

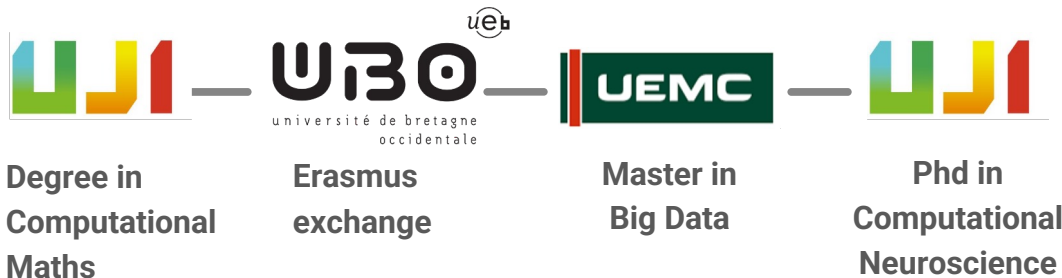


How to Set Up a Psychophysical Experiment

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Academic background



Experience

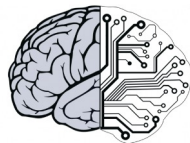


Data Scientist
Trading Algorithms



Data Engineer
ETL & SQL

Research



Computational neuroscience
NEURO-ML: Machine learning
through bio-inspired models

Interests

Deep Learning

NLP

Neuroscience

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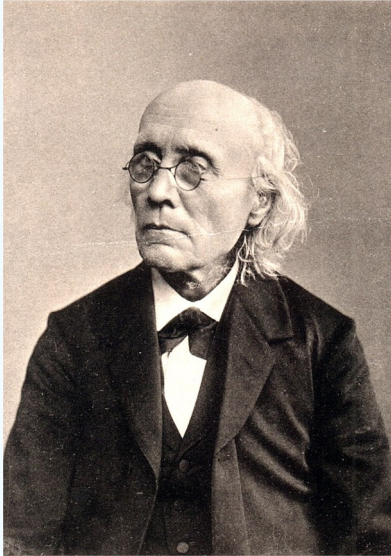
Introduction

Psychophysics

Psychophysics quantitatively investigates the relationship between physical stimuli and the sensations and perceptions they produce

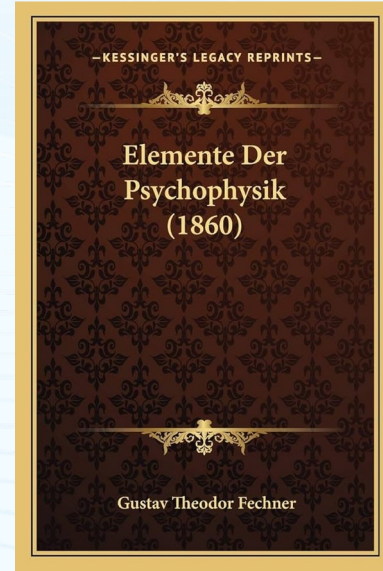


Gustav Fechner



German physicist, philosopher, and experimental psychologist

Fechner's law: $S = c \log R$



Fechner established the **principles of psychophysics**, describing various procedures to delineate the relationship between matter and mind

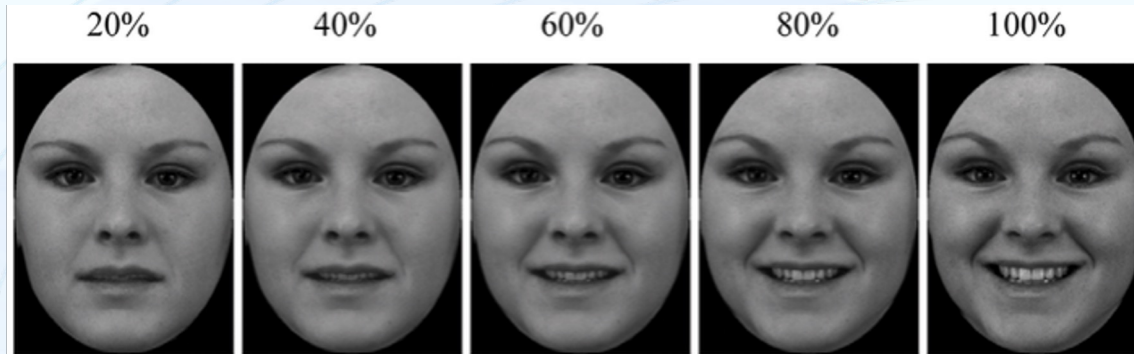
02

Components of a psychophysics experiment

Components of an experiment

We present the two images in the screen to the observer

Stimulus: any physical object, event, or situation that elicits a sensory or perceptual response in the observer



Components of an experiment

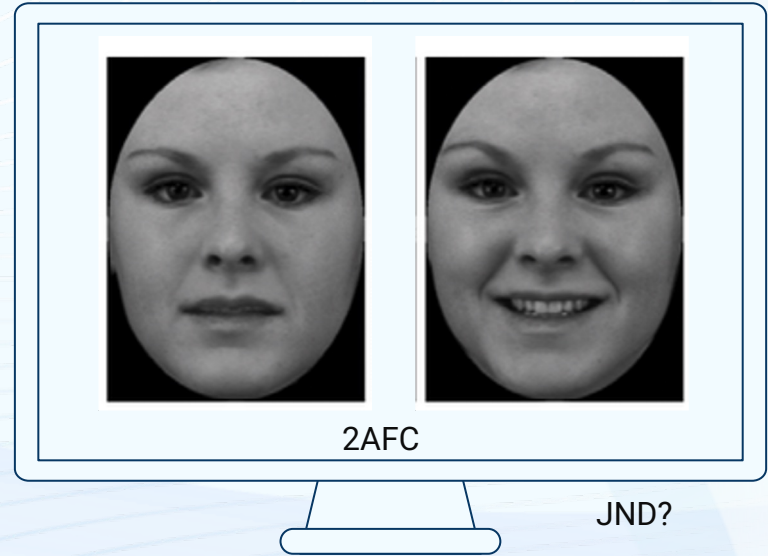
Stimulus: two images with different degrees of happiness of the person

Task: the activity or judgment assigned to the observer to perform

Method: the experimental procedure used to collect data

Analysis: the process of converting collected data into meaningful measurements

Measure: the result or specific metric of interest



03

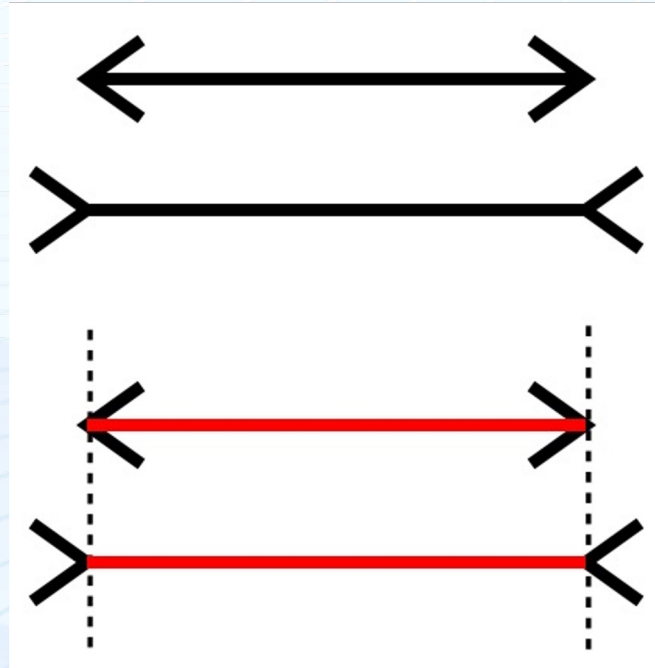
Classifying Psychophysical Experiments

Dichotomies

“Type 1” versus “Type 2”

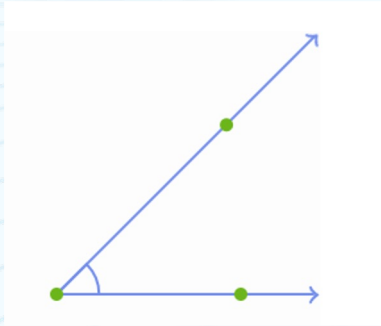
Psychophysical tasks that have correct and incorrect responses are termed Type 1, and those that do not are termed Type 2

Muller - Lyer illusion

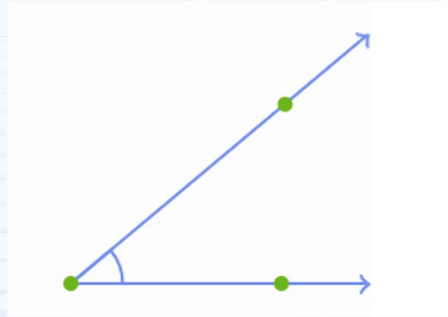


Dichotomies

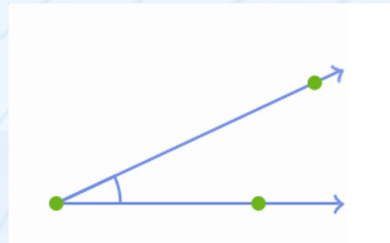
“Performance” versus “Appearance”



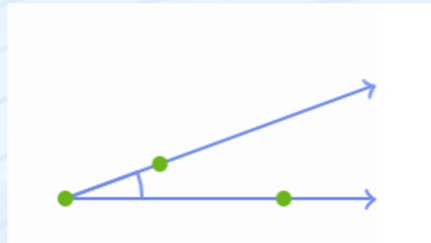
45°



40°



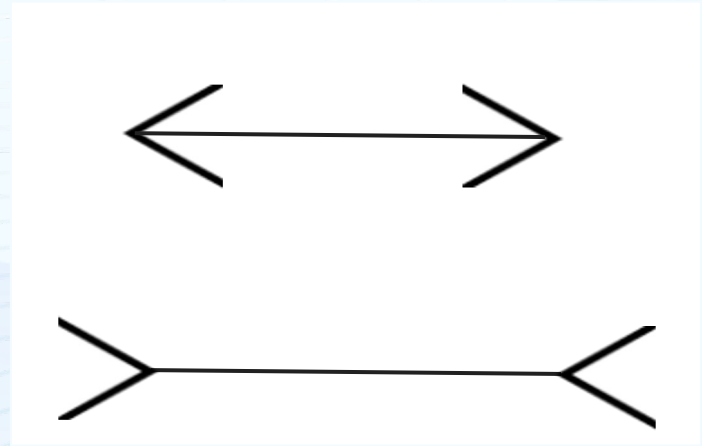
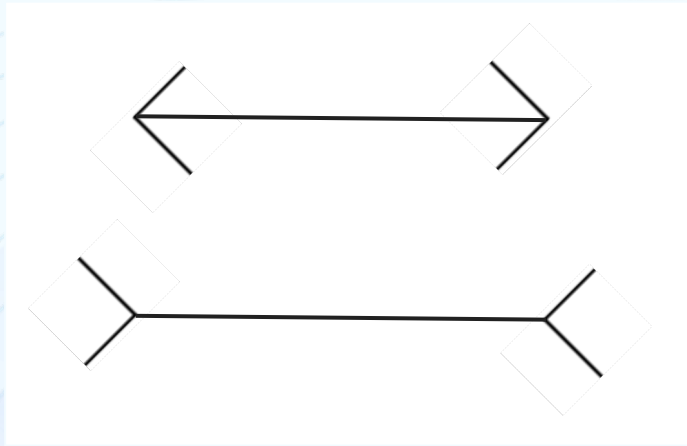
25°



20°

Dichotomies

“Performance” versus “Appearance”



Dichotomies

“Forced-Choice” versus “Non-forced-Choice”

Non-forced-choice: Observers may not be constrained to choose from pre-specified alternatives

Forced-choice: the observer is presented with predetermined response options and is required to select one of them on each trial

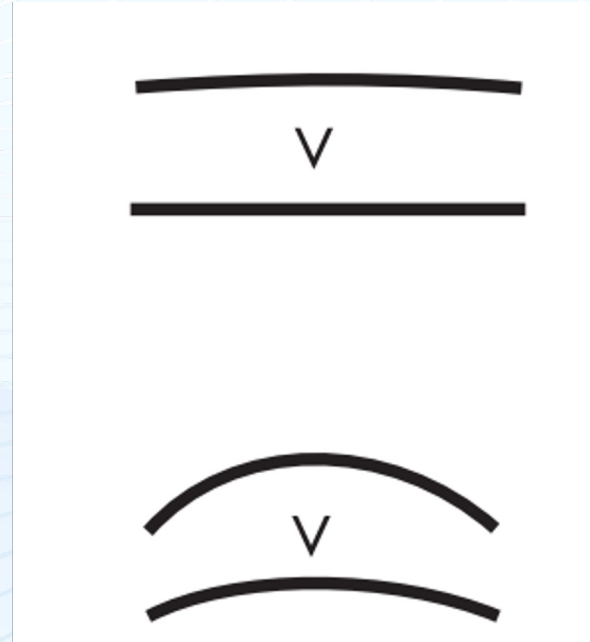


Dichotomies

“ Detection ” Versus “ Discrimination ”

Detection tasks: involve determining the presence or absence of a stimulus. The primary goal is to identify whether a sensory signal is present or not.

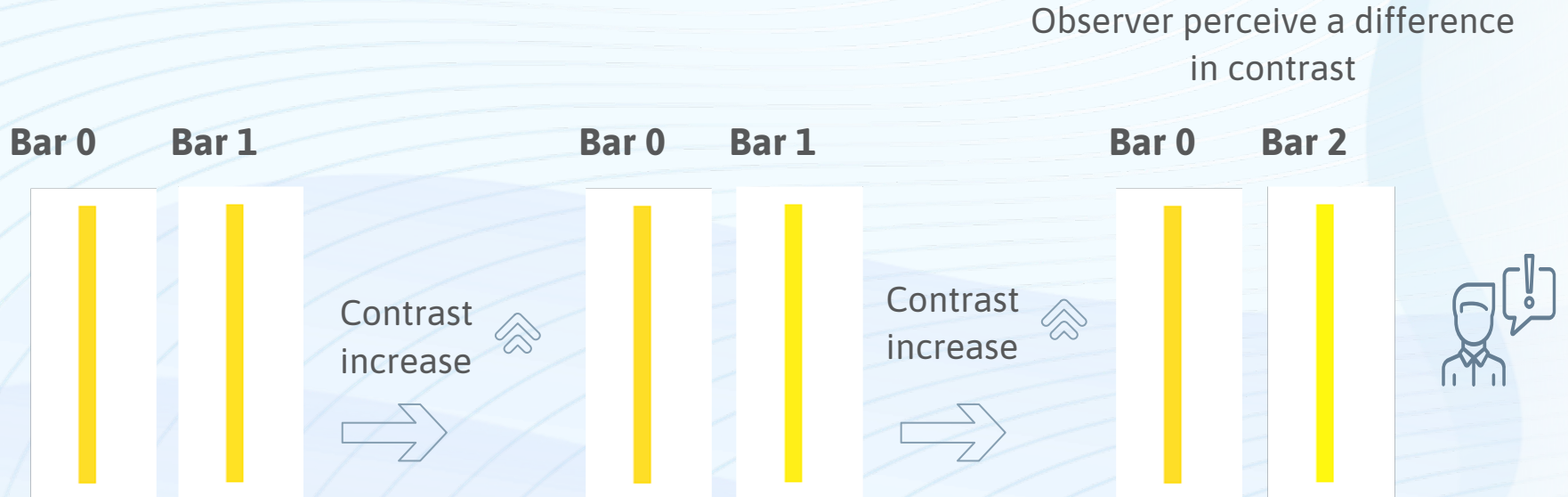
Discrimination tasks: involve distinguishing between different stimuli or different features of a stimulus. Both stimuli are usually non-null



Dichotomies

“Threshold” Versus “Suprathreshold”

Threshold (Contrast Discrimination) Task



Dichotomies

“ Threshold ” Versus “ Suprathreshold ”

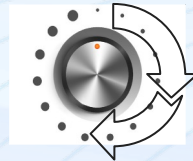
Suprathreshold (Contrast-Matching) Task

Match the perceived contrast of the adjustable Bar 1 to that of the constant Bar 3

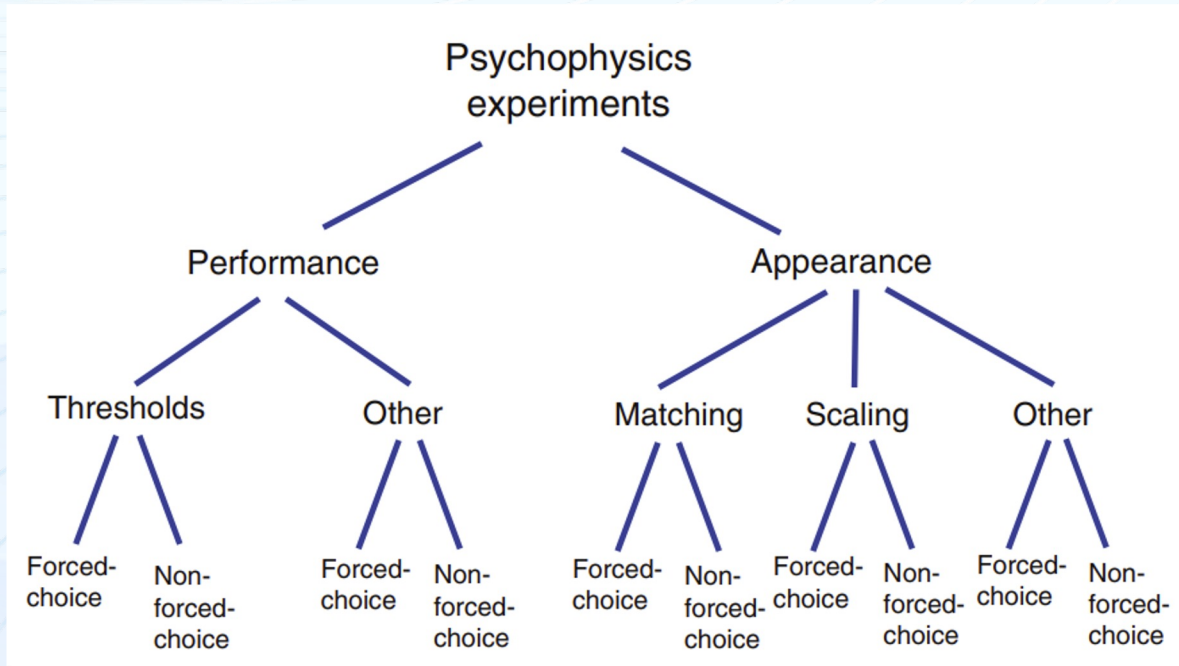
Bar 1



Bar 3



Classification of experiments



04

Methods and Procedures

Method of Constant Stimuli

The method of constant stimuli involves presenting stimuli of varying magnitudes randomly selected from a predefined set during an experimental session.

It is a versatile approach used to investigate both performance and appearance aspects in forced-choice experiments.

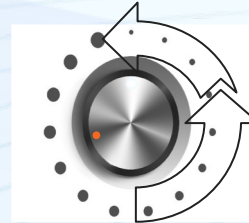


Methods Based on Threshold Measurements

Method of Adjustment



The goal is to decrease the luminance until it becomes imperceptible to the observer



Methods Based on Threshold Measurements

Method of Limits

The stimuli are presented in ascending or descending order.

The participant responds when they detect or stop detecting the stimulus.

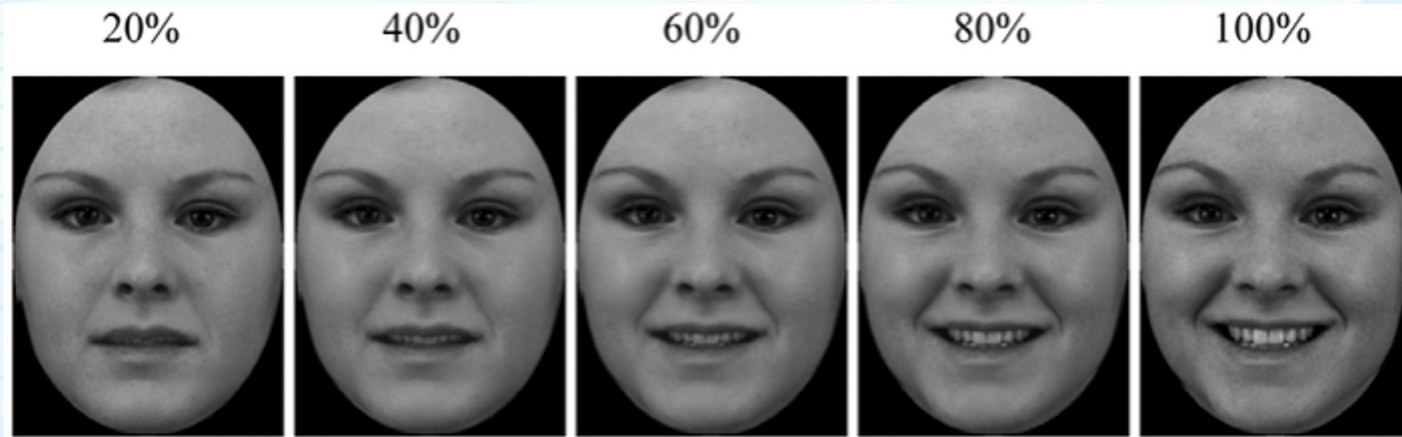


■ **FIGURE 2.4** Absolute threshold.

Illustration of the detection of absolute thresholds through the method of descending limits. Each light is more dim than the one to its left.

Forced-Choice Methods

Paired Comparisons



Forced-Choice Methods

Method of Triads

°TID 2008 is an example

Subjective experiments for TID2008



John Name
17 Image set

Start new experiment



Time: 1:01

Path to the image database:
d:\vid08\

Among two images in the upper part of the screen select the image that differs less from the sample image in the bottom part. Click mouse on it.

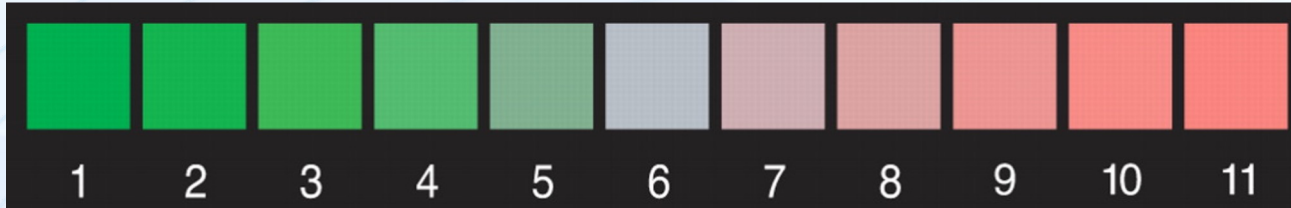
Please do not think too much. For each selection use up to 2-3 seconds.

If it is difficult to select (images quality is comparable) click on any of them.

Forced-Choice Methods

Method of Quadruples

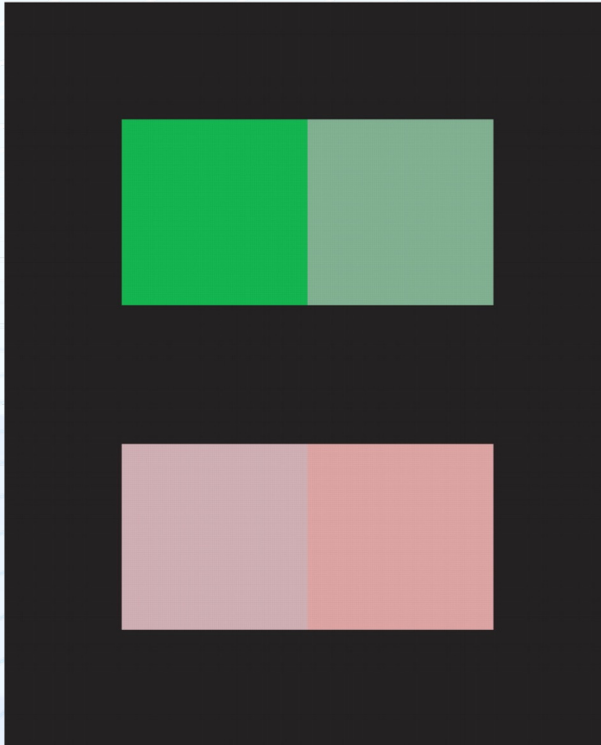
Method of Quadruples



Forced-Choice Methods

Method of Quadruples

Which is the most different pair?



05

Scaling Methods

MLDS

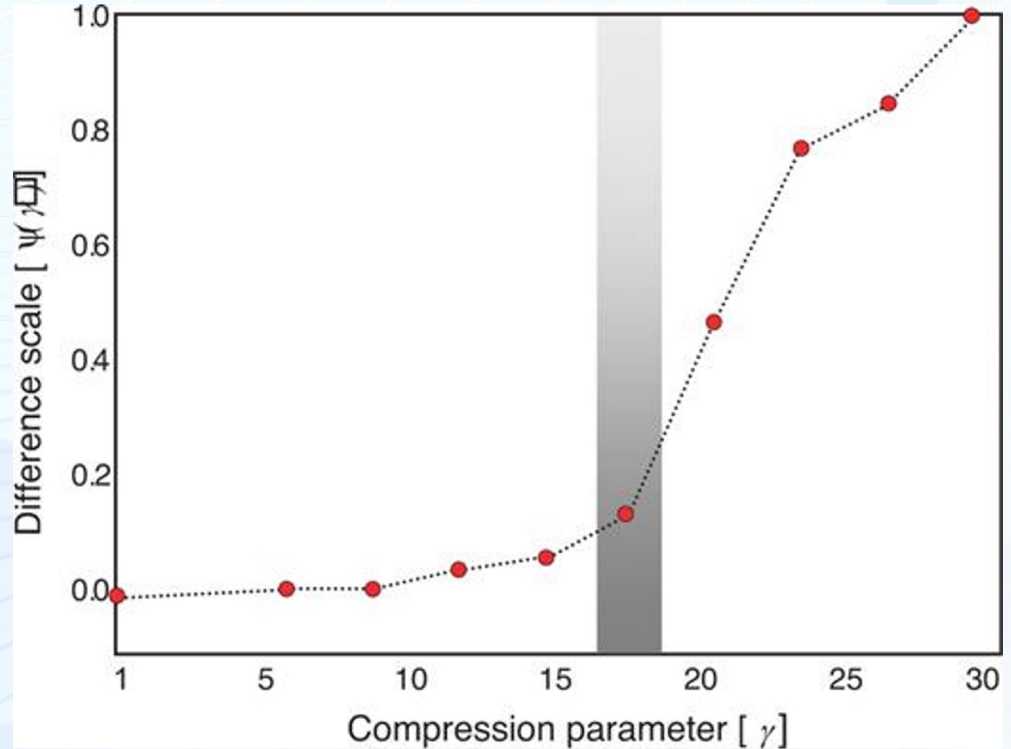
- We apply an image compression algorithm (vector quantization) on 'image quality' task
- The degree of compression is controlled by an arbitrary, univariate parameter, γ , that ranges from 1 ('no compression') to 30 ('maximum compression').



MLDS

The nominal value plotted on the horizontal axis is γ .

The values plotted along the vertical axis are scale values assigned to the 10 compressions of the same image by a maximum likelihood difference scaling



MLDS

What is being used for the MLDS?

- Obein et al. (2004) for measuring gloss
- Lindsey et al. (2010) used MLDS to estimate perceptual intervals between color stimuli to search for (and not find) evidence of categorical color boundaries
- Radonjić et al. (2019) developed a variation that extends MLDS to two-dimensional physical scale values rather than a unidimensional scale
- Knoblauch et al. (2020) investigated luminance and chromatic contrast response using MLDS in normal and anomalous trichromats

06

Conclusions

Conclusions

Summary of key findings

Finding A	Carefully designing the experiment is fundamental
Finding B	Appropriate methods should be selected and control variables that could influence the results
Finding C	Use appropriate statistical techniques to analyze the collected data
Finding D	Results should be interpreted cautiously, taking into account possible biases and limitations

Potential future advancements we are working on

- How are the rotation, translation and zoom transformations perceived by the humans?

Resources

[Maximum likelihood difference scaling | JOV | ARVO Journals](#)

[Nikolay Ponomarenko homepage - TID2013](#)

[Psychophysics | ScienceDirect](#)

[Measuring and Modeling Visual Appearance | Annual Review of Vision Science](#)

Thanks for your attention!

Do you have any questions?

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David Agost Beltrán

