Fechnerian Psychophysics

* G. T. Fechner, *Elements of Psychophysics (Vol. 1)*. New York: Holt, Rinehart and Winston, Inc., 1860/1966.

© Hong Z. Tan & Zygmunt Pizlo

1

Outline

- Definition of perception
- Fechnerian causal chain of events
- Inner and outer psychophysics
- Percept viewed as an inverse problem
- Definition of absolute and difference threshold
- Classical threshold theory
- **■** Weber's Law
- Fechner's and Steven's Laws

© Hong Z. Tan & Zygmunt Pizlo

Definition of Perception

The goal (task) of perception is to acquire accurate and reliable (precise) information about the environment.

© Hong Z. Tan & Zygmunt Pizlo

3

Fechnerian causal chain of events

Distal stimulus (e.g. object in 3D space)

Proximal stimulus (e.g. 2D retinal image)

Transduction (e.g. light to electrical energy)

Brain Processes

Percept

© Hong Z. Tan & Zygmunt Pizlo

Inner and Outer Psychophysics

- Inner psycho-physics refers to the relation between the brain and the percept (mind-body problem)
- Outer psycho-physics refers to the relation between the stimulus (distal or proximal) and the percept

This course covers the methodology of studying outer psychophysics

© Hong Z. Tan & Zygmunt Pizlo

5

Percept Viewed as an Inverse Problem

Outer psychophysics can also be viewed as a composition of forward and inverse problems:

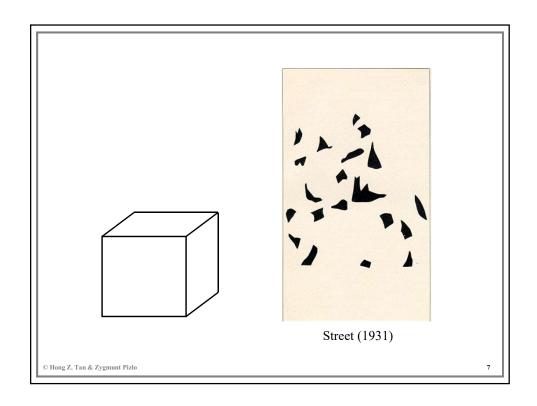
distal stimulus \longrightarrow proximal stimulus

this is a forward problem and it is expressed in the rules of physics

proximal stimulus → percept

this is an inverse problem and it involves perceptual inferences - inverse problems are difficult

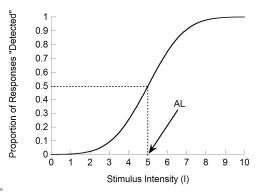
© Hong Z. Tan & Zygmunt Pizlo



Absolute threshold Absolute threshold (AL: absolute limen) is the smallest amount of stimulus energy that can be reliably detected **Classical Threshold Theory:** Proportion of Responses "Detected" 0.9 8.0 0.7 0.6 0.5 0.4 0.3 0.2 4 5 6 7 8 9 10 Stimulus Intensity (I) © Hong Z. Tan & Zygmunt Pizlo

Perceptual representation of a stimulus is not constant; it involves an additive random error. It follows that the psychometric function is not a step-function. Instead it is an S-shaped curve.

AL is defined as the 50th percentile point:

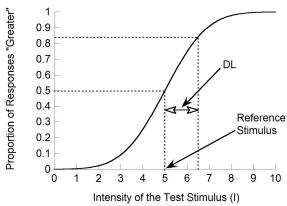


© Hong Z. Tan & Zygmunt Pizlo

9

Difference threshold

Difference threshold (DL: difference limen) is the smallest difference between two stimuli that can be reliably detected



© Hong Z. Tan & Zygmunt Pizlo

Weber's Law

Difference threshold is proportional to the magnitude (intensity) of the stimulus:

$$DL = w \cdot I$$

w = DL/I is called the Weber fraction

w is a constant for many variables (i.e., DL grows linearly with I)

© Hong Z. Tan & Zygmunt Pizlo

11

Perceived Magnitude

■ Fechner's Law:

$$dP = c \cdot dI/I \longrightarrow P = c' \cdot log(I/I_0)$$

■ Compare to Weber's Law:

$$w = DL/I = constant \longrightarrow DL = w \cdot I$$

© Hong Z. Tan & Zygmunt Pizlo (JND: just noticeable difference = change in P w.r.t. DL)

Perceived Magnitude (cont.)

■ Stevens's (power) Law:

$$dP/P = c \cdot dI/I \longrightarrow P = c' \cdot I^n$$
(n: fraction or integer)

© Hong Z. Tan & Zygmunt Pizlo

13

Reading

■ Chapter1 of Gescheider's Psychophysics book (available on the course website)

© Hong Z. Tan & Zygmunt Pizlo