Memory

SSC2025

Course manual 2017-2018

General Information

Imagine you have no memory at all. What would that be like? Memory psychologist Alan Baddeley describes a patient, Clive Wearing, who was a famous musician before he fell ill with encephalitis (i.e. inflammation of the brain). Clive's brain was so severely damaged, that he ended up with virtually no memory after recovery from his illness. Baddeley (1997, p. 2-3) writes:

"Amnesia is not an all-or-none condition, and most amnesiacs can appear to be relatively normal on initial meeting. Not so in the case of Clive, since his amnesia was so dense that he could remember nothing than more from a few minutes before, a state that he attributed to having just recovered from consciousness. Left to his own devices, he would often be found writing down a time, for example 3.10, and the note "I have just recovered consciousness", only to cross out the 3.10 and add 3.15, followed by 3.20, etc. If his wife left the room for a few minutes, when she returned he would greet her with great joy, declaring that he had not seen her for months and asking how long he had been unconscious. Experienced once, such an event could be intriguing and touching, but when it happens repeatedly day in, day out, it rapidly loses its charm. Clive was not capable of showing new learning of people or events, rapidly becoming frustrated in a learning situation and fulminating against anyone so stupid as to waste his time on silly tests when he had only recovered consciousness a few moments before. In some patients, new learning may be impaired, while their recollection of earlier learning is normal. Not so, alas, in the case of Clive, whose capacity to recall his earlier life was patchy in the extreme. He could still remember general features, such as where he had been to school and what college he had attended at Cambridge, together with highlights such as singing for the Pope on his visit to London, and some particularly dramatic musical events that he had organized. In all cases, however, his capacity to recall detail was extremely poor."

What this example shows is that memory plays a key role in defining who we are. It is the interpretation of our memories that provides insight into the present. This is one of the key features in famous movies such as *Memento*, or *Blade Runner*, in which artificial humans or robots are given a sense of identity by implanting (false) memories. Memory is involved in almost all cognition. Perception, attention, language, understanding, learning, thinking, reasoning, problem solving: in each of these cognitive activities, information retrieved from memory plays an important or even decisive role. Our dynamic archives of acquired experiences help us to be better prepared in dealing with the future.

Together with the ability to learn, memory may therefore be considered our most important faculty. We are our memories, in a way. Psychologists grasped this already a long time ago. *Ebbinghaus* published his memory experiments in 1885, six years after *Wundt* founded the first psychological laboratory in Leipzig. A few years later *Freud*'s ideas about the role of repressed memories in psychological problems began to take shape. Now, more than a century later, a lot of knowledge is available about the workings of memory, about the structure of our memories, and about their biological substrates and processes. We know many things about how people learn, how they store knowledge and how they retrieve it when they need it. We think we understand why our memory sometimes fails or why people remember things that did not actually take place. We can explain to a large extent why people have no memories for their early childhood or why Korsakoff patients can hardly process explicit information. However, despite all this knowledge, there is (still) no grand theory of memory yet – there is no singular framework in which all or most memory phenomena can be understood.

What we do have is a collection of fascinating findings, a large number of experimental paradigms and a number of theoretical controversies. This course offers an inevitably limited sampling of what we know about memory. To this end, the course coordinator has linked various scientific perspectives in order to understand memory, which includes cognitive and biological perspectives and – to a lesser extent – social perspectives. You will study, for example, the cognitive interpretations of the retrieval process as well as the biological processes that make this process possible. At the same time, this knowledge may help in understanding and appreciating the value of eyewitness testimonies in court cases.

The psychology of memory has much been the psychology of dichotomies: semantic versus episodic memory, implicit versus explicit memory, working memory versus long-term memory, laboratory memory versus memory of daily life, memory processes versus memory structures. This course will confront you with a number of these distinctions. However, one of the key questions in memory research – and this course – is whether these dichotomies are actually meaningful, or even helpful. For example, would it not be more likely that working memory is on a continuum with long-term memory? Do implicit and explicit memory tests indeed tap different memory systems? Can laboratory findings and research with real-life tasks perhaps complement each other? The impact of *neuroscience* research to understanding memory is increasing, and in some cases suggests that we redefine our models and definitions of the function and structure of memory.

Structure and Content

Coordinators

Course coordinator: Vincent van de Ven, Faculty of Psychology and Neuroscience (FPN), Department of Cognitive Neuroscience, Oxfordlaan 55, Room 1.020, e-mail: v.vandeven@maastrichtuniversity.nl.

Practical coordinator: Christine Resch, Faculty of Psychology and Neuroscience (FPN), UNS40, Room 3.747, e-mail: christine.resch@maastrichtuniversity.nl.

Objectives of the course

The coordinator aimed at composing a balanced course in which both biological and cognitive psychology are represented. The objectives include the acquisition of:

• Knowledge of recent theories in the field of working memory, explicit memory and knowledge, false memories and autobiographical memory;

• Knowledge of the principles of memory decline, forgetfulness and reconstructive processes;

• Insight into the role of biological processes in learning, emotion and retrieval;

• Knowledge of brain anatomy (at least as far as relevant to understand memory);

• Experience with common experimental memory paradigms.

Attendance

Compulsory attendance is 85% for tutorial group meetings (= minimum of 10 tutorial meetings) and 100% for practical meetings. Should you miss 3 or 4 tutorial meetings, you must compensate for this loss by an extra assignment in order to be allowed entry to the exam. The extra assignment will usually come down to a clearly written summary of the literature of (one of) the missed tasks. You must contact the course coordinator at the end of the course and notify which meetings you missed. Please note that not abiding to these compensation rules may render your exam entry or obtained grade invalid. Failing to attend more than 4 tutorials automatically disqualifies you for exam entry. More information can be found in the UCM Student Handbook.

Practical

The practical aims to make you familiar with a number of important paradigms of memory psychology and to train you to administer standard memory tests. Knowledge and practical skills in connection with the measuring of memory-related processes will be offered. The practical teaches the students how to apply several important methods and how to conduct a more or less complete examination of memory-related processes by using experimental and clinical neurological tests. The attendance requirement for the practical is 100%. You will be asked to test individuals in your social surroundings (friends, family or fellow students) and you will have to write a report about the results of your testing. Students will work in teams of two to three persons (teams will be formed during the practical session). The basic idea is to make sure that you learn from your fellow student with respect to assessment, observations and writing. We want you and your partner(s) to make one final report, which will be graded. You should further clearly indicate the contribution of each team member to the final report.

Requirements for the report

The final report must include three so-called case reports per team member (thus, six case reports for a team of two students). Each individual case report needs to include at least four parts, namely:

• **Anamnesis** (e.g., how did the subject describe his or her own memory? Does his or her memory function well, according to the subject's description? Was he or she a fast learner?)

• **Observations** made during the actual assessment of memory tasks (How did the subject react to the assessment of memory tests? Was he or she anxious for instance?)

• **Test performance** (e.g., a description of the tests administered; the scores of the subject on the individual tests)

• **Conclusion** (i.e., what can we conclude based on the anamnestic data, observations and test performance? Are there signs of pathological forgetfulness?).

Note: In a clinical setting, a case report also consists of a fifth (well actually a first) part, namely the referral question (i.e., the report always starts with a description of why the subject was referred to, in our case, a neuropsychologist). Because your subjects are not actually clinically-referred, it is not necessary to include a referral question at the beginning of each case report. You need to administer the tests that we practiced during the practical. Each case report will consist of a recap on how a subject performed on each of the following tests:

1) Digit span and digit span backwards

2) Sentence repetition

3) Repetition of nonsense words

4) Knox Block test

5) 15-Word learning test

6) Rey-Osterrieth Complex Figure test

7) Verbal pairs association for adults (in case of testing a child, use the Learning names test)

8) Brown Peterson Technique.

The report should also contain an extended description of these tests. You are allowed to provide this description only once (e.g., in a general introduction or in the first case reports). However, you should briefly refer to this general description in all of the case reports (e.g., "for a description of the tests, see …"). The deadline for the report is **11:59 PM, Friday December 8th, 2017**. Hand in an electronic version through *Safe Assignment* in EleUM.

Note on citing sources in your paper assignment

If you use literature or websites, and you put a point made by another author in your paper, then always make a reference to the work from which you have taken the point. Most of what you will be doing is putting the arguments, theories or data that you have found into a logical order in your paper. You paraphrase the position of others in your own words. The latter is important: Do not just copy a paragraph from a book. Instead, rephrase texts in your own words. Sometimes, when an author makes a very interesting point, uses a particularly happy phrase or says something that you want to criticize/comment on in detail, you may want to *quote* the author. Always put quotation marks around anything that you have copied, and never copy large sections of text (i.e. more than say 4 lines) for this purpose. Don't forget to mention the source of the quotation (author, year, pages).

Assessment and resit

Assessment will be based on a practical report (35%) a final exam (65%). The final exam consists of open questions that are closely related to the topics included in the problems and to the content of the lectures. To pass the course you must be graded minimally with a 5.5 on both assessments. The resit for this course includes a written exam; if the resit grade is higher than the grade of the initial exam it will replace that grade. There is no possibility to redo the practical report. Not handing in the practical report in time or failing to attend the final exam forfeits the possibility to attend the resit exam.

Literature

You will be referred to books and articles that can be found in the UM library, UCM reading room and in the e-reader for this course. The e-reader can be found in the Blackboard environment for this course. It is strongly recommended to buy:

Gluck, M.A., Mercado, E., & Myers, C.E. (2016). Learning and Memory: From Brain to Behavior. Third Edition. Worth Publishers Macmillan Learning, NY.

In addition, we expect you to consult other sources for each subject. The library offers a wealth of relevant literature. It is also useful to look at learning and memory-related literature you studied in previous courses. However, please realize that the presence of an e-reader does not mean that visiting the library to carry out your own literature search has become redundant. On the contrary, we encourage you to regularly consult other literature than is offered in the e-reader. We assume that you handle your literature reading in the classic *Problem-based Learning* approach (see also some comments at the end of this manual).

As noted, a substantial portion of the tasks will be about how memories are represented in the brain. The course assumes that you at least have an introductory level of biological psychology (as is provided in the 1000 level course Introduction to Psychology).You may want to review your previous literature and knowledge you may have had on brain anatomy and function in previous courses. To be sure, basic elements of the hippocampus and more detailed aspects of neurophysiology will be discussed in the latter part of the course.

On-line materials

Hyper-links to online material will be available on EleUM for many of the tasks, which include Youtube videos of interviews or lectures, Wikipedia pages for technical concepts or general news media articles about relevant topics. It is highly advised to consult these online sources in addition to the course literature.

Lectures

The lectures provide you with information to extend your knowledge of the problems you have studied. The content of the lectures is part of the subject matter you have to study.

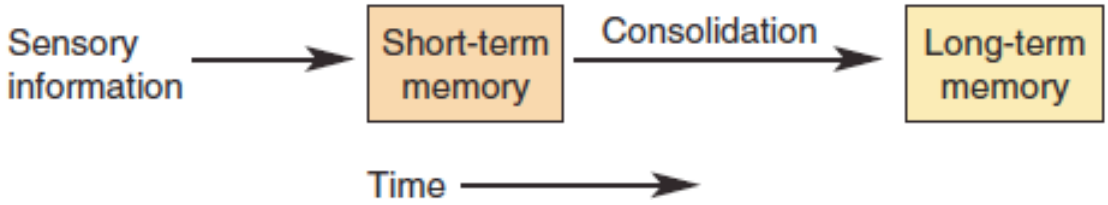
List of tasks

TASKS

1 A tale of two systems?

Our memories are our most personal possession. Our recollections can include the sentence you just read, events that happened during your last birthday party, or even some events in your childhood. These recollections also define who we are, and the choices we make.

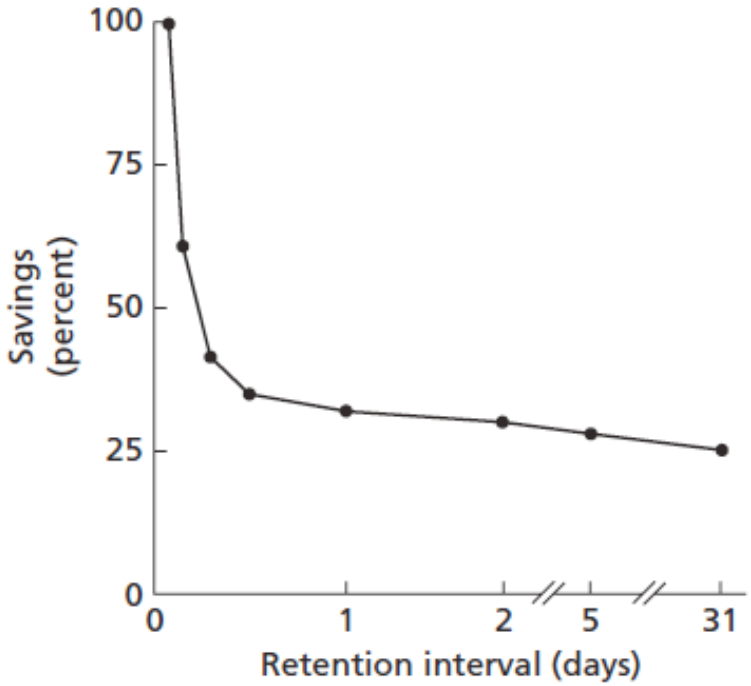
Psychologists who are interested in memory functions created a model of these cognitive processes, in which different boxes distinguish different types of memory.



In addition, psychologists often separate Long-Term memory into different memory systems. Evidence for different systems can be easily demonstrated using a simple experiment:

- Describe in some detail what you ate for breakfast this morning.
- Now describe how you actually ate your breakfast. Not which utensils you used, but how you used them.

Hermann Ebbinghaus was a memory research pioneer: He was the first to systematically investigate under which conditions memory works or fails. Using himself as the sole participant, he had himself learn many lists of nonsense syllables and then tested his memory of those lists. For some of his studies, he plotted his memory performance at several occasions after learning, thereby introducing the classic and well-known Forgetting Curve.



Traditionally, researchers have distinguished the acquisition of memories – learning – from the actual storage of memories. However, results from more recent brain research suggests that learning and memory share similar mechanisms. If so, can acquisition and storage then be considered separately?

2 Working with letters and words

A classic idea about human memory is that it functions as an electronic storage device in computers or photo cameras. Input into the apparatus – a typed text or datafile, or light passing through the camera lens and falling on a light-sensitive plate – is then stored onto the storage device. The representation of the memory is a very accurate copy of the information that was entered into the system, and the representation is very resistant to corruption over time. This model of human memory suggests that our memory has high reliability and fidelity.

How well do you remember information? Read out each letter of the following word below, then cover this page with a sheet of paper and recall the letters from memory.

A C U I L F G T L I S R S R A C I P E I

How many letters did you correctly recall? Were they also recalled in the right order?

Now do the same thing for the letters below.

S U P E R C A L I F R A G I L I S T I C

What did you find out? Can you explain this effect?

Gerard usually studies with his radio on. He does not actually listen to it, but he likes the noise in the background. One day his radio breaks down. The next day he has a test on German vocabulary. He scores a much higher grade than usual for this test. He decides to investigate whether the radio broadcasts, although he never really listens to them, have an effect on his vocabulary learning. He studies German words with the following programs in the background: an interview with Angela Merkel, a Chinese news broadcast (he did not take Chinese in school), a classical piece of twelve cellos, and the radio turned off. He finds that his memory for German words is slightly worse when listening to classical music, compared to listening to silence. However, studying while listening to Merkel's interview or the Chinese news have even worse effects on word memory. Fascinated by his learning experiment, he tries to do his stereometry assignments while listening to the news, or while picturing the route he walks home from school. The first has no negative impact, but the latter does.

3 I'm an expert in the things I know

What do you know of Maastricht? Did you know that the name of Maastricht, which derives from Mosa Trajectum, means road or bridge over the river Maas? Surely you have noticed that Maastricht has a very dramatic history that goes back to pre-Roman ages. At the same time, Maastricht has a contemporary connotation, with a fundamental treaty of the European Union named after it. Also, Maastricht is great for shopping and fine dining. You can have your brain measured at Maastricht's Brains Unlimited facilities that house top-of-the-line MRI scanners. Maybe you have other, perhaps more personalized, knowledge of Maastricht. Fill out the drawing below with any knowledge you might have of Maastricht. Draw straight lines between the various concepts as you associate them.

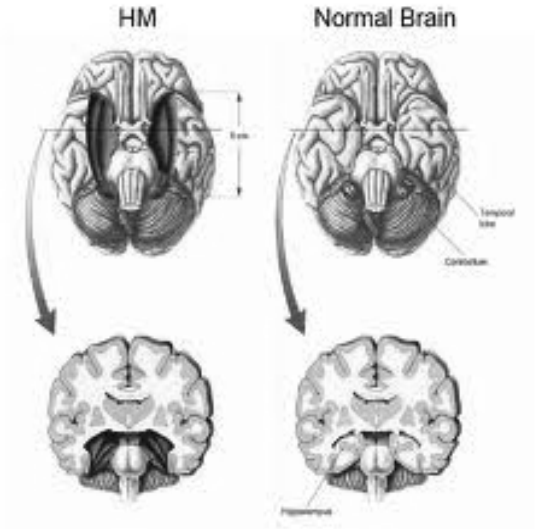
Can you extend this network of associations to non-semantic knowledge, such as how to use Problem-Based Learning in this course? Or how to play a chess game? If not, then – according to logical deduction – another type of knowledge representation must exist.

4 No more past, no more future

Henry Molaison has the dubious honour to be one of the famous cases – if not the most famous case – in psychological history. Suffering from a severe form of epilepsy that did not respond to medication from his early youth onwards, his physician decided to apply a controversial experimental procedure. In epilepsy, a 'storm' of neurophysiological activity rages through the brain. This storm often starts somewhere in cortical or subcortical grey matter in the ventral parts of the temporal lobe. In Mr. Molaison, it was thought that his epileptic storm started in one of the hippocampal structures. Surgical procedures to alleviate epileptic symptoms include the removal of the part of the brain at which the neurophysiological storm starts, which meant that it was decided to remove left and right hippocampal structures (plus neighboring cortex) from the brain.

The surgery went well. When Mr. Molaison woke up, he found that his epileptic symptoms had dramatically decreased in severity and frequency. Unfortunately, it soon became apparent that the surgery also brought about a new symptom: Mr. Molaison could not form new autobiographical and episodic memories. The surgeon would come into the patient's room and be greeted as if they saw eachother for the first time. After a chat of several minutes, the surgeon would leave the room, come back quickly after, and was again greeted as if he met the patient for the first time.

Henry Molaison – a.k.a. patient HM – was the starting point for the development of memory research in the human brain in the 1950s, and the theories and insights that were obtained in those days are still used in contemporary research.



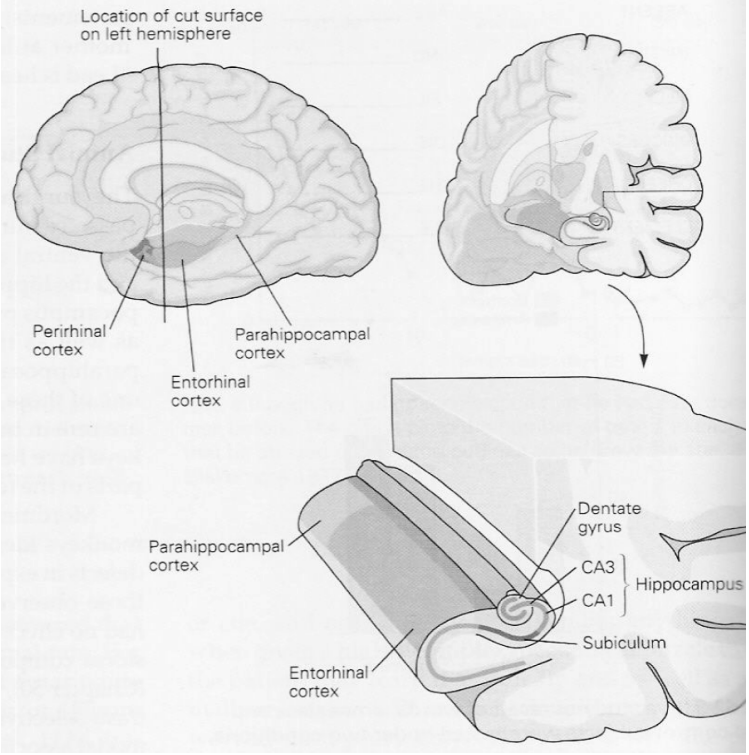
Apart from an understanding of how the hippocampus relates to memory formation and storage, the case of patient HM also showed how the hippocampus is NOT related to memory. For example, investigators had HM repeatedly draw a complex figure over many days. Every time he started with the trial he showed surprise as if doing the task for the first time. However, his performance markedly increased over time. He seemed to be able to form a memory for the drawing, but had not recollection of the experiences.

Studies of other clinical patients have further extended our understanding of the brain areas related to formation and retrieval of episodic and semantic memories.

5 A seahorse's trace of a place in a maze

Picture yourself in the main hall of the UCM building, facing the stairs that lead to the first floor. Walk up the stairs, cross the computer landscapes and take a right-turn into the corridor with offices on your left hand. Follow the corridor and take consecutive right-turns until you reach the small steps that lead to the first floor and the stairs in the main hall. Walk down the stairs and find your way to the Office of Student Affairs.

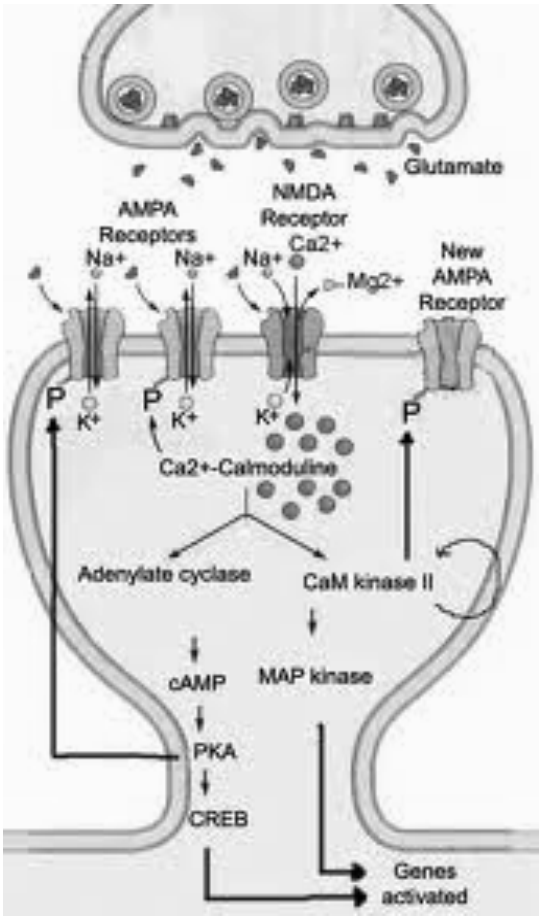
You just did mentally what rats and mice do physically in many an animal laboratory: Walk through a maze. Differences are that the rodents have measurement electrodes stuck into their brain that record activity of many neuronal cells in hippocampus and cortex simultaneously as the rodent travels. (Also, rewards await you and the animals, although it is pieces of fruit lying at particular corners for rodents, and unfolding fundamental knowledge of the brain for you.)



This research has shown that the hippocampus is important for memory consolidation as well as for spatial navigation. Different cells in the hippocampus respond to different locations in space, and are therefore referred to as 'place cells'. The plot below is a representation of a place field, the activity preference of a place cell.

Could place cells in hippocampus be associated with how autobiographical memories are stored?

More importantly, how are place cells related to memory formation? Donald Hebb (1949) postulated a highly influential idea that has revolutionized our understanding of memory formation in the brain: "cells that fire together, wire together". Hebb's hypothesis was purely hypothetical – at the time, the neurobiological substrate for "fire together wire together" still had to be discovered. Nowadays, there is strong agreement that Long Term Potentiation (LTP) is the main neurobiological mechanism for experience-dependent changes in neural connectivity. The main principle of LTP is that, after an event that strongly triggers activity of two synaptically connected neurons, the receiving – post-synaptic – neuron becomes more sensitive to inputs from the sending – pre-synaptic – neuron. This increase in sensitivity can last for hours, days or weeks.

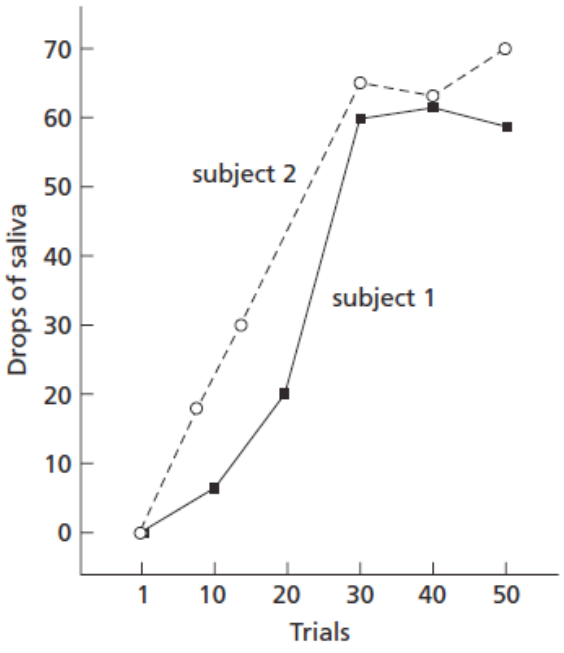


6 Learning associations

Our perceptions of the world, and thus the decisions we make on how to act on these perceptions, are for a large part influenced by top-down processes, such as awareness, attention, beliefs and experiences. The latter top-down process brings us full circle: Our past experiences influence how we perceive the world at this moment.

Consider a well-known human reflex: Whenever you see food you start to salivate and get a feeling of hunger. It is a very reliable reflex in many mammals, including humans and dogs, which prepares the organism for food intake and subsequent. For example, consider seeing a nice plate of French fries, or a hamburger. Perhaps only the thought or mental imagining of these fast foods will make you salivate and feel hungry! Now, suppose that you happen to live close to a fast food restaurant in Maastricht that advertises itself using a large yellow letter 'M'. Every time that you decide to go out and get a hamburger and fries, you go to this restaurant with the yellow 'M'. After several months of hamburger eating at this fast food place, you find yourself walking through your home town, minding your own business, when suddenly you encounter a large advertisement poster at a bus stop with the large yellow 'M' displayed on it. What do you think will happen to you? And why?

In the previous example, you "associated" the yellow 'M' with food. That is, your body and nervous system has somehow learned to consider the yellow 'M' as a strong predictor of food. This concept is known as classical conditioning, and was first investigated – accidentally – by Ivan Pavlov at the beginning of the 20th century. In his experiments, he used dogs, rather than humans, but essentially got the same result. He and others found humans and animals can associate stimuli to responses through a number of conditioning principles. One important principle is that it does not involve a conscious or voluntary decision.



At the same time, classical conditioning is more than the "mere" association between a stimulus and a response. Consider for example an extension of the yellow 'M' and hamburger association. Suppose that, after some time, the fast food place now starts to advertise itself with an additional item: A blue teddy bear. For several weeks, you keep visiting the restaurant as you have done before, but now each time seeing the yellow 'M' and the blue bear. Then, at some moment, you encounter the blue bear, without the yellow 'M'. What do think you will happen to you?

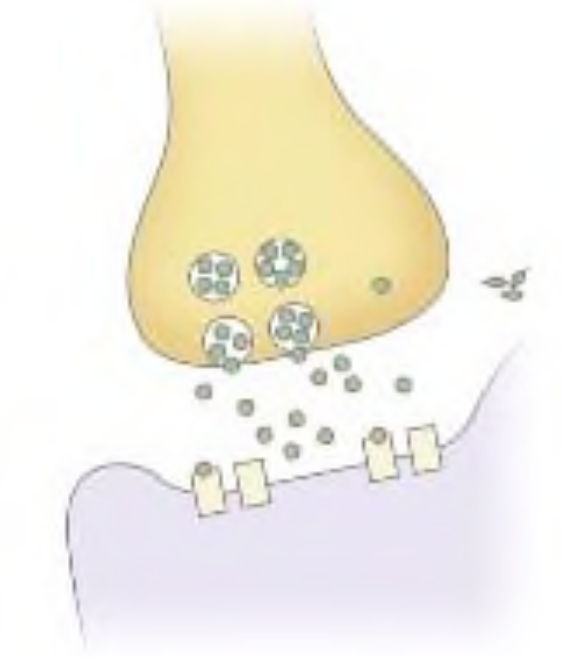
7 Practise makes perfect

Annie is a first-year academic student. For her first exam she studies hard and gets a very high grade, which makes her feel happy. For her next exam, Annie adopts a more lacklustre manner of studying. She completes the exam and subsequently receives a poor grade for it, giving her a feeling of disappointment. She decides to go back to her initial studying behaviour for her next exam, for which she gets a high grade again. After several exams, Annie has made her hard studying behaviour as her default, automatic response to studying for an exam. This is an example of operant conditioning – sometimes also referred to as instrumental conditioning.

The elements of reward and punishment are essential to this form of learning, and distinguish it from classical conditioning. There are many other examples of operant conditioning in daily life: Consider for example potty training in toddlers, or teaching a squirrel the subtle art of waterski-ing.

Naturally, the choice of reward or punishment in acquiring a desired response – or unlearning an undesired response – will be important in the eventual success of learning. Likewise, the manner in which you reward or punish a behaviour will matter for how long a learned response will be made for future events. For example, what do you will work better when teaching a child not to ask for candy moments before dinner is served: Punishing the asking, or rewarding the not asking? Should you do before every dinner, or only occasionally?

Sometimes, a reward may be obtained when it is not actually desirable. Smokers receive a reward each time they smoke a cigarette, even though they know that smoking hurts their health. Gamblers may get a rewarding "kick" out of gambling, even if they do not have the financial means to support their gambling. What is perhaps puzzling is that the behaviour itself may loose its reward, but that somehow the brain has learned to predict, and therefore seek or even demand, the initially rewarding experience. Thus, addicts may stop liking what they do, but still wanting to do it. In fact, the brain's high sensitivity to reward, which makes us so eager to learn new behaviours, may be the reason why some people are sensitive to acquiring addictive behaviours. Understanding the cognitive and neurobiological basis of operant conditioning is then required to develop successful treatments for addiction.



8 What gets in must get out?

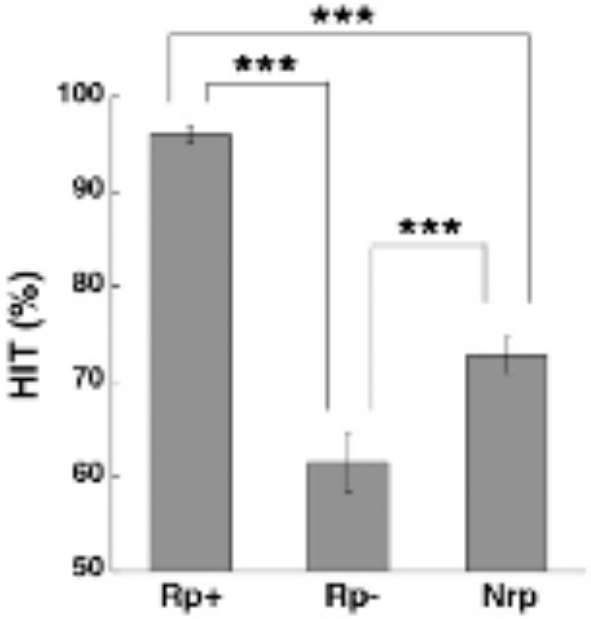
Now, what do you think of the following? In the movie City Lights, Charlie Chaplin goes into a bar, gets drunk and meets a millionaire and prevents him from committing suicide. Some time later he meets the millionaire again but does not recognize him. Only when Chaplin becomes intoxicated again does he recognize the millionaire whose life he saved. Suppose you would be able to measure people's recognition performance in various states of intoxication. The results could look something like the one depicted in the graph below. Is alcohol actually a powerful mnemonic?

A prevailing opinion among psychologists is that forgetting is a matter of a memory trace being erased. The memory of one's primary school teachers is fading away in time, because the memory trace somehow falls into decay. It is like tracks on a sandy road that are slowly erased by the rain. The experimental paradigm supporting this decay theory of forgetting is the Brown-Peterson task. Participants had to learn three letters by heart; subsequently they were offered shorter or longer series of three digits. Forgetting the three letters was a function of the length of the series of digits. The more digits were offered between the moment of learning and that of recalling the letters, the lower memory performance. The researchers concluded that the memory trace is fading away if the participant is not given the opportunity to strengthen it (by means of rehearsal).

But what can you make of the following:

Anderson, Bjork, and Bjork (1994) made test participants learn category-exemplar pairs (e.g. FRUITS-BANANA, FRUITS-ORANGE or DRINKS-SCOTCH, DRINKS-BEER). In the second part of their experiment the participants had to practice and recall half of the pairs from one category in the following way: FRUIT–AP. In this example, the participants then had to complete the word (here, APPLE). After twenty minutes, participants received a cued-recall task (e.g., FRUIT-*). Unsurprisingly, the pairs that had been practiced (Rp+)* were remembered better than unpracticed items (*Rp-*). However, the *unpracticed* items were remembered *worse* than the unpracticed items from a *different category* (*Nrp*) (see graph).

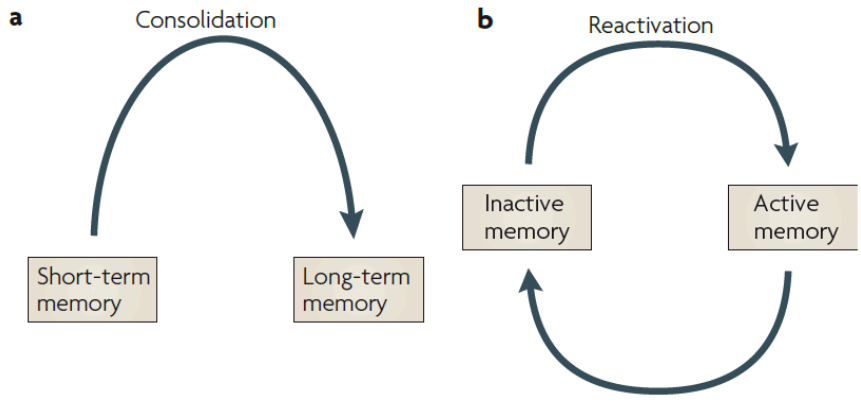
A follow-up study then looked at what happened to the memories: Was there an impairment in the connection between a pair of items, or did the items themselves got impaired?

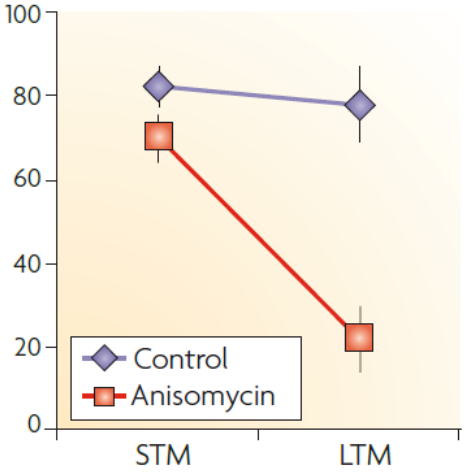


9 Memory consolidation – permafrost or melting clocks?

In previous tasks you discussed how memories may impact on behavior or cognition, or how cognition may influence memory performance. In these tasks, we assumed that experiences were somehow transferred via short-term memory to a long-term memory store. This process of storing experiences into long-term memory is called consolidation. Most people – layman and researchers alike – believe that, once memories are formed in the mind or brain, they stay as they are. Perhaps this state of long-term memories can be described as some sort of mnemonic permafrost – the representation of memories reaches a solid and unchangeable state. The left panel below serves to illustrate this view of consolidation. Any errors in memory are then not the result of impaired memories, but rather impaired cognition, such as errors in attention or inhibition.

An alternative model of consolidation is presented in the right panel. In this model, memories can be reactivated, which require a new process of (re-)consolidation to put the memory back into the system. Consider for a moment what this means for long-term memories. What happens to memories in an active or inactive state? Do long-term memories ever 'freeze' into a stable and lasting state? Are there any benefits to memory reconsolidation?





To investigate models of memory consolidation, investigators injected a substance called Anisomycin, which inhibits protein synthesis, into the hippocampus of rats or mice after a memory was acquired. The results are shown in figure on the Left.

Consider the ramifications this finding could have e.g. in treating patients suffering from Posttraumatic Stress Disorder, who are troubled by spontaneous relivings of traumatic events.

10 Memory illusions

In 1975, two men forced the assistant manager of a department store into a car, one of whom pointed a gun at him and told him to lie down in the back of the car. He got only a glimpse of the men before they pulled stocking masks over their faces. They then drove to the store and demanded that he open the safe. He convinced them he did not know the combination, so the robbers took 35 dollars from his wallet and let him go.

The victim could say very little about his kidnappers. However, amongst other things, he did say that one of the men resembled someone who had recently applied for a job in the store.

Three days later the police stopped a car and arrested the driver and passenger, Sandy and Lonnie Sawyer. Neither men looked like the composite sketch, neither had applied for a job at the store, and both denied knowing anything about a kidnapping. At the trial, the manager positively identified the Sawyers as the kidnappers. Despite four witnesses providing an alibi for both the brothers, the jury found the Sawyers guilty.

After a long search by individuals unrelated to the brothers, another man thus far unquestioned by the authorities confessed he was one of the kidnappers. Further, inquiries of the jurors showed that several jury members were not convinced by the evidence, but grew tired of the process and eventually conformed to the opinion of the majority. After having spent two years in jail, the brothers were freed, narrowly escaping sentences of 28 and 32 years.

One of the causes of the wrongful conviction was that jurors were more impressed with the testimony of the victim-slash-eyewitness than they were with the counteracting testimonies from eight individuals.

And what about the – apparently – false memory of the victim himself? How much can we rely on our own memories? In the courtroom as well as in class, what types of pitfalls or sins of memory do we have to watch out for?

Literature List

Task 1. A tale of two systems?

Gluck, Mercado & Myers (2016). Chapter 1: The psychology of learning and memory. Pp. 1-33.

Lieberman, D.A. (2004). An introduction to memory. Learning and memory: An integrative approach. Canada: Thomson-Wadsworth. Chapter 8: Memory: An introduction. Pp. 289-295.

Task 2. Working with letters and words

Gluck, Mercado & Myers (2016). Chapter 9: Working Memory and Cognitive Control. Pp. 351-387. Last section on "Clinical Perspectives" not required.

Lieberman, D.A. (2004). An introduction to memory. Learning and memory: An integrative approach. Canada: Thomson-Wadsworth. Chapter 8: Memory: An introduction. Pp. 306-313 (Starting at "Two clues for a memory model").

Task 3. I'm an expert in the things I know

Gluck, Mercado & Myers (2016). Chapter 7: Episodic and semantic memory. Pp. 267-274, until "Encoding new memories".

Lieberman, D.A. (2004). Learning and memory: An integrative approach. Canada: Thomson-Wadsworth. Chapter 10: Long-term memory. Pp. 354-394. SKIP pages 360-370, start again at "Organization of semantic memory" (pp. 392-414).

Task 4. No more past, no more future

Gluck, Mercado & Myers (2016). Chapter 7: Episodic and semantic memory. Pp. 290-309, start at "Brain substrates".

Bear, M.F., Connors, B.W., & Paradiso, M.A. (2007). Memory systems. Neuroscience: Exploring the brain. Chapter 24, pp. 725-744, until "Memory functions in the hippocampus".

Task 5. A seahorse's trace of a place in a maze

Gluck, Mercado & Myers (2016). Chapter 2: The neuroscience of learning and memory. Pp. 62-67, start at "Causing changes in neural connections" **&** Chapter 3: Habituation, sensitization and familiarization. Pp. 101-105, start at "Temporal lobe involvement in spatial learning and familiarity".

Bear, M.F., Connors, B.W., & Paradiso, M.A. (2007). Neuroscience: Exploring the brain. USA: Lippincott, Williams & Wilkins. Chapter. 24, pp. 744-750, until "The striatum and procedural memory" **&** Chapter 25, pp. 776-792, starting at "Plasticity in the hippocampus".

Online materials about place cells and LTP, links are available on EleUM.

Task 6. Learning associations

Gluck, Mercado & Myers (2016). Chapter 4: Classical conditioning. Pp. 115-147. Read until "Brain Substrates".

Lieberman, D.A. (2004). Principles and applications of conditioning. Learning and memory: An integrative approach. Chapter 2: Classical conditioning (pp. 87-91). Canada: Thomson-Wadsworth.

Task 7. Practise makes perfect

Gluck, Mercado & Myers (2016). Chapter 5: Operant conditioning. Pp. 167-211. Skip parts "The orbitofrontal cortex and learning to predict outcomes" and "Punishment signaling in the brain".

Lieberman, D.A. (2004). Principles and applications of conditioning. Learning and memory: An integrative approach. Chapter 4: Reinforcement (pp. 141-173), until "Configural learning". Read this chapter after reading Gluck, you can then skim over the parts that are very similar to those of Gluck.

Task 8. What gets in must come out?

Gluck, Mercado & Myers (2016). Chapter 7: Episodic and semantic memory. Pp. 274-286, until "Memory consolidation and reconsolidation".

Baddeley, A., Eysenck, M.W., & Anderson, M.E. (2015). Memory, 2nd Edition. Psychology Press. Chapter 9: Incidental forgetting, Pp. 231-263.

Shaw, J. S., Bjork, R. A., & Handal, A. (1995). Retrieval-induced forgetting in an eyewitness-memory paradigm. Psychonomic Bulletin and Review , 2, 249-253.

Anderson, M. C., Bjork, R. A., & Bjork, E. L. (1994). Remembering can cause forgetting: retrieval dynamics in long-term memory. Journal of Experimental Psychology: Learning, Memory, and Cognition, 20(5), 1063–87. Focus on Experiments 1 and 3, and general discussion about Retrieval-induced Forgetting.

Task 9. Memory consolidation – permafrost or melting clocks?

Nader, K., & Hardt, O. (2009). A single standard for memory: The case of reconsolidation. Nature Reviews Neuroscience, 10, 224-234.

Hupbach, A., Gomez, R., Hardt, O., & Nadel, L. (2007). Reconsolidation of episodic memories: a subtle reminder triggers integration of new information. Learning & Memory, 14(1-2), 47–53.

Schiller, D., et al. (2010). Preventing the return of fear in humans using reconsolidation update mechanisms. Nature, 463, 49-54.

Task 10. Memory illusions

Schacter, D. L. (1999). The seven sins of memory: Insights from psychology and cognitive neuroscience. American Psychologist, 54, 182-203.

Roediger, H. L., & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. Journal of Experimental Psychology: Learning, Memory, and Cognition, 21(4), 803–814. Focus on first experiment!

Appendix I: How to study in this course

This course follows the educational structure of Problem Based Learning (PBL). Each task describes one or a few problems or cases that are representative of a particular topic in psychology. You will pre-discuss each task in the tutorial group, in which one of the group members acts as 'discussion leader' – he/she keeps everyone's attention at the task, and tries to organize the ensuing 'brainstorming' about the task so that everyone can follow the discussion. Organize the pre-discussion in the following way:

1) check that everyone understands the task – are there any difficult words or phrases?

2) in one or two sentences, summarize what the task is about – only mention the main aspect (e.g., "The task is about how we memorize items and recall them from memory"), no details yet

3) discuss any pictures or schemas in the task BEFORE you start creating problem statements– What does the picture say? Does everyone understand the picture? It is meaningless to start brainstorming if you don't understand the visual materials of the task!

4) create one or two (!) very general problem statements. You will not have time to go into detail of more problem statements. You can always come up with new questions should there be enough time.

5) keep brain storm sessions focused! Everyone is free to come up with possibly relevant or important keywords, descriptions or explanations, but *keep anecdotal accounts to a minimum*! Write down questions that are left unanswered or items that are left unexplained. These will guide you in the creation of your learning goals. If you're done brainstorming, you're done.

6) Form a number of learning goals to guide you in your studying. No need to be very precise, it is likely that you currently don't have the proper knowledge to form specific learning goals – you haven't read the relevant literature yet. Be precise enough so that everyone understands what the goal is.

Very important: Keep the duration of the pre-discussion to a minimum if it is clear that everybody misses the proper background to engage into in-depth discussion.

Different people have different studying styles, and perhaps you are currently discovering and developing your own. To help you out in studying effectively, here are a few tips:

1) Read your literature for the task at least twice! You don't have to read the chapter at your highest level of attention and concentration each time, but reading the material at least once again after a first superficial reading often gives you a better overview and understanding of the information.

2) It may help you to approach the literature in a 'holistic' fashion by drawing out schemas, graphs or pictures of the information. This is especially helpful for biology literature about the brain, and for literature that discusses particular models or schemas of a psychological topic (e.g., processes of memory formation, pathways of emotion processing).

3) Don't just note down a name or definition (i.e., passive learning), but ask yourself what it means (active learning!). A name is just a name if you cannot '*work or play*' with it. Use your knowledge and imagination to form yourself an image or idea of what is meant with a definition / model / explanation. For more tips, see Chapter 8 of the book (Task 7).

During the post-discussion, you have the opportunity to further 'chew' on the information you read, and check if you actually understood it. It is tempting to reiterate the information you have

read to the rest of the group. However, DO NOT RECITE THE LITERATURE TO THE GROUP. Your group members have read similar or even the same literature, and merely copying what you have read is a senseless and time-wasting exercise for everyone. Also, it doesn't help you to further understand the literature – at best it helps you practice your public reading skills. Instead, use the following steps to make the post-discussion worthwhile:

1) Close your books or papers. If you explain or discuss something from the literature, use your own words (possibly aided by your own notes). But:

2) Be specific and clear in your wording! Don't bluff your way out by using vague or anecdotal terms, they are of no help to you and are confusing to others. If you don't know the exact jargon or definitions, your group members will help you out – which is in itself a good test to see if you and the group understood the literature.

3) Use the board! Draw, sketch, list or mime the information you have read – preferably such that multiple individuals contribute to the recreation of the information. Holistic presentations of the literature will help you to get a proper overview of the information, and point out what is important, fill in relevant details, and show you what you already know and what you need to pay more attention to. Also, as the saying goes, "a picture says a thousand words" (or something along this line). But, don't create pictures that offend the previous point.

4) Don't reiterate definitions for their own sake. Everyone (should have) read them. Instead, use definitions in a constructive manner, for example, to introduce your explanation of a model or study that you read about.

5) Include information from previous tasks whenever you can. For example, in task 2 you will learn about particulars of experimental design, which you can apply in basically all of the tasks of the course. Same goes for task 3 in which you learn about brain areas and their functions.

6) It may happen that, for whatever reason, you are not prepared properly for the post-discussion. Not a big deal, just make sure you come prepared for the coming tasks. However, do not disturb the efforts of the other group members to discuss the task by intervening with irrelevant remarks or questions about particular items of the literature that you can easily check up on yourself. If this means that you cannot participate in the post-discussion, than that's the way it is – perhaps an incentive to come prepared for future meetings.

Take your time to complete the post-discussion to everyone's satisfaction – it is important that everyone understands the literature. If needed, sacrifice pre-discussion time – it is better to post-discuss for one-and-a-half hours and be sure that everyone understands the task, then to leave important aspects un-discussed just to be able to 'brainstorm' about a new task.

For many tasks, everyone will read the same literature. Therefore, refrain from spelling out what everyone else already knows. Instead, try to find out about aspects of the literature you don't understood well. You can do this by asking questions about things you are struggling with yourself, to have someone explain something to you (but don't cheat – respect point 6 of the list above!), or to draw out a schema of (a part of) the literature – if anything proves difficult to grasp this will turn up in such an exercise. This all means that you have to be assertive and engaging in the post-discussion – find and fix the weak spots in your understanding of the literature, and help others find and fix theirs!

Finally, find the fun in gaining further understanding of how we form our memories – our most private and fundamental possessions!

Notes