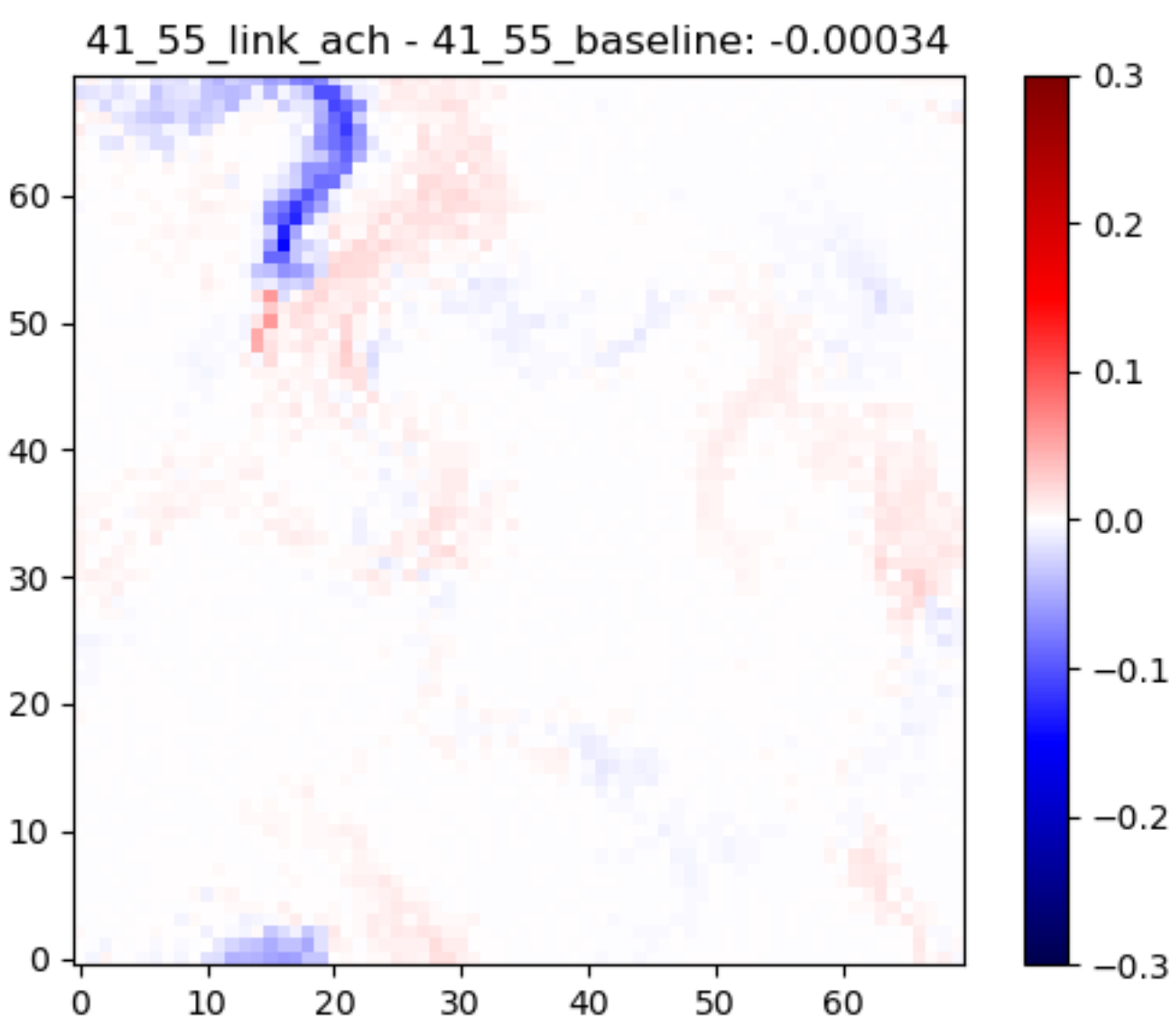


Neighboring sequence passing by

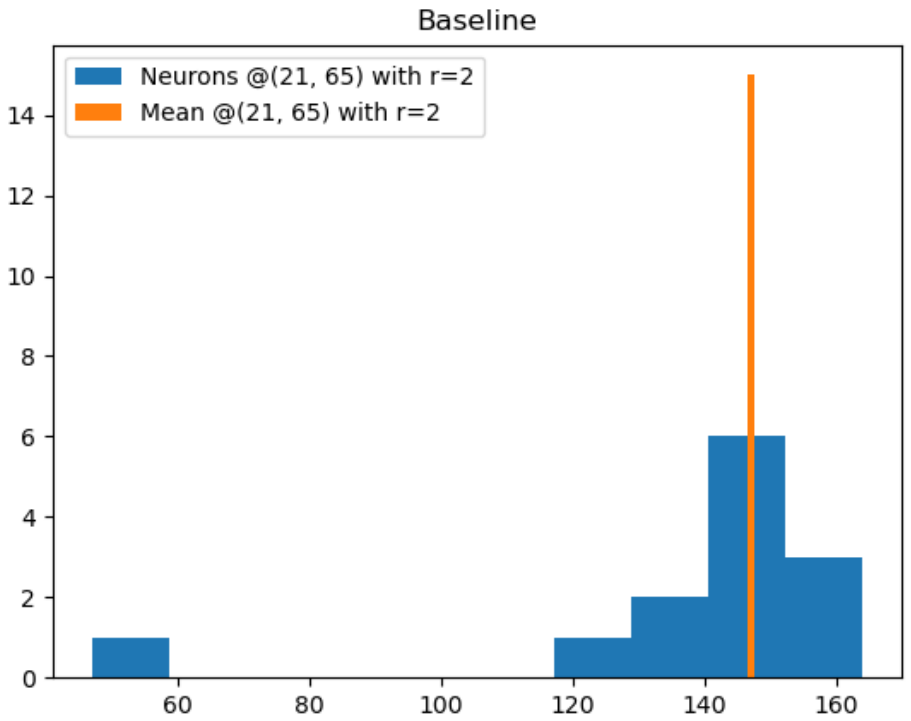


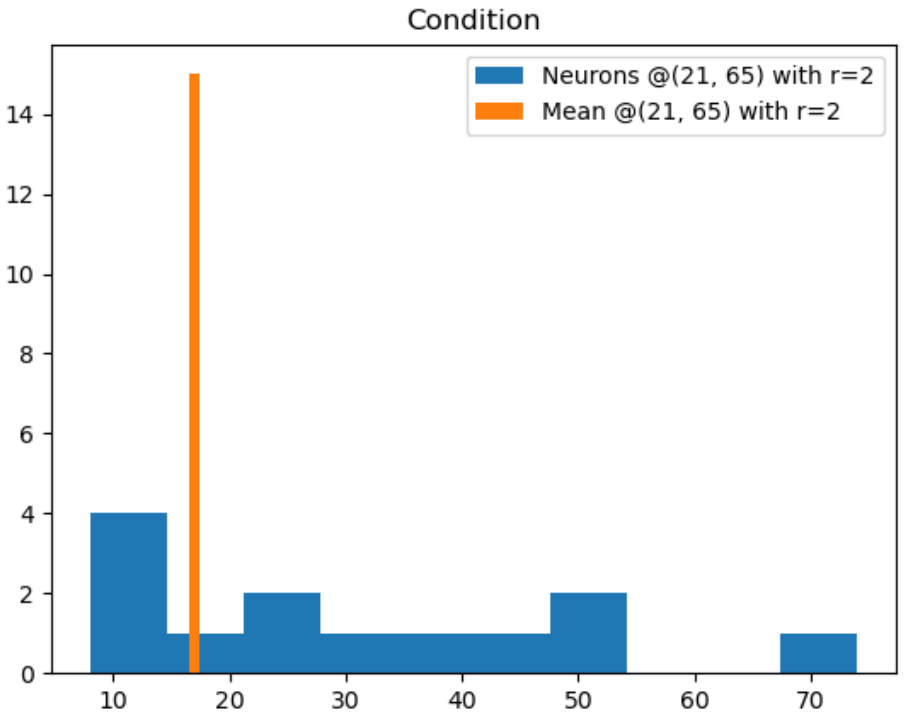


- linker patch (ACh) @(16, 56), r=4
- Decreasing the (avg.) activation in and past the patch
- Alters other sequences (see right beside it)
- No. of sequence analysis need to be done.

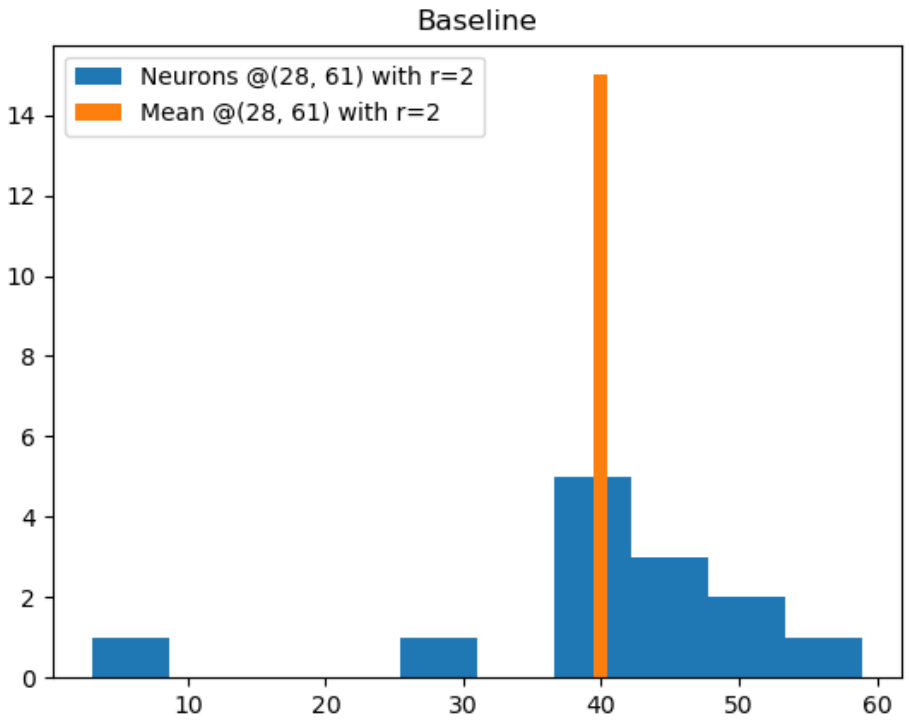


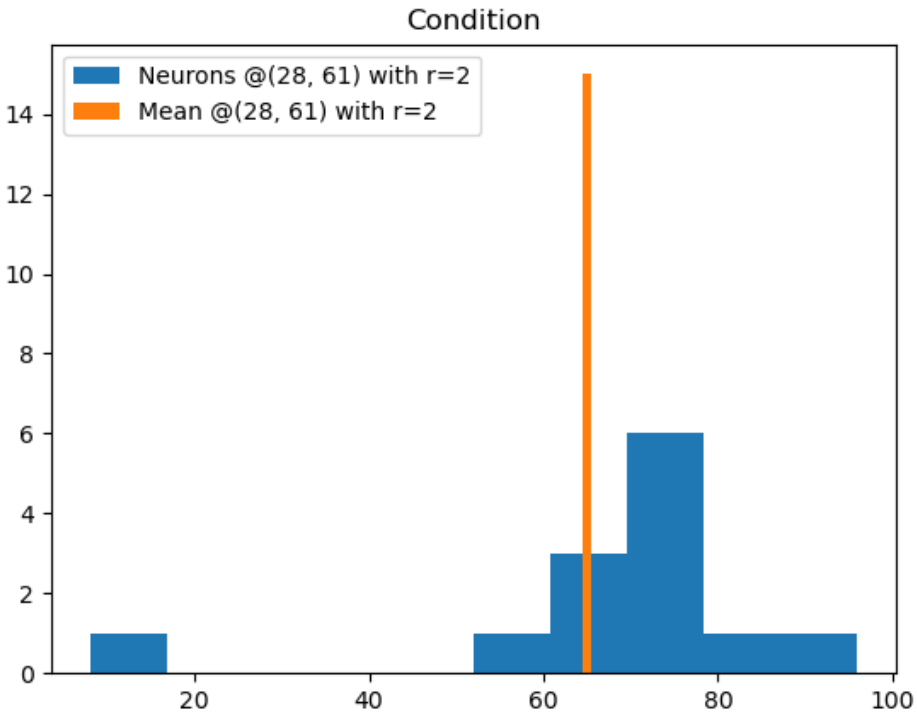
Sequence passing by





Neighboring sequence passing by

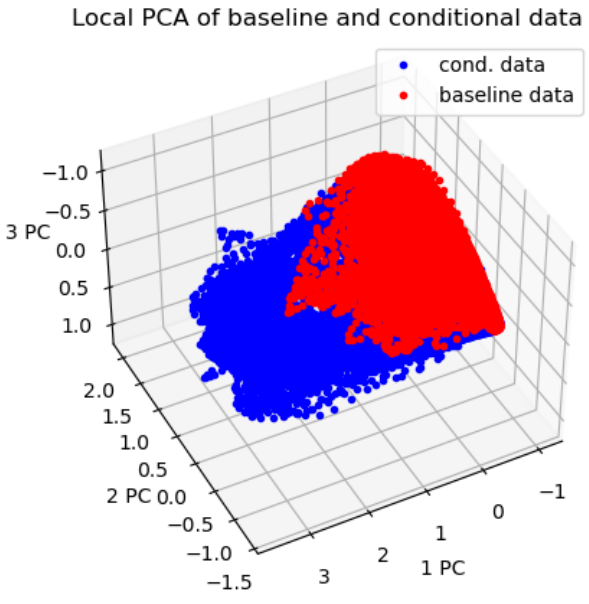


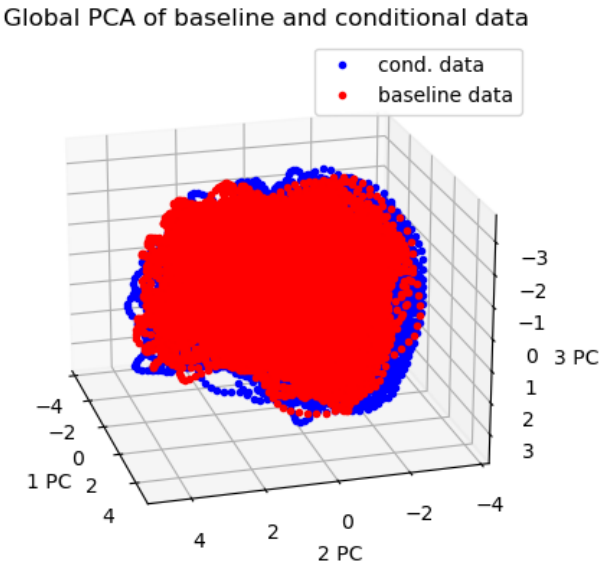


Manifold analysis

Comparing the manifolds of the different patches on a local level (@patch but with a larger radius of 8 instead of 4), and on a global level (everything than the local part)

Repeater (17, 34)

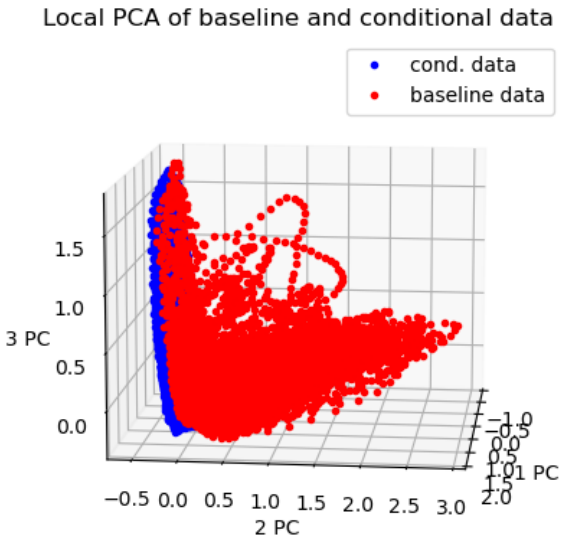


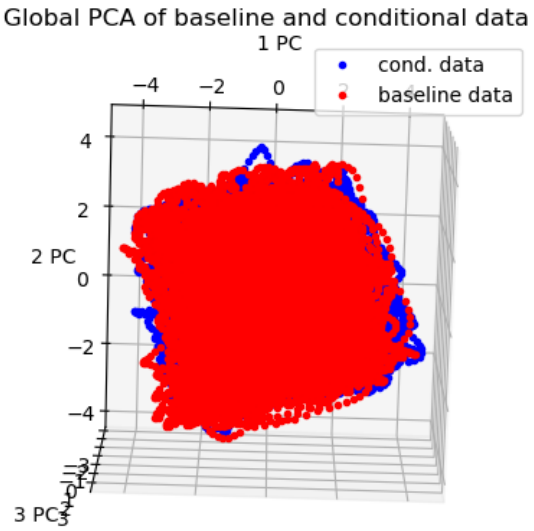


Repeater (17, 34)

Local: More exploration in the PCA-space, and thus in the neural space
Global: No visible effect

Repeater ACh (17, 34)





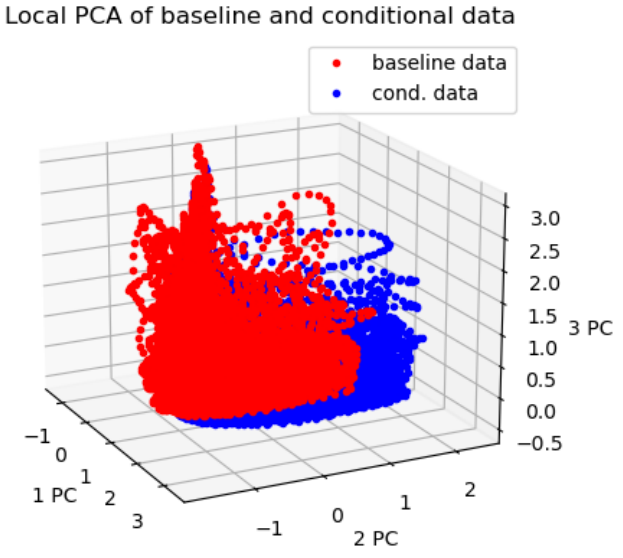
Repeater ACh (17, 34)

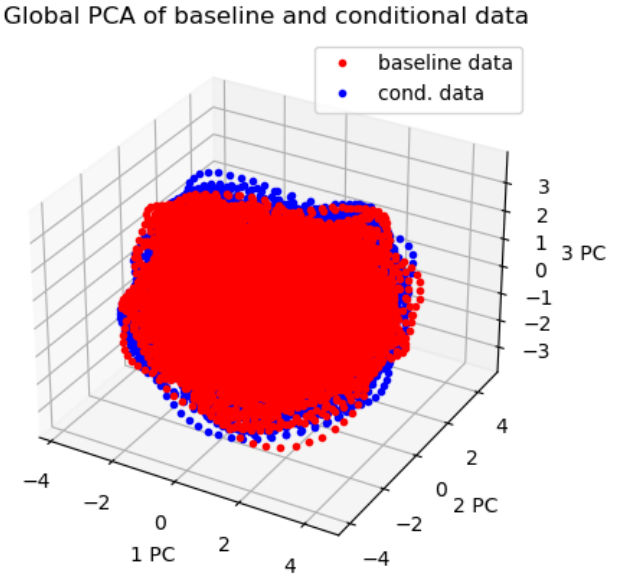
Local: Much less exploration in the PCA-space, and thus in the neural space
Global: No visible effect

Linker (affecting neighboring sequences)

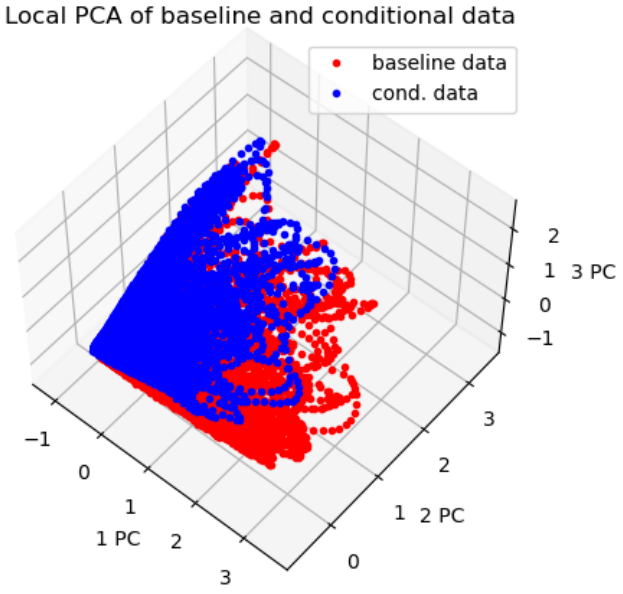
- As we observed in the no. of sequences passed by the linked branch, and the neighboring branch, we expect a strong deviation of the manifolds
- Interestingly, the conditional simulation (DP and ACh) lead to a rather disc-like shape of the activity in the PC space. So without any patch, the neural space is exploited more intensiv.

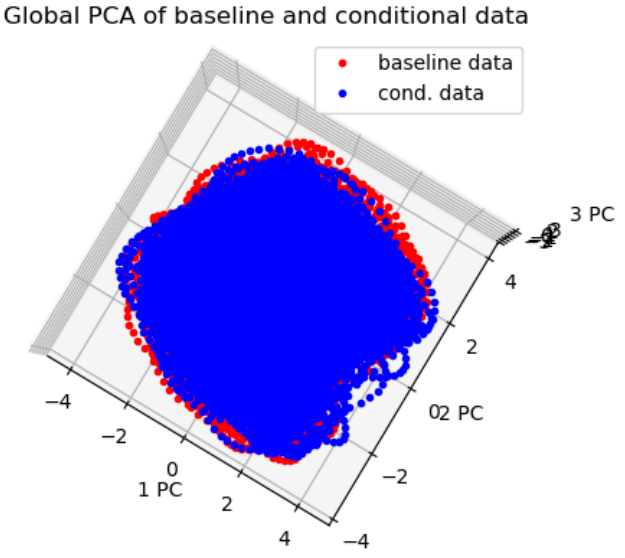
Linker (24, 64)


Local PCA of baseline and conditional data
baseline data
cond. data
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
3 PC
−1
0
1
2
3
1 PC
−1
0
1
2
2 PC


Global PCA of baseline and conditional data
baseline data
cond. data
3
2
1
0
−1
−2
−3
3 PC
−4
−2
0
2
4
1 PC
4
2
0
−2
−4
2 PC

Linker ACh (24, 64)

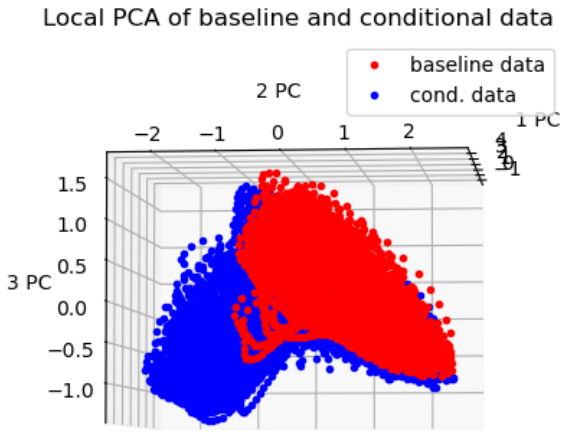


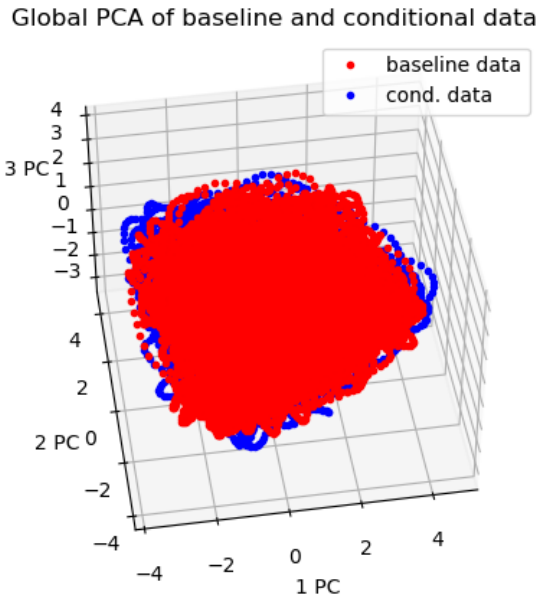


Edge (exploring a new path)

Expectation: High deviation of the manifolds
Result: The PCA in the local area around the patch shows a butterfly. Seems to explore more PC sapce, hence more neural space

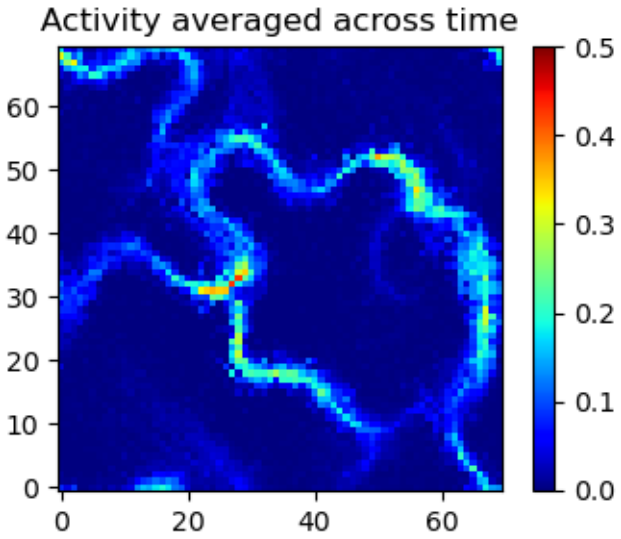
Edge (64, 35)

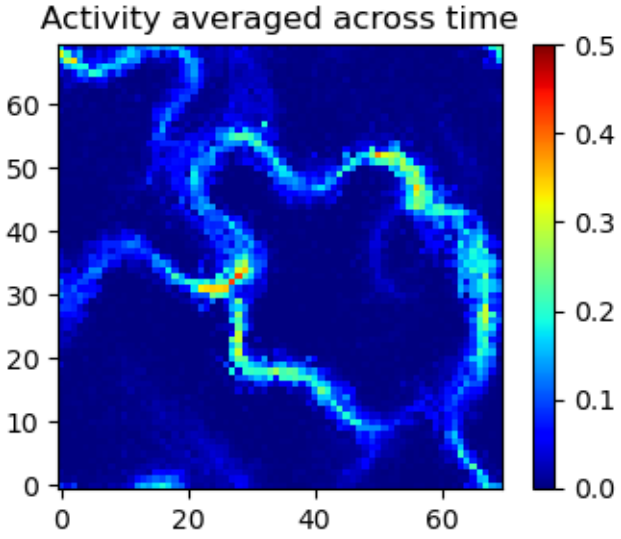

Local PCA of baseline and conditional data
baseline data
cond. data
2 PC
1 PC
3 PC


Global PCA of baseline and conditional data
baseline data
cond. data
3 PC
2 PC
1 PC

Control

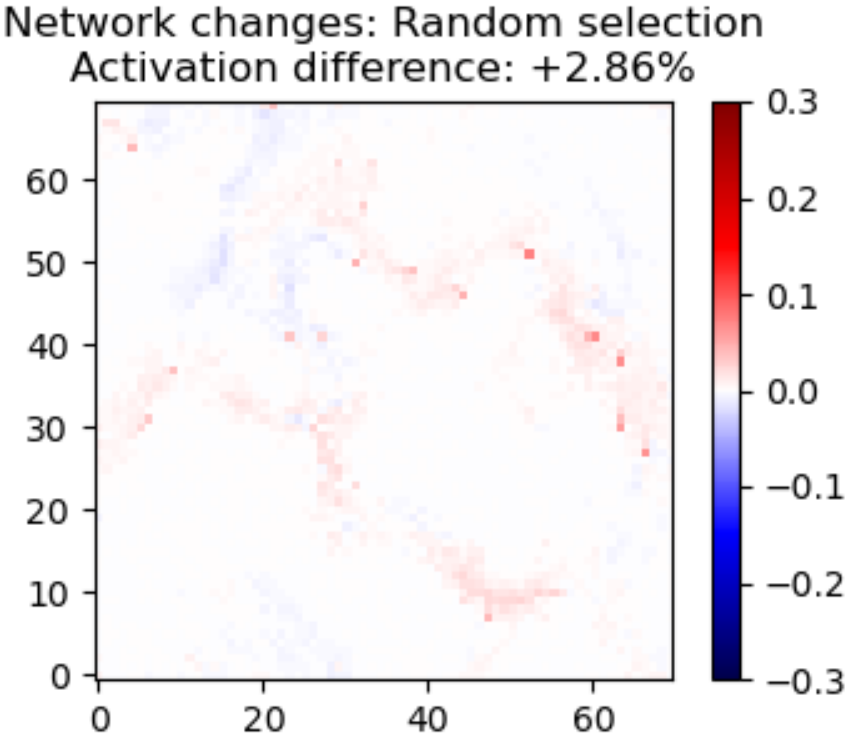
- The same number of neurons as one patch comprises are sampled randomly
- Increase of 20% of the incoming syn. weights





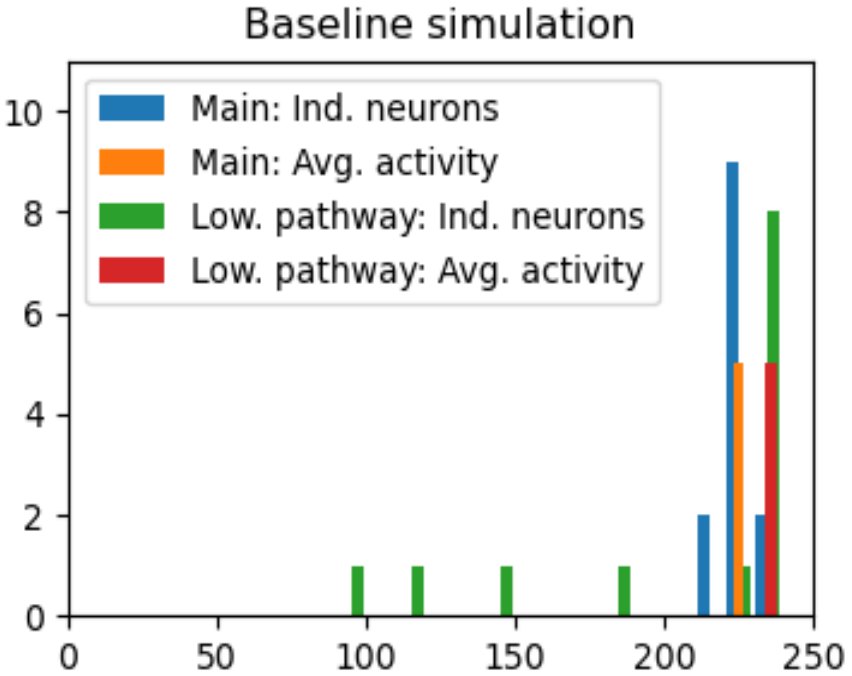
Control

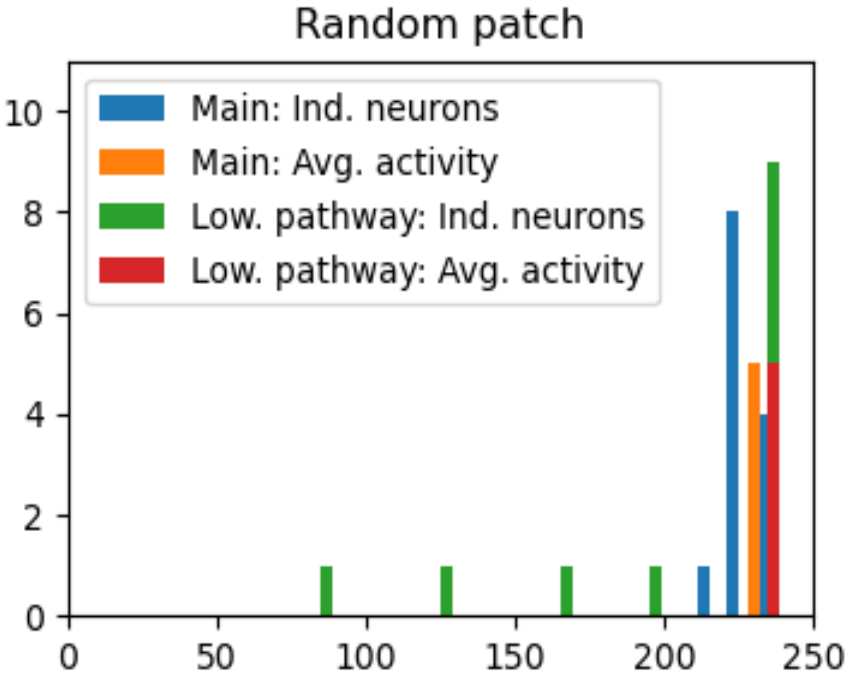
Baseline (upper) and control (lower)



Control

Slightly stronger activation in the pathways
The *Main* is measured at (66, 34) (close to the activator patch), and the lower pathway observed the sequences at (35, 18) (see in-patch)
The no. of detected sequenced raised from 225 to 230, and from 236 to 237, respectively.

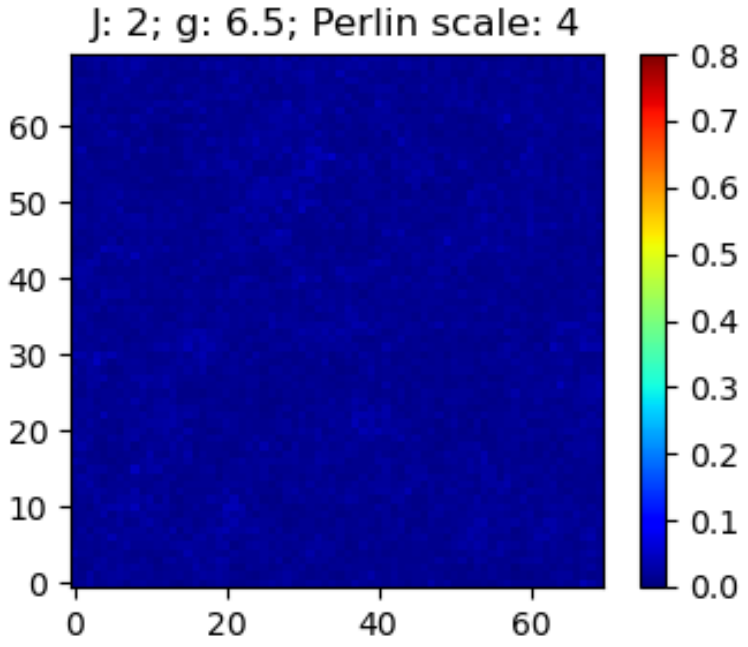


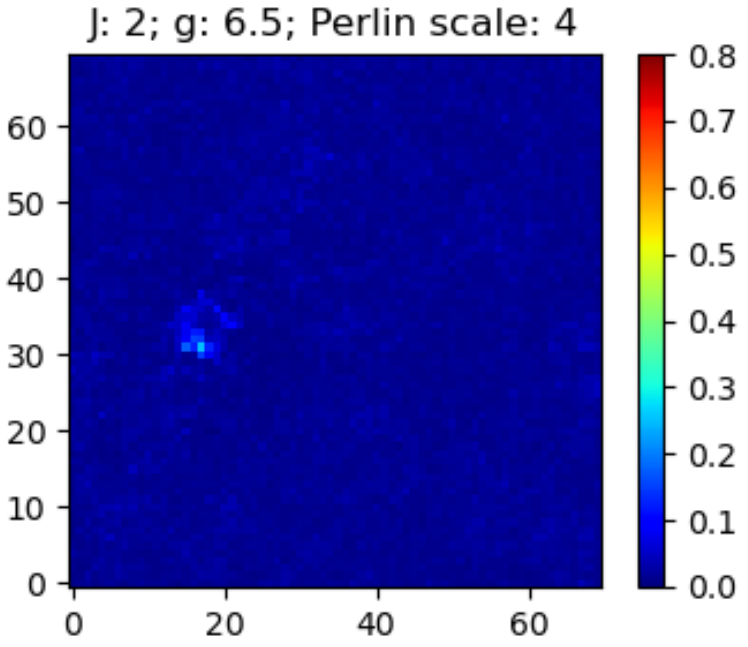


Control

- Symmetric layout
- Increase of 20% of the incoming syn. weights

Repeater


J: 2; g: 6.5; Perlin scale: 4
0
10
20
30
40
50
60
0
20
40
60
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8


J: 2; g: 6.5; Perlin scale: 4
0
10
20
30
40
50
60
0
20
40
60
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8