# Illusions

# A re-examination of the Hermann grid illusion

Peter H. Schiller

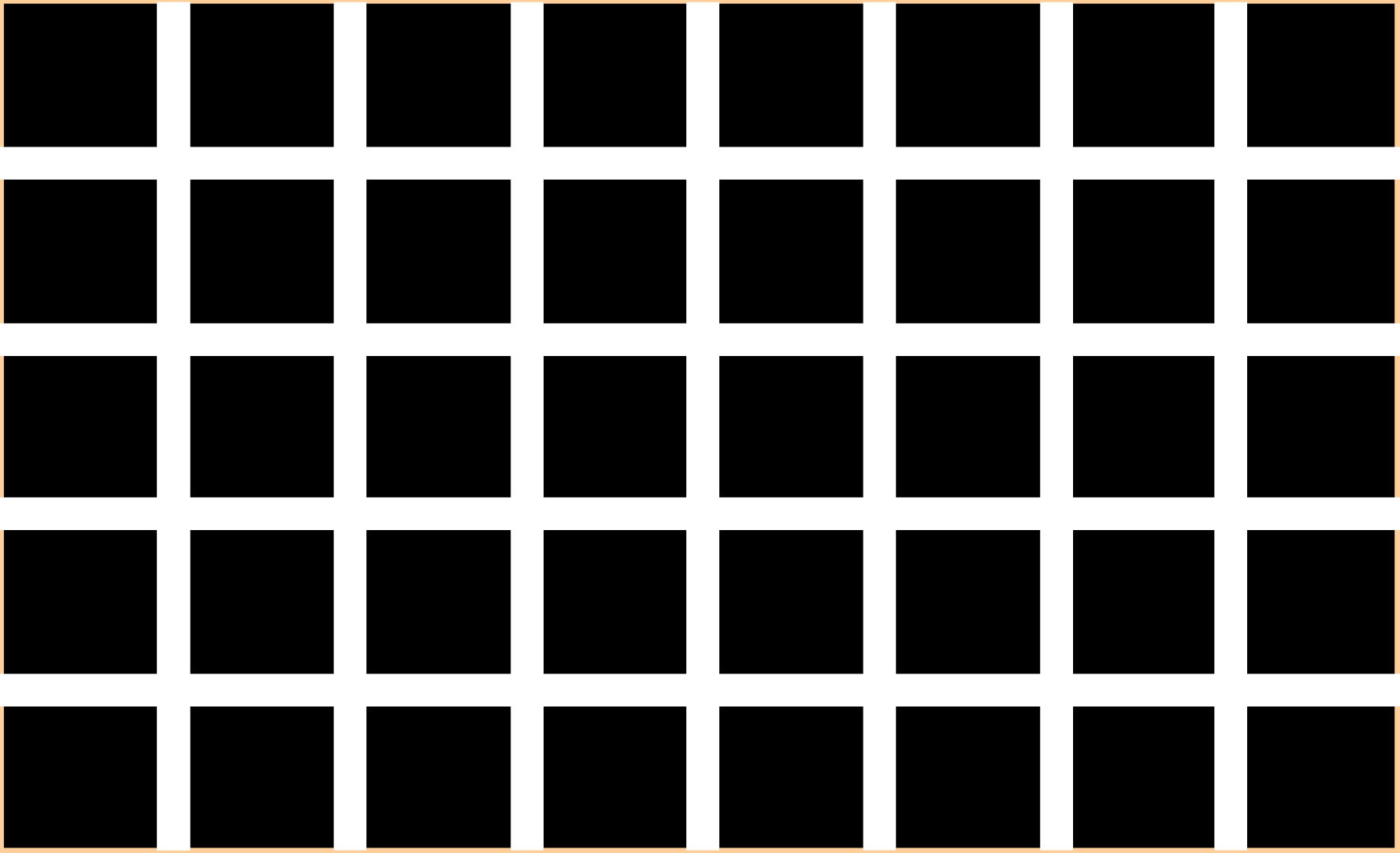


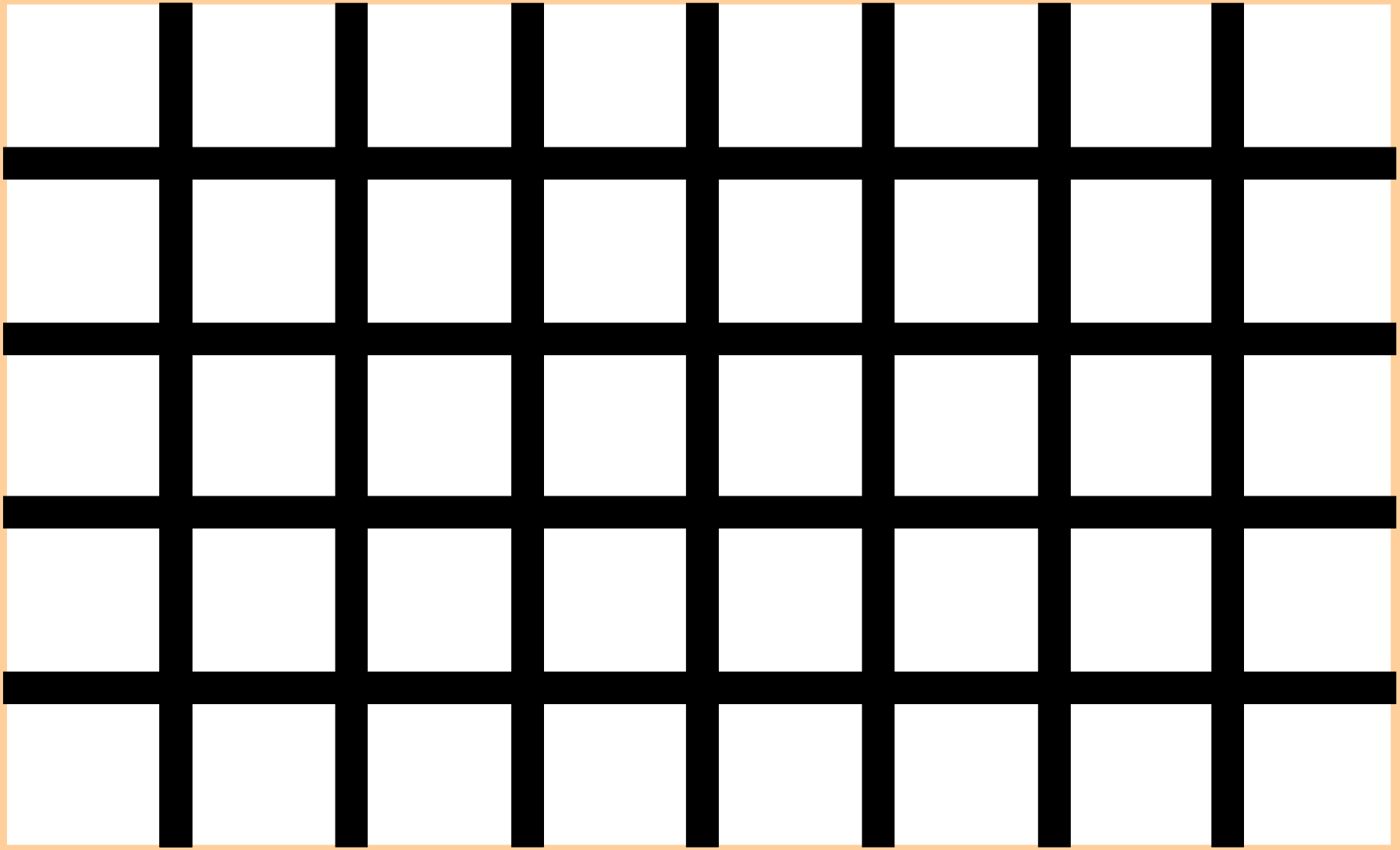
Image is in public domain.

The most widely cited theory purported to explain the illusion:

Figure removed due to copyright restrictions.

Please see lecture video or Schiller PH, Carvey CE (2005). "The Hermann Grid Illusion Revisited." *Perception* 34 (11): 1375–97.

Due to antagonistic center/surround organization, the activity of ON-center retinal ganglion cells whose receptive fields fall into the intersections of the grid produces a smaller response than those neurons whose receptive fields fall elsewhere.



# The effect is not size dependent

Figure removed due to copyright restriction.

Please see lecture video or Schiller PH, Carvey CE (2005). "The Hermann Grid Illusion Revisited." *Perception* 34 (11): 1375–97.

# Illusion is less pronounced when display is rotated 45 degrees

Figure removed due to copyright restriction.

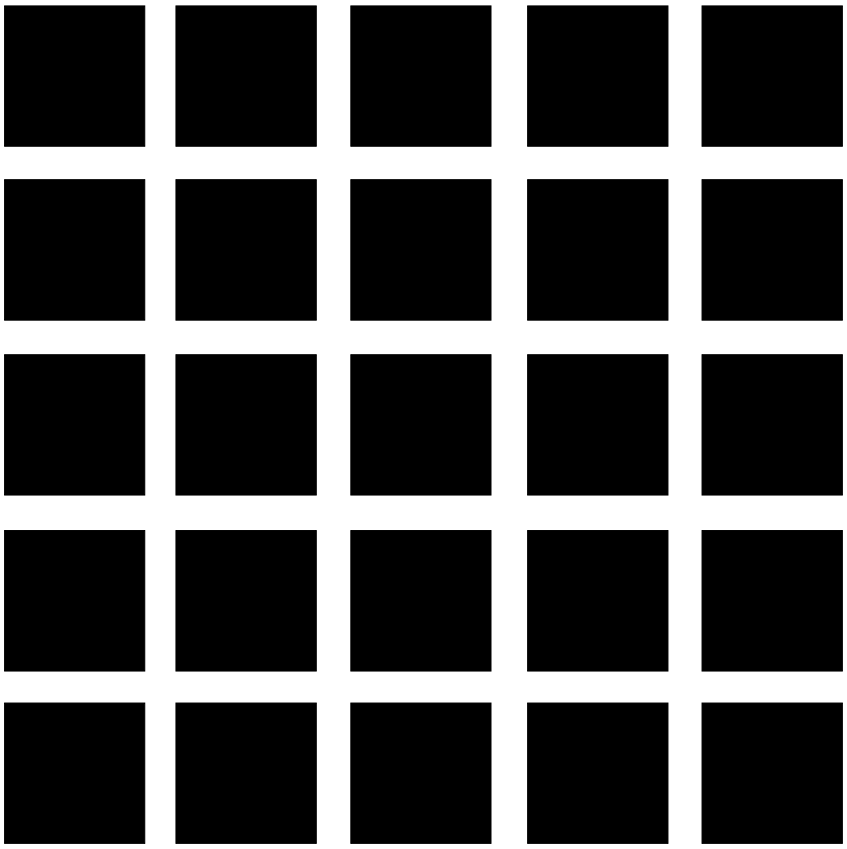
Please see lecture video or Schiller PH, Carvey CE (2005). "The Hermann Grid Illusion Revisited." *Perception* 34 (11): 1375–97.

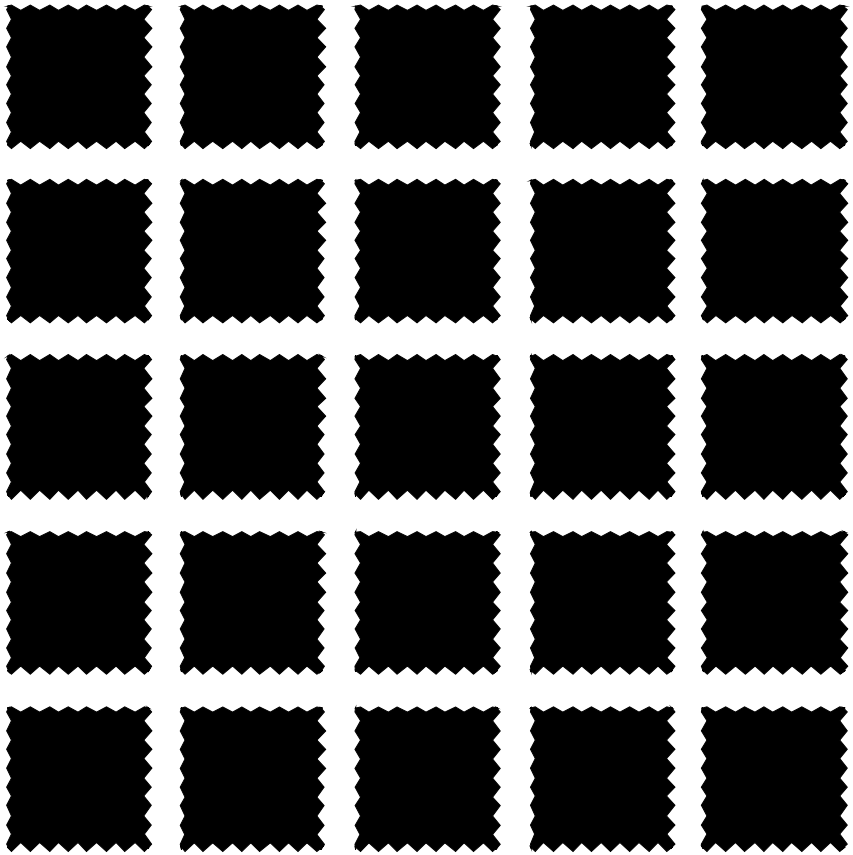
# Differently oriented vertical and horizontal lines reduce illusion

Figure removed due to copyright restriction.

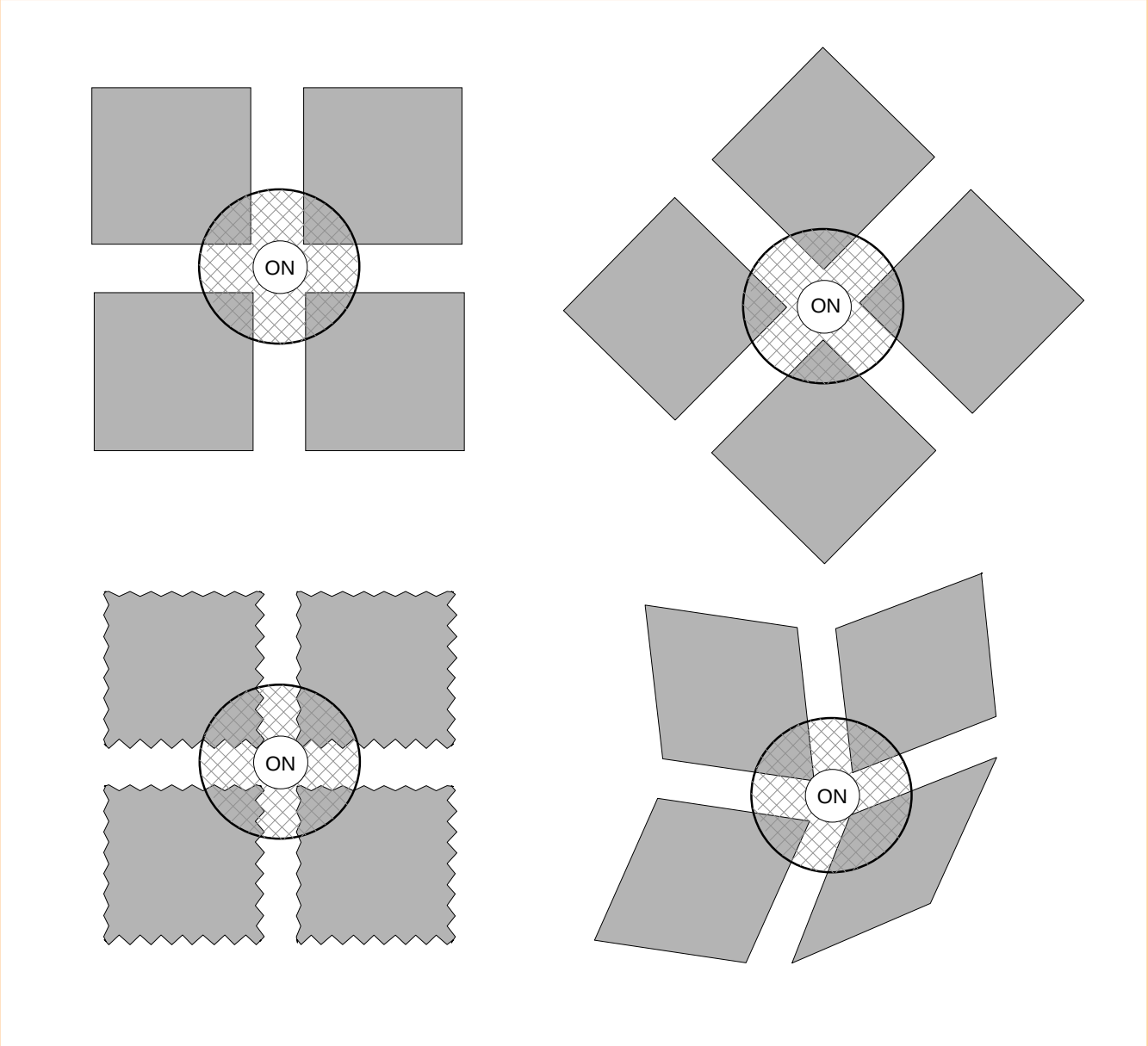
Please see lecture video or Schiller PH, Carvey CE (2005). "The Hermann Grid Illusion Revisited." *Perception* 34 (11): 1375–97.

# Serrated edges reduce illusion





The center-surround antagonism produced in ON-center ganglion cells is similar for the four displays but they induce notable differences in the illusory effect

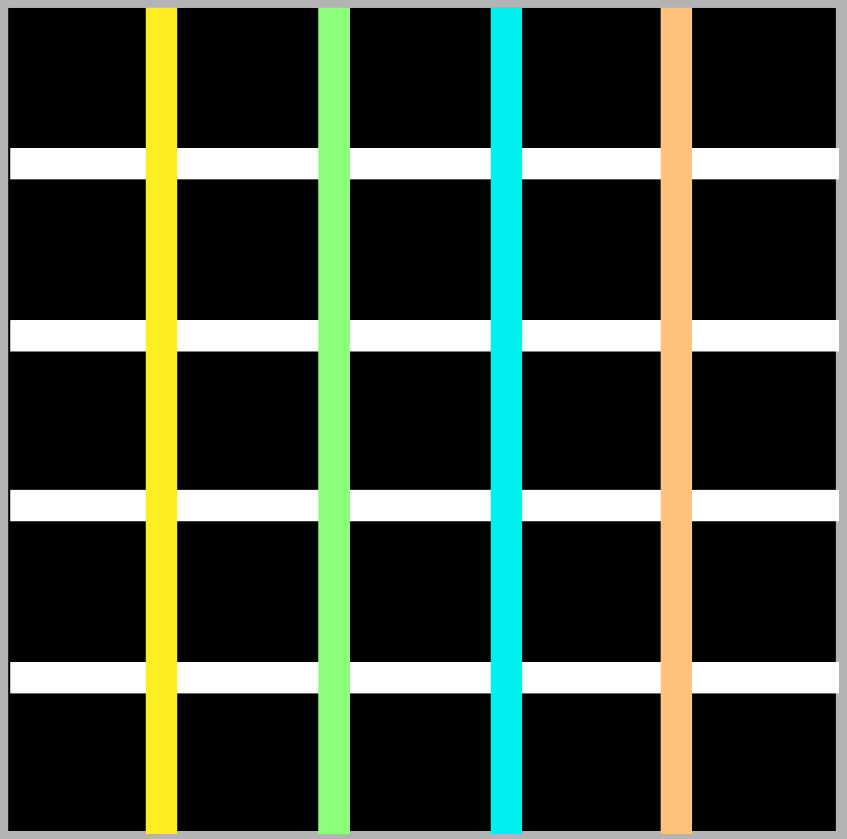


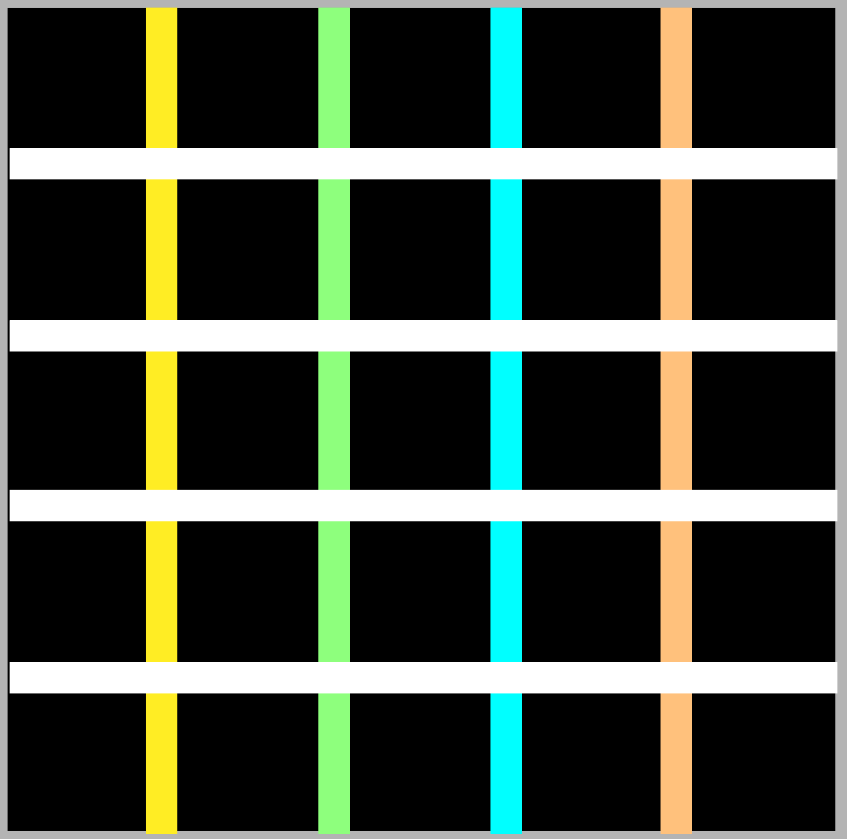
Smudges are seen on the left where gray lines are in front and are not seen or the right where white lines are in front.

Figure removed due to copyright restriction.

Please see lecture video or Schiller PH, Carvey CE (2005). "The Hermann Grid Illusion Revisited." *Perception* 34 (11): 1375–97.

Color of smudges is defined by which set of lines is in front. On left color lines are in front and smudges have the same color. On right the white lines are in front and the smudges are weakly darker gray.





# The illusion is reduced at isoluminancde

Figure removed due to copyright restriction.

Please see lecture video or Schiller PH, Carvey CE (2005). "The Hermann Grid Illusion Revisited." *Perception* 34 (11): 1375–97.

# Retinal ganglion cell receptive field layout at an eccentricity of 5 degrees

Figure removed due to copyright restriction.

Please see lecture video or Schiller PH, Carvey CE (2005). "The Hermann Grid Illusion Revisited." *Perception* 34 (11): 1375–97.

# S1 cell theory

Figure removed due to copyright restriction.

Please see lecture video or Schiller PH, Carvey CE (2005). "The Hermann Grid Illusion Revisited." *Perception* 34 (11): 1375–97.

# The Lingelbach scintillating grid illusion

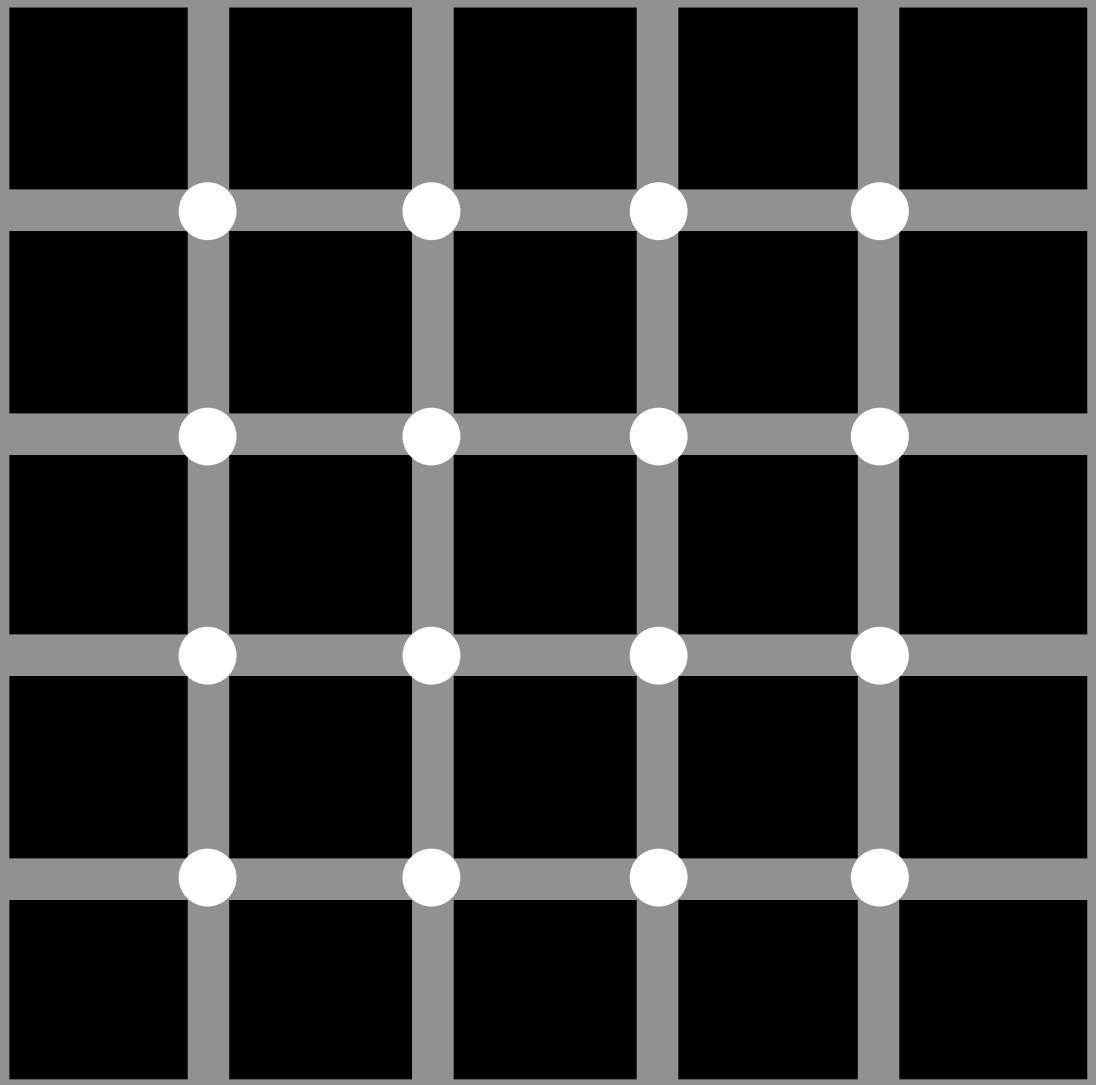


Figure 1. Schrauf, Michael, Bernd Lingelbach, et al. "The Scintillating Grid Illusion." *Vision Research* 37, no. 8 (1997): 1033-8. Courtesy of Elsevier, Inc., http://www.sciencedirect.com. Used with permission.

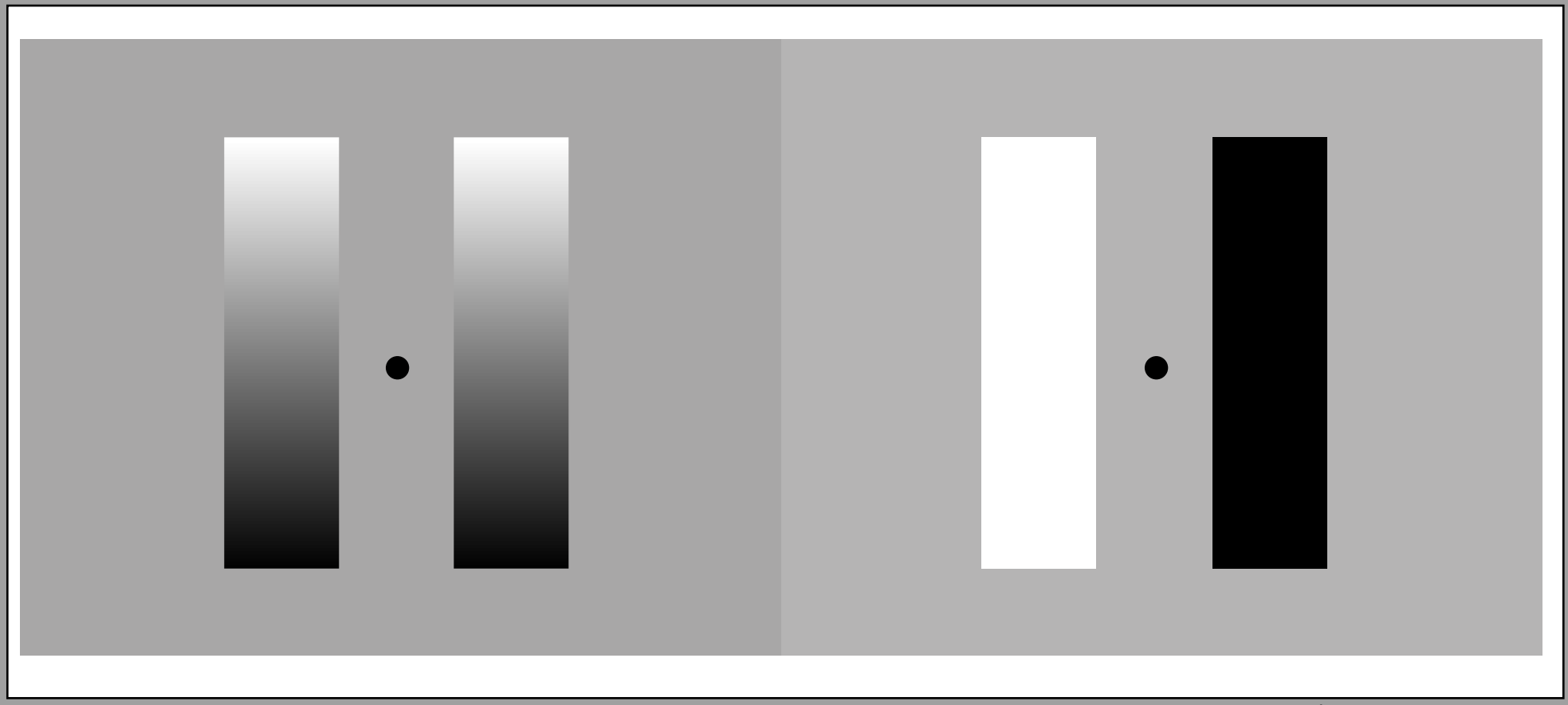
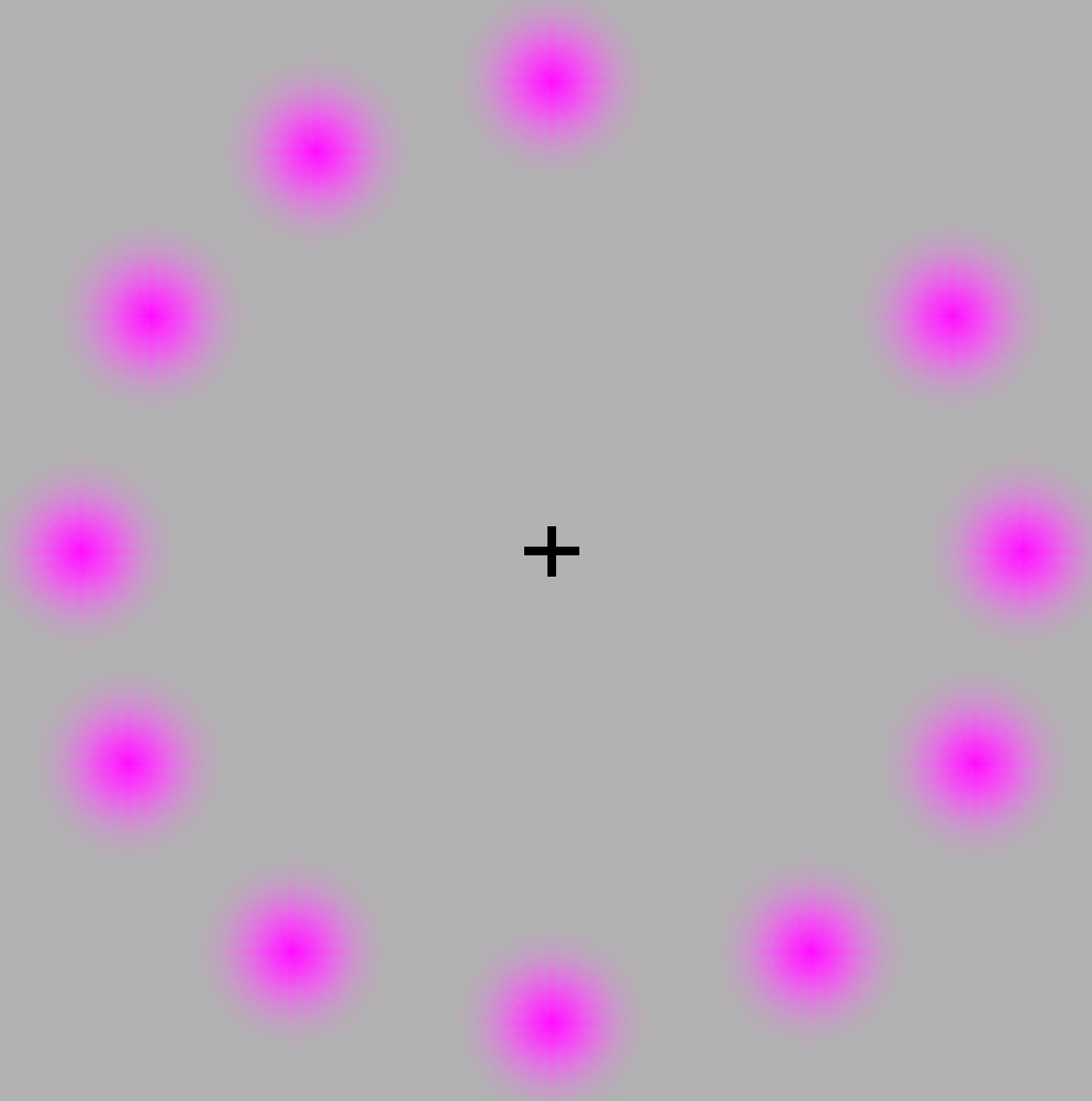


Image by MIT OpenCourseWare.



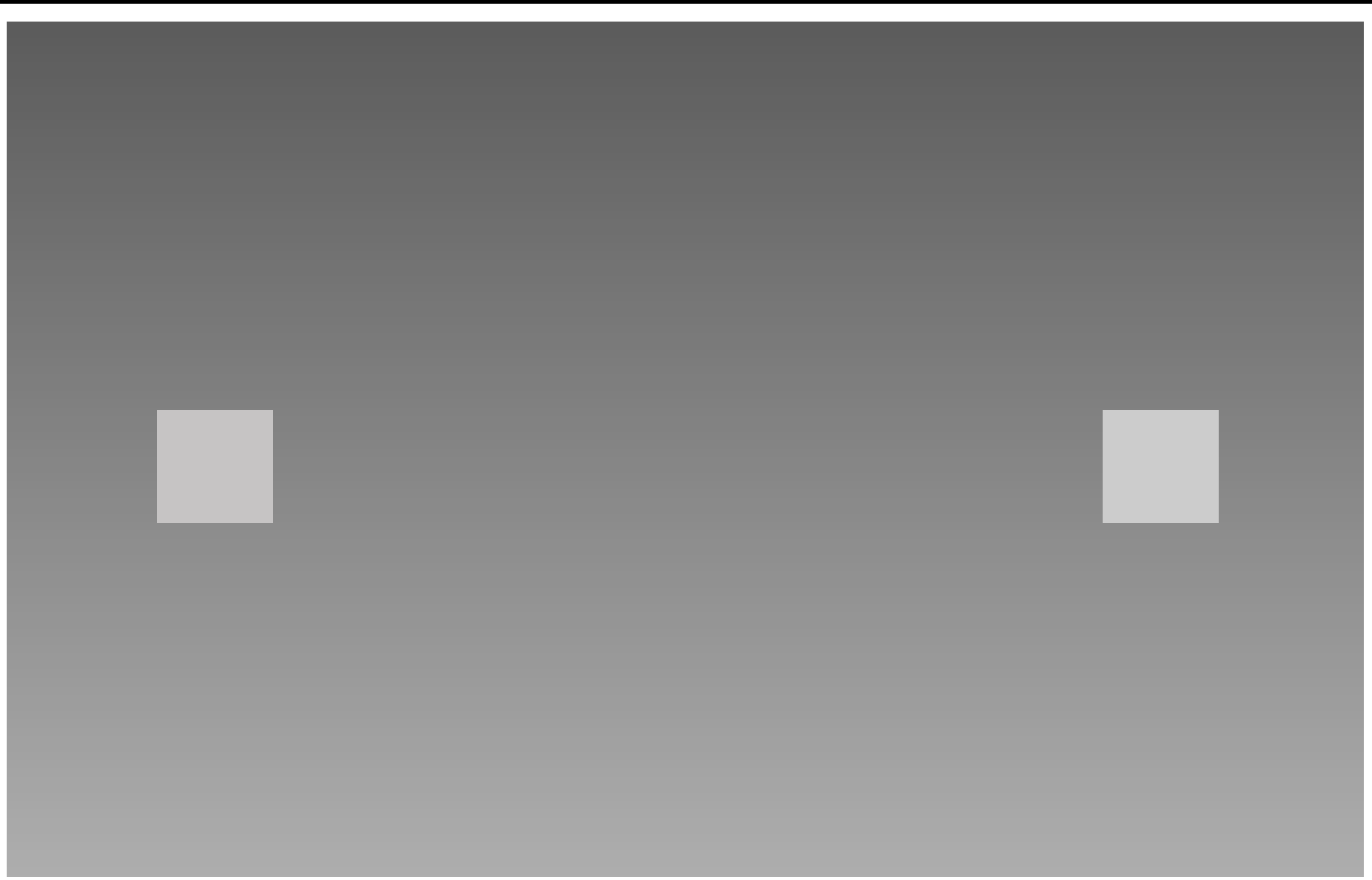


Image by MIT OpenCourseWare.

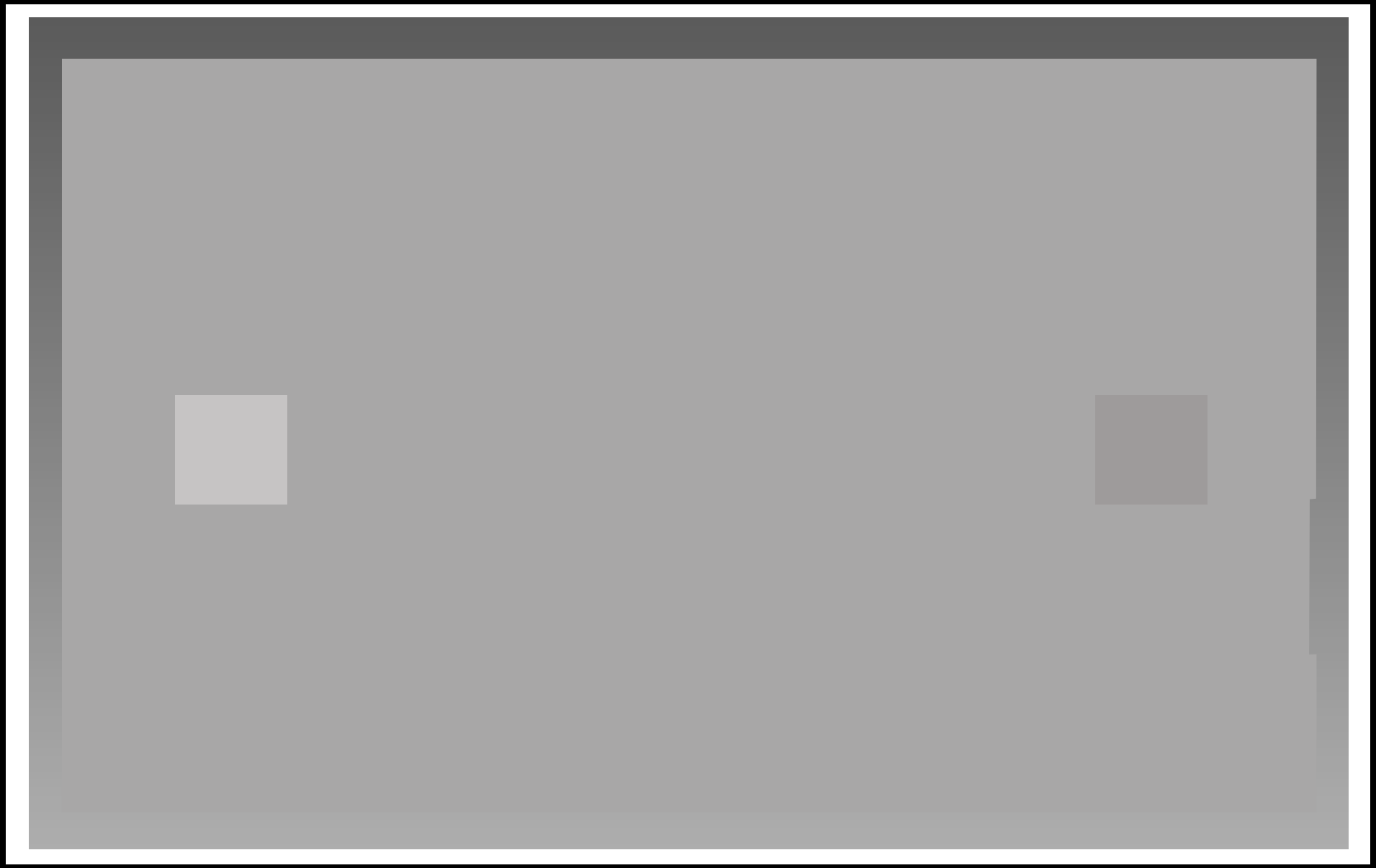


Image by MIT OpenCourseWare.

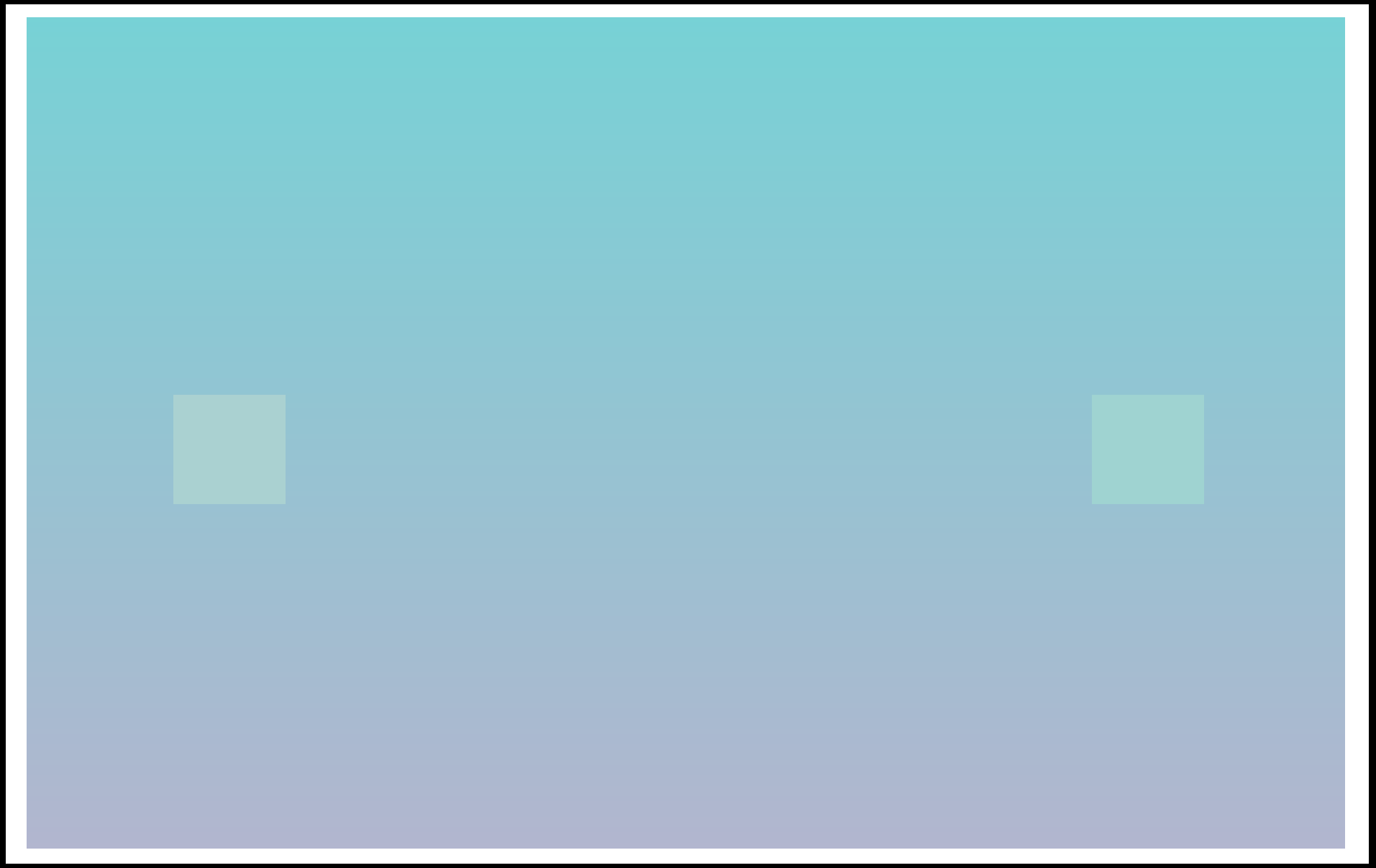
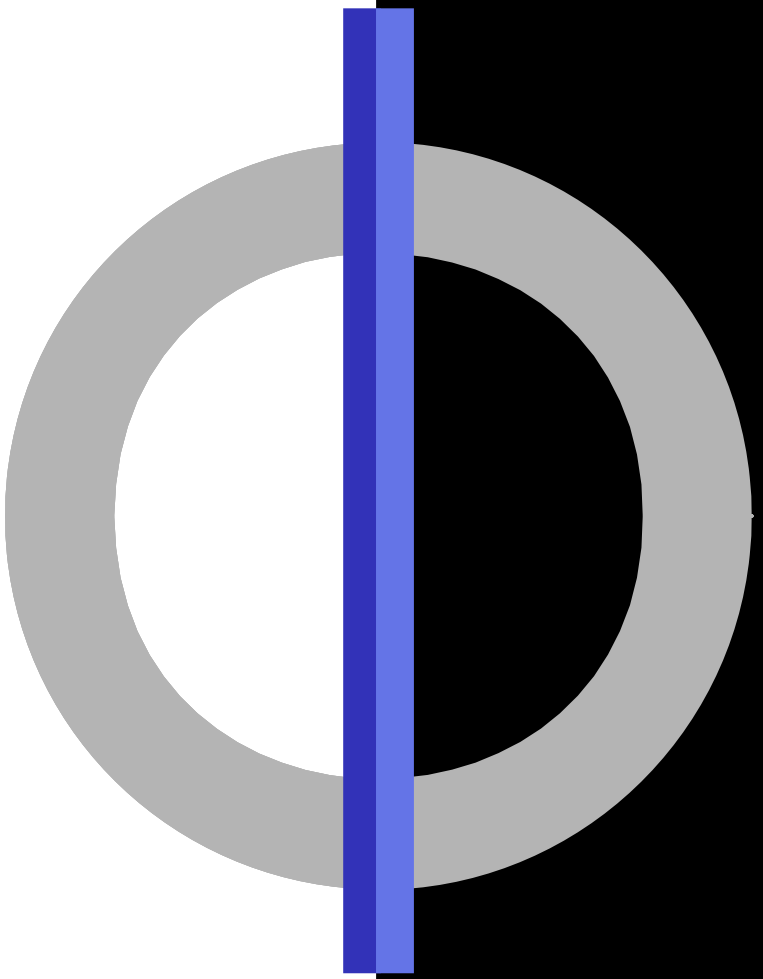
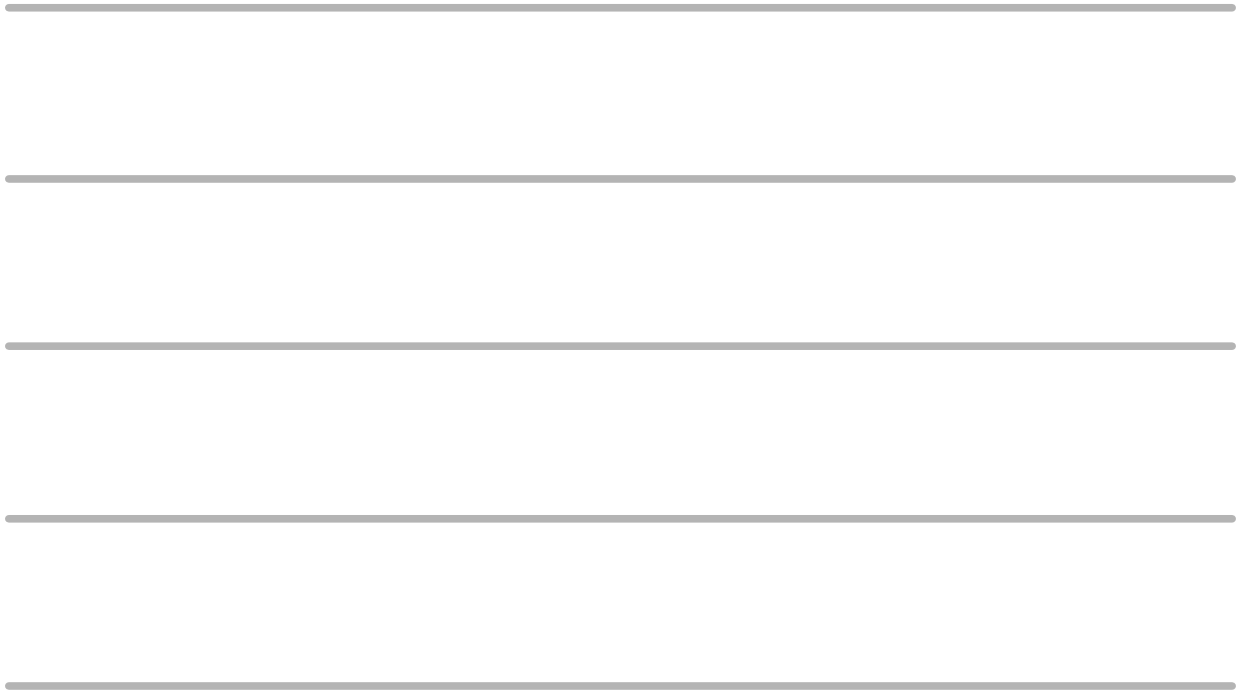


Image by MIT OpenCourseWare.





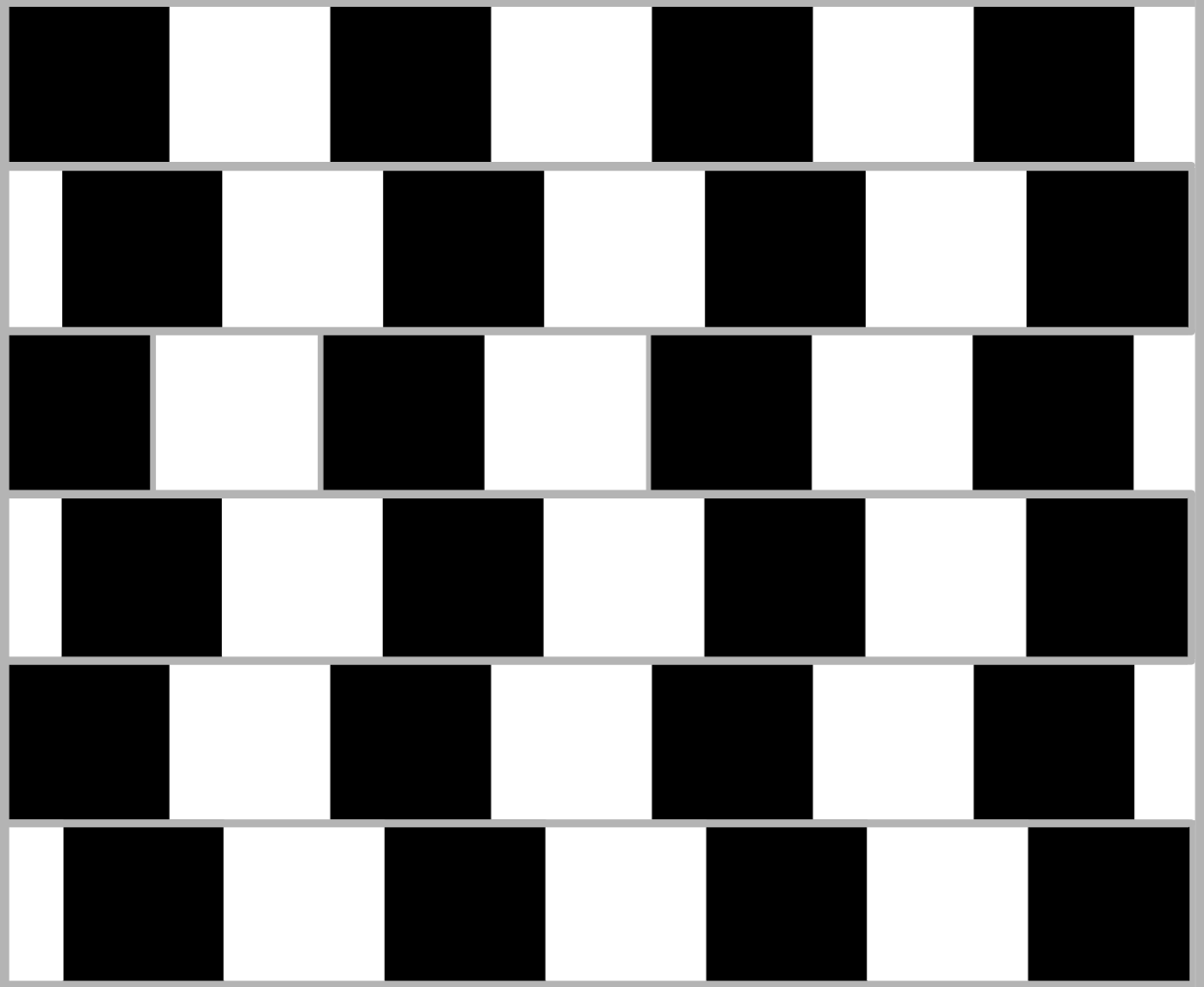


Image is in public domain.

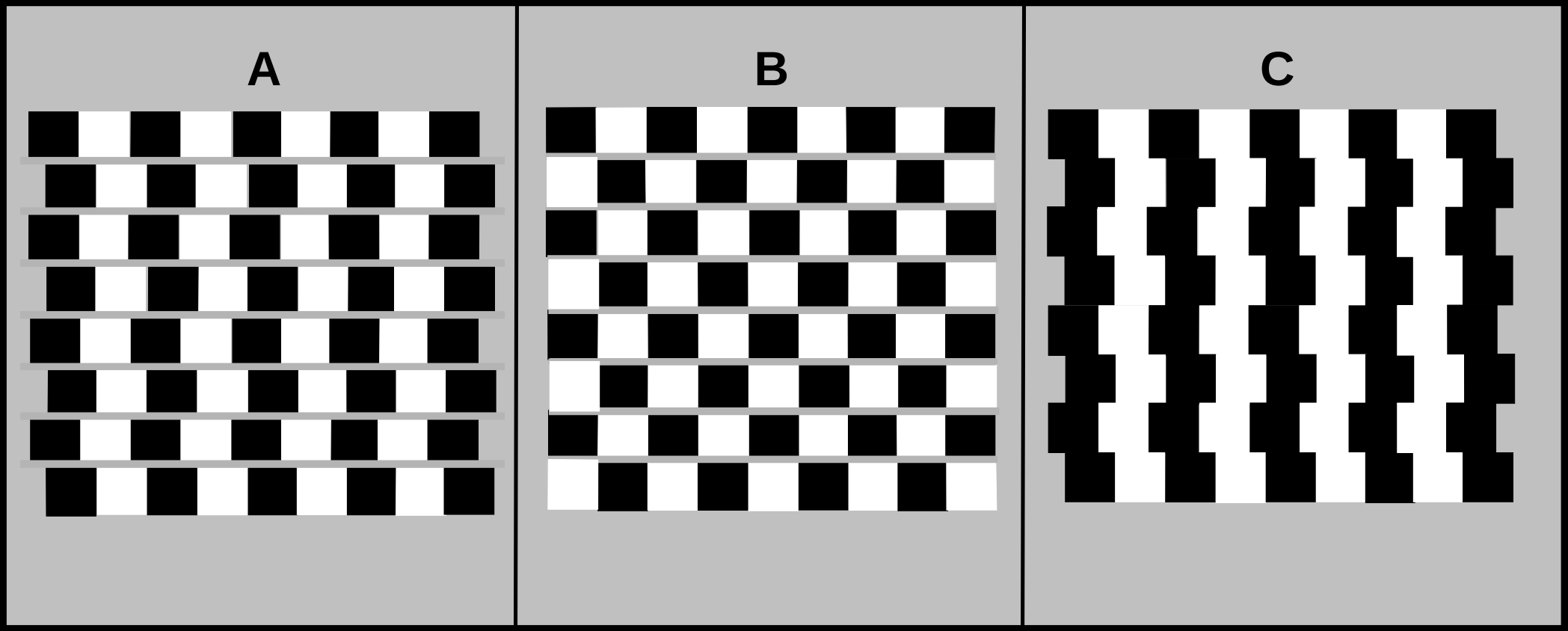
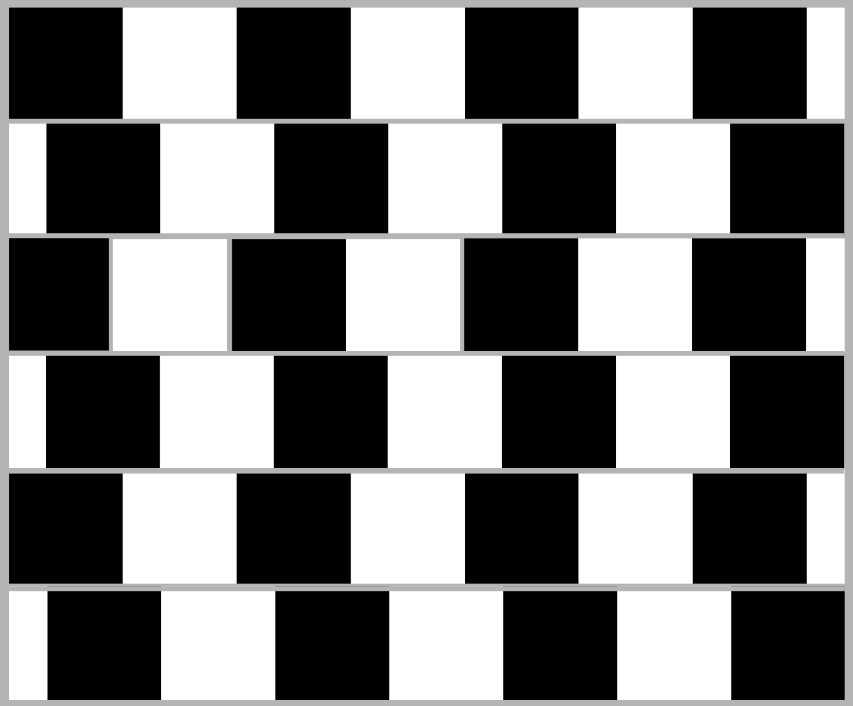



Image is in public domain.



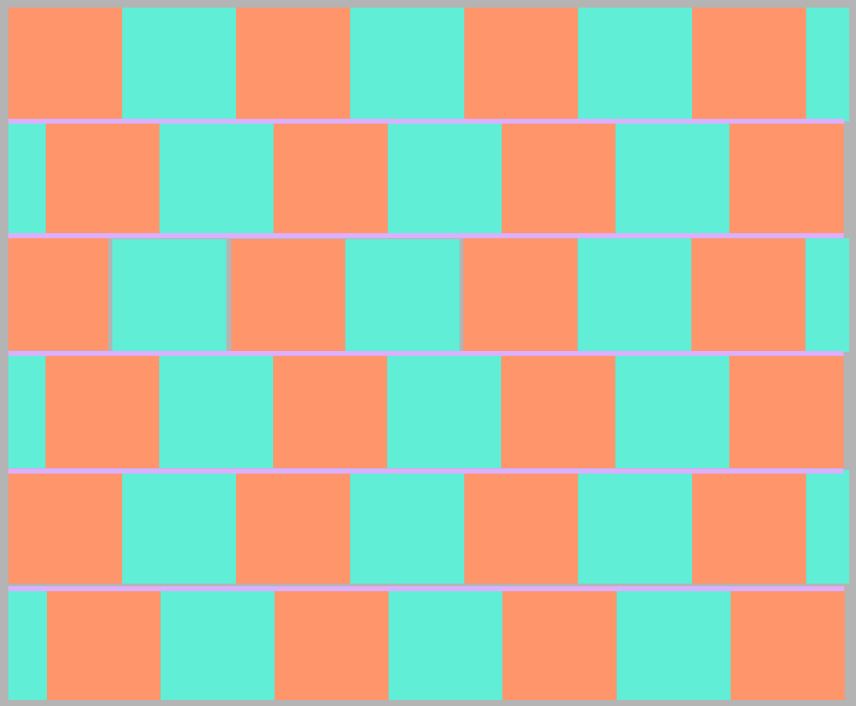


Image is in public domain.

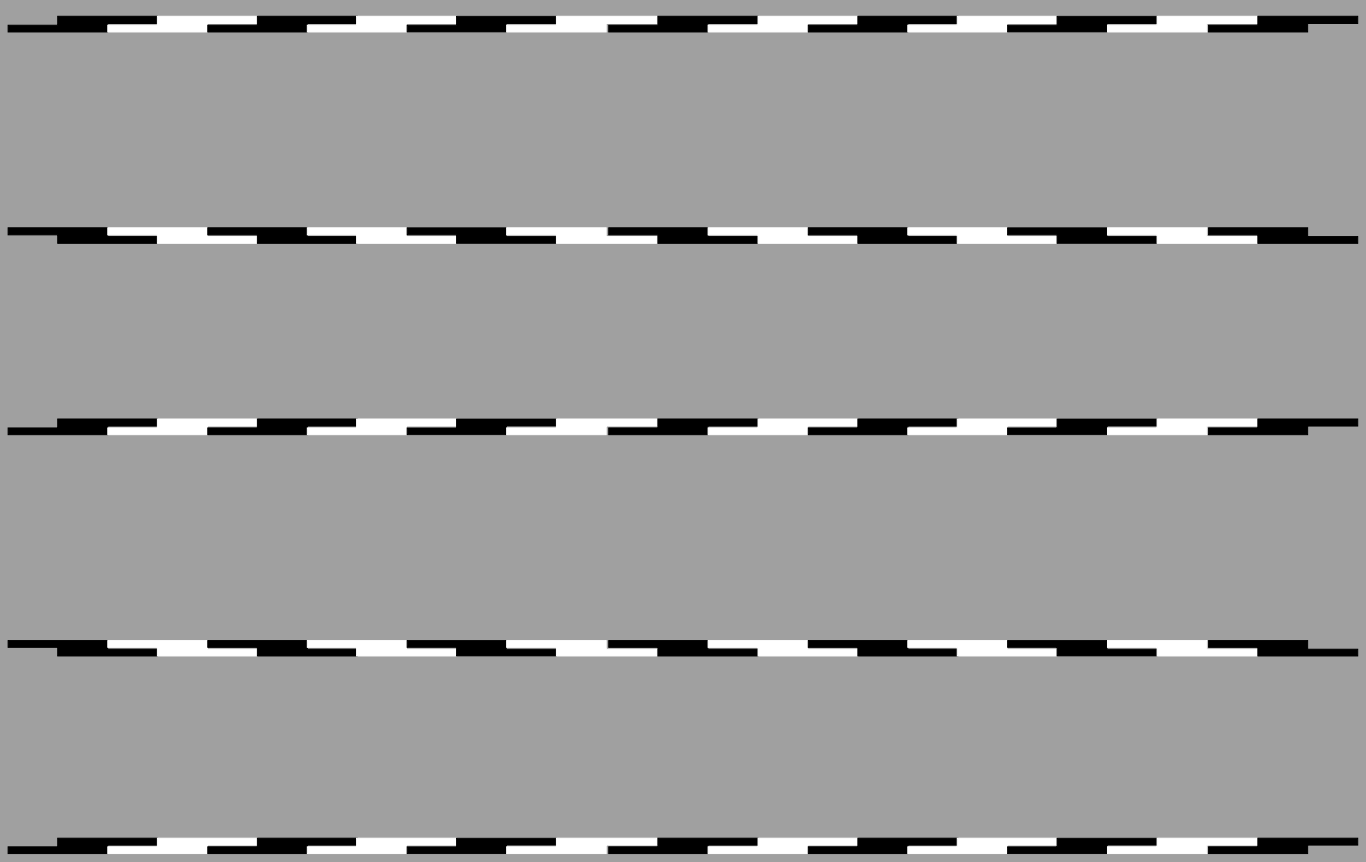


Image is in public domain.

Image is in public domain.

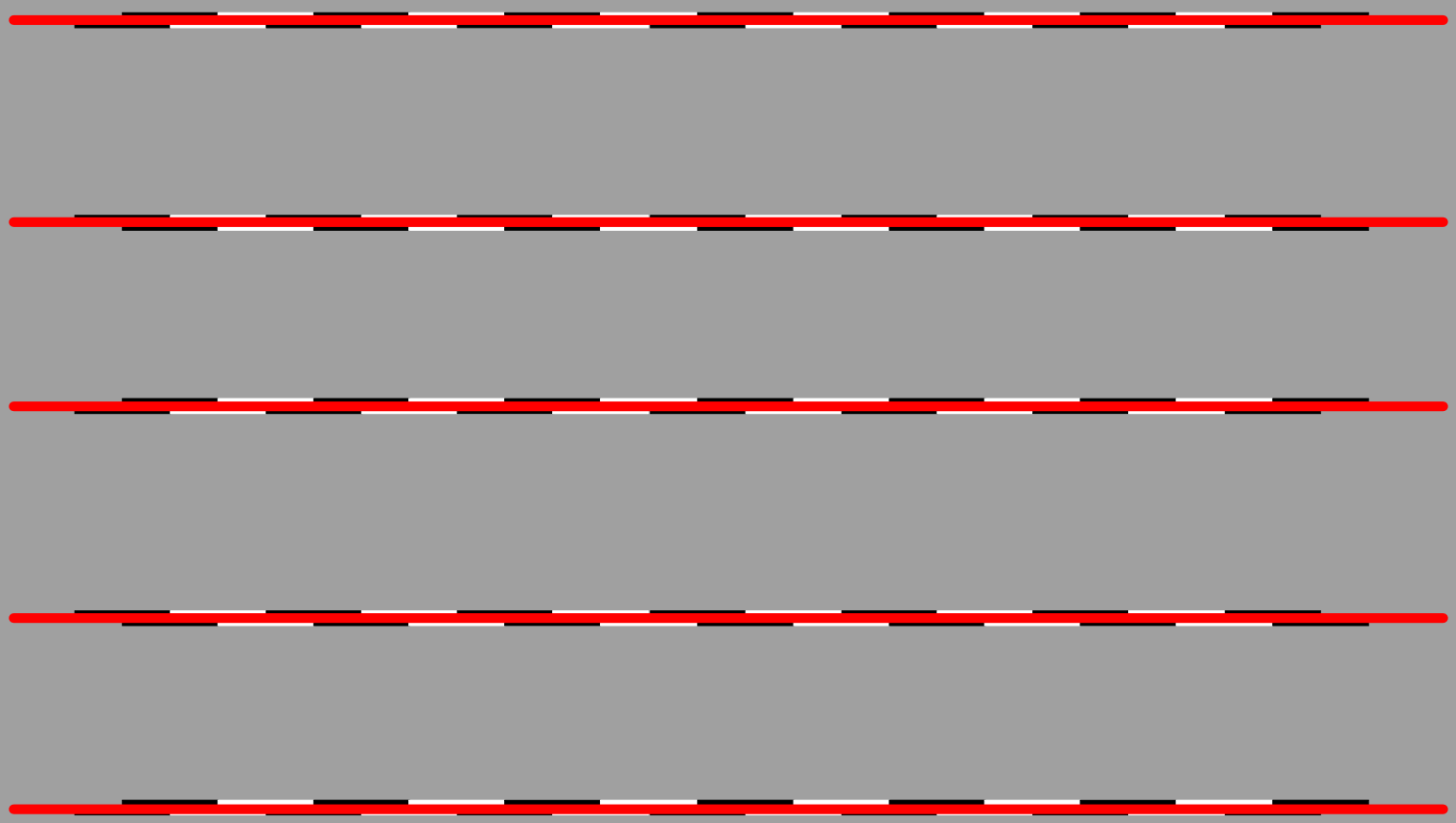


Image is in public domain.

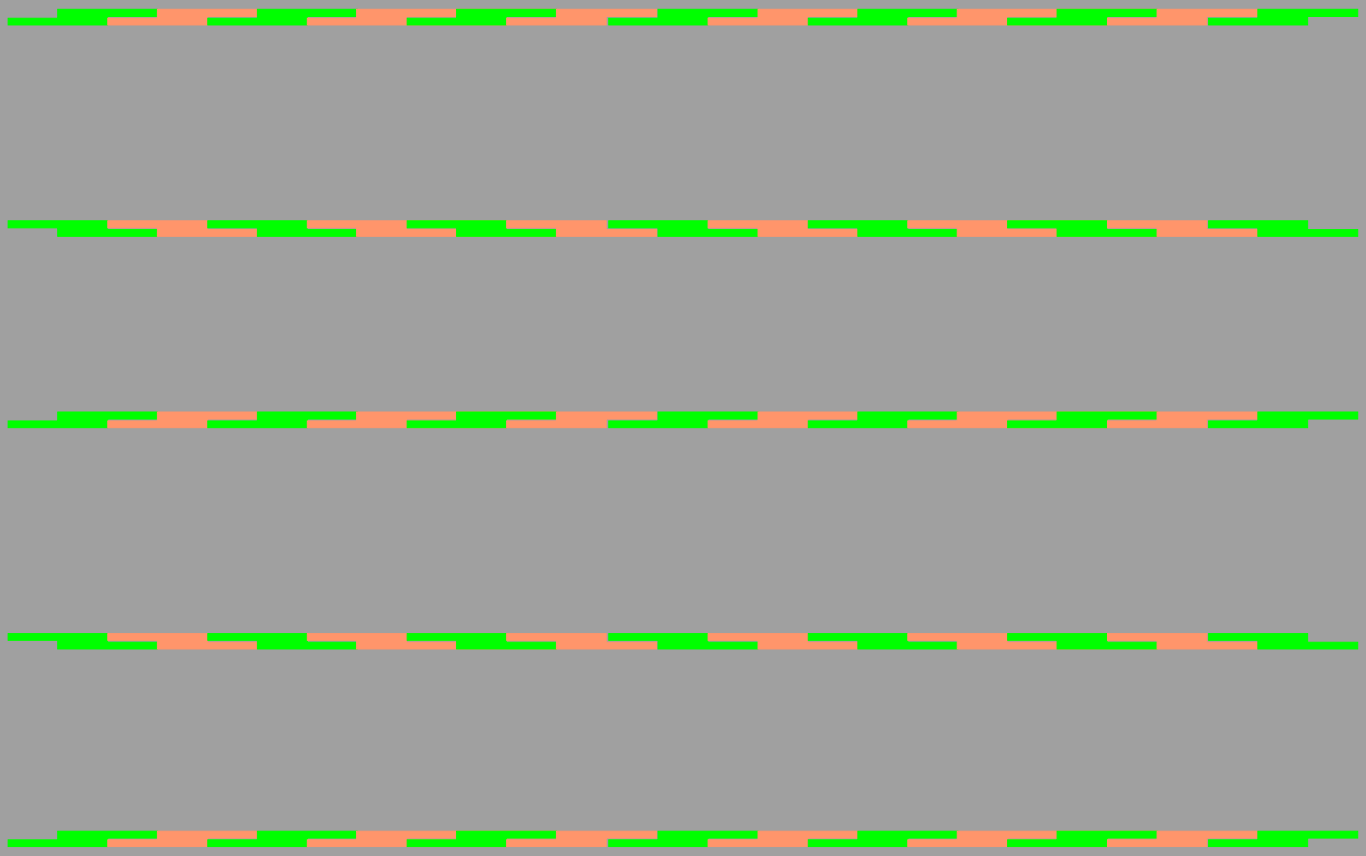


Image is in public domain.

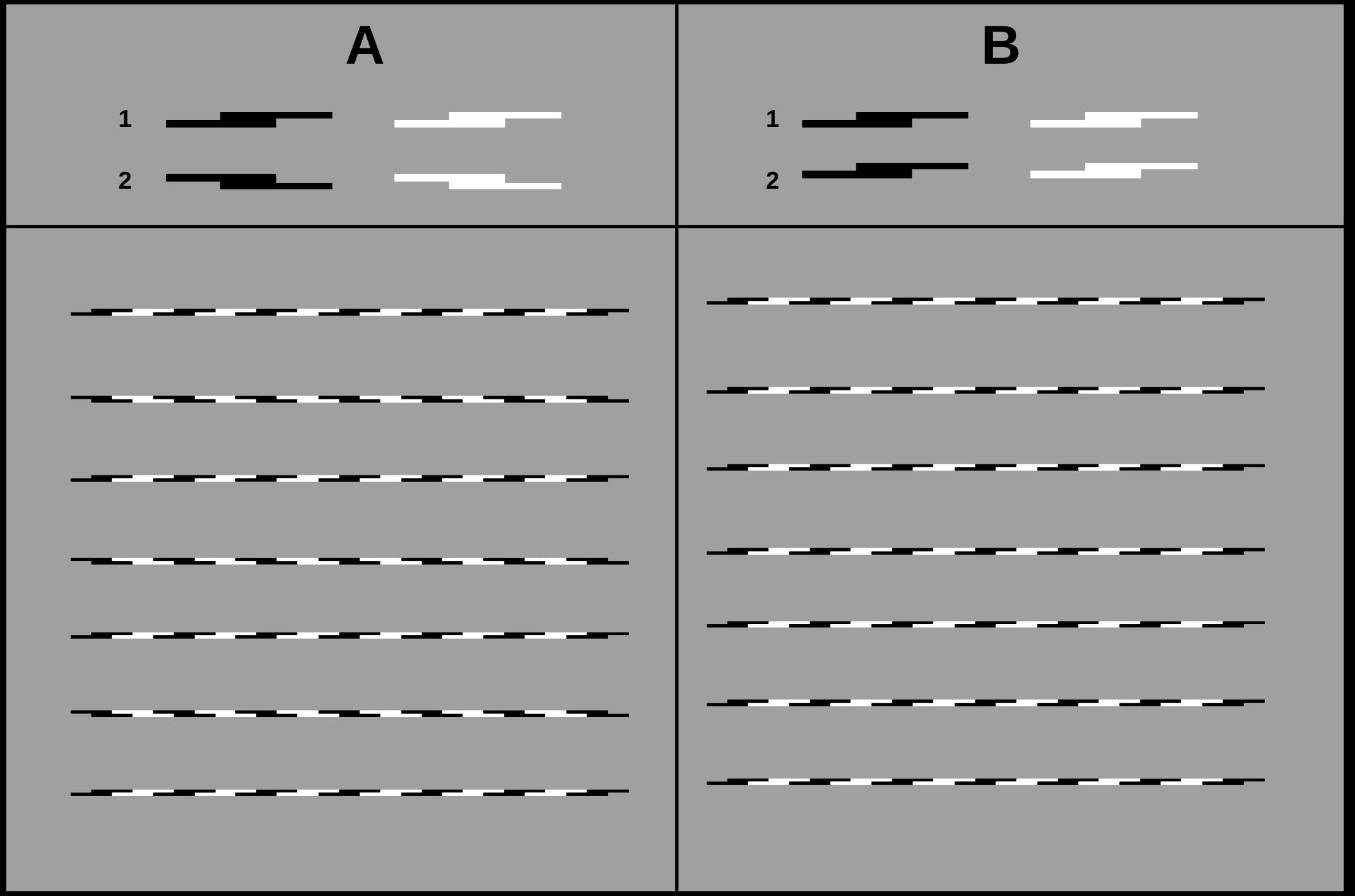



Image is in public domain.

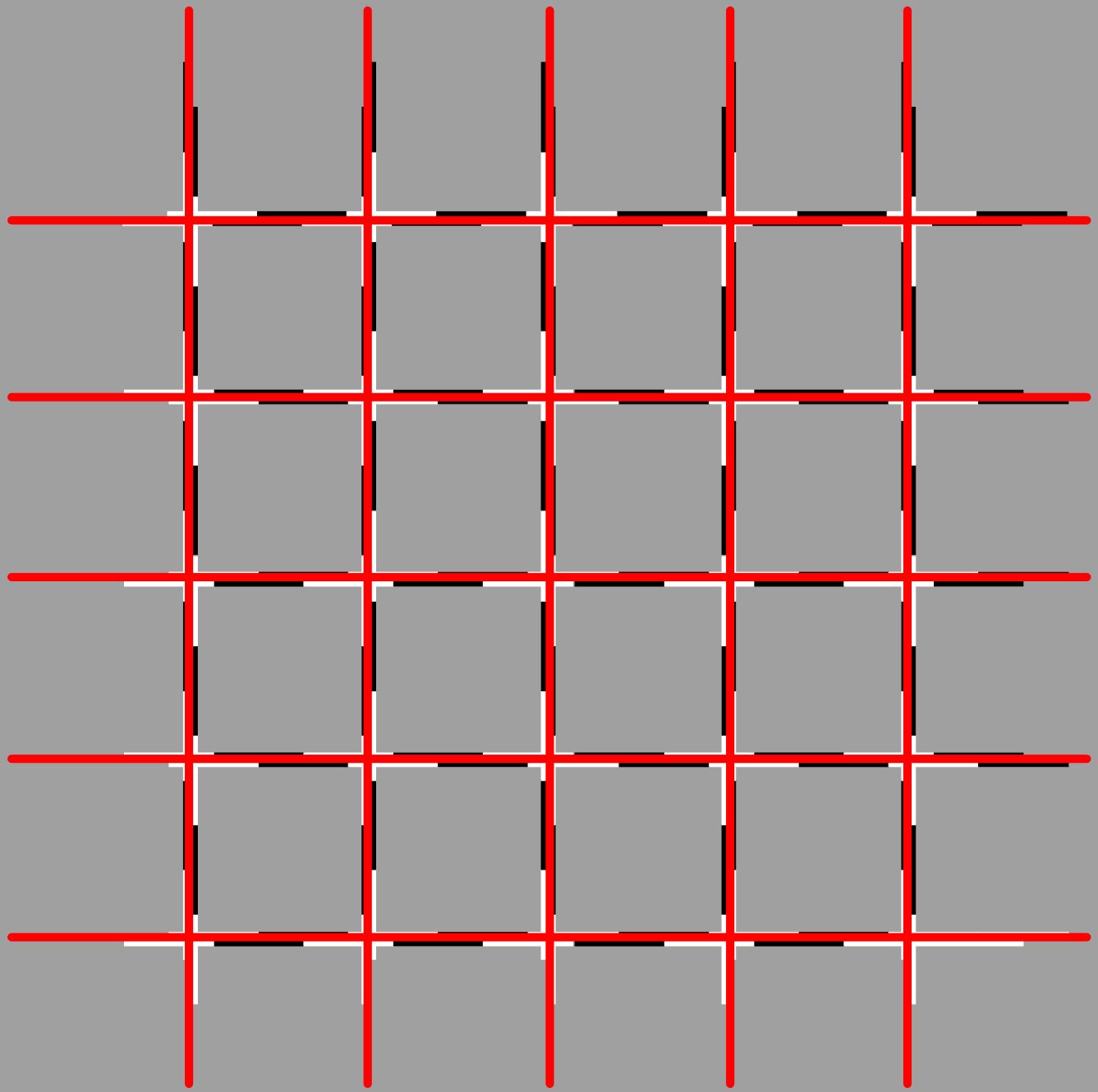
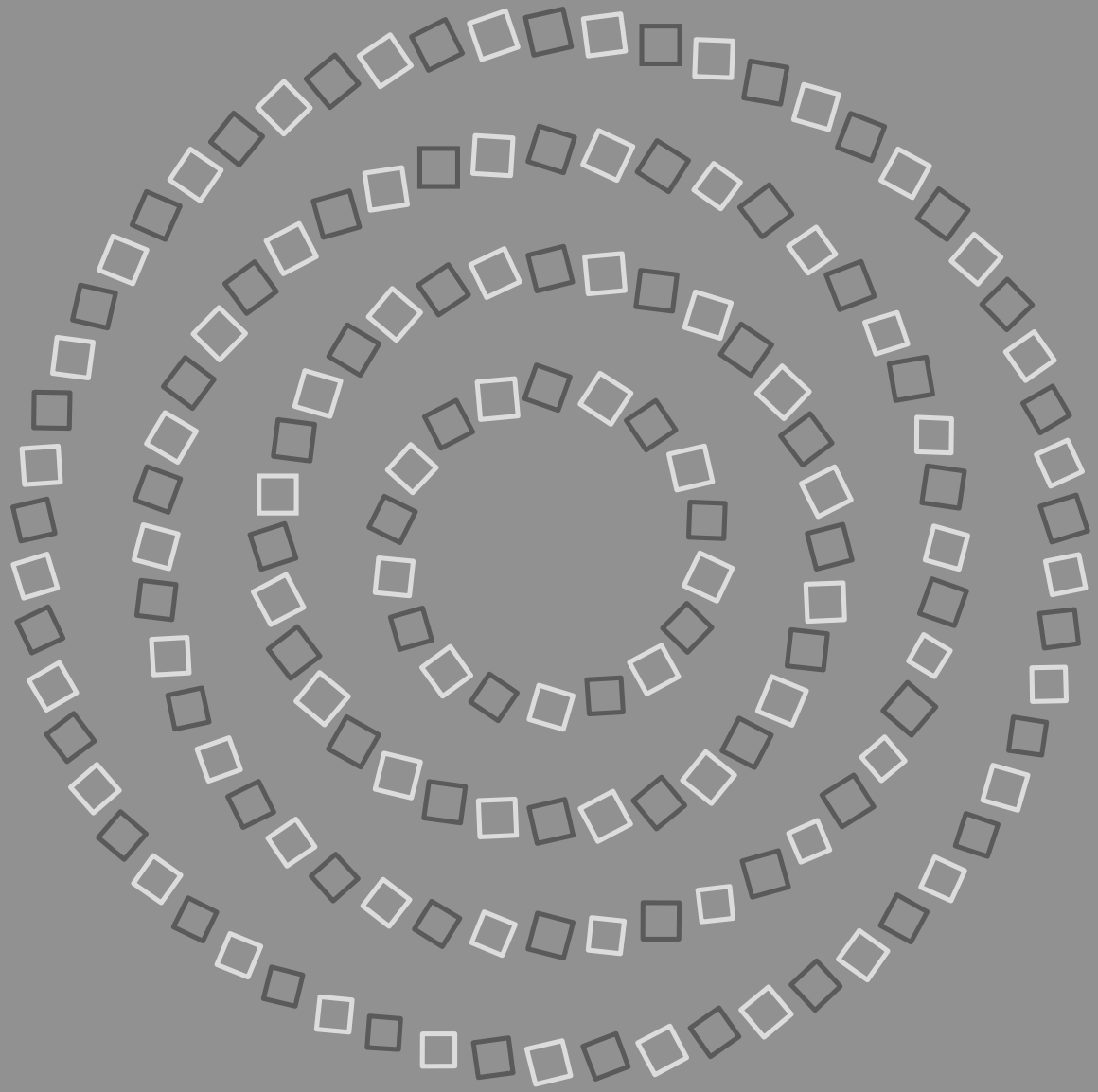


Image is in public domain.

# The four circles illusion

Baingio Pinna and Lothar Spillman

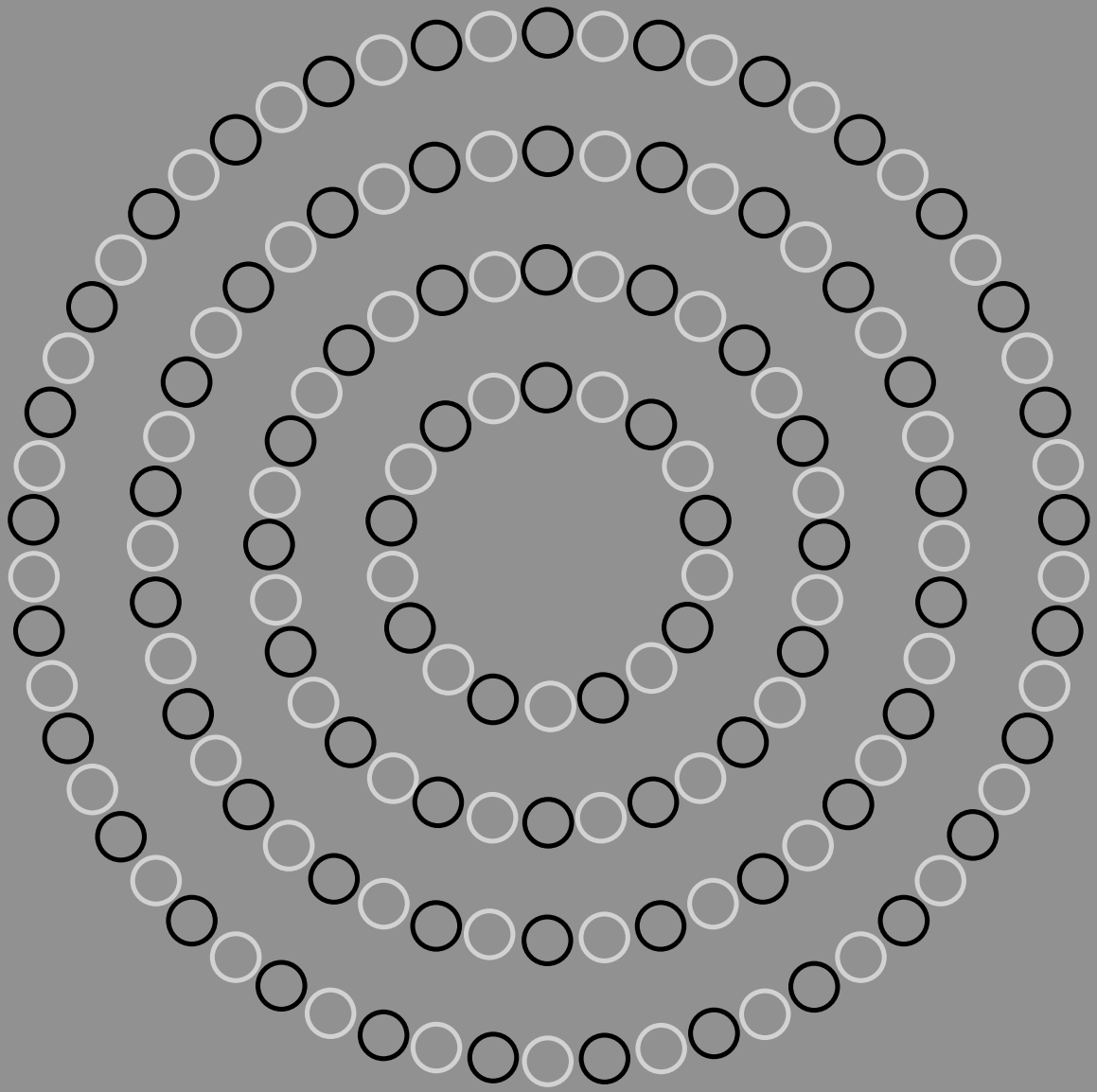
## Handout

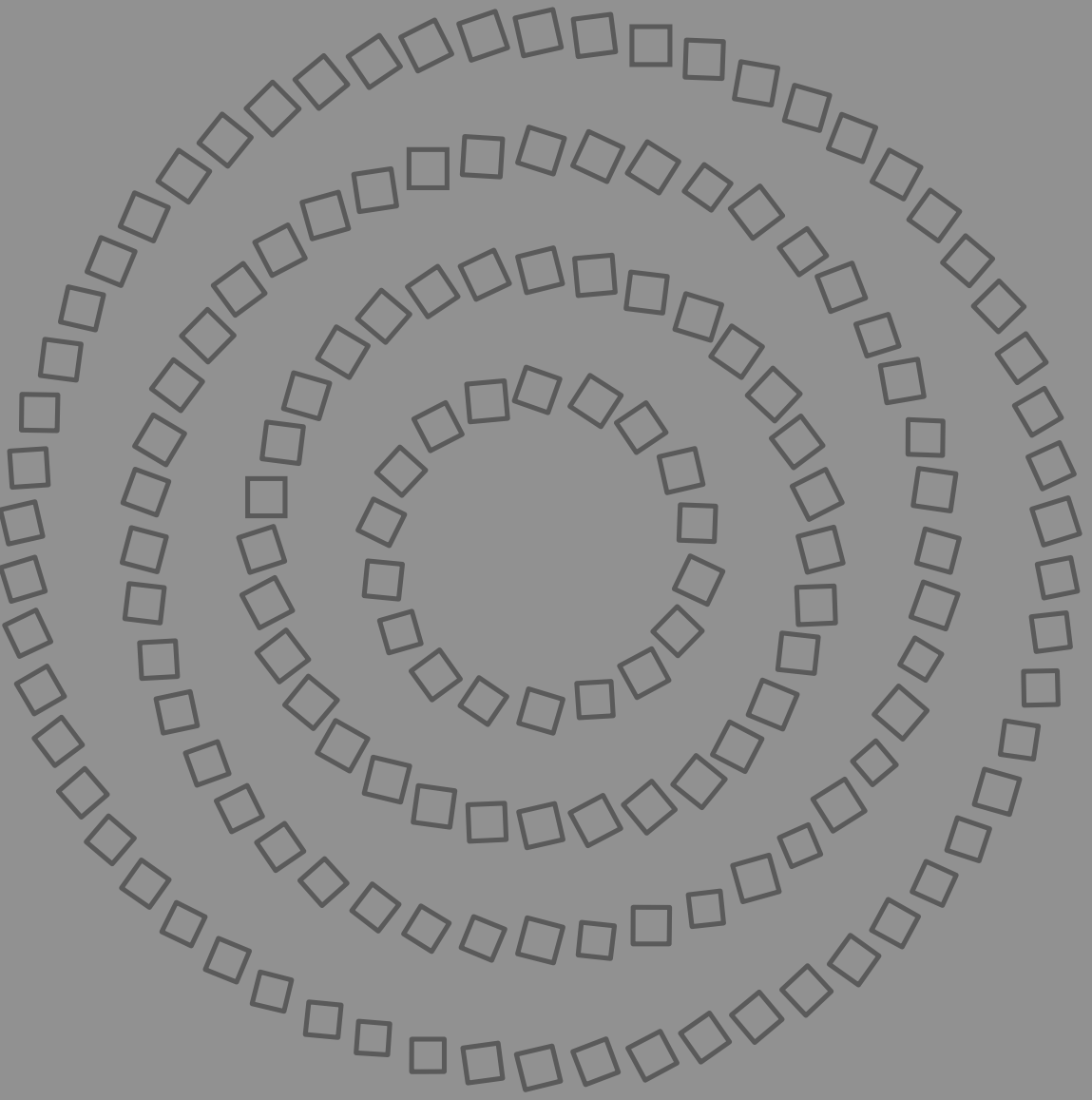


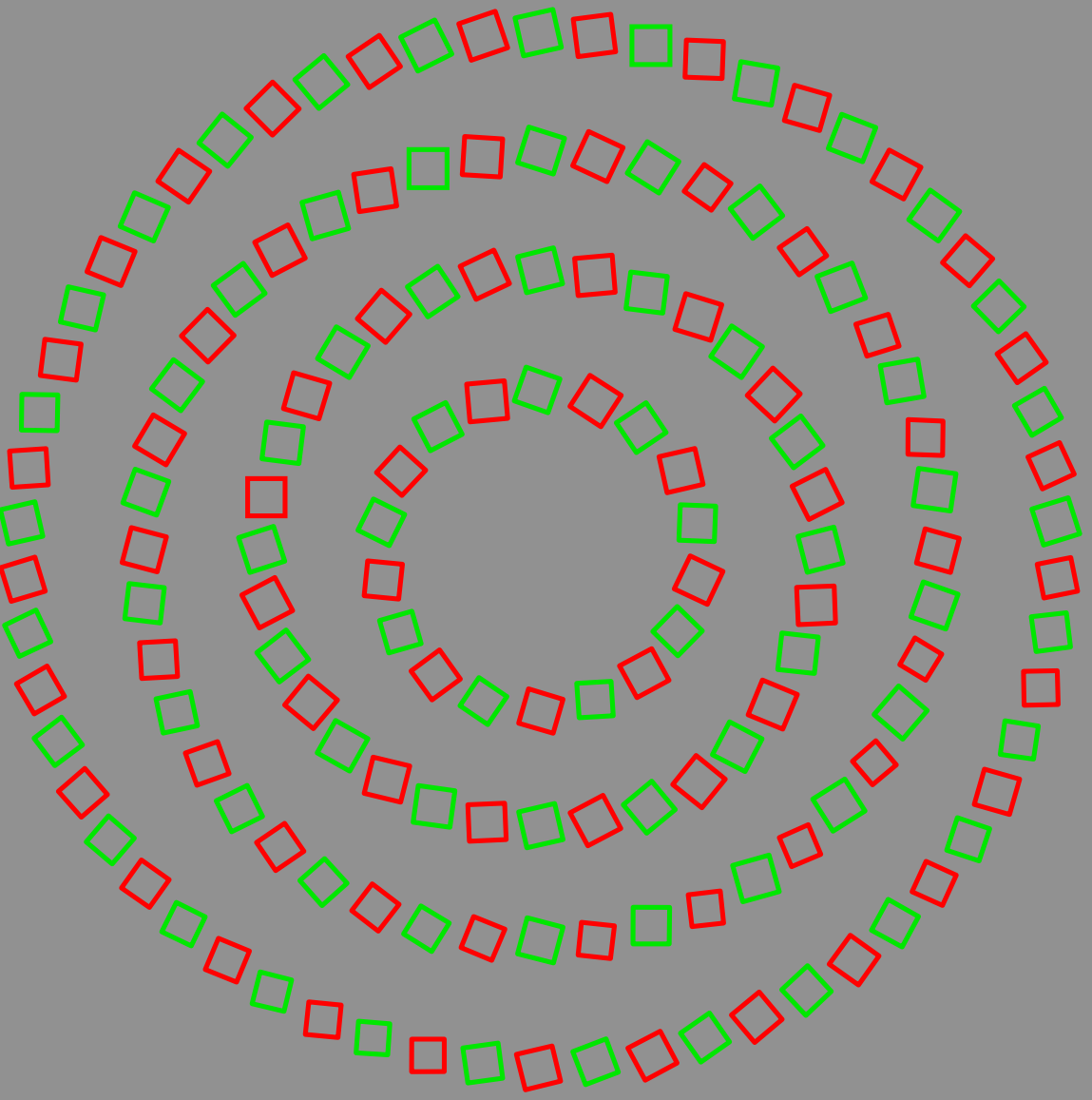
Pinna, Baingio, and Richard L. Gregory. "Shifts of Edges and Deformations of Patterns." *Perception* 31, no. 12 (2002): 1503. © Pion Ltd. All rights reserved. This content is excluded from our Creative Commons license. For more information, see http://ocw.mit.edu/help/faq-fair-use/.

**The four circles illusion**

**Baingio Pinna and Lothar Spillman**







# Muller-Lyer illusion

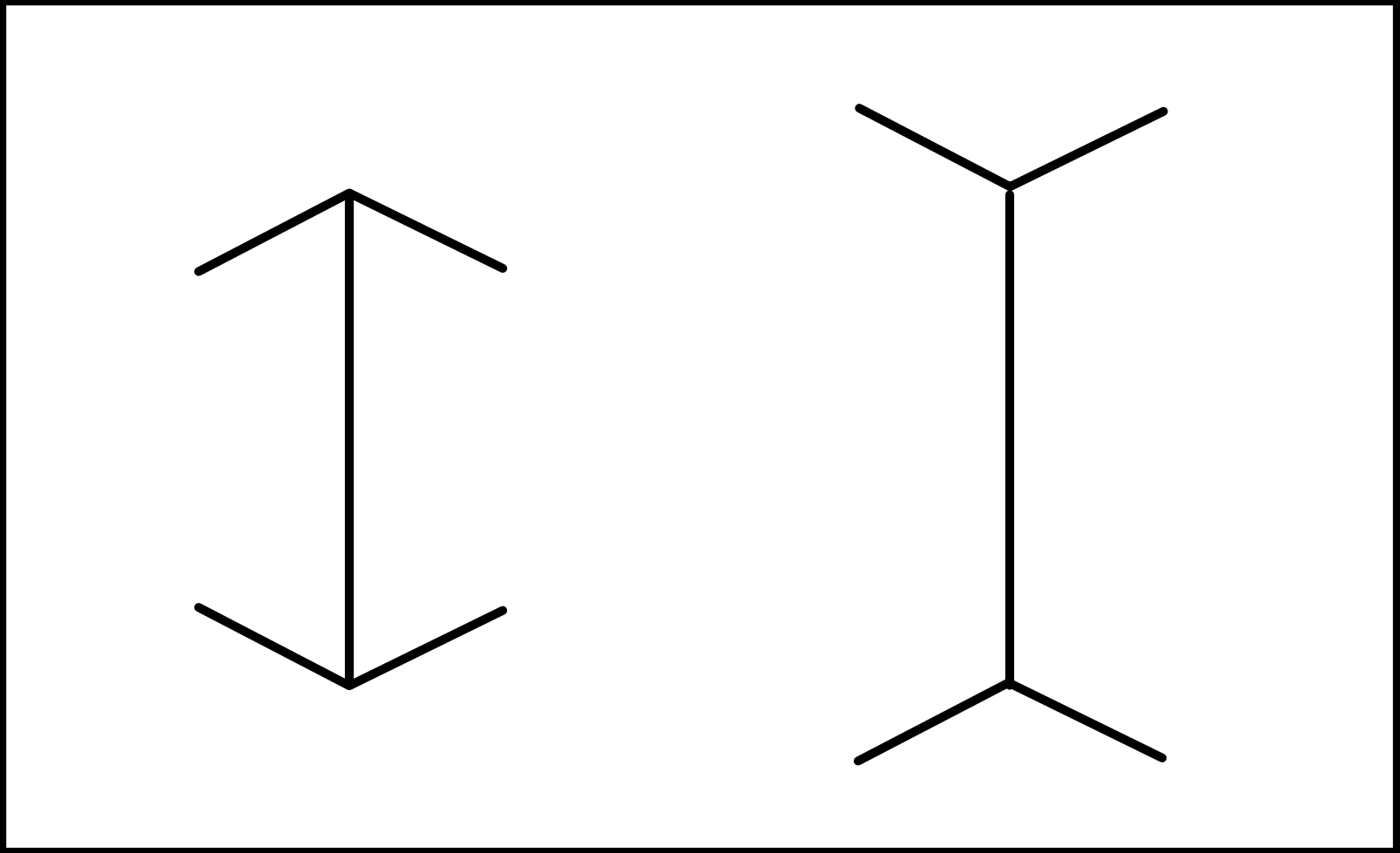
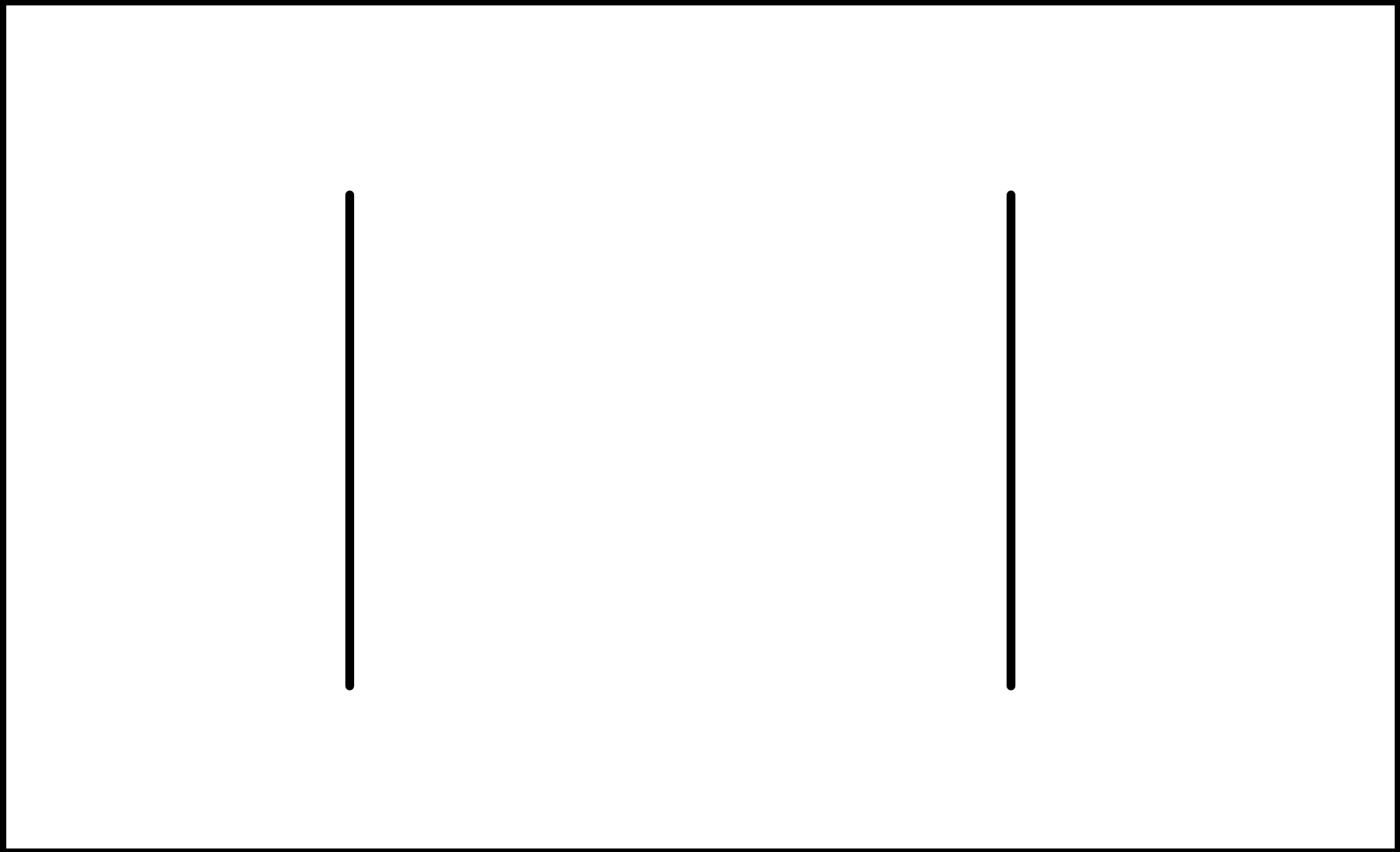
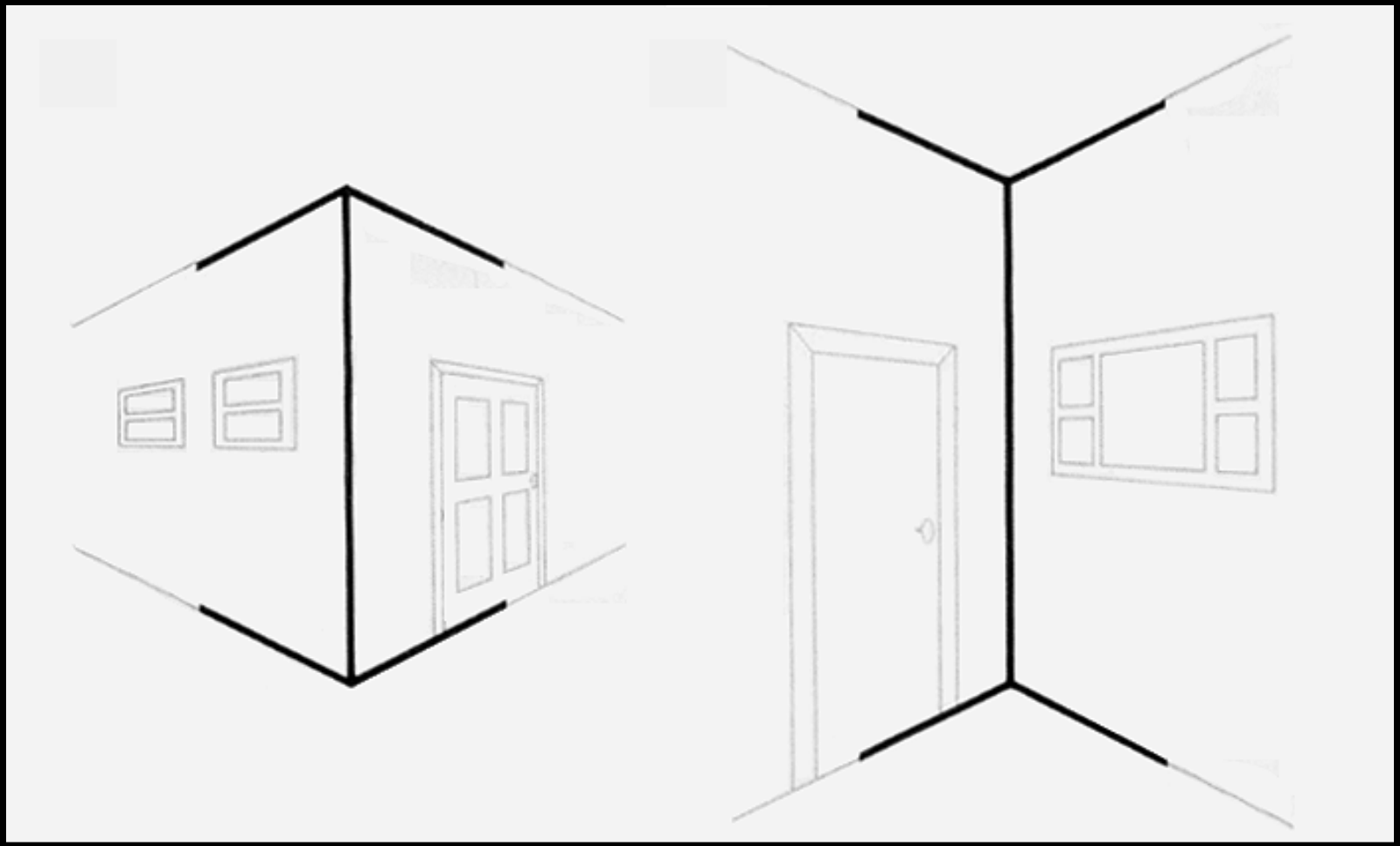


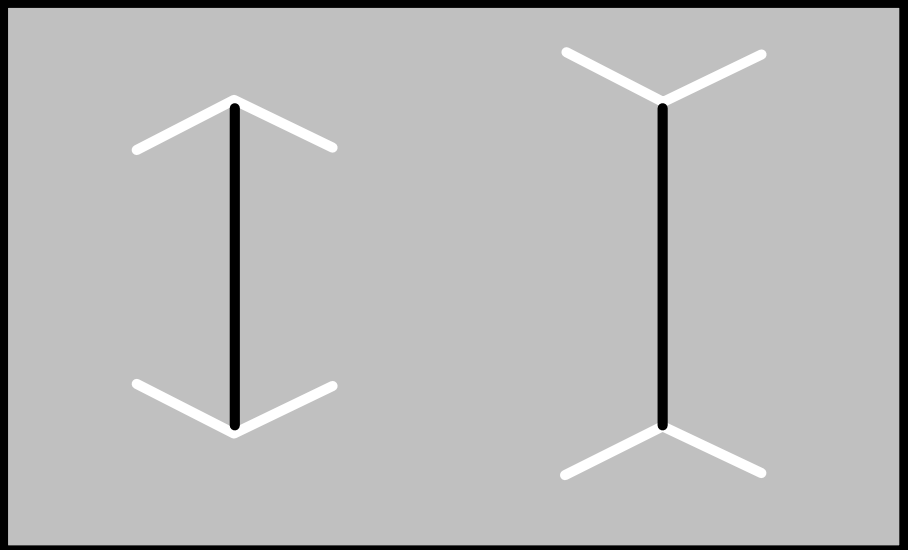
Image is in public domain.

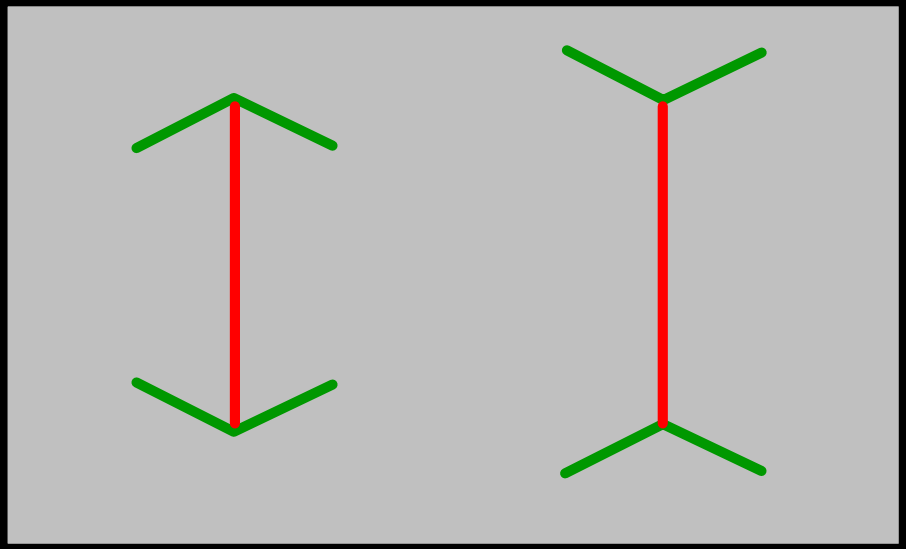
# Muller-Lyer illusion



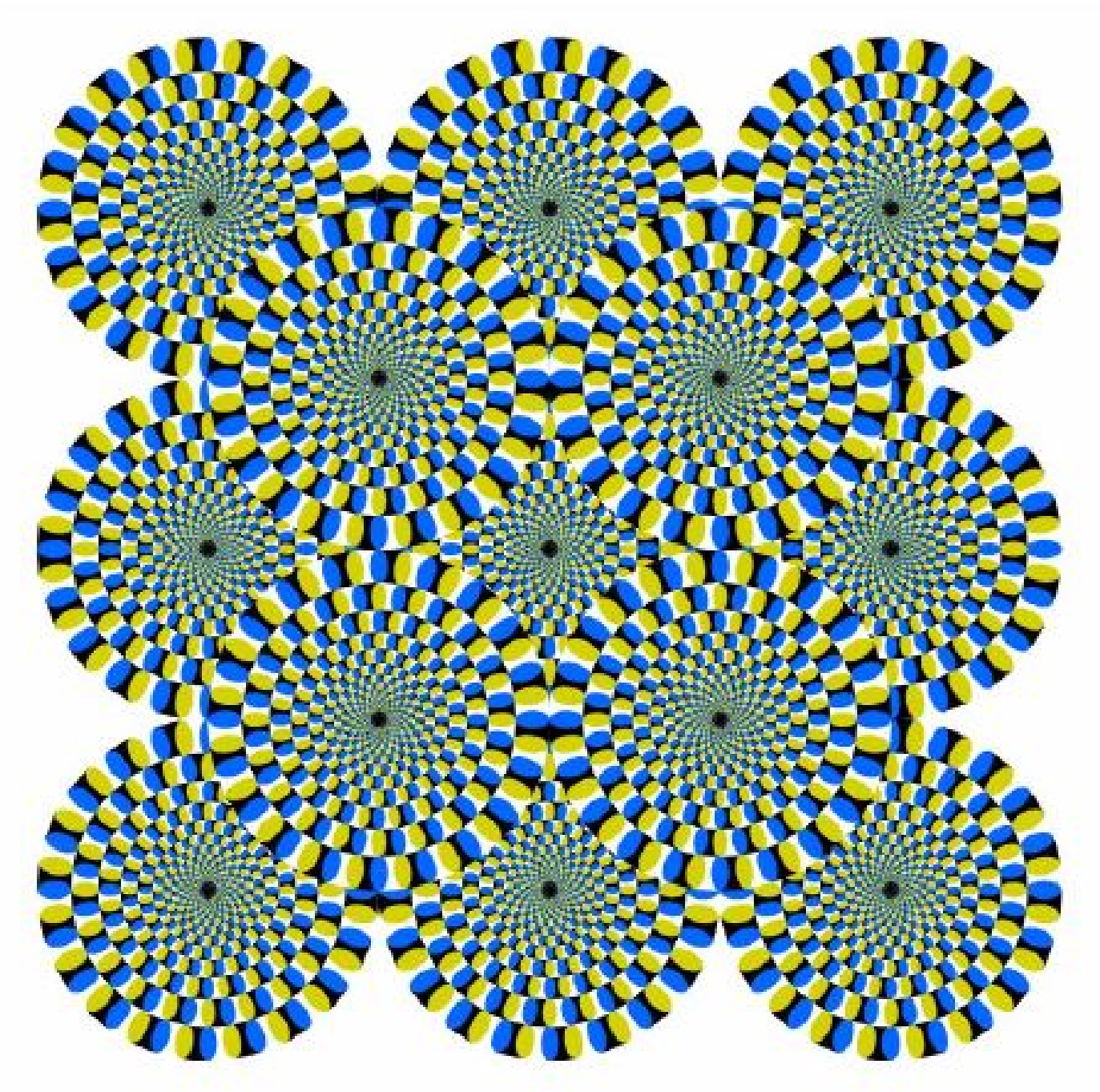
# Müller-Lyer illusion







# Motion illusions



Courtesy of Akiyoshi Kitaoka. Used with permission.

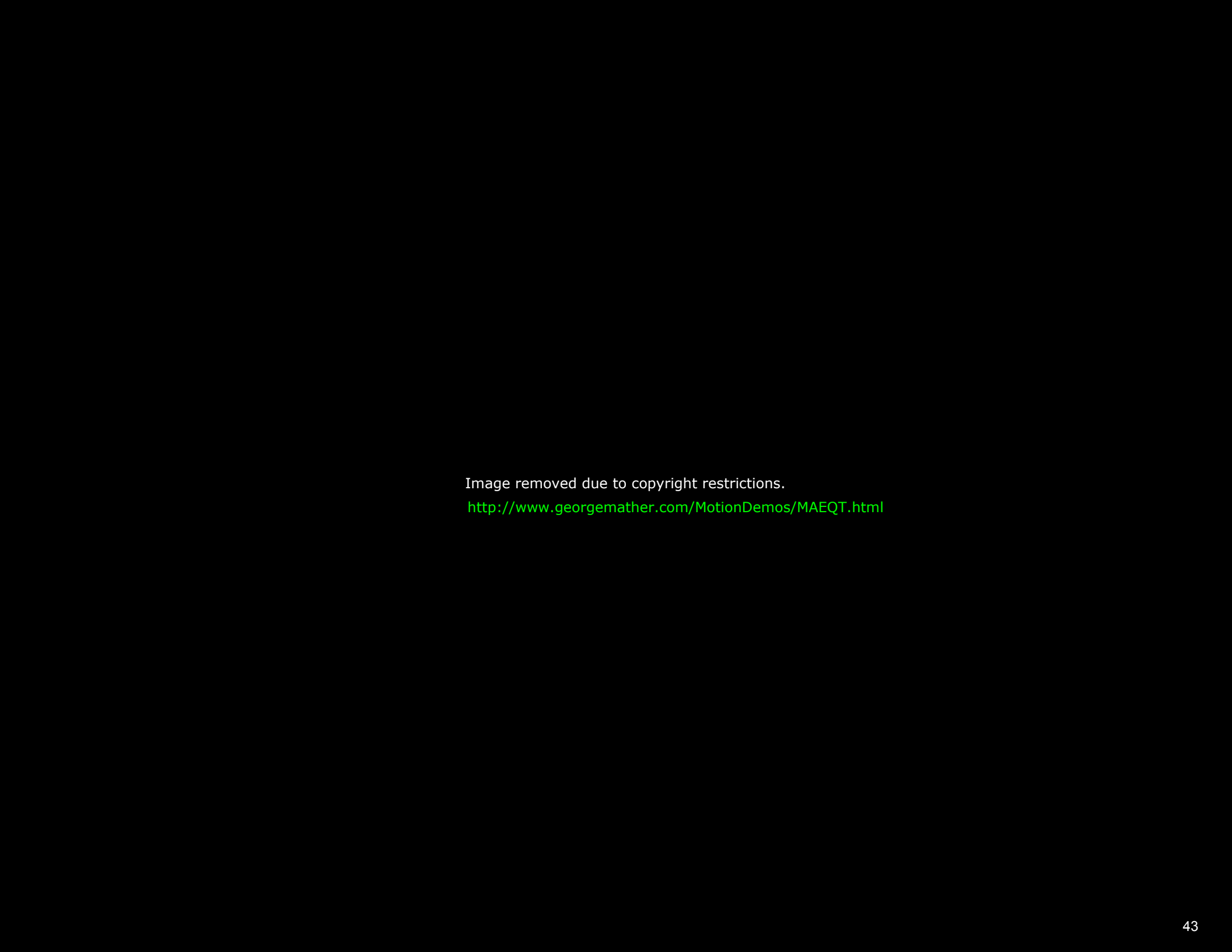
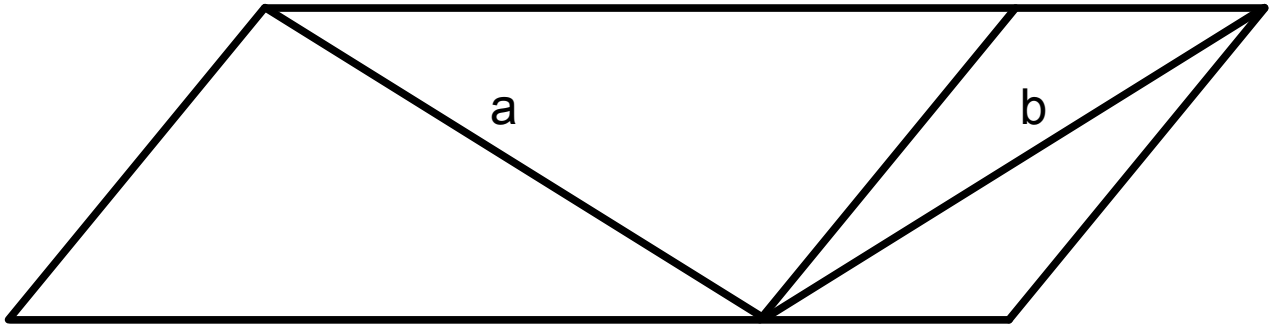
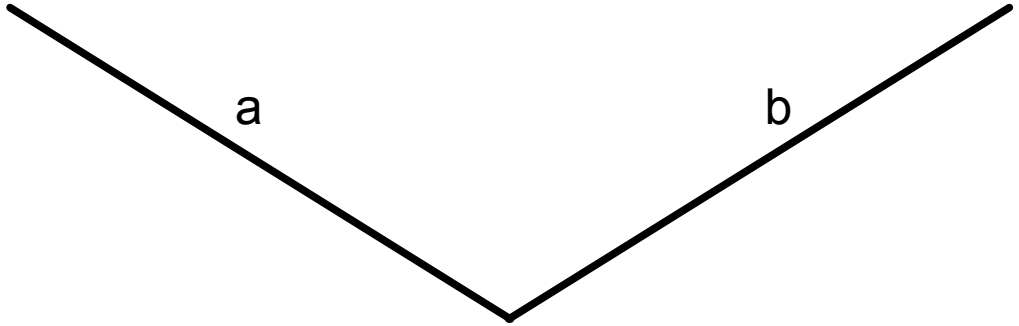


Image removed due to copyright restrictions.
http://www.georgemather.com/MotionDemos/MAEQT.html

# Limitations and ambiguities in perception:

## Figure/ground relationships


a
b


a
b

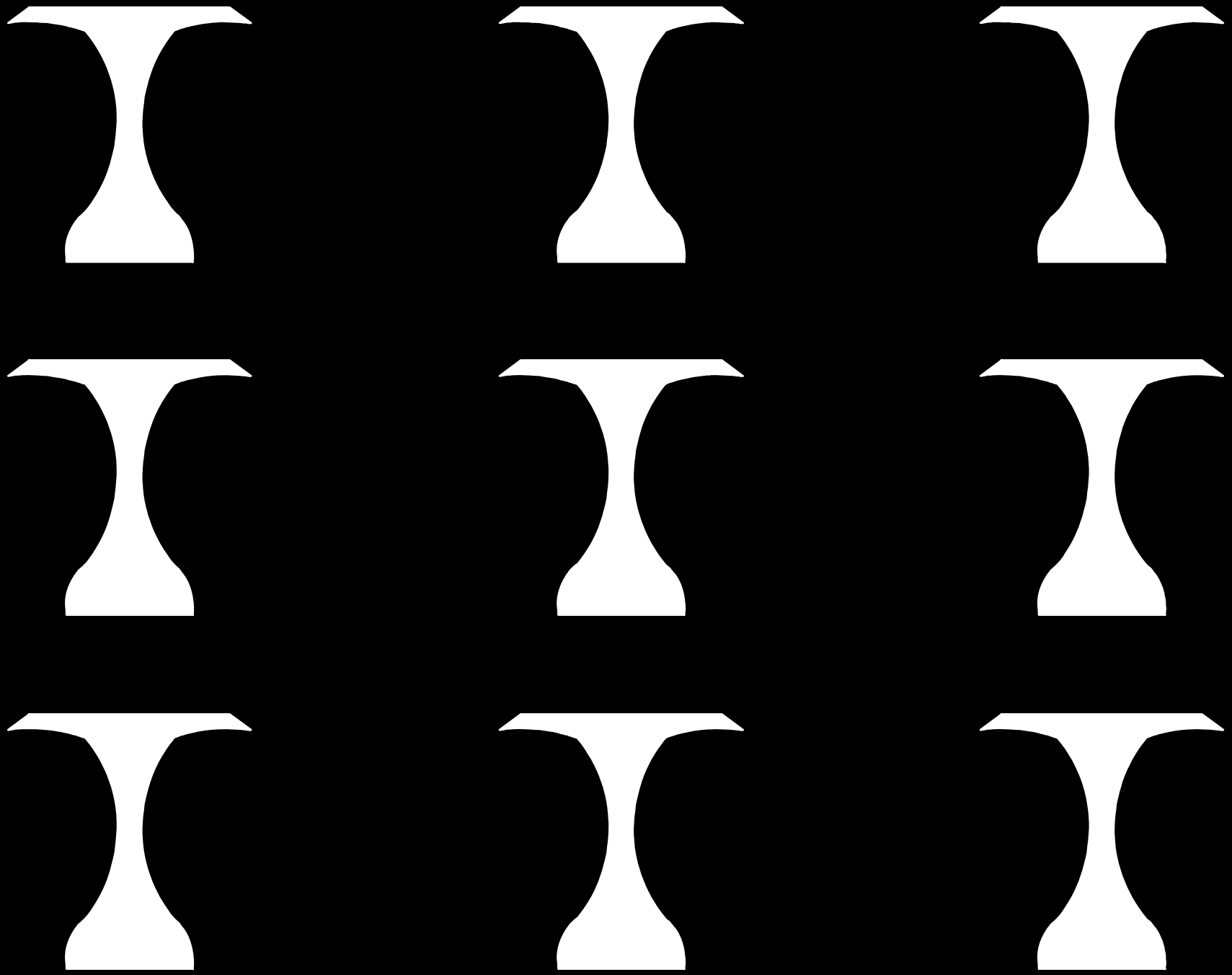


Image is in public domain.

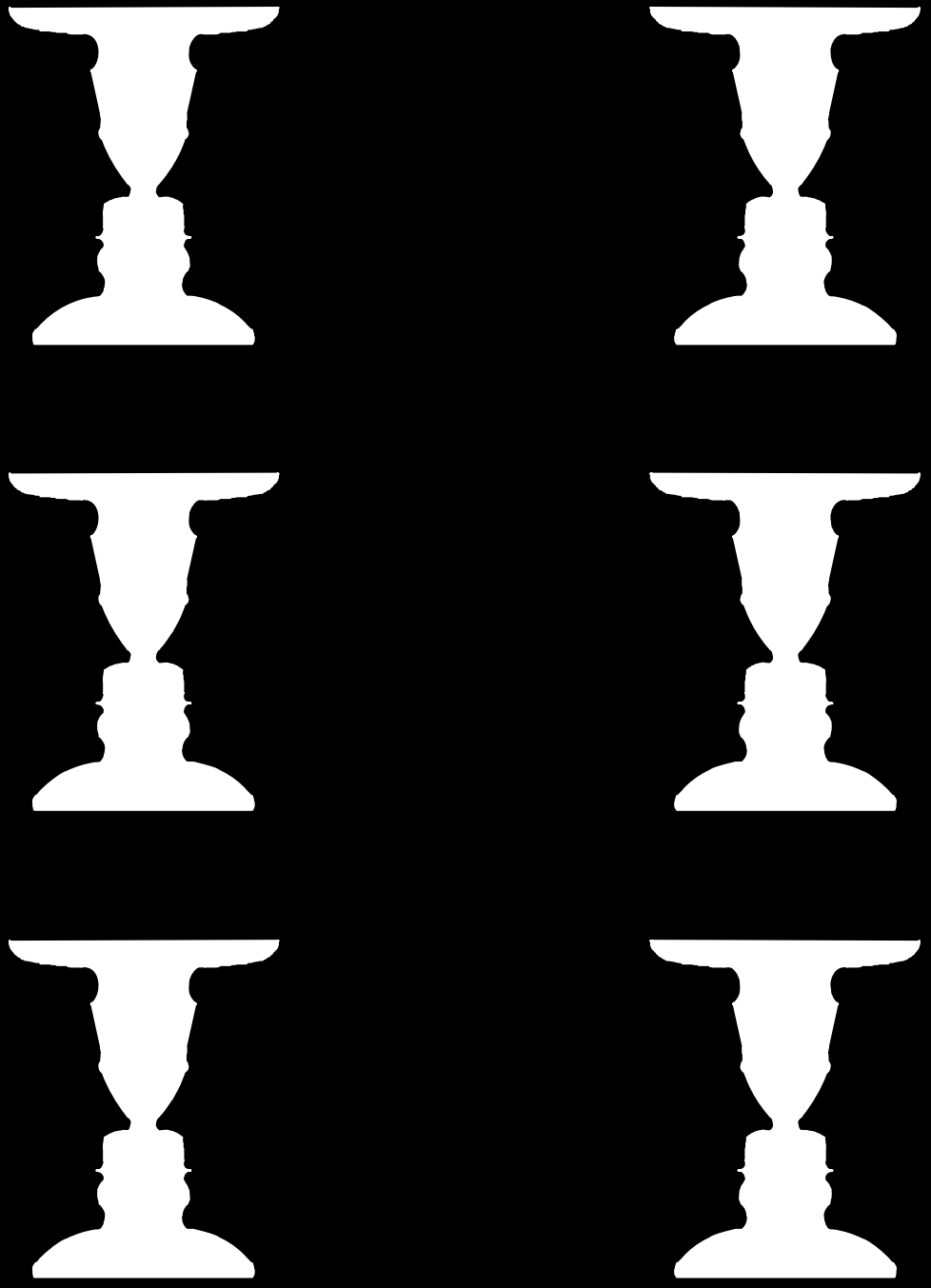


Image is in public domain.

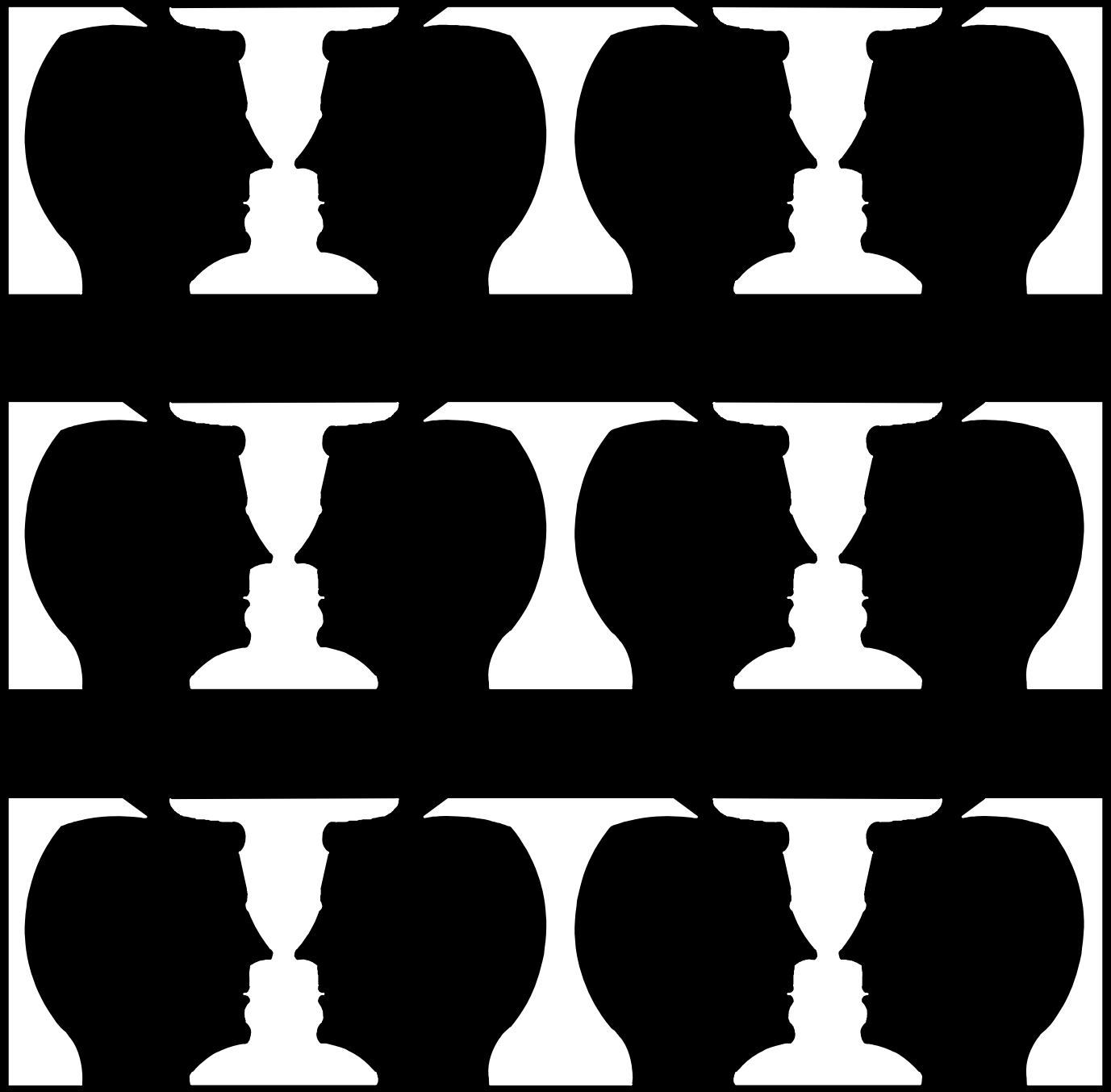
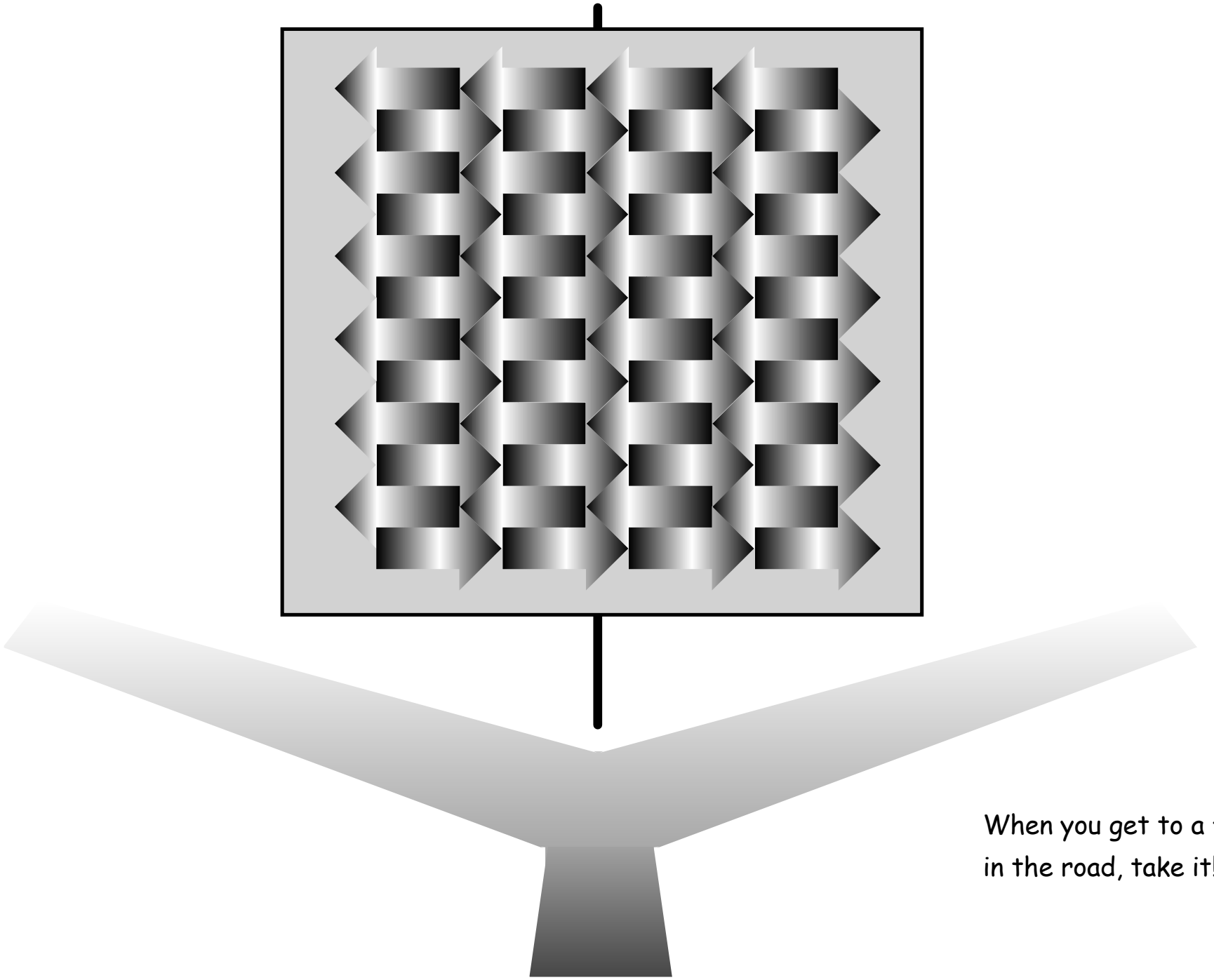


Image is in public domain.

Image is in public domain.

# The Road to Salvation



When you get to a fork in the road, take it! *YB*

Image removed due to copyright restrictions.

Please see lecture video.

# The Greek key motif

Basis: The myth of the labyrinth that imprisoned the Minotaur

This motif, supposedly symbolic of democracy, graces some of the walls in the US senate building

King Minos' wife was Pasiphae who bore the Minotaur after having intercourse with a bull.

King Minos had Deadalus build a Labyrinth in which the Minotaur was housed

King Minos and Pasiphae also had a daugher named Ariadne, who helped Theseus kill the Minotaur by giving him a spool of thread so he would not get lost in the labyrinth.

Daedalus and his son Icarus were imprisoned by King Minos. To escape, Daedalus fashioned wings made of feather and wax. Icarus flew too close to the sun, which melted the wax and he fell to his death.

Courtesy of Jastrow on Wikimedia Commons. Image is in public domain.

Image removed due to copyright restrictions.

Please see lecture video.

# Visual Prosthetics

## A. What aspects of vision are most desirable to recover with a prosthetic device?

1. Pattern perception
2. Motion perception
3. Depth perception

## B. Problems and issues:

1. Type of prosthetic device
2. What brain area should be the target for the device?
3. What is the longevity of any selected prosthetic device?

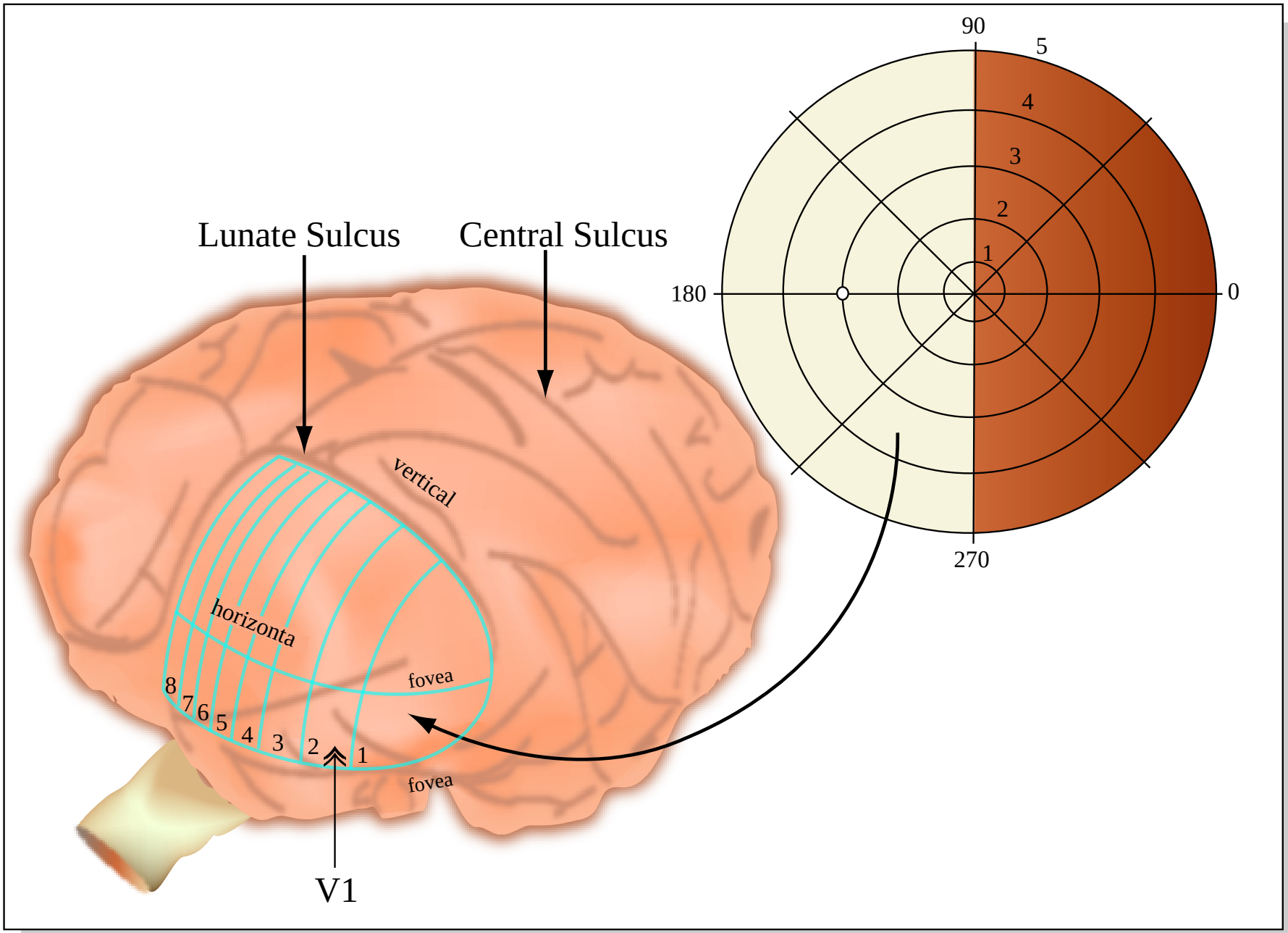
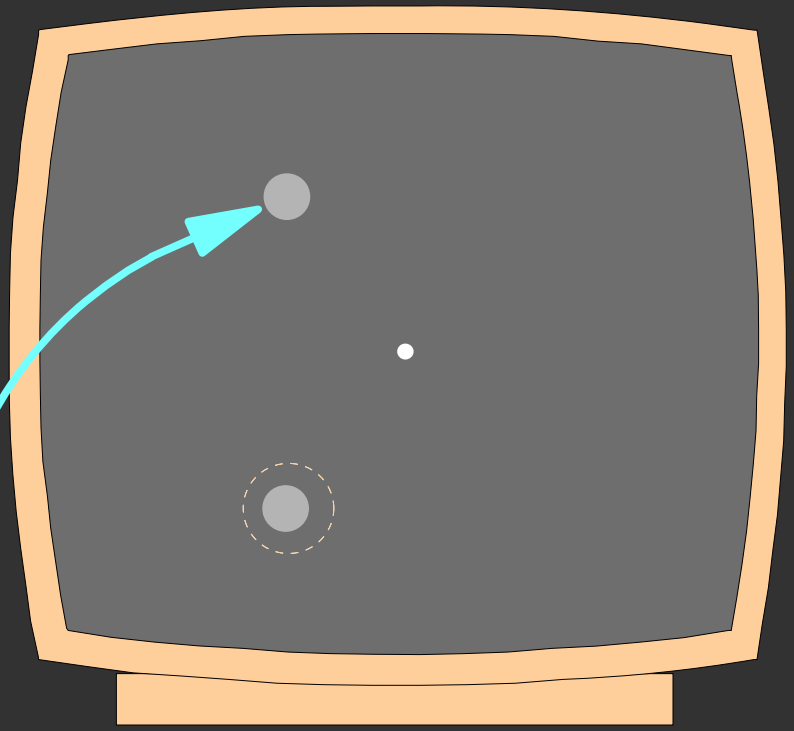
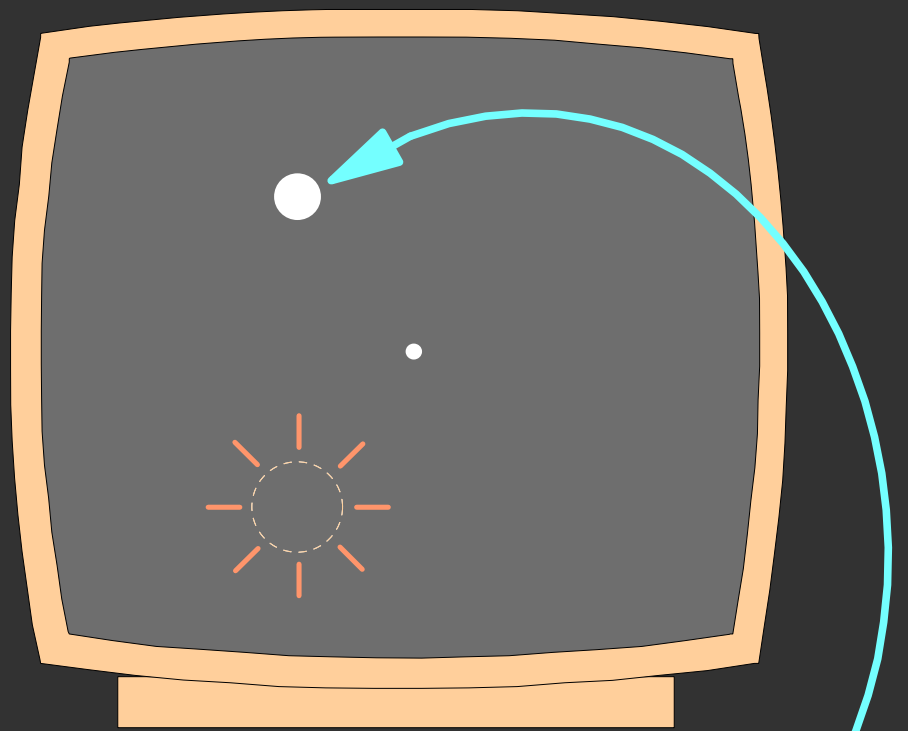



Image by MIT OpenCourseWare.

Present two visual targets

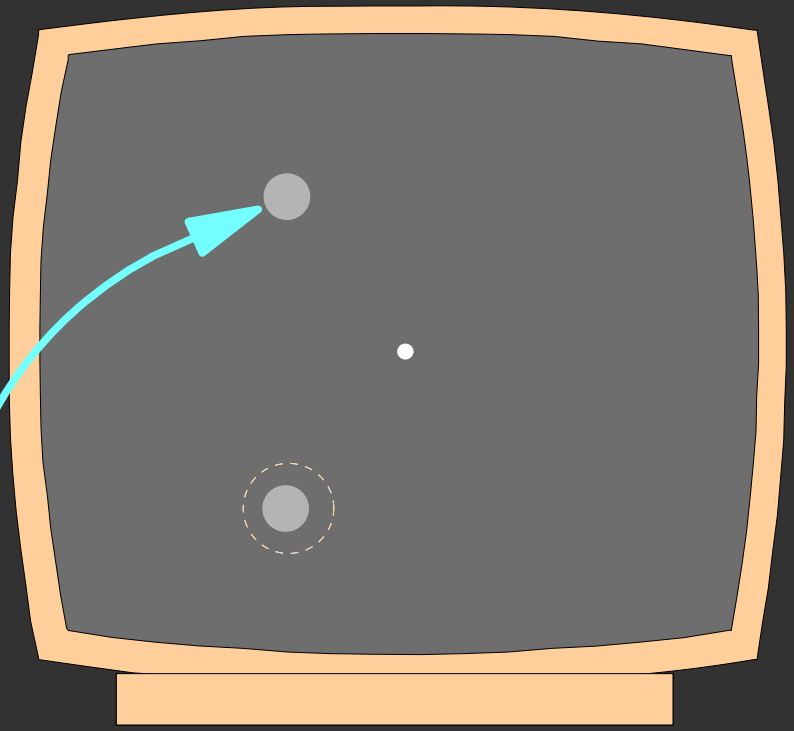


Present one visual target and stimulate

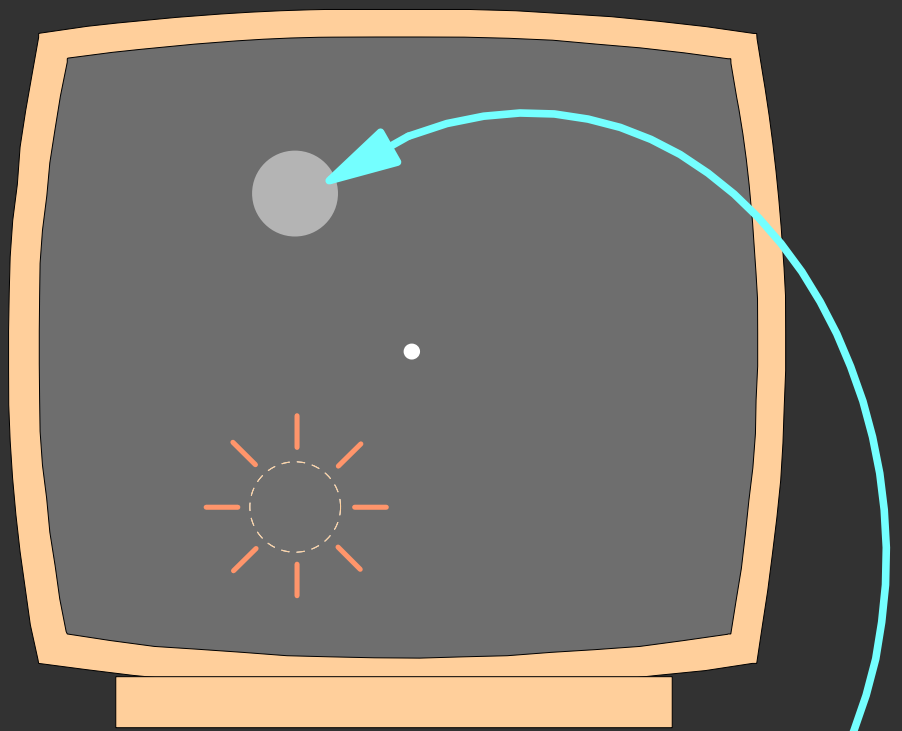


Vary the contrast of the visual stimulus not in the receptive field

Present two visual targets

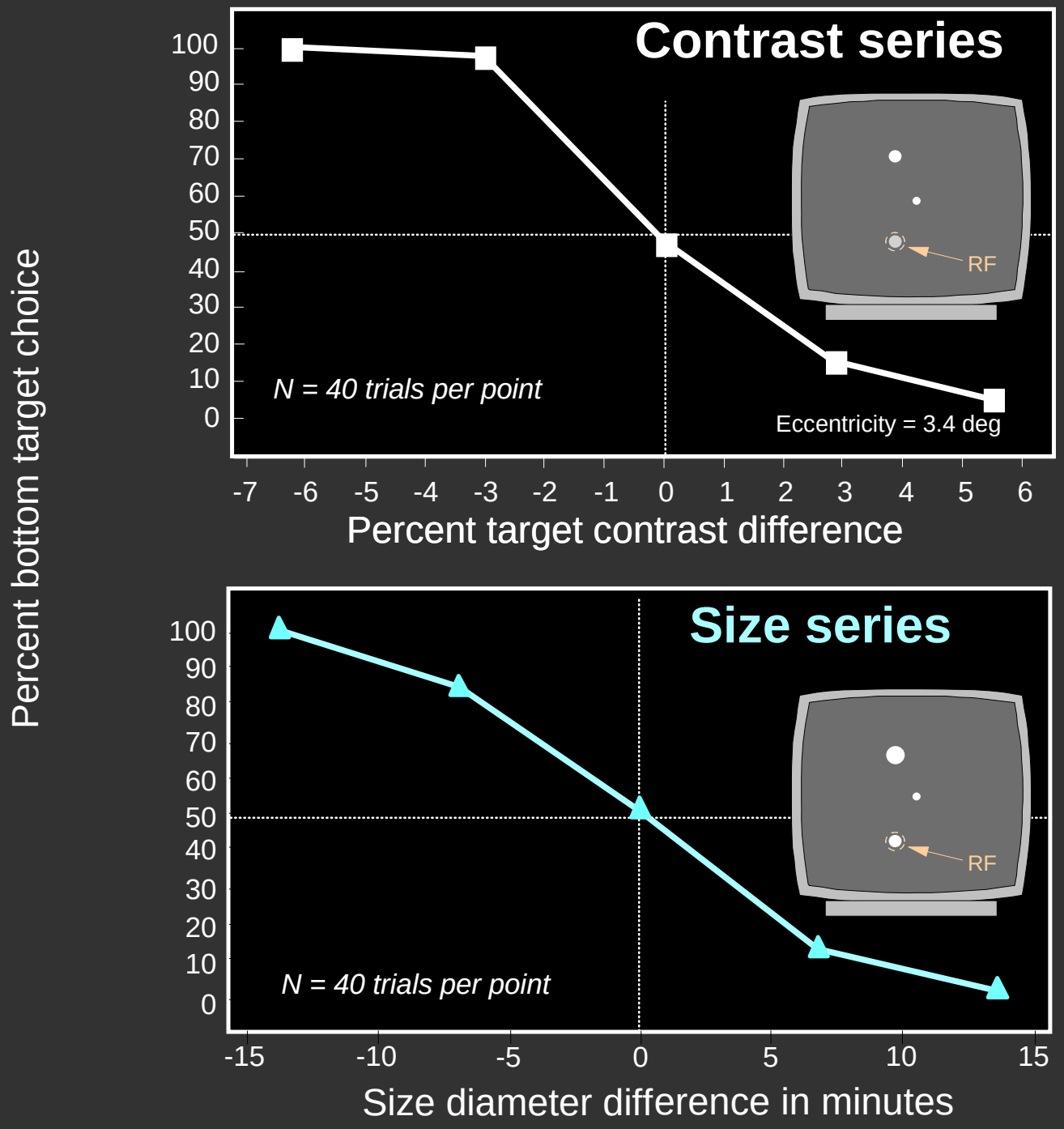


Present one visual target and stimulate



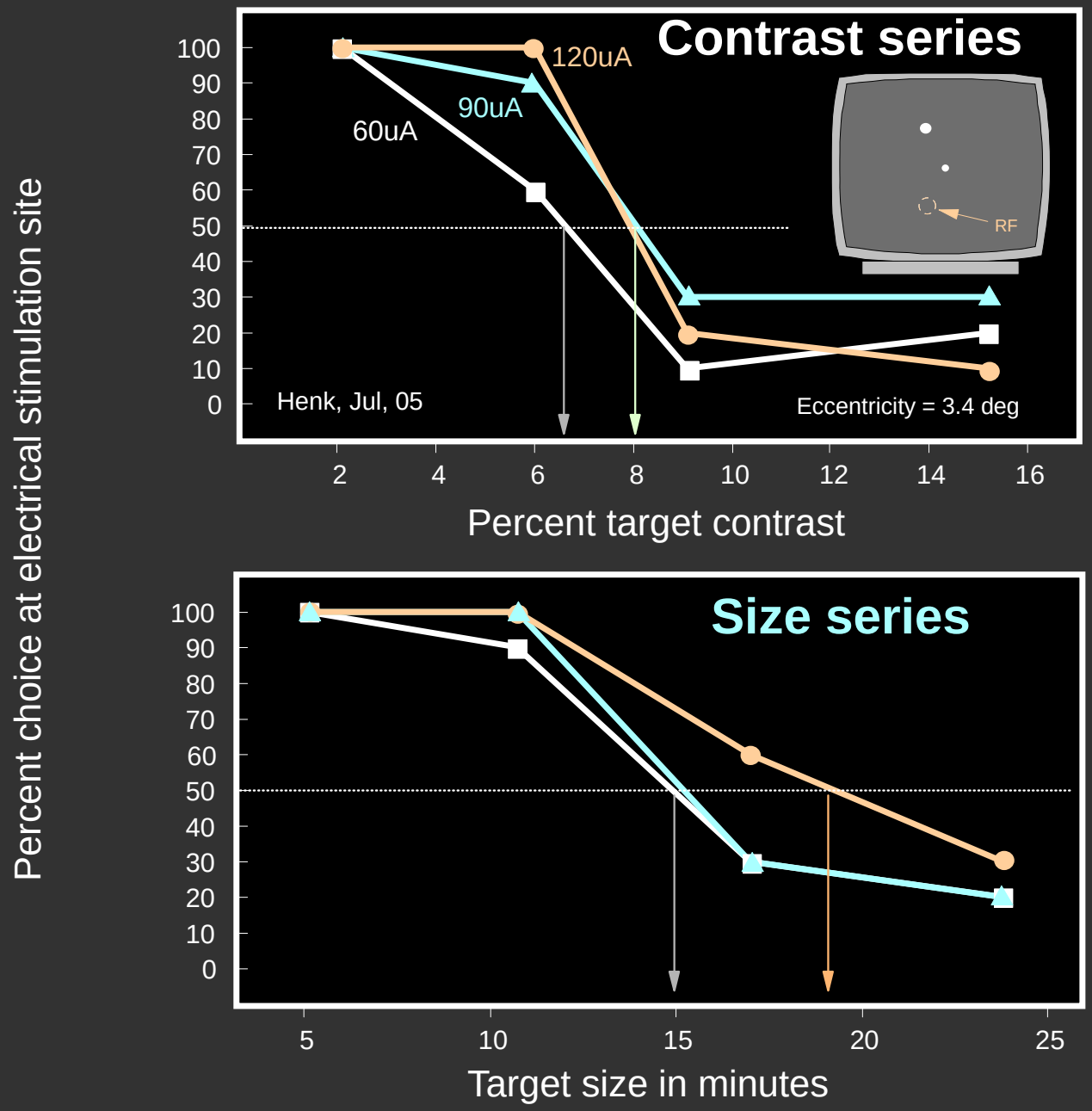
Vary the size of the visual stimulus not in the receptive field

# Two visual targets




Courtesy of National Academy of Sciences, U. S. A. Used with permission.
Source: Schiller, Peter H., Warren M. Slocum, et al. "New Methods Devised Specify the Size and Color of the Spots Monkeys See when Striate Cortex (area V1) is Electrically Stimulated." *Proceedings of the National Academy of Sciences* 108, no. 43 (2011): 17809-14.Copyright © 2011 National Academy of Sciences, U.S.A.

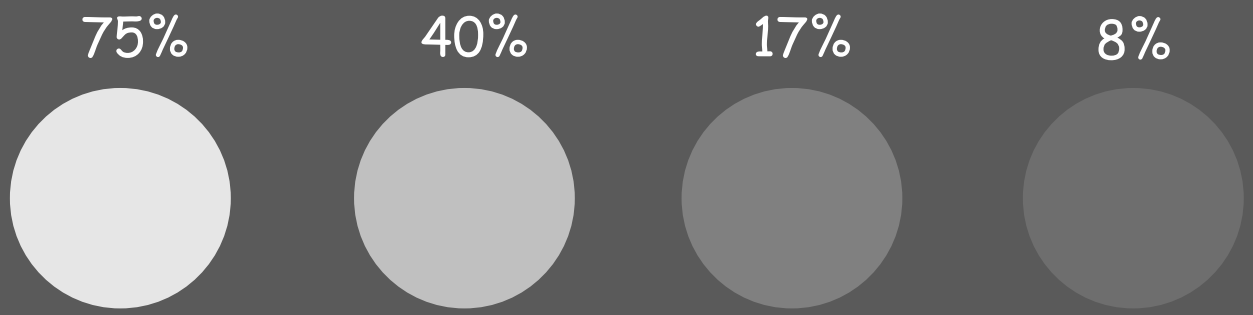
# One visual target paired with electrical stimulation




Courtesy of National Academy of Sciences, U. S. A. Used with permission.
Source: Schiller, Peter H., Warren M. Slocum, et al. "New Methods Devised Specify the Size and Color of the Spots Monkeys See when Striate Cortex (area V1) is Electrically Stimulated." *Proceedings of the National Academy of Sciences* 108, no. 43 (2011): 17809-14.Copyright © 2011 National Academy of Sciences, U.S.A.

Using currents of 20 to 120 microamps at eccentricities between 2.5 and 3.5 degrees, the contrast of the visual percept created in monkeys is 6 to 12% and the size is between 15 and 20 minutes of visual angle.

# Percent contrast




$$\text{Contrast} = \frac{A - B}{A + B} \times 100$$

# The spatial arrangement of electrode arrays

Figure removed due to copyright restrictions.

Please see lecture video or Figure 1 of Schiller, Peter H., and Edward J. Tehovnik. "Visual Prosthesis." *Perception* 37, no. 10 (2008): 1529.

Figure removed due to copyright restrictions.

Please see lecture video or Figure 4 of Schiller, Peter H., and Edward J. Tehovnik. "Visual Prosthesis." *Perception* 37, no. 10 (2008): 1529.

Figure removed due to copyright restrictions.

Please see lecture video or Figure 5 of Schiller, Peter H., and Edward J. Tehovnik. "Visual Prosthesis." *Perception* 37, no. 10 (2008): 1529.

Figure removed due to copyright restrictions.

Please see lecture video or Figure 6 of Schiller, Peter H., and Edward J. Tehovnik. "Visual Prosthesis." *Perception* 37, no. 10 (2008): 1529.

Figure removed due to copyright restrictions.

Please see lecture video or Figure 7 of Schiller, Peter H., and Edward J. Tehovnik. "Visual Prosthesis." *Perception* 37, no. 10 (2008): 1529.

Figure removed due to copyright restrictions.

Please see lecture video or Figure 9 of Schiller, Peter H., and Edward J. Tehovnik. "Visual Prosthesis." *Perception* 37, no. 10 (2008): 1529.

Figure removed due to copyright restrictions.

Please see lecture video or Figure 11 of Schiller, Peter H., and Edward J. Tehovnik. "Visual Prosthesis." *Perception* 37, no. 10 (2008): 1529.

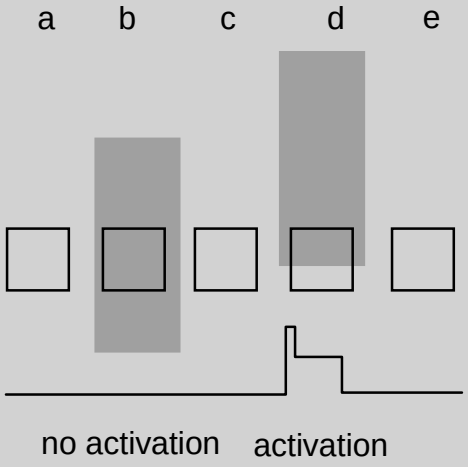
Figure removed due to copyright restrictions.

Please see lecture video or Figure 10 of Schiller, Peter H., and Edward J. Tehovnik. "Visual Prosthesis." *Perception* 37, no. 10 (2008): 1529.

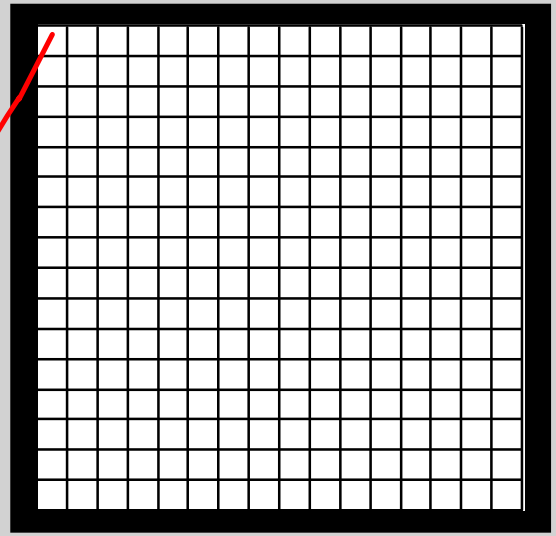
# Scheme for mimicking a prosthetic device: Intercell comparator arrangement

**camera cell**

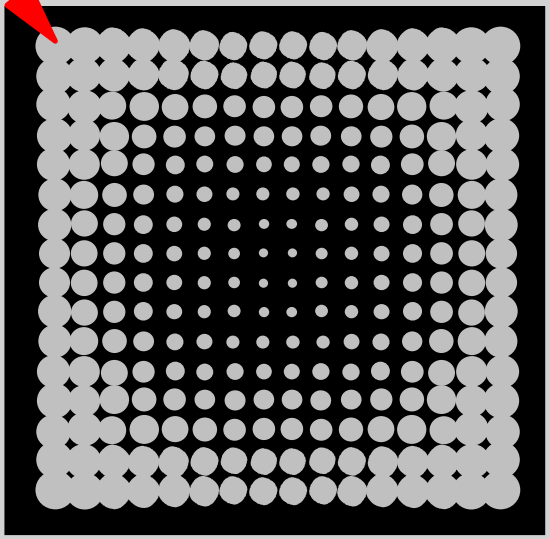

If a = b = c = d there is no response
If the four are not equal there is a response the magnitude of which increases with increasing difference




CAMERA UNIT



DISPLAY UNIT



256 cells. Each cell connects with corresponding region in display unit. The size of the regions activated in the display unit vy each camera cell is as shown.

Each camera unit is about 40 by 40 pixels.

# Summary:

1. Research on visual prosthetics is in its infancy. A great deal of basic research is needed before such a device can become effective.
2. The brain area that holds considerable promise for a prosthetic device based electrical microstimulation is V1.
3. A prosthetic device for electrical stimulation of V1 must take intoaccount the magnificagtion factor.
4. There is no unitary explanation for the great many visual illusions extant.
5. The most popular theory explaining the Hermann grid illusion based on the center/surround organization of retinal ganglion cells is incorrect. A more likely theory is the one that assumes that V1 cells are involved.
6. Retinal adaptation processes can explain illusions based on after-effects.
7. Many illusions disappear under isoluminant conditions.
8. There are no viable theories that explain illusions based on figure/ground relationships.

MIT OpenCourseWare
http://ocw.mit.edu

# 9.04 Sensory Systems

Fall 2013

For information about citing these materials or our Terms of Use, visit: http://ocw.mit.edu/terms.