Perception, Cognition, Ergonomics

9

Georgia Tech

Unless otherwise noted, images take from Chapter 3 of 3D UI text

Perception, Cognition, Ergonomics

- Perception (3.3)
  - Visual (3.3.1)
  - Auditory (3.3.2)
  - Somatosensory (haptic) (3.3.3)
  - Chemical (taste, smell) (3.3.4)
  - Sensory Substitution and Multisensory Processing (3.3.5)
- Cognition (3.4)
- Physical Ergonomics (3.5)

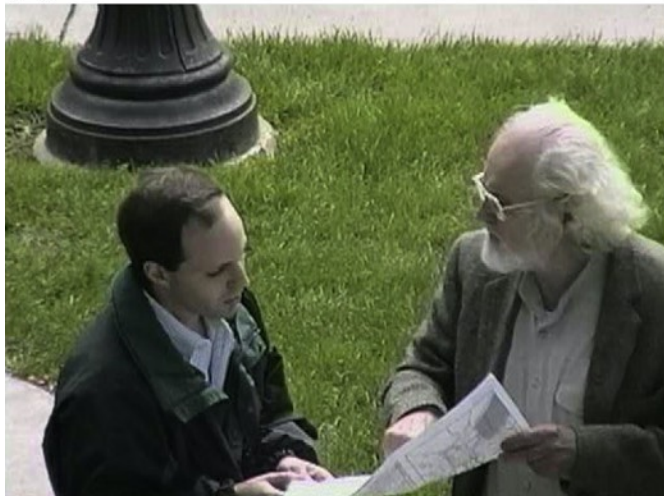- Most of this covered (differently) in Chapter 3 of VR book

(A)

(B)

(C)

(D)

FIGURE 3-7 Understanding VR. *People can be surprisingly unaware of details around them. Here an interruption to a conversation wherein an unsuspecting subject is presented with a different person after the interruption often continues the conversation, failing to notice they are speaking with a different individual [Simons and Levin 1998]. (A) A confederate in the experiment asks a person-on-the-street for directions. (B) Two members of the experiment team pass between questioner and subject, and in the process the question asking confederate swaps places with one of the interrupters. (C) The new questioner pretends to be the same person and continues the conversation with the subject. (D) The two questioners (from before and after interruption) can be compared. (Figure provided by Dan Simons—www. dansimons.com.)*

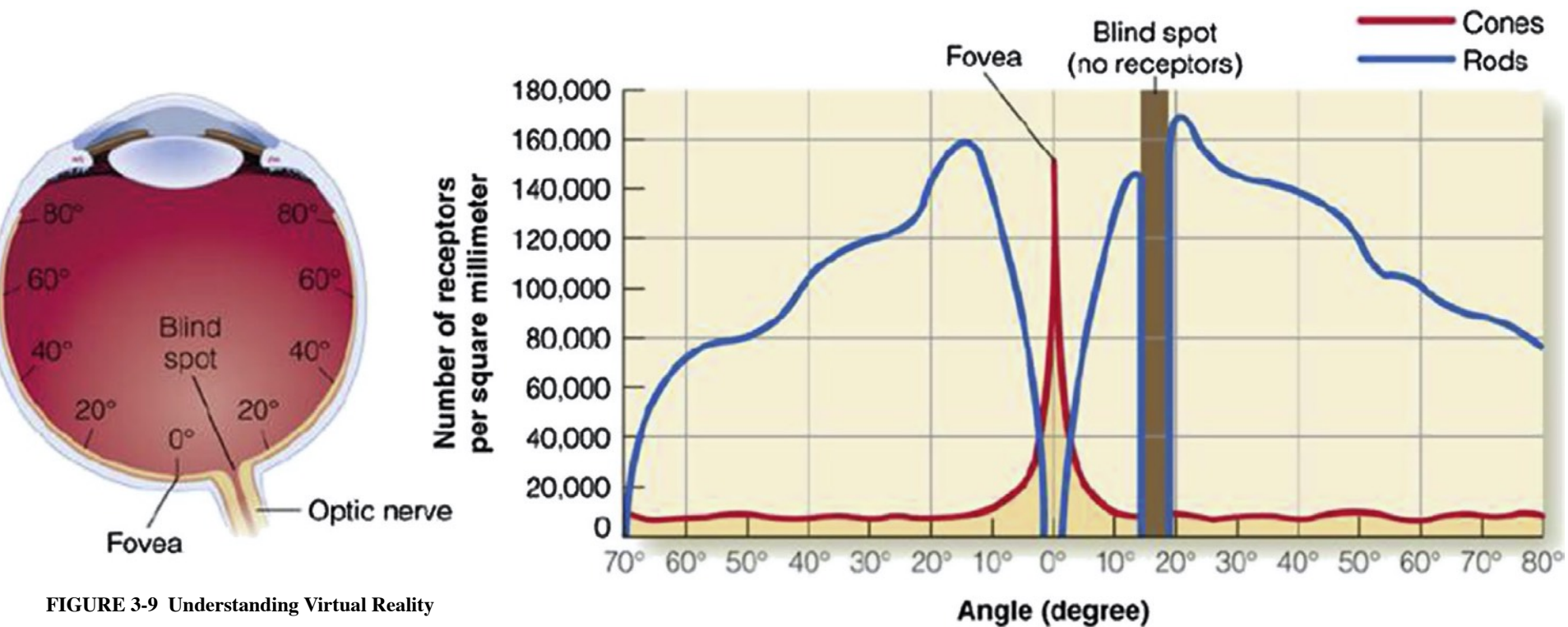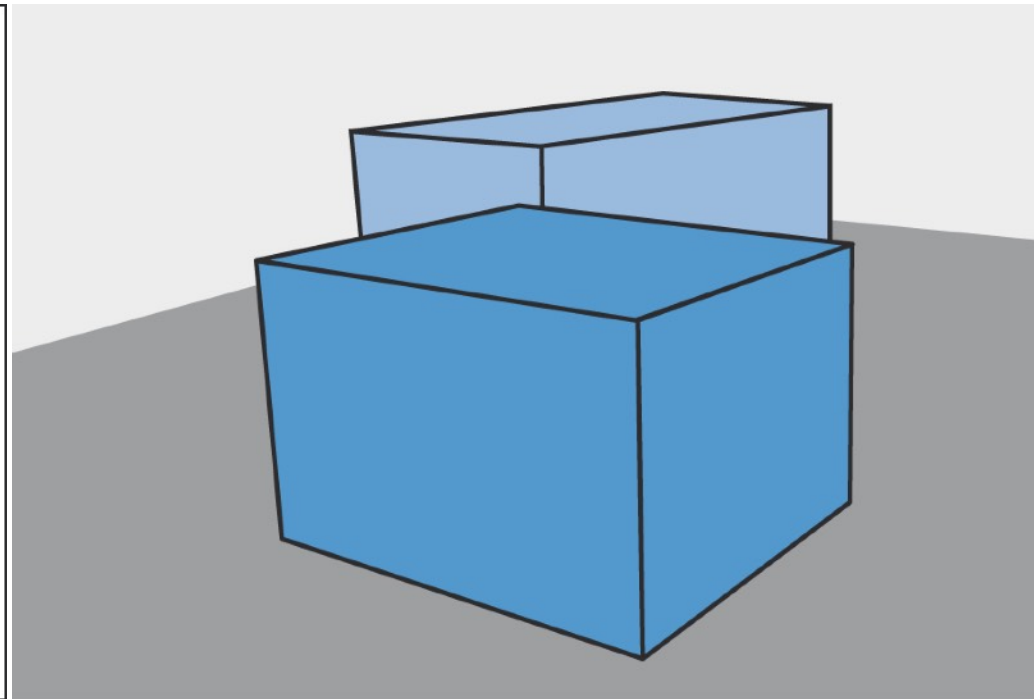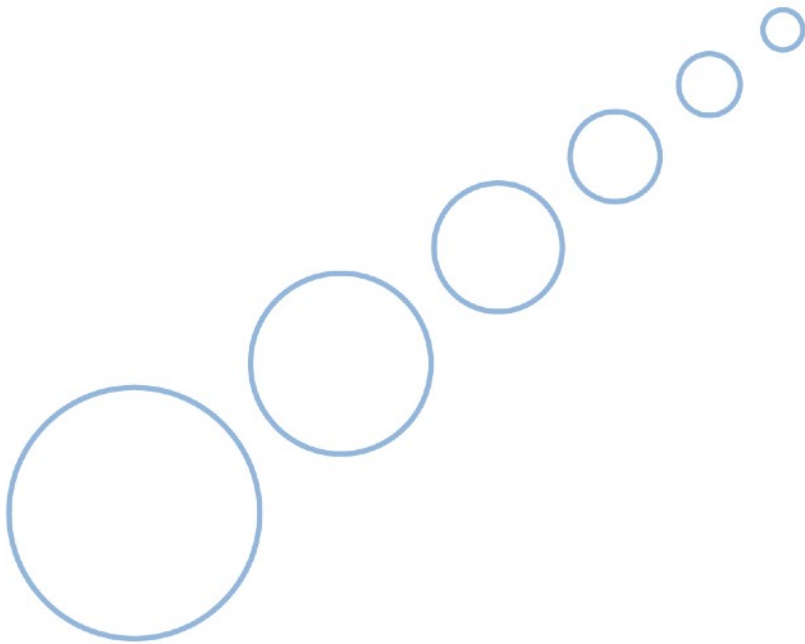- Rods & Cones, Peripheral & Foveal, Motion & Detail

FIGURE 3-9 Understanding Virtual Reality

4

Visual Cues

- Monocular, static cues
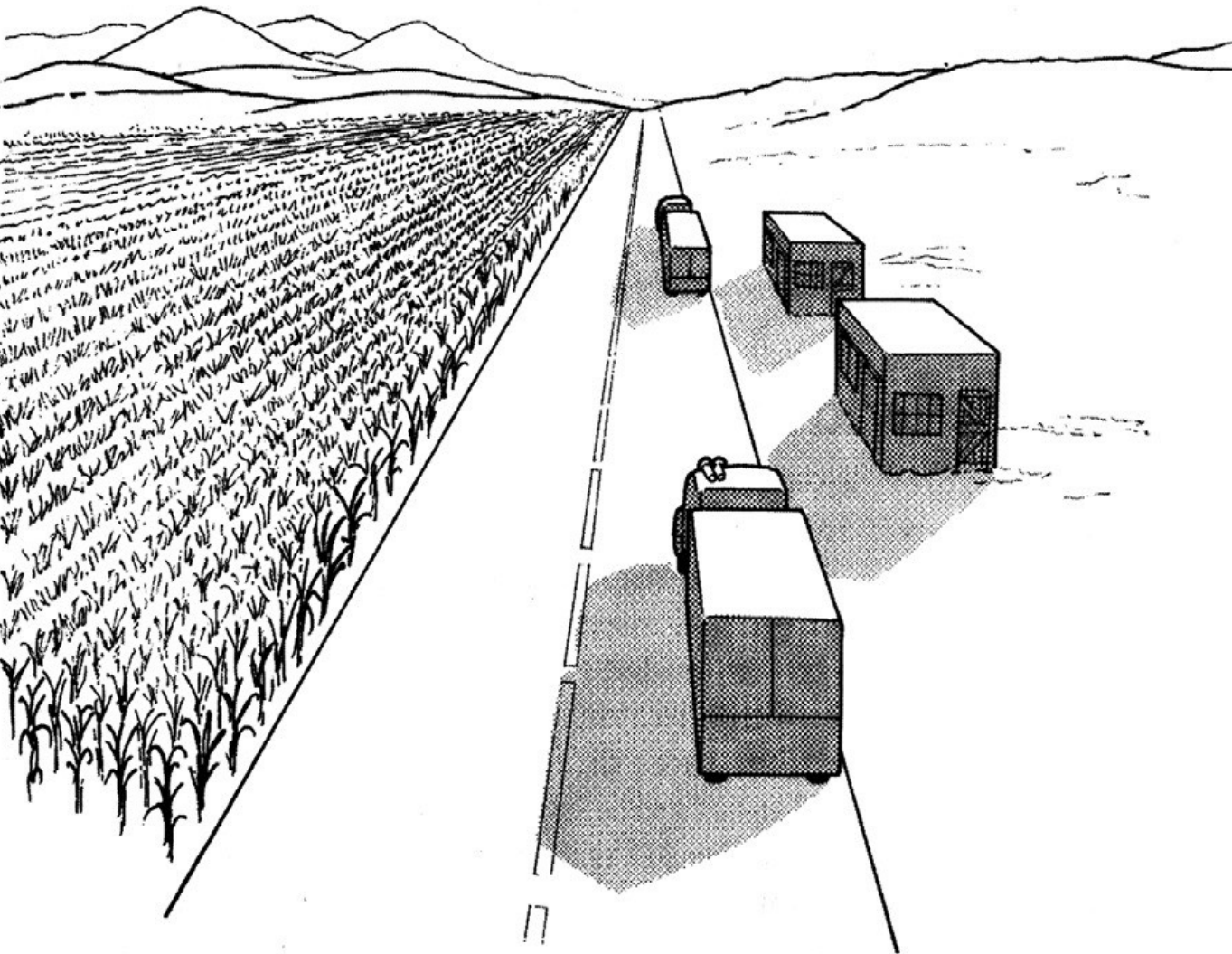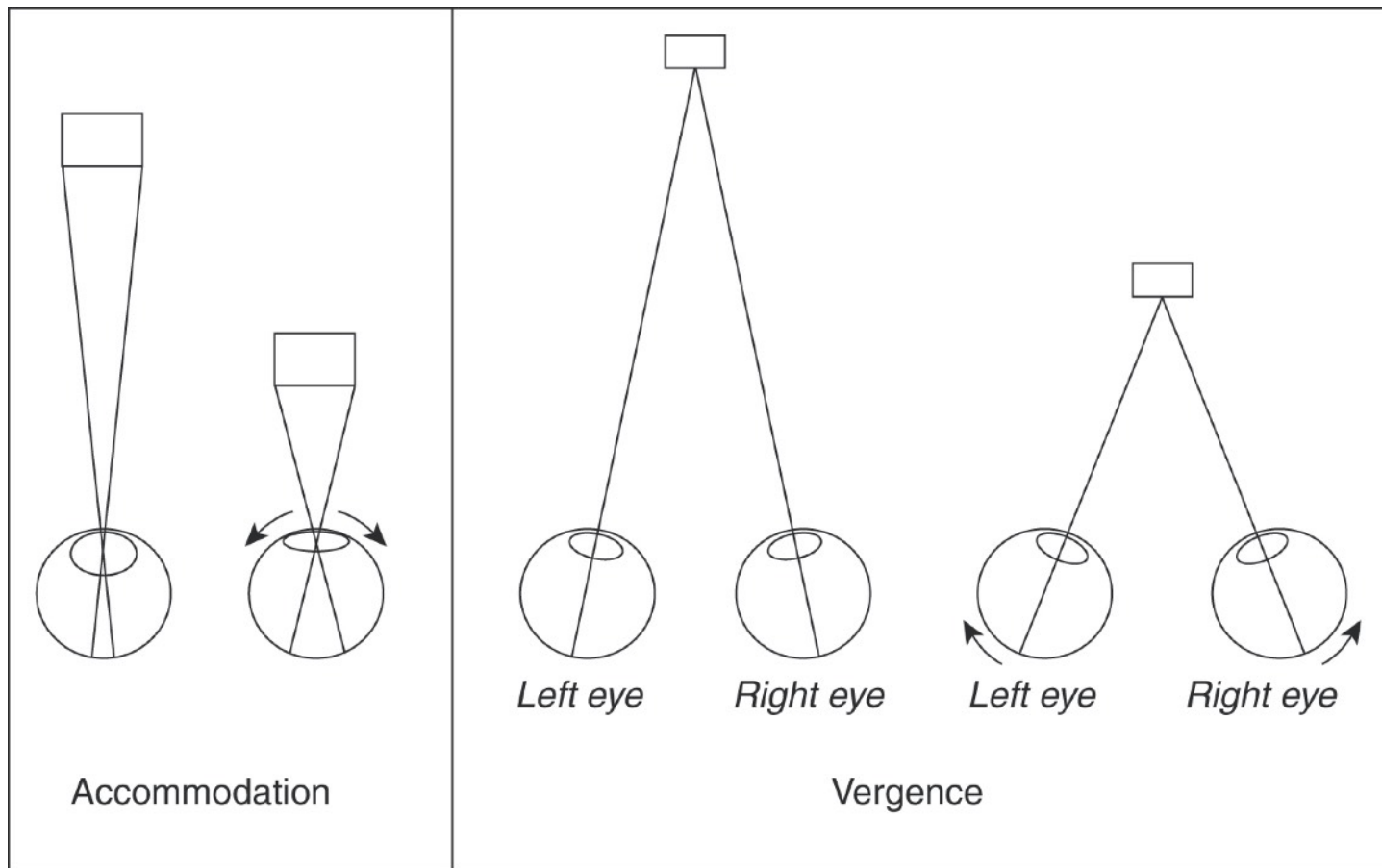 - size, occlusion, perspective

FIGURE 3-18 Understand Virtual Reality. This simple drawing provides a number of monoscopic image cues. Interposition and shadows help define the size and location of the buildings. Size, height in the visual field, and shadows provide geometric information about the trucks. We can observe from the road the linear perspective as it recedes from the observation point. The brightness of the road's center line as well as a texture gradient give clues about the stretch of road ahead. A texture gradient is also seen in the corn field. Haze in the atmosphere makes the observation of details of the mountains hard to discern. (Image from Engineering Psychology and Human Performance 3/E by Wickens/Hollands, © 2000.)
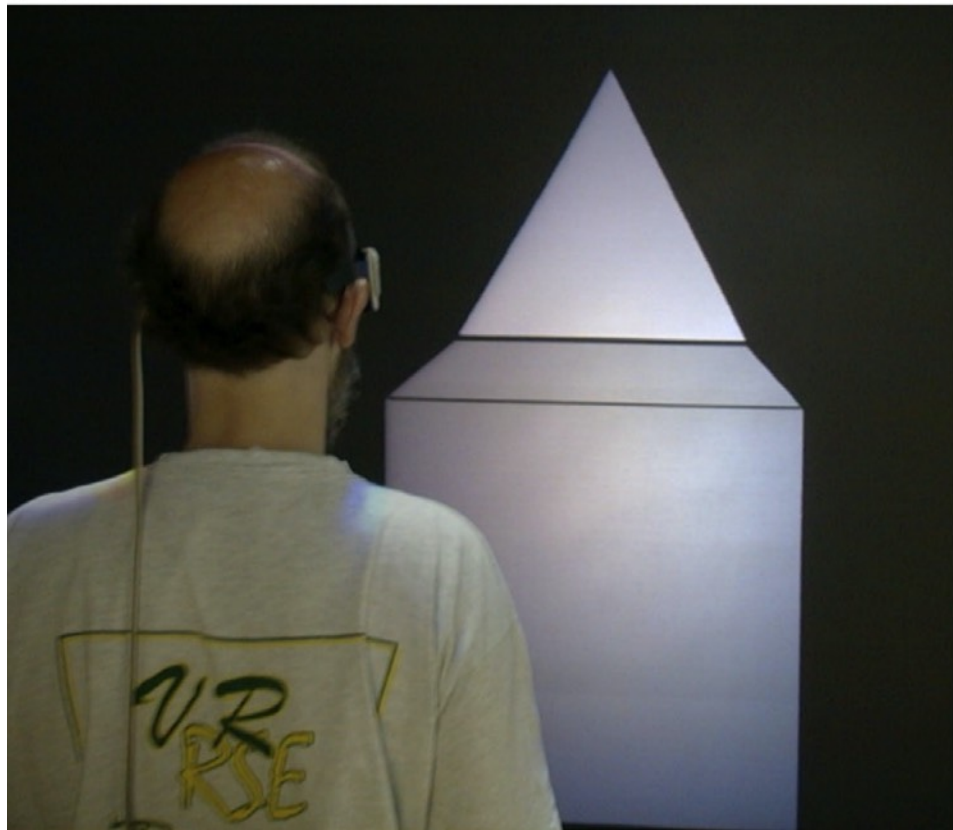
Visual Cues

- Oculomotor Cues: Accommodation and Vergence

Accommodation | Vergence

Left eye | Right eye | Left eye | Right eye

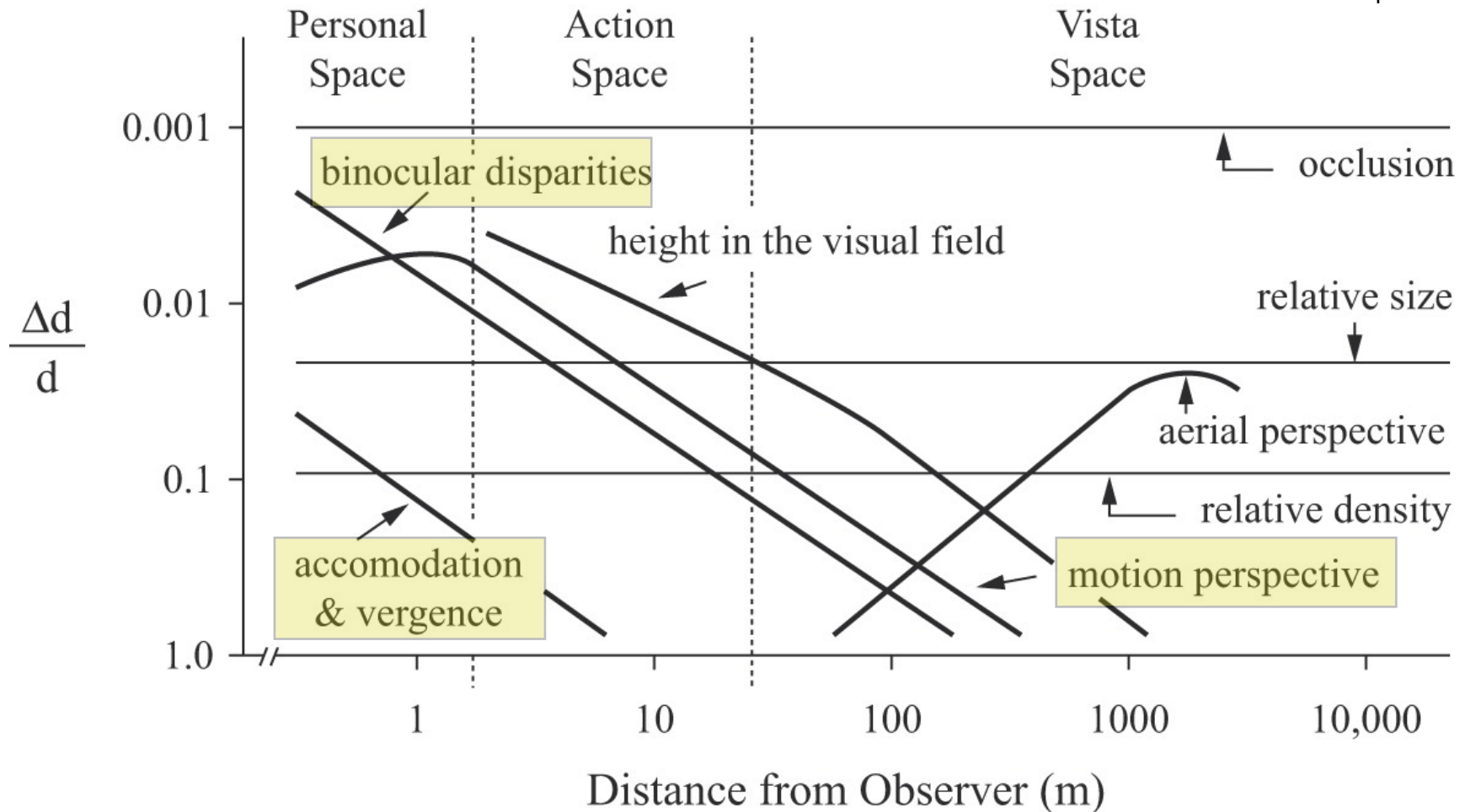# Visual Cues

- Motion Parallax

FIGURE 3-19 Understanding Virtual Reality

Relative Importance of Cues

Auditory Cues

- (Maribeth spent a class on this already)

Somatosensory (haptics)

- Cutaneous, proprioceptive, and kinesthetic senses
  - Geometry, roughness (touch), weight and inertia (force)

- Haptic cues
  - Tactile: texture, pressure
    - Brief (tap, pat, pressure, push, …)
    - Prolonged (vibration, pinching, stretching, scratching, rubbing, sliding, …)
  - Thermal cues, pain

- Kinesthetic and Proprioceptive
  - Position and angle of body joints
  - Relationship between body and physical objects (via muscular tension)

Somatosensory (haptics)

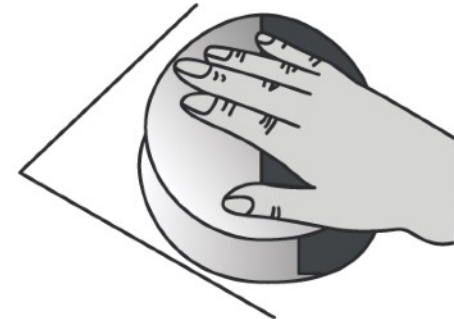- Effects of Tactile and Kinesthetic Cues on Haptic Perception
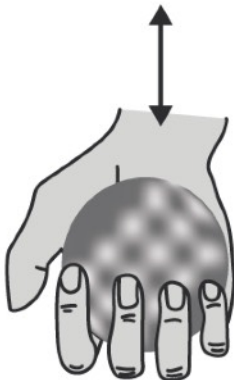

Lateral motion: texture
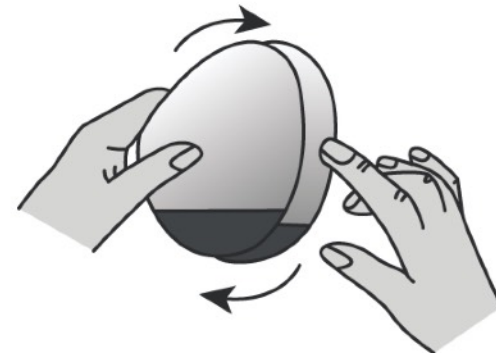
Pressure: hardness

Static contact: temperature

Unsupported holding: weight

Enclosure: global shape, volume

Contour following: global shape, exact shape

Chemical Sensing

- Olfactory and Gustatory

- There has been work done, but not a lot of progress.
  - No standard classifications
  - No precise way to create smells and tastes
  - No convenient way to create smells and tastes

Sensor Substitution and Multisensory Processing

- Multiple sensations can create more powerful cues
  - e.g., visual + auditory
- Generally, most sensations are multisensory in real UIs
  - Sensations influence each other (cross-modal effects)
    - bias, enrichment, transfer

Cognition

- Things we perceived are processed by cognition
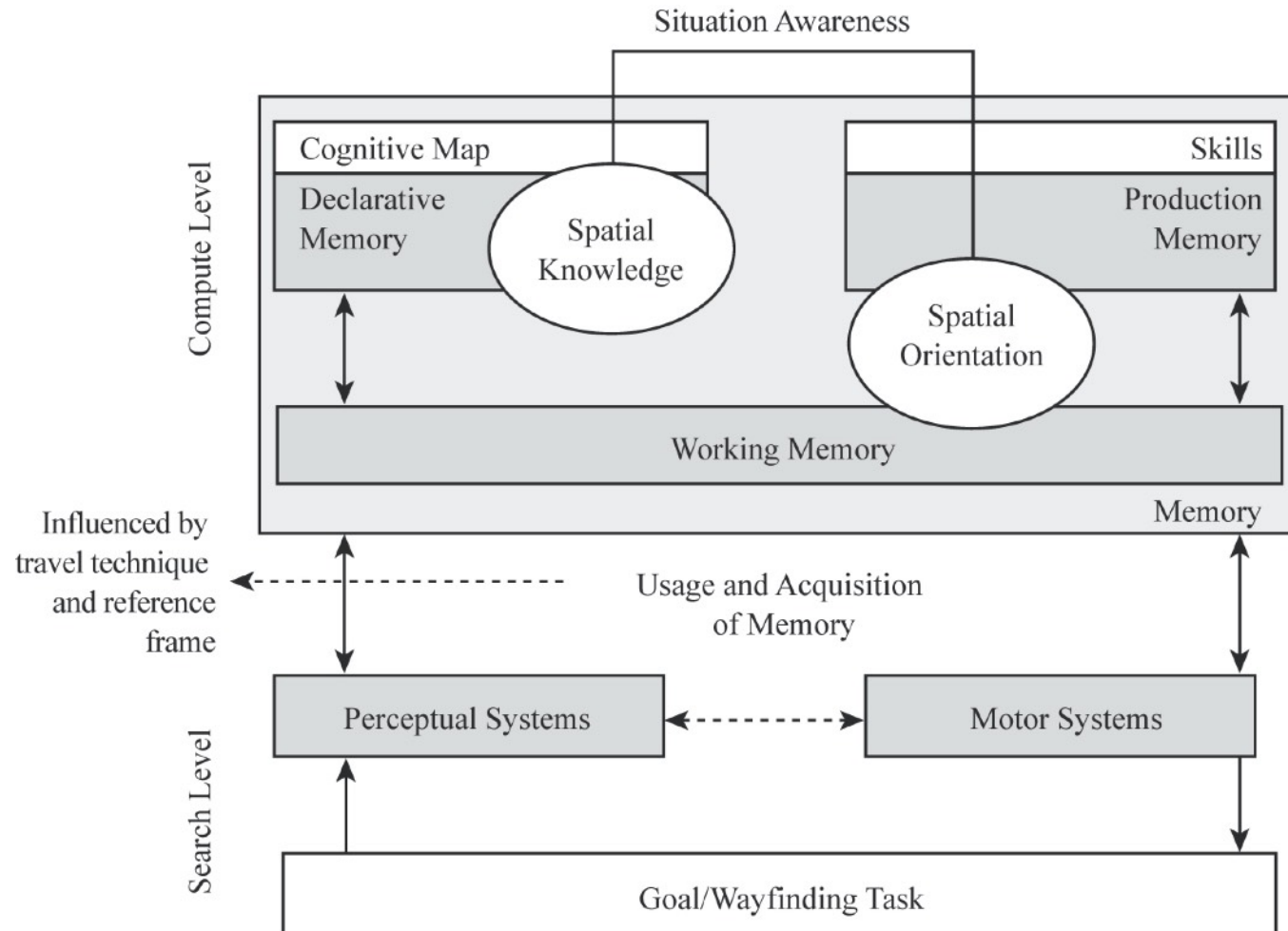
Cognition: Situational Awareness

Figure 3.10 A representation of wayfinding as a decision-making process.
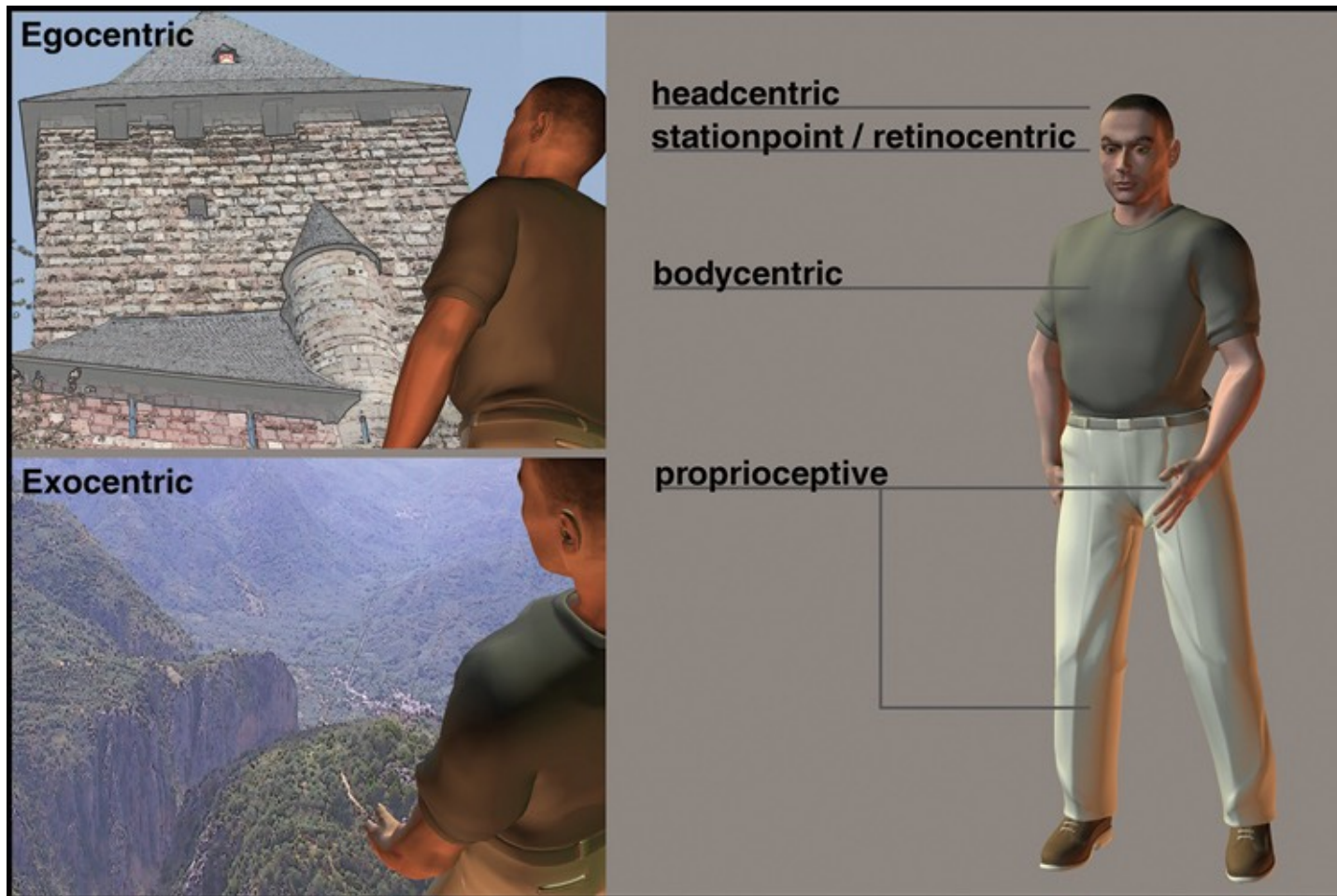
Frames of Reference

Figure 3.11 Human reference frames (right) and associated views (left). In an egocentric view (top left), the user is inside the environment, while in exocentric view (bottom left), the user is outside the environment, looking in (Image courtesy of Ernst Kruijff).

Physical Ergonomics

- Physical properties of our musculoskeletal system
  - Basic human anatomy and physiology

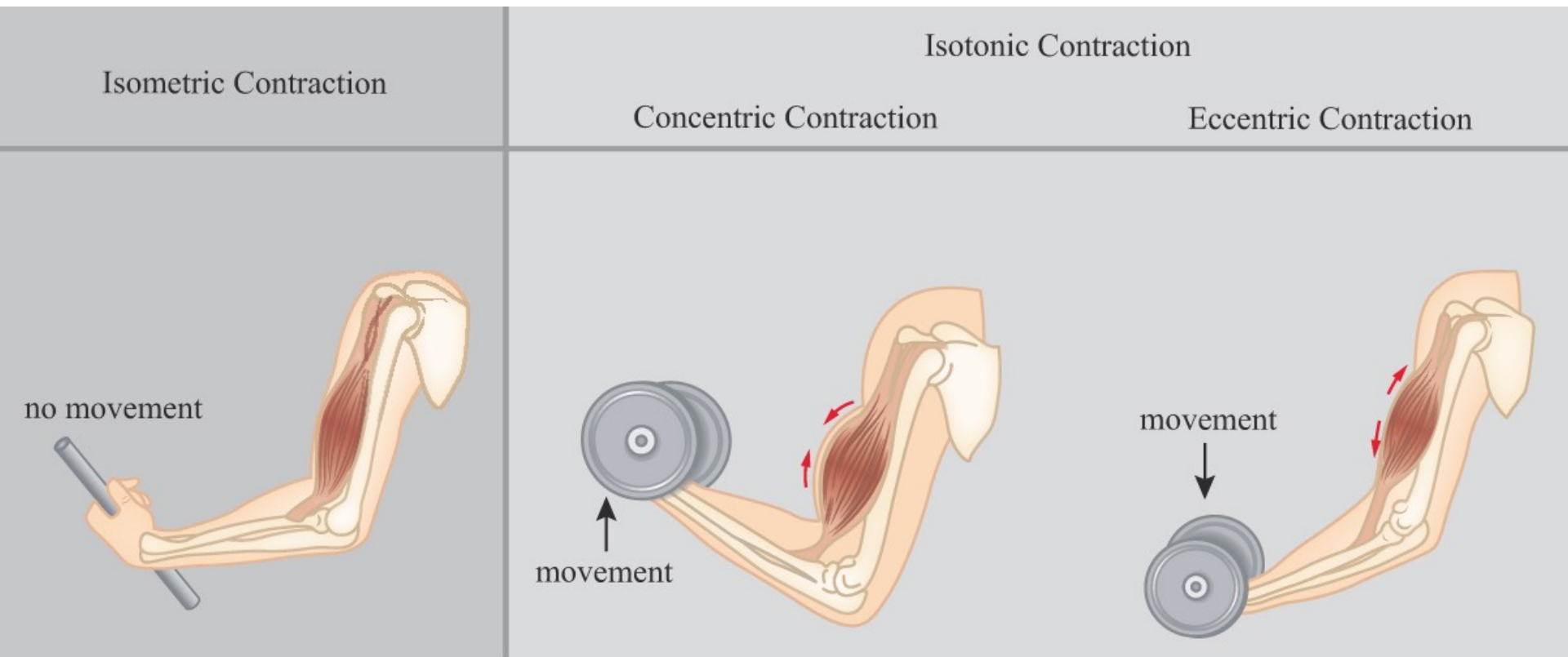**Figure 3.12** Isometric versus isotonic contraction

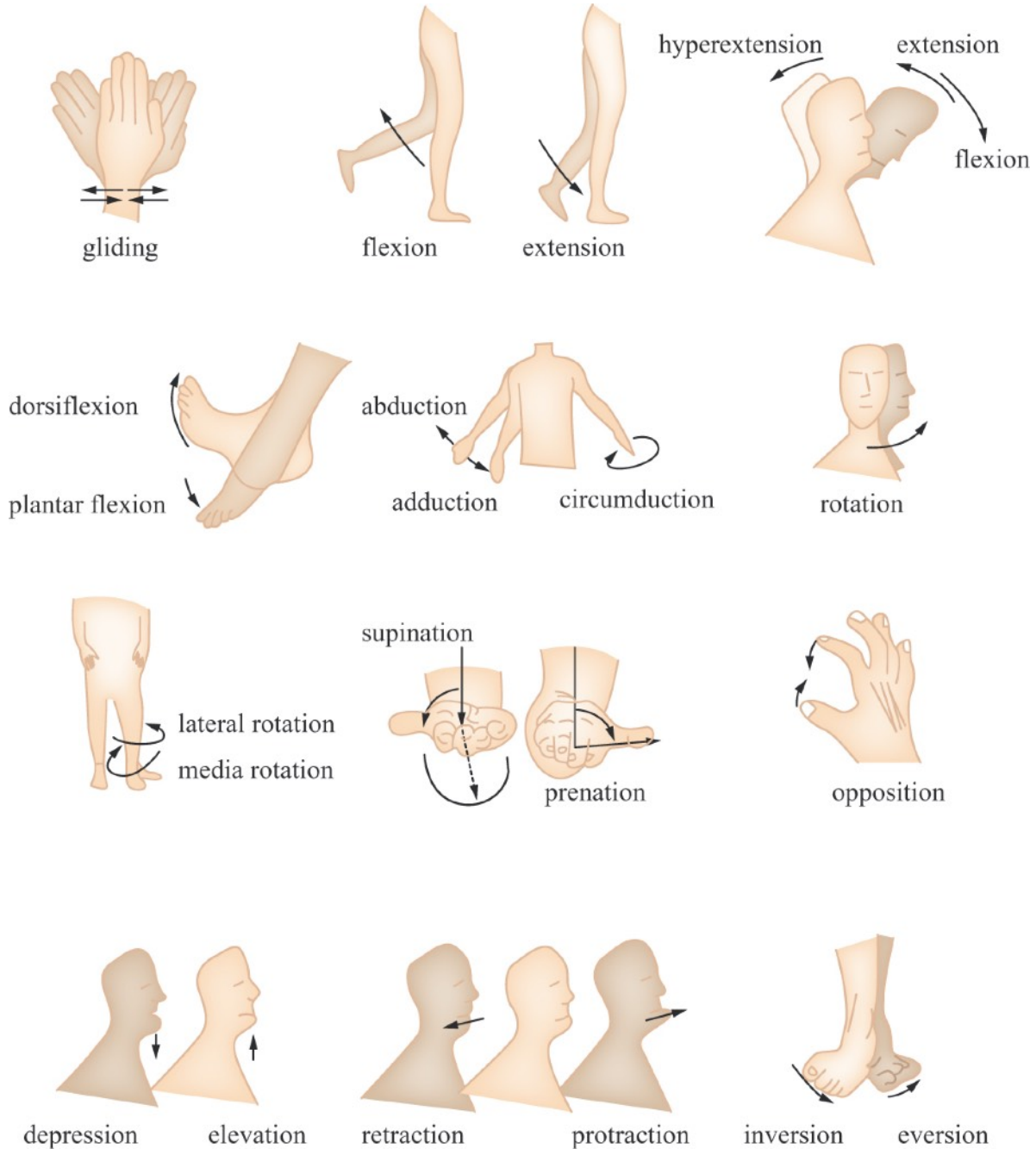**Figure 3.12** Isometric versus isotonic contraction

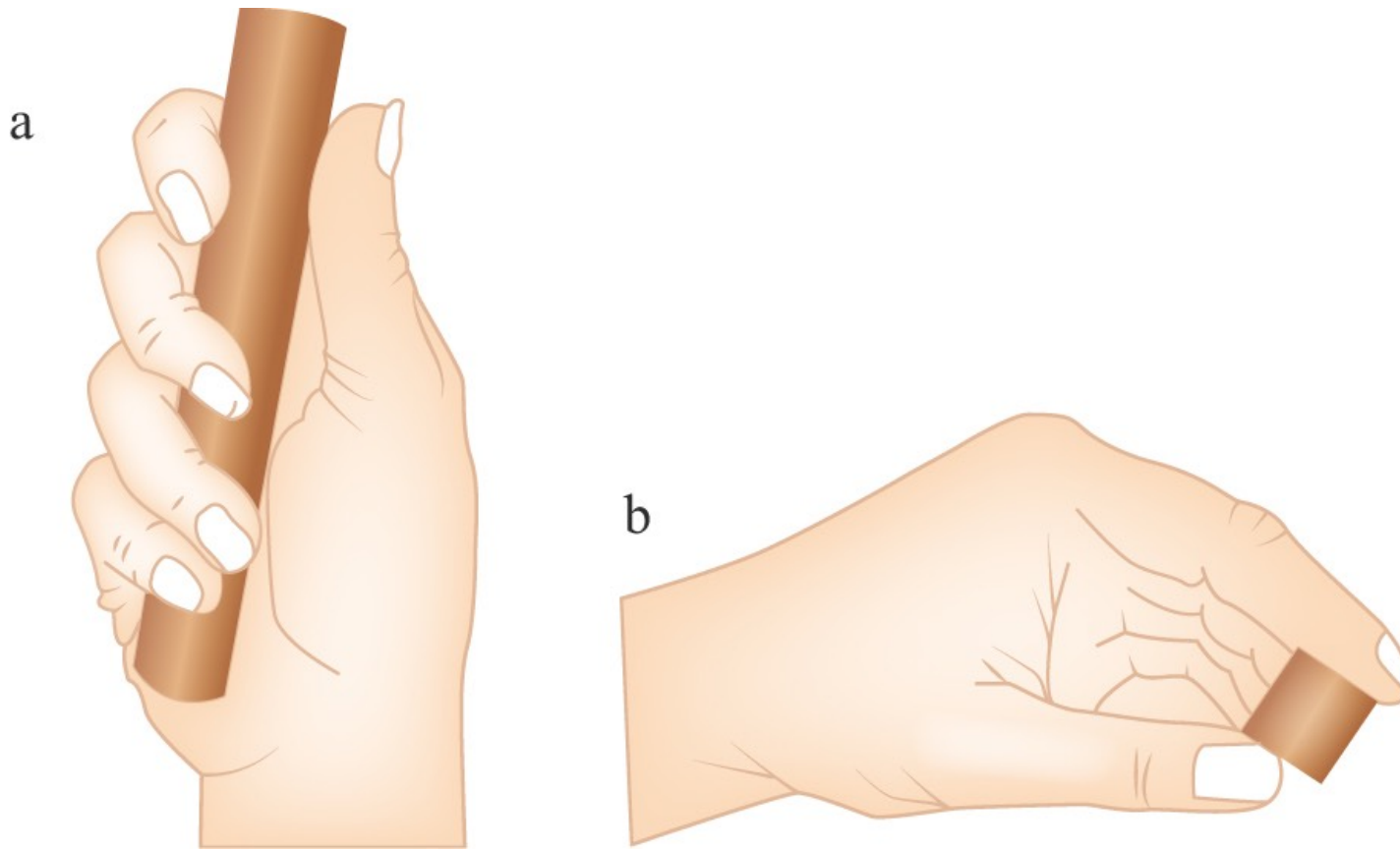**Figure 3.13** Selected physical motion types.

a
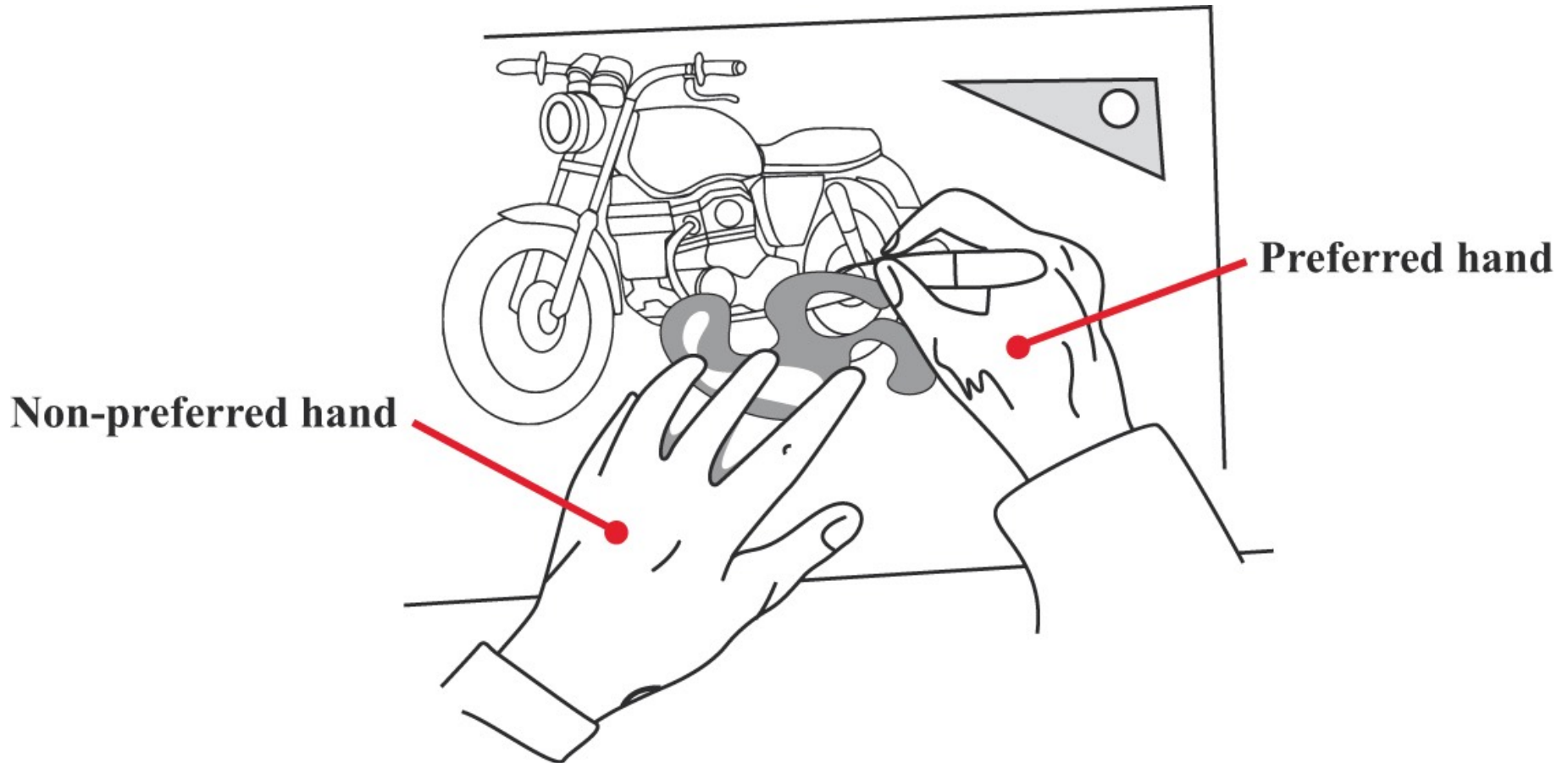
b

Figure 3.15 Power (a) and precision (b) grip. Redrawn from Castiello 2005.

Figure 3.16 Bimanual interaction.