Psychophysics & Signal Detection Theory

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Perception (PSY 345 / NEU 325)

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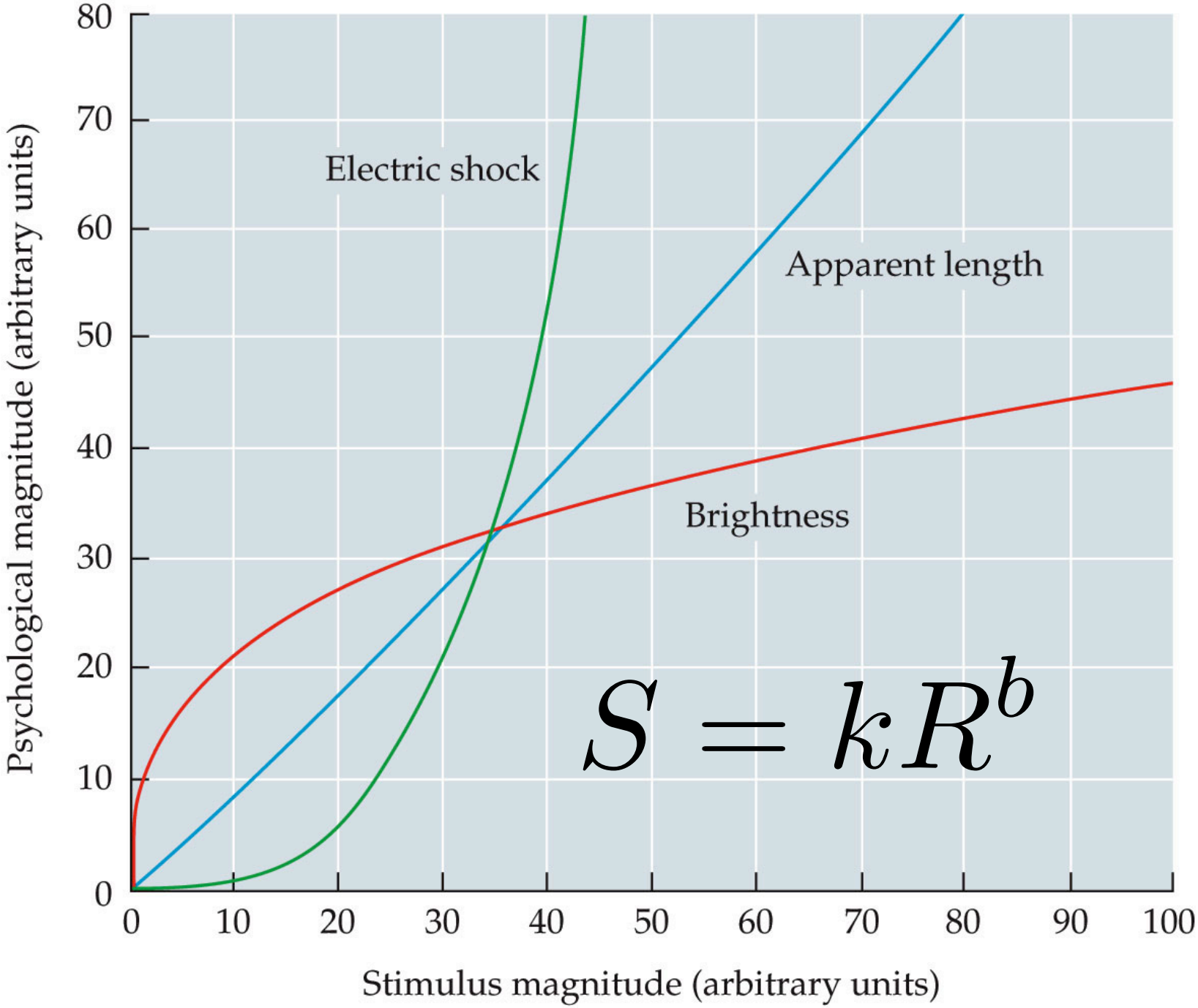
Lec. 3

Chapter 1

Outline for today:

- Stephen's power law
- psychophysics
- Signal Detection Theory

Stevens' Power Law

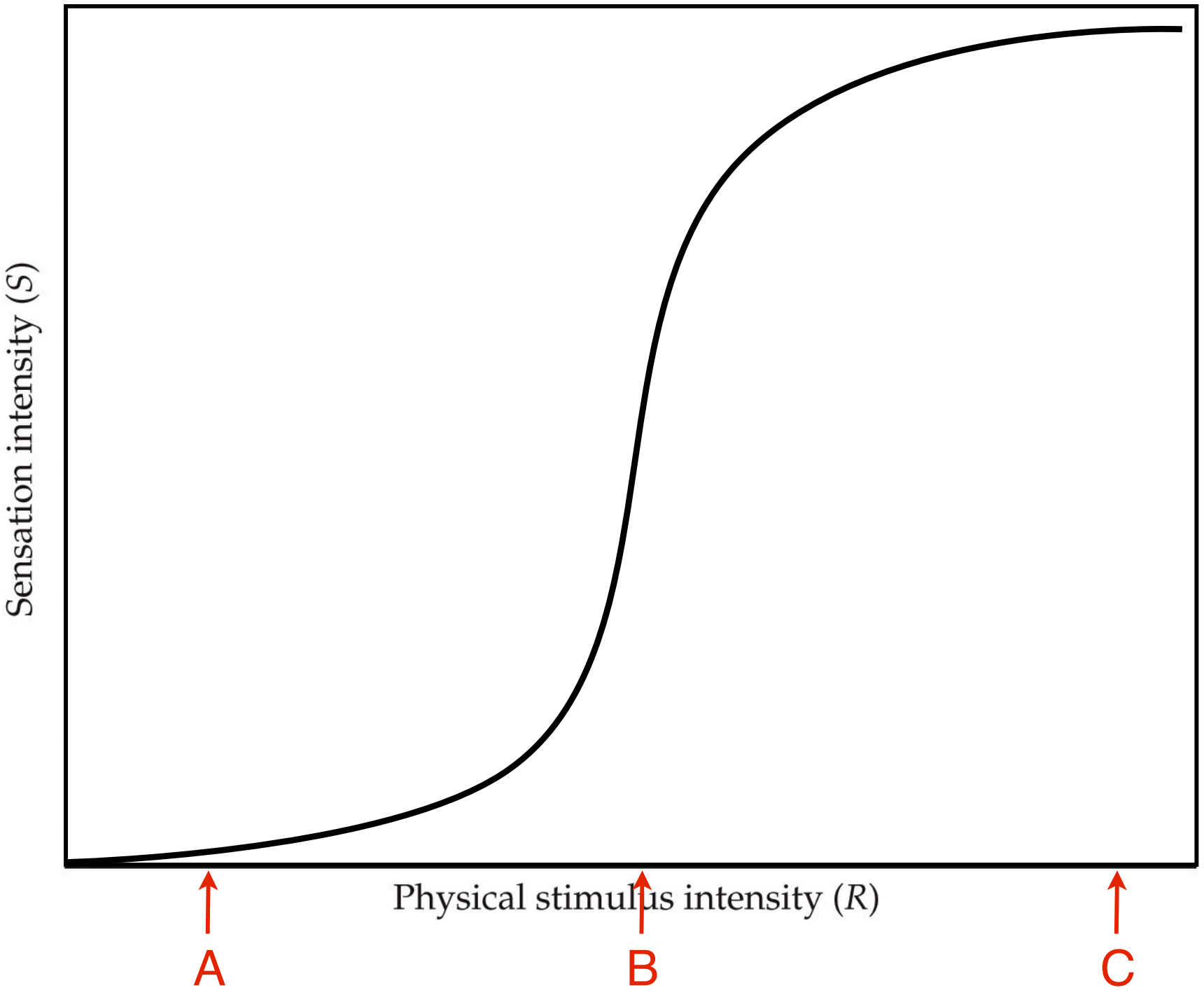


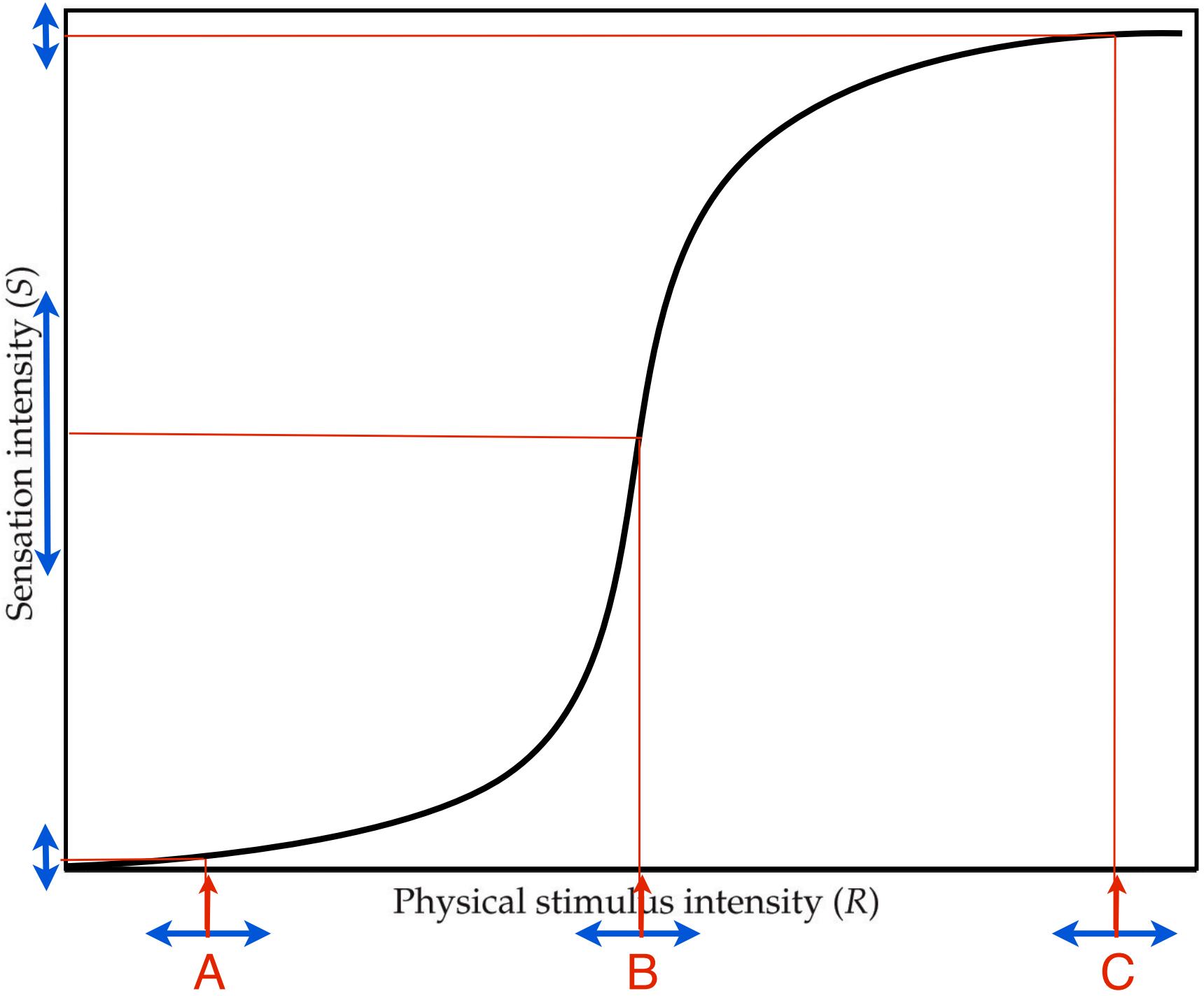
Stevens' Power Law

- subjective
- based on rating data
- no "right" answer: just a mapping between one unknown scale ('pain') and another unknown scale ('numbers')

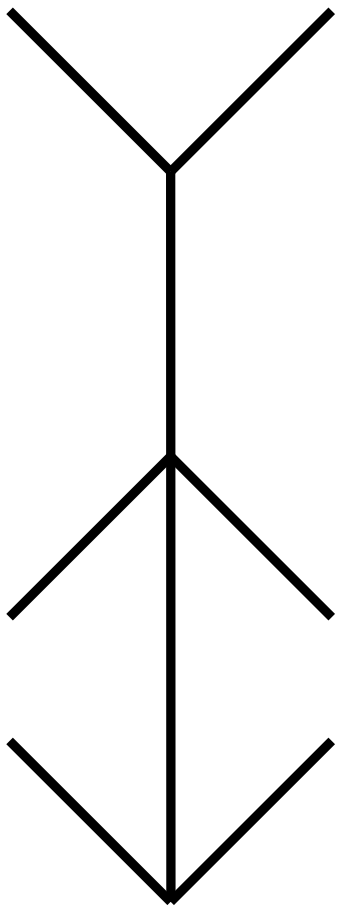
(my rating: "meh")

Test yourself: at which intensity are changes most detectable?

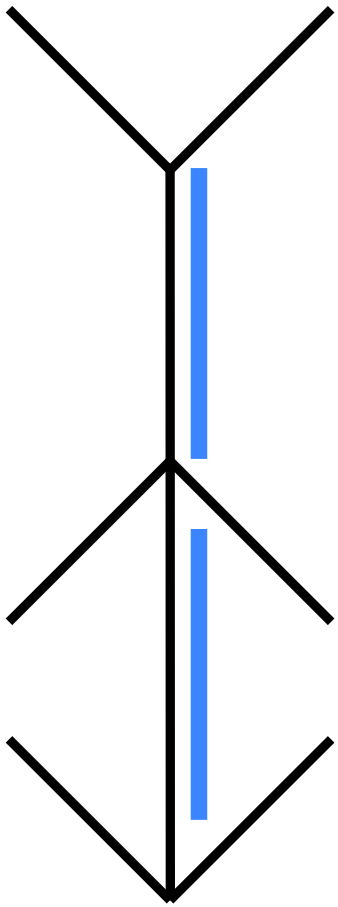


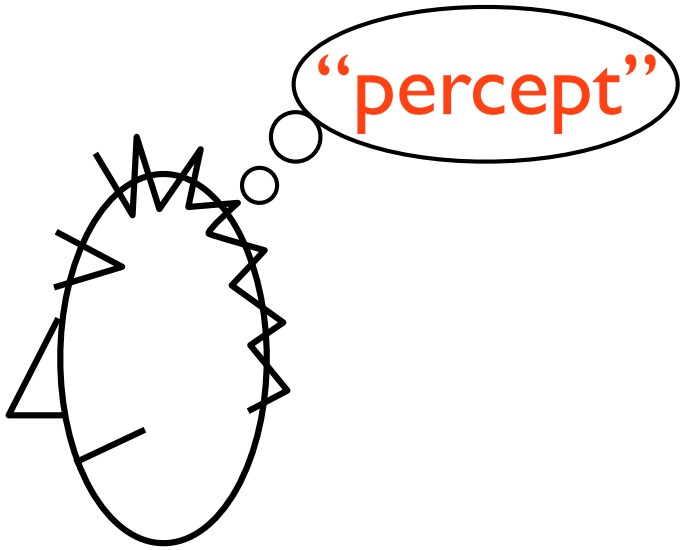

Sensation intensity (S)
Physical stimulus intensity (R)
A
B
C

How to measure perception?



müller-lyer illusion





“percept” is internal

müller-lyer illusion

Psychophysics

- detection (yes/no)
- discrimination (e.g., bigger than)
- estimation (report the stimulus exactly)

All provide indirect measure of internal mental state!

Table 1.1

Absolute thresholds in the real world

Sense	Threshold
Vision	Stars at night, or a candle flame 30 miles away on a dark, clear night
Hearing	A ticking watch 20 feet away, with no other noises
Vestibular	A tilt of less than half a minute on a clock face
Taste	A teaspoon of sugar in 2 gallons of water
Smell	A drop of perfume in three rooms
Touch	The wing of a fly falling on your cheek from a height of 3 inches

Source: From Galanter, 1962.

***SENSATION & PERCEPTION 5e*, Table 1.1**

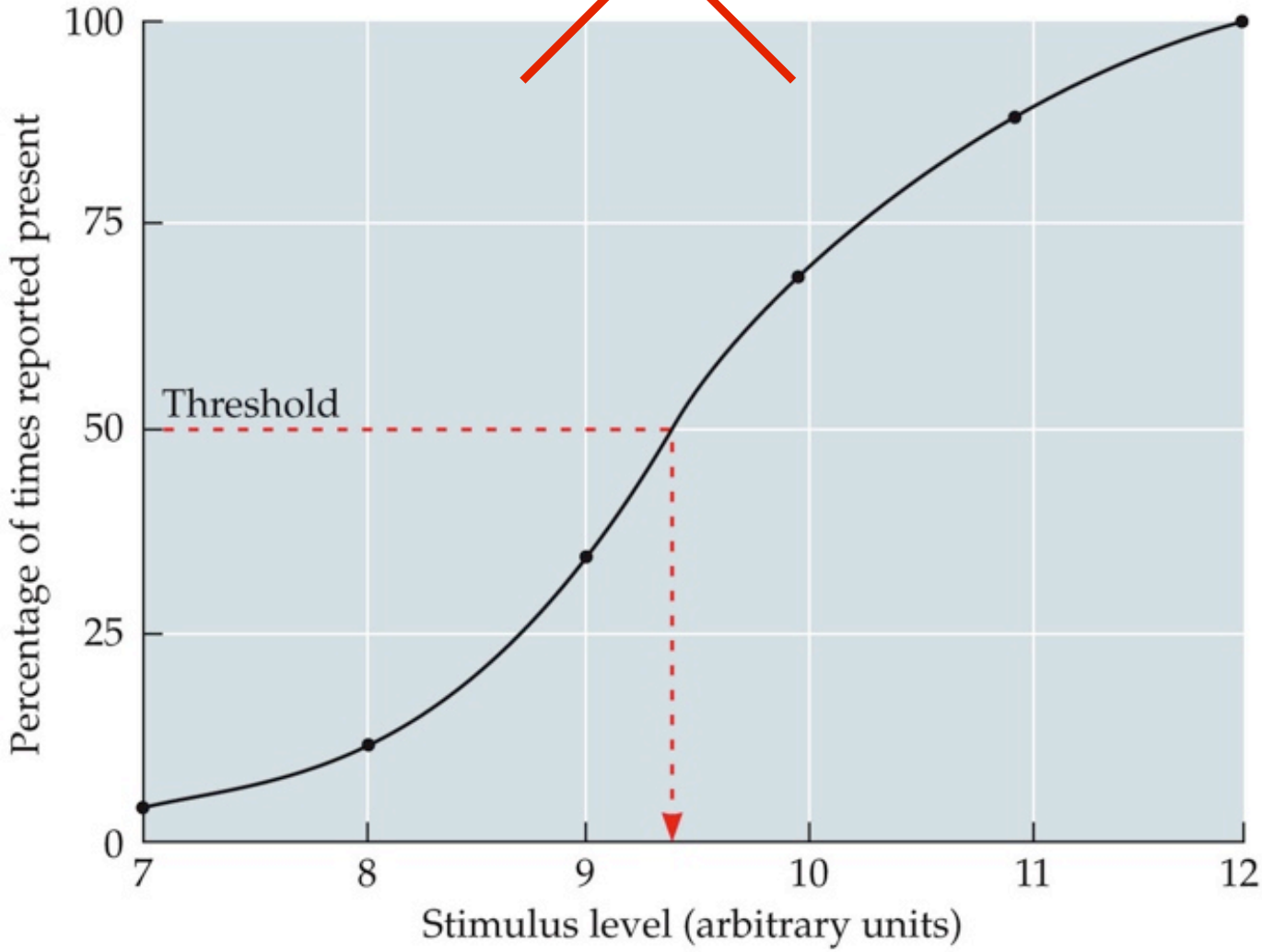
Detection

perfect threshold

Detection

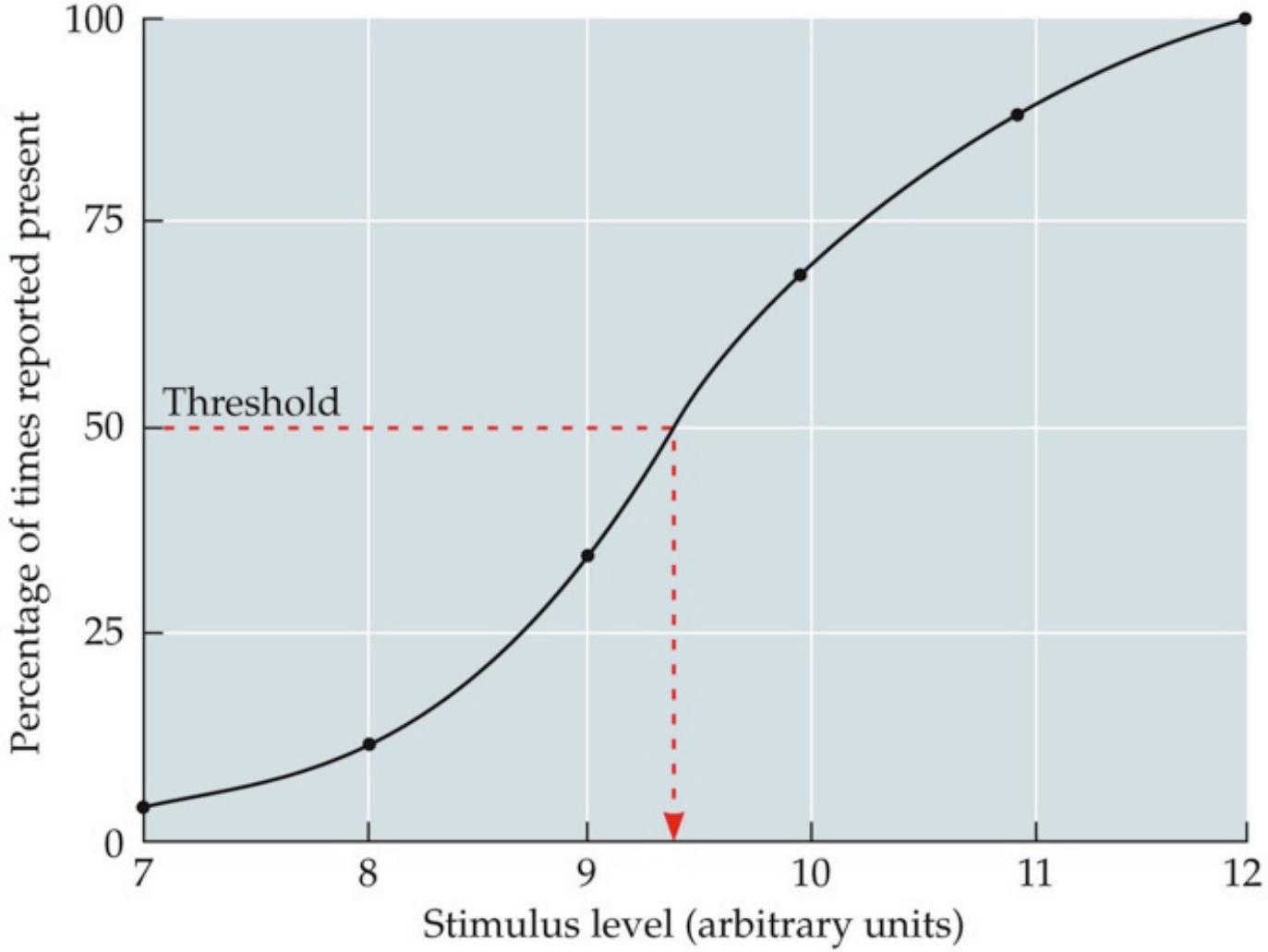
perfect threshold

noise



psychometric function

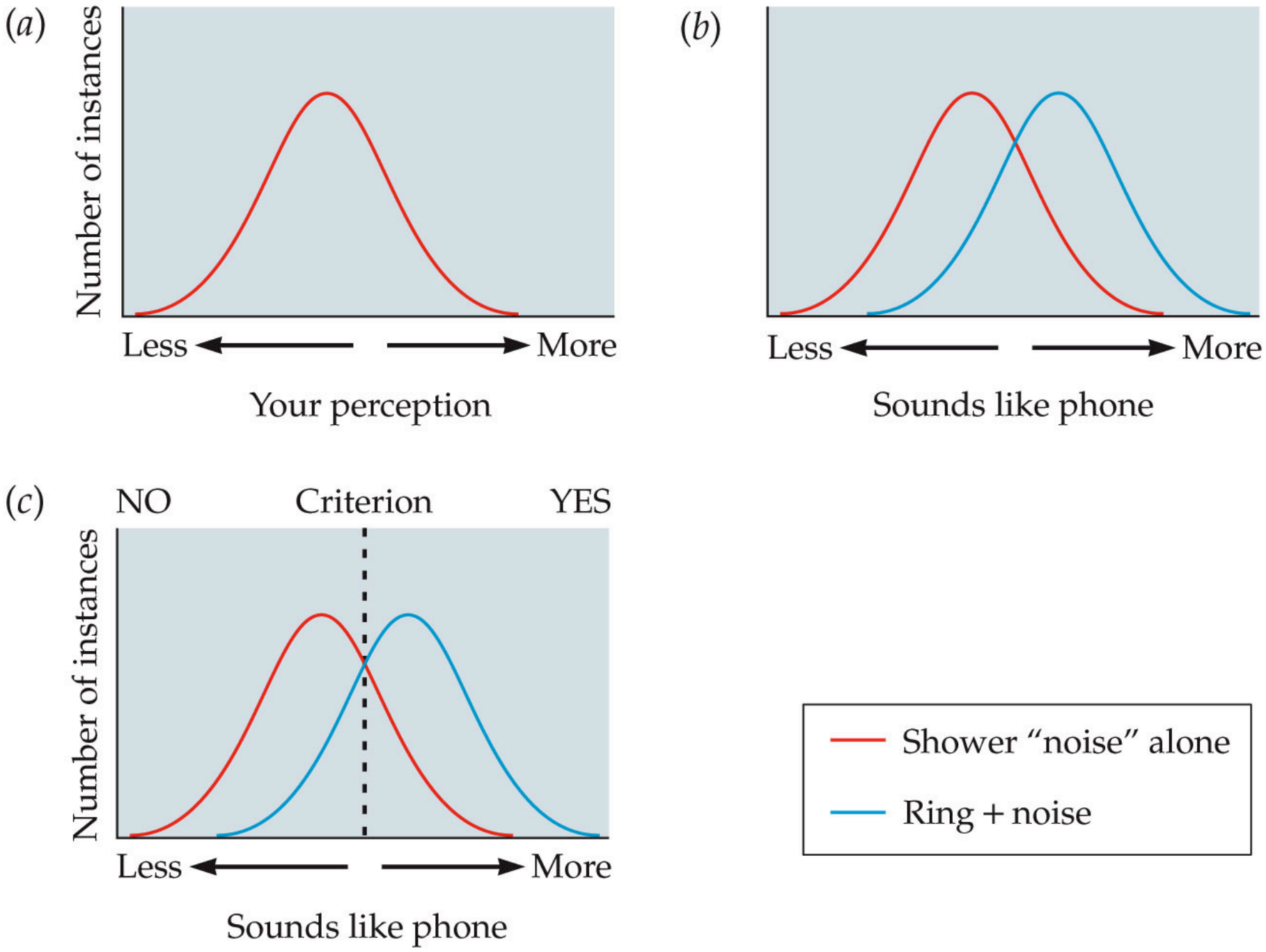
- relates physical quantity to the probability of detecting it



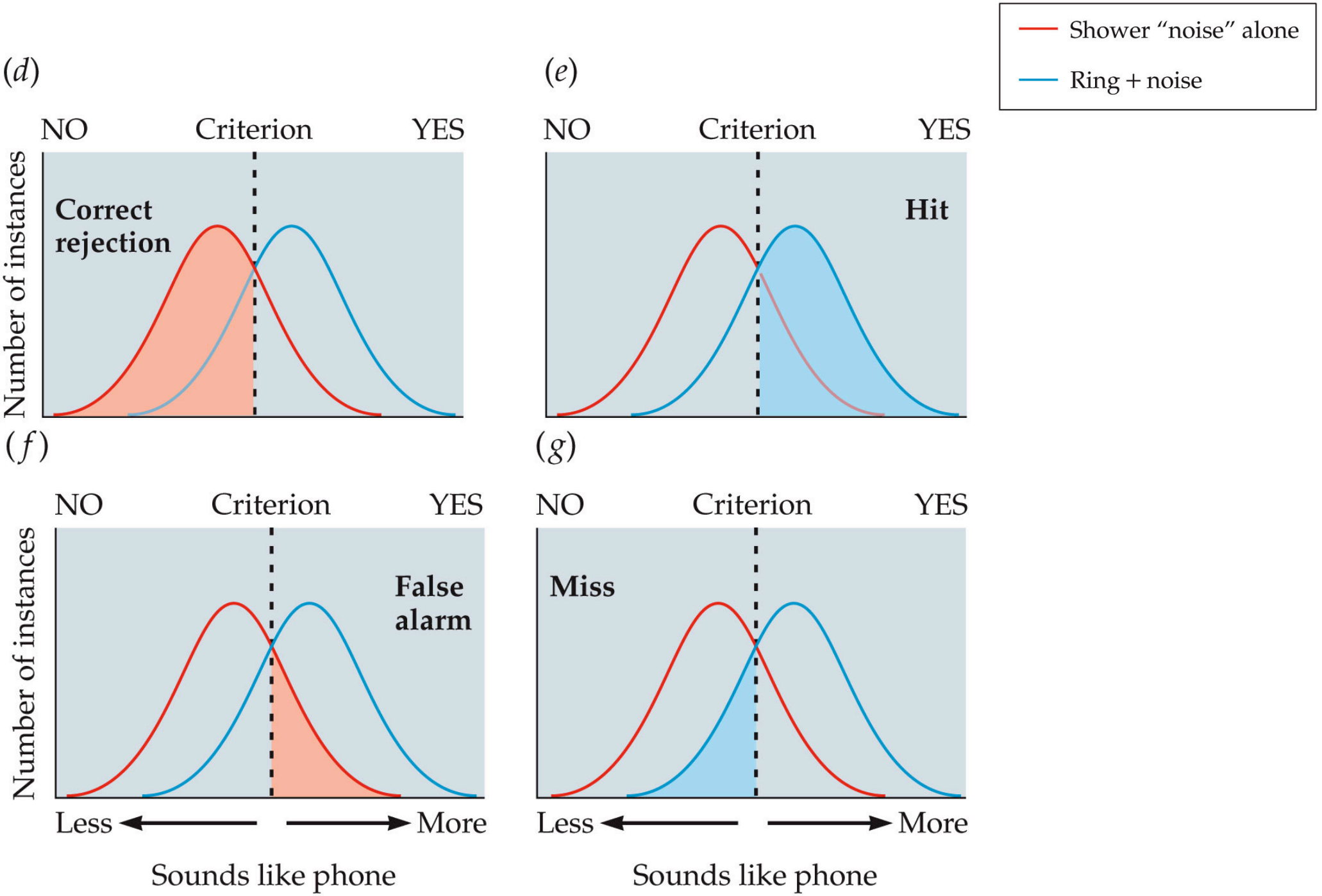
Signal detection theory: A psychophysical theory that quantifies the response of an observer to the presentation of a signal in the presence of noise

(On board)

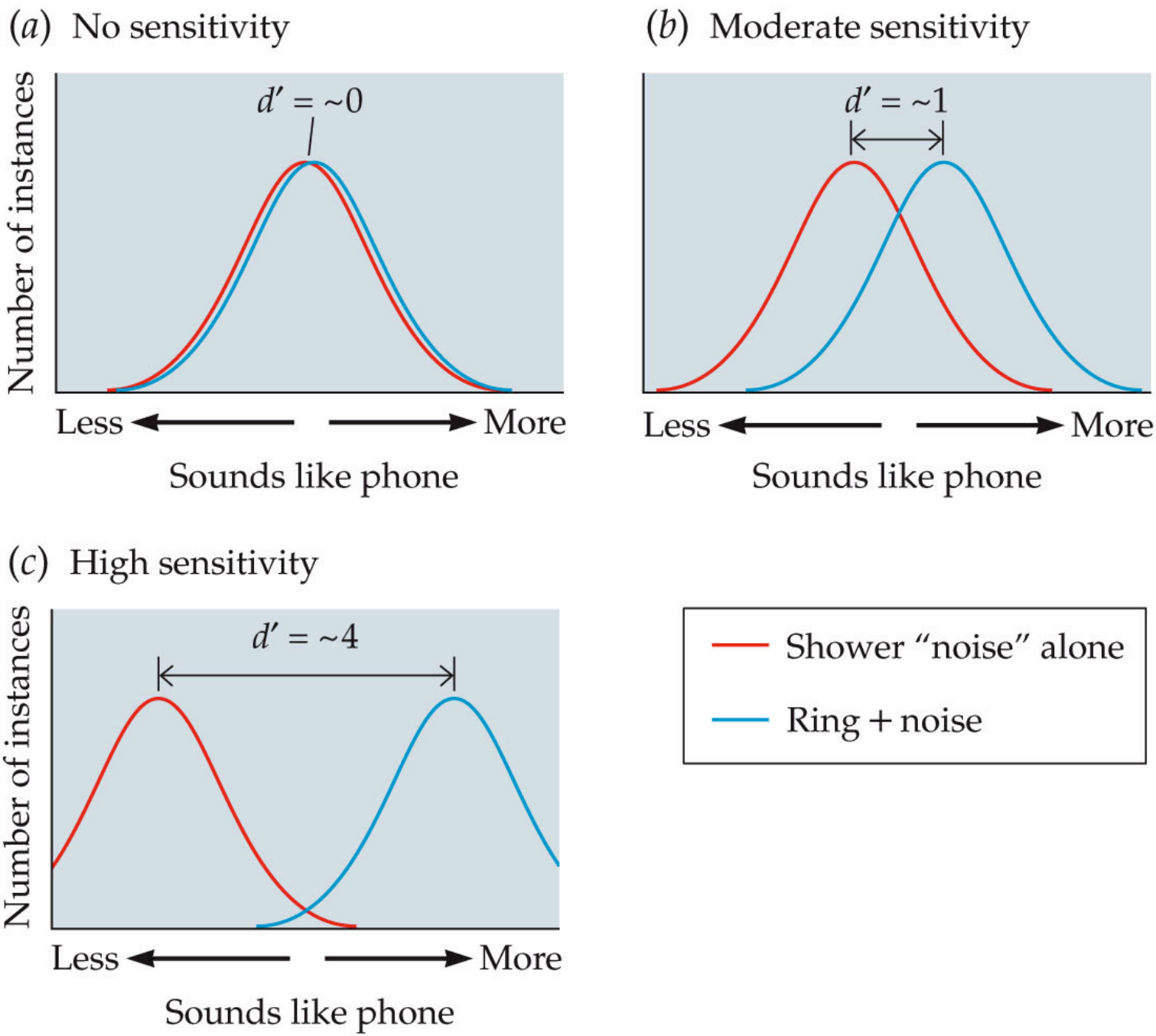
Detecting a stimulus using the signal detection theory (SDT)



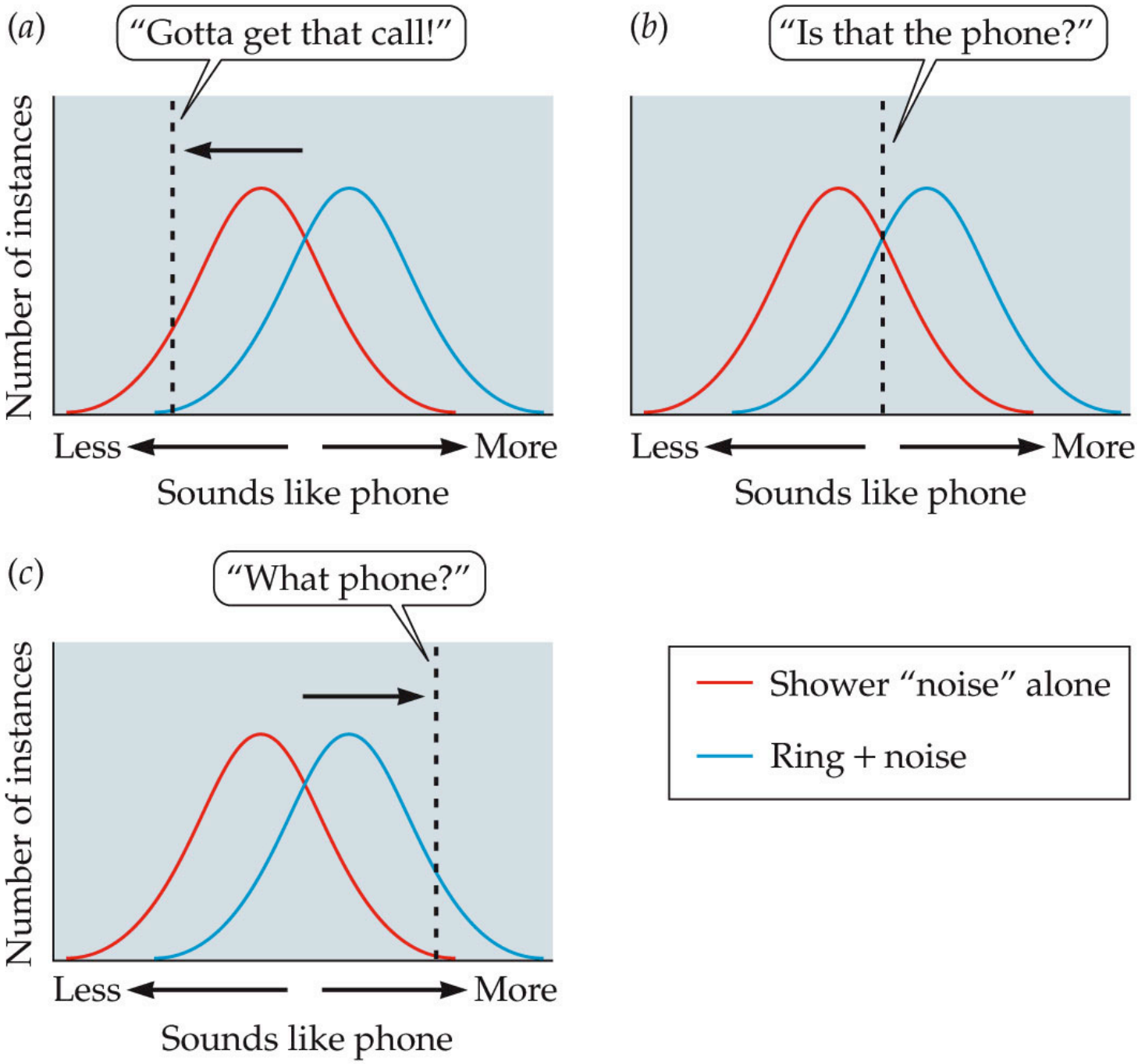
Detecting a stimulus using the signal detection theory (SDT)



Sensitivity to a stimulus: The separation between the distributions of response to noise alone and to signal plus noise



For a fixed d', shifting the response criterion



Signal detection theory

- **Hit**: Stimulus is presented and observer responds “Yes”
- **Miss**: Stimulus is presented and observer responds “No”
- **False alarm**: Stimulus is not presented and observer responds “Yes”
- **Correct rejection**: Stimulus is not presented and observer responds “No”

Signal Detection Theory Terms to know:

“noise” distribution: values arising when stimulus not present

“signal” distribution: values arising when signal + noise present

Type I error: rate of “false alarms”, or false positives

Type II error: rate of “misses”, or false negatives

psychometric function: describes probability of saying “I heard it” as function of stimulus intensity

Chapter 1 Summary

- Weber-Fechner law
- Stevens' power law
- psychophysics
- psychometric function
- signal detection theory: threshold, criterion, Hit/Miss, FA/CR, d' (i.e., "d-prime")
- spikes, synapses, neurotransmitter

You can safely ignore (for now)

- method of constant stimuli / method of adjustment
- ROC curves
- Fourier analysis (though we will come back to it!)
- Cranial nerves (Fig 1.20)
- brain anatomy (Fig 1.21, but we will come back as needed)

Next: Read Chapter 2