Foundations Of Mind

Today: Visual Cliff
Next Time: Size and Shape
Constancy

Next approach: Eleanor J. Gibson and the comparative study of perceptual development

Assumption: many basic perceptual capacities evolved before humans and so are shared by humans and other animals.

Strategy: (1) study space perception in a wide range of animals. If the same capacities appear across different species, the capacities probably are shared by humans.
(2) study space perception in precocial animals (e.g., those who locomote at birth) and in animals reared under controlled conditions. If space perception is innate, it should appear at birth and without visual experience.

The visual cliff (Gibson & Walk, 1958)

Gibson’s incidental discovery: newborn goats on a pedestal.
All goats crossed the shallow side.
No goats crossed the deep side.
An innate capacity to perceive and avoid visual drop-offs.

The Problem of Depth

Strategy: Test for innateness by using animal models
Precocial animals

No way!

The visual cliff: Further studies

(1) Is this effect specific to animals that live on mountains?
Tests of other animals: lambs, chickens, rats, turtles, cats, dogs, humans.

Findings: Cliff avoidance in every animal tested.

Cliff avoidance appears as soon as an animal is capable of visually guided locomotion:

- goats, chicks, lambs: at birth
- rats and cats: weeks after birth
- humans??
Reflexes

**Reflex:** Stepping

**Stimulation:** Supported infant’s bare feet touch surface

**Response:** Alternating stepping response

**Probable function:** Preparation for voluntary walking

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Motor Milestones: Gross Development

Cephalocaudal trend: motor control proceeds from head downwards
A Continuity Assumption

Other things being equal, basic mechanisms and capacities will be preserved over the course of evolution and therefore will be common to humans and other animals.

true: heart, lungs, eyes, ears, breathing, …
false: bi-pedal motion, talking, ...

Is it true of cliff avoidance?

The visual cliff in human infants

9-month old
Infants crossing the visual cliff

The Problem of Depth

Question: Can infants use any of these cues to perceive depth???

3-month olds
Campos: When pre-crawlers Are lowered onto deep side, Heart rate changes…

Infants perceived depth even prior to crawling experience!
The Problem of Depth

So which depth cues do babies/animals use??

Possible depth cues:
- Binocular cues (convergence)
- Motion cues (motion parallax)

Amount of retinal motion from sideways head movement

Shallow side & center board

Deep side

The Problem of Depth

So which depth cues do babies/animals use??

Possible depth cues:
- Binocular cues (convergence)
- Motion cues (motion parallax)
- Pictorial cues (texture size smaller on deep side)

Retinal image of shallow side

Retinal image of deep side

The visual cliff: Controlled rearing studies

(2) Do animals (rats, cats, humans) learn to perceive the visual spatial layout prior to locomotion?

Further studies of rats and cats:

--Newborn animals randomly assigned to two groups.

--The two groups are treated identically except for visual experience: light-reared vs. dark-reared.

--For testing, all animals introduced into the light and placed immediately on the cliff.

Experimental tests:

1) Monocular viewing does not impair cliff avoidance:
   Binocular cues not necessary

2) Texture size does not affect cliff avoidance at birth:
   Texture differences not necessary

3) Removing texture altogether/prohibiting movement eliminates cliff avoidance:
   Motion cues provide the critical information
The Problem of Depth

Strategy: Test for innateness by using animal models
Controlled rearing conditions

Light-reared (normal) rats
Dark-reared rats

• Cliff avoidance in both dark-reared and light-reared animals
• No reliable difference between the two groups
• Cliff avoidance is independent of visual experience

The visual cliff: Controlled rearing studies of cats
Cats willing to sit on the deep side

• Dark-reared, reintroduced to light at age 3-4 weeks
• Immediately after dark-rearing, no cliff avoidance.
• After 2-3 days in light, normal avoidance.
Experience effects in cats: What happens in the first 3 days in the light?

Two possible answers:
--Experience teaches the cat that visual cliffs are dangerous. Specific effect of experience.
--Experience tunes up the cat’s visual system and allows innate capacities to perceive depth and avoid dropoffs to be expressed. Non-specific effect of experience.

Gibson’s test: controlled rearing on the deep side of the cliff.
--if specific effect, cat will learn that the cliff is safe.
--if non-specific effect, cat will begin to avoid the cliff.
Finding: normal cliff avoidance after 3 days.

Cliff avoidance depends on non-specific visual experience but **not** on learning that visible dropoffs are dangerous.

More experience effects in cats:
Held & Hein’s studies of active vs. passive locomotion.

Cliff avoidance depends on experience with active locomotion. Compare: prism adaptation in human adults.

The visual cliff: Conclusions

Across a range of species, cliff avoidance emerges at the onset of locomotion

Cliff avoidance is independent of any visual experience in some animals (goats, chicks, rats)

Cliff avoidance depends on active locomotion and non-specific visual experience in other animals, but is independent of specific experience with cliffs (cats)

Cliff avoidance appears in humans as soon as a baby crawls and can be observed even before then by measuring heart rate

The Problem of Depth

*So how do we ever figure out how far away objects are?*

Cue # 2:
**Binocular disparity**
The closer an object is, the more different the image received by the left vs. right eye

Binocular cue
The Problem of Depth

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Binocular cue

The Problem of Depth

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Cue # 3: Optical expansion: A sudden increase in apparent object size may signal that the object is approaching

Motion cue

The Problem of Depth

So how do we ever figure out how far away objects are?

Cue # 4: Motion parallax: Nearby objects appear to “pass by” at a faster rate than more distant objects

Motion cue

The Problem of Depth

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Cue # 4: Motion parallax: Nearby objects appear to “pass by” at a faster rate than more distant objects

Motion cue
The Problem of Depth
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Cue # 5:
Interposition: Nearby objects are usually more complete; farther away objects are often occluded

Monocular/ pictoral cue

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The Problem of Depth
So how do we ever figure out how far away objects are?

Cue # 6:
Texture: Objects that are farther form a finer texture than nearby objects

Monocular/ pictoral cue

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The Problem of Depth
So how do we ever figure out how far away objects are?

Cue # 7:
Linear perspective: Lines appear to converge with increasing distance

Monocular/ pictoral cue

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