

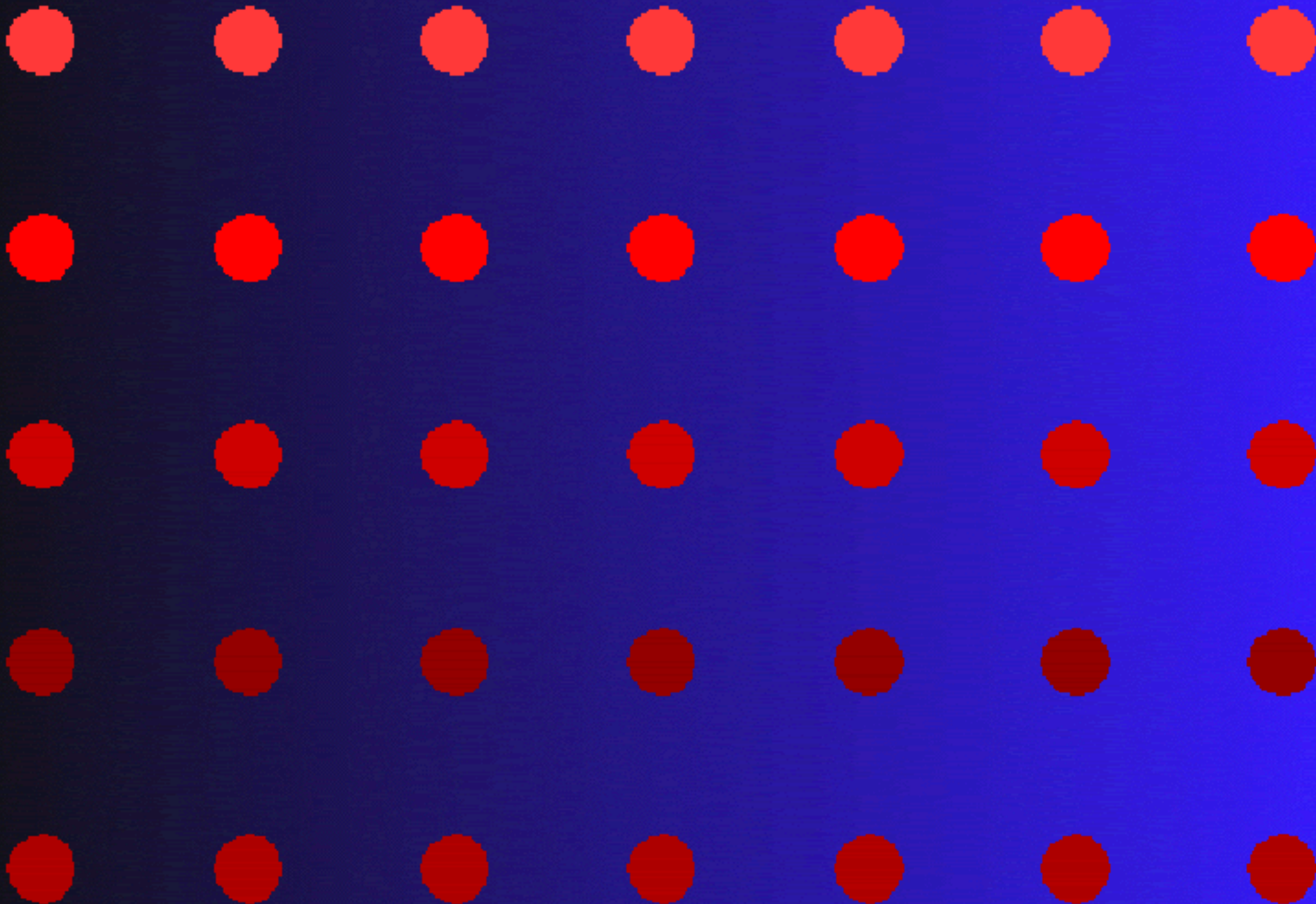


Don
Macleod

Stuart
Anstis

UCSD

Why
hearts flutter



Previous theories

1. Helmholtz 1867: cones more sluggish than red **Wrong**
2. Von Kries 1896: rods more sluggish than cones
3. 1975: lateral inhibition at borders **Wrong**
4. 2003: equiluminance is slow **Wrong**

Previous theories

1. Helmholtz 1867: cones more sluggish than red **Wrong**
- * 2. Von Kries 1896: rods more sluggish than cones
3. 1975: lateral inhibition at borders **Wrong**
4. 2003: equiluminance is slow **Wrong**
- * **AND: Rods reverse Red/blue polarity (Purkinje shift)**

Our theory:



You see each heart TWICE--
First with the cones
Then with the more sluggish rods.



Brightness REVERSES, because rods
are 20x more sensitive to blue than to red (Purkinje shift)



SIMULATION

Our theory explains

1. Flutter,

and predicts two ***NEW*** illusions:

2. Light or Dark Ghostly twins (50 ms delay)

3. Reversed red-blue motion

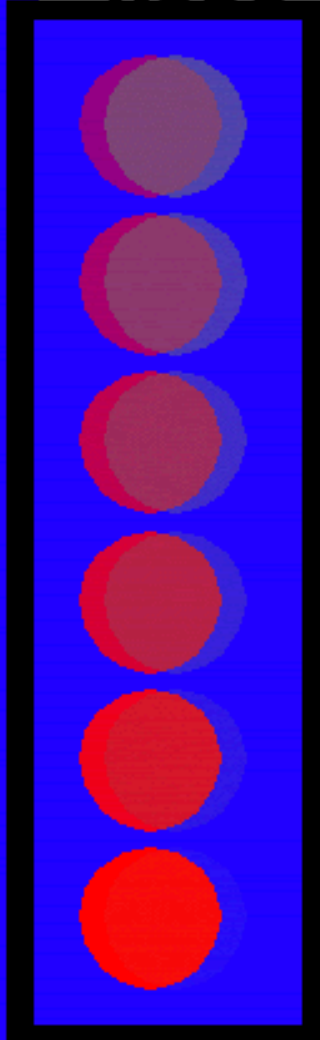
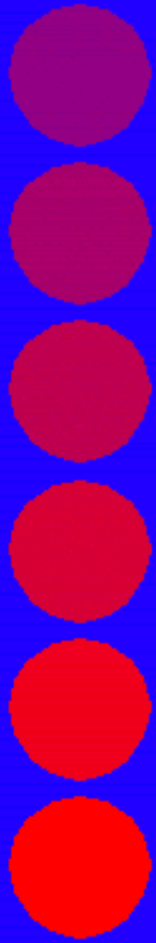
which I shall now ~~fake~~ simulate

SIMULATED FLUTTER

CONES

RODS

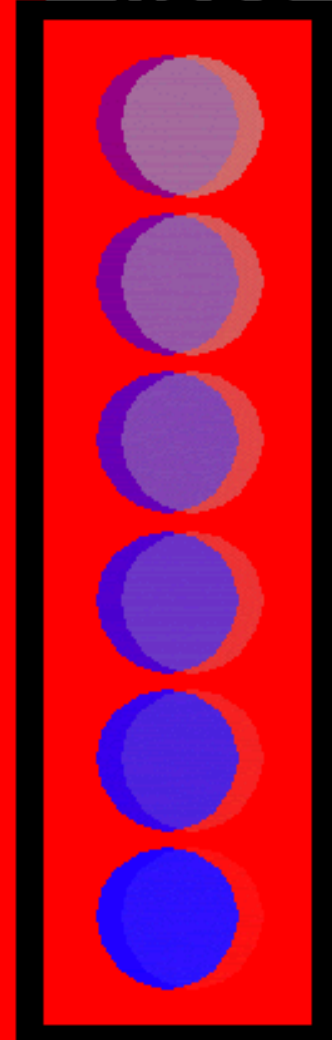
**CONES +
RODS**



CONES

RODS

**CONES +
RODS**



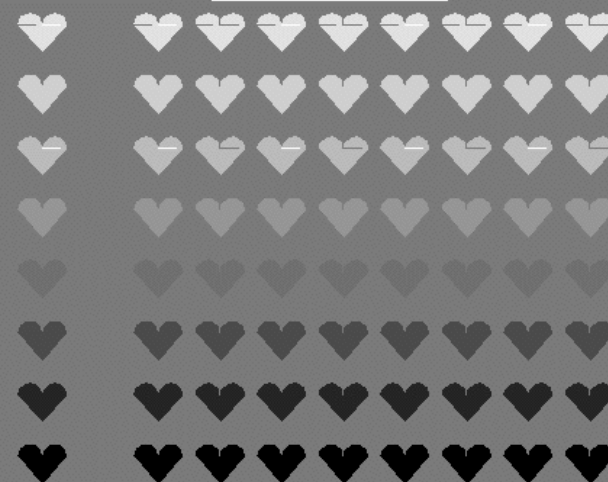
**SIMULATED
FLUTTER**

**Cones
Rigid**



**SIMULATED
FLUTTER**

**Rods
Rigid**



**SIMULATED
FLUTTER**

**Rods+Cones
FLUTTER**



**SIMULATED
FLUTTER**

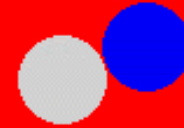
**Cones
Rigid**



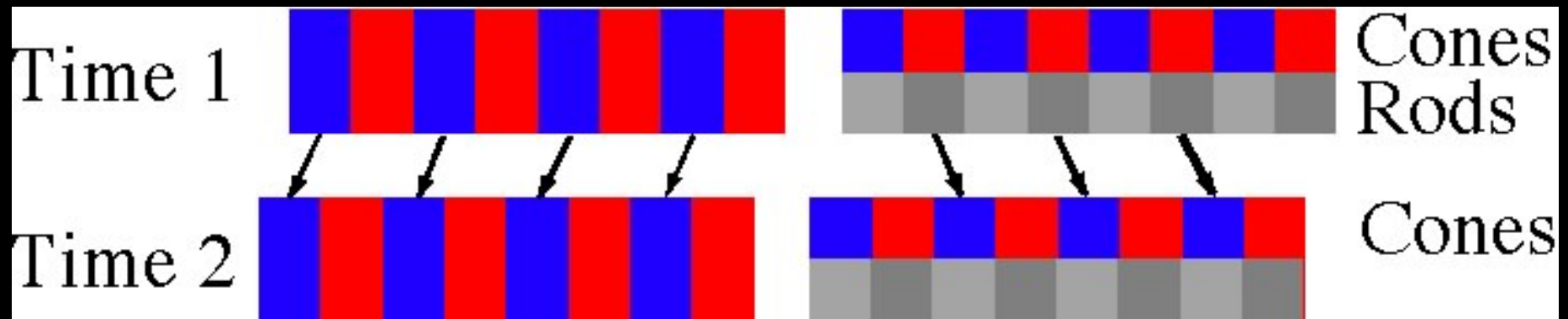
STIMULI



SIMULATED GHOSTLY TWINS



SIMULATED MOTION REVERSAL



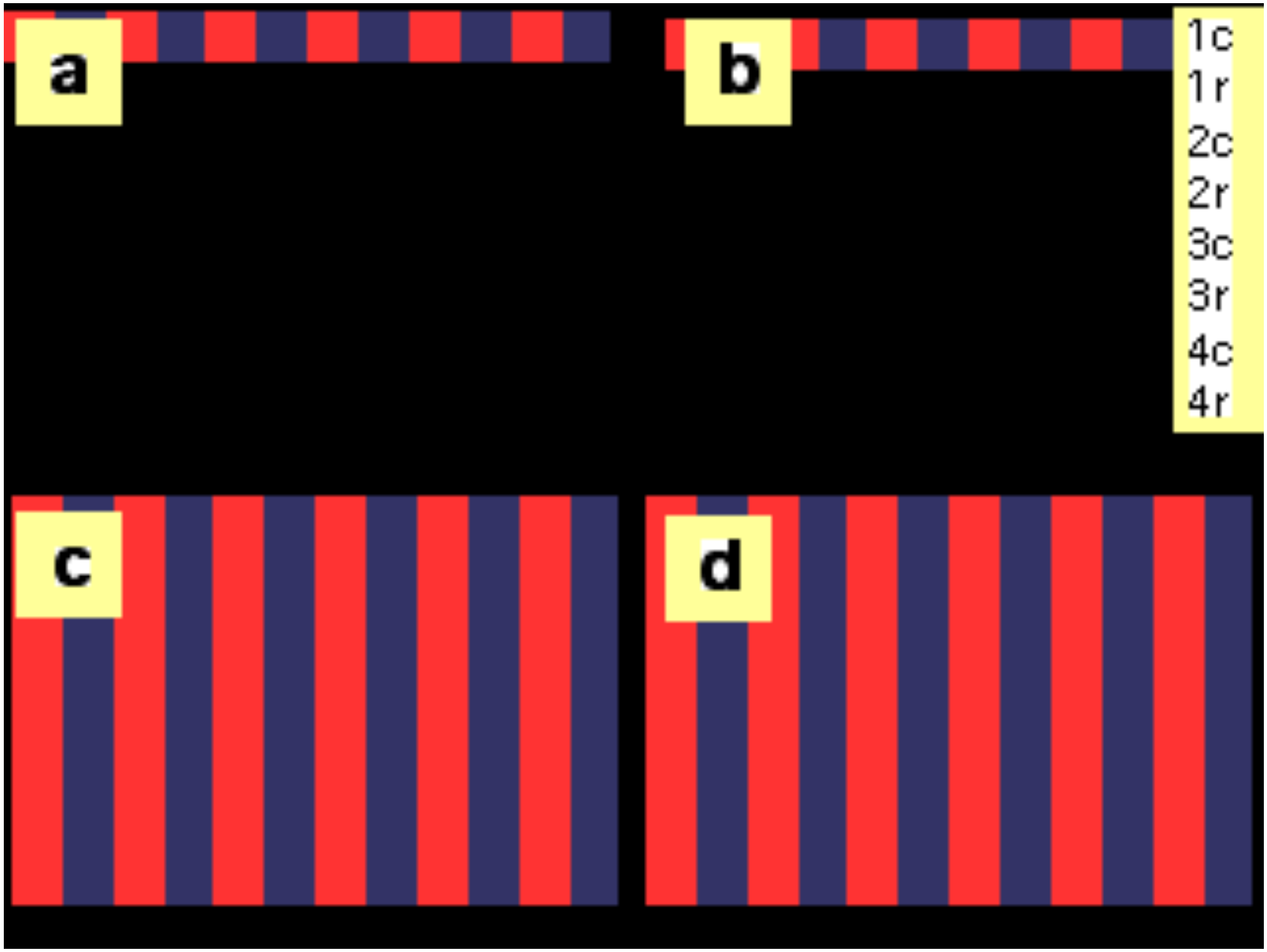
a

b

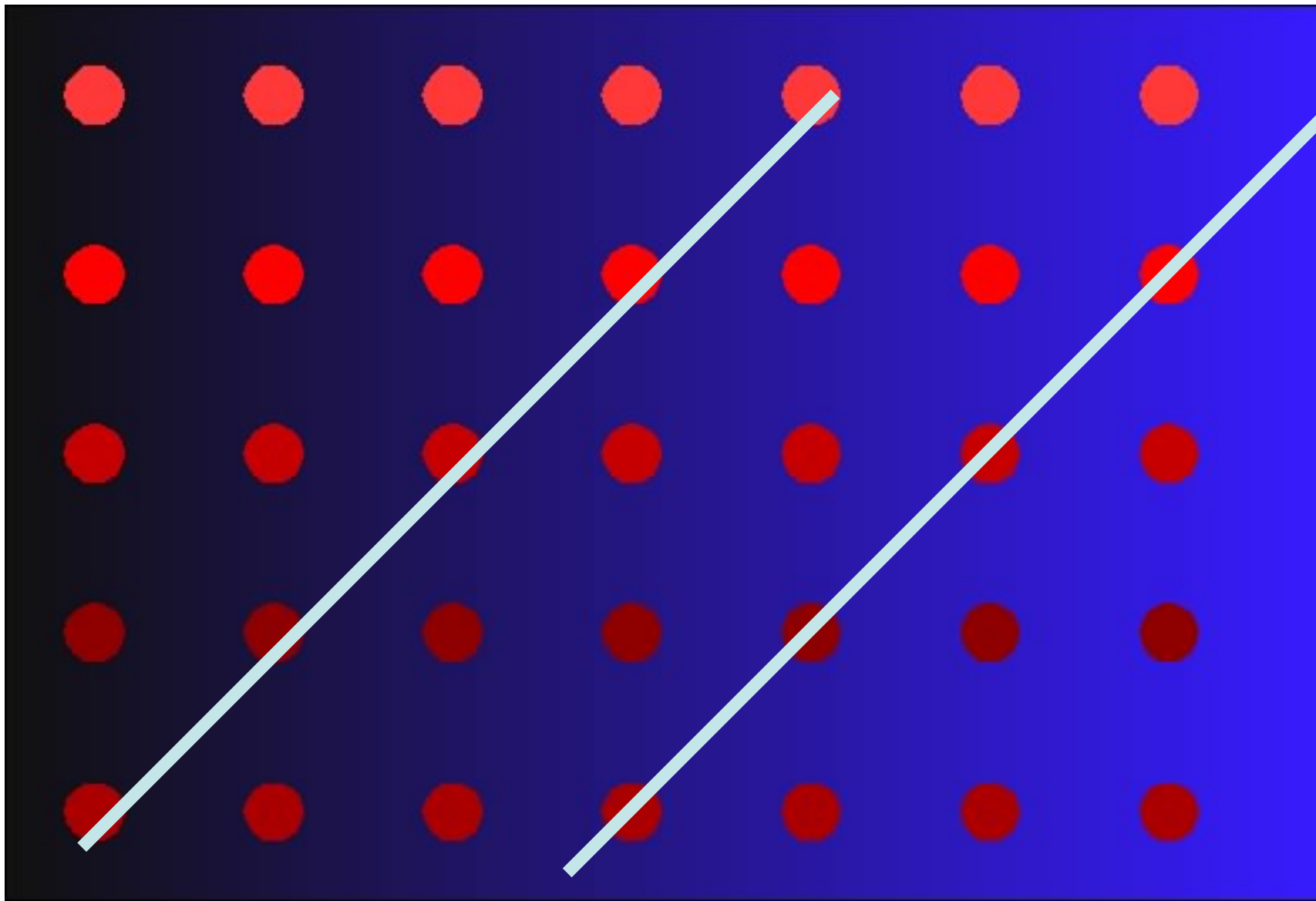
1c
1r
2c
2r
3c
3r
4c
4r

c

d

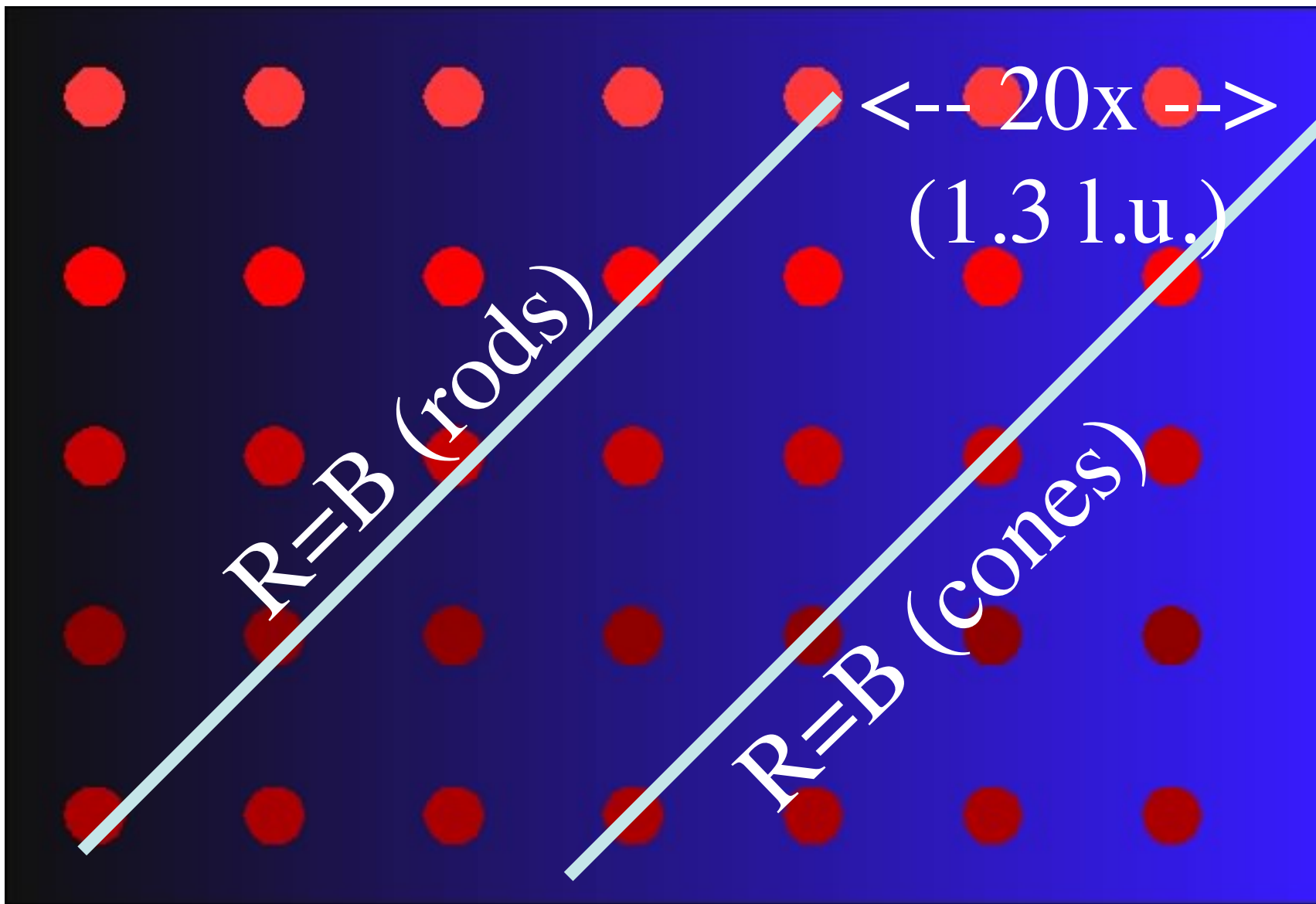


Red luminance -->



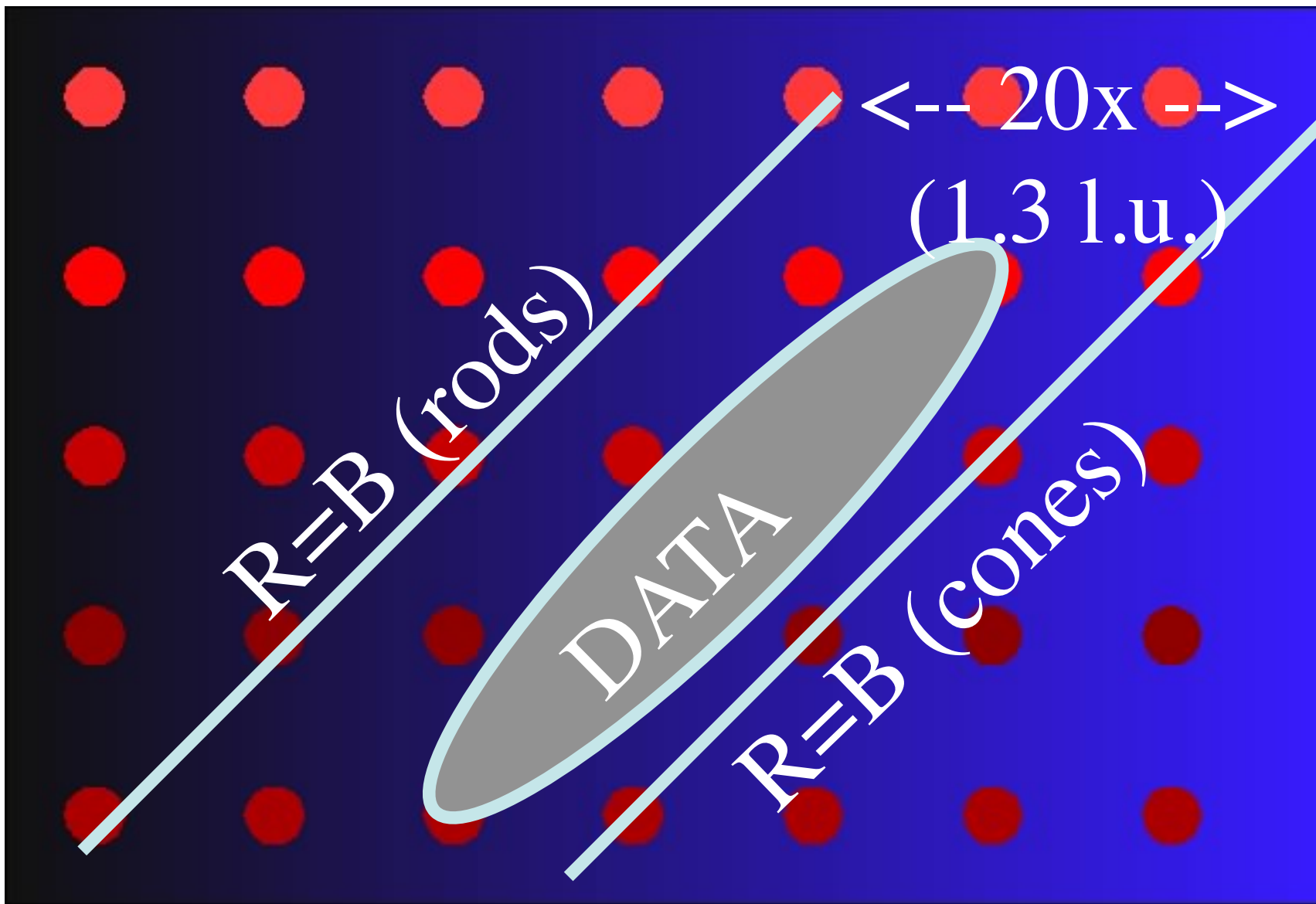
Blue luminance -->

Red luminance \dashrightarrow



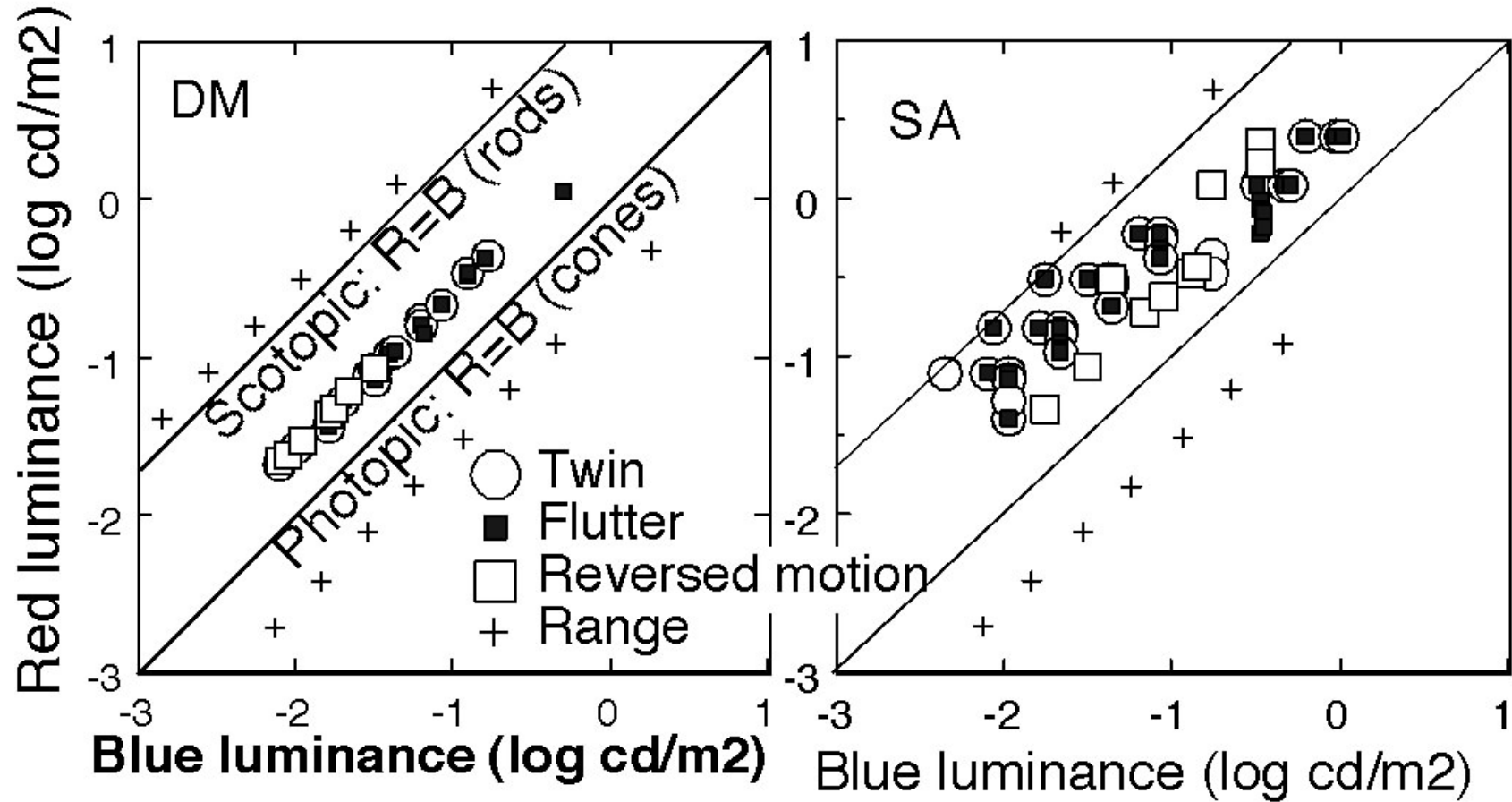
Blue luminance \dashrightarrow

Red luminance \dashrightarrow



Blue luminance \dashrightarrow

Data!



CONCLUSIONS

All three illusions:

1. Flutter
2. Ghostly twins
3. Reversed motion

Occur when **R** > **B** for cones

R < **B** for rods

So we can explain one old illusion
and two new ones

1. Flutter
2. Ghostly twins
3. Motion reversal

with two old mechanisms:

1. Rods are sluggish (50 ms)
2. Rods reverse **R/B** luminance polarity,
giving a positive superimposed on its own
negative.



YOU



THANK

