

BCS 151 : Perception & Action

<http://www.bcs.rochester.edu/courses/151.html>



Prof. Duje Tadin

[www.ski.org/Vision/Eyepage/index.html](http://www.ski.org/Vision/Eyepage/index.html)

*Perception and Action (BCS 151) | Fall 2011*  
Tuesdays & Thursdays, 11:05am - 12:20pm, Dewey Hall 1101

**Instructor:** Dr. Duje Tadin ([duje@cvs.rochester.edu](mailto:duje@cvs.rochester.edu))  
**Office:** Meliora Hall 317 (NEW BCS area, just past the Bursar's Office) **Phone:** 275-8682  
**Office hours:** Tuesdays & Thursdays after class, or by appointment

**TA:** Ruyuan Zhang ([rzhang@bcs.rochester.edu](mailto:rzhang@bcs.rochester.edu))  
**Office:** Meliora Hall 277  
**Office hours:** TBD, or by appointment

**About the course:** This course provides an overview of contemporary theory and research in perception, including related philosophical and biological issues. We learn how animals acquire, process and utilize information about objects and events in the environment, covering vision, audition, taste, smell and touch. A recurring theme in the course is the relation between perceptual experiences and their neural correlates. Lectures are supplemented with demonstrations and exercises. **Prerequisites:** BCS 110 and/or BCS 111. These are important because this course assumes introductory knowledge of the organization/function of the nervous system. Exceptions will be made only for students who demonstrate such knowledge.

(pronunciation: Doo-yay Tah-din)

**Materials:**

- Textbook:**
- Student website:**
- Additional readings:**

Sensation & Perception, 2<sup>nd</sup> Edition, Wolfe et al., **Sinauer Associates**  
The website contains study materials and integrative activities to help you better understand textbook material: <http://www.sinauer.com/wolfe2e/home/startF.htm>  
**(required)** Articles from the scientific literature that supplement and extend the textbook. Students who are enrolled in the course can download these readings each week from Blackboard (<http://my.rochester.edu>). The login is your **NetID**.

**Exams:** There will be 4 exams and no final exam. All exams will contain multiple choice, fill-in-the-blank and short essay questions. Questions will be drawn from BOTH the lecture and reading material. The emphasis will be on *understanding* rather than simply recalling course material. **Make-up exams will be entirely essay. Only students who suffer a documented medical or family emergency will be granted the opportunity to take a make-up exam.** Official university events require an **advance notice** so that an alternative accommodation can be made.

**Perception Journal:** Each student will be required to keep a "perception journal." It will have a minimum of five entries and 1000 words. Additional details will be provided in the first two weeks of class.



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**Grading:**

- The lowest exam score is excluded. The three remaining exams will each account for 30% of the final grade.
- Perception journal: 10% of the final grade
- Grades are rounded to two decimal points (89.99 = 89.99, 89.999 = 90.00). **There is NO "grade bumping"!**
- Final grade curve will be applied only if the class average is less than 80%.
- Grading scale: (note that 94.00% is A-, and 89.99 is B+):

	87 < x < 90 = B+	77 < x < 80 = C+	67 < x < 70 = D+	
x > 94 = A	83 < x < 87 = B	73 < x < 77 = C	63 < x < 67 = D	< 60 = E
90 < x < 94 = A-	80 < x < 83 = B-	70 < x < 73 = C-	60 < x < 63 = D-	

**Learning Assistance:** Students who require assistance with note taking, studying for exams, or essay writing should contact Learning Assistance Services in **Lattimore 107 (5-9049)**.

**Expectations:** By taking this course, you can expect to learn about and be intrigued by the topics we discuss in class. In turn, I expect that you will respect the learning environment and be courteous to your instructor and classmates by:  
(1) using the highest standards of academic honesty and integrity (University of Rochester's policy is available at <http://www.rochester.edu/College/honesty/>.)  
(2) asking for help during office hours or via email if you don't understand something in the lectures or the readings  
(3) asking questions in class (if they require a lengthy answer, they may be deferred until after class)

\*\*\*\* Anonymous web feedback form \*\*\*\*

<http://www.bcs.rochester.edu/courses/crsmf/151/crsarc/F10/feedback.html>

**Brain & Cognitive Sciences**

Description Syllabus Schedule Archives Blackboard Feedback

**BCS 151 Anonymous Feedback F**

All comments will be sent Prof. Duje Tadin

Comments

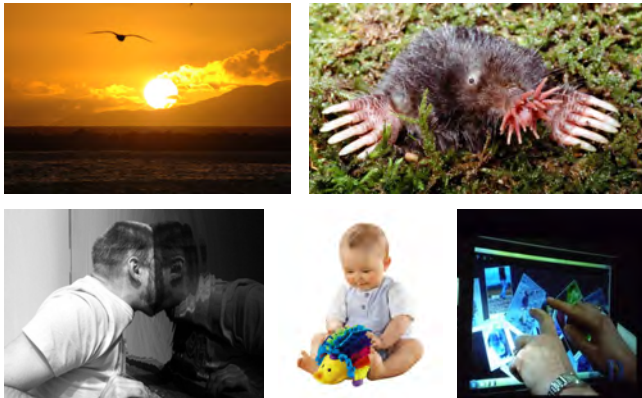
submit

Date	Lecture	Readings
9:1	General principles of perception	---
9:6	Measuring perception I	Ch 1: 19-end
9:8	Measuring perception II	Kim & Blake (2005)
9:13	The eye & introduction to vision	Ch 2: start-56
9:15	Early visual processing	Ch 2: 56-end
9:20	Cortical visual processing	Ch 3
9:22	<b>EXAM 1</b>	
9:27	Form vision	Ch 4: start-93
9:29	Color perception	Ch 5
10:4	Perception in 3D - I	Ch 6: start-146
10:6	Perception in 3D - II	Ch 6: 146-end
10:11	<b>FALL BREAK</b>	
10:13	Motion perception I	Ch 7
10:18	Motion perception II	Ch 7
10:20	<b>EXAM 2</b>	
10:25	Current research in vision	Tadin & Blake (2005)
10:27	Object and flow perception	Ch 4: 93-end
11:7	Visual attention	Ch 8
11:7	Auditory sensation	Ch 9: start-237; 240-end. Ch 10: 260-265 (complex sounds)
11:8	Hearing I	Ch 9: 237-260
11:10	Hearing II	Ch 10: start-260
11:10	Hearing II	Ch 10: 265-end
11:15	<b>EXAM 3</b>	
11:17	Touch & Haptics	Ch 12: start-309; 313-316
11:21	Touch & Haptics	Ch 12: 309-313 (start); 316-end Ch 15: To be assigned
11:24	<b>THANKSGIVING BREAK</b>	
11:29	Chemical senses: taste/smell I	Ch 13
12:1	Chemical senses: taste/smell II	Ch 14
12:6	A world beyond human experience	To be assigned
12:8	Perceptual Awareness	To be assigned
12:13	<b>EXAM 4</b>	

## So what exactly is perception?

- Talking to friend about a concert you both attended last month, your friend asks, "Remember the last piece they played?" You respond by saying, "Yes, I can hear it clear as a bell."
- Five miles from home you get the vibes that your dog has just ate your homework. You arrive home to discover that your dog has done actually exactly that.
- I flash a brief, dim message on the screen: "Drop this course before it's too late." When asked if you saw anything, you say "no" but tomorrow you drop the course.
- While playing baseball, you accidentally get hit in the head by the ball, causing you to see stars for a few moments

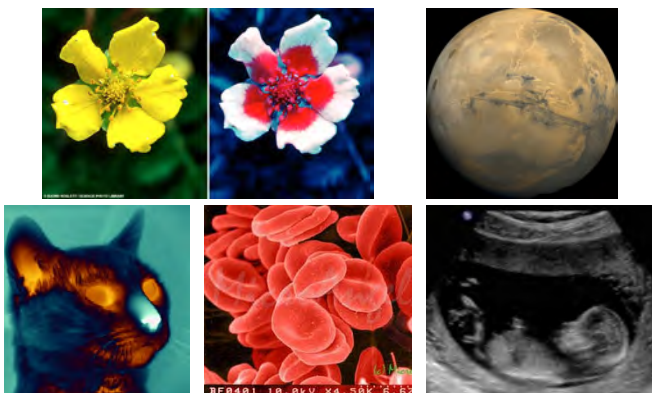
### Perception is a fundamental freedom



### Perception is a fundamental freedom



### Perception is a fundamental freedom Perception is a fundamental limitation



## Perception...

- ... is self-referenced
- ... is active
- ... is constructive
- ... is relative
- ... is invariant in the face of changing stimulation
- ... is changes in the face of unchanging stimulation
- ... enhances the novel & ignores the unchanging
- ... is guided by expectations and by context
- ... can be educated
- ... is an intelligent, adaptive process
- ... involves competing demands

## Perception...is self-referenced

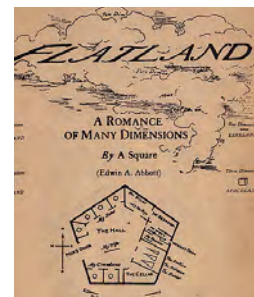
Objects and events are perceived **relative** to the perceiver's perspective

- How would you describe "color vision" to someone who was blind?
- Our perceptual experiences set boundaries on the imaginable ("what is it like to be a bat?")
- Up / down / left / right / near / far are automatically referenced in an egocentric framework

## Perception...is self-referenced

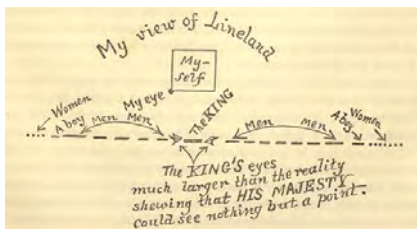
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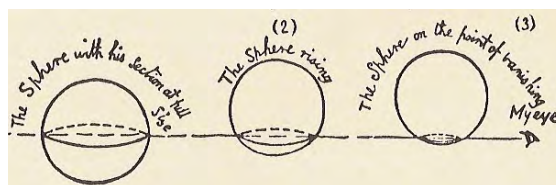
## Perception...is self-referenced

**The Square of Flatland:** "The Monarch [of LineSpace] could not refrain from constantly assuming that whatever was familiar to him must also be known to me ... It seemed that this poor ignorant Monarch was persuaded that the Straight Line which he called his Kingdom ... constituted the whole of the world, and indeed the whole of space. Not being able either to move or to see, save in his straight line, he had no conception of anything out of it."



**Monarch of LineSpace:** "You ask me to believe that there is another Line besides that which my senses indicate, and another motion besides that of which I am daily conscious. I, in return, ask you to describe in words or indicate by motion that other Line of which you speak. Instead of moving, you merely exercise some magic art of vanishing and returning to sight; and instead of any lucid description of your new World, you simply tell me the numbers and sizes ... Can anything be more irrational or audacious?"

## Perception...is self-referenced



Are we stuck in a 4D equivalent of Flatland?



## Perception...is active

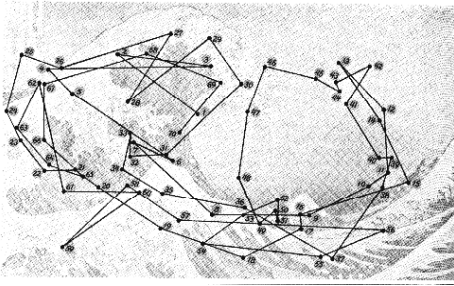
To see, we *look*.  
To hear, we *listen*.  
To smell, we *sniff*.  
To feel, we *touch*.

Perception guides action  
&  
action informs perception.

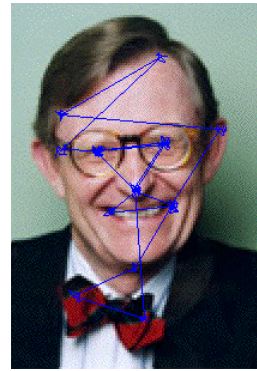
## Perception...is active



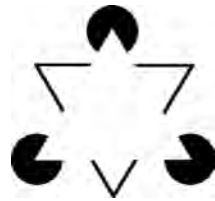
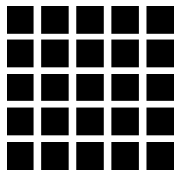
Perception...**is active**



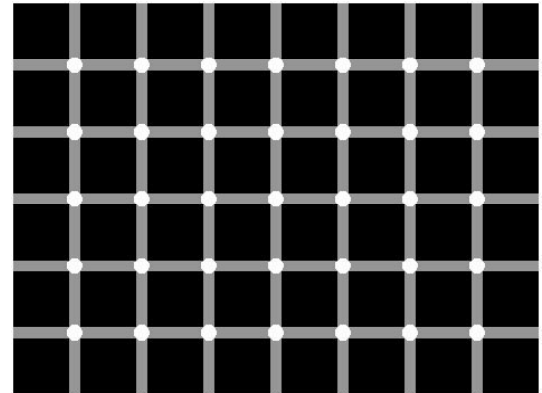
Perception...**is active**



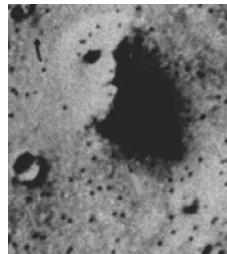
Perception...**is constructive**



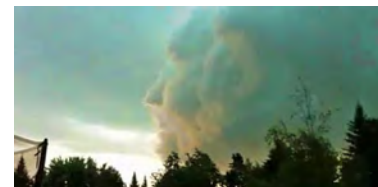
Perception...**is constructive**



Perception...**is constructive**



Perception...**is constructive**



## Perception...**is constructive**



Eric Hoffer,  
*The Passionate State of Mind*

We usually see only the things we are looking for — so much so that we sometimes see them where they are not.

## Perception...**is constructive**



Vision tries to find "meaning" in everything we see



What do you see?

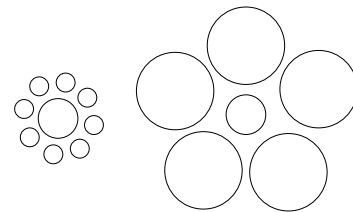
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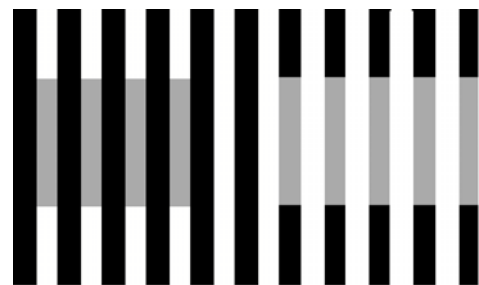
## Perception...**is relative**



## Perception...**is relative**



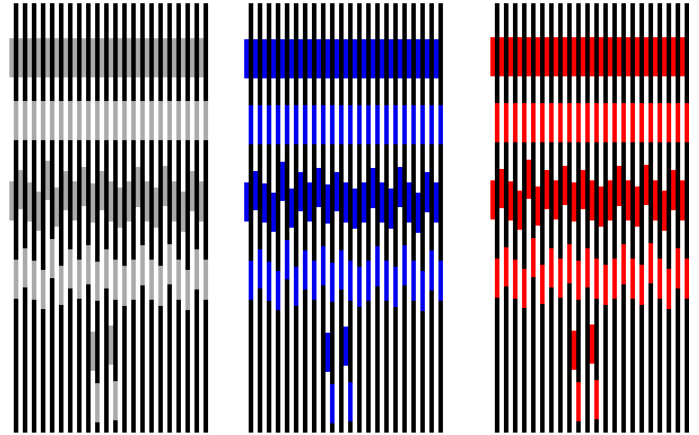
## Perception...**is relative**



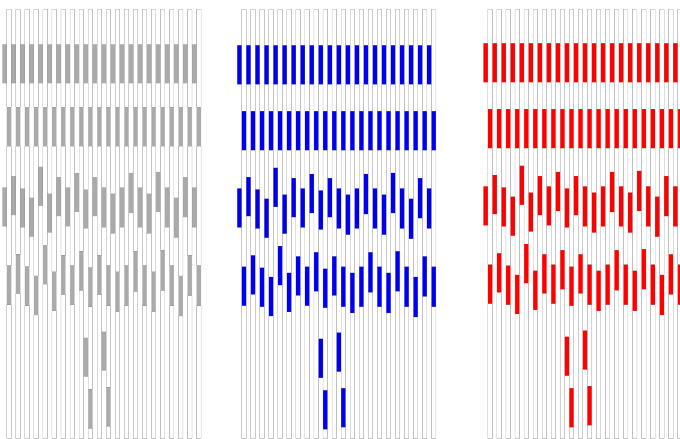
## Perception...is relative



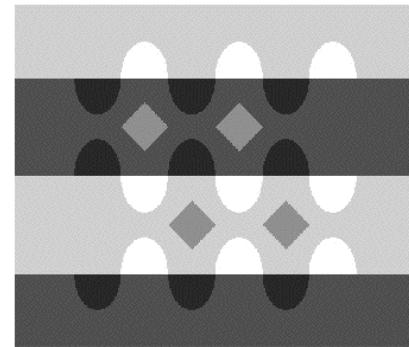
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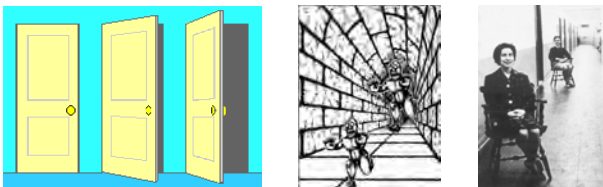
## Perception...is relative



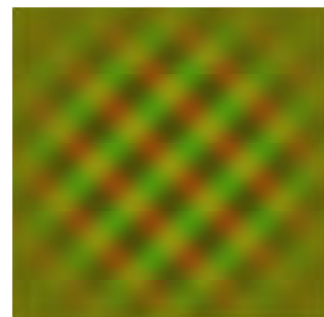
## Perception...is invariant in the face of changing stimulation

Perception remains constant even when the associated sensory data varies  
"perceptual constancy"

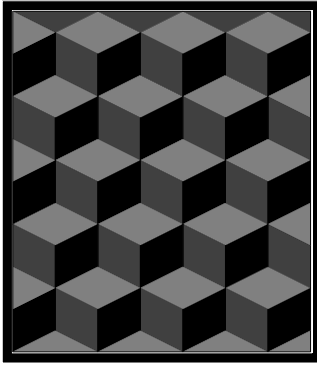
Shape constancy, size constancy, color constancy, melodic constancy...



## Perception...changes in the face of unchanging stimulation



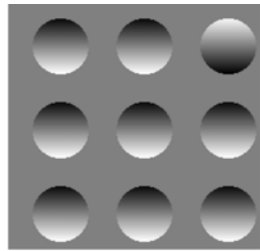
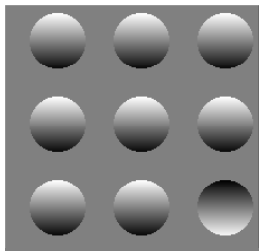
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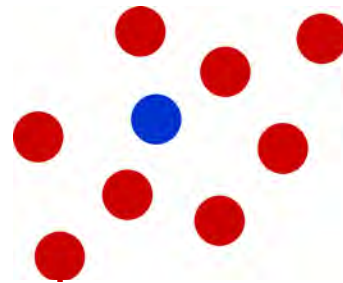
Perception...changes in the face of unchanging stimulation



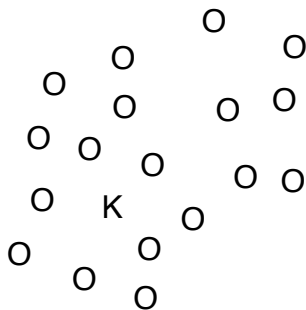
Perception...enhances the novel & ignores the unchanging



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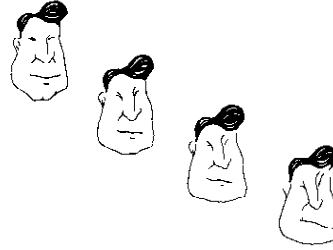


Perception...is guided by expectations and by context

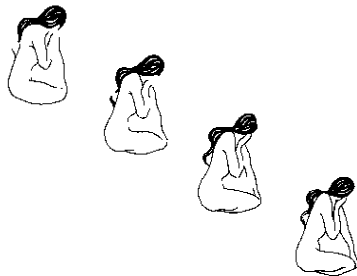


What does this figure depict?

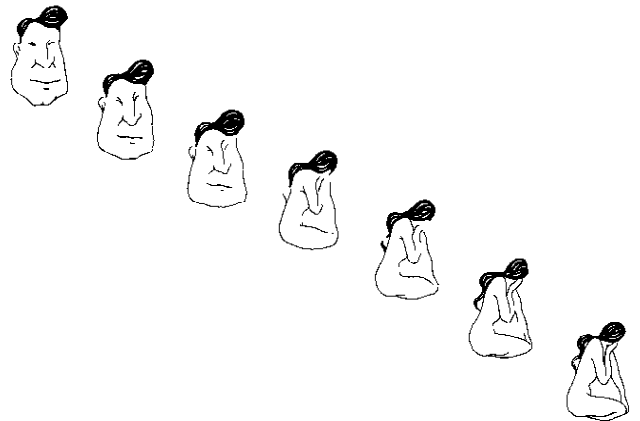
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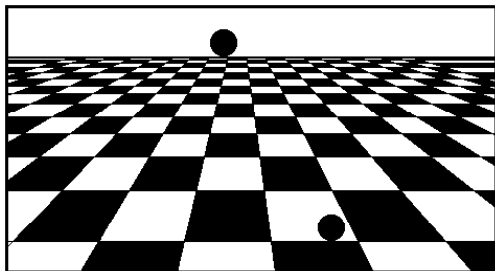
Perception...is guided by expectations and by context



Perception...is guided by expectations and by context



Perception...is guided by expectations and by context



Perception...is guided by expectations and by context

Moon and its changing size...



## Perception...**is guided by expectations and by context**



## Perception...**can be educated**



What is this?

## Perception...**can be educated**



How about this one?

## Perception...**is an intelligent, adaptive process**

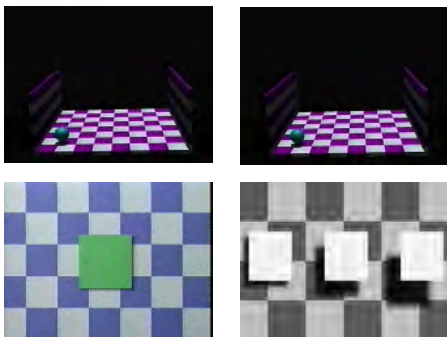
Perception is an intelligent process:  
it takes limited sensory data and, using built-in assumptions, deduces what in the world gave rise to that sensory data



(AND, we can't always tell which aspects of your perception are a product of your brain, and which are real)

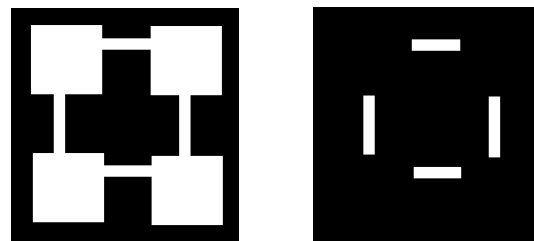
## Perception...**is an intelligent, adaptive process**

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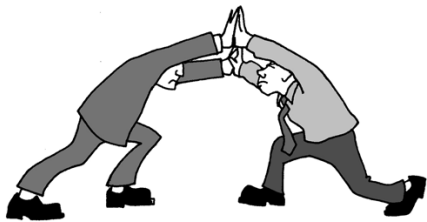


## Perception...**is an intelligent, adaptive process**

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## Perception... **involves competing demands**



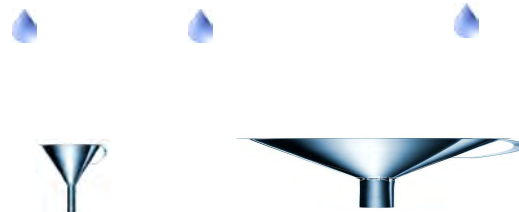
sensitivity vs. resolution  
discrimination vs. generalization  
grouping vs. segmentation

## Perception... **involves competing demands**

### sensitivity vs resolution

**Sensitivity** - being able to detect "faint" signals

**Resolution** - being able to distinguish among multiple signals (e.g., their location)



## Perception... **involves competing demands**

### generalization vs discrimination

**Generalization** - being able to categorize distinct objects based on a common feature

**Discrimination** - being able to distinguish among similar objects

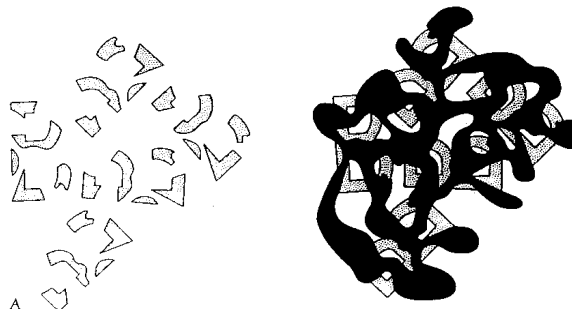


## Perception... **involves competing demands**

### grouping vs segmentation

**Grouping** - combining elements based on their common features

**Segmentation** - picking out a given element from a background of similar elements



## Perception... **involves competing demands**

### grouping vs segmentation

**Grouping** - combining elements based on their common features

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## Perception...

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- ... can be educated
- ... is an intelligent, adaptive process
- ... involves competing demands

# So what exactly is perception?

The word literally means (Latin), "to seize what is in front of us"

Perception is a **biological process** that provides us with useful, although not necessarily accurate, **information about the objects and events** in our world that can be used by the brain to guide our cognitions and actions.

# So what exactly is perception?

... a **biological process** that provides us with useful, although not necessarily accurate, **information about the objects and events** in our world that can be used by the brain to guide our cognitions and actions.

Muller's doctrine of specific nerve energies (1826)

The nature of perception is defined by the pathway over which the sensory information is carried, not by the origin of the sensation.



# So what exactly is perception?

... a **biological process** that provides us with useful, although not necessarily accurate, **information about the objects and events** in our world that can be used by the brain to guide our cognitions and actions.

Vernon Mountcastle (1975):

"Each of us lives within . . . the prison of his own brain. Projecting from it are millions of fragile sensory nerve fibers, in groups uniquely adapted to sample the energetic states of **the world** around us: heat, light, force, and chemical composition. **That is all we ever know of it directly**; all else is logical inference."



Materialism over dualism

# So what exactly is perception?

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Philosophy's "brain in a vat" thought experiment



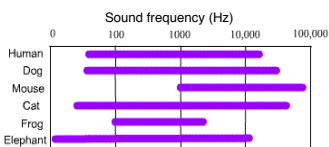
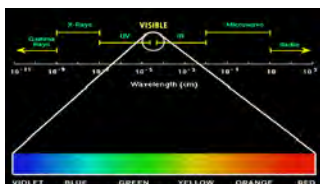
Transcranial magnetic stimulation



# So what exactly is perception?

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We are in perceptual contact with only a tiny sliver of the real world



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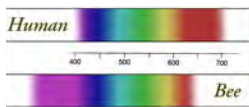
Q: What determines which parts of the world are sampled by perception?



# So what exactly is perception?

... a **biological process** that provides us with useful, although not necessarily accurate, **information about the objects and events** in our world that can be used by the brain to guide our cognitions and actions.

- Q: What determines which parts of the world are sampled by perception?**  
**A: Portions of the environment are perceptually important to an organism?**



# What determines portions of the environment that are perceptually important to an organism?

- **What are the habits of the members of that species?**
  - Who are their enemies, and what are the habits of those enemies?
  - What do they eat and how do they acquire their food?
  - How do members of the species communicate with one another?
  - What are the mating habits of members of the species, and how do those members signal sexual receptiveness to one another?
- **What kind of environment do they live in?**
  - Aerial
  - Arboreal
  - Underground
  - Aquatic
- **What time of day are they active?**
  - Diurnal
  - Nocturnal
  - Crepuscular
    - Vespertine (dusk)
    - Matutinal (dawn)
  - Arrhythmic (us)

## Extending parts of the world that are sampled by our perceptual systems!

- Relieved of the constant pressures of survival, we members of the species *Homo sapiens* have devised new, **recreational** ways to stimulate our perceptual systems:



## Extending parts of the world that are sampled by our perceptual systems!

- Relieved of the constant pressures of survival, we members of the species *Homo sapiens* have devised new, **recreational** ways to stimulate our perceptual systems:
  - Preparing and eating exotic foods and drinks
  - Composing and listening to "novel" sounds (music)
  - Creating and enjoying "artificial" visual images (animations, paintings)
  - Engaging in activities that challenge our senses of touch, proprioception and vision (skiing, rock-climbing, mountain biking)



## Extending parts of the world that are sampled by our perceptual systems!

- Relieved of the constant pressures of survival, we members of the species *Homo sapiens* have devised new, **recreational** ways to stimulate our perceptual systems:
- Our species has created different means for **extending** our perceptual grasp of the world, allowing us to discover objects and events beyond the limits of our sensory organs:

