VISUAL PERSPECTIVE TAKING (VPT)

The ability to predict the visual experience of someone or something else.

VPT helps us answer the questions:
1. Can that other person (thing) see this or that object?
2. How is that object located in relation to that other person (thing)?
VISUAL PERSPECTIVE TAKING (VPT)

Perspective Switching:

Level 1 Knowledge: what is visible from another viewpoint?

Level 2 Knowledge: what would it look like from over there?

Michelon & Zacks 2006

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VISUAL PERSPECTIVE TAKING (VPT)

Spatial Transformations:

Analogue Perspective Transformations:
update the location and/or orientation of one's egocentric perspective.

Line of Sight:
drawing an imaginary line
IMAGINAL PERSPECTIVE SWITCHES

We and other intelligent mobile animals keep track of spatial relations as they change:

- Changes due to our own bodily movement
- Changes due to imaginal perspective switching

For humans many every day problems are solved using imaginal perspective switches.

- Giving directions
- Planning our own movements and anticipating those of others
- Etc…
IMAGINAL PERSPECTIVE SWITCHES

What if we were an A.I. in an old space factory competing for resources with other A.I.’s, but our only way to act in the world is programming robots?

We (the A.I.s) have an allocentric – environment based – mode of processing.

What about the robots? They have an egocentric – self centered – mode of reasoning.
IMAGINAL PERSPECTIVE SWITCHES

- Rotations
- Translations
- Combinations of both
IMAGINAL PERSPECTIVE SWITCHES

Which rotation and which translation will cause the most delay when calculating the new perspective?

Will card number one or card number seven be the hardest (most mentally time consuming) to figure out the position of the robot for?
IMAGINAL PERSPECTIVE SWITCHES

Mental Transformation Hypothesis

Imaginal perspective switches are hard because they require one or more transformation combinations in an imagined environment each time the imagined object’s coordinates are switched.

How does Sholl’s model try to explain this?

There is an environment based system of object-to-object relations and a body-centric system for self-to-object relations that must be superimposed and result in procedure costs (time and errors).

Allocentric & egocentric analogue perspective transformations as reinforced in Michelon and Zacks, 2006
IMAGINAL PERSPECTIVE SWITCHES

Sensorimotor Interference Hypothesis
Perspective changes are hard because my actual perspective is competing with the imagined perspective, i.e. my experience of the environment is in contradiction to that of the imagined perspective.

What You See Is Not What You Get
The conflict costs time and errors in calculations.
Object Direction Disparity

My body is oriented differently than the task object (robot). So my representation of the space produced by the direct input of my eyes is at odds to that of the robot’s.
IMAGINAL PERSPECTIVE SWITCHES

Object Direction Disparity: Rotation

→ Head Direction Disparity

Player Orientation

Robot Orientation

Mark May, 2004
IMAGINAL PERSPECTIVE SWITCHES

Object Direction Disparity: Translation

45°
IMAGINAL PERSPECTIVE SWITCHES

Object Direction Disparity:

Bodily performed rotations do not show the same latency and errors. Anecdotally, this may be why some people Robo-Dance to select their program cards.

http://www.youtube.com/watch?v=xY9PI4CI CWI
A CONTROL PERSPECTIVE

Defining the control mechanisms for imaginal perspective taking (IPT) and demonstrating them in a computational model.
A CONTROL PERSPECTIVE

Task Switching

Task execution is most difficult after switching the task (e.g. deciding if a letter is a vowel when shown in a letter-number pair, vs. deciding if the number is odd or even when shown in a letter-number pair.)

How does Schultheis propose this is analogous to IPT?

“…assuming that different perspectives correspond to different tasks and the bodily perspective corresponds to the previously executed task.”
A CONTROL PERSPECTIVE

Task Switching

Task execution is most difficult after switching the task (e.g. deciding if a letter is a vowel when shown in a letter-number pair, vs. deciding if the number is odd or even when shown in a letter-number pair.)

IPT Example:

1. Actual Position of the card (and board) as related to the player.
2. Actual position of the robot and how depicted rotation will effect the robot
   → New robot position
1. → Actual Position of the card as related to the player...
A CONTROL PERSPECTIVE

IPT as Task Switching in a Computational Model

How do we split IPT into two tasks to switch between?

What do the models of Meiran (2000), Sohn and Anderson (2001), and Rubinstein, Meyer, and Evans (2001) suggest?

1. The mechanism which can be prepared for represents one of the controls (the reduced cost).
2. The mechanism which cannot be prepared for represents the other control (the residual cost).
A CONTROL PERSPECTIVE

Stimulus Disambiguation: Choosing a Reference Frame

Without successful disambiguation the response to the target description will be incorrect.

Modeling Reference Frame Selection

A number of units (nodes) representing different reference frame characteristics such as direction and orientation are activated to a certain level via top-down or bottom-up input connections. This acts like the intended imagined perspective.
Response Selection: Response Priming

When working on a task, stimulus response mappings relevant to the task are made more readily available in working memory, or primed. This is claimed to be what is responsible for the residual cost in task switching.

Modeling Priming

Since IPT has been shown to involve priming of low-level motor mechanisms, this model uses an array of units representing neurons in the motor cortex which are most activated in a preferred direction, with lesser activation from other directional stimulus.
A CONTROL PERSPECTIVE

How are the spatial relations represented for priming?

By using a perceptual-motor-system that keeps track of the body and the directional relation to the other objects at all times. This is so that directional information is always available for every object, or is like the bodily perspective.

How do these parts of the model come together?

(a) the target direction from the imaginal perspective is determined using the selected frame and the existing memory representation,
(b) The corresponding motor unit will be activated, and
(c) Response priming will add to the activation of the relevant motor unit. Once any motor unit is activated maximally the corresponding pointing response is selected and executed.
A CONTROL PERSPECTIVE

How does the model explain the following effects?

How well do you think it does?

1. Difficulty with IPT

2. Difficulty with Rotations

3. Difficulty Increases with Disparity

4. Difficulty Can Partly be Reduced by Preparation
REFERENCES


IMAGES

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