

## 9.35 lecture: Basic psychophysics

### How do we measure sensory/perceptual responses in humans?

Mainly through behavior: i.e., ask people to do a task.  
Most basic tasks involve detection and discrimination:  
Can you detect this stimulus?  
Can you discriminate one stimulus from another?

### Threshold psychophysics

Pioneered by Weber & Fechner.  
Absolute threshold: e.g., how bright does a light have to be before you can just detect it?  
Increment threshold: e.g., how much do you have to increase the intensity of a light before you see the change?  
Difference threshold: e.g., how much do I have to change the shape of an object for you to just notice.  
Note: "difference threshold" is the general case that includes the others as special cases.

### Some methods.

Hearing test: can you hear the beeps?  
Method of adjustment: subject turns the knob up and down to find the point where the beep can just be heard.  
Method of limits: increase until you just hear it, or decrease until you just stop hearing it.  
Method of constant stimuli: randomly present a set of standard intensities, see which ones are heard. Get a psychometric function.

(Image removed due to copyright considerations.)

### Criterion problems

If one person has a lower threshold, is it just because they are willing to say "yes" even when they aren't sure?  
Use forced choice methods to avoid this problem.  
Listen to two intervals: there is a beep in one, not in the other. Which had the beep? (Or, one beep is louder than the other -- guess which one).  
Called "2 interval forced choice" (2IFC) or "2 alternative forced choice" (2AFC).

### Example in vision testing

The Snellen E chart:  
Can you tell which way the E is facing? (Image removed due to copyright considerations.)  
Four interval forced choice.  
Regular Snellen chart, with letters, is also forced choice. (How many alternatives?)  
With 4AFC, subject will guess correctly 25% of the time. We can set an arbitrary threshold of, say 75% correct. (Image removed due to copyright considerations.)

## Objective versus subjective judgments.

For some tasks there is a right answer (e.g., is this light brighter than the other one).

For others, there is no right answer (e.g., is this wine mellower than the other, is this sound more irritating than the other?)

## Objective or subjective?

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(Red and gray can be compared in terms of luminance, which is an objective physical measurement. But luminance is just a made up quantity that approximately matches the subjective brightness).

## Psychophysical “laws”

**Weber's law:**  $\Delta I/I = c$ , where  $c$  is a constant

This holds true for a surprising array of physical properties. Weber's law can be tested objectively.

**Fechner's law:**  $R = k \log(I)$ , where  $k$  is a constant

This law is about the “strength” of a sensation. It is neither objective nor subjective. It is inferred from Weber's law but it can't be directly tested.

**Steven's power law:**  $S = k I^p$

Ask people to assign a number to the brightness of a light, or the loudness of a sound, or the painfulness of an electric shock. It almost always fits a power law, with different exponents. No one knows why. It is inherently subjective.

## How would we measure a dark adaptation curve?

(Image removed due to copyright considerations.)