



OHV60 Thinking and Deciding

Lecture 1: Cognition and Technology

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About me...

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@mcwillemsen



Associate Professor: Human Decision Making in Interactive Systems
TU Eindhoven, Human Technology Interaction & JADS



Decision Making, Process tracing, Cognition, Data Science,
Recommender Systems, online behavior, e-coaching

Recommender LAB @JADS

How can decisions be supported by recommender systems?

The LAB focuses on:

- how insights from decision psychology can improve recommender algorithms
- how to best evaluate recommender systems
- novel recommendation methods that help users with developing their preferences and goals

Domains include movies, music, health-related decisions and recommendation of energy-saving measures.

Show case: <http://www.jads.nl/recommender.html>



In this lecture

Course logistics

About the lectures, lab sessions, debates, quizzes and exams

Some applications

A birds-eye view of cognition and technology

Course logistics

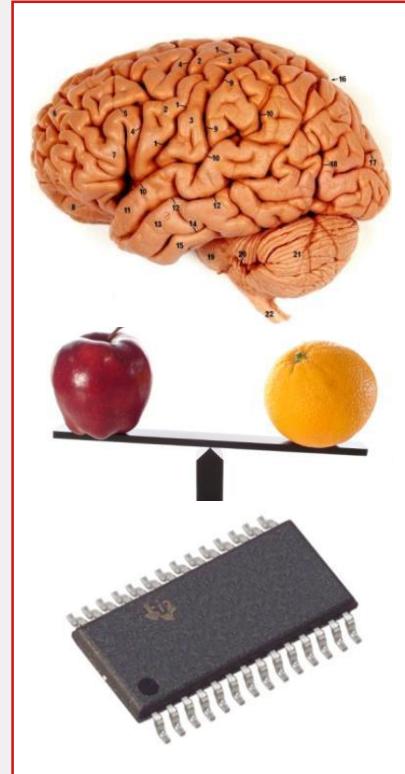
Goal of the course

Topics:

- Cognitive Psychology
- Decision-making
- Technology

Coverage:

- Basic theory (books/papers/video clips)
- Hands-on experience (lab sessions)
- Reflection (Debates)
- Some applications / technology examples



Learning goals: Knowledge-related

1. The student is able to understand, describe and explain the most important **theoretical approaches in the study of Thinking and Deciding** and the scientific research on which these theories are based.
2. The student can explain and discuss both **traditional approaches** in the study of Thinking and Deciding, as well as **recent developments** considering these topics.
3. The student is able to discuss **boundary conditions** of each theoretical approach and can analyze differences between approaches.
4. The student is able to explain and discuss **applications of these theories in the technological domain**.

Learning goals: skill-related

1. The student is able to work independently with a scientific handbook and to learn the material presented
2. The student can read a scientific paper and formulate a discussion topic
3. The student is able to defend and discuss their position on discussion topics in small groups and write a short essay about it.
4. Students can reflect on their own writing and those of their peers and provide feedback to peers

Organization of the Course

Regular lectures (Tuesday 1/2h & Friday 5/6h)

Summarizes the main points of the reading material

Provide additional information / structure / applications

Meant to stimulate critical thinking / room for questions
occasional polls / small tests during the lecture

Workshops/Debates (Tue 3/4 hour)

Some lab sessions (hands-on experience)

4 debates on scientific issues (15% of grade)

prof. Skills: reflection and writing using discussion points

Grading:

weekly quizzes (15%) & Discussion points (15%)

final exam (70%): final assignment (20%) / exam (50%)

Stress Reduction Kit



Directions:

1. Place kit on FIRM surface.
2. Follow directions in circle of kit.
3. Repeat step 2 as necessary, or until unconscious.
4. If unconscious, cease stress reduction activity.

Lecture format in times of Corona

I favor streaming the lectures so we can still have interaction, do polls in between and small experiments.

- I will try to use **canvas conferences** as it has the easiest facilities
- I will (try to) record so you can also choose to (re-)watch later
- If it fails we move to an MS teams link

For most lectures I will try to provide some videos of basic concepts that you can watch upfront

- This reduces time needed for lecturing (focus on the main points)
- I will give lectures in bits of 40 minutes with a break: start times will be 8:45, 9:45 etc.. (as usual)

Quizzes using canvas

Multiple choice: Every Tuesday (**at 9.45am, 2nd hour**) you will get about 5 multiple choice questions (and perhaps an occasional short open question) that cover the material (mostly from the week before) in a 5-10 minute randomized canvas quiz.

7 quizzes planned, the average of the 6 best grades will determine the final quiz grade (10% of the 15% for quizzes)

Goal: Motivate you to read along with the lectures and practice with type of questions in the exam

(however: the quizzes will use questions you should be able to answer just by attending lectures and having read the chapter)

Practice quizzes in the book (9th ed) will be helpful to test yourself!



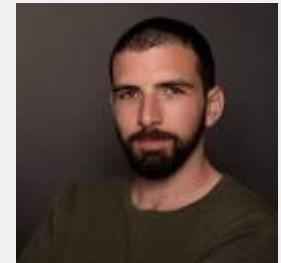
Workshop time (3rd and 4th hour on Tuesday)

Lab sessions

During the 3rd and 4th hour on Tuesdays we have more interactive lectures with labs

Debates (April 28, May 12, May 26, June 9): organized by Leonid Tiokhin

- Everyone before debate: Read material / post a discussion point in forum of your session
- 4 groups of 6 students debate, one group chairs the session (graded), tutor is present
- After debate: other 3 groups write a discussion summary (submit before Monday 8:45)
 - Discussion points (max 300 words) peer reviewed (anonymously) by other students
 - Discussion point and reviews assessed by tutor
 - Every group writes 3 discussion summaries (80% of grade), everyone reviews three discussion summaries (20% of grade for review quality)
 - Reviewing quality is part of PRV reflection
 - More info on canvas and in the assignment documents



Leonid Tiokhin

Professional Skills Writing/Reflecting 2

Your progress in writing and reflecting during the debates will be graded separately by the tutor to grade your professional skills (writing and reflecting).

The feedback you get in writing the discussion points (by tutor and your peers), the experience in debating and the peer review process will help you to improve your writing and reflecting skills.

Attending the debates (and coming prepared!) is required and will also allow you write the discussion summary before submitting them.

Peer reviewing is required (and part of your grade and reflection skill)

Writing skill is assessed in the final assignment (not on group work)

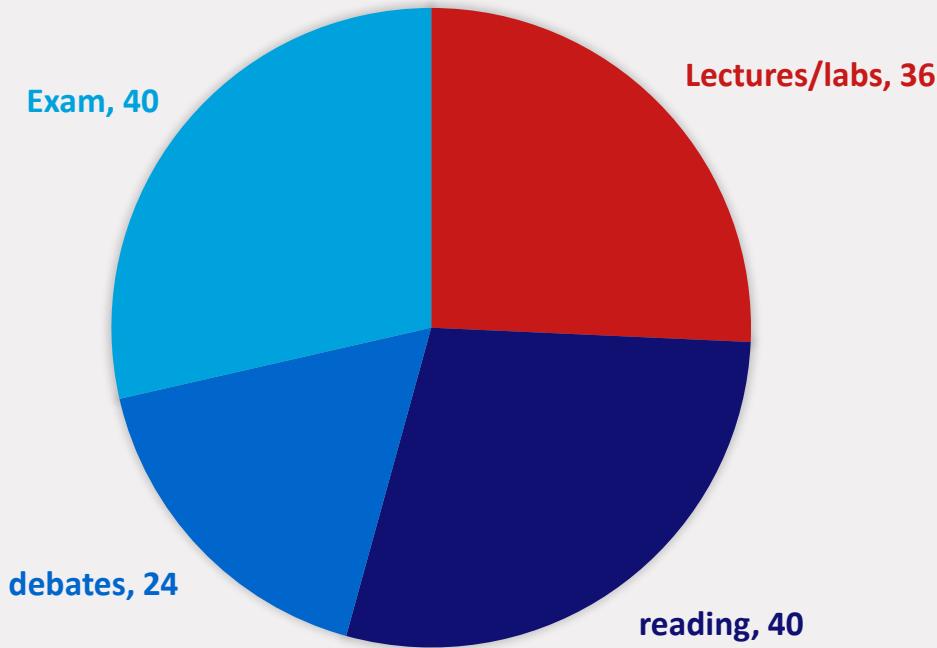
Time table (first 5 weeks)

week	Date	time	Location	topic	Preparation
1	Tue 21-04	08:45 - 10:30	Canvas conferences / MS teams	Introduction: Cognition and Technology	Matlin Ch1
	Tue 21-04	10:45 - 12:30	Canvas conferences / MS teams	Perception	Matlin Ch 2
	Fri 24-04	13:30 - 15:15	Canvas conferences / MS teams	Attention & Consciousness	Matlin Ch 3
2	Tue 28-04	08:45 - 10:30	Canvas conferences / MS teams	Quiz 1 Working Memory and Long term memory	Matlin Ch 4/ Ch 5
	Tue 28-04	10:45 - 12:30	Canvas conferences	Debate 1: Multitaskers	Read paper
	Fri 01-05	13:30 - 15:15	Canvas conferences / MS teams	Introduction: judgment, decisions and rationality	Kahneman Part 1
3	Tue 05-05	08:45 - 10:30		No lecture (TU/e closed)	
	Tue 05-05	10:45 - 12:30		No lecture (TU/e closed)	
	Fri 8-05		Canvas conferences / MS teams	Heuristics & Biases	Kahneman Part 2: ch 10-18 + paper (appendix A)
4	Tue 12-05	08:45 - 10:30	Canvas conferences / MS teams	Quiz 2 Memo Strategies and Mental Imagery	Matlin Ch 6/Ch 7
	Tue 12-05	10:45 - 12:30	Canvas conferences	Debate 2: Priming	Paper/blog
	Fri 15-05	13:30 - 15:15	Canvas conferences / MS teams	Overconfidence	Kahneman Part 3: Ch 19-24 excl. ch 23
5	Tue 19-5	08:45 - 10:30	Canvas conferences / MS teams	Quiz 3 Using general knowledge	Matlin Ch 8
	Tue 19-5	10:45 - 12:30	Canvas conferences / MS teams	Lab: Connectionism	
	Fri 20-05	13:30 - 15:15		No lecture (TU/e closed)	

Time table (last 4 weeks and exams)

6	Tue 26-5	08:45 - 10:30	Conferences / MS teams	Quiz 4 Language	Matlin Ch 9&10
	Tue 26-5	10:45 - 12:30	Canvas conferences	Debate 3: Turing (AI)	Papers Turing/Searle
	Fri 29-5		Conferences / MS teams	Prospect Theory + framing	Kahneman Part 4: cha 25, 26, 29-31 and 34 (+ paper: appendix B)
7	Tue 04-6	08:45 - 10:30		No lecture (TU/e closed)	
	Tue 04-6	10:45 - 11:30		No lecture (TU/e closed)	
	Fri 05-06	13:30 - 15:15	Conferences / MS teams	Quiz 5 problem solving and logic	Matlin Ch. 11, 12: only 'deductive reasoning')
8	Tue 09-06	08:45 - 10:30	Conferences / MS teams	Quiz 6 Choices, choice architectures, defaults / nudges	Kahneman Part 4: ch 27, 28 , 32, 33, 34 + papers
	Tue 09-06	10:45 - 12:30	Canvas conferences	Debate 4: Nudging	Papers on nudging
	Fri 12-06	13:30 - 15:15	Conferences / MS teams	Choice over time & Experiential decisions	Kahneman Part 5: Ch 35-38
9	Tue 16-06	08:45 - 10:30	Conferences / MS teams	Quiz 7 Decision Strategies and recommender systems	Paper Bettman et al. 1998
	Tue 16-06	10:45 - 12:30	Conferences / MS teams	Q&A, practice questions	
	Fri 19-06	Deadline: 23:59		Work on final assignment	
	Fri 26-06	09:00-12:00		Exam	
	Fri 14-8	13:30-16:30		Re-exam	

Studyload (5 ECTS = 140 hours)



Grading

This course will be graded based on:

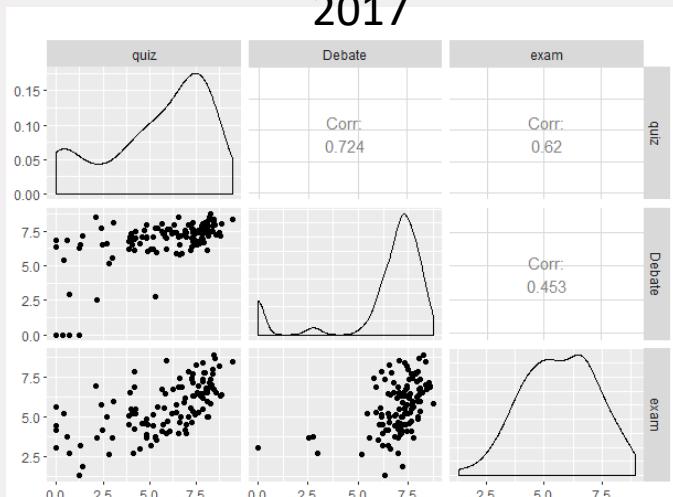
- final exam (70%): assignment (20%) and exam (50%)
- the debate/essay assignments (15%)
- quizzes (15%).

The grade of the final exam needs to be 5.0 or higher to pass the course.

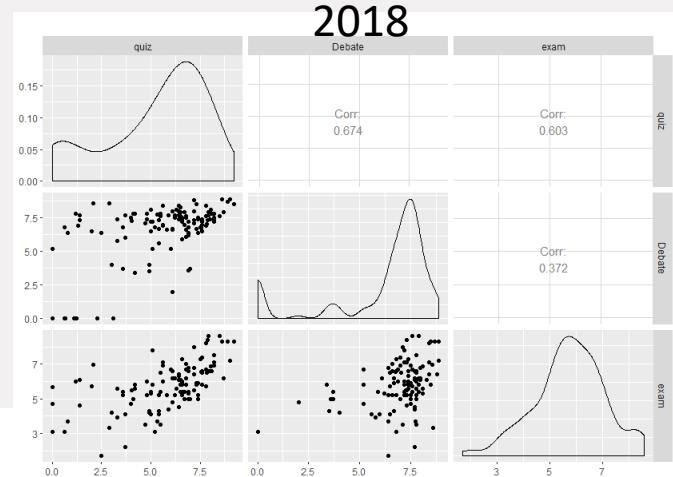
Do you want to prepare for the quizzes?

YES you do!

2017



2018

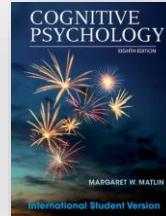


Content of the Course

Cognition (Matlin and Farmer, 2017)

- How do we think, remember, solve problems
- How does our brain work (mental processes)
- What is (artificial) intelligence?
- How to apply in (human-centered) technology?

8th ed.



9th ed.

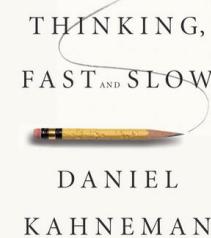


10th ed.
(new...)



Decision Making (Kahneman, 2011)

- How do people form judgments and make choices?
- How do they assess uncertainty, probabilities etc?
- How are our decisions and judgments affected by context, emotions, other people?
- How to apply in (human-centered) technology?



Some applications

A birds-eye view of cognition and technology

Example 1: The vOlCe

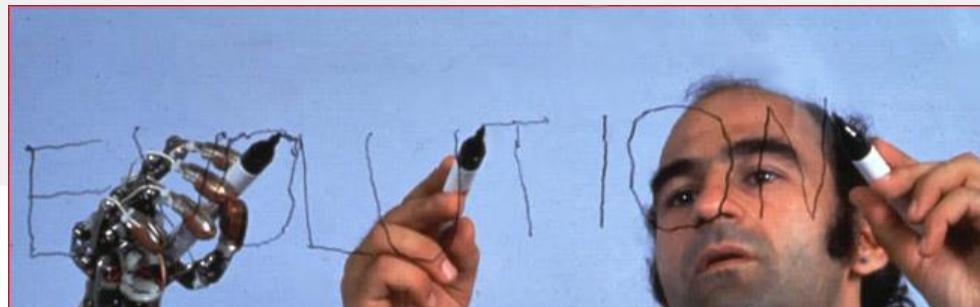
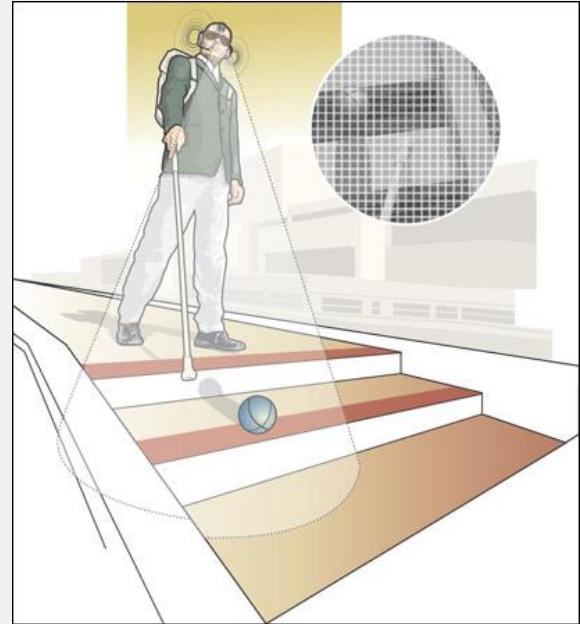
Seeing with sound

Scan camera snapshot from left to right
Height = pitch, brightness = loudness

Cognition is generally adaptive

We can redefine our bodies and brains!

Stelarc: third hand controlled by abdominal and leg muscles
(<http://stelarc.org/?catID=20265>)



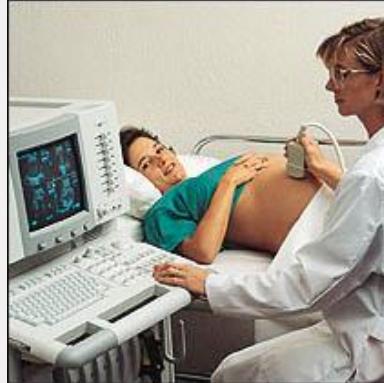
Example 2: Sonic Flashlight

Old ultrasound

look here, work there

Sonic Flashlight

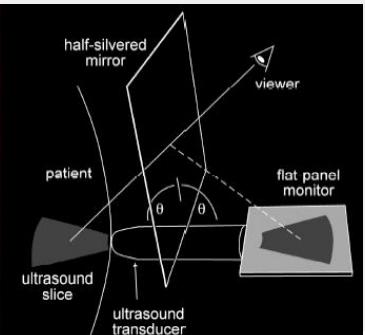
projects data onto the body



Enables direct perceptual representation of target

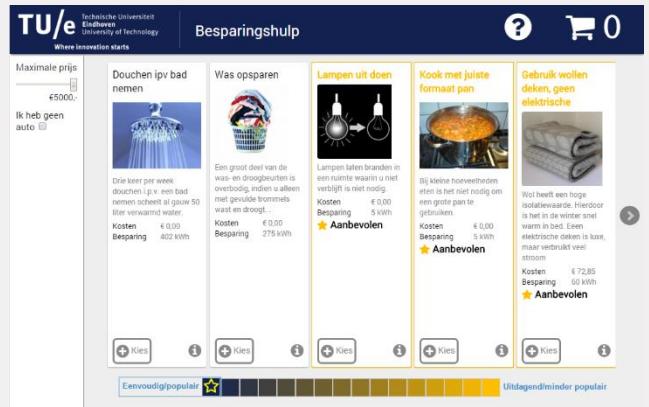
without cognitive mediation

Seamless interaction is very important!



Example 3: Recommender systems

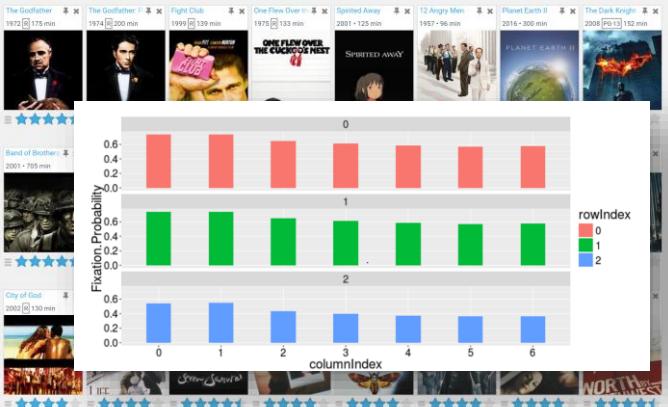
Energy recommender recommend personalized energy measures that fit with your ability



Movie Recommender systems:

Attention and inattention for items in the topic picks using eye-tracker...
should we recommend movies not attended to?

(movielens.org)



Summary

Cognition and Technology work together to improve human life

Technology improved by Cognition

Cognition improved by Technology

Cross-fertilizations!

The book: Cognitive Psychology Matlin

Chapter 1: Introduction

Introduction

Important Terms

Cognition: mental activity, acquisition, storage transformation and use of knowledge
cognitive psychology -> cognitive approach (different from behaviorism /
Psychodynamic)

Why learn about cognition?

Cognition occupies a major portion of human psychology

Cognitive psychology will help you appreciate many other areas of psychology, as well as disciplines outside psychology

Cognitive psychology provides an "owner's manual" for your mind

What is Cognitive Psychology?

The study of cognizing by individual humans, including:

... perception

... attention

... memory

... knowledge

... language

... reasoning

... problem solving

... decision-making

What is Cognitive Psychology?

The study of cognizing by individual humans, including:

... perception (Ch 2, OHV20)

... attention

... memory

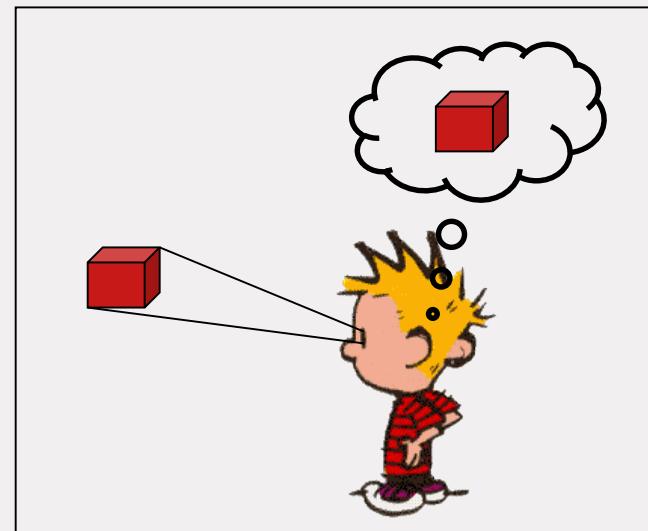
... knowledge

... language

... reasoning

... problem solving

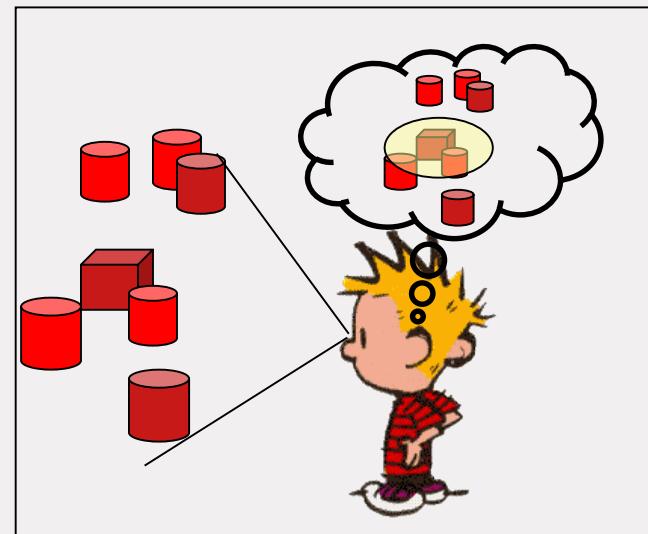
... decision-making



What is Cognitive Psychology?

The study of cognizing by individual humans, including:

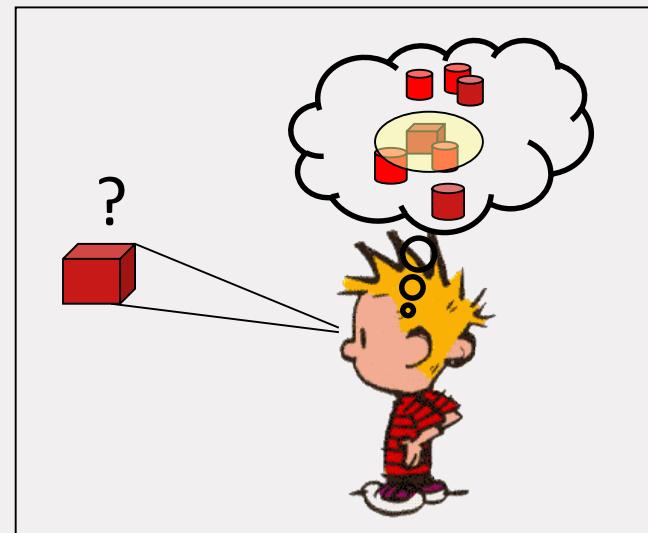
- ... perception
- ... attention (Ch 3, video, lab)
- ... memory
- ... knowledge
- ... language
- ... reasoning
- ... problem solving
- ... decision-making



What is Cognitive Psychology?

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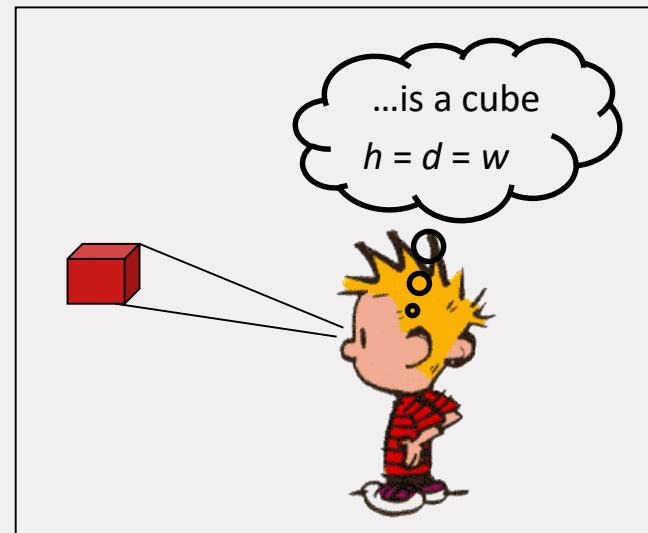
- ... perception
- ... attention
- ... memory (Ch 4-6, lab)
- ... knowledge
- ... language
- ... reasoning
- ... problem solving
- ... decision-making



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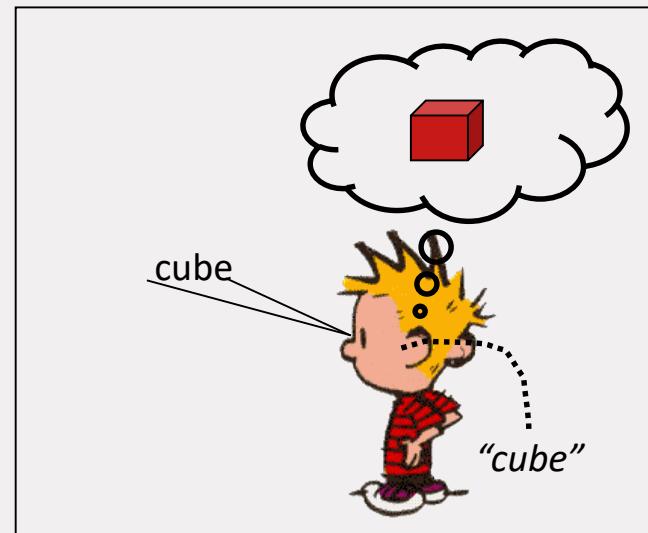
- ... perception
- ... attention
- ... memory
- ... knowledge (Ch 7 & 8)
- ... language
- ... reasoning
- ... problem solving
- ... decision-making



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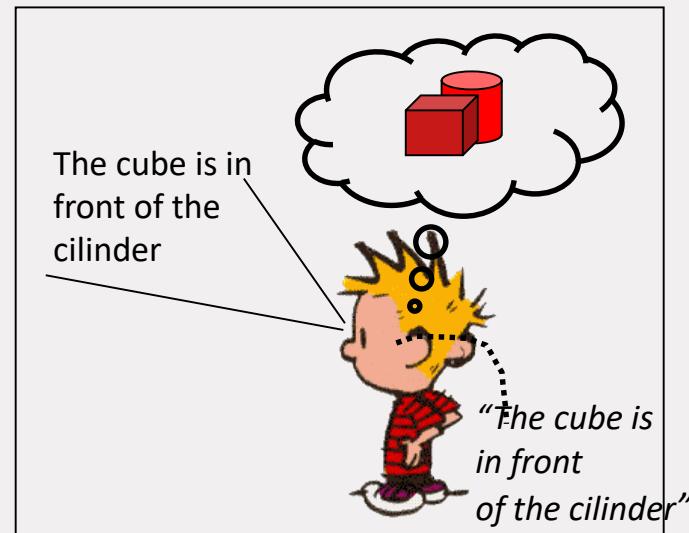
- ... perception
- ... attention
- ... memory
- ... knowledge
- ... language (ch 9 & 10)
- ... reasoning
- ... problem solving
- ... decision-making



What is Cognitive Psychology?

The study of cognizing by individual humans, including:

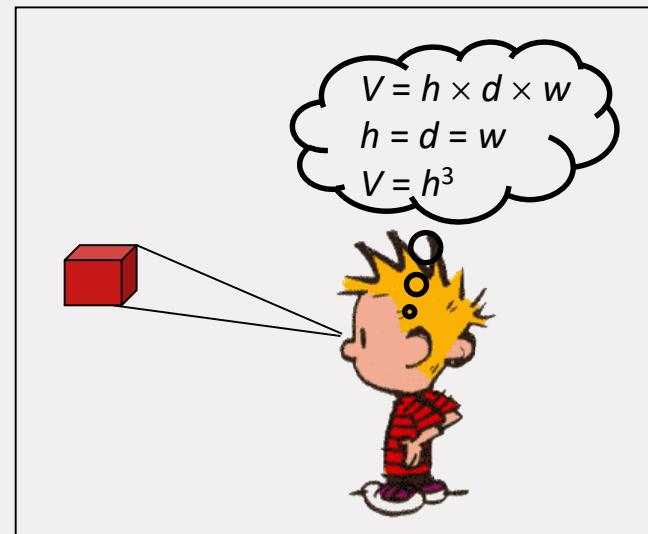
- ... perception
- ... attention
- ... memory
- ... knowledge
- ... language (ch 9 & 10)
- ... reasoning
- ... problem solving
- ... decision-making



What is Cognitive Psychology?

The study of cognizing by individual humans, including:

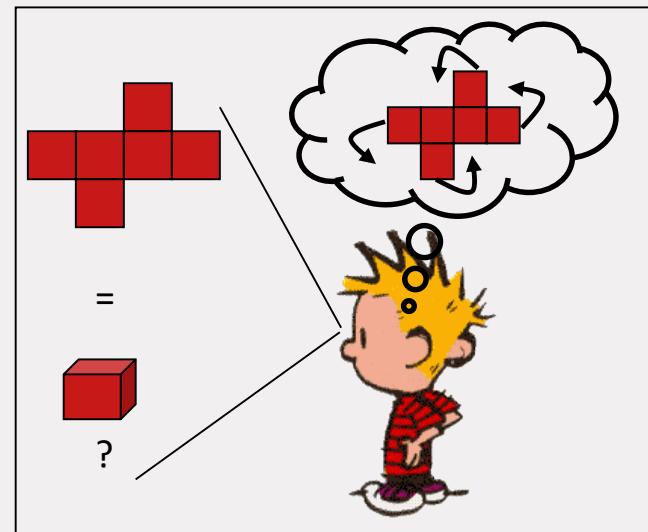
- ... perception
- ... attention
- ... memory
- ... knowledge
- ... language
- ... reasoning (Ch 12)
- ... problem solving
- ... decision-making



What is Cognitive Psychology?

The study of cognizing by individual humans, including:

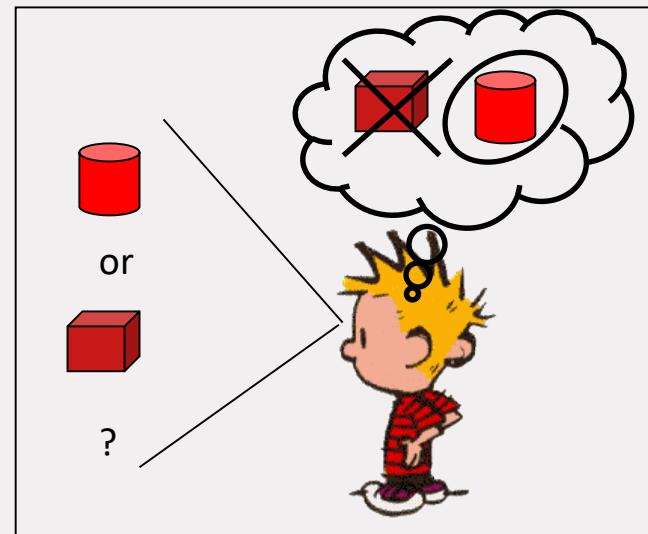
- ... perception
- ... attention
- ... memory
- ... knowledge
- ... language
- ... reasoning
- ... problem solving (ch. 11)
- ... decision-making



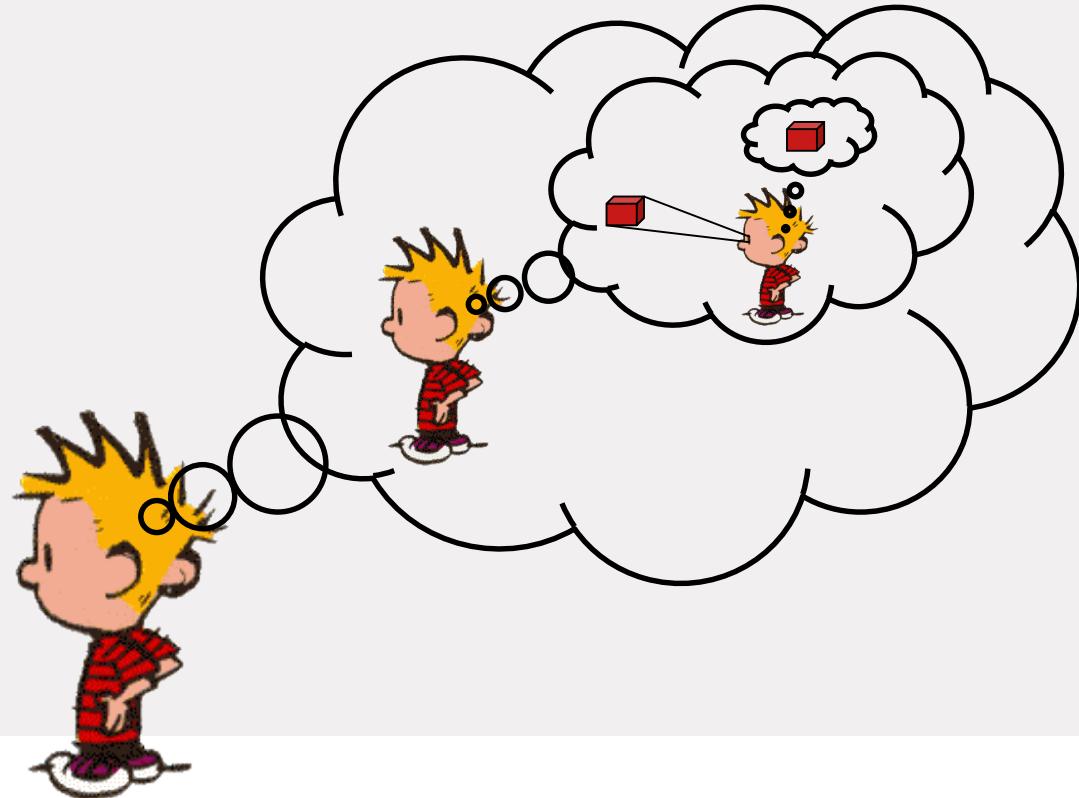
What is Cognitive Psychology?

The study of cognizing by individual humans, including:

- ... perception
- ... attention
- ... memory
- ... knowledge
- ... language
- ... reasoning
- ... problem solving
- ... decision-making (2nd part: Fridays)



We study the study of cognition



What do you think?

There exist mental properties
(beliefs, desires, intentions)
that cause behavior.

- A) Agree (True)
- B) Disagree (False)

What do you think?

Mind and brain are the same thing.
(Consciousness can be explained in physical terms.)

- A) Agree (True)
- B) Disagree (False)

What do you think?

Non-biological things can have minds.

- A) Agree (True)
- B) Disagree (False)

Now check this out

<https://www.youtube.com/watch?v=n9TWwG4SFWQ>

Animation from:
Heider, F. & Simmel, M. (1944).
An experimental study ofapparent behavior.
American Journal of Psychology, 57, 243-290.

Courtesy of:
Department of Psychology
University of Oregon, Eugene

Philosophical Antecedents: The Greeks

Plato (427-347 BC)



Aristotle (384-322 BC)



Philosophical Antecedents: The Greeks

Plato (427-347 BC)



Two 'worlds':

observable, imperfect world

the eternal, changeless, abstract world of (perfect) forms/ideas

Body is part of physical, ending world, Mind (soul) is part of the abstract eternal world (dualism)

Knowledge:

Rationalism: gain knowledge through good thinking (mathematics and Philosophy)

Remembering: mind knows everything (nativism), just remember!

Plato versus Aristotle

	Plato	Aristotle
Mind/Body	Dualism	
Knowledge	Rationalism	
Origin of Mind	Nature (Nativism)	

Philosophical Antecedents: The Greeks

Aristotle (384-322 BC)



Guided by observations of natural and biological processes

Rejected Plato's dualism

Solution: one world, the observable reality

Change is central: we learn and change by observation
(empiricism)

Plato versus Aristotle

	Plato	Aristotle
Mind/Body	Dualism	Monism
Knowledge	Rationalism	Empiricism
Origin of Mind	Nature (Nativism)	Nurture

Structuralism

Wilhelm Wundt
(1832 -1920)



Father of scientific psychology
Established 1st Psychology Lab in 1875 in Germany

Physiological Psychology (experimental) relation between sensation and perception through introspection

Völker psychology

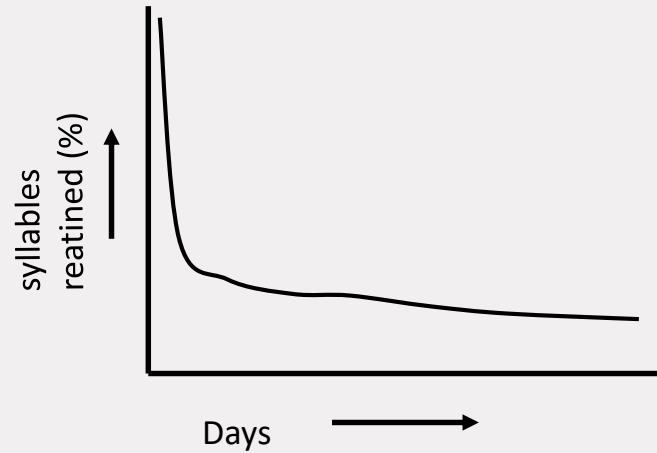
Higher order processes and social processes cannot be studied by experimentation:
too complex, introspection is too fallible

Early Memory research

Zeitgeist (Wundt): Memory is a higher order process: not studied experimentally

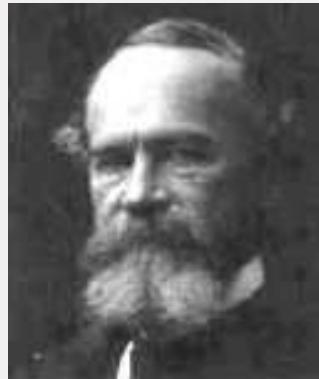
Ebbinghaus studied his own memory, learning nonsense syllables
(ZAF BUQ QUJ)

US: Calkins discovered recency effect
(She argued to study real processes!)



Functionalism

William James
(1842 –1910)



Influential book: “Principles of Psychology”

- Introspection has issues
- Nonsense syllables are not reflecting the real world

Aim: To understand functional relationships between stimuli and responses

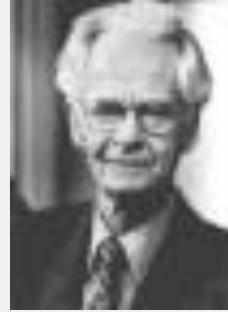
-> everyday experiences rather than decompose cognition in structural aspects

Behaviorism (mostly US)

Watson
(1878-1958)



Skinner
(1904-1990)



- Inspired by Functionalism
- Studied the association between stimulus and responses
- Rejected introspection and studied observable behavior only
- Darwin's influence: Animal experiments

John B. Watson

Founder of Behaviorism

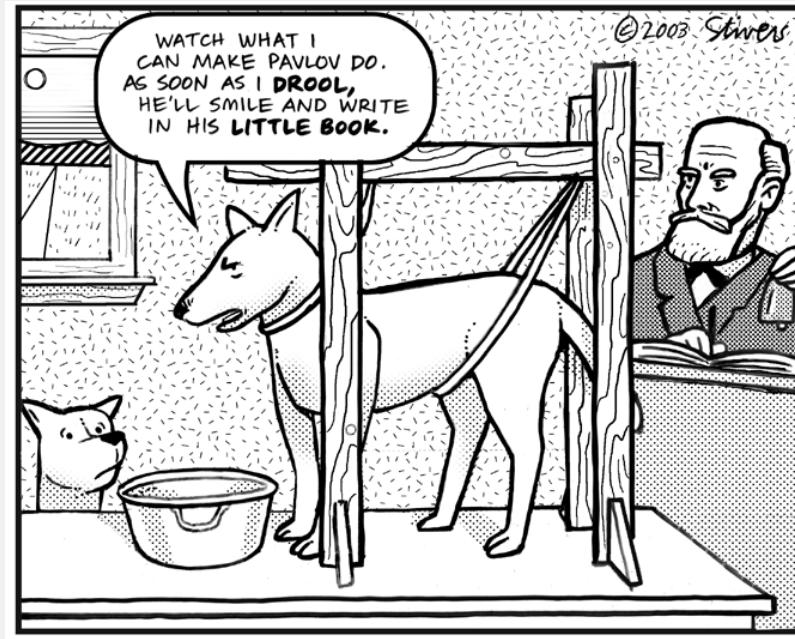
“ Behaviorism ... holds that the subject matter of human psychology is the behavior of the human being. Behaviorism claims that consciousness is neither a definite nor a usable concept.”



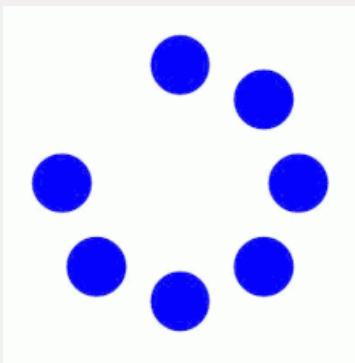
→ Total rejection of mentalism in scientific psychology
(e.g. thinking is simply silent speech).

B. F. Skinner's Radical Behaviorism

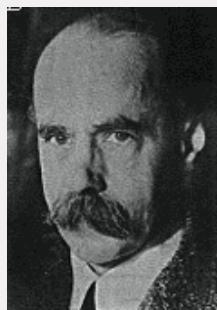
- Understanding = Control
- Skinner Box
- Classical conditioning (Pavlov) vs. Operant conditioning (Skinner)



Gestalt Psychology (mostly Europe)



Wertheimer
(1880-1943)



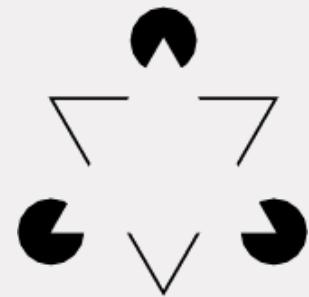
[https://en.wikipedia.org/
wiki/Phi_phenomenon](https://en.wikipedia.org/wiki/Phi_phenomenon)

e.g. Phi-phenomenon

Koffka
(1886-1941)



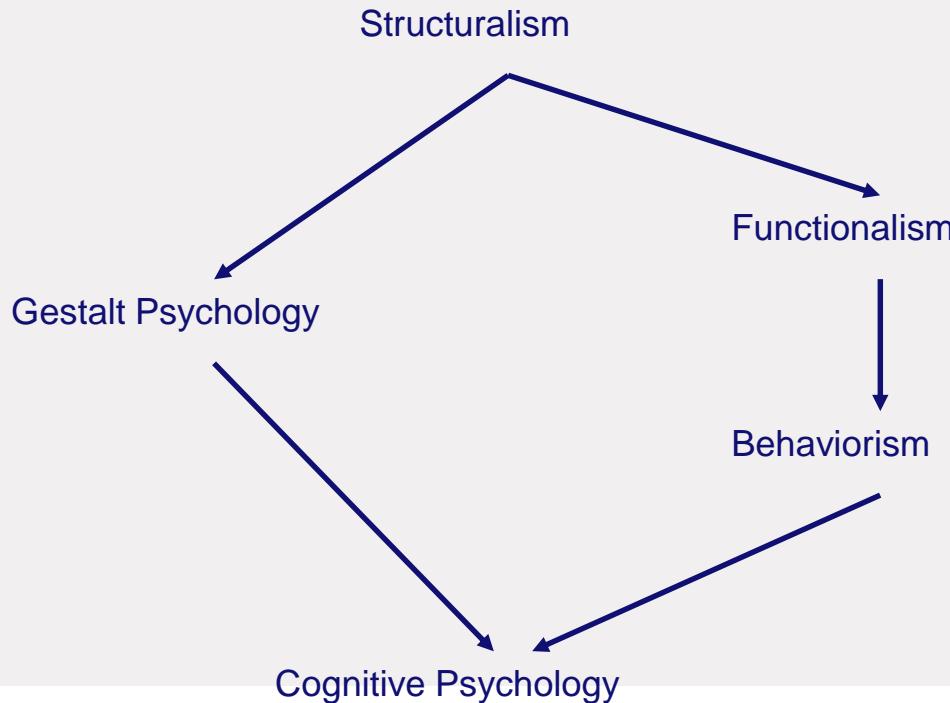
e.g. Law of Prägnanz



The Kanisza triangle

The whole is different from the sum of its parts

Psychological Antecedents



A Brief History of Cognitive Psychology

The Emergence of Modern Cognitive Psychology

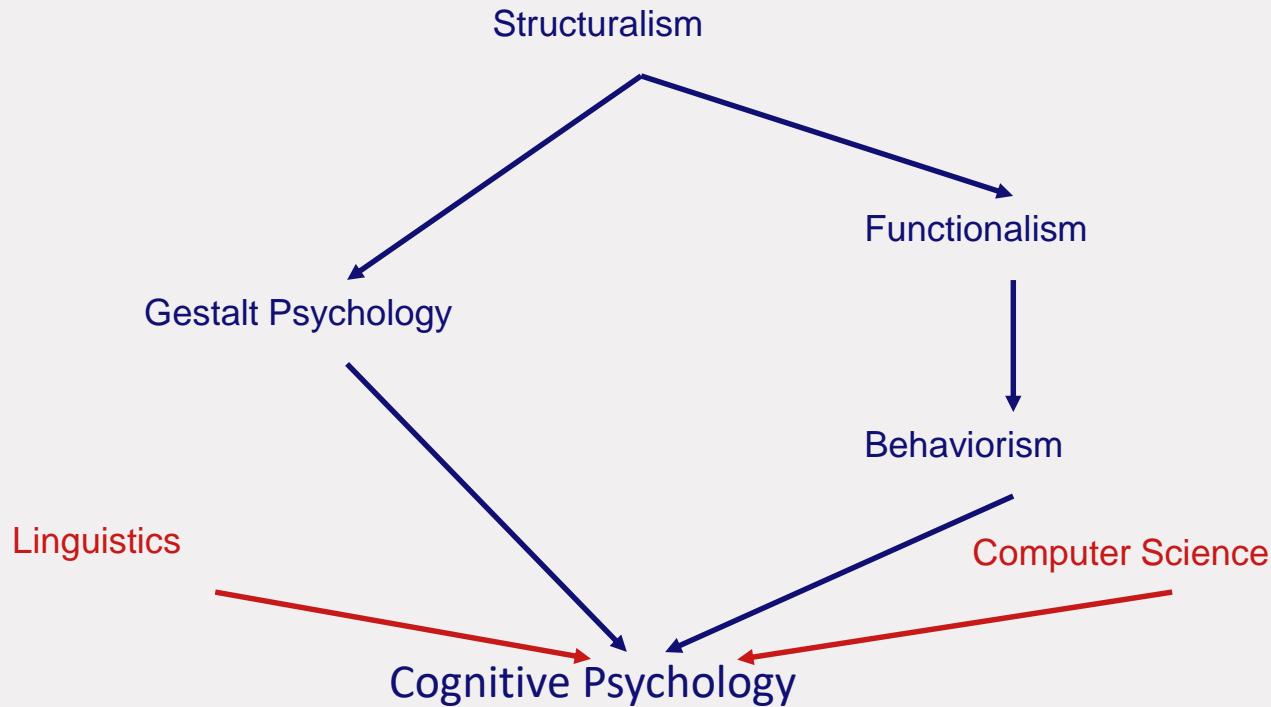
1956 & the MIT symposium

Ulric Neisser's *Cognitive Psychology*

Factors Contributing to the Rise of Cognitive Psychology

- Disappointment with Behaviorism
- Linguistics; Noam Chomsky
- Memory research
- Developmental psychology; Jean Piaget
 - object permanence

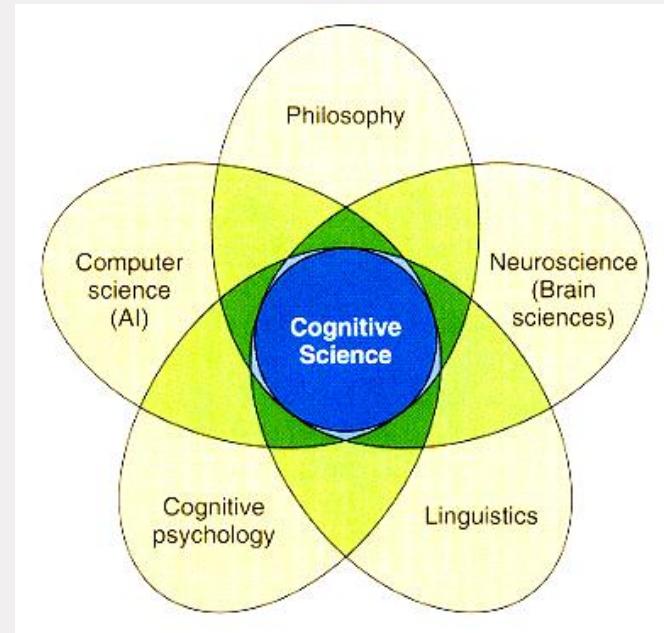
The Cognitive Revolution



Cognitive Science

Interdisciplinary—cognitive psychology, neuroscience, and artificial intelligence PLUS philosophy, linguistics, anthropology, sociology, and economics

Focus on internal representations



Current Issues in Cognitive Psychology

Artificial Intelligence

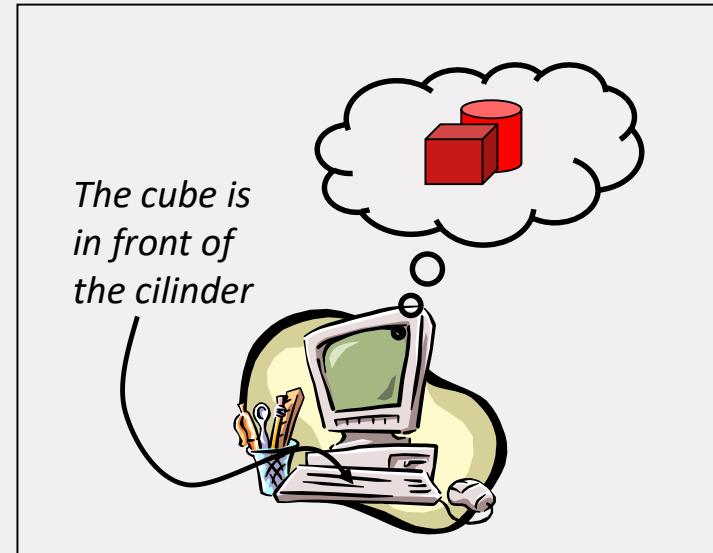
Getting 'hot' again...

Pure AI (Strong AI)

Efficiency: chess computer, language understanding...

Computer Simulation/ Computer Modeling (Weak AI)

take human limitations into account
(should produce similar errors)



*The cube is
in front of
the cylinder*

Computer metaphor:

Structures and processes

Human is a symbol processor just like a computer... (limited attention and memory capacities)

Like a cookbook:

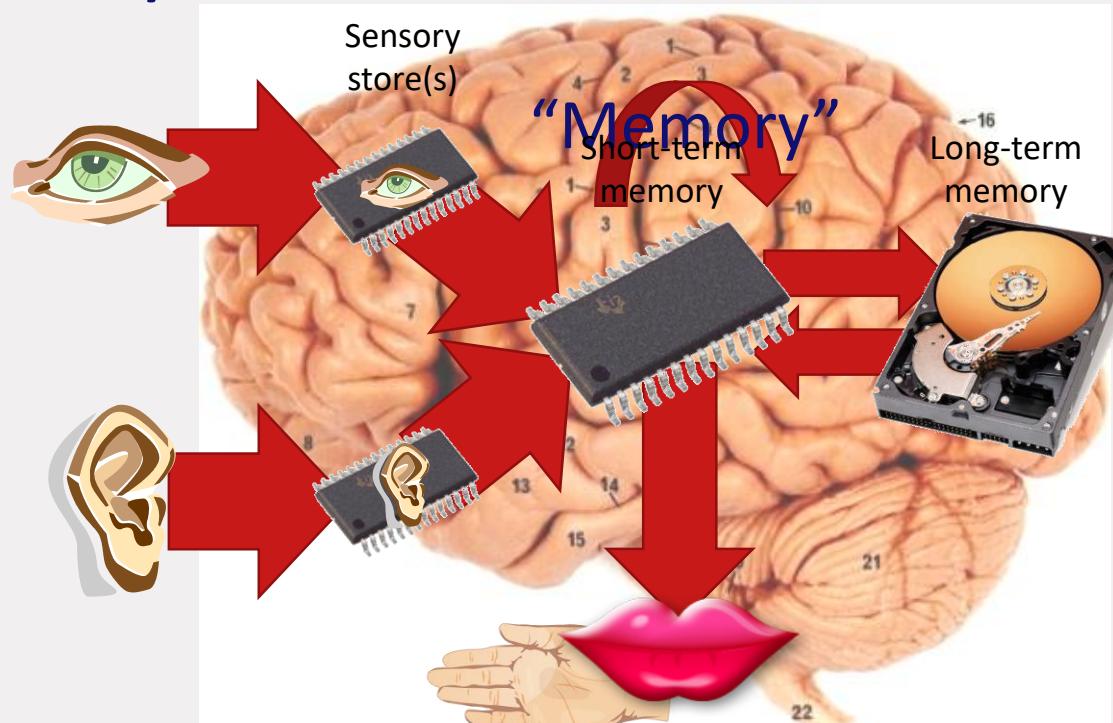
Knowledge structures (~ingredients of a recipe) and processes that operate on these structures (~cooking instructions)

The Information-Processing Approach

- a) a mental process can be compared with the operations of a computer
- b) a mental process can be interpreted as information progressing through the system in a series of stages, one step at a time

Serial processing!

Atkinson and Shiffrin (1968): information processing model (chapter 2-5)



Connectionist approach

The Parallel Distributed Processing Approach

connectionism

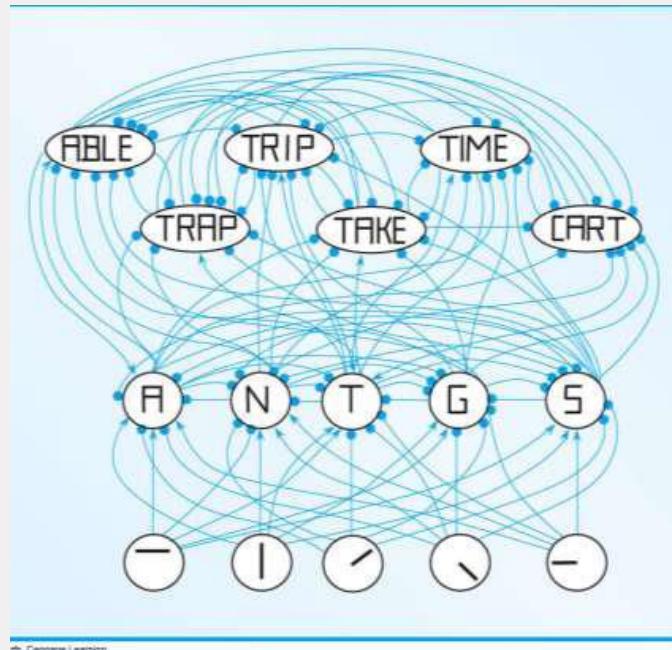
neural networks

cerebral cortex

parallel processing!

Has inspired current AI and deep learning.

Chapter 8 and a lab on this!



Cognitive NeuroScience: Scanning the brain...

Several techniques:

Single unit recording

Event-related potentials (using EEG)

PET and fMRI: indirect measures (blood flow)

MEG: direct measure (neural activity)

TMS: temporal lesions

Spatial versus temporal resolution

Problems:

needs good theory

arbitrary criteria

EEG / ERP

Electroencephalogram

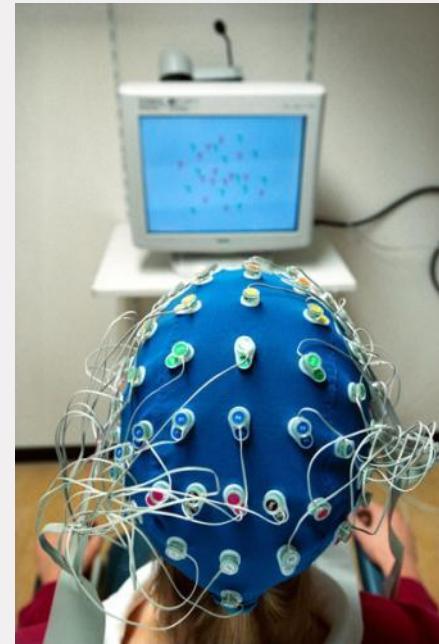
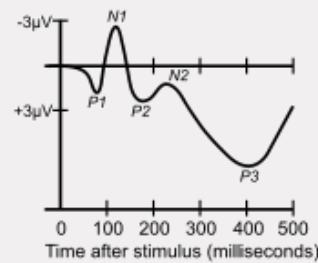
Electrical activity of the brain

On the scalp

Low spatial, high temporal resolution

ERP: event-related potentials

Averaging out noise



MEG

Magnetoencephalography

Measuring magnetic fields from electrical activity of the brain

Like EEG, but:

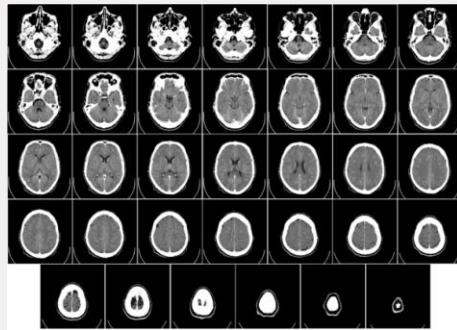
Better spacial resolution (less distortion)

Needs a magnetically shielded room and large MEG scanner
(more expensive)

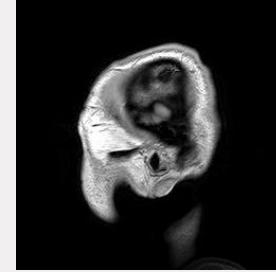


Static imaging

CT scan (Computed tomography): rotating X-ray beam, to view a 'slice'



MRI (Magnetic Resonance imaging)
Better contrast than CT



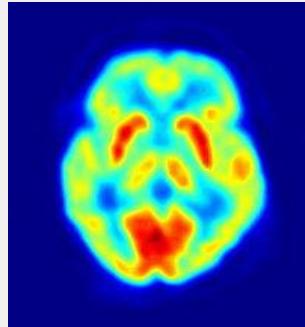
Metabolic Imaging: PET/fMRI

Glucose / oxygen intake as measure for brain activity

Differential activation between tasks

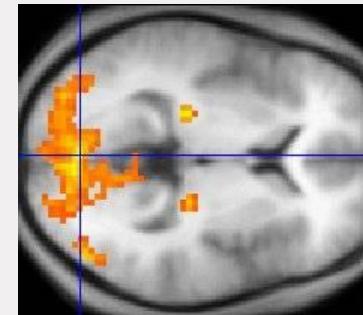
Pet Scan

(radioactive glucose)



fMRI

Oxygen level



Thoughts about PET/fMRI

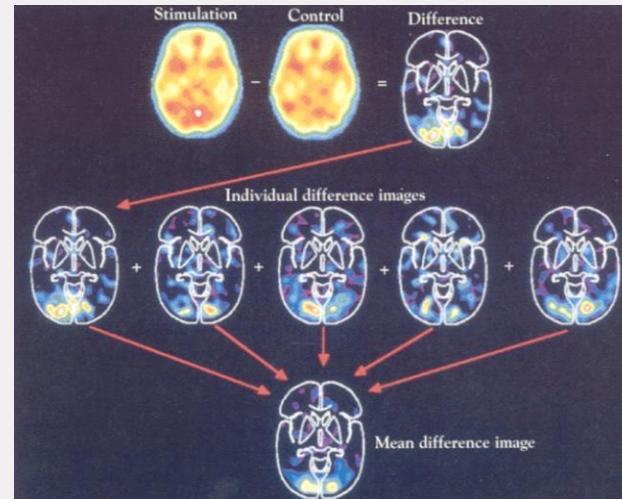
Subtraction method

Assumes activation is additive

Output depends much on method used,
thresholds set

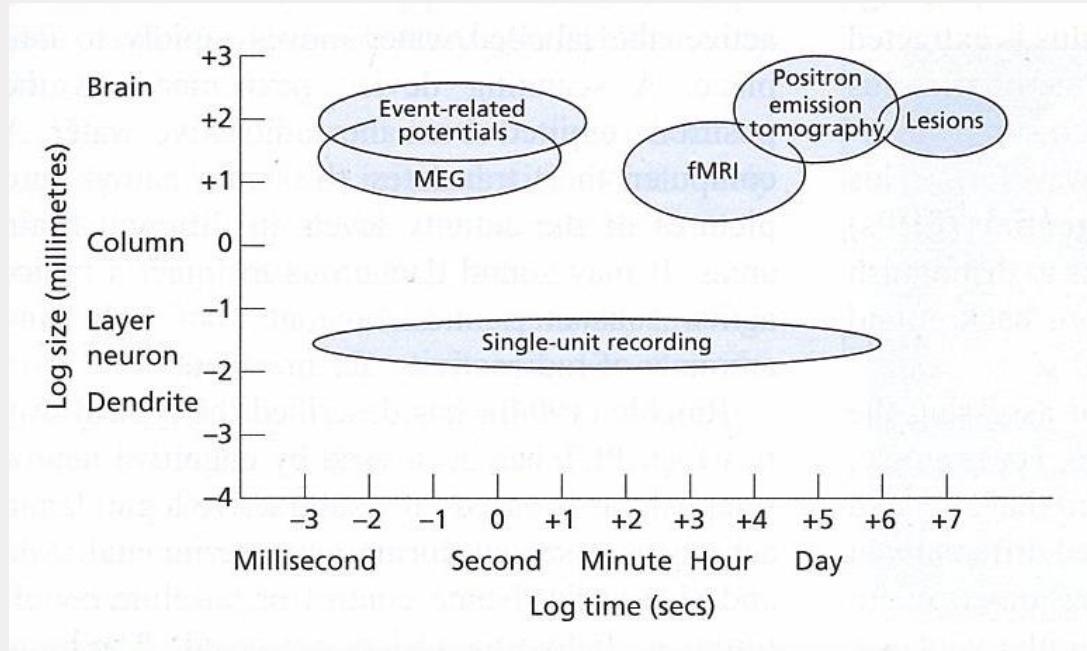
How good is the mapping?

Ambiguous mapping of regions and
structures to functions



Spatial and temporal resolution

from Eysenck & Keane (2005)



Five Themes in the Book

Cognitive processes are ...

Theme 1: active, rather than passive.

Theme 2: remarkably efficient and accurate.

Theme 3: handle positive information better than negative information.

Theme 4: interrelated with one another; they do not operate in isolation.

Theme 5: rely on both bottom-up and top-down processing.



0HV60 Thinking and Deciding

Lecture 2: Recognizing Visual and Auditory Stimuli (perception)

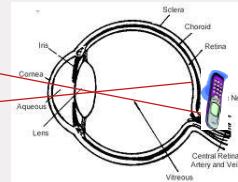
Martijn Willemsen

Background on Visual Object Recognition

The Visual System



Proximal stimulus



retina



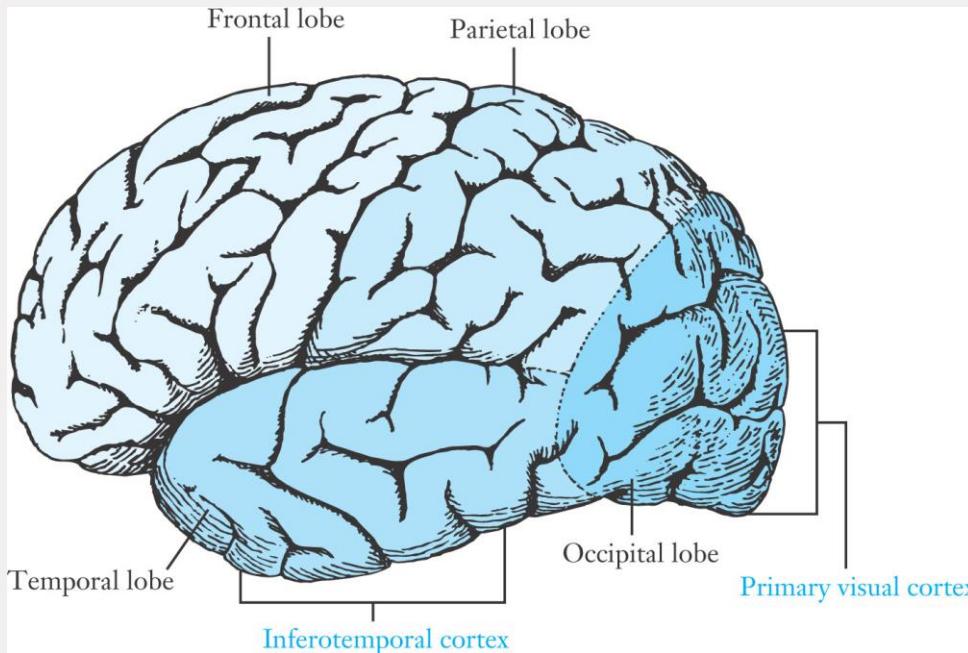
Object recognition

Recognize despite angle, distortion etc.!

You can recognize objects in a scene

If the scene is presented only 1/10 of a second!

Cerebral Cortex



Background on Visual Object Recognition

Organization in Visual Perception

Gestalt Psychology

figure

ground

ambiguous figure-ground relationship: flips

Explanation for figure-ground reversal

1. adaptation of neurons in visual cortex
2. people try to solve the visual paradox

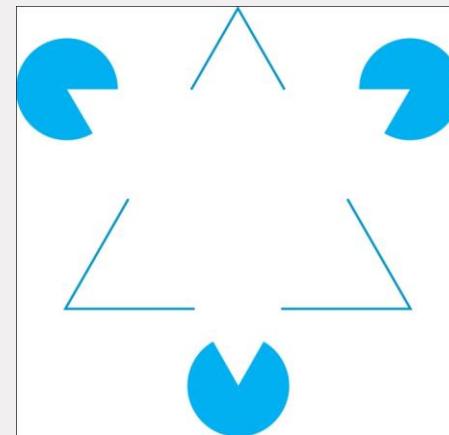


Background on Visual Object Recognition

Organization in Visual Perception

Illusory Contours (subjective contours)

- 1) early stages of processing:
Some cells respond
- 2) later stages of processing:
system tries to make sense



Background on Visual Object Recognition

Theories of Visual Object Recognition

Template-Matching Theory

templates

compare stimulus to templates until a match is found

Problems

inflexible

only works for isolated letters,
numbers, objects



What is the template
for the letter <A> ?

A A A A
A A A A

Background on Visual Object Recognition

Feature-Analysis Theory

distinctive features

Eleanor Gibson's research (1969)

time to decide if two letters are different Increases with the number of shared features

Neuroscience evidence

(feature detectors)

Problems with Feature-Analysis approach

doesn't account for the relationship between features
doesn't explain recognition of more complex objects

The letter <A> defined by 3 basic features?



Background on Visual Object Recognition

The Recognition-by-Components Theory

Irving Biederman

Object can be represented by 3D shapes called geons

combining geons to form objects

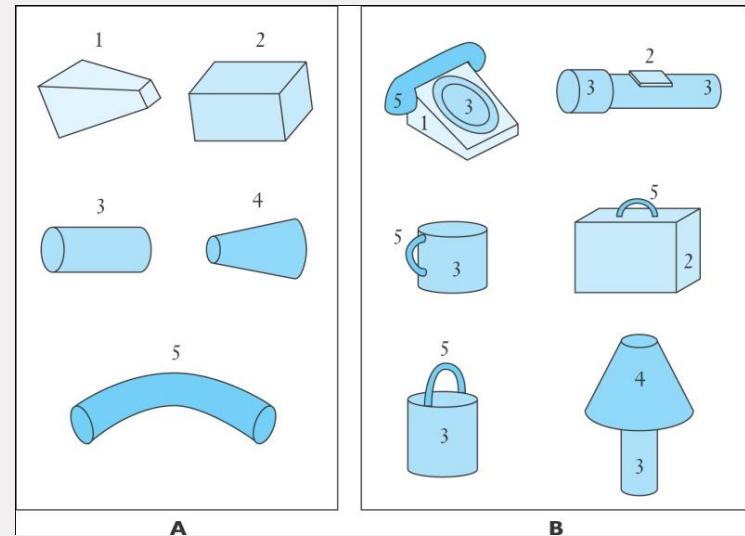
fMRI research

Problem

standard viewpoint is faster than a different viewpoint

Viewer-centered approach

store a small number of views and other views need rotation...



Top-Down Processing

Bottom-Up Processing and Top-Down Processing

T A E C A T

Top-down processing is especially strong when stimuli are incomplete or ambiguous.

Top-down processing is also strong when a stimulus is registered for just a fraction of a second.

more on this in the connectionism lecture and lab!

Top-down processing & Blindness

Inattentional Blindness

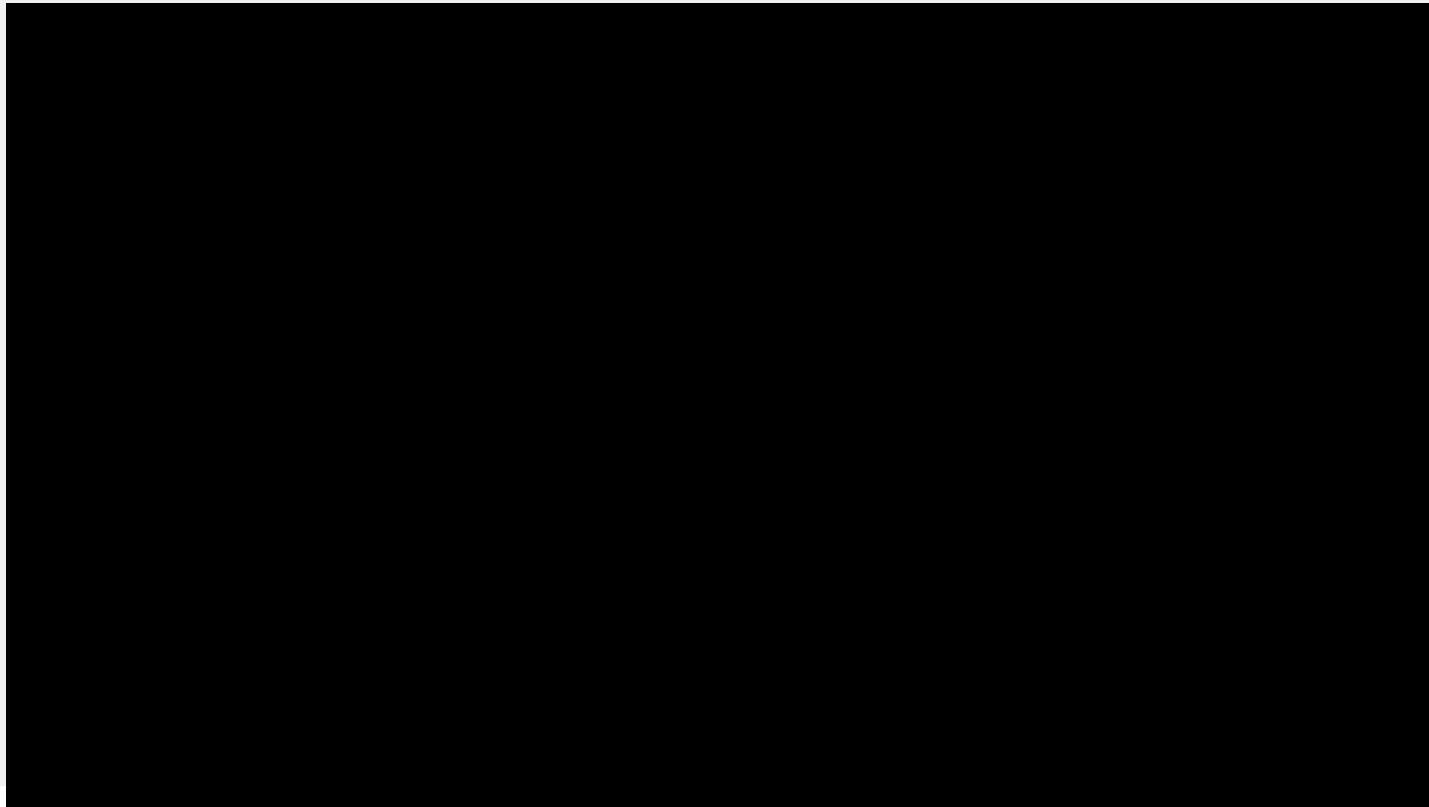
http://www.youtube.com/watch?v=IGQmdoK_ZfY

Change Blindness

<http://www.youtube.com/watch?v=ubNF9QNEQLA>

<https://youtu.be/qpPYdMs97eE>

Inattentional blindness



Change blindness



Face Perception

Face perception seems different from object perception

Face perception is holistic / gestalt

Neuroscience evidence:

Prosopagnosia: Face 'blind'

<https://www.youtube.com/watch?v=vwCrjomPbtY>

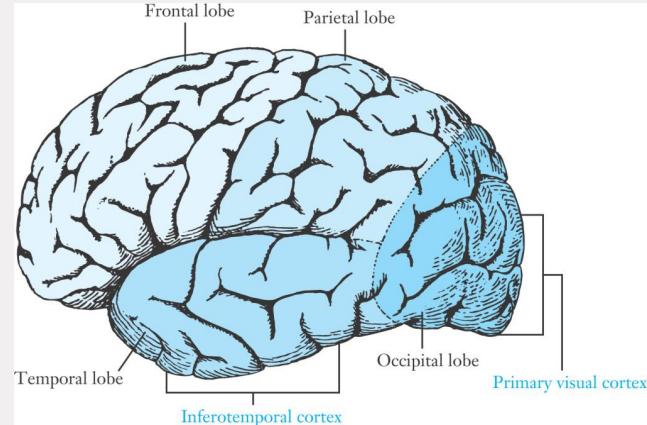
Visual Agnosia: Object 'blind' (video)

<https://www.youtube.com/watch?v=ze8VVtBgK7A>

Face perception located in the inferotemporal cortex

Upper part of the face is important in recognition:

<https://annex.exploratorium.edu/exhibits/wig/index.html>



Prosopagnosia

Sensation Without
Perception:
Visual Prosopagnosia

Visual Agnosia



Applied research on face perception

Face recognition works well for familiar faces,
but people are inaccurate with unfamiliar faces
(and often overconfident)

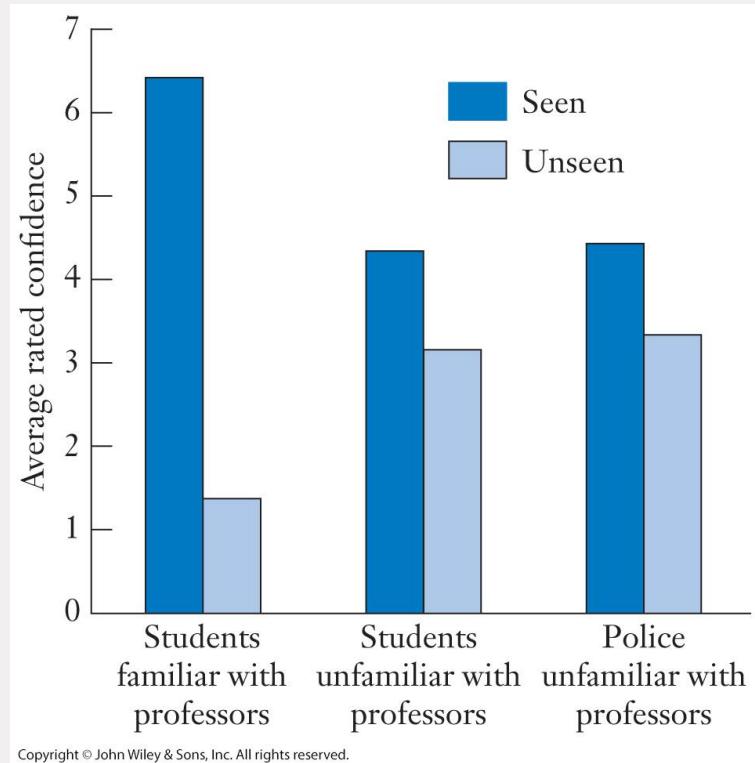
cashiers' judgments about ID photos

93% correct identification but missed
64% of the wrong photos were missed

security surveillance systems

Video clips of 10 professors, recognize 20
pictures from videos

Accurate if they knew the professors, not if
unfamiliar, or if you are an expert (police officer)



Speech Perception

We hear sounds

Put sounds together to form words

Comprehend the phrases of another's sentences

Understand the ideas being conveyed

Often done with slurred, accented, or incomplete speech input



Speech Perception

Perceive >50 phonemes per second

less than one per second for nonspeech sounds

Coarticulation: Phonemes overlap in time so:

Boundaries of phonemes overlap

Boundaries between words also tend to overlap

No one-to-one correspondence between the acoustic stimuli and the speech sounds we hear

Also in nonverbal language (sign language)

How do we recognize sounds in a way so a stable set of phonemes is perceived?

Top-down processing and context!

Ambiguous speech sounds

a door

a maze

adore

amaze

Top-down processing in speech segmentation

Context

He walked through <a door>

I <adore> chocolate

These results <amaze> me

The rats run through <a maze>

Phonemic restoration: we can fill in a missing phoneme:

It was found that the **eel was [on the axle / was on the orange]

The McGurk Effect



The McGurk Effect

<http://www.youtube.com/watch?v=MeWoqkOvd1Y>

Using visual cues in speech perception to disambiguate sounds.

You here ba, but the lips make it into fa...

Why would the visual system prevail here?

More detail: <http://www.youtube.com/watch?v=G-IN8vWm3m0>

Speech Perception is “*Special*”

Evidence of categorical perception

Continuous dimension *perceived* as discrete

- Sudden break between categories
- No discrimination within categories



Continuous = Actual sounds



Discrete = Actual perception

This suggests a separate phonetic module, but...

Categorical perception also for non-speech sounds

How to explain effect of visual cues if it is a separate (independent) module?

Speech Perception is “*Ordinary*”

General consensus is that speech perception is not special...

General mechanism:

Analyze auditory signals

(Need a template matching or feature detection process)

Then go to higher level processing using context to help figure out what is heard

Bottom-up and Top-down processes needed

Lab: Stroop Experiment for Friday

Go to <https://edu.vlab.nl/stroop>

You will need a computer with a mouse or trackpad!

Special version of the classical Stroop effect: we will analyze the data on Friday as a lab...



OHV60 Thinking and Deciding

Lecture 3: Attention and Consciousness (Matlin ch3)

Martijn Willemsen

Outline

Overview

Consciousness and Automatic processing

Attentional processes

Selective Attention and theories

Saccadic Eye movements

Neuroscience research on attention

Divided Attention

(note that is more or less in reverse order than in the book chapter...)

Attention and Consciousness

Attention

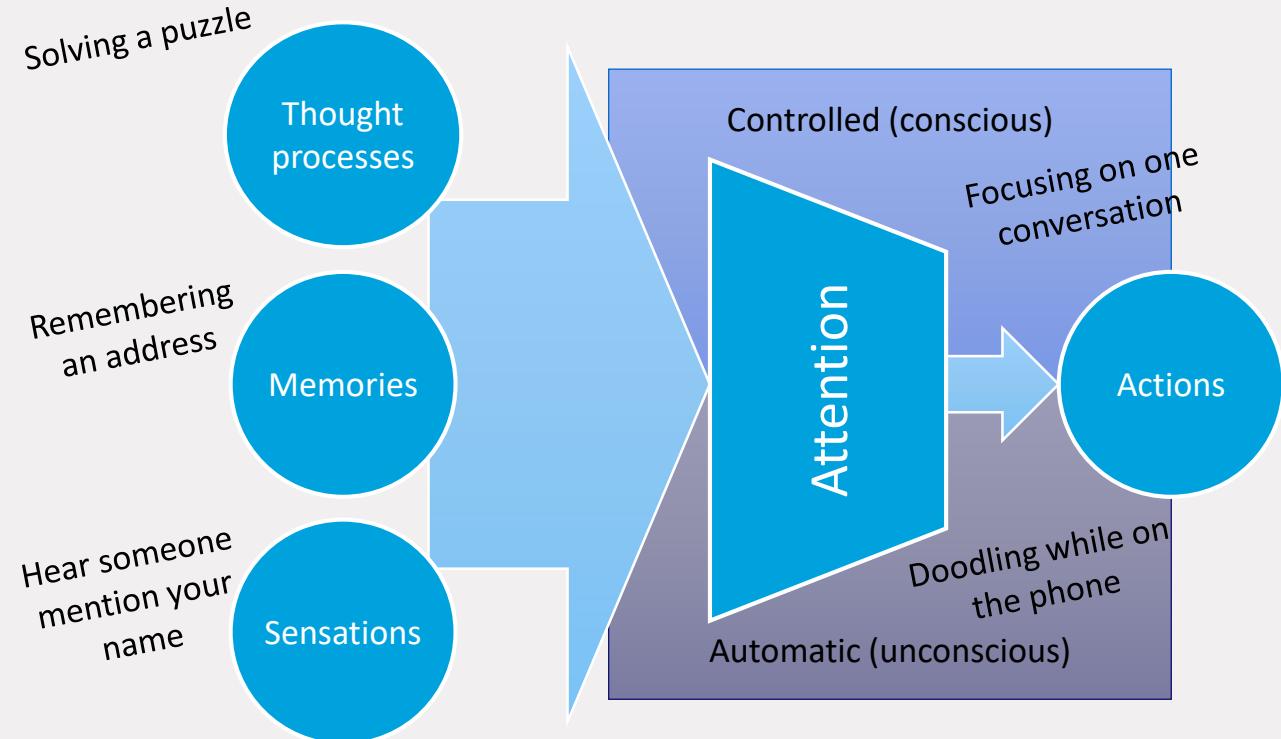
Is the means by which we actively process a limited amount of information from the enormous amount of information available through our senses, our stored memories, and our other cognitive processes

“Attention is a concentration of mental activity that allows you to take in a limited portion of the vast stream of information available from both your sensory world and your memory” (Matlin, p. 71)

Consciousness

includes both the feeling of awareness and the content of awareness, some of which may be under the focus of attention

Overview



Attention and Consciousness

Attention consists of conscious and unconscious processes!

Preconscious processing (no awareness)

Automatic processes (no active control, but can be aware of it: parallel processes)

Controlled processes (actively controlled, often serial processes)

Pre-consciousness

Things that are available to your consciousness, but not under current attention

Bodily sensations, memories

Tip-of-the-tongue phenomenon

You know you know it, you just “can’t get to it”

Pre-conscious perception / processing does occur!

Blind-sight person (video)



Blindsight

Blind sight

Blindsight

Lesions in some areas of the visual cortex

Patients claim to be blind on one side



When forced to guess about a stimulus in the “blind” region, they correctly guess locations and orientations of objects at above-chance levels
(‘left – unaware’, ‘right – unaware’)

Explanations:

portion of the information from the retina
travels to other locations on the cerebral cortex, outside the visual cortex



**primary visual cortex necessary for conscious
awareness of visual information**

Automatic / Controlled processes

Controlled processes

Require intentional effort; full conscious awareness; consume many attentional resources; performed serially; relatively slow

Automatic Processes

Little or no intention or effort; occur outside of conscious awareness; do not require a lot of attention, performed by parallel processing; fast

Is Typing Automatic or Controlled for You?

Do you type without thinking where your fingers are? Are you a search-and-peck typer?

If you do type without using attention, what happens when you think about the letters as you are typing them?

What about other automatized tasks?



Stroop Effect

Name as quickly as possible the color of ink in which each word is printed. Name from left to right across each line.

Red Yellow Blue Green

Blue Red Green Yellow

Yellow Green Red Blue

Stroop Effect

Name as quickly as possible the color of ink in which each word is printed. Name from left to right across each line.

Red Blue Green Yellow

Yellow Red Blue Green

Blue Yellow Green Red

Stroop Task (Stroop, 1935)

Demonstrates the psychological difficulty in **selectively** attending to the color of the ink and trying to ignore the word that is printed with the ink of that color

Explanation: reading is an automatic process that cannot be suppressed when looking at the color

Other explanation: interference of activation of two distinct mental pathways

Stroop effect also used for other goals:

Emotional Stroop task

More interference due to suppressing emotions

Selective Attention

Selective Attention

respond selectively to certain kinds of information, while ignoring other information

people notice little about the irrelevant tasks

Dichotic Listening

one message presented to left ear
and a different message presented
to right ear

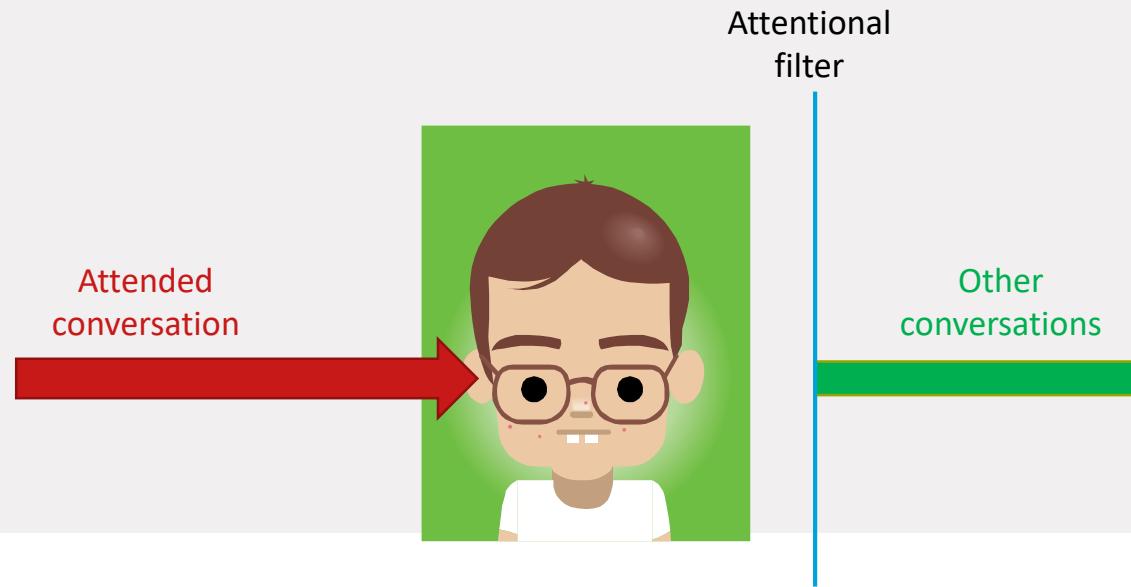
shadow one of the messages



Selective attention

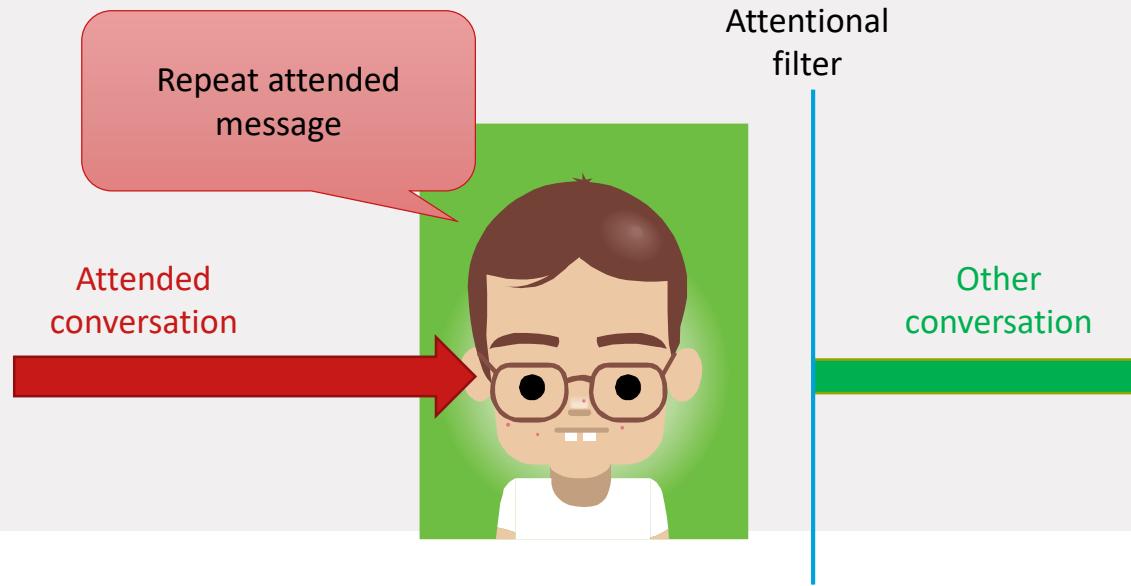
The cocktail party problem (Cherry, 1953)

The process of tracking one conversation in the face of the distraction of other conversations



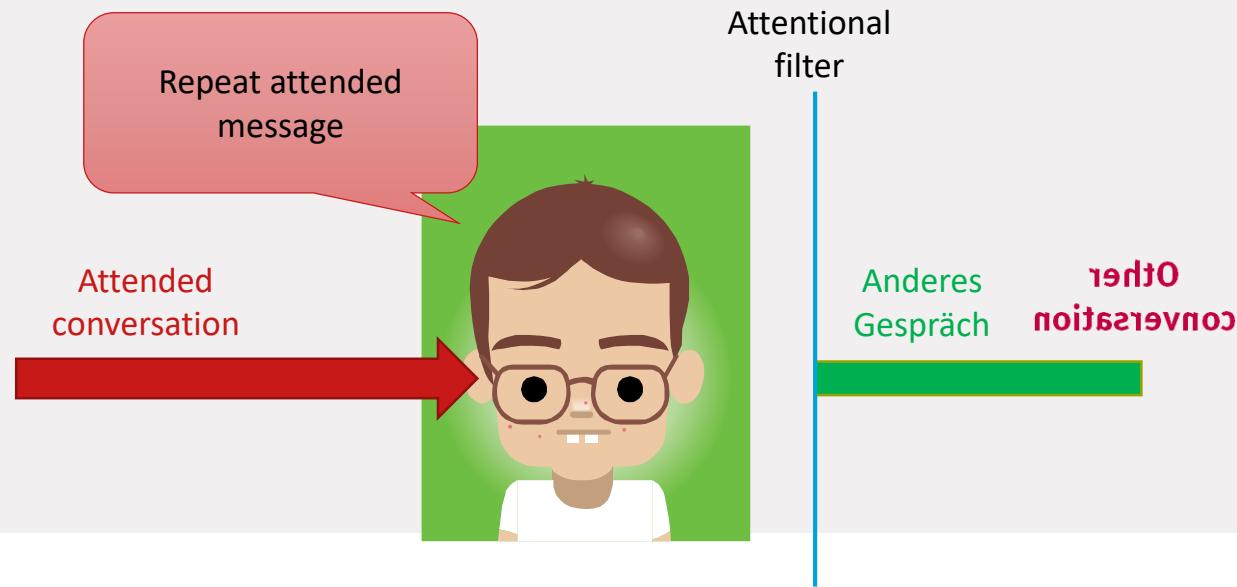
Selective attention

Dichotic presentation



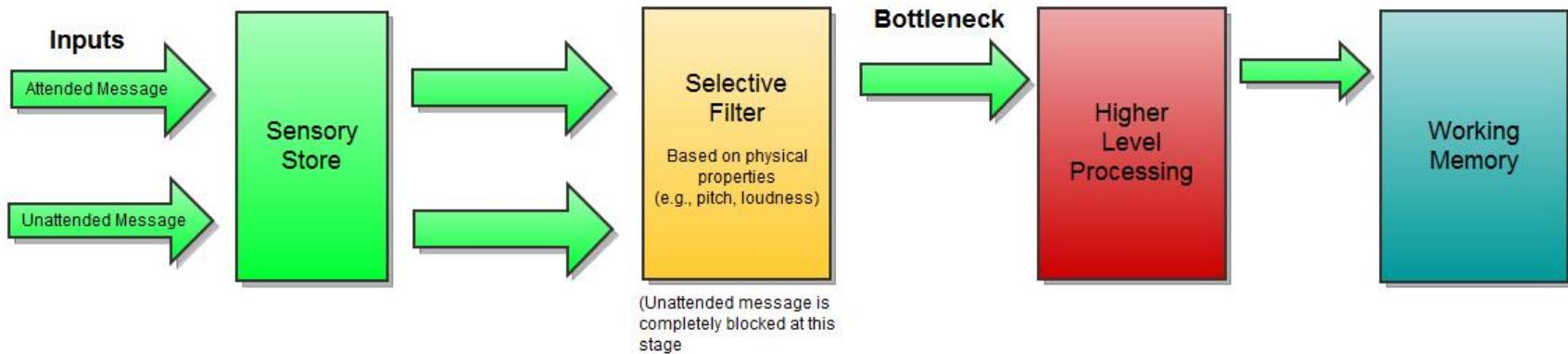
Selective attention

Dichotic presentation



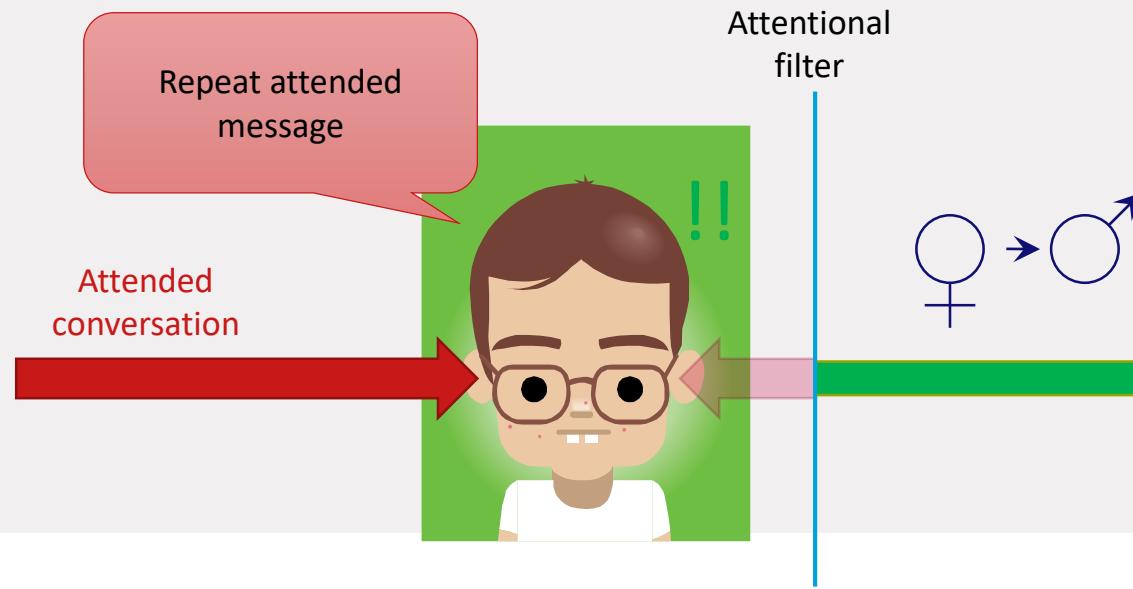
Broadbent's filter theory

Broadbent's Filter Model



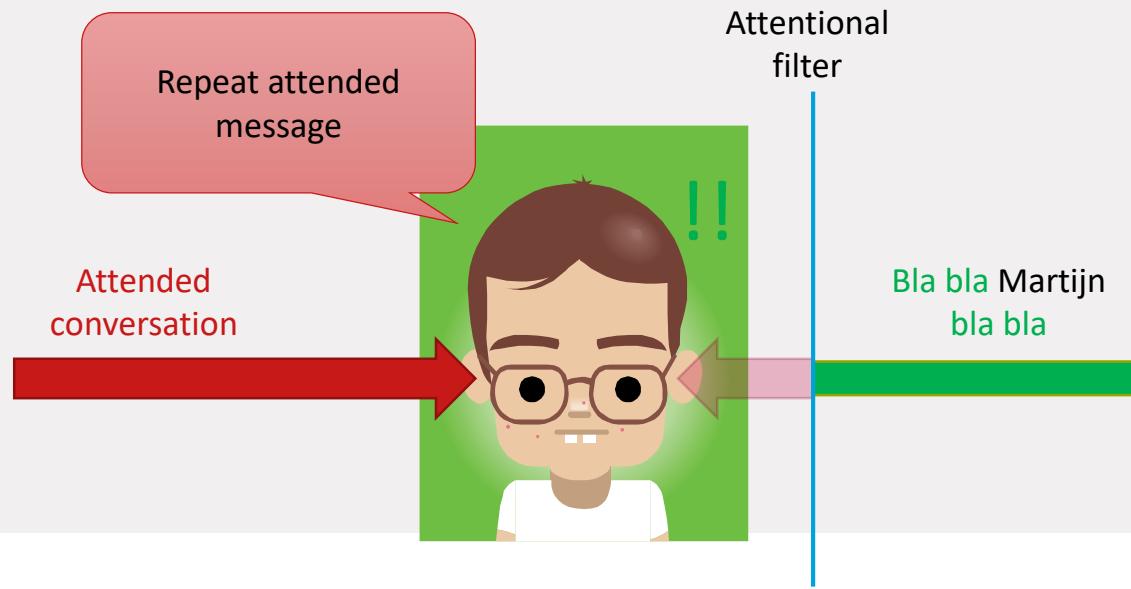
Selective attention

Dichotic presentation



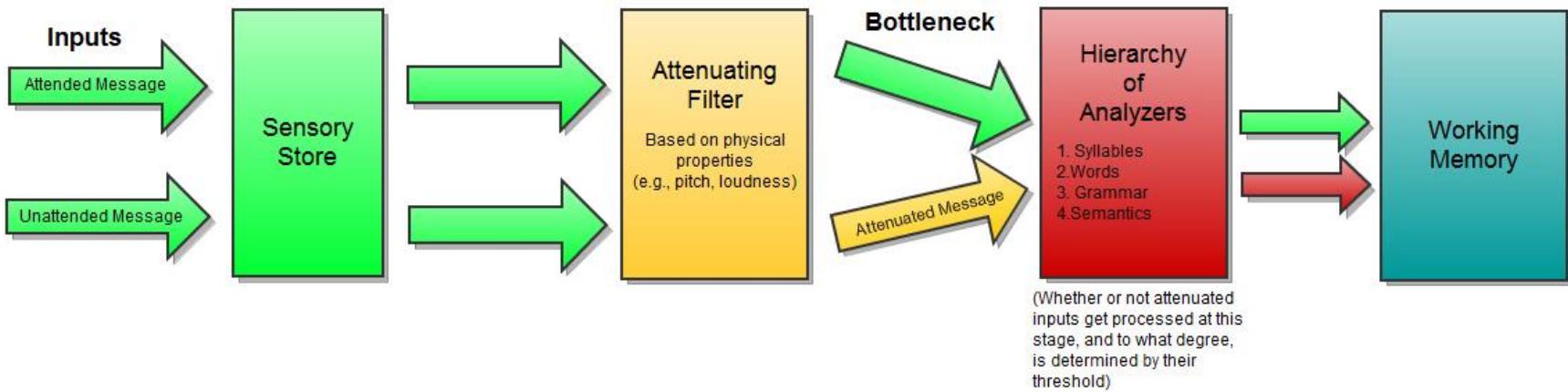
Selective attention

Dichotic presentation



Treisman's attenuation model

Treisman's Attenuation Model

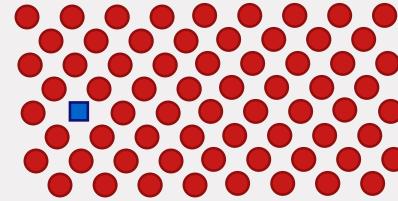


Threshold effect: minimum amount of attention needed for conscious awareness

Visual Search

Find the blue square

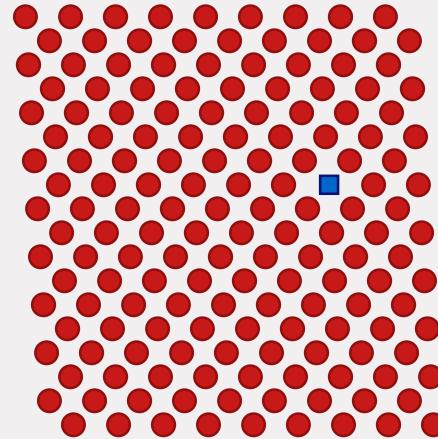
Easy: isolated feature



Visual Search

Find the blue square

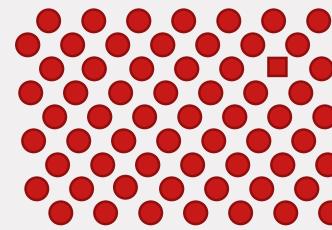
Easy: isolated feature: also with more items



Search

Find the square

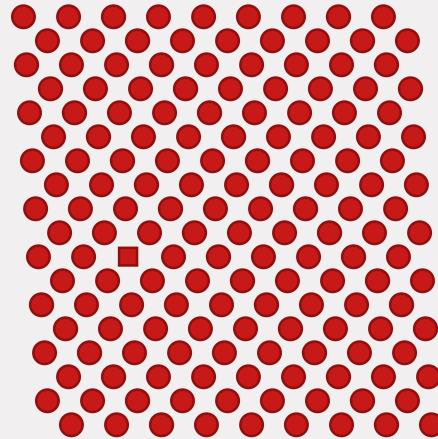
Harder: Distractors are more similar



Search

Find the square

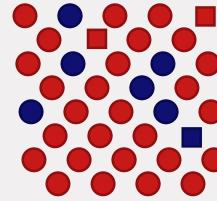
Harder: Distractors are more similar



Search

Find the blue square

Very hard: Conjunction search

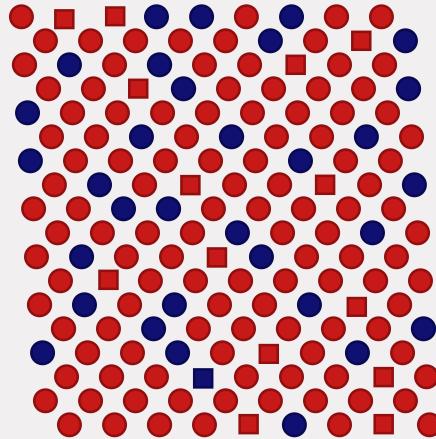


Search

Find the blue square

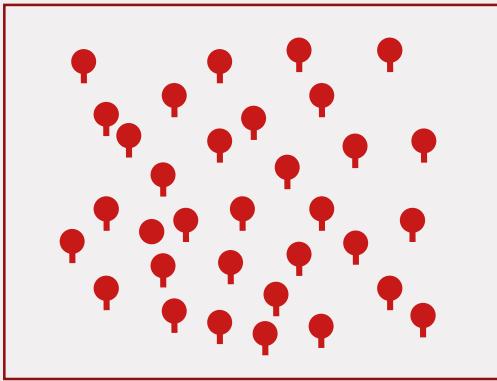
Very hard: Conjunction search

Especially with many items...!

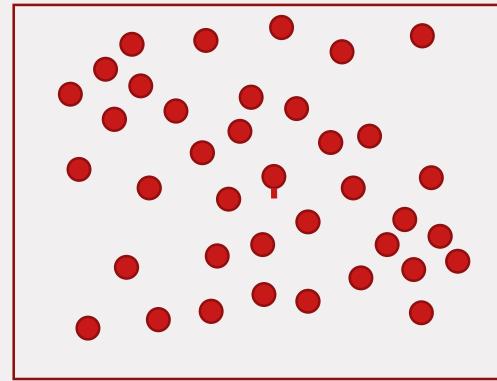


Feature present/absent

A



B



Feature-integration theory (Treisman 1980, p. 87)

The basic elements:

Distributed Attention

Automatic, effortless (parallel)

Focused Attention

Effortful, slow processing (needed for conjunction search)

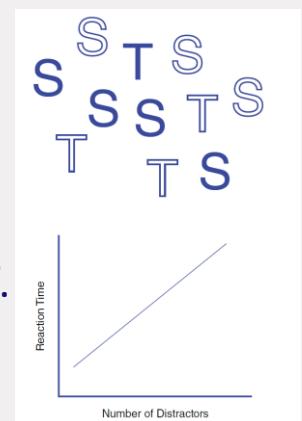
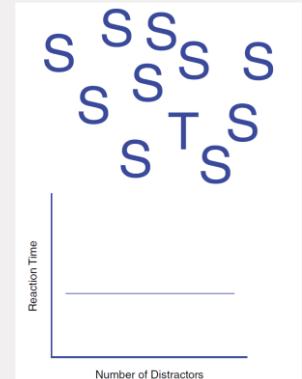
Illusory conjunctions

Object features are processed separately and combined again.

N & T -> T

Given two nonsense syllables “dax” and “kay”, participants respond with “day”.

Presence of illusory conjunctions suggests that features are processed separately and put together later in our minds (**Binding problem**)



Saccadic Eye Movements

Very rapid movement of the eyes from one spot to the next.

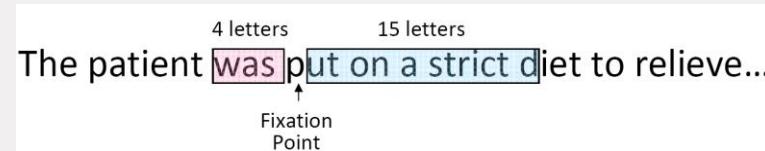
Viewing a scene/following movement/reading text

Bring the fovea into position over the words you want to read

During fixation, the visual system pauses for 50-500 ms

Perceptual span: letters 4 positions to the left and 15 positions to the right.

Moves ignore spaces and
short or predictable words



Size of movements, regressions and pauses depend on:

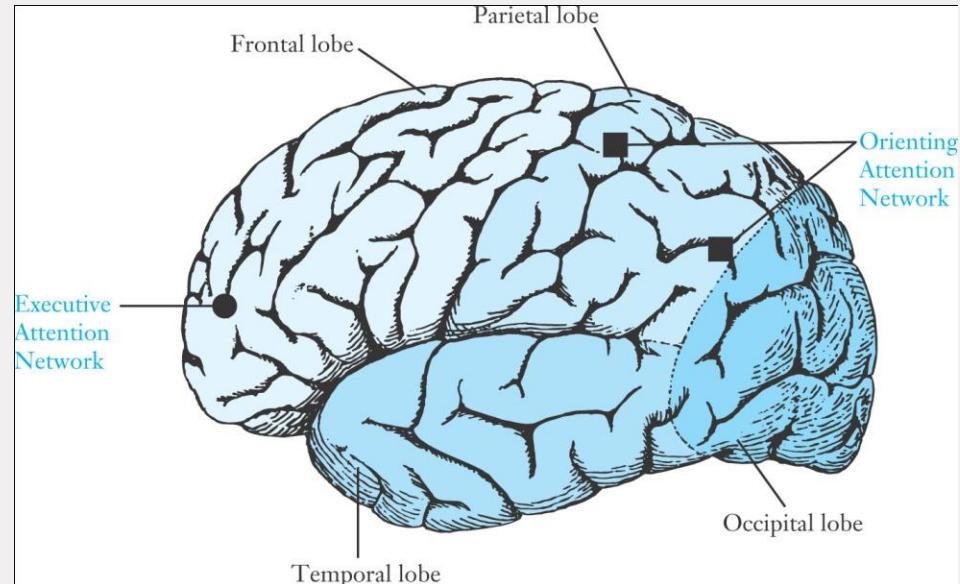
Reading ability

Meaning of the text, surprising ending

Neuroscience Research on Attention

Three systems in the cortex manage different aspects of attention
(Posner and Rothbart 2007)

The orienting attention network
The executive attention network



Neuroscience Research on Attention

The Orienting Attention Network

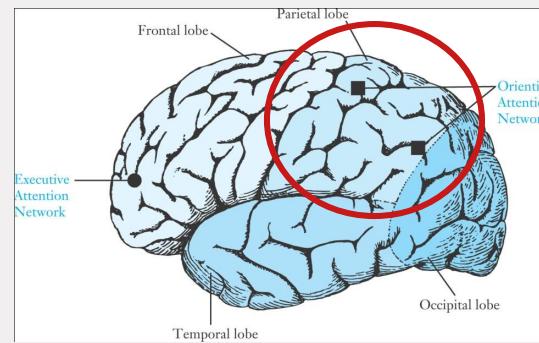
selecting information from sensory input

Responsible for attention required for visual search

Developed at 4 months of age

Localized in the parietal lobe

brain lesions aided localization
unilateral neglect (video)



Neuroscience Research on Attention

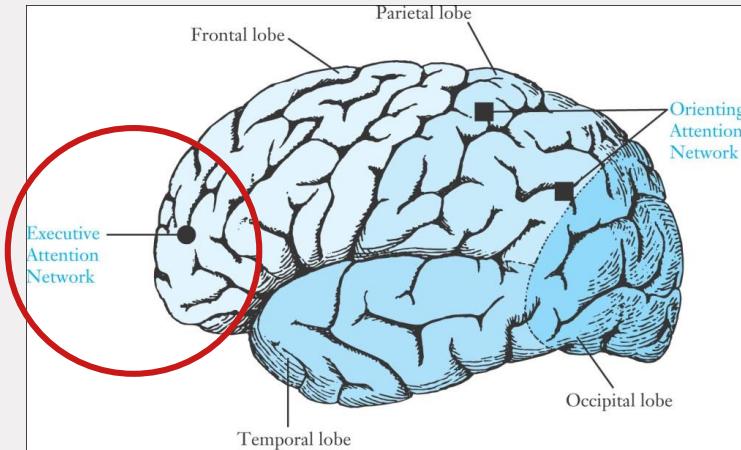
The Executive Attention Network

used when task features conflict:
inhibiting automatic responses to stimuli

Stroop task!

Developed at age of 3

top-down control of attention
academic learning, acquiring new ideas



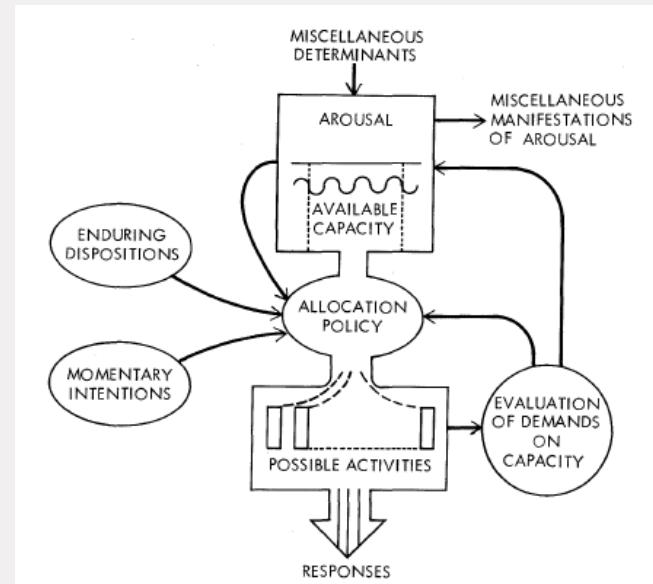
Attentional-Resource Theories

We have attentional resources specific to a given modality

Explains why we can study and listen to a music but not listen to news

Filter and bottleneck for competing tasks (attentionally incompatible)

Attentional Resource theories for more complex (divided attention) tasks and more automated tasks



Kahneman's attention model

Doodling

Can make you more alert!

Memory test of 40 volunteers

Listen to a phone call en recall names and places

Half of them were asked to doodle

Those doodling recalled 29% better!

Doodling prevents you from daydreaming...

(thinking about other things)

That might be why we like to listen to music while studying...



Divided attention

It is really hard to coordinate two tasks

Reading for comprehension and writing dictated words
Even if the tasks are quite simple separately

When is it possible?

If one task is automatic
After (lots) of practice

Spelke: Practice leads to automation

Tasks become one unit...
...but not completely automated!

Debates on Tuesday!



Psychological Refactory Period

Central bottleneck theory:

Many tasks can be done simultaneously (parallel)
response generation is however a serial process!

This indicates that automatic processes are never really fully automatic...

Implications for multitasking actions (like driving)

While Driving...

Driving simulation

Tracking task: tracking a moving target with a joystick.

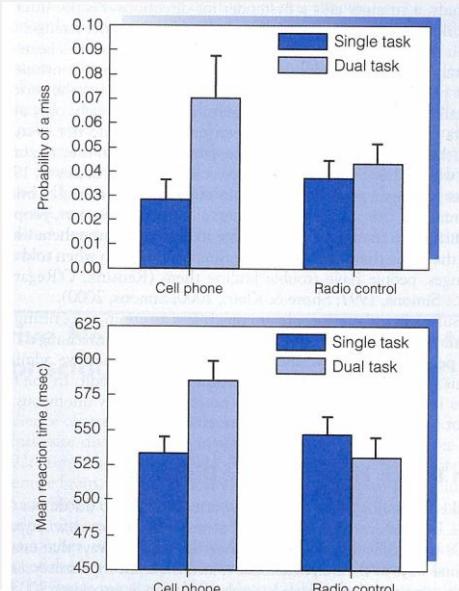
Green flash: ignore, red flash: hit break (button)

Single or dual task

'Driving'

Listing to radio / talking on a cell phone

Cell phone: more mistakes and
lower reaction times than radio listening



While following lectures... 😞

Multitasking on a laptop

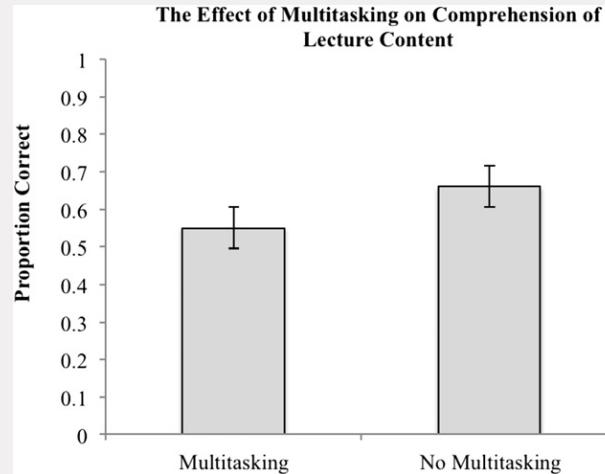
Primary task: Attend a 45 min. lecture and take notes using a laptop

Secondary task: half completed some other simple online tasks

e.g. what is on ch3 tonight at 10 pm?
(15 min time needed, 33% of lecture,
on average 9 of 12 tasks completed)

Results

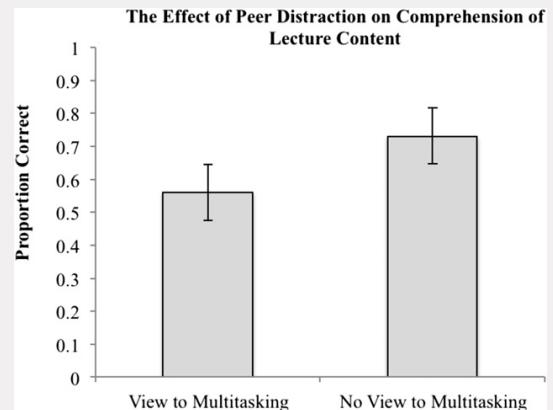
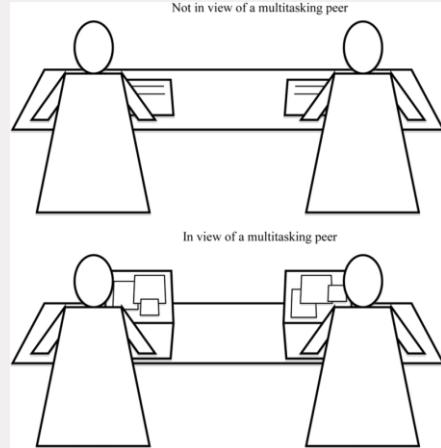
Notes of MT were of poorer quality
MTers scored 11% lower on
post-lecture Comprehension test!



You better close your laptop... or sit in the front

Study 2 investigated paper and pencil note takers behind others or behind multi taskers
(similar to study 1)

Notes were of equal quality but final test showed much poorer performance again!





0HV60 Thinking and Deciding

Lecture 4: Working Memory (Matlin ch 4) and Long term memory (ch. 5)

Martijn Willemsen

Traditional Model of Memory



Early models

Tasks: Encoding, storage and retrieval

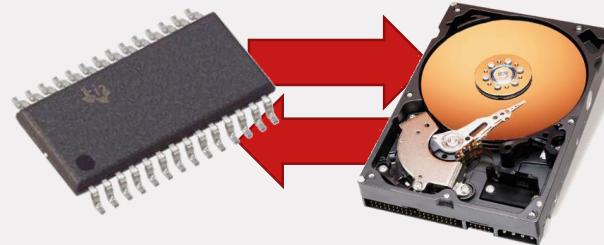
Spatial metaphor:

memories are stored in specific locations in the mind, retrieval involves search

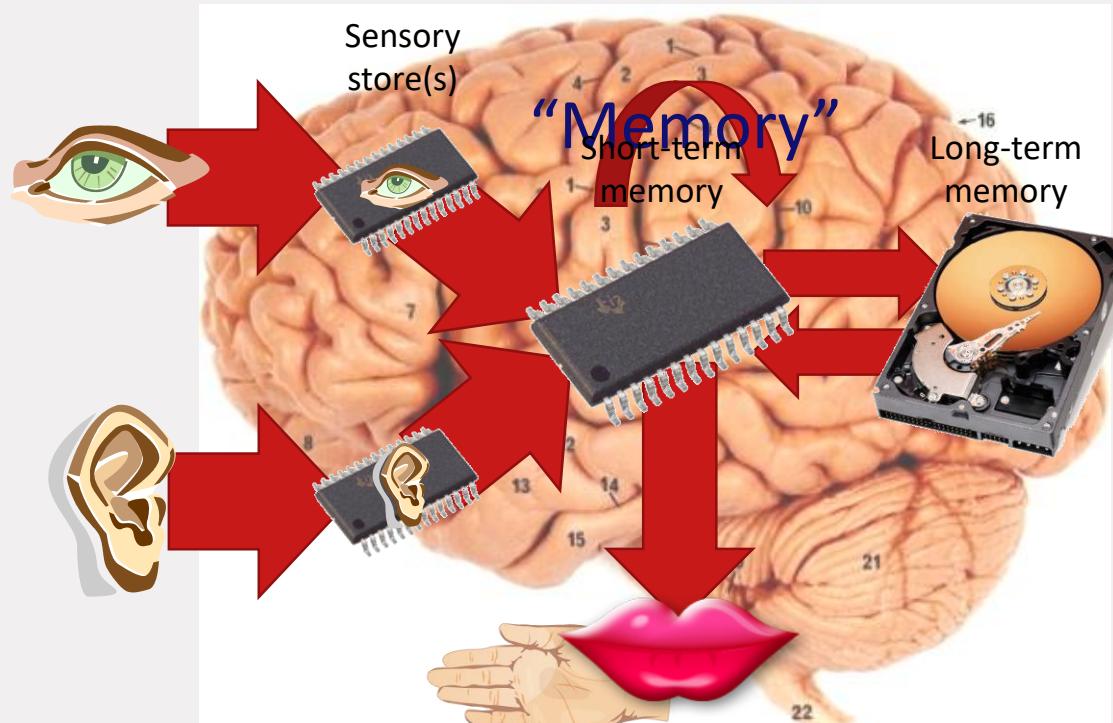
Plato: mind is aviary, birds are memories

William James:

Primary memory (temporary info)	Secondary memory (permanent storage)
------------------------------------	---



Atkinson and Shiffrin (1968)



Sensory store



Modality specific

(vision, hearing, etc)

Info is held very briefly

Some info attended to and
processed further

Can easily be erased by new info:
Merging, masking

Iconic store: visual persistence

DEMO!

Short-term store -> working memory

Typically 30 seconds

Unless rehearsed

Acoustically stored

Very limited capacity

Miller: Span: 7+/-2

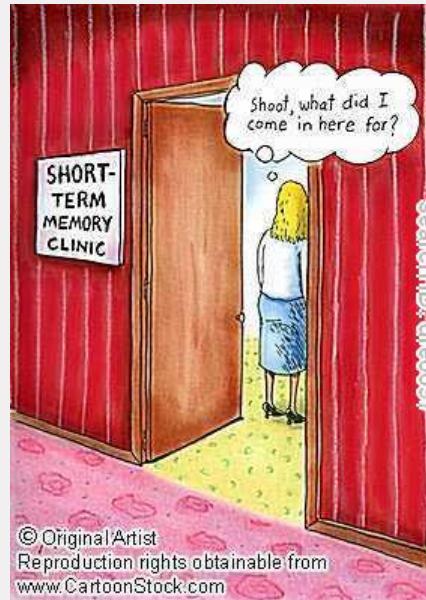
Fragile storage (easily distracted)

With interference: down to 3

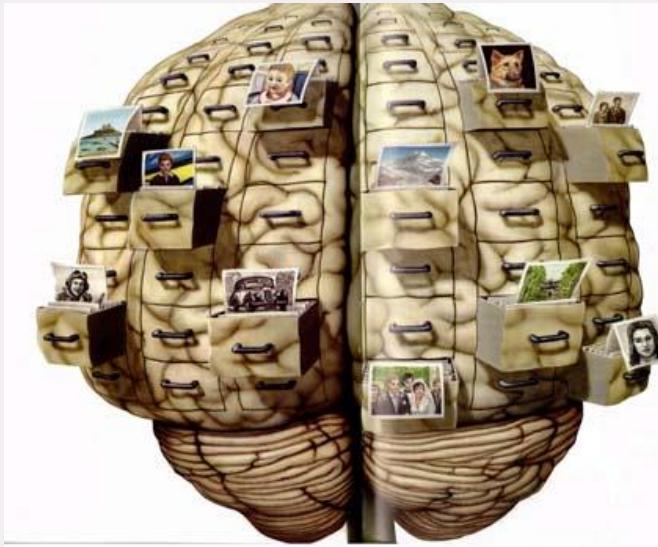
Visual information: 4 objects

Trick to retain more info: **chunking**

visual test: <http://neutralx0.net/home/mini04.html>



Long-term store



Retain over very long periods

- Indefinitely?

Limits unknown

- Capacity
- Retention

Differences in type of info

- Recognition vs. recall
- Facts vs. skills

Permastore (long retention of information)

Working Memory (chapter 4)

Let's try a quick memory test

Listen/read to the following 14 words

Afterwards, write down all words you can remember on a piece of paper.

If you are born on an odd day (Feb 1) you need to first count downwards from 22 to 1 in steps of 3 before you write down anything

Steal

robber

crook

money

police

bad

prison

gun

villain

crime

bank

bandit

criminal

jewelry

if you are born on an even day (e.g. 2 Feb):

Write down all the words you can recall

if you are born on an odd day (e.g. 1 Feb):

count backwards from 22 to 1 in steps of 3 (22...19..)

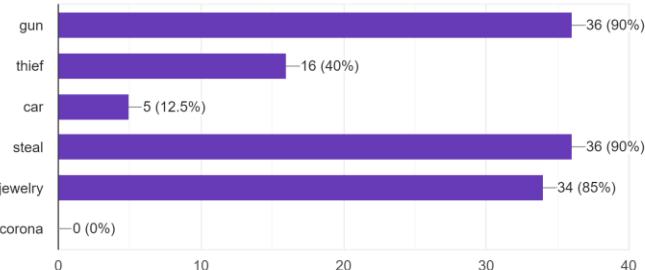
than write down all the words you can recall

Now fill in this form

Odd day (e.g. Feb 1): (counting backwards)

was this word read by me?

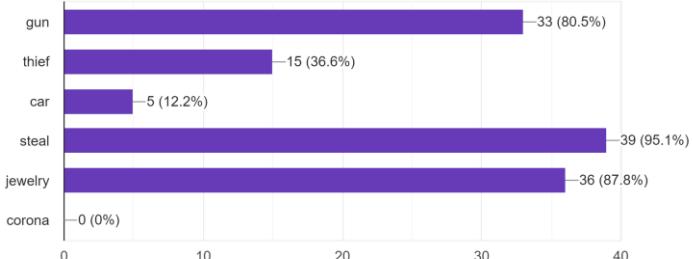
40 responses



Even day (e.g. Feb 2): Immediately

was this word read by me?

41 responses



Brown/Peterson & Peterson

Retention in working memory

material held in memory for less than a minute is frequently forgotten

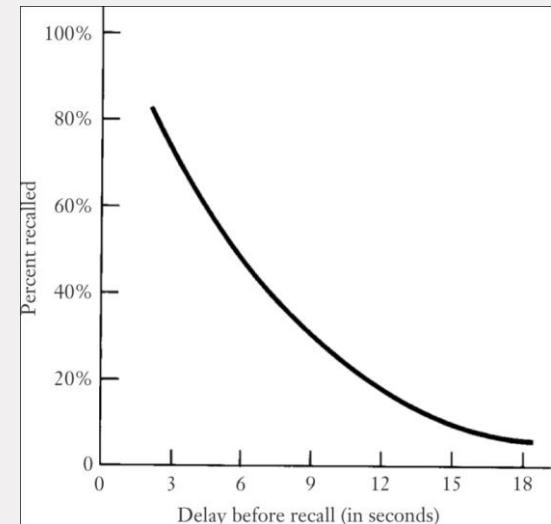
Task: remember a trigram (CHJ) consisting of 3 non-morphemic letters

Why? No context / memory aid

count backwards by threes from a given number for x seconds

Why? prevent rehearsal!

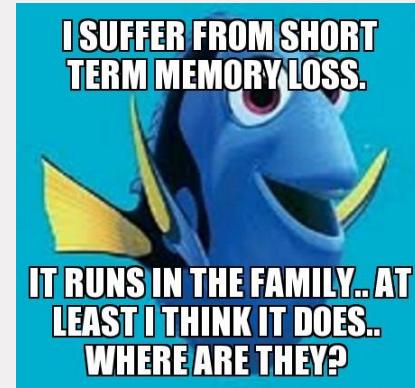
After some trials, previous trigrams interfere and recall is poor: strongly decreases with longer delays



Interference theory

How do we forget so easily?

Without rehearsal information decays quickly and is not retained...



Interference (inhibition): recall of certain items interferes with recall of other items

Retroactive interference: occurs after learning but before recall: new information coming in (and counting backwards by threes...) (discussed in the book in chapter 5)

Proactive interference: interfering material occurs before learning (influence of prior knowledge and expectations, or items you learned before like in brown-Peterson task)

Serial position effect

learn a list of at least 9 words

recency effect

Only proactive interference
(and STM)

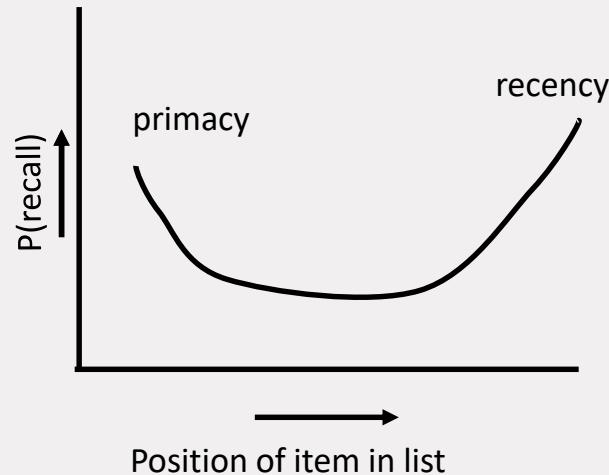
primacy effect

Only retroactive interference
(and LTM, more rehearsal)

Middle words

both types

Effect of counting backwards...?



Serial position effect

learn a list of at least 9 words

recency effect

Only proactive interference
(and STM)

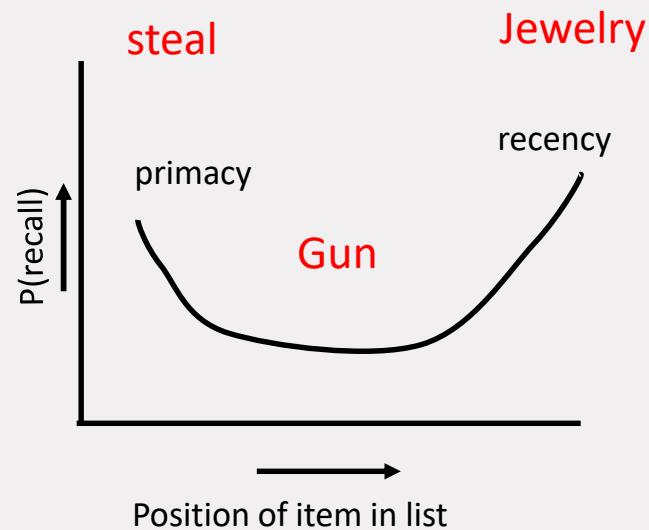
primacy effect

Only retroactive interference
(and LTM, more rehearsal)

Middle words

both types

Effect of counting backwards...?



Semantic Similarity

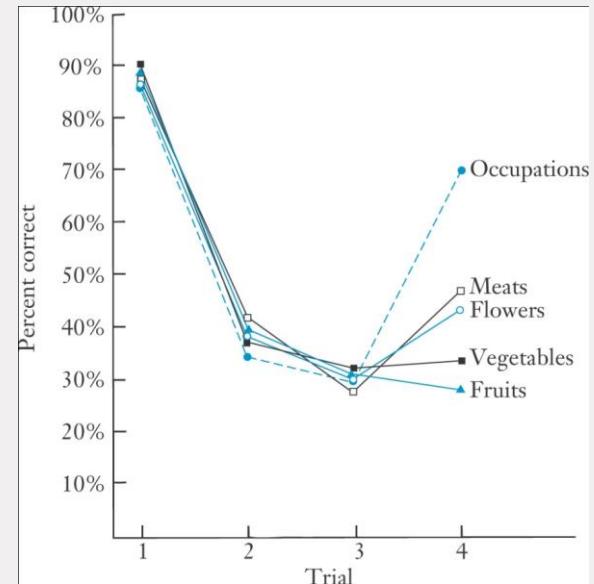
Semantic Similarity of the Items in Working Memory

Semantics: meaning of the words have effect on working memory span

Wickens and colleagues (1976)

release from proactive interference

Brown/Peterson & Peterson task varying semantic similarity on Trial 4



Last trial is worse for more similar categories

Working Memory

Alan Baddeley & Graham Hitch:

What does short-term memory accomplish for our cognitive processes?

working-memory approach—our immediate memory is a multipart system that temporarily holds and manipulates information as we perform cognitive tasks

Evidence for independent capacities (Baddeley & Hitch, 1974):

Rehearse string of up to 8 random numbers

Spatial reasoning task: AB: A follows B?

Emphasis on active manipulation of information in working memory!

Baddeley

Visuospatial sketchpad

Briefly holds visual images

Phonological loop

Inner speech, for comprehension, reasoning and rehearsal

Episodic buffer

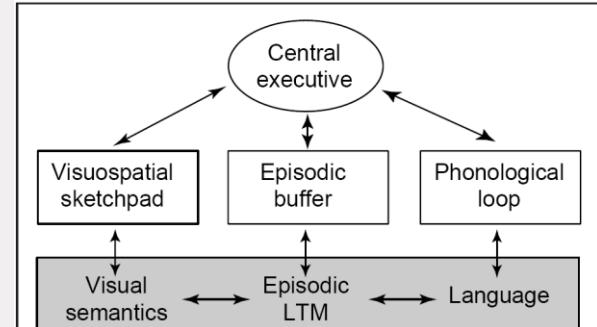
Integrate sources

Central executive

Coordinate attention and responses

Slave systems

LTM and special tasks



trends in Cognitive Sciences

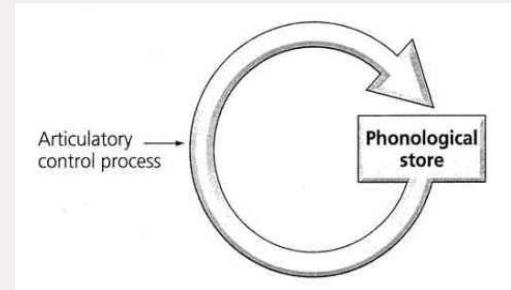
Fig. 1. The current version of the multi-component working memory model. The episodic buffer is assumed to be capable of storing information in a multi-dimensional code. It thus provides a temporary interface between the slave systems (the phonological loop and the visuospatial sketchpad) and LTM. It is assumed to be controlled by the central executive, which is responsible for binding information from a number of sources into coherent episodes. Such episodes are assumed to be retrievable consciously. The buffer serves as a modelling space that is separate from LTM, but which forms an important stage in long-term episodic learning. Shaded areas represent 'crystallized' cognitive systems capable of accumulating long-term knowledge, and unshaded areas represent 'fluid' capacities (such as attention and temporary storage), themselves unchanged by learning.

Phonological loop

Components:

Phonological store: auditory memory (decay 2s) can hold limited number of sounds

Articulatory rehearsal loop:
retention of sequential information (subvocalization)



Evidence

Word-length effect (sequence of short words easier to recall): but this has also other explanations...

Acoustic confusions: Phonological similarity effect (similar sounding items are harder to remember)

Articulatory suppression (recite irrelevant sound prevents rehearsal and declines performance)

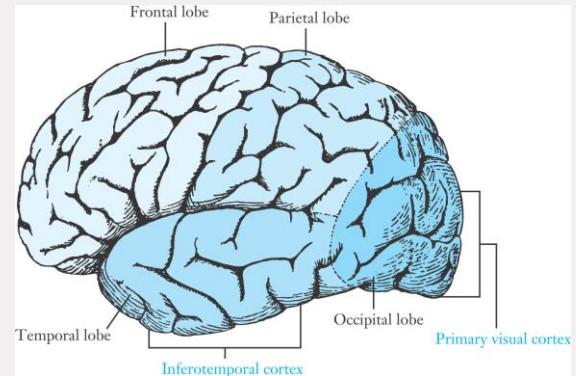
Phonological Loop

Uses for the Phonological Loop: gateway to long term memory!

- Counting
- Reading
- Learning language
- Mathematical calculations
- Problem-solving tasks
- Complex task instructions / self-instruction

Neuroscience Research on the Phonological Loop

- frontal lobe
- left** temporal lobe
- Left** parietal lobe



TMS and the phonological loop

Transcranial Magnetic Stimulation

Stimulates region on the cortex (temporal 'lesion')

Two areas are stimulated:

Left frontal lobe: rehearsal

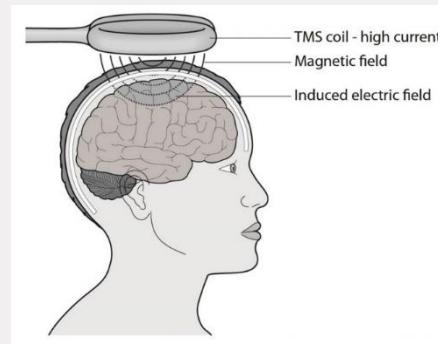
Left parietal lobe: store auditory info

sentences matched with a sketch

For short sentences: no effect of TMS

Longer sentences: affected most by
TMS on left parietal lobe

Longer complex sentences: affected by both



Visuospatial sketchpad

visuospatial sketchpad—processes both visual and spatial information

- store appearance and relative position

- store visual information encoded from verbal stimuli (visualizing a story)

Research on the Visuospatial Sketchpad

- Difficult to perform two visuospatial tasks simultaneously

- (driving an understanding a football game on the radio)

Research is limited:

- no standardized set of visual stimuli

- tendency to provide names for visual stimuli, thus using phonological loop instead:

- “Look, that is a circle in a square”

- Can be overcome by loading the Phonological loop (Brandimont 1992: la-la-la)

Visuospatial sketchpad

Uses for the Visuospatial Sketchpad

Engineering, art, architecture

retaining image of a scene (reaching for objects)

finding your way from one location to another (see also chapter 7)

videogames, jigsaw puzzles, mazes

Watching television



Neuroscience Research on the Visuospatial Sketchpad

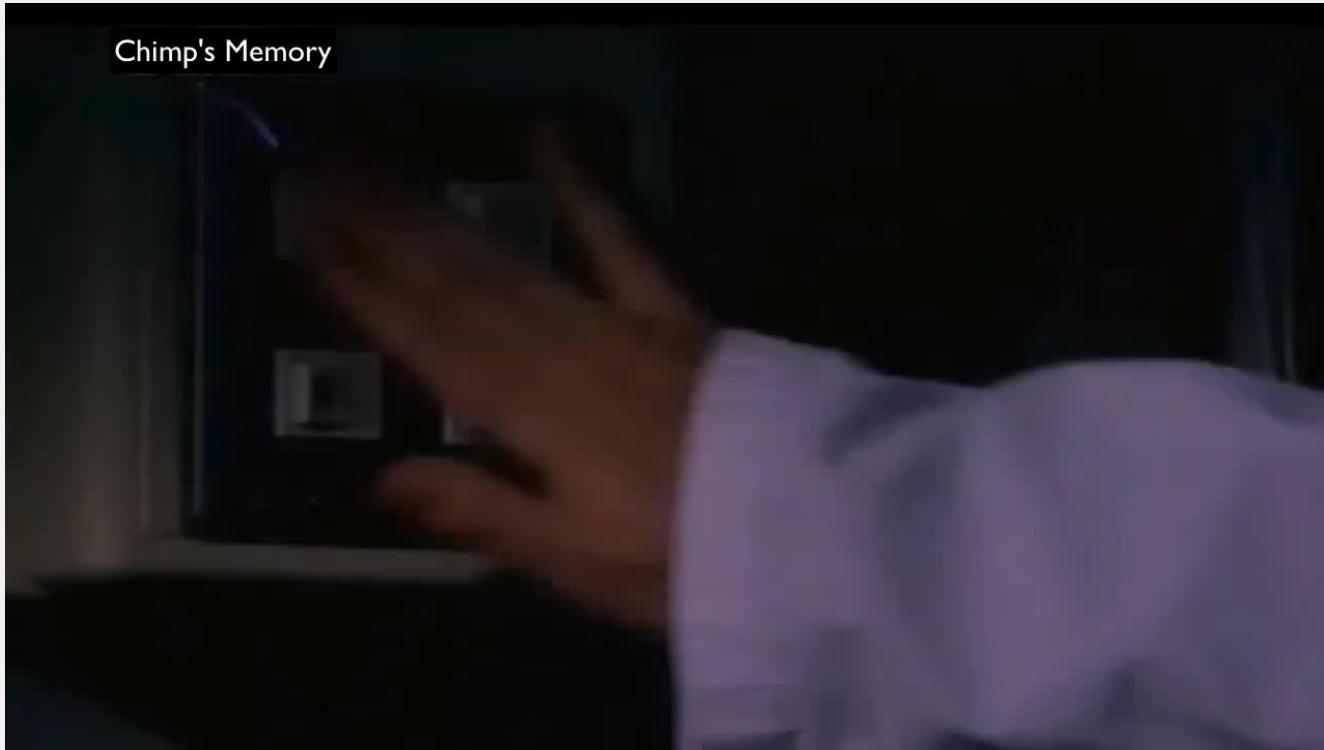
right hemisphere

occipital lobe (visual perception)

frontal cortex

frontal and parietal lobes (rehearsal)

Visual-Spatial Sketchpath in Chimps



<https://www.youtube.com/watch?v=aAIGVT3N7B0>

Central Executive

Central executive—integrates information from the phonological loop, the visuospatial sketchpad, the episodic buffer and from long-term memory

Characteristics of the Central Executive

plans and coordinates, **but does not store information**

executive supervisor: decides which issues deserve attention (and what to suppress)

limited capacity to perform simultaneous tasks

Research: random number generation:

those daydreaming did not generate random sequences

Why: because daydreaming needs your C.E.

Neuroscience: frontal lobe

(version 9 of the book compares with with executive attention network: ch 3!)

Episodic Buffer

episodic buffer—temporary storehouse where we can gather and combine information from the phonological loop, the visuospatial sketchpad, and long-term memory

integrates information from different modalities

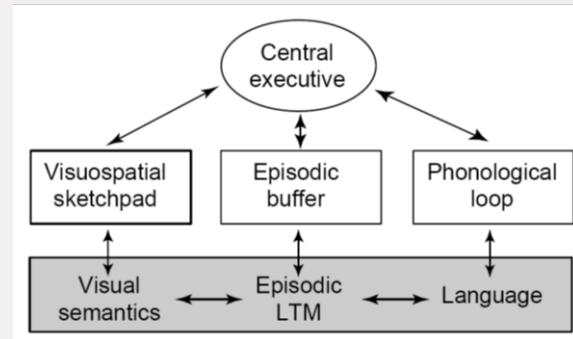
Limited capacity

temporary

Episodic: time sequences!

As the central executive has no memory, another integrating component was needed...

Creates a richer, complex representation that can be stored in LTM



Working memory performance

Working memory performance relates to:

overall intelligence and grades in school

verbal fluency, reading comprehension, reasoning ability, note-taking skills

reading ability

Attention-deficit/hyperactivity disorder: central executive issues or just problems in the phono. Loop or vis.spat. Sketchpad?

Major depression and working memory

Problems with the phonological loop, visuospatial sketchpad and central executive

Patients have difficulty concentrating, are distracted by negative thoughts which

reduces their WM capacity

Using Long term memory encoding and retrieval

Chapter 5, Matlin

Long Term Memory

long-term memory: large capacity; memory for experiences and information accumulated over a lifetime

episodic memory

your memories for events that happened to you (ch 5!)

semantic memory

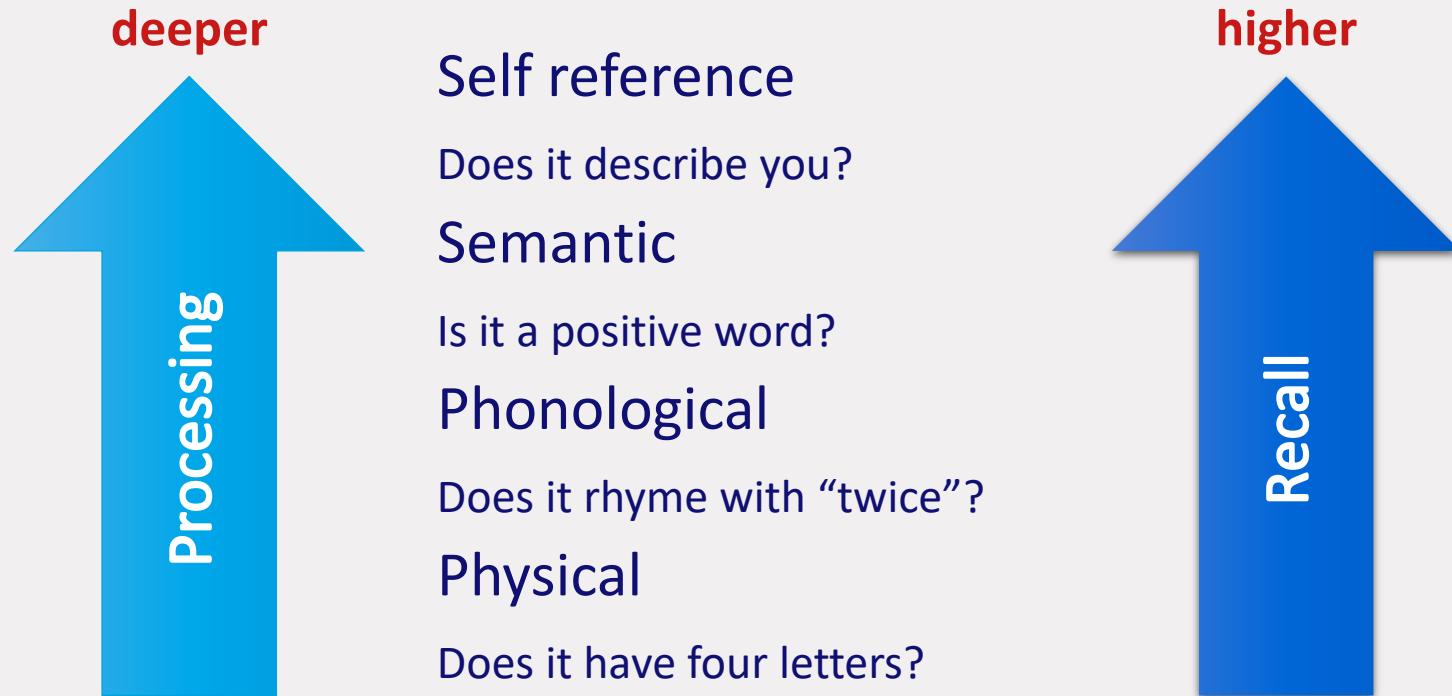
organized knowledge about the world (chapter 8)

procedural memory

knowledge about how to do something

Encoding vs. retrieval

Levels-of-processing model: the word “nice”



Levels of processing (Craik & Lockhart, 1972)

Depth of processing determines level of recall

Two factors:

Distinctiveness: process why a stimulus is different from others. Less interference!

Elaboration: process more aspects and meanings of a stimulus and relations to other stimuli.

Asking whether a word was appropriate for a sentence:

More elaborate sentences gave better recall.

Self-reference effect (why selfies work...)

Self-reference effect:

Remember more information if you relate it to yourself...

Especially positive things come up (Theme 3) ☺

Influences other levels of processing:

Foley (1999): visualize object or imagine use the object

Many people already visualized themselves

Why? More and richer cues, more elaboration, more rehearsal!



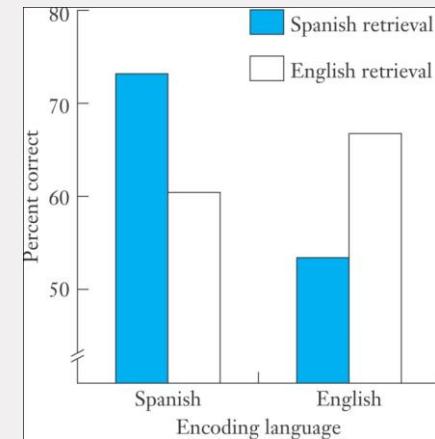
Encoding Specificity

encoding specificity principle—recall is better if the retrieval context is similar to the encoding context

I go to the secretary office, forget what I needed, and remember it when I am back in my office
Helps to put memories to context!

Marian and Fausey (2006):
read stories in English and Spanish;
questions about the stories in matched or mismatched languages

Same effect for gender of voice of reader and questioner



Encoding Specificity

Different kinds of memory tasks

recall vs. recognition

Encoding specificity most likely to occur in tasks that:

- assess your recall
- use real-life incidents
- examine events that happened long ago
- more about mental context than physical context

Levels of Processing and Encoding Specificity

similarity between encoding and retrieval conditions

encoding specificity can override levels of processing

To determine how to store some information, you'll need to figure out the characteristics of the retrieval task

Retrieval: Measuring Memory



Fill in the blanks

P _ y _ h _ lo _ _

Psychology

R _ tr _ _ va _

Retrieval

A _ n _ si _

Amnesia

Un _ _ nsc _ o _ s

Unconscious

Re _ r _ gr _ _ e

Retrograde

S _ ma _ ti _

Semantic

Ph _ _ ol _ _ ic _ l

Phonological

Ep _ s _ di _

Episodic

How to measure memory?

Explicit memory (conscious recollection)

Serial recall: repeat list in exact order	shown: 5-4-9-2-1-3	Recall: 5-4-9-2-1-3 ✓ 5-2-9-4-1-3 ✗
Free recall: repeat items in order you like	shown: dog, cat, ape	ape, dog, cat ✓ dog, cat, ape ✓
Cued-recall: memorize list of paired items Recall based on cues	Shown: time-city, car-wheel, first-cloud	recall: time - ____? car - ____? first - ____?

How to measure memory?

Recognition: usually better than recall

recognition: was this item on the list?	shown: Dog, cat , ape, bird, horse	present?: <input type="checkbox"/> dog <input type="checkbox"/> rabbit
---	---------------------------------------	--

Implicit memory: unconscious recollection (Priming)

Fill in the blank: Try to complete word fragments	shown: Implicit recognition	Complete: i_pl_c_t re_og_ti_n
Repetition priming: Name three animals	shown: (see above)	Ape and horse more likely to be mentioned than fish or bug

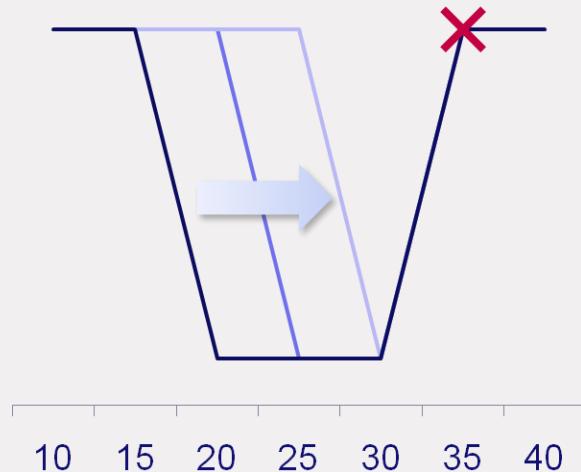
Amnesia

Retrograde amnesia

Accident at the age of 35

Complete memory loss of several years of memory (person thinks she's 15)

Recovery progresses from past to present



Amnesia

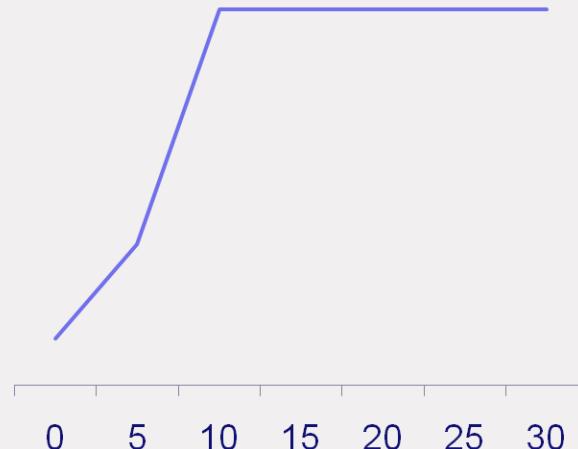
Infantile amnesia

We all experience this

No recollections before the age of 5

Any recollections are important events

Extremely inaccurate



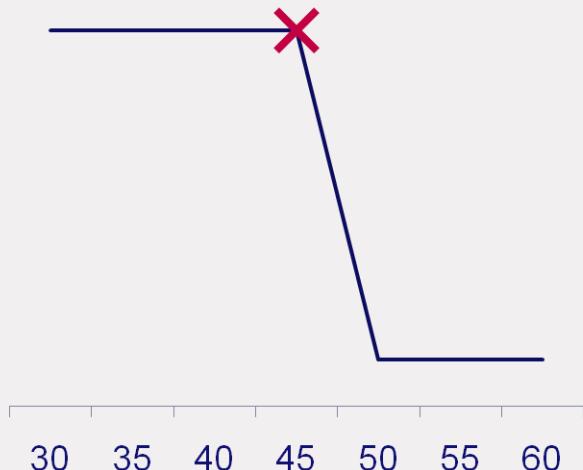
Amnesia

Anterograde amnesia

Complete inability to remember anything after the accident

Patient lives in eternal present (still thinks it's 1953)

Complication: patient can't remember he has this condition!



Clive Wearing

<http://www.youtube.com/watch?v=Vwigmktix2Y>

Implicit memory is not impaired (why not with Clive Wearing?)

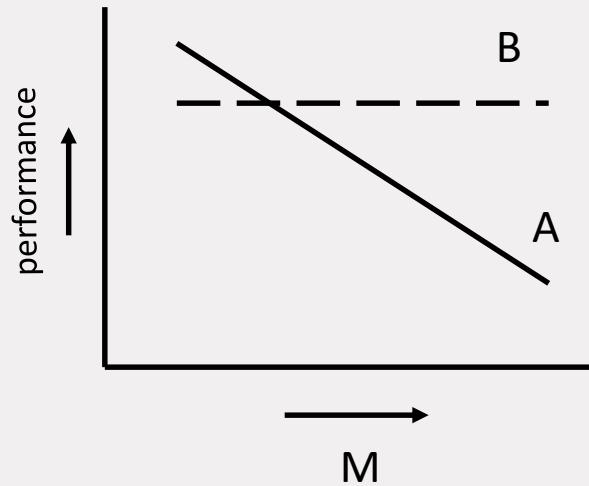
Clive Wearing



Dissociation Methodology

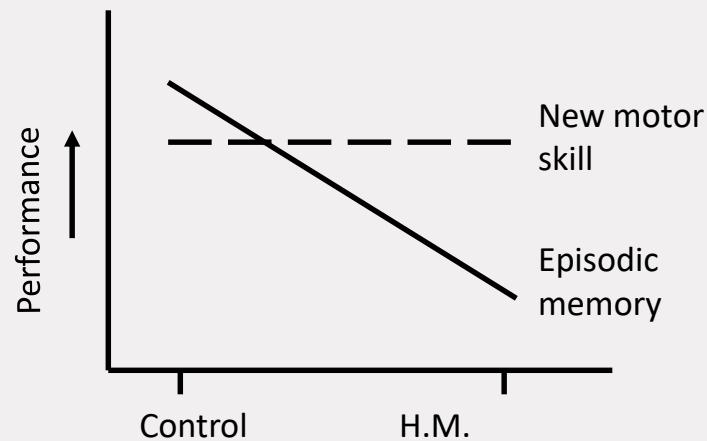
Single Dissociation

Two tasks (A and B) and a manipulation (M)
Single dissociation: M affects A but not B



Single dissociation

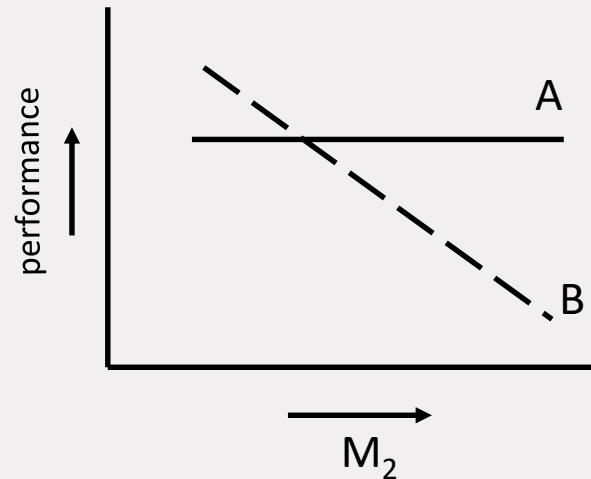
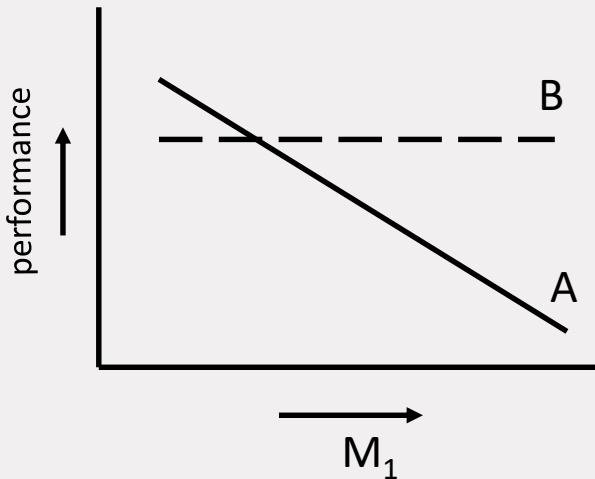
Example: Amnesic HM impaired episodic memory (explicit) but capable of learning new motor skill (implicit, procedural memory)



Double dissociations

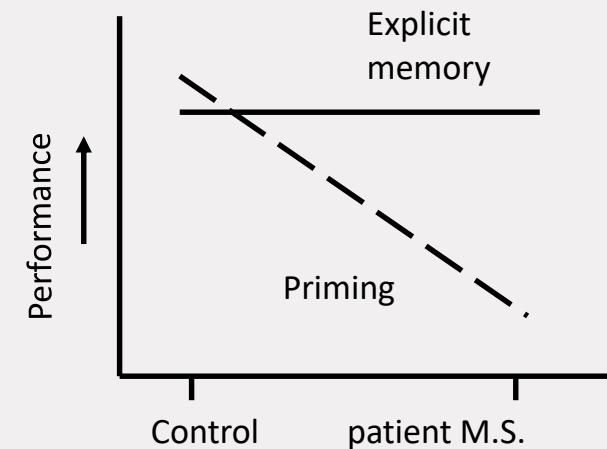
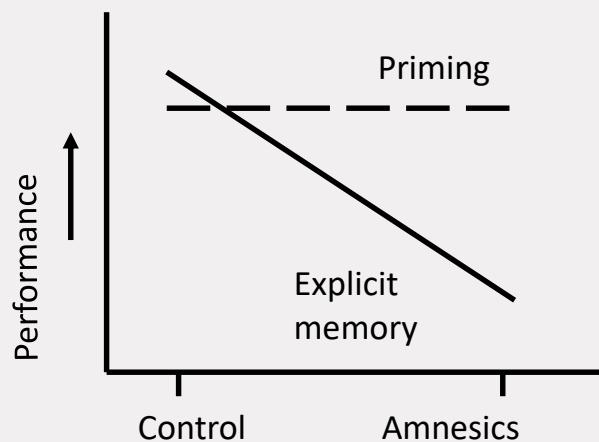
one of the tasks simply more difficult?

two tasks and two manipulations



Double dissociations

Example: Amnesics (e.g. Graf et al. 1982, Vaidya et al. 1995) versus patient M.S. (Gabrieli et al., 1995) on priming and explicit memory tests



Expertise (more in chapter 8 and 11)

Expert: shows consistently exceptional performance in a particular area

Practice more important than skill

The Context-Specific Nature of Expertise

strong positive correlation between knowledge about an area and memory performance in that area

more accurate than non-experts in both recognition and recall, for immediate and delayed testing

no difference in general memory skills or intelligence

Expert vs. Novices

Better knowledge structure, forming chunks, see the distinctiveness and rehearse differently

Example Face recognition



We are all experts in
recognizing faces!

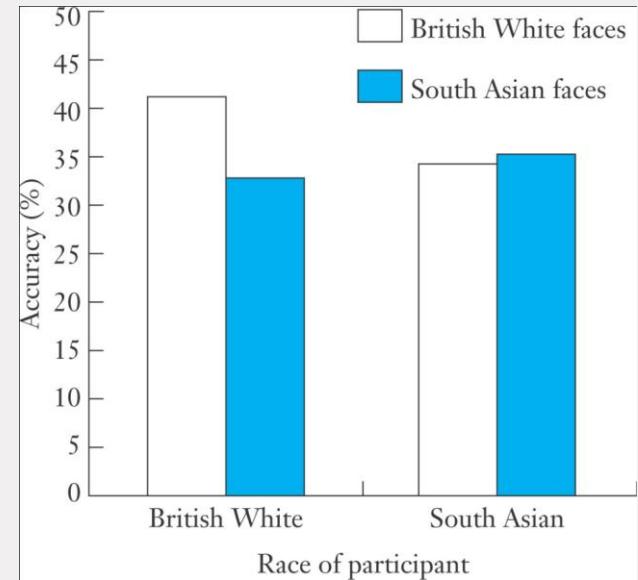
Own-race Bias

own-race bias—people are generally more accurate in identifying members of their own ethnic group than members of another ethnic group

Walker and Hewstone (2006)

discrimination task—photos differing along a continuum of race; 2 photos judged same or different

British high school students, White and South Asian
accuracy of responses



contact hypothesis

Autobiographical memory

Autobiographical memory: memory for events and issues related to yourself; verbal narrative, imagery, emotional reactions, procedural information.

Often accurate (can remember street names from our childhood)

Errors are often peripheral, not on central information

Memory is constructive: we blend together information

Schema and Autobiographical memory:

Schema: your general knowledge or expectation distilled from past experiences with an event or a person: schema for eating lunch

We use Schemas to guide recall...

consistency bias:

exaggerate the consistency between our past feelings and beliefs and our current viewpoint

Source Monitoring

source monitoring: the process of trying to identify the origin of memories and beliefs

Marsh and colleagues (1997): Students discuss an open-ended question on a topic (improving the university)

Second session:

First group: recognition for own ideas and someone else's ideas: little source monitoring errors

Other group: Generate new answers: many source monitoring errors (using ideas from others in the first session as their own new ideas)

Reality monitoring: did an event occur?

Flashbulb memories

Memory for very important, surprising, dramatic (emotional) events (9/11, Challenger, Bijlmerramp)

Vivid memory with better recall?

Emotion makes it better encoded and recalled

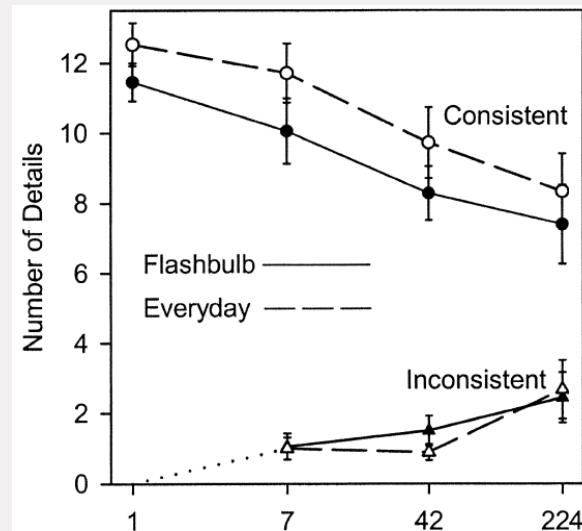
Rehearsal might make it better recalled!

Recent study: no better recall of 9/11 event...

One day after 9/11: report specific details of attack and an ordinary event

Recall of these one week later, 6 weeks later or 32 weeks later

Proximity: more factual details



Eye-witness testimonies (Loftus)

150 students were shown a film of a multiple car crash.

Group 1: `About how fast were the cars going when they **smashed** into each other?'

Group 2: `About how fast were the cars going when they **hit** each other?' (Control)

Higher speed estimated for group 1

Week later: "Did you see any broken glass?"

32% of the "smashed" subjects reported seeing broken glass

14% of the "hit" group reported seeing broken glass

How accurate are eye-witness testimonies?

Video: <https://www.youtube.com/watch?v=GtElV9lmzQc#t=459>

Line ups (3:55-6:26)



Post event information (7:38-9:29)



The Post-Event Misinformation Effect

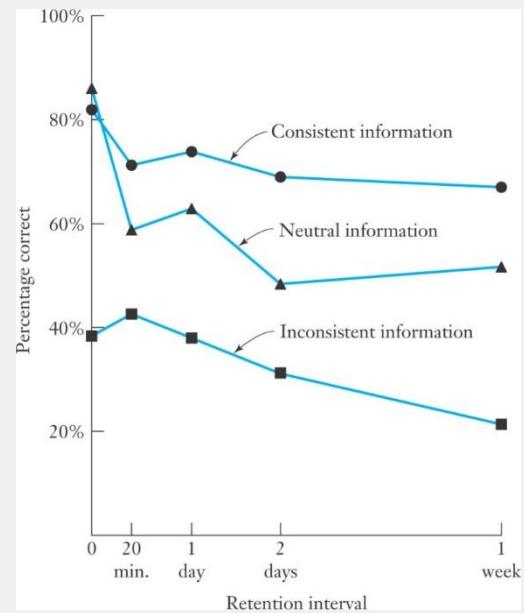
post-event misinformation effect:

people view an event, are given misleading information about the event, mistakenly recall the misleading information rather than the event itself

- A) retroactive interference?
- B) proactive interference?

Loftus and coauthors (1978)
stop/yield sign experiment;
consistent vs. inconsistent information

faulty source monitoring
constructivist approach to memory:
consistency bias



Factors affecting the accuracy

Besides, schema-consistency, source monitoring and post-event misinformation, some other important factors are:

Errors more likely in stressful circumstances

Errors are more likely when there is a long delay between the original event and the time of the testimony.

Errors are more likely if the misinformation is plausible

Errors are more likely if there is social pressure

Errors are more likely if eyewitnesses have been given positive feedback.

People are often as confident about their misinformed memories than on real ones.
Confidence and accuracy do not correlate very strongly...

Emotion, mood and memory

Pollyanna Principle: pleasant items are processed more efficiently/accurately.

How can emotional nature of stimuli influence memory?

1) More accurate recall for pleasant items

pleasant items recalled significantly more accurately than unpleasant items; neutral items recalled least accurately

2) More accurate recall for neutral stimuli associated with pleasant stimuli

Bushman (1998)—media violence and commercials

3) Over time, unpleasant memories fade faster

positivity effect—people tend to rate past events more positively with the passage of time

Application: Memory for ratings!

Recommender systems require ratings for items previously consumed!

In two user experiments, users rated a number of movies that were aired on Dutch TV in the previous month (~150 movies)

Rate 15-20 movies from that set that you know and indicate how long ago you have seen these movies (last week, last month, last 6 months, last year, last 3 years, longer ago)

Motivate ratings for two movies (one seen recently and one seen more than a year ago)

Results

247 users, 4212 ratings

Rating distributions:

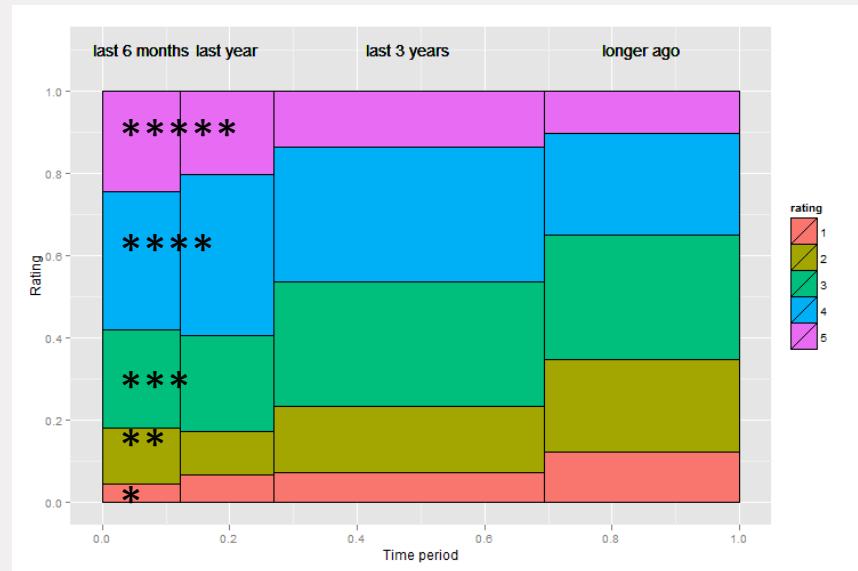
Most movies are seen long ago...

Only 28% seen in the last year

Positive ratings decrease with time

1st timeslot: 60% 4/5 star

Last timeslot: only 36%



Modeling the ratings

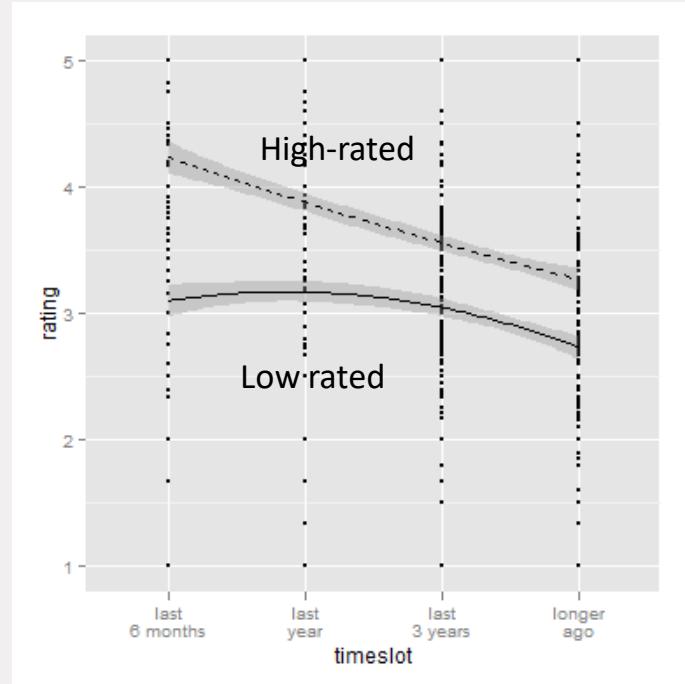
Multilevel model:

Random intercepts for movies and users

high-rated versus low-rated shows a different pattern

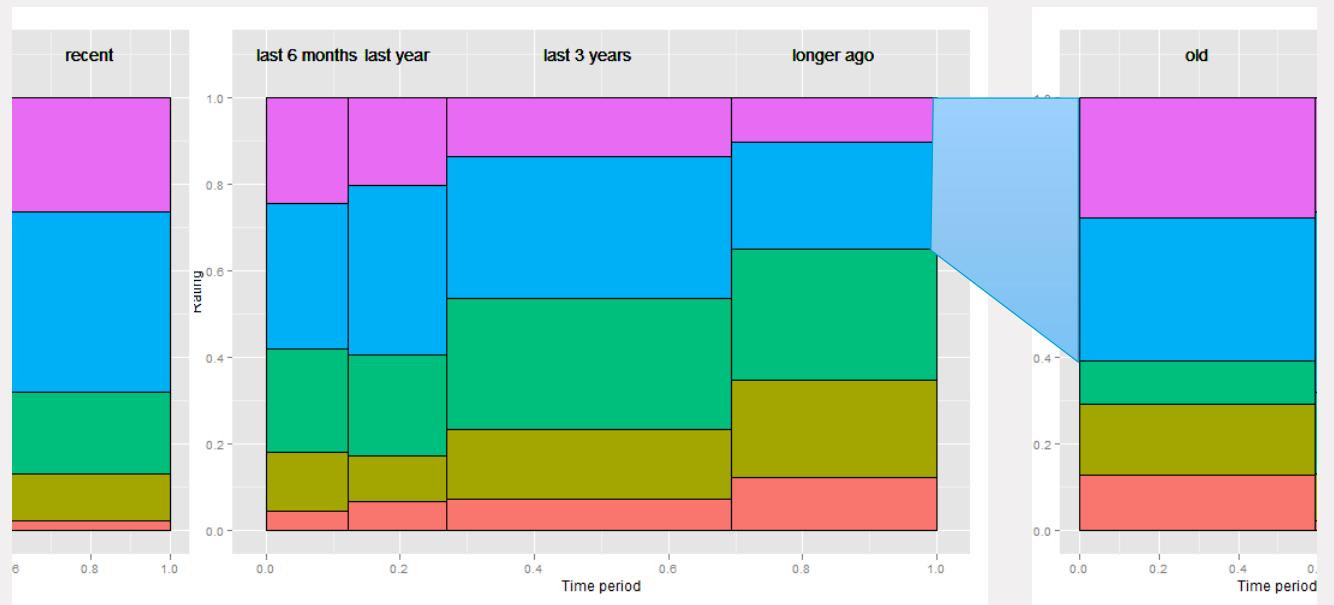
Regression towards the mean?

	Coefficient	Std. Err.	t-value
intercept	2.95	0.15	19.05
time	0.29	0.13	2.31
highrated	1.62	0.22	7.43
time ²	-0.09	0.02	-3.55
Time x highrated	-0.73	0.18	-4.10
Time ² x highrated	0.11	0.03	3.26



How did people motivate their ratings?

Motivated recent



Motivated older

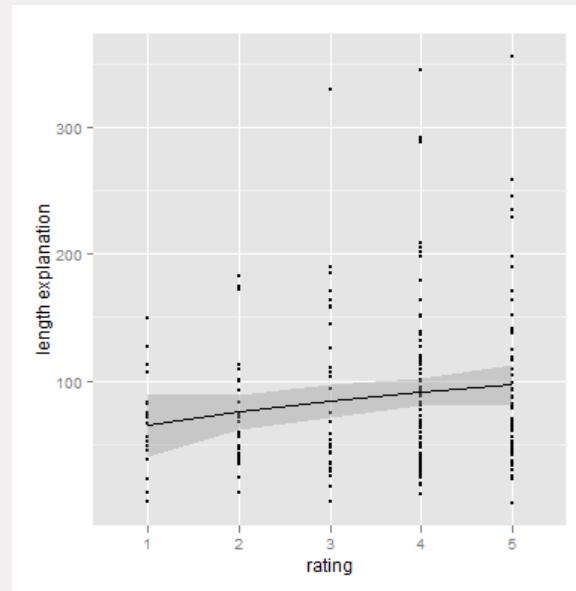
Most like to motivate why they like the good movies not the bad movies (especially for old movies): **Positivity effect in what to motivate/write about**

Motivation: explanation length

Most people like to motivate the movies they like (rated 4/5)

Lower ratings get shorter explanations

Around 8 characters extra per rating point ($p < .05$)



Recovered versus false memories

Controversy in the field

In situations like childhood abuse, there is a large potential for memory errors.
Are these memories planted during therapy or are they real?

False memory research suggests that people can easily recall things that were not there...

Not just for words, also for false childhood memories like 'getting lost in a shopping mall'

Related to accuracy of autobiographical memory (source monitoring!)

But still lacking in ecological validity

false memories can only be implanted in 25-50% of people

Did you recognize Thief in the word list?? ->**35-40% did!**



0HV60 Thinking and Deciding

Lecture 5: Rationality, judgment & Decision Making (Kahneman Part 1)

Martijn Willemsen

Decision making...

Part of most cognition books, as a combination of problem solving and reasoning

Originates from cognition and economics

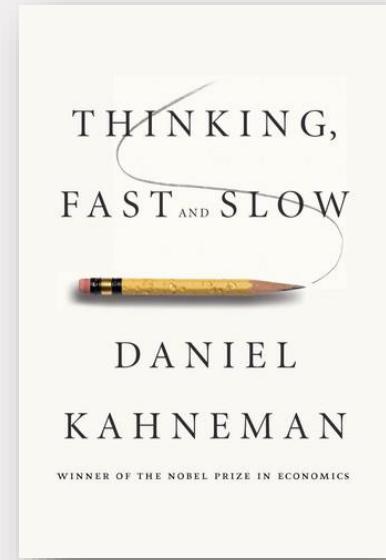
With influences from social psychology

Kahneman's book: strong system 1
versus system 2 perspective

Post-hoc explanation to provide a
better 'why' for the results

The field started differently:

Challenging the assumption of **Rationality**



Decision making-why is it difficult?

Requires effort

Decisions involve uncertainty

1. About what we want
2. About the external world
3. About our ability to execute our plans

Decisions involve conflict

you can't have your cake and eat it too!

Costs and benefits

Avoiding regret

Accountability of your decisions



What is a good decision?

Good decisions are rational decisions!

Decision Theory -> OLSUCO (USE)

Rational means adherence to a normative model.

Based on probability theory and decision theory

Classical economists assume one needs to be rational to survive

Homo Economicus

Rational, no mistakes, uses all information

Selfish

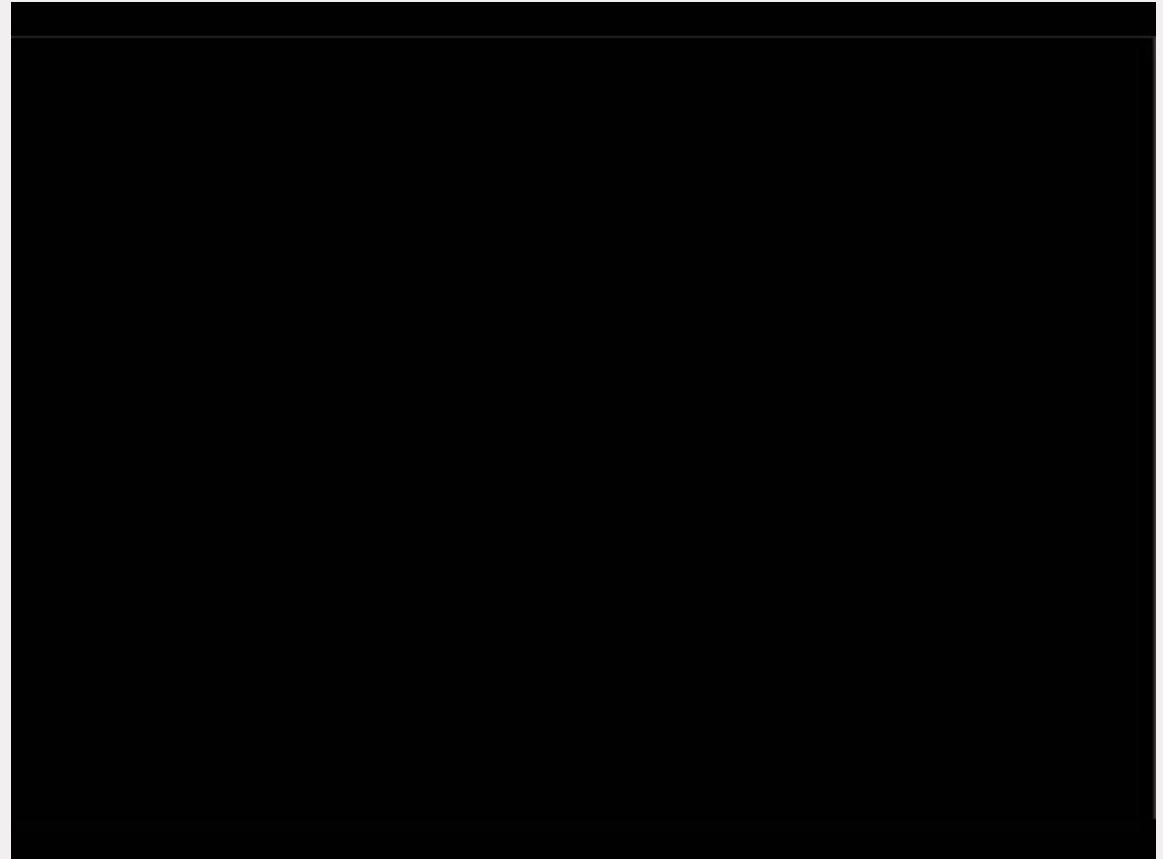
Complete will power

Homo Economicus

Rational, no mistakes,
uses all information

Selfish

Complete will power



The rationality question

What does rationality imply?

1. Being reasonable.
2. Satisfying some formal logical requirements.

Two major requirements:

Consistency: If A is preferred to B, B cannot be preferred over A.

Transitivity: If A is preferred to B, and B to C, A must be preferred to C



Intransitivity => money pump

Gamble A .20 1000 Euro

Gamble B .40 500 Euro

Gamble C .80 250 Euro

Suppose you prefer A > B, B > C, C > A

I buy from you A and pay 100 Euro.

I buy from you B give you A and receive 10 Euro.

I buy from you C give you B and receive 10 Euro.

I buy from you A give you C and receive 10 Euro.

and so on...

A game...

Let's assume you and somebody else, who you do not know, play the following game (the game will be played only once!).

There is 60 euro (10 euro bills) and one person is given the role of the 'proposer'. The other person is the 'responder'.

The proposer proposes a division of the money between him/herself and the responder. The responder has to decide whether to accept this division or not.

If the responder accepts it, both receive the money according to the division proposed. If the responder rejects, both get **nothing**.

Which division would you propose?

Birthday on an odd day (Feb 1): you are proposer

What division would propose? Enter the right letter

Proposer gets	50	40	30	20	10
responder gets	10	20	30	40	50
response	A	B	C	D	E

Enter your value in poll

Birthday on an even day (Feb 2): you are responder

What amount would you need (**minimally**) to accept?

Proposer gets	50	40	30	20	10
responder gets	10	20	30	40	50
response	A	B	C	D	E

Enter your value in the poll

Challenges to the rationality assumption

Some real life examples of deviations from rationality:

Ultimatum game

NY cabdriver problem

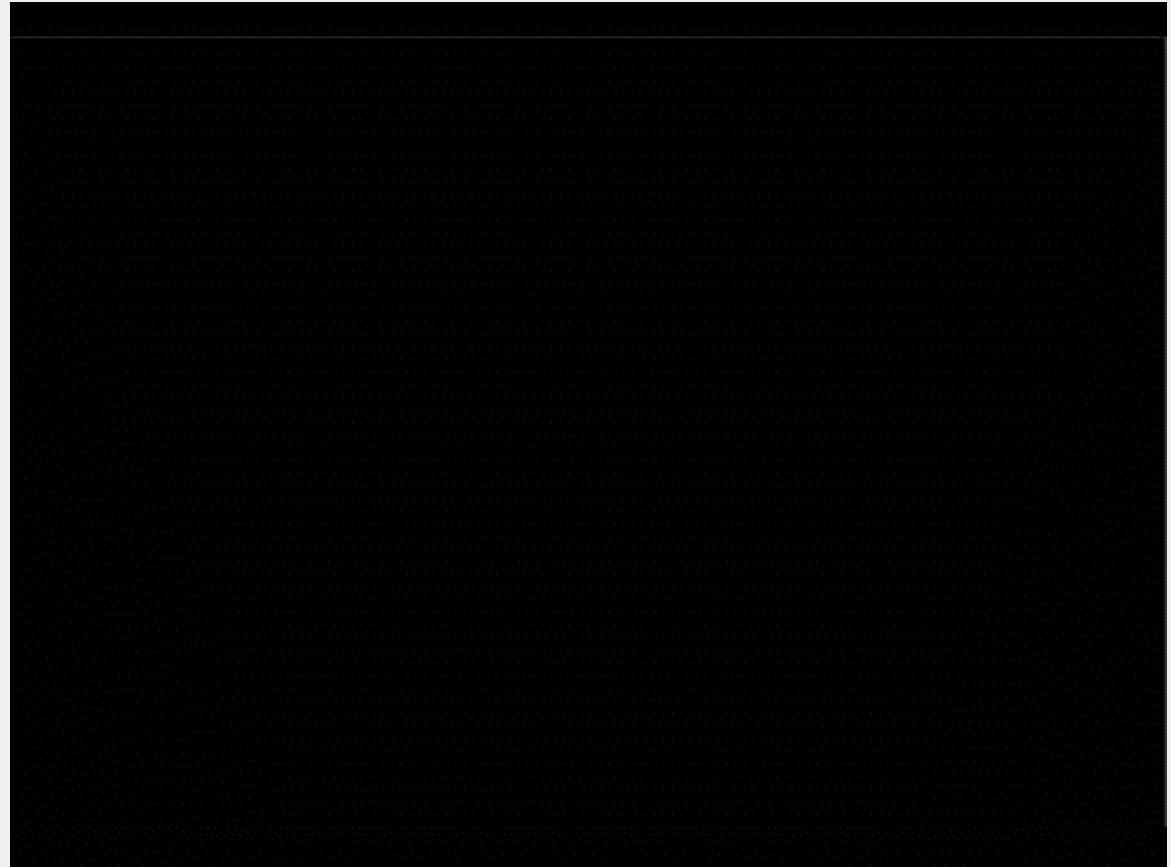
Characteristics of decisions:

1. Reason-based (rationality and pseudo-rationality).
2. Shaped by perceptual processes (framing – Muller lyer).
3. Influenced by emotions (greed and fear). Hot/cold decision making

(Kahneman now calls it System 1)

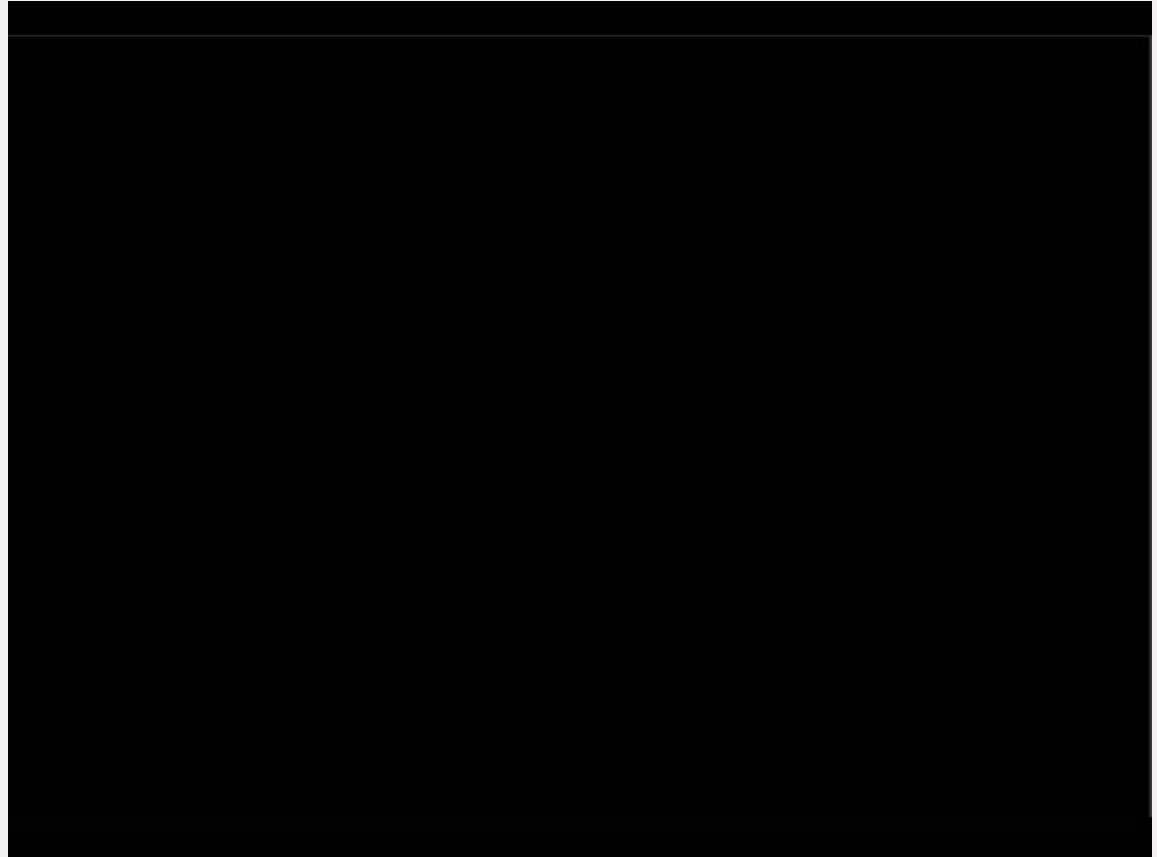
Challenges to the rationality assumption

I: The ultimatum game



Challenges to the rationality assumption

II: NY Cabdriver problem



Bounded Rationality

Herb Simon (1955)

Rational models ignore situational and personal constraints such as time pressure and limited cognitive capacity



Bounded rationality

Short-cut strategies that work well (mostly): Heuristics
Satisficing rather than maximizing

Approaches

Two streams in the field:

Heuristics and Biases
(Tversky & Kahneman)



Fast and Frugal Heuristics
(Gigerenzer et al.)



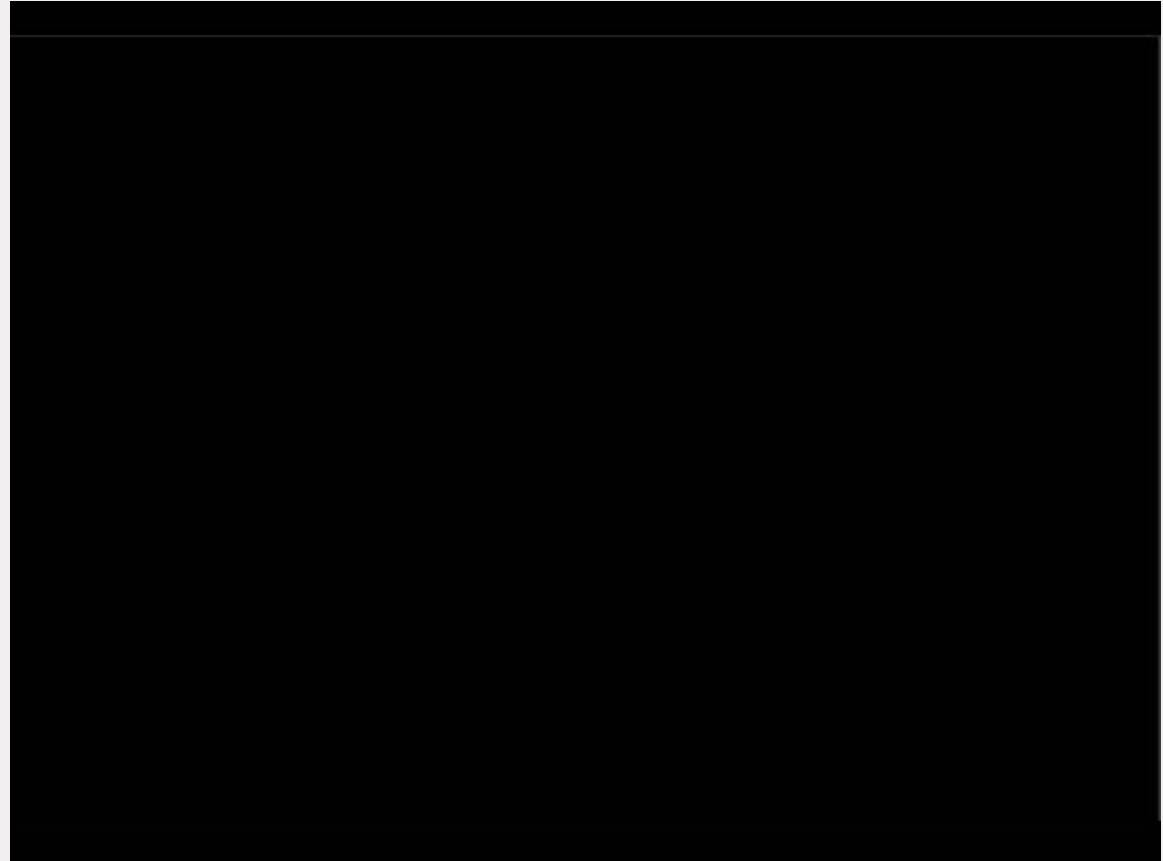
Adaptive decision maker (Payne et al., 1993)

Strategies: effort versus accuracy tradeoff

Conscious versus unconscious decision making

System 1 vs System 2!

Rationality again...



Normative and Descriptive

How we ought to make decisions

Normative: based on **reflection**

analytical, using logic and formal (rational) theories

How we actually make decisions

Descriptive: based on **observation**

mathematical adaptations or heuristics

How to improve our decision making

Prescriptive: based on **design**, providing rules to improve our decision making

Examples

The screenshot shows the Bellen.com website interface. At the top left is the logo 'Bellen.com' with the tagline 'Voor objectieve en actuele vergelijkingen!'. A sidebar on the left contains language selection (English), a menu with links like 'Vaste telefonie', 'Mobiele telefonie', and 'Belwijzer (advies)', and links for 'Ladyphone (nieuw)', 'Pers', 'FAQ', 'Contact', and 'Bencom sites'. Below the sidebar is a 'Bellen.com zakelijk' link. The main content area features a 'Mobiel' icon and a red banner with the text 'Belwijzer Mobiel'. The 'Belwijzer Mobiel' section has a sub-header 'Vergelijkt onafhankelijk zowel belkosten als toestelprijzen ([meer info](#))'. It contains several input fields and dropdown menus for calculating mobile costs:

- Hoeveel minuten belt u mobiel? [?] minuten per maand
- Hoeveel sms-jes verstuur u? [?] berichten per maand
- Hoeveel mms-jes verstuur u? [?] berichten per maand
- Hoeveel keer luistert u uw voicemail af? [?] keer per maand
- Welke korting wilt u meenemen in de berekening? [?] Studentenkorting (OV verplicht)
- Voor welke looptijd wilt u de kosten berekenen? [?] 1 jaar 2 jaar
- Welke belvorm(en) wilt u meenemen in de berekening? [?] Abonnementen Prepaid Sim-only

At the bottom right of the form is a 'Berekenen' button with a mobile phone icon. Below the form is a note 'Gesponsord door: [KPN](#)'.

Examples



Examples



Elstar	type	Conference
50 kcal/100 gr.	verbruik	47 kcal/100 gr.
5 mg vitamine C	extra's	4 mg vitamine C
85 % water	megeleverd	83 % water
★★★★★	houdbaarheid	★★★★★
zoet/zuur, sappig	smaak	zoet, sappig
1975	introduction	1894
kruising Golden Delicious & Ingrid Marie	oorsprong	vrije bestuiving van Léon Leclerc de Laval
€ 0,18 - € 0,54	prijs	€ 0,32 - € 0,90

 **vergelijk.nl** ...voor je iets koopt!

Je kunt alles vergelijken. Vergelijk.nl zet de producten en prijzen van ruim tweehonderd winkels tot in detail voor je op een rij. Zo bepaal je zelf wel wat je koopt en wat je ervoor betaalt, of je nou een camera zoekt of een kinderwagen. Vergelijk.nl zorgt er al zes jaar voor dat dagelijks meer dan zeventigduizend Nederlanders de beste keus maken. Dus wil je iets kopen? Ga dan eerst naar Vergelijk.nl. Zodat je precies weet wat je kiest en dat je niet teveel betaalt.

Back to the book...

Part 1 is introductory

Introduces system 1 versus system 2

We have seen these before ☺ but in cognition there is no sharp distinction made

System 1: automatic, quick effortless

Compare: skills, procedural and implicit memory etc...

System 2: effortful, deliberative, complex

Compare: reasoning, logic, explicit memory etc...

Conflict!

Your first task is to go down both columns, calling out whether each word is printed in lowercase or in uppercase. When you are done with the first task, go down both columns again, saying whether each word is printed to the left or to the right of center by saying (or whispering to yourself) "LEFT" or "RIGHT."

LEFT		upper
	left	lower
right		LOWER
RIGHT		upper
	RIGHT	UPPER
	left	lower
LEFT		LOWER
	right	upper

From chapter 1

System 1 runs automatically and generates suggestions for System 2
(associative)

System 2 in low effort mode often accepts these:

Impressions, intuitions (Sys1) -> beliefs, actions (Sys2)

Only system 2 can construct thoughts in an orderly series of steps and sometimes can override system 1 (but often does not...)



From chapter 2: attention and effort

Related to (selective) Attention (ch 3) in Matlin

Kahneman's early work was on attention and how pupil dilation shows cognitive effort

(add-1/3 task remembering a number and keeping rhythm: high WM load)

High effort causes inattentional blindness: participants did not notice the K

This chapter offers a more general view on what happens automatic (without much selective attention) and what needs (executive) control

Add-1 Task: example in the book

3421

Tap a steady Rhythm

<http://metronomebot.com/60-beats-per-minute-click-track-metronome.html>

Read the number out loud. Wait 2 beats and

Add 1 to every digit. Keeping rhythm is important

Actual task was different: you hear a digit every second and have to memorize and do the add-1 task one digit at a time afterwards...

<https://psychology.stackexchange.com/questions/16531/kahnemans-add-one-three-exercise>

Chapter 3: effort and self control

Most of this will be discussed in choice over time at the end of the lecture series...

Ego-depletion: system 2 work requires effort that depletes resources to control other things (and make system 1 overrule it...)

Make a series of choices that involve conflict...

Less like to keep your diet or persist in a handgrip task

Tired judges fall back to default positions to deny parole...

Chapter 4 Priming (DEBATE 2!)

Associative memory (see also chapter 5 and 8!)

Priming (and implicit memory!)

EAT -> SO_P

WASH -> SO_P

A word generates associations to other concepts that facilitate other words and concepts (network)

Many examples of surprising priming studies...

**But quite some doubts and discussion
on the replicability... -> Debate 2**

But priming seems to work...

W__H S__P

Indeed, you will see WASH and SOAP if you paid attention before...

See also semantic priming later in Matlin Chapter 8...

Reading suggestions

Try to link all the examples by Kahneman to what you learned and will learn for cognition

Some suggestions from chapter 5:

P 62: recall versus recognition (using familiarity to guess the true answer on a MC test)

P 63: make it memorable to make it persuasive:

Encoding specificity (using rhyme)

P 64: Choose a name easy to pronounce (chunking! Word superiority effect)

More links from chapter 6

Norm theory has many aspects of PDP models; what is normal -> default assignment! (ch 8)

After spending a day exploring beautiful sights in NY, Jane discovered her wallet was missing

False memory: pickpocket more associated than sights in a recall test

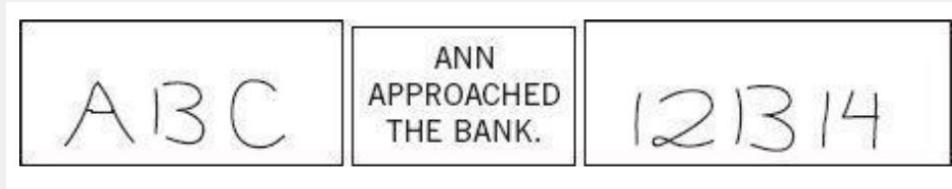
“How many animals of each kind did Moses take into the ark?”

‘Moses Illusion’: Moses and Noah both biblical

graceful degradation going wrong
System 1 fixing the wrong error

A Machine for Jumping to Conclusions (ch 7)

Chapter 7: your associate system (1) resolves ambiguity outside of your awareness (compare PDP, perception, etc...)



Believing and unbelieving: you can only reject (unbelieve) a statement after you 'believe' it.

Unbelieving is system 2: hard when occupied

Compare to Matlin, theme 3 and Wason selection task (Ch 12)!

Halo effect

Exaggerated emotion coherence: Halo effect

Tendency to like or dislike everything
about a person

You meet a person that seems easy
to talk to: would she also be generous?

Asch: what do you think of ...?

Alan

Intelligent, industrious,
impulsive, critical,
stubborn, envious



Halo effect

Exaggerated emotion coherence: Halo effect

Tendency to like or dislike everything
about a person

You meet a person that seems easy
to talk to: would she also be generous?

Asch: what do you think of ...?

Alan

Intelligent, industrious,
impulsive, critical,
stubborn, envious

Ben

envious, stubborn,
critical, impulsive,
industrious, intelligent



Alan looks more favorable!

Initial traits change further interpretation

More on Halo effect and chapter 7

Overcoming the Halo effect:

In grading exams...

Or when making judgments:

decorrelate error: independent observations

Wisdom of the crowds! -> coin estimate

WYSIATI: what you see is all there is, system 1 just tries to find an easy and coherent story and it require work/effort of System 2 to overcome that

How Judgments happen (ch 8)

Two types of judgments

Automatic assessments (Sys1):

basic assessment: continuous/parallel

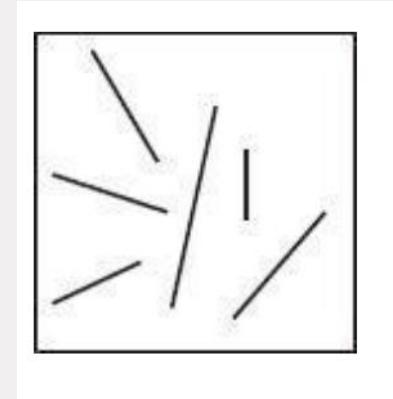
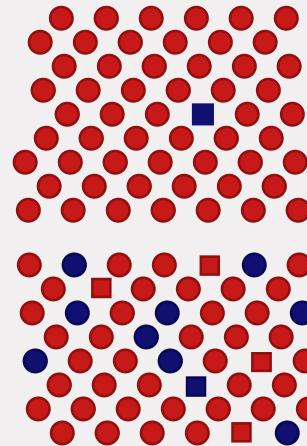
Using selective attention (Sys2):

counting capital letters

Find the red square

Easy to judge average lengths but
not the sum of the lengths!

Use of prototypes/exemplars
(connectionism: generalization)



How judgments happen

Continuous stream of assessments made by our automatic system 1 provides cues for system 2

Intensity matching:

if crimes were colors: **MURDER** vs. **THEFT**

System 1: mental shotgun

Sentence literally true?

- 1) Some roads are snakes
- 2) Some jobs are snakes
- 3) Some jobs are jails

1 and 3 are harder to say false, as they are metaphorically true...

Answering an easier question (ch 9)

Substitution:

A difficult question (sys2) is replaced by an easier question (sys1):

Target Q: Do I think this is a good candidate for Europe?

Replaced by

Heur. Q: Did I like this person when she was in this TV show?

Heuristics: intensity matching + mental shotgun
matching your liking on his abilities...

How does it work: mood heuristic

Survey with two questions

- 1) How happy are you these days?
- 2) How many dates did you have last month?

Q1 hard to answer (system 2), no correlation between Q1 and Q2

With the reversed order Q2 becomes an easy substitute for Q1, and now Q1 is easy to answer...

What is a heuristic?

In computer science:

An algorithm is a method for reliably achieving some goal; a heuristic achieves the goal often or closely, but not always perfectly.

Heuristics as a strategy (Polya: If you can't solve a problem, then there is an easier problem that you can solve: find it!)

In Decision making:

explanations for observed deviations that arise more or less automatically: system 1 not being corrected enough by system 2

Heuristics and biases

Based on very early work of Tversky and Kahneman (1974): **READ appendix A!**

How do people arrive at their judgments of probabilities and values?

Anchoring and Adjustment

Availability

Representativeness

System 1 and 2 is a new way of providing an explanation of the underlying process of these findings...Chapter 1-9 gives background on that before discussing these heuristics



0HV60 Thinking and Deciding

Lecture 6: Heuristics and Biases (Kahneman Part 2: ch 10-16)

Martijn Willemsen

Law of Small Numbers

(chapter 10, Kahneman)

Cases of kidney cancer...

Most rural, sparsely populated (republican oriented) counties in US have the lowest number of incidents in kidney cancer

Not republicans but rural: clean living?

But what counties have the highest incidents?

Most rural, sparsely populated (republican oriented) counties in US also have the highest number of incidents in kidney cancer!

Poverty, lifestyle, medical care

Rural? No! Small populations? Yes!

Small populations/samples...

System 1: causal inferences, rather than just statistics

Smaller samples have more extreme values...!

DUH!?

Law of Large Numbers!

Large samples are more precise...

But do you also experience that?

The Marble simulation!

Let's use Excel to simulate drawing
Marbles from an Urn!

Drawing 4 balls: all white/red
Drawing 7 balls: all white/red

What are the odds?

$$4 \text{ balls: } 2 * \left(\frac{1}{2}\right)^4 = \frac{1}{8}$$

$$7 \text{ balls: } 2 * \left(\frac{1}{2}\right)^7 = \frac{1}{64}$$



4 BALLS, extreme values (0 or 4)				7 Balls, extreme values (0,7)									
ball1	ball2	ball3	ball4	draw 4 balls		ball1	ball2	ball3	ball4	ball5	ball6	ball7	draw 7 bal
0	0	0	0	0	0	0	1	1	1	1	1	1	2
0	0	0	1	1	1	1	0	0	1	0	1	0	6
0	0	1	1	1	2	0	0	1	0	1	0	0	2
1	0	1	1	1	3	0	1	1	1	0	0	0	3
1	0	1	1	1	3	1	0	1	0	1	0	1	4
0	1	1	1	1	3	1	1	1	0	1	1	0	5
0	0	0	0	0	0	1	1	0	0	0	1	0	3
0	1	1	1	1	3	1	0	0	1	1	1	1	5
0	1	1	1	1	3	0	1	0	1	0	1	1	4
0	1	1	1	1	3	0	0	0	0	0	0	0	0
1	0	1	0	2	1	0	1	1	0	0	0	1	4
1	0	0	0	1	1	1	0	1	1	0	0	1	4
1	0	0	0	1	1	1	0	0	1	1	0	1	4
1	1	0	0	2	1	1	1	1	0	0	0	1	5
0	0	1	0	1	1	1	1	1	0	1	0	1	5
0	0	1	0	1	1	1	1	1	1	0	1	0	6
1	0	0	0	1	1	1	1	1	1	0	1	1	6
0	0	0	1	1	1	0	1	1	1	1	0	0	4
1	0	0	0	1	2	0	1	0	0	1	0	0	3
0	0	1	0	1	2	0	1	0	0	1	0	0	2
1	1	1	1	4	0	0	0	0	1	1	0	0	2
0	0	0	1	1	3	0	1	1	1	0	0	0	3
1	0	0	1	1	3	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	0	1	0	0	1	3
0	1	1	1	1	3	0	1	0	1	1	0	1	4
1	0	0	0	1	2	1	1	0	0	0	1	1	4
1	0	0	0	1	2	1	0	1	1	1	1	1	6
0	1	1	0	2	0	0	1	0	1	0	1	1	3
1	1	1	1	4	0	0	0	0	1	0	0	0	3
0	0	1	1	2	1	0	0	0	1	1	1	1	4
1	1	1	1	3	0	1	0	1	1	0	1	1	4
1	1	0	0	1	2	1	1	0	0	0	1	1	6
0	1	1	1	2	0	0	1	0	1	0	1	1	3
1	1	1	1	4	0	0	0	0	1	0	0	0	4
0	0	1	1	2	1	0	0	0	1	1	1	1	4
1	1	1	1	3	0	1	0	1	1	0	1	1	4
1	1	0	0	1	2	1	0	1	1	1	1	1	0
1	1	1	1	4	0	0	1	0	1	0	1	1	0
1	1	1	0	2	1	0	0	1	1	0	1	1	1
1	1	1	1	4	0	0	0	0	1	0	0	0	5

Law of small numbers

Even people trained in statistics, like researchers, fall for it

Controversy in Priming research (and other domains) is also due to this:

- Small samples used: more extreme results
- File drawer: only the interesting results are published

Power analysis:

Power ($1-\beta$) is the ability to find a statistically significant difference when the null hypothesis is in fact false, in other words power is your ability to find a difference when a real difference exists.

Examples

German bombing London in WOII

Pattern of hits seem to have gaps

St Paul's Cathedral miraculously escaped WWII air raids.



Misperceptions of randomness in Basketball

A basketball player with a hot hand (streak shooter) is a player who is more likely to score after some successful shots (than after having missed a shot)

Investments in small schools as they seem most successful (6 of top 50 schools are small...)



Anchoring and adjustment

Chapter 11

Question A1

Suppose there are two lotteries (gambles) and you are asked in which one you would like to participate.

Lottery A: There is an urn with 2 red and 18 white balls. You win if you draw a red ball.

Lottery B: There is an urn with 10 red and 10 white balls. You have to draw 4 times with replacement (you put the ball back). You will win if you only draw red balls.

I would choose:

- Lottery A
- Lottery B

Question A2

Suppose there are two lotteries (gambles) and you are asked in which one you would like to participate.

Lottery A: There is an urn with 14 red and 6 blue balls. You win if you draw a red ball.

Lottery B: There is an urn with 4 red and 16 blue balls. You have to draw 6 times with replacement (you put the ball back). You will win if you draw at least one red ball.

I would choose:

- Lottery A
- Lottery B

Questions?

Was Gandhi more or less than 144 years old when he died?

How old was Gandhi when he died?

What is the boiling temperature of water on the Mount Everest?

Anchoring and adjustment

Imagine a wheel of fortune with numbers 1-100. After spinning the wheel the needle lands on 65 (10)?

You are then asked:

1. Is the percentage of African countries in the U.N. larger or smaller than 65 (10)?
2. Now give an exact estimate.



Results: Those who were exposed to 65 → median=45

Those who were exposed to 10 → median=24

Anchoring: Estimation is often a process of anchoring on a salient number and adjusting up or down.

Anchoring and adjustment

Assess $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8$ (median est. = 512)

Assess $8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$ (median est. = 2250)

Correct = 40,320

The phenomenon occurs even when the anchors are extreme and unrealistic
(i.e., whether the price of a college textbook was more or less than \$712.58)

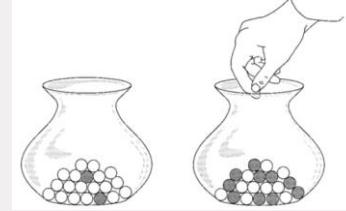
Happens to experts as well, when warned not to use the anchor, or when incentives are used

Compound Events: conjunctive

Tendency to overestimate conjunctive probabilities: $P(A \& B)$

Choose between simple lottery 2R and 18W (red wins) and a (conjunctive) lottery with 4 consecutive drawings with 10R and 10 W (all red wins).

- $p(\text{Red} | \text{simple}) = .1,$
- $p(\text{Red} | \text{compound}) = 1/(2^2 \cdot 2^2) = .0625$
- **80% preferred the conjunctive lottery!**



Subjects get anchored on the simple 'single event' and adjust too little for the large number of events that have to co-occur

Overestimating conjunctions important when estimating p of complex systems (or plans) to function properly.

- Ballistic missile with 500 independent parts: $p(\text{part works}) = .99$, chance that it works the first attempt? $p < .01!$

Compound events: disjunctive

P(A or B): disjunctive

Tendency to underestimate disjunctive probabilities

Choose between a simple lottery ($p=.70$) and a compound of 6 throws ($p=.20$) winning with 1 success.

- $P(1 \text{ success}) = 1 - .8^6 = .74$
- **70% preferred the simple lottery!**

Underestimating of the probability of a pregnancy occurring in many years of contraceptive use...

Question 1

What is the probability that in a group of 23 people, some will share their birthday?

[0-100%]



Birthdays

How likely is it that in a group of 23 people, some will share their birthday?

Actual p = 50%

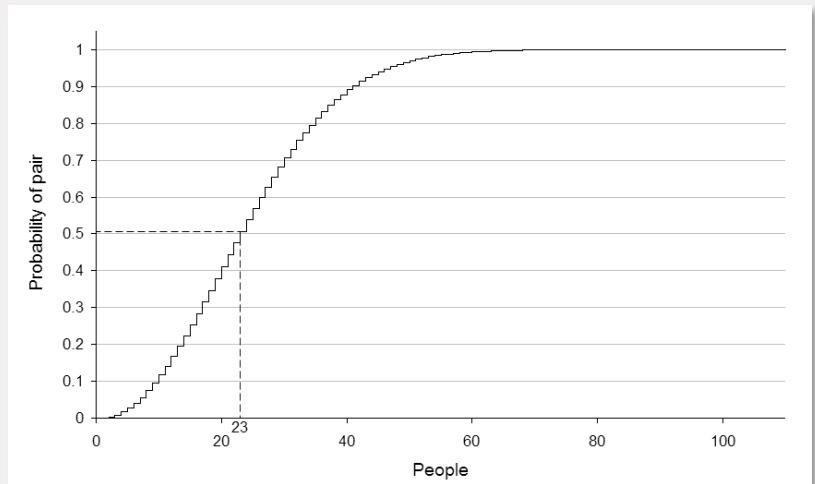
**Calculate chance of all
different birthdays**

With 23 people: $(23*22)/2 = 253$ pairs

One pair: $p = 1 - 1/365 = 364/365 = .997260$

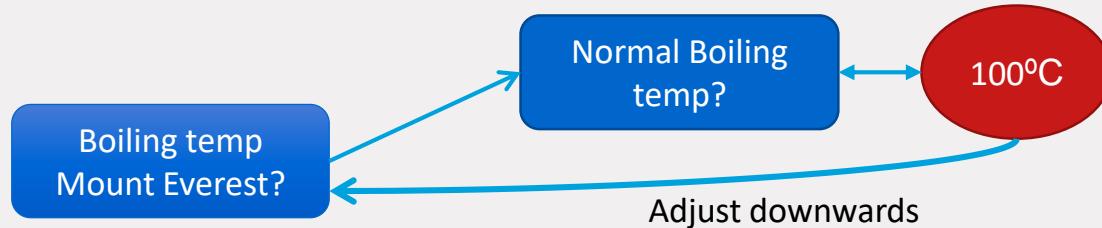
Having all 253 pairs different
 $(364/365)^{253} = .4995$

[http://betterexplained.com/articles/
understanding-the-birthday-paradox/](http://betterexplained.com/articles/understanding-the-birthday-paradox/)

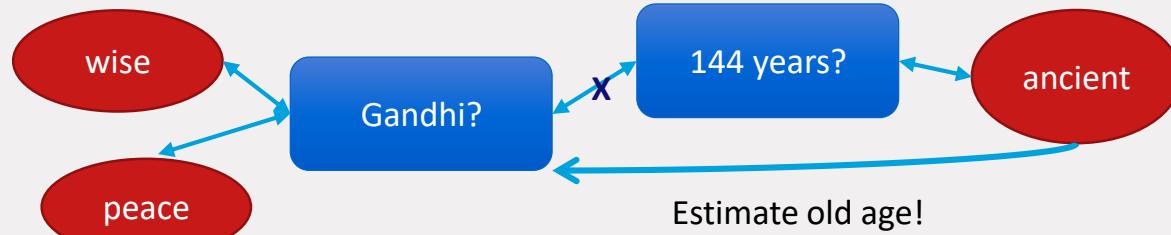


Two types of anchoring

What is the boiling temperature of water on the Mount Everest?



Was Gandhi more or less than 144 years old when he died?



How old was Gandhi when he died?

Underlying processes of anchoring

In real life, anchors are mostly self-generated, hence we know them to be wrong. **SYSTEM 2**

Consider the question: “When was George Washington elected president?”

US students often don't know, but know Declaration of Independence was 1776 (self-generated anchor)



Eply and Gilovich: insufficient adjustment is underlying the effect

Participants only report anchoring and adjustment for self-generated anchors

External anchors evoke an activation process

Underlying processes of anchoring

Selective accessibility (Mussweiler and Strack)

The comparative question task activates information in memory that is subsequently more accessible when making an absolute judgment. **SYSTEM 1**

“Is the annual mean temp. in Germany higher or lower than 20º C / 5º C?”

20ºC makes it easier to recognize summer words, whereas 5º C facilitated winter words

Same effect for average car prices after being anchored by a mercedes or a volkswagen.

But this account does not seem to have any need of the adjustment element...

Anchoring and assessing real estate

Real estate agents looking at houses and brochures

Only difference was list price in brochure...



Apparent listing price	Appraised value	Recommended selling price	Reasonable purchase
119,900	114,204	117,745	111,454
129,900	126,772	127,836	123,209
139,900	125,041	128,530	124,653
149,900	128,754	130,981	127,318

Anchoring Index

Achoring Index:

0% for no anchoring, 100% for full adoption of anchor

Low versus high anchor:

Real estate: 119,900 versus 149,900

Estimated: 114,204 versus 128,754

Range anchors: 149k -119k = 30k

Range responses: 128k -114k = 14k

Anchoring index: $14/30 \sim 46\%$

Kahneman shows these anchoring indexes also occur for irrelevant anchors!

Uses and abuses

Sales promotion: soup 10% off

'Limit of 12 cans' (2x) > 'no limit'



Price negotiation: when presented an unreasonable first offer: do not give a counter offer but walk away... (too large a gap...)

Cap on awards (e.g. 1M\$) for size of damages in lawsuits... good idea?

Availability (Ch 12&13)

Availability

How many words can you construct from:

XUZONLCJM

TAPCERHOB

Easy! Without generating any word, you know!

You substitute the question for an easier one: how many instances come to mind easily...

Availability!

Availability

Which is a more likely cause of death in the U.S. – being killed by falling airplane parts or by a shark?



Most people rate shark attacks as more probable
they certainly receive more publicity and are easier to imagine.

The probability of dying from falling airplane parts is 30 times larger than
dying from shark attacks.

Availability: events are judged more likely to the extent that they are vivid or easily recalled.

Question 3

How many (real) ambulances are there in The Netherlands in total?



How many Ambulances?

Thanks to my daughter Hylke!



Yes, I was wrong too!

Salience of ambulances in traffic!
What would be a good baseline?



examples

List with 19 famous names and 20 less known

Famous were male or female

More recall of famous names and participants thought more females/males were in the list if females/males were the famous names

(from appendix A)

We judge our own contribution to be bigger in...

Household tasks

Writing a paper with a group
turning the game into a winning one...



Availability might help to warn against COVID-19...

Famous people contracting the virus made people more aware of the high probability of getting it (perhaps overestimating it and giving is wrong perceptions, but at the time that was helpful...)



Tom Hanks 'feeling better' after Covid-19 diagnosis

Hanks, who was hospitalised for coronavirus in Australia, urged people to use 'common sense' and shelter in place to stop spread of disease

- [Coronavirus and culture – a list of major cancellations](#)
- [Coronavirus – latest updates](#)
- [See all our coronavirus coverage](#)



<https://sloanreview.mit.edu/article/how-to-make-better-decisions-about-coronavirus/>

Recall of content / ease of retrieval

Ambiguous whether availability is about how easy it is to recall, versus how many instances can be recalled

Schwartz et al. (1991): it's ease of recall

recall 6 examples of assertive behavior is easy: people rate themselves as more assertive than recalling 12 examples of assertive behavior

But when indicated that recall is difficult (background music is supposed to break the fluency of recall) content does matter: if you can recall more you think you are more assertive

Availability in emotion and risk (ch 13)

Death by accidents 300x likely than of diabetes

True ratio is 1:4

Estimates strongly affected by media coverage!

Media coverage: novelty and poignancy

Also higher estimates for more emotional risks

Paul Slovic: Affect heuristic

- How do I feel -> What do I think about it

Highly implausible negative correlation between benefits and risks: the more benefits, the less risks perceived/estimated! (and vice versa)

But informing about one (benefits) reduces the perception of the other (risks)

Public versus experts on risk perception

Availability cascades:

Go from minor event to public panic to large scale governmental action

Sunstein: irrational reactions to low probability risks lead to too strong impacts on public policy

Slovic: yes, small risks with large effects are overestimated but there is a genuine conflict:

Experts only look at the numbers (of lives)

Public distinguishes between 'good' and 'bad' deaths, finer perception

Representativeness

Kahneman Chapter 14-16

Thinking and Deciding

Martijn Willemsen

Librarians versus farmers (p. 7: intro)

“Steve is very shy and withdrawn, invariably helpful but with little interest in people or in the world of reality. A meek and tidy soul, he has a need for order and structure and a passion for detail”



Is Steve more typical for a librarian or a farmer?

-> similarity...

Is Steve more likely to be a librarian or a farmer?

-> probability!

Representativeness

Three groups of subjects:

1. Base rates of number of students in each field?

Consider all first year graduate students in the U.S. today. Please write down your best guesses about the percentage of these students who are now enrolled in each of the following nine fields of specialization.

Business administration
Computer science
Engineering
Humanities and education
Law
Medicine
Library science
Physical and life sciences
Social science and social work

Representativeness

Three groups of subjects:

1. Base rates of number of students in each field?
2. Judgment of Tom as similar to other students in that field?

Business administration
Computer science
Engineering
Humanities and education
Law
Medicine
Library science
Physical and life sciences
Social science and social work



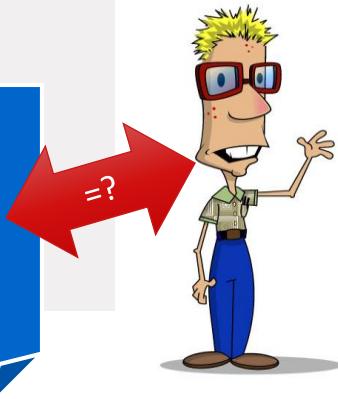
Tom W. is of high intelligence, although lacking in true creativity. He has a need for order and clarity, and for neat and tidy systems in which every detail finds its appropriate place. His writing is rather dull and mechanical, occasionally enlivened by somewhat corny puns and by Hashes of imagination of the sci-fi type. He has a strong drive for competence. He seems to have little feel and little sympathy for other people and does not enjoy interacting with others. Self-centered, he nonetheless has a deep moral sense.

Representativeness

Three groups of subjects:

1. Base rates of number of students in each field?
2. Judgment of Tom as similar to other students in that field?
3. How likely is it that Tom is a graduate student in each field?

Business administration
Computer science
Engineering
Humanities and education
Law
Medicine
Library science
Physical and life sciences
Social science and social work



Tom W. is of high intelligence, although lacking in true creativity. He has a need for order and clarity, and for neat and tidy systems in which every detail finds its appropriate place. His writing is rather dull and mechanical, occasionally enlivened by somewhat corny puns and by Hashes of imagination of the sci-fi type. He has a strong drive for competence. He seems to have little feel and little sympathy for other people and does not enjoy interacting with others. Self-centered, he nonetheless has a deep moral sense.

Representativeness

Three groups of subjects:

1. Base rates of number of students in each field?

2. Judgment of Tom as similar to other students in that field?

3. How likely is it that Tom is a graduate student in each field?

Tom was thought to be more likely to be a student in the less popular courses!

Base rates neglected, judgment based on representativeness (similarity)

TABLE 1

ESTIMATED BASE RATES OF THE NINE AREAS OF GRADUATE SPECIALIZATION AND SUMMARY OF SIMILARITY AND PREDICTION DATA FOR TOM W.

Graduate specialization area	Mean judged base rate (in %)	Mean similarity rank	Mean likelihood rank
Business Administration	15	3.9	4.3
Computer Science	7	2.1	2.5
Engineering	9	2.9	2.6
Humanities and Education	20	7.2	7.6
Law	9	5.9	5.2
Library Science	3	4.2	4.7
Medicine	8	5.9	5.8
Physical and Life Sciences	12	4.5	4.3
Social Science and Social Work	17	8.2	8.0



Category membership

Representativeness used for assessing category membership

Probability of individual belonging to a category is related to the similarity (representativeness) with the category stereotype

i.e. Tom is very similar to a nerd, so he is very likely to do a nerdy study

how much Tom represents a typical nerd is used as the **heuristic attribute** to assess the likelihood of him being a nerd (ignoring other information like base-rates)

Ignoring base-rates

More controlled version (see appendix A):

Descriptions are said to be sampled from a group of professionals: 30 engineers and 70 lawyers (or reversed: 70/30)

Likelihood of person being an engineer did not depend on the base-rates (but odds ratio is $(.7/.3)^2=5.44!$)

Even for a neutral description people estimated the chance of being an engineer about 50%, irrespective of the base-rate of 70% or 30%...

Only without descriptions we observe reliance on base rates...

Is representativeness always bad?

No: there is some truth in stereotypes

person with PhD more likely to read New York Times

But we should not forget the base rates

On the NY subway a person reading the NY times...

System 2 can be helped

Think like a statistician / Frowning



Another example from Appendix A

Imagine urn with balls, 2/3 of one color, 1/3 of another color.

Person A draws 5 balls, 4 Red and 1 White

Person B draws 20 balls, 12 Red en 8 white

Who SHOULD feel more confident that the urn has 2/3 red and 1/3 white balls?

Odds:

person A: (5 balls) 8 to 1 (*compare $\binom{5}{4} \frac{2}{3}^4 \frac{1}{3}^1$ to $\binom{5}{4} \frac{1}{3}^4 \frac{2}{3}^1$*)

Person B: (20 balls) 16 to 1

Randomness

X and O are the result of independent random events (e.g. heads and tails on a coin)

Which sequence is more random?

1. XOXXXOOOOXOXOOXXXOX
2. XOXOXOOOXXOXOXOOXXXOX

Back to randomness

Law of small numbers:

'belief that random samples of the population will resemble each other and the population more closely than statistical sampling theory would predict.'

Local representativeness

Which is more random?

alteration

1. XOXXXOOOOXOXOOOXXXOX p=.5
2. XOXOXOOOXXOXOXOOXXXOX p=.7

Alteration bias

Hot Hand

A basketball player with a hot hand (streak shooter) is a player who is more likely to score after some successful shots (than after having missed a shot)

Subjects selected sequences with 70% alterations as best examples of chance sequences

50% alterations have many contained runs and are seen as "streak shooting"



IQ

Mean IQ of a population of kids in a large city is known to be 100. You have selected a random sample of 50 kids. The first child tested has an IQ of 150. What do you expect the mean IQ to be for the whole sample?

- A: 100
- B: 101
- C: 105
- D: 110

Self-correcting statistics

After 3 heads, the probability of tails is thought to be higher on the next coin toss...

test:

Mean IQ of a population of kids in a large city is known to be 100. You have selected a random sample of 50 kids. The first child tested has an IQ of 150. What do you expect the mean IQ to be for the whole sample?

Not 100, but 101: $EV=(1*150+49*100)/50 = 101$

Chance does not correct or cancel out high scores, it merely dilutes high scores with additional scores that are closer to the average

Linda: Less is more

Chapter 15

Representativeness – conjunction fallacy

Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.



How likely is it that...

Rank the following items in terms of probability:

Linda is a teacher in an elementary school

Linda is active in the feminist movement (F)

Linda is a psychiatric social worker

Linda is a bank teller (B)

Linda is an insurance salesperson

Linda is a bank teller and is active in the feminist movement (B&F)

Main finding: $p(F) > p(B \& F) > p(B)$

Again representativeness Heuristic

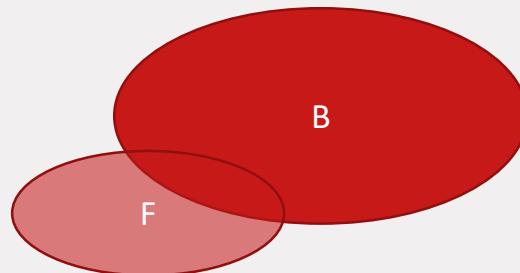
Judgments based on similarity: the description of linda is not very representative for bank-tellers but is more representative for bank-tellers who are feminists...

Goes against the conjunction rule: $P(B \& F) \leq P(B)$

In more detail:

$$P(B) = P(B \& F) + P(B \& \text{not } F)$$

thus: $P(B \& F) \leq P(B)$



Other linda designs

Original design was between subjects

Only one of the critical items (B) or (B&F) present

Some ranked resemblance, some similarity

89% ranked B&F higher than B

This should be apparent within! But it is not...

As shown: 6th and 8th item (one item in between)

85% ranked B&F higher than B

Finally: 2 option: Which alternative is more probable:

Linda = B or Linda = B + F?

again 85-90% ranked B&F higher than B

(but 64% of graduate sample got it correct)

Other attempts seem to fail (p. 162)

People do get the math correct

$$P(\text{jane} = \text{teacher}) > P(\text{jane} = \text{teacher} \ \& \ \text{walks to work})$$

But many other versions still show the fallacy

Borg loses 1st set < Borg loses 1st set and wins match

RGRRR < GRGRRR (red/green on a die)

Except when using frequencies

not: what percentage of the men but...

How many of 100 ppn had heart attack(s)?

Is indeed judged more likely than

How many of 100 ppn and over 55 years had heart attack(s)?

Causes trumps stats

chapter 16

More on representativeness

Cab involved in a hit-and-run accident at night.

85% green cabs, 15% blue cabs

Witness identified cab as blue. Reliability of the witness: 80% she correctly identifies the color

What is the probability that the cab involved was Blue?

Most subjects say $p>.5$, and many say $p=.80$

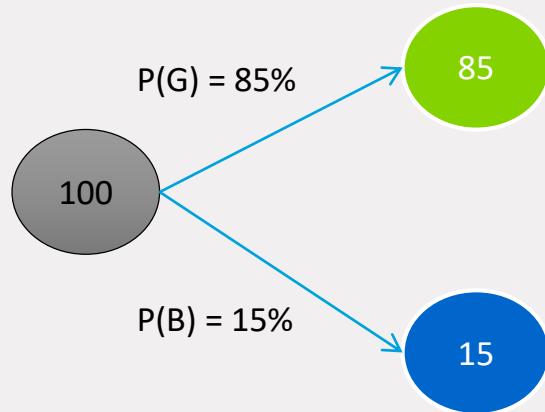
Do not take into account base rate...



Can you calculate this probability?

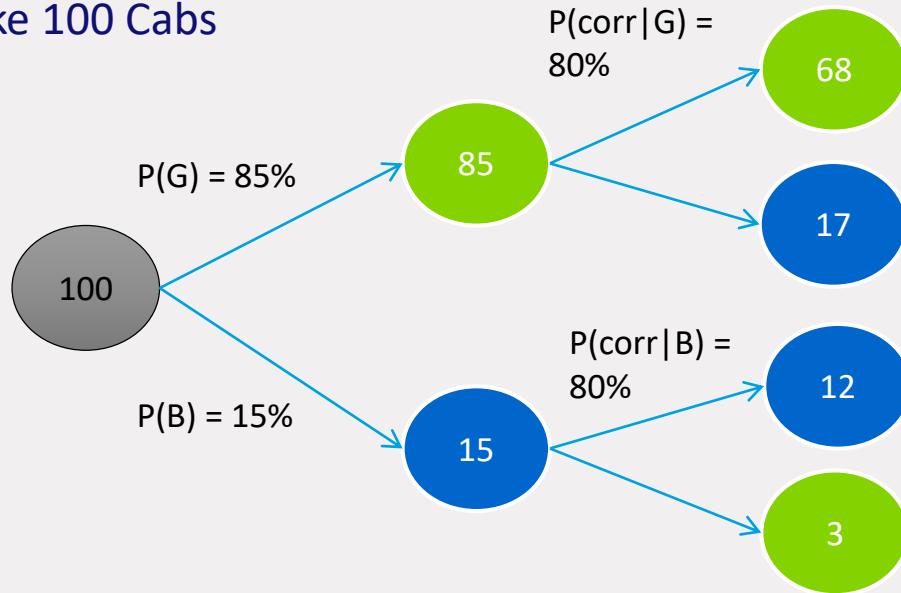
Bayesian solution using frequencies

Take 100 Cabs



Bayesian solution using frequencies

Take 100 Cabs



$$P(\text{blue} \mid \text{witness says blue}) = 12 / (12 + 17) = .41$$

More relevant than ever...

What is the base-rate?

What is the false positive rate?

10 out of 1724 seems rather low...

We discuss this more later in this
slidedeck...

The New York Times

Positive Coronavirus Tests Bring Scrutiny to German Soccer's Reopening Plans

Germany's closely watched Bundesliga confirmed 10 coronavirus cases in its first wave of mass testing. Government officials are expected to announce on Wednesday whether the league can restart.

By Tariq Panja

Published May 4, 2020 Updated May 6, 2020



LONDON — As one of the first major sports leagues to detail plans to return to action, [Germany's](#) soccer league has become the bellwether for the thorny task of restarting sports events postponed by the [coronavirus](#) epidemic.

That decision became more complicated on Monday when 10 players were found to have the virus after blanket testing of 1,724 individuals from the 36 teams in the top two divisions of the league, the Bundesliga.

<https://www.nytimes.com/2020/05/04/sports/soccer/coronavirus-german-soccer-bundesliga.html>

Causal stereotypes help...

Another description:

“companies have equal size, but 85% of accidents involve green cabs and 15% blue cabs”

Much less neglect of the prior probabilities!

Green Cabs cause more accidents, so a green cab is more **representative** (stereotypical) of a ‘reckless driver’ and people do not accept the witness testimony so easily.

“She says blue but....”

Stereotypes

Causal base rates are treated as relevant information about the individual and thus get more weight when combined with the other case-specific information

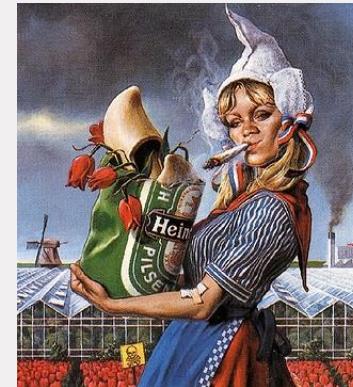
Stereotypes: bad word in our culture

Are social versions of prototypical exemplars

Stereotyping often helps our judgments:
they ironically help the cab problem...

But in many cases there is a valid social norm against them: job hiring / profiling...

Biased algorithms / fake news!



Causal base rates: exam

From Ajzen: estimate probability that a student passed the exam

Students draw from a class were 75% passed

Students draw from a class were 25% passed

Inference: test must be very difficult! Causal factor...

Responses took into account base rates

Other version:

The investigator was interested in the causes of failure and constructed a sample in which 75% had failed the exam

Pure statistical base rate thus this was not accounted for...

Can Psychology be taught?

Students learned about the helping experiment (Bystander effect: 4 out of 15 pps helped...)

New group watched movies of interviews with 2 previous participants

How quickly did these persons help the stranger...?

Base rate? 4 out of 15 = 27%

Neglected base rates and estimated higher probabilities, even though they knew the results of the study!

But: knowing that the 2 people shown in video did not help... Accurate estimates!

Surprising individual cases trump statistical facts!

More on Bayes Theorm and probabilities

Appendix: Coherence rules for probability

- $p(A) + p(\neg A) = 1$: any proposition is true or false, $p=1$ is certainty
- Mutual exclusive: $p(A) + p(B) = p(A \text{ or } B)$ (additivity)
- $p(A | B)$ is the conditional probability of A given that B is true
- $p(A \& B) = p(A | B) * p(B)$
- Independence of A and B: $p(A | B) = p(A)$:
 $p(A \& B) = p(A) * p(B)$

The Base - Rate fallacy: corona version

A woman aged 32 has symptoms that might indicate Corona / Covid-19. On the basis of her age, recent contacts and her symptoms we estimate that chance of corona is $p(\text{cor})=.10$ (base-rate). She is now being tested with a newly developed corona test that will give a positive test:

1. In 90% of the cases where the person indeed has corona (hit rate).
2. In 20% of the cases where the person does not have corona (false-alarm)

Suppose the test is positive. What is the probability that the woman actually has corona?

Conditional probabilities & the Bayesian solution

No corona (.90) ---- positive (.20) $.90 * .20 = .18$

No corona (.90) ---- negative (.80) $.90 * .80 = .72$

corona (.10) ---- positive (.90) $.10 * .90 = .09$

corona (.10) ---- negative (.10) $.10 * .10 = .01$

Conditional probabilities & the Bayesian solution

No corona (.90) ---- positive (.20) $.90 * .20 = .18$

No corona (.90) ---- negative (.80) $.90 * .80 = .72$

corona (.10) ---- positive (.90) $.10 * .90 = .09$

corona (.10) ---- negative (.10) $.10 * .10 = .01$

$$P(\text{corona} \mid \text{positive test.}) = .09 / (.09 + .18) = .33$$

Bayes Theorem

We often know $p(\text{Datum} \mid \text{Hypothesis is true})$

Hit rate of many medical tests

How likely is it to draw a red ball from an urn, given that I know the distribution of red balls.

But we want to know $p(\text{Hypo is true} \mid \text{Datum})$

Do I have a disease, given that test is positive

If I draw a red ball, how likely is it that the urn has distribution Y

This depends on prior probabilities (base rates) and false alarm rates.

Bayes Theorem

$$p(H | D) = \frac{p(D | H) \cdot p(H)}{p(D)}$$
$$= \frac{p(D | H) \cdot p(H)}{p(D | H) \cdot p(H) + p(D | \neg H) \cdot p(\neg H)}$$

$p(H) = .1$ (Cancer base rate)

$p(D | H) = .9$ (hit rate)

$p(D | \neg H) = .2$ (false alarm)

$$p(H | D) = \frac{p(D | H) \cdot p(H)}{p(D | H) \cdot p(H) + p(D | \neg H) \cdot p(\neg H)}$$

$$p(H | D) = \frac{.9 \cdot .1}{.9 \cdot .1 + .2 \cdot .9} = .33$$

Change of estimate with different Base-rates

Base rate changed from $p(H) = .1$ to $p(H) = .05$

No corona (.95) ---- positive (.20) $.95 * .20 = .19$

No corona (.95) ---- negative (.80) $.95 * .80 = .76$

corona (.05) ---- positive (.90) $.05 * .90 = .045$

corona (.05) ---- negative (.10) $.05 * .10 = .005$

$P(\text{corona} | \text{positive test}) = .045 / (.045 + .19) = .19$

(note: applications like quality control).

Change of diagnosticity: hit rate

Change hit rate ($p(D|H) = .9$ to $p(D|H) = .95$)

No corona (.90) ---- positive (.20) $.90 * .20 = .18$

No corona (.90) ---- negative (.80) $.90 * .80 = .72$

corona (.10) ---- positive (.95) $.10 * .95 = .095$

corona (.10) ---- negative (.05) $.10 * .05 = .005$

$P(\text{corona} | \text{positive test}) = .095 / (.095 + .18) = .35$

Change of diagnosticity: false alarm

Reducing false alarm rate: $p(D|\neg H) = .2$ to $p(D|\neg H) = .1$

No corona (.90) ---- positive (.10) $.90 * .10 = .09$

No corona (.90) ---- negative (.90) $.90 * .90 = .81$

corona (.10) ---- positive (.90) $.10 * .90 = .09$

corona (.10) ---- negative (.10) $.10 * .10 = .01$

$$P(\text{corona} | \text{positive tes}) = .09 / (.09 + .09) = .50$$

The Bayesian Approach

Updating probabilities in light of new information.

Posterior probabilities combine the base-rates (prior probabilities) with the new evidence (likelihood)

$$\frac{p(H | D)}{p(\neg H | D)} = \frac{p(D | H)}{p(D | \neg H)} \cdot \frac{p(H)}{p(\neg H)}$$

Posterior odds of Hyp. being true given Datum Diagnostic ratio Prior odds

$$\frac{.09}{.18} = \frac{.90}{.20} \cdot \frac{.10}{.90}$$

Base rate neglect: people focus on the new (salient) evidence neglecting the importance of base-rates.

Some examples from the book

End of chapter 14: working with base rates

“mathematical details not relevant for the book”

But they are for you ;-)

$$\frac{p(H | D)}{p(\neg H | D)} = \frac{p(D | H)}{p(D | \neg H)} \cdot \frac{p(H)}{p(\neg H)}$$

If you believe 3% is CS student and Tom is 4x likely to be from that field...

Priors? $P(\text{CS})/P(\neg \text{CS}) = .03/.97$

Diagnosticity ratio of data: 4

Posteriors get updated to $z = 4 * .03/.97 = 0.123$

$P(\text{CS} | \text{data}) = z/(1+z) = 11\%$



0HV60 Thinking and Deciding

Lecture 7: Memory Strategies (ch 6 Matlin)

Martijn Willemsen

Memory strategies from previous chapters

Divided Attention (Ch3): don't multitask...

Working memory capacity (Ch4): fast pace of the lecturer...

Levels of Processing (Ch5)

deep processing emphasizing elaboration and distinctiveness rather than simple rehearsal

use "why questions"

using distinctiveness to learn names

self-reference effect

Encoding Specificity

study strategies should consider how the information will be tested: open book exam?

Rehearsal & Practice

Consolidation: integrating new information into existing (stored) information

Rehearsal: practicing information keeps it active and better encoded

Distributed practice: learning in various sessions spaced over time (*how I would like you to study*)

Massed learning: sessions in a very short space of time (*how students often study...*)

Retrieval Practice effect: practice retrieval during studying

Total time hypothesis

amount of time spent meaningfully rehearsing: using **elaboration** (rather than just **maintenance** rehearsal)

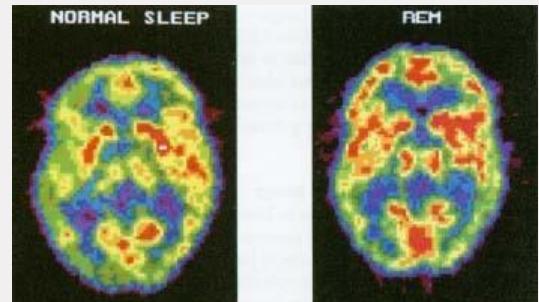
Why is distributed practice better?

Context of encoding varies more if spacing between sessions is larger, enriching and elaborating the schemas for information

desirable difficulties!

Influence of sleep on memory: a good nights sleep helps consolidation: REM stages are required!

Hippocampus: maintains new experiences until they can be assimilated with existing representations



Testing effect

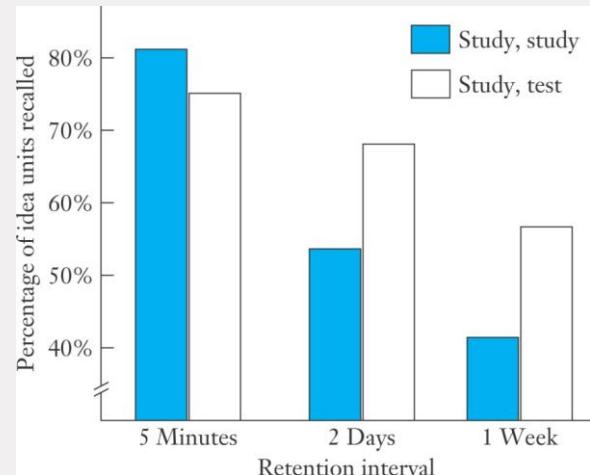
taking a test is actually an excellent way to boost your long-term recall for academic material

Roediger and Karpicke (2006)

reading essays, testing immediately or after delay,
with repeated study or intervening test

testing provides practice in retrieving the relevant
material

produces desirable difficulties



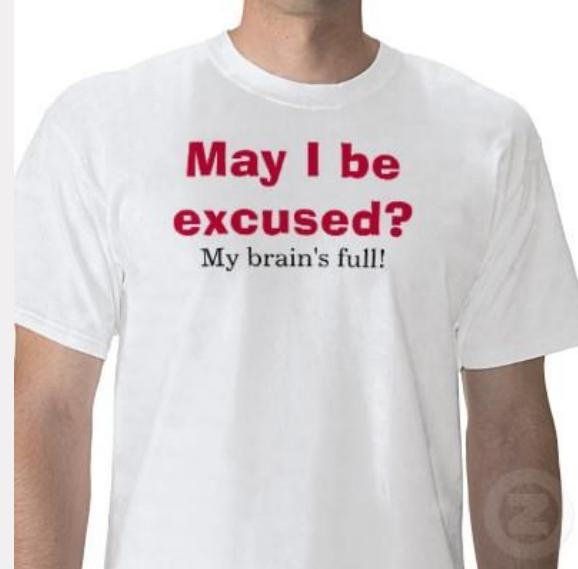
Still wonder why we have the quizzes?

Mnemonics

Some people remember virtually anything

Remember the 10 words I tell you

How many correct?



Mnemonics

Some people remember virtually anything

Remember the 10 words I tell you

How many correct?

Apple, dog,
bicycle, hat,
rock, phone,
cup, sweater,
bag, pencil

Mnemonics

Some people remember virtually anything

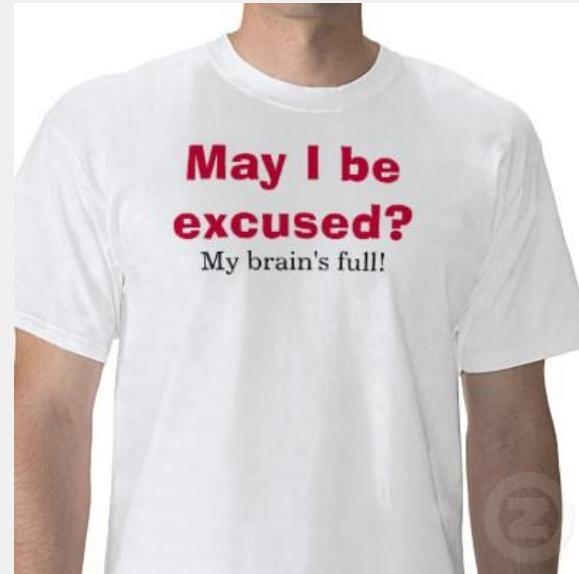
They seem to use “tricks”

Make information meaningful

Relate it to relevant information already stored in memory

Now do the same, but link each word to a something in a room in your house

How many correct?



Mnemonics

Some people remember virtually anything

They seem to use “tricks”

Make information meaningful

Relate it to relevant information already stored in memory

Now do the same, but link each word to a something in a room in your house

How many correct?

Second list:

Ball, cat, box, book, plant, scissors, lamp, socks, key, glasses

Andi Bell



Mnemonics using Imagery

Using Imagery

Imagery: cat-window pair, imagine a cat sitting in the window

Keyword system: beurre->bear : Bear eating butter

Method of loci: connect items to landmarks in an area

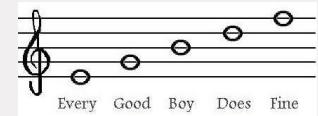
Using Organization

Chunking: combining items into meaningful units

Hierarchy: provide meaningful structure

First letter: Acronyms (colors of the rainbow: ROY G. BIV) or Acrostic: form a sentence: Every Good Boy Does Fine

Narrative Technique: story that links words together



Prospective memory

Retrospective memory: memory for past items

Prospective memory: memory for things we need to do or remember for the future

Very different kind of memory: needs attention!

Time-based: do something at time X (meeting at 16h)

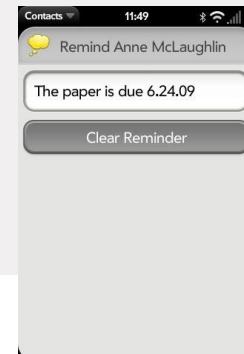
Event-based: do something when Y happens

(When I see Bart, let him know the paper is due)

External memory aids:

Agendas and alarms?

[http://humanfactorsblog.org/2009/06/18/smartphone s-as-event-based-prospective-memory-aids/](http://humanfactorsblog.org/2009/06/18/smartphone-s-as-event-based-prospective-memory-aids/)



Metacognition

Using our cognitive processes to think about our cognitive processes.

Metamemory and the Prediction of Memory Performance

Metamemory on a Total-Score Basis

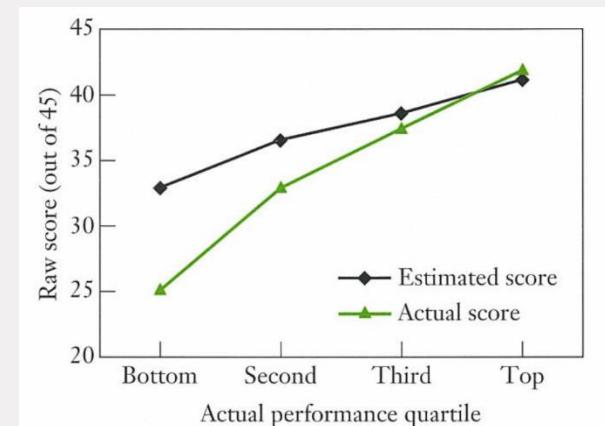
predict total number of correct responses

foresight bias—people overestimate
the number of answers that they
will supply on a future test

Dunning and coauthors (2003)

estimate of total score *after* finishing exam

less competent students overestimated performance



Metacognition

Metamemory on an Item-by-Item Basis

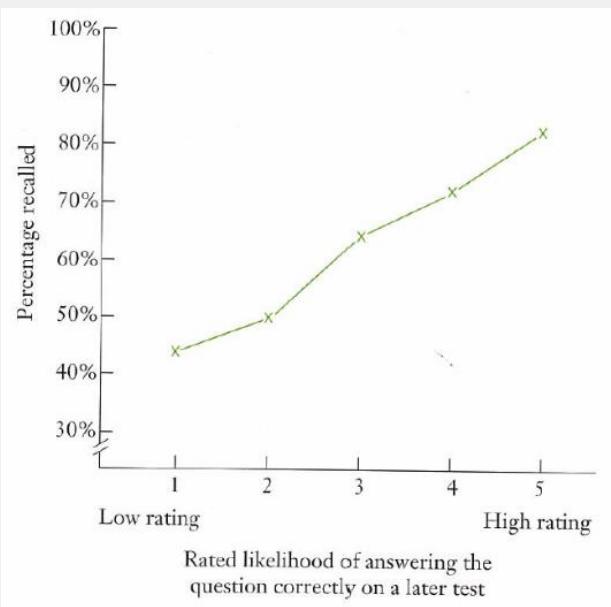
Lovelace (1984)

word pairs, rate likelihood of answering the item correctly, test recall

people can accurately predict their likelihood of recalling an item

Even better with some delay between learning and rating of likelihood:

LTM rather than working memory!



Metacognition and study strategies

Allocating time when task is easy:

Students study more and longer on things they think are difficult to master, but correlation is low (0.3)

They spend too much time on things they already know and too little on things they don't master...

Allocating time when the task is difficult

Students are asked to study biographies: hard task, only 30 mins for a task that would require 60 min just to read: time pressure!

Students spend most of their time on easier biographies

- Wise strategy given the time pressure

Expert students (in other studies) show to choose the more challenging materials

The Tip-of-the-Tongue Phenomenon

tip-of-the-tongue phenomenon—the subjective feeling you have when you are confident that you know the target word for which you are searching, yet you cannot recall it

Brown and McNeill's Classic research

- given the definition of an uncommon English word, try to identify the word (e.g. nepotism)
- when the definition produced a tip-of-the-tongue phenomenon, try to generate words with similar sound
- similar sounding words did indeed resemble the target words in terms of first-letter and/or number of syllables

Tip-of-the-Tongue Phenomenon

Later Research on the Tip-of-the-Tongue Phenomenon

frequency of occurrence: once every week

bilinguals vs. monolinguals

successfully retrieve the word about 50% of the time, often within 2 minutes, and correct at later recognition

first letter and number of syllables often guessed correctly

semantic characteristics of target

Feeling of Knowing

predicting whether you could correctly recognize the correct answer to a question: more conscious process



0HV60 Thinking and Deciding

Mental Imagery (ch 7 Matlin)

Martijn Willemsen

Stephen Wiltshire



Mental Imagery

Mental representation:

Internal representation of items that are not currently being sensed

May be old, new, futuristic, imaginary

May involve any of the sensory modalities

- Imagine a taste, a sight, a touch, a voice

Top down processing!

Majority of research on **Visual Imagery**

Hard to investigate, why?

No control, introspection is unreliable

Experiments: how we manipulate mental images

Neuroscience evidence

Mental Imagery

Kosslyn proposes images are used to help solve certain types of problems

How many chairs are there in your house?

Which is larger, room Aud 16 or room Aud 7?

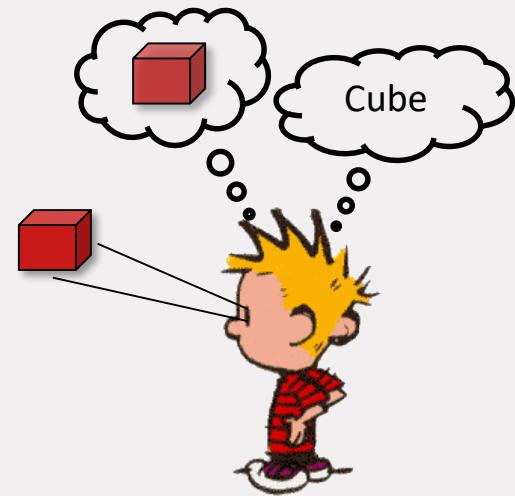
Two streams:

Mental image is stored in an **analog code** that closely resemble perception

Evidence: mental rotation (Shephard, 1971)

Mental image is stored as **propositional code** language-like representation (not perceptual)

Evidence: labeled pictures (Carmichael et al. 1932)

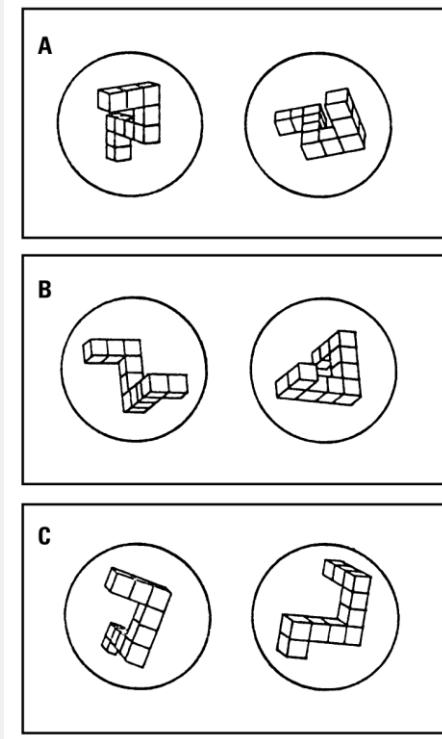


Mental Rotations

Shepard & Metzler (1971)

Subjects had to decide whether displays had two similar shapes

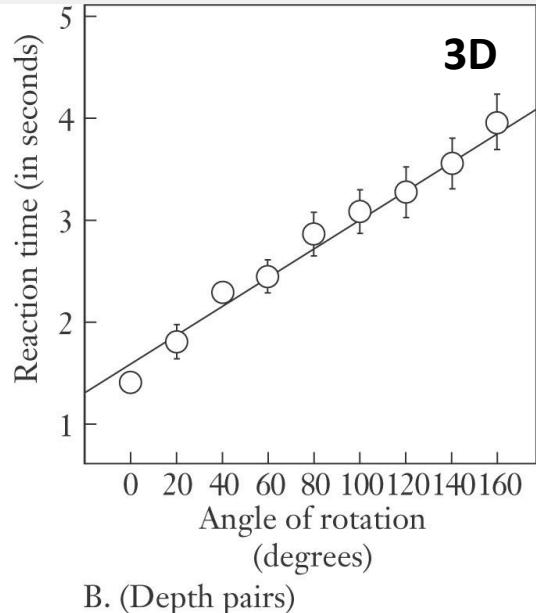
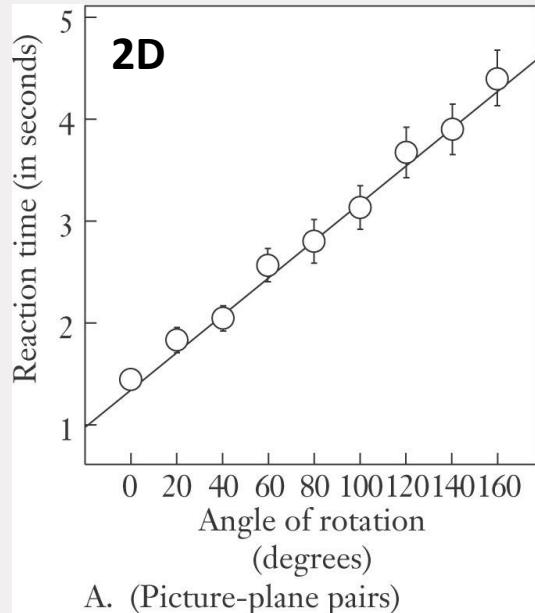
Some pairs were similar, but rotated to various degrees



Shepard & Metzler (1971) Results

Functional equivalence of
mental rotation with
rotation in physical space!
Also in 3D!

**Strong evidence for an
analog code...**



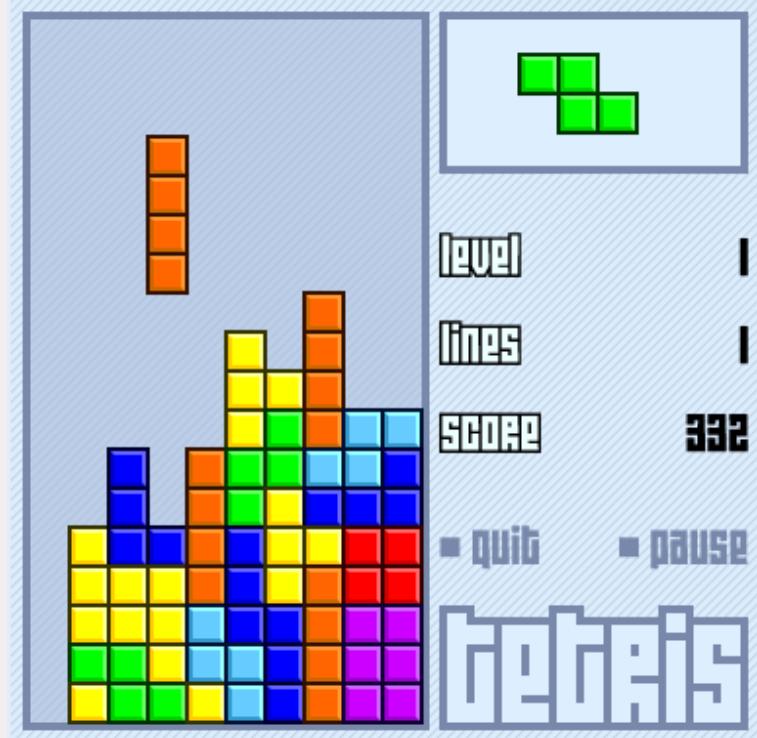
Recent Research

Age: older people are slower at mental rotation

Practice? Does not transfer to other visual stimuli

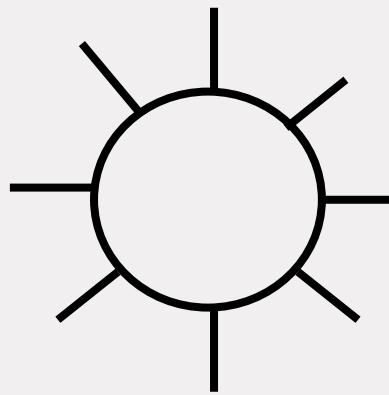
Sign Language

Fluent ASL very good at rotating a scene for 180 degrees

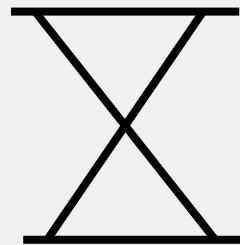


Carmichael, Hogan, & Walters (1932)

Participants were shown simple figures with one of two verbal labels



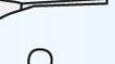
Sun or ship's wheel



Hourglass
Or
Table

P.S.: Example not in Matlin (from Cogn. Psy, Sternberg)

Carmichael, Hogan, & Walters (1932) Results

Reproduced figure	Verbal labels	Stimulus figures	Verbal labels	Reproduced figure
	Curtains in a window		Diamond in a rectangle	
7	Seven	7	Four	4
	Ship's wheel		Sun	
	Hourglass	X	Table	X
	Kidney bean		Canoe	
	Pine tree		Trowel	
	Gun		Broom	
2	Two	8	Eight	8

Carmichael, Hogan, & Walters (1932) Results

Later participants were asked to draw items seen: Participants distorted the images to fit the labels

This pattern supports the idea that images may be stored propositionally not as original analog image

Analog limitations

Inability to see parts has led some to support a propositional code rather than an analog code

... Demonstrates mental images are not always precise

Propositional Theory (Pylyshyn)

Conceptual-Propositional Hypothesis holds that mental representations are abstract.

Proposition: *meaning underlying a particular relationship among concepts, using neither images nor words.*

Assumptions:

We do not store in form of images, but instead have a “generic” code that is called “propositional”

Stores the meaning of the concept

Create a verbal or visual code by transforming the propositional code

Images are secondary phenomena, occurring as a result of other cognitive processes.

Propositional Representations

How can we propositionally represent:

Type of relationship: Spatial

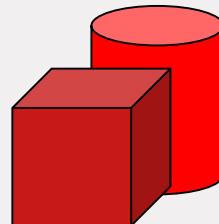
Verbal representation:

The cube is in front of the cylinder

Propositional representation:

Before [Cube,Cylinder]

Imaginal representation:



Test Your Visual Imagery Ability!

Form a mental image of this picture

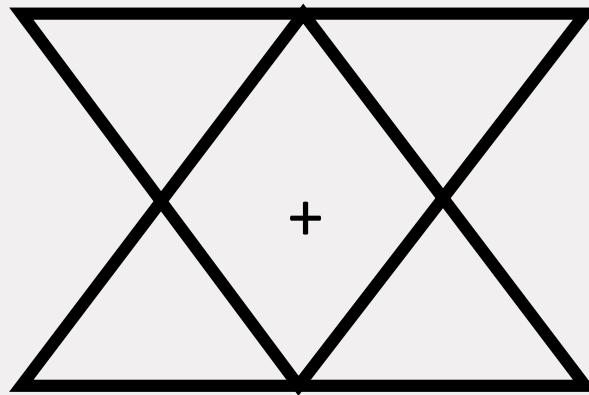
Which of the pictures on the next slide are part of this picture?

+

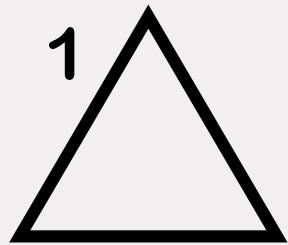
Test Your Visual Imagery Ability!

Form a mental image of this picture

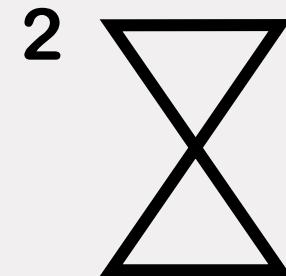
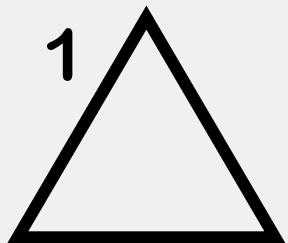
Which of the pictures on the next slide are part of this picture?



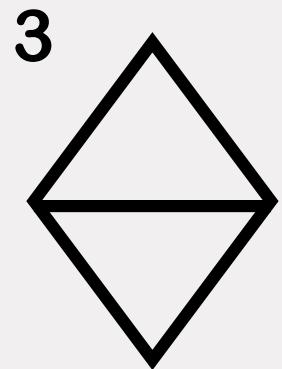
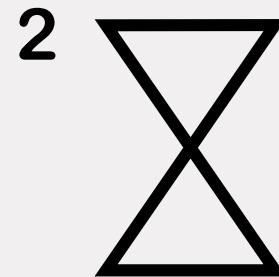
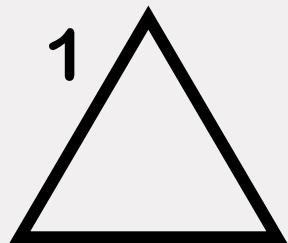
Part of figure? Answer True/False



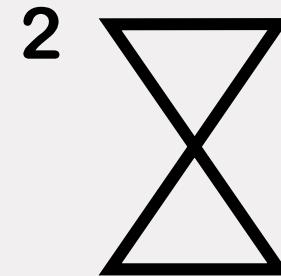
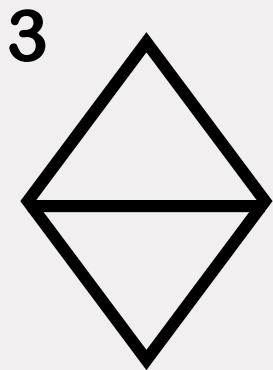
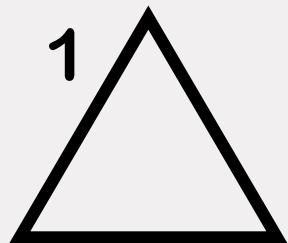
Part of figure?



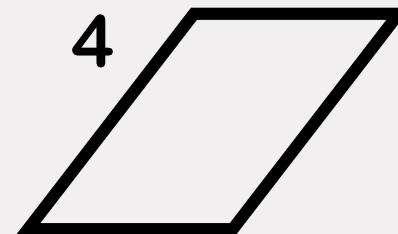
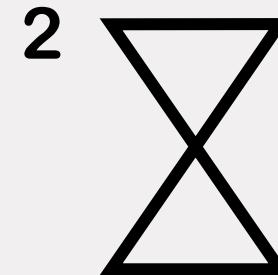
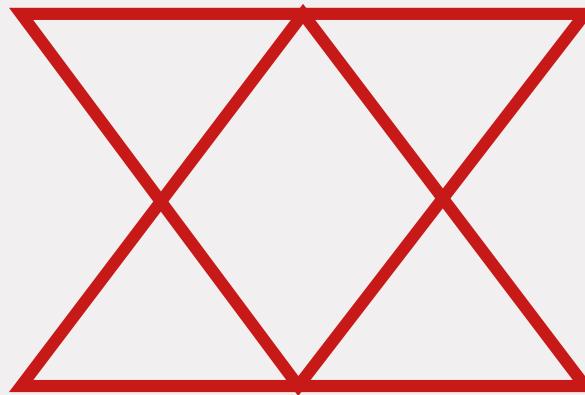
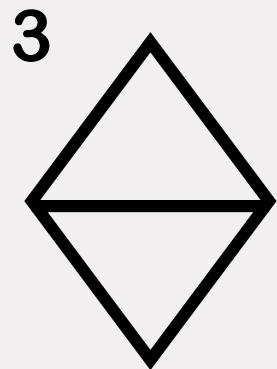
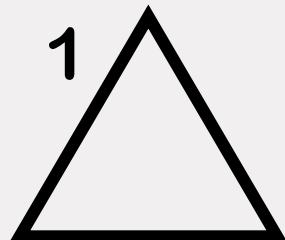
Part of figure?



Part of figure?



Part of figure?



Try Again with Another Design

Form a mental image of this picture

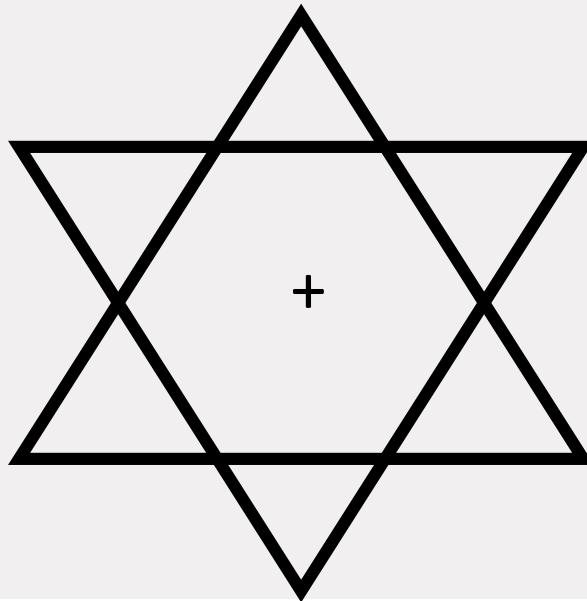
Which of the pictures on the next slide are part of this picture?

+

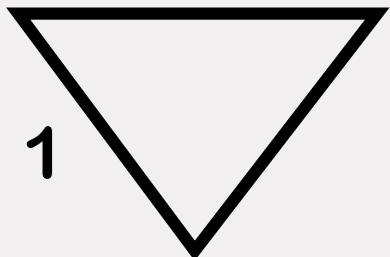
Try Again with Another Design

Form a mental image of this picture

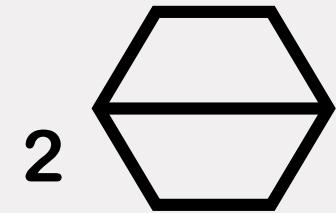
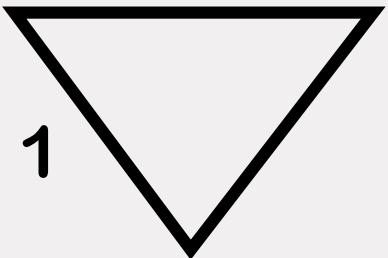
Which of the pictures on the next slide are part of this picture?



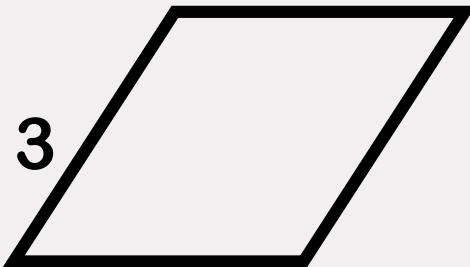
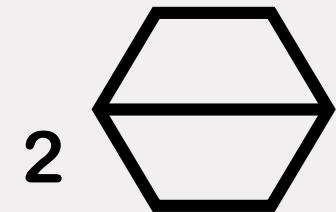
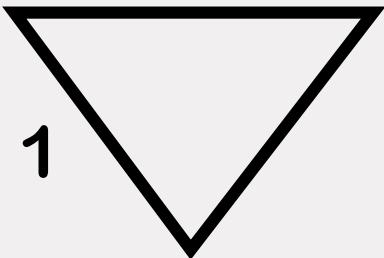
Part of figure? TRUE, FALSE



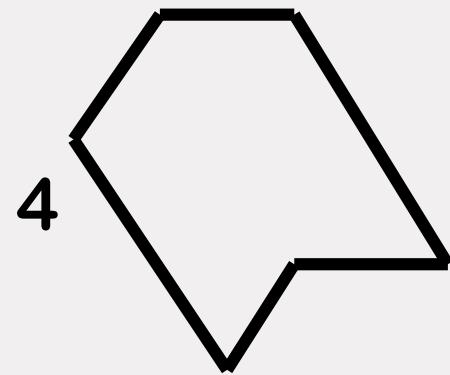
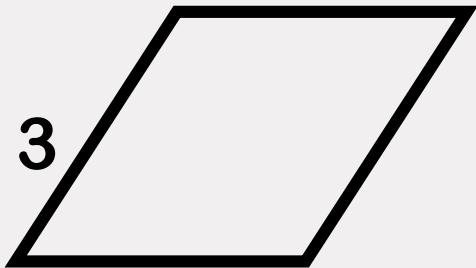
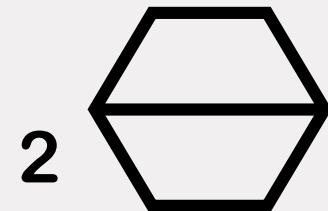
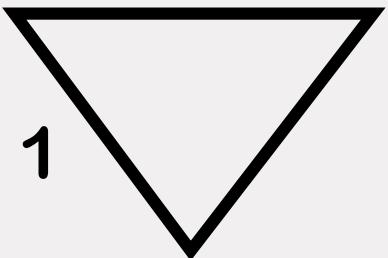
Part of figure? A = TRUE, B = FALSE



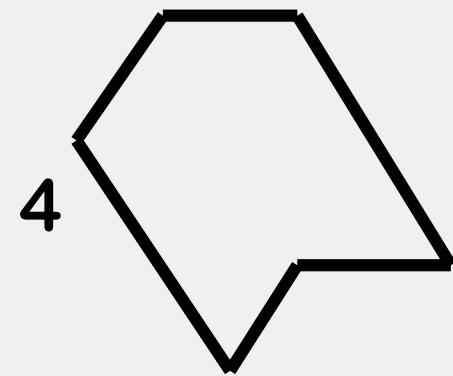
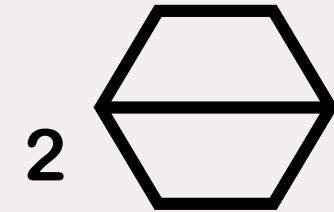
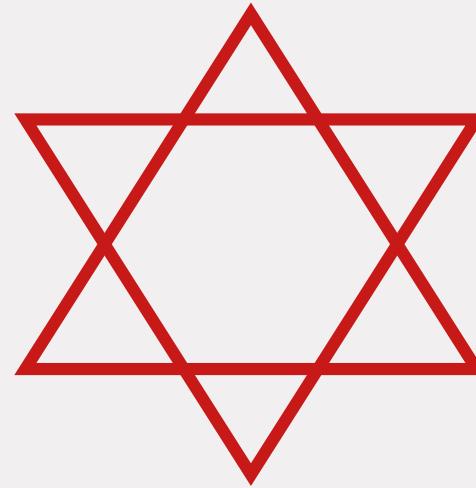
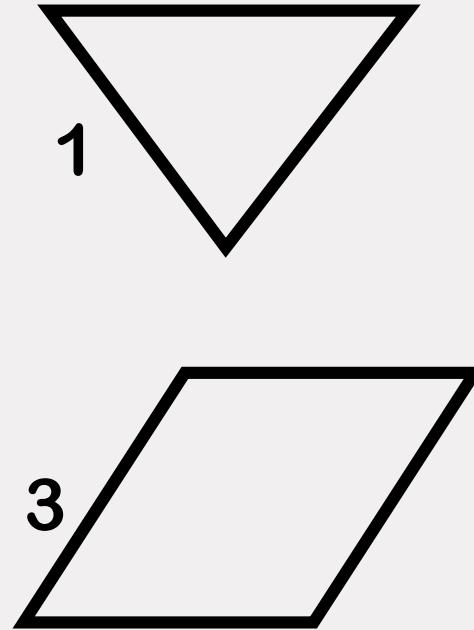
Part of figure? A = TRUE, B = FALSE



Part of figure? A = TRUE, B = FALSE

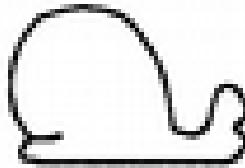


Part of figure? A = TRUE, B = FALSE



Another test

What do you see?

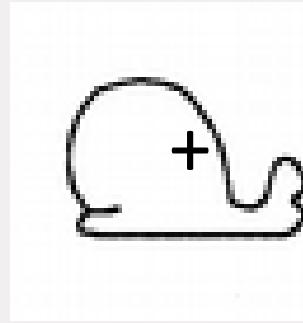


Another test

What do you see?

Recreate image in your mind

Can you also see a different animal
in this image?



Another test

What do you see?

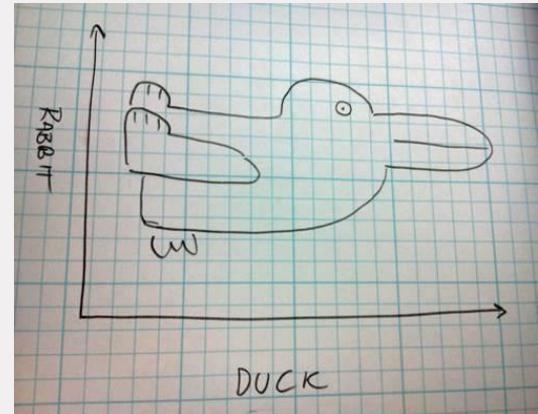
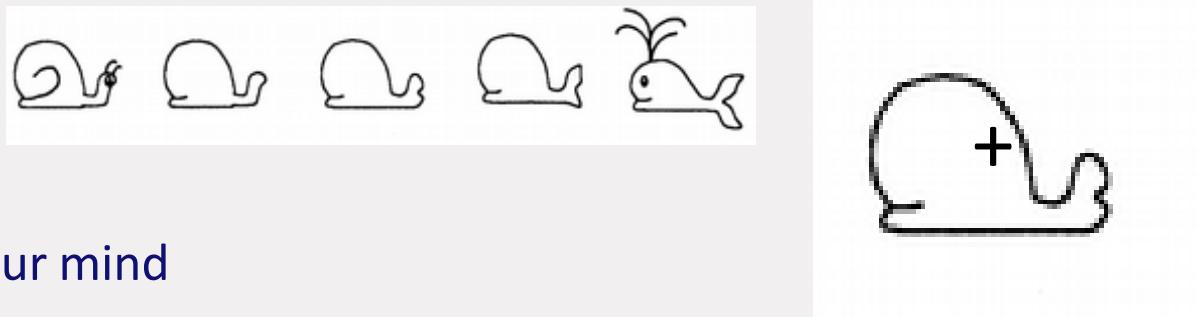
Recreate image in your mind

Can you also see a different animal
in this image?

Ambiguous figures

Most people cannot see the alternative figure, unless you give them the actual percept

Verbal labels helpful for complex stimuli



Another test



What do you see?

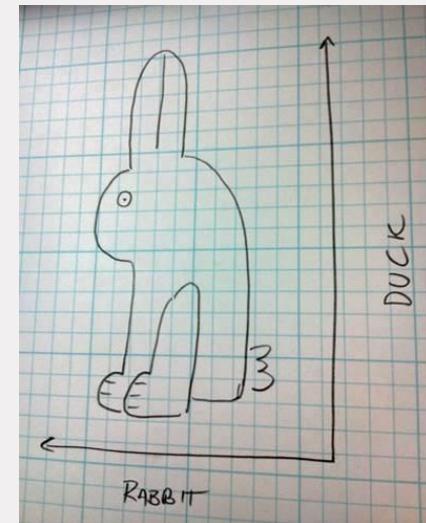
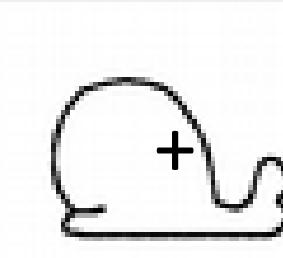
Recreate image in your mind

Can you also see a different animal
in this image?

Ambiguous figures

Most people cannot see the alternative figure, unless you give them the actual percept

Verbal labels helpful for complex stimuli



Problems with Propositional Hypothesis

Propositional codes are less likely to influence image representations when the representations are created from scratch by people:

Imagine a capital letter D. Rotate the figure 90 degrees to the left. Now place a capital letter J at the bottom

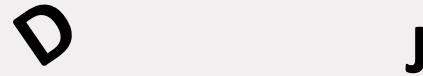
D

J

Problems with Propositional Hypothesis

Propositional codes are less likely to influence image representations when the representations are created from scratch by people:

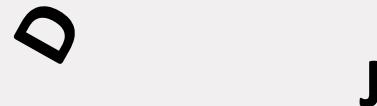
Imagine a capital letter D. Rotate the figure 90 degrees to the left. Now place a capital letter J at the bottom



Problems with Propositional Hypothesis

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Problems with Propositional Hypothesis

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Problems with Propositional Hypothesis

Propositional codes are less likely to influence image representations when the representations are created from scratch by people:

Imagine a capital letter D. Rotate the figure 90 degrees to the left. Now place a capital letter J at the bottom



Some evidence that mental imagery may be manipulated directly, rather than via a propositional code.

(Finke, Pinker & Farah, 1989)

So there is support for both codes!

Functional-Equivalence Hypothesis

Functional-Equivalence Hypothesis:

we construct images that are functionally equivalent to percepts (see also page 213: Hubbard, 2010)

Mental rotations

image scaling

Imagery and shapes

image scanning / distance

Image Scaling

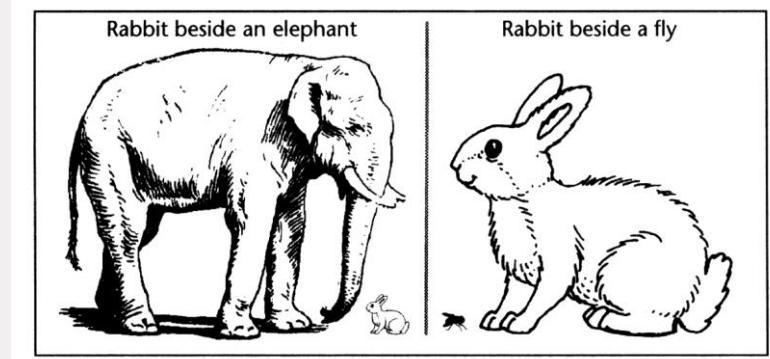
Imagine rabbit next to fly or to elephant

Does the rabbit have whiskers?

Does the rabbit have ears?

Reaction time faster if object is the larger one (comparing with fly rather than elephant)

Takes longer to describe details of smaller objects than to describe details of larger objects. (zoom in)



Imagery and shape (Paivio)

Visualize and judge the angle of the two hands on a non-digital clock...

Create an image if the time is 9:50

Create an image if the time is 4:30

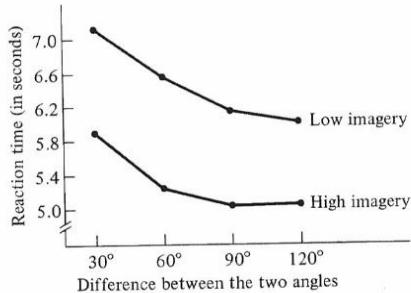
Which Angle is larger?

Now try 1:10 versus 4:45...

People make decisions about *shape* in a similar fashion for mental images and physical stimuli



The Influence of Angle Difference on Reaction Time for High-Imagery and Low-Imagery People.



Source: Paivio, 1978.

Imagery & Distance: Scanning

Memorize map (Kosslyn)

Later ask to scan image

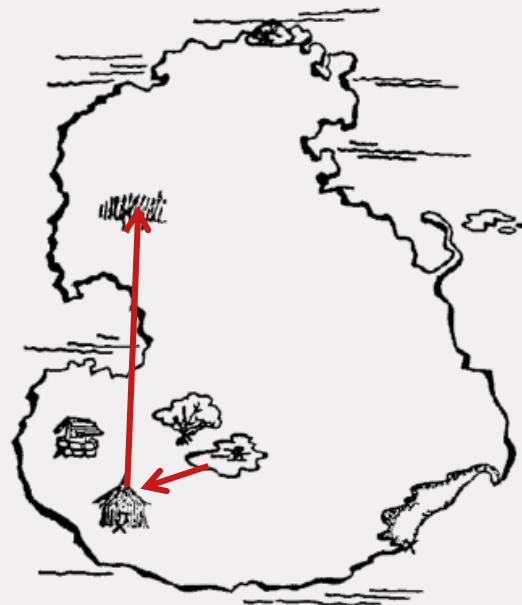
Manipulate distance between items in scan

Hut to grasses

Lake to Hut

Measure reaction time

Linear relationship between distance to scan and actual reaction time



Demand Characteristics

Major criticisms of Kosslyn's Research

Pylyshyn :There is only one code, propositional, The results are due to task demands

The instructions imply some necessary relationship between the physical distance and time required

Participants give the experimenters the pattern they expect

Jolicoeur & Kosslyn (1985)

Created a false demand characteristic for a U shaped function for participants: Proposed that Gestalt principle of proximity makes close points "hard", and distant points would also take longer

No experimental expectancy effect found

Supports idea that image is being used!

Neuroscience evidence

How similar are imagery and perception on the biological level?

Advanced levels of processing (beyond retina) are involved in imagery as well (two-thirds of the same regions as in visual perception, according to Kosslyn)

Damage in the visual cortex: people cannot produce mental images

Visual perception and imagery show similar activation in the primary visual cortex (mostly for inspecting mental images)

Mental rotation: Motor cortex only active during mental rotation when people just have rotated actual stimuli with their hands, not when watching a motor rotating an object...

Gender Differences

There are few gender differences found in cognitive tasks

Meta analysis: only evidence for some spatial differences

Spatial ability represents several different skills

spatial visualization: find something in a scene (small)

spatial perception: dark room, adjusting a rod to be vertical (moderate)

mental rotation: are two figures the same? (moderate to large)

TABLE 7.1
**The Distribution of Effect Sizes (d) Reported
in Meta-Analyses of Cognitive Skills**

Skill	Magnitude of d			
	Close to Zero ($d \leq 0.10$)	Small ($d = 0.11$ to 0.35)	Moderate ($d = 0.36$ to 0.65)	Large ($d = 0.66$ to 1.00)
Verbal Ability	4	1	0	0
Mathematics Ability	4	0	0	0
Spatial Ability	0	4	3	1



Auditory Imagery (not in 7th edition!)

Make Mental image of the sound of

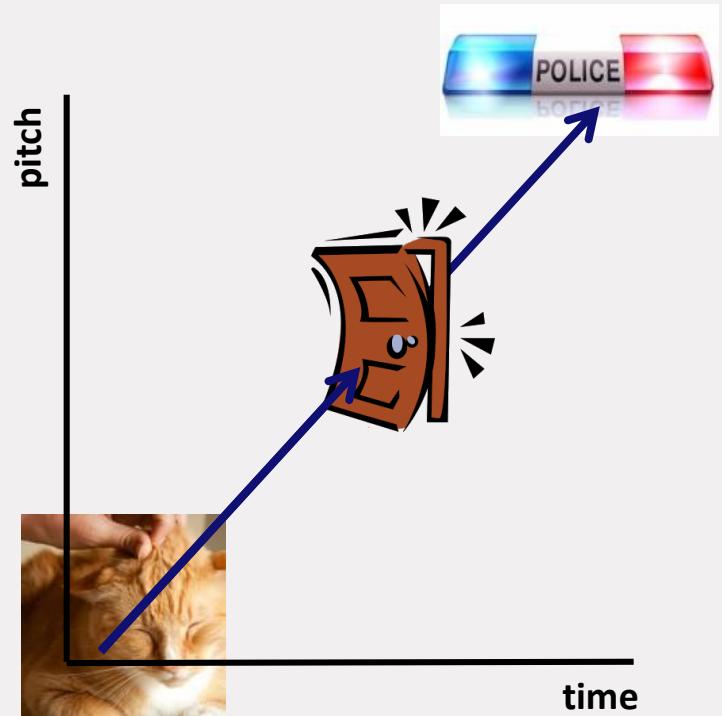


Auditory imagery and pitch: **scaling!**

("travel the distance" between two auditory images)

From purring cat to slamming door: 4 seconds

From purring cat to policy siren: 6 seconds



Auditory Imagery and Timbre

Happy Birthday on:

Different timbre



Participants familiar with timbre of several instruments

judging timbre similarities between pairs of instruments

Both mentally (auditory image) or physically (1.5 sec soundbite)

Judgments of similarity from mental imagery and real perception where highly correlated!

We can have a mental image of timbre!

Cognitive Maps

cognitive map: mental representation of the environment that surrounds us

Neighbourhoods, cities, countries: anything that is too large to see in a single glance

spatial cognition: our thoughts about spatial issues; cognitive maps, remembering the world we navigate, keeping track of objects in a spatial array

environmental psychology, computer science, linguistics, anthropology, geography, architecture, urban planning

our knowledge of spatial cognition includes an enormous amount of commonsense information

Cognitive Maps

cognitive maps both analog and propositional

Tend to be accurate, but details are systematically distorted (simplified) on:

Distance

Shape

Relative position

People use **heuristics**: a general problem solving strategy that, usually, produces a correct solution

Cognitive Maps and Distance

Intervening Cities (Thorndike)

Distance between two cities is judged to be longer if more cities between them: "cluttered" routes seem longer

Semantic Categories

People tended to shift each location closer to other sites that belonged to the same semantic cluster: courthouse closer to police station, but not to golf course

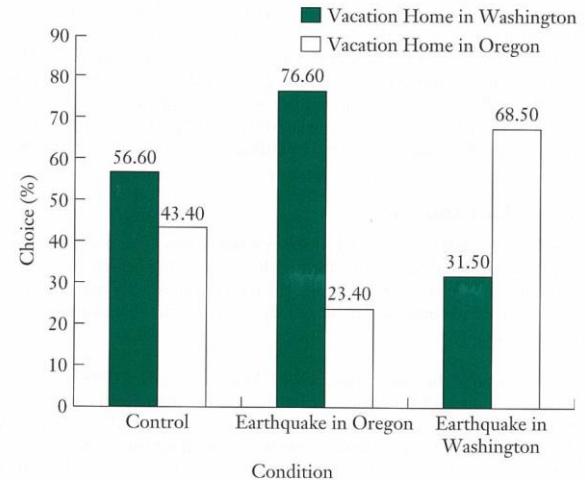
Separated by border: larger distances

Landmark vs Non-Landmark

Shorter estimated distances from a non-landmark to a landmark

FIGURE 7.4

An Example of Border Bias: Percentage of Participants Choosing Each Vacation Home, as a Function of Which State Had Experienced an Earthquake. When people hear about an earthquake, they prefer to select a home in a different state, rather than a home that is equally close, but in the same state (Mishra & Mishra, 2010).



Cognitive Maps and Shape

Angles

People tend to regularize the angles of intersections

degree-angle heuristic: we represent angles on a map as being closer to 90 degrees than they really are (schemas!)

Curves

Symmetry heuristic: We remember figures as being more symmetrical and regular than they truly are

Which province does not share a border with Noord-Brabant?

- a) Utrecht
- b) Zuid-Holland
- c) Gelderland



Cognitive Maps and Shape

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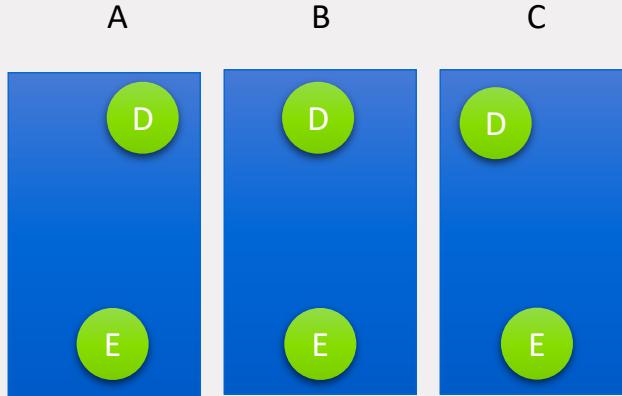
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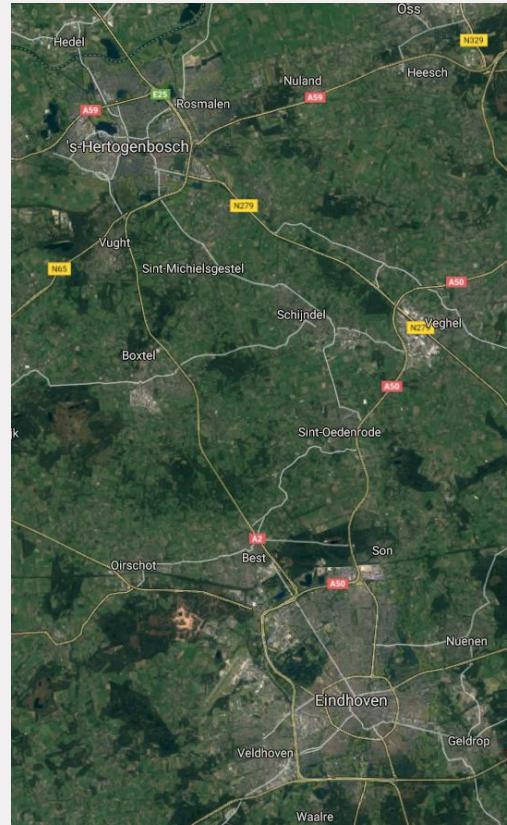
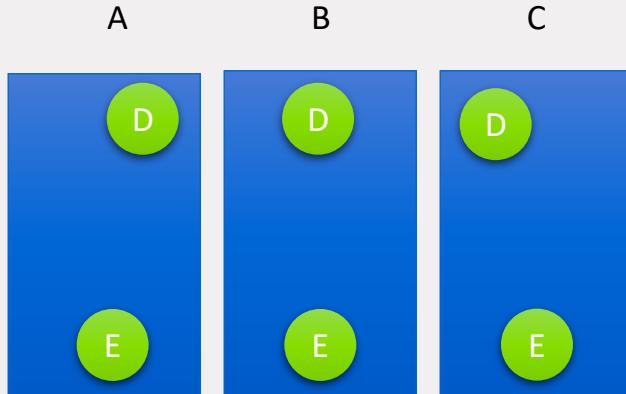
Relative-position

What is the position of Eindhoven and Den Bosch?



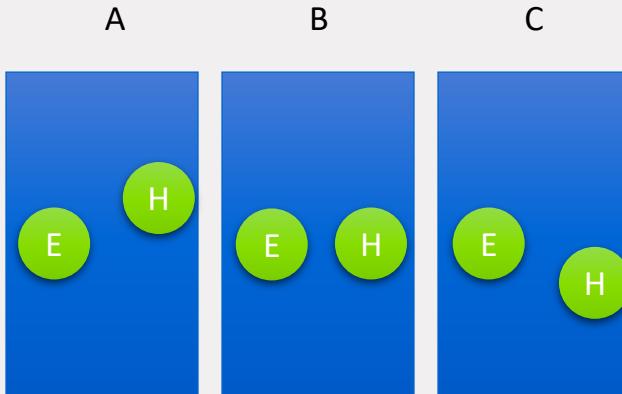
Relative-position

What is the position of Eindhoven and Den Bosch?



Relative-position

What is the position of Eindhoven and Helmond?



Relative-position

What is the position of Eindhoven and Helmond?

A



B



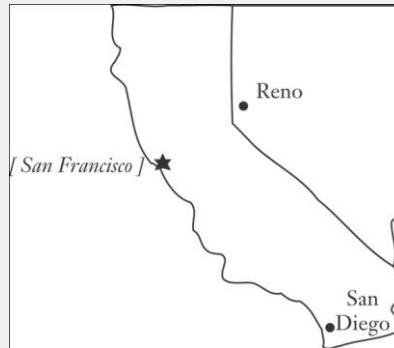
C



Cognitive Maps and Relative Position

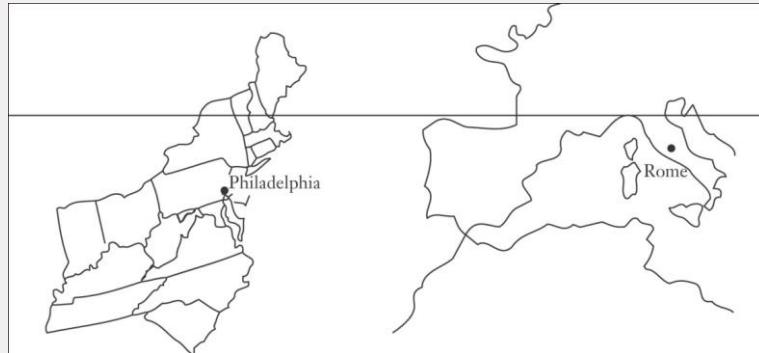
Rotation heuristic

We remember a tilted geographic structure as being either more vertical or more horizontal than it really is



Alignment heuristic

we remember geographic structures as being arranged in a straighter line than they really are



Creating Cognitive Maps

Creating a cognitive map from descriptions or directions

similar to maps created from looking at a scene

integrate information from separate statements

Franklin and Tversky's Research

verbal descriptions of ten different scenes

five objects located in a plausible location relative to the observer: above, below, in front, in back , left or right

imagine facing one of the objects; specify which object located in each of several directions

Response times:

Shortest for above/below, longer for ahead/behind

longest for left/right

Spatial Framework model

spatial framework model—emphasizes that the above-below spatial dimension is especially important in our thinking, the front-back dimension is moderately important, and the right-left dimension is least important

- The vertical dimension is correlated with gravity
- The vertical dimension on an upright human's body is physically asymmetric.
- Front-back: interact with the front / asymmetric
- Left/right: fewer asymmetries or interaction differences, more often confused

Situated cognition approach: we use our immediate environment in cognition



0HV60 Thinking and Deciding

Lecture 8: Regression towards the mean and overconfidence (Kahneman Part 2: ch 17-18, Part 3: ch 19-22, 24)
Martijn Willemsen

Regression towards the mean

Chapter 17-18 Kahneman

Thinking and Deciding

Regression towards the mean

Extreme scores from sampling a population are usually followed by less extreme ones...

Flight training example: reward good performance, punish bad performance

Flight trainers complained:

reward is followed by poorer performance

punishment is followed by better performance



Imperfect correlations

Succes = talent + luck

Great success = a little more talent + a lot of luck

Sportsman (like golfer) performing exceptional on day 1 often perform less well at day 2

500m speed skating: winner first run often is not the best in second run.

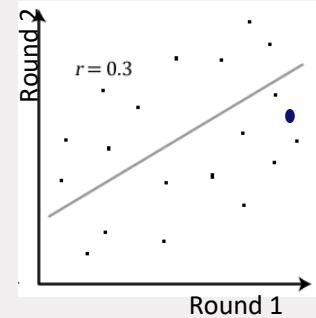
Relation between performance is not perfect correlation (skill + noise (=luck)) which leads to regression to the mean



Understanding regression

Correlation often limited (0.3 is not too bad)

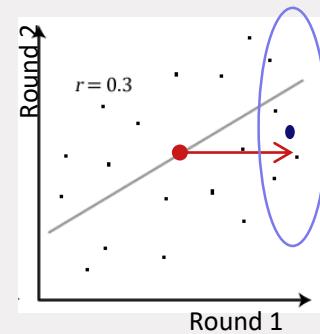
Extreme scores in round one regress
towards the mean in round 2
(and vice versa)



Understanding regression

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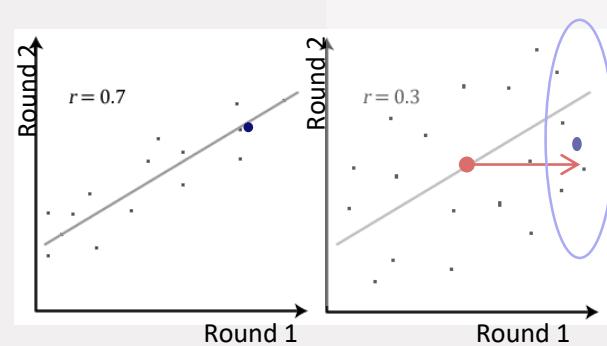
Extreme scores in round one regress towards the mean in round 2
(and vice versa)

Less regression for higher correlation! ($r=.7$)

But still there is:

Tall parents get kids not being as tall...

Professors get kids no so smart?



Understanding regression

Correlation often limited (0.3 is not too bad)

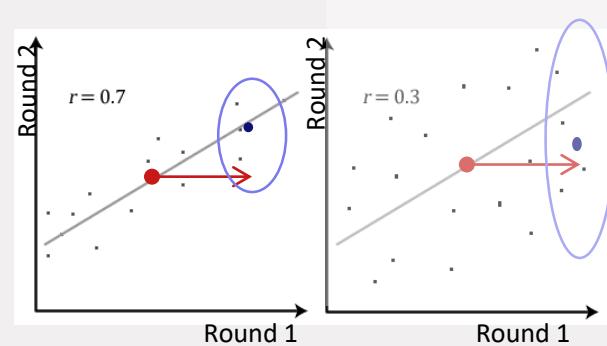
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(and vice versa)

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Tall parents get kids not being as tall...

Professors get kids no so smart?



What about the speed skaters 500m

500m: used to have two runs on two consecutive days

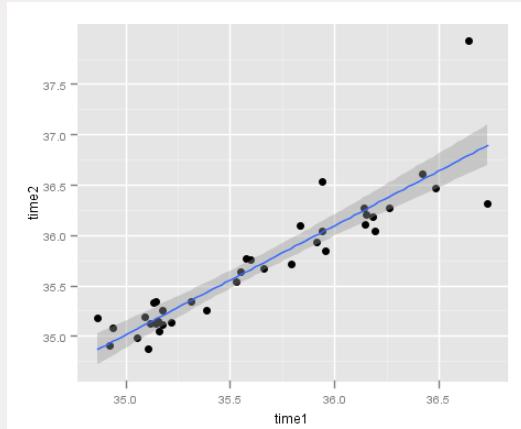
2010 Olympics (Vancouver)

Correlation ($r=0.91$)

This is clearly a skill-based

Sport: high correlation...

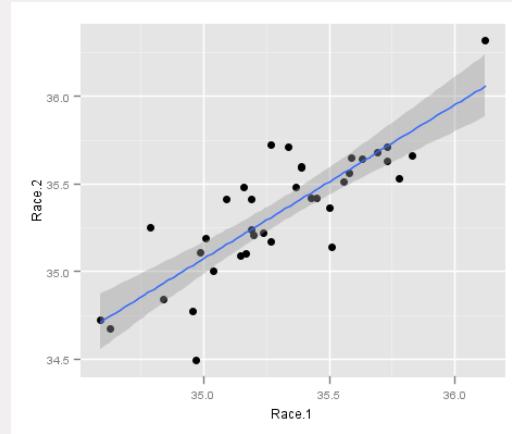
But sprint -> many small factors can influence the results



What about the speed skaters 500m

2014 Olympics (Sotsji)

Correlation ($r=.83$)



What about the speed skaters 500m

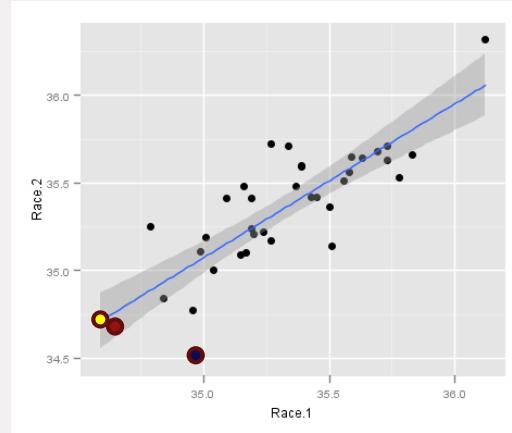
2014 Olympics (Sotsji)

Correlation ($r=.83$)

But yes: Ronald Mulder

Showed regression from

Race 2 to Race 1



Naam	Land	Race 1
Jan Smeekens	NED	34,59
Michel Mulder	NED	34,63
Keiichiro Nagashima	JPN	34,79
Mo Tae-bum	KOR	34,84
Joji Kato	JPN	34,96
Ronald Mulder	NED	34,97

Naam	Land	Race 2
Ronald Mulder	NED	34,49 BR
Michel Mulder	NED	34,67
Jan Smeekens	NED	34,72
Joji Kato	JPN	34,77
Mo Tae-bum	KOR	34,84
Roman Kretsj	KAZ	35,00



Impact of regression towards the mean

Regression towards the means has an explanation but no cause...

Highly intelligent women tend to marry men less intelligent than they are

- *Correlation between spouses is less than perfect*

Depressed children treated with energy drink improve significantly over a 3 month period...

- *Successive test are less than perfectly correlated*

Taming intuitive predictions (ch. 18)

Julie is a senior in a state university. She read fluently when she was 4 years old. What is her GPA?

System 1: intensity matching:

percentile score on reading precocity ->

Percentile score on GPA!

But these relations are not perfectly correlated! Noise happens...

Correcting these intuitive predictions

Julie:

Reading age = shared factors + (reading age factors) = 100%

GPA = shared factors + (GPA specific factors) = 100%

Shared factors = genetics + academic environment etc...

But both aspects are influenced by other factors, so correlation is only the shared factors!

- 1) Start with average GPA estimate (system 2, base rate)
- 2) Determine GPA based on evidence (system 1 intensity matching)
- 3) Estimate correlation
- 4) If correlation is .3, move 30% from average to matching GPA

Overcoming the biases

Tradeoff between baseline predictions (base rate) and intuitive predictions (system 1)

Tom W.: base rate being an CS versus representativeness towards a typical CS student

No good intuitive evidence  keep baseline

Very good evidence  adjust strongly to prediction

Usually a tradeoff between the two

But moderated predictions are a bit dull and won't bring you the new Google:
high risk is important in some cases (venture capitalist)

Hiring example

- Kim recently completed her graduate work. Her **recommendations are spectacular** and she gave a **brilliant talk** and **impressed everyone** in her interviews. She has **no substantial track record** of scientific productivity.
- Jane has held a postdoctoral position for the last three years. She has been **very productive** and her research **record is excellent**, but her **talk and interviews were less sparkling** than Kim's.

What should you do?

Illusion of Understanding & Validity

Chapter 19-20, Kahneman

Thinking and Deciding

Narrative Fallacy

The rise of Google: Two smart guys made a series of good decisions and became rich and famous

At some point they were lucky not to be bought for 1M\$

Good story: but was this event predictable?

Reading about success stories in the field you one day hope to build your web business in is an excellent idea, you can see their mistakes as well as their triumphs, and therefore will have foresight that they did not have. Here is a success story about Google and their rise to power from a small business in a friend's garage to the company it is today.

<http://www.youngwebbuilder.com/how-google-became-so-successful-and-how-you-can-too/>



Illusion of understanding

Successful Rafter = SKILL + luck

Successful Entrepreneur = skill + LUCK

Build the best possible story: easier to do so with limited information!

Illusion of understanding

Successful Rafter = SKILL + luck

Successful Entrepreneur = skill + LUCK

Build the best possible story: easier to do so with limited information!

“I knew well before 2008 that financial crisis was inevitable”

Misuse of the word knew: should be ‘I thought’!

To know is only after the fact but the use of the word suggests that the world is more knowledgeable than it really is

Hindsight bias!

Tip: read back your emails from early March: did you feel corona was really an issue that would last months (or even longer....)

Hindsight Bias

Mind is a sense-making organ, we adjust our view of the world to accommodate surprising outcomes.

Take a topic (death penalty), ask peoples opinions provide persuasive pro/con message

New attitude: closer to persuasive message

Recall old attitude: reconstruct former beliefs is difficult (ch 5 of Matlin!): consistency bias in autobiographical memory.

Creeping determinism (Fischhoff, 1975)

Interpret past in light of the outcomes

Particular outcomes seemed to be more foreseeable than they actually were

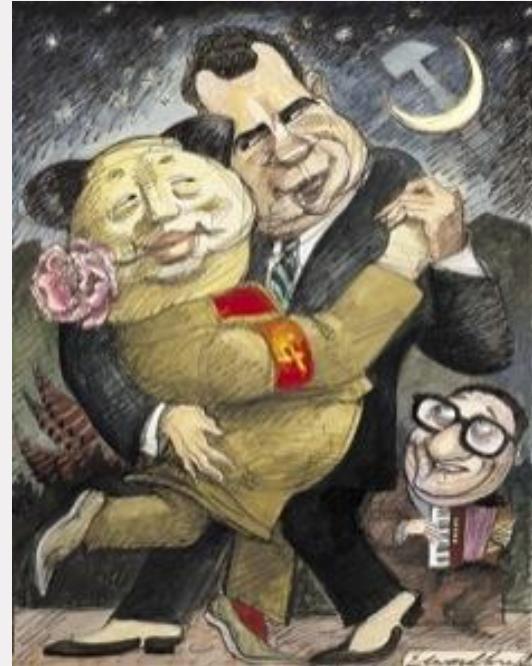
Nixon Study

President Nixon visits to China and Soviet Union

Prior to event, students were asked to rate likelihood of various events.

After the visits, students were asked again for these likelihoods, and asked to give their original probabilities

Probabilities of events that actually occurred were inflated relative to others, especially after a long gap between initial and later assessments



Outcome bias

We blame decision makers for good decisions that turn out badly and little credit for successful moves

Outcome bad: decision is bad (in Hindsight!)

Larger consequences more hindsight bias

9/11: CIA got some information on July 10 but did not bring that to the president (but to C. Rice)

Washington Post: “If you got the story that will dominate history, so might as well go directly to the president”...

Hindsight fosters risk aversion

But rewards successful risk-seekers!

Regression towards the mean again...

Success of the firm vs. quality of CEO

Suppose a (generous) correlation of 0.30

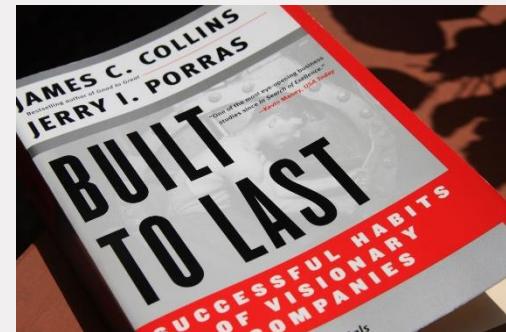
You will find the stronger CEO to lead the more successful firm in 60% of the time...
10% more than random guessing...

But those stories don't sell...

Book "built to last"

18 pairs of competing companies (one more successful)
and how they differ on culture, strategy etc

Differences between firms vanished after publication:
regression towards the mean...



Illusion of validity (ch. 20)

Kahneman: evaluate candidates for officer training

Strong agreement on scores between judges

poor forecasting, just a bit better than random guesses

But confidence did not suffer and predictions were not moderated... **Illusion of validity**

Representativeness: one hour observation can serve as a cue for predicting performance in officer training and combat

Individual cases not affected by the base-rates from the general rule... still feeling confident in his judgments...

Stock-picking ‘skill’

Odean: 10k brokerage account analyzed over 7 year period: 163k trades

Return of stock sold and stock bought in replacement:

Shares sold did **better** than those they bought by 3.2%!

Odean and Barber: Most active traders have the poorest results

Lock their gains by selling winners

Hang on to stocks that loose money

But recent winners do better than recent losers...

Stock selection for most traders is close to random...

Average correlation between performance of investment advisors for 8 different years: not even low (~0.3) but zero (0.01)!

Illusions of pundits

Pundits offer convincing accounts based on hindsight... their skills and knowledge are supported by those who believe in them...

Philip Tetlock interviewed 284 of these ‘experts in political and economic trends’ over 20 years

Assess probabilities of event in near future, for three outcomes: status quo, getting more, or less of something

Own area of expertise and others

About 80k predictions

Results: worse than when providing equal probabilities to each outcome...

Hedgehogs versus Foxes

“Hedgehogs tend to have a focused worldview, an ideological leaning, strong convictions; foxes are more cautious, more centrist, more likely to adjust their views, more pragmatic, more prone to self-doubt, more inclined to see complexity and nuance. And it turns out that while foxes don’t give great sound-bites, they are far more likely to get things right.”

<http://www.nytimes.com/2009/03/26/opinion/26Kristof.html?em>

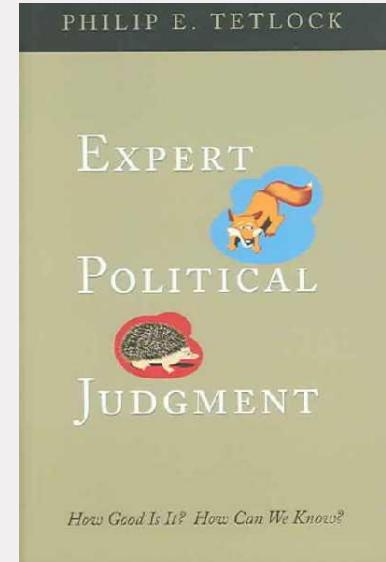
Tetlock found that

Expert forecasters were strongly overconfident

Especially in their own area of expertise, and more so if they have more knowledge

Did worse than simple algorithms (e.g. follow the recent trend)

Hedgehogs did worse than foxes (but hedgehogs make a much better TV show...)



Intuitions vs. Formulas

Chapter 21 Kahneman

Thinking and Deciding

Social Judgment Theory

When making judgments, how much should we weigh different kinds of information?

Normative theory: gather all information and weigh them appropriately to arrive at a judgment

Can people do that?

Social Judgment Theory: statistical (actuarial) models often outperform expert judges

Probabilistic Mental Models: how simple heuristics sometimes are very efficient!

Not in the book as Kahneman and Gigerenzer do not get along very well...

Clinical versus statistical predictions

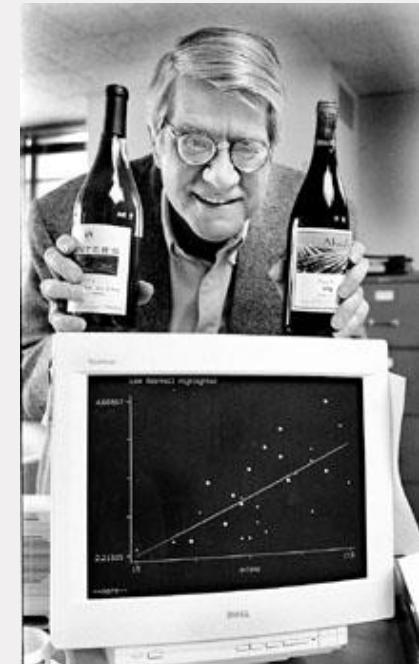
Paul Meehl: showed already in 1954 that simple (regression-like) models can outperform experts

Despite that they only use a few variables

Orley Ashenfelter: predicting future prices of Bordeaux based on weather better than experts do

- amount of rain previous winter
- amount of rain during harvest
- average temperature during summer

Correlations of 0.9!



Interviews are notoriously bad... (p225)

Intake interviews for medical school (De Vaul, 1987)

800 interviewed, and top 350 were further processed. From these 150 were selected for admission

Then, intake had to be boosted to 200 students

Only those ranked 700-800 in the interview session were available (43% not admitted to any medical school)

Later it was discovered these 50 students did not perform any worse than the 150 from the top-ranked students.

Why are actuarial models better?

Experts are good (and necessary) to select relevant variables and cues

Actuarial models are better at applying the right cues in the best way

Why do expert judgments go wrong?

Looking too much at individual cases (overrule formula)

people can be inconsistent, and rely too much on specific information (context), or weigh it wrongly

Skewed samples, missing information (a psychiatrist does not see the 'healthy people')

Influence of recent experiences, lack of good feedback

Improper linear models (Dawes)

So-called because they do not optimally weight the cues.

Bootstrap model: model of the judge

Random linear model: randomly-chosen weights

Equal weighting model: each cue equally weighted



Dawes & Corrigan (1974): equal weight model the most accurate

Another Example: Apgar Score

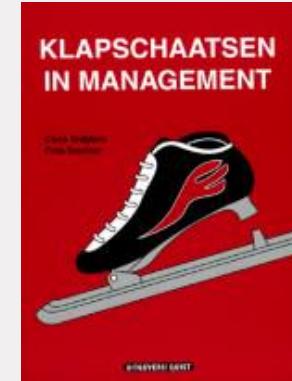
	Score 0	Score 1	Score 2
Appearance			
Pulse	No pulse	<100/min.	>100/min.
Grimace			
Activity			
Respirations	No respirations	Weak, slow	Strong cry

apgar www.fotosearch.com

Lack of impact

Despite the clear evidence that we should not trust human judgments, we have not abandoned clinical judgments (and still use interviews and expert judgments)

- Reluctance to use formulas (questions expertise, mechanical)
- Selective memory (remember their good judgments, and the bad judgments from models)
- "Every case is unique"



Probabilistic Mental Models

Social Judgment Theory: not a cognitive / process model of human judgment

Probabilistic mental models provide a cognitive account:

search for a cue that provides a reason to select one over the other and stop if you find such a cue

Assumption: judgment based on a single cue

one-reason decision making

Fast and Frugal Heuristics

rooted in the idea of people being satisficers

See: http://www.youtube.com/watch?v=PIsNt_7sah4

Recognition Heuristic

Which has the larger population:

- A) Bonn or B) Heidelberg ?

Recognition Heuristic

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Recognition Heuristic

Which has the larger population:

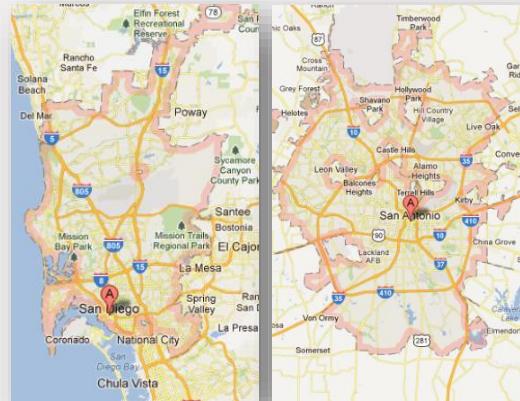
- A) San Diego or B) San Antonio ?

Recognition Heuristic

Which has the larger population:

Bonn or Heidelberg ?

San Diego or San Antonio ?



Recognition Heuristic: take the one you recognize

One reason decision making

Many other cues are available to make this judgment:

Capital? Soccer team? University? Airport?

Simple Heuristics

Cues differ in their ecological validity versus discriminability.

Other heuristics than Recognition:

Take The Best:

select the most valid cue, until you find a discriminating cue

Take The Last:

select the cue that worked last time

Minimalist:

select a cue at random

Table 2.1. Cues, ecological validities, and discrimination rates for deciding which of two German cities has the largest population

Cue	Ecological validity	Discrimination rate
National capital (Is the city the national capital?)	1.00	.02
Exposition site (Was the city once an exposition site?)	.91	.25
Soccer team (Does the city have a team in the major league?)	.87	.30
Intercity train (Is the city on the Intercity line?)	.78	.38
State capital (Is the city a state capital?)	.77	.30
Licence plate (Is the abbreviation only one letter long?)	.75	.34
University (Is the city home to a university?)	.71	.51
Industrial belt (Is the city in the industrial belt?)	.56	.30
East Germany (Was the city formerly in East Germany?)	.51	.27

Source: Gigerenzer & Goldstein, 1996.

Take The Best

First part: recognition

then search for best reason, based on cue validity

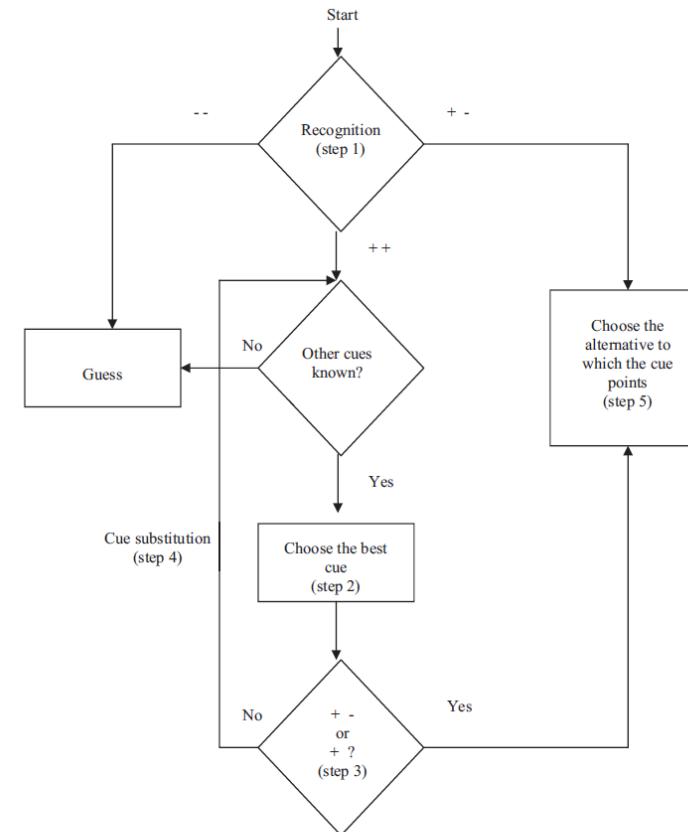


Figure 1. Flow diagram for the Take The Best heuristic. Adapted from "Reasoning the Fast and Frugal Way: Models of Bounded Reality," by G. Gigerenzer and D. G. Goldstein, 1996, *Psychological Review*, 103, p. 653. Copyright 1996 by the American Psychological Association.

Evidence for these heuristics

Many of the heuristics tested by simulations

they seem to be coming close in performance to linear regression models (but require much less cues)

When training and test sets are different, heuristics sometimes outperform linear regression

Richter and Späth (2006) gave information about the presence of an airport (and noted this is a cue for size)

Unrecognized city was chosen much more often when the recognized city was known not to have an airport

Not just recognition but use of other cues!



Expert Intuition

Chapter 22, Kahneman

Thinking and Deciding

Adversarial Collaboration

Klein and Kahneman

What type of expert intuition can we trust?

Klein (Naturalistic DM): Biases are not the right way to study real decisions.

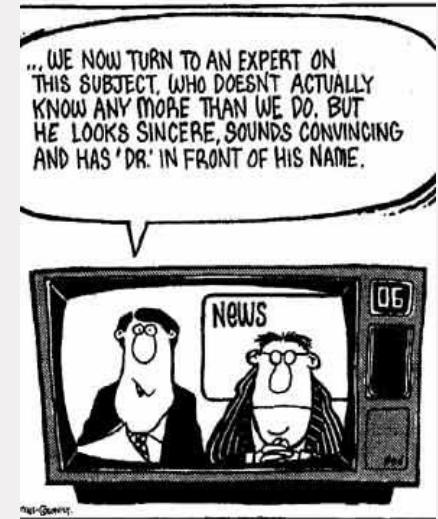
Expert decision making is often very skilled and adequate

For example, fire fighters use simple recognition strategies to understand dangerous situations

Recognition-based priming decisions

System 1 come up with a tentative plan

System 2 mentally checks its workings



Conclusions

Klein and Kahneman have different experts in mind: Klein's experts are professionals that worked in more predictable, skill-based situations

Two basic conditions for acquiring skill

- An environment that is **sufficiently regular**
- An opportunity to learn regularities through **practice**

Applies to many domains (Chess, poker, nursing) but not to domains in which experts try to make long term predictions based on low correlations... (i.e. the many examples in ch. 19-21)

Overconfidence (chapter 24)



Confidence Intervals

Provide a high and low guess such that you are 90% sure your answer is within these two bounds

Do not be overconfident or under-confident:

Statistically this means you would have (on average) 10% wrong...

For this Quiz you thus would miss only one item...

Quiz Answers

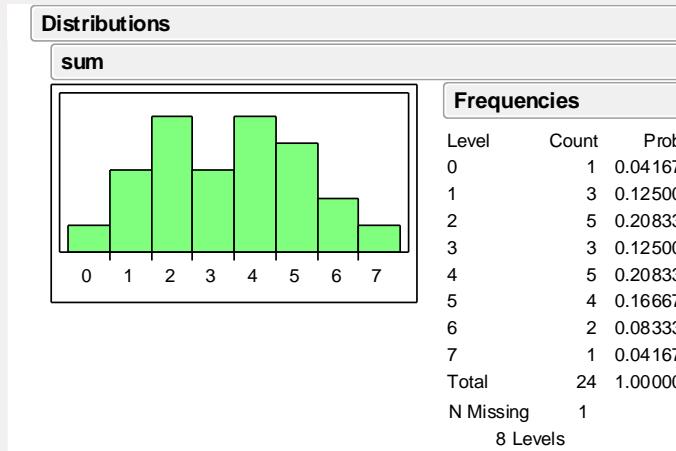
1. Total number of German casualties in World War I
2. Number of stone blocks used in the largest of the Egyptian Pyramids
3. Number of Americans declared MIA in WWII
4. Seating Capacity in the Coliseum of Rome
5. Total number of Popes, starting with St. Peter and ending with Benedict XVI
6. Number of people who died in the sinking of the Titanic
7. San Marino, located in Europe, is the oldest republic in the world. How many years has it retained its status as a republic?
8. Year first successful kidney transplant took place
9. New Zealand became the first country to give women the right to vote. What year did this take place?
10. Fidel Castro made the longest speech in the history of the United Nations. How long did this speech last?

Quiz Answers

1. Total number of German casualties in World War I	7,142,558
2. Number of stone blocks used in the largest of the Egyptian Pyramids	2,300,000
3. Number of Americans declared MIA in WWII	78,751
4. Seating Capacity in the Coliseum of Rome	50,000
5. Total number of Popes, starting with St. Peter and ending with Benedict XVI	265
6. Number of people who died in the sinking of the Titanic	1,513
7. San Marino, located in Europe, is the oldest republic in the world. How many years has it retained its status as a republic?	301 after Chr
8. Year first successful kidney transplant took place	1954
9. New Zealand became the first country to give women the right to vote. What year did this take place?	1893
10. Fidel Castro made the longest speech in the history of the United Nations. How long did this speech last?	4 hrs 29 min

Results from a previous year

Number of items within the 90% interval:



No one gets 9 out of 10!

Your intervals are too narrow...

Unrealistic optimism

Weinstein (1980):

Students rated themselves as 15% more likely than others to experience positive events and 20% less likely to experience negative events.

some examples:

42% more likely to receive good starting salary

58% less likely to develop a drinking problem



Kahneman: Optimistic Bias

Kahnemans' explanation

Are you a good driver?

Easy to answer: most say yes

Are you better than average as a driver?

Hard to answer: what is the average?

just replace with the answer to the first question ☺...

This makes us ignore the skills of others!



Reasons / Causes for overconfidence

Overconfidence and the confirmation bias

Confirmation bias: Tendency to seek evidence in favor of a prior belief (as opposed to evidence against it)

Skill, egocentrism and illusion of control

New business owners: 81% prob. of success for themselves, 59% prob. of success for others

- reality: 2/3 fail within a year, 80% in 10 years

Starting a new restaurant when 6 owners already failed

More skill, more control, results in more overconfidence

competition neglect: I can do better than my competitors

Partial remedy: Premortem

How can we overcome overconfidence?

Hard because system 1 tends to preserve the coherence of the story rather than look at the supporting evidence...

Gary Klein: Premortem: close to a final decision you should write a brief history about what happened while imagining a year in the future and the decision led to a disaster!

- Overcomes groupthink
- Allows knowledgeable individuals to share their important opinions...



0HV60 Thinking and Deciding

Lecture 10: Using General Knowledge (Matlin chapter 8)

Martijn Willemsen

Knowledge

Jan went into a restaurant and ordered a hamburger. When the hamburger arrived Jan stormed out of the restaurant angrily, without paying.

Think of the inferences you can make here!

Knowledge

Jan went into a restaurant and ordered a hamburger. When the hamburger arrived Jan stormed out of the restaurant angrily, without paying.

Think of the inferences you can make here!

- What do you know about Jan / The burger/ The restaurant?
- Did he sit down at a table?
- Did he drink a beer?
- Did he eat the hamburger?
- Did he tip?

Knowledge

Semantic memory

Is our **organized knowledge** about the world

Knowledge



Knowledge



Knowledge



Knowledge



Knowledge



Knowledge

What is conceptual knowledge?

concepts are the bodies of knowledge that are stored in long-term memory
and

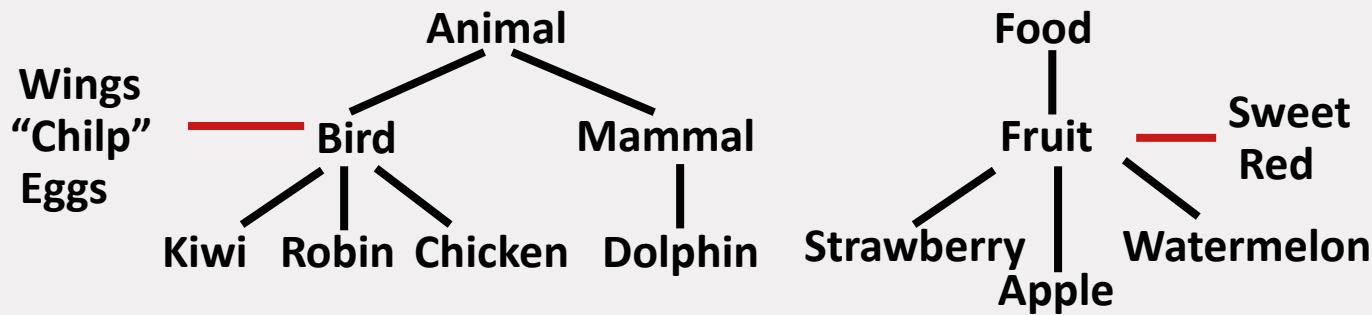
that are used by our cognitive processes when we categorize, make inductions, understand languages, draw analogies, etc.

Matlin: Concept is a mental representation of a category (i.e., set of objects belonging together)

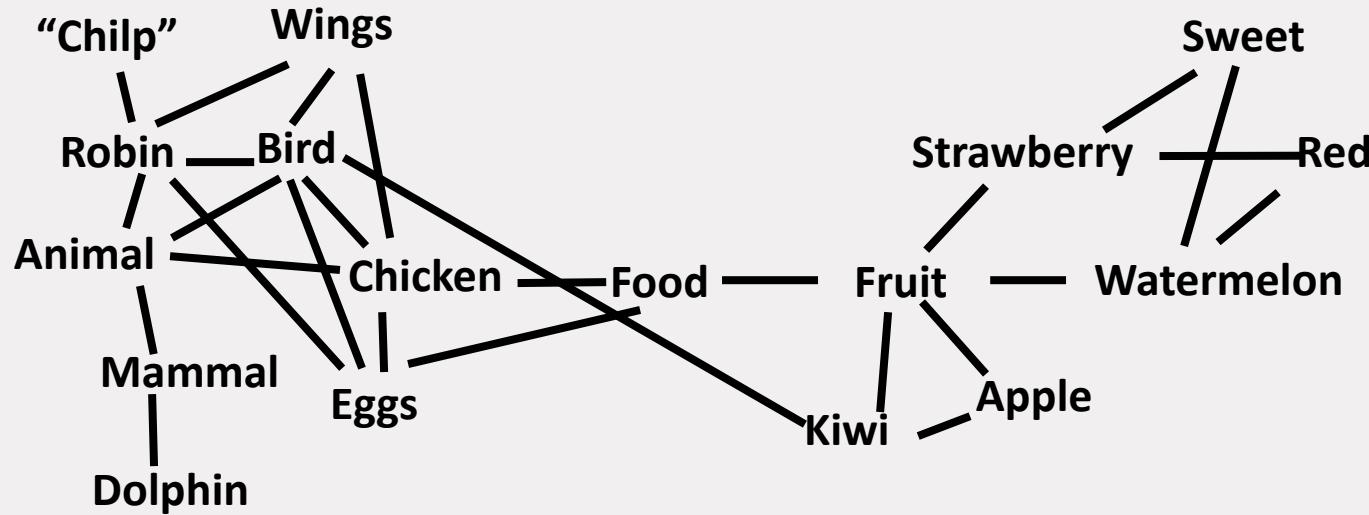
Knowledge: organization



Knowledge: hierarchy



Knowledge: network



The underlying knowledge structure that we use as a model (e.g. categories, networks) defines/describes how we store knowledge and how it's being used in behavior

Outline of this lecture:

Category membership models

Feature comparison

Prototype

Exemplar

Relational models

Network models: but PDP-> connectionism

Schema about events

Structure captures general information about routine events

Category membership models

Classical View: Features based model

Concepts are stored in memory according to a list of features



Furry

4 legs

Brings newspaper

Barks

...

Classical View: Features based model

Concepts are stored in memory according to a list of necessary features



Defining features:

- Attributes necessary to the meaning of the object (e.g. living, fur)

Characteristic Features:

- Attributes that are descriptive but are not essential (e.g. Bring newspaper)

Classical View: Features based model



Classical View: Features based model



Classical View: Features based model



Bachelor ??

Unmarried

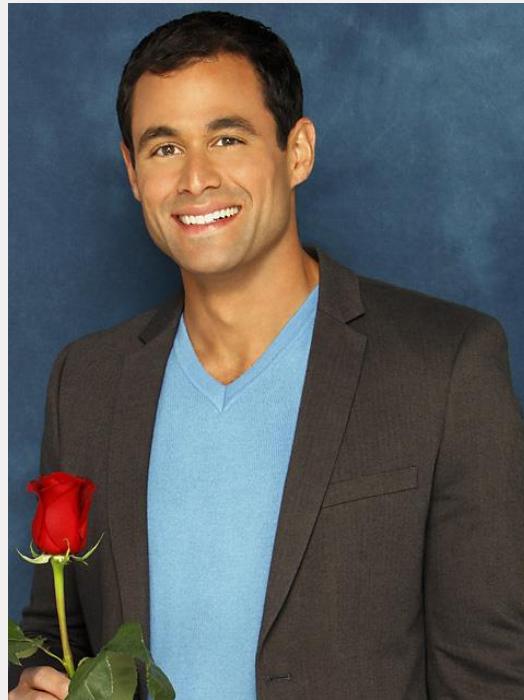
Male man

→ Adult male

Classical View: Features based model

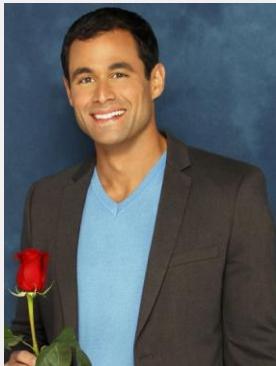


Classical View: Features based model



Classical View: Defining Features

Typicality effect



People reach decision faster when an item
is a typical member of a category

Classical View: Defining Features

Problems :

Few concepts can be captured by a specific list of features

- Imagine robin that cannot fly without red breast, etc

Assumption that individual features are independent (but many are not)

- Leaves -> no fur
- Leg -> fur

Does not explain how members of categories are related to one other

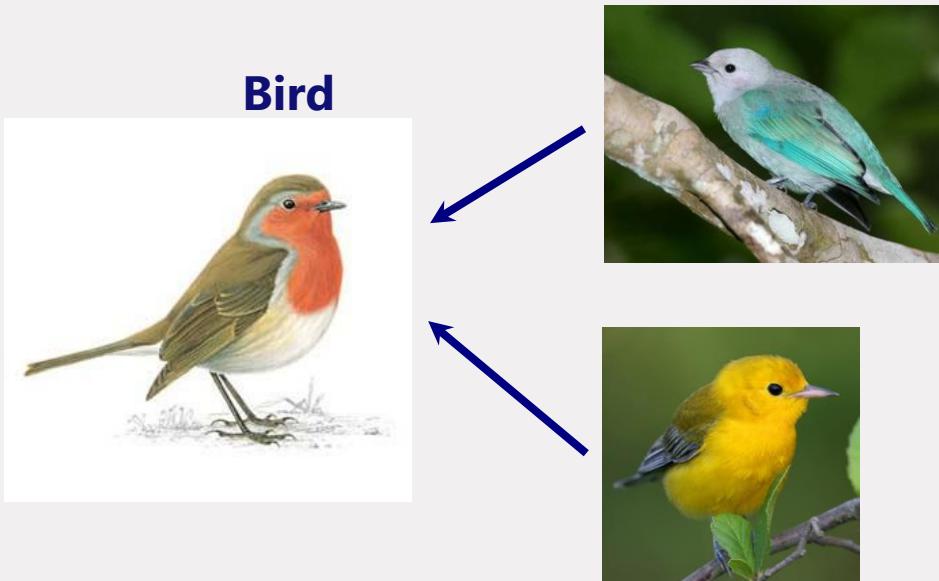
Prototype Theory

Abstract and idealized example

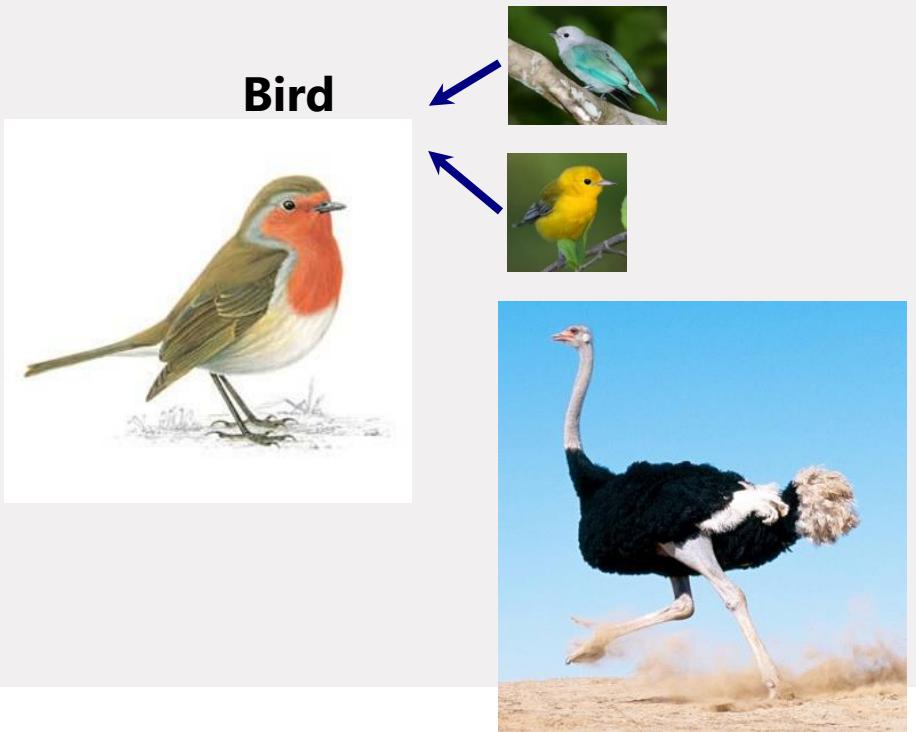
Characteristic features which describe what members of that concept are like



Prototype Theory



Prototype Theory



Typicality effect

Bachelor



More prototypical



Prototype Theory

Graded Structure :

Members of a category are not equal

Some birds are better prototypes than others

Classified as belonging to a category if sufficiently similar to prototype:

but what is 'similar'?

Number of features shared?

Prototype Theory: Characteristics of prototypes

Prototypes are supplied as examples of categories (Mervis, 1976).

Group 1 : Examples of categories such as “birds”, “fruit” and “sport”

Group 2 : Provide prototype rating for each of the examples

Items that were rated most prototypical were same items that people had supplied most often category examples

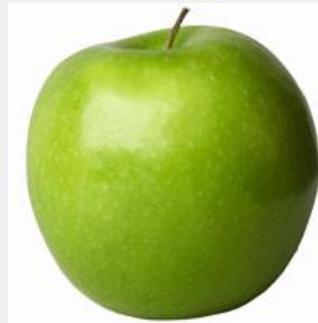
Typicality effect can also be explained by this!

Prototype Theory: Characteristics of prototypes

Prototypes are judged faster after semantic priming

Semantic priming :

Fruit



Animal

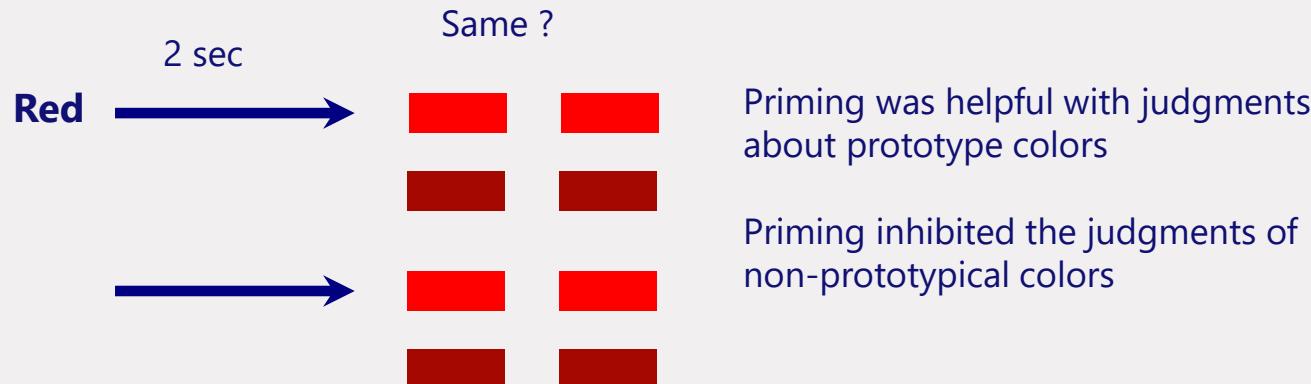


Semantic priming: helps us to understand how we retrieve information from memory!

Prototype Theory: Characteristics of prototypes

Prototypes are judged faster after semantic priming

- Priming facilitates responses to prototypes more than to non-prototypes
- Color pair judgment task: are the two colors the same?



Prototype Theory

Family resemblance

Not a single attribute is shared by all examples of a concept, but each has at least one in common with another

Most prototypical items had the largest number of attributes in common

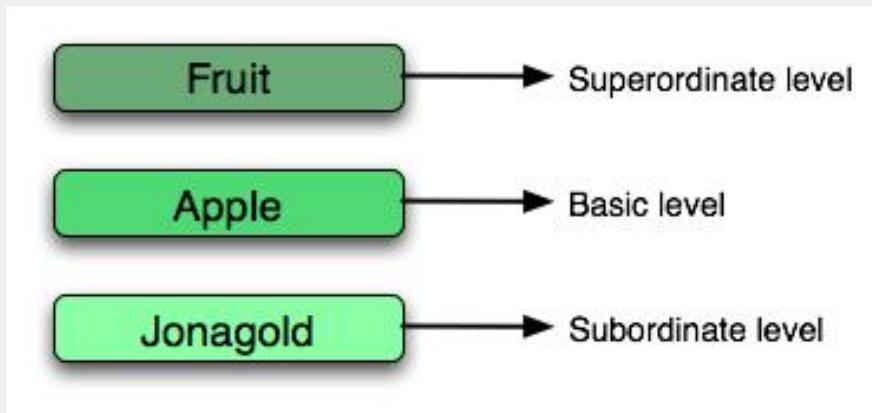
Prototype Ratings for Words in Three Categories.

Item	Vehicle	Vegetable	Clothing
1	Car	Peas	Pants
2	Truck	Carrots	Shirt
3	Bus	String beans	Dress
4	Motorcycle	Spinach	Skirt
5	Train	Broccoli	Jacket
6	Trolley car	Asparagus	Coat
7	Bicycle	Corn	Sweater
8	Airplane	Cauliflower	Underwear
9	Boat	Brussels sprouts	Socks
10	Tractor	Lettuce	Pajamas
11	Cart	Beets	Bathing suit
12	Wheelchair	Tomato	Shoes

Source: Rosch & Mervis, 1975.

Prototype Theory : levels of categorization

Organizing of concepts



Prototype Theory : levels of categorization

People almost exclusively use basic-level names in free-naming tasks

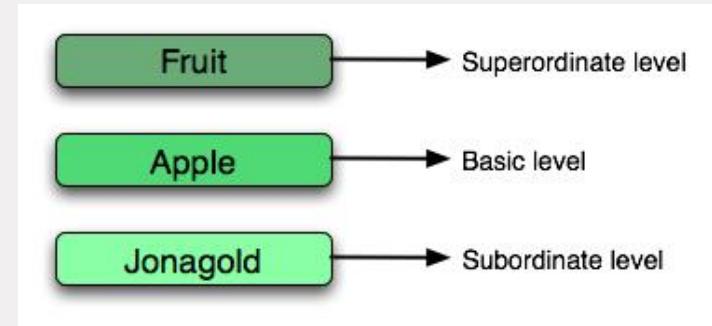
Children learn basic-level concepts sooner than other levels

Basic-level is much more common in adult discourse than names for superordinate categories

Different levels: activate different parts of the brain when asked to judge whether words match a picture.

Superordinate: more prefrontal (language)
Subordinate: more parietal (visual)

Organizing of concepts



Prototype Theory : levels of categorization

Basic level names are more likely to produce the priming effect

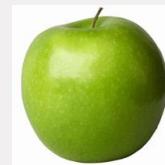
fruit

apple

Jonagold



Same ?



Conclusions Prototype Theory

Advantages:

loosely structured, broadly applicable

Also for complex social relationships and other non-object like concepts

Problems :

Concepts can be unstable (Context effects)

Sometimes we do store specific information about individual examples

("Applying prototype approach to social relationships": has been dropped in 9th ed)

Exemplar View

No single prototype (idealized representation) but rather multiple examples convey idea what the concept represents

The more similar a specific exemplar is to a known category member, the faster it will be categorized

Dog exemplars



Exemplar View

Structure of superordinate category animal

Group A: Examples for each basic level categories
(assess frequency)

Group B: Rate typicality with respect to the
"Animal" category

Group C: Rate 7 categories in terms of how typical
for superordinate "animal"

Is it possible to determine a equation that predicts
the typicality of the rating of the 7 categories (C)
from A and B ?

Information about frequency and typicality predicts which of the 7 categories were most typical $r = +.92$

Leaving out less typical (not relevant for prototype) reduced the fit of the model strongly

Exemplars and Typicality

A. For the first part of this demonstration, take out a sheet of paper and write the numbers 1 through 7 in a column. Then, next to the appropriate number, write the first example that comes to mind for each of the following categories:

1. amphibian
2. bird
3. fish
4. insect
5. mammal
6. microorganism
7. reptile

B. For the second part of the demonstration, look at each of the items you wrote on the sheet of paper. Rate how typical each item is for the category "animal." Use a scale where 1 = not at all typical, and 10 = very typical. For example, if you wrote *barracuda* on the list, supply a number between 1 and 10 to indicate the extent to which *barracuda* is typical of an animal.

C. For the final part of this demonstration, rate each of the seven categories in Part A in terms of how typical each category is for the superordinate category "animal." Use the same rating scale as in Part B.

Exemplar View

Similar to Prototype View

Representation is not a definition

Different: Representation is not abstract (idealized)

Descriptions of specific examples

To categorize, compare to stored examples

Problem:

Our memory would become full

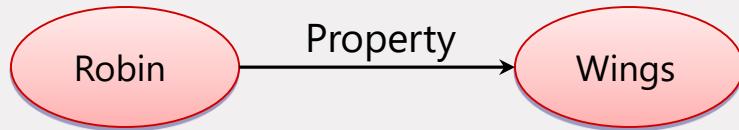
Exemplar works well for smaller categories

Network models

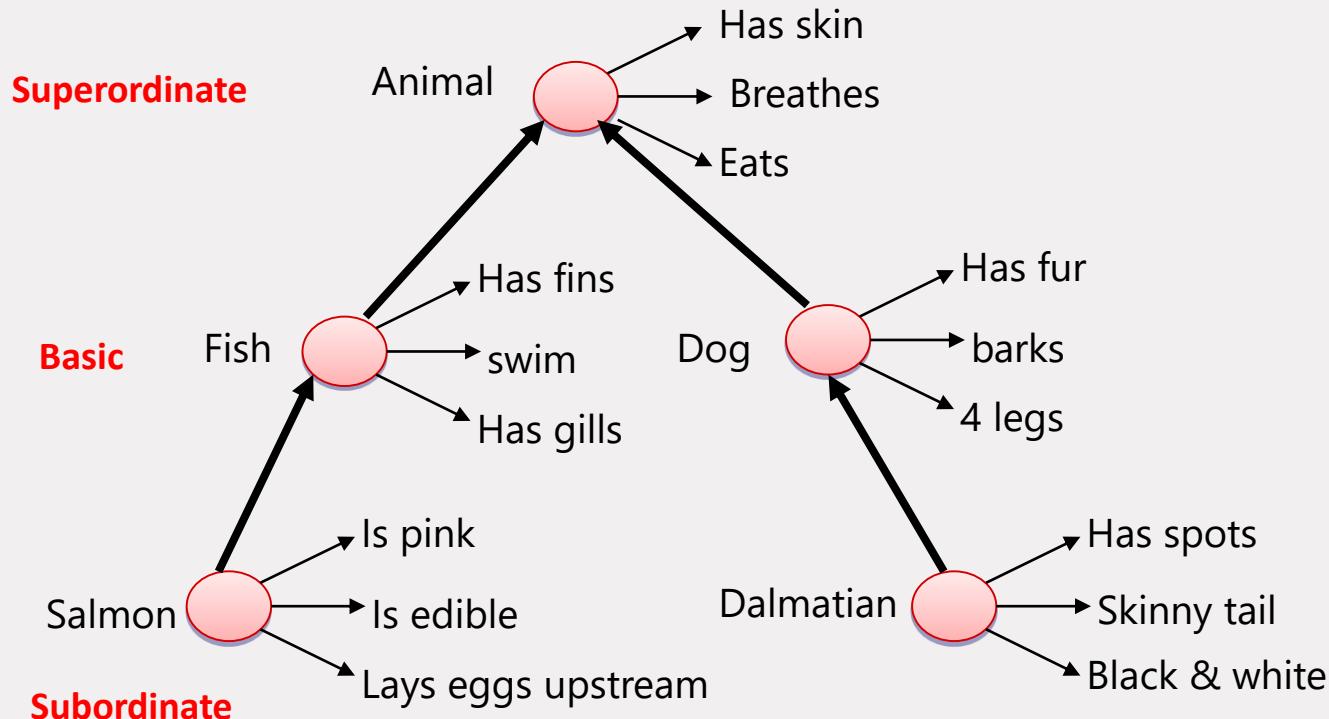
Semantic Network Model

Nodes represent concepts in memory

Relations represented links among sets of nodes



Collins & Quillian's Model (1969)



Collins & Quillian's Model (1969)

Structure is hierarchical

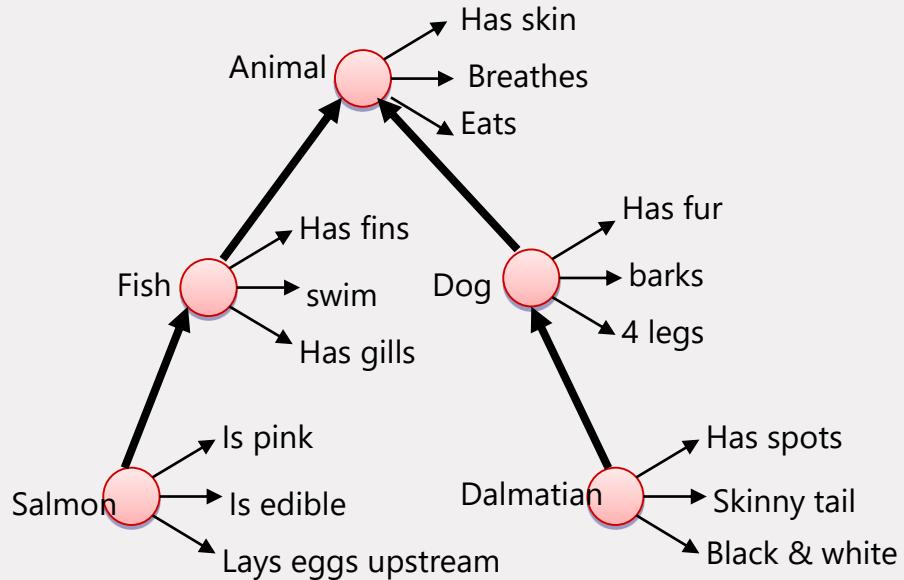
Time to retrieve information
based on number of links

Cognitive economy

Properties stored only at
highest possible level

Inheritance

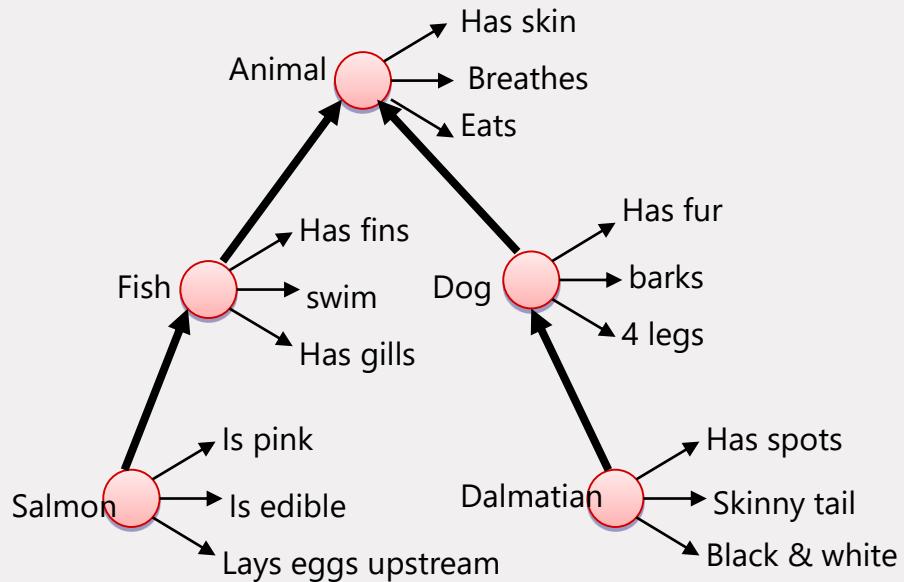
Lower-level items also share properties of higher level items



Support for Collins & Quillian Model

Sentence verification task

- Salmon are pink.
- Animals breathe.
- A dog has four legs.
- A dalmatian has skin.



The more links traveled according to model,
the longer the reaction time of truth verification

Collins & Loftus (1975) Semantic Model

Problems with Collin & Quillan

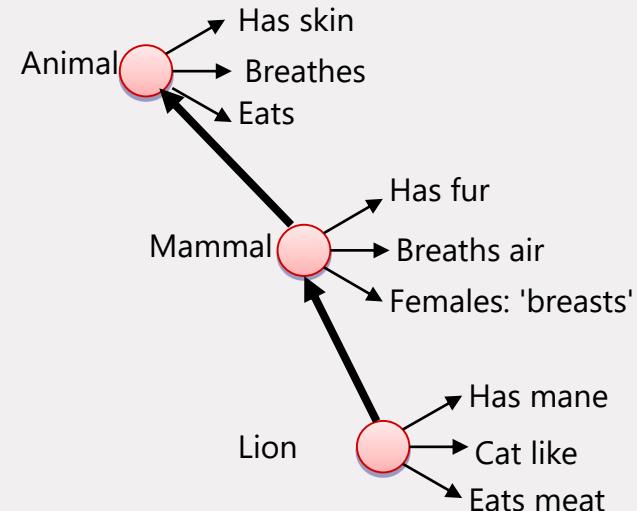
- Anomalies: "Lion is a mammal"
- takes longer than "lion is an animal"

Newer models:

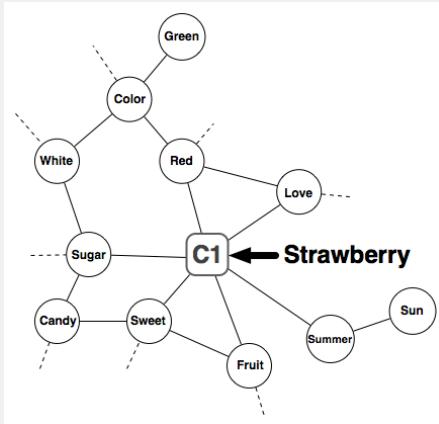
- Got rid of hierarchy
- Allowed links to vary in length to account for typicality effects

Spreading activation

- Activation is the arousal level of a node
- Spreads down links
- Used to extract information from network



Semantic network without hierarchy



Word Association experiments



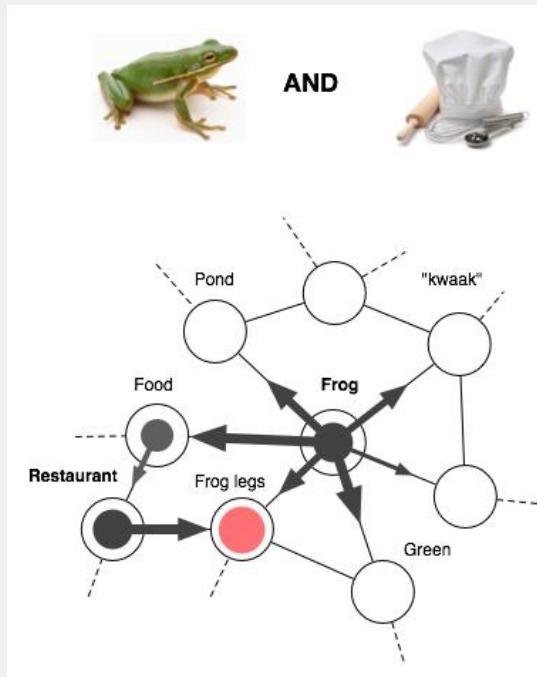
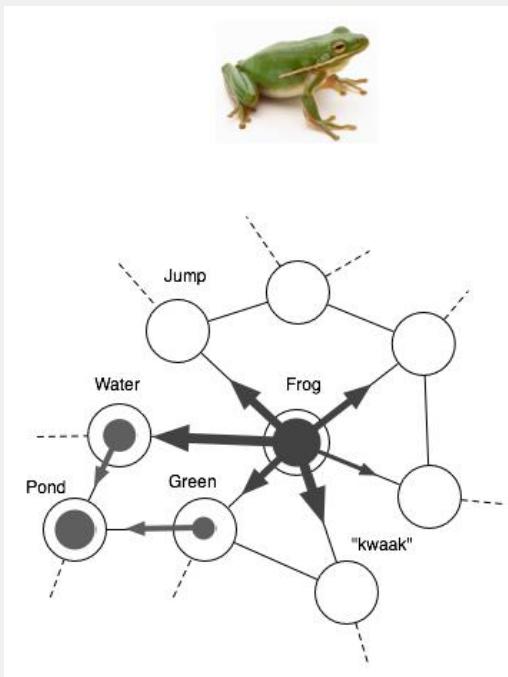
p1 : Red, Love

p2 : Fruit, sweet

p3 : Summer

Semantic network without hierarchy

Retrieval : Spreading of activation



Properties in semantic networks

Semantic networks can represent simple properties:

“is a” or “has a”

How to model/represent more complex relationships, such as:

“the cat chased the mouse”?

ACT-R model uses propositional semantic network

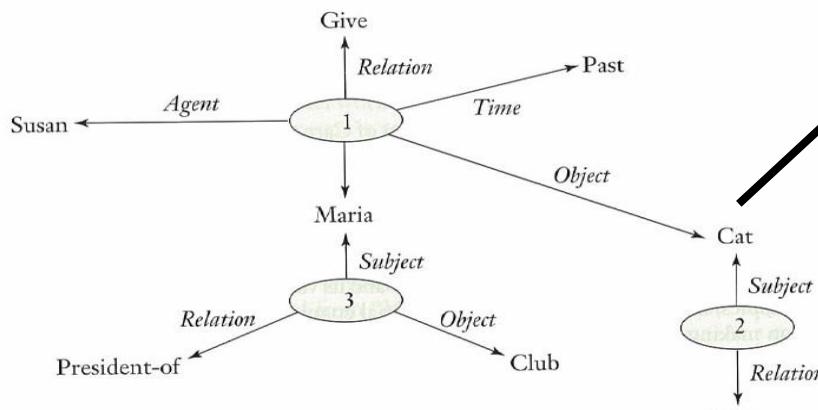
Agent, object and relation links

ACT-R (Adaptive Control of Thought – Rational)

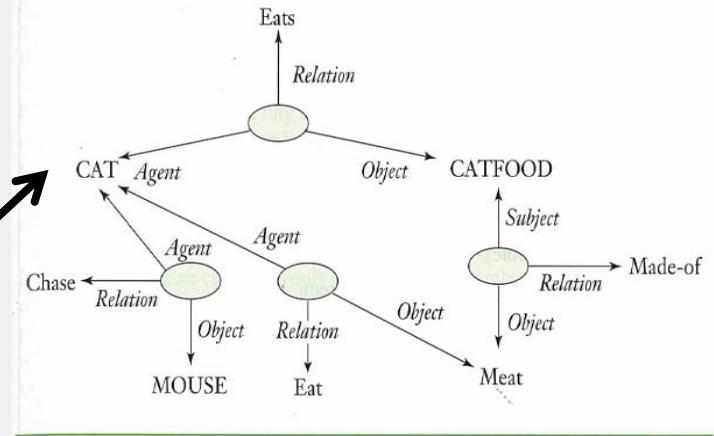
ACT-R models large parts of cognition

Meaning of sentence: **propositional network**
Proposition is smallest unit of knowledge

A Propositional Network Representing the Sentence “Susan gave a white cat to Maria, who is the president of the club.”



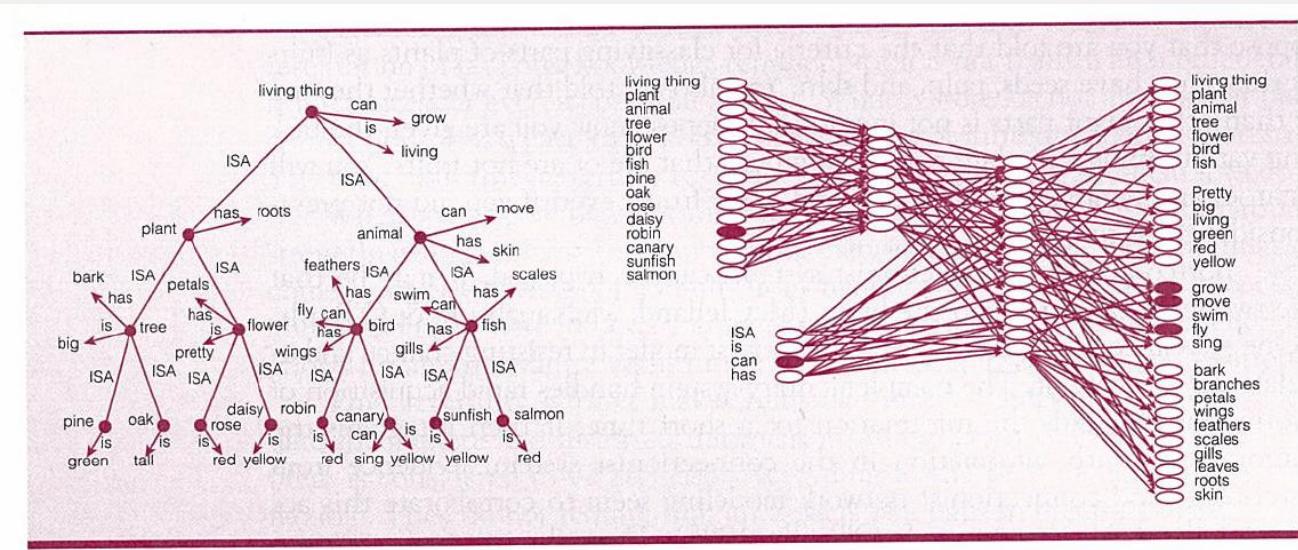
A Partial Representation of the Word Cat in Memory.



Each concept again has its own network!

Differences with semantic networks

Network model
(nodes represent)



Parallel distributed
(connections represent)

Retrieving information

Memory representations using a connectionist network

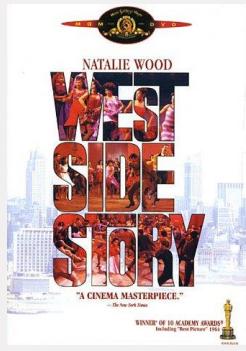
Content addressability

Easy access to memory using cues

Standard list like memory has problems (needs index or sequential search and is hard to build error-free)

Memory is a network of properties (units) with inhibitory activations to other memories!

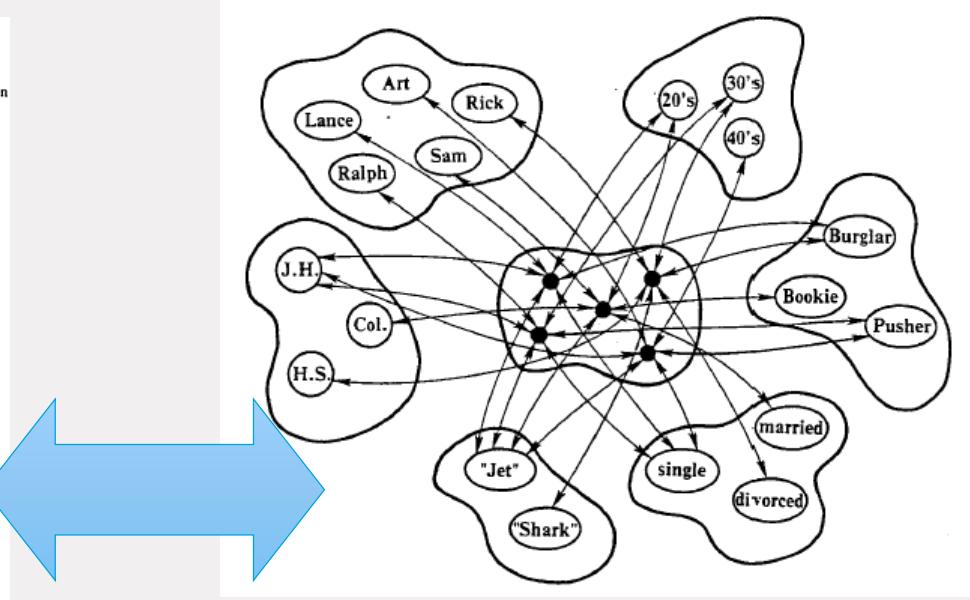
Warning: Matlin (fig. 8.3) forgets to mention that the units within each ‘cloud’ inhibit each other!



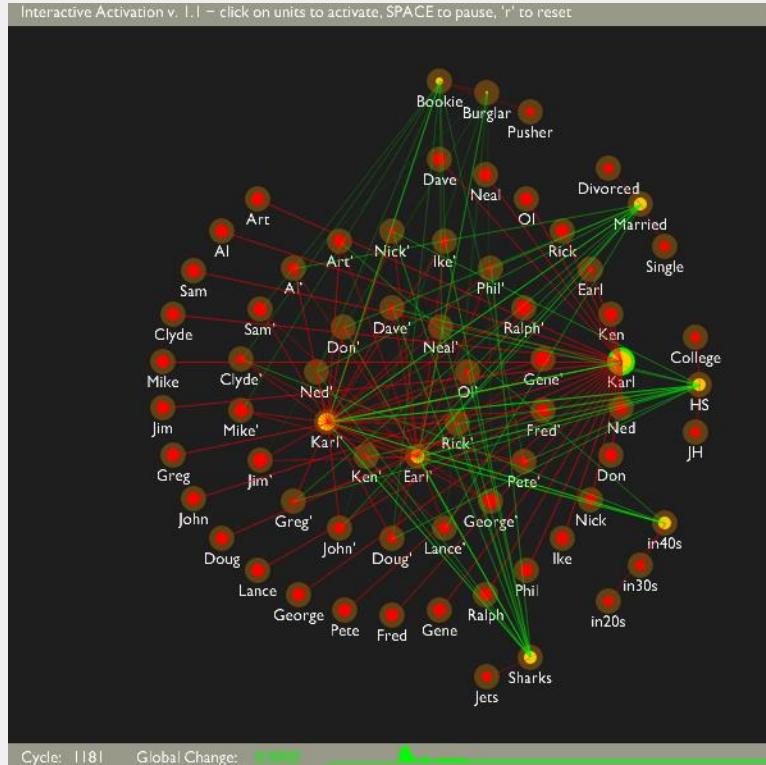
Jets and sharks model



The Jets and The Sharks					
Name	Gang	Age	Edu	Mar	Occupation
Art	Jets	40's	J.H.	Sing.	Pusher
Al	Jets	30's	J.H.	Mar.	Burglar
Sam	Jets	20's	COL.	Sing.	Bookie
Clyde	Jets	40's	J.H.	Sing.	Bookie
Mike	Jets	30's	J.H.	Sing.	Bookie
Jim	Jets	20's	J.H.	Div.	Burglar
Greg	Jets	20's	H.S.	Mar.	Pusher
John	Jets	20's	J.H.	Mar.	Burglar
Doug	Jets	30's	H.S.	Sing.	Bookie
Lance	Jets	20's	J.H.	Mar.	Burglar
George	Jets	20's	J.H.	Div.	Burglar
Pete	Jets	20's	H.S.	Sing.	Bookie
Fred	Jets	20's	H.S.	Sing.	Pusher
Gene	Jets	20's	COL.	Sing.	Pusher
Ralph	Jets	30's	J.H.	Sing.	Pusher
Phil	Sharks	30's	COL.	Mar.	Pusher
Ike	Sharks	30's	J.H.	Sing.	Bookie
Nick	Sharks	30's	H.S.	Sing.	Pusher
Don	Sharks	30's	COL.	Mar.	Burglar
Ned	Sharks	30's	COL.	Mar.	Bookie
Karl	Sharks	40's	H.S.	Mar.	Bookie
Ken	Sharks	20's	H.S.	Sing.	Burglar
Earl	Sharks	40's	H.S.	Mar.	Burglar
Rich	Sharks	30's	H.S.	Div.	Burglar
Ol	Sharks	30's	COL.	Mar.	Pusher
Neal	Sharks	30's	H.S.	Sing.	Bookie
Dave	Sharks	30's	H.S.	Div.	Pusher



IAC model



<http://axc.ulb.be/>

Properties (and demo)

Content addressability

Graceful Degradation / Robust for noise

Incomplete or wrong cues are not disastrous and can even be corrected!

Default assignment

Filling in plausible defaults for things we do not know

Spontaneous Generalization

What are single gang members like?

Schemas

Mental framework
for organizing
knowledge



Meaningful structure of related
concepts underlying situations, events,
or sequences of actions

Models of the external
world based on past
experience

Abstraction that allows particular
objects or events to be assigned to
general categories

Schemas

Organize our knowledge

May include other schemas

Schema for animals includes a schema for cow, ape and so on.

Help in encoding, storage, and recall

Typical general facts that can vary slightly between instances (all mammals have fur but some more than others)

Often include information on relationships (concept and context: fish in the ocean)

Can vary in degree of abstraction (justice versus apple)

Allows us to make inferences

Who is the mother of that crying child?

Scripts

Type of schema about events

Structure captures general information about routine events

Eating in a restaurant, attending a movie, visiting a doctor's office

Scripts have typical roles

(Customers, waiter, cook), (ticket vendor, patrons, refreshments), (doctor, nurse, patient)

Life script: list of events most important throughout life time. (having children/ school/ marriage /death /jobs)

Remember the picture



Schema Research

Memory: Schema consistent

Waiting room

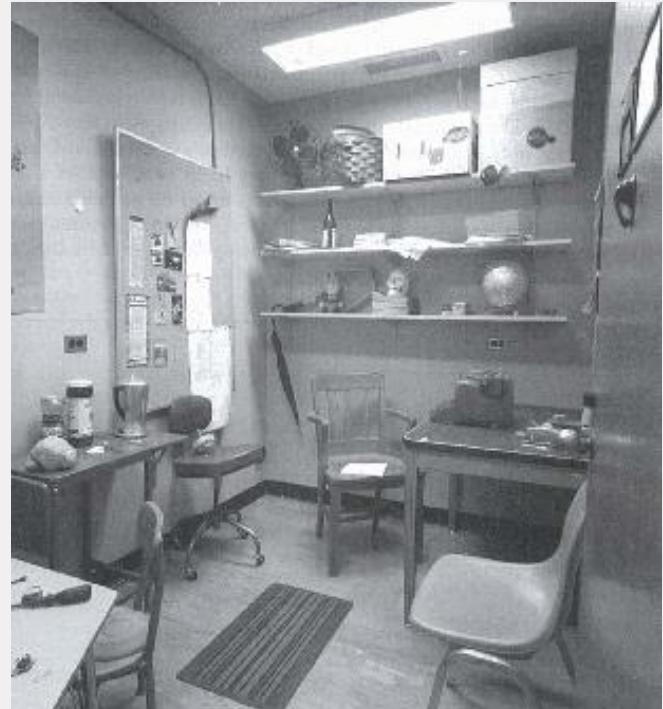
- Office
- 35 sec

What is being remembered?

Recall objects consistent with “office schema”

Less recall of inconsistent items

Remembered objects not in the office (e.g. books)



Schema Research

Memory: Schema inconsistent



Now draw the remembered picture



Memory Abstraction

Try to remember this little fact:

Many people think that Napoleon was small, but he was actually of average height. The misconception here was caused because the French foot was larger than the English foot.

Memory Abstraction

Now try to remember this Limerick:

Jack and Jill went up the hill

And planned to do some kissing

Jack made a pass,

and grabbed her ass

Now two of his teeth are missing.

Memory Abstraction

It is difficult to remember the exact words

We abstract

Remember only the general message

Unless all words in a sentence are important

Like in case of a Rhyme

Why?

So it will fit better in our general schemas

Memory Abstraction

Many people think that napoleon was small, but he was actually of average height. The misconception here was caused because the French foot was larger than the English foot.

Jack and Jill went up the hill
And planned to do some kissing
Jack made a pass,
and grabbed her ass
Now two of his teeth are missing.

Memory integration

Placing the memory in context of the schema

This is where it goes wrong

You add things that fit the schema

You forget things that do not fit the schema

You merge memories/knowledge

Bartlett: recall of a story shaped to expectations / viewpoint of the students

Gender stereotypes: stereotypes influence recall

Implicit tasks: The nurse prepared himself for the operation: increase in brain activation

IAT: faster for stereotypical pairs: female – art, male – math.



OHV60 Thinking and Deciding

Tutorial: Connectionism

Martijn Willemsen

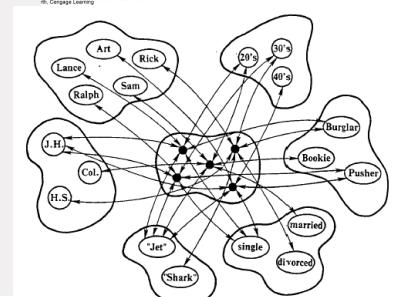
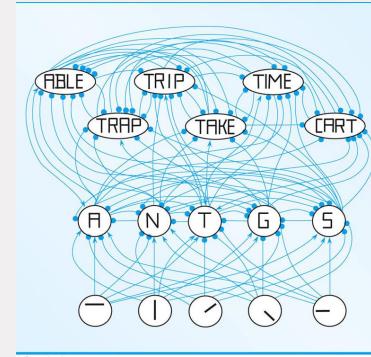
Topics

Matlin 9th ed: The connectionist approach (p. 18-19), Top down processing and reading: (p. 53-56)

Interactive Activation models by McClelland and Rumelhart (1981)

A connectionist model of letter perception in context (p 53-56)

A connectionist model of semantic memory (p. 288-294)
(done in lecture)

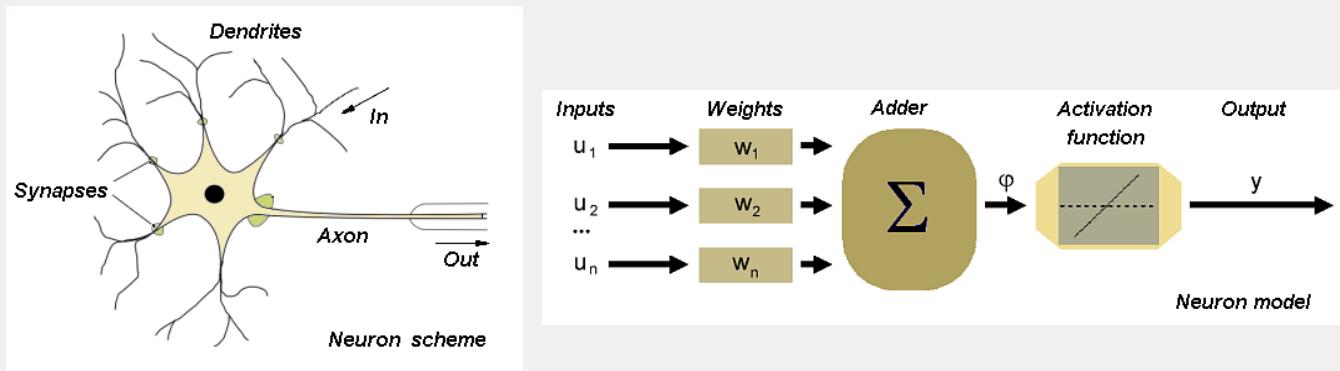


Parallel Distributed Processing

Neurological plausibility

Neurons can be inactive, excitatory and inhibitory

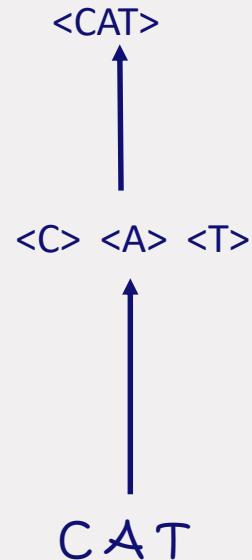
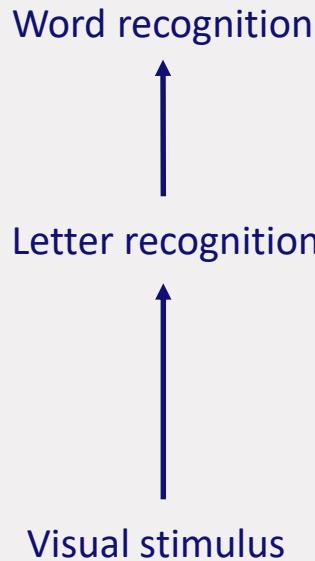
Patterns of activation represent cognitive processes



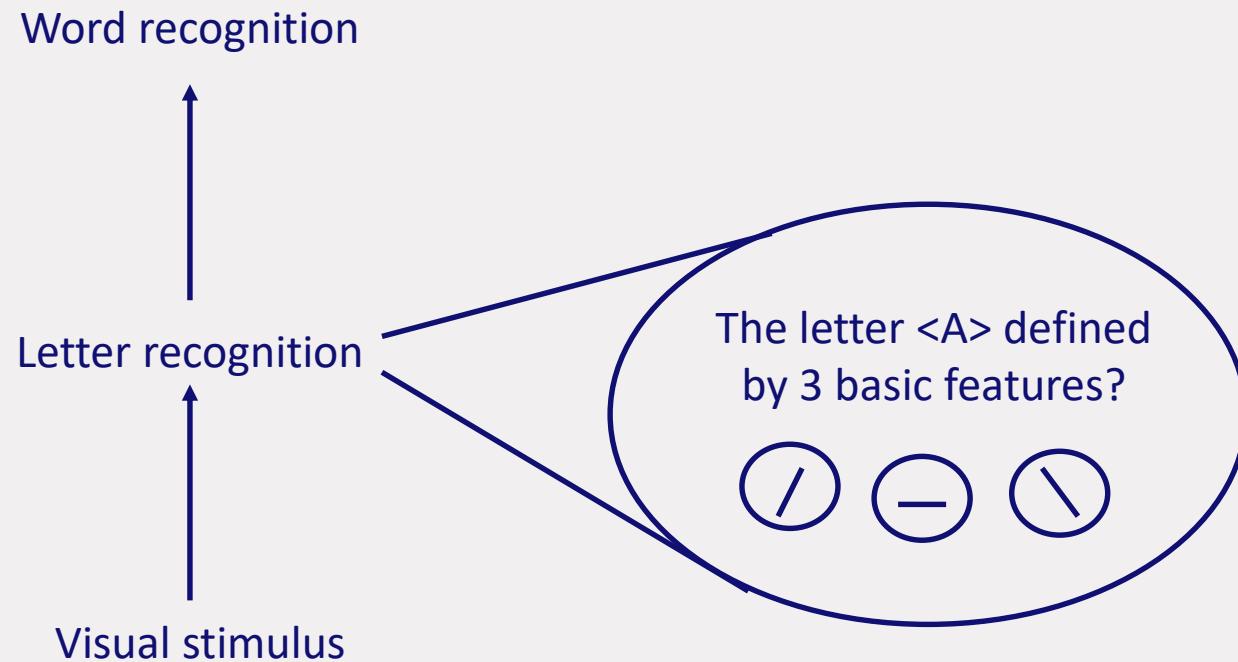
Serial processing versus parallel processing

Local versus distributed representations

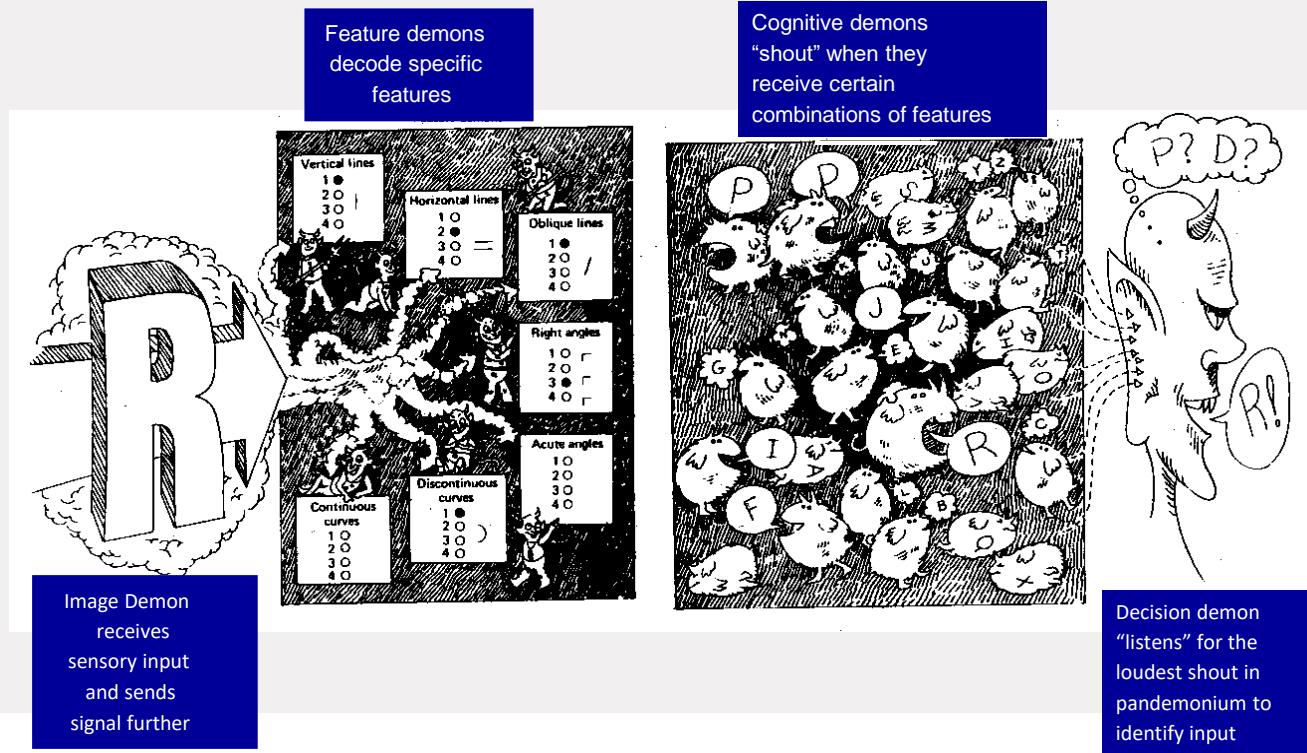
Lexical Access: Word recognition



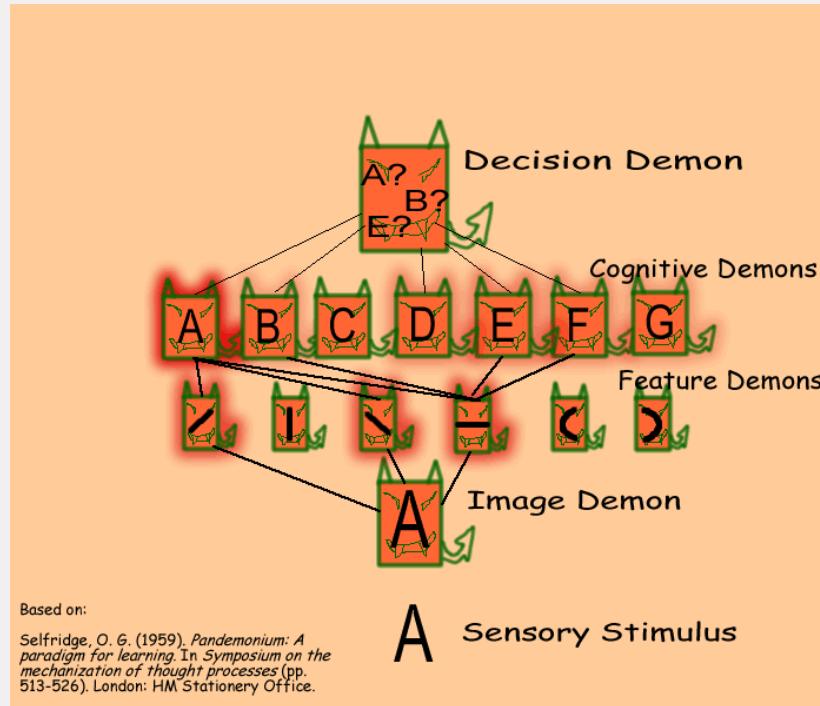
Word recognition



Pandemonium model of letter recognition (Selfridge, 1959)



Selfridge's Model (cont.)



Evaluation of Pandemonium model

Pandemonium model is a bottom-up model

Hence, it cannot account for the top-down effects:

- Letter identity is context-dependent
- Degraded letter correction
- Word superiority effect

Top-down effects in letter recognition

THE CAT

Top-down effects in letter recognition



Top-down effects in letter recognition

R E B
S R O T
E I S H
D E B T

Top-down effects in word recognition

Aoccdrnig to a rscheearch at Cmabrigde Uinervtisy, it deosn't mttaer in waht oredr the ltteers in a wrod are, the olny iprmoatnt tihng is taht the frist and lsat ltteer be at the rghit pclae. The rset can be a toatl mses and you can stil raed it wouthit porbelm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe.

But see:

<http://www.mrc-cbu.cam.ac.uk/people/matt.davis/Cmabrigde/>

A more detailed look

“it deosn't mttaer in waht oredr the ltteers in a wrod are, the olny iprmoatnt tihng is taht the frist and lsat ltteer be at the rghit pclae”

This is not true, try:

A dootcr has aimttded the magltheuansr of a tageene ceacnr pintaet who deid aetfr a hatospil durg blendur

A doctor has admitted the manslaughter of a teenage cancer patient who died after a hospital drug blunder.

A more detailed look

“the rset can be a toatl mses and you can sitll raed it wouthit porbelm...”

“the rest can be a total mess and you can still read it without problem”

What makes it so easy to read this:

- Short words don't change at all, and function words (the be) don't change therefore. Preserves the structure
- Of 15 words, 8 have the correct order
- Transpositions of adjacent letters are easier (porbelm vs pborlem)
- No new words occur due to the scrambling and/or the transpositions retain the sound of the words
- The text is predictable

A more detailed look

Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe.

This is basically correct:

Whole word approach (direct access, ch. 9)

Shape of the word plays and important role (CaSe MiXiNg is problematic ☺) and the transpositions are not that dramatic that the shape is distorted completely

But we do also use individual letter information when reading quite a lot!

Demonstration

Based on Reicher (1969)

On the next several slides, a row of six letters will appear.

You will then see two letters, one above and one below a letter that appeared

Guess which of the two letters actually appeared in the appropriate location

XXXXXX

JBDVLM

----B-

XXXXXX

----L-

Top-down effects in letter recognition

Word superiority effect

Easier to detect a letter presented in a word than in a non-word: e.g. D or J in WORD versus ORWD

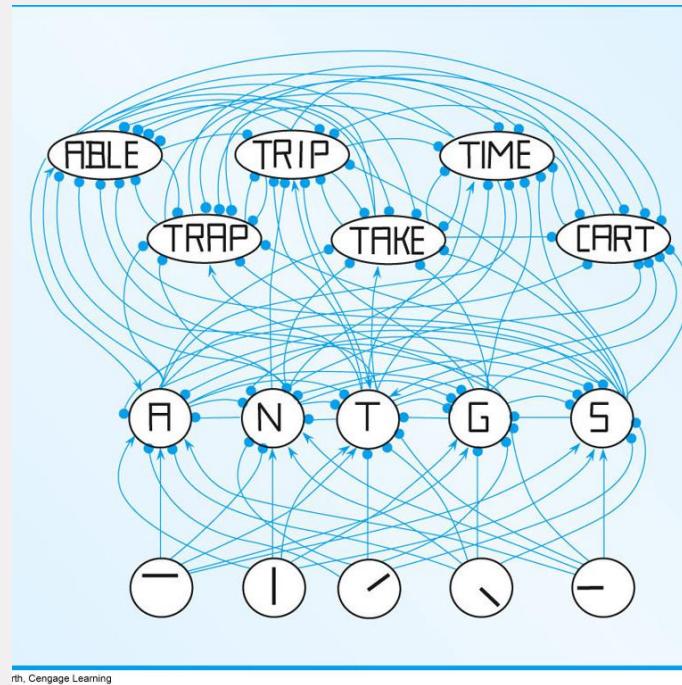
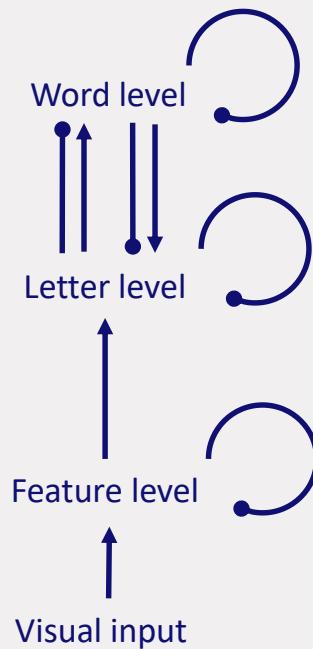
Even easier to detect a letter presented in a word than a letter presented alone: e.g. D or J in WORD versus D

Pseudo-word superiority effect

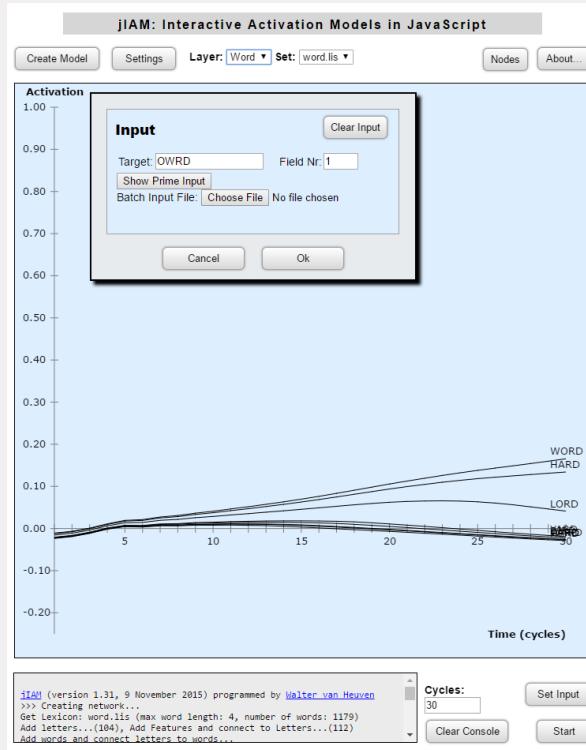
Easier to detect a letter presented in a pronounceable non-word than in an unpronounceable non-word:

e.g. easier to detect D (or reject J) in TORD than in ORTD

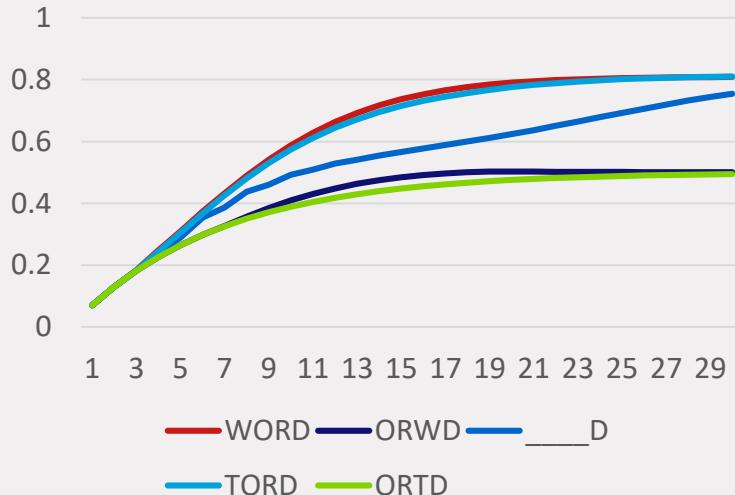
Interactive Activation Model



Word Superiority (more in the workshop)



Word Superiority effects for letter D (4th pos)



<http://www.psychology.nottingham.ac.uk/staff/wvh/jiam/startjiam.html>



OHV60 Thinking and Deciding

Lecture 10: Comprehending and producing Language (ch 9 & 10 Matlin)

Martijn Willemsen

Language

Organized way to combine words to communicate

- Written, spoken or signed

Language is unique to humans

A communication system that is learned instead of biologically inherited



Properties of Language

Communicative

Arbitrarily symbolic

Regularly structured

Structured at multiple levels

Generative

Dynamic



Communicative Property

Language is used to communicate

Communication has meaning

Ability to communicate thoughts and feelings is remarkable!

Failures of communication as an object of study



Arbitrarily Symbolic

No connection between symbol and concept

Flexible representation possible!

Words do not have to look or sound like what they describe

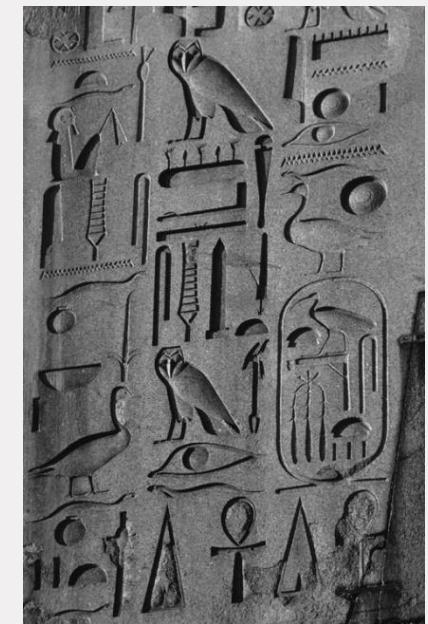
Principle of conventionality

Meanings of words are determined by conventions

Principle of contrast

Different words have different meanings

Strong differences between languages: Fiets, bicycle, fahrrad...



Generative Property of Language

Language is productive:

Using rules of language can create an unlimited number of new utterances

Language is creative

We are capable of producing entire new sentences we never heard

Chomsky posed this as one of the big problems for Behaviorism

Dynamic Nature of Language

Allows for new developments with the creation of new words and ideas

Blog

Online diary meant to be read by others

Spam has a new meaning

Weird meat in a can

Unwanted email

Shut Up! Has new meaning

One meaning is to quit talking

YouthSpeak for “Really?”

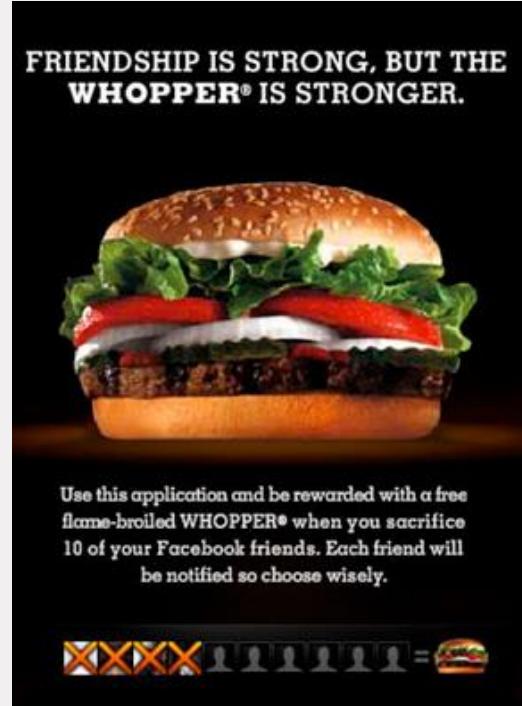


New words

English: De-friend

To remove someone from your Livejournal, MySpace, Facebook, or other social networking site. Doing this is often seen as a passive-aggressive move, telling the person without telling them that you no longer want to be friends...

"Yeah, so I had to defriend Charlie. He kept cluttering up my friendlist with stupid memes, and we haven't even communicated in a year. We'll probably never see each other again, so there's no point."



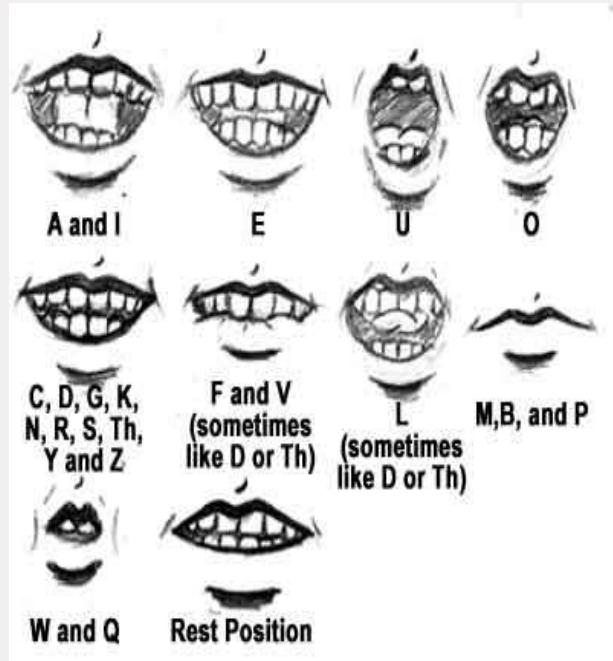
Structure of Language: Phonology

Phoneme

- Smallest unit of speech
- Sounds of language
- /s/ /f/ /t/ /l/ /ae/ represent the sounds common in English
- Different languages use different sets of phonemes

46 for English

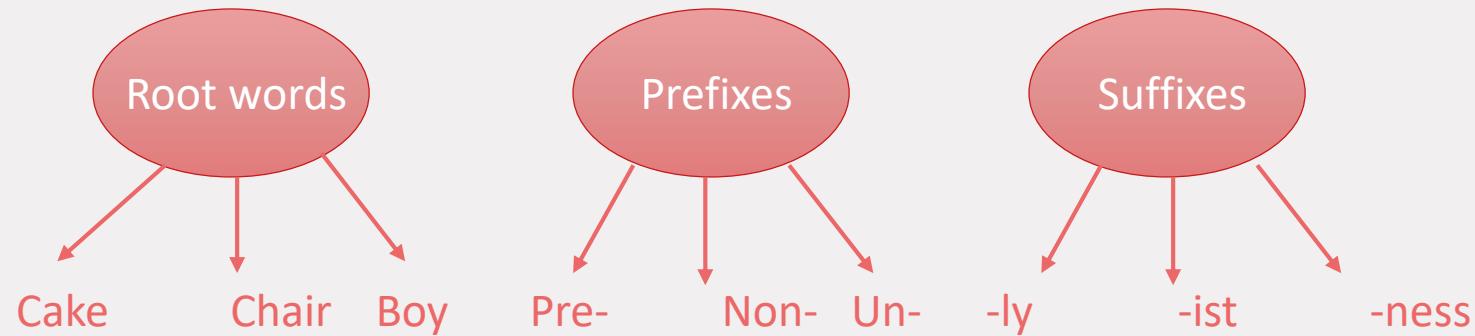
12 in Hawaiian and 147 in Xu (spoken near Kalahari desert)



Structure of language: Morphology

Study of word structure: Morpheme

- The smallest unit that denotes meaning
- Root words and affixes



Morphology

Content Morphemes

Word that conveys the core of the meaning (e.g., attractive, happy)

Function Morphemes

Add nuances to core meaning (e.g., unattractive, happiness)

Lexicon

Entire set of morphemes for a language

Adults: 80k morphemes in English

kids: grade 1: 10k, grade 5: 40k

Vocabulary expands due to new words created from combining existing morphemes

Structure of Language: Syntax

Rules used to put words together for a sentence

Sentence = Noun Phrase + Verb Phrase (constituents)

Noun phrase [NP]

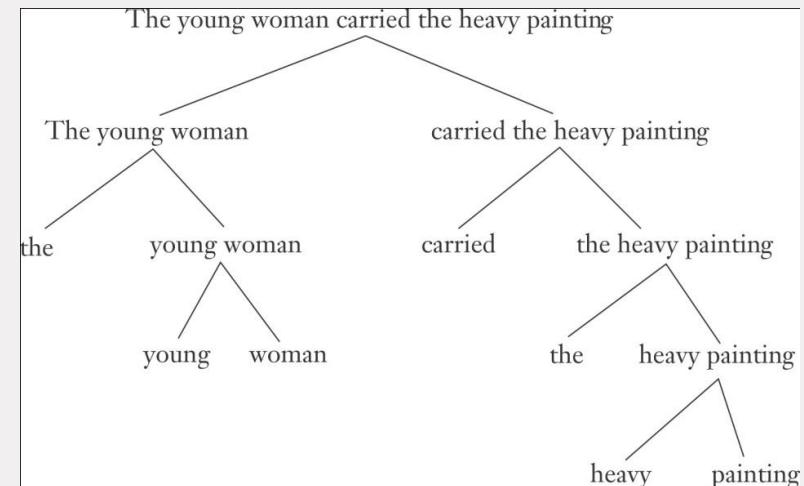
Contains a noun and relevant descriptors

Verb phrase [VP]

Contains at least one verb and possibly objects it acts upon

We need the **entire constituent** to denote its meaning:

to know painting is a noun not a verb!



Structure of Language: Semantics

The study of meaning in a language

To best understand semantics, read the following sentences:

The honest umbrella is in the garage.

Cindy slept badly due to the sniffling dream.

Knowing that the sentences do not make sense is your knowledge of semantics



Semantics

Denotation

Definition of the word

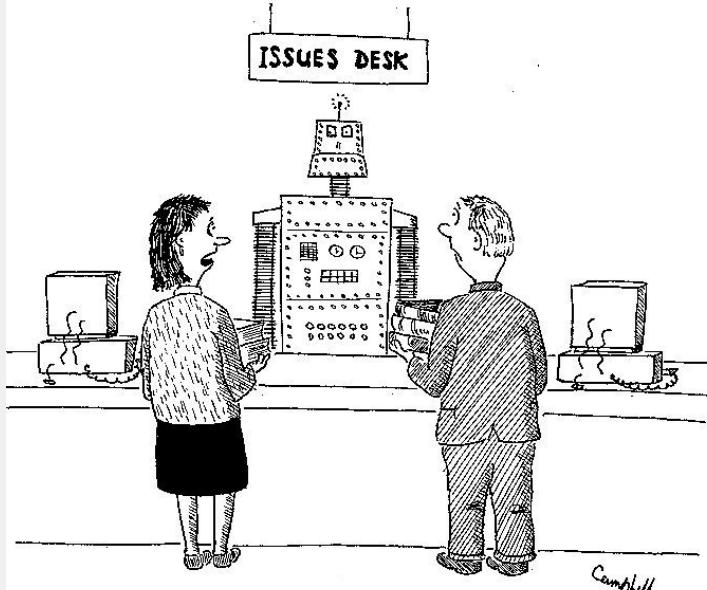
Connotation

Additional nuances of word meaning
(emotional, social, cultural)

Consider these examples

Bachelor, Spinster

Hungry, Starving



Personally, I think they went a step
too far in making the library electronic

The Nature of Language

A Caution: Psycholinguistics Is English-Centered

6,000-7,000 spoken languages

languages differ in terms of:

- the meaning of changes in pitch
- use of passive voice
- whether nouns have grammatical gender
- brain processing
- English is an outlier: simple grammar, difficult/irregular pronunciation

History: Chomsky

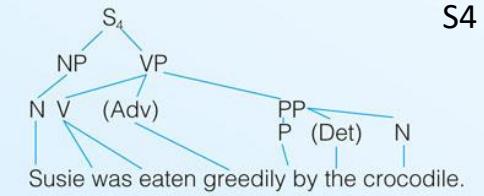
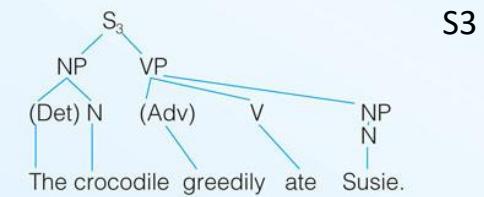
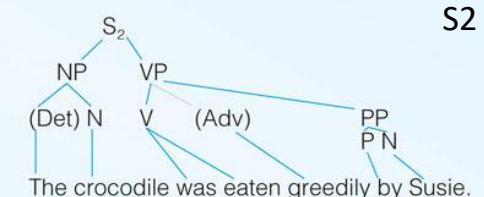
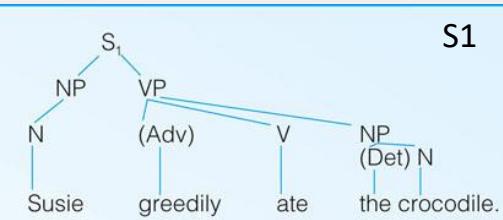
innate language skills: grammar separate from semantics: **Colorless green ideas sleep furiously**

language is modular
(language is special)

Not enough to look at structure within sentence, but also need to study syntactical relations between sentences

S1 & S2: same meaning (deep structure), different syntactical (surface) structure

S1~S3 / S2~S4: similar in structure, but not in meaning



Chomsky's Transformational Grammar

Grammar that explains how the underlying propositions can be rearranged to form multiple phrase structures

Deep Structure

- The structure of the sentence that conveys the connections between sentences

Surface Structure

- The actual phrase structures that may occur from transformations

Problems with Transformational Grammar

Not always relation between number of transformations and processing time. Universal patterns different for many non-EU languages

Current focus more on meaning and semantics (cognitive-functional approach, see demo 9.2)

Sentence Comprehension (more info than in version 8)

Negatives

negative statements require more processing time than affirmative statements
few people strongly deny that the world is not flat

The Passive Voice

active form of a sentence is easier to understand than the passive form
The paper was written by the student

Nested Structures: syntactic complexity

Incremental interpretation: we do not wait till the end of a sentence
can result in memory overload (working memory!)
process tracing studies showed that complex sentences take more time per word
The paper that the student that was sitting in the front row has written

Factors affecting comprehension

Lexical ambiguity

GRANDMOTHER OF EIGHT MAKES HOLE IN ONE

people pause longer when they are processing an ambiguous word

when people encounter a potential ambiguity, the activation builds up for all the well-known meanings of the ambiguous item

People are likely to choose one particular meaning

1. if that meaning is more common than the alternate meaning
2. if the rest of the sentence is consistent with that meaning

Pat took the money to the bank

Ambiguous Sentences:
wandering down the wrong path....

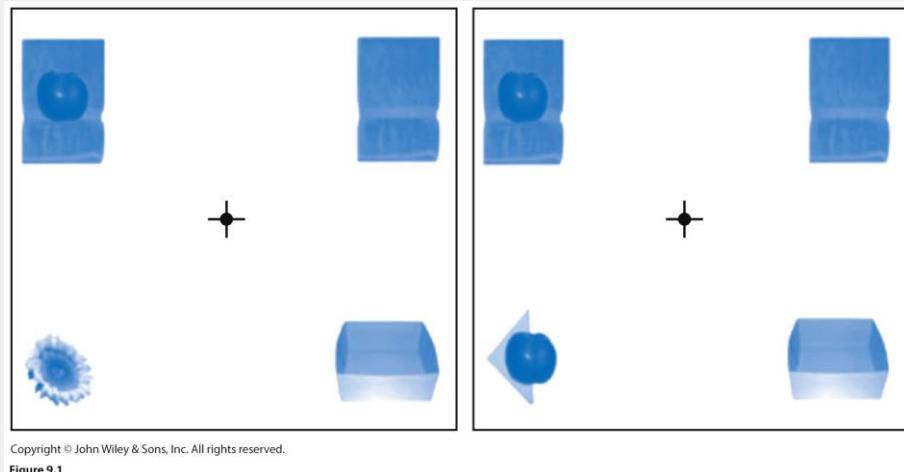


Syntactic Ambiguity (9th ed only)

Put the apple ...on the towel
....in the box

Eye-tracking study:

Different eye-tracking patterns for the two stimuli:
context dependency: early influence on grammar interpretation



look at apple and
empty towel, then box

Look at the two apples,
never at the towel

Neurolinguistics

fMRI and ERP studies

Initial work: Individuals with **Aphasia**

Broca's area/Broca's aphasia

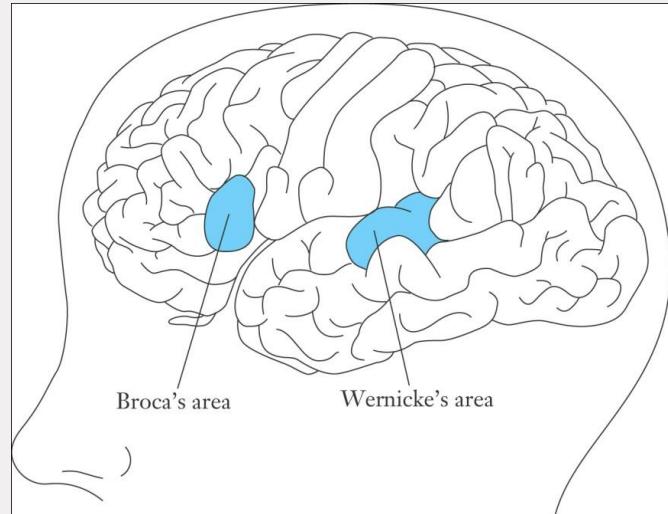
expressive-language deficit (motor movements)

<http://www.youtube.com/watch?v=1aplTvEQ6ew>

Wernicke's area/Wernicke's aphasia

receptive-language deficit

<http://www.youtube.com/watch?v=B-LD5jzXpLE>



both kinds of aphasia can decrease grammatical accuracy

(Wernicke: endings to nouns for non-English languages)

Broca's aphasia

revisiting the
research (9th ed):

**perhaps more
general cognitive
processes**
- executive attention
network (Stroop!)

Wernicke's aphasia:
Answering interview questions

Hemispheric specialization

Left hemisphere:

Does most of the work (highest neural activity)
Active in speed perception and interpretation

Right hemisphere:

Abstract processes: emotional tone, appreciating humor
Helping out with ambiguous sentences or subtle meanings

Sometimes I wake up grumpy
Other times I let him sleep in

Note: Not all people show dominant left hemisphere localization for language processes

Reading processes

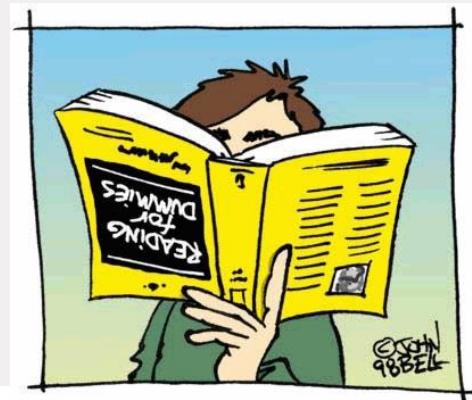
Reading requires virtually every cognitive process

Reading is remarkably efficient and accurate (200-300 words/minute)

Many challenges including (in English) irregular pronunciations due to lack of one-to-one correspondence between alphabet and speech sounds (phonemes)
(beauty, bread, clear, heard)

Context-dependent: meaning of unfamiliar words recognized from the context

Working memory is important when reading:
large span: better performance



Two pathways for reading words

How do we look at a pattern of letters and actually recognize that word?

Do we ‘sound out’ the words?

Dual-route approach to reading

skilled readers employ both a direct-access route (recognize word directly through vision) and an indirect-access route (recognize word by first sounding out the word)

Research on Dual-route

Direct access route:

Mown-down, horse-worse

read first word, pronounce second word

Sound of first word does not interfere with pronouncing second word

Indirect access route:

Lion-Bare, lion-bean

say if related or not: more errors if second word's pronunciation sounded like a related word (bare-bear) than if not (bean)

Dual Route compromise

Dual-route Approach: we tend to use both paths

Flexible

Characteristics of the reading material determine whether access is indirect or direct

Uncommon words use indirect access more often: Tong-twisters!

Characteristics of the reader also determine whether access is indirect or direct

individual differences: level of experience

Teaching reading: **whole word** approach versus **phonetic** approach

Understanding Discourse

Discourse: language units larger than a sentence

Frederick Bartlett's research (Chapter 8): recall of stories more consistent with a schema after long delay

theory of mind—In everyday life, people try to figure out the mental state of other people in their lives.

importance of context, general background knowledge, expertise, scripts, and schemas

make an inference during reading: draw on our world knowledge in order to activate information that is not explicitly stated in a written passage

Constructionist View of Inferences

Read a passage:

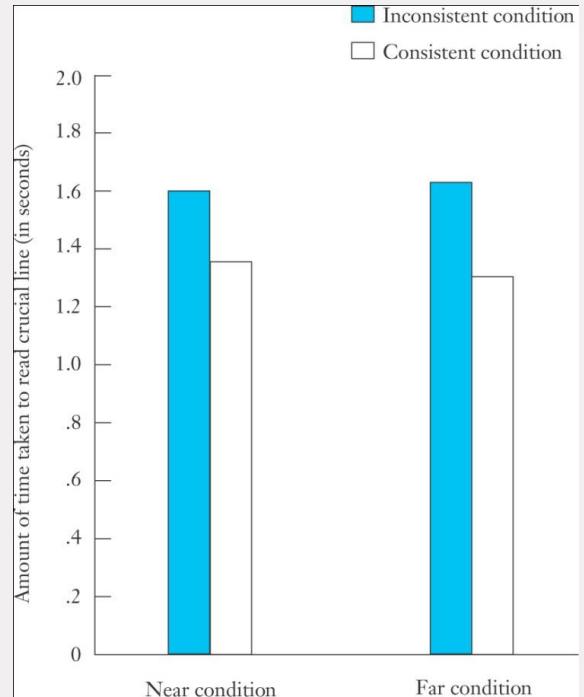
- Dick had a week's vacation due
- And he wanted to go to a place
- Where he could swim and sunbathe
- He bought a book on travel
- ...
- And asked for a plane ticket to Alaska

Draw inference on line 3:

Dick goes to the beaches

contradicted later in line 4 (near) or 8 (far)

Inconsistent information takes longer to process, even if presented later: try to construct consistent representation!



Latent semantic analysis (not in 9th edition anymore...)

LSA: Latent Semantic Analysis: similarity of two discourse segments

<http://lsa.colorado.edu/>

Can even be used to analyze texts and do some grading ☺ it can show which text is a more accurate summary of an original text...

but LSA ignores syntax and cannot handle negations...!

LSA Similarity	Term
1.00	scientist
0.84	scientists
0.79	scientific
0.77	experiments
0.77	observations
0.73	hypothesis
0.70	science
0.67	hypotheses
0.67	biologist
0.67	discoveries

Application: Thesis Simon Nouwens

Bachelorportal.eu

Enriching the buttons to be descriptive of what comes next if pressed, based on information foraging theory.

Using LSA and similar techniques to find the right subordinate and/or basic level terms from the text on the pages.

We find that basic level category info helps but subordinate not (too detailed...)

The screenshot shows a program details page for the "Academy Profession (AP) Environmental Management" at Business Academy Aarhus, Aarhus, Denmark. The page includes the following information:

- Program: Academy Profession (AP) Environmental Management
- Institution: Business Academy Aarhus | Aarhus, Denmark
- Start Date: Aug 2016
- Fees: EEA € 0 per year
- Duration: 2 Years (120 ECTS)
- Location: On campus
- Language: English (Take IELTS Test)
- Description: The AP degree programme in Agro Business and Landscape Management is divided into various study lines. The study line Environmental Management is taught in English.
- Buttons: "Add to comparison" and "Detailed Description"

A red callout box highlights the "Detailed Description" button, which is labeled "Details (Applied Mathematics, Data Processing)" and has an arrow pointing to it.

Chapter 10:

Producing Language

Speaking: Producing a word

Selecting a word from 75 000 candidates...

Grammatical, semantic, and phonological accuracy

Are all three kinds of information retrieved simultaneously or independently?

Van Turenhout and colleagues (1998):

- Name pictures: grammatical gender accessed about 40 milliseconds before phonological properties

Motor movements of vocal system and gestures

Frick-Horbury and Guttentag (1998)

- read definitions and identify word with or without hand movements restricted: 19 vs 24 words out of 50! (9th edition has a entire section on gestures)

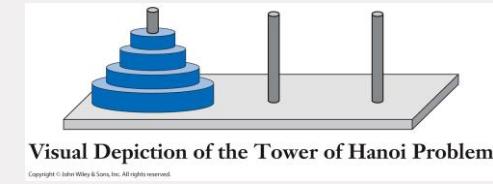
Eyes and looking before naming

Using gestures (embodied cognition, 9th ed.)

Cook and Tanenhaus (2009): **Tower of Hanoi puzzle**

Conditions of “real life” version (with heavy discs) vs. computerized version.
Participants then became teachers of the task.

- Teachers who lifted the heavy discs produced higher gestures than those who just had to slide the cursor across the screen.
- Learners taught by “real-life” teachers made higher and more arched movements while moving the discs around the computer display.



Embodied cognition

- People use their bodies to express their knowledge.
- ongoing connection between motor system and processing spoken language
- importance of concrete physical actions, rather than abstract meaning

Speaking: producing a sentence

Limits of attention and memory

Stages:

Planning the gist

Devise general structure of sentence

Choose specific words and grammatical form

Convert these intentions into speech

Linearization problem—transforming general thought or mental image into an ordered, linear sequence of words

We also need to plan the **Prosody** ("melody", rhythm, emphasis)

Slips of the Tongue / Speech Errors

Speech errors: we mean to say one thing, but utter another

Chipping the flannel

Flipping the channel

Box in the Jack

Jack in the box

Your model is renosed

Your nose is remodeled

Slips of the Tongue / Speech Errors

Errors seem to follow a structure and can be analyzed to assess what level of speech production was incorrect

Errors can occur at any stage of the speech production

Error analysis tell us how speech production is planned

Sound errors: Phoneme exchange

At the lead of spite: Speed of light

Go and shake a tower: Go and take a shower

Morpheme errors:

self-instruct destruction: self-destruct instruction

Word errors:

Your model is renosed: Your nose is remodeled

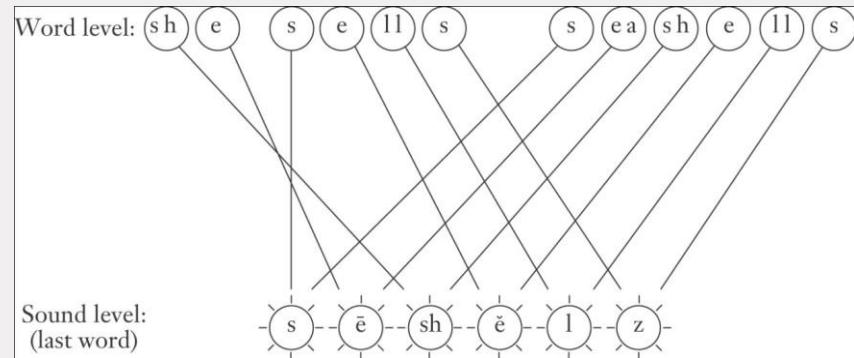
I have to fill up my gas with car: I have to fill up my car with gas

Speech errors

Dell's Model of Sound Processing in Sentence Production

similar to connectionist approach
spreading activation
planning activates sound elements

each sound can be activated by several different words
high activation can cause the incorrect sound to be produced



Producing Discourse

Discourse: language units larger than a sentence

Little research on this...

Narrative: type of discourse in which someone describes a series of actual or fictional events

time-related sequence

emotionally involving

goal to convey

words chosen carefully

entertaining

Social context of speech

Speakers must consider their conversation partners

- coordinating turn-taking
- agreed meanings
- intentions

Pragmatics: knowledge of the social rules that underlie language use; how speakers successfully communicate messages to their audience

common ground: occurs when conversationalists share similar background knowledge, schemas, and experiences necessary for mutual understanding

Directives: direct versus indirect request (speeding ticket example)

Framing: different meanings of the word responsibility (social vs. individual)

Common ground

Clark and Wilkes-Gibbs (1986)

pairs of participants arranging figures in order

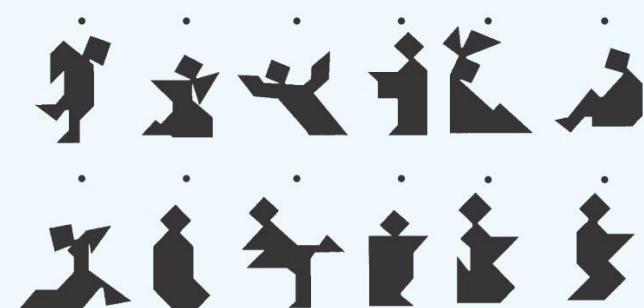
developing mutual shorthand and shared vocabulary

conversational partners become more skilled in communicating efficiently

6 rounds:

First round, 4 turns needed

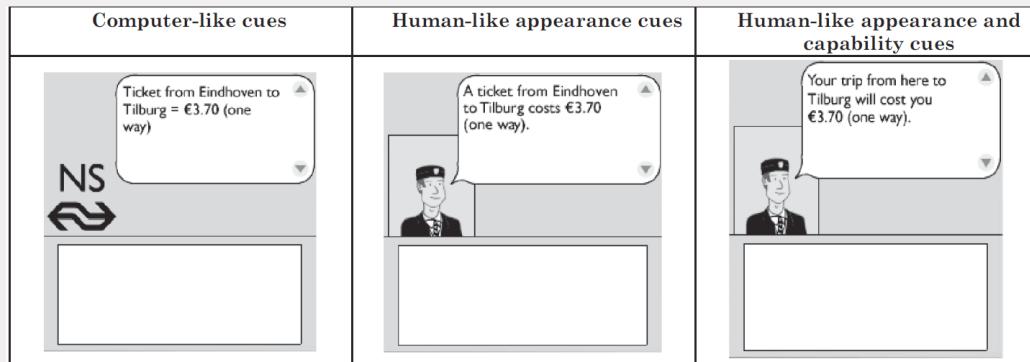
4th-6th round: only 1 turn...



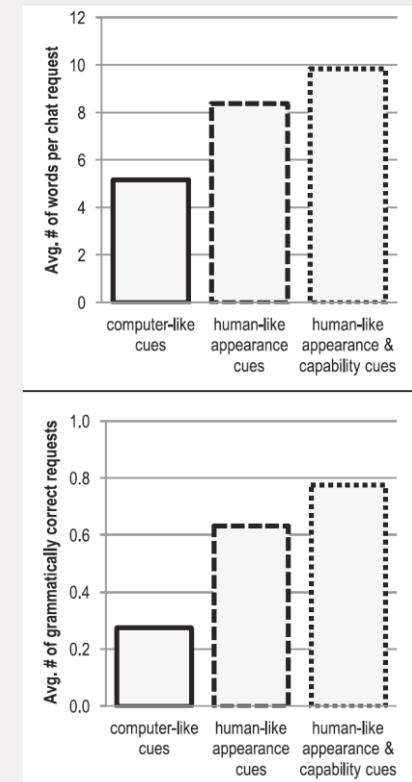
lexical entrainment: communicators adopt standard terms

Inferring capabilities from an intelligent agents' traits

What happens if an agent looks more intelligent than it actually is... It breaks as we expect the system to understand us more than it does...



•Knijnenburg, B.P., & Willemsen, M.C. (2016). Inferring Capabilities of Intelligent Agents from Their External Traits. ACM Transactions on Interactive Intelligent Systems (TiiS) vol. 6 (4), 1-25. [free access via ACM](#)



Writing

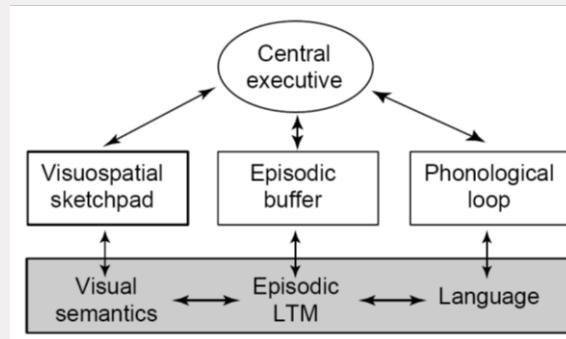
Writing requires virtually every cognitive process

One of the least understood linguistic tasks
Similarities and differences from speaking

A Cognitive Model of Writing working memory

- phonological loop
- visuospatial sketchpad
- central executive

long-term memory including semantic memory, expertise, schemas, and knowledge about specific writing style



Bilingualism

most people throughout the world have mastered two or more languages

bilingual speaker: a person who actively uses two different languages



Second language important in many countries:

Social-psychological factors predictive of success in acquiring a second language—motivation and attitude toward speakers of that language

Learning a language can also influence attitudes



Advantages of Bilingualism (list slightly diff. in 9th ed.)

1. Bilinguals actually acquire more **expertise** in their **native (first)** language.
2. Bilinguals are more aware that the **names** assigned to concepts are **arbitrary**.
3. Bilinguals excel at paying **selective attention** to relatively subtle aspects of a language task, ignoring more obvious linguistic characteristics.
4. Bilingual children are better at **following complicated instructions** and performing tasks where the instructions change from one trial to the next.
5. Bilinguals perform better in **nonverbal intelligence** and score higher on **problem-solving** tasks that require them to ignore irrelevant information.
6. Bilingual children score higher on **creativity**.
7. Bilingual children are more sensitive to some **pragmatic aspects** of language.

Advantages of Bilingualism

Bialystok (2001, 2002)—most advantages can be traced to selective-attention skills; inhibiting the most obvious response to produce an alternative response

Disadvantages far outweighed by advantages

Bilinguals seem to subtly alter their pronunciation
and might process language a bit slower

Second-Language Proficiency as a Function of Age of Acquisition

Phonology

age of acquisition does influence mastery of phonology
(sounds of speech): critical period?

Flege and coauthors (1999): Korean-Americans

- degree of accent inversely correlated with age of emigration
- fairly smooth decline rather than abrupt drop

http://www.ted.com/talks/lang/en/patricia_kuhl_the_linguistic_genius_of_babies.html

Vocabulary

when the measure of language proficiency is vocabulary, age of acquisition does not seem to be related to language skills

Simultaneous Interpreters and working memory

Translation: from a text written in one language into a second written language

Interpreting: the process of translating from a spoken message in one language into a second spoken language

- three working-memory tasks at the same time: comprehend, transform and speak out loud!
- At a rate of 100-200 words per minute...

Are these interpreters better in their working memory tasks?

Experiment on interpreters

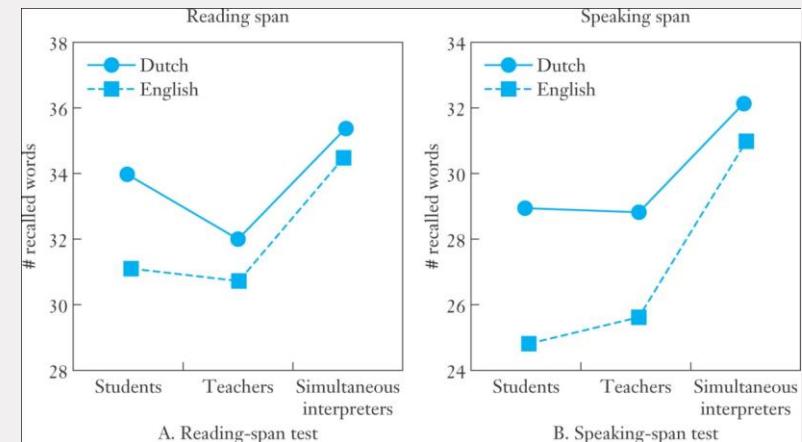
Dutch speakers: students, teachers of English, interpreters

reading-span test: recall last word of a sentence

speaking-span test: speak out a sentence with words presented

all groups recalled more words in their native language (Dutch)

simultaneous interpreters remembered significantly more words than the other two groups, both in reading span and speaking span





0HV60 Thinking and Deciding

Lecture 11: Prospect Theory and Framing (Kahneman 25,26,29-31, 34)

Martijn Willemsen

Prospect theory: Decision making under risk and uncertainty

Kahneman Chapter 25/26/29

Thinking and Deciding

Gambling paradigm (chapter 25)

Within the field of decision making, choosing between gambles is studied extensively

Gambling paradigm

elementary units of a decision are outcomes (consequences) and probabilities: every decision can be reduced to a bet

Which gamble would you take?

We throw a six-sided die and you get:

- Gamble A: 60 euro if we throw 1, 2, 3, or 4, otherwise nothing
- Gamble B: 150 euro if we throw 1 or 2, otherwise nothing



Gambling paradigm

Toss a coin: you loose 10 euro for tails
how much should heads win to accept?

Gambling paradigm

Consider the following game:

We toss a coin

You loose 10 euro for tails

You win 15 euros for heads

We play the game 10 times, would you play it?

- 1) Yes
- 2) No

The EV principle

The Expected Value principle: $EV = \sum_i p_i * V_i$

Example of a payoff matrix and calculation of $E(V)$

How much are you willing to pay ($c=cost$) for a coin toss which pays X if it lands on heads?

	Head $p=.5$	Tail $p=.5$
Accept	$X-c$	$-c$
Reject	0	0

$$EV(\text{Accept}) = \frac{1}{2} (X-c) + \frac{1}{2} (-c) = \frac{1}{2} X - c, \quad EV(\text{Reject}) = 0$$

Question

How much money would you pay to play a game in which an unbiased coin is tossed until it lands on Tails, and at the end of the game you are paid €2.00 to the power of K, where K equals the number of tosses until Tails appears?

In other words, you would be paid €2 if Tails comes up on the first toss, €4 if tails comes up on the second toss, €8 if tails comes up on the third toss, and in general:

Tosses until Tails:	1	2	3	4	5	...	K
Payoff in euros:	2	4	8	16	32		2^K

The EV principle & st. Petersburg paradox

Always choose the option with the highest E(V)

Observations suggest that people do not follow the rule. For instance, insurance (selling to insurance company an unfavorable gamble)

The st. Petersburg paradox:

$$\begin{aligned}EV &= (1/2)^1 \times 2^1 + (1/2)^2 \times 2^2 + (1/2)^3 \times 2^3 + \dots \\&= (1/2) \times 2 + (1/4) \times 4 + (1/8) \times 8 + (1/16) \times 16 + \dots \\&= \text{infinite...}\end{aligned}$$

Expected utility

A major problem with $E(V)$ is the assumption that the value of a dollar is the same for each person regardless of assets.

The introduction of utility theory (Bernoulli 1738)

$$EU = \sum_i p_i * U(V_i)$$

Different utility functions for different individuals.

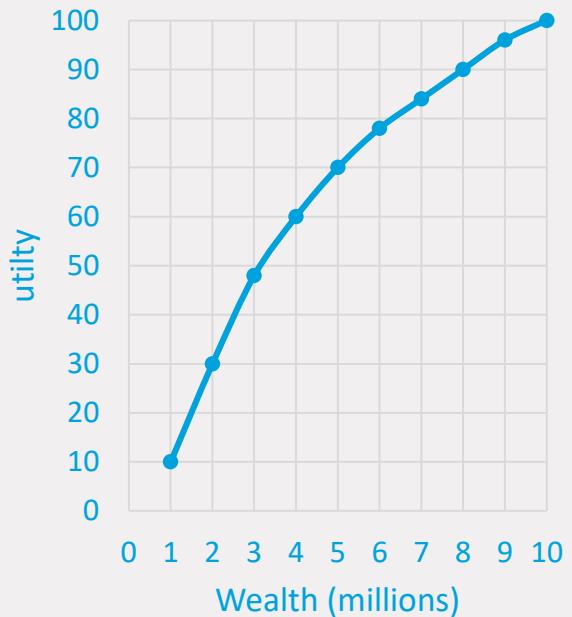
The idea of decreasing marginal utility

(in perception – Weber's law of decreasing sensitivity).

Utility of money (ch 25, p 273)

Bernoulli: utility of wealth is concave and roughly proportional to its logarithm

Declining marginal utility (margin of growth in wealth)



Utility of money (ch 25, p 273)

Bernoulli: utility of wealth is concave and roughly proportional to its logarithm

Declining marginal utility (margin of growth in wealth)

Concavity can explain:

- Risk aversion & Unattractiveness of even bets
- Why people take/sell insurance

Assumption: we assess outcome in terms of **total wealth!**



Example chapter 25:
Equal chance 1 or 7 million:
 $U=10*.5+84*.5=47$
4 million for sure: $U = 60$

The problem: total wealth assumption

Today Jack and Jill each have 5 Million

Yesterday, jack had 1 Million and Jill had 9 million.

Are they equally happy?

Bernouilli's theory says yes...

But it lacks a reference point...

We are sensitive to **changes** in wealth!

Descriptive issues

Expected utility theory provides a good normative framework, but there are many problems with it

Systematic violations are found

Most important: it lacks a reference point!

Four-fold Pattern of risk attitudes (Kahneman & Tversky, 1979, see also chapter 29)

Outcomes as gains or losses

Probabilities small versus medium-large

Note: I combine Chapters 25/26 and 29 here at once, to give the full picture!

Reflection effect (see also p 279)

Gamble A: 100% chance of losing 3000 euro

Gamble B: 80% chance of losing 4000 euro, and 20% of loosing nothing

Reflection effect (see also p 279)

Gamble A: 100% chance of losing 3000 euro

Gamble B: 80% chance of losing 4000 euro, and 20% of loosing nothing

92% chooses B

Gamble C: 100% chance of receiving 3000 euro

Gamble D: 80% chance of receiving 4000 euro, and 20% of receiving nothing

Reflection effect (see also p 279)

Gamble A: 100% chance of losing 3000 euro

Gamble B: 80% chance of losing 4000 euro, and 20% of loosing nothing

92% chooses B

Gamble C: 100% chance of receiving 3000 euro

Gamble D: 80% chance of receiving 4000 euro, and 20% of receiving nothing

20% chooses D

Risk aversion for gains, risk seeking for losses!

But for small probabilities...

Gamble A: 100% chance of losing 5 euro

Gamble B: 0.1% chance of losing 5000 euro

But for small probabilities...

Gamble A: 100% chance of losing 5 euro

Gamble B: 0.1% chance of losing 5000 euro

17% chooses B

Gamble C: 100% chance of receiving 5 euro

Gamble D: 0.1% chance of receiving 5000 euro

Certainty effect (page 313)

What would you choose?

- a) 61% chance of winning 520 euro
- b) 63% of winning 500 euro

And between these?

- c) 98% chance of winning 520 euro
- d) 100% chance of winning 500 euro

Most people choose a) and d)

We value certainty a lot!

But for small probabilities...

Gamble A: 100% chance of losing 5 euro

Gamble B: 0.1% chance of losing 5000 euro

17% chooses B

Gamble C: 100% chance of receiving 5 euro

Gamble D: 0.1% chance of receiving 5000 euro

72% chooses D

Risk seeking for gains, risk averse for losses if probabilities are small!

Possibility effect, going from 0% to small %

Allais Paradox

Situation X		
Option 1	\$1M	1.00
Option 2	\$1M	.89
	\$5M	.10
	\$0	.01
Situation Y		
Option 3	\$1M	.11
	\$0	.89
Option 4	\$5M	.10
	\$0	.90

Allais Paradox

Situation X		
Option 1	\$1M	.10
Option 2	\$1M	.89
	\$5M	.10
	\$0	.90
Situation Y		
Option 3	\$1M	.11
	\$0	.89
Option 4	\$5M	.10
	\$0	.90

Allais Paradox

Situation X			
Option 1	\$1M	1.00	
Option 2	\$1M	.89	
	\$5M	.10	
	\$0	.90	
Situation Y			
Option 3	\$1M	.11	
	\$0	.89	
Option 4	\$5M	.10	
	\$0	.90	

Ball numbers			
	1	2-11	12-100
Situation X			
Option 1	\$1M	\$1M	\$1M
Option 2	\$0	\$5M	\$1M
Situation Y			
Option 3	\$1M	\$1M	\$0
Option 4	\$0	\$5M	\$0

Allais Paradox

Situation X			
Option 1	\$1M	1.00	
Option 2	\$1M	.89	
	\$5M	.10	
	\$0	.90	
Situation Y			
Option 3	\$1M	.11	
	\$0	.89	
Option 4	\$5M	.10	
	\$0	.90	

Ball numbers			
1	2-11	12-100	
Situation X			
Option 1	\$1M	\$1M	\$1M
Option 2	\$0	\$5M	\$1M
Situation Y			
Option 3	\$1M	\$1M	\$0
Option 4	\$0	\$5M	\$0

Allais paradox (ch 29)

One of the earlier demonstrations (1953) of problems with expected utility theory

Violates sure thing principle (cancellation/sure thing principle)

Choices should depend upon attributes that differ
low probabilities (.01) get overweighed

Other representations that reveal the common outcomes (balls: Savage, 1954) overcome this effect

Different representations result in different preferences: invariance principle

The isolation effect

Which do you prefer?

A : (4000, .20) B: (3000, 0.25)

The isolation effect

Which do you prefer?

A : (4000, .20)	B: (3000, 0.25)
N=95	(65%)
	(35%)

Consider the following 2-stage gamble:

p=.75 winning nothing and p=.25 to pass to next stage.

Next stage: Choose between A (4000, .80) and B (3000).

Your choice has to be made before the game starts.

The isolation effect

Which do you prefer?

A : (4000, .20)	B: (3000, 0.25)
N=95	(65%)
	(35%)

Consider the following 2-stage gamble:

p=.75 winning nothing and p=.25 to pass to next stage.

Next stage: Choose between A (4000, .80) and B (3000).

Your choice has to be made before the game starts.

N=141	A: (22%)	B: (78%)
-------	----------	----------

Two possible presentations of this gamble. In terms of final outcomes (standard presentation) or as isolated stages (sequential presentation).

Framing examples (see also p. 280)

Gain-frame

Assume yourself richer by 300\$ than you are today. You have to choose between:

- Sure gain of \$100
- 50% chance to gain \$200
50% chance to gain nothing

Framing examples (see also p. 280)

Gain-frame

Assume yourself richer by 300\$ than you are today. You have to choose between:

- Sure gain of \$100
- 50% chance to gain \$200
50% chance to gain nothing

Loss-frame

Assume yourself richer by 500\$ than you are today. You have to choose between:

- Sure loss of \$100
- 50% chance to lose nothing
50% chance to lose \$200

Framing examples (see also p. 280)

Gain-frame

Assume yourself richer by 300\$ than you are today. You have to choose between:

- Sure gain of \$100
- 50% chance to gain \$200
50% chance to gain nothing

72%

28%

Outcomes:
• \$400 for sure
• Even chance at \$300 or \$500

Loss-frame

Assume yourself richer by 500\$ than you are today. You have to choose between:

- Sure loss of \$100
- 50% chance to lose nothing
50% chance to lose \$200

36%

64%

Outcomes:
• \$400 for sure
• Even chance at \$300 or \$500

Towards a Descriptive theory

Previous examples show several phenomena that are problematic for the normative rules underlying expected utility:

- transformations of probabilities (certainty effect)
- Framing of outcomes (violation of invariance)
- Valuation not based on total wealth, but on relative considerations: reference points and losses and gains...

Prospect Theory (Kahneman and Tversky, 1979)

Two phases: Editing and evaluation.

Editing consists of:

Coding: Prospects are evaluated as **gains and losses relative to a reference point** (depending on current asset position and context).

Combination, segregation and cancellation:

simplifying prospects by **combining** probabilities with identical outcomes.

Segregating riskless from risky components

Discarding: cancelling common elements

Prospect theory- Evaluation

Evaluation: The overall value of an edited prospect, denoted V , is expressed in terms of two scales, v and π .

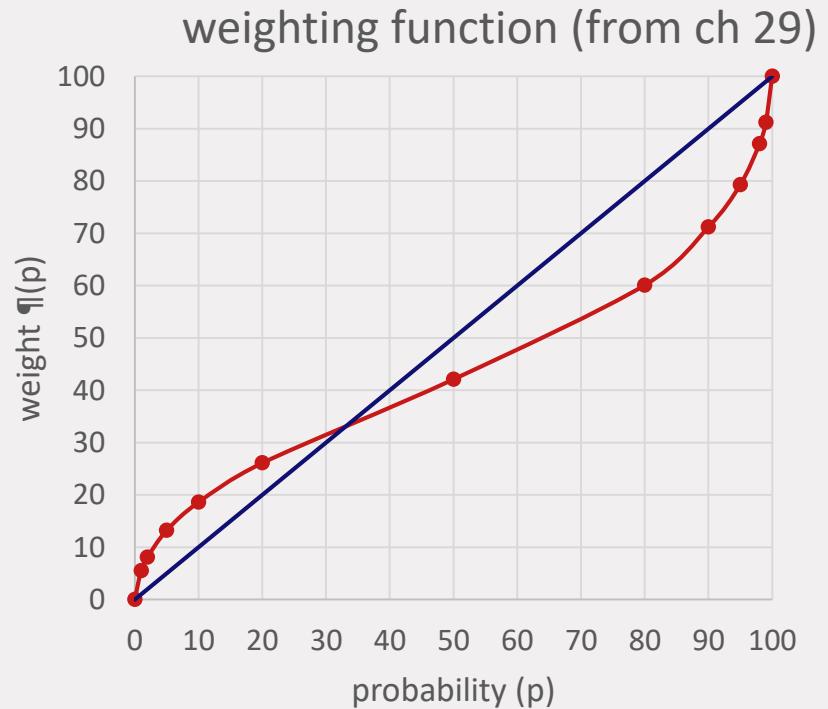
Not only outcomes (o) are transformed into utilities (like in expected utility theory) but also probabilities (p) are transformed into decision weights

$$U(x) = \sum_i \pi(p_i) \cdot v(o_i)$$

Decision weights (probabilities)

$\pi(p)$ is a decision weight that reflects **the impact of p on the overall value of the prospect**. It is not a probability measure and often $\pi(p) + \pi(1-p) < 1.0$ (subadditivity)

Function is unstable/stEEP at end points!



Consequences of weighting function

Underweighting of **moderate and high probabilities** contributes to risk aversion for gains

- Reduces the attractiveness of positive gambles
...and risk seeking for losses
- Attenuates averseness of negative gambles

Overweighting **small probabilities**

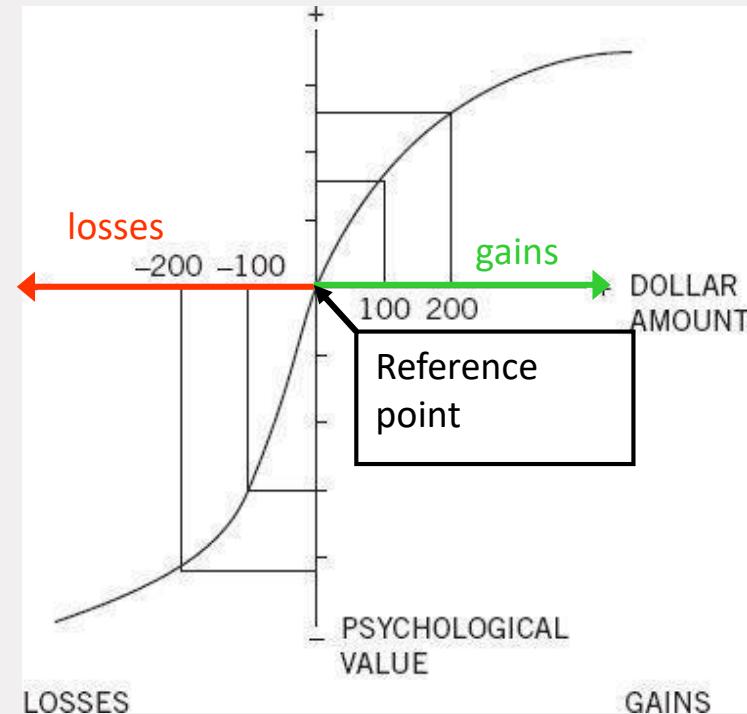
- Small chances of big losses are overweighed: that is why people buy insurance even for low value items
- Small chances of large gains are overweighed: attractiveness of lottery tickets

The value function (outcomes) p. 283

$v(x)$ reflects the subjective value of the outcome measured in terms of deviations from a reference point

- Concave for gains
- Convex for losses

Losses loom larger than gains



Major features of Prospect Theory

1. Gains and losses are considered relative to a *reference point* (rather than evaluating total assets)
2. Losses loom larger than gains
3. Prospects are transformed by decision weights, $\pi(p)$, reflecting the impact of p on the overall value of the prospect

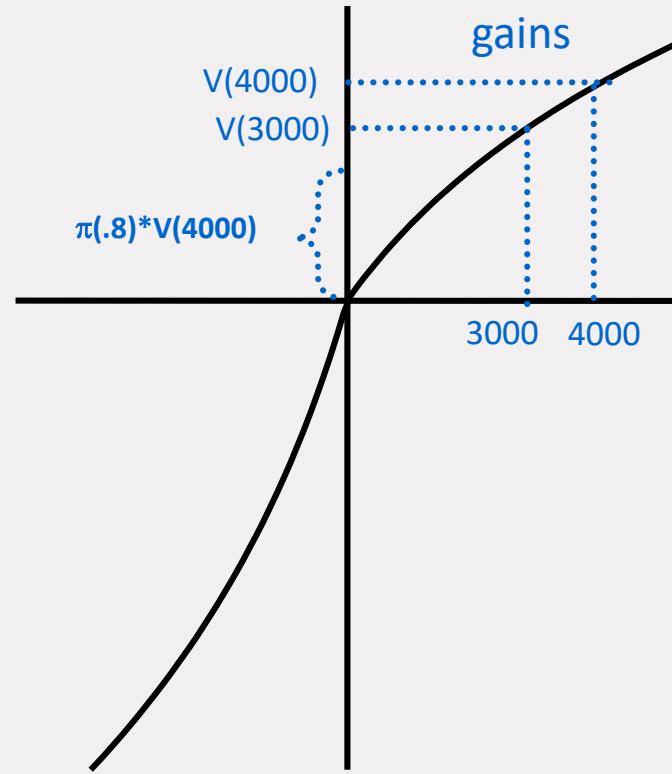
Reflection effect revisited

Gamble A: 100% chance of receiving 3000 euro

Gamble B: 80% chance of receiving 4000 euro,
and 20% of receiving nothing

20% chooses B

Prospect theory explanation



Reflection effect revisited

Gamble A: 100% chance of receiving 3000 euro

Gamble B: 80% chance of receiving 4000 euro,
and 20% of receiving nothing

20% chooses B

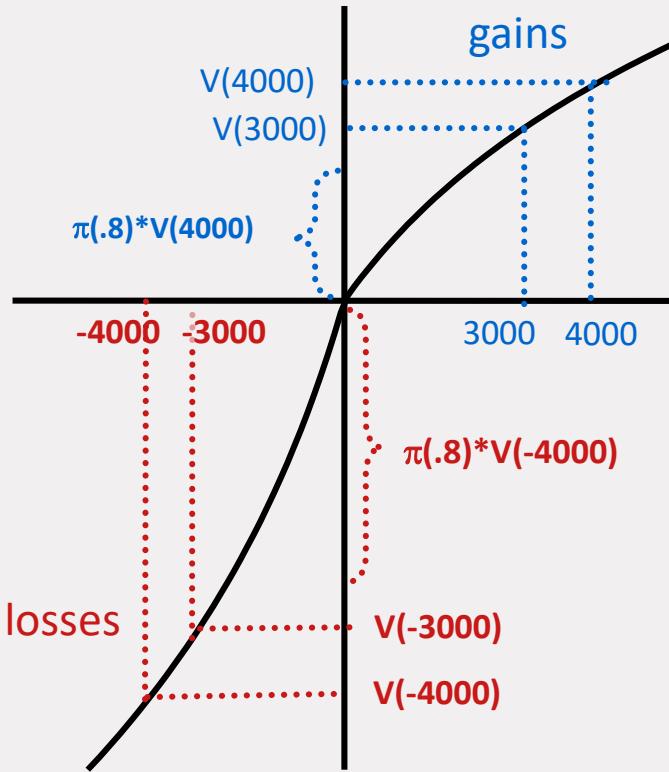
Gamble C: 100% chance of losing 3000 euro

Gamble D: 80% chance of losing 4000 euro, and
20% of loosing nothing

92% chooses D

Risk aversion for gains, risk seeking for losses!

Prospect theory explanation



More on probabilities... chapter 30/31

Beyond decision weights: rare events (ch 30)

Many examples how people overweight small probabilities in chapter 30

Unlikely events: high availability, too large dec. weight

Total probability of a set of mutual exclusive events (who wins the playoffs in basketball) is >>100%

However, probabilities have less impact for vivid outcomes

e.g. kissing a movie star/receiving an electric shock

Kahneman: “But this is normal” probabilities have more impact for monetary outcomes where people can calculate

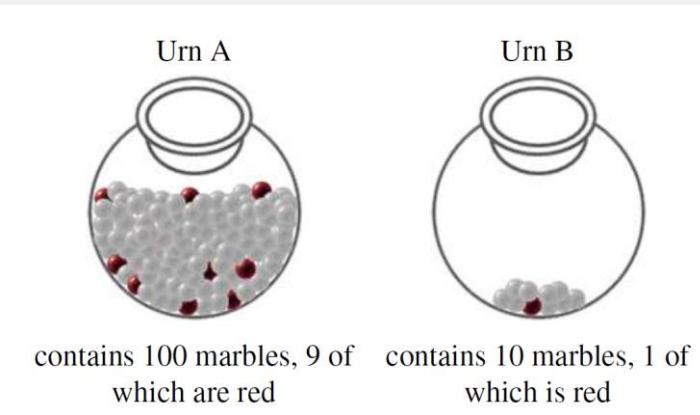
WTP: 84% chance of winning \$59 -> EV!

WTP: 84% chance of receiving 12 red roses in a vase -> EV?

Vivid probabilities

Denominator neglect

Vividness of the marbles make you more likely to pick Urn A!



Risk communication:

0.01% risk that a vaccine has severe side-effects

Versus 1 in 10.000 ... one individual child will be damaged!

(more good examples in the book)

Decisions from experience

Examples up till now; choice from description

Some research paradigms use choice from experience: have participants experience actual probabilities in many consecutive trials

a button that gives a 5% chance of \$12 versus one that gives 95% on \$1.

Mostly underweighting rather than overweighting

Rare events are not experienced (earthquakes, economic bubbles that burst)

Less impact than required as it is not vivid...

Narrow and broad framing (ch 31)

Decision 1:

- A. Sure gain of \$240
- B. 25% chance gain \$1000 and 75% chance gain nothing

Decision 2:

- C. Sure loss of \$750
- D. 75% chance lose \$1000 and 25% chance lose nothing

Narrow and broad framing (ch 31)

Decision 1:

- A. Sure gain of \$240
- B. 25% chance gain \$1000 and 75% chance gain nothing

Decision 2:

- C. Sure loss of \$750
- D. 75% chance lose \$1000 and 25% chance lose nothing

Typical choice pattern: A and D

But A+D < B+C!

AD: 25% win \$240 and 75% lose \$760

BC: 25% win \$250 and 75% lose \$750

Broad versus narrow frames

Narrow frame: consider decisions separately

Broad frame: single comprehensive decision

Prospect theory show that when in a narrow frame, decisions are suboptimal (gains and losses have too strong impacts)

Consider our one shot and repeated coin toss!

Risk Policies:

Do not look at every stock or daily fluctuations but look at portfolio and over longer time periods

Don't buy extended warranties or small insurances!

Prospect Theory and Framing

Kahneman Chapter 34

Thinking and Deciding

Framing examples (see also p. 280)

Gain-frame

Assume yourself richer by 300\$ than you are today. You have to choose between:

- Sure gain of \$100
- 50% chance to gain \$200
50% chance to gain nothing

72%

28%

Outcomes:
• \$400 for sure
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Loss-frame

Assume yourself richer by 500\$ than you are today. You have to choose between:

- Sure loss of \$100
- 50% chance to lose nothing
50% chance to lose \$200

36%

64%

Outcomes:
• \$400 for sure
• Even chance at \$300 or \$500

Framing

Description invariance: Preference should not depend on the way the options are described

Framing:

Only description varies between frames (loss/gain)

Frames are normatively/logically equivalent

Outcomes are evaluated separately (in isolation) within their own frame



Other examples (from chapter 34)

How acceptable is this?

1. A gamble that offers 10% chance to win \$95 and 90% to lose \$5?
2. A \$5 lottery ticket that offers a 10% chance of \$100 and 90% of winning nothing?

Second one is much more attractive...

Asked to physicians: surgery or radiation?

The one month survival rate of this surgery is 90%

There is a 10% mortality rate in the 1st month

84% selected it in gain frame, 50% in loss frame!

Another famous Framing example

Asian Disease

US is preparing for unusual Asian disease, which is expected to kill 600 people. Two alternative programs are proposed to combat the disease. Assume that the exact scientific estimates of the two programs are as follows:

Gain-frame

Program A: **72%**

200 people will be saved

Program B: **28%**

600 people saved with $p=1/3$

0 people saved with $p=2/3$

Loss-frame

Program A: **22%**

400 people will die

Program B: **78%**

0 people will die with $p=1/3$

600 people will die with $p=2/3$

Prospect Theory on Asian

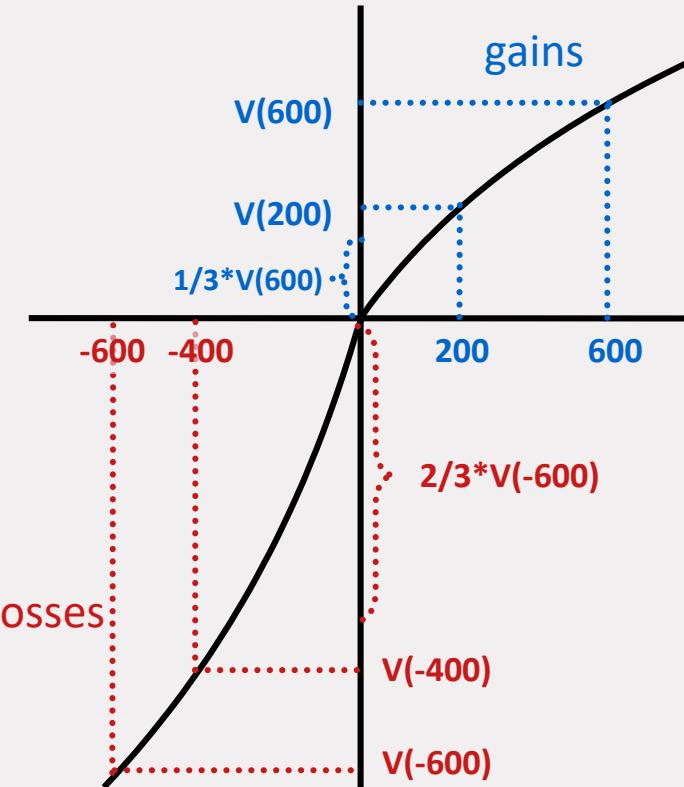
Framing sets a reference point

Gain: 600 lives lost

Loss: 0 lives lost

Prospect theory predicts
different valuations from this
reference point

Value Function is also usable
for non-monetary outcomes





OHV60 Thinking and Deciding

Lecture 12: Problem Solving (ch 11 Matlin) and deductive reasoning (ch 12)

Martijn Willemsen

Sample Problem

15% of the people in Topeka have unlisted numbers. You select 200 names at random from the Topeka phone book. How many of these people will have unlisted numbers?

Sample Problem

15% of the people in Topeka have unlisted numbers. You select 200 names at random from the Topeka phone book. How many of these people will have unlisted numbers?

Did you say 30?

The correct answer is zero

Problem Solving

problem solving: you want to reach a certain goal, but the solution is not immediately obvious and obstacles block your path



Thinking: requires you to go beyond the information you were given, so you can reach a goal

transformation of knowledge

Problem Representation

Understanding: you have constructed a mental representation of the problem

Based on problem information and your own experience

The importance of determining what information is relevant and what information is irrelevant is the process of problem representation

People pay attention to the wrong information or do not focus on the appropriate part

Organization of Information

Organize to aid solution

Effective representation!

1) Symbols

Mary is 10 years younger than twice Susan's age. Five years from now, Mary will be 8 years older than Susan's age at that time. How old are Mary and Susan?

2) Matrixes:

The long haired professor is in room 101
Mr green is in room 105
Professor Lopez has short hair
Professor Thomas has long hair

Organization of Information

Organize to aid solution

Effective representation!

1) Symbols

$$\text{Mary} = m, \text{susan} = s$$

$$m = 2s - 10$$

$$m + 5 = s + 5 + 8$$

2) Matrixes:

	Room 101	Room 102	Room 105
Thomas	x		
Lopez			
Green			x

Organization of Information

Organize to aid solution

Effective representation!

3) Diagrams

Represent large amount of information: e.g. fault tree

4) Visual Images

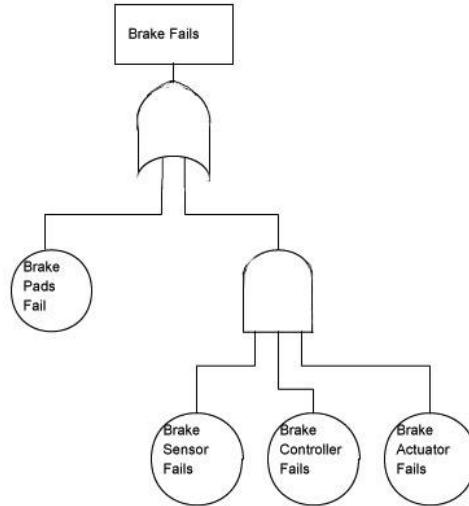
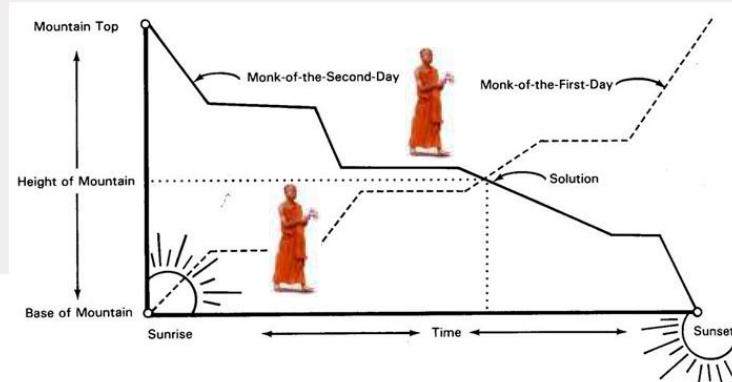


Figure 2: Example of a simple fault tree for a brake system



Situated Cognition

situated-cognition approach: our ability to solve a problem is tied into the specific context in which we learned to solve that problem

We often fail to translate this to other situations

abstract intelligence or aptitude tests
often fail to measure real-life problem
solving: **street kids in Brasil**



real-life cognition more complex than traditional cognitive approach

Embodied cognition

Embodied cognition emphasizes the role of your own body in cognition
(e.g. mental rotation: allow to move hands)

Two string problem: easier solved when instructed (during break) to swing their arms



Types of Problems

Well-structured problems

Clear path to the solution

Math problems

Anagrams

III-structured problems

Dimensions of problem are not specified or easy to infer

Finding an apartment

Writing a book

Finding the right product on a website!



Strategies to Solve Problems

Algorithms: Systematic procedure guaranteed to find a solution

Exhaustive Search

But... cognitive limitations

restrict proper executions of such algorithms

Newell and Simon: mental shortcuts

Heuristics

Useful rule of thumb based on experience

Efficient but does not guarantee a correct solution

LSSTNEUIAMYOU

SIMULTANEOUSLY

Analogy approach

analogy approach: using a solution to a similar, earlier problem to help in solving a new problem

The Structure of the Analogy Approach

determining the real problem

problem isomorphs

surface features

structural features

failure to see analogies

Rutgers: college applications analog to tracking systems



Termite-Inspired Sustainable Building **biomimicry**

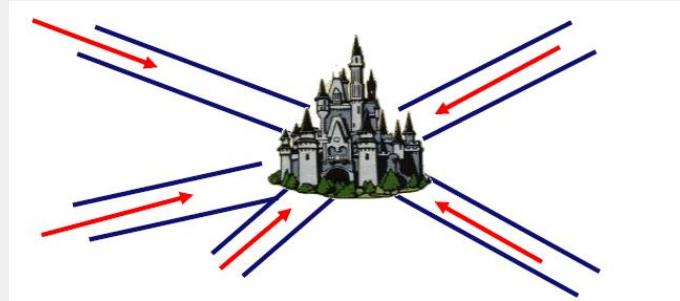
Classic example of Analogy research

A dictator ruled a small country from a fortress. The fortress was situated in the middle of the country and many roads radiated outward from it, like spokes on a wheel. A great general vowed to capture the fortress and free the country from the dictator. The general knew that if his entire army could attack the fortress at once it could be captured. But a spy reported that the dictator had planted mines on each of the roads. The mines were set so that small bodies of men could pass over them safely, since the dictator needed to be able to move troops and workers about, however, any large force would detonate the mines. Not only would this blow up the road, but the dictator would destroy many villages in retaliation. A full-scale direct attack on the fortress therefore seemed impossible.

Fortress problem

Solution to general problem

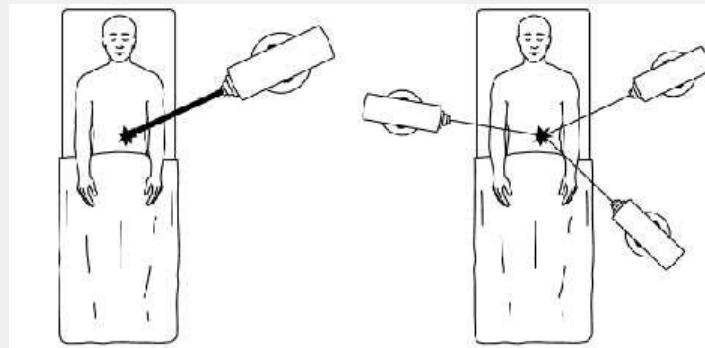
The general, however, was undaunted. He divided his army up into small groups and dispatched each group to the head of a different road. When all was ready he gave the signal, and each group charged down a different road. All of the small groups passed safely over the mines, and the army then attacked the fortress in full strength. In this way the general was able to capture the fortress.



Ask Participants to Solve this Problem

Radiation problem

Given a human being with an inoperable stomach tumor, and rays that destroy organic tissue at sufficient intensity, by what procedure can one free him of the tumor by these rays and at the same time avoid destroying the healthy tissue that surrounds it?



Structural Similarities

Fortress Problem

Fortress
Mined Roads
Attacking troops

Small groups of troops
Converging on fortress

Radiation Problem

↔ Tumor
↔ Surrounding tissue
↔ Rays varying in intensity
↔ Weak rays focused on tumor

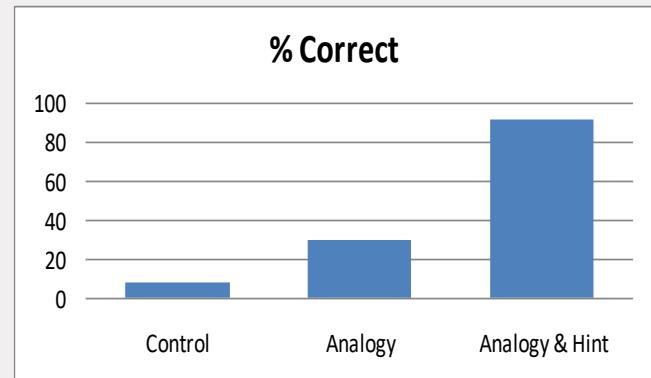
Gick & Holyoak (1980)

3 groups of participants

Control group that only tried to solve the radiation problem

A group previously given the **analogous** General/Fortress problem & solution

A group given the General/Fortress problem and **hinted** that its solution would help in solving the radiation problem



Heuristics for Problem Solving

Mean-ends analysis

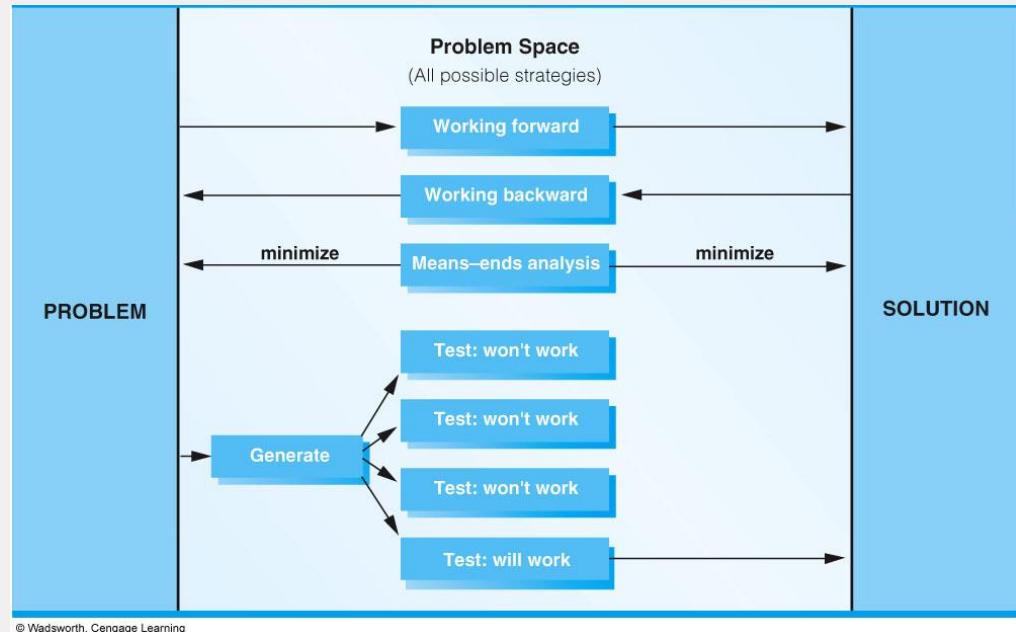
Split into sub-problems

Working forward

Working backward

Generate and test

Book only discusses
means-ends and
hill climbing...



© Wadsworth, Cengage Learning

Working Forward

Start at initial state and work to goal state

Math problems

$$(2 + 6)/(4 \times 1) = ?$$

Complete the math inside parenthesis first, then divide the quantities to get to solution

Working Backward

Figure out the last step needed to reach your goal, then the next-to-the-last step, and so on

- You have lost your keys
- Try to remember the last time you used them and work backwards

Work backwards from goal state

BACKWARDS

Means-End Analysis

Compare your current state with the goal and choose an action to bring you closer to the goal

Break a problem down into smaller sub goals

Win at Monopoly

You start by buying properties,
continue to buy until you get a set,
buy houses, then buy hotels,
wait for others to land on spaces, etc.

May not work if sub goals cannot be identified

Often you have to move backwards...



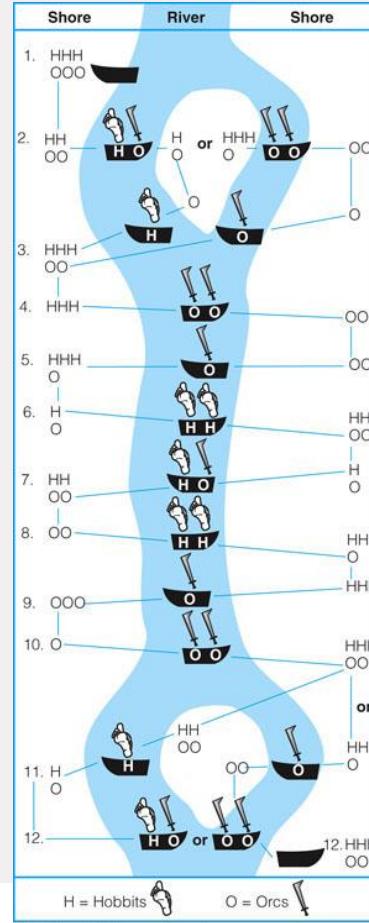
Transformation Problem

Hobbits & Orcs

Three hobbits and three orcs come to a river and find a boat that holds two. If the Orcs ever outnumber the Hobbits on either bank, the Hobbits will be eaten.

How do you get them all to the other side?

Have to move backwards... increase distance between initial and goal state



Wolf, Goat and Cabbage

A farmer is returning from market where he bought a goat, a wolf and cabbage.

On the way home he has to cross a river.

His boat is little, allowing him to take only one of the three things at a time. He cannot leave the goat with the cabbage, or the goat with the wolf...



<http://jeux.lulu.pagesperso-orange.fr/html/anglais/loupChe/loupChe1.htm>

(do try the second level!)

Did anyone wonder why a farmer would buy a wolf at a market?

http://www.youtube.com/watch?v=g3O2dQ0_7HM

Generate and Test

Trial and error strategy

Create possibilities, test them and discard the ones that are incorrect

Your car will not start

Wait a moment, try again, may be flooded

Check to see if there is gas, if no success

Check to see if the battery is charged... etc.

This may not be the most efficient strategy

Hill-climbing: take the ‘steepest path’ upwards!
(useful when not enough info on alternatives)



My school project is to find ways to save electricity,
so I un-plugged the fridge before we went to bed
because we don't use it during the night.

Methods for Studying Problem Solving

Error analysis or reaction time

Global measures of performance

Verbal protocols

Participants speak their thoughts out loud while solving problems

Strategies become evident in protocols

Computer simulation

Create models that can recreate human data

GPS: Newell and Simon (1972)

Expertise

Not a general ability

Experts have extensive knowledge that is used to organize, represent, and interpret information

Thus affecting their abilities to remember, reason, and solve problems



Experts vs. Beginners in Chess

Participants were chess masters and beginning chess players

Studied a chess board that had the pieces randomly displayed or a chess board with pieces in the middle of a game.

Beginners and experts had to recall as many pieces as they could

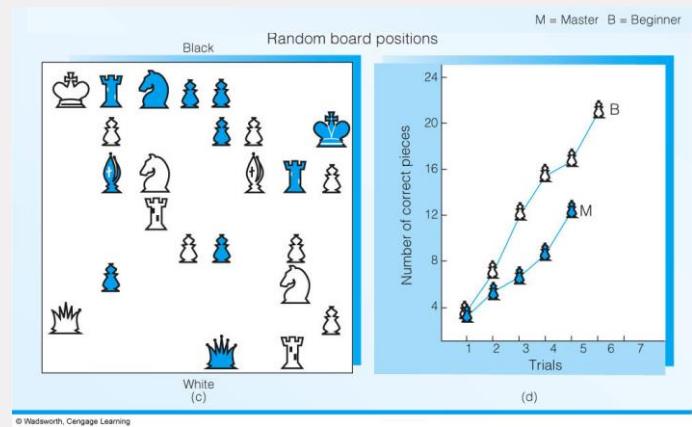
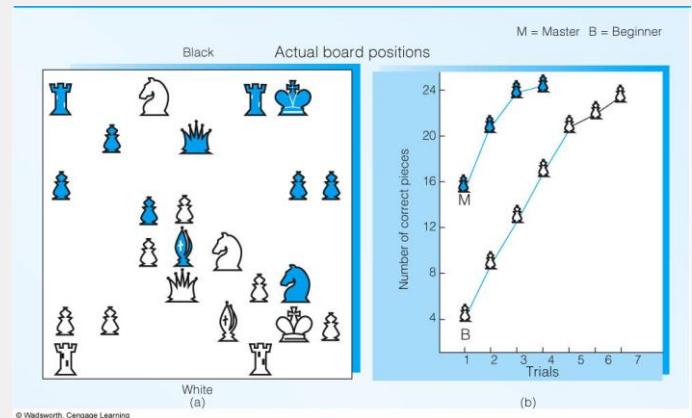
Realistic board positions

Experts (masters) outperform novices dramatically

Random board positions:

Experts do even worse than beginners...

Experts use larger chunks and can attach to meaning knowledge in their memory



Experts Differ From Novices

Knowledge base: Better schemas

Memory: Well organized knowledge in specific domain (e.g. chess example)

Strategies: Select more appropriate strategies (e.g. means-end) and spend more time on problem representation

Faster and more accurate at solving problems (more parallel processing)

More metacognitive skills

Obstacles to Problem Solving

Mental set

Functional fixedness

Incorrect or incomplete representation of the problem

Lack of domain knowledge

Often caused by overactive top-down processing 😊

Mental Set

Seeing a problem in a particular way instead of other plausible ways due to experience or context

May cause you to adopt an ineffective strategy and prevents problem solving

May make assumptions without realizing it

May find it hard to approach the problem in a new way

Dweck: fixed mindset versus growth mindset

Luchins (1942) Water Jar Problem

How would you use 3 jars with the indicated capacities to measure out the desired amount of water?

$$2-6: B-A+2C$$

$$7: A - C$$

$$8: A + C$$

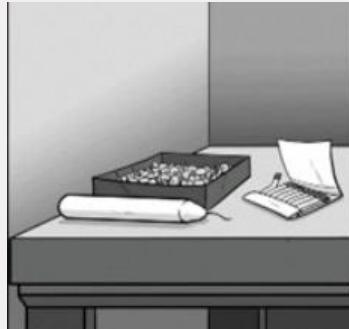
Problem	Jar A	Jar B	Jar C	Desired
1	29	3	2	20
2	21	127	3	100
3	14	163	25	99
4	18	43	10	5
5	9	42	6	21
6	20	59	4	31
7	23	49	3	20
8	15	39	3	18
9	28	76	3	25

Functional Fixedness

An inability to assign new functions and roles to elements of a problem

Duncker's candle problem

The task is to take the candle, matches, and tacks held in a box, and affix the candle to the wall so that the wax does not drip on the table.



Some nice examples from Hotel life

<https://www.youtube.com/watch?v=G0G36ShGYEO>

<https://twitter.com/rklau/status/1179965234624286721?s=20>

Rick Klau 
@rklau

I don't remember who posted this on Twitter a few years ago, but whoever you are: you have improved every night I've spent in a hotel since.

Tweet vertalen



5:43 a.m. · 4 okt. 2019 · Twitter for Android



Incubation

Time away from a problem provides new insights or otherwise facilitates the problem solving process

- Release from a problem solving set, or functional fixedness
- Retrieval of new information by changing context
- Recovery from fatigue



Gender stereotypes and problem solving

Stereotype threat: if you think of your self as a member of a group with negative stereotype, your performance may suffer....

Research with Asian-American Females

asian: good at math

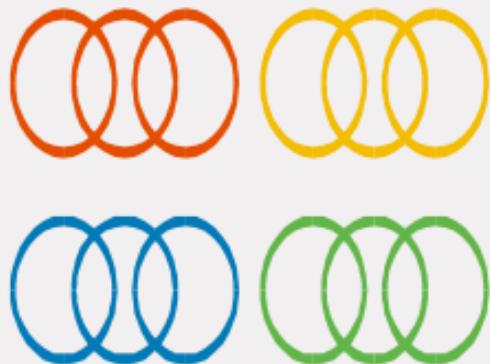
female: bad at math

Indicate ethnicity: 54% correct

Control: 49% correct

Indicate gender: 43% correct

Problem representation: cheap-necklace problem



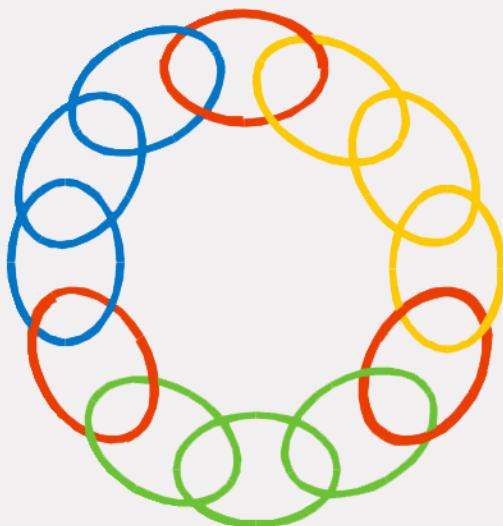
You are given four pieces of a chain; each made up of three links.

It costs 2 cent to open a link, and 3 cent to close a link. All links are closed at the beginning of the problem.

Your goal is join all 12 links of chain into a single circle at a cost of no more than 15 cent.

Silveira, 1971

Problem representation: cheap-necklace problem



Silveira, 1971

You are given four pieces of a chain; each made up of three links.

It costs 2 cent to open a link, and 3 cent to close a link. All links are closed at the beginning of the problem.

Your goal is join all 12 links of chain into a single circle at a cost of no more than 15 cent.

III-structured problems: Insight

III-structured problems have no well-defined problem spaces

Difficult to construct appropriate representations and see clear paths to solution

Insight: the apparent sudden solution to a problem some time after the problem has been presented

Metcalf & Wiebe (1987) Results

Participants were given either insight or algebra problems to solve

Insight: A prisoner was attempting escape from a tower. He found in his cell a rope which was half long enough to permit him to reach the ground safely. He divided the rope in half and tied the two parts together and escaped. How could this be?

Algebra: $(3x^2 + 2x - 10)(3x) = ?$

Participants indicated how close they were to solution every 15 seconds: 1 very cold to 7 very warm

For insight problems: Sudden shift in warmth rating

For algebra problems: A getting warmer pattern

Creativity

similarities to and differences from other forms of problem solving

Definitions

novelty, originality

need to reach some goal

useful and appropriate

Creativity: finding solutions that are novel, high quality, and useful

ordinary vs. exceptional thinking

Approaches to Creativity

Divergent Production (Guilford)

measure creativity in terms of the number of different responses made
moderate correlations between divergent production and other judgments
of creativity

But it is not just about the number of outcomes but about novelty and originality

Also needs convergent thinking: single best response might be better than many less useful solutions

Task Motivation and Creativity

Curiosity drives creativity

intrinsic motivation

desire to work on a task for its own sake

people are most likely to be creative when they are working on a task that they truly enjoy

High scores on intrinsic motivation tests and self-efficacy, but not with perserverance

extrinsic motivation

desire to work on a task to earn a promised reward

students tend to produce less creative projects if they are working on these projects for external reasons

Deductive Reasoning

Chapter 12

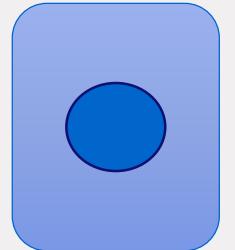
Thinking and Deciding

Reasoning challenge

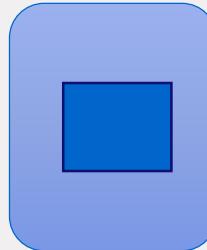
Each card has a shape on one side, and a color on the other side

Rule: If there is a circle on one side of the card, then it has a red color on the other side

Which cards to turn test the rule?



1



2



3



4

Different types of logical reasoning

Deduction: general principles to true conclusion

Conditional reasoning:

Logically certain conclusion!

Induction : from particular instances to general conclusion

No logically certain conclusion possible!

Deduction

Formal procedure that ensures accuracy if rules of logic are followed

Given some premises that are true, one can reach a conclusion that must also be true

Typically deductive arguments have three statements:

If P, then Q (Conditional if-then statement): antecedent and consequent

Statement about whether P or Q is true or not true

A conclusion about P or Q

Deduction: conditional reasoning

correct rules to test premises	Modus ponens If p then q p, Therefore q	Modus tollens If p then q Not q, Therefore not p
	Affirmation of the consequence If p then q q, Therefore p	Denial of the antecedent If p then q Not p, Therefore not q

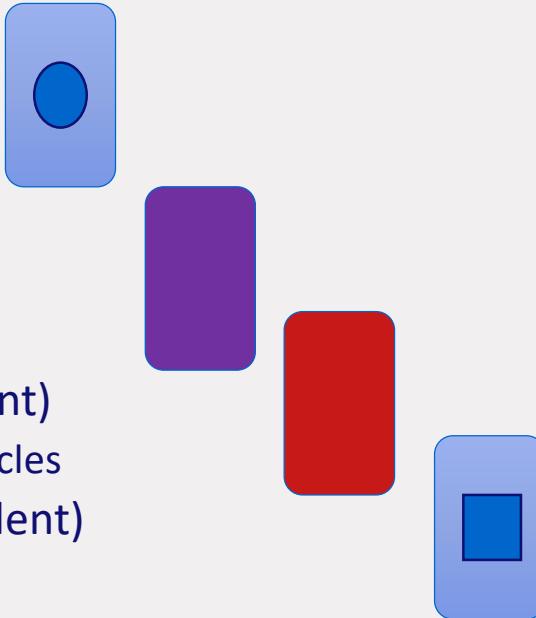
Wason selection task

Rule: if circle on one side, then red color on the other side

Must turn over Circle (Modus Ponens)

Most get this card right, confirmation bias

Because a circle, want to see if red on other side



Must turn over purple card (Modus Tollens)

Only 15% of college students get this correct

Must be sure there is not a circle on the other side

Red card doesn't matter (affirming the consequent)

Rule does not state that all red cards have to have circles

Square card doesn't matter (denying the antecedent)

Rule does not specify anything about other shapes

Influence of context

Four people are having a party. Who do you question to determine whether the law is being broken? If a person is drinking beer, then the person must be 18 or over.



Belief-bias effect

If a feather is thrown at a window, the window will break

A feather is thrown at a window

Therefore, the window will break

Logically valid (affirmation of the antecedent, modus ponens) but very unrealistic.

Belief-bias: make judgments on beliefs and knowledge rather than on rules of logic



0HV60 Thinking and Deciding

Lecture 13: Choices, Description Invariance and Defaults/Nudges (Kahneman Ch 27-28, 32,34)

Martijn Willemsen

Choice under certainty

Loss Aversion & Description invariance:

Endowment and bad events (ch 27/28)

keeping score & Mental accounting (ch 32)

Framing and Default effects / Nudging (ch 34 / papers)

Procedure invariance (ch 33) next Friday...

Compatibility

Evaluability

Note: I deviate from the order in the book and give a few more theoretical relevant examples: **Consider the slides leading!**

Description invariance

The preference order among alternatives should not depend on how their outcomes (and probabilities) are described. Two equivalent formulations of the same options should yield the same choice.

Many violations (framing, endowment, mental accounting, status quo/defaults)

Prospect Theory can explain many of these violations !

Indifference curves (ch 27)

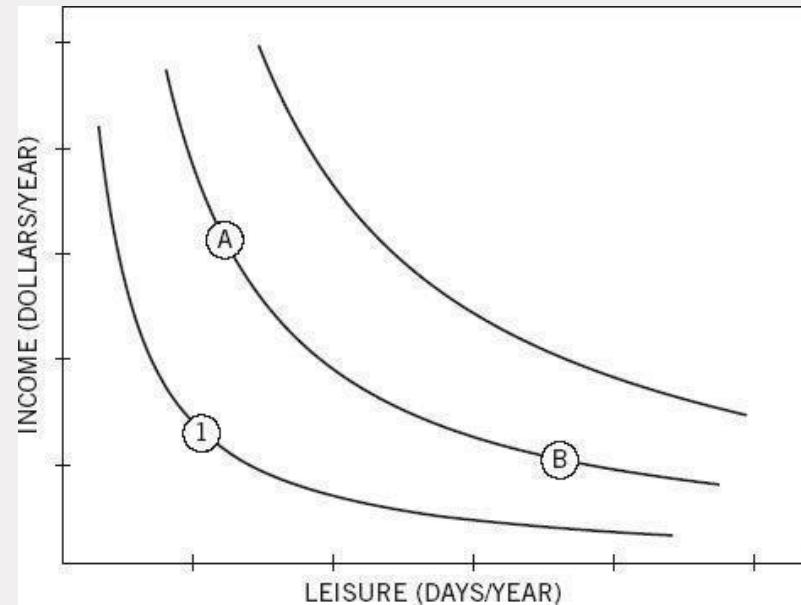
Tradeoffs between aspects of the decision

(equal utility contour)

Convex: decreasing marginal utility

No reference point!

Once in A, B feels more like a loss of income than a gain in vacation days!



Loss Aversion in choice

Imagine you are looking for a new job and there two options, that differ only in terms of the social contact and travel time. Your present job X is quite isolated but has a short commute: Which job would you chose, A or B?

Job	Social contact	Daily travel time
Present Job X	Isolated for long stretches	10 min
New Job A	Limited contact with others	20 min
New Job B	Moderately sociable	60 min

Loss Aversion in choice

Same difference between two options is given greater weight if viewed as a difference between two disadvantages (losses) rather than as a difference between two advantages (gains)

Present job serves a reference point

Job	Social contact	Daily travel time
Present Job X	Isolated for long stretches	10 min
New Job A	Limited contact with others	20 min
New Job B	Moderately sociable	60 min
Present job Y	Much pleasant social interaction	80 min

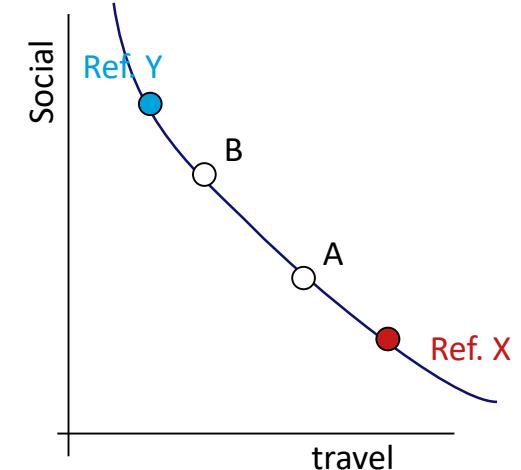
Ref X:
70% for A

Ref Y:
66% for B

Loss Aversion in choice

Same difference between two options is given greater weight as a difference between two disadvantages (losses) rather than between two advantages (gains)

Present job serves a reference point

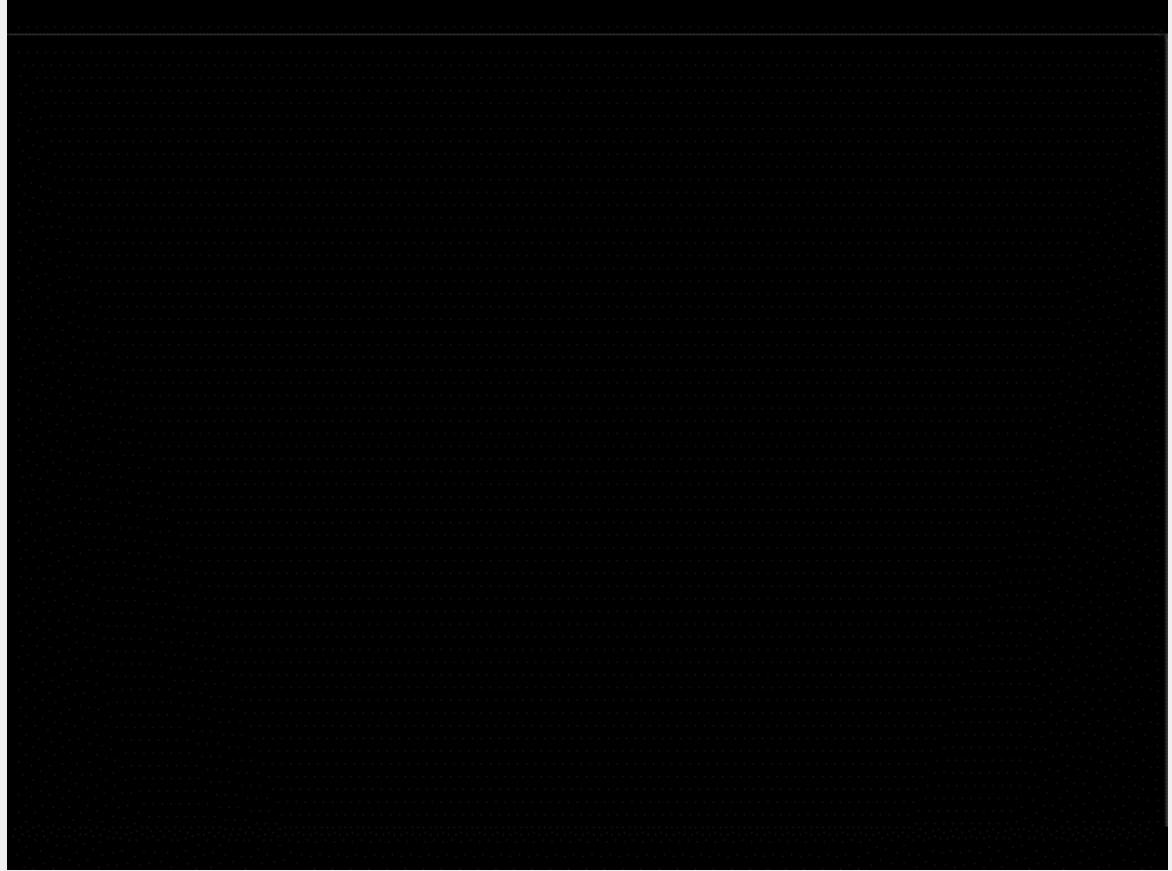


Ref X:
70% for A

Ref Y:
66% for B

Job	Social contact	Daily travel time
Present Job X	Isolated for long stretches	10 min
New Job A	Limited contact with others	20 min
New Job B	Moderately sociable	60 min
Present job Y	Much pleasant social interaction	80 min

Endowment effect (ch. 27)



Endowment effect: better version

Sellers receive a ‘Mug’

They have to choose between receiving a certain amount of money for the Mug or keeping the Mug

Choosers do not receive a ‘Mug’

They have to choose between receiving a certain amount of money or receiving a Mug

Both groups gain something: the only difference is the possession of the Mug

Endowment experiment

Sellers make sequential choices between:

sell mug for \$1	keep mug
sell mug for \$1.25	keep mug
....	...
sell mug for \$9.25	keep mug

Median
selling price:
\$7.12

Endowment experiment

Sellers make sequential choices between:

sell mug for \$1	keep mug
sell mug for \$1.25	keep mug
....	...
sell mug for \$9.25	keep mug

Median
selling price:
\$7.12

Choosers make sequential choices between:

receive \$1	get mug
receive \$1.25	get mug
....	...
receive \$9.25	get mug

Median
buying price:
\$3.12

Endowment effect not universal

Not for money or any other situation that focuses on ‘the exchange’



Endowment most pronounced ‘for use’

to be consumed or otherwise enjoyed: wine, tickets, mug

Original price of a house affects the asking price

Current market value is only thing that should count...

Professional traders don’t show endowment effect

Experts switch mug/chocolate bar reward for a survey

They think about other things they could do with the money from the mug...

Endowment and reasons...

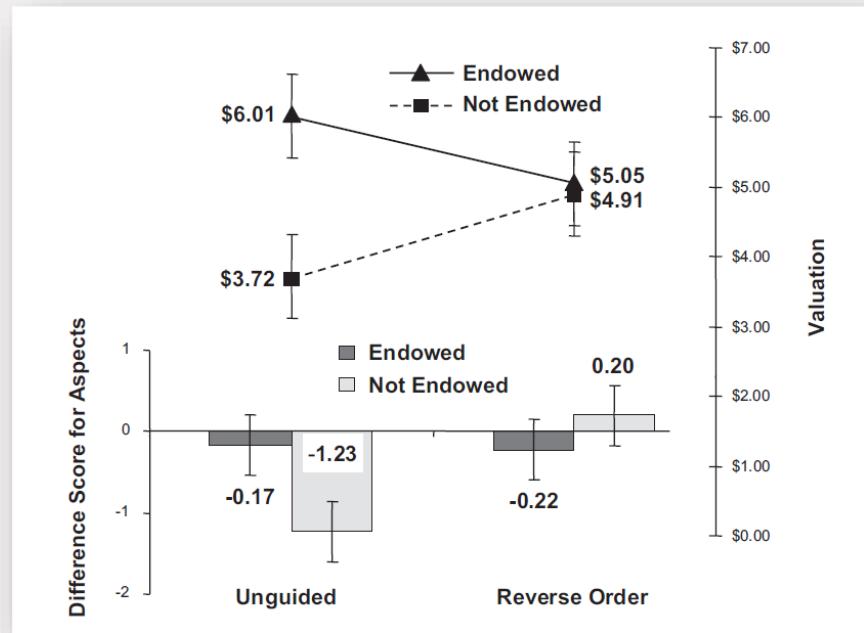
Asking for reasons for or against (aspects) can eliminate endowment effect
(Johnson et al, 2007)

Aspect listing:

type all reasons why they personally would want to either have the mug or have the money, one reason at a time

Order can be reversed: first why the mug, or first why the money

Johnson, Haubl and Keinan (2007)
Journal of Experimental Psychology:
Learning, Memory, and Cognition vol. 33,
No. 3, 461–474



Bad events (ch. 28)

Our brain reacts stronger to threats (bad events)

One angry face pops out among many friendly ones

One bad action can ruin a friendship or a marriage

Goals are reference points

We work harder to avoid not achieving a goal (loss!)

New York taxi drivers (intro/rationality lecture)

Golfers work more to avoid a bogey (**one above par: loss**) than to achieve a birdie (**one below par: gain**)

Defending the status quo

Negotiations are all about communicating reference points: your gain is my loss...

Loss aversion in law

Loss aversion and fairness: public evaluates loss and gains very differently in moral terms

- Not fair to raise a price when demand will get higher
- Not fair to reduce an existing wage, but fair to reduce the wage of a new employee
- **Exploitation of market power to impose losses is unfair!**

Reducing catalog prices will give previous buyers a feeling of unfairness
They paid a higher price: loss!



Mental accounting (ch 32)



People as **naive accountants** (Thaler)

We keep score in several accounts, and count losses and gains separately for each account

e.g., holiday, household, or clothing budgets

Put money into a savings account while maintaining debt

Golfers have an account for each hole, not just one single account for overall success

More likely to face a blizzard/storm to go to a concert if the **tickets were bought from own money** rather than **given by a friend**

Closing balance is more negative!

Against Econ: these are just sunk costs!

Narrow framing again

Need money and have to sell some of your stocks: sell the winners or the losers?

Selling the winner closes an account successfully, selling losers not!

Current winners are likely to gain more and losers to loose more, so better sell the losers

Tax advantages of selling losers...

Sunk cost Fallacy: rational decision maker should only be interested in future consequences...

That is why often CEOs and project leaders are taken of projects that failed...

Sunk costs effects



<http://youtu.be/g5ehKjfcQEo>

Other examples of budgeting

Money: Income, wealth, expenditures

- Economic perspective: money is fungible, and thus can be moved between accounts
- In practice: People set budgets for specific expenditures

Calculator problem (topical mental account: Appendix B)

- Jacket (\$125 / \$15) and calculator (\$15 / \$125). Calculator is on sale (\$10 / \$120) at other branch of store, 20 min. away.
- People only want to make the trip if they saved \$5 from the \$15 calculator, not from the \$125 calculator
- Reference point dependent on the context and account!

Mental accounting: Extra Cost effect

1. Imagine that you have bought a ticket to the theater worth \$50. On the eve of the performance, while at the entrance you realize that you have lost the ticket.
2. Imagine that you decided to go to a play. A ticket is priced at \$50. At the eve of the performance, while standing in line, you realize that you lost \$50.

Current wealth is the same in both conditions, but...

Most people are willing to buy a ticket in the second (loss is in another account) but not in the first condition (loss in the same account)

(not sure why this example is in Ch 34..., see also appendix B)

Regret: blaming action over inaction

Regret: counterfactual emotion. If one had chosen differently, things would have turned out much better “want to kick yourself, undo/correct mistake”

More regret for abnormal actions

Mr Brown never picks up hitchhikers but did and was robbed: **more regret but less ‘blame’**

Mr. Smith frequently picks up hitchhikers and was robbed: **less regret but more ‘blame’**



More on regret

Anticipating regret can influence decisions

e.g. postcode lottery uses regret in their promotions

“What if you decided not to play in this lottery and your neighbors win a lot of money...!”



It is all about justified action/inaction

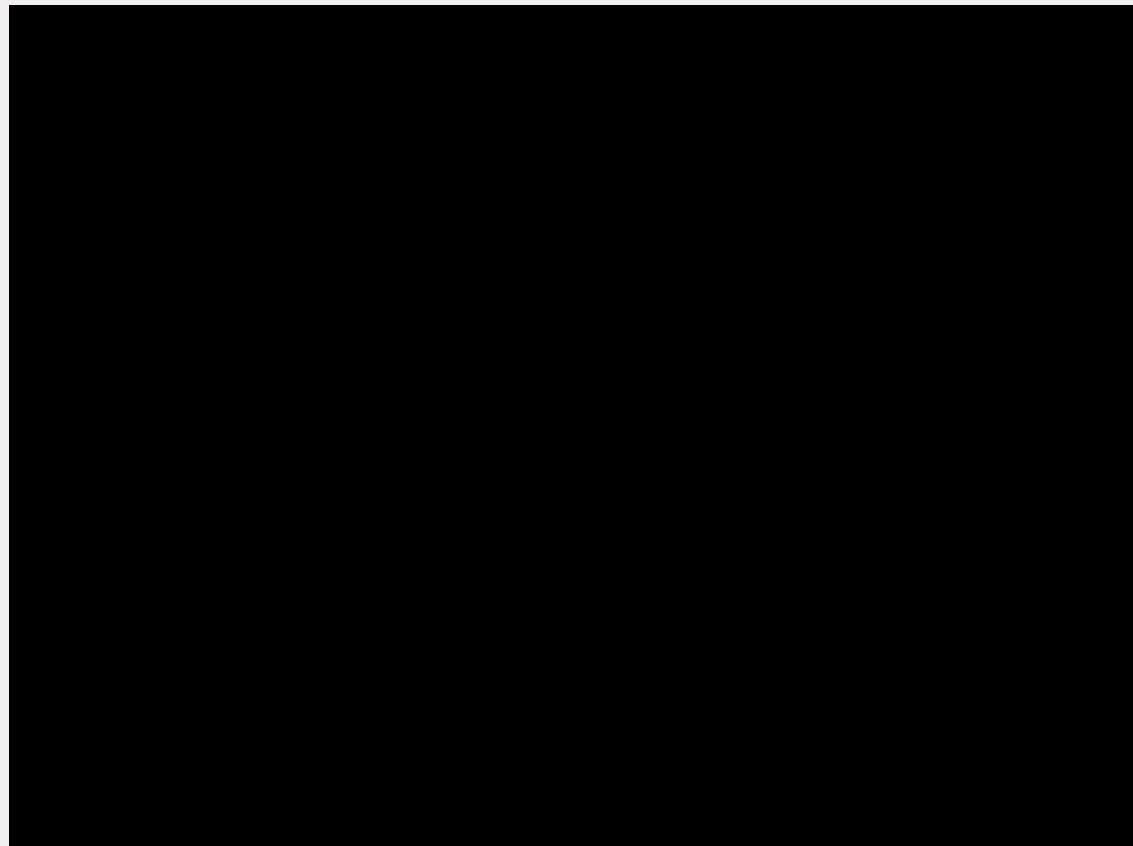
It is not about the action per se but the deviation from the norm that causes regret:

Soccer coach that **changes** his team after **winning** last weekend and now loses this weekend...

Soccer coach **NOT changing** his team after **loosing** last weekend and now loses again this weekend...



Value of Life (p. 349-350: responsibility)



Responsibility and Omission bias (p. 349)

People are reluctant to change as they might run risk due to their actions

Classical example of Ritov and Baron (1990) (similar ones in the book)

- Hypothetical disease: 10 of 10.000 children can be killed
- Vaccination prevents disease but has a risk of 5 out of 10.000 children
- Overall benefit is clear, but people do not want to be responsible for death due to an active decision of vaccinate.

Taboo tradeoff (selfish regret rather than optimized child safety)

Defaults

Ch 34

defaults

Chapter 34 offers many framing examples we already discussed in the prospect theory lecture.

Framing is one type of description invariance

Defaults also show description invariance

Same set of choices and same task

Different reference points/perspectives

This lecture:

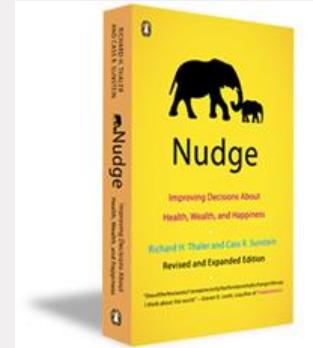
two important science papers

Nudging and Adaptive defaults

The importance of defaults

We are all Choice architects whether we like it or not
(Nudge: Thaler and Sunstein)

- Defaults are the unavoidable building blocks
- We can shape good and bad decisions
- help people make right decisions in important domains (retirement, health care, environment)



*“A Nudge is any aspect of the choice architecture that alters people’s behavior in a predictable way...
...without forbidding any options or significantly changing economic incentives.”*

Book ‘Nudge’ (Thaler & Sunstein, 2008; p. 6)

Example Nudge



The choice here is whether to make an effort or not!

Classical Nudge: Status quo and defaults

Willingness to change insurance (Johnson et al. 1993)

New Jersey: default is limited right to sue

- Acquire full right only actively: **20% acquired full right**

Pennsylvania: default is full right to sue

- Limited right is active change: **75% retained full right**

People tend to stick with the status quo!

-> cf. Loss aversion!



Limited versus Unlimited Right to Sue Car Insurance Policies

Source:

<https://fredsonstatmore.com/2018/04/28/limited-versus-unlimited-right-to-sue-car-insurance-policies/>

Defaults: Opt-in or Opt-out (old)

RYANAIR.COM SEARCH » SELECT » CONFIRM » **CONTACT** » PAYMENT » ITINERARY

Passenger Details

Title	First name	Last name	Price	More information
1 Mr			18.00 EUR Bag/Airport Fee Info	
Would you like to be one of the first passengers to board the aircraft? YES <input checked="" type="radio"/> NO <input type="radio"/>			6.00 EUR Priority Boarding?	
Confirm Country of Residence to Purchase Travel Insurance Ireland			7.50 EUR View Benefits	

If you would prefer NOT to purchase travel insurance simply choose **No Travel Insurance Required** in the drop down menu

The opt outs

Baggage Total 18.00 EUR
Insurance Total 7.50 EUR

Priority Boarding Aanmelden **RYANAIR**

Passenger Services VLUCHTEN SERVICES AUTO HOTEL BETALING REISROUTE

Contact

Let op: Het hieronder ingevulde e-mailadres/telefoonnummer kan gebruikt worden om u op de hoogte te brengen van dringende vluchtinformatie en voor het beantwoorden van correspondentie.

E-mailadres

m.c.willemsen@tue.nl

Bevestig e-mailadres

m.c.willemsen@tue.nl

De door u verstrekte gegevens worden uitsluitend gebruikt om contact met u op te nemen over uw boeking, tenzij u bent geregistreerd op onze ledenlijst. Leden ontvangen informatie over Ryanair en onze partners. Schakel het selectievakje in als u onze beste aanbiedingen niet wilt ontvangen.

But wrong defaults are still there...

Unsubscribe from a news letter: have to Uncheck to boxes even after clicking the unsubscribe link



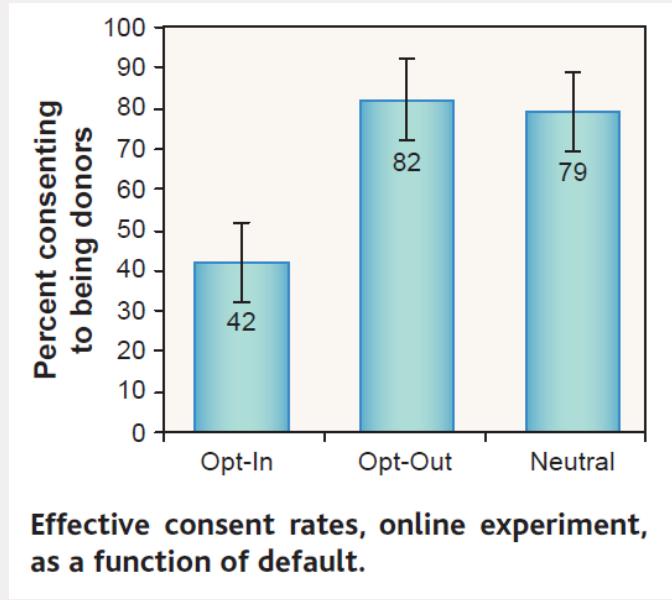
Organ Donation

Default option is presented by the government

Opt-in (NL)

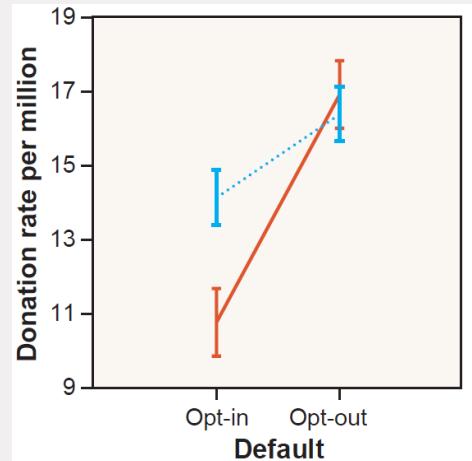
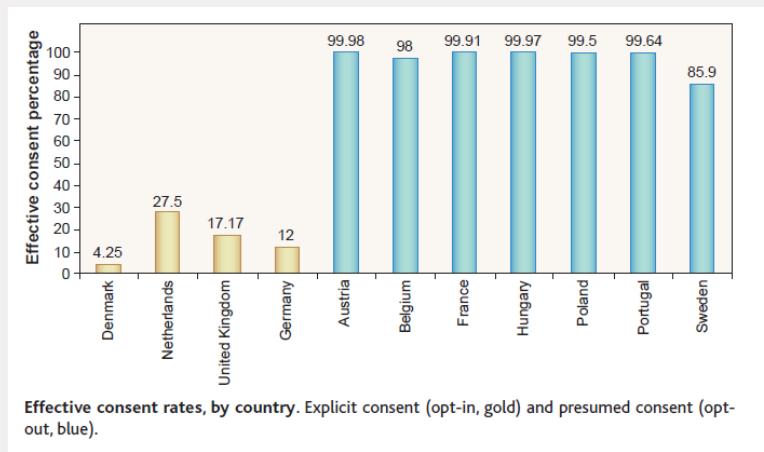
Opt-out (Belgium)

Experiment shows, Opt-out equals neutral (no default) version
so what is the right default?



Defaults in Organ Donation

Opt out defaults not only give more potential donors, but they are also more likely to become one!



Johnson, E. J. & Goldstein, D. G. (2003). [Do defaults save lives?](#) Science, 302, 1338-1339.

the best default representation for Fuel efficiency?

Larrick, R.P., & Soll, J.B. (2008). The MPG Illusion, Science, 320, 1593-1594

Replace the SUV?

BMW X5

3.0SI 200KW 4WD

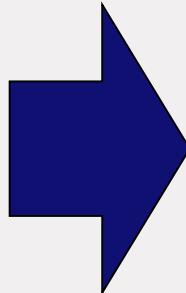
9.8 km per liter, 15.000 km/year



BMW 523i

140 KW

13.7 km per liter, 15.000 km/year



Replace the Family Car?

Volkswagen JETTA

1.4TSI 90KW

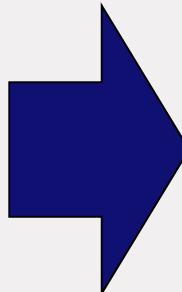
15.6 km per liter, 15.000 km/year



Toyota PRIUS

1.5VVTI 57KW

23.3 km per liter, 15.000 km/year



What whould you decide?

Replace SUV?

From 9.8 km per liter to 13.7 km per liter

Replace family car?

From 15.6km per liter to 23.3 km per liter

What whould you decide?

Replace SUV?

From 9.8 km per liter to 13.7 km per liter

translates into: **10.2 l/100km to 7.3 l/100km**

Diff = 2.9 l/100km

Replace family car?

From 15.6km per liter to 23.3 km per liter

translates into: **6.4 l/100km to 4.3 l/100km**

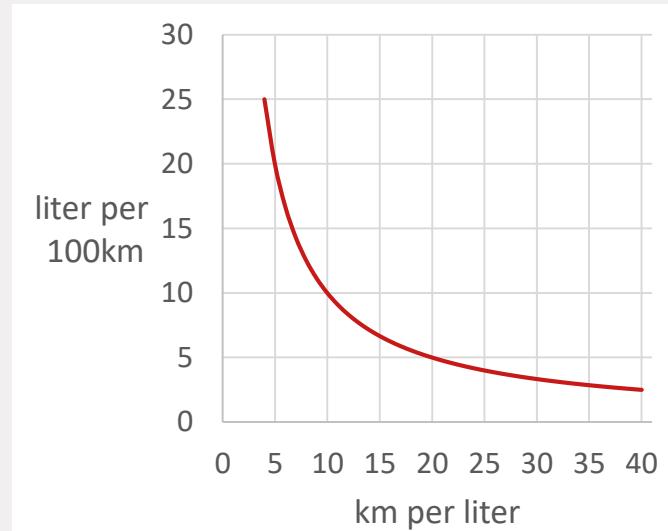
Diff = 2.1 l/100km

The MPG illusion

People expect gas consumption to be linearly related to MPG (or km/l)
actual relation is curve-linear ($1/x$)

Changes on lower part of the scale
have more impact

GPM representation results in less error



Larrick, R.P., & Soll, J.B. (2008). The MPG Illusion, Science, 320, 1593-1594

Does the right information help?

Larrick and Soll asked which is better:

Improving car A from 15 to 19 MPG

Improving car B from 34 to 44 MPG

25% correct decisions (car A)

Does the right information help?

Larrick and Soll asked which is better:

Improving car A from 15 to 19 MPG

⇒ 6.7 to 5.3 GPM

Improving car B from 34 to 44 MPG

⇒ 2.9 to 2.3 GPM

25% correct decisions (car A)

Another group also received **GPM information**

Correct choices increased to 65%!

Using the right frame can help the decision making process!

New label (see also chapter 34)

The New E.P.A. Label

The government has redesigned its fuel economy sticker for new vehicles, which will start showing up for the 2013 model year. Here are some key features of the label for gasoline models.

COMBINED FUEL ECONOMY

The new sticker prominently displays a single mileage figure, based on a combination of 55 percent city and 45 percent highway driving. Currently, the city and highway numbers are both shown, with no combined figure.

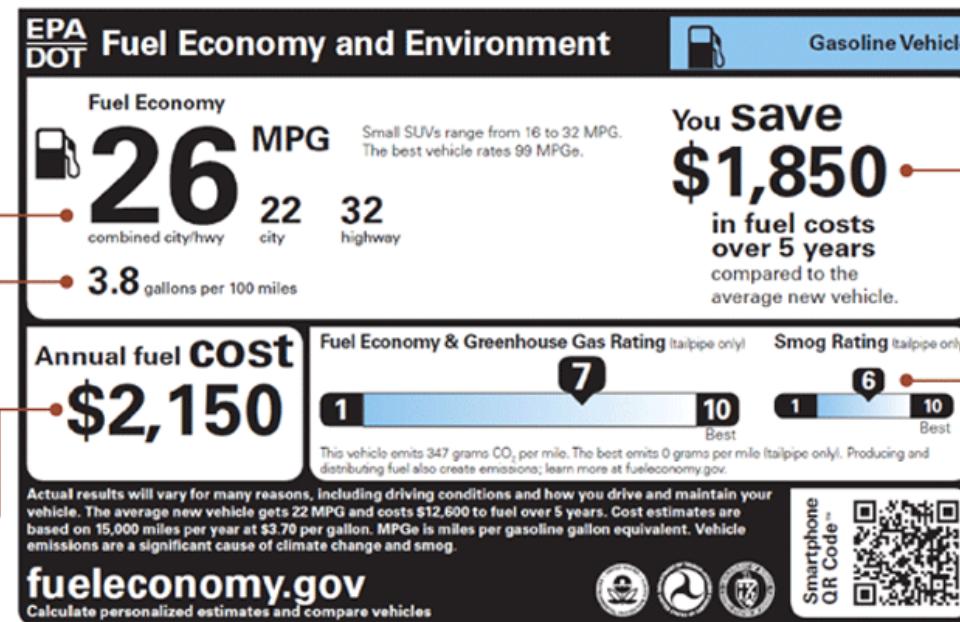
GALLONS PER 100 MILES

This new figure gives drivers another way to compare efficiency among vehicles, especially ones with low mileage ratings.

ANNUAL FUEL COST

Currently shown. The assumptions behind it — gasoline at \$3.70 a gallon and 15,000 miles driven, in this case — are shown in the fine print at the bottom.

Source: Environmental Protection Agency



WHAT YOU MIGHT SAVE
The sticker provides an estimate of how much more or less a driver might spend on fuel over five years compared with the average vehicle.

POLLUTION RATINGS

New ratings on a scale from 1 to 10 will be provided for M.P.G., greenhouse gas emissions and smog. For some vehicles, separate ratings will be shown for M.P.G. and greenhouse gases.

LINK FOR SMARTPHONES

Consumers will be able to scan this code to get more information.

THE NEW YORK TIMES

Nudging and defaults

Goldstein, Johnson, Hermman and Heitmann
(HBR, 2008)

Tool Kit
BY DANIEL G. GOLDSTEIN, ERIC J. JOHNSON, ANDREAS HERRMANN, AND MARK HEITMANN

A large hand points from the left towards a vending machine. The vending machine is filled with various snacks like chips, pretzels, and candy. A small character stands next to the machine, looking up at it.

Nudge Your Customers Toward Better Choices

The standard version of your product or service can boost satisfaction and profits – or fuel defections and lawsuits. Here's how to design defaults so that everyone wins.

A taxonomy of default effects

Goldstein et al. (2008)

Nudge your customer towards better choices

Mass defaults (*one-size-fits-all*)

Random defaults, Benign defaults, Best guess, Prompted choice, Hide options

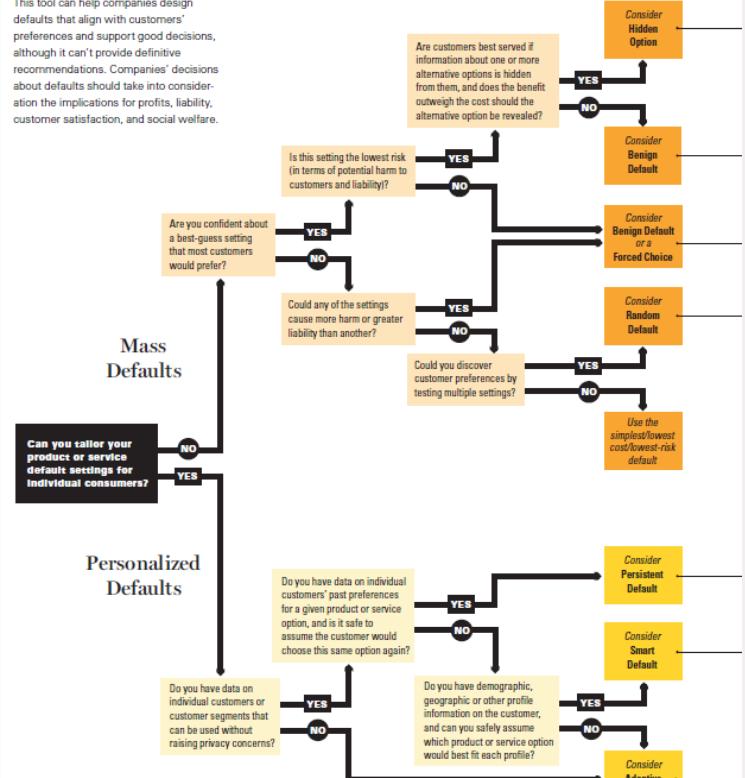
Personalized defaults

Based on previous choice, characteristics, or current behavior

(persistent, smart or adaptive default)

A Decision Tree for Setting Defaults

This tool can help companies design defaults that align with customers' preferences and support good decisions, although it can't provide definitive recommendations. Companies' decisions about defaults should take into consideration the implications for profits, liability, customer satisfaction, and social welfare.



Mass defaults

Best guess for most customers?

Use benign default

No harm? hide options

Important? use forced choice

No best guess?

Use benign default

random default: arbitrarily assign customers and test what works best

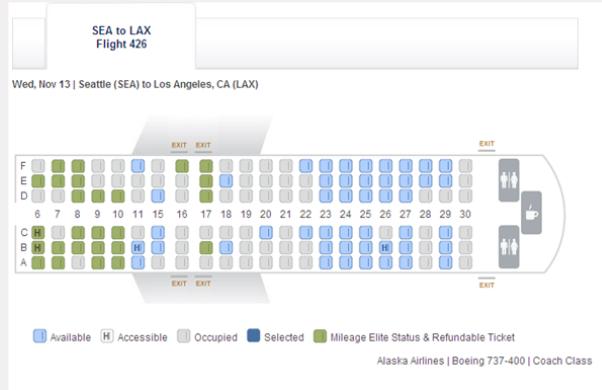
randomly assign elderly in the US to drug prescription plans



Personalized defaults

Persistent defaults

use past choices for future preferences
(e.g., airline seat assignment)



Smart defaults

Use customer info to generate best choices (e.g., use age to prefill retirement plan)

Adaptive defaults

Real time adaptation using current behavior

-> use in PC/laptop configuration; preselect further options based on a initial choice for a protection plan (DELL)



0HV60 Thinking and Deciding

Lecture 14: Procedure Invariance (Kahneman Ch 33) and Future events (35-38)

Martijn Willemsen

Choice under certainty

~~Loss Aversion & Description invariance:~~

~~Endowment and bad events (ch 27/28)~~

~~keeping score & Mental accounting (ch 32)~~

~~Framing and Default effects / Nudging (ch 34 / papers)~~

Procedure invariance (ch 33)

Compatibility

Evaluability

Note: I deviate from the order in the book and give a few more theoretical relevant examples: **Consider the slides leading!**

Preference reversals (violations of procedure invariance)

Ch 33: Kahneman (and more)

Thinking and Deciding

Eliciting preferences

Different ways of measuring preferences:

Choice task

Rating judgments (quality, satisfaction)

Pricing judgments

Matching (making equal)

Procedure invariance: either of these procedures should result in similar preference orderings: if an option is preferred in choice, it should also be assigned a higher rating/pricing

Procedural invariance

Phenomenon of preference reversal

- As already observed in loss aversion and framing examples before..
- Preference reversal also occurs between different preference elicitation procedures

Attribute weights affected by other aspects:

- Prominence
- Compatibility (-> chapter 33)
- Evaluability (-> Chapter 33)

Choice versus Judgment

Judgment does not involve commitment

Can be done sequentially (non-comparative)

Matching: making two options equally attractive (i.e. putting them on an indifference curve)

The prominence effect: The more prominent (more important) attribute weighs more heavily in choice than in matching

Choice and Matching: prominence

About 600 people are killed each year in Israel in traffic accidents. The Ministry of Transportation investigates various programs to reduce the number of casualties. Consider the following two programs, described in terms of yearly costs and the number of casualties per year that is expected following the implementation of each program.

Choice: Which program do you favor?

	Deaths	Cost
Program 1 [68%]	500	55 M\$
Program 2 [32%]	570	12 M\$

Matching: Make the two programs equally attractive:

	Deaths	Cost
Program 1	500	... M\$
Program 2	570	12 M\$

Choice and Matching: prominence

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Matching: Make the two programs equally attractive:

	Deaths	Cost
Program 1	500	... M\$
Program 2	570	12 M\$

4% of subjects assign a value greater than 55 M\$, showing a preference for program 1. The average value that is assigned is 40 million \$.

Compatibility (challenging econ, p. 355)

Consider two types of bets:

- \$-bets $11/36$ to win \$160, $25/36$ to lose \$15
- P-bets $35/36$ to win \$40, $1/36$ to lose \$10

When presented in pairs (P-bet compared with a \$-bet), there is a clear preference for P-bets.

When asked to provide willingness to pay (WTP) the \$-bets are priced higher than the P-bets (even within!)

Contingent weighting: The weighting of a dimension (probability or value) is “contingent” on the way in which preferences are elicited.

Response-mode compatibility is a cause for this contingent weighting: \$-bet gets more important for pricing task...

Joint vs. Separate Evaluation

Two ways of measuring overall judgments of options: **jointly or separately**.

Discrepancies in evaluations between joint and separate modes.

Cause: Differential weighing of attributes in the two modes of evaluation.

Example: **Evaluability** of attributes

(Hsee, 1996; Hsee et al. 1999)

Most of chapter 33 is from a broader perspective

Dictionary Example (Hsee, 1996)



Dictionary A

Entries: 10.000

State: like new

Dictionary Example (Hsee, 1996)



Dictionary B
Entries: 20.000
State: torn cover,
otherwise like new

Dictionary Example (Hsee, 1996)



Dictionary A

Entries: 10.000
State: like new



Dictionary B

Entries: 20.000
State: torn cover,
otherwise like new

Evaluability Hypothesis

Weight of an attribute increases with the **evaluability** of the attribute.

Some attributes (e.g., number of entries) are hard to evaluate separately.

Separate Evaluation:

Hard-to-evaluate attribute has little impact

Easy-to-evaluate attribute is the primary determinant

Dictionary: weight of the ‘entries’ attribute increases from separate to joint evaluation, causing a **preference reversal** between JE and SE mode.

Choosing candidates: The programmer study

Evaluations of two job candidates for a computer programmer position expecting the use of a special language called KY.

	Candidate A	Candidate B
Education	B.Sc. computer Sc.	B.Sc. computer Sc.
GPA (0-5)	4.8	3.1
KY Experience	10 KY programs	70 KY programs

Mean WTP (in thousands):

Separate	\$ 32.7	\$ 26.8
Joint	\$ 31.2	\$ 33.2

Broader consequences from ch 33...

Kahneman: Life is a between-subjects experiment
(you are often in separate evaluation mode)

Saving Dolphins from pollution versus Farmers from skin cancer...
The ‘human’ attribute only plays a role in JE

Amount of punitive damages awarded to a child burned versus an defrauded bank...

Jurors are prohibited to compare cases: legal system favors single evaluation
Very different amounts between fields:
Working safety: \$7000, Wild life: \$25000!

What mode should you use?

Buying a new speaker set

Shop: Joint evaluation mode (looks/price versus Q)



At Home:
Single evaluation...



Application: ratings in recommenders

Recommender systems use ratings: Separate Evaluation

Ratings are absolute statements of preference...

But preference (voorkeur) is a relative statement...



Application: ratings in recommenders

Recommender systems use ratings: Separate Evaluation

Ratings are absolute statements of preference...

But preference (voorkeur) is a relative statement...

I like Grand Budapest hotel more than King's Speech



Which do you prefer?

Applications: Exemplar Interface

Support rating on the scale by providing exemplars:

Exemplar: Similar movies rated before by that user for that level on the scale

This helps to anchor the values on the scale better: more consistent ratings



(c) Exemplar Interface

Choice-based preference elicitation

Can we use a set of choices rather than a set of ratings to learn the preferences of a user?

Participant makes 10 choices
for 10 movies.

Less effort, less difficult to choose
from recommendations and more
satisfaction with the movies chosen
in choice-based over rating-based Pref. Elic.

SELECT THE MOVIE YOU WOULD LIKE TO SEE

Remaining number of choices: 10

Trailer



The wife of a barbaric crime boss engages in a secretive romance with a gentle bookseller between meals at her husband's restaurant. Food, colour coding, sex, murder, torture and cannibalism are the exotic fare in this beautifully filmed but brutally uncompromising modern fable which has been interpreted as an allegory for Thatcherism.

Summary

Genres

Crime|Drama|Romance

Director

Peter Greenaway

Cast

Richard|Richard Bohringer|Albert|Michael Gambon|Georgina|Helen

Movies



Select Select Select Select Select Select Select Select Select



Temporal aspects (time discounting)

Not in Kahneman...

Fill in the quiz on canvas for today: Lecture quiz temporal decision making

Temporal aspects of decision making

Many decisions involve a conflict between satisfying **immediate** vs. **future** goals.

Spend now, or save and spend more later

Bias in favor of the present:

People are temporally myopic (nearsighted)
strong preference for immediate over delayed rewards

Computeridee (<http://www.computeridee.nl>)

Vakantiegeld naar laptop of computer

maandag 18 mei - Door: Annemarie Korevaar



Een nieuwe laptop of computer zijn de meest gewilde elektronica-producten waaraan het vakantiegeld in de maand mei besteed gaat worden. Meer dan een kwart (27%) kiest daarvoor, een vijfde geeft de voorkeur aan een televisie. Ook zijn dit jaar digitale foto- en videocamera's zeer in trek.

Opvallend is dat, zo blijkt uit het onderzoek door Maurice de Hond, uitgevoerd in opdracht van elektro-retailer BCC, vrouwen hun vakantiegeld aanmerkelijk vaker dan mannen zouden besteden aan een fotoapparaat of videocamera, een i-pod of keukenapparatuur. Mannen spenderen dit eerder aan geluidsinstallaties, koelkasten en vriezers en navigatiesystemen.

http://www.computeridee.nl/artikel_print.jsp?id=2427031&rubriek=284536

Delay of gratification and uncertainty

Time discounting as a result of this time preference

Economists call it discounting of the future because future gains or losses are discounted (underweighted).

There are good reasons to discount the future:

- If you have \$100 now, you can invest it and get more in the future anyway
- You might be more certain about your preferences now than in the future
- The future is uncertain (the economy can collapse, you can die or become a millionaire) and therefore you might discount future gains and losses

Discounting

Discounted Utility model (Samuelson, 1937)

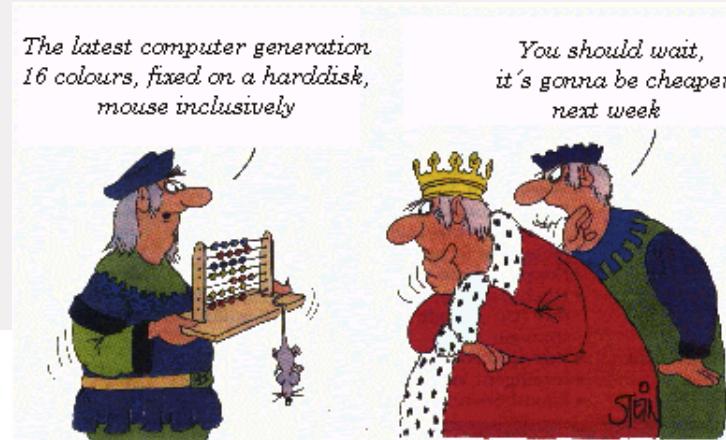
DU tries to capture discounting in one factor:

discount rate: if I am indifferent between 100 euro now, and 120 euro in a year, my discount rate is 20%

Good reasons to discount future (as future is always uncertain)

Compare Interest rates!

Discounting models use exponential decay



Dynamically inconsistent choices

Economic theory: rewards lose their utility at a constant (percentage) rate over time.

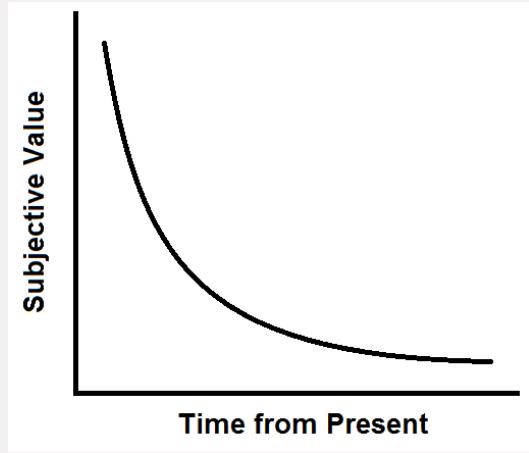
- idea behind interest rates
- exponential function

Consequence: Delay independence:

The relative preference among two future outcomes at different times should depend only on the outcomes and on the time difference between them, but not on the time at which you make your choice.

- (a) What do you prefer: € 90 today or €100 in a month?
- (b) What do you prefer: € 90 in 24 months or €100 in 25 months?

These should be the same...



Immediacy effect

Problem 1: (a) € 150 today

(b) € 170 in 6 months

Problem 2 : (c) € 150 in 2 years

(d) € 170 in 2 years and 6 months.

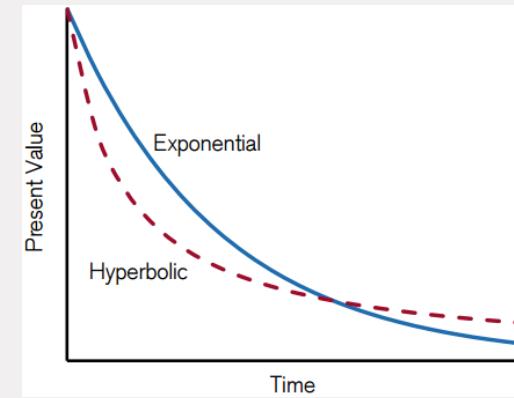
Immediacy effect

Problem 1: (a) € 150 today
(b) € 170 in 6 months

Problem 2 : (c) € 150 in 2 years
(d) € 170 in 2 years and 6 months.

The *immediacy effect*: Most people prefer a>b and d>c
(note similarity with the certainty effect)

Hyperbolic rather than exponential discount functions.



Commitment and Procrastination

Postpone ought, do nice things (vices) now

But we do set deadlines to control ourselves!

Study 2: Proofreading texts for money, but with a deadline and penalties
(Ariely & Wertenbroch, 2002)

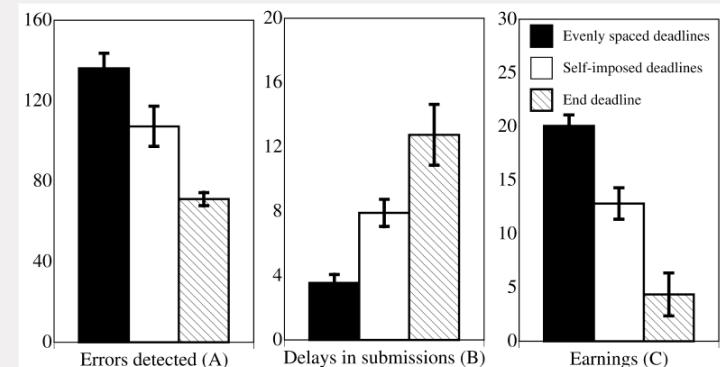
<https://bigthink.com/videos/dan-ariely-on-overcoming-procrastination>

Conditions: evenly spaced deadlines, Self-imposed deadlines, or end deadlines

People do not put deadlines at the end (but distribute)

Evenly spaced worked best

- More errors detected
- Less submission delays
- Highest earnings



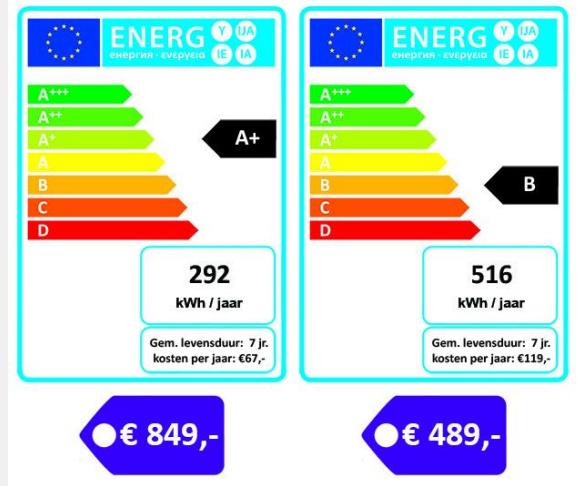
Application: dryers

Temporal decision:

Cheaper now versus cheaper in the future!

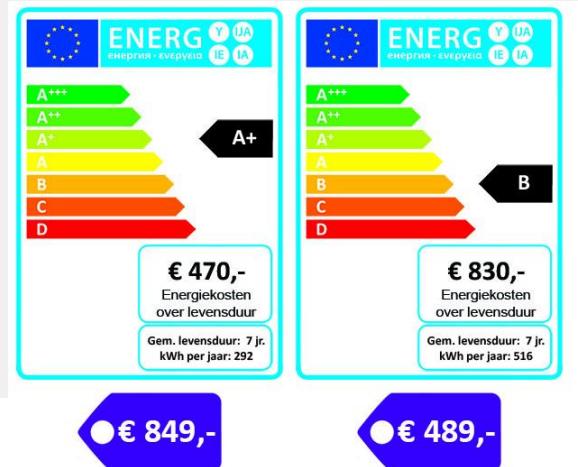
Top: Yearly usage costs and energy consumption

55% choice for efficient one



Bottom: Life cycle costs (costs over the life time)

80% choice for efficient one



(HTI MSc research project)

Temporal and experiential decisions

Kahneman Part 5

Thinking and Deciding

Martijn Willemsen

Experiential decisions (ch 35)

Different types of utility can be observed:

Decision utility: The utility at the time of decision, as revealed from one's choice

Experienced utility: Experiencing the consequences of the decision, feeling with the chosen option

Reducing painful injections from 20 to 18 or from 6 to 4: increase in experienced utility is the same, but people would pay more for the second one...

Decisions and experiences are not always aligned...

Lay Economism

Imagine that you could receive a piece of chocolate at the prize of winning a lottery and could choose either a smaller and less expensive (.5 oz/\$.50) chocolate with the shape of a heart, or a larger and more expensive (2 oz/ \$2.00) chocolate with a shape of a cockroach.

A



\$.50

B



\$ 2.00

Which would you enjoy most, A or B?

Which would you choose, A or B?

Lay Economism

Imagine that you could receive a piece of chocolate at the prize of winning a lottery and could choose either a smaller and less expensive (.5 oz/\$.50) chocolate with the shape of a heart, or a larger and more expensive (2 oz/ \$2.00) chocolate with a shape of a cockroach.



\$.50



\$ 2.00

Most respondents say they would enjoy more the heart shaped chocolate but when asked to choose most choose the cockroach shape.

Inconsistency between decision and (predicted) experienced utility

Experiences: Peak/end rule

Overall experience should depend on length and intensity: duration is important (integral: area under curve)

Snapshot model

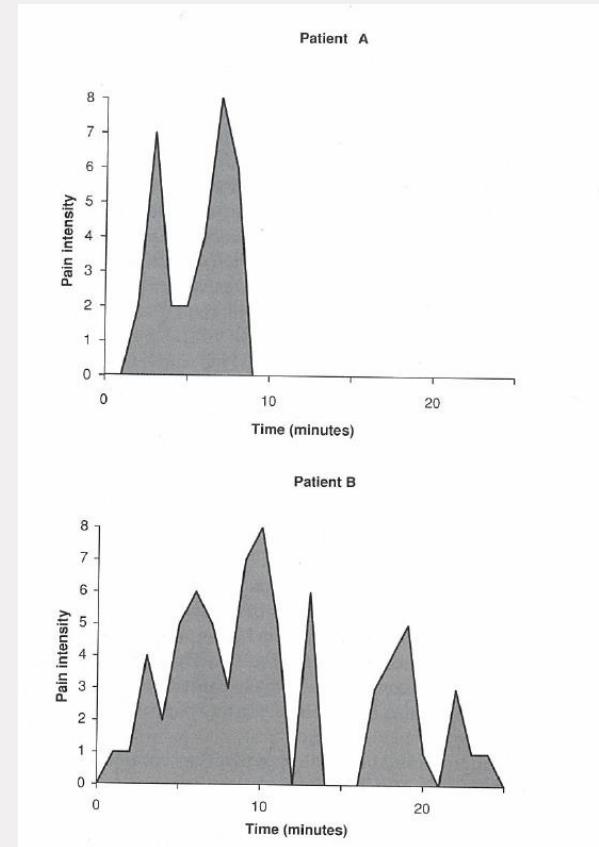
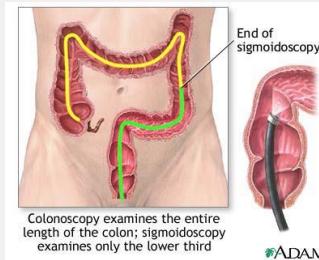
averaging the peak and the end experiences replaces the duration as a heuristic attribute

Example: Painful Colonoscopy

Patient B has a worse colonoscopy, but A evaluates the total experience as worse

A's peak/end average is worse!

Duration neglect!



Two Selves

Experiencing Self: momentary evaluation of how we feel (Does it hurt now?)

Remembering Self: overall evaluation based on memory (how was it, on the whole?)

Generated by averages, prototypes, not sums!

Bad endings do not ruin the experience, but they can ruin the memory, and our memory is all we get to keep...

More controlled experiment...

Cold water study (Kahneman et al. 1993)

Holding hand in painfully cold water:

1. 60s of very cold water and then 30s of mildly-cold water
2. 60s of very cold water



People typically select 1) to do again, despite the longer suffering (for the experiencing self)

- They chose the one for which they had better memory!
- Disconnect of decision and experienced utility

Less is more effect ruled by System 1

Prototypical representation of the trial from memory guides the evaluation

Life as a story (ch 36)

Happiness & Well-being: Ed Diener

Jen: never married, died painlessly in accident

- A) Extremely happy through life (30/60 years)
- B) Extremely happy (30/60 years) + 5 years pleasant

Questions:

Taken her life as a whole, how desirable was it?

How much TOTAL happiness did she experience?

Results

Both duration neglect and peak-end effect...

Doubling the duration (30/60 yr) did not matter on both desirability as well as total happiness

Prototypical slice of time, not the sum of slices...

Less is more: adding 5 slightly happy years caused large drop in overall happiness

For between but ALSO for a within experiment!

Amnesic vacations

Vacations are all about generating memories

Enjoy the view later.... From your photos?

Diener: Spring break, students maintaining diaries and gave a final, global rating

Repeat the vacation? based on global rating (memory) not on day to day experience

- Would you go on holiday if we wipe your memories?

Why then do we still experience longer vacations as better? more refreshed at the end (better end!)



Experienced well-being (ch 37)

Trying to get a better measure of well-being than global Satisfaction: “*all things considered, how satisfied are you with your life as a whole these days?*”

A profile of well-being over successive moments in a life

Experience sampling -> DRM
(Day reconstruction method)

Relive day, break un in episodes feeling of prototypical moment in each episode



U-index

U-index: Duration of unpleasant episodes: more negative than positive feelings

4 out of 16 waking hours in unpleasant state: 25%!

Large individual differences in U-index scores

Examples of U-index scores:

Commuting 29%, Work 27%, child care 24%, house work 18%,
socializing/watching TV 12%, Sex 5%

Need attention to enjoy something (US versus France eating/dinner)

Well-being is strongly situational!

We control our time and therefore our experienced well-being...

Life evaluation versus exp. well-being

Some things influence life evaluation more than experienced well-being or vice versa

- Education: higher life evaluation but not more well-being (side effects of stress etc)
- Ill health or children decrease well-being but not life evaluation
- Exp. Well-being does not increase above \$75k
high income allows for getting more pleasure but also reduces the ability to enjoy small pleasures...

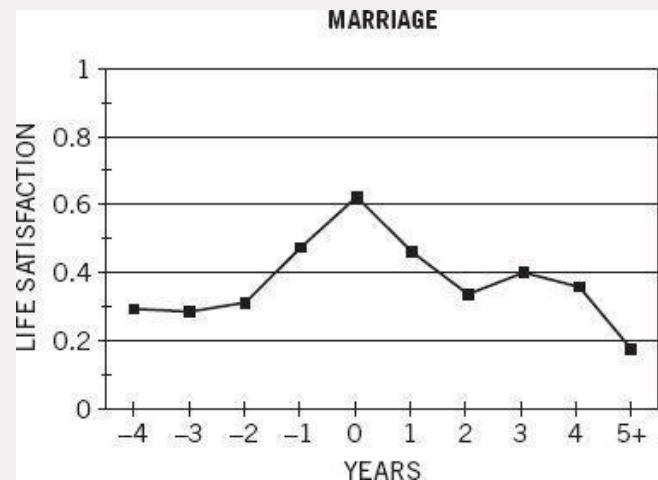
Conclusion: life satisfaction/evaluation is just different from experienced well-being!

Affective forecasting (ch 38)

Life satisfaction and marriage: problem of affective forecasting?
(we think we will end up happier when married)

Kahneman: attention is the key: only when asked about life sat. close to your marriage, you take that as a cue...

At other moments, experienced-well being will be quite equal (reasons for and against being happier...when married or not)



Focusing illusion

“Nothing in life is as important as you think it is when you are thinking about it”

Midwest and Californian people tended to believe Californians were more happy than Midwesterners

However, actual happiness ratings showed no difference (too much focus on the climate)

Lottery winners are not much happier after some time than others

Too much focus on the lottery, less on other aspects

Paraplegics are not less happy after some time

And their friend know, but others not...

Corona times...

What would you have predicted (in March) how you would feel after working 3 months from home? Compare to one month?

How would you describe that experience now: does the duration matter?
Does it matter that you have some activities starting again?



0HV60 Thinking and Deciding

Lecture 14 Decision Strategies & Recommender Systems

Martijn Willemsen

Literature for this part

Bettman, J.R., Luce, M.F., & Payne, J.W. 1998,
Constructive Consumer Choice Processes, Journal of
Consumer Research, 25, 187-217

relevant part: pp 187-192

Constructive Consumer Choice Processes

JAMES R. BETTMAN
MARY FRANCES LUCE
JOHN W. PAYNE*

Consumer decision making has been a focal interest in consumer research, and consideration of current marketplace trends (e.g., technological change, an information explosion) indicates that this topic will continue to be critically important. We argue that consumer choice is inherently constructive. Due to limited processing capacity, consumers often do not have well-defined existing preferences, but construct them using a variety of strategies contingent on task demands. After describing constructive choice, consumer decision tasks, and decision strategies, we provide an integrative framework for understanding constructive choice, review evidence for constructive consumer choice in light of that framework, and identify knowledge gaps that suggest opportunities for additional research.

Consumer choices concerning the selection, consumption, and disposal of products and services can often be difficult and are important to the consumer, to market-

defined preferences that do not depend on particular descriptions of the options or on the specific methods used to elicit those preferences. Each option in a choice set is

Decisions & Preference elicitation

What alternative to choose from a larger set of alternatives (e.g., consumer decisions)

No direct outcome uncertainty as in gambles/bets

Most often, there is no dominating alternative

Alternatives have conflicting values: how much do we value one attribute relative to another?

Making a decision involves making trade-offs and resolving conflicting values to assess what is the best option of a set

Rational choice theory and MAUT

How do people cope with decisions?

- Considering all possible alternatives...
- Making difficult tradeoffs...
- Dealing with uncertainties...

Rational choice theory

- Option has a utility based on the utility of its attributes and weights for each attribute
- Utility depends only on characteristics of that option
- DM has the ability and motivation to do all computations
- DM choice is based on maximizing his received value

Normative decision rule: MAUT

Similar to expected utility for gambles

- Find all alternatives
- Describe (all) attributes of these alternatives
- Assess utility of each attribute value (u_i)
- Rate importance of each attribute (weights: w_i)

Select alternative with highest weighed value (multi- attribute utility theory):

MAUT:

$$U(x) = \sum_{i=1}^n w_i u_i$$

Descriptive information-processing approach

Humans have Bounded Rationality (Simon, 1955)

Limited capacities: working memory and computational abilities

Perceptions attuned to changes rather than absolute magnitudes
(diminishing sensitivity)

Interaction between properties of human the information-processing system and properties of task environment

Preferences of any complexity are often constructed: no well-defined preferences for many situations

Preferences not retrieved from a master list of preferences

DM use a wide variety of strategies/approaches

Decision tasks

Set of alternatives described by some attributes or consequences

Number of alternatives and attributes can vary

Difficulty of a choice task increases with:

- more options and attributes,

- Increased uncertainty about values of the attributes,

- Number of attributes that are difficult to tradeoff,

- Decrease in the number of shared attributes.

Decision strategies

A variety of strategies can be used depending on the task and context

Strategies be characterized by:

Total amount of information processed

Selectivity of the information processing

Pattern of processing (alternative or attribute-wise)

Compensatory or non-compensatory process

Decision task

Computer	Processor	Memory	HD	price
HP	2.0 GHz	6 GB	500 GB	€ 799
Dell	2.4 GHz	4 GB	750 GB	€ 699
IBM	2.6 GHz	8 GB	320 GB	€ 999
Asus	2.4 GHz	8 GB	1000GB	€ 750

Weighted Adding (Linear, ~MAUT)

		$W1 = .3$		$W2 = .3$		$W3 = .2$		$W4 = .2$		Σw_u
Computer	Processor		Memory		HD		price			
HP	2.0 GHz	3	6 GB	5	500 GB	7	€ 799	5		4.8
Dell	2.4 GHz	5	4 GB	3	750 GB	8	€ 699	7		5.4
IBM	2.6 GHz	6	8 GB	6	320 GB	4	€ 999	2		4.8
Asus	2.4 GHz	5	8 GB	6	1000GB	9	€ 750	6		6.3

Properties: extensive information search, consistent (not selective), alternative based and compensatory processing

Equal Weight

W1 = .25 W2 = .25 W3 = .25 W4 = .25 Σw_u

Computer	Processor	Memory	HD	price	
HP	2.0 GHz 3	6 GB 5	500 GB 7	€ 799 5	5.00
Dell	2.4 GHz 5	4 GB 3	750 GB 8	€ 699 7	5.75
IBM	2.6 GHz 6	8 GB 6	320 GB 4	€ 999 2	4.5
Asus	2.4 GHz 5	8 GB 6	1000GB 9	€ 750 6	6.5

Properties: extensive information search, consistent (not selective), alternative based and compensatory processing

Majority of confirming dimensions (MCD)

Alternatives are considered in pairs, values of the attributes are compared: those with the majority of winning attributes is retained and compared with the next option...

Computer	Processor	Memory	HD	price
HP	2.0 GHz	6 GB ✓	500 GB	€ 799
Dell	2.4 GHz ✓	4 GB	750 GB ✓	€ 699 ✓
IBM	2.6 GHz ✓	8 GB ✓	320 GB	€ 999
Asus	2.4 GHz	8 GB ✓	1000GB ✓	€ 750 ✓

Properties: extensive information search, consistent processing, attribute-based and compensatory processing

Lexicographic strategy

Select alternative with the best value on the most important attribute

Computer	Processor	Memory	HD	price
HP	2.0 GHz	6 GB	500 GB	€ 799
Dell	2.4 GHz	4 GB	750 GB	€ 699
IBM	2.6 GHz	8 GB	320 GB	€ 999
Asus	2.4 GHz	8 GB	1000GB	€ 750

Properties: limited information search, very selective across attributes, attribute-based and non-compensatory processing

Satisficing strategy

Alternatives are considered sequentially, in order of choice set: the first option that passes the cut-off for all attributes is selected

Computer	Processor	Memory	HD	price
HP	2.0 GHz ✗	6 GB	500 GB	€ 799
Dell	2.4 GHz ✓	4 GB ✗	750 GB	€ 699
IBM	2.6 GHz ✓	8 GB ✓	320 GB ✓	€ 999 ✓
Asus	2.4 GHz	8 GB	1000GB	€ 750

Properties: information search varies, selective processing, alternative-based and non-compensatory processing

Elimination by Aspects

EBA: eliminate options that do not reach cut-off for most important attribute, then for second most important until one option is left...

Computer	Processor	Memory	HD	price
HP	2.0 GHz ✗	6 GB	500 GB	€ 799
Dell	2.4 GHz ✓	4 GB ✗	750 GB	€ 699
IBM	2.6 GHz ✓	8 GB ✓	320 GB	€ 999 ✗
Asus	2.4 GHz ✓	8 GB ✓	1000GB	€ 750 ✓

Properties: amount information search varies, selective across attributes (varies), attribute-based and non-compensatory processing

Information processing versus perceptual processes

These decision strategies are all about amount of information processing...

Part of the so-called: Effort/accuracy framework

Perceptual approaches stress the importance of decision strategies that consider the relational and perceptual aspects of a decision

- Dominance relations among pairs of options
- Relative tradeoffs or disadvantages and advantages to other options

Componential context model

Componential Context model

Absolute (global) value component like in MAUT or in weighted adding

$$V(x; S) = \sum \beta_i v_i(x_i) + \theta \sum_{y \in S} R(x, y)$$

$$\text{where } R(x, y) = \frac{A(x, y)}{A(x, y) + D(x, y)}$$

Relative component to model the local context: relative advantages (A) and disadvantages (D) between options

Characteristics:

Compensatory, consistent and both attribute/alternative based.
amount of info processed? Depends...

Context effects: Adding options and justifications

Context effects: Choice between two options is influenced by additional options included in the choice set

Analysis in terms of reasons can explain observed violations of the principle of *independence of irrelevant alternatives* (preference ordering between two options should not be altered by the introduction of additional alternatives)

Context effects: **asymmetric dominance and extremeness aversion**

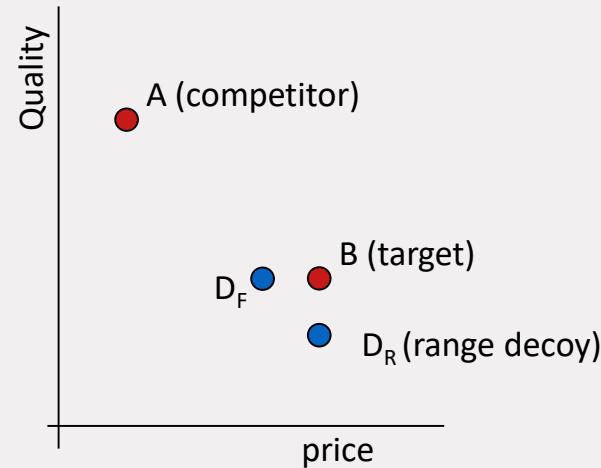
Asymmetric Dominance

Decoy (D) is inferior to target (B),
but not to competitor

Decoy will not be chosen, but target
receives increased choice share

Range (D_R) versus Frequency
(D_F)

Violates regularity (share of B
increases with D)

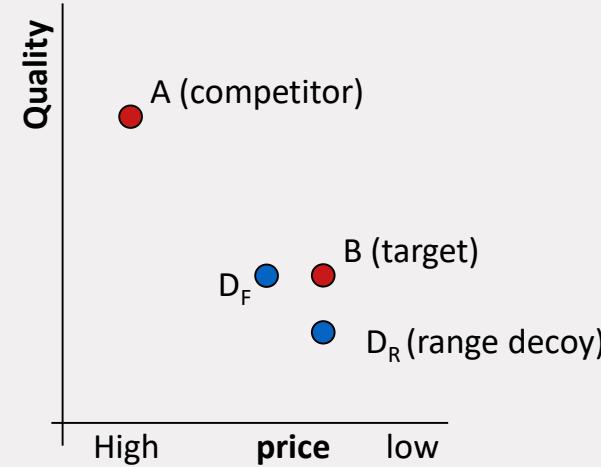


Examples Asym. Dominance

six pack beer

Option	Price	Quality
A (competitor)	\$2.60	70
B (target)	\$1.80	50
D _R (range decoy)	\$1.80	40
D _F (freq. decoy)	\$2.20	50

- No decoy: $P_B = 44\%$
Range decoy: $P_B = 66\%$
Freq decoy: $P_B = 52\%$



What explains Asym. Dominance

Range and frequency effects can only provide partial explanations

Based on reason-based choice:

Target wins from both competitor and decoy across attributes (target has an additional reason!)

Cost of thinking: Easy choice between target and competitor, difficult choice between target and competitor and decoy and competitor (justifiability)

Simonson found that asking for justification led to larger dominance effects

Compromise Effect (extremeness aversion)

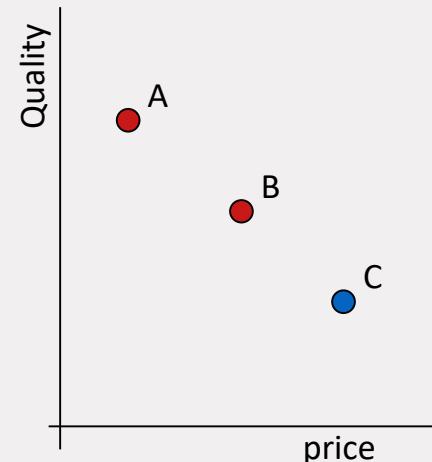
Loss aversion: disadvantages looms larger than advantages

Middle option (B) has smaller advantages and disadvantages to other options than extreme options: *Extremeness aversion*

Adding option C to A & B increases the relative share of B (compared to A)

Violation of proportionality, (C takes more from A than from B)

Potential violation of regularity



Examples of compromise

35 mm Camera	Set 1 (n=106)	Set 2 (n=115)
Minolta X-370	50%	
Price: \$ 169.99		
Minolta Maxxum 3000i	50%	
Price: \$239.99		
Minolta Maxxum 7000i		
Price: \$469.99		

Note: Participants had reviewed 5 cameras, including these three, prior to making the choice in both conditions (thus not due to an effect of different states of information)

Cognitive processes

We used mouselabWEB to understand the cognitive processes in context effects

4 product types:

Printers, cell phones, dvd-players and small TVs

Two attributes: features (Quality) and price

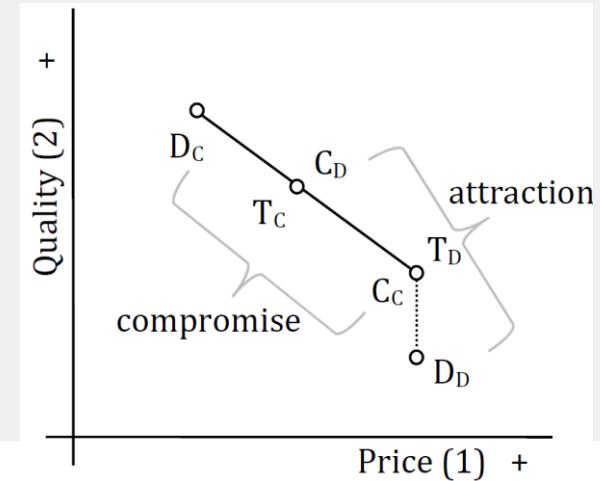
Each participant did a
binary choice (TC)
compromise (TCD_c)
attraction (TCD_a)

Cell Phone

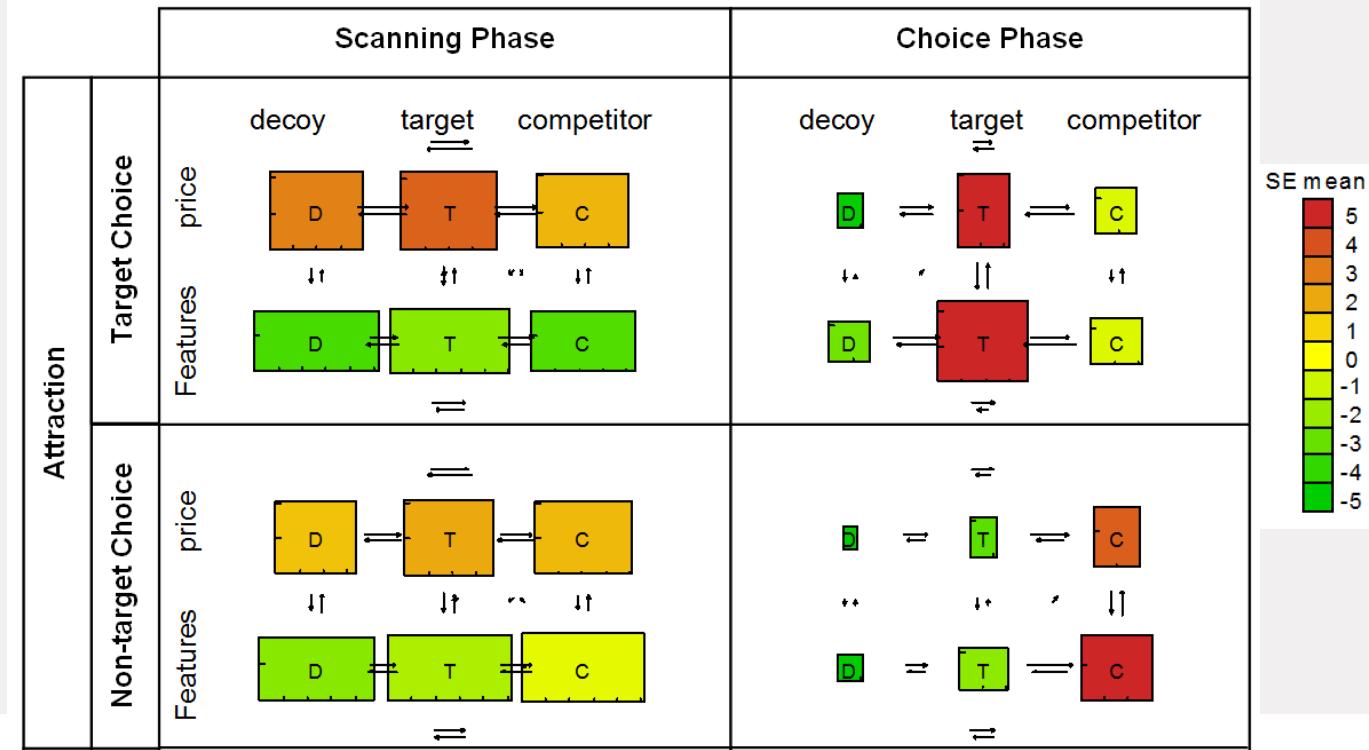
Imagine you are moving to a different city. Your current cell phone provider does not serve this new city and you have to select a new plan with a new cell phone from another provider. In the new city there are several providers that offer similar network coverage. Their plans and the cell phones they offer are presented below. Because you are not sure how long you will remain in this area, you have decided not to commit to a long term plan. Thus the phones are not (fully) subsidized by the providers and you will have to pay some amount for the phone.

Make a choice among these cell phones and plans by pressing the button below the phone/plan of your choice.

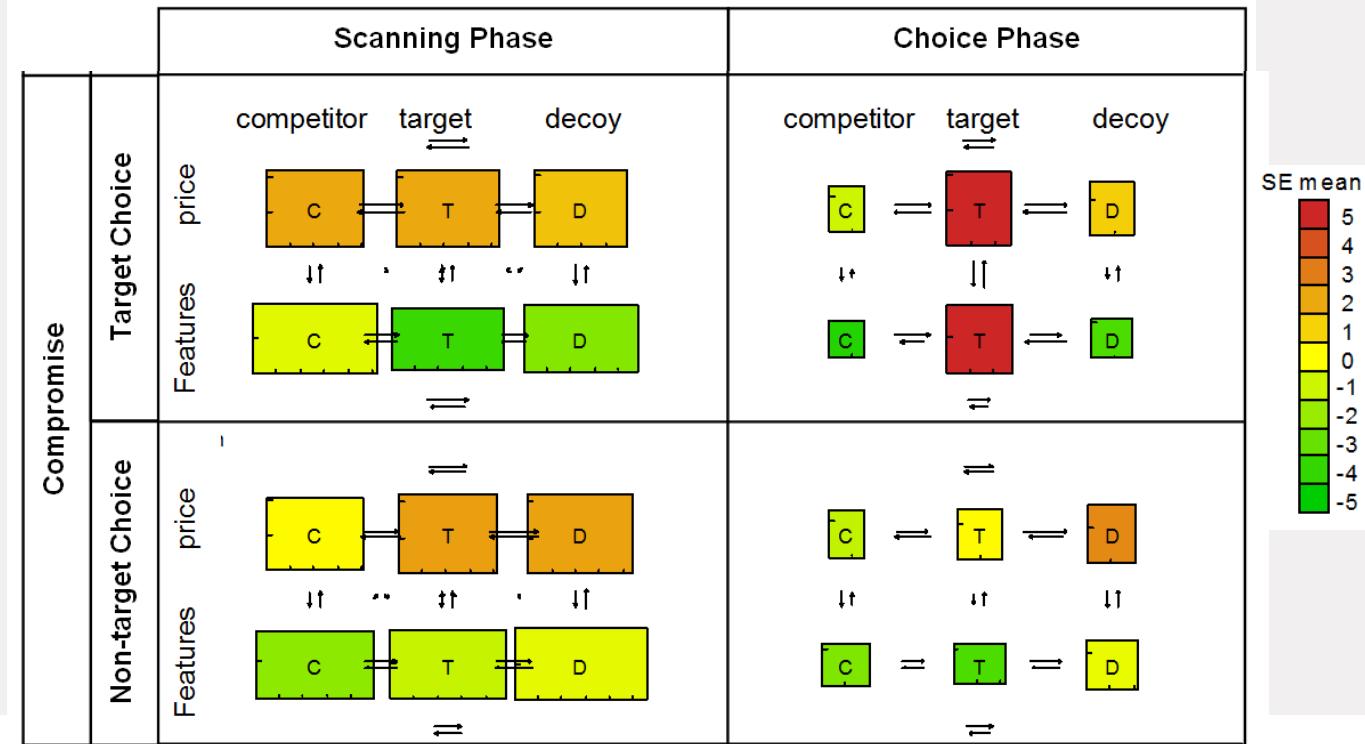
	A-plus	B-ext	Freedom-C
Features			
Price			
	<input type="button" value="A-plus"/>	<input type="button" value="B-ext"/>	<input type="button" value="Freedom-C"/>



Icon graphs Attraction



Icon Graphs Compromise



Strong order effects

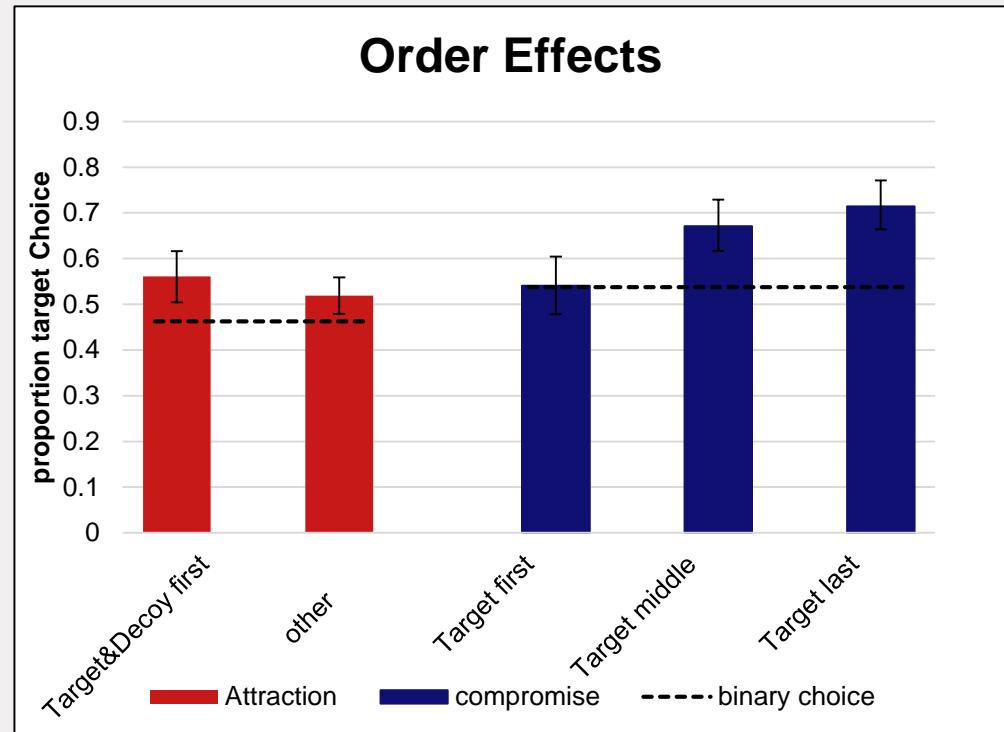
Compromise:

No comp. effect for T first

Strong effects for others first

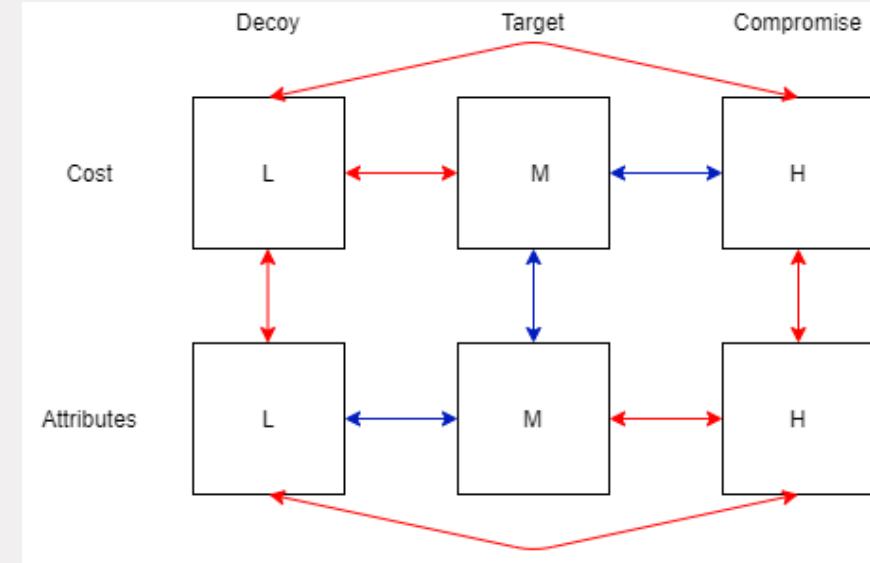
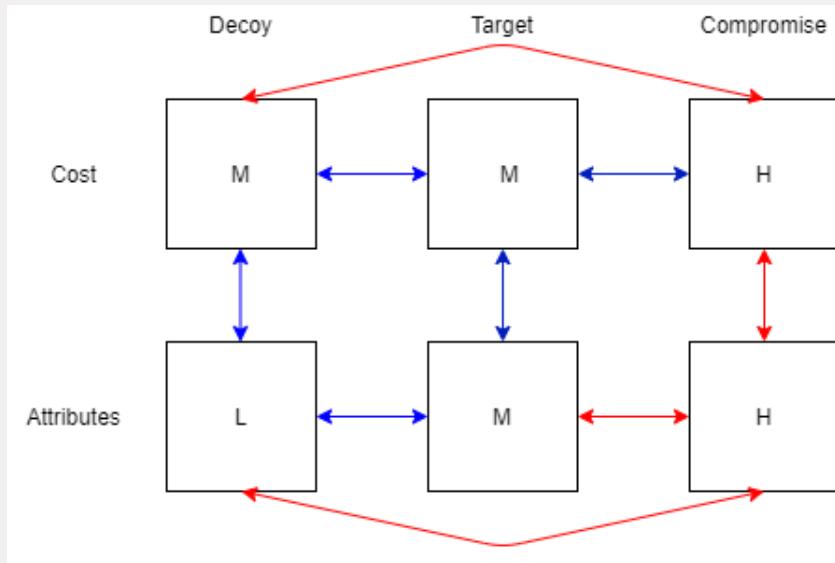
Attraction:

No effect for 'other', small effect for TD first



New experiment with mouselab

We use opening delays to boost or hinder target attention and target choice
attraction compromise



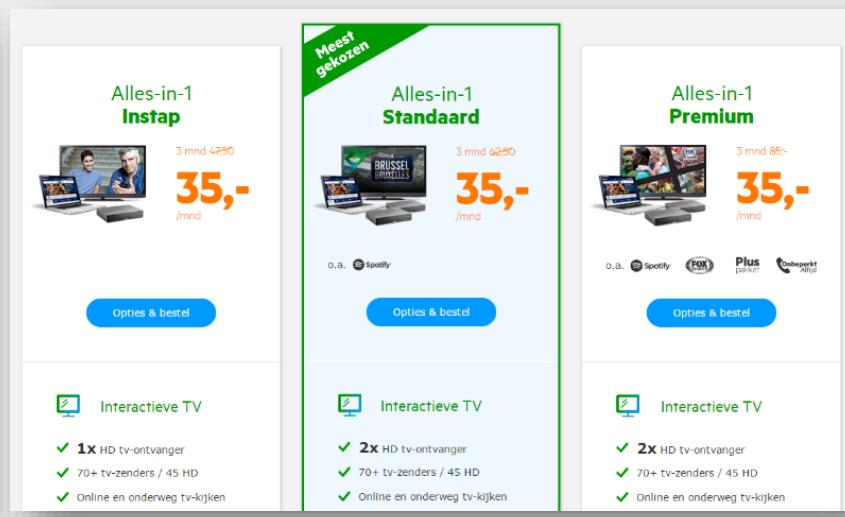
try this yourself: what strategies are supported?

The screenshot shows a search results page for "Smartphones" on the tweakers.net website. The top navigation bar includes links for Nieuws, Reviews, Pricewatch, Vraag & Aanbod, Forum, Meer, Inloggen, Registreren, and a TRUE logo. The main content area features a smartphone icon and the title "Smartphones". Below this, the breadcrumb navigation shows Tablets en telefoons » Telefoons » Smartphones. The search results are titled "Vergelijk Smartphones" and include a sidebar with filtering options: Trefwoord (Verfijn resultaten), Toestelprijs (€ 0 - ≥ € 1.200), Beoordeling (1-5 stars), and Merken (wel, Apple, Huawei). The main table lists four smartphone models with their details and pricing:

Model	Specificaties	Prijs
Samsung Galaxy S7 32GB Zwart	5,1" display, 4G-support, met geheugenslot 32GB Keuze uit 6.360 abonnementen ★★★★★ 34 reviews	€ 529,95 41 prijzen
Alcatel Shine Lite Goud	5" display, 4G-support, met geheugenslot 16GB Keuze uit 1.496 abonnementen ★★★★★ 2 reviews	€ 175,92 13 prijzen
Huawei P9 Lite Dual Sim (3GB) Zwart	5,2" display, 4G-support, met geheugenslot 16GB Keuze uit 5.146 abonnementen ★★★★★ 7 reviews	€ 243,02 30 prijzen
Lenovo P2 Grijs	5,5" display, 4G-support, met geheugenslot 32GB Keuze uit 1.583 abonnementen ★★★★★ 12 prijzen	€ 298,-

Let's try this yourself

CPU Technical Specifications			
CPU Cores	4 ✓	vs	✓ 4
CPU Threads	4 ✓	vs	✓ 4
Clock Speed	4 GHz ✓	vs	3.2 GHz
Turbo Frequency	4.2 GHz ✓	vs	3.6 GHz
Max TDP	95 W ✓	vs	65 W
Lithography	28 nm ✓	vs	14 nm
Bit Width	64 Bit ✓	vs	✓ 64 Bit
Max Temperature	72°C ✓	vs	71°C
Virtualization Technology	no	vs	no
Comparison			



All-in-1 Instap
3 mind 4750
35,-
/maand

All-in-1 Standaard
3 mind 2250
35,-
/maand

D.A. Spotify FOX Plus pakket Onderwerp Acht

All-in-1 Premium
3 mind 85-
35,-
/maand

Spotify FOX Plus pakket Onderwerp Acht

Opties & bestel

Opties & bestel

Opties & bestel

Interactieve TV

✓ 1x HD tv-ontvanger
✓ 70+ tv-zenders / 45 HD
✓ Online en onderweg tv-kijken

Interactieve TV

✓ 2x HD tv-ontvanger
✓ 70+ tv-zenders / 45 HD
✓ Online en onderweg tv-kijken

Interactieve TV

✓ 2x HD tv-ontvanger
✓ 70+ tv-zenders / 45 HD
✓ Online en onderweg tv-kijken

What sort of support are we missing on regular websites?

Decision Aids:

A simple energy recommender system using MAUT

Martijn Willemsen

with Bart Knijnenburg & Ron Broeders

How can we help people to save energy?

De geschatte besparingen in dit overzicht zijn gebaseerd op een gemiddeld huishouden

Alle 70 bespaartips

 U bespaart
€ 37 p.jr.

Koop een LCD-TV in plaats van een plasma-TV. Het energieverbruik van een plasma-TV ligt bijna vier keer hoger dan dat van een LCD-TV. Een LCD-TV gebruikt 'slechts' 50% minder energie dan een plasma-TV. Een LCD-TV is daarmee een zuinige optie over te stappen naar een plat beeldscherm.

Besparing per jaar op basis van een gemiddeld huishouden:

- Verbergen
- Audio en Video

 U bespaart
€ 160 p.jr.

Isoleer uw gevels

- + Meer
- Isolatie

 U bespaart

Overweeg de vervanging van uw oude vriezer

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Home Generation Distribution Retail Services Media Careers About us



Interactive house
→ Room-by-room energy saving tips

99 Energy Saving Tips

250 tips om energie te besparen

250 tips om energie te besparen

e.on

Eneco

In huis

Isolatie	5
Verlichting	11
Verwarming	14
Huishoudelijke apparaten	21
Wassen en drogen	24
In de slaapkamer	29

In keuken

Waterverbruik	30
Koelen en vriezen	31
Koken	32
Afwasmachine	35
	39

In de badkamer

	43
--	----

In de studeer-/werkkamer

	46
--	----

Om het huis

In de tuin	51
De auto	54
	59

Overige bespaartips

	60
--	----

Decision makers need help...

Information on these measures is unstructured, incomplete and hard to compare

Options are not described on the same attributes

Information is lacking on relevant attributes

Difficult to make tradeoffs

first step: We constructed a broad list of 80 measures described on 8 relevant attributes (effort, costs, savings, return on investment, comfort)

Second step: we build a recommender system to help people choose from these 80 measures

All measures on all attributes...

energiemaatregel	Moeite eenmalig [0-50]	Moeite continu [0-50]	Kosten eenmalig	Besparing euro/jaar	Besparing kWu/jaar	Terugverdientijd	Milieu-effecten [-25-25]	Comfort [-25[25]	
LED lampen plaatsen	10	0	€ 105.00	€ 121.20	537 kWu	11 maanden	3	-3	
PC energiebeheer inschakelen	5	0	geen	€ 67.20	320 kWu	direct	8	-2	
Warmtewisselaar op ontlichting plaatsen	49	0	€ 1139.50	€ 261.06	3055 kWu	5 jaar	-9	0	
Koken op gas ipv elektrisch	27	0	€ 190.00	€ 75.00	210 kWu	31 maanden	10	16	
Groene stroom	15	0	geen	geen	0 kWu	direct	24	0	
PC uitzetten bij afwezigheid	0	7	geen	€ 96.28	458 kWu	direct	0	-6	
Was opsparen	0	1	geen	€ 57.75	275 kWu	direct	7	-10	
Laptop in plaats van PC	9	0	€ 95.00	€ 31.50	150 kWu	3 jaar	12	6	
‘s Avonds gordijnen/luiken sluiten	0	2	geen	€ 57.47	639 kWu	direct	0	6	
3 minuten korter douchen	0	3	geen	€ 50.00	450 kWu	direct	6	-5	
Spaarlampen plaatsen	5	0	€ 69.30	€ 85.99	460 kWu	9 maanden	-5	0	
Waakklam CV doven in de zomer	0	4	geen	€ 59.85	665 kWu	direct	0	0	
Drogen op waslijn	0	25	geen	€ 60.90	290 kWu	direct	15	-13	
Thermostaat 1 graad lager zetten	0	0	geen	€ 51.00	567 kWu	direct	0	-6	
A++ Koel/vriescombi	3	0	€ 180.00	€ 73.50	350 kWu	29 maanden	-7	11	
Boliertemperatuur op 65 graden	6	0	geen	€ 25.41	121 kWu	direct	6	0	
A+ Koel/vriescombi	6	0	€ 110.00	€ 56.70	271 kWu	21 maanden	-4	10	
Douche ipv bad	0	0	geen	€ 6.00	0.02 kWu	direct	0	-10	
Lagere temperatuur wassen	0	3	geen	€ 21.00	100 kWu	direct	4	0	
Altijd gedimde lampen vervangen	1	0	geen	€ 45	10.96	62 kWu	2 maanden	5	0
Shirts kort in de droger ipv strijken	0	7	geen	€ 12.75	56 kWu	direct	0	24	
Waterbesparende douchekop	1	0	€ 30.00	€ 36.00	400 kWu	10 maanden	1	7	
Gasverwarmde wasdroger	16	0	€ 650.00	€ 100.00	370 kWu	7 jaar	-5	7	
Programmeerbaar thermometer	20	3	€ 48.05	€ 58.00	644 kWu	10 maanden	-3	11	
Wollen deken ipv elektrisch	0	0	€ 72.85	€ 12.60	60 kWu	6 jaar	0	11	
Thermostaat voor slapen op 14 graden	0	2	geen	€ 29.00	322 kWu	direct	0	-3	
Beeldscherm PC uitschakelen	7	0	geen	€ 0.69	8 kWu	direct	8	-2	
Opladers ontkoppelen	0	6	geen	€ 29.40	140 kWu	direct	2	-5	
Kleding lichten ipv wassen	0	4	geen	€ 5.46	26 kWu	direct	9	-14	
TFT-monitor ipv CRT	19	0	€ 200.42	€ 45.86	218 kWu	5 jaar	-4	16	
A-label wasdroger met warmtepomp	4	0	€ 600.00	€ 75.60	360 kWu	8 jaar	-6	2	
Dubbel glas plaatsen	41	0	€ 2460.00	€ 302.00	1438 kWu	9 jaar	-23	14	
Zonneboiler	12	0	€ 400.00	€ 104.49	1161 kWu	4 jaar	-14	0	
Telefoon met snoer	11	0	€ 15.00	€ 2.20	9 kWu	7 jaar	8	-8	
Wasmachine volledig uitschakelen	0	4	geen	€ 11.04	95 kWu	direct	2	-4	
Lampje in bedrukker verwijderen	1	0	geen	€ 1.58	18 kWu	direct	1	0	
Senseo helemaal uitzetten	4	2	€ 3.00	€ 16.59	79 kWu	2 maanden	1	-6	
Tochtstrip op ramen aanbrengen	17	0	€ 46.00	€ 41.40	460 kWu	13 maanden	-6	8	
Oven eerder uitzetten	0	1	geen	€ 2.25	11 kWu	direct	0	0	
PC met schakeldoos uitschakelen	4	1	€ 4.00	€ 15.77	175 kWu	1 maanden	-3	3	
Radiatorfolie aanbrengen	30	0	€ 35.00	€ 45.00	500 kWu	9 maanden	-4	8	

energiemaatregel	Moeite eenmalig [0-50]	Moeite continu [0-50]	Kosten eenmalig	Besparing euro/jaar	Besparing kWu/jaar	Terugverdientijd	Milieu-effecten [-25-25]	Comfort [-25[25]
Lampen uit doen	0	7	geen	€ 2.31	11 kWu	direct	2	0
Processor ondervolten	21	0	geen	€ 36.80	175 kWu	direct	-4	2
Koelkast uit bij vakantie	13	0	geen	€ 4.20	20 kWu	direct	0	5
Ontkalken koffiezetterapparaat	0	20	geen	€ 1.68	8 kWu	direct	7	6
Koei/vrieskast ijsvrij maken	0	11	geen	€ 9.87	47 kWu	direct	1	2
Dakisolatie	39	0	€ 3100.00	€ 299.00	1424 kWu	10 jaar	-15	6
Geen warme dingen in koelkast	0	3	geen	€ 0.42	2 kWu	direct	0	-2
Wasmachine ontkalken	0	6	geen	€ 8.25	10 kWu	1 maanden	-1	0
Vervang wekker(door) op wind-wekker	6	3	€ 11.50	€ 1.47	7 kWu	8 jaar	3	-7
Vaatwasser uit na gebruik	0	9	geen	€ 6.50	72 kWu	direct	0	-1
Tochtstrip op deuren aanbrengen	14	0	€ 7.50	€ 7.20	80 kWu	12 maanden	-3	7
Koken met deksel op de pan	0	13	geen	€ 1.05	5 kWu	direct	0	8
Tuinlampen op zonne-energie	7	0	€ 24.00	€ 5.75	54 kWu	5 jaar	-5	5
Roerbakken	0	10	geen	€ 2.00	5 kWu	direct	0	0
Thermostaat lager bij afwezigheid	0	14	geen	€ 1.10	13 kWu	direct	0	0
Mengkraan kouder zetten	18	0	geen	€ 8.00	38 kWu	direct	0	-4
Brievenbus met tochtstrip	15	1	€ 2.52	28 kWu	24 maanden	-2	3	
HR-E ketel / WKK	0	0	€ 3500.00	€ 320.00	2500 kWu	10 jaar	-16	0
Dagelijks 20 minuten luchten	0	19	geen	€ 25.00	8 kWu	direct	0	-13
Dag-nacht tarief	34	2	€ 102.40	€ 67.10	10 kWu	18 maanden	-8	0
Vegen ipv stofzuigen	0	10	€ 11.00	€ 12.00	56 kWu	11 maanden	-2	-11
Deurdanger	13	0	8.00	€ 19.60	218 kWu	4 maanden	-7	-6
Bewegingssensor	0	0	€ 7.99	€ 2.00	22 kWu	4 jaar	-4	15
Koffie in thermoskan ipv warmhoudpotje	0	16	geen	€ 4.83	23 kWu	direct	-7	6
Koelkast op de goede plek plaatsen	26	0	geen	€ 1.77	20 kWu	direct	0	-16
Trekbel ipv elektrische bel	24	0	€ 35.50	€ 0.79	9 kWu	45 jaar	-5	0
Warmwater-leidingen isoleren	32	0	€ 60.00	€ 13.00	133 kWu	5 jaar	-7	0
Hot-fill wasmachine	36	0	€ 125.00	€ 20.00	40 kWu	7 jaar	-10	7
Met de hand afwassen	0	46	geen	€ 63.63	303 kWu	direct	0	-22
Bladeren harken ipv blazen	0	28	geen	€ 2.19	10 kWu	direct	0	-14
Achterzijde koelkast stofvrij houden	0	30	geen	€ 1.18	13 kWu	direct	0	-20
Vloerisolatie	45	0	€ 1500.00	€ 126.00	600 kWu	12 jaar	-17	5
Magnetisch koelen	25	0	€ 1200.00	€ 8.10	90 kWu	150 jaar	-8	8
Geiser schoonmaken	0	7	geen	€ -38.63	120 kWu	nooit	2	0
Swifferen ipv stofzuigen	5	3	€ 19.97	€ -43.00	78 kWu	nooit	-4	13
Kaarsen	0	15	€ 2.00	€ -18.00	22 kWu	nooit	-3	0
BBQ-en	8	12	€ 27.00	€ -14.00	11 kWu	nooit	-8	0
Zonnepanelen	44	0	€ 3000.00	€ 110.00	325 kWu	25 jaar	-23	13
Mini-windmolens plaatsen	35	0	€ 4765.00	€ 19.00	1400 kWu	17 jaar	-25	-3

This is too much!
How to help
people choose?

Our recommender system

Indicate your preference
possible important they multiple your

Set attribute weights

	less important	more important
Little initial effort	8%	more important
Little continuous effort	11%	more important
Low initial costs	8%	more important
Save more money	14%	more important
Save more energy	22%	more important
Quick return on investment	8%	more important
Positive environmental effects	14%	more important
High comfort	15%	more important

Make a choice

Here are several recommendations; choose those energy-saving measures from this list which you

Recommendations

Name	Initial effort	Continuous effort	Initial costs	Turn on stment	Env. effects	Comfort
Roof insulation	high	low	€ 95.00	3 year	+	+
Laptop instead of a PC	medium	medium	none	direct	-	+
Turn off PC when absent	low	low	€ 96.28	458 kWh	+	+
Heap laundry	low	low	€ 10.00	3 year	+	+
Close curtains/shutters	low	low	€ 10.00	3 year	+	+
Wash clothes in 3 minutes	low	low	€ 10.00	3 year	+	+
Use heated dryer	low	low	€ 10.00	3 year	+	+
Air-dry clothes	low	low	€ 10.00	3 year	+	+
A++ Fridge/freezer	low	low	€ 10.00	3 year	+	+
A+ Fridge/freezer	low	low	€ 10.00	3 year	+	+

Show items with highest $U_{item,user}$ where

$$U_{item,user} = \sum V_{item,attribute} \cdot W_{attribute,user}$$

Your savings

Here are your selected savings!
Show totals in euro kWh

You have been using the system for 1 minutes. When you press stop, you will be asked a few final questions, after which you can print your savings.

stop

Selected measures

This is what I want to do:	
Enable PC energy management	€ 67.20
Install LED light bulbs	€ 121.20
Place heat exchangers on the air vents	€ 281.06
Shut down boiler in the summer	€ 59.85
This is what I will save per year:	€ 509.31

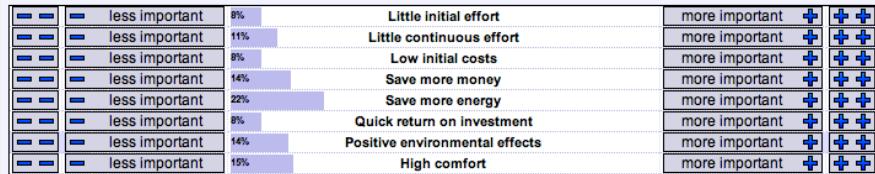
This is what I already do:	
Double glazing	€ 302.00
Green energy	none
Cook on gas instead of electric	€ 75.00
I was already saving per year:	€ 377.00

This is what I don't want to do:	
HR-E boiler	€ 320.00
Install CFL light bulbs	€ 85.99

Things you already do or don't want to

Attribute-based and implicit PE

Attribute-based: Users directly **set the weight** of each attribute. First used by Häubl and Trifts (2000)



Note: Straightforward, but **knowledge** of product attributes is required

Implicit: Attribute weights are **automatically inferred** from user's browsing behavior based on attribute values of inspected/ selected/ discarded recommendations

Note: Less input required, but may cause **narrowing** (a positive reinforcement loop)

Hybrids and base-line methods

Hybrid: A **combination** of implicit PE and attribute-based PE: Combines the convenience of Implicit PE with the ability to monitor and control the attribute weights manually

Note: Can overcome narrowing, but adds some **complexity**

Base-line methods: Test systems against one or more non-personalized baseline systems

Top-N: simply ranks the energy-saving measures in decreasing order of popularity.

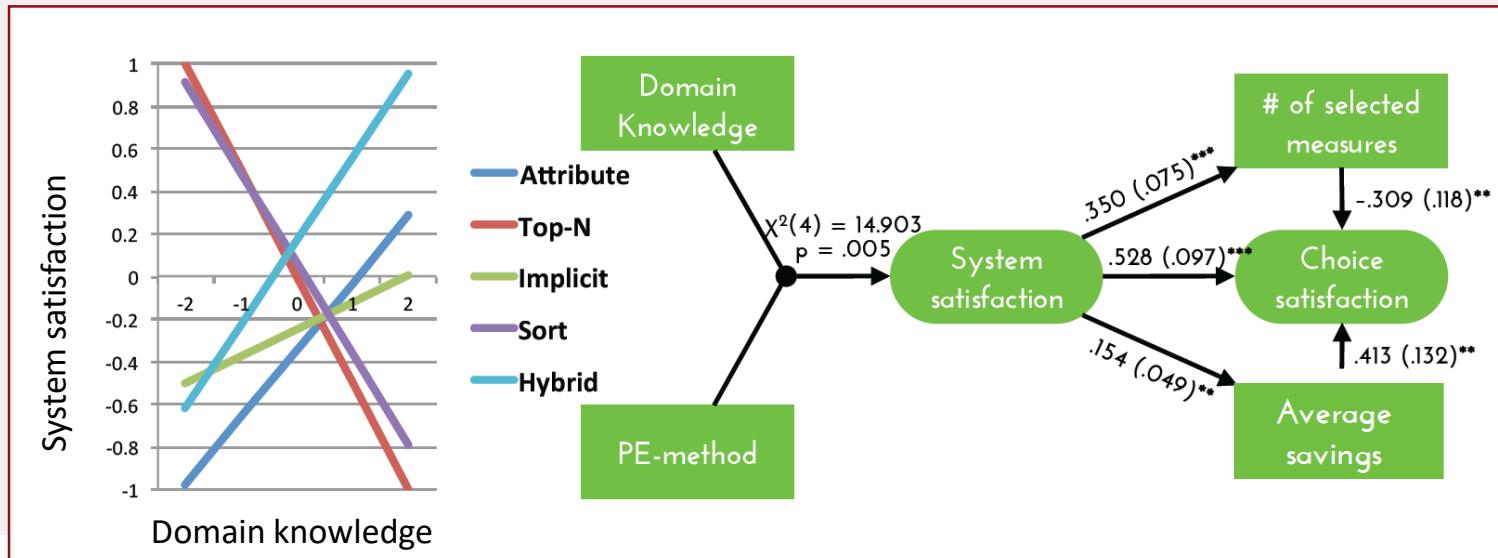
Sort: allows users to sort the recommendations on one of the attributes (Lexicographic strategy!)

Note: These methods are simple but provide **little control** over the recommendations

Study 1 — Results

Experts prefer Attribute-based PE and Hybrid PE, novices prefer Top-N and Sort (baselines)

System satisfaction mediates the effect on choice satisfaction and behavior



A Rasch-based energy recommender

Work with Alain Starke

Starke, A., Willemsen, M., & Snijders, C. (2017). Effective User Interface Designs to Increase Energy-efficient Behavior in a Rasch-based Energy Recommender System. In Proceedings of the Eleventh ACM Conference on Recommender Systems (pp. 65–73). New York, NY, USA: ACM.

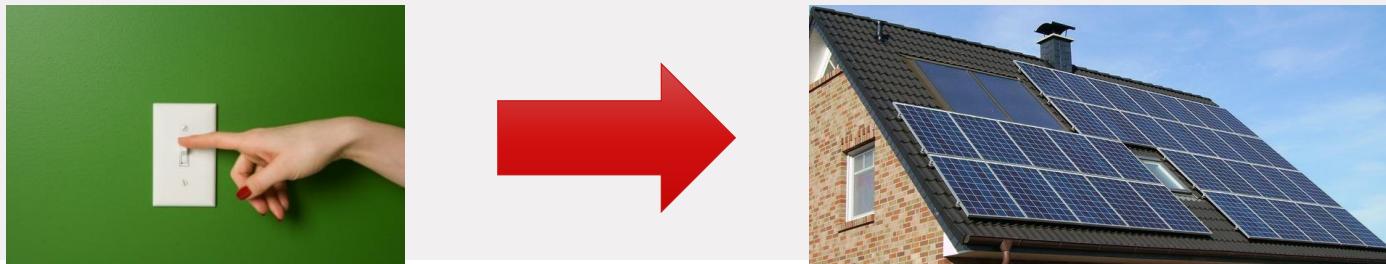
(paper is not exam material)

A different approach:

Regular RecSys approaches, e.g. collaborative filtering, are prone to reinforcing current behavior

If we want consumers and users to achieve (energy-saving) goals, we should not only focus on past behavior but ‘move forward’ (cf. Ekstrand & Willemsen, 2016)

We need a model which considers future goals



These steps reflect willingness & capacity to save energy: a person's energy-saving ability

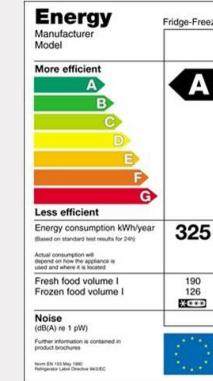
(Kaiser et al., 2010; Urban & Scasny, 2014)



<

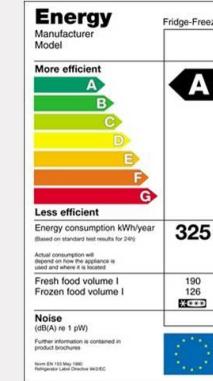


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Energy-saving measures can be **ordered** as increasingly difficult behavioral steps towards attaining the goal of saving energy

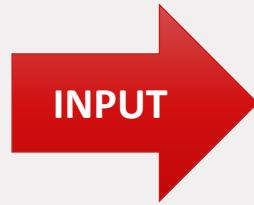
(Kaiser et al., 2010; Urban & Scasny, 2014)



We infer behavioral difficulties based on engagement frequencies



Persons indicate which measures they perform



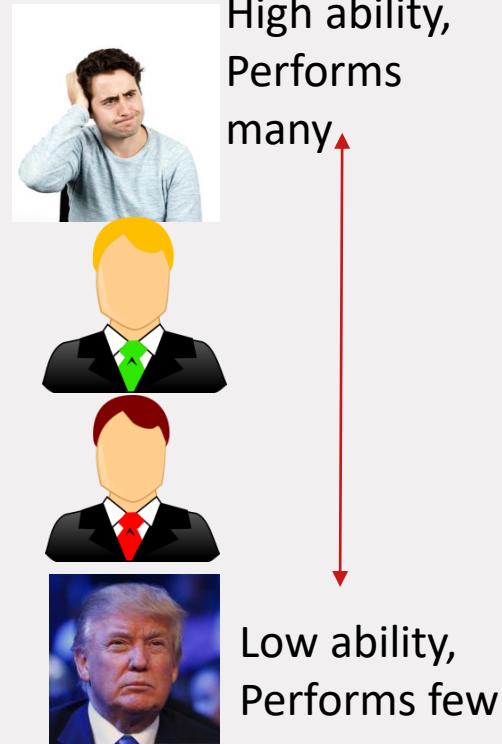
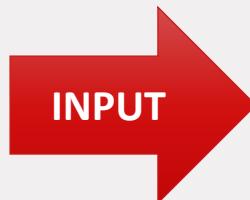
Difficult /
Obscure

Easy /
Popular

In a similar vein, we infer energy-saving abilities

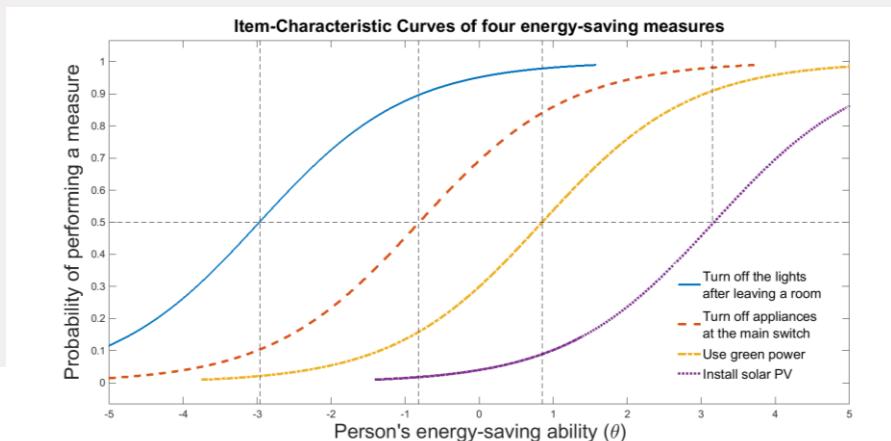
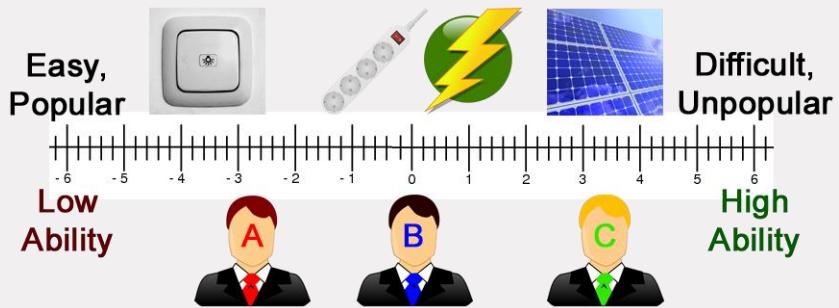


Persons indicate which measures they perform



This results in a Rasch Scale

Probability of a person executing behavior depends on the **Ability - Costs**



$$\ln \left(\frac{P_{ni}}{1 - P_{ni}} \right) = \theta_n - \delta_i$$

The Rasch model equates behavioral difficulties δ and individual propensities θ in a probabilistic model
Log-odds of engagement levels (yes/no):

θ = an individual's propensity/attitude
 δ = behavioral difficulty
 P = probability of individual n engaging in behavior i

Let's test this in a real user study

Study 1:

Using a Rasch scale, are ability-tailored recommendations more satisfactory and effective than non-personalized suggestions?

Study 2:

How should advice be tailored around a user's ability to support energy-efficient behavior?

Can persuasive interface aspects support this?

Energy Webshop: Besparingshulp.nl

We arranged 79 energy-saving measures on their behavioral costs

The screenshot shows a grid of five cards on the website:

- Douchen ipv bad nemen**: Shows a showerhead. Description: Drie keer per week douchen i.p.v. een bad nemen scheelt al gauw 50 liter verwarmd water. Kosten: € 0,00; Besparing: 402 kWh.
- Was opsparen**: Shows a laundry basket. Description: Een groot deel van de was- en droogbeurten is overbodig, indien u alleen met gevulde trommels wast en droogt.. Kosten: € 0,00; Besparing: 275 kWh.
- Lampen uit doen**: Shows two lightbulbs. Description: Lampen laten branden in een ruimte waarin u niet verblijft is niet nodig. Kosten: € 0,00; Besparing: 5 kWh. Status: **Aanbevolen**.
- Kook met juiste formaat pan**: Shows a pot on a stove. Description: Bij kleine hoeveelheden eten is het niet nodig om een grote pan te gebruiken. Kosten: € 0,00; Besparing: 5 kWh. Status: **Aanbevolen**.
- Gebruik wollen deken, geen elektrische**: Shows a stack of blankets. Description: Wol heeft een hoge isolatiewaarde. Hierdoor is het in de winter snel warm in bed. Een elektrische deken is luxe, maar verbruikt veel stroom. Kosten: € 72,85; Besparing: 60 kWh. Status: **Aanbevolen**.

At the bottom, there is a color scale from blue (Eenvoudig/populair) to yellow (Uitdagend/minder populair).

Webshop for energy-saving measures: Experiment

We inferred a user's ability through his current behavior

Asking 13 random items from across the entire scale

Able to suggest new measures by matching costs & attitude

User was subject to one of 4 conditions

No tailoring, ascending cost order ('Most popular')

No tailoring, descending cost order ('Most difficult')

Ability-tailored, ascending cost order

Ability-tailored, descending cost order

Dependent Measures from the interaction

Users interacting with the website

Behavioral difficulty of chosen measures

Number of chosen measures

Clicking behavior

Evaluative Survey (UX)

Perceived Effort

Perceived System Support

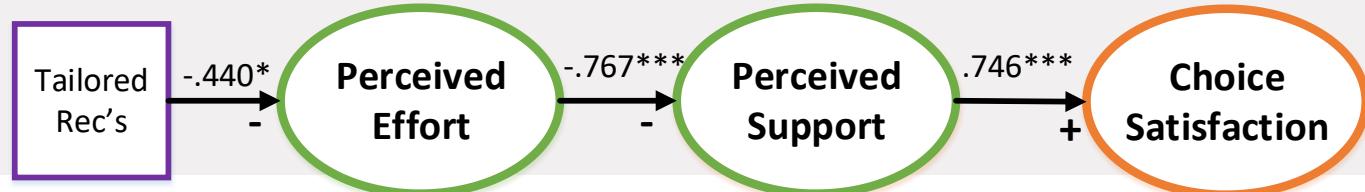
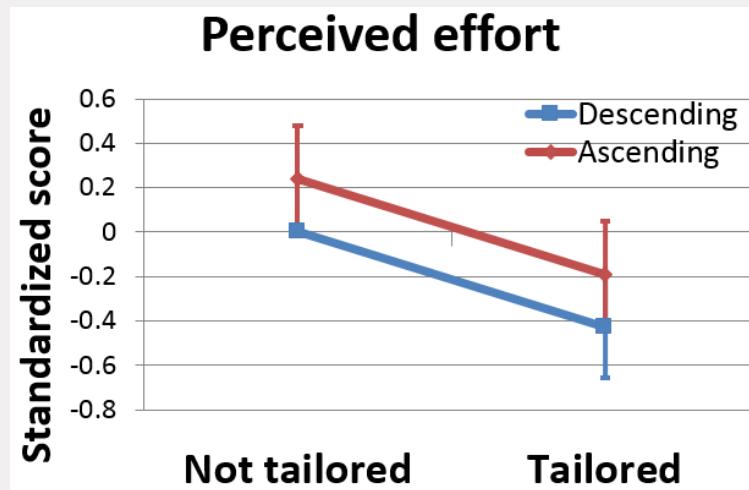
Choice Satisfaction

Follow up survey after 4 weeks

Extent of implementation of chosen measures

PERCEIVED EFFORT – survey items AVE = 0.511; ALPHA = 0.69	Factor Loading
I took me little effort to use the Saving Aid.	
The Saving Aid takes up a lot of time.	0.804
I quickly understood the functionalities of the Saving Aid.	-0.554
Many actions were required to use the Saving Aid properly.	0.741
The Saving Aid is easy to use.	
PERCEIVED SUPPORT – survey items AVE = 0.615; ALPHA = 0.81	Factor Loading
I make better choices using the Saving Aid tool.	0.551
The Saving Aid is helpful to find appropriate measures.	0.608
The Saving Aid does not help to come to a decision.	
The Saving Aid presents the measures in a convenient way.	
Because of the Saving Aid, I could easily choose measures.	0.678
CHOICE SATISFACTION – survey items AVE = 0.598; ALPHA = 0.78	Factor Loading
I am happy with the measures I've chosen.	0.574
I think I've chosen the best measures from the list.	
I would have liked to choose different measures than the ones I've chosen.	
It would be fun to perform the chosen measures.	0.550
The measures I've chosen fit me seamlessly.	0.549

Ability-tailored advice was perceived as less effortful and – in turn – more supportive & satisfactory

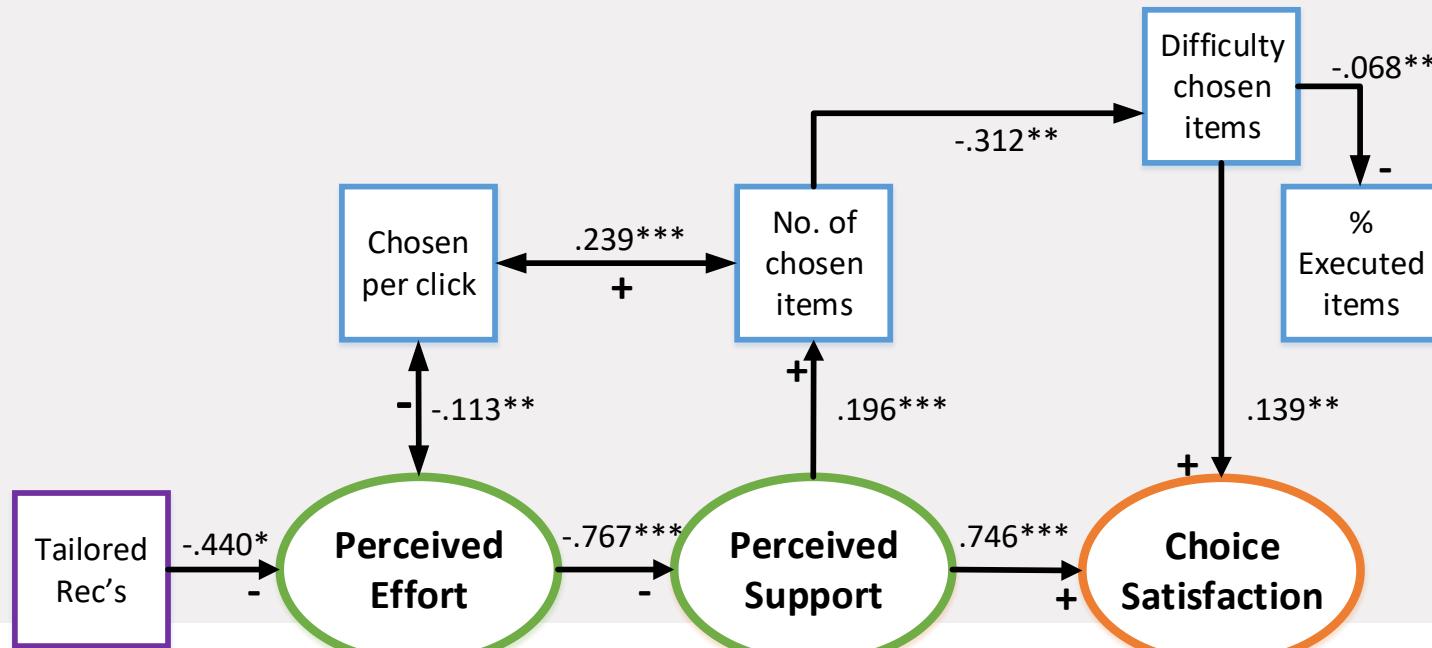


*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

User experience aspects reflected interface behavior

Users perceiving system support selected more (easy) items

Behavioral follow-up was higher for easy items



*** p < 0.001, ** p < 0.01, * p < 0.05.

Lessons learned

Ability-tailored advice was a more effective approach than simply using the Rasch scale

Ambiguous results for behavioral follow-up

Easy (feasible) measures might lead to more energy-efficient behavior in the long run

Difficult (novel) measures had a positive effect on choice satisfaction

Study 2: How should advice be tailored to support energy-efficient choices?

(And can fit scores help to **persuade** users to pick more challenging measures?)

Modified (vertical) webshop with tabs

‘Recommended’ contains 15 best-matching measures, with fit scores ranging 100% to 60%

‘Base’ are easier

‘challenging’ more difficult

Besparingshulp



Kies maatregelen die u nog niet toepast maar wel wilt gaan toepassen.

Wanneer u klaar bent gaat u naar uw winkelwagen. Controleer uw keuzes en klik op ‘bevestigen’.

Basis

Aanbevolen

Uitdagend

Ga ik doen (0)



Kleding luchten i.p.v. wassen

Laat uw kleren een keer luchten in plaats van ze meteen in de wasmand te gooien.
Dit kan per week ongeveer 1 wasbeurt schelen.

BESPARING
26 kWh/j

BESPARING
€ 5,- p.j.

INVESTERING
€ 0,-

MATCH
100%



Koffie zetten zonder warmhoudplaatje

Bij sommige koffiezetterapparaten is er aanzienlijk wat stroom nodig voor het warmhoudplaatje. Door bijvoorbeeld een thermoskan te gebruiken kunt u een flinke besparing bereiken en toch uw koffie warm houden.

MATCH
99%

Design

3x2 Between-subject

3 levels of difficulty: determining contents of the ‘recommended’ list:

Easy / below ability (~75% probability)

Ability-tailored (~50% probability)

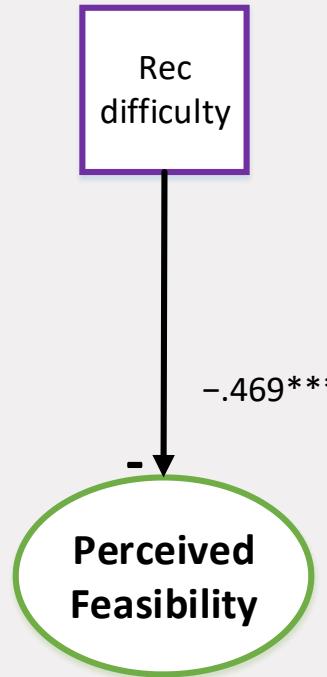
Difficult / above ability (~25% probability)

2 levels of fit score: they were either shown or not

The 100% score was ‘consistent’ with the difficulty condition

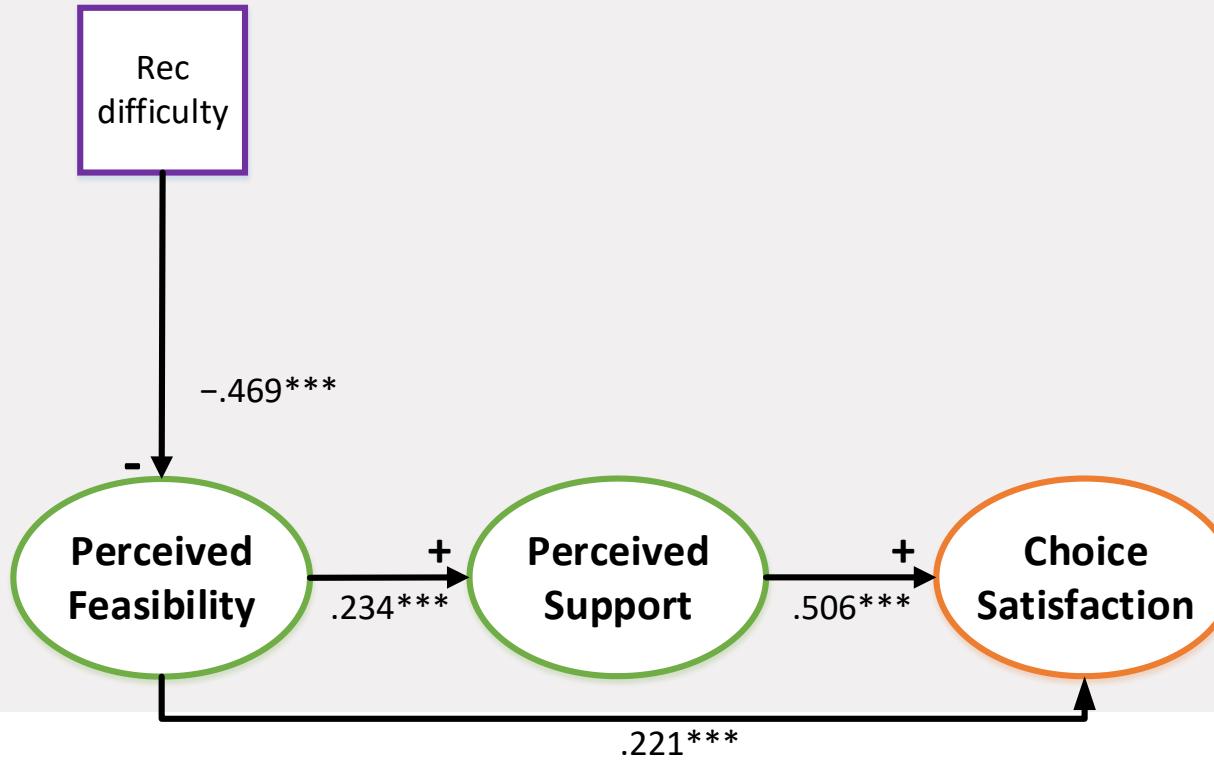
E.g. in the easy condition, measures below a user’s ability (75%) had a 100% match score

Easy recommendations were perceived as feasible and, in turn, supportive & satisfactory



*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

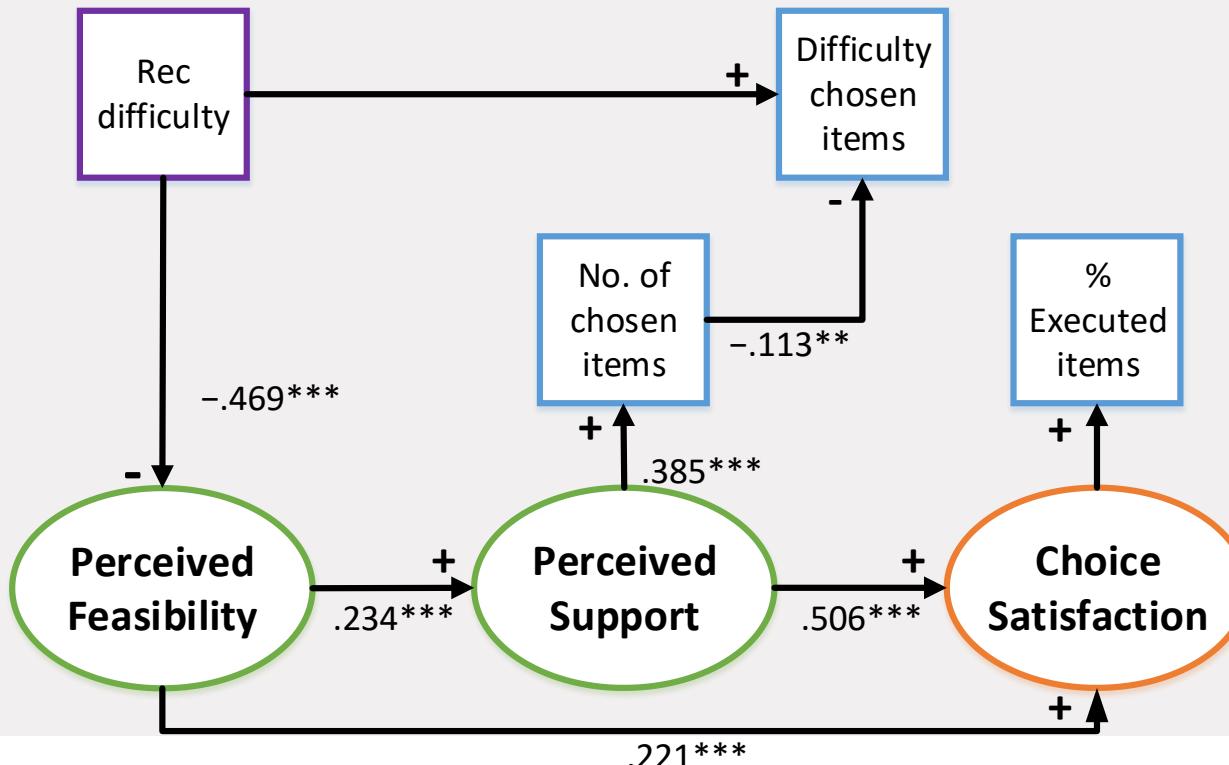
Easy recommendations were perceived as feasible and, in turn, supportive & satisfactory



$^{***} p < 0.001$, $^{**} p < 0.01$, $^* p < 0.05$.

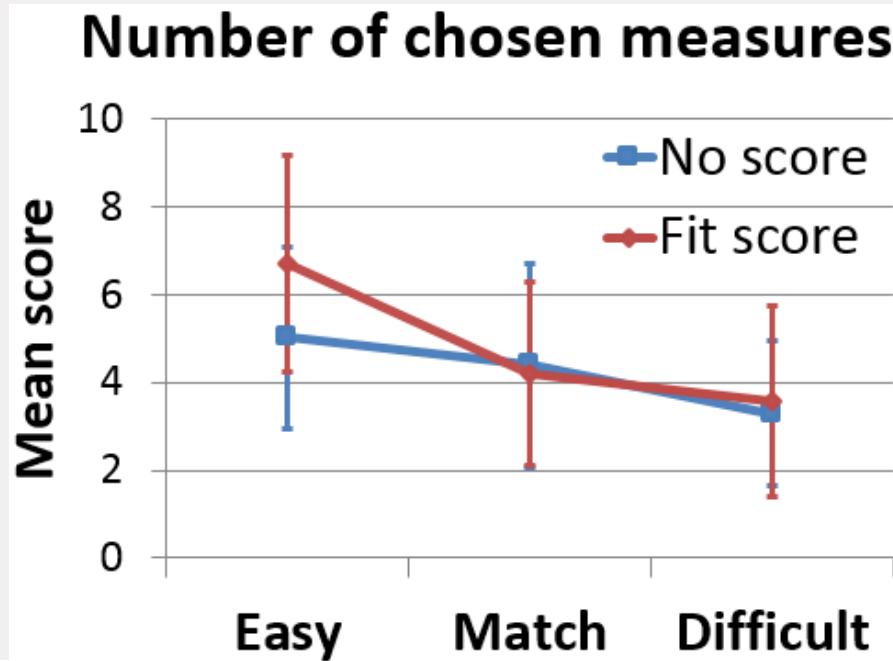
Users who felt supported selected more measures

Satisfied users showed a higher % of follow-up

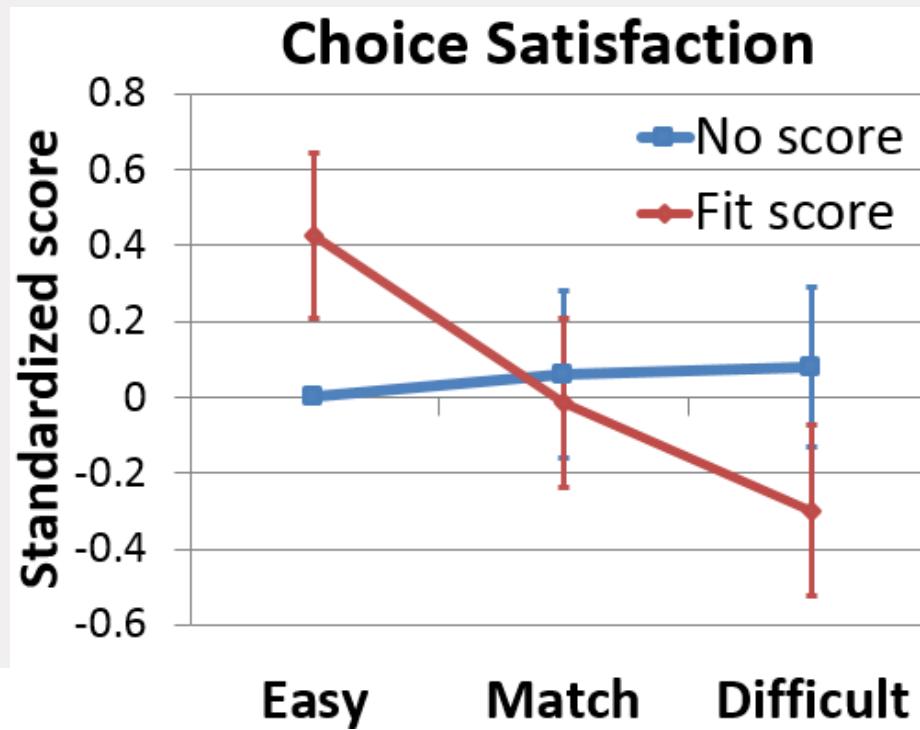


*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Users chose slightly more measures when presented easier ones
(Showing fit scores did not really matter)



Fit scores boosted satisfaction levels for easy measures, but backfired for difficult ones



Lessons learned from study 2

A satisfactory user interface can lead to the adoption of more energy-saving measures (within system + after 4 weeks)

Easy tailored measures seem to be attractive, as they were perceived as feasible and chosen more often

Fit scores were merely self-reinforcing, not **persuasive** to attain ‘more difficult goals’
persuasion might not work anymore once we already have personalized...

Music Genre Exploration

Work by my PhD student Yu Liang

**Can we help people to develop a new taste
for a different genre of music?**

<https://www.jads.nl/recommender.html>

We also used this to tune an opera concert
(2018)

and a choir concert (2019)

to the preferences of the audience
during the Den Bosch Data Week



<https://medium.com/@m.c.willemsen/a-night-at-the-jads-opera-294c814e2871>



<https://medium.com/@m.c.willemsen/singing-with-data-7556bd98a0eb>

How does our exploration tool works?

We use the Spotify API: **major challenge**: we don't get relevance/ratings of tracks for each user (I.e. we don't know what tracks are liked)

We can only download toptracks (50 each of long, medium and short term)

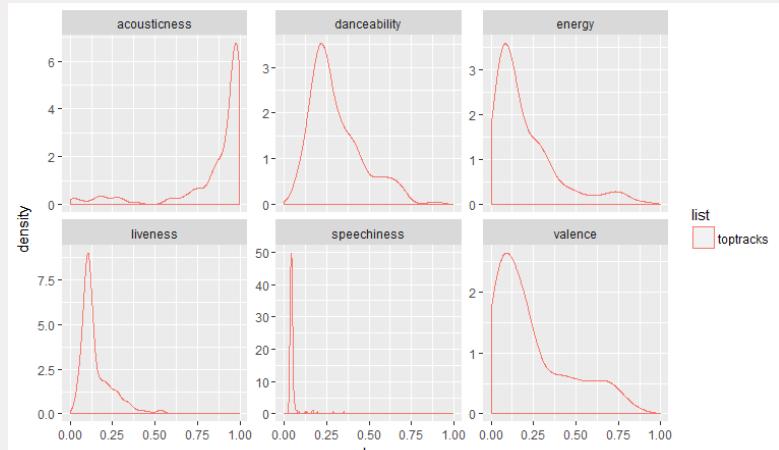
Solution:

Build a user profile by fitting a gaussian model on the features of your top tracks: what values on the features do you typically like?

Use this density as a surrogate

The closer a feature value is to a peak in your density, the more you probably like it

We can rank songs on how many features fit the profile as a surrogate for liking



My (classical) profile on Spotify

Matching a profile with a (new) genre

WE match songs from a (new) genre to your density profile

Songs with more features that match your profile are more personalized
(they match your taste)

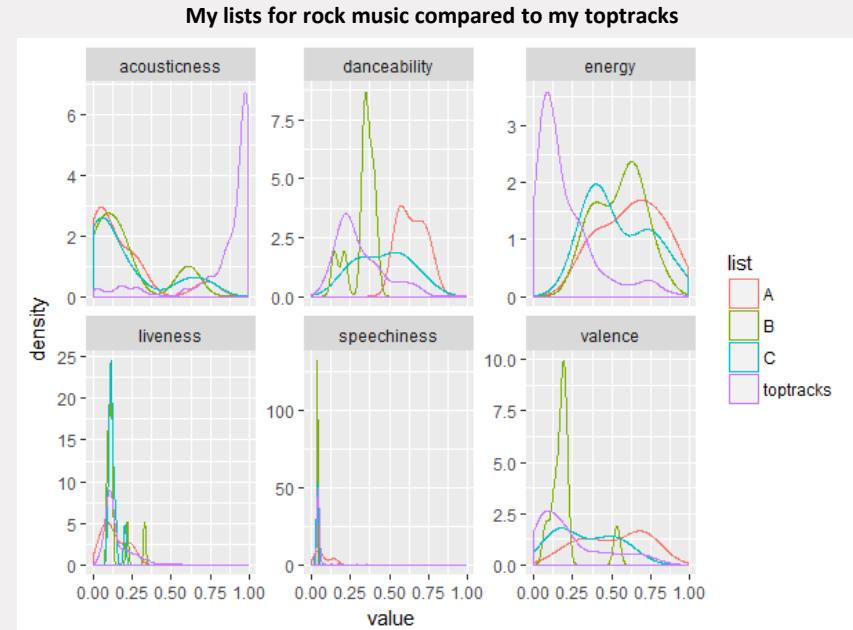
For each genre we have a few hundred songs to choose from

We generate 3 lists:

List A: the most popular songs from that genre, no personalization

List B: the songs from the genre best fitting your profile

List C: a mix of both, we weigh popularity as match as having a match with your profile



Genre exploration

In the new version (BEP project, 2019) you can tune the recommendations based on Energy & Valence features of the songs.

On the right, my exploration of RnB

You can see how the exploration tool finds a balance between my profile and the RnB profile, that differ a lot on the valency & energy features

