Presentation 1
Modularity and development: the case of spatial reorientation
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Abstract
- Disoriented young children reorient in accord with large-scale shape of environment
- Do not reorient with nongeometric properties of environment (ex. color of a wall)
- Suggests reorientation depends on mechanism that is informationally encapsulated and task-specific
- But adult do use nongeometric for reorienting

Comparison with mature rats
- Orientation intact = use nongeometric cues
- Inertially disoriented = evidence suggests do not use nongeometric cues
- Cheng experiment: location of food partly specified by shape of environment, fully specified by patterns and odors, etc.

Results of Cheng experiment
- Exploring: forms cognitive map of environ.
- Reintroduction: uses allocentric locations of food and itself to compute food’s egocentric location
- Disoriented: must re-establish allocentric position
- Therefore, search patterns reflect in part ability to reorient
Results

Margules and Gallistel: both geometric and nongeometric cues specified location, found food immediately. Shape and nongeometric only available, rats failed to use nongeometric, searched two geometrically appropriate locations.

Other experiments

Biegler and Morris: could not reorient using polarizing cue (three black curtained walls, one white). Double dissociation between mechanisms for movable object search, for which rats use nongeometric landmarks but cannot encode spatial relationships.

Summary of findings

Rats reorientation depends on encapsulated, task-specific mechanism: “geometric module.” Nongeometric cues depend on extensive associative learning.
Things to consider…

- What capacities for spatial reorientation are found in humans? geometric considering our ancestors who lived in natural environ. (geometric info)? more flexible reorientation because have additional systems by which we represent space?

To Test This. . .

Experiment 1

- Studied reorientation abilities of adults (17-26)
- Witnessed hiding of object, were disoriented
- Condition 1: rectangular chamber, no distinctive landmarks to break symmetry
- Condition 2: same with one bright blue wall

Principle Analyses: Codes

- “geometrically appropriate”: search at correct (C) or rotational equiv. (R)
- “geometrically inappropriate”: search at others (N and F)
- “proximal”: search at C or corner nearest to C (N)
- “distant”: search at R and F
**Results**

- All white room: geometrically appropriate more, but not proximate more
- Blue wall: geometrically appropriate more and proximate (on correct side of chamber)
  adults used both geometry and the blue wall to search

**Discussion**

- Adults use geometric and nongeometric to reorient
- In white room confined search to C and R: can reorient in accord with shape of environ. like rats
- In blue wall searched C: can take account of nongeometric property of environ.

**Experiment 2**

- Given the successful performance of the adults, wondered how children would perform
- 18.1-24.1 months
Results

- White room: no difference in search at C and R (searched R more than C)
- Searched correct corners of white and blue with equal frequency

Discussion

- Children reorient using shape of environ.: search at corners with appropriate metric and sense relations
- Findings suggest sensitivity to room geometry
- Cannot reorient using nongeometric

Experiment 3

- Motivation: argument that wall color is not a very salient nongeometric property for young children
- Reorientation tasks, identity of interesting objects serve to mark position and heading
- 18.3-23.9 months

Setup
Results

- Searched geometrically appropriate in both conditions
- Did not search proximate, relied only on geometry of room at start of session

Discussion

- Resemble findings of Exp. 2
- Reorient in accord with shape of environ.
- Color of the wall and the objects did not serve as effective landmarks
- Suggests they reorient through purely geometric process

Other possibilities

- Children did not notice configuration of landmarks at time when object hidden
- Possible children use nongeometric landmarks if toy moves on path that calls attention to landmark
- Memory requirements of task
- Result: Experiment 4
Logic behind setup

- If the path of the toy while being hidden draws attention to the nongeometric landmark, child should find the toy.
- If children have difficulty remembering nongeometric of one object while searching for another, they should fail.
- If children do not use nongeometric to reorient, might fail reorientation but succeed in find-the-object.

Results

- Disoriented searched equally at C and R, oriented more at C.
- Search at C in find-the-object exceeded that in reorientation (opposite for R).

Discussion

- Disoriented reoriented by geometry alone.
- Nongeometric specified container with object, still failed to use info, suggests failure to use nongeometric does not result from lack of attention to landmarks at a distance from hidden object.

Discussion

- Children can represent and remember nongeometric properties of a container and use these to locate an object that has moved, but they do not use the same properties to reorient themselves so as to find an object whose location has not changed.
**Things to Consider**

- Different exposure to the room for each two tasks
- Disorientation process may be confusing or distracting, causing child to forget color or pattern
- Perceptual or memory limitations

**Summary**

- Young children, like rats, reorient in accord with shape of environ.
- Adults use room geometry and nongeometric info
- Limits of disoriented children’s performance stem from constraints on reorientation process itself

**Potential explanations ruled out**

- Failure to reorient using nongeometric not due to:
  - searching immediately visible corners
  - limits on attention or memory
  - (effects of disorientation process itself)
  - (reliance on a single salience hierarchy)

**Summary con’t**

- Children’s reorientation process depends on a “geometric module”
- This process may have served as adaptive purpose in natural environ.
- Children’s reorientation appears to have intrinsic structure
How do adults use G and NG?

- Reorientation might become more flexible
- G may persist and new processes may emerge that allow one to locate objects even if disoriented

What the studies suggest

- There is a core cognitive process for representing the shape of the surrounding environment and for using this to compute one's own position within the environment.

Things to consider

- System of geometric knowledge may have emerged early in mammalian evolution
- Homologous systems of knowledge in humans and animals: valid only if show deep similarities behaviorally
- Studies revealed considerable similarity at all levels of investigation

Things to consider con’t

- Evolutionary changes tend to be implemented late in organism’s development ex. Cognitive capacities
- These experiments suggest humans share with others early-developing, task-specific mechanism for re-establishing heading and position; limitations with system are overcome with further development
For the future

- Studies that ask how humans overcome these limits could shed light on one feature of human cognition that may be unique to us: our capacity to extend our systems of knowledge into realms which our biology has not prepared us.