DEGGENDORF INSTITUTE OF TECHNOLOGY

Human Factors and Human-Machine Interaction

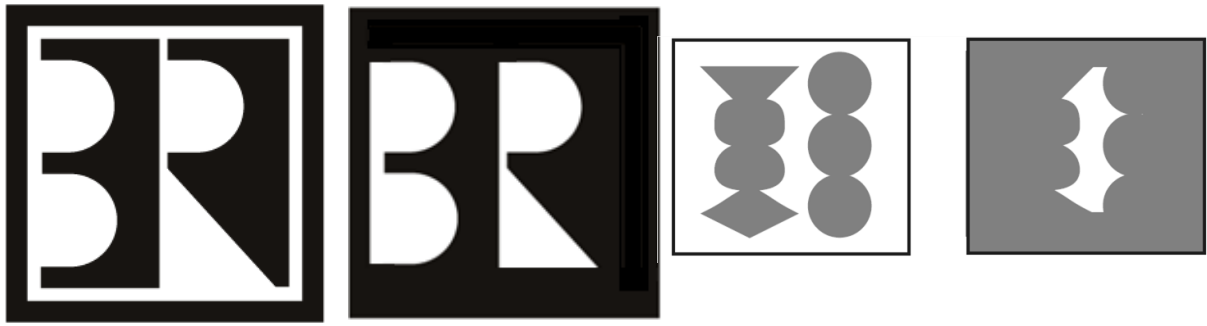
Cognitive Basics – Part 2

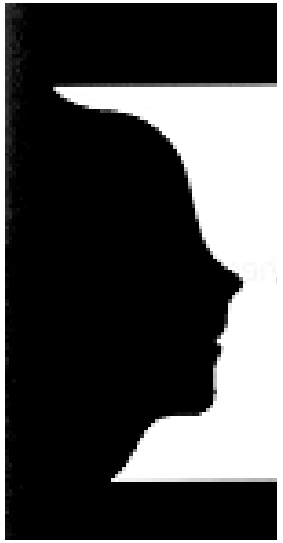
FACULTY

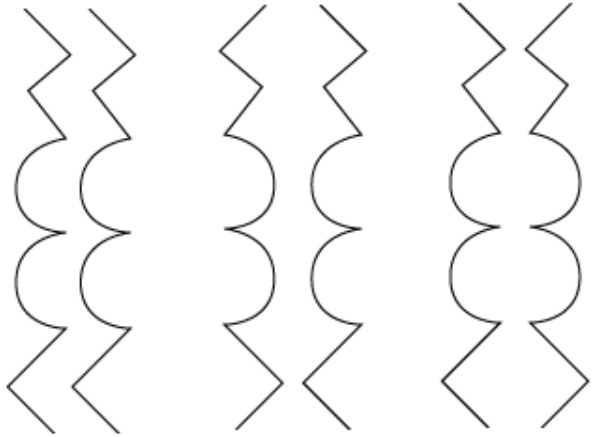
OF COMPUTER SCIENCE

PERCEPTUAL STRUCTURE

- **Objects** are perceived as separate from the **scenery**
- Problem of the **figure-ground** separation
- Decisive factors for the perception of a **figure**
  - symmetry - symmetrical objects
  - size - smaller objects
  - Orientation – vertical/horizontal objects
  - Meaning - meaningful representations
  - Outward curved shapes



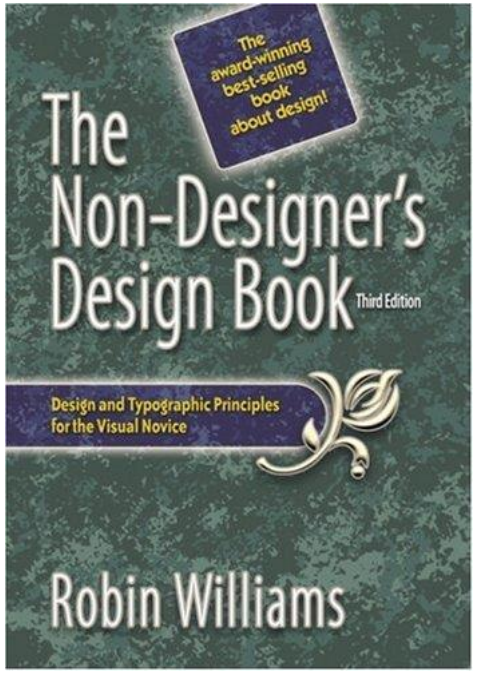




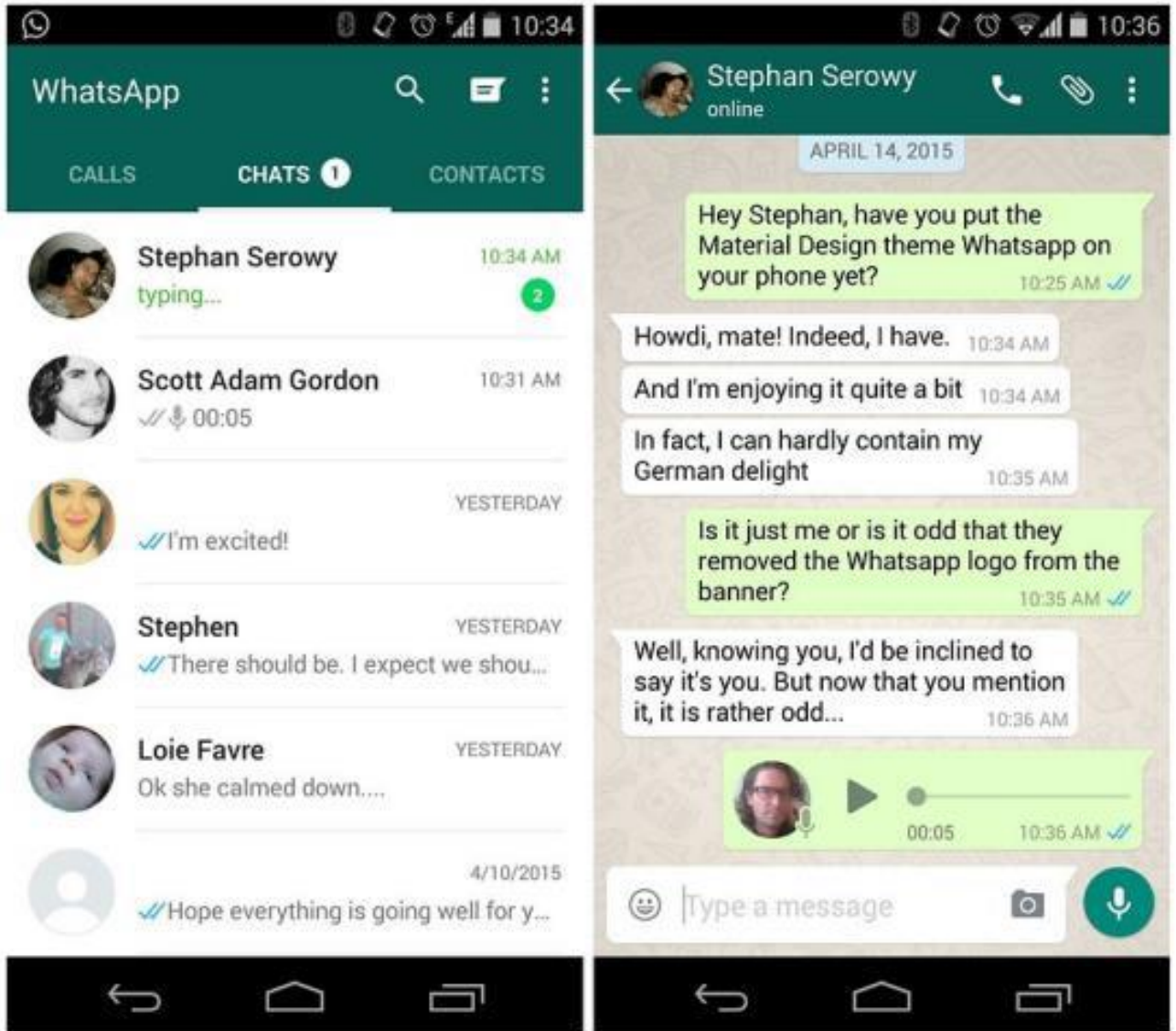
C.R.A.P.

Today you will learn about C.R.A.P.

- C.R.A.P. : The 4 basic principles of design.
- **C**ontrast
- **R**epetition
- **A**lignment
- **P**roximity
  - "...the basic principles of design that appear in every well-designed piece of work."
    - - Robin Williams,
    - *The Non-Designer's Design Book*



C.R.A.P. & GESTALT LAWS



- C.R.A.P. : The 4 basic principles of design.
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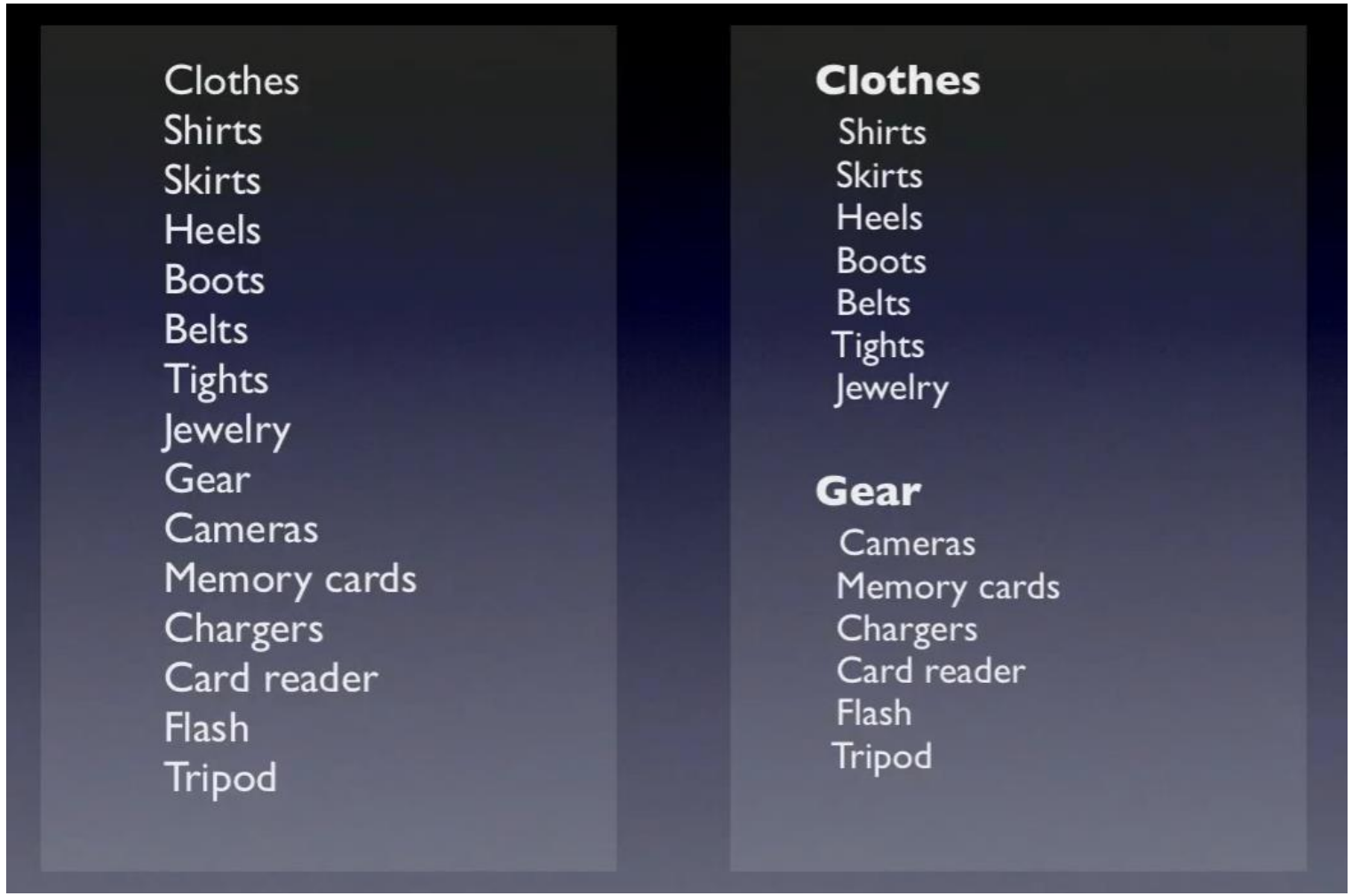
C.R.A.P. & GESTALT LAWS



C.R.A.P. : The 4 basic principles of design.

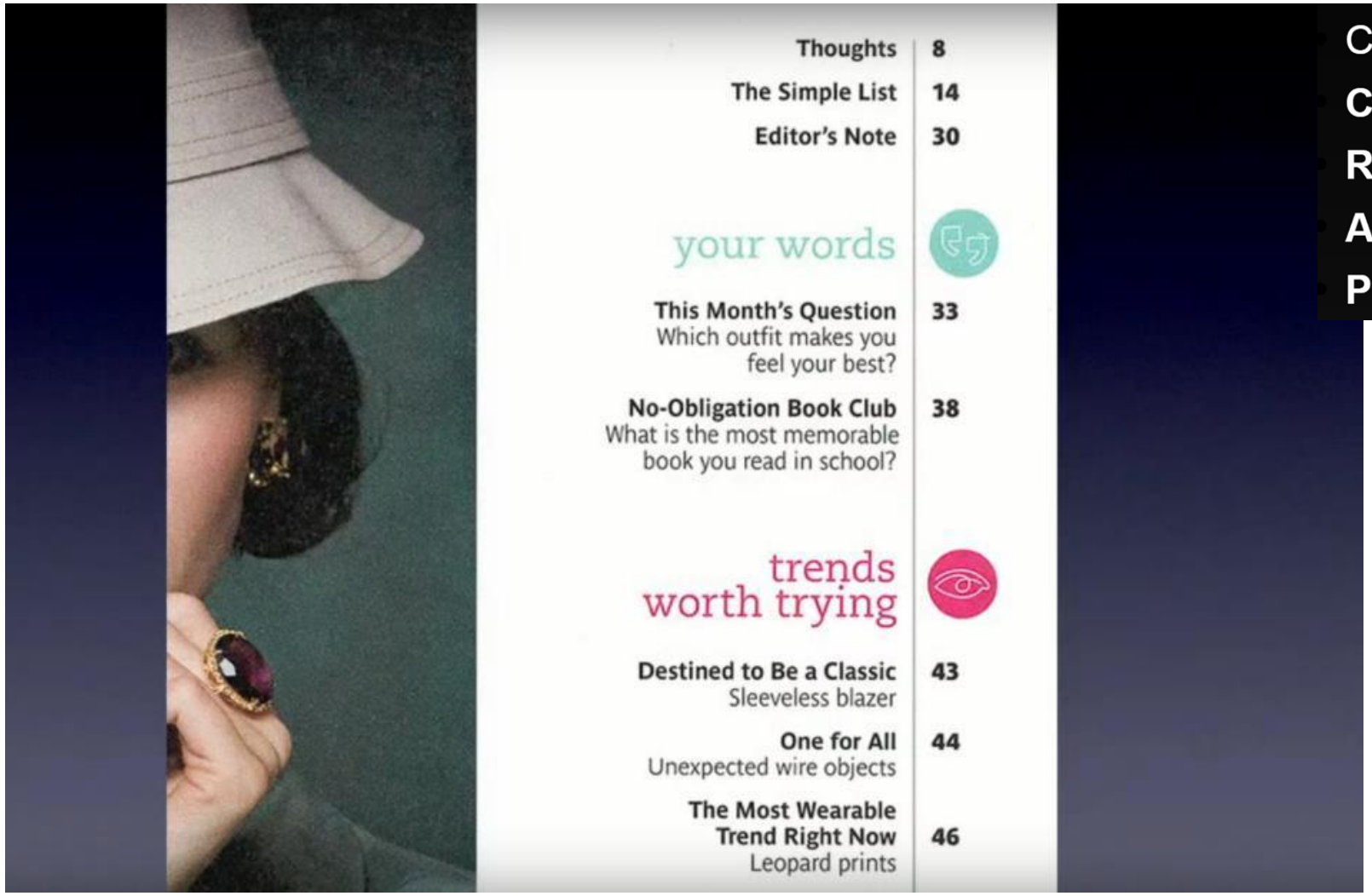
Contrast

Repetition

Alignment

Proximity

C.R.A.P. & GESTALT LAWS



- C.R.A.P. : The 4 basic principles of design.
- **C**ontrast
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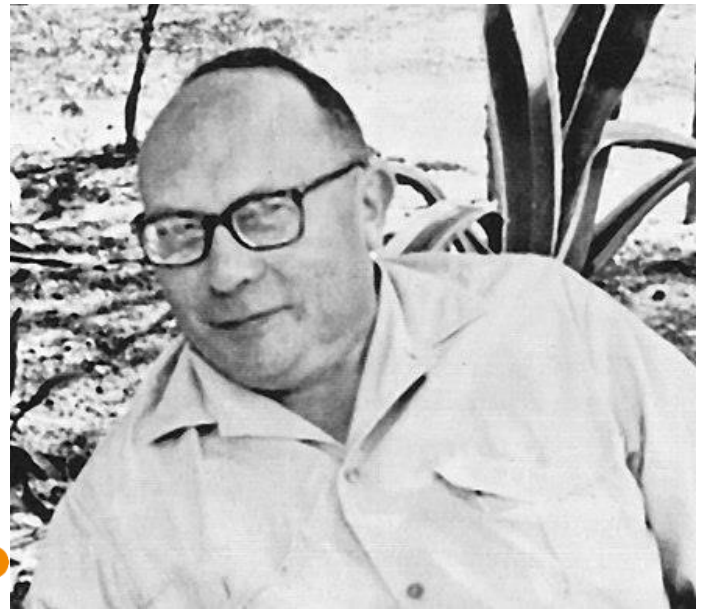
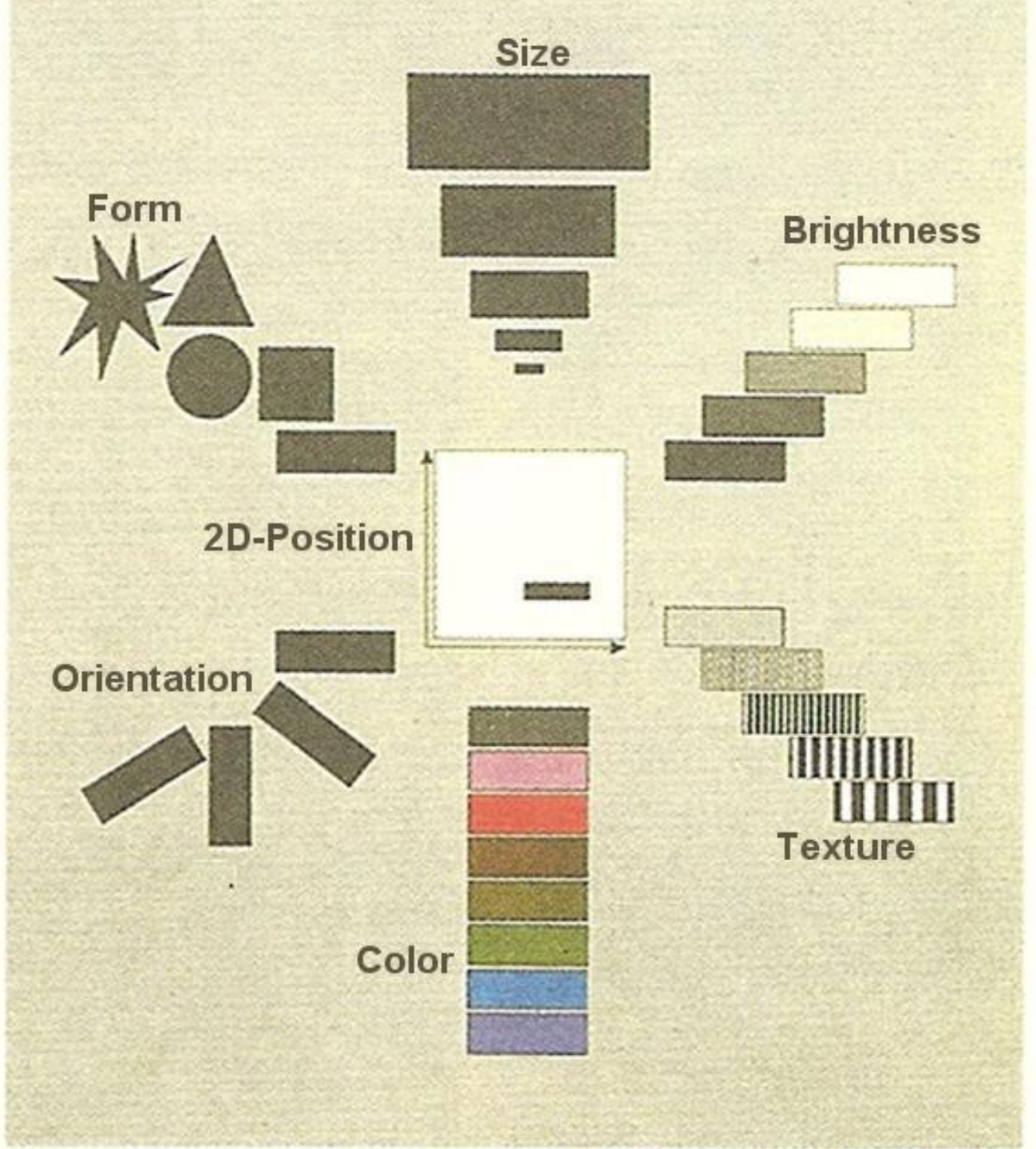
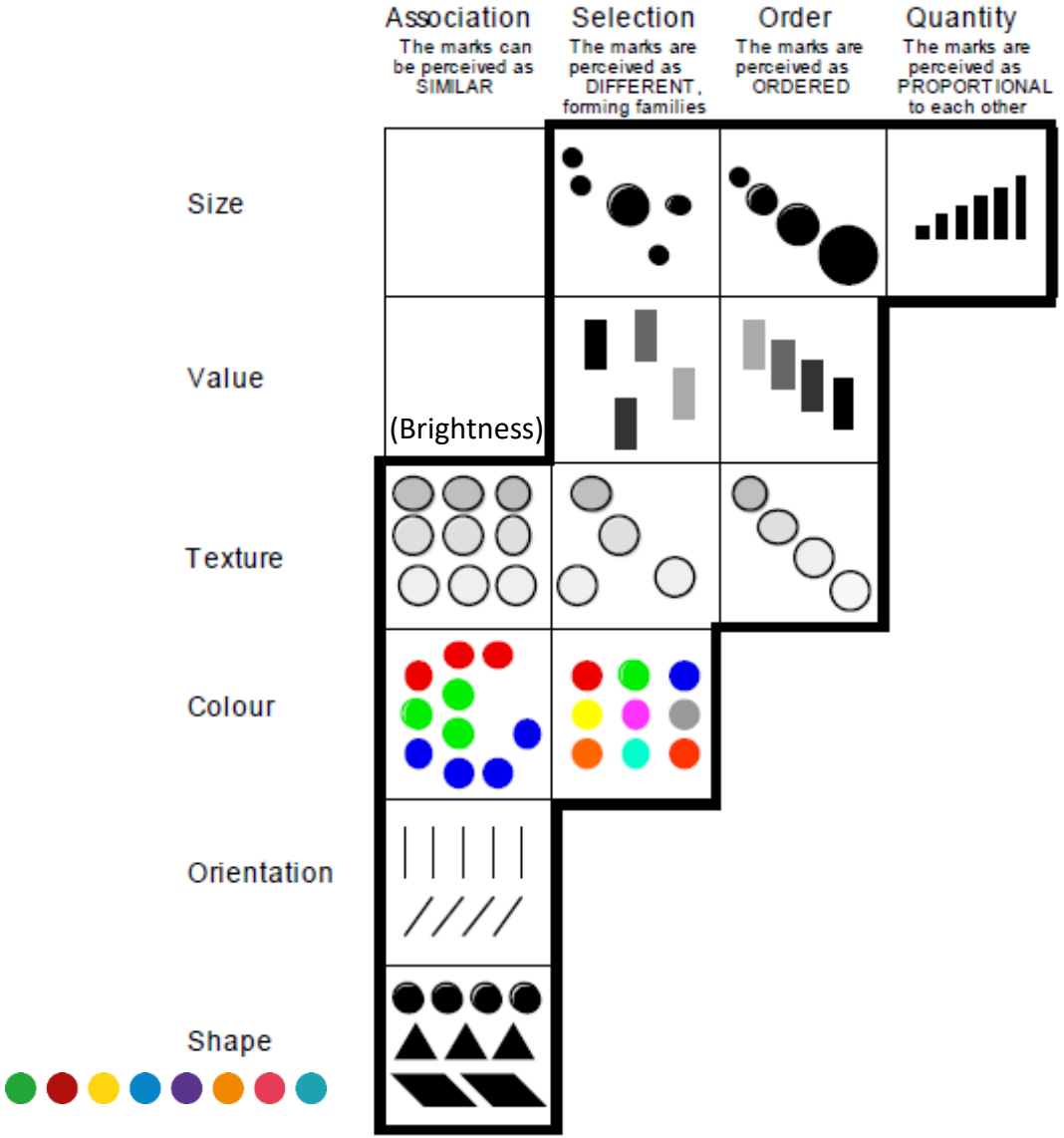
GRAPHIC VARIABLE

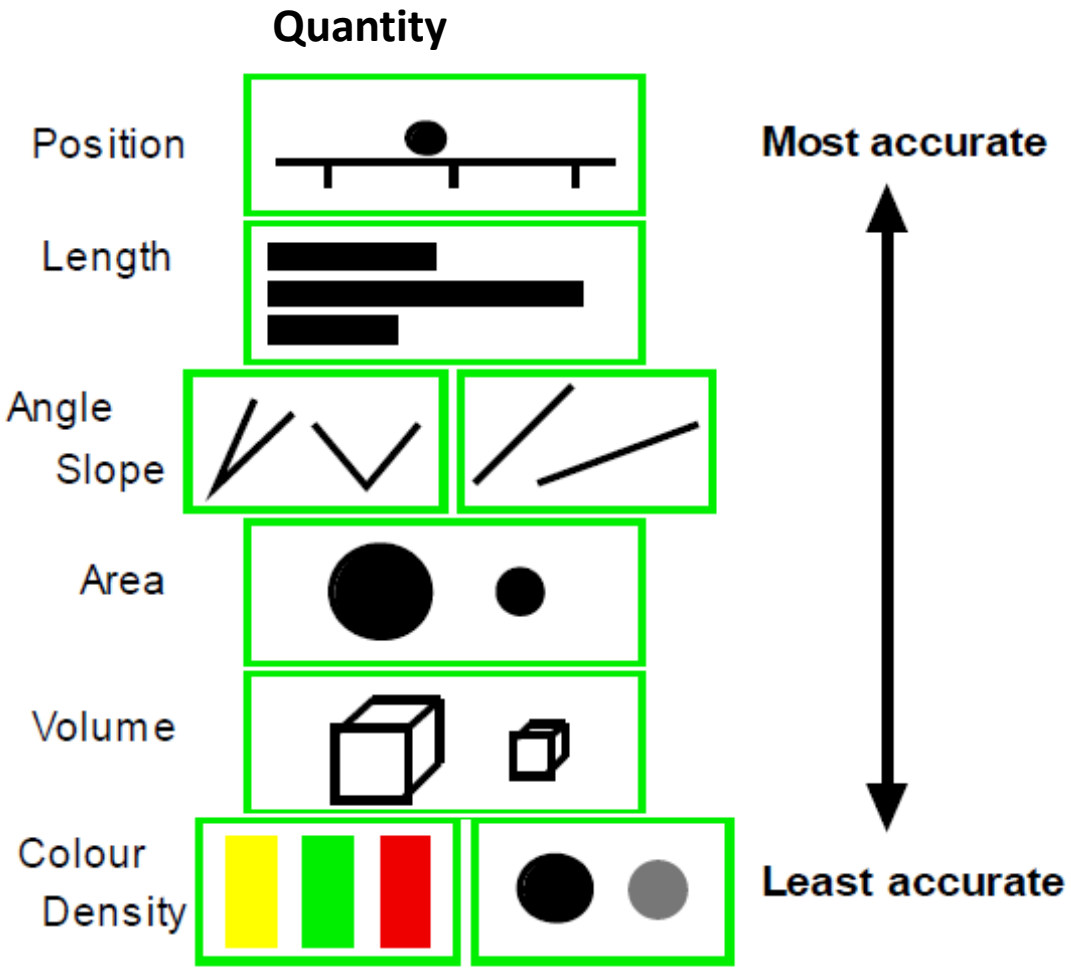
Jacques Bertin



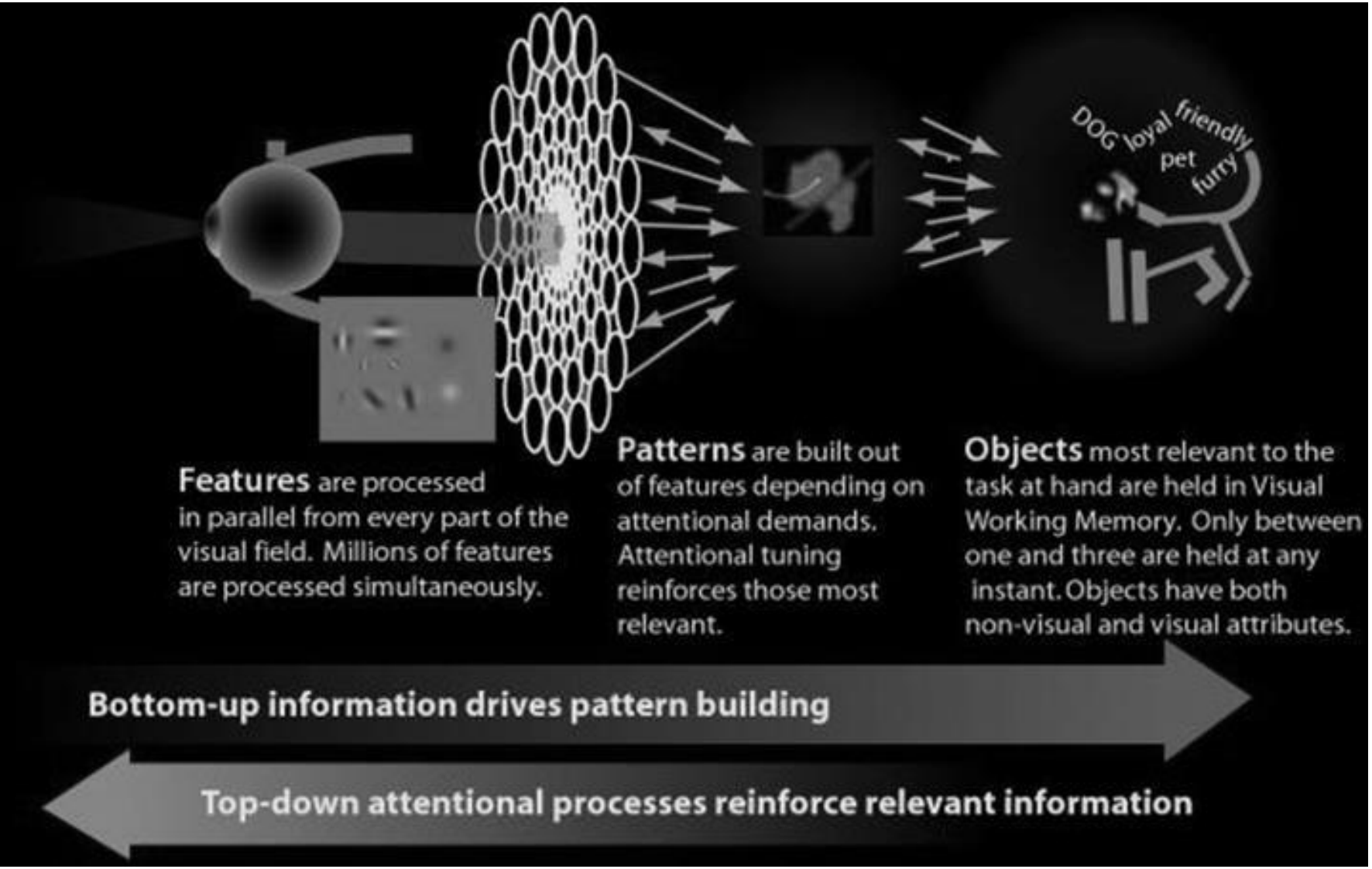


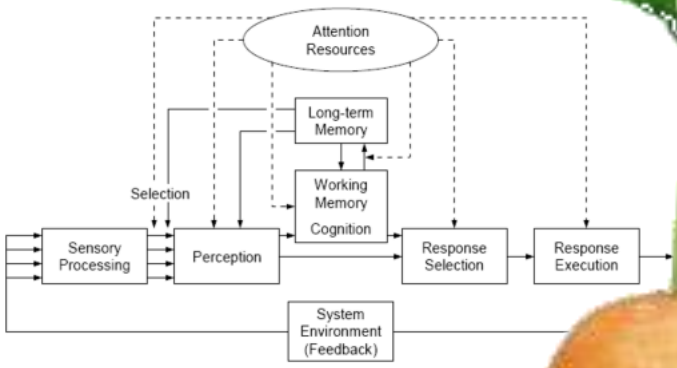
APPLICATION: INFORMATION VISUALIZATION

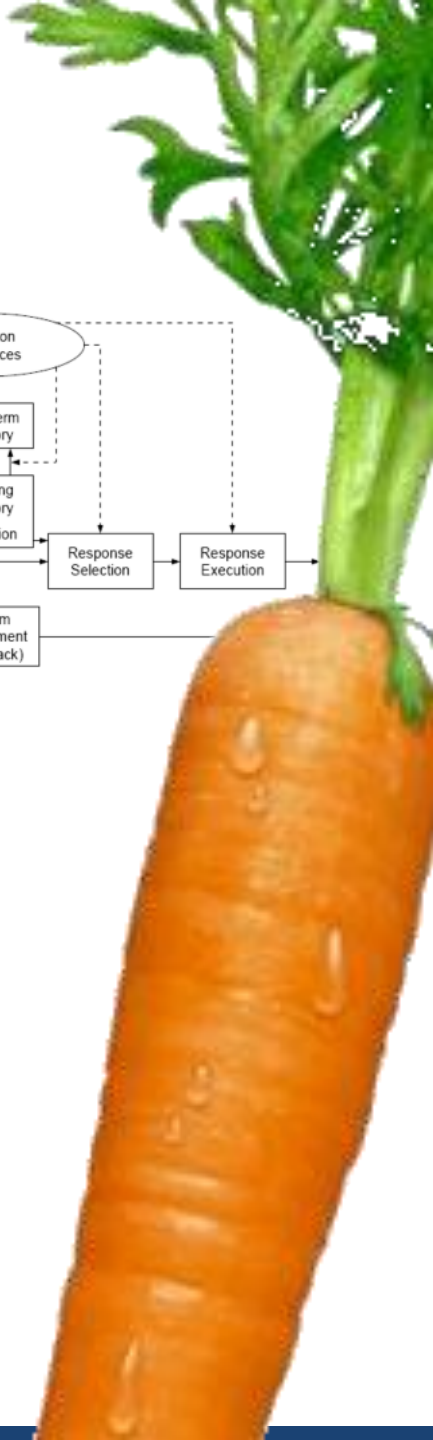




VISUAL PERCEPTION: TOP DOWN







Ware, C. (2008). *Information Visualization: Perception for Design.*San Francisco: Morgan Kaufmann.

VISUAL PERCEPTION: TOP DOWN

- stage 2-3: proto-object flux
- Stage 3: Ongoing **linking** of visual and non-visual information
- **Attention** influences feature and pattern analysis. It **reinforces** signals we are looking for. The receptors "shout"
- This amplification **occurs at every stage** of information processing.
- Influence increasing from left to right (**1 < 2 < 3**)
- Consequence: what we see is strongly influenced by what we want to achieve (**goals**)

→ Attentional Tuning

VISUAL PERCEPTION: TOP DOWN

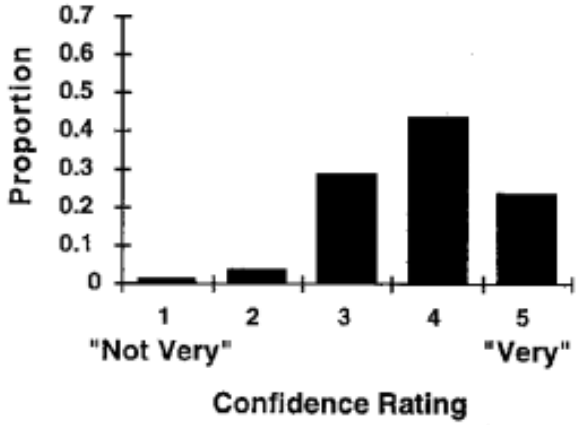
CHANGE BLINDNESS

CHANGE BLINDNESS BLINDNESS

A: Notice Plates Switch?

Survey:
Y = 76.3% N = 24.7%
(229/300)

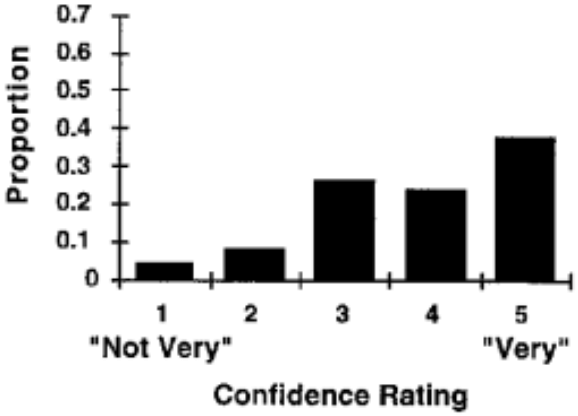
Actual:
Y = 0% N = 100%
(0/10)



C: Notice Actor Change?

Survey:
Y = 69.5% N = 30.5%
(203/292)

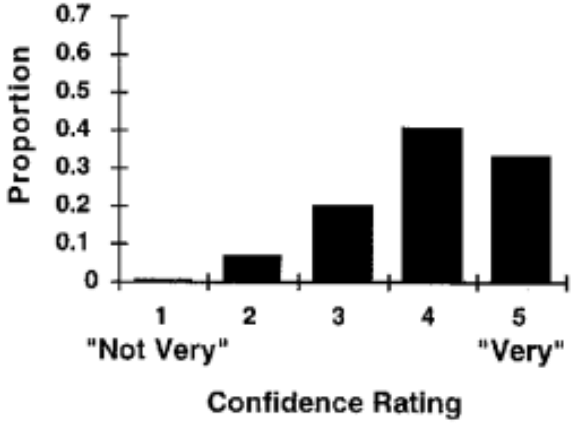
Actual:
Y = 0% N = 100%
(0/10)



B: Notice Scarf?

Survey:
Y = 90.5% N = 9.5%
(269/297)

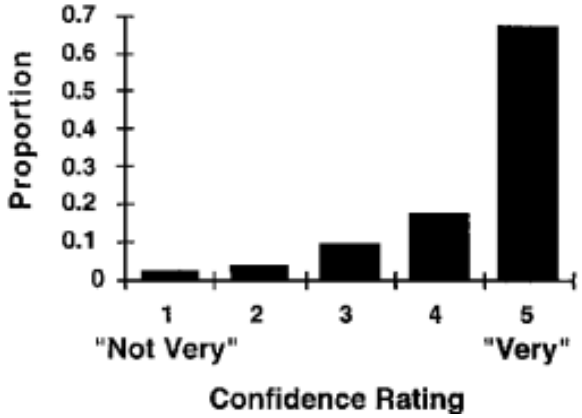
Actual:
Y = 0% N = 100%
(0/10)



D: Notice Person Change?

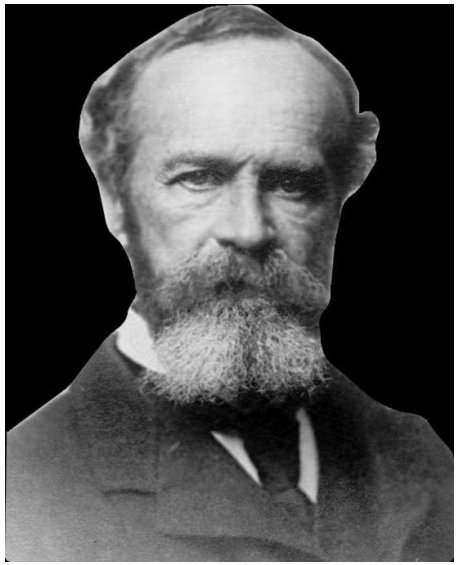
Survey:
Y = 97.6% N = 2.4%
(288/295)

Actual:
Y = 46%[2] N = 54%
(5.5/12)



Levin, D. T., Momen, N., Drivdahl, S. B. & Simons, D. J. (2000) Change blindness blindness: The metacognitive error of overestimating change-detectionability. *Visual Cognition*7:397–412.

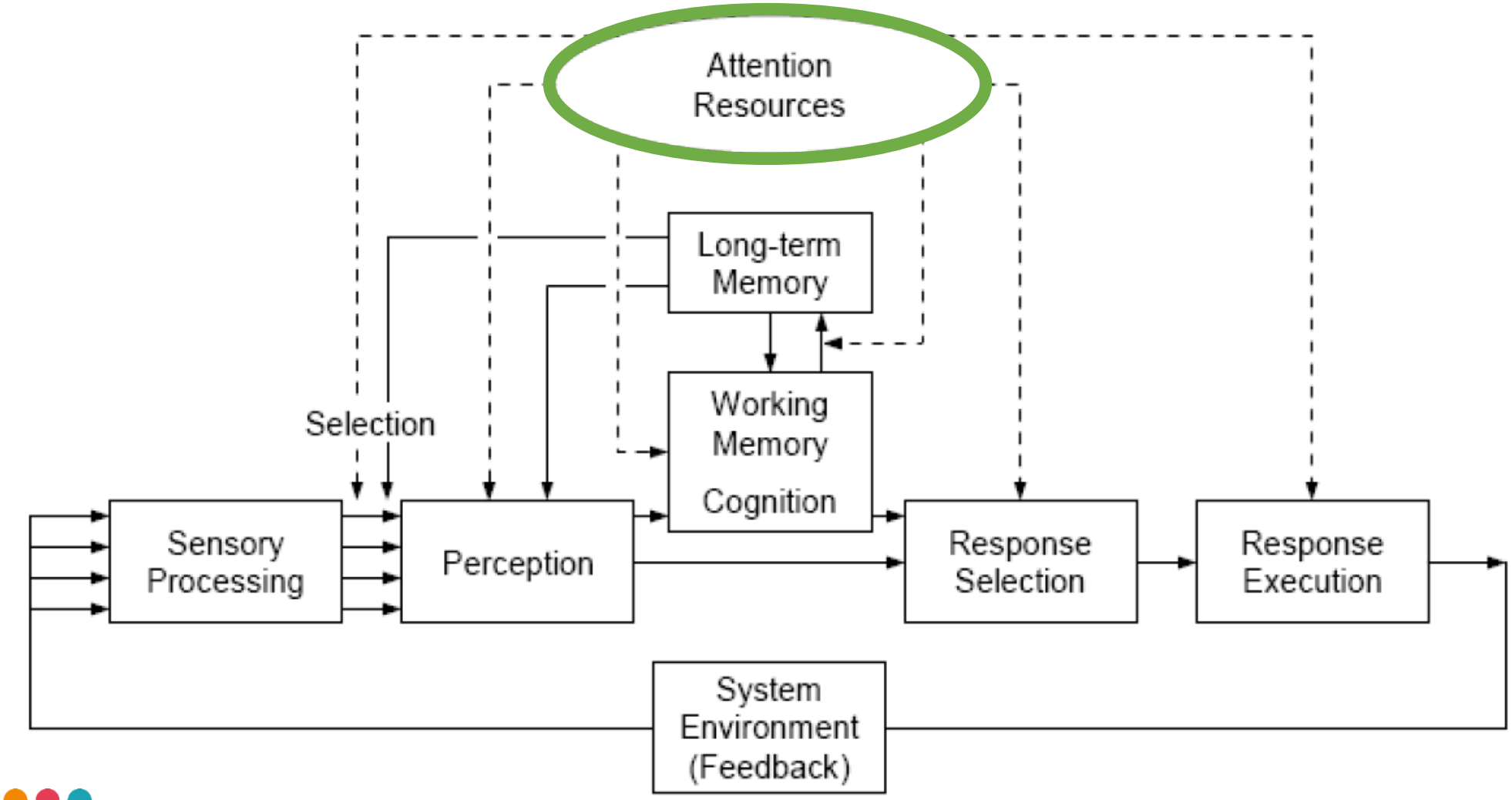
ATTENTION



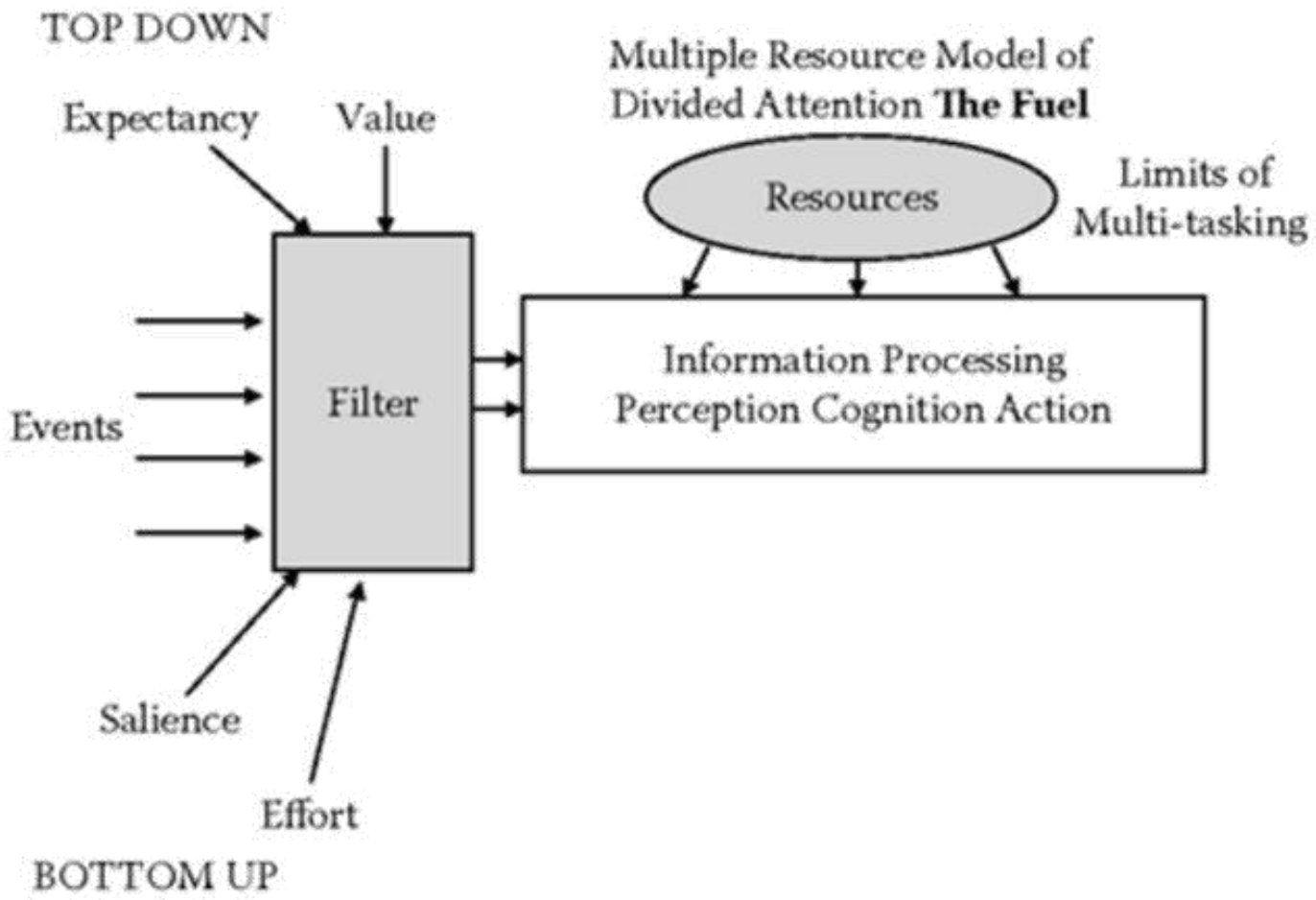
William James (1890): *»**Everyone knows what attention is**«*

Elizabeth Styles (2006): *»Despite William James's often-quoted remark it would be closer to the truth to say that ›**Nobody knows what attention is**‹ or at least not all psychologists agree«*

INFORMATION PROCESSING

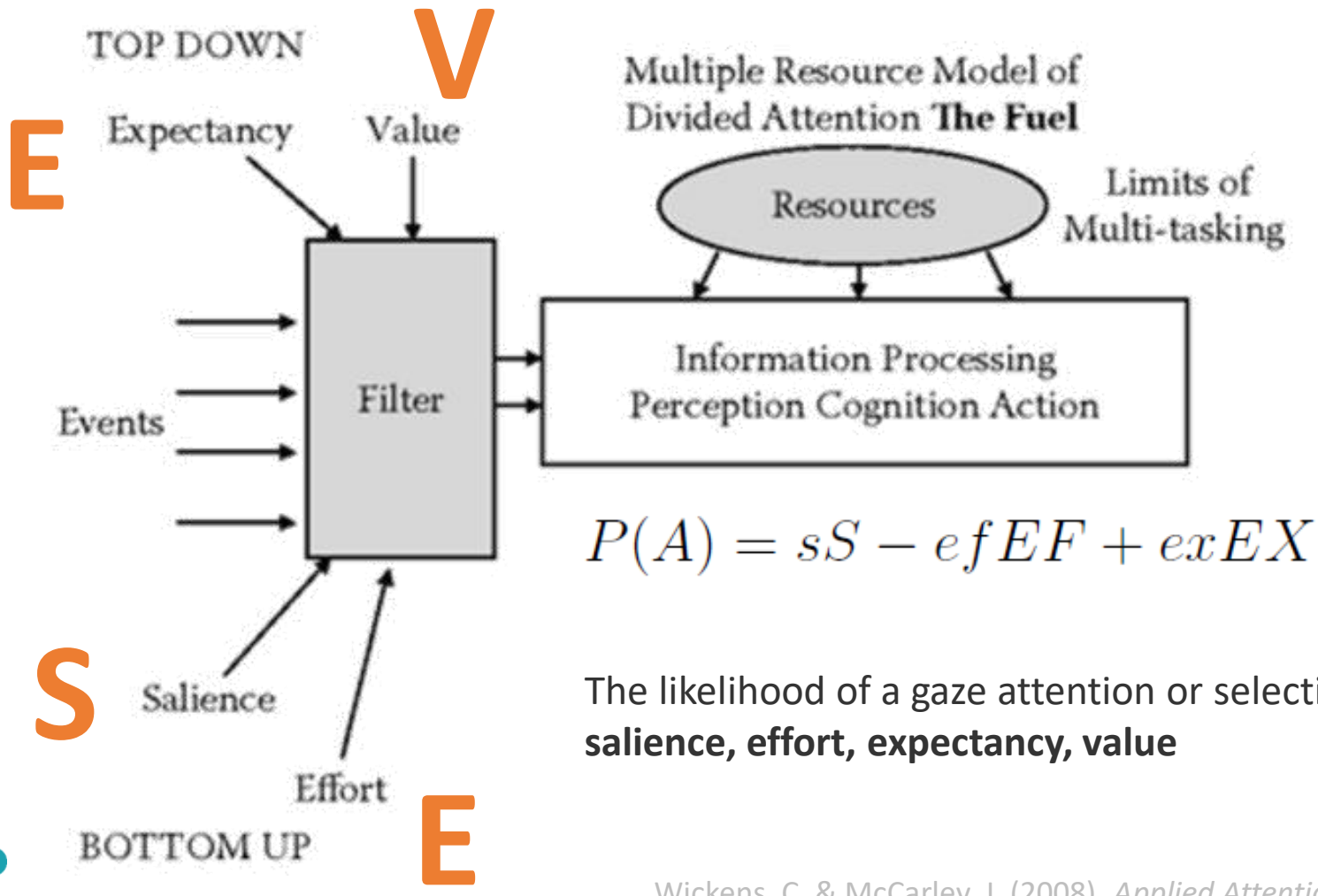


ATTENTION: FILTER & FUEL



Wickens, C. & McCarley, J. (2008). *Applied Attention Theory.* Boca Raton: CRC Press.

SELECTIVE ATTENTION: SEEV-MODEL

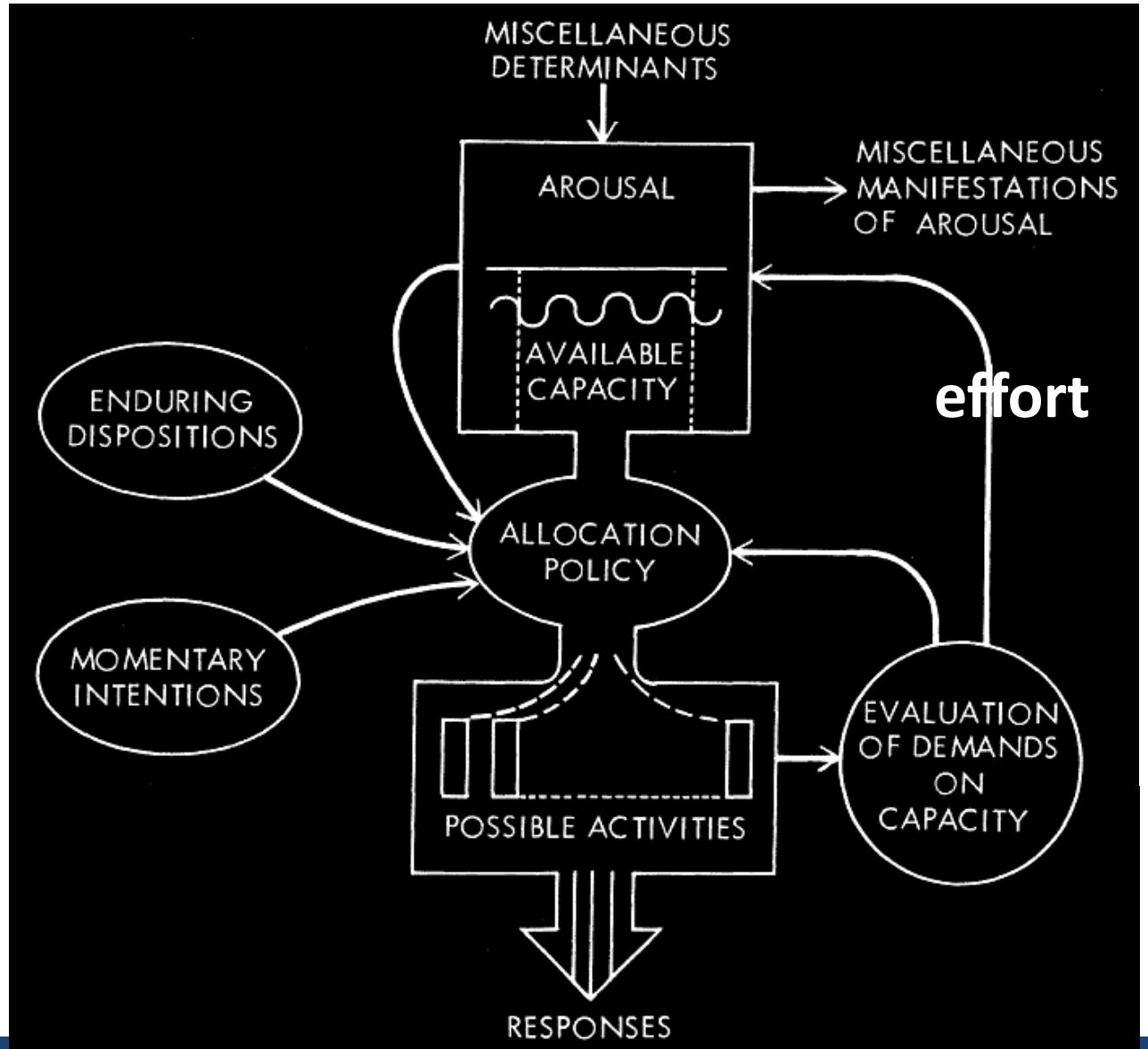


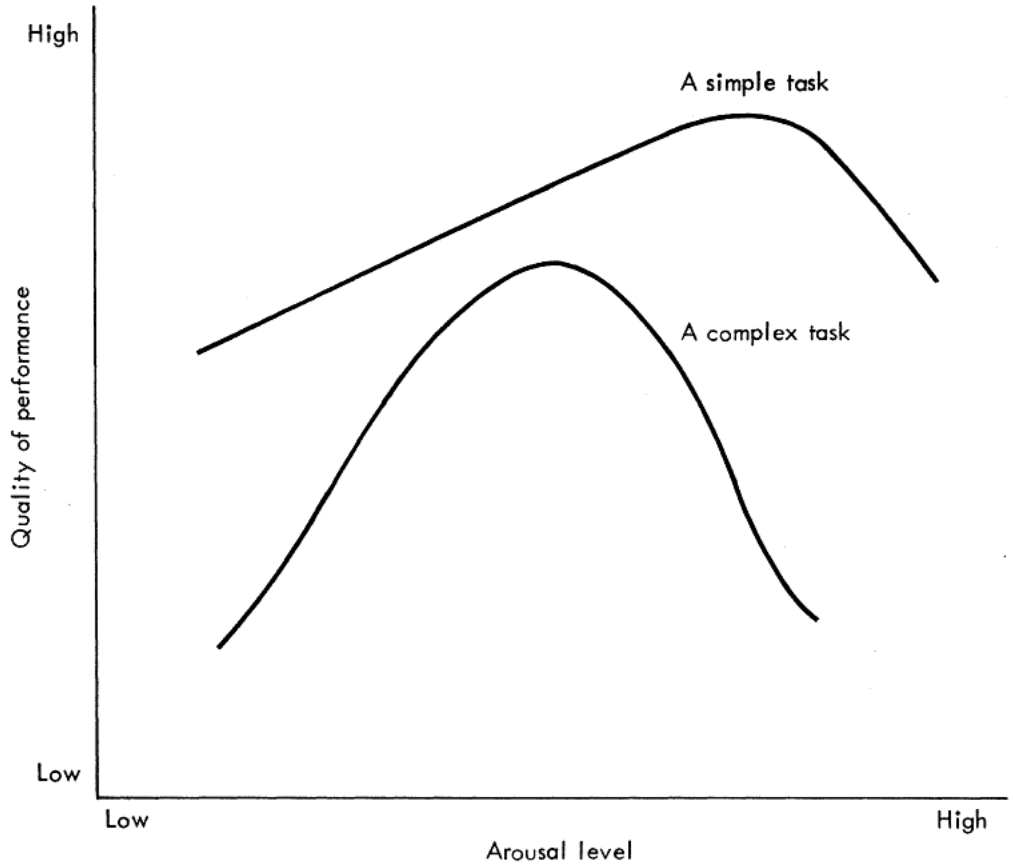
$$P(A) = sS - efEF + exEX + vV$$

The likelihood of a gaze attention or selection is determined by **salience, effort, expectancy, value**

Wickens, C. & McCarley, J. (2008). *Applied Attention Theory.* Boca Raton: CRC Press.

CAPACITY MODEL





Yerkes & Dodson


Workload

WORKLOAD


... und wer fährt?
BG
DVR
Bundesministerium
für Verkehr, Bau-
und Wohnungswesen

WORKLOAD

WORKLOAD DEFINITIONS

Workload is a general term used to describe the cost of **accomplishing task requirements** for the human element of man-machine systems

Hart, S. G., & Staveland, L. E. (1988). Development of NASA TLX (Task Load Index): Results of experimental and theoretical research. In P.A. Hancock & N. Meshkati(Eds.), Human mental workload(pp. 139–183). Amsterdam: North-Holland.

Workload is a hypothetical construct intended to capture **limitations on the operator's information processing apparatus** as these are viewed from the perspective of some assigned task

Gopher, D. & Donchin, E. (1986). Workload –An examination of the concept. Handbook of Perception and Human Performance, 2, 1–49.

Workload is the specification of the amount of **information processing capacity** that is used for task performance

De Waard, D. (1996). The Measurement of Drivers' Mental Workload. Haren, Traffic Research Centre VSC: University of Groningen, Ph.D. Thesis.

MEASURING WORKLOAD

- **Why?**
  - Relation to performance
  - Identification of processing **bottlenecks**
  - **Evaluation** of new designs

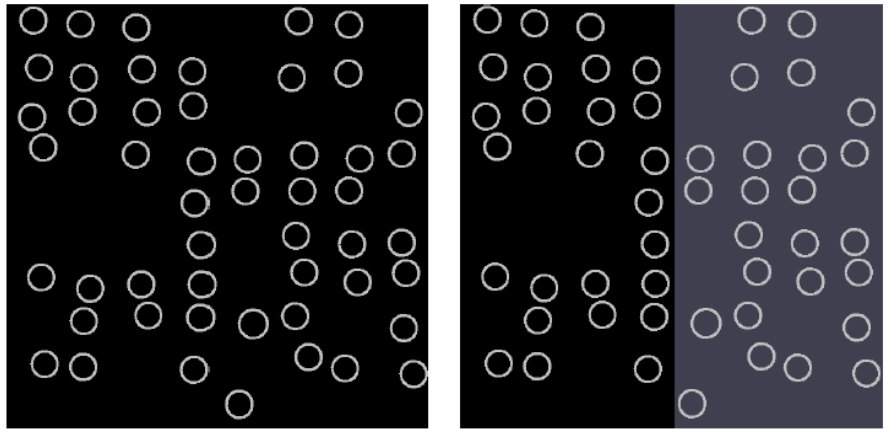
- **How?**
  - Behaviour
  - Physiology
  - Subjective

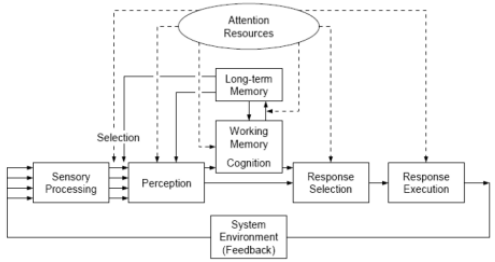
MEASURING WORKLOAD: BEHAVIOUR

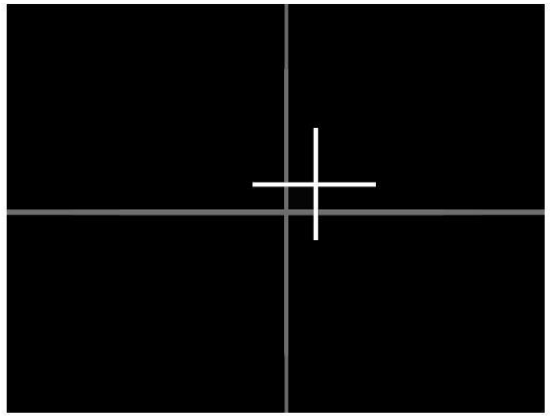
- Deviation from a standard course
- RMSE: Root Mean Square Error
- Artificial driving task: **Lane Change Task**

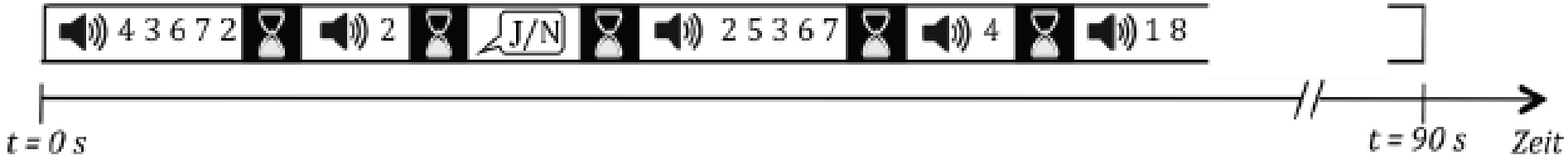
MEASURING WORKLOAD: BEHAVIOUR

- **Additional task**
  - Second task
  - Loading task
- **Visual** task
- **Motor** task
- **Cognitive** task





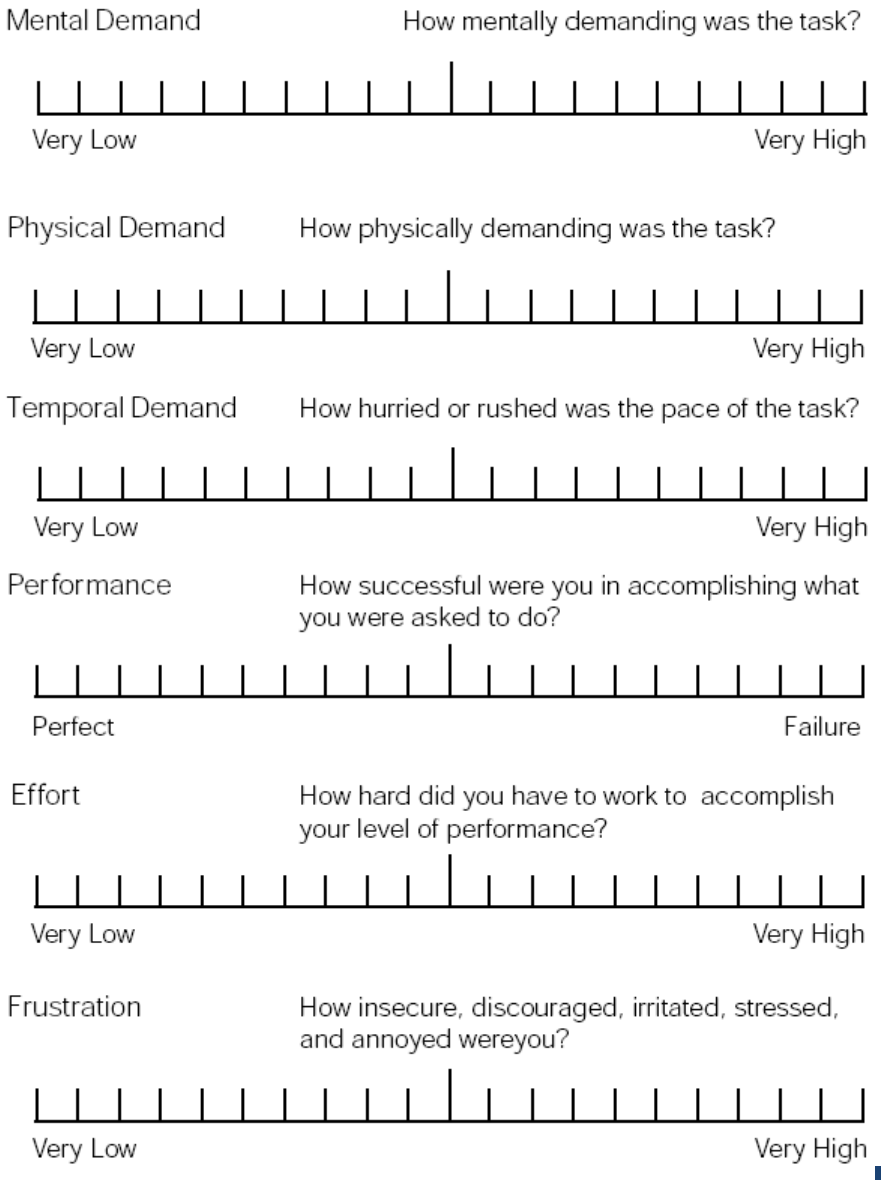


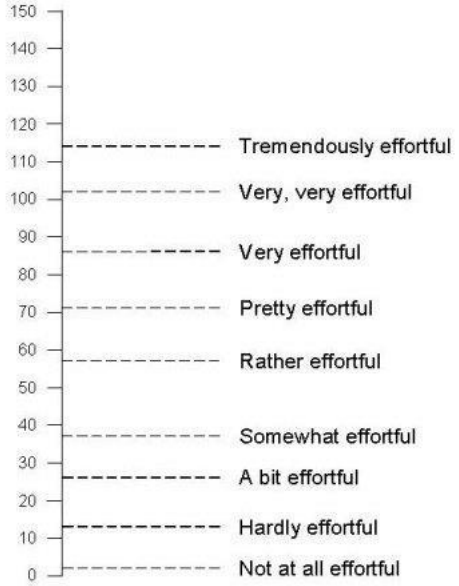


MEASURING WORKLOAD: SUBJECTIVE

Questionnaires

- NASA TLX
- **R**ating
  Scale
  Mental
  Effort - RSME

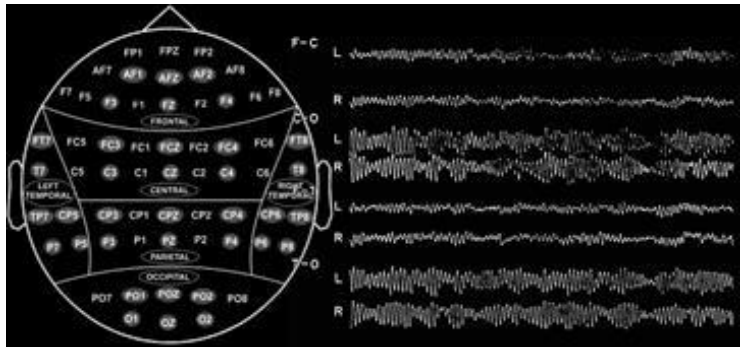




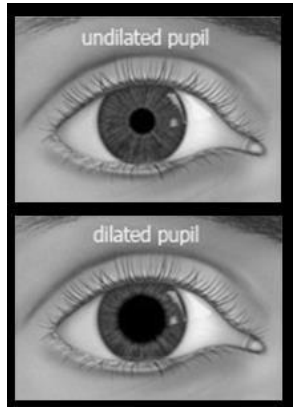
MEASURING WORKLOAD: PHYSIOLOGY

Heart rate variability

EEG



Pupil diameter



EXCERCISE: C.R.A.P.

1. Is your app C.R.A.P.? Select at least three apps installed on your smartphone and analyse, how the C.R.A.P. principles are implemented.

2. Is there room for improvement concerning the principles?

3. Report and present.