

Lecture 2-1 The human visual system, perception

Yuyao Zhang, Xiran Cai PhD

zhangyy8@shanghaitech.edu.cn caixr@shanghaitech.edu.cn

SIST Building 2 302-F/302-C

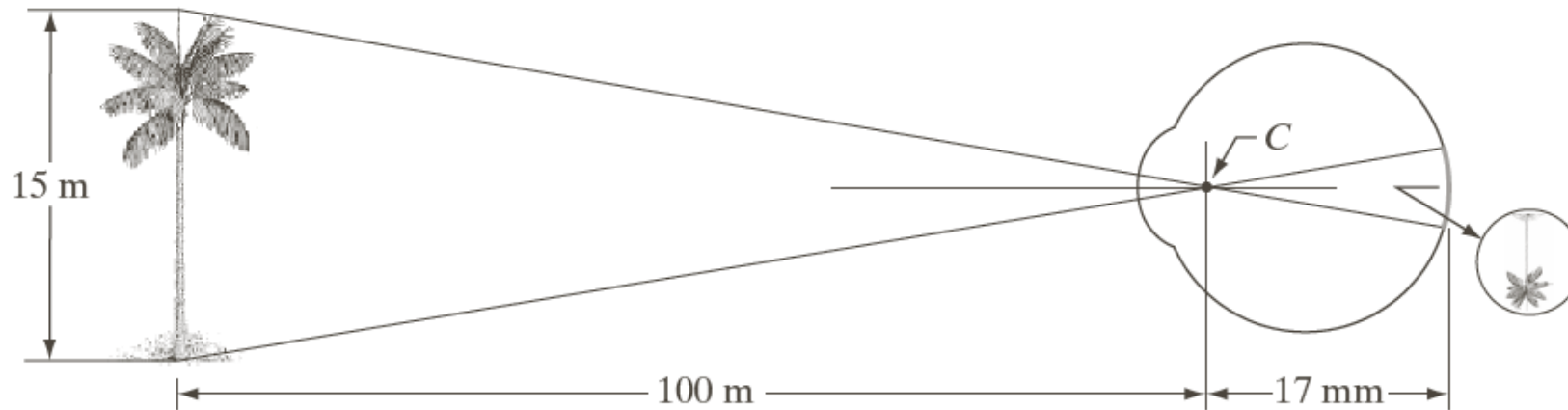
Course piazza link: piazza.com/shanghaitech.edu.cn/spring2021/cs270spring2021

Outline

- Anatomical structure of eye ball.
- Image formation and brightness adaptation in the eye.
- Visual illusions.

Graphical representation of human eye

- Objects captured as focused images on the image plane at retinas
- Perspective projection based on pinhole model geometry,
- Image size depends on distance of object
- In practice, optical devices with lens



Human Visual Perception

Lens: 晶状体
Blind spot: 盲点

Rod: 杆状体
Cone: 锥状体

Fovea: 中央凹
Retina: 视网膜

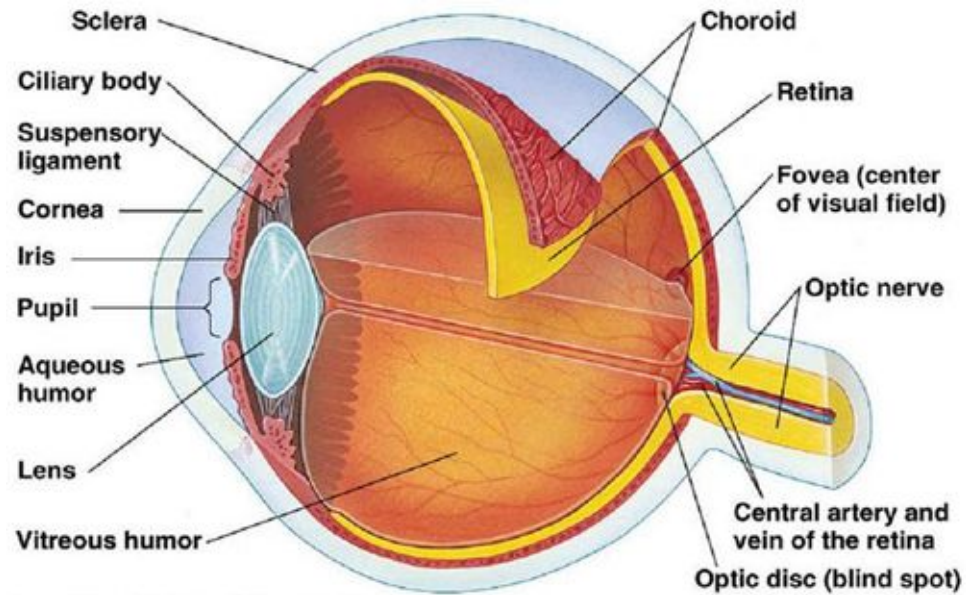


Figure 2.1: Sagittal Eye ball anatomy .

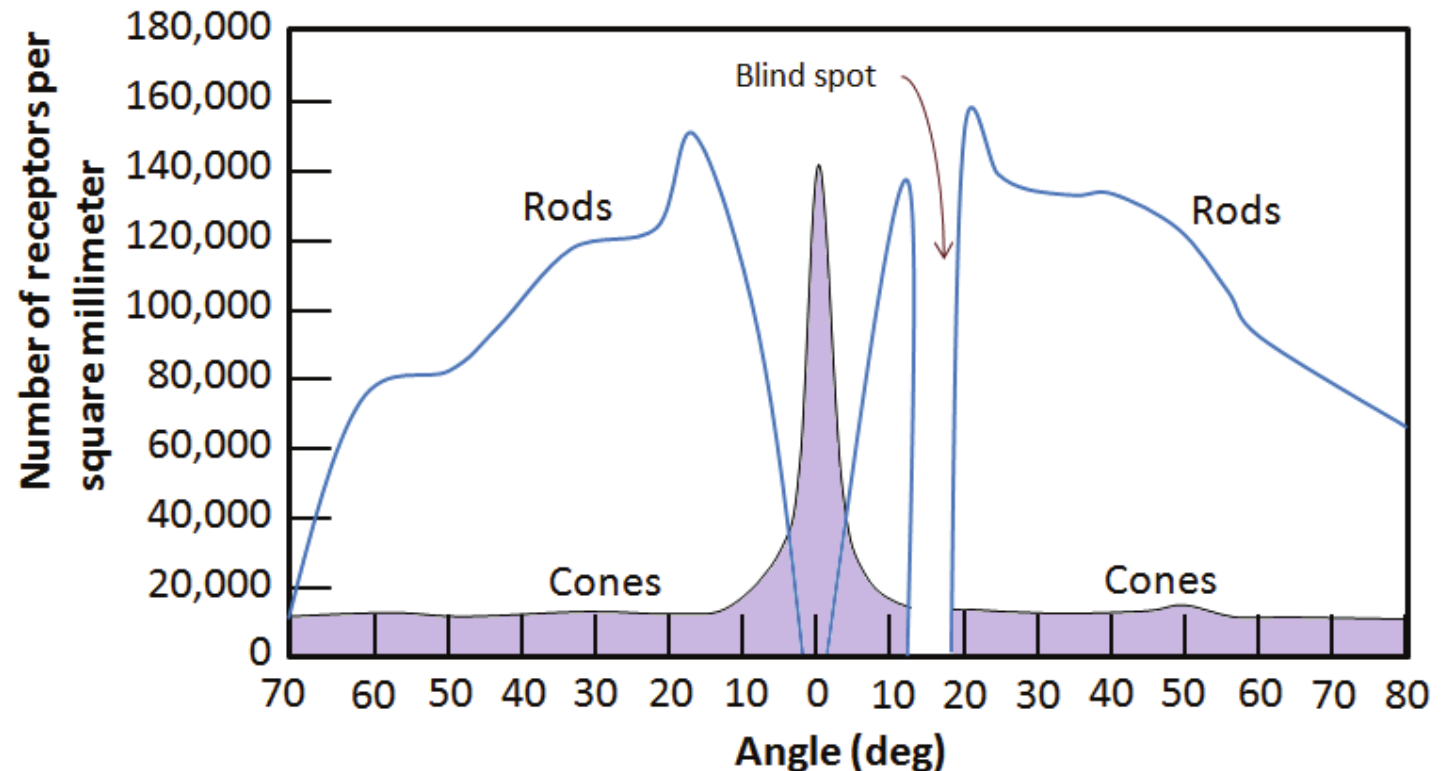
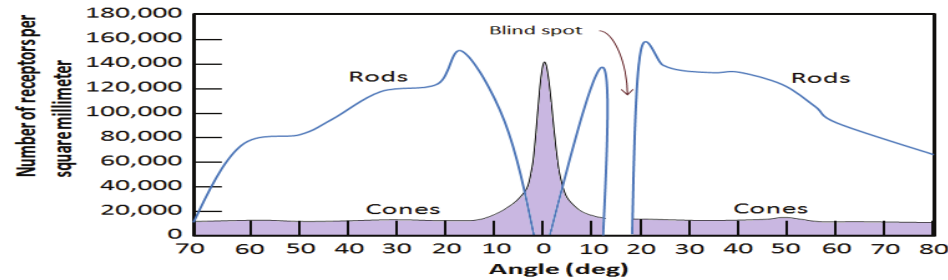


Figure 2.2: Distribution of rods and cones in the retina.

Human visual system perception elements



• Rods

- Sensitive to light intensity.
- Night “scotopic” vision.
- Achromatic.
- Low acuity (many per nerve end).
- Peripheral vision.
- Slow response.
- 75-150 Million/Retina.

• Cones

- Only direct to direct light.
- “Photopic” vision.
- Chromatic (3 “colors”).
- Concentrated in fovea (1 per nerve end).
- High visual acuity, spatial resolution.
- Fast response.
- 6-7 Million/Retina.

Characteristics of Human Visual System

- **Brightness adaption**
- Simultaneous contrast
- Mach band effect
- Optical illusion

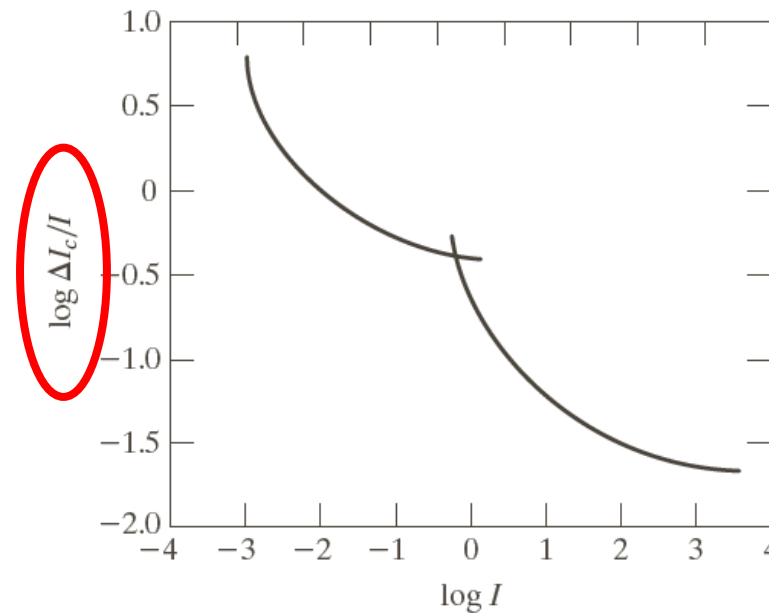


FIGURE 2.6
Typical Weber
ratio as a function
of intensity.

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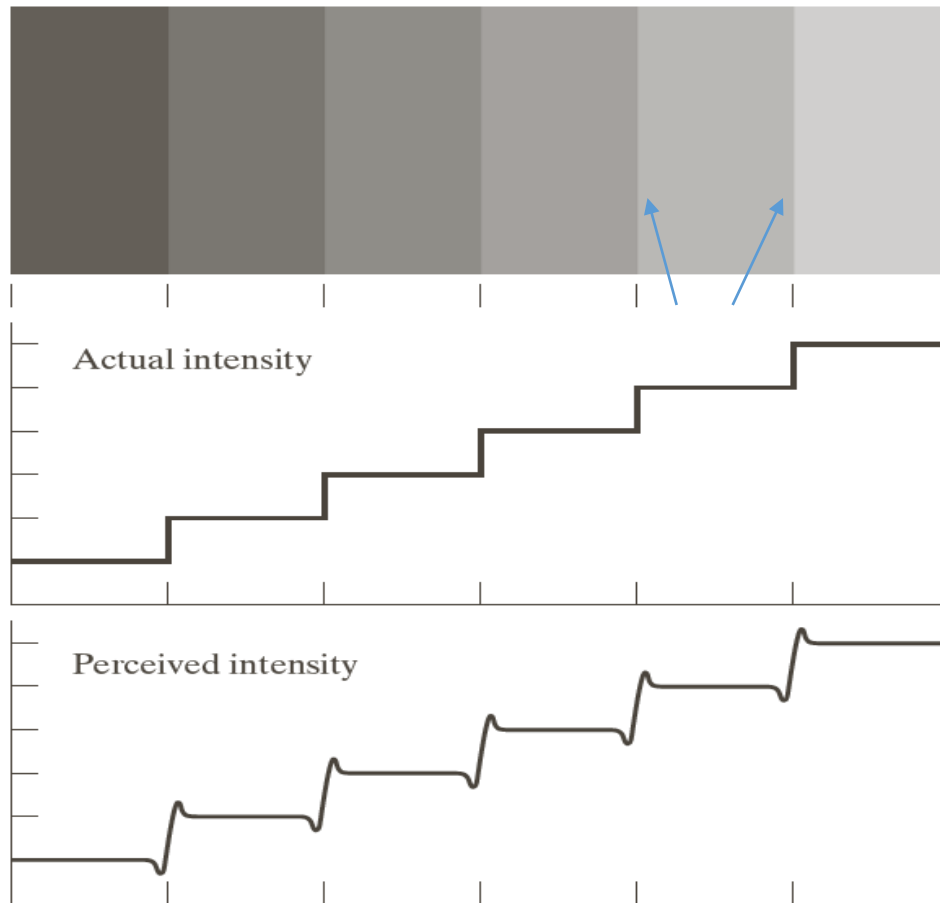
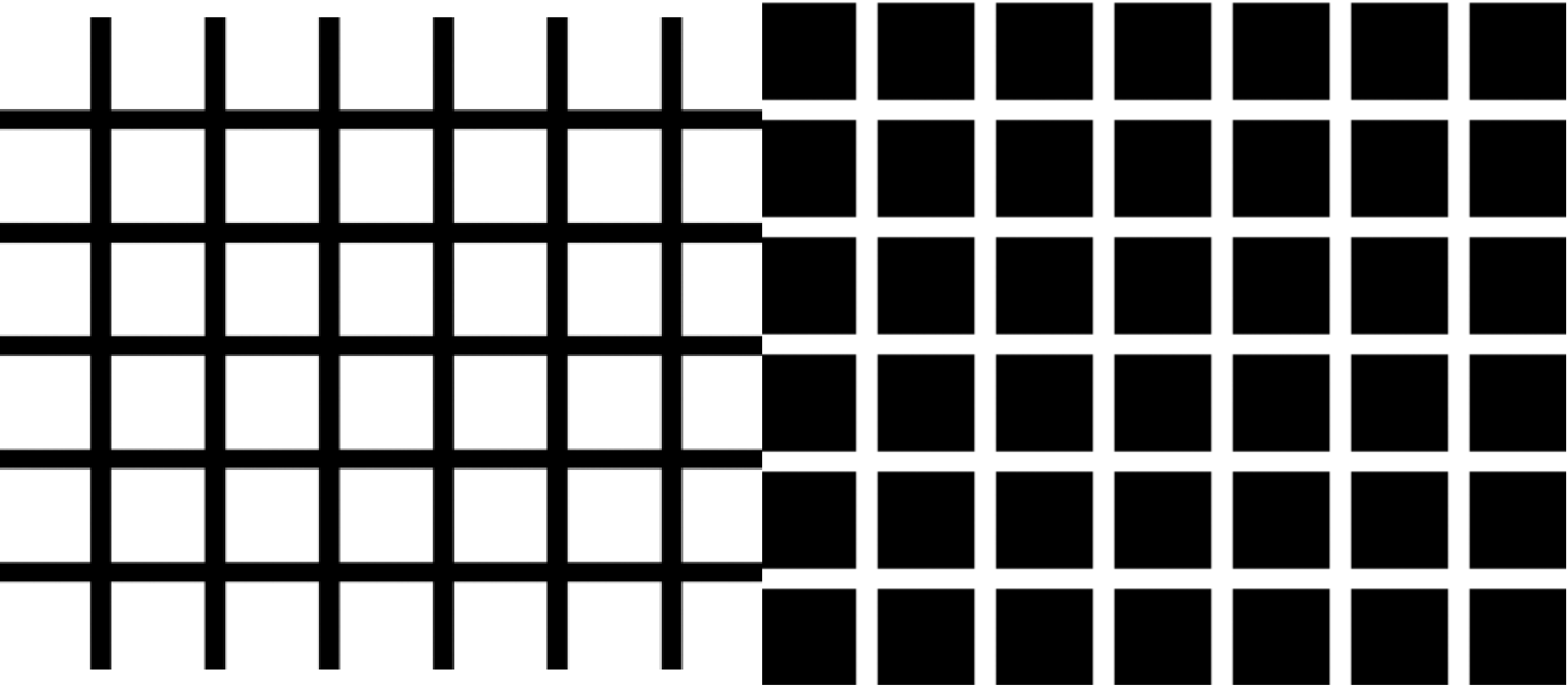
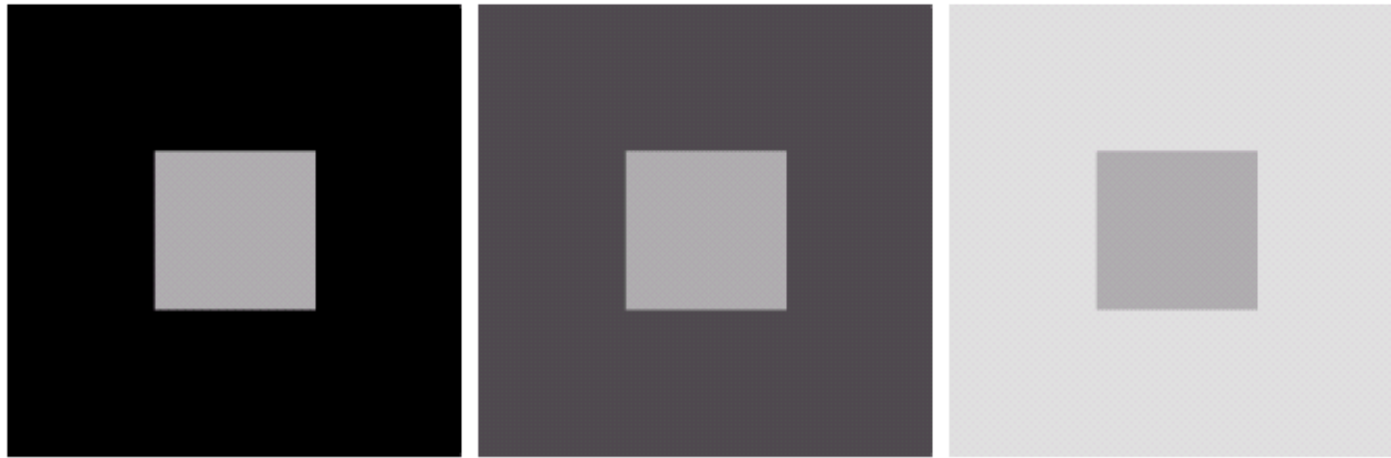


Figure 2.7: Perceived intensity is not a simple function of actual intensity



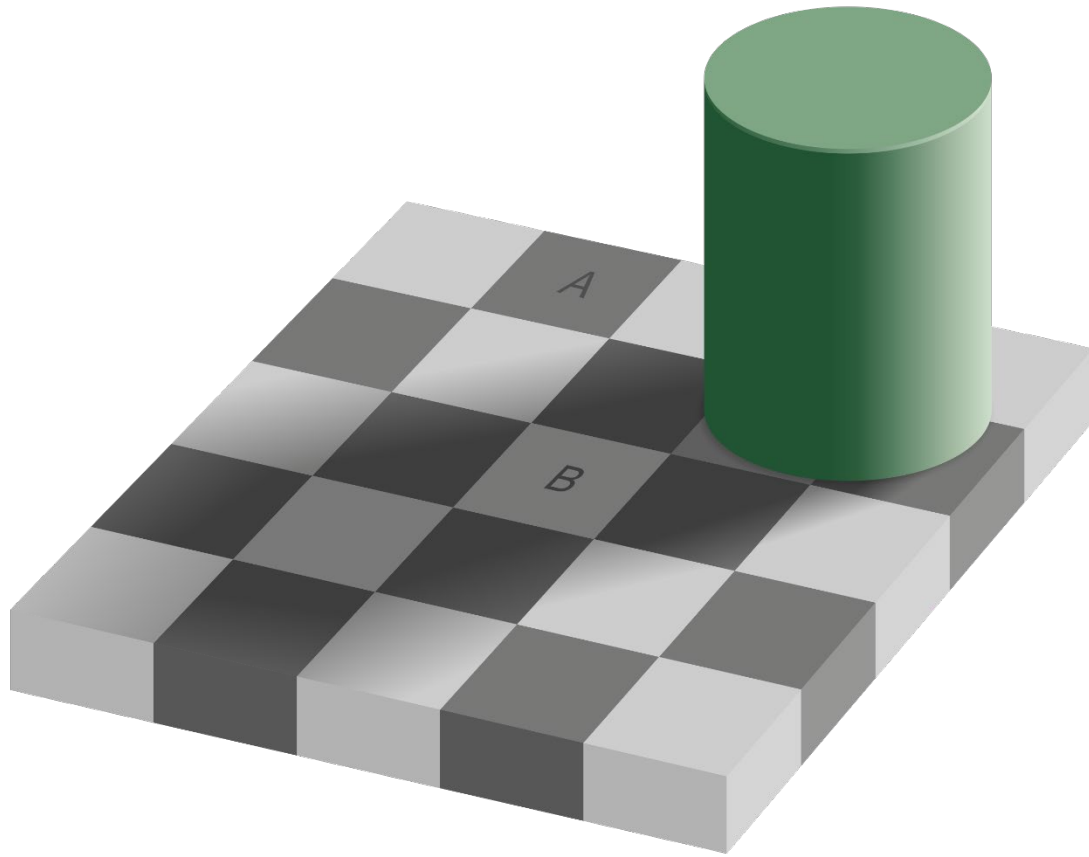
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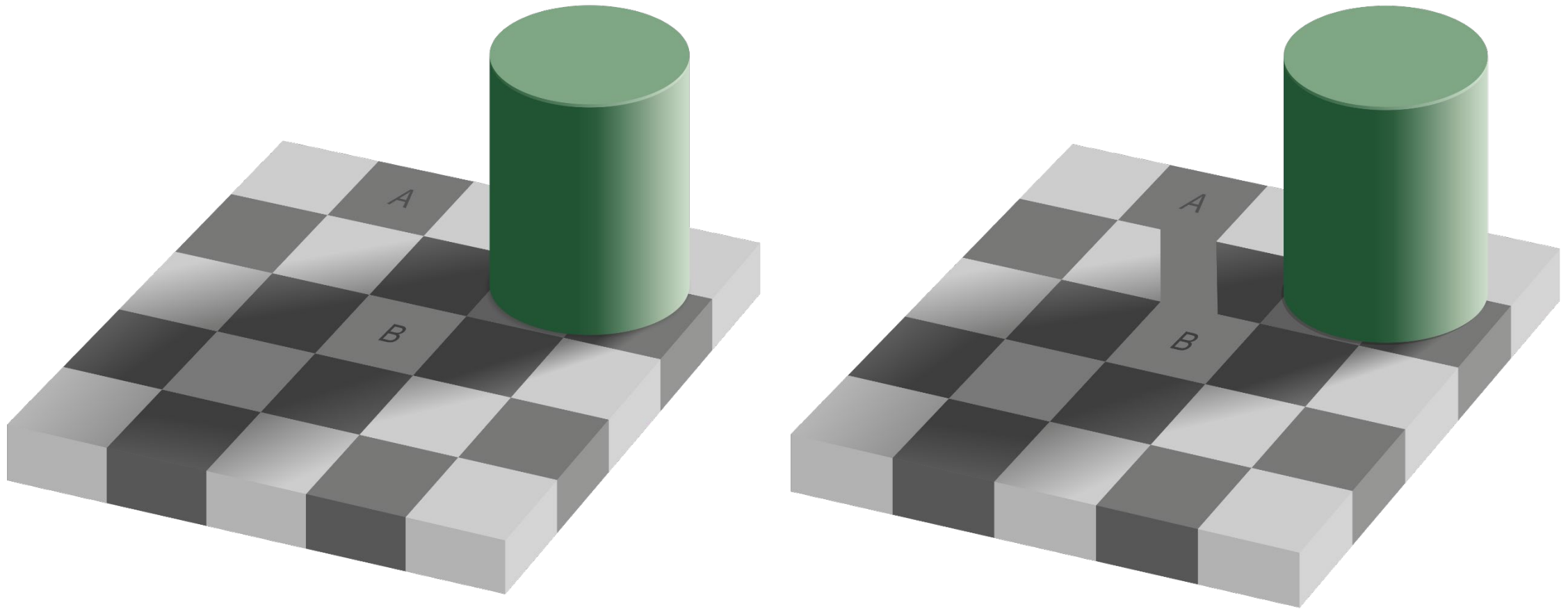


All the inner squares have the same intensity,
but they appear progressively darker as the background becomes lighter

Checker shadow illusion



Checker shadow illusion



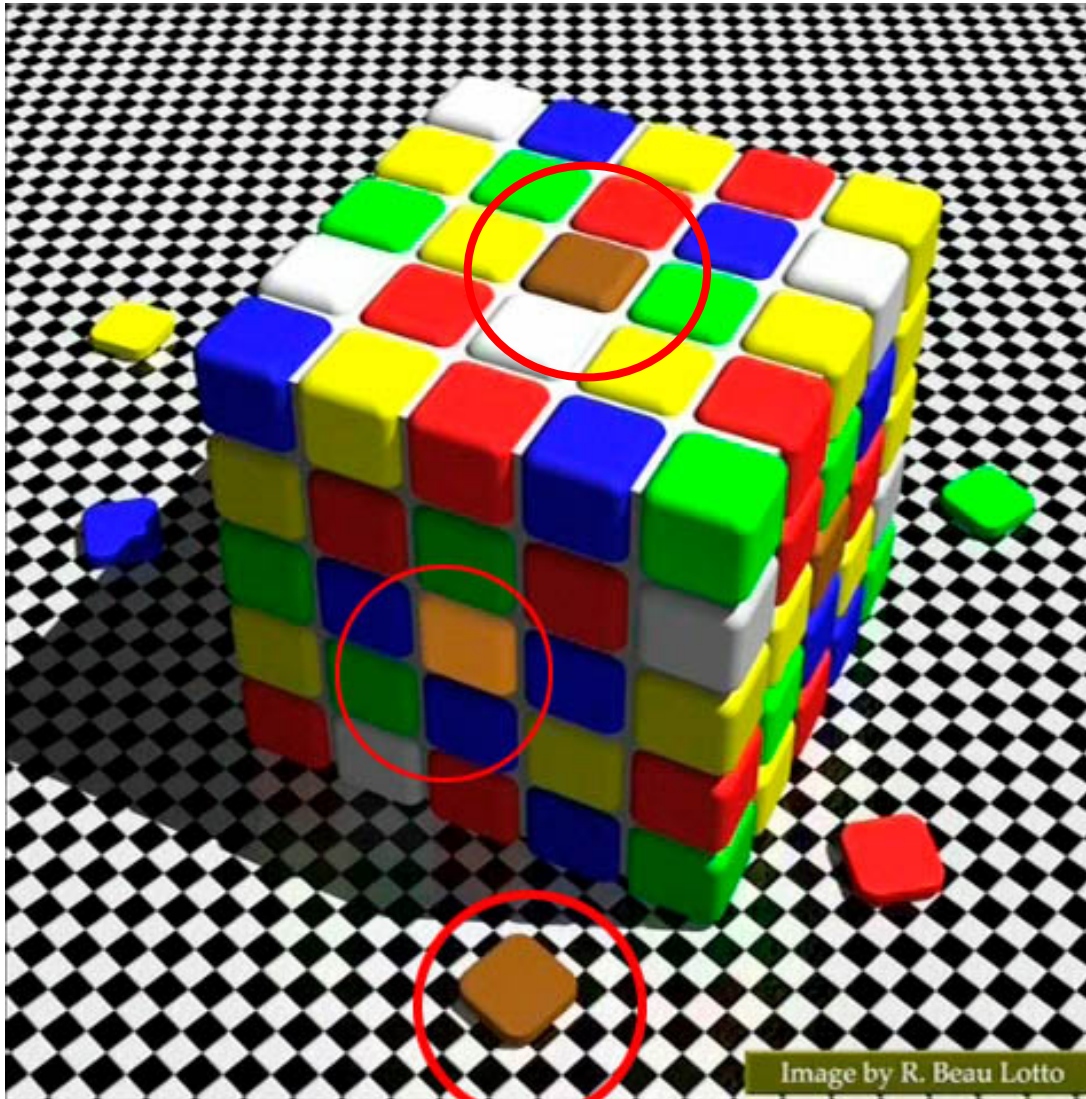
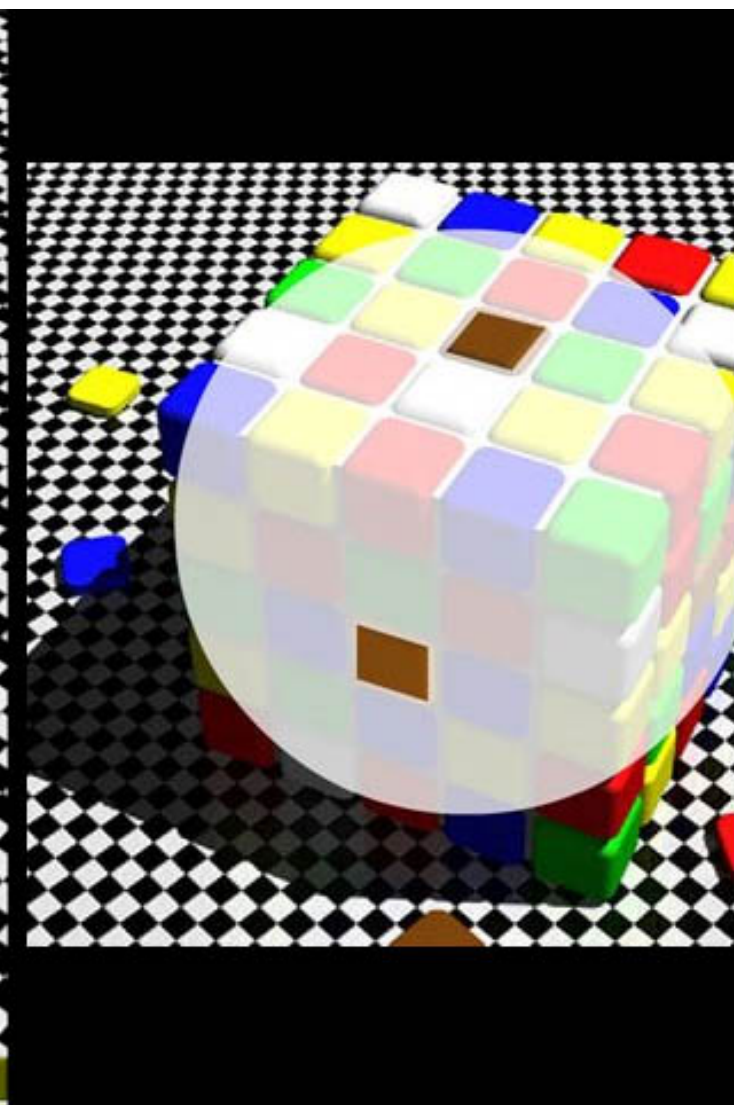
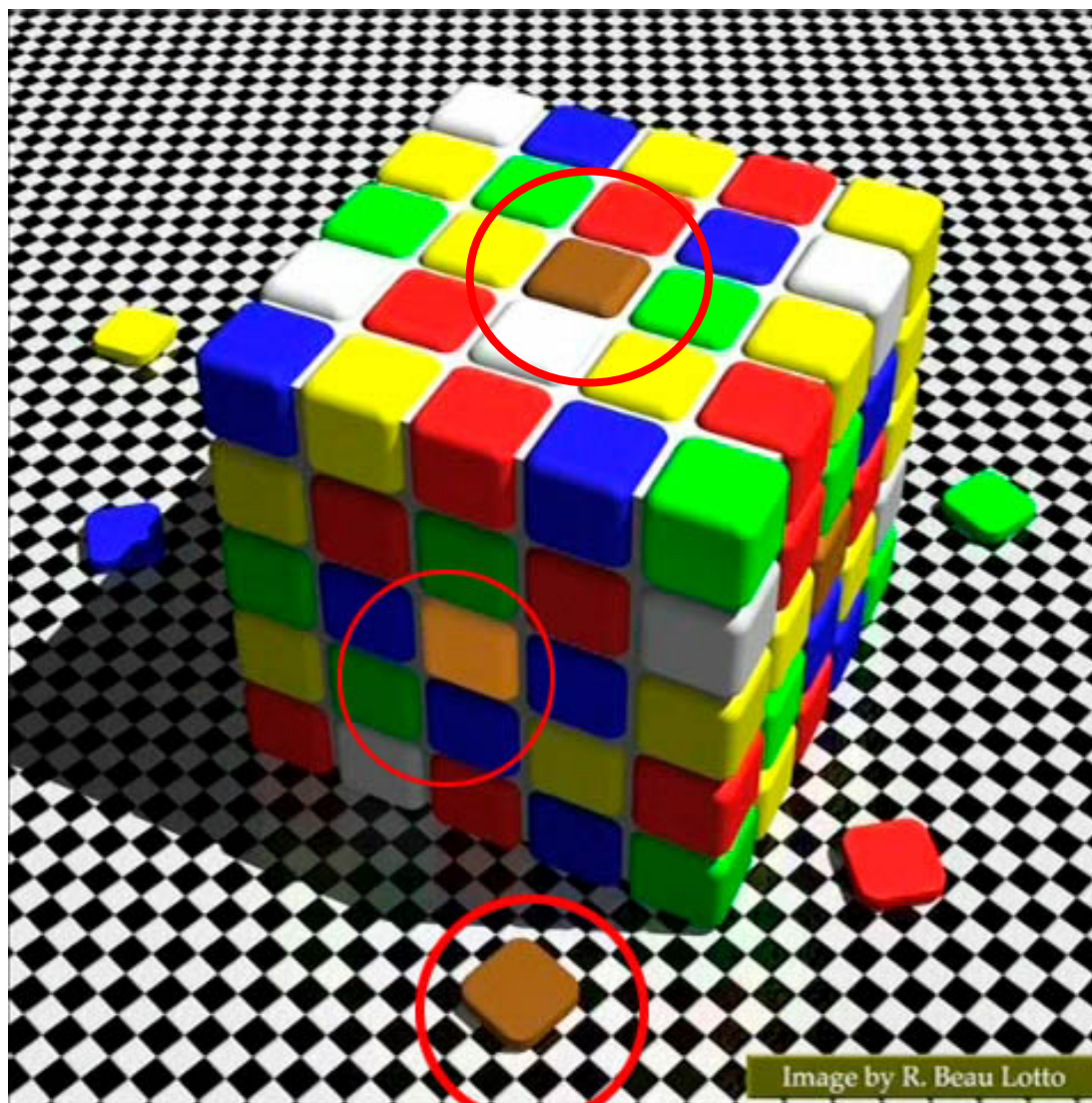
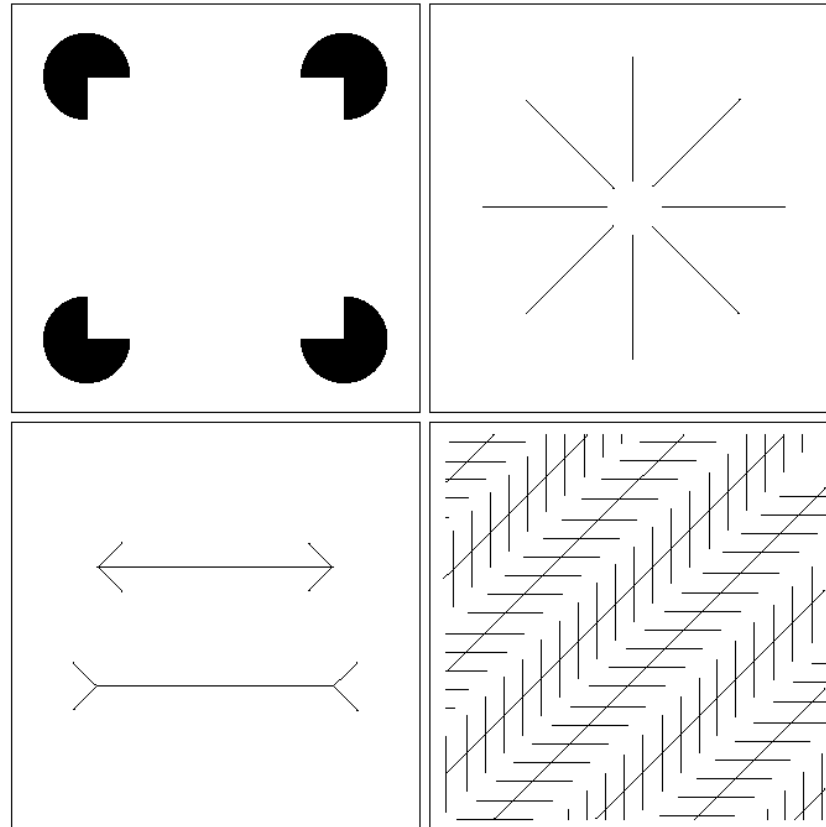


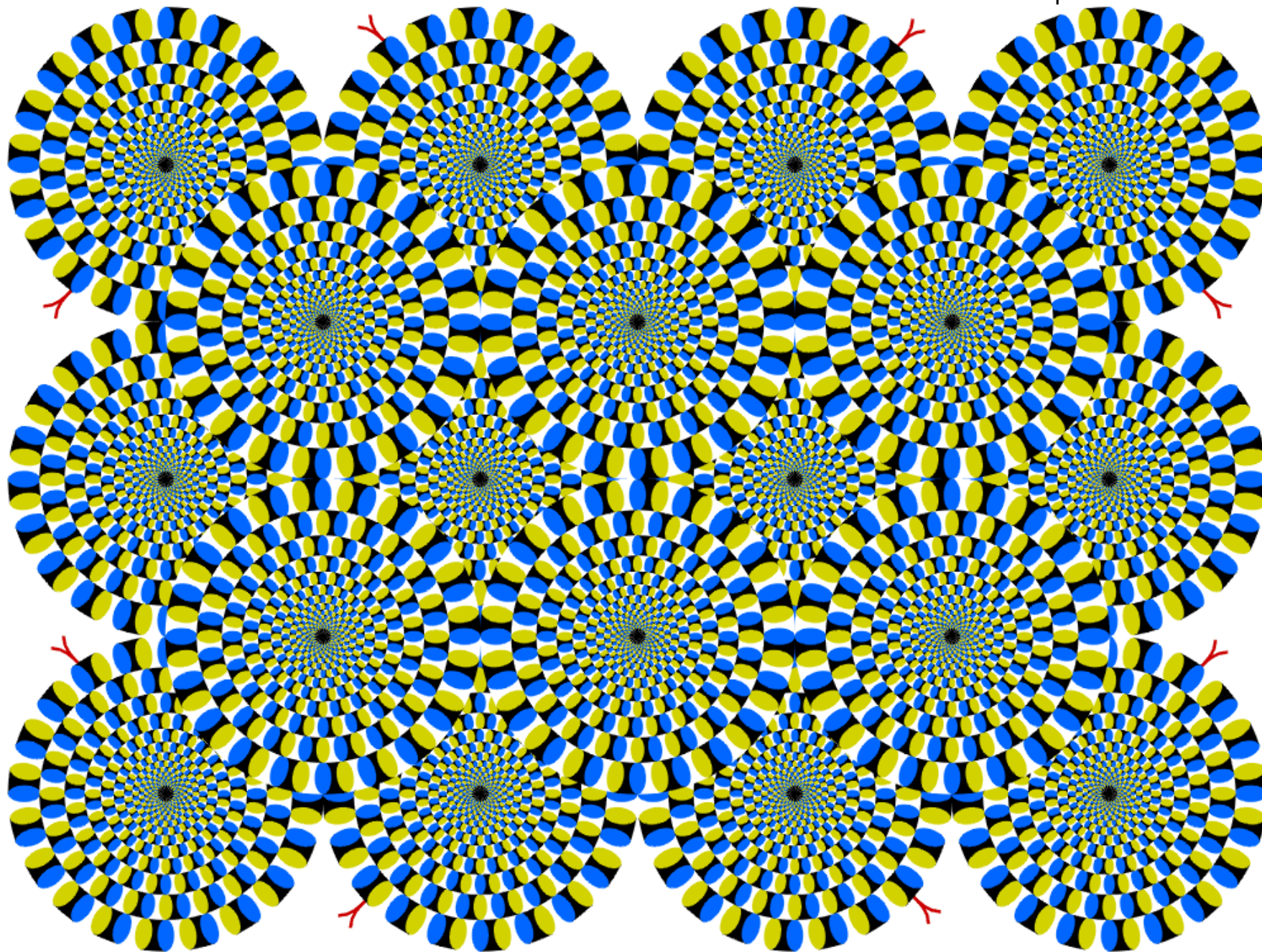
Image by R. Beau Lotto



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- Mach band effect
- **Optical illusion**





Gender illusion



Your eyes can do more than you think...

- McGurk effect
 - <https://www.youtube.com/watch?v=G-IN8vWm3m0>
 - <https://www.youtube.com/watch?v=jtsfidRq2tw>
- Rubber hand illusion
 - <https://www.youtube.com/watch?v=DphlhmtGRql>

Take home message



- Be careful of your brain, it might be alien...