Different skills involved in using maps, and whether they are innate

**Studies in Children and Indigenous Groups**

* Symbolic Artifacts: Two Possibilities


**Problem:**
Some propose that the ability to use a symbolic artifact requires representational insight.
Some propose that using a symbolic artifact is only the ability to match low-level features in the model and the world.
   Rather than understanding a model/room relation, children could simply use correspondences for successful searching.

If the first is true, children might be able to match features but still fail at a retrieval task.
If the latter is true, then children who fail at the task would also fail at noticing correspondences.

**Basic Task:** find a hidden object in a room, indicated by an object in a scale model of a room.

**Background**
- excellent performance by 3 year olds
- poor performance by 2.5 year olds
- both pay attention to hiding
- both remember where hidden in the model
- both are motivated to find the toy

**Experiment 1 (2.5 yr olds):** Experimenter pointed to object in the model and ask children to find the matching object in the room.
- the furniture and arrangement were similar in the room and model
- model was aligned in same orientation as the room
- experimenter introduced each piece of furniture and showed the child the correspondence between the two, holding each miniature next to its larger counterpart, calling one big snoopy’s room and one little snoopy’s room.
- model was perceptually similar

**Matching Task:**
- experimenter pointed without naming an object
- asked child to find the one in that looks like that one

**Model Task (Same children, after the Matching Task):**
- the experimenter pointed without naming and hid the toy in the model
- said they were going to hide the toy in the same place in big snoopy's room
- asked the child to find the one belonging to big snoopy.
- children allowed to eventually find it, but only the first round was counted
- then asked to find the one in the little room again (to verify memory of original location)
Comparison Group: completed the Model Task without having done the Matching Task first.

General Results:
- children performed well at matching
- both groups, with/without the Matching Task were unsuccessful at the Model Task
- the initial Matching Task practice did not seem to help
- memory retrieval was very high (re-finding in the model)
- no gender effect

Individual Results
- success at Model Task depended on success at Matching (no child who failed at Matching succeeded at the Model Task).
  1 successful at both, 4 failed at both, 7 successful at Matching but not Model Task.

Experiment 2 (3 yr olds):
- models were perceptually different. had different material & color but same location and orientation.

Same tasks used as in Experiment 1.

Results: Similarly, significantly better at the Matching Task than the Model Task, but better than the 2.5 year olds.
  3 successful at both, 2 failed at both, 6 successful at Matching but not Model Task, 1 succeeded at Model but not Matching on 1 trial.

Conclusions: Results support the claim that retrieval requires matching but is not enough. Even the same children performed poorly at the Model Task immediately after establishing that they could complete the Matching Task. Some understanding of higher level correspondence is needed.

Discussion:
- Pointing might convey intent more clearly than hiding something, or simpler for children to understand.
- Performance improved when there was only a reward for finding on the first try.
- In another experiment, performance improved when there was a window between the model and the child and experimenter; possibly this helped them see it as a dual representation.
- In some, it required two modifications to improve performance. Other studies also show that certain factors might work in concert.
- In any event, the experiment has shown that simply understanding correspondence is not enough and that some understanding of representational relation is necessary.

* Map Geometry: Children


Problem: Are children able to use geometric information in simple maps without instruction or feedback? - builds on and clarifies the below study that used children and adults in a tribe that doesn't use maps.
(a) Do children spontaneously detect a correspondence between geometric relationships in a simple map and a layout of objects, 
(b) do they show the same error patterns shown in the past with older children, 
(c) do they show enhanced attention to geometry under conditions when no landmark is present?

**Background:** Previous studies show map understanding emerges around 4 years.

**Basic Task (4 yr olds):** Using a map depicting 3 containers, children had to place an object in a container in the world. 
- Containers arranged in a line, isosceles triangle, or a right triangle. 
- Object tested at each location. 
- Some blocks of trials the maps were egocentric and some were allocentric orientation. 
- Experimenter indicated target location on the map, and encouraged the child to place an object at that location. 
- Analysed Ego/Allocentric Map Presentation, which container the object was placed in (landmark or not), and the effects of the type of array. 
- Use of geometry defined by ability to choose the correct non-landmark location.

**Experiment 1:** Includes Landmark, Angle, Distance, and Sense Information. 

**Experiment 2:** Does Not Include Landmark. Only: Angle, Distance, and Sense. To question whether geometry was encoded relative to landmarks, and whether landmark and geometry information compete. 
- If so - should fail at this task. If not, results should resemble experiment 1. 
- If they compete - should show greater geometric sensitivity.

**Results:** In both children used Angle and Distance, but not Sense, showing error patterns also found in adults. 

**Experiment 1**  
- No effect of map orientation. 
- Performed better when object was at a landmark. 
- Correctly chose a non-landmark location when not landmark, not as good at choosing the right one. 
  - Above chance for right triangle, not for isosceles array or linear array. 
  - Showed geometric sensitivity more in right triangle than isosceles (use of distance and angle). 

Did not use distance (linear) or sense (isosceles) to distinguish alone, but in combination (right angle) were able to distinguish the two non-landmark locations. 

**Experiment 2**  
Performance better on linear and right triangle than isosceles arrays, but no difference in significance between two triangles (kind of confusing). 
- Can't tell if they're using distance or angle information in right triangle. 
Chose correctly when it was the more distant object. 
Used geometric information more than in landmark trials, in right triangle and linear, but not isosceles arrays. 
Did not use sense information, which contrasts with results in older children and adults in Dehaene study (possibly from age or feedback). 

**Conclusions:**  
Landmarks competed with geometric cues. 
They detect geometrical properties and correspondences between the 2D maps and 3D layouts, and use them to guide navigation. 
Performed better when it was hidden at a landmark, and showed greater sensitivity to
geometry when there wasn't a landmark.
Tests show limits of innate geometric abilities in a symbolic task -- show what kind of
information children encode and use.
  Landmarks helped but only directly.
Map use emerges early in development, unclear how. Possibly they are used to other
symbolic systems like language, and children see pictures a lot.
Instruction in maps and graphs maybe enhance children's already developing
symbol-related abilities.

* Map Geometry: Similar Results in Amazonian Indigene Group

* Core Knowledge of Geometry in an Amazonian Indigene Group. Stanislas Dehaene,

Similar to above study.
Tested "conceptual primitives."

**Question:** Whether geometry is inherent in the mind, and whether abilities arise
spontaneously.
- This group didn't use maps and had little geometrical vocabulary.

**Experiment 1:** Showed groups of objects, had to point out the one that didn't fit.
Could have chosen size, orientation, or personal preference, in addition to basic
geometrical concepts like shape.

**Experiment 2:** abstract map test, similar to above, but finding task.

**Results**
- Scored above chance on picking out concepts related to topology (or
  connectedness), Euclidean geometry (point, line, parallelism, and right angle), and
  basic geometrical figures (square, triangle, and circle).
- More difficulty but better than chance on symmetry and metric properties (e.g.
  equidistance).
- Poor performance in geometrical transformations, and orientation.

- Children and adults spontaneously made use of points, lines' parallelism, and right
  angles to detect intruders in simple pictures.
- Used distance, angle, and sense in maps to locate hidden objects.
- Provides evidence for geometrical intuition without training.
- Children and Adults in Munduruku performed about the same as American children,
  not the same as the American adults.
  - Shared profile of difficulty. Does not support Piaget's idea of progression
    through different types of geometry.
- Children did not differ from Amazonian adults
- No effect of map orientation.
- Did not show overall effect of presence of landmark, but used more by adults.
- Similar landmark/non-landmark performance to other paper.
- Geometrically driven behaviour more present without landmark.
- Used some sense relationships.

**Criticisms:** Children were 6 years old, so unclear how it develops, and the task
involved feedback.
My criticism: Transformations might not be harder, but might seem less significant.
Additional Skills Used With Maps, what they seem correlated with (Not Exhaustive).

* Ability to form a cognitive map (from route experience), correlated with mental rotation of simple geometric shapes and ability to imagine oneself on a map.  
  [they claim] less correlated: generating mental images from memory, mentally manipulating objects  
  also found: gender difference  
  Mental imagery skills and topographical orientation in humans: A correlation study.  

* Visuo-spatial working memory breaks down into many types.  
  Found evidence that the simultaneous (but not sequential) skills correlated with map learning abilities.  
  No interference with verbal skills.  

* Different cortical structures involved in allocentric and egocentric strategies in virtual navigation task.  
  Suggests that they are using two different skills.  

* Experience plays a role in forming a mental map from a route perspective  

Terms used:
symbolic artifact: scale model, picture, video image, map  
reprensentational insight: the understanding of a symbol as a symbol  
dual representation: understanding the model as an object and also a representation of something else  
sense: similar to direction or orientation, such as a direction along a line or a clockwise/counterclockwise orientation of an angle.