

Cognitive (Neuro) Psychology

IV. Psychophysics

Marianne Maertens

Technische Universität Berlin

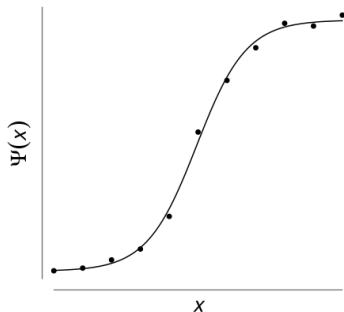
July 2016

Layout

1 Definition

2 Classification of Experiments

Psychophysics



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

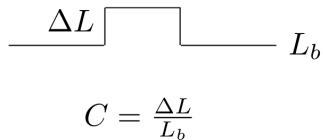
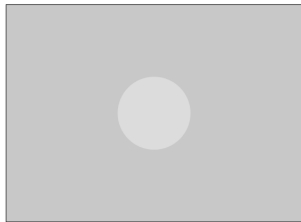
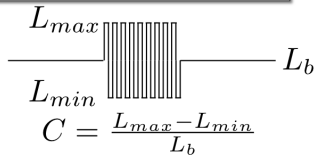
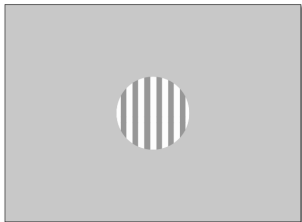
Components of a psychophysics experiment

- stimuli
- task
- method
- analysis
- measure

Measure: contrast sensitivity

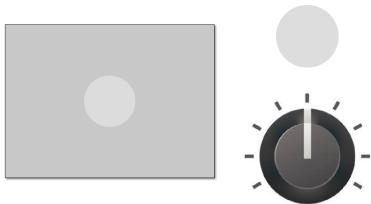


Stimulus



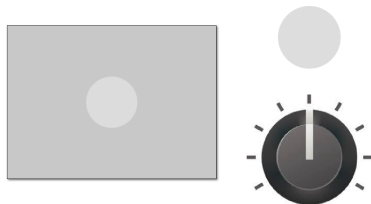
Task

- Method of adjustment



Task

- Method of adjustment

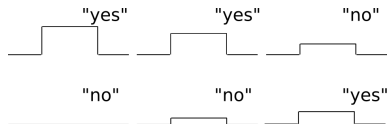


- 2-alternative forced-choice (2-AFC)



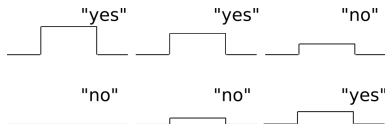
Method & Analysis

- Adaptive procedure

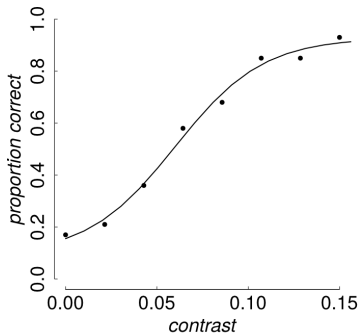


Method & Analysis

- Adaptive procedure



- Method of constant stimuli



Layout

1 Definition

2 Classification of Experiments

Dichotomies



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

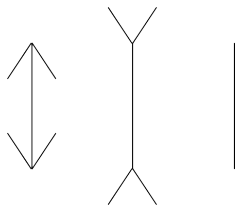
Dichotomies



- 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

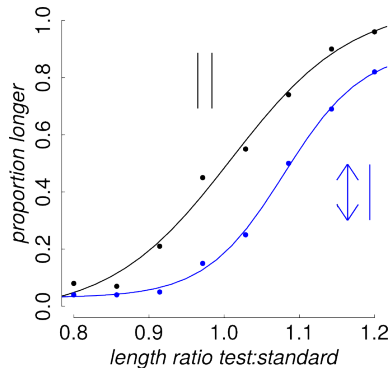
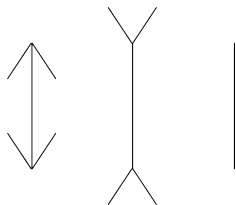
Objective vs. Subjective

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



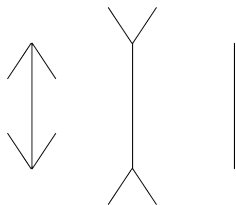
Objective vs. Subjective

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

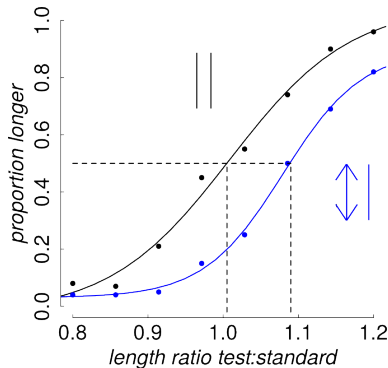


Objective vs. Subjective

- 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

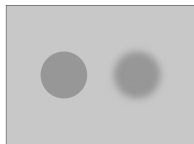
method of constant stimuli = objective

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

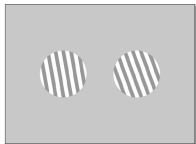
Performance vs. appearance

- 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

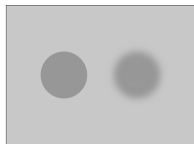


Performance vs. appearance

- 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

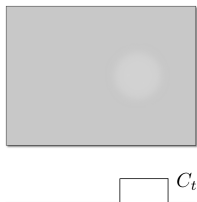
- criterion-free vs. criterion-dependent

Detection vs. Discrimination

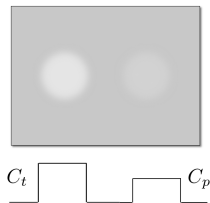
- is there a / where is the single stimulus?
- which of two stimuli is more 'x'?

Detection vs. Discrimination

- is there a / where is the single stimulus?

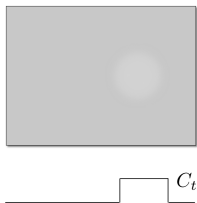


- which of two stimuli is more 'x'?

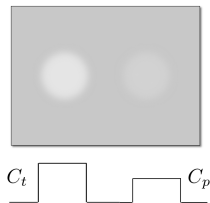


Detection vs. Discrimination

- is there a / where is the single stimulus?

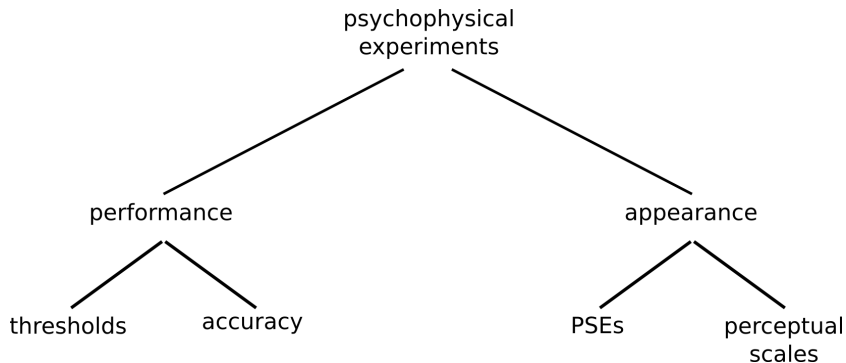


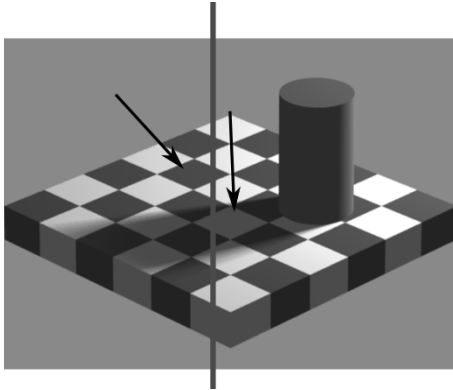
- which of two stimuli is more 'x'?



- contrast discrimination - detection of an increment on a pedestal

Psychophysics Summary

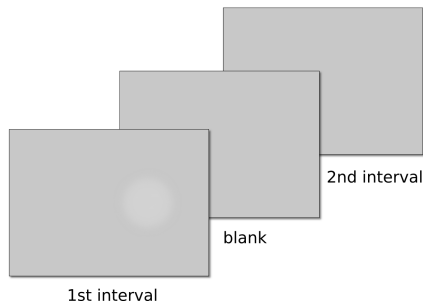




Thinking

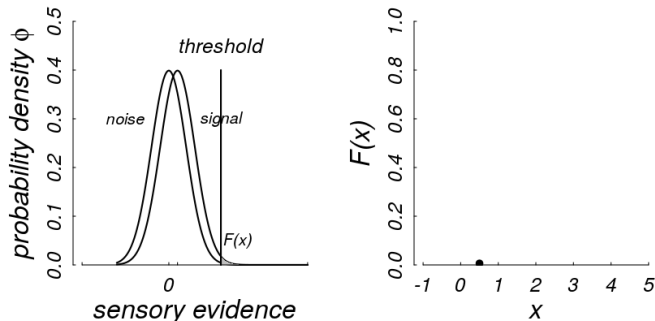
The two checks indicated by arrows have the same retinal luminance but differ in apparent lightness. Design an experiment to quantify the perceived difference between the two checks!

Psychometric function theories: high threshold theory



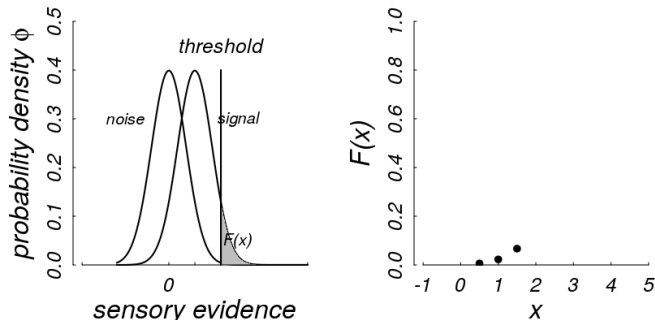
- 2-IFC: S signal and N noise
- Which of the two intervals contained the stimulus?
- sensory evidence fluctuates from trial to trial $n \sim N(0, 1)$

Psychometric function theories: high threshold theory



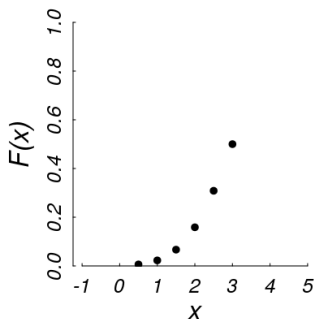
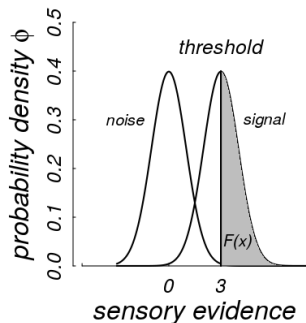
- according to high-threshold theory the sensory mechanism will detect the stimulus when the amount of sensory evidence exceeds a fixed internal criterion
- $F(x)$: probability that the threshold will be exceeded by a stimulus of intensity x

Psychometric function theories: high threshold theory



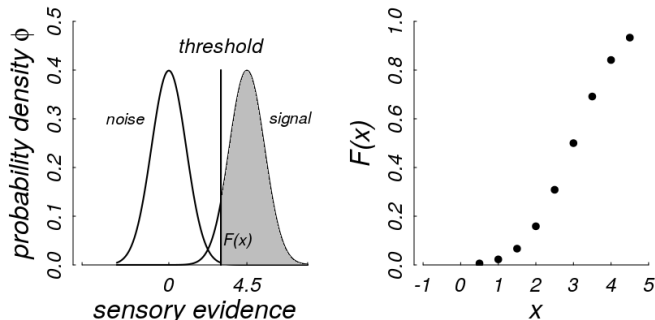
- according to high-threshold theory the sensory mechanism will detect the stimulus when the amount of sensory evidence exceeds a fixed internal criterion
- $F(x)$: probability that the threshold will be exceeded by a stimulus of intensity x

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

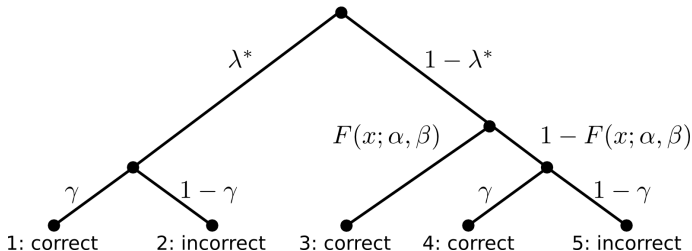
Psychometric function theories: high threshold theory



- 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

High threshold theory - assumptions

- 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

References

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