Foundations Of Mind

Perceptual Knowledge:
Lecture #2
Space
Objects

Space Perception is Hard
• We perceive a stable, continuous, 3D spatial layout
• Perception seems immediate, effortless & nearly error-free
• The mechanisms of perception are complex and puzzling

All senses operate on contact
(e.g. surface touches skin, molecules interact with tastebuds)
But, Perception brings us knowledge of things at a distance
How?

space perception in other modalities:
(1) audition
(2) touch

Vision: first steps
Hussain ibn Abdullah ibn Hassan ibn Ali ibn Sina
Latinized: “Avicenna” (980-1037 CE) (av′i sen′ə)

overturned the common idea that somehow the eye emitted rays that bounced off an object being viewed

(note: modern invented image, 1976)
Some problems of visual space perception:

1. Depth

2. Size

3. Position and motion

Object motion

Observer motion

Visual space perception: depth cues

Interposition

Linear perspective
Two Theories of Space Perception

Nativism (Descartes):
The human mind and brain are built to infer space automatically
Perceptual processes are like reasoning processes:
geometric inferences

Perception of depth involves internal innate unconscious computations

Empiricism (Berkeley):
The human mind and brain are built to sense only impinging stimuli (light, muscular effort)
We learn through experience to interpret these stimuli in terms of depth, by association with touch: no reasoning involved.

Perception of depth involves rote learning, associative pairing of convergence & accommodation with the sense of touch.

Two Theories of Space Perception

The prejudice shared by Rationalism and Empiricism is that man does not know things directly but grasps only their impressions (sense data).

Both Rationalism and Empiricism needed a new method; the former adopted mathematical deduction, the latter scientific induction.
Descartes Theory of Vision

demo

A Nativist Theory of Space Perception

René Descartes (The Optics, 1637) 
philosopher, mathematician, scientist
Analogy: the blind man

Descartes’ theory is:
• mechanistic (light, refraction, nerves, signals to brain)
• computational (geometric inferences)
• rationalist and nativist (“natural geometry”)

Berkeley’s critique and alternative theory
(1709)
“I appeal to any one’s experience, whether, upon sight of an object, he compute its distance by the bigness of the angle made by the meeting of the two optic axes? … In vain shall all the mathematicians in the world tell me, that I perceive certain lines and angles which introduce into my mind the various ideas of distance; so long as I myself am conscious of no such thing.”
Method: introspection
Primitives: sensations (e.g., muscular effort)
Interpretive process: learning to associate vision & touch

Berkeley’s theory is:
• empiricist
• associationist

NEAR in focus: more effortful

Convergence

Berkeley’s “effort”
Q: Do we perceive depth by innately structured computational mechanisms or by associative learning?

A: To answer, must study space perception in infants and children. But we cannot do this! 
Next best thing: screw around with adult perception

Helmholtz on the origins of space perception:

Helmholtz’s next-best strategy: Study the modifiability of space perception in adults.

-- alter the spatial relationship between the perceiver and the layout so that visual space perception is systematically in error.
-- observe whether the perceiver adapts to the altered relationship & corrects the error.

If adaptation occurs: adults are able to learn to perceive space correctly. most reasonable to suppose babies learn too.

If no adaptation occurs: the mechanisms of space perception are fixed in adults. most reasonable to suppose they are fixed in infants.

Perceptual change or conscious decision? aftereffects

Conclusions: space perception is modifiable in adults on grounds of plausibility, probably learned in children.
More on prism adaptation: Harris (1960s)

(1) Where does the perceptual change occur: in vision or in touch? (if vision learned by association with touch, as Berkeley claims, then vision should change in adaptation experiments).

(2) how does the perceptual change occur? By associative pairing or active motion? (if Berkeley’s associative theory is correct, then associative pairing should suffice)

Prism adaptation: conclusions

(1) mechanisms of space perception are modifiable, but touch is more modifiable than vision.

(2) modifications depend on active, self-produced motion.

If studies of prism adaptation in adults sheds light on visual space perception in infants, then initially Helmholtz’s studies show some support for Berkeley, but the further studies of Harris show that the phenomenon more accurately offers some support for Descartes’ nativist theory and no support for Berkeley

--touch doesn’t teach vision

--learning is not by passive association

Helmholtz said:
We can’t study babies directly

Tomorrow
Spelke et al. Say: Oh yes we can