Vision: Motion perception

•Without background: 10-20 minutes of angular velocity per second (a minute is 1/60th of a degree)

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•(the motion in this display is much faster than 10-20 minutes per second)

•With background (visual context): 1-2 minutes of angular velocity per second (the context gives you a lower threshold)



•(the motion in this display is much faster than 1-2 minutes per second)

•In both cases, if the motion is shown in the fovea, you're somewhat more sensitive than if it's shown in your periphery.

- •Induced motion (Dunker, 1929)
 - You can deceive people about what is moving and what isn't.
 - 4 conditions in experiment:
 - 1: Dot moving against empty background (just like above), only slow enough that there was no motion detection.
 - 2: 2 dots, only one moving, against an empty background.

Result: People could see motion, but were uncertain which dot was moving

Induced motion (cont.)

- 4 conditions in experiment(cont.):
 - 3: 1 dot, inside a rectangle, providing context, while the dot moved:



Result: People could see the motion, and correctly reported the dot as moving.

Induced motion (cont.)

- 4 conditions in experiment(cont.):
 - 4: 1 dot, inside a rectangle, providing context, while the *rectangle* moved:



Result: People could see the motion, but *incorrectly* reported the dot as moving.

Biological motion perception Point-light displays: people are filmed in darkness, in black clothes, with only small lights (or reflective tape) fixed to their joints.



One example at: http://www.biomotionlab.ca/Demos/BMLwalker.html

Biological motion perception

Point-light displays(cont)

- people can easily interpret a few points moving in darkness as a person walking, jogging, jumping, or even 2 people dancing.
- people can detect effort in point-light displays: push-ups, throwing or lifting weights. & How much they're throwing or lifting. (You can also tell if someone's trying to fake it!)
- people can detect motion of other animals in point light displays: camels, frogs, horses, etc.
- people can determine gender, weight, mood, and other factors from point-light walker displays

Biological motion perception

- Point-light displays(cont)
 - people can determine gender, weight, mood, and other factors from point-light face displays (even identity, if you're familiar with the person).
 - point-light motion is difficult to hide or mask with other points; motion can be detected among dots moving randomly, and only becomes somewhat more difficult when the dots look biological themselves.
 - biological motion perception not innate; develops within first year of life.

•Optic flow gives information about direction of heading, and can be confusing, at times.

- Ex: you're sitting at a stoplight in your car, and suddenly realize you're rolling backwards.
 After a brief moment of panic, it occurs to you that you're not moving backward – the car in front of you has (slowly) moved forward (the self-motion illusion).
- Optic flow produces looming, and gives rise to time-to-contact (tau)

Looming – object expansion in your visual field



 Human infants are sensitive to looming fairly early – within a few months after birth (White, 1971; Yonas, 1977)

•Time-to-contact (tau): using both image size and expansion rate, we can determine how long it will be until we hit something.

- Tau= image size/expansion rate
- (originally proposed in a science fiction story, by the way)
- Lee and Reddish (1976) Gannets plummet to the ocean to feed. Are they sensitive to when they'll hit?
 - Yes they need to pull in their wings before they hit the water. When they're falling faster, they begin wing retraction sooner than when they're falling slowly.

•Time-to-contact (tau, cont.)

 Wang and Frost, 1992.
 Collision sensitive neurons in the pigeon.

Small sphere, moving slowly

Large sphere, moving quickly

•Regardless of size or speed, the neuron responded 1 second before (simulated) impact.



- •Optic flow (cont.)
 - Aronson (1974)
 - Toddler in an artificial room a (very) big box hanging from the ceiling in a gym



•Optic flow (cont.)

- Aronson (1974)
 - Because the "room" is hanging from the ceiling, we can move it while the toddler is just standing still:





•Apparent/ stroboscopic motion – stationary displays produce a feeling of motion, if they're interchanged rapidly enough – like animation, or the movies



•Apparent motion can be even more complicated:



Looks (generally) like:





•Apparent motion can be even more complicated:



(Note that this is similar to the correspondence problem in binocular vision – how do you decide what point on the left goes with a particular point on the right?)

Looks (generally) like:





- Movement aftereffects
 - after watching much continuous movement, stationary objects will appear to move in a direction opposite that seen before.
 - Ex: waterfall illusion

Physiology

•Brain area MT (middle or medial temporal lobe) seems critical for viewing motion

- Damage to area MT can result in akinetopsia, inability to perceive motion (although can still see)
- Ex: one patient "had difficulty, for example, in pouring tea or coffee into a cup, because the fluid appeared top be frozen, like a glacier. In addition, she could not stop pouring at the right time, since she was unable to

perceive the movement in the cup when the fluid rose. The patient also complained of difficulties in following a dialog, because she could not see the movements of the mouth of the speaker."

- Difficulty crossing roads, because "when I'm looking at a car first, it seems far away. But then, when I want to cross the road, suddenly the car is very near."
- Hence, movement vision is a separate function from just "vision." Weird.

Velocity detection thresholds (not absolute numbers, but relative values for

With context

Without context

Fovea

periphery

Dunker experiment

Everything (well, everything we talked about in class) about biological motion perception

Looming

Tau, including the formula

Wang and Frost experiment

Gannet study

Aronson experiment

Self-motion illusion

Apparent motion

Movement aftereffects, waterfall illusion

Area MT

Akinetopsia

List of terms, section 10