Comparison of interocular suppression for binocular rivalry and flash suppression

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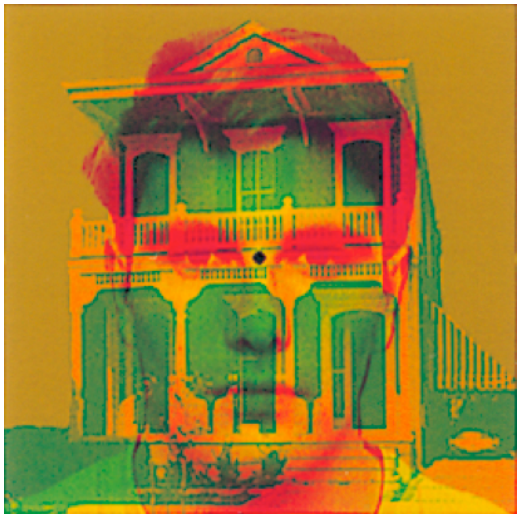
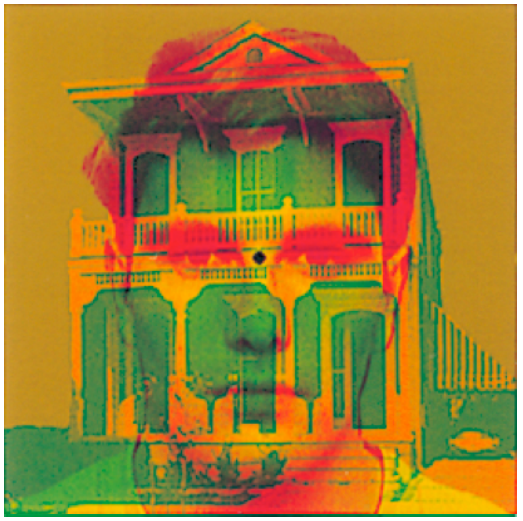
Background

Binocular Rivalry



Background

Binocular Rivalry



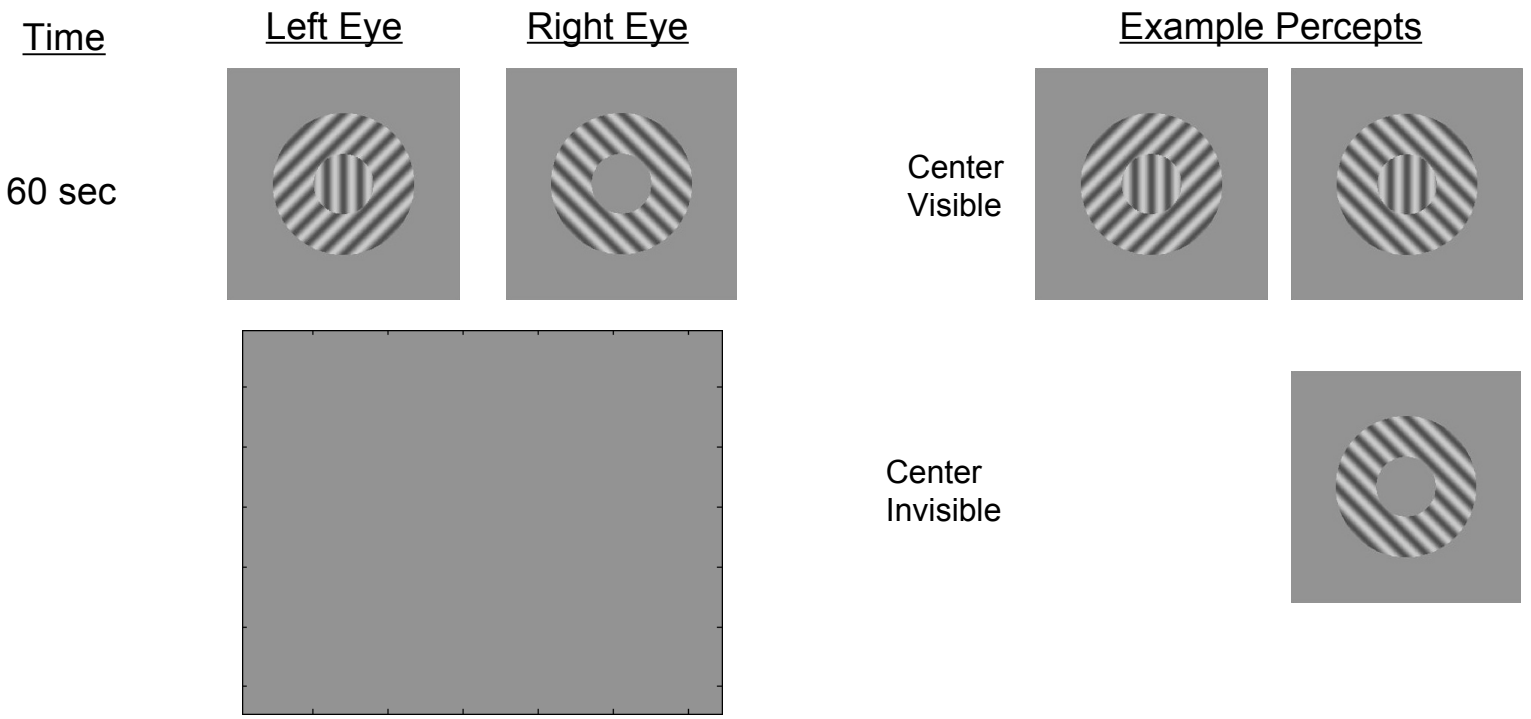
Flash Suppression

Suppression spreads across space.

Purpose

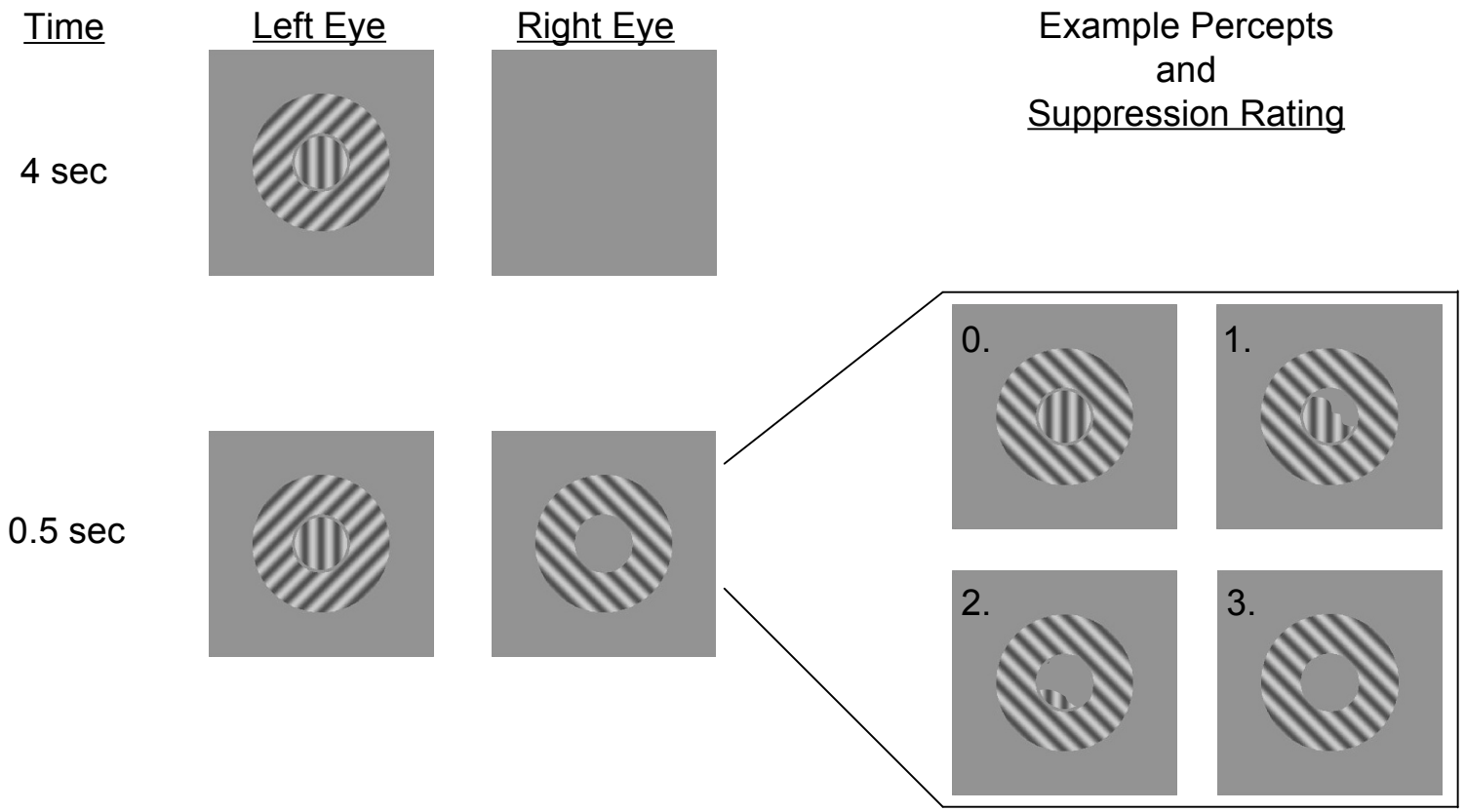
- Examine similarities and differences between binocular rivalry and flash suppression
- Test with: Experiments and Model
- Hypothesis:
  same inhibitory mechanisms underlie both

Binocular Rivalry Methodology



Participants reported whenever the center: A) Became Invisible.
B) Any portion was visible.

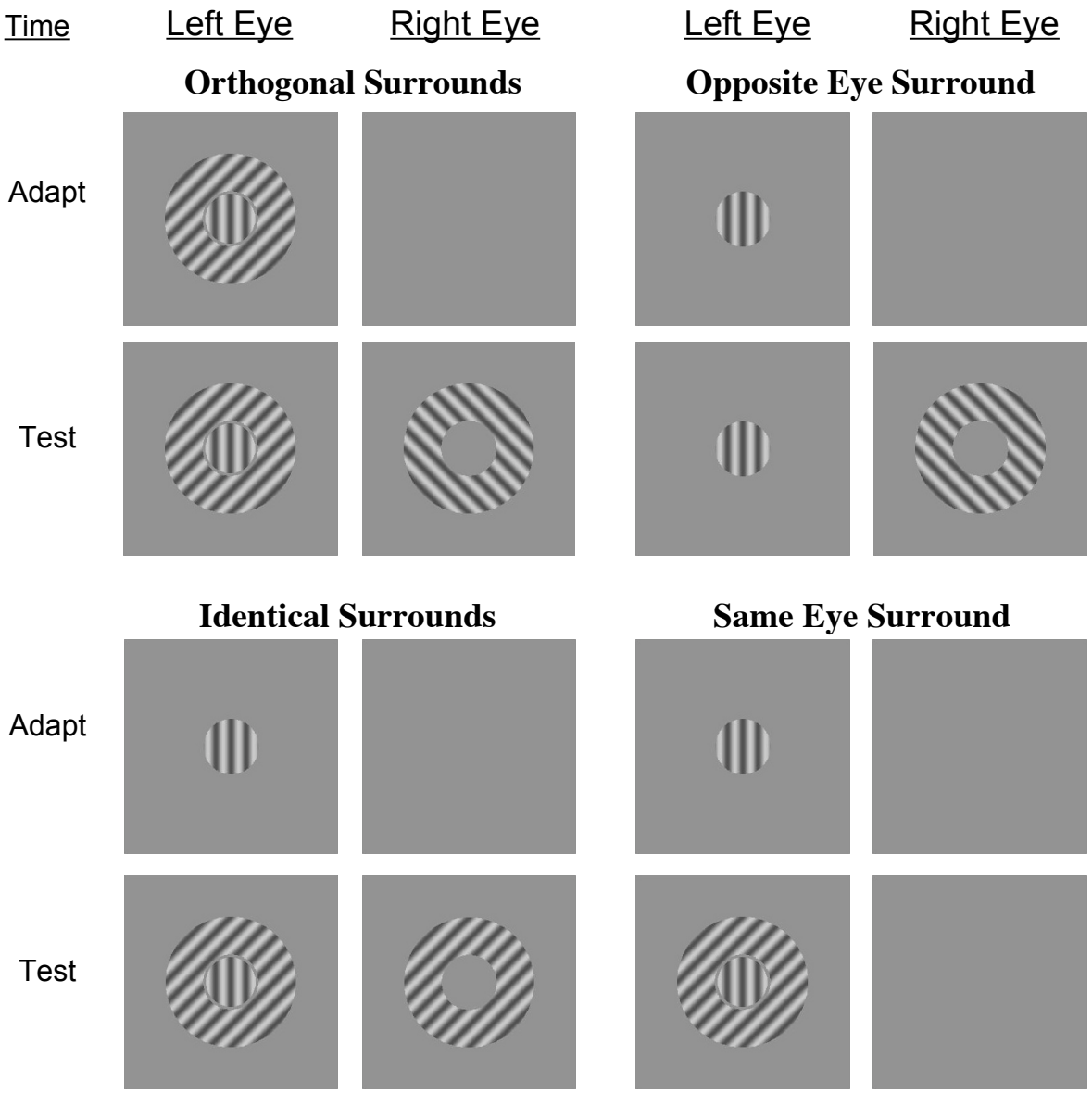
Flash Suppression Methodology



Participants rate suppression of center:

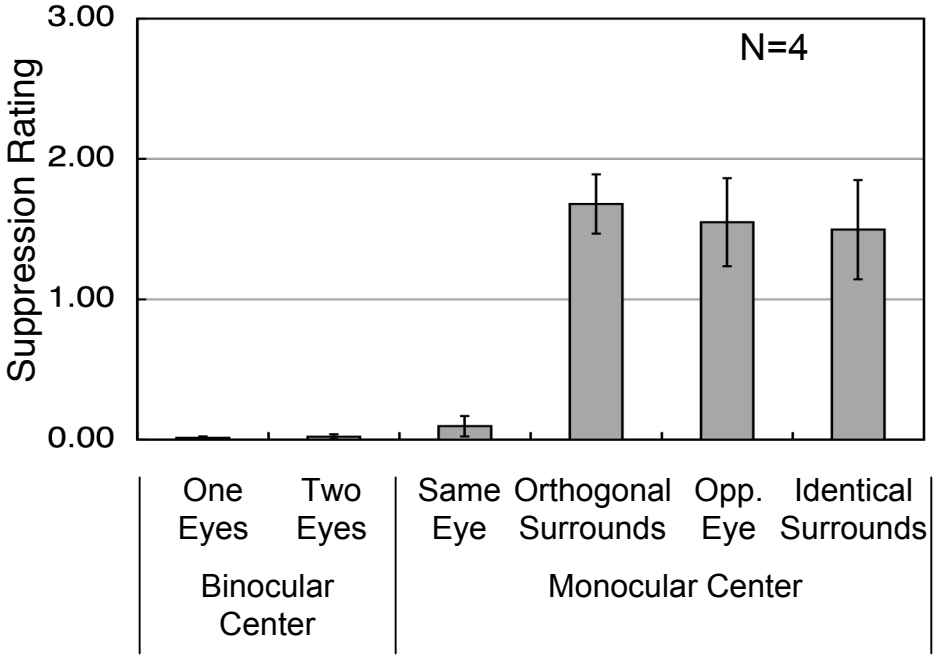
0: Entirely visible, 1: Mostly visible, 2: Mostly invisible, 3: Entirely invisible

Experiment 1 Methodology

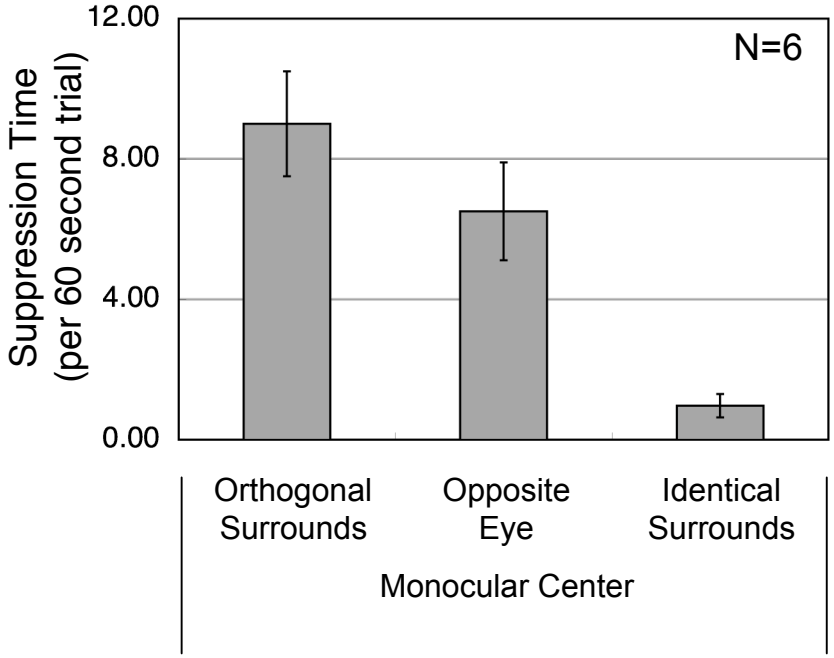


Experiment 1 Results

Flash Suppression



Binocular Rivalry

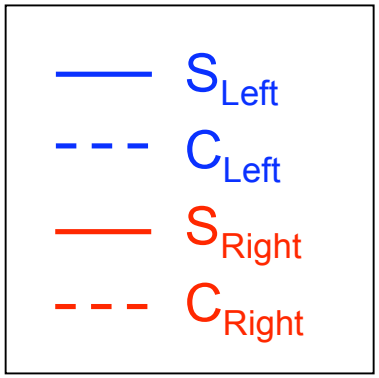


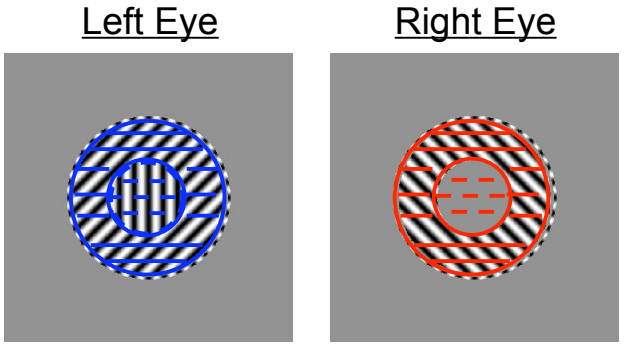
Necessary and sufficient: monocular center and surround in contralateral eye

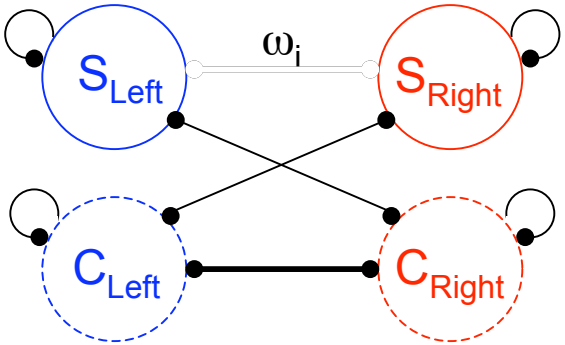
Ipsilateral surround: no effect

Identical surrounds prevents suppression

Model Simulations of Common Mechanism





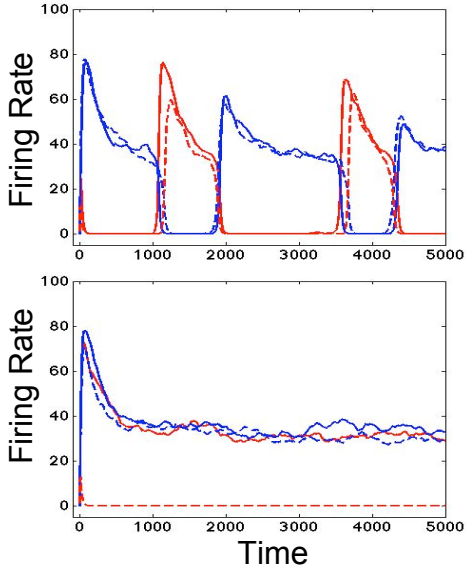


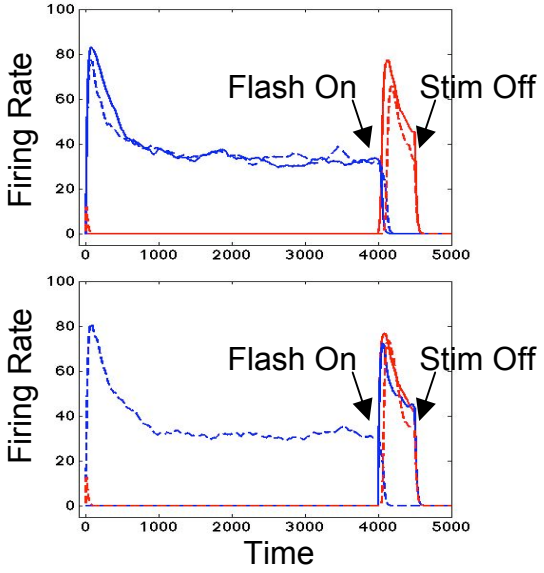
Binocular Rivalry

Flash Suppression

Orthogonal Surrounds (ω_i=1)

Identical Surrounds (ω_i=0)



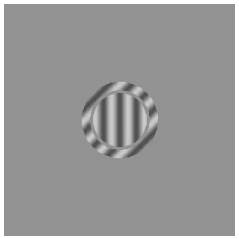
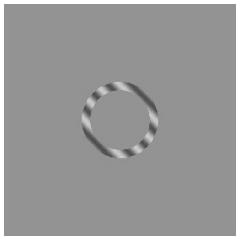
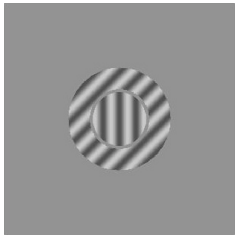
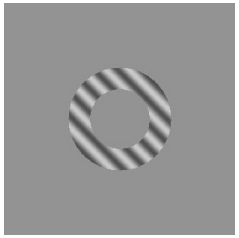


Model consistent with experimental data.

Experiment 2 Methodology

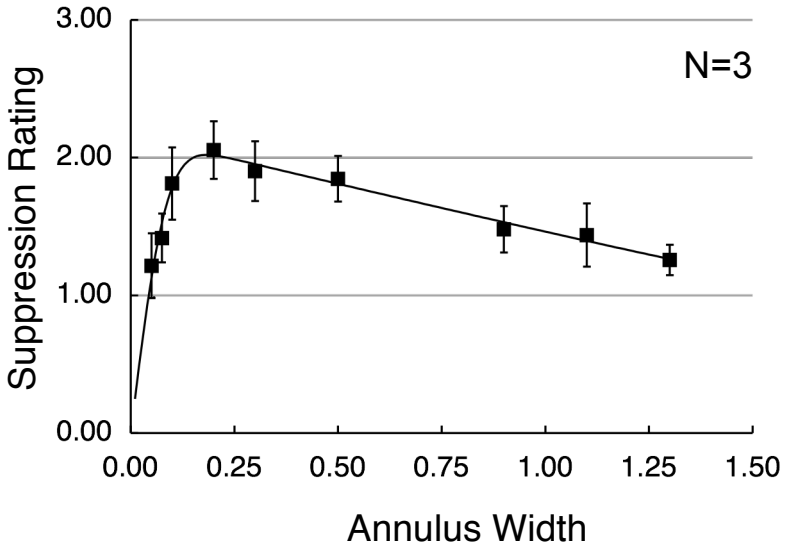
For Flash Suppression:
9 Annulus Widths:
0.05º - 1.30º

For Binocular Rivalry:
3 Annulus Widths:
0.05º, 0.20º, 1.30º

Annulus Width	Ipsi Eye	Contra Eye
0.50º		
1.30º		

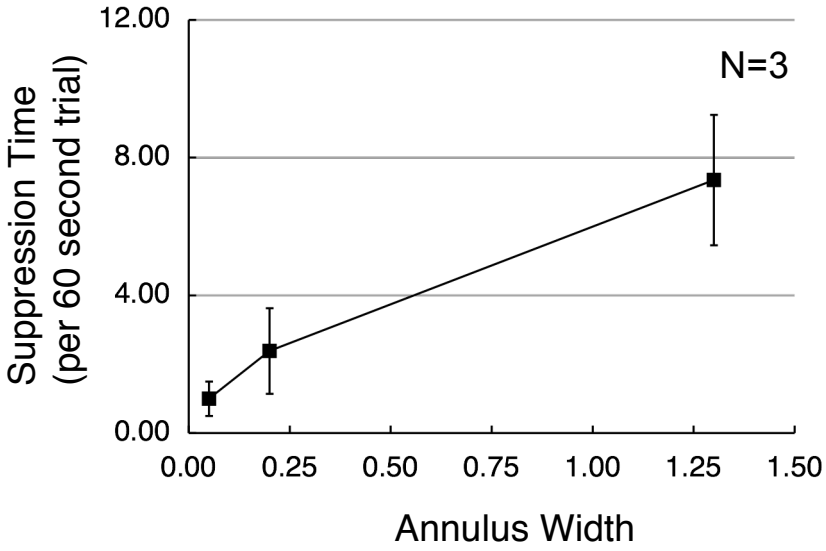
Experiment 2 Results

Flash Suppression



Maximum suppression:
mid-range annulus width (~0.18 deg)

Binocular Rivalry



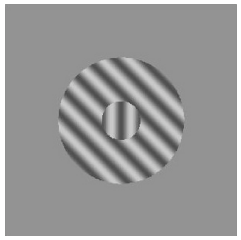
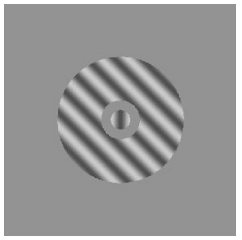
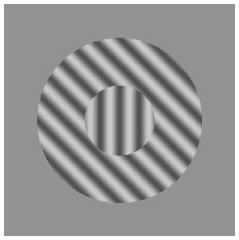
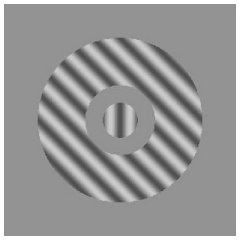
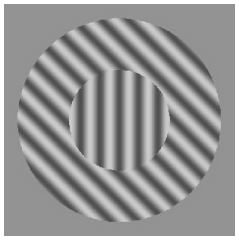
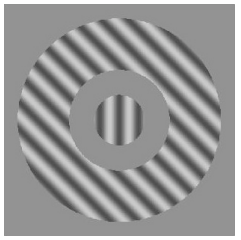
Maximum suppression:
highest annulus width

Why the difference?

Experiment 3 Methodology

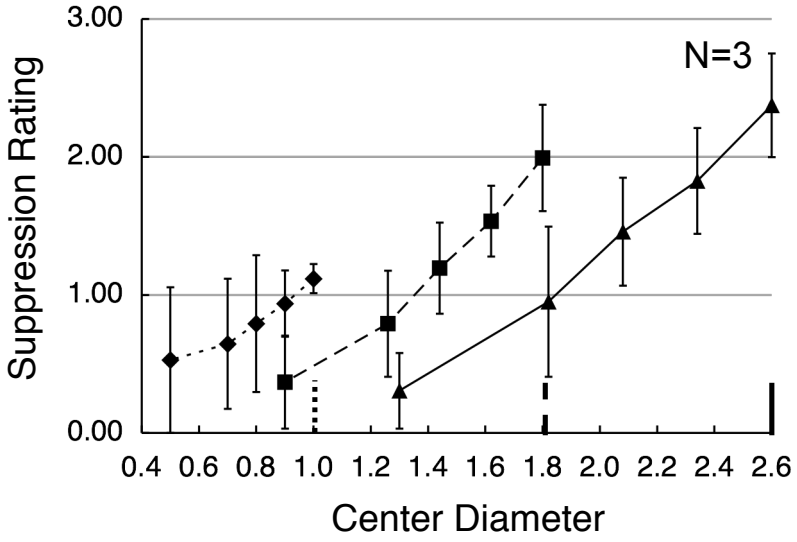
Different Center Diameters:

100% - 50%

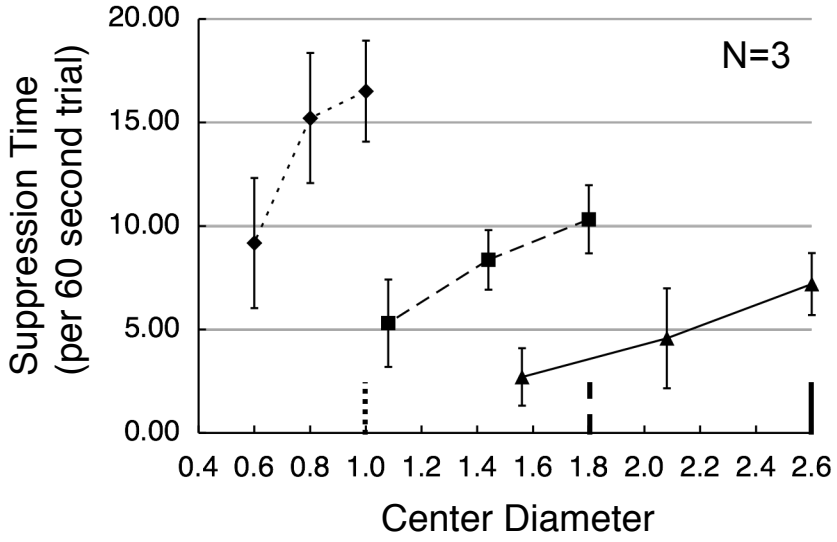
Center Diameter	Center: 100%	Center: 50%
1.0º		
1.8º		
2.6º		

Experiment 3 Results

Flash Suppression



Binocular Rivalry

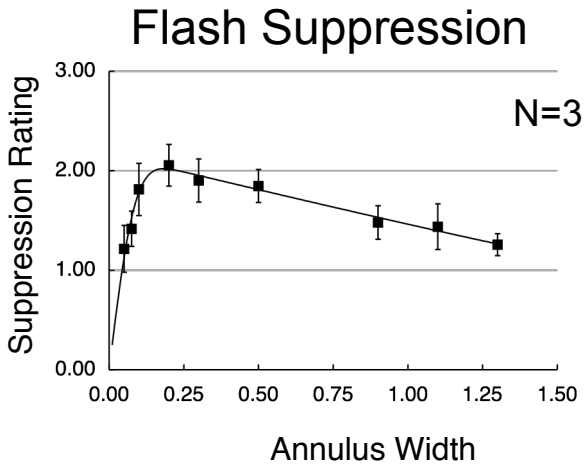


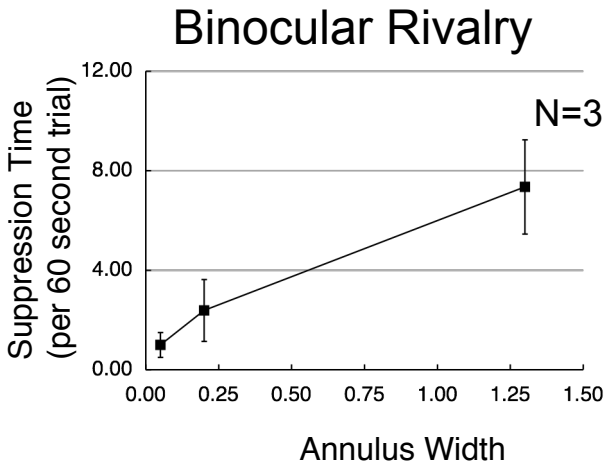
Maximum suppression:
large annulus/center

Maximum suppression:
small annulus/center

Why the difference?

Experiment 2b: Binocular Rivalry

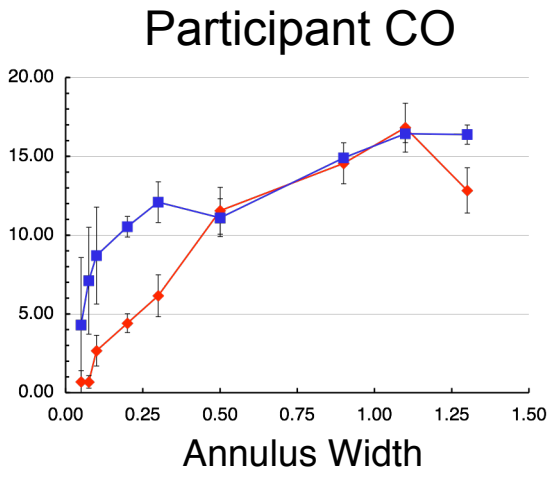


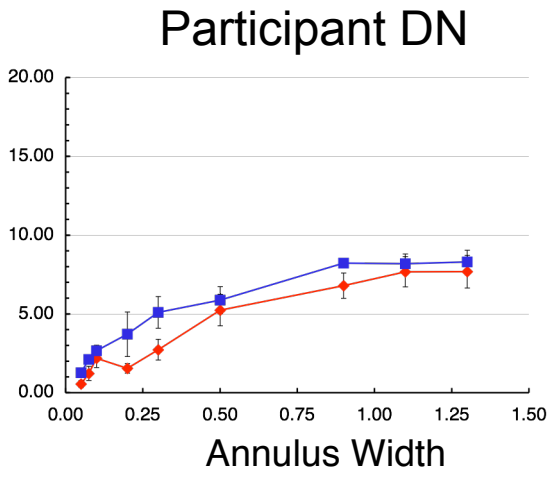


Is dominance of surround in opposite eye correlated with suppression?

Dominance Durations
(Opposite Surround)

Suppression Durations
(Center Grating)

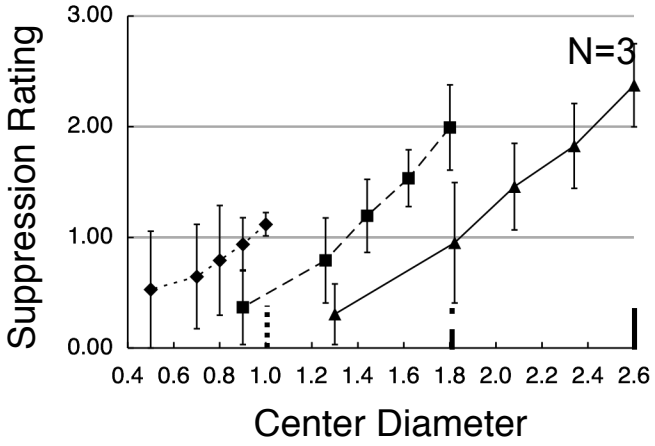




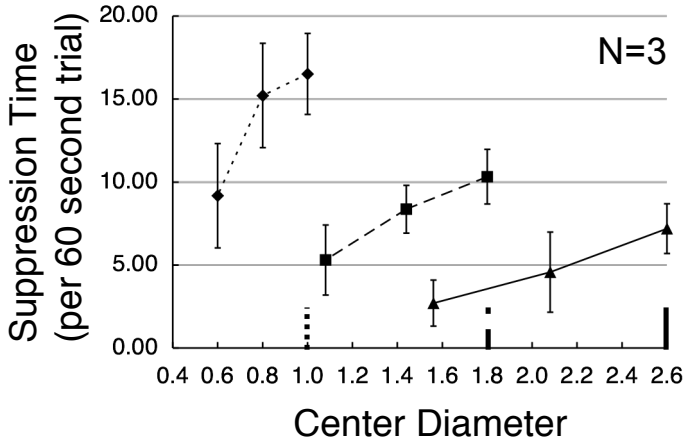
Dominance of contralateral surround necessary for suppression.
Flash Suppression: immediate, Binocular Rivalry: requires interaction

2-D Spatial Model

Flash Suppression



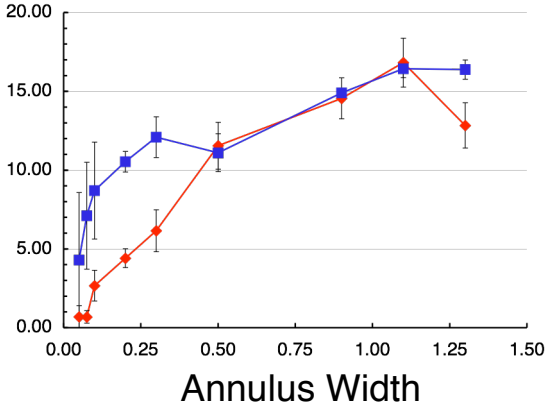
Binocular Rivalry

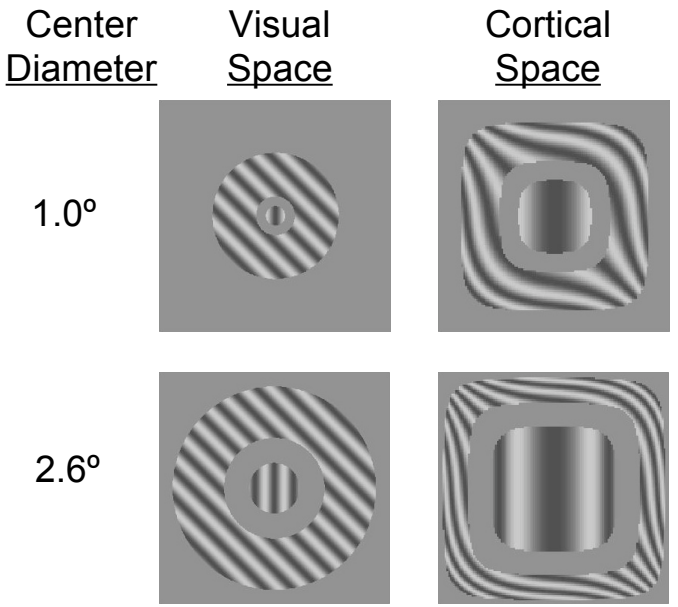


Participant CO

Dominance Durations
(Opposite Surround)

Suppression Durations
(Center Grating)





Conclusions

1) Differences between Binocular Rivalry and Flash Suppression:

   A. Flash Suppression: Get suppression with contralateral surround.

      Binocular Rivalry: Fusable surrounds prevents suppression.

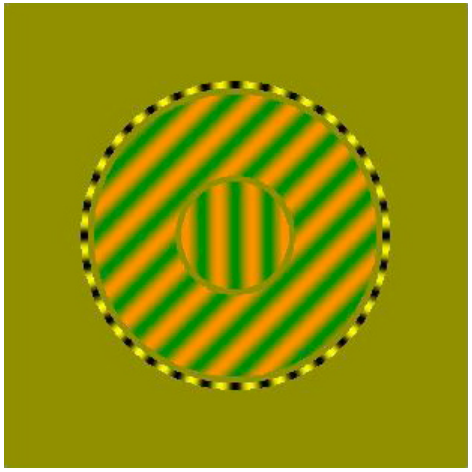
   B. Suppression increased monotonically as a function of annulus width for Binocular Rivalry, but peaked at mid-range width for Flash Suppression.

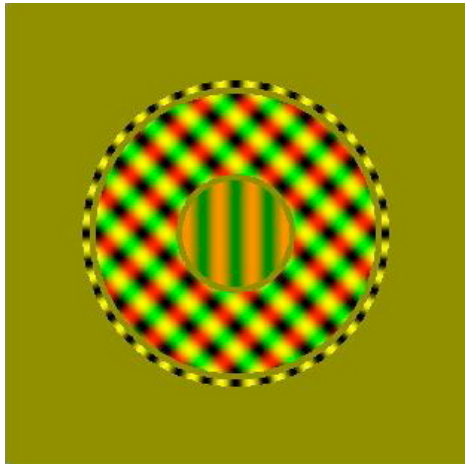
   C. Suppression increased with annulus diameter for Flash Suppression, decreased with annulus diameter for Binocular Rivalry.

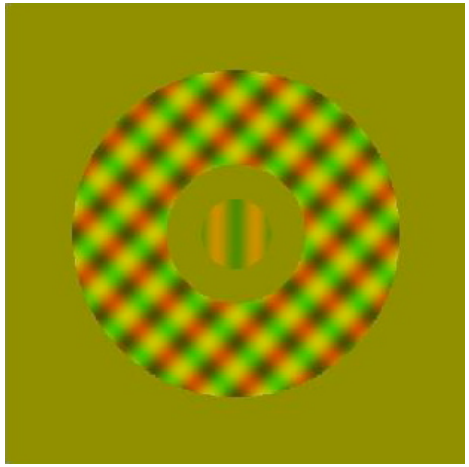
2) Modeling: different experimental findings result of sustained versus transient activation.

Thank you.

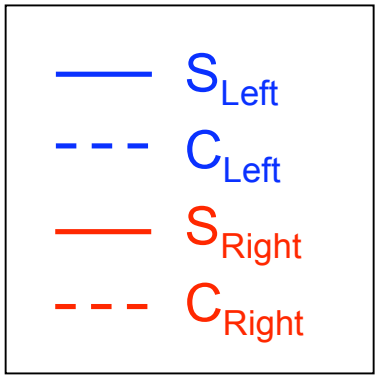
Example Stimuli

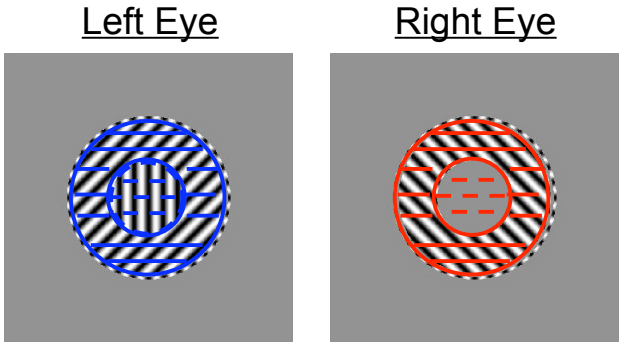


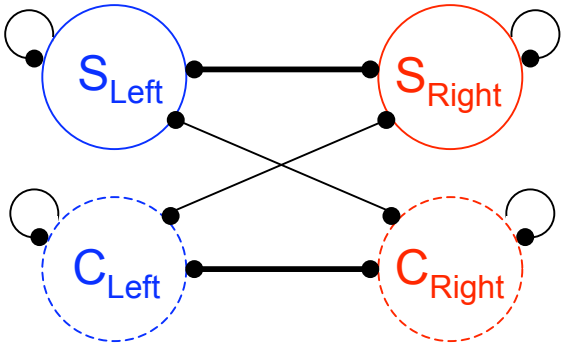




Model Simulations of Common Mechanism







$$20 * \frac{dS_{Left}}{dt} = -S_{Left} + \frac{100 * \left[30 - .75 * S_{Right} - .10 * C_{Right}\right]_+^2}{\left(10 + H_{LS}\right)^2 + \left[30 - .75 * S_{Right} - .10 * C_{Right}\right]_+^2}$$

$$900 * \frac{dH_{LS}}{dt} = -H_{LS} + S_{Left} + noise$$

$$20 * \frac{dS_{Right}}{dt} = -S_{Right} + \frac{100 * \left[30 - .75 * S_{Left} - .10 * C_{Left}\right]_+^2}{\left(10 + H_{RS}\right)^2 + \left[30 - .75 * S_{Left} - .10 * C_{Left}\right]_+^2}$$

$$900 * \frac{dH_{RS}}{dt} = -H_{RS} + S_{Right} + noise$$

$$20 * \frac{dC_{Left}}{dt} = -C_{Left} + \frac{100 * \left[30 - .75 * C_{Right} - .10 * S_{Right}\right]_+^2}{\left(10 + H_{LC}\right)^2 + \left[30 - .75 * C_{Right} - .10 * S_{Right}\right]_+^2}$$

$$900 * \frac{dH_{LC}}{dt} = -H_{LC} + C_{Left} + noise$$

$$20 * \frac{dC_{Right}}{dt} = -C_{Right} + \frac{100 * \left[30 - .75 * C_{Left} - .03 * S_{Left}\right]_+^2}{\left(10 + H_{RC}\right)^2 + \left[30 - .75 * C_{Left} - .03 * S_{Left}\right]_+^2}$$

$$900 * \frac{dH_{RC}}{dt} = -H_{RC} + C_{Right} + noise$$