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(1527-1593)

# Observing and Categorizing

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## Preview: Observation and Categorization

* At the foundations of science are procedures for gaining evidence about the world
  * We learn about the world through our five senses and are reliant on them for our evidence
* Tests of predictions ultimately rely on observations
  * Observations with the unaided senses
  * Observations made with the use of instruments
* Before observations can be used for testing predictions, they must be brought under categories
* Two fundamental questions about observation
  * How reliable are observations?
  * What does categorization involve?

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## Clicker Question

Is this line straight?
A. Yes
B. No
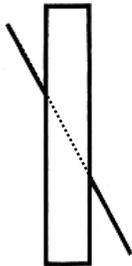
## Can these lines possibly be parallel?
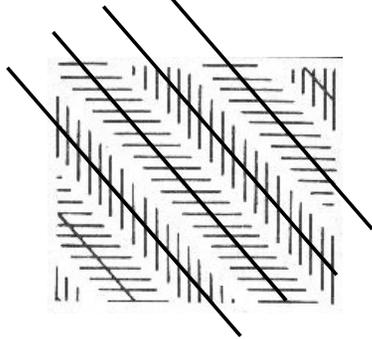


## Seeing More than One Thing
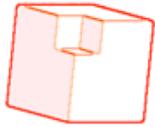


## Seeing what isn't possible
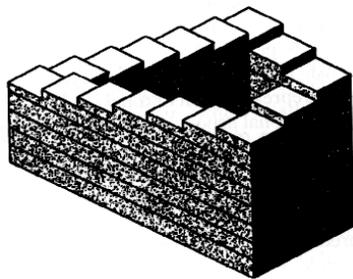
## Clicker Question

Why is it that we sometimes see what isn't there, misperceive what is there, etc.?

A. We tend to be very careless when we see—if we were only more careful, we would not make mistakes

B. I never make mistakes in seeing—the world is wrong

C. Our visual system performs operations on sensory input, and these operations are fallible

D. We have learned that vision is unreliable and we need to find other sources of information

## What Changes?



## Watch Carefully

❖ Count the times the players in white pass the ball

## Perception seems transparent

* But it relies on
  * The way in which the visual system is constructed
  * The effects of attention
  * What we have previously learned
  * What we expect to see
* It does not provide unmediated access to the world
* As a result, reports of perceptual experience are fallible
  * And can be revised in light of subsequent evidence
    * what others perceive
    * our hypotheses about the world
    * etc.

## Perception and categories

* What we see is heavily influenced by the categories we use to organize the world



* Images for which we lack categories we have a difficult time interpreting



## Why categorize?

* Categories not only allow us to recognize what we see, but allow us to access knowledge about the items in the category
  * What knowledge do you access from knowing that some liquid is water?
  * What knowledge do you access from knowing that something is an airplane?

* Even when something isn't true of all members of a category, we still make inferences
  * What are some things we infer from knowing that something is a bird?
  * What are some things we infer from knowing that someone is a convicted felon?

## Multiple category schemes

- But there is not just *one* right way to categorize the things we can see
- Different category schemes result in different knowledge claims

- Scientific progress often occurs as a result of re-categorizing something
  - The sun and moon were once considered planets
    - What happened when we changed the category?
  - Humans were not always grouped with primates
    - What changed when such a grouping was made?

## Discussion Question

How many ways can *you* come up with to categorize these items

A. 1
B. 2
C. 3
D. 4
E. 5+
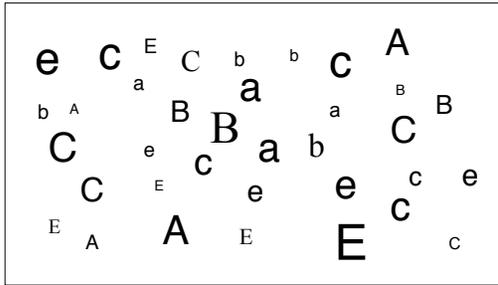
## Categorizing by letter

## Categorizing by Color



## Capitals vs lowercase



## Categories and names

- We tend to put things into categories for which we have names
  - But categories do not have to be nameable

- Rather, languages name those categories which are important to its speakers
  - About which they want or need to say something

- The categories available to us in our language, though, constrain what we can say
  - And what we can make generalizations about

## Perfectly good category—

e C C c E C b b B
A c a a
b A B B E a a e
C B e c a b
c C E c a
E A c A e E
c
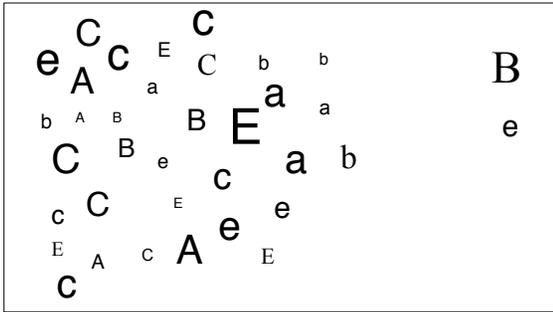
## Data from observations

- Although predictions against which hypotheses are tested involve individual entities or events, it is the entities or events as categorized that serve as evidence in science

- It is critical to develop appropriate categories to use in reporting evidence and formulating hypotheses

- Frequent issue--whether
  - to split: record each different model of car
  - to lump: count each different model of car as a car

## Hierarchical organization

- In political contexts, hierarchy refers to power relations
- In taxonomy, it simply refers to the inclusion of more specific categories into more general ones
- What is true of the more general categories is true of each of the sub-categories within it
- Provides a powerful way of organizing and keeping track of information

## High-level category

A  a  A  e  e  e  E  a  a  E  e  a  A  e  A  E  E  E

C  C  C  C  C  C  C  C  c  c  c  b  b  b  B  B  B  B  b  B
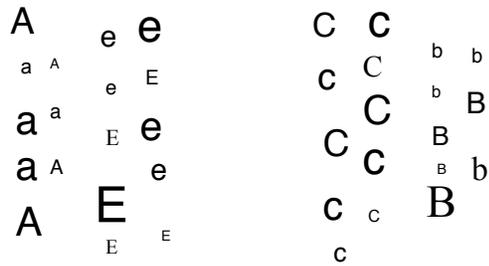
## Exclusive and exhaustive

- Given the analysis one might want to do with the categorized items, it is sometimes important to design sets of categories that are exhaustive and exclusive
  - Exhaustive categories: each item fits into at least one category
    - Important so as to insure that each individual gets counted (otherwise percentages are meaningless)
  - Exclusive categories: no items fits into two categories
    - Important so that no one gets counted twice

## Clicker Question

Applied to living organisms, the categories *plant, fish, insect, mammal, bird*, are

A. Exclusive but not exhaustive

B. Exhaustive but not exclusive

C. Both exclusive and exhaustive

D. Neither exclusive not exhaustive

## Clicker Question

Applied to baseball players, the categories bats
left handed and bats right handed are:
 A. Exclusive but not exhaustive
 B. Exhaustive but not exclusive
 C. Both exclusive and exhaustive
 D. Neither exclusive not exhaustive

## Categories or their names influence what we see

C /‾\ T
A
T

## Word Superiority Effect

READ

# Why proof reading is hard

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We see what we espect to see and so mis errors

This is exspecially truu when we have writen the text and now what is suposed to be their.

To xllxstxatx, I cxn rxplxce xvexy txirx lextex of x sextexce xitx an x, anx yox stxll xan xanxge xo rxad xt wixh sxme xifxicxltx.

# Clicker Question

How many f's are there in the following sentence:

Federal fuses are the result of years of scientific study combined with the first-hand experience of fifty years.

A. 6

B. 7

C. 8

D. 9

# Count the f's

..........................................................................

Federal fuses are the result of years of scientific study combined with the first-hand experience of fifty years.