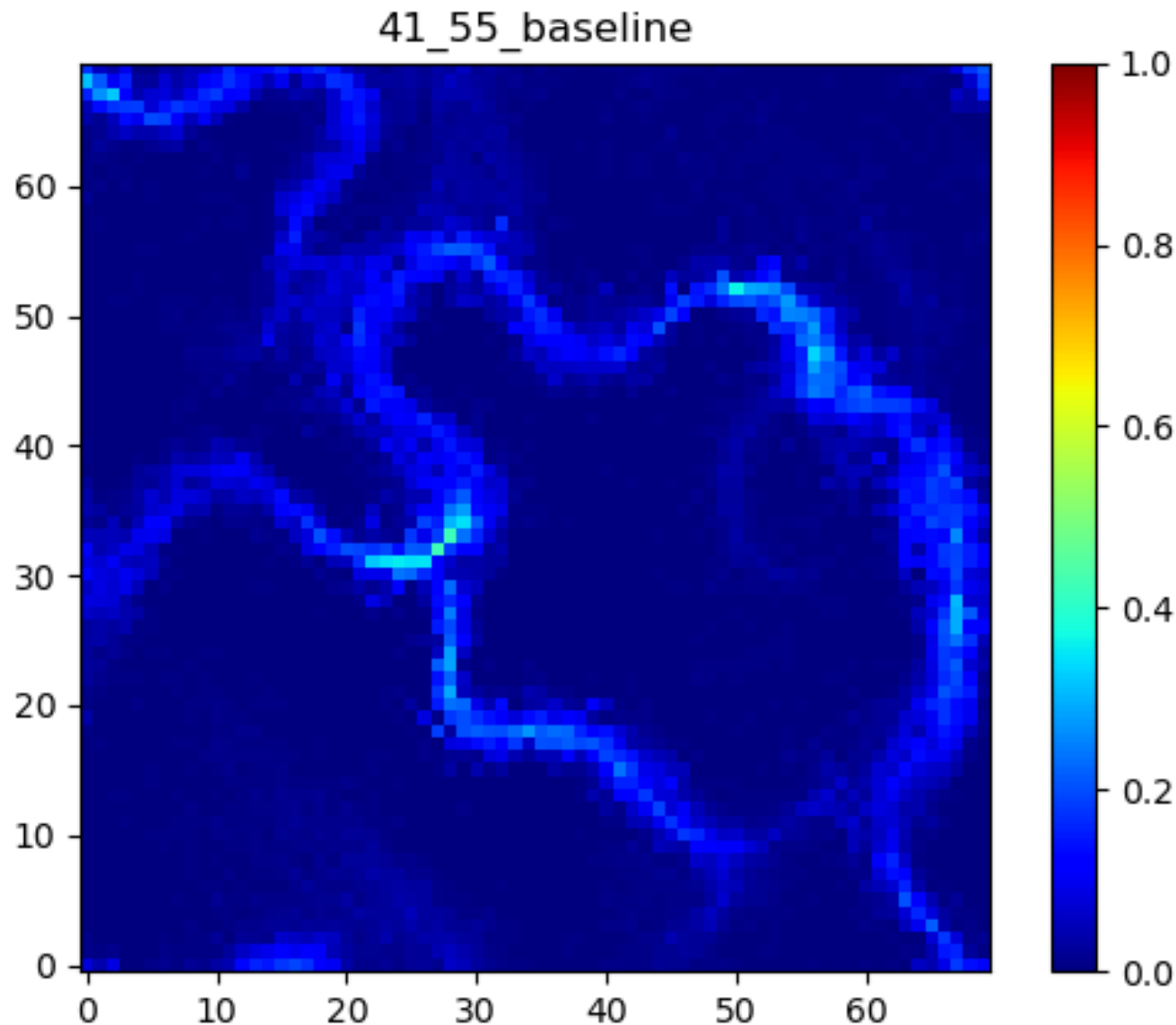


Dopamine arithmetics

Configuration:

- Perlin size: 4 (base/seed: 1), $\text{sig}_{EE}=5$, $\text{sig}_{II}=5$
- $J=2$, $g=6.5$, ext. drive= 20 ± 20
- $N_{\text{rows}}=70$, $p=20\%$, seed=912
- Transfer function: steepness=0.5, $x_0=50$

- 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)

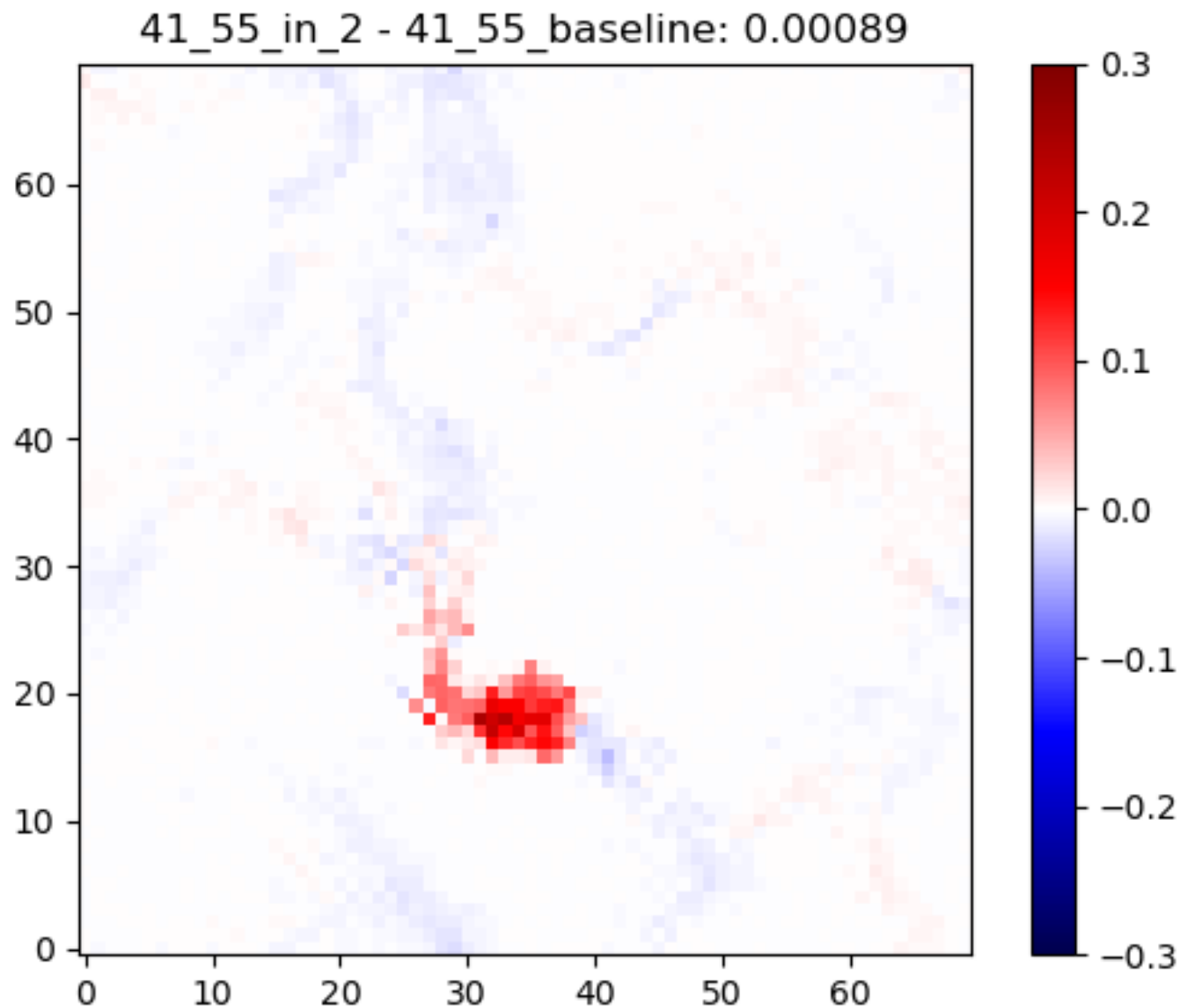


Patch placed orthogonal to STAS direction

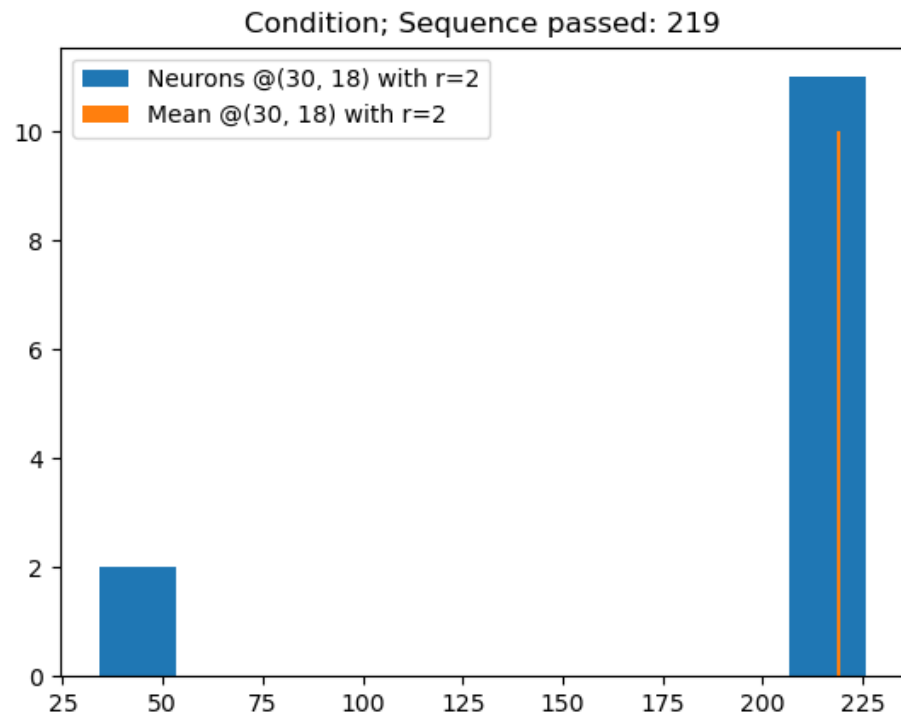
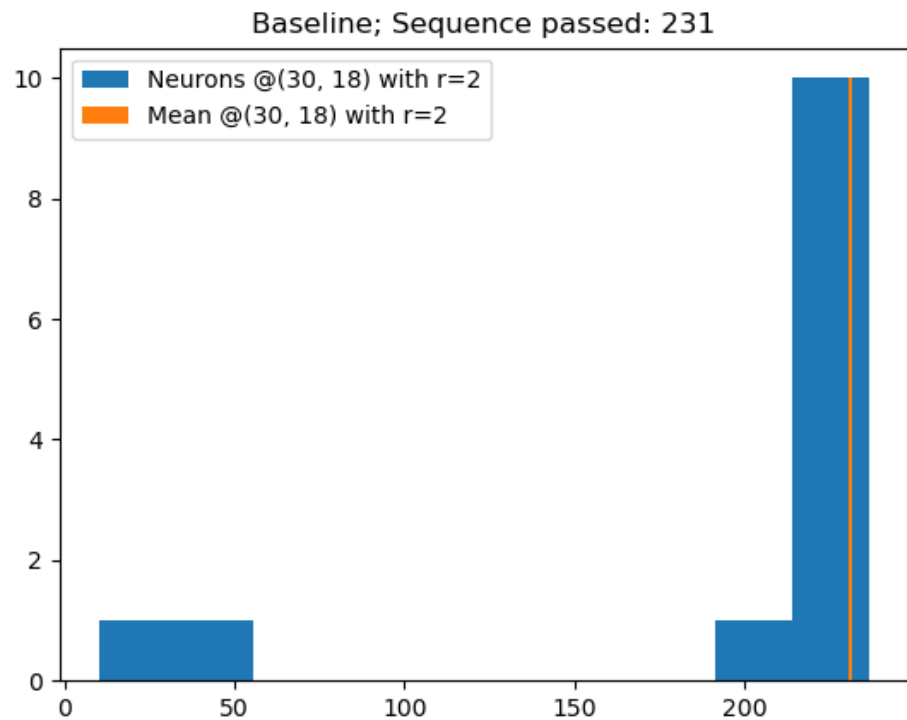
In-, edge-, and out- patch

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

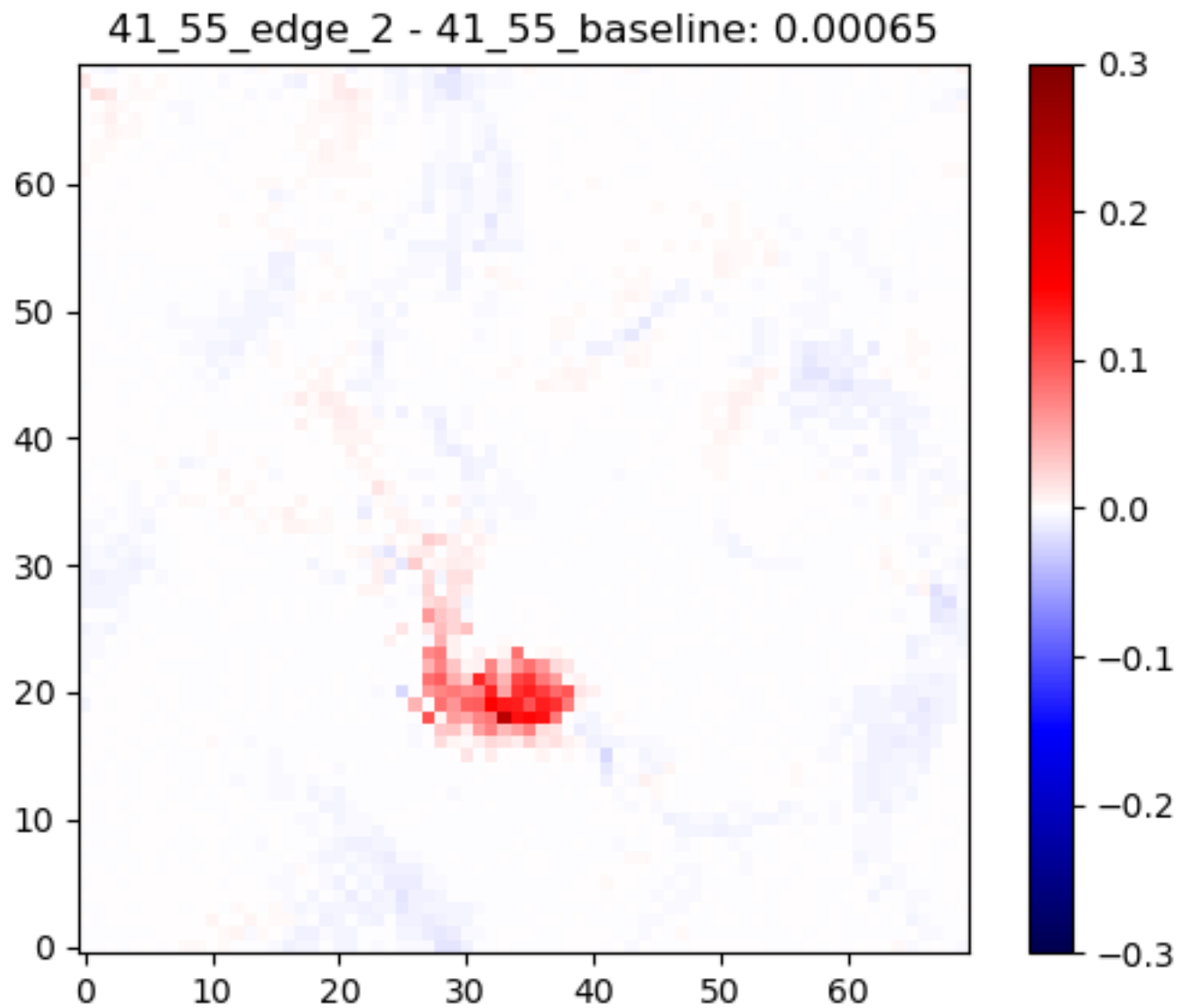
- In patch $@(35, 18)$, $r=4$
- Increasing the (avg.) activation in and past the patch
- Reducing the avg. activation prior to the patch



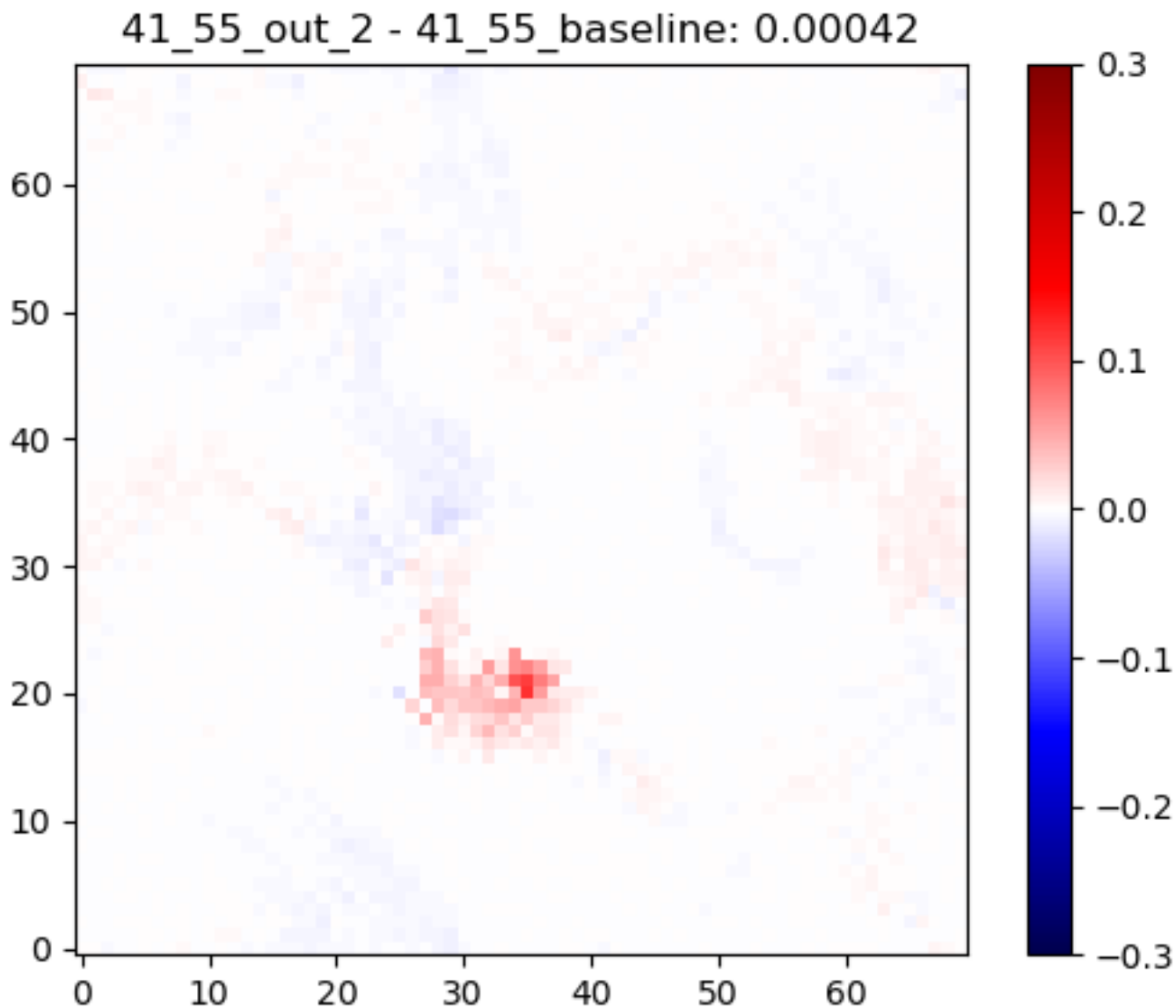
Sequence passing by



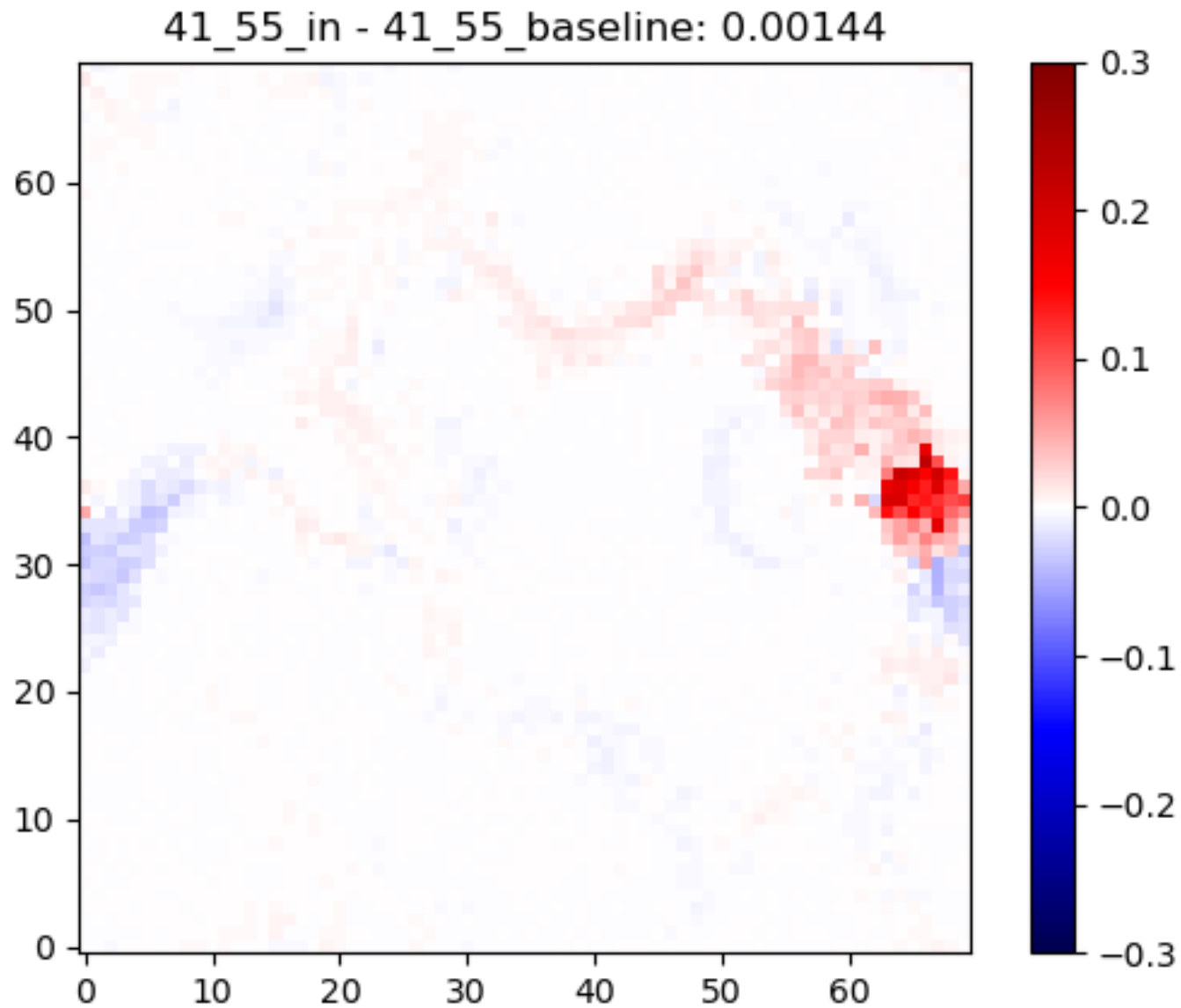
- edge patch @(35, 21), $r=4$
- Increasing the (avg.) activation in and past the patch
- Reducing the avg. activation prior to the patch
- Effect is smaller compared to the in-patch
- No. of sequence analysis need to be done.



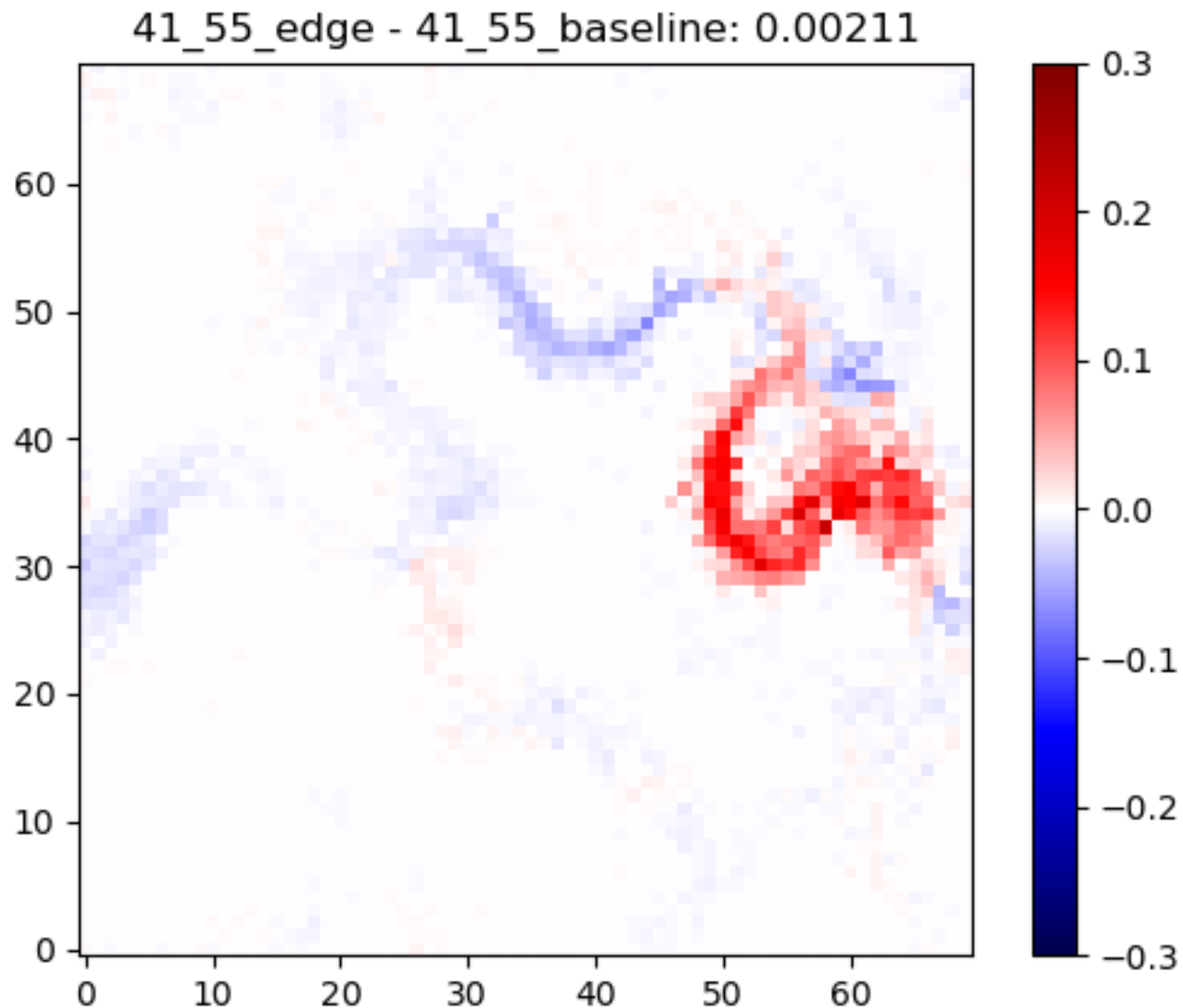
- out patch @(35, 24),
r=4
- Increasing the (avg.)
activation in and past
the patch
- Reducing the avg.
activation prior to the
patch
- Effect is smaller
compared to the in-
patch and edge-
patch
- No. of sequence
analysis need to be
done.



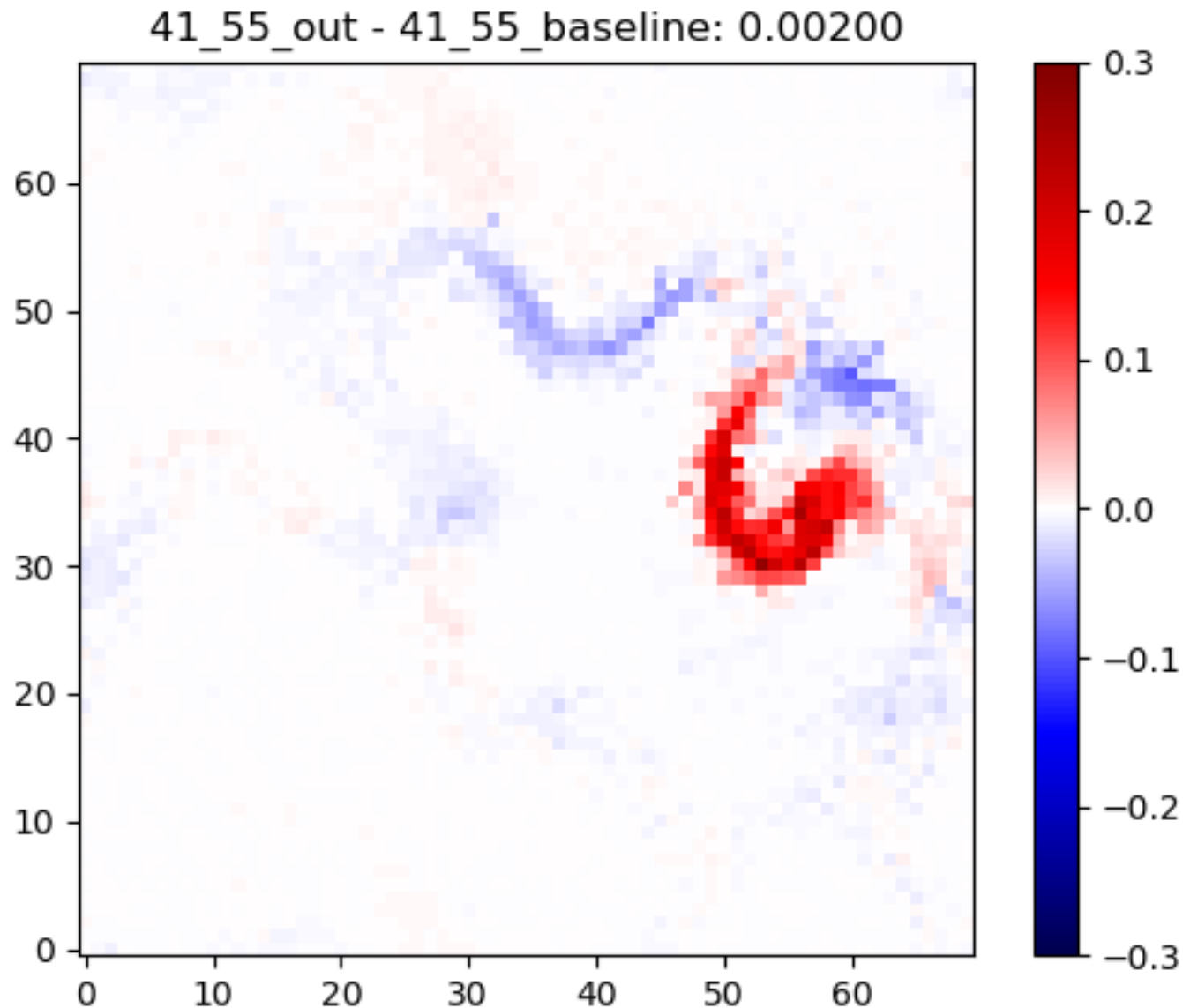
- in patch @(66, 34), r=4
- Increasing the (avg.) activation in and past the patch
- Reducing the avg. activation prior to the patch
- No. of sequence analysis need to be done.



- 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

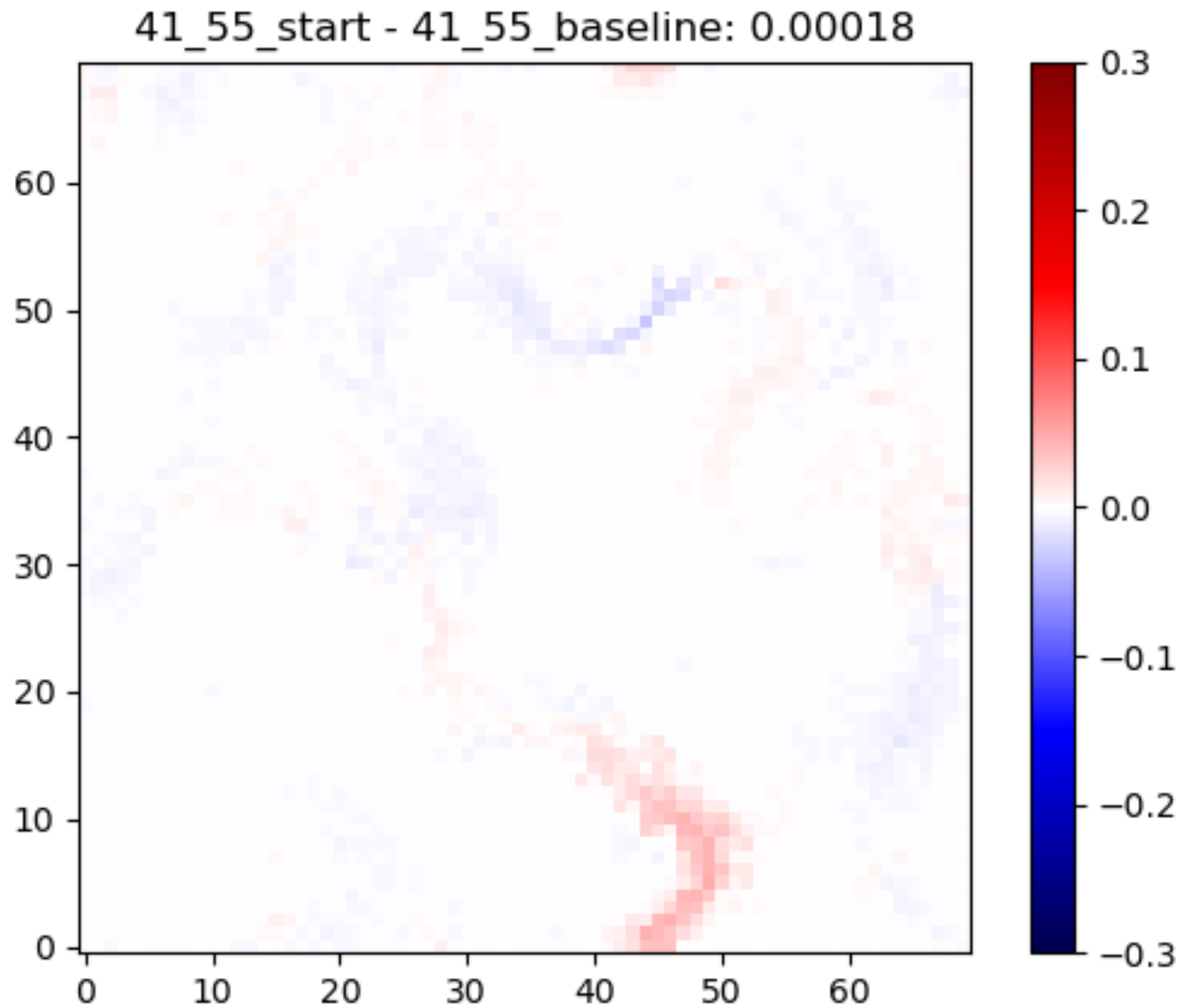
Repeater patch

Linker patch

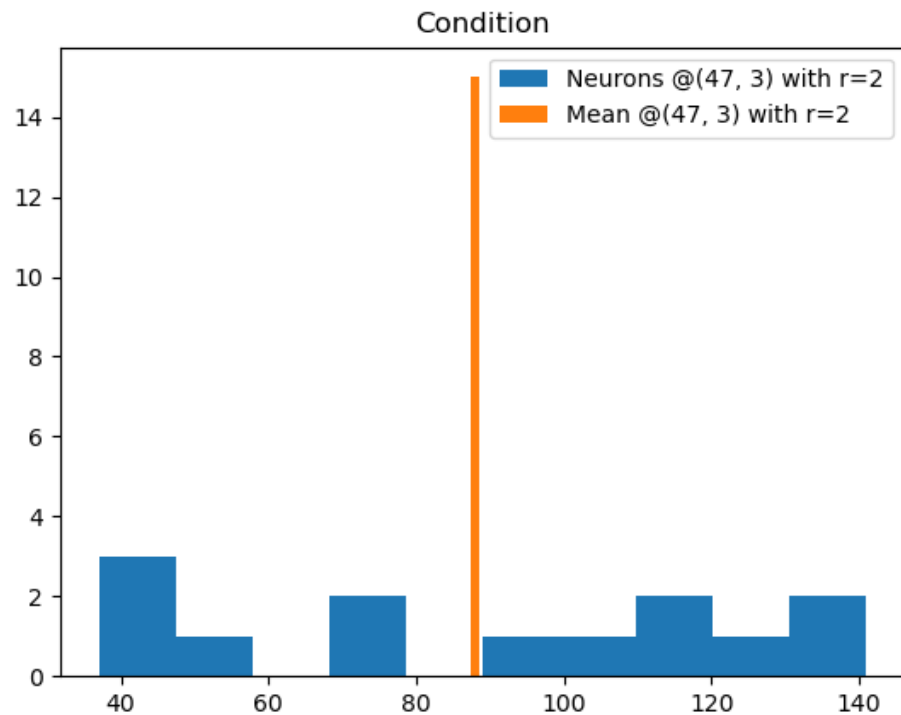
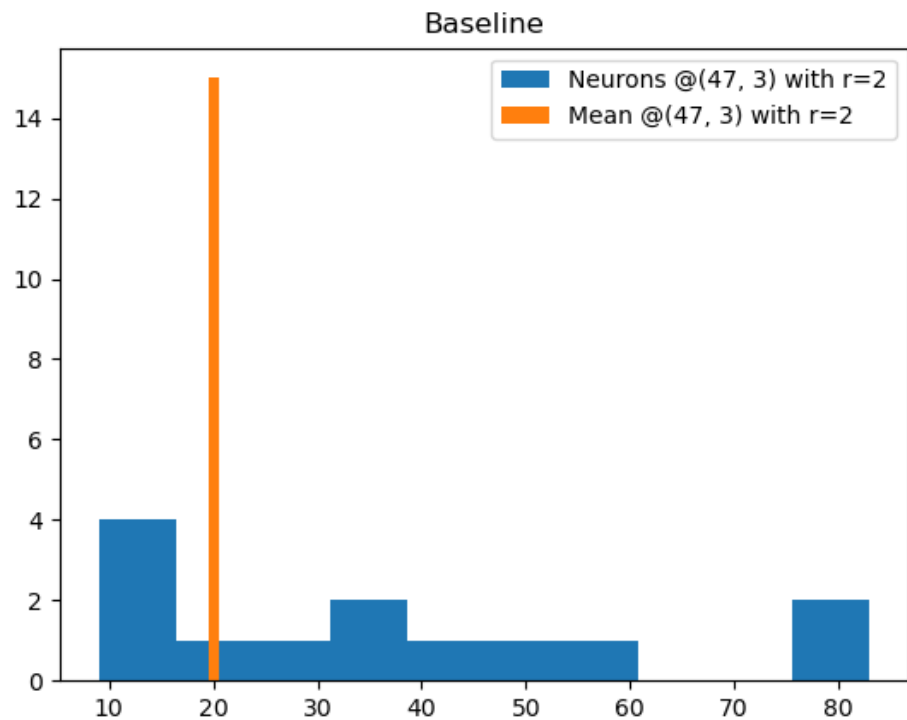
Effectively changing the sequence pattern occurring in the network. Thus, the combination of the patches allows for arithmetics of sequences.

Simple binary operations are possible.

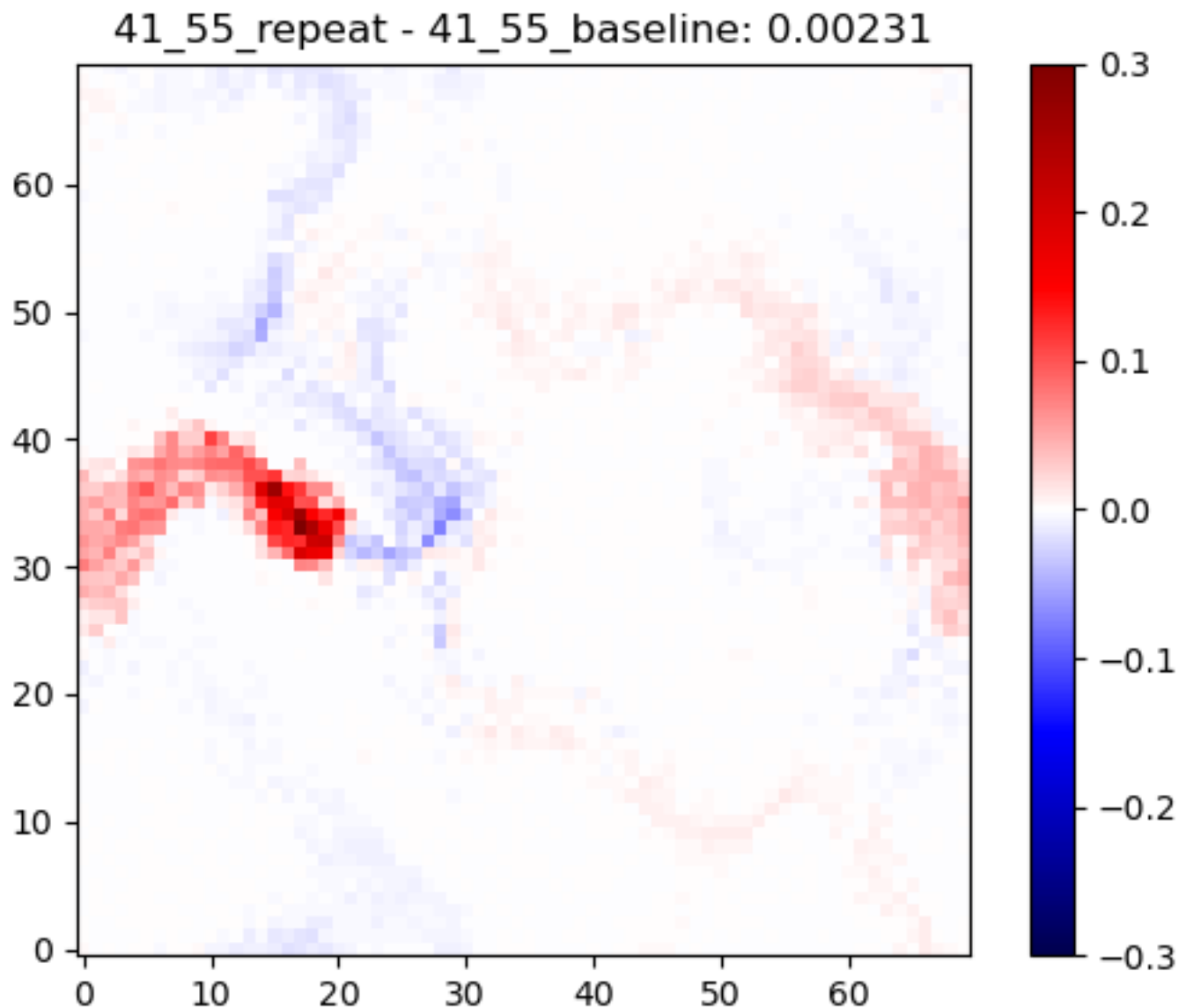
- starter patch
@ (43, 68), $r=4$
- Increasing the
(avg.) activation
in and past the
patch (see the
red pixels on
the bottom)
- No. of
sequence
analysis need
to be done.



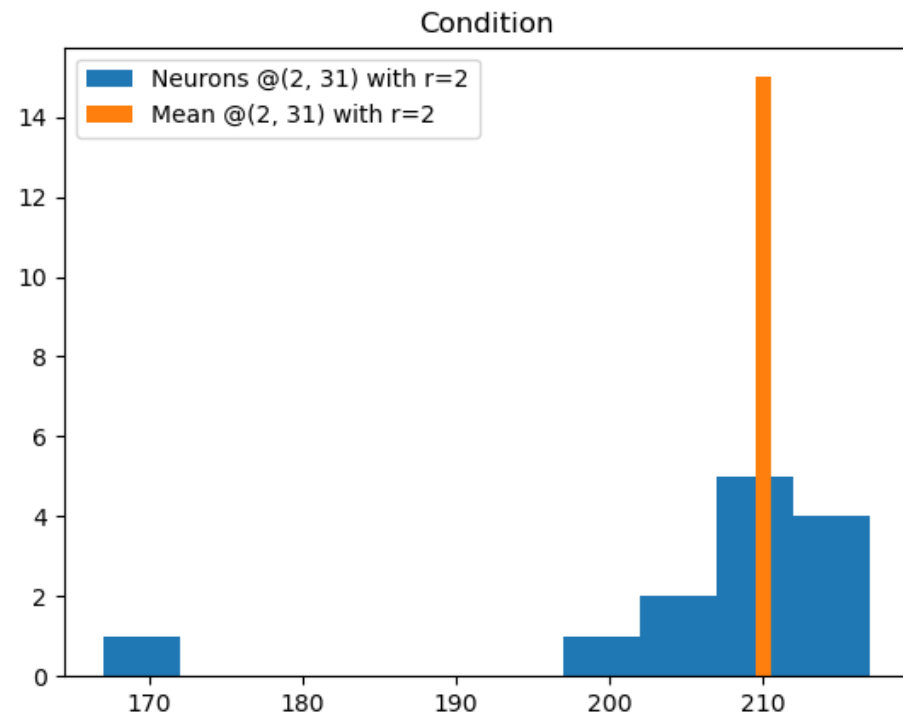
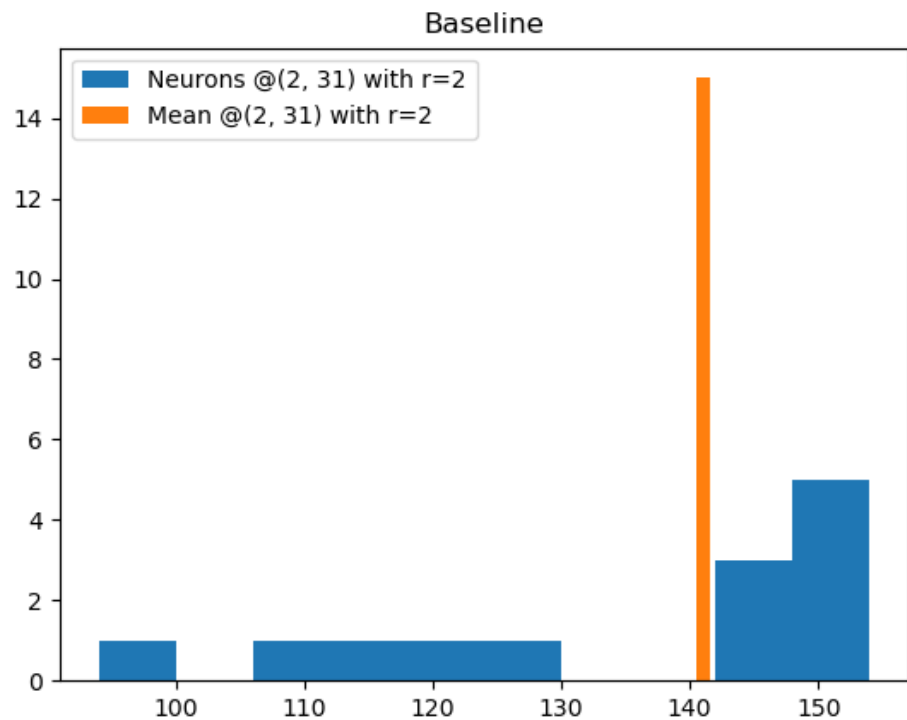
Sequence passing by



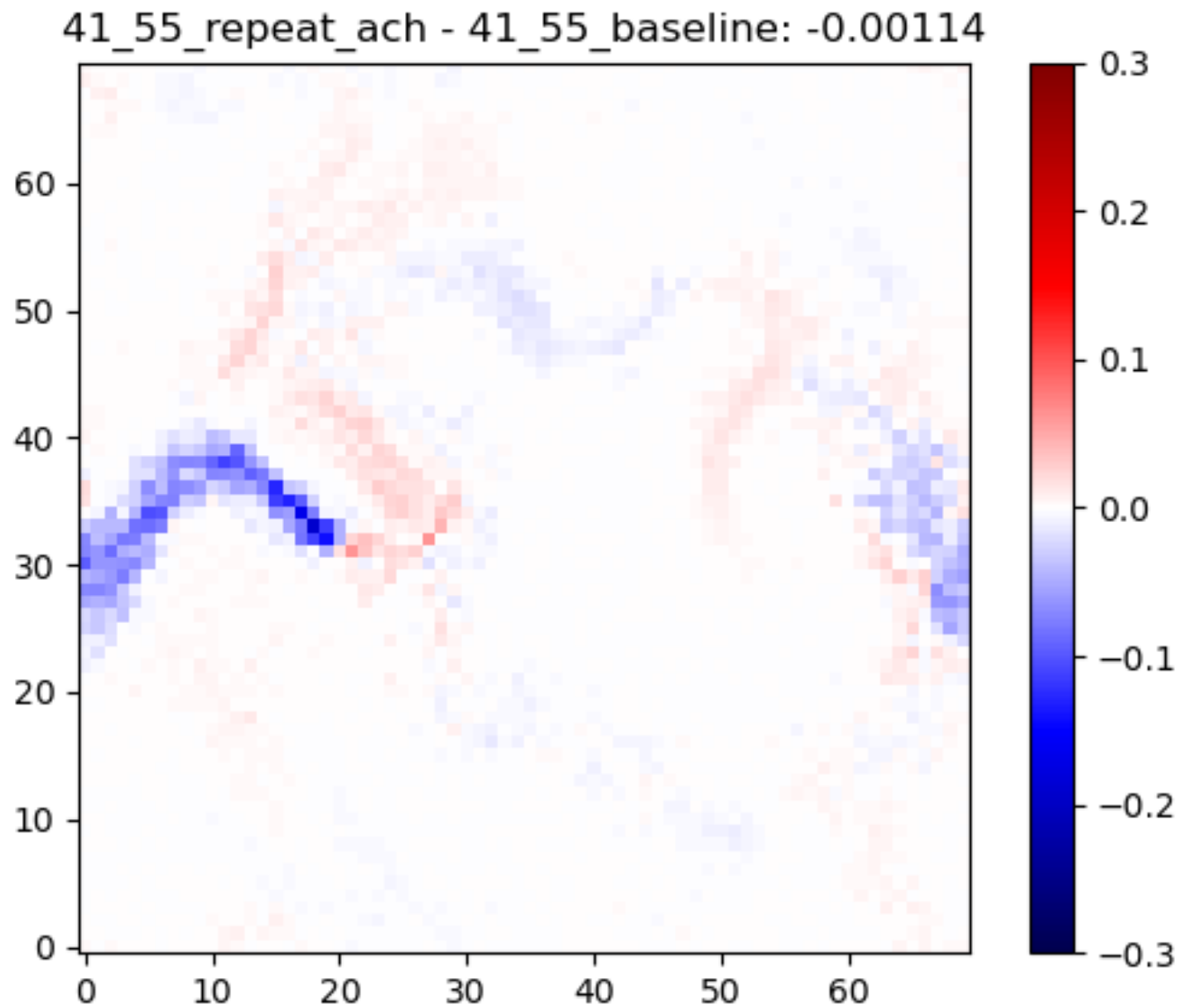
- repeater patch
@ (17, 34), $r=4$
- Increasing the
(avg.) activation
in and past the
patch
- Alters other
sequences (see
upper one)
- No. of sequence
analysis need to
be done.



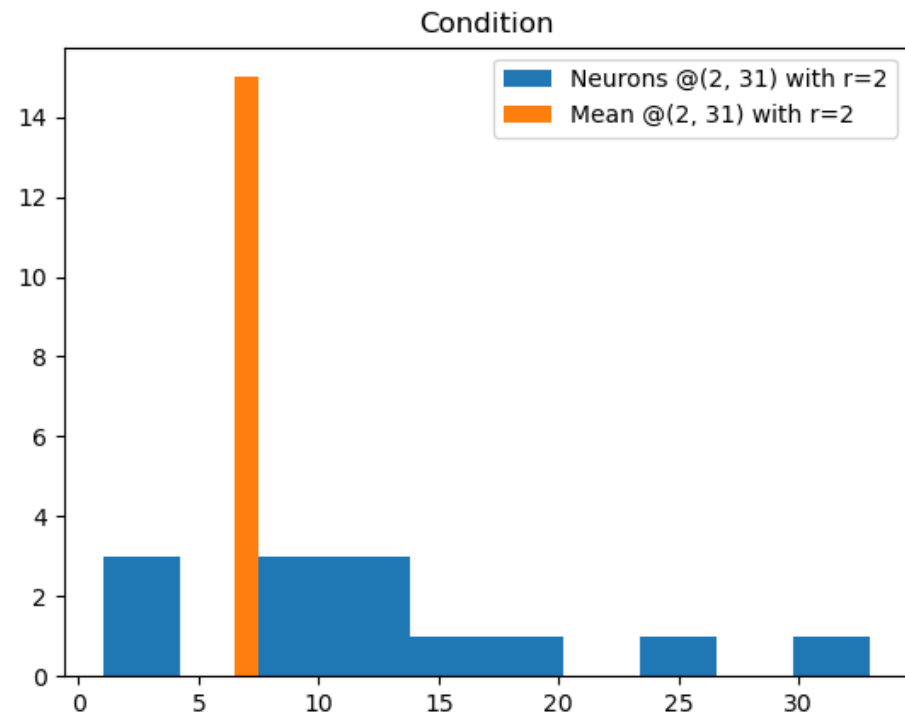
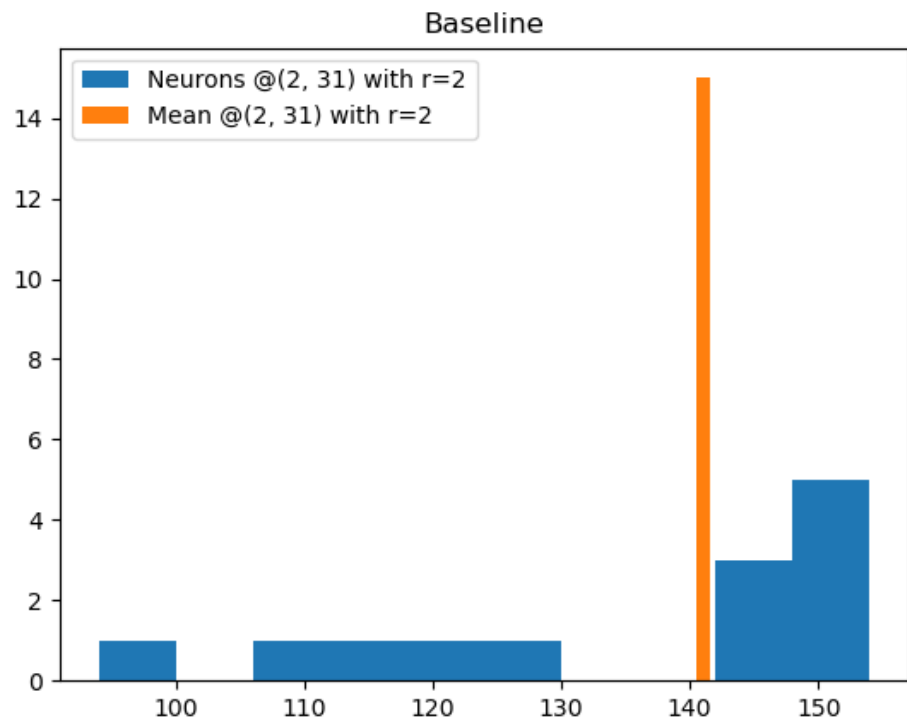
Sequence passing by



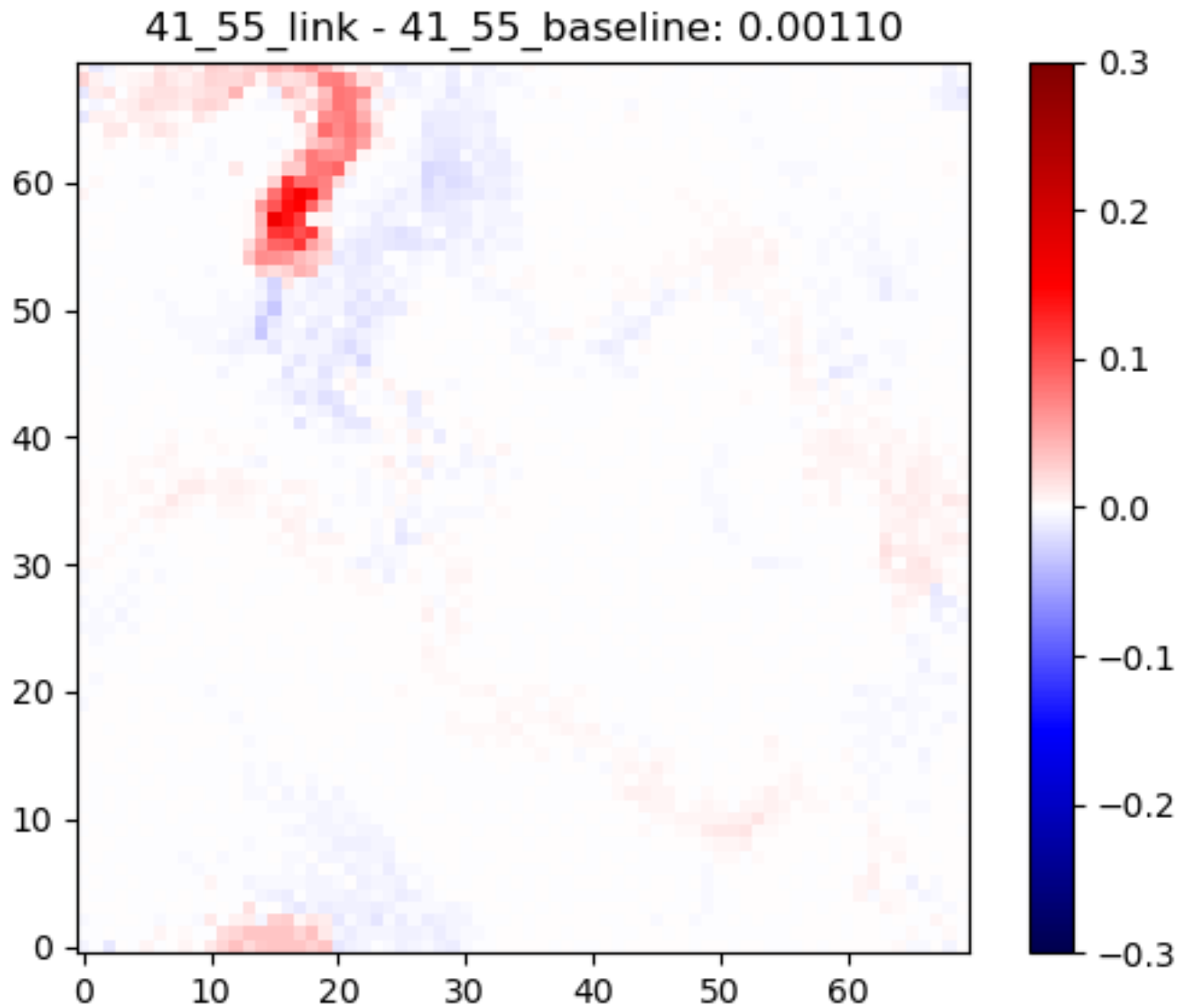
- repeater patch (ACh) @ (17, 34), $r=4$
- Decreasing the (avg.) activation in and past the patch
- Alters other sequences (see upper one)
- No. of sequence analysis need to be done.



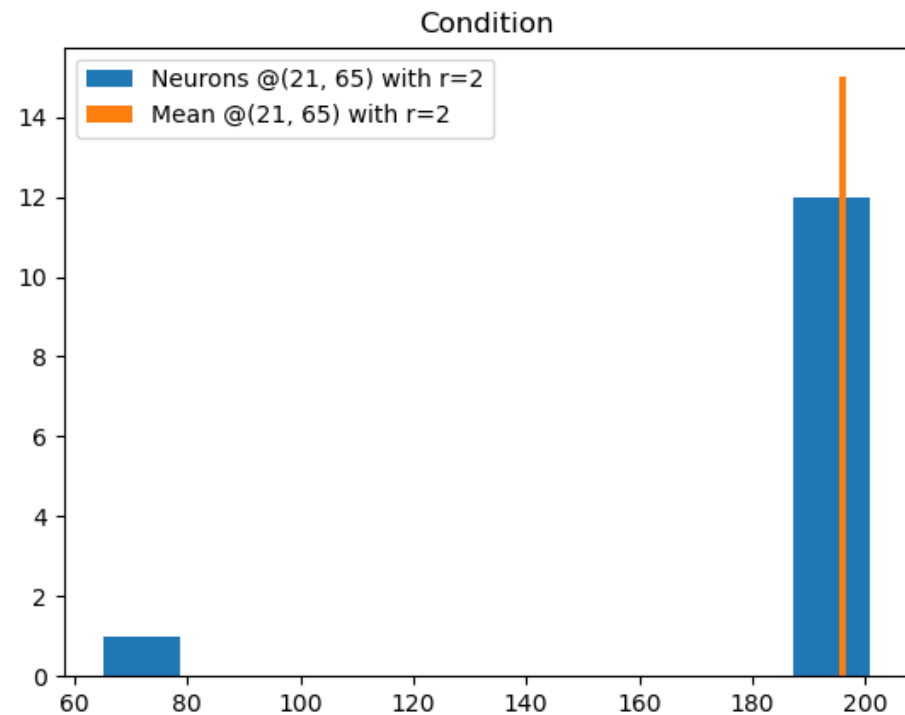
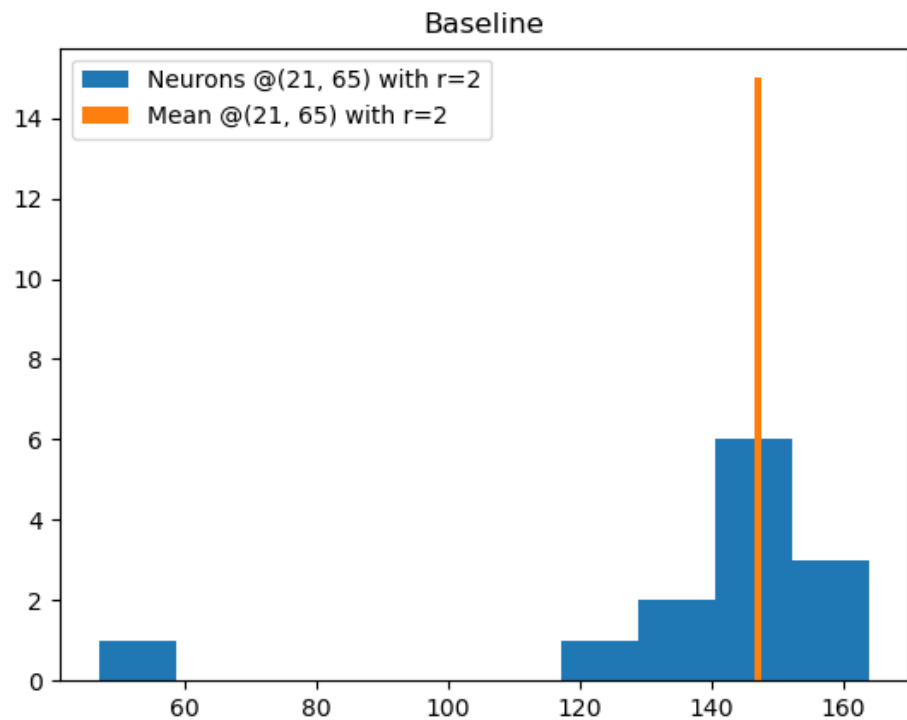
Sequence passing by



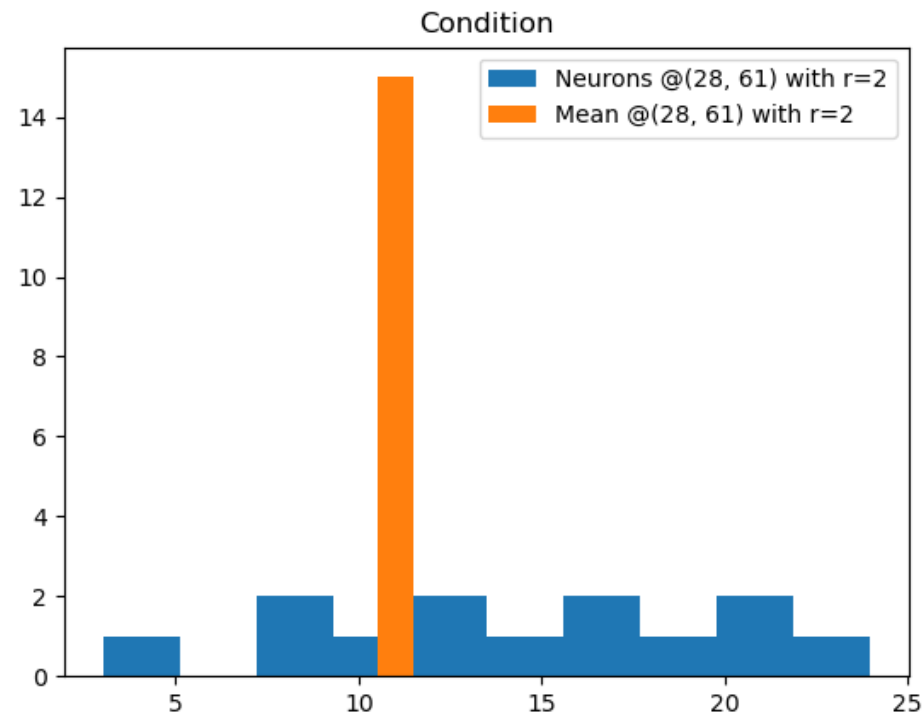
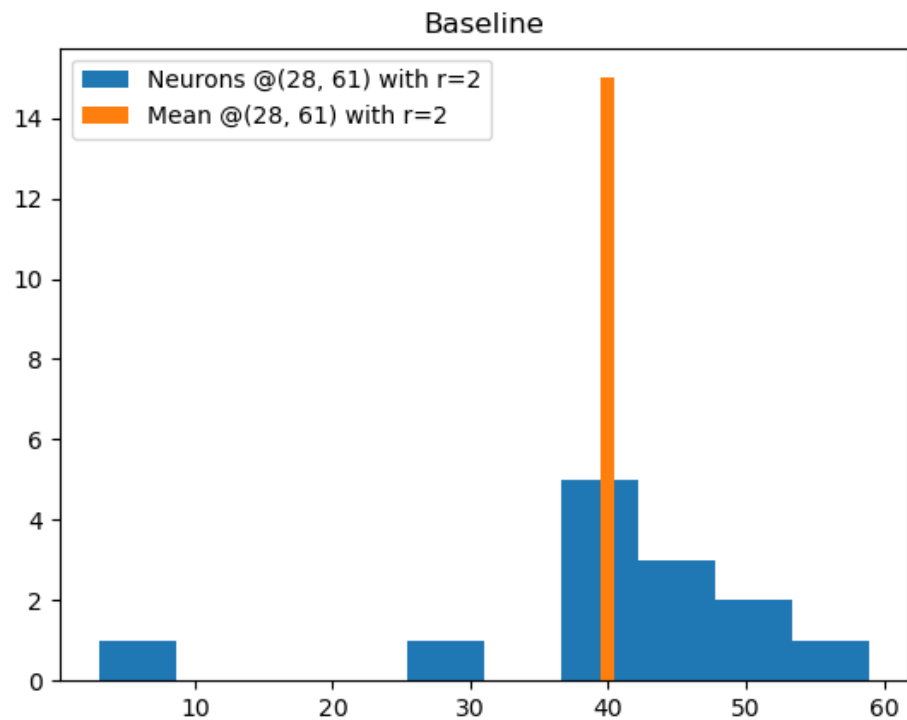
- linker patch
@ (16, 56), $r=4$
- Increasing the
(avg.) activation
in and past the
patch
- Alters other
sequences (see
right beside it)
- No. of sequence
analysis need to
be done.



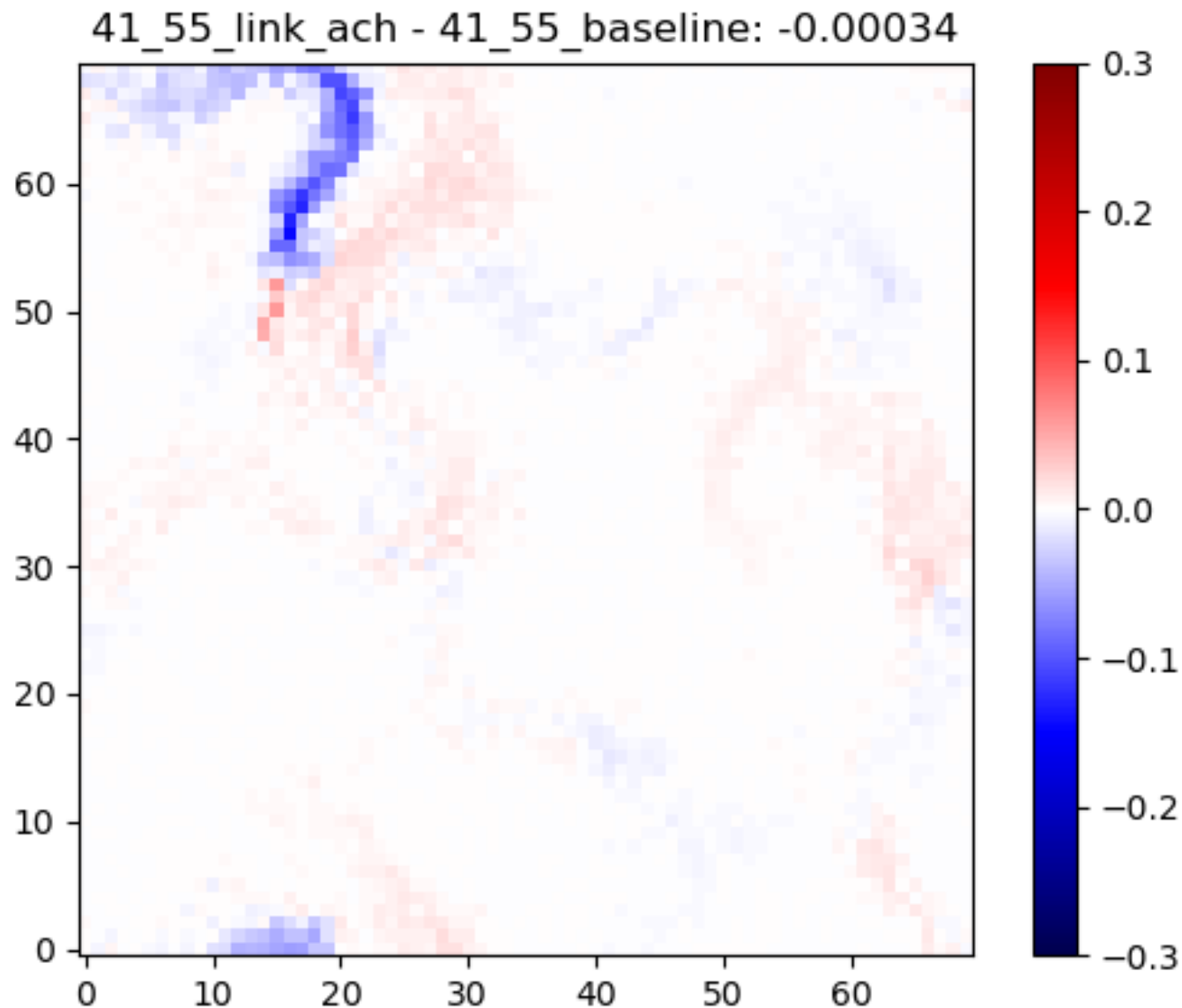
Sequence passing by



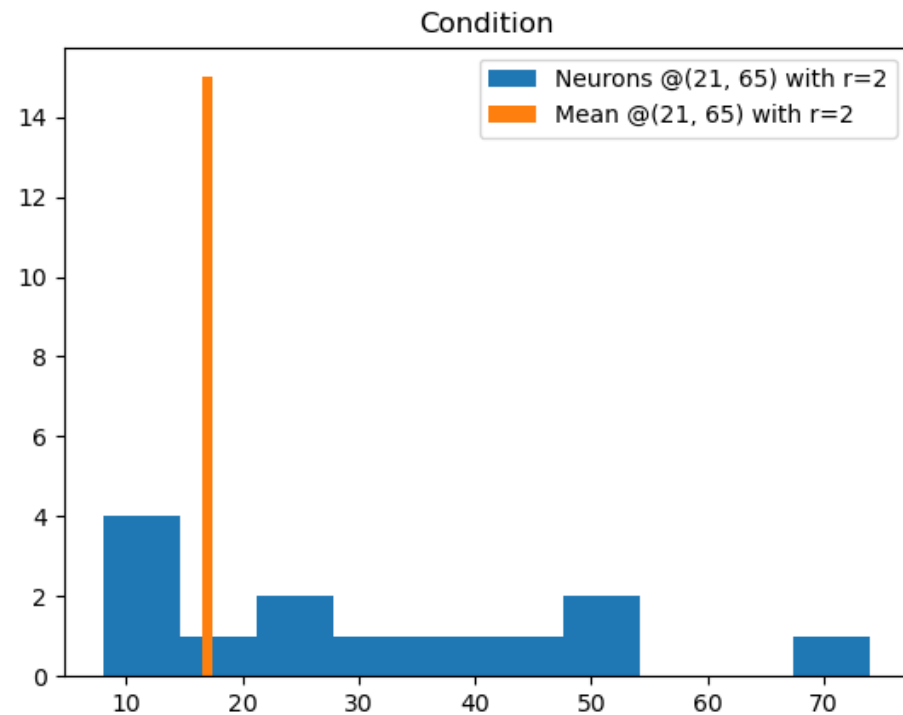
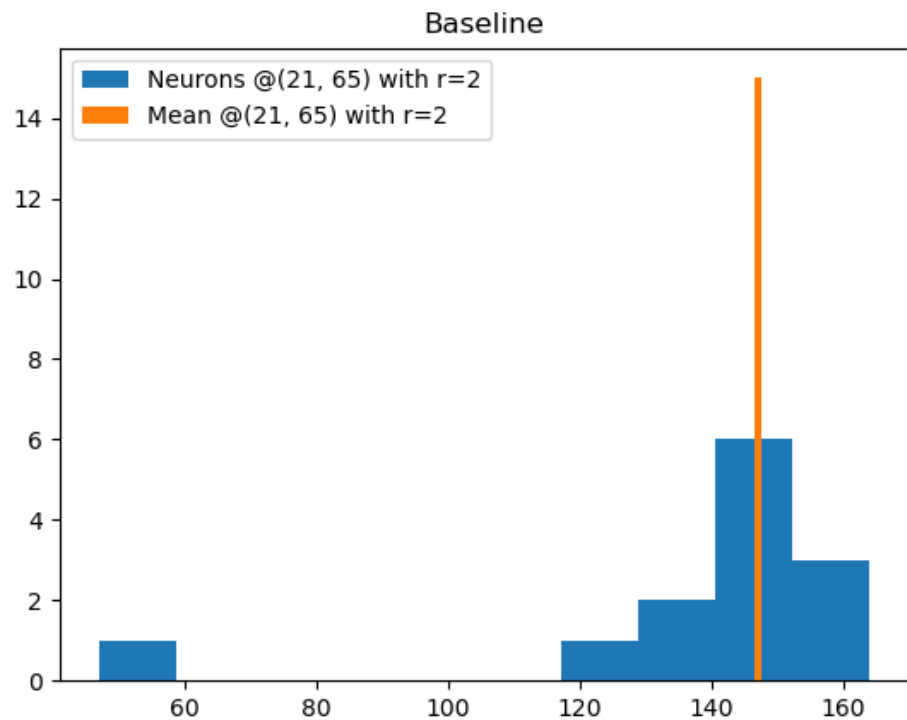
Neighboring sequence passing by



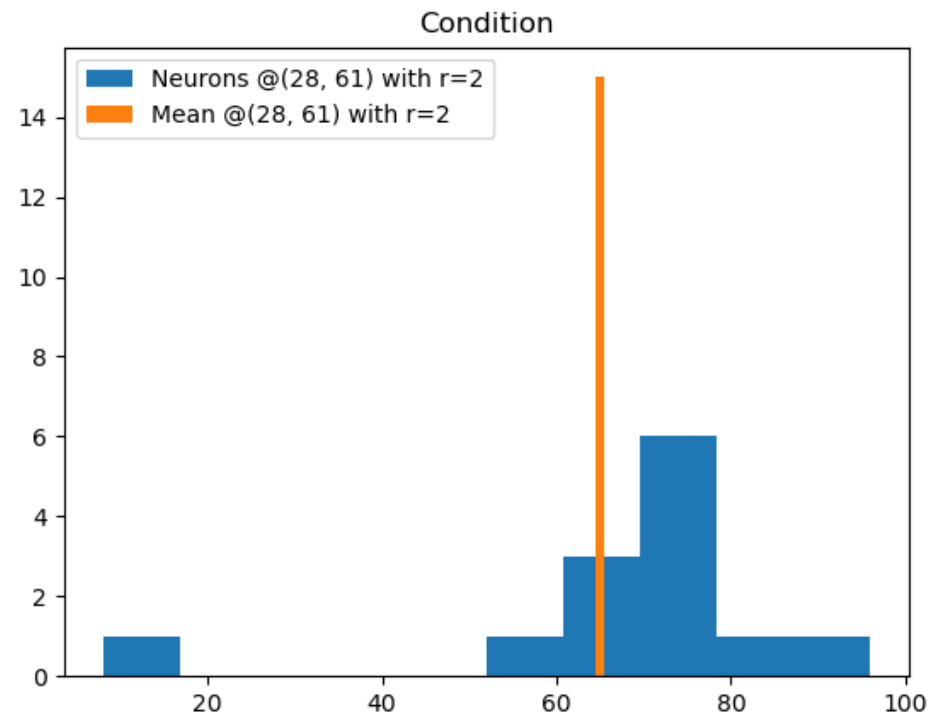
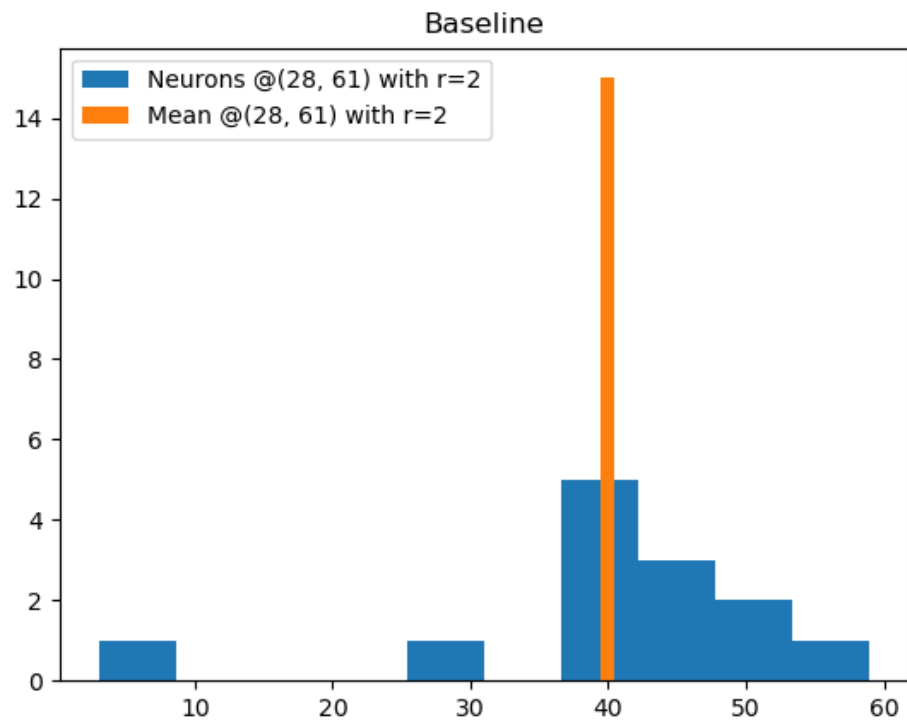
- linker patch (ACh) @ (16, 56), $r=4$
- Decreasing the (avg.) activation in and past the patch
- Alters other sequences (see right beside it)
- No. of sequence analysis need to be done.



Sequence passing by



Neighboring sequence passing by

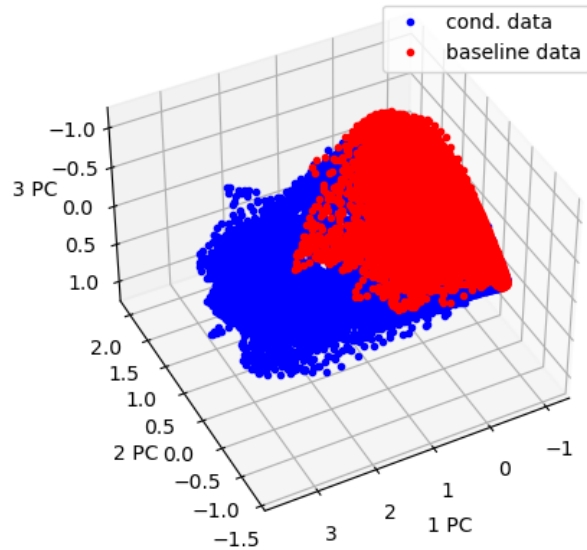


Manifold analysis

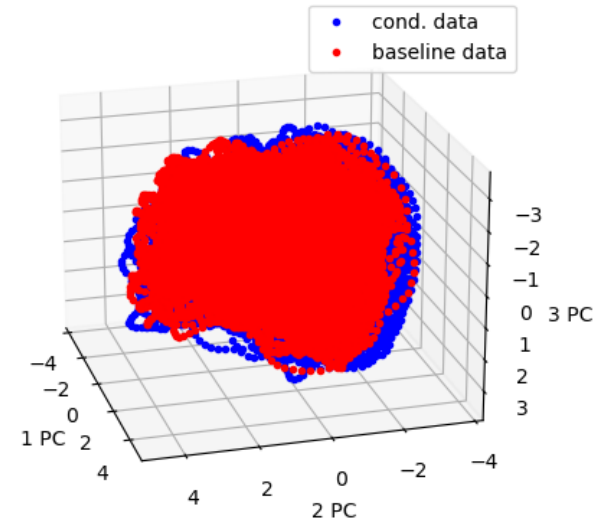
Comparing the manifolds of the different patches on a local level (@patch but with a larger radius of 8 instead of 4), and on a global level (everything than the local part)

Repeater (17, 34)

Local PCA of baseline and conditional data



Global PCA of baseline and conditional data

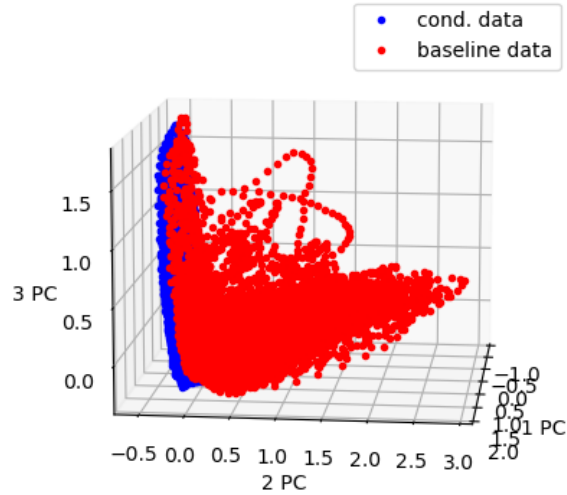


Repeater (17, 34)

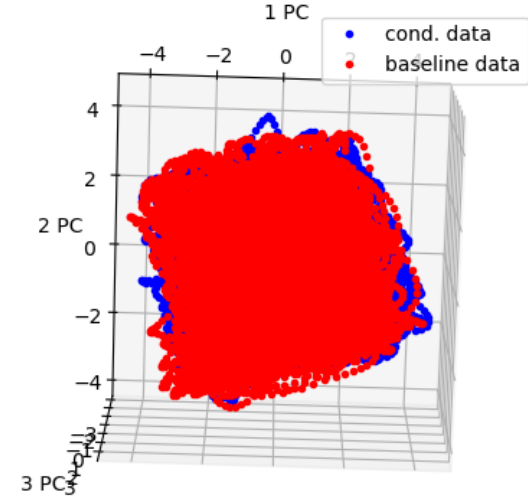
Local: More exploration in the PCA-space, and
thus in the neural space
Global: No visible effect

Repeater ACh (17, 34)

Local PCA of baseline and conditional data



Global PCA of baseline and conditional data



Repeater ACh (17, 34)

Local: Much less exploration in the PCA-space,
and thus in the neural space

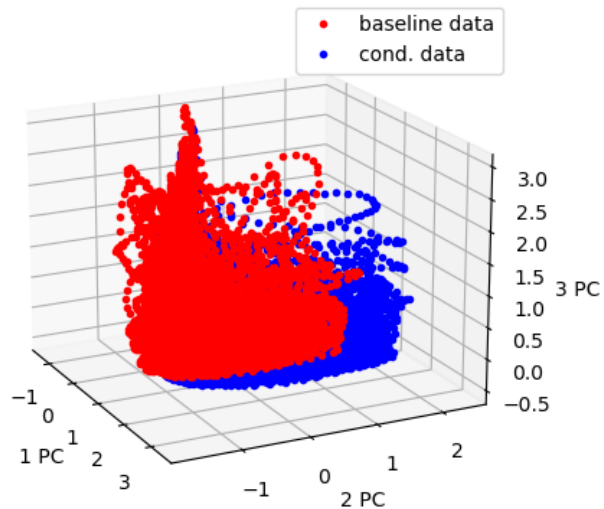
Global: No visible effect

Linker (affecting neighboring sequences)

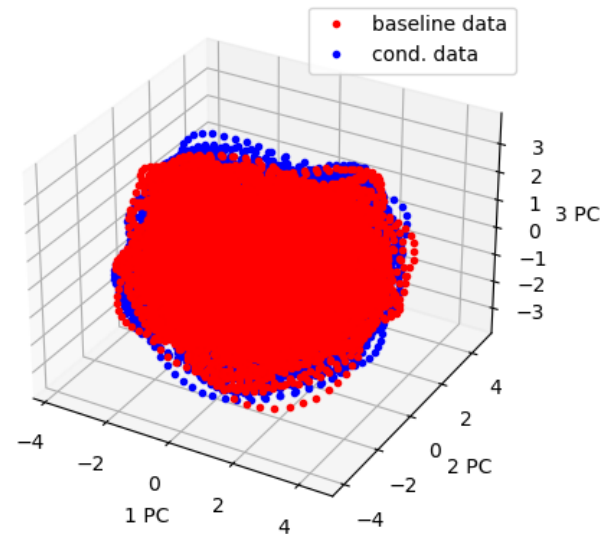
- As we observed in the no. of sequences passed by the linked branch, and the neighboring branch, we expect a strong deviation of the manifolds
- Interestingly, the conditional simulation (DP and ACh) lead to a rather disc-like shape of the activity in the PC space. So without any patch, the neural space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

Linker (24, 64)

Local PCA of baseline and conditional data

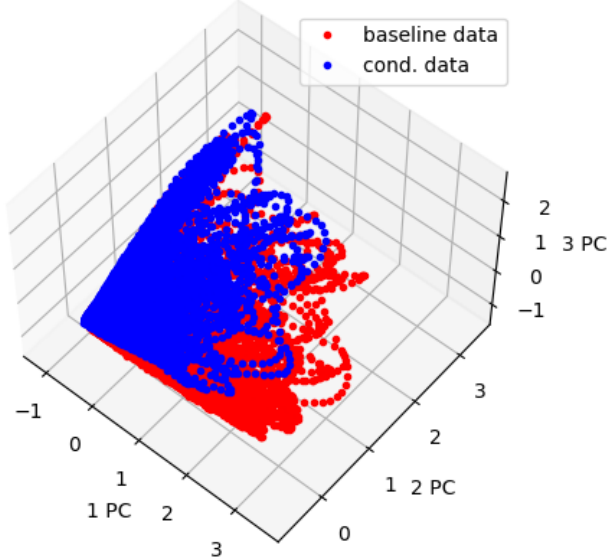


Global PCA of baseline and conditional data

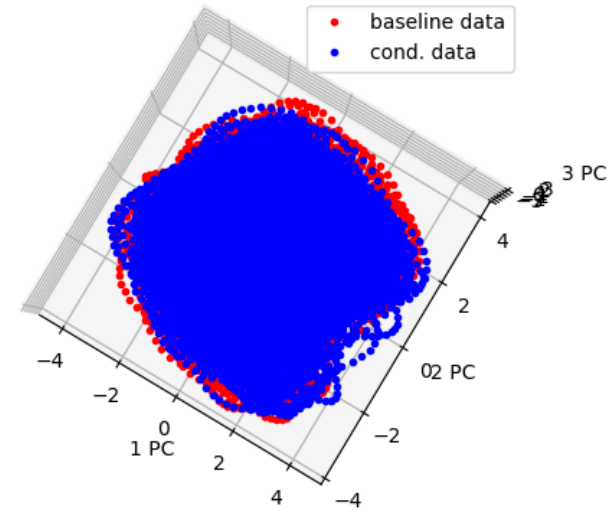


Linker ACh (24, 64)

Local PCA of baseline and conditional data



Global PCA of baseline and conditional data



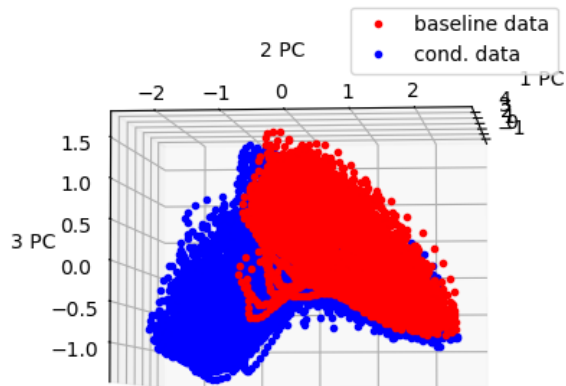
Edge (exploring a new path)

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



Global PCA of baseline and conditional data

