Cognitive (Neuro) Psychology
IV. Psychophysics

Marianne Maertens

Technische Universität Berlin
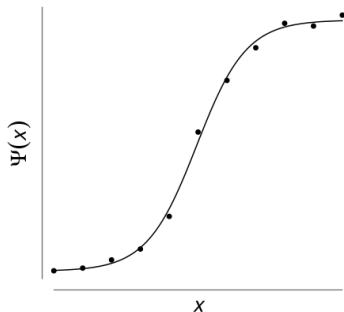
July 2016

Layout

Psychophysics

- subdiscipline of psychology
- addresses the relationship between physical stimuli, x, and their subjective correlates (percepts), $\Psi(x)$
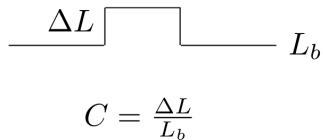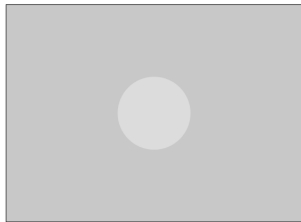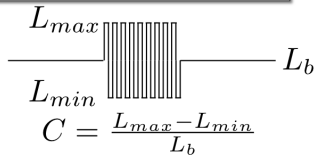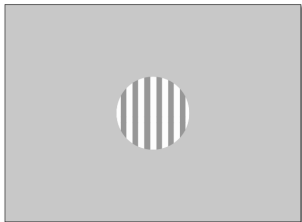
Components of a psychophysics experiment

- stimuli
- task
- method
- analysis
- measure

Measure: contrast sensitivity

Stimulus

L_{max}

L_{min}

L_b

$C = \frac{L_{max} - L_{min}}{L_b}$

ΔL

L_b

$C = \frac{\Delta L}{L_b}$
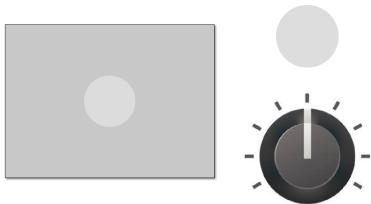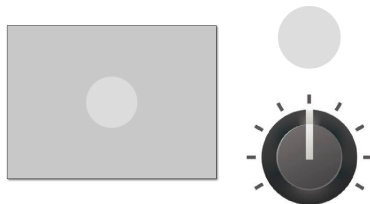
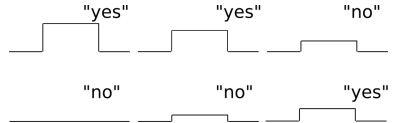- Method of adjustment

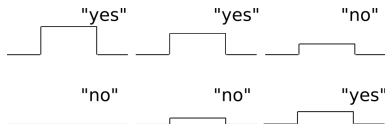# Task

- Method of adjustment

- 2-alternative
  forced-coice (2-AFC)

Method & Analysis

- Adaptive procedure

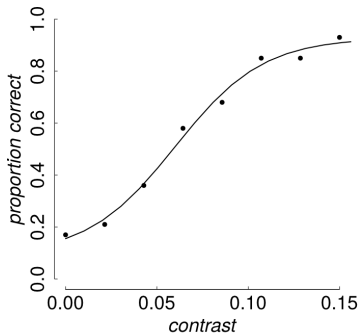# Method & Analysis

- Adaptive procedure

- Method of constant stimuli

Layout

Dichotomies

- all understanding begins with making comparisons and those comparisons, in turn, lead to the construction of categories
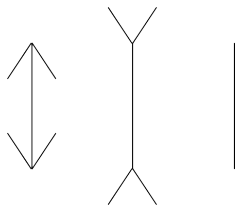
Dichotomies

- all understanding begins with making comparisons and those comparisons, in turn, lead to the construction of categories

- simplify and make explicit design choices
- which method is appropriate for studying which aspect of visual functioning
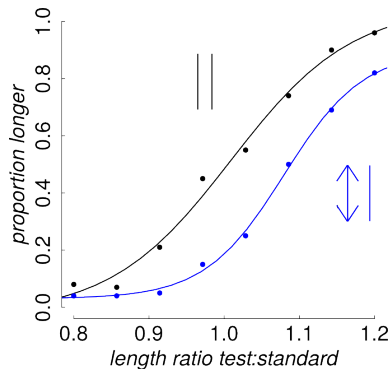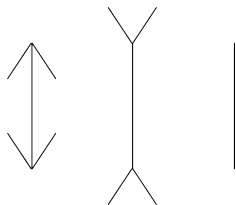
Objective vs. Subjective

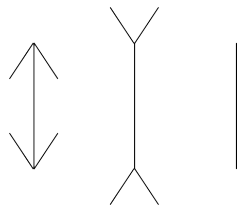- nature of measurement e.g. Muller-Lyer illusion

Objective vs. Subjective

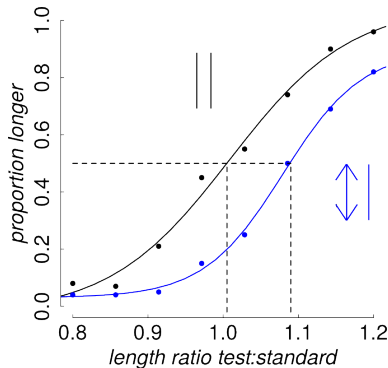- nature of measurement e.g. Muller-Lyer illusion

Objective vs. Subjective

- nature of measurement e.g. Muller-Lyer illusion

- PSE: point of subjective equality
- objective: correct vs. incorrect

Objective vs. Subjective

- method of data collection

  method of adjustment = subjective
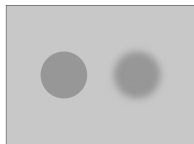 method of constant stimuli = objective

Performance vs. appearance

- How good is an observer in a particular task? e.g. orientation discrimination in the fovea vs. the periphery

- Performance can not be meaningfully considered as 'better' e.g. apparent lightness of targets

Performance vs. appearance

- How good is an observer in a particular task? e.g. orientation discrimination in the fovea vs. the periphery

- Performance can not be meaningfully considered as 'better' e.g. apparent lightness of targets

Performance vs. appearance

- How good is an observer in a particular task? e.g. orientation discrimination in the fovea vs. the periphery

- Performance can not be meaningfully considered as 'better' e.g. apparent lightness of targets
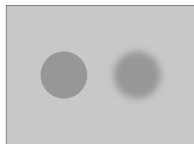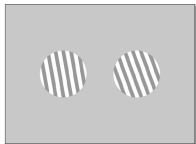

- accuracy
- threshold

- PSE
- scales

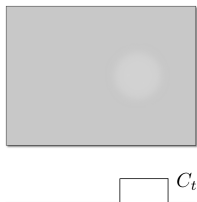# Forced-choice vs. non-forced

- criterion-free vs. criterion-dependent
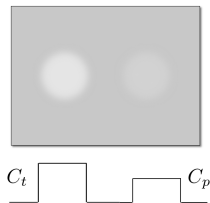
Detection vs. Discrimination

- is there a / where is the single stimulus?
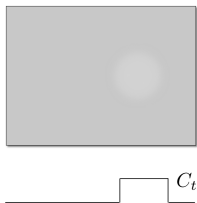
- which of two stimuli is more 'x'?

Detection vs. Discrimination

- is there a / where is the single stimulus?

- which of two stimuli is more 'x'?
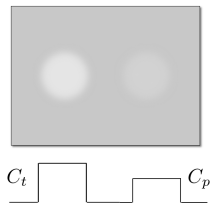
Detection vs. Discrimination

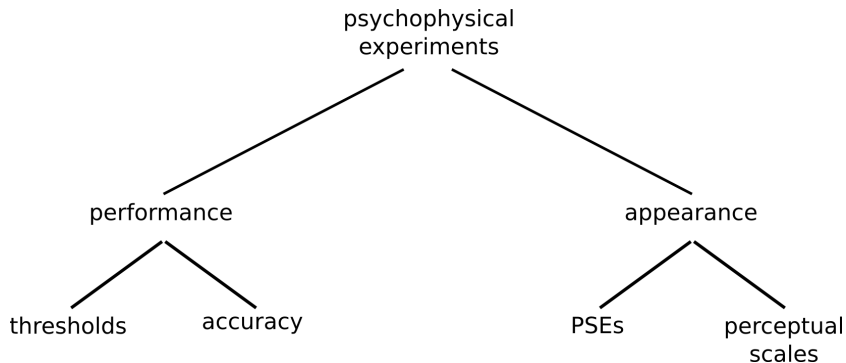- is there a / where is the single stimulus?

- which of two stimuli is more 'x'?
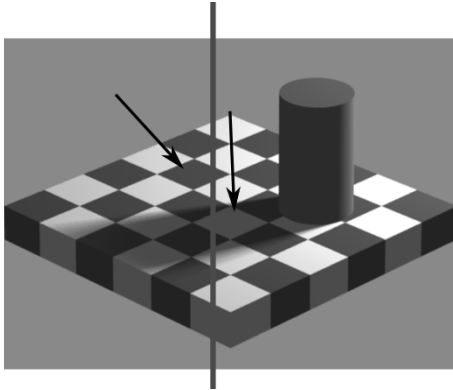

C_t

C_t C_p

- contrast discrimination - detection of an increment on a pedestal

Psychophysics Summary

Thinking
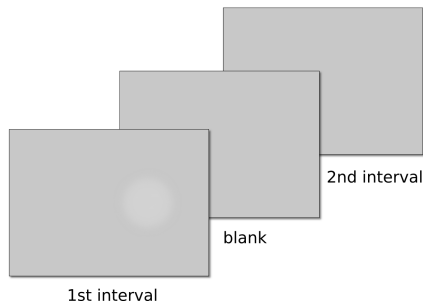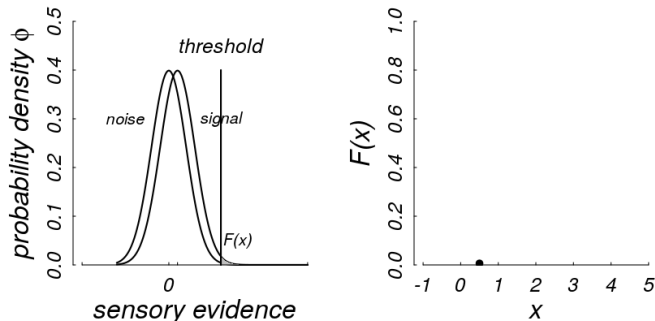
The two checks indicated by arrows have the same retinal luminance but differ in apparent lightness. Design an experiment to quantify the perceived difference between the two checks!

Psychometric function theories: high threshold theory

- 2-IFC: *S* signal and *N* noise
- Which of the two intervals contained the stimulus?
- sensory evidence fluctuates from trial to trial $n \sim N(0, 1)$

Psychometric function theories: high threshold theory

- according to high-threshold theory the sensory mechanism will detect the stimulus when the amount of sensory evidence exceeds a fixed internal criterion
- $F(x)$: probability that the threshold will be exceeded by a stimulus of intensity x

Psychometric function theories: high threshold theory

- according to high-threshold theory the sensory mechanism will detect the stimulus when the amount of sensory evidence exceeds a fixed internal criterion
- $F(x)$: probability that the threshold will be exceeded by a stimulus of intensity x

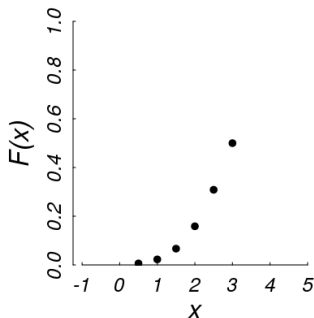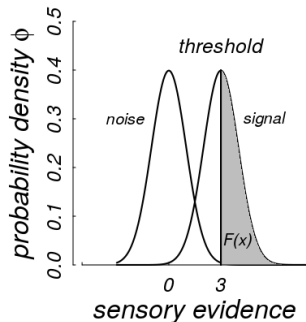# Psychometric function theories: high threshold theory

- according to high-threshold theory the sensory mechanism will detect the stimulus when the amount of sensory evidence exceeds a fixed internal criterion
- $F(x)$: probability that the threshold will be exceeded by a stimulus of intensity x

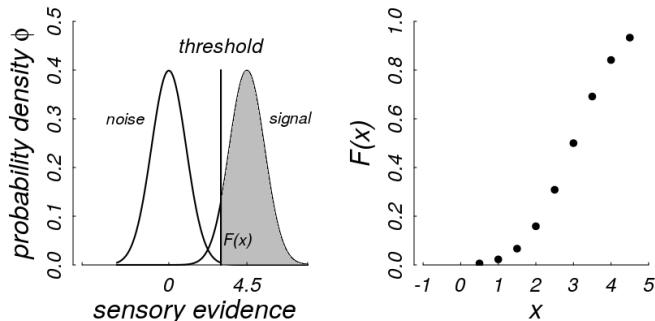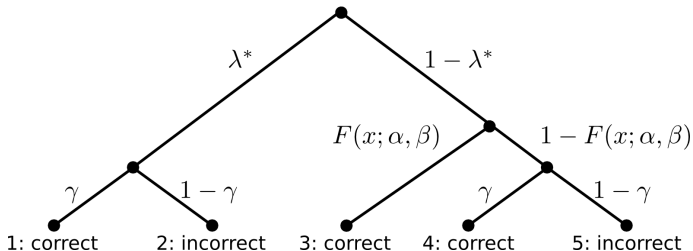# Psychometric function theories: high threshold theory

- according to high-threshold theory the sensory mechanism will detect the stimulus when the amount of sensory evidence exceeds a fixed internal criterion
- $F(x)$: probability that the threshold will be exceeded by a stimulus of intensity x

High threshold theory - decision process

$$\Psi(x; \alpha, \beta, \gamma, \lambda) = \gamma + (1 - \gamma - \lambda^* + \gamma \cdot \lambda^*) \cdot F(x; \alpha, \beta)$$

- relation between observable behavior $\Psi(x)$ and unobservable decision mechanism $F(x)$
- λ : lapse rate
- γ : guess rate

- amount of sensory evidence accumulated is unavailable to the decision process
- probability that the threshold is exceeded when x=0, i.e. by noise is effectively zero, no false alarms

- Kingdom & Prins, Psychophysics. A practical introduction.
-
-