The Role of Noise in Visual Deprivation
a comparison between models and experimental results
in visual cortex

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**THE PROBLEM**

- Two forms of long-term depression (LTD)
  - heterosynaptic LTD
  - homosynaptic LTD
- Can these synaptic depression mechanisms account for the ocular dominance shift in monocular deprivation?
- Can we find a way to distinguish between these two different types of depression?
Monocular Deprivation (MD)

(Mioche and Singer, 1989)
HETEROSYNAPTIC LTD

input stimulus

HFS

synapse A

synapse B

(Christie et al., 1995)
Homosynaptic LTD

input stimulus
LFS
synapse A
synapse B

(Dudek and Bear, 1992)
Model Architecture

$\mathbf{c} = \sigma (\mathbf{m} \cdot \mathbf{d})$

Diagram:
- Image Plane
- Left Retina
- Right Retina
- LGN
- Cortex (single cell)

Graph:
- $\sigma$ function
- $\mathbf{c} = \sigma (\mathbf{m} \cdot \mathbf{d})$
Heterosynaptic LTD

\[ \frac{d \mathbf{m}}{dt} = f(c) \mathbf{d} - g(c) \mathbf{m} \]

- PCA, non linear PCA, subtractive kurtosis, subtractive skew
- Synaptic competition works using a weight decay term
- MD: more noise to closed eye reduces the effect of competition
Homosynaptic LTD

\[
\frac{dm}{dt} = h(c, \theta) d
\]

- quadratic BCM, multiplicative kurtosis, multiplicative skew
- synaptic competition works using whole cell sliding threshold
- MD: more noise to closed eye increases the effect of depression
MD Simulation: Heterosynaptic
Low Noise (TTX)

RF → RF →

Cell Response

Stimulus Orientation
Closed eye
Open eye

Heterosynaptic
High Noise (Lid Suture)

RF → RF →

Cell Response

Stimulus Orientation
Closed eye
Open eye
**MD Simulation:** Homosynaptic
Low Noise (TTX)

RF → RF →

**High Noise (Lid Suture)**

RF →
Experimental Results

- 2 days MD
- 2 days MI

(N=273)

(N=238)

(Rittenhouse et al., 1997)
SUMMARY

• Predictions
  homosynaptic LTD: more noise \(\uparrow\) faster OD shift \(\uparrow\)
  heterosynaptic LTD: more noise \(\uparrow\) slower OD shift \(\downarrow\)

• Outcome
  experimental results: more noise \(\uparrow\) faster OD shift \(\uparrow\)

EXPERIMENTS TO DO

* chronic deprivation experiments
* measurements of LGN output statistics