Lecture 9: Lab in Human Cognition

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Agenda for Today

- Discuss writing for lab 2
- Discuss lab 1 grades and feedback
- Background on lab 3
- (rest of time: Finish analyses for lab 2)

First

Discuss writing for lab 2

Second

Feedback about Lab 1

(will be handed back at the end of class)

Third

Background on Lab 3

(please send data!)

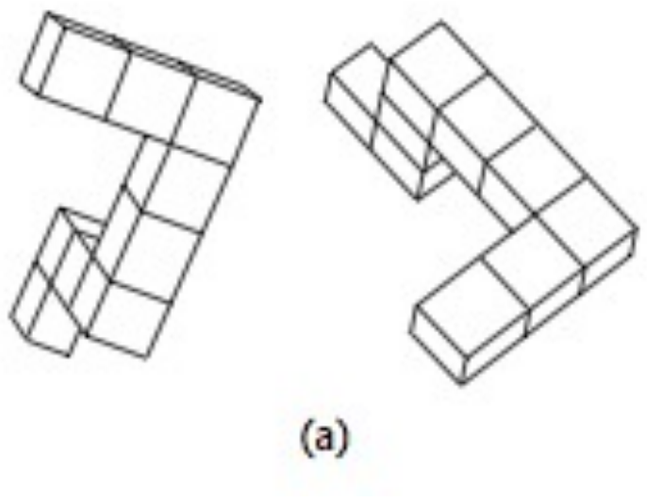
Mental Rotation

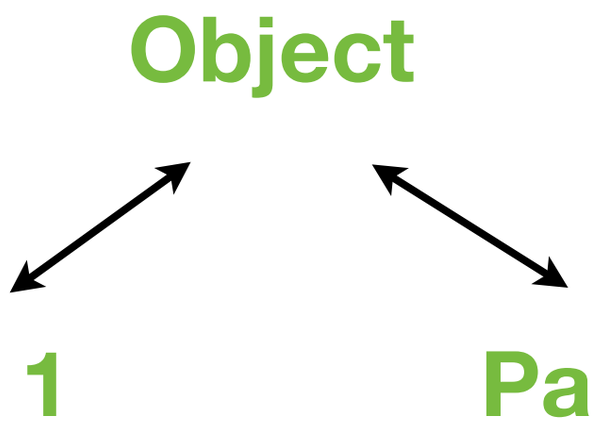
Key Question

Are mental images “pictures” or language-like symbolic representations?

(aka “Analog” versus “Propositional” representations)

Mental Rotation

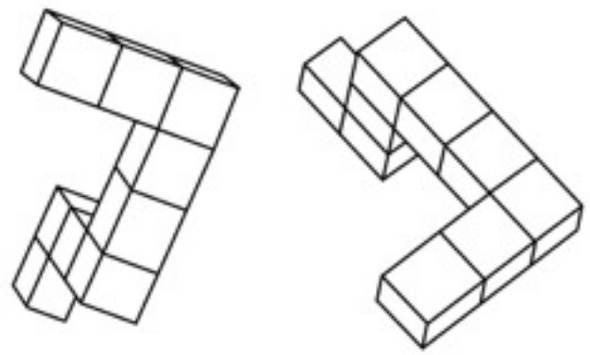




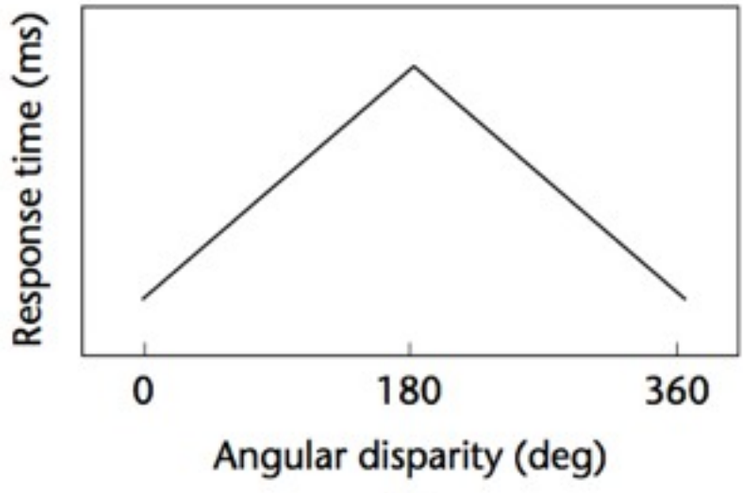
Images: pictures in the mind

Propositional representations are “language-like” abstract representations. Predicates, arguments (like first order logic)

Mental Rotation



(a)



(b)

Figure 1. Materials and results in a typical mental rotation experiment: (a) an example of a 'different' pair of objects used by Shepard and Metzler (1971); (b) a schematic illustration of a typical mental rotation function.

Mental Rotation

- Cooper (1976)
- First measured slope for rotation for each person
- Then, participants have to mentally rotate an object. An object appeared at the orientation that the observer's rotation was expected.
- People were as fast as when the objects were at the same orientation, giving strong evidence that the object was actually rotated.

Mental Rotation

- **More familiar object are faster to rotate**
- **Unfamiliar objects which are MADE familiar become faster too!!**

Mental Rotation

- **Can you rotate just anything?**

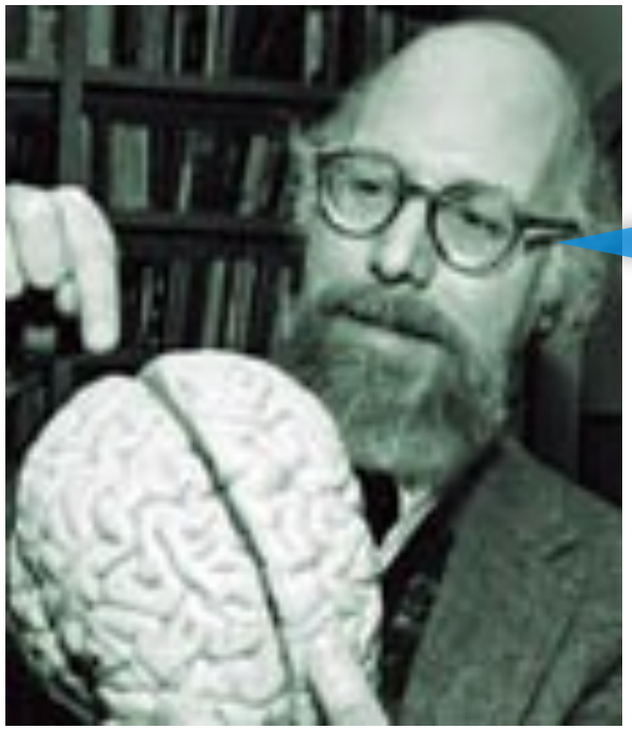
Mental Rotation

- **Can you rotate just anything?**

Mental Rotation

- **Theoretical debates**
  - **Kosslyn (1973) - Analog representations**
  - **Pylyshyn (1973) - Propositional representations**

Mental Rotation

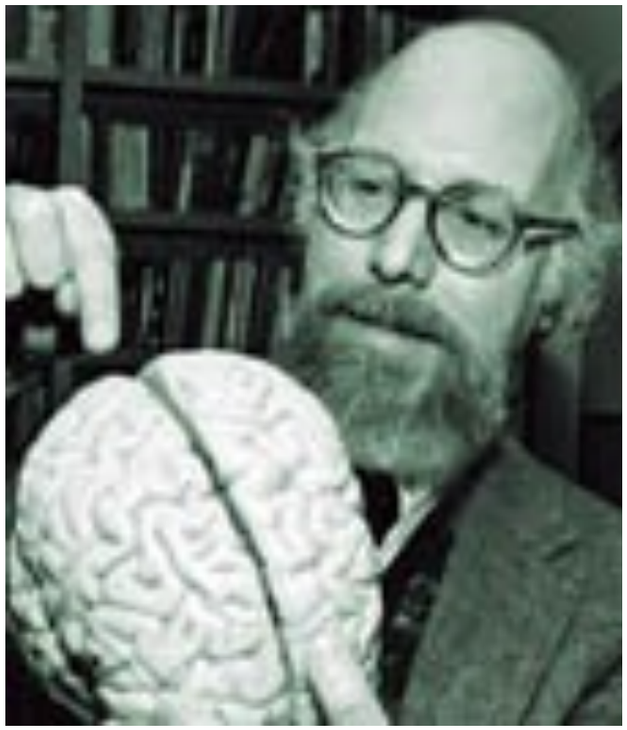


Analog!

Kosslyn

Pylyshyn

Mental Rotation

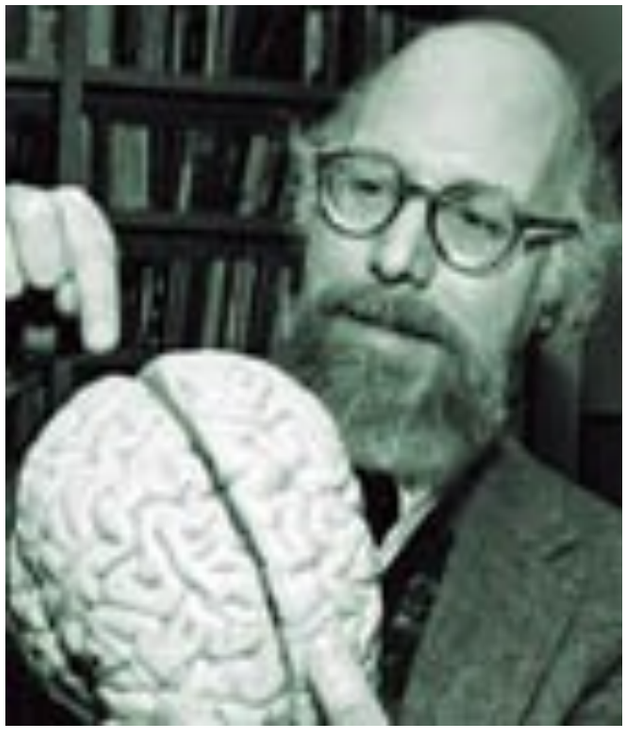


Propositional Propositions!

Kosslyn

Pylyshyn

Mental Rotation

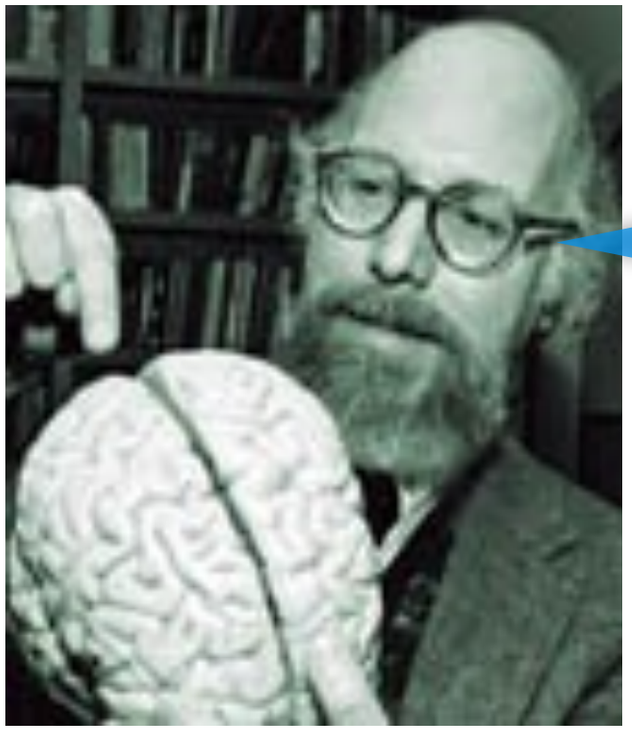


If it was analog why would familiarity matter?

Kosslyn

Pylyshyn

Mental Rotation

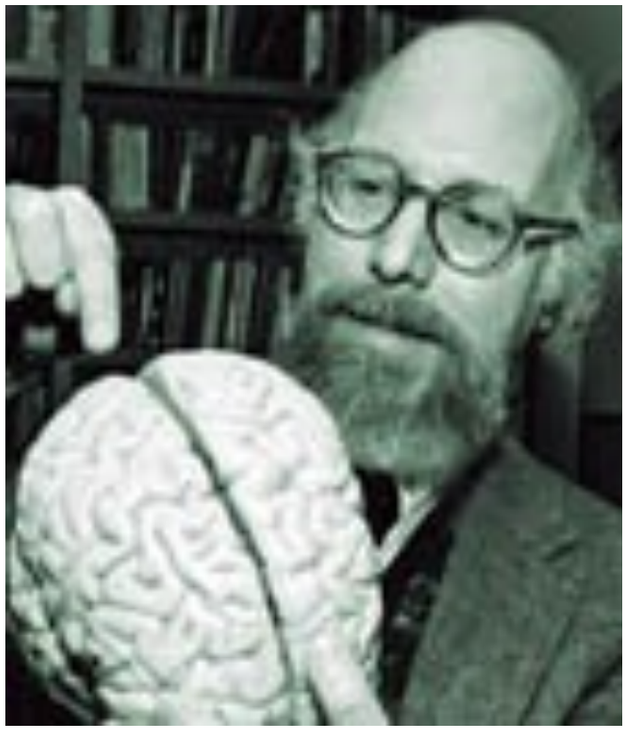


Kosslyn

Analog doesn't mean literally the same as the object you know!

Pylyshyn

Mental Rotation

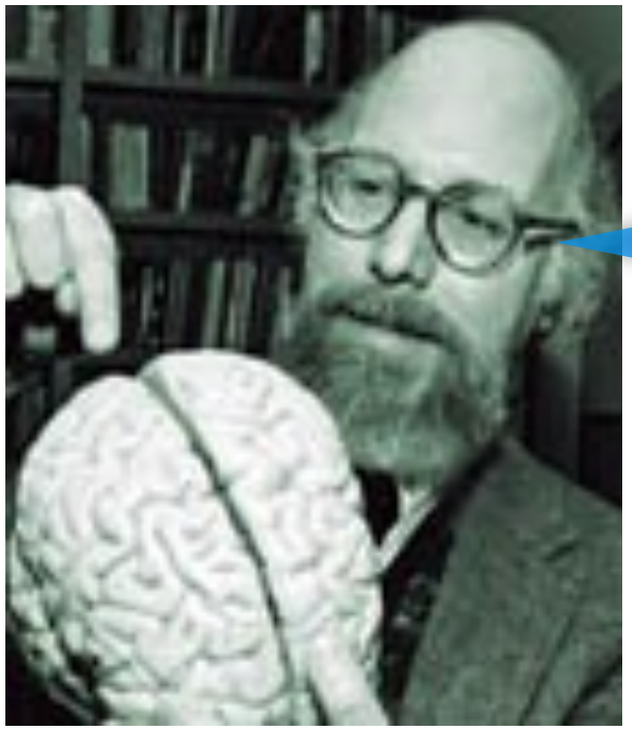


Kosslyn

Then what do you mean by image?

Pylyshyn

Mental Rotation

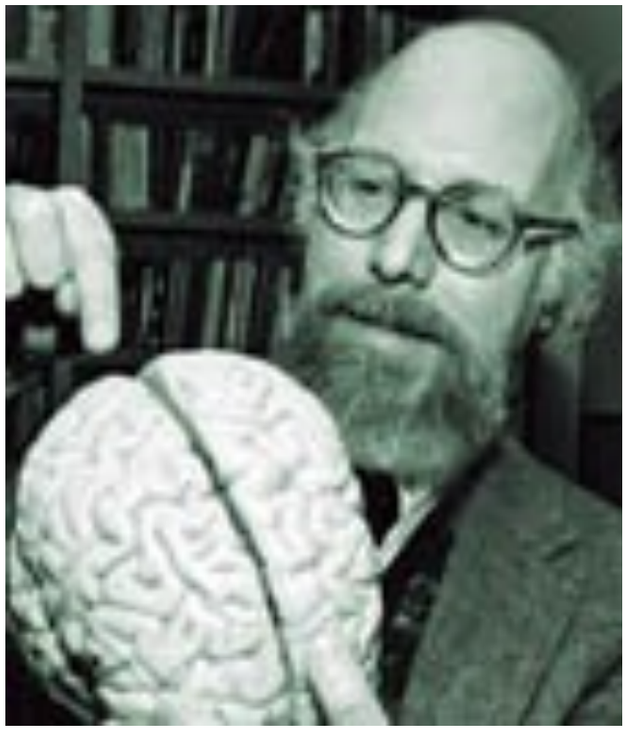


"Images are like surface displays generated on a cathode ray tube by a computer."
- Kosslyn and Pomerantz (1977)

Kosslyn

Pylyshyn

Mental Rotation

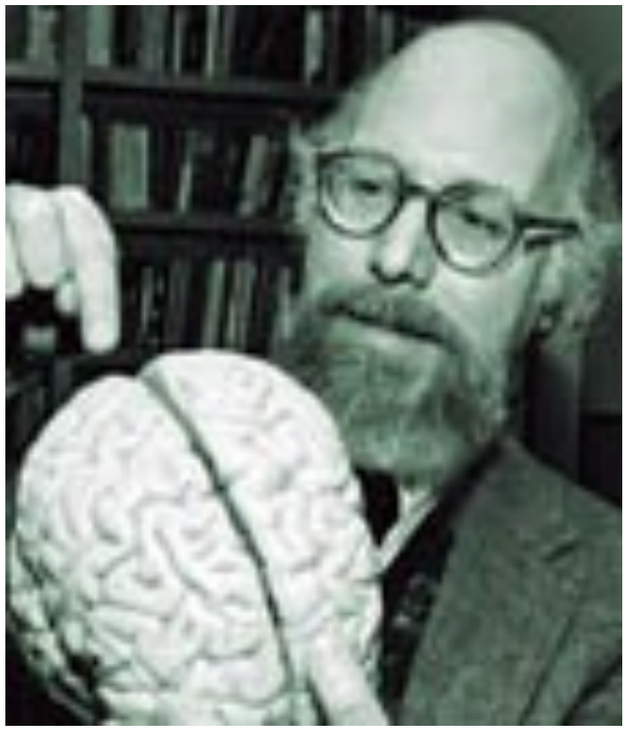


Noone believes that.

Kosslyn

Pylyshyn

Mental Rotation



Kosslyn

Noone believes that. Think of your "living room", you get a picture, unlike what youd get if it was stored as a bitmap picture.

Pylyshyn

Mental Rotation

What about this?

(Dual code theory)

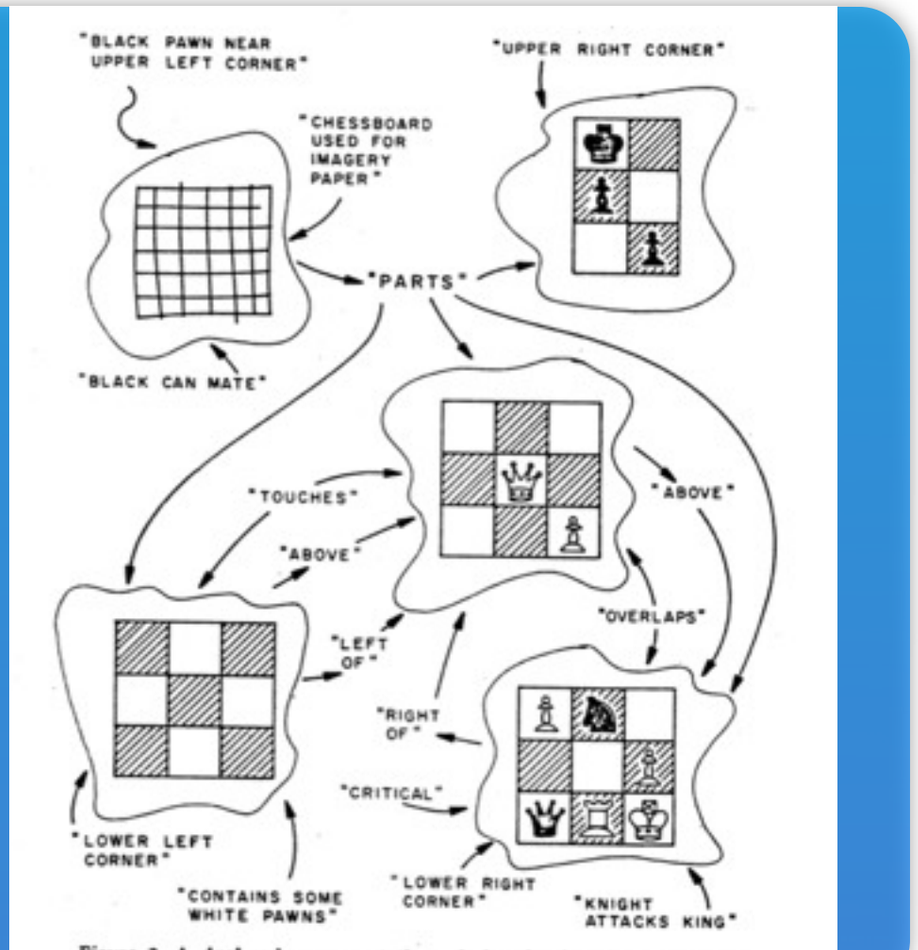
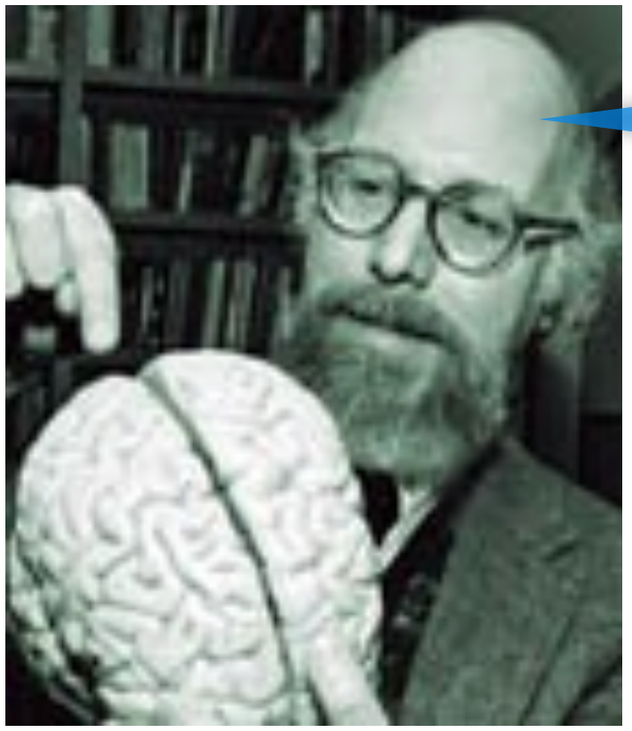


Figure 2. A dual-code representation of the chessboard in Figure 1.

John Anderson

Mental Rotation



who are you?

who are you?

Kosslyn

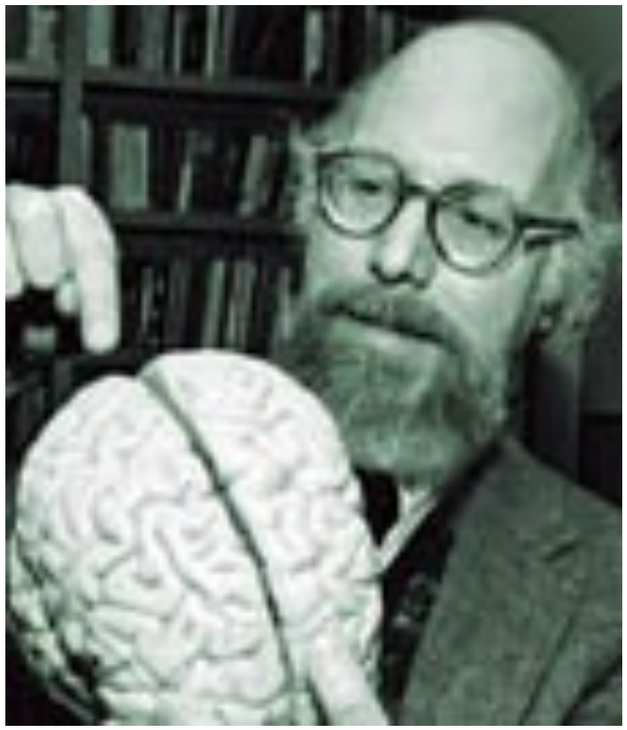
Pylyshyn

Mental Rotation

John Anderson,
a very famous
cognitive psychologist

John Anderson

Mental Rotation

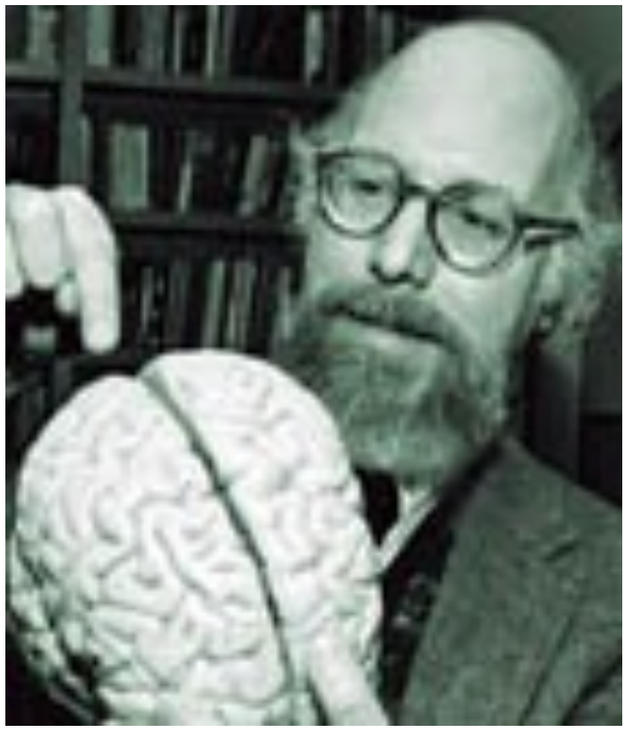


Kosslyn

Anyway...

Pylyshyn

Mental Rotation

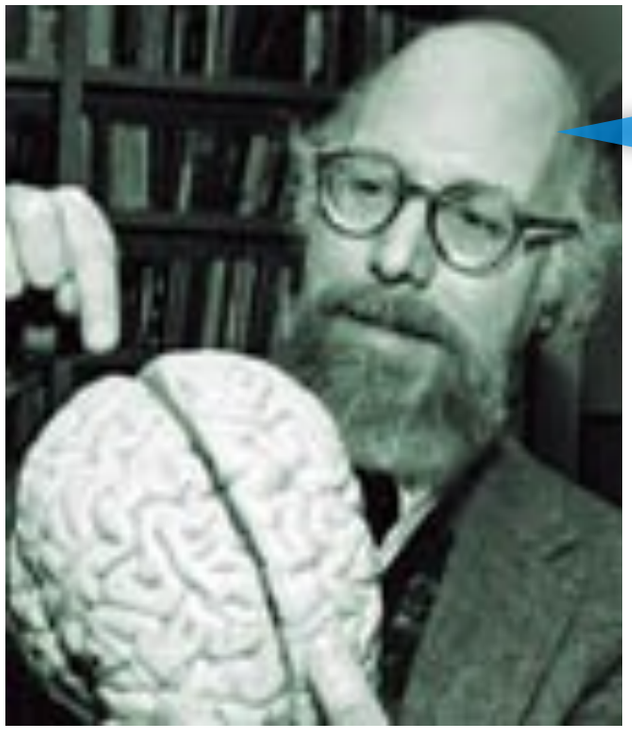


Kosslyn

There must be some kind of intermediate representation. How could you describe a picture verbally? or draw a picture of an idea?

Pylyshyn

Mental Rotation

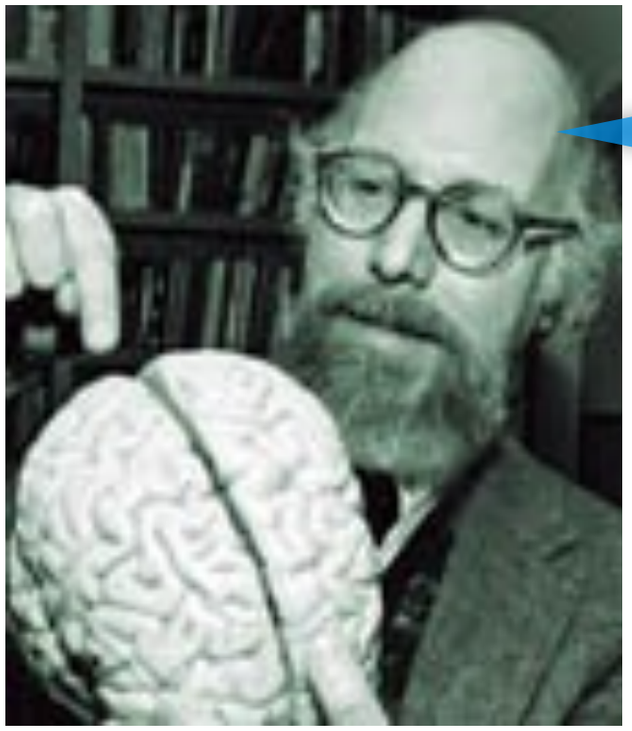


Kosslyn

The problem with propositional theories, ... is that they may be too powerful. They possess no inherent constraints, and the theorist must add restrictions onto his theory to make it conform with experimental observations.

Pylyshyn

Mental Rotation



Some things are easier with images (like seeing if three cities are on a line a map would be good). In other cases, a set of distances between cities would be good.

Kosslyn

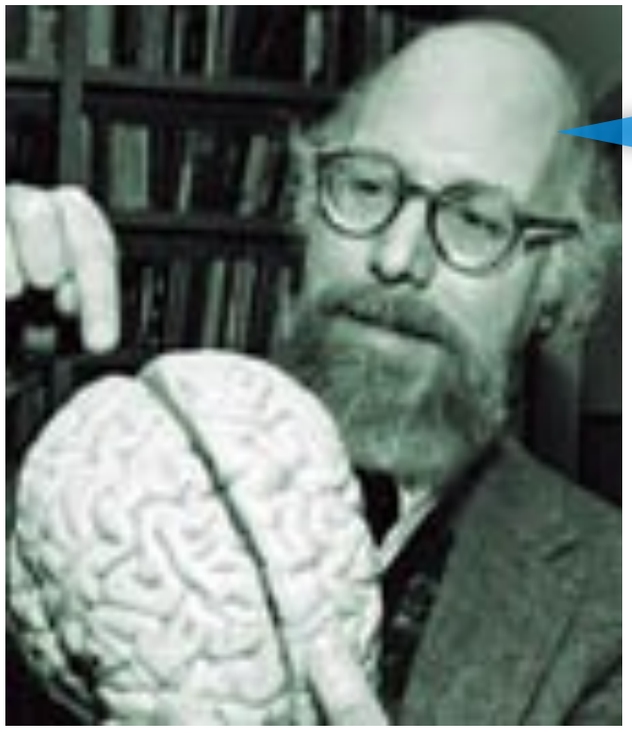
Pylyshyn

Mental Rotation

Yes, but both **representation** and **process** must always be specified. You can't argue about what pictures are good for without specifying a corresponding process first.

John Anderson

Mental Rotation



Think about it, doesn't your mental inner life SEEM like pictures? (argument from introspection)

Kosslyn

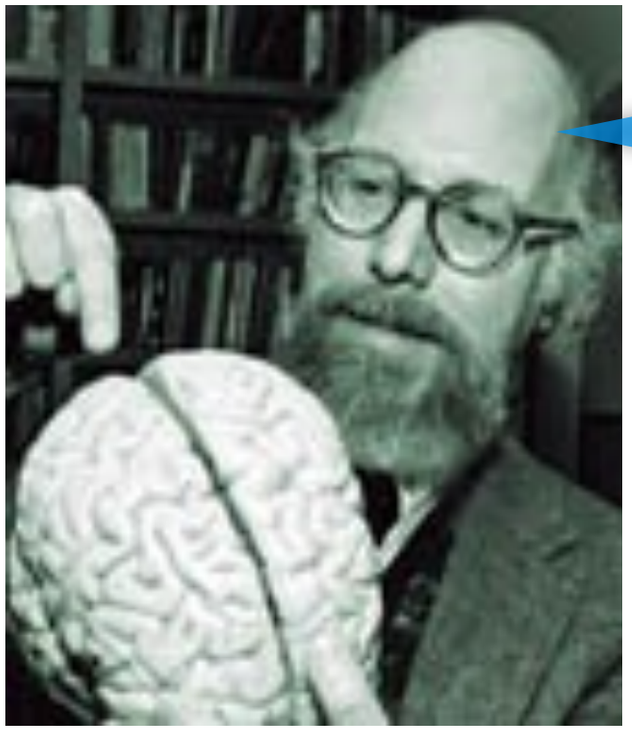
Pylyshyn

Mental Rotation

Let's be scientists here folks.

John Anderson

Mental Rotation

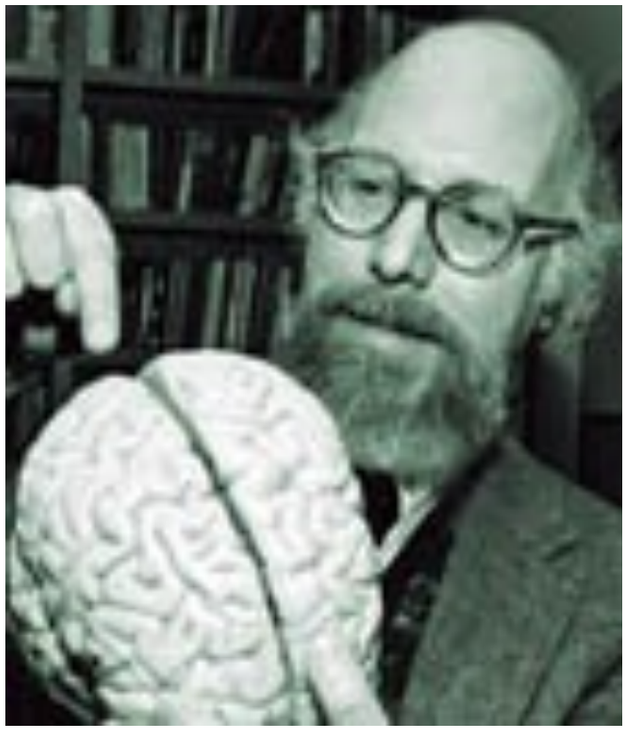


Ok... LHC's mental rotation lab data suggests that people manipulate the "image"!

Kosslyn

Pylyshyn

Mental Rotation

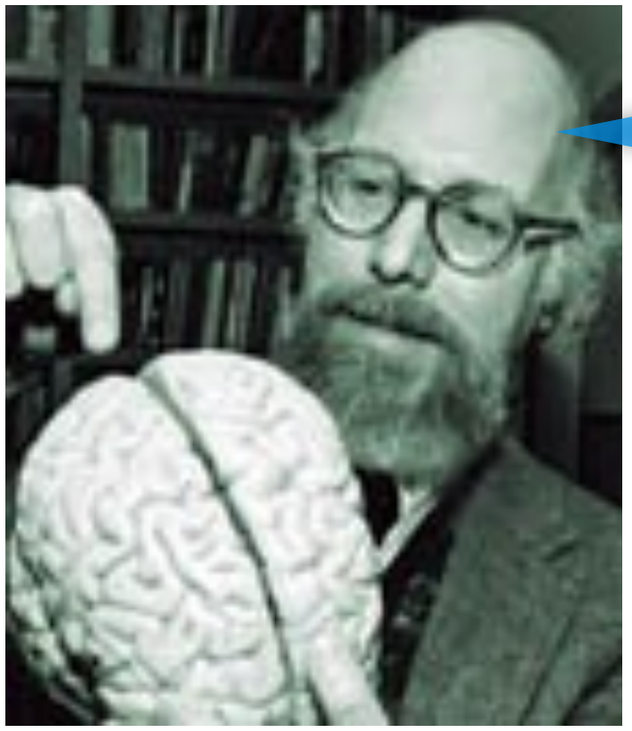


I can make a propositional model that mimics that! Basically you represent the shape and then apply a series of little symbolic changes to it.

Kosslyn

Pylyshyn

Mental Rotation



Kosslyn

If that were true, you could just as well jump directly from one orientation to the next!

Pylyshyn

Mental Rotation

John Anderson

What about images demands this?

Pylyshyn

Mental Rotation

John Anderson

I'm getting tired of this.
"1. the picture metaphor is the only current explicit interpretation of the image theory

2. The frequent criticisms made of the picture metaphor are not valid. One can have a viable dual-code model involving picture and verbal representations (see Fig. 2)

3. The arguments for the necessity of a propositional representation are far from compelling. The best have to do with the utility of such a representation for inference making.

4. The arguments for imaginal representation are based on introspection, computational considerations, empirical results and physiological considerations are not convincing

5. It is not possible to decide between imaginal and propositional representation strictly on the basis of behavioral data

- Anderson (1978)

Variables

- Current interest in mental rotation
  - What are the neural systems underlying mental rotation (e.g., do they involve spatial or motor areas?)
  - Embodied cognition (like mental image theories, assume mental/perceptual representation are grounded in our actions with the world)