Foundations of Cognitive Psychology

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Foundations of Cognitive Psychology

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Course coordinator

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Introduction

The present course is an introduction to the study of mind. This calls for a definition of 'mind' even though in everyday life we use the term easily and often. For example phrases like "Keep this in mind" or "Make up your mind" are never[1] met with wonder or confusion as to what is meant by mind in these cases. We all seem to know intuitively what mind refers to, but when asked to explain what a mind is or 'having a mind' means, most of us find it rather challenging to do so. We might say things like "The mind is the thing that thinks" or "The mind is what separates us from plants or lower animals; it makes us think and feel". Moreover, a quick glance at some of the available (scientific) literature on mind reveals two important things about definitions of *mind*. First, it is often implicitly assumed that the concept is both self-explanatory (and therefore not explicitly defined) or defined in terms of what the mind does. This is like asking 'What is a pen?" and the answer being "A thing that is used for writing"; it does not tell you what it *is*, but what it *does*. An example of the latter is the definition that Goldstein (2011) provides in his widely used basic textbook *Cognitive Psychology: Connecting Mind, Research and Everyday Experience*. He states that "The mind creates and controls mental functions such as perception, attention, memory, emotion, language, deciding, thinking, and reasoning (…). The mind is a system that creates representations of the world so that we can act within it to achieve our goals" (p. 5). This tells us what the mind *does*, but it leaves us ignorant as to what the mind *is*. In all fairness, the question of what mind is, is in essence an ontological[2] question (i.e. the philosophical question of what 'stuff' something is made of) known as the mind-body problem. The mind-body problem is largely, if not completely ignored in the current course since is the main topic of the 3000 level UCM *Philosophy of Mind* course. Second, defining what mind is very much depends on the academic field that the definition is based on. The various perspectives on mind can be coarsely divided into three types: philosophical, neuropsychological and cognitive perspectives. Where philosophers such as David Chalmers (1996, 2010) and Thomas Nagel (1984) put emphasis on how having a (conscious) mind *feels*, neuroscientists equate having a mind with 'having a brain'. Mind is produced by or equal to neural activity. Cognitive scientists in contrast focus on the mind as information processor comparable to how a computer takes in information and follows a program to produce an output. The present course only deals with the latter definition of mind: the mind as (sophisticated) *information processing unit*. Comparable to the different software programs (e.g. Word, Excel, or Paint) used by computers, the mind also has different 'programs' or mental processes, such as perception, attention, memory, language, decision making, and problem solving. Roughly put: in the present course we could care less about how these mental processes feel or how neurons produce them; we only focus on *what the mind does* or *how these mental processes work*.

[1] With the exception of very dedicated philosophers or incurable skeptics of course.

The aim of the present course is to introduce and study the fundamental questions, theories, and methods of cognitive psychology/ science. The cognitive processes considered here are central to our lives, yet we typically take them for granted. For example, consider what makes you able to understand the words written on this page. You *perceive* the different letters and *recall* meaning of the words by using *language comprehension modules*. You may become distracted by *thoughts* such remembering that you have to pick up your laundry. You may *decide* to for now *concentrate* on the current text. This morning you may have gone to the introductory lecture and *thought about* whether it was better to walk, ride, or drive to class. Without the cognitive processes that underlie these various abilities, you would be unable to do something as simple as getting up and coming to class this morning. Thus, all aspiring psychologists or enthusiasts of mind (and maybe especially those that are in the thralls of neuroscience) should understand the basics of cognitive psychology.

The study of mind: 11 topics

Where neuroscientists divide the brain into different functional brain areas (e.g. the hippocampus or prefrontal cortex); cognitive scientists have a so-called modularly view of mind. That is they divide the mind into different *functional modules* (e.g. a working memory module and a facial recognition module). Based on this modularly view of mind the different cognitive processes that underlie our behavior can be divided into *non-complex* and *complex* cognitions. Complex cognitive processes rely on the interaction of number of cognitive modules. Examples of complex cognitions are reasoning, decision making, (moral) judgment, and problem solving. They are topic of *Human Reasoning and Complex Cognition*, a 3000 level UCM course that draws upon the current course as basic knowledge. In the current course the complex cognitive processed are largely ignored; the focus here lies upon the non-complex or basic cognitive processes that underlie these complex cognitions. Non-complex does not means that they are simple; they are non-complex because they do not rely on the (inter)action between several cognitive systems or processes, but are believed to be processed by single specialized processing modules. Examples of non-complex cognitive processes are perception, long-term and working memory, and attention. Like in the *Human Reasoning and Complex Cognition* course mention above, the topics of the current course also are part of Cognitive Psychology and thereby Cognitive Science. This means that for any given topic the chances are high that there are multiple (competing) explanatory models of these processes along with various experimental finding to back them up. Moreover, definitions may also vary and often divert from non-psychological common sense definitions. The eleven topics studied in the current course are: the history of cognitive science, concept and knowledge representation, conscious and unconscious perception, attention, vigilance and signal detection, language comprehension and production, the psychology of action, emotions and their effects on non-complex cognitions, and artificial intelligence. Note: even though memory processes and complex cognitions are major

[2] Ontology is the philosophical inquiry of the fundamental nature of existence or being as such.

topics in cognitive science, they are not studied in the current course for the simple reason that they are taught in other UCM courses (*Memory* and *Human Reasoning and Complex Cognition*).

Set-up of the course

The current course consists of two parts: 1) studying different aspects of human cognition in a traditional Problem-Based Learning (PBL) approach and 2) psychological testing and describing these findings in a practical report.

1. The reading

- Problems and Tutorials

Cognitive theories on the topics mentioned above cover a broad terrain. Therefore, you do not have the time to study all facets of a given topic. Problems differ in the emphasis they put on certain themes (e.g., cognitive models, practical implications). Your tutor will intervene if your learning goals do not cover the area intended by the problem in question. Note that this precludes a tempting solution for formulating learning goals: it often happens that tutorial groups come up with the two obvious questions of 1) What is X? 2) What are the theories on X?). It should be clear that using these questions as learning goals may in most cases simply be too general. It does not help you focus on those parts of the literature that are most relevant for a certain topic. General learning goals will turn out to be a problem when selecting the appropriate literature for self-study. Of course (one of) those two questions might serve as problem statement for the brainstorm in your group. But remember; if you want to ask these questions, use them as a starting point but not as the conclusion of the first discussion of a problem.

- Literature study

As is common practice in PBL, the learning goals emerging from the group discussion should give rise to literature study. The next question is where to find relevant sources of information. Note that even though in this course we do not use a single basic textbook; there are several e-readers available via blackboard that should help get a deeper understanding of the topics. Furthermore, the list is not intended as obligatory reading. Do not attempt to read every chapter or article that is listed for a certain case (especially when the list contains relatively many articles). Scan through the papers (or their abstracts) to see if they contain useful information for your learning goals, and only read (the parts of) those papers that do.

2. The practical assignment

Next to taking an exam, you also have to write a practical report. More details are offered during the second lecture of the course.

Attendance and Grading

Since the current course is taught in a PBL format, an 85% tutorial attendance is required. You can miss 2 of the 12 tutorial meetings without it having any negative consequences for your attendance requirement. If you miss 3 meetings you can ask for an additional assignment for failed attendance via the form that can be picked up at the Office of Student Affairs. If you miss more than 3 meetings you will fail the current course with no chance of making up for failed attendance.

There are two grades to be earned during this course:

a. There is an exam at the end of the course. This exam consists of open-ended non-essay questions (on the literature as well as the lectures!) and is graded on a 0-10 scale
b. During the course, a practical report has to be written that is graded on a 0-10 scale.

The final grade is a weighed average of the exam grade and the practical report grade. The exam counts for 65% and the report for 35% of the final grade. If your final grade is 5.4 or below, you may be eligible for a resit. You are eligible to resit the part of the grade that made you fail (i.e. the exams or the report or both) if the following requirements are met:

- Your final grade is 5.4 or below
- Your exam and report are considered a valid attempt[3]
- You passed attendance

The format of the resit depends on which part(s) you are resitting. If you failed the report, you are allowed to write a new one or re-write the one you handed in (this will be decided by the tutor).

[3] The person who grades the exam and/ or report decides what is considered a valid attempt.

Weekly overview of the course

Week	Monday	Thursday
1 (5 - 9 February)	Lecture *1* PBL-meeting	PBL-meeting
Carnival week 27 February - 3 March		
2 (19- 23 February)	Lecture *2* PBL-meeting	PBL-meeting
3 (26 Feb. - 2 Mar.)	Lecture *3* PBL-meeting	PBL-meeting
4 (5 - 9 March)	Lecture *4* PBL-meeting	PBL-meeting
5 (12-16 March)	Lecture *5* PBL-meeting	PBL-meeting
6 (19-23 March)	PBL-meeting	PBL-meeting
7 (26- 30 March)	**EXAM** **26th of March 11.00 -13.00**	**Deadline practical report (Friday, 5 p.m.)**

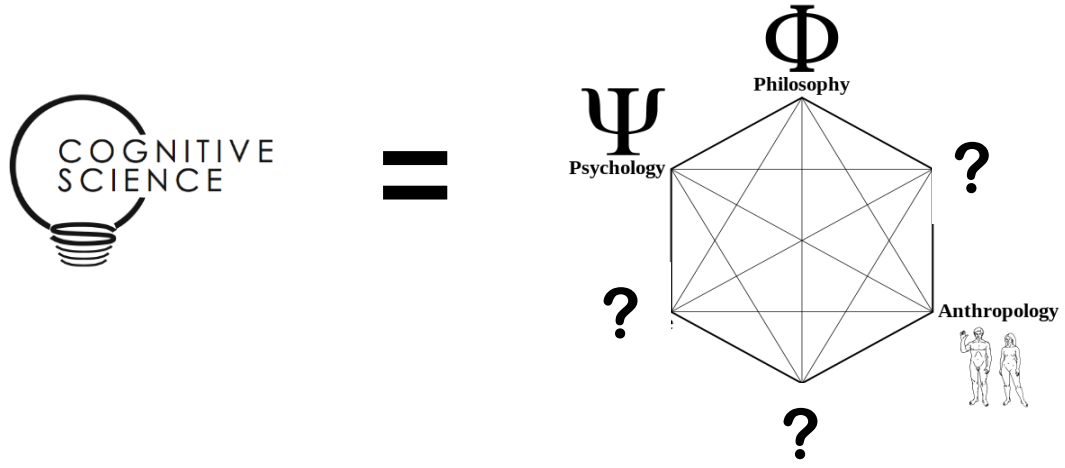
Problems

Problem 1: Study of the Mind

A

"*If you are reading this in the first couple of decades of the third millennium of the Common Era, chances are that the human [mind] is the most complex toy you'll ever come near, let alone get to play with, and you're trapped inside one for the foreseeable future. Wouldn't it be fun to get to know how it works? Even if you are not by inclination a tinkerer, you may resent being confined in this way. Indeed you may wish to evaluate the prospect of upgrading the game console to a better model or at least to make the most of the current one*" Shimon Edelman in *Computing the Mind*

Let us suppose you agree with Edelman here, what team of scientist would you bring together to attempt this and what would your grand project goals be?



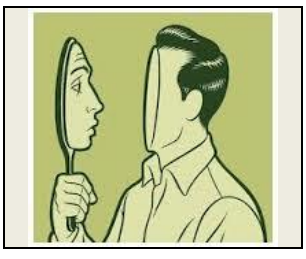
Paul Thaggard phrases the project as follows: "The interdisciplinary study of mind (cognitive science) has a core: the Computational-Representational Understanding of Mind (CRUM)."

B

Psychologists study the human mind and behavior, but the mind hasn't always been topic of study in psychology. In the boxes below you can find pieces of the history of the study of the mind. From what 'school' are they and what is the correct order in history?

"All behaviors are either reflexes produced by a response to certain stimuli in the environment, or a consequence of that individual's history"

= a theory in philosophy or psychology which regards the simple association or co-occurrence of ideas or sensations as the primary basis of meaning, thought, or learning.



"The mental world can be grounded in the physical world by the concepts of information, computation, and feedback."

Problem 2: Representation and computation

A

Mental representations in general can be divided into images and concepts. Images are topic of another problem, so we'll ignore those for now. So for now let's focus on concepts and the theories of conceptual representation.

Judge the following sentences and indicate whether they are true or false.

A golden retriever is a cat

A penguin is a mammal

A shih tzu is a dog

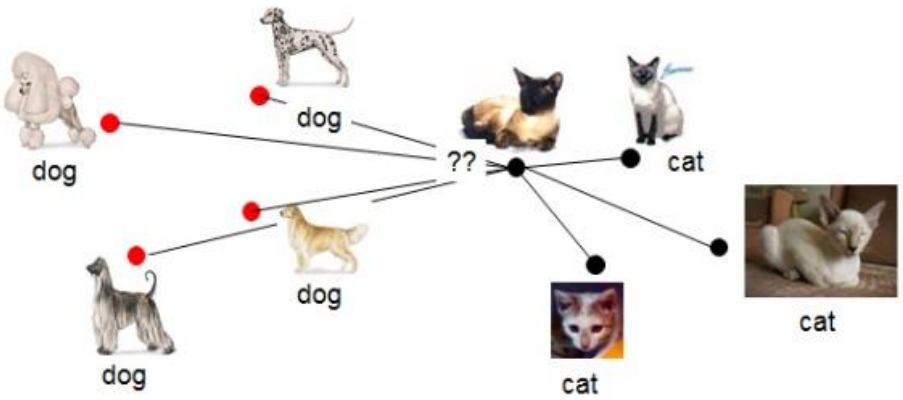
The flu is an infectious disease

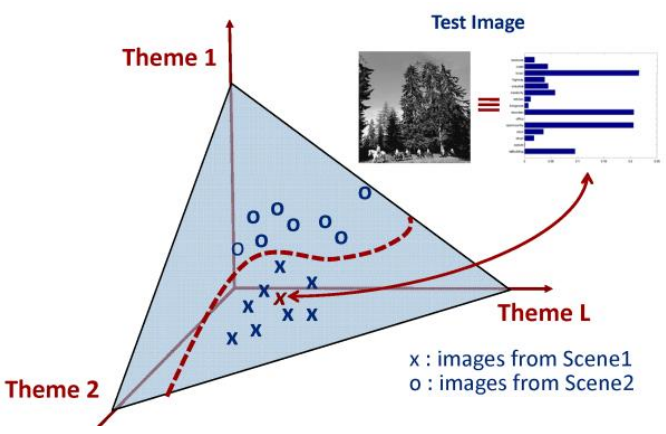
A sparrow is a bird

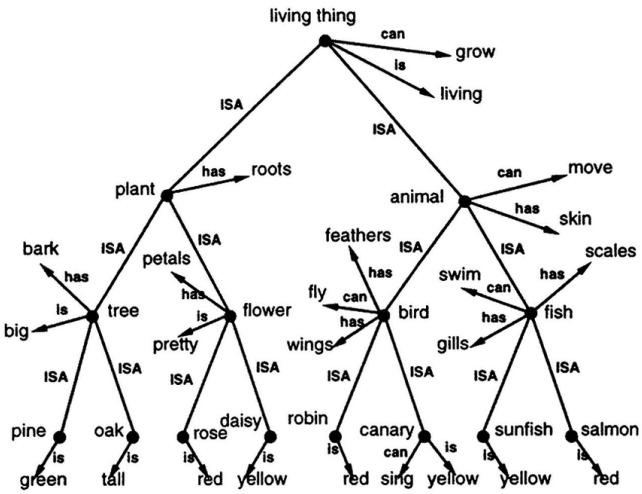
Meningitis is an infectious disease

Studies show that the reaction times to one sentence over the next differ. One of the explanations is called the 'typicality' effect, but there are more. The differences in reaction times are a problem for one theory on how we represent concepts and evidence for the next. Furthermore, theorists also have to explain how knowledge in the form on concepts is *organized* in our minds. One way is in the form of a semantic network, but there are others as you can see below.

Does it look like this in our minds?

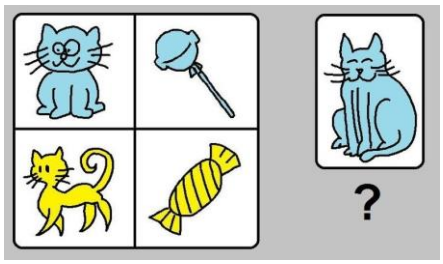


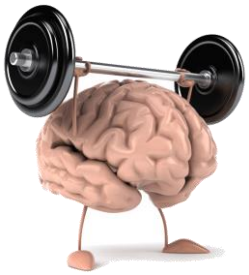


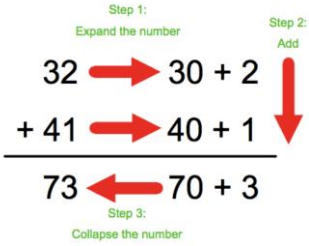


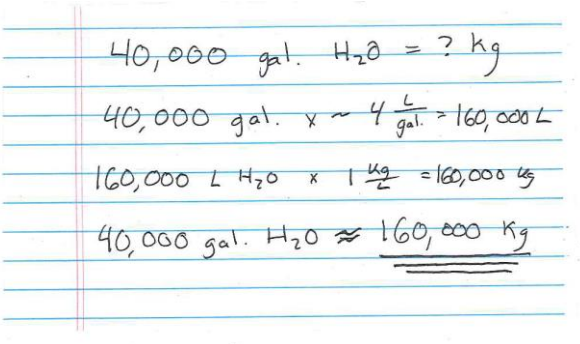
B

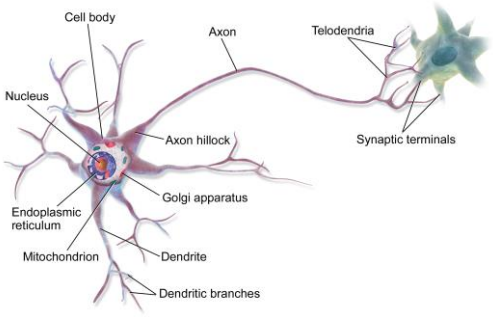
Keep in mind that for cognitive scientists it is very important to link minds with computers and thereby computation. There are several ways in which that can be established. Very famous is Marr's (1982) *tri-level hypothesis* where cognition needs to be understood at (at least) three different, complementary levels: The computational, algorithmic, and implemental level. Or more simply said: what is done, how is it done, and what it does? Below are several things that represent those 3 levels. What goes where?

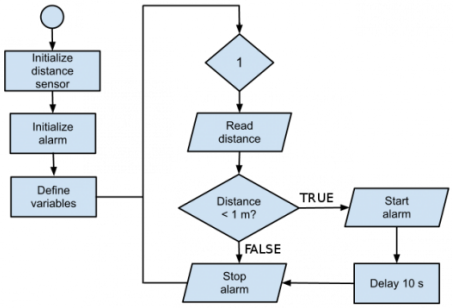






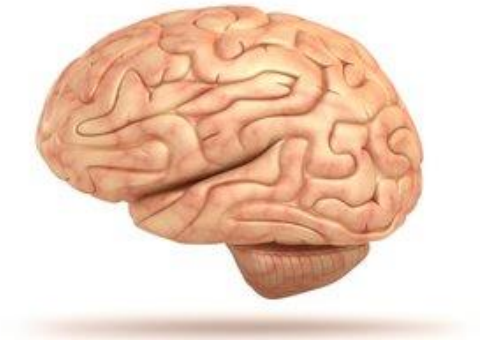


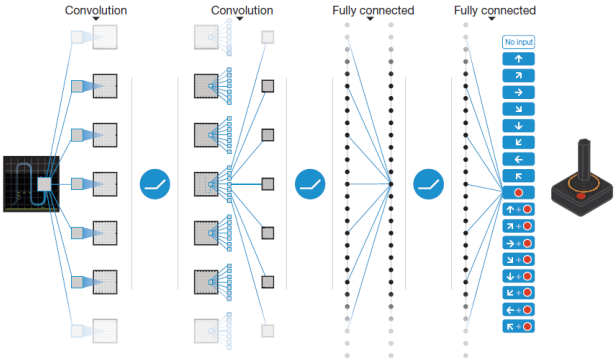


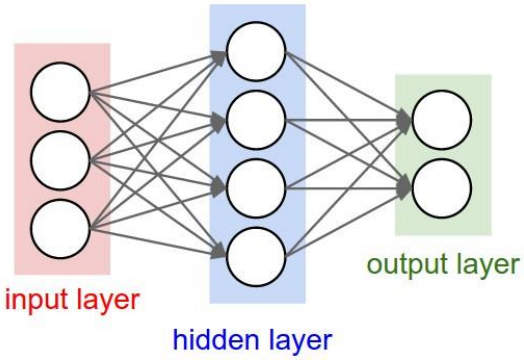


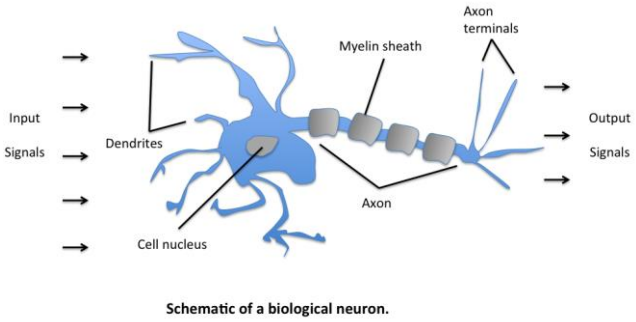
Problem 3: Not quite the brain…

So if we make the models of the mind, should we ignore the brain? But how do we make models of the brain? How would you make a model of the brain? What are the essential parts? How would it be different from the models we have seen before? Another way to link minds with computation might be….









Schematic of a biological neuron.

How powerful would such models be? What can they explain? What can they do? Could they beat you and your little brother at Mario Cart? How much would they be like us? Could they recognize your love-interest in a carnival outfit in a dim-lit Maastricht street? Even after having a brain-splitting head-ache?

So even if these things are really useful, they must be really complicated to build no? Nah! Just three elements and just three rules…

$$input_{ij} = a_j w_{ij}$$

$$netinput_i = \sum_j a_j w_{ij}$$

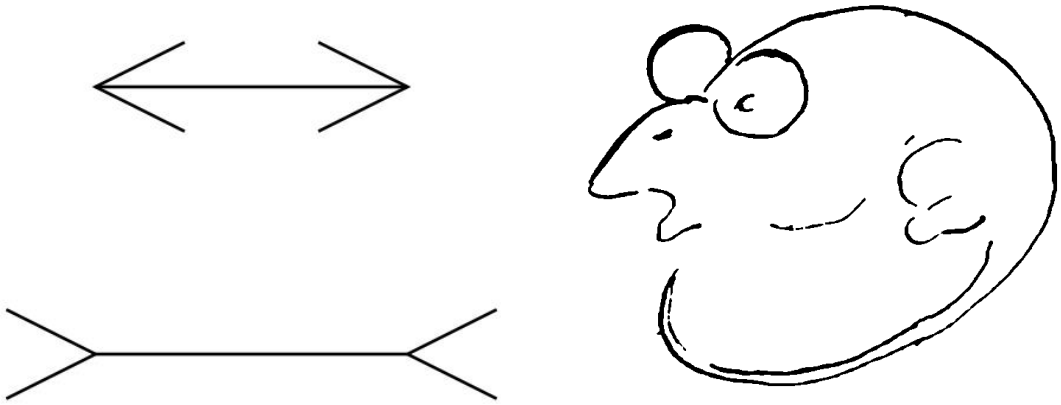
$$\Delta w_{ij} = [a_i(desired) - a_i(obtained)]a_j \varepsilon$$

Problem 4: I see and imagine…

"The eye sees only what the mind is prepared to comprehend."
Robertson Davies (1913-1995), Canadian novelist, playwright, critic, journalist, and professor

A

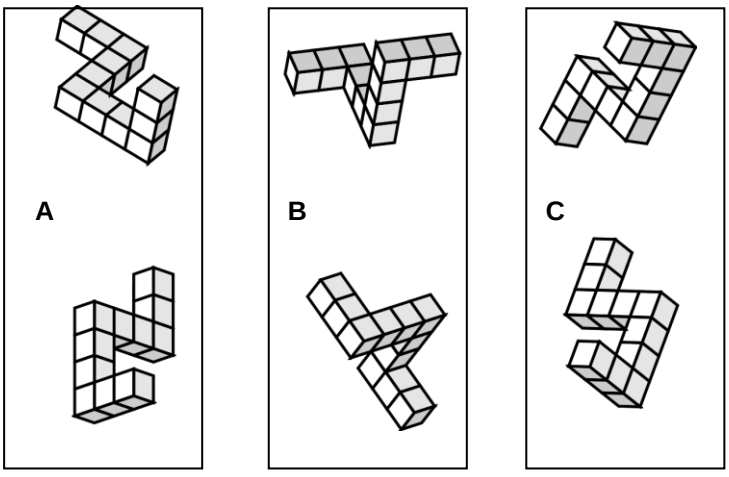
The quote above nicely differentiates between bottom-up and top-down processing in the flow of information in perception. What do you see below? Keep in mind that most of our visual perception is actually *recognition*. Several *Gestalt principles* have been proposed to explain how we view scenes and objects.



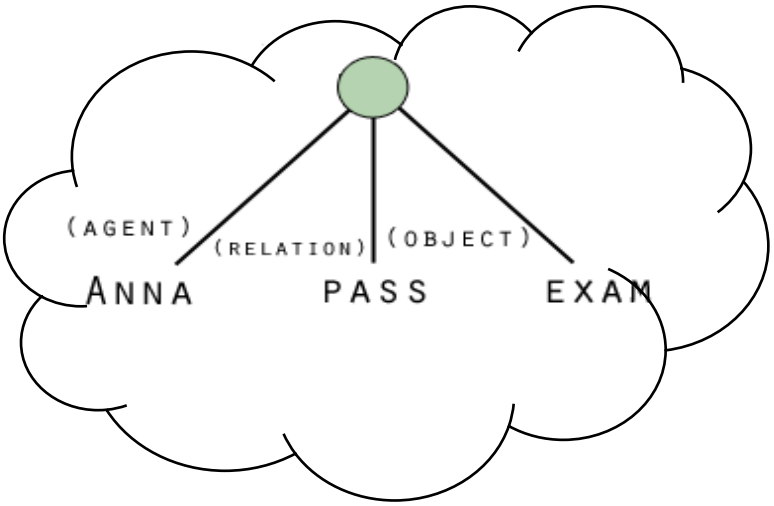
B

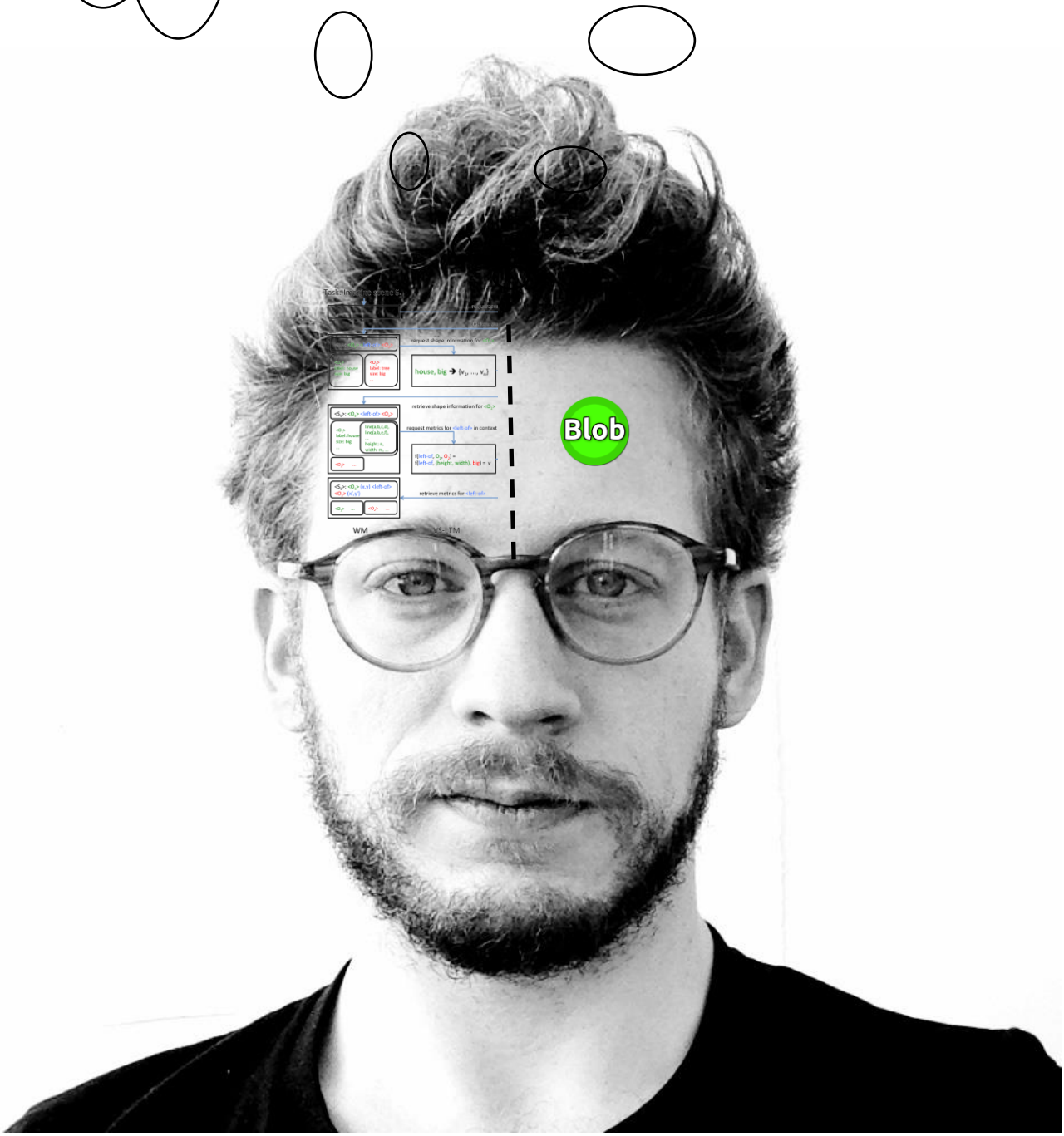
Imagine that you're lying in your bed facing the ceiling and that since today is your lucky day instead of walking to the UCM building you can jump to UCM. You have been given a jet-pack that you can control by thinking, but it can only leap 500m at a time. Trace out the path you would take in the air with your finger and give a description of the path. What *kind of mental representations* you use to perform cognitive tasks like this one (I am assuming you never flew to school so it is not a path you have ever seen before) is topic of the so-called 'Imagery debate' in cognitive psychology.

For the picture below indicate whether the rotated figures are the same or not for A, B, and C. There seems to be a subtle difference between 'high' and 'low' imagers in how they do these task .



Images or Propositions?





Problem 5: Sublime!

James Vicary coined the term 'subliminal advertising'. He conducted a variety of unusual studies of female shopping habits and reached several conclusions. For instance he discovered that women's eye blink rates drop significantly in super markets. Vicary's studies were largely forgettable, save for one experiment he conducted at a movie theater in 1957. Vicary placed a tachitoscope in the projection booth, and throughout the playing of the film *Picnic*, he flashed a couple of different messages on the screen every five seconds. Messages like "Hungry? Eat popcorn" were all played below the viewer's conscious perceptual threshold. Not surprisingly there was a whopping 57.8% increase in popcorn sales. Or so the legend goes…

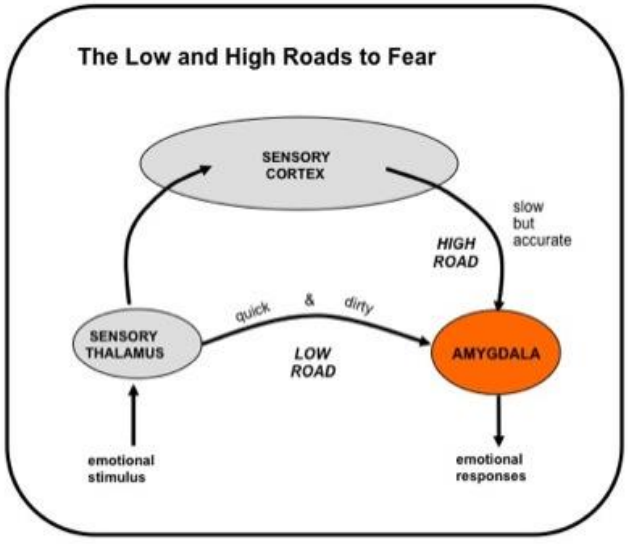
See Vicary lied about the results of his experiment. And they were never replicated. Current research however, shows that this lack of replication probably was due to some basic methodological flaws. So, is subliminally persuasion myth or fact?

The standard experimental setup of subliminal persuasion or priming experiments is:

- A control group (no prime) and an experimental group (subliminal message)
- Outcome variable: change in behavior

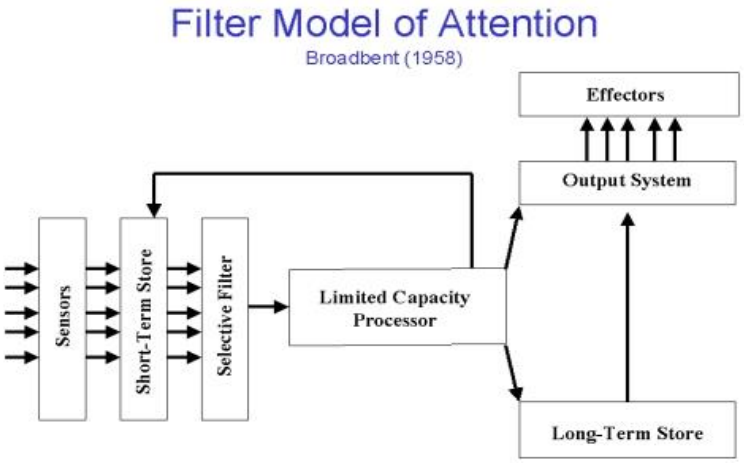
Can I prime people to drink more? To drink my brand? How would you find out?

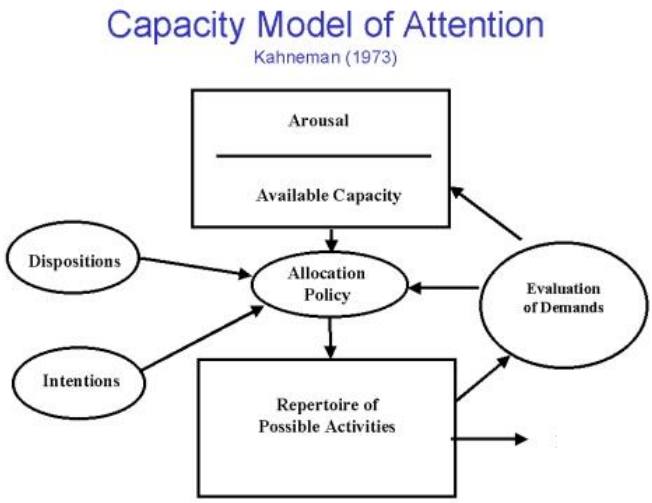
The low and high sensory roads to the amygdala. Sensory information reaches the amygdala from the sensory thalamus (low road) and sensory cortex (high road). Both are probably non-conscious inputs the amygdala. However, the information in the high road is potentially the same or similar to information that is projected to cortical areas that allow for conscious perceptual experience (e.g. frontal and parietal areas). The low road is a quick and dirty route, as it provides only crude stimulus information.



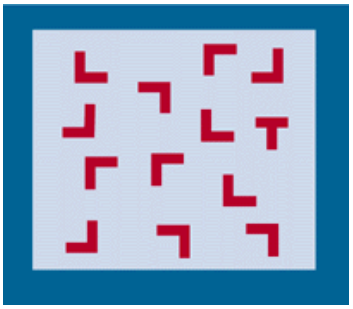
Problem 6: Attention please

Like perception, attention can be bottom-up or top-down or *internal* or *external*. Or one could say there is early or late selection. The nice thing is that the names of the theories should be enough to give you some idea of what attention is and how it works. In general, there are *filter* or *bottleneck* theories of attention. Since they prove to be a bit problematic there are also *resource* or *capacity* theories of attention that treat attention more like a spotlight.



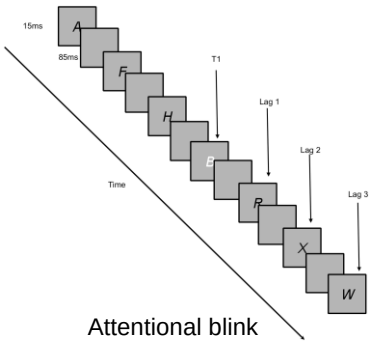


In order to find out what attention is and how it works, obviously we need experiments. There are data on both *normal* attention and *failures* of attention. Below you can find examples of the stimuli used in attention research. How would you use them and what can they tell us about attention? Dig deep and find those 'research methods cognitions' and put them to good use.

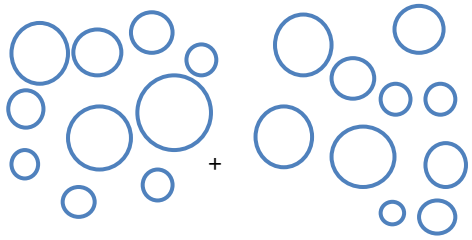


Visual search

Change blindness



Attentional blink



Distributed attention

Inattentional blindness

Problem 7: Vigilant detectives

> "Signal Detection Theory (SDT) characterizes how perceivers separate meaningful information from 'noise'… SDT is particularly useful in situations of risk and uncertainty"

A

A radiologist is examining a CT scan looking for evidence of malign growth. Interpreting CT images is hard and takes a lot of training. Because the task is so hard, there is always some uncertainty as to what is there or not. Either there is a tumour (signal present) or there is not (signal absent). Either the doctor sees the tumour (responds "yes") or does not (responds "no"). There are four possible outcomes: two decisions are good and two are bad.

		Fracture present	
		yes	**no**
Choice	**yes**	.....	.....
	no	.....	.....

B

Sensing phantom phone vibrations is a strangely common experience. Around 80% of us have imagined a phone vibrating in our pockets when it's actually completely still. Almost 30% of us have also heard non-existent ringing. Are these hallucinations ominous signs of impending madness caused by digital culture?

Not at all. In fact, phantom vibrations and ringing illustrate a fundamental principle in psychology.

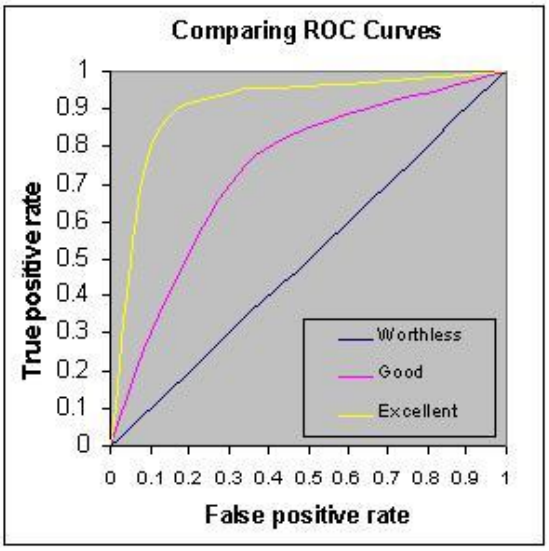
You are an example of a perceptual system, just like a fire alarm, an automatic door, or a daffodil bulb that must decide when spring has truly started. Your brain has to make a perceptual judgment about whether the phone in your pocket is really vibrating. And, analogous to a daffodil bulb on a warm February morning, it has to decide whether the incoming signals from the skin near your pocket indicate a true change in the world.

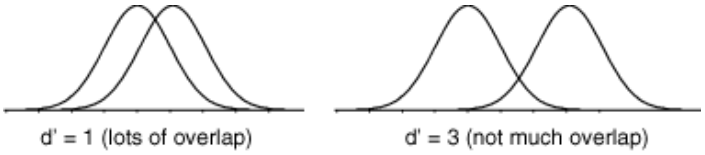
Would chewing gum help you in this task?

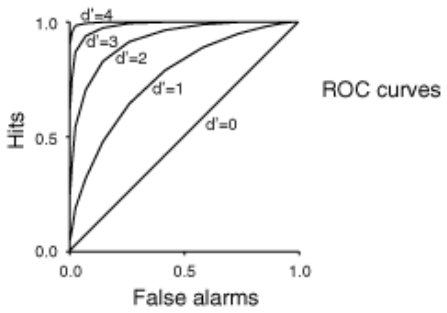
C

ROC curves describe the kinds of decision making processes under **A** and **B** pretty adequately. Failing to notice a fracture or failing to notice a bad waffle have different consequences, making the criteria used by the operators to be very different. If the criterion is high, then both the false alarm rate and the hit rate will be very….? If we move the criterion lower, then the hit rate and the false alarm rate both…. ?

Notice also that for any reasonable choice of criterion, the hit rate is always larger than the false alarm rate, so the ROC curve is bowed upward. You may set the criterion anywhere, but any choice that you make will land you with a hit and false alarm rate somewhere on the ROC curve.



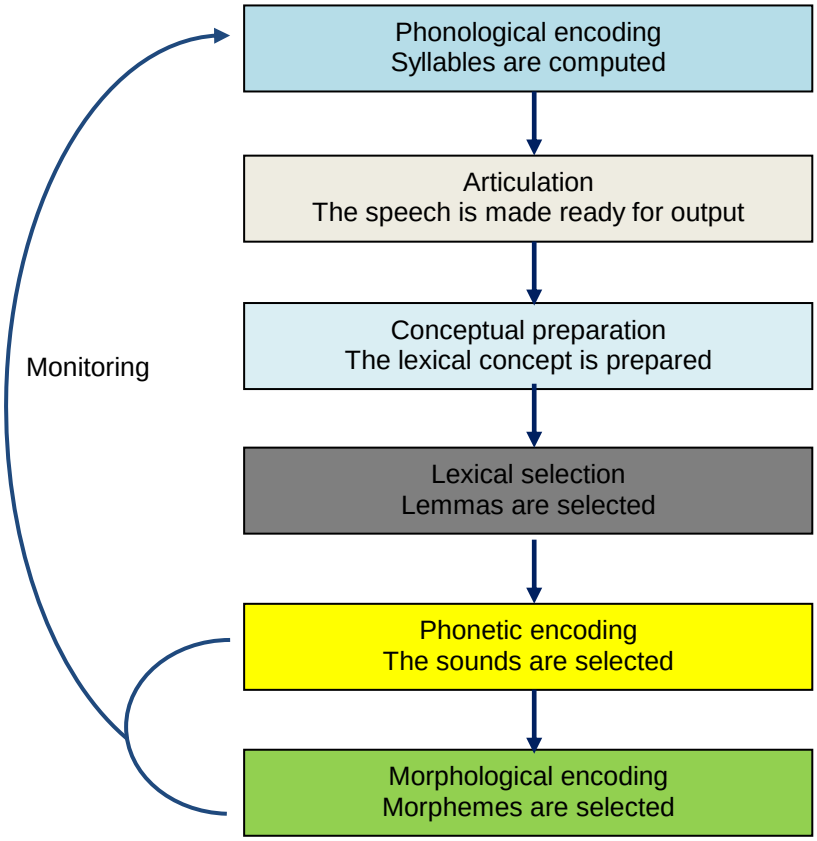




Problem 8: Sending and receiving?

A

If there is one thing that is considered to be uniquely human it is our ability to produce language. We are able to communicate the content of our minds in detail during conversations. Our language has different components such as *phonemes* and *morphemes*, and it has *syntax*, *semantics* and *discourse*. One of the most influential models of speech production is Levelt's model. Below all the components of the model are presented, however not in the correct order. Mind you, Levelt's model is famous, but not the only one of course. Do you find this model convincing or do you prefer another? What are your arguments?



B

"*Saucy hot peas. Get me cod please. Rock talk to boy who believes. Suck juice from moose. Fun, handsome goose. Cement pizza? Noobie please! Open bra top. Get him locked up. Leaky aquariataries. Look there, fruitloop! Don't sue Youtube They wrote the dictionary. Salsa cookies! Windmill cookies! They gave you gonorrhea! This octopus! Let's give him boots! Send him to North Korea!*". 'O Fortuna' from the Carmina Burana

What's happening with these lyrics? What model can explain this phenomenon? What other phenomena should models like this be able to explain?

C

How did you just read the works that make up this sentence?

> Aoccdrnig to a rseearch sduty at Cmabrigde Uinervtisy, it deosn't mttaer in waht oredr the ltteers in a wrod are, the olny iprmoetnt tihng is taht the frist and lsat ltteer be in the rghit pclae. The rset can be a toatl mses and you can sitll raed it wouthit porbelm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe.

Oh wait, it's "How did you just read the word*s* that make up this sentence" or did you not notice perhaps?

Problem 9: And… action!

A

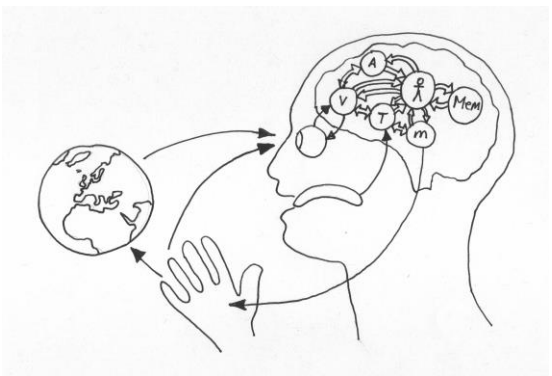
Perception, directing attention, communicating, understanding, feeling…They all serve one final purpose in the end: allowing us to respond to our environment. Our mind is nothing more than a processor in a body that helps the body survive by moving and reproducing (which is just another type of movement). To grab food when we need sustenance, to run when we are in danger, to write when we need to express our feelings, and so on. What is important in these examples is that there is an ultimate link between perception and action; we see food and then we grab it.

Hmmm corn chips…me wants…me grabs!
(Or more nicely put: I am taking hold of and manipulating objects)

But how? And does is matter what you plan do to with the object(s. For example, how would you pick up the glass in the picture below if you just need to pick it up? And how about if you are expected to fill it with water?

B

Some take this obvious connection between perception and action a step further and argue that cognitive science should be more action centered. Often they emphasize so-called *Embodied cognition*: cognitions are deeply dependent upon characteristics of the physical body of an agent, such that the agent's beyond-the-brain body plays a significant causal role, or a physically constitutive role, in that agent's cognitive processing. Has cognitive science so far been wrong in accepting CRUM? Should it be more action-centered?



Problem 10: I think I feel...

A

According to cognitive psychologists emotions have different key features and components. Consider the following two situations below: Name the emotions, separate the things that happen into clusters and label the clusters.

1. You went to see a horror movie with a friend. The two of you are walking to the train station in have to go through a dark alley. It reminds you of a scene from the movie...
All of a sudden you:

Sweat Cry a little Have a strange sensation in your stomach Feel scared Scream
Think something's wrong Experience nervousness Feel a bit dizzy Start walking faster
Have increased awareness of your surroundings Have goose bumps Have heart palpitations
Have paranoid thoughts: is someone following you? Have increased blood pressure

2. You're having dinner in a lovely restaurant while on vacation with your friends. You are having a great time and you are munching on the best chocolate ganache of your life.
You:

Smile Think life is great; you should post this on Facebook right now Cry a little
Have goose bumps Feel great Take pictures of the ganache and post it all over Instagram
Have a slight increase in blood pressure Like your friends even more Eat way too much
Feel so relaxed Wish you could stay here forever

B

Defining emotions seems clear-cut (does it?), even from a cognitive perspective. However, what emotions are and relating them to cognitions seems to be a more difficult task; multiple theories can be found on the matter. Furthermore, we need to consider the effects emotions have on a variety of cognitive processes. E.g. what directs your attention to emotionally salient stimuli?

C

In **B** we considered the normal effects (i.e. in healthy participants) of emotions on cognitions. However, the importance of emotions for cognitive processing becomes even clearer in two very different phenomena. In one there is a lack of emotions and in the other there too many or extreme emotions, that both have an effect on normal cognitive processing. However, the behavioral responses and conscious thoughts that result from these emotional processing deficiencies are very different.

Too little vs. Too much

Predict the results of the following Alexithymia studies:

- Single men vs. married men vs. divorced men?
- Suppression or dissociation?
- Men vs. women?

Predict the results of the following studies on hoarders:

- Anxiety sensitivity distress tolerance?
- Positive and negative emotions?

Note: For the readings you may focus on either alexithymia or hoarding disorder

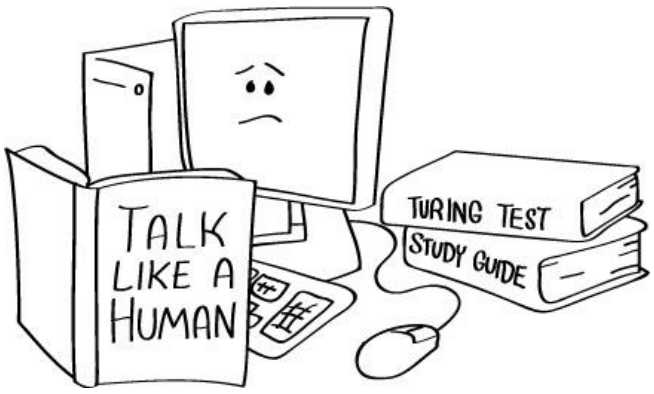
Problem 11: Artificial minds

> "Asking whether computers can think, is like asking whether submarines can swim"
> Edser W. Dijkstra, Dutch computer scientist (1930 –2002)

A

So now you have learned what cognitions are (thinking, perceiving, imagining, communicating, feeling, etc.) or in other words what having a mind entails. But so far we've only considered human cognition… How about computers? We are not talking about your laptop or tablet of course. But future artificial intelligent agents like 'Skynet' in *The Terminator* film series, or 'Data' or 'Emergency Medical Hologram Mark I a.k.a. 'The Doctor' in the *Star Trek* television series and films.
Do they have minds? Let us end this course with a little debate, just for the heck of it.

In order to find out whether an AI system has a mind, Alan Turing introduced what is now known as the Turing test for AI. He proposed the test in his 1950 paper *Computing Machinery and Intelligence*, which opens with the words: "I propose to consider the question, 'Can machines think?' One should see it as an imitation game; if it can imitate having a mind it must have one." Of course, it kind of depends on what having a mind means. A famous objection to the Turing test is the Chinese Room Argument and was brought forward by Searle.



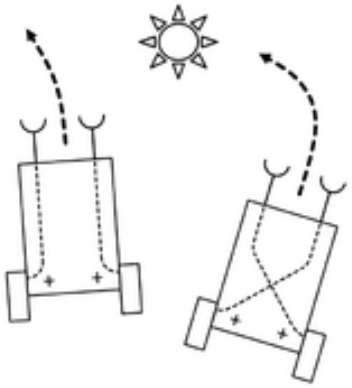
B

A lot of people accept that computers can reason, however, most do not accept that they can have emotions. Emotions involve feeling stuff and that is for most somehow only reserved for the human mind (some include the animal mind, but technically that is the same thing). Opponents of emotional computer minds emphasize *embodied cognition* and why that obviously is a problem for artificial affective computation. Proponents reject embodied cognition and emphasize that one should not be looking at emotions as feelings but rather terms of arousal states. For example, when you are scared you are in a higher state of arousal which influences your attention and perceptual systems which in turn influences your behavior. So for AI that would mean: input is camera detects 'scary stimulus' → change settings in camera ('pay more attention to stimulus') → 'see more details of stimulus' → output is move away from stimulus, throw robot arms in the air and scream. A very nice and extremely simple way of modeling emotions in well not even AI, but very simple 'cognitive agents' is via a brilliant thought experiment: Braitenberg Vehicles.

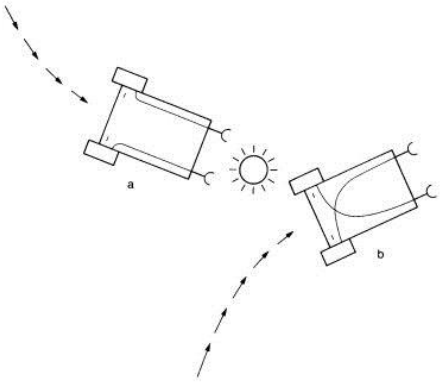
Imagine the following:

Vehicle 1 is the simplest vehicle; the speed of the motor (the rectangular box at the tail end) is controlled by a sensor (the half circle on the stalk at the front end). If the sensor senses something (whatever it is supposed to sense), it speeds up the motor. Motion is always forward, in the direction of the arrow, except for perturbations. Vehicle 2, with 2 motors and 2 sensors, otherwise like vehicle 1, the connections differ in 2a and 2b. Same for 3a and 3b, now the connections are inhibitory (they slow down the motor).

Vehicle 1



Vehicles 2a and 2 b



Vehicles 3a and 3b

Simple is it not? Obviously, vehicle 2a is a coward, and 2b is aggressive. Oh, and vehicle 3a is in very much in love, 3b is a bit of a Casanova…

Sources of information

CB = Course book: Gilhooly, K., Lyddy, F., & Pollick, F., (2014). *Cognitive Psychology*. Berkshire: McGraw-Hill Education

E = E-reader on Eleum

H = handout (either printed or digital format) in tutorial

UL = University library, location Randwyck

***** = introductory level

****** = intermediate (read after *)

******* = difficult (read after * or **)

****** =** impossible to grasp, don't even try

Problem 1: The cognitive approach I: The study of mind

Note: Since most of the readings for problems 1 and 2 are introductory chapters of cognitive science/ psychology books, some of the content overlaps. It may seem redundant to read the same thing again, however do have a look at most of them and focus on what makes them different. You may also prefer how one author explains the same thing over another.

Bermudez, J.L., (2014). *Cognitive Science*. Cambridge: Cambridge University Press. (***E**: Chapter 4: Historical Landmarks, pp. 87-90)

Braisby, N., & Gellatly, A., (2012). *Cognitive Psychology*. Oxford University Press: Oxford. (***H**: Chapter 1: pp. 1-17)

Friedenberg, J., & Silverman, G. (2006). *Cognitive Science: An Introduction to the Study of Mind*. Sage Publications: London. (***E**: pp. 95-99)

Gilhooly, K., Lyddy, F., & Pollick, F., (2014). *Cognitive Psychology*. Berkshire: McGraw-Hill Education. (***CB**: Chapter 1: pp.3-17)

Thaggard, P. (2005). *Mind: Introduction to Cognitive Science*. MIT Press: Cambridge, MA. (****E**: Chapter 1: pp. 3-21)

Thaggard, P. (2014). Cognitive Science. In: *Stanford Encyclopedia of Philosophy*. (****E**: pp. 1-7)

Problem 2: The cognitive approach II: Representation and Computation

Bermudez, J.L., (2014). *Cognitive Science*. Cambridge: Cambridge University Press. Chapter 4: Historical Landmarks, pp. 46-47, 122-123, 126-128. (***E**)

Braisby, N., & Gellatly, A. (2012). *Cognitive Psychology*. Oxford University Press: Oxford. (***E**: Chapter 1: pp. 20-26).

Gilhooly, K., Lyddy, F., & Pollick, F., (2014). *Cognitive Psychology*. Berkshire: McGraw-Hill Education. (***CB**: Chapter 7: pp.209-222) **Note**: the second half of the chapter should be read for problem 3.

Gleitman, H., Gross, J., & Reisberg, D. (2011). *Psychology*. W.W. Norton & Company, Inc.: New

York. (*__E__: Parts of chapter 9: pp. 341- 347)

Sternberg, R. J., & Sternberg, K. (2012). *Cognitive Psychology*. (*__E__: Chapter 8: 322- 340).

Problem 3: Not quite the brain

Note: the chapters contain the basics, the articles some applications. You are allowed to do either LeCun OR Mnih. Schölkopf helps with reading Mnih. Both are quite technical, but it's not about the details, but about the applications and why they work.

McLeod, P., Plunkett, K., & Rolls, E. T. (1998). *Introduction to connectionist modelling of cognitive processes*. Oxford University Press. (*__H:__ Chapter 1 and Chapter 2)

LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *Nature*, *521*(7553), 436.(***__E__)

Mnih, V., Kavukcuoglu, K., Silver, D., Rusu, A. A., Veness, J., Bellemare, M. G., etc. & Petersen, S. (2015). Human-level control through deep reinforcement learning. *Nature*, *518*(7540) (***__E__)

Schölkopf, B. (2015). Artificial intelligence: Learning to see and act. *Nature*, *518*(7540), 486. (*__E__)

Problem 4: I see and imagine…

Gilhooly, K., Lyddy, F., & Pollick, F., (2014). *Cognitive Psychology*. Berkshire: McGraw-Hill Education. (*__CB__: Chapter 2: pp 28-37, 53-64, Chapter 7: pp.223-232)

Gleitman, H., Gross, J., & Reisberg, D. (2011). *Psychology*. W.W. Norton & Company: New York. (*__E__: Chapter 5: pp. 181-187)

Gross, R. (2010). Psychology: *The science of mind and behavior*. Bookpoint Ltd.: Oxon. (*__E__: chapter 15: Perception: Processes and theories, pp. 233-238).

Logie, R.H., Pernet, C.R., Buonocore, A., & Della Sala, S. (2011). Low and high imagers activate networks differentially in mental rotation. *Neuropsychologia*, 49, pp. 3071– 3077. (**__E__)

Sima, J.F., & Freksa, C. (2012). Towards Computational Cognitive Modeling of Mental Imagery: The Attention-Based Quantification Theory. *Künstl Intell*, 26, pp. 261–267. (**__E__)

Problem 5: Sublime!

Gilhooly, K., Lyddy, F., & Pollick, F., (2014). *Cognitive Psychology*. Berkshire: McGraw-Hill Education. (*__CB__: Chapter 5: pp 156-157, Chapter 7: pp.223-232)

Karremans, J.C., Stroebe, W., & Claus, J. (2006). Beyond Vicary's fantasies: The impact of subliminal priming and brand choice. *Journal of Experimental Social Psychology*, 42, pp. 792–798 (**__E__)

Murphy, S. T., & Zajonc, R. B. (1993). Affect, cognition, and awareness: affective priming with optimal and suboptimal stimulus exposures. *Journal of personality and social psychology*, *64*(5), 723.

Den Dulk, P. A. U. L., Capalbo, M., & Phaf, R. H. (2002). A connectionist dual-route model for affective priming. *Cognitive Processing*, *3*(4), 43-64.

Problem 6: Attention please!

Chun, M.M., Golomb, J. D., &Turk-Browne, N.B. (2011). A Taxonomy of External and Internal Attention. Annu. Rev. Psychol., 62, pp. 73–101. (****H**)

Gilhooly, K., Lyddy, F., & Pollick, F., (2014). *Cognitive Psychology*. Berkshire: McGraw-Hill Education. (***CB**: Chapter 3: pp.74-99)

Logan, G.D. Attention, Automaticity, and Executive Control. In: *Experimental cognitive psychology and its applications* (2005*).* A.F. Healy, (Ed). American Psychological Association: Washington, DC. (****E**book: chapter 10, pp. 1-11).

Problem 7: Vigilant detectives

Goldstein, E.B. (2014). *Sensation and Perception*. Pacific Grove, CA: Wadsworth. (***E**: Chapter 1, pp. 16-17, and Appendix: Signal Detection: Procedure and Theory, pp. 395-400).

Kantowitz, B. H., Roediger, H. L. III, & Elmes, D. G. (2009). *Experimental Psychology*. Cengage learning, CA: Wadsworth. (***E**: Parts of chapter 6: pp. 162-169).

Lynn, S. K., & Feldmann Barrett, L. (2014). "Utilizing" Signal Detection Theory. *Psychological Science*, 25(9), pp. 1663-1673. (****E**)

Morgan, K., Johnson, A. J., & Miles, C. (2014). Chewing gum moderates the vigilance decrement. *British Journal of Psychology*, 105, 214–225. (*****E**: feel free to skip some of the methodology)

Warm, j. S., Parasuraman, R., & Matthews,G. (2008). Vigilance Requires Hard Mental Work and Is Stressful. *Human Factors*, 50(3), pp. 433–441. DOI 10.1518/001872008X312152. (****E**)

Problem 8: Sending and Receiving?

Gilhooly, K., Lyddy, F., & Pollick, F., (2014). *Cognitive Psychology*. Berkshire: McGraw-Hill Education. (***CB**: Chapter 12: pp.358-385)

Gilhooly, K., Lyddy, F., & Pollick, F., (2014). *Cognitive Psychology*. Berkshire: McGraw-Hill Education. (***CB**: Chapter 13: pp.400-435)

Problem 9: And… action!

A fair warning for most of the readings: they involve some neuroscience here and there, feel free to ignore that and focus on the learning goals. Plus again: skim and skip!

A nice link on some basics of embodied cognition: http://blogs.scientificamerican.com/guest-blog/2011/11/04/a-brief-guide-to-embodied-cognition-why-you-are-not-your-brain/

Anderson, M.L. (2003). Embodied Cognition: A field guide. *Artificial Intelligence*, 149, 91–130. (****H**)

Davies, J.I., Markman, A.B. (2012). Embodied Cognition as a Practical Paradigm: Introduction to the Topic, The Future of Embodied Cognition. *Topics in Cognitive Science*, 4, 685–691. (****E**)

Engel, A.K., Maye, A., Kurthen, M., & König, P. Where's the action? The pragmatic turn in cognitive science. (2013). *Trends in Cognitive Sciences*,17(5), pp. 202-209. (*****E**)

Gilhooly, K., Lyddy, F., & Pollick, F., (2014). *Cognitive Psychology*. Berkshire: McGraw-Hill

Education. (*__CB__: Chapter 8: pp.234-261)

Rosenbaum, D.A., Chapman, K.M., Weigelt, M., Weiss, D.J., & van der Wel, R. (2012). Cognition, Action, and Object Manipulation. *Psychological Bulletin*, 138(5), pp. 924–946. (**__E__)

Problem 10: I think I feel… (For the research articles: do not focus on the statistical methods, the results are what matter)

Gilhooly, K., Lyddy, F., & Pollick, F., (2014). *Cognitive Psychology*. Berkshire: McGraw-Hill Education. (Chapter 14: Cognition and Emotion, you may skip box 14.1 and the part on 'Emotion and memory" as this is part of the UCM course *Memory*). (**CB***)

Levant, R.F., Hall, R. J., Williams, C.M., Hasan, N.T. (2009). Gender Differences in Alexithymia. *Psychology of Men & Masculinity*, 10(3), pp. 190–203. (**__E__)

Levant, R.F., Allen, P.A., & Lien, M-C. (2014). Alexithymia in Men: How and When Do Emotional Processing Deficiencies Occur? *Psychology of Men & Masculinity*, 15(3), pp. 324–334. (***__E__: skip most of the methodology, focus on their discussion)

Timpano, K.R., Bucker, J.D., Richey, J.A., Murphy, D.L., & Schmidt, M.B. (2009). Exploration of anxiety sensitivity and distress tolerance as vulnerability factors for hoarding behaviors. *Depression and Anxiety*, 26, pp. 343–353 (**__E__)

Timpano, K.R., Shaw, A. M., Cougle, J. R., & Fitch, K. E. (2014). A Multifaceted Assessment of Emotional Tolerance and Intensity in Hoarding. *Behavior Therapy*, 45, pp. 690–699. (**__E__)

Problem 11: Artificial minds

Braitenberg, V. (1984). *Vehicles: Experiments in Synthetic Psychology*. MIT Press. (**__E__)

Cañamero, L. (2014). Bridging the Gap between HRI and Neuroscience in Emotion Research: Robots as Models. Workshop "HRI: a Bridge between Robotics and Neuroscience". (**__E__)

Crowder, J.A., Friess, S. (2013). Artificial Psychology: The Psychology of AI. *Journal of Systemics, Cybernetics and Informatics*, 11(8), pp. 64- 68. (**__E__)

Gross, R. (2010). *Psychology: The science of mind and behaviour*. pp. 311-316. (*__E__)

Picard, R.W. (2003). Affective computing: challenges. Int. J. Human-Computer Studies, 59, pp. 55–64. (**__E__)

Thaggard, P. (2005). Mind: Introduction to Cognitive Science. MIT Press: Cambridge, MA. (**__H__: Chapter 10: Emotion, chapter 12: Bodies, The World and Dynamic Systems) Note: obviously this is way too much for you to read all of it, so be selective; finally you get to use those PBL skills. Scan and skip where needed!