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Notes on Inhibition and BCM

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What does inhibition do?

- Stabilize network activity
- Reduce spontaneous activity [Turrigiano]

Why we should care about inhibition with BCM

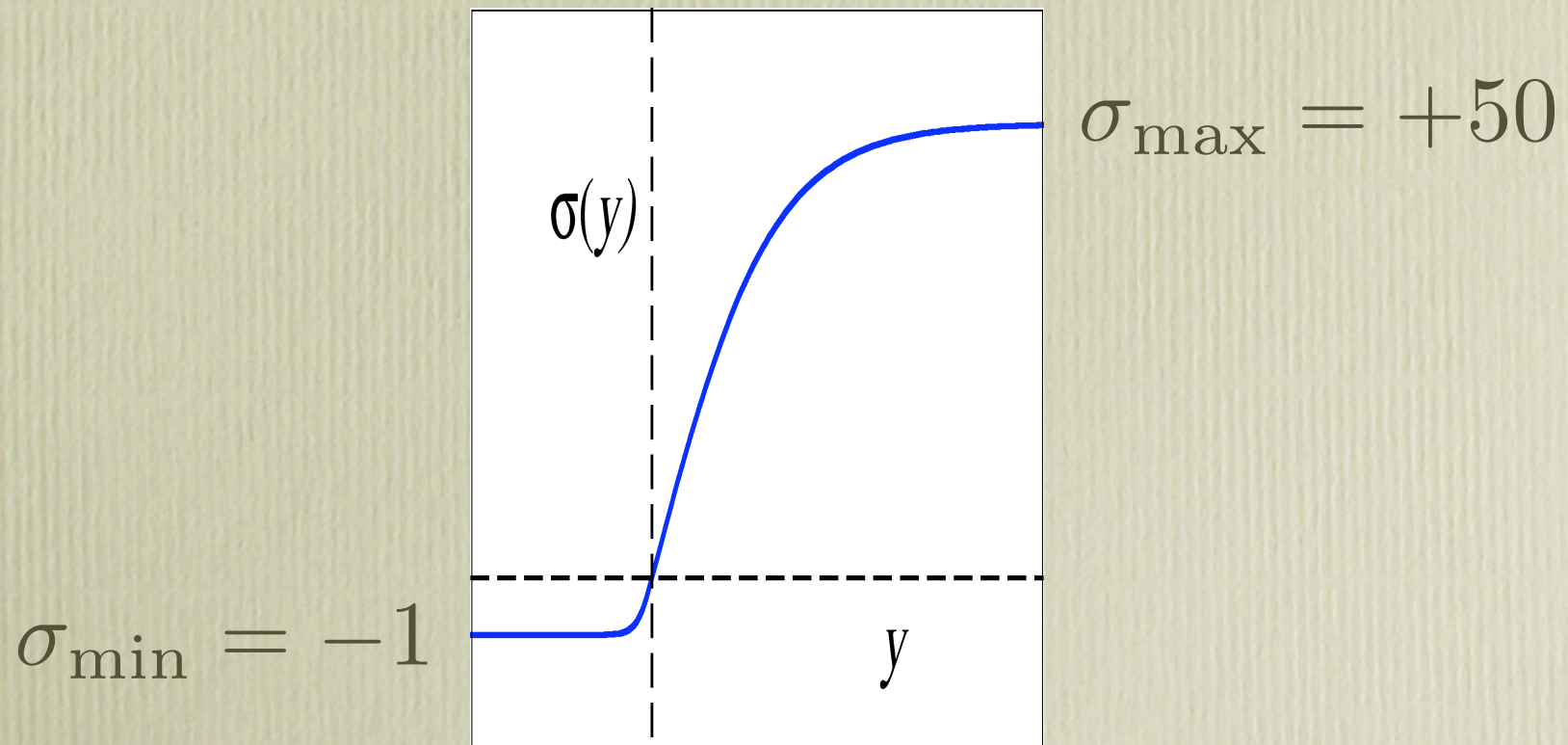
- Negative weights (mean field)
- Negative inputs
- Negative outputs (spontaneous activity)
- Beyond the single cell

What we know about inhibition with BCM

- Uniform inhibition can act as a “mean-field”:
negative weights
- Inhibition of the form: $y = Wx + Ly$ does not affect fixed points (in y) or stability [Castellani, 1999]
- Changes the probability of getting to certain fixed points

Spontaneous Activity

- $y = \sigma(\boldsymbol{w} \cdot \boldsymbol{x})$ where $\sigma(\cdot)$ is a function with a min/max
- negative portion: below spontaneous activity



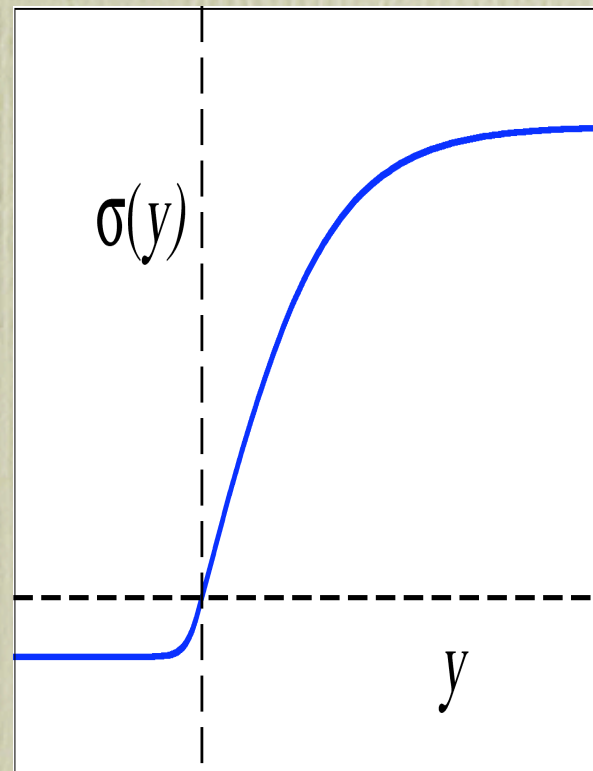
Spontaneous Activity

- $y = \sigma(\boldsymbol{w} \cdot \boldsymbol{x})$ where $\sigma(\cdot)$ is a function with a min/max
- negative portion: below spontaneous activity

If σ_{\min} is, say, -2:

higher level of
spontaneous

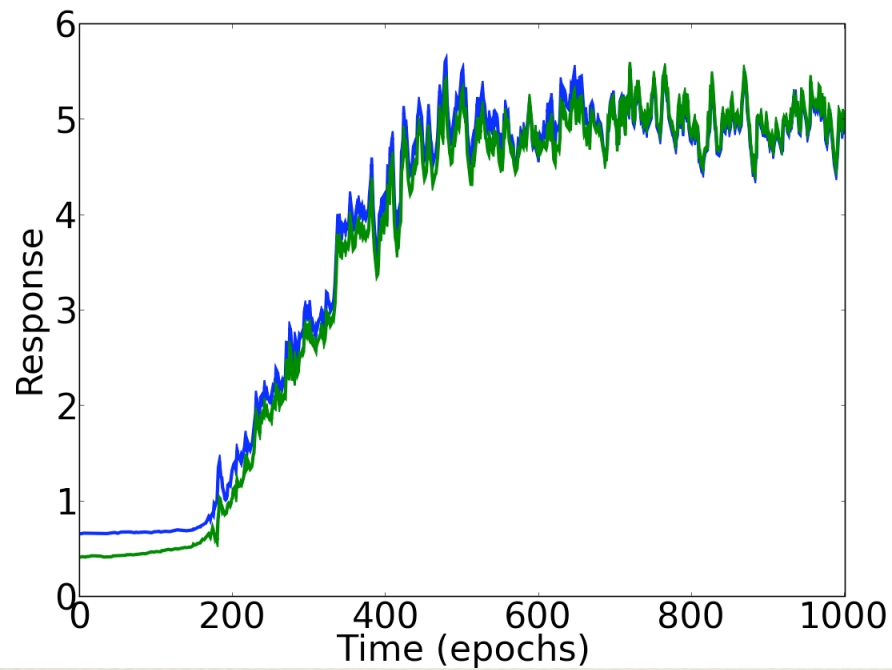
$$\sigma_{\min} = -2$$



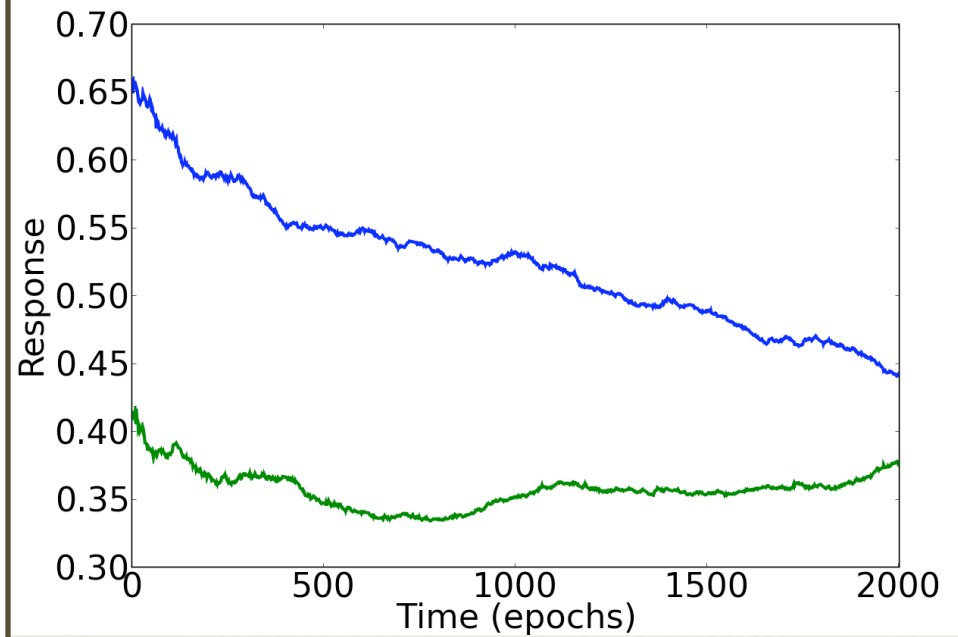
$$\sigma_{\max} = +50$$

Normal Rearing

$$\sigma_{\min} = -1$$

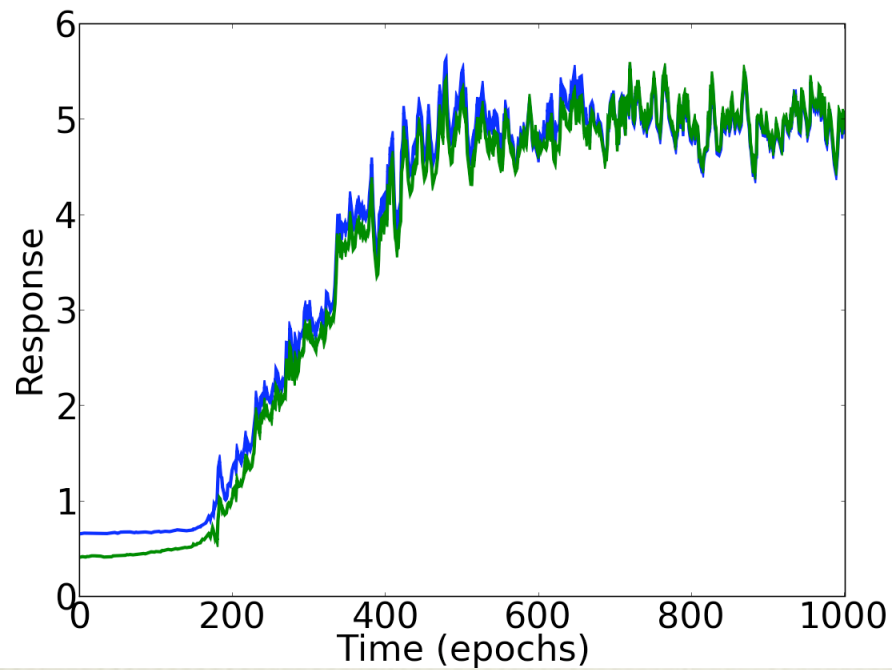


$$\sigma_{\min} = -2$$

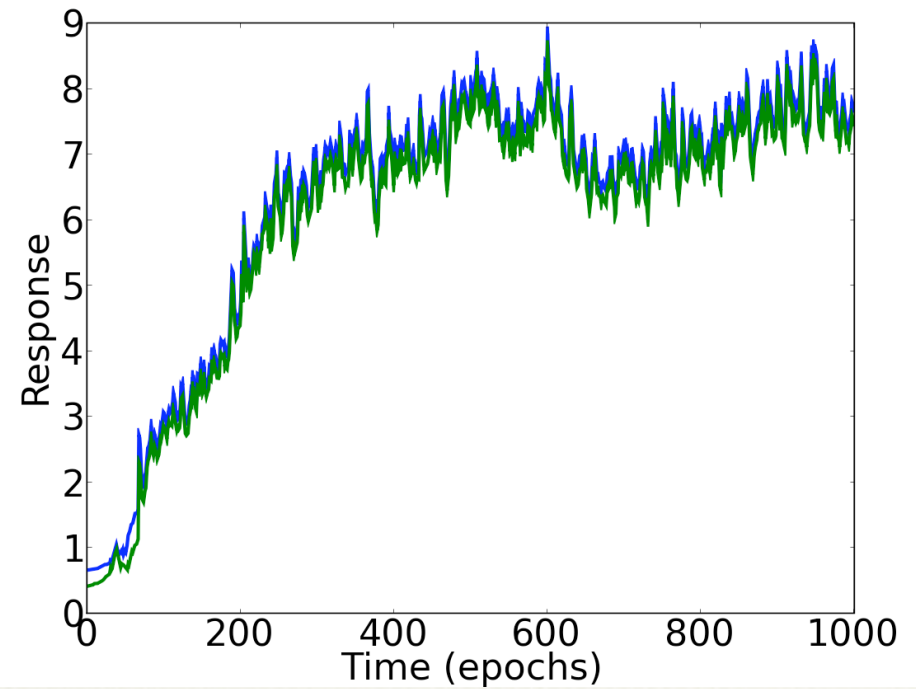


Normal Rearing

$$\sigma_{\min} = -1$$

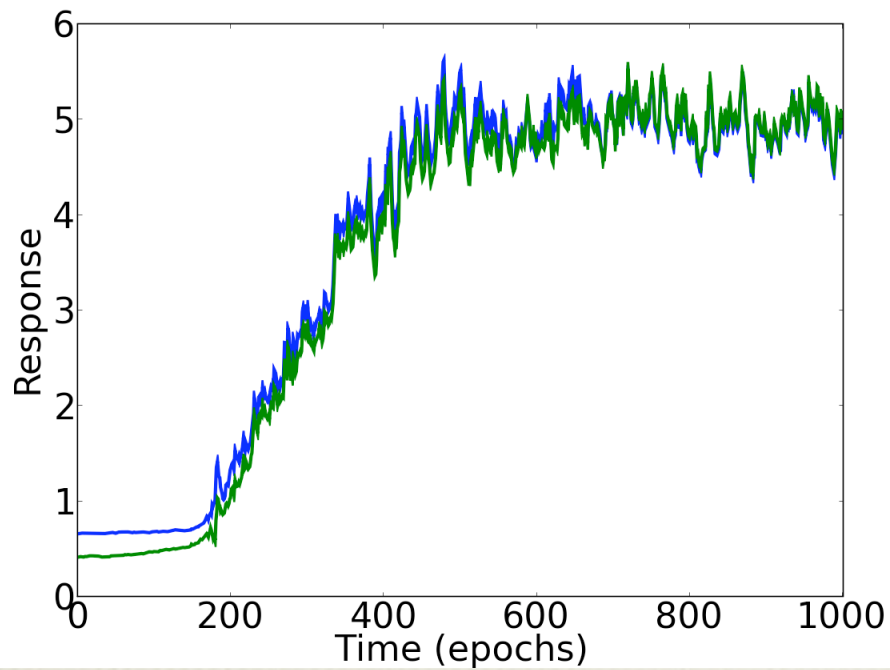


$$\sigma_{\min} = 0$$

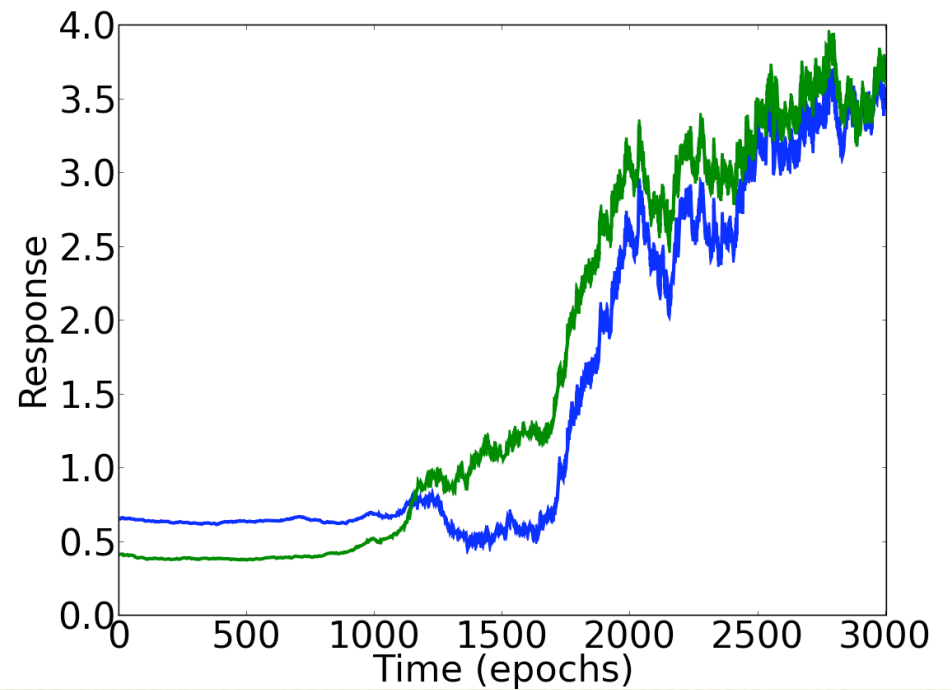


Normal Rearing

$$\sigma_{\min} = -1$$



$$\sigma_{\min} = -1.31$$



Normal Rearing

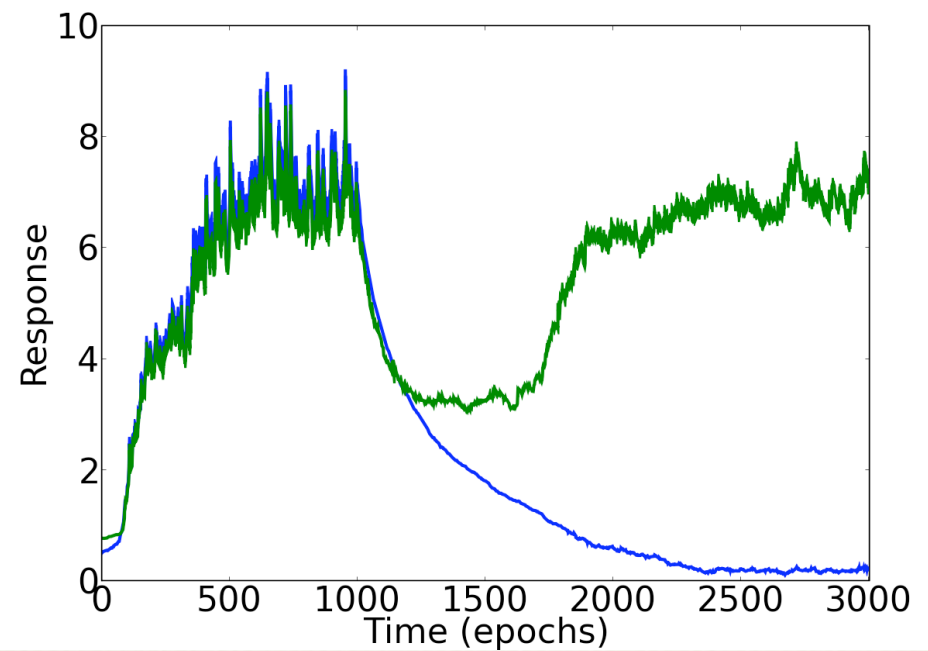
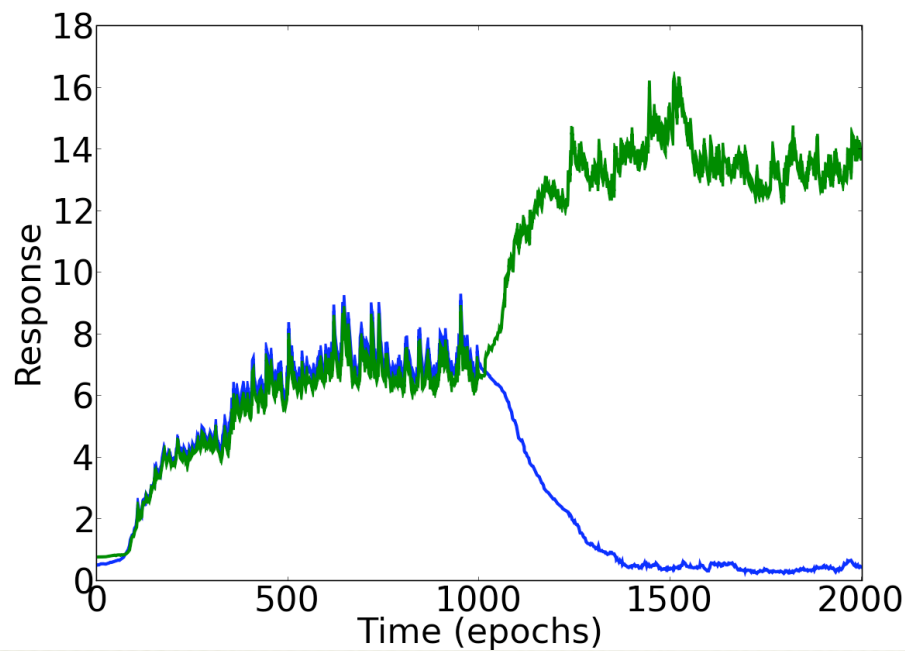
- Anything larger (in magnitude) than $\sigma_{\min} = -1.31$ results in no development
- The larger (in magnitude) the spontaneous level results in slower development

Monocular Deprivation

Normal Rearing uses the standard $\sigma_{\min} = -1$

$$\sigma_{\min} = -1$$

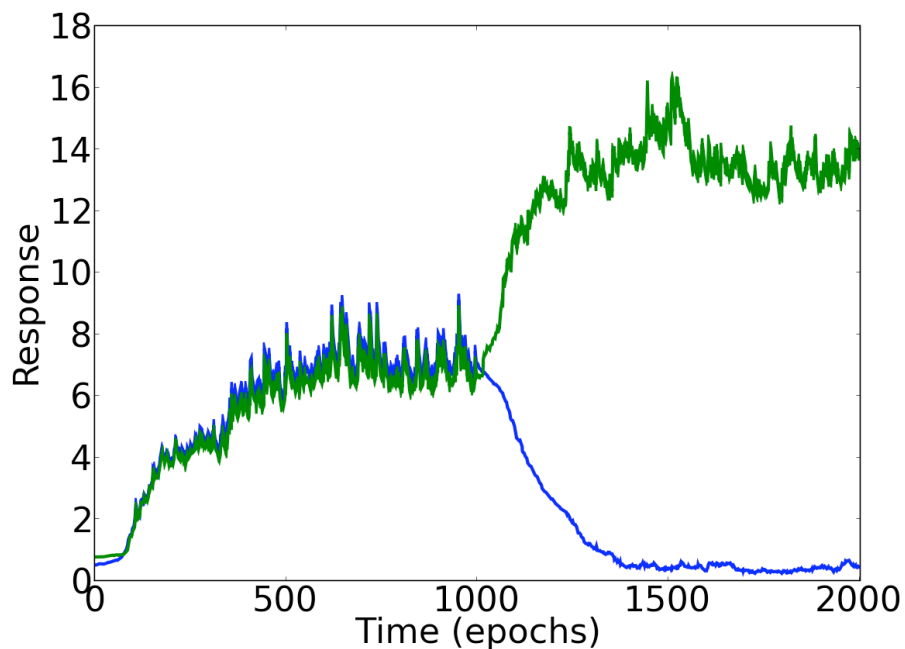
$$\sigma_{\min} = -2$$



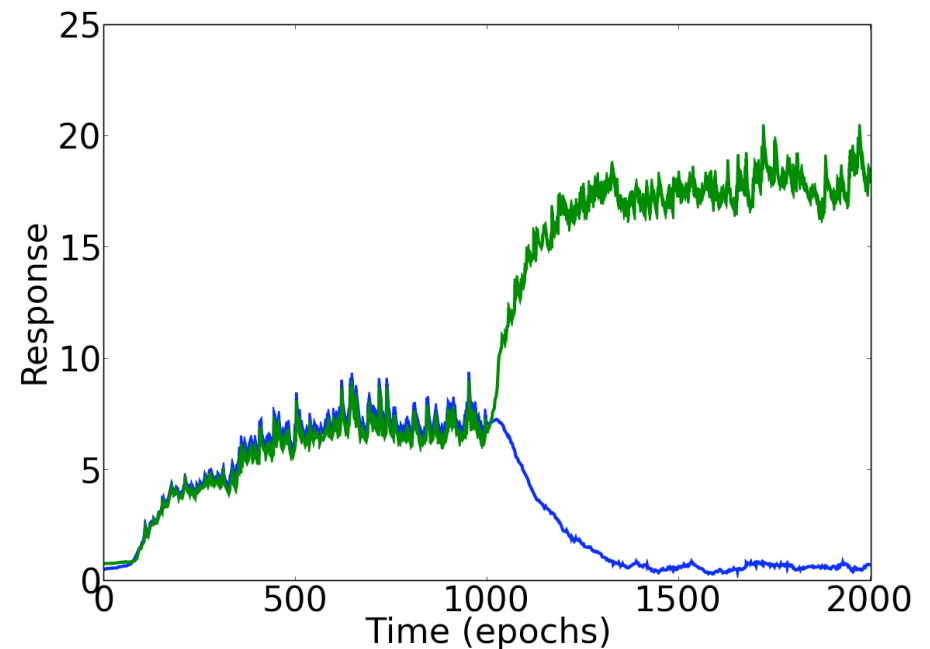
Monocular Deprivation

Normal Rearing uses the standard $\sigma_{\min} = -1$

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Monocular Deprivation

Normal Rearing uses the standard $\sigma_{\min} = -1$

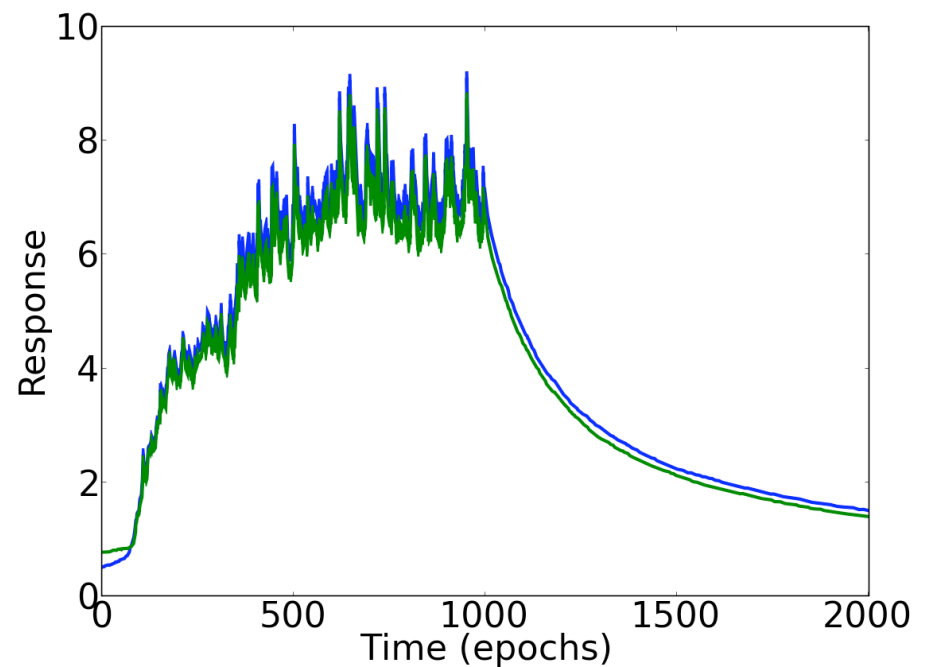
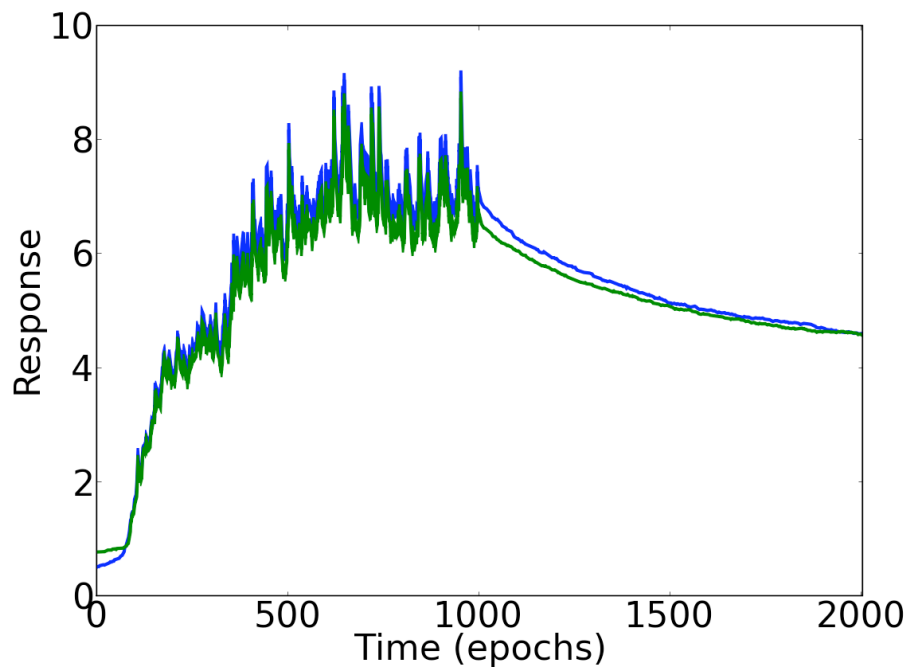
- Not as sensitive to the spontaneous level as NR
- With high spontaneous
 - both eyes drop transiently
 - recovery of the open eye responses not as robust as with low spontaneous
- With low spontaneous
 - no effect

Binocular Deprivation

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$$\sigma_{\min} = -1$$

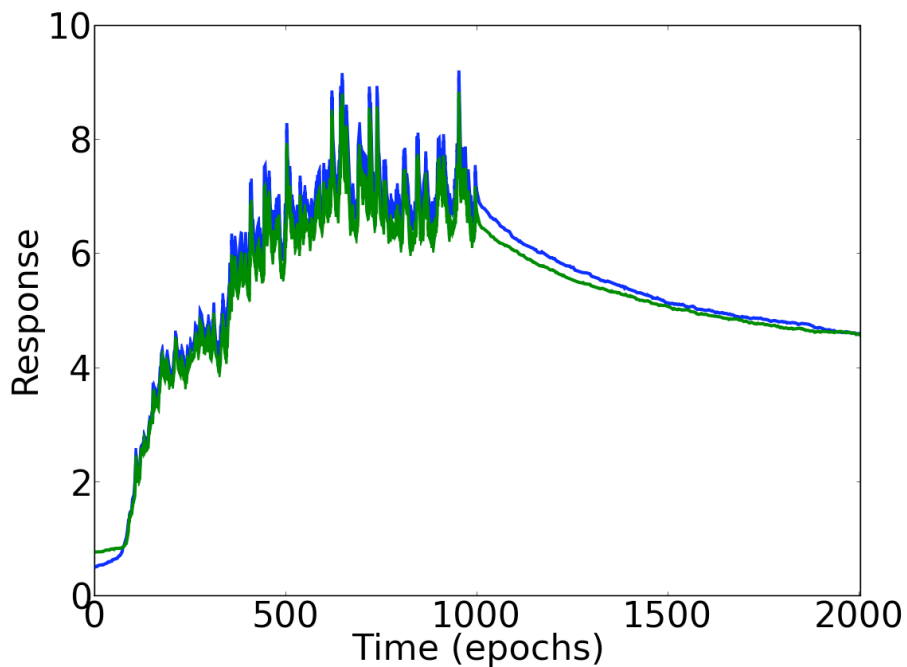
$$\sigma_{\min} = -2$$



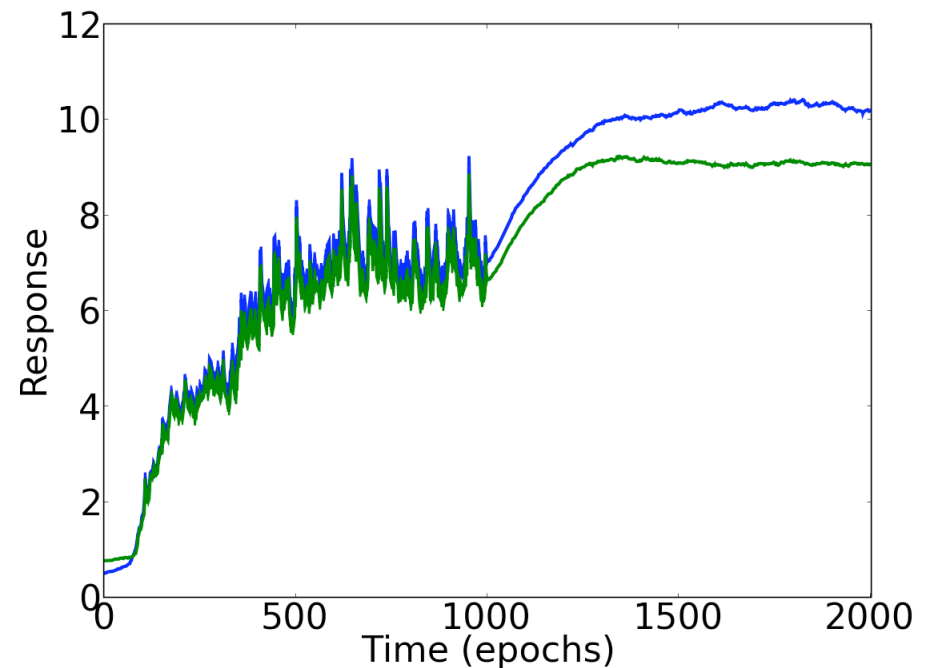
Binocular Deprivation

Normal Rearing uses the standard $\sigma_{\min} = -1$

$$\sigma_{\min} = -1$$



$$\sigma_{\min} = 0$$



Binocular Deprivation

Normal Rearing uses the standard $\sigma_{\min} = -1$

- Higher spontaneous
 - faster depression
- Lower spontaneous
 - responses go up!