
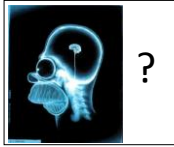



APA 2120

Lecture 5: Response Programming & Sensory Systems 1: Vision
Sept 20, 2012



Review

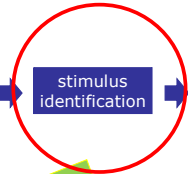
Input (stimulus) →  → Output (response)



Factors Affecting Stimulus Identification

→ stimulus identification → response selection → response programming →


Factors related to stimulus identification
Stimulus modality
Stimulus intensity

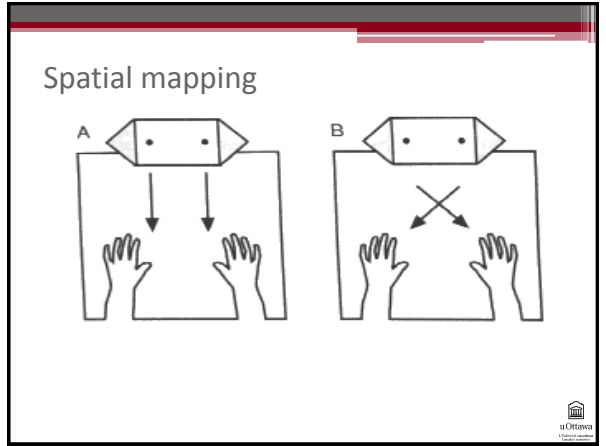
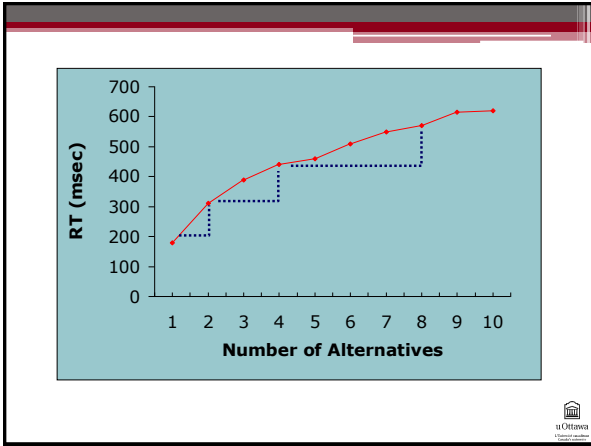


Factors Affecting Response Selection

→ stimulus identification → response selection → response programming →

Factors related to stimulus-response translation
S-R Alternatives (Choices)
S-R Compatibility
Practice

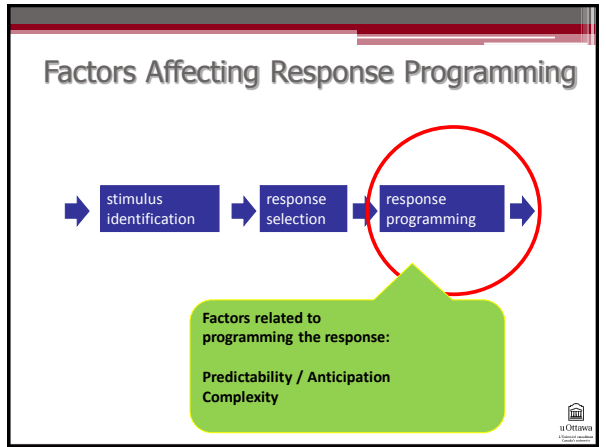




New

Response programming stage

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Event Predictability

- How does the predictability of an event influence response preparation?
 - allow performer to anticipate and bias preparation process



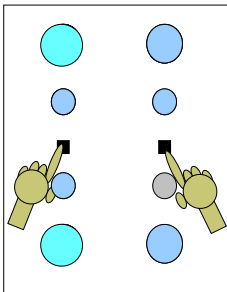
RT and Response Predictability

- Precuing



The Precue Method

e.g. Rosenbaum, 1980



Results

- Advance information about arm, direction, and extent (amplitude) reduces RT.
 - Knowing which arm reduces RT by **150 ms**.
 - Knowing the amplitude of the movement reduces RT by **100 ms**.
- Therefore Reduction in RT cannot be explained simply as a reduction in uncertainty.

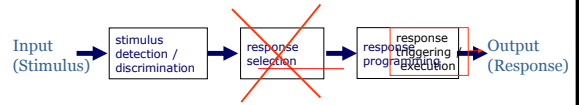


Event Predictability

- How does the predictability of an event influence response preparation?
 - allow performer to anticipate and bias preparation processes
 - *i.e. Anticipation allows information processing in advance*



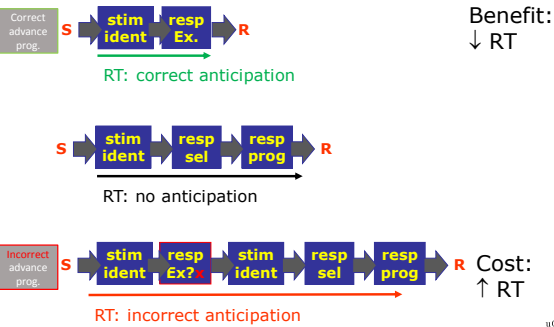
Human Information Processing



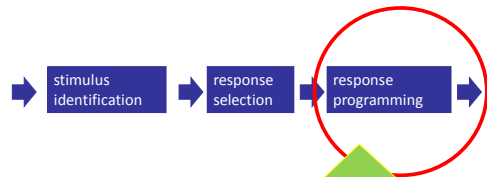
More like a Simple RT Situation



Cost-Benefit Analysis of Anticipation



Factors Affecting Response Programming

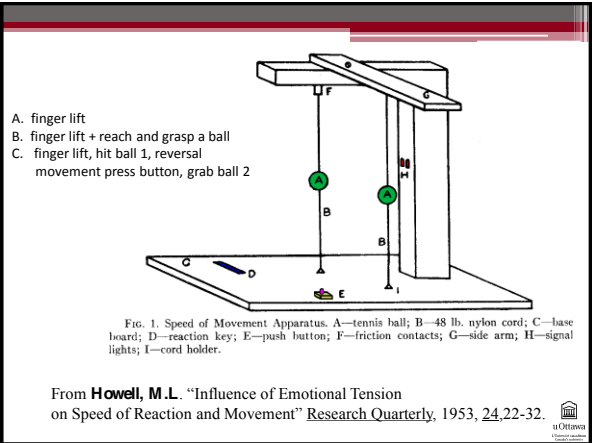


Factors related to programming the response:
Predictability / Anticipation Complexity



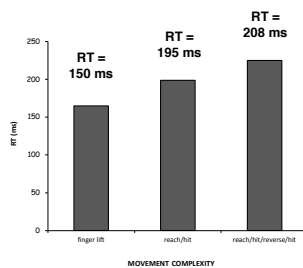
RT and movement complexity

- If a motor program is prepared in advance then do movements of greater complexity take longer to prepare?
- If so, then
 - RT should increase as movement complexity increases
 - and
 - Increased time must be required to organize more complex movements



Movement Complexity Experiment

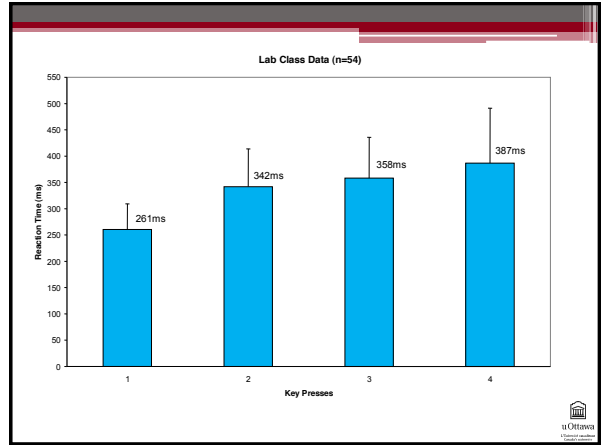
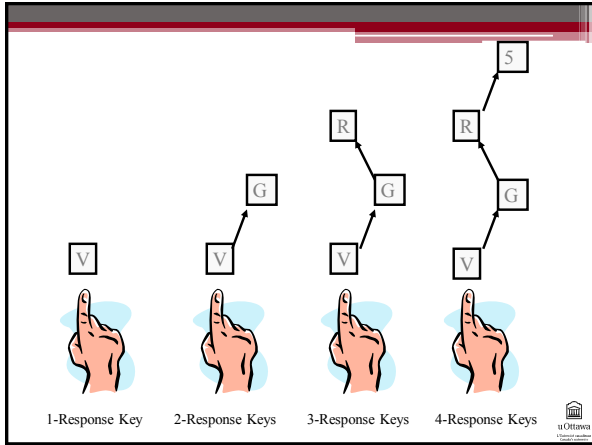
- Henry & Rogers (1960) - studied simple RT and movement complexity
 - finger lift
 - finger lift and reach and grasp a ball
 - finger lift, hit ball, reversal movement to button, hit ball 2



Franklin Henry's conclusions

- "Under controlled conditions Simple RT becomes longer when the type of movement which follows the reaction is varied from very simple to relatively complex."
- "Further increase in complexity produces additional slowing, but to a lessened degree"(p.457)

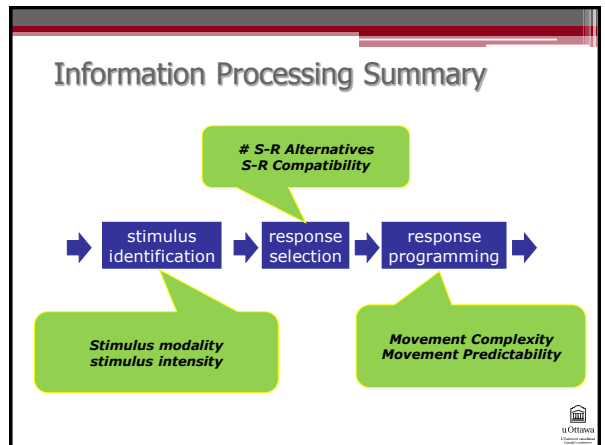





Franklin Henry's Statement #2

- "neuromotor coordination patterns are conceived of as stored..." (i.e. programmed)
- Time required for accessing the program via a memory mechanism requires increasing time as the motor act becomes more complex.(p.457)
 - Think of copying larger (e.g. more complex) files to a USB memory stick

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Sensory Systems




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- Q: Where do information processing stages occur




Movement Control


- Where does this information processing take place in the nervous system?
 1. Stimulus Identification – where does input come from?
 2. Response Selection – how do we decide to act and then select an appropriate response?
 3. Response Programming – how do we develop a plan of action and sent it to the muscles?
- ☆ What happens after the plan gets to the muscles?



Follow the information

- Sensory information comes in....
 - Types?
 - Then what?

Input (stimulus) →  → Output (response)



Sensory Contributions 1



VISION

- Exteroceptor
- Proprioceptor
- Dominates when performing motor tasks
 - http://www.youtube.com/watch?v=dOwLtahmHg&feature=player_embedded
- Feedback mechanism
- Feedforward function



Seeing the Light

- Retina
 - Light sensitive receptor segment of the eyes
 - Cell types

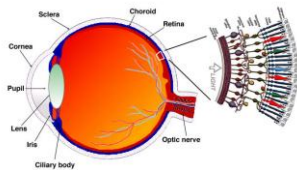


Fig. 1.1. A drawing of a section through the human eye with a schematic enlargement of the retina.

Light bombarding the retina produces the Optic Array



Vision as a Proprioceptor



Vision as a Proprioceptor

Moving Room Experiment

Lee and Aronson (1974)

<http://www.youtube.com/watch?v=NtVtmUJelnY>



Vision as an Exteroceptor



Vision as an Exteroceptor

1. Locomotion

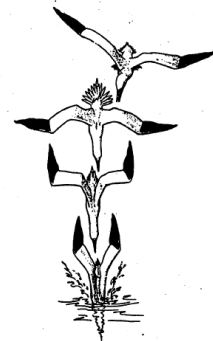
- Crowded streets
- Doorways
- Obstacles
- Other examples?



Environmental cues provide us with information about how we must accommodate our actions.

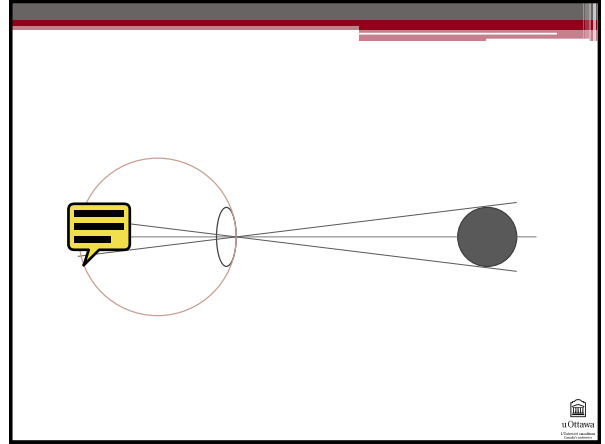


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Processing Visual Information

- Time to Contact (T_c) or “Tau (τ)”



Computation of T_c (Time to contact)



Proportionate rate of expansion

A = RETINAL IMAGE

\dot{A} = RATE OF EXPANSION OF RETINAL IMAGE OCCURRING AT TIME t

$$T_c \propto (A / \dot{A})$$



T_c Continued

The rate of change in retinal image is larger the faster the object's velocity

- Dividing by a larger \dot{A}
- $\rightarrow T_c$ is less



$$T_c \propto (A / \dot{A})$$

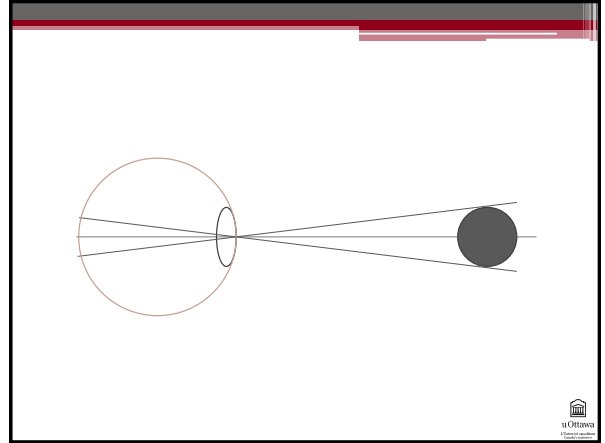
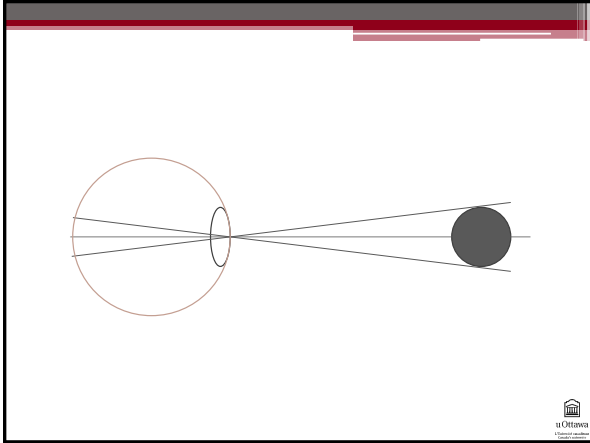
$$T_c = 1 (2m / 2 m/s) \times = 1 \text{ sec}$$

$$T_c = 1 (2m / 4 m/s) \times = .5 \text{ sec}$$




NOTE: velocity assumed to be constant






- T_C may be a **control variable** for certain actions.
 - In other words, T_C may be one of the factors that animals use to guide their motions. T_C may be used in various ways:

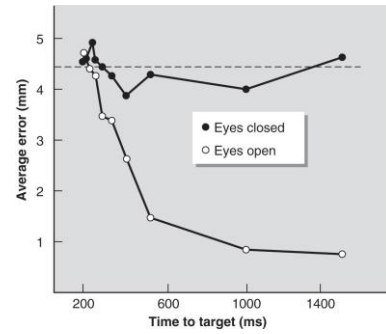


Time to Process Visual Information

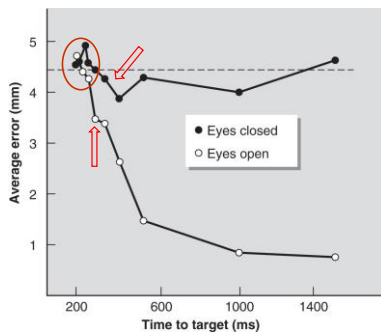

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Time to process Visual Information

- Woodworth (1899)
 - Make back and forth movement with a pen
 - GOAL: each movement be equal in length to the prior movement.
- CONDITIONS:
 - Eyes open vs. Eyes closed
 - Various speeds 300 ms to 3 s per movement cycle
 - example



- Time to Process Visual Information = **215 TO 250 ms**



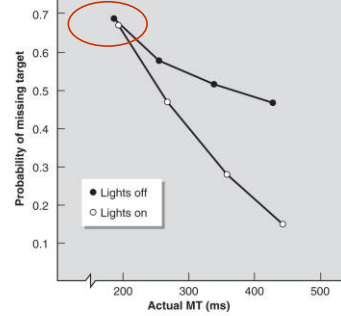
Woodworth Results

- Time to process visual info:
- 200-250 ms



KEELE AND POSNER (1968)

- Subjects performed discrete aiming movements in a situation in which the lights in the room could be extinguished when the movement had started (variable)



From Keele and Posner 1968.

Time to process visual information = 190-260 ms



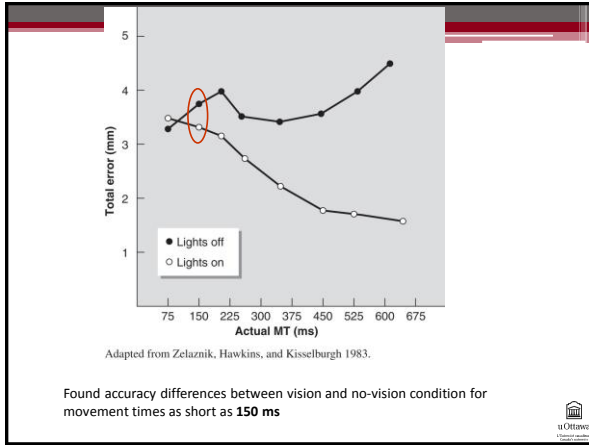
- On-line vision provides accuracy advantages, even for very rapid movements
- But...
- Vision under various conditions can be processed for motor control considerably faster than our usual estimates of RT to a visual stimulus



Zelaznik, Hawkins and Kisselburgh (1983)

- **Uncertainty of visual information**
- Set up trials so visual information was available in a blocked pattern
- e.g. : on, on, on, on, on, - off, off, off, off, off,





How Much Time is Needed to Process Visual Information?

- Initial studies suggested 300 ms is needed
- More recent studies suggest 150 ms and some even as short as 100 ms, depending on predictability of vision
- ? Is this better / faster visual processing or optimization of pre-planning?

How Vision Provides Information: Two Cortical Visual Systems

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Two Cortical Visual Systems

Dorsal route
Milner and Goodale: "Where?" **ACTION**
Possibly immune to the effects of visual illusions
- It is thought to 'ignore' context, and process only the action target

Ventral route
Milner and Goodale: "What?" **PERCEPTION**
Thought to be responsible for many illusion effects
- Processes the target and its context

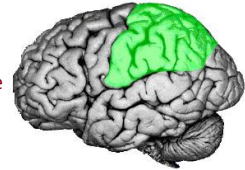
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- Ventral: conscious perception of object identification (shape, size, color, lightness, relative location)
- Dorsal: unconscious action towards objects (how to interact with object)



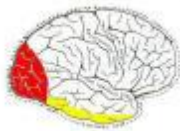
What Happens if a System is Damaged?

- Optic Ataxia – brain damage occurring to the parietal lobe / Dorsal System
 - Patients can describe the object but reaching movements are inaccurate



What Happens if a System is Damaged?

- Visual Agnosia – brain damage occurring to the temporal lobe / Ventral system
 - Patients can pick up the object but cannot recognize or describe it



• <http://www.youtube.com/watch?v=rwQpaHQ0hYw#t=0m20s>

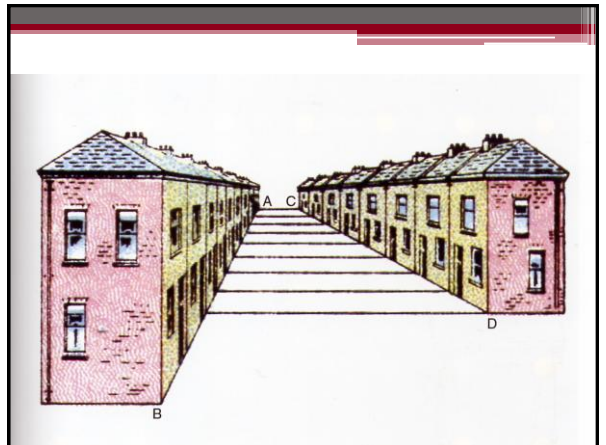
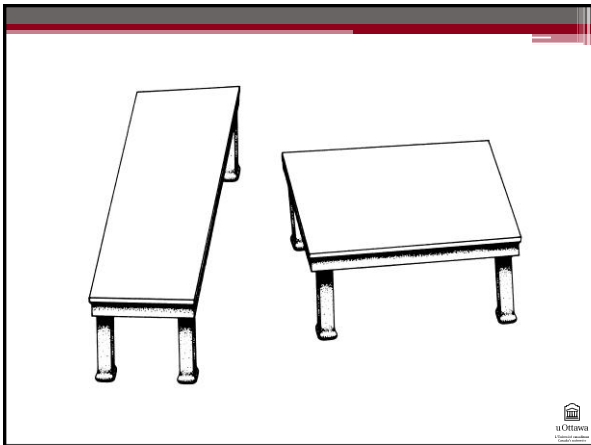
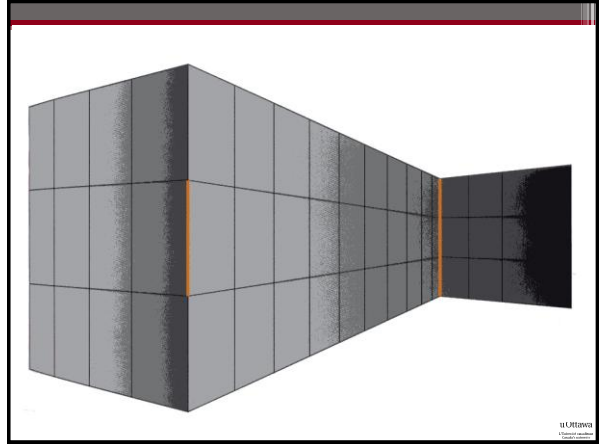
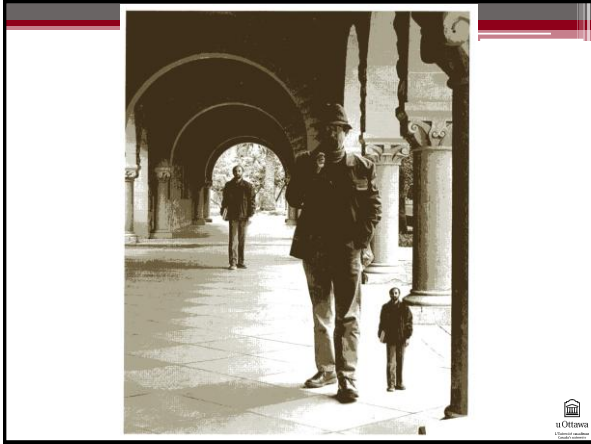
• <http://www.youtube.com/watch?v=kuKqI93FMgQ#t=1m16s>

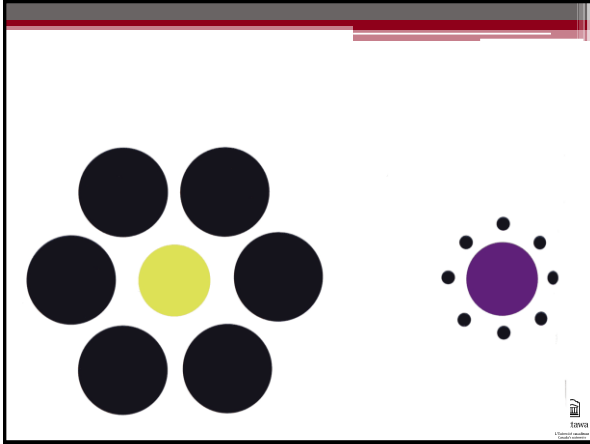


Visual Illusions

- How perception and action interact
- Illusions







Interacting with Illusions

- Some studies show that, while our perceptions are affected by illusions, our actions are not

