Læring og ferdighetstilnærming (hovedtittel)

Introduksjon

Denne artikkelen er for å gi et overblikk over konsepter og temaer knyttet til læring og hukommelse. Det er en samling av nøye utvalgte artikler som er kuttet ned til det essensielle og mest interessante. Det meste er fra Wikipedia. Det er ingen kilder inkluder, hovedsakelig pga. hensyn til plass og tid, men det er veid opp mot det jeg har lest i ferske fagbøker i psykologi, og Wikipedia skriver ofte advarsler hvis det er kildeløst materiell eller kildereferansene er falske, pluss at jeg sørger for å lese gjennom kritikk når det er til stede. Dette garanterer ikke den vitenskapelige kvaliteten på innholdet her, men jeg tror at andelen nyttig info over misledende info er høy. Du som leser vil sikkert sette pris på verdien av at jeg har brukt timevis på å velge ut artikler, viktige deler av de artiklene, utdypet konsepter, sett gjennom uviktige distraksjoner og organisert materialet på en fornuftig måte. Det ville vært optimalt med grundig gjennomgang av kilder og vitenskapelig litteratur, men det er en fulltidsjobb for psykologer. Vi amatører må leve etter prinsippet "nokså god info for noe arbeid" i stedet for "perfekt info for store arbeidslass".

Innholdet er organisert etter viktighet og avhengighet.

Contents

Læring

Human learning may occur as part of education, personal development, schooling, or training. Learning may occur consciously or without conscious awareness.

There are two domains of learning:

- Cognitive: To recall, calculate, discuss, analyze, problem solve, etc.
- Psychomotor: To dance, swim, ski, dive, drive a car, ride a bike, etc.

These domains are not mutually exclusive. Sub-skills in each domain will be used interspersed in a more complex and dynamic global activity.

Types of learning

Informal learning

Informal learning occurs through the experience of day-to-day situations (for example, one would learn to look ahead while walking because of the danger inherent in not paying attention to where one is going). It is learning from life, during a meal at table with parents, play, exploring, etc.

Formal learning

Main article: Education

Formal learning is learning that takes place within a teacher-student relationship, such as in a school system. The term formal learning has nothing to do with the formality of the learning, but rather the way it is directed and organized. In formal learning, the learning or training departments set out the goals and objectives of the learning.

Nonformal learning

Main article: Nonformal learning

Nonformal learning is organized learning outside the formal learning system. For example, learning by coming together with people with similar interests and exchanging viewpoints, in clubs or in (international) youth organizations, workshops.

Nonformal learning and combined approaches

The educational system may use a combination of formal, informal, and nonformal learning methods. The UN and EU recognize these different forms of learning (cf. links below). In some schools, students can get points that count in the formal-learning systems if they get work done in informal-learning circuits. They may be given time to assist international youth workshops and training courses, on the condition they prepare, contribute, share and can prove this offered valuable new insight, helped to acquire new skills, a place to get experience in organizing, teaching, etc.

To learn a skill, such as solving a Rubik's Cube quickly, several factors come into play at once:

- Reading directions helps a player learn the patterns that solve the Rubik's Cube.
- Practicing the moves repeatedly helps build "muscle memory" and speed.
- Thinking critically about moves helps find shortcuts, which speeds future attempts.
- Observing the Rubik's Cube's six colors help anchor solutions in the mind.
- Revisiting the cube occasionally helps retain the skill.

Tangential learning

Tangential learning is the process by which people self-educate if a topic is exposed to them in a context that they already enjoy. For example, after playing a music-based video game, some people may be motivated to learn how to play a real instrument, or after watching a TV show that references Faust and Lovecraft, some people may be inspired to read the original work.

Incidental learning

This learning is not planned by the instructor or the student, but occurs as a byproduct of another activity—an experience, observation, self-reflection, interaction, unique event, or common routine task. This learning happens in addition to or apart from the instructor's plans and the student's expectations.

Incidental learning is an occurrence that is not generally accounted for using the traditional methods of instructional objectives and outcomes assessment. This type of learning occurs in part as a product of social interaction and active involvement in both online and onsite courses. Research implies that some un-assessed aspects of onsite and online learning challenge the equivalency of education between the two modalities. Both onsite and online learning have distinct advantages with traditional on-campus students experiencing higher degrees of incidental learning in three times as many areas as online students. Additional research is called for to investigate the implications of these findings both conceptually and pedagogically.

Episodic learning

Episodic learning is a change in behavior that occurs as a result of an event. For example, a fear of dogs that follows being bitten by a dog is episodic learning. Episodic learning is so named because events are recorded into episodic memory, which is one of the three forms of explicit learning and retrieval, along with perceptual memory and semantic memory. Episodic learning happens all the time.

Knowledge

Knowledge is a familiarity, awareness or understanding of someone or something, such as facts, information, descriptions, or skills, which is acquired through experience or education by perceiving, discovering, or learning.

Knowledge can refer to a theoretical or practical understanding of a subject. It can be implicit (as with practical skill or expertise) or explicit (as with the theoretical understanding of a subject); it can be more or less formal or systematic.

Knowledge acquisition involves complex cognitive processes: perception, communication, and reasoning; while knowledge is also said to be related to the capacity of *acknowledgment* in human beings.

Communicating knowledge

Los portadores de la antorcha (The Torch-Bearers) – Sculpture by Anna Hyatt Huntington symbolizing the transmission of knowledge from one generation to the next (Ciudad Universitaria, Madrid, Spain)

Symbolic representations can be used to indicate meaning and can be thought of as a dynamic process. Hence the transfer of the symbolic representation can be viewed as one ascription process whereby knowledge can be transferred. Other forms of communication include observation and imitation, verbal exchange, and audio and video recordings. Philosophers of language and semioticians construct and analyze theories of knowledge transfer or communication.

Major libraries today can have millions of books of knowledge (in addition to works of fiction). It is only recently that audio and video technology for recording knowledge have become available and the use of these still requires replay equipment and electricity. Verbal teaching and handing down of knowledge is limited to those who would have contact with the transmitter or someone who could interpret written work. Writing is still the most available and most universal of all forms of recording and transmitting knowledge. It stands unchallenged as mankind's primary technology of knowledge transfer down through the ages and to all cultures and languages of the world.

Partial knowledge

One discipline of epistemology focuses on partial knowledge. In most cases, it is not possible to understand an information domain exhaustively; our knowledge is always *incomplete* or partial. Most real problems have to be solved by taking advantage of a partial understanding of the problem context and problem data, unlike the typical math problems one might solve at school, where all data is given and one is given a complete understanding of formulas necessary to solve them.

This idea is also present in the concept of bounded rationality which assumes that in real life situations people often have a limited amount of information and make decisions accordingly.

Intuition is the ability to acquire partial knowledge without inference or the use of reason. An individual may "know" about a situation and be unable to explain the process that led to their knowledge.

Scientific knowledge

Sir Francis Bacon, "Knowledge is Power"

The development of the scientific method has made a significant contribution to how knowledge of the physical world and its phenomena is acquired. To be termed scientific, a method of inquiry must be based on gathering observable and measurable evidence subject to specific principles of reasoning and experimentation. The scientific method consists of the collection of data through observation and experimentation, and the formulation and testing of hypotheses. Science, and the nature of scientific knowledge have also become the subject of Philosophy. As science itself has developed, scientific knowledge now includes a broader usage in the soft sciences such as biology and the social sciences — discussed elsewhere as meta-epistemology, or genetic epistemology, and to some extent related to "theory of cognitive development". Note that "epistemology" is the study of knowledge and how it is acquired. Science is "the process used everyday to logically complete thoughts through inference of facts determined by calculated experiments." Sir Francis Bacon was critical in the historical development of the scientific method; his works established and popularized an inductive methodology for scientific inquiry. His famous aphorism, "knowledge is power", is found in the Meditations Sacrae (1597).

Until recent times, at least in the Western tradition, it was simply taken for granted that knowledge was something possessed only by humans — and probably *adult* humans at that. Sometimes the notion might stretch to (ii) *Society-as-such*, as in (e.g.) "the knowledge possessed by the Coptic culture" (as opposed to its individual members), but that was not assured either.

Nor was it usual to consider *unconscious* knowledge in any systematic way until this approach was popularized by Freud.

Other biological domains where "knowledge" might be said to reside, include: (iii) the *immune system*, and (iv) in the *DNA of the genetic code*. See the list of four "epistemological domains": Popper, (1975); and Traill (2008: Table S, page 31)—also references by both to Niels Jerne.

Such considerations seem to call for a separate definition of "knowledge" to cover the biological systems. For biologists, knowledge must be usefully *available* to the system, though that system need not be conscious. Thus the criteria seem to be:

- The system should apparently be dynamic and self-organizing (unlike a mere book *on its own*).
- The knowledge must constitute some sort of representation of "the outside world", or ways of dealing with it (directly or indirectly).
- Some way must exist for the system to access this information quickly enough for it to be useful.

Scientific knowledge may not involve a claim to certainty, maintaining skepticism means that a scientist will never be absolutely certain when they are correct and when they are not. It is thus an irony of proper scientific method that one must doubt even when correct, in the hopes that this practice will lead to greater convergence on the truth in general.

Religious meaning of knowledge

In many expressions of Christianity, such as Catholicism and Anglicanism, knowledge is one of the seven gifts of the Holy Spirit.

The Old Testament's tree of the knowledge of good and evil contained the knowledge that separated Man from God: "And the LORD God said, Behold, the man is become as one of us, to know good and evil..." (Genesis 3:22)

In Islam, knowledge is given great significance. "The Knowing" is one of the 99 names reflecting distinct attributes of God. The Qur'an asserts that knowledge comes from God and various *hadith* encourage the acquisition of knowledge. Muhammad is reported to have said "Seek knowledge from the cradle to the grave" and "Verily the men of knowledge are the inheritors of the prophets". Islamic scholars, theologians and jurists are often given the title *alim*, meaning "knowledgeble".

In Jewish tradition, knowledge is considered one of the most valuable traits a person can acquire. Observant Jews recite three times a day in the Amidah "Favor us with knowledge, understanding and discretion that come from you. Exalted are you, Existent-One, the gracious giver of knowledge." The Tanakh states, "A wise man gains power, and a man of knowledge maintains power", and "knowledge is chosen above gold".

Skill

A **skill** is the ability to carry out a task with pre-determined results often within a given amount of time, energy, or both. Skills can often be divided into domain general and domain-specific skills. For example, in the domain of work, some general skills would include time management, teamwork and leadership, self-motivation and others, whereas domain-specific skills would be useful only for a certain job. Skill usually requires certain environmental stimuli and situations to assess the level of skill being shown and used.

People skills

According to the *Portland Business Journal*, people skills are described as:

- understanding ourselves and moderating our responses
- talking effectively and empathizing accurately
- building relationships of trust, respect and productive interactions.

A British definition is "the ability to communicate effectively with people in a friendly way, especially in business." The term is not listed yet in major US dictionaries.

The term people skills is used to include both psychological skills and social skills, but is less inclusive than life skills.

Social skills

Social skill is any skill facilitating interaction and communication with others. Social rules and relations are created, communicated, and changed in verbal and nonverbal ways. The process of learning such skills is called socialization.

Soft skills

Soft skills are a combination of interpersonal people skills, social skills, communication skills, character traits, attitudes, career attributes and emotional intelligence quotient (EQ) among others.

Hard skills

Hard skills are any skills relating to a specific task or situation. These skills are easily quantifiable unlike soft skills which are related to one's personality.

Hjernemekanismer

Automaticity

Automaticity is the ability to do things without occupying the mind with the low-level details required, allowing it to become an automatic response pattern or habit. It is usually the result of learning, repetition, and practice.

Examples of automaticity are common activities such as walking, speaking, bicycle-riding, assembly-line work, and driving a car (the last of these sometimes being termed "highway hypnosis"). After an activity is sufficiently practiced, it is possible to focus the mind on other activities or thoughts while undertaking an automatized activity (for example, holding a conversation or planning a speech while driving a car). This happens through the creation of integrated neuronal circuits or pathways, axons are grown and sheths are myelinated.

Characteristics

John Bargh (1994), based on over a decade of research, suggested that four characteristics usually accompany automatic behavior:

Awareness
: A person may be unaware of the mental process that is occurring.

Intentionality
: A person may not be involved with the initiation of a mental process.

Efficiency
: Automatic mental processes tend to have a low cognitive load, requiring relatively low mental resources.

Controllability
: A person may not have the ability to stop or alter a process after initiation.

Bargh states that these are simply common characteristics; not all are needed for a process to be considered automatic. For instance, stereotype activation has been described as an automatic process: it is unintentional and efficient, requiring little effort. However stereotype activation is accompanied by above chance awareness and if conflicting processing goals are available then it becomes controlled. Therefore stereotype activation only satisfies two of Bargh's criteria, but is still considered to be an example of automatic processing.

In reading

LaBerge and Samuels (1974) helped explain how reading fluency develops. Automaticity refers to knowing how to perform some arbitrary task at a competent level without requiring conscious effort — *i.e.*, it is a form of unconscious competence.

Moreover, if the student is automatic or is "a skilled reader, multiple tasks are being performed at the same time, such as decoding the words, comprehending the information, relating the information to prior knowledge of the subject matter, making inferences, and evaluating the information's usefulness to a report he or she is writing" (Samuels).

Disruption

Automaticity can be disrupted by explicit attention when the devotion of conscious attention to the pattern alters the content or timing of that pattern itself. This phenomenon is especially pronounced in situations that feature high upside and/or downside risk and impose the associated psychological stress on one's conscious mind; one's performance in these "clutch" situations may either *a*) be unimpaired or even enhanced ("flow") or *b*) deteriorate ("choke").

This effect has been named the "centipede effect" after the fable of the "Centipede's dilemma", where a toad immobilises a centipede simply by asking it how it walks. The centipede's normally unconscious locomotion was interrupted by conscious reflection on it. The psychologist George Humphrey referred to this parable in his 1923 *The story of man's mind*: "No man skilled at a trade needs to put his constant attention on the routine work," he wrote. "If he does, the job is apt to be spoiled."

Neuroplasticity

Neuroplasticity, also known as brain plasticity or neural plasticity, is an umbrella term that describes lasting change to the brain throughout an individual's life course. It is a confusing term that has many meanings. All plasticity is fundamentally changes in connections between neurons (synaptic) or changes in the neurons internal machinery (non-synaptic). These changes allow the brain to alter its own state. There are short term alterations, e.g. working memory, and there are long term alterations, which might allow you to remember a fact for years or get more proficient at table tennis (in response to practice).

When it comes to learning, some of the specific mechanisms of plasticity becomes important to know about. To become proficient at a skill, the brain needs to myelinate the right connections. Those connections become active when practicing, and the brain myelinates those connections. But it doesn't myelinate it to the highest degree without good reason. It must be connections you use regularly. This is important, so it doesn't myelinate random connections that happened to be activated through association or chance. But this also sets a limit on how much you can progress in one day. Repetition is required. This mechanism is blind. It will myelinate connections that represent bad habits if they are repeated. That's why life-long bad habits die hard. They are so ingrained in the brain, that only years upon years of non-activation will erode them away. That is a hard task, since you will feel the urge to do it and feel empty when not doing it. The flipside of this is good though, in that good habits also die hard.

Myelination is not just important for skills like football, but also for remembering specific facts and for doing more brainy things like math's and finance.

The brain changes in small ways all the time. Every time you have a thought, an emotion or perform a task. Something changes. You have slightly more memories, small new

insights, incrementally better performance, or a new attitude. This is the idea behind activity dependent plasticity.

That the brain is plastic shouldn't be surprising. To store knowledge, it must be ingrained into some physical medium. Take a message chiseled into a stone tablet or an essay written a piece of paper. In the brain, knowledge is ingrained into living biological matter. The knowledge itself reside in the logical layer, but there needs to be a physical computer to encode, store and manipulate it. That can be a microchip or a human brain. There is no way to compute anything without changing the state of some component in the hardware. The only thing that is news is exactly how the brain does this, how it likely has evolved to be that way and what practical implications that might have for our learning.

Neurobiology

One of the fundamental principles underlying neuroplasticity is based on the idea that individual synaptic connections are constantly being removed or recreated, largely dependent upon the activity of the neurons that bear them. The activity-dependence of synaptic plasticity is captured in the aphorism which is often used to summarize Hebbian theory: "neurons that fire together, wire together"/"neurons that fire out of sync, fail to link". If two nearby neurons often produce an impulse in close temporal proximity, their functional properties may converge. Conversely, neurons that are not regularly activated simultaneously may be more likely to functionally diverge.

Applications and example

Fitness and exercise

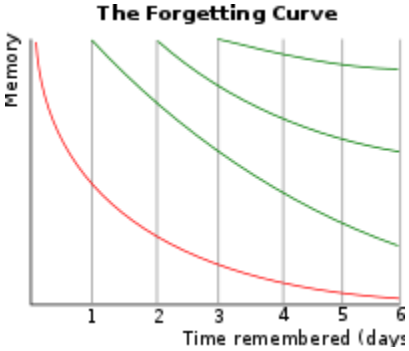
See also: Neurobiological effects of physical exercise § Structural growth

Aerobic exercise promotes adult neurogenesis by increasing the production of neurotrophic factors (compounds that promote growth or survival of neurons), such as brain-derived neurotrophic factor (BDNF), insulin-like growth factor 1 (IGF-1), and vascular endothelial growth factor (VEGF). Exercise-induced neurogenesis in the hippocampus is associated with measurable improvements in spatial memory. Consistent aerobic exercise over a period of several months induces marked clinically significant improvements in executive function (i.e., the "cognitive control" of behavior) and increased gray matter volume in multiple brain regions, particularly those that give rise to cognitive control. The brain structures that show the greatest improvements in gray matter volume in response to aerobic exercise are the prefrontal cortex and hippocampus; moderate improvements are seen in the anterior cingulate cortex, parietal cortex, cerebellum, caudate nucleus, and nucleus accumbens. Higher physical fitness scores (measured by VO_2 max) are associated with better executive function, faster processing speed, and greater volume of the hippocampus, caudate nucleus, and nucleus accumbens.

Human echolocation

Human echolocation is a learned ability for humans to sense their environment from echoes. This ability is used by some blind people to navigate their environment and sense their surroundings in detail. Studies in 2010 and 2011 using functional magnetic resonance imaging techniques have shown that parts of the brain associated with visual processing are adapted for the new skill of echolocation. Studies with blind patients, for example, suggest that the click-echoes heard by these patients were processed by brain regions devoted to vision rather than audition.

Forgetting curve



A typical representation of the forgetting curve.

The **forgetting curve** hypothesizes the decline of memory retention in time. This curve shows how information is lost over time when there is no attempt to retain it. A related concept is the **strength of memory** that refers to the durability that memory traces in the brain. The stronger the memory, the longer period of time that a person is able to recall it. A typical graph of the forgetting curve purports to show that humans tend to halve their memory of newly learned knowledge in a matter of days or weeks unless they consciously review the learned material.

The forgetting curve supports one of the seven kinds of memory failures: transience, which is the process of forgetting that occurs with the passage of time.

Description

Ebbinghaus hypothesized that the speed of forgetting depends on a number of factors such as the difficulty of the learned material (e.g. how meaningful it is), its representation and physiological factors such as stress and sleep. He further hypothesized that the basal forgetting rate differs little between individuals. He concluded that the difference in performance (e.g. at school) can be explained by mnemonic representation skills.

He went on to hypothesize that basic training in mnemonic techniques can help overcome those differences in part. He asserted that the best methods for increasing the strength of memory are:

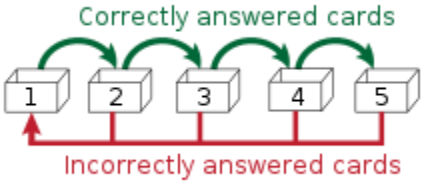
1. better memory representation (e.g. with mnemonic techniques)
2. repetition based on active recall (esp. spaced repetition).

His premise was that each repetition in learning increases the optimum interval before the next repetition is needed (for near-perfect retention, initial repetitions may need to be made within days, but later they can be made after years). Later research suggested that, other than the two factors Ebbinghaus proposed, higher original learning would also produce slower forgetting.

Spending time each day to remember information, such as that for exams, will greatly decrease the effects of the forgetting curve. Reviewing material in the first 24 hours after learning information is the optimum time to re-read notes and reduce the amount of knowledge forgotten.

There is debate among supporters of the hypothesis about the shape of the curve for events and facts that are more significant to the subject. Some supporters, for example, suggest that memories of shocking events such as the Kennedy Assassination or 9/11 are vividly imprinted in memory (flashbulb memory). Others have compared contemporaneous written recollections with recollections recorded years later, and found considerable variations as the subject's memory incorporates after-acquired information. There is considerable research in this area as it relates to eyewitness identification testimony. It should be noted that eye witness accounts are demonstrably unreliable.

Spaced repetition



In the Leitner system, correctly answered cards are advanced to the next, less frequent box, while incorrectly answered cards return to the first box for more aggressive review and repetition.

Spaced repetition is a learning technique that incorporates increasing intervals of time between subsequent review of previously learned material in order to exploit the psychological spacing effect. Alternative names include *spaced rehearsal*, *expanding rehearsal*, *graduated intervals*, *repetition spacing*, *repetition scheduling*, *spaced retrieval* and *expanded retrieval*.

Although the principle is useful in many contexts, spaced repetition is commonly applied in contexts in which a learner must acquire a large number of items and retain them indefinitely in memory. It is, therefore, well suited for the problem of vocabulary acquisition in the course of second language learning, due to the size of the target language's inventory of open-class words.

With the increase in access to personal computers in the 1980s, spaced repetition began to be implemented with computer-assisted language learning software-based solutions, enabling automated scheduling and statistic gathering, scaling to thousands of cards scheduled individually. To enable the user to reach a target level of achievement (e.g. 90% of all material correctly recalled at any given time point), the software adjusts the repetition spacing interval.

Material that is hard appears more often and material that is easy less often, with difficulty defined according to the ease with which the user is able to produce a correct response.

Software

Anki used for memorizing Russian vocabulary

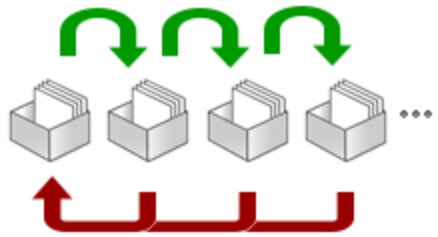
Most spaced repetition software (SRS) programs are modeled after the manual style of learning with flashcards: items to memorize are entered into the program as question-answer pairs. When a pair is due to be reviewed, the question is displayed on screen, and the user must attempt to answer. After answering, the user manually reveals the answer and then tells the program (subjectively) how difficult answering was. The program schedules pairs based on spaced repetition algorithms. Without a program, the user has to schedule flashcards; this is time-intensive and limits users to simple algorithms like the Leitner system.

Further refinements with regard to software:

- Questions and/or answers can be a sound-file to train recognition of spoken words.
- Automatic generation of pairs (e.g. for vocabulary, it is useful to generate three question-pairs: *written foreign word*, its *pronunciation* and its *meaning*, but data only has to be entered once.)
- Additional information retrieved automatically is available, such as example sentences containing a word.
- Opportunities to combine spaced repetition with online community functions, e.g. sharing courses.

Notable implementations include Anki, Brainscape, Cerego, Course Hero, Duolingo, Lingvist, Memrise, Mnemosyne, Skritter, SuperMemo, Synap and WaniKani.

Flashcard



A set of flashcards demonstrating the Leitner system. Cards that the learner knows are promoted to a box for less frequent review (indicated by green arrows); cards for which the learner has forgotten the meaning are demoted to be studied more frequently (indicated by red arrows.)

A **flashcard** or **flash card** is a set of cards bearing information, as words or numbers, on either or both sides, used in classroom drills or in private study. One writes a question on a card and an answer overleaf. Flashcards can bear vocabulary, historical dates, formulas or any subject matter that can be learned via a question-and-answer format. Flashcards are widely used as a learning drill to aid memorization by way of spaced repetition.

Use

Flashcards exercise the mental process of active recall: given a prompt (the question), one produces the answer. Beyond the content of cards, which are collected in **decks**, there is the question of *use* – how does one use the cards, in particular, how frequently does one review (more finely, how does one *schedule* review) and how does one react to errors, either complete failures to recall or mistakes? Various systems have been developed, with the main principle being spaced repetition – increasing the review interval whenever a card is recalled correctly.

Two-sided

Physical flashcards are two-sided; in some context one wishes to correctly produce the opposite side on being presented with either side, such as in foreign language vocabulary; in other context one is content to go in only one direction, such as in producing a poem given its title or incipit (**opening**). For physical flashcards, one may either use a single card, flipping it according to the direction, or two parallel decks, such as one English-Japanese and one Japanese-English. They have a number of uses that can be very simple or very elaborate for the person to memorize.

Systems

See also: Spaced repetition

There are various systems for using flashcards, many based around the principle of spaced repetition – reviewing information at increasing intervals. Manually managing interval length can add greatly to the overhead of using flashcards: the Leitner system is a simple spaced repetition system designed for paper flashcards, based on a small number of boxes and a simple algorithm, while the SuperMemo algorithms are more complicated, tracking each card individually, and designed for implementation by computer.

Three-sided cards

Physical flashcards are necessarily two-sided. A variant, found in electronic flashcards, is what is known as a **three-sided card**.[1] This is a particular kind of asymmetric two-sided card; abstractly, such a card has three fields, Q, A, A*, where Q & A are reversed on flipping, but A* is always in the answer – the two "sides" are thus Q/A,A* and A/Q,A*. Concretely, these are most used for learning foreign vocabulary where the foreign pronunciation is not transparent from the foreign writing – in this case the Question is the native word, the Answer is the foreign word (written), and the pronunciation is always part of the answer (Answer*). This is particularly the case for Chinese characters, as in Chinese hanzi and Japanese kanji, but can also be used for other non-phonetic spellings, including English as a second language.

Examples

A Chinese-English example, for learning the word 人 (rén, person):

> Q: person
> A: 人, rén

Reverse:

> Q: 人
> A: rén, person

An example for a French student of English learning "enough", which in French is *assez*, and due to the -ough has irregular pronunciation (pronunciation given in IPA):

> Q: assez
> A: enough /ɪˈnʌf/

Reverse:

> Q: enough
> A: assez

Purpose

The purpose of three-sided cards is to provide the benefits of two-sided cards – ease of authoring (enter data once to create two cards), synchronized updates (changes to one are reflected in the other), and spacing between opposite sides (so opposite sides of the same card are not tested too close together) – without the card needing to be symmetric.

One can generalize this principle to an arbitrary number of data fields associated with a single record, with each field representing a different aspect of a fact or bundle of facts.

Software

Main article: List of flashcard software

There is a wide range of software (including open source and online services) available for creating and using virtual flashcards as an aid to learning.

Operant conditioning

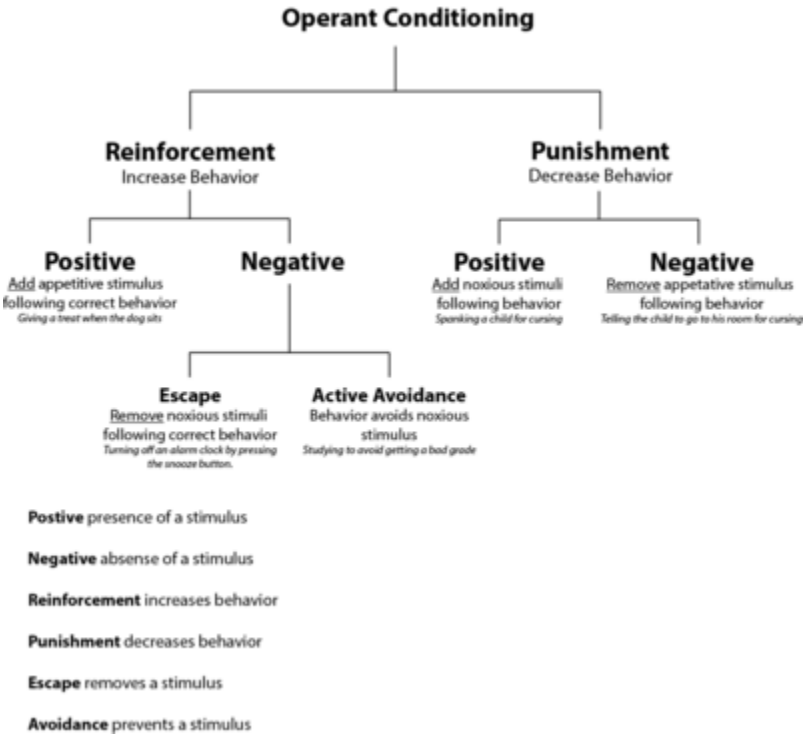


Diagram of operant conditioning

Operant conditioning (also called "**instrumental conditioning**") is a type of learning in which (a) the strength of a behavior is modified by the behavior's consequences, such as reward or punishment, and (b) the behavior is controlled by antecedents called "discriminative stimuli" which come to signal those consequences.

While operant and classical conditioning both involve behaviors controlled by environmental stimuli, they differ in nature. In operant conditioning, stimuli present when a behavior is rewarded or punished come to control that behavior. For example, a child may learn to open a box to get the candy inside, or learn to avoid touching a hot stove; the box and the stove are discriminative stimuli. However, in classical conditioning, stimuli that signal significant events produce reflexive behavior. For example, the sight of a colorful wrapper comes to signal "candy", causing a child to salivate, or the sound of a door slam comes to signal an angry parent, causing a child to tremble.

The study of animal learning in the 20th century was dominated by the analysis of these two sorts of learning, and they are still at the core of behavior analysis.

Historical note

Thorndike's law of effect

Main article: Law of effect

Operant conditioning, sometimes called *instrumental learning*, was first extensively studied by Edward L. Thorndike (1874–1949), who observed the behavior of cats trying to escape from home-made puzzle boxes. A cat could escape from the box by a simple response such as pulling a cord or pushing a pole, but when first constrained the cats took a long time to get out. With repeated trials ineffective responses occurred less frequently and successful responses occurred more frequently, so the cats escaped more and more quickly. Thorndike generalized this finding in his law of effect, which states that behaviors followed by satisfying consequences tend to be repeated and those that produce unpleasant consequences are less likely to be repeated. In short, some consequences *strengthen* behavior and some consequences *weaken* behavior. By plotting escape time against trial number Thorndike produced the first known animal learning curves through this procedure.

Humans appear to learn many simple behaviors through the sort of process studied by Thorndike, now called operant conditioning. That is, responses are retained when they lead to a successful outcome and discarded when they do not, or when they produce aversive effects. This usually happens without being planned by any "teacher", but operant conditioning has been used by parents in teaching their children for thousands of years.

Skinner

Main article: B. F. Skinner

B.F. Skinner (1904–1990) is often referred to as the father of operant conditioning, and his work is frequently cited in connection with this topic. His book "The Behavior of Organisms", published in 1938, initiated his lifelong study of operant conditioning and its application to human and animal behavior. Following the ideas of Ernst Mach, Skinner rejected Thorndike's reference to unobservable mental states such as satisfaction, building his analysis on observable behavior and its equally observable consequences.

To implement his empirical approach, Skinner invented the operant conditioning chamber, or "*Skinner Box*", in which subjects such as pigeons and rats were isolated and could be exposed to carefully controlled stimuli. Unlike Thorndike's puzzle box, this arrangement allowed the subject to make one or two simple, repeatable responses, and the rate of such responses became Skinner's primary behavioral measure. Another invention, the cumulative recorder, produced a graphical record from which these response rates could be estimated. These records were the primary data that Skinner and his colleagues used to explore the effects on response rate of various reinforcement schedules. A reinforcement schedule may be defined as "any procedure that delivers reinforcement to an organism according to some well-defined rule". The effects of schedules became, in turn, the basic findings from which Skinner developed his account of operant conditioning. He also drew on many less formal observations of human and animal behavior.

Many of Skinner's writings are devoted to the application of operant conditioning to human behavior. In 1948 he published *Walden Two*, a fictional account of a peaceful, happy, productive community organized around his conditioning principles. In 1957, Skinner published *Verbal Behavior*, which extended the principles of operant conditioning to language, a form of human behavior that had previously been analyzed quite differently by linguists and others. Skinner defined new functional relationships such as "mands" and "tacts" to capture some essentials of language, but he introduced no new principles, treating verbal behavior like any other behavior controlled by its consequences, which included the reactions of the speaker's audience.

Concepts and procedures

Origins of operant behavior: operant variability

Operant behavior is said to be "emitted"; that is, initially it is not elicited by any particular stimulus. Thus one may ask why it happens in the first place. The answer to this question is like Darwin's answer to the question of the origin of a "new" bodily structure, namely, variation and selection. Similarly, the behavior of an individual varies from moment to moment, in such aspects as the specific motions involved, the amount of force applied, or the timing of the response. Variations that lead to reinforcement are strengthened, and if reinforcement is consistent, the behavior tends to remain stable. However, behavioral variability can itself be altered through the manipulation of certain variables.

Modifying operant behavior: reinforcement and shaping

Main article: Reinforcement

Reinforcement and punishment are the core tools through which operant behavior is modified. These terms are defined by their effect on behavior. Either may be positive or negative, as described below.

- Positive Reinforcement and Negative Reinforcement increase the probability of a behavior that they follow, while Positive Punishment and Negative Punishment reduce the probability of behaviour that they follow.

There is an additional procedure

- **Extinction** occurs when a previously reinforced behavior is no longer reinforced with either positive or negative reinforcement. During extinction the behavior becomes less probable.

Thus there are a total of five basic consequences -

1. **Positive reinforcement** (reinforcement): This occurs when a behavior (response) is rewarding or the behavior is followed by another stimulus that is rewarding, increasing the frequency of that behavior. For example, if a rat in a Skinner box gets food when it

presses a lever, its rate of pressing will go up. This procedure is usually called simply *reinforcement*.

2. **Negative reinforcement** (escape): This occurs when a behavior (response) is followed by the removal of an aversive stimulus, thereby increasing that behavior's frequency. In the Skinner box experiment, the aversive stimulus might be a loud noise continuously sounding inside the box; negative reinforcement would happen when the rat presses a lever, turning off the noise.
3. **Positive punishment**: (also referred to as "punishment by contingent stimulation") This occurs when a behavior (response) is followed by an aversive stimulus, such as pain from a spanking, which results in a decrease in that behavior. *Positive punishment* is a rather confusing term, and usually the procedure is simply called "punishment."
4. **Negative punishment** (penalty) (also called "Punishment by contingent withdrawal"): Occurs when a behavior (response) is followed by the removal of a positive stimulus, such as taking away a child's toy following an undesired behavior, resulting in a decrease in that behavior.
5. **Extinction**: This occurs when a behavior (response) that had previously been reinforced is no longer effective. For example, a rat is first given food many times for lever presses. Then, in "extinction", no food is given. Typically the rat continues to press more and more slowly and eventually stops, at which time lever pressing is said to be "extinguished."

It is important to note that actors (e.g. rat) are not spoken of as being reinforced, punished, or extinguished; it is the actions (e.g. lever press) that are reinforced, punished, or extinguished. Also, reinforcement, punishment, and extinction are not terms whose use is restricted to the laboratory. Naturally occurring consequences can also reinforce, punish, or extinguish behavior and are not always planned or delivered by people.

Schedules of reinforcement

Schedules of reinforcement are rules that control the delivery of reinforcement. The rules specify either the time that reinforcement is to be made available, or the number of responses to be made, or both. Many rules are possible, but the following are the most basic and commonly used

- Fixed interval schedule: Reinforcement occurs following the first response after a fixed time has elapsed after the previous reinforcement.
- Variable interval schedule: Reinforcement occurs following the first response after a variable time has elapsed from the previous reinforcement.
- Fixed ratio schedule: Reinforcement occurs after a fixed number of responses have been emitted since the previous reinforcement.
- Variable ratio schedule: Reinforcement occurs after a variable number of responses have been emitted since the previous reinforcement.
- Continuous reinforcement: Reinforcement occurs after each response.

Factors that alter the effectiveness of reinforcement and punishment

The effectiveness of reinforcement and punishment can be changed in various ways.

1. **Satiation/Deprivation:** The effectiveness of a positive or "appetitive" stimulus will be reduced if the individual has received enough of that stimulus to satisfy its appetite. The opposite effect will occur if the individual becomes deprived of that stimulus: the effectiveness of a consequence will then increase. If someone is not hungry, food will not be an effective reinforcer for behavior.
2. **Immediacy:** An immediate consequence is more effective than a delayed consequence. If one gives a dog a treat for "sitting" right away, the dog will learn faster than if the treat is given later.
3. **Contingency:** To be most effective, reinforcement should occur consistently after responses and not at other times. Learning may be slower if reinforcement is intermittent, that is, following only some instances of the same response, but responses reinforced intermittently are usually much slower to extinguish than are responses that have always been reinforced.
4. **Size:** The size, or amount, of a stimulus often affects its potency as a reinforcer. Humans and animals engage in a sort of "cost-benefit" analysis. A tiny amount of food may not "be worth" an effortful lever press for a rat. A pile of quarters from a slot machine may keep a gambler pulling the lever longer than a single quarter.

Most of these factors serve biological functions. For example, the process of satiation helps the organism maintain a stable internal environment (homeostasis). When an organism has been deprived of sugar, for example, the taste of sugar is a highly effective reinforcer. However, when the organism's blood sugar reaches or exceeds an optimum level the taste of sugar becomes less effective, perhaps even aversive.

Shaping

Main article: Shaping (psychology)

Shaping is a conditioning method much used in animal training and in teaching non-verbal humans. It depends on operant variability and reinforcement, as described above. The trainer starts by identifying the desired final (or "target") behavior. Next, the trainer chooses a behavior that the animal or person already emits with some probability. The form of this behavior is then gradually changed across successive trials by reinforcing behaviors that approximate the target behavior more and more closely. When the target behavior is finally emitted, it may be strengthened and maintained by the use of a schedule of reinforcement.

Noncontingent reinforcement

Noncontingent reinforcement is the delivery of reinforcing stimuli regardless of the organism's behavior. Noncontingent reinforcement may be used in an attempt to reduce an undesired target behavior by reinforcing multiple alternative responses while extinguishing the target response.

Stimulus control of operant behavior

Main article: Stimulus control

Though initially operant behavior is emitted without an identified reference to a particular stimulus, during operant conditioning operants come under the control of stimuli that are present when behavior is reinforced. Such stimuli are called "discriminative stimuli." A so-called "three-term contingency" is the result. That is, discriminative stimuli set the occasion for responses that produce reward or punishment. Thus, a rat may be trained to press a lever only when a light comes on; a dog rushes to the kitchen when it hears the rattle of its food bag; a child reaches for candy when she sees it on a table.

Discrimination, generalization & context

Most behavior is under stimulus control. Several aspects of this may be distinguished:

- "Discrimination" typically occurs when a response is reinforced only in the presence of a specific stimulus. For example, a pigeon might be fed for pecking at a red light and not at a green light; in consequence, it pecks at red and stops pecking at green. Many complex combinations of stimuli and other conditions have been studied; for example an organism might be reinforced on an interval schedule in the presence of one stimulus and on a ratio schedule in the presence of another.
- "Generalization" is the tendency to respond to stimuli that are similar to a previously trained discriminative stimulus. For example, having been trained to peck at "red" a pigeon might also peck at "pink", though usually less strongly.
- "Context" refers to stimuli that are continuously present in a situation, like the walls, tables, chairs, etc. in a room, or the interior of an operant conditioning chamber. Context stimuli may come to control behavior as do discriminative stimuli, though usually more weakly. Behaviors learned in one context may be absent, or altered, in another. This may cause difficulties for behavioral therapy, because behaviors learned in the therapeutic setting may fail to occur elsewhere.

Behavioral sequences: conditioned reinforcement and chaining

Most behavior cannot easily be described in terms of individual responses reinforced one by one. The scope of operant analysis is expanded through the idea of behavioral chains, which are sequences of responses bound together by the three-term contingencies defined above. Chaining is based on the fact, experimentally demonstrated, that a discriminative stimulus not only sets the occasion for subsequent behavior, but it can also reinforce a behavior that precedes it. That is, a discriminative stimulus is also a "conditioned reinforcer". For example, the light that sets the occasion for lever pressing may be used to reinforce "turning around" in the presence of a noise. This results in the sequence "noise - turn-around - light - press lever - food". Much longer chains can be built by adding more stimuli and responses.

Escape and avoidance

In escape learning, a behavior terminates an (aversive) stimulus. For example, shielding one's eyes from sunlight terminates the (aversive) stimulation of bright light in one's eyes. (This is an example of negative reinforcement, defined above.) Behavior that is maintained by preventing a stimulus is called "avoidance," as, for example, putting on sun glasses before going outdoors.

To change human behavior

Applied behavior analysis is the discipline initiated by B. F. Skinner that applies the principles of conditioning to the modification of socially significant human behavior. It uses the basic concepts of conditioning theory, including conditioned stimulus (S^C), discriminative stimulus (S^d), response (R), and reinforcing stimulus (S^{rein} or S^r for reinforcers, sometimes S^{ave} for aversive stimuli). A conditioned stimulus controls behaviors developed through respondent (classical) conditioning, such as emotional reactions. The other three terms combine to form Skinner's "three-term contingency": a discriminative stimulus sets the occasion for responses that lead to reinforcement. Researchers have found the following protocol to be effective when they use the tools of operant conditioning to modify human behavior:

1. **State goal** Clarify exactly what changes are to be brought about. For example, "reduce weight by 30 pounds."
2. **Monitor behavior** Keep track of behavior so that one can see whether the desired effects are occurring. For example, keep a chart of daily weights.
3. **Reinforce desired behavior** For example, congratulate the individual on weight losses. With humans, a record of behavior may serve as a reinforcement. For example, when a participant sees a pattern of weight loss, this may reinforce continuance in a behavioral weight-loss program. A more general plan is the token economy, an exchange system in which tokens are given as rewards for desired behaviors. Tokens may later be exchanged for a desired prize or rewards such as power, prestige, goods or services.
4. **Reduce incentives to perform undesirable behavior** For example, remove candy and fatty snacks from kitchen shelves.

MEMORY

Memory is the faculty of the mind by which information is encoded, stored, and retrieved (Atkinson & Shiffrin, 1968). Memory is vital to experience. Without memory, we are not us. If we could not remember past events, we could not learn or develop language, relationships, nor personal identity (Eysenck, 2012).

Often memory is understood as an informational processing system with explicit and implicit functioning that is made up of a sensory processor, short-term (or working) memory, and long-term memory (Baddely, 2007). The sensory processor allows information from the outside world to be sensed in the form of chemical and physical stimuli and attended to with various levels of focus and intent. Working memory serves as an encoding and retrieval processor. Information in the form of stimuli is encoded in accordance with explicit or implicit functions by the working memory processor. The working memory also retrieves information from previously stored material. Finally, the function of long-term memory is to store data through various categorical models or systems (Baddely, 2007).

Explicit and implicit functions of memory are also known as declarative and non-declarative systems (Squire, 2009). These systems involve the purposeful intention of memory retrieval and storage, or lack thereof. Declarative, or explicit, memory is the conscious storage and

recollection of data (Graf & Schacter, 1985). Under declarative memory resides semantic and episodic memory. Semantic memory refers to memory that is encoded with specific meaning (Eysenck, 2012), while episodic memory refers to information that is encoded along a spatial and temporal plane (Schacter & Addis, 2007; Szpunar, 2010). Declarative memory is usually the primary process thought of when referencing memory (Eysenck, 2012).

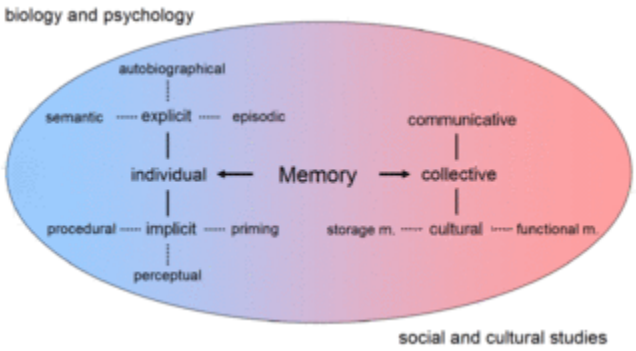
Non-declarative, or implicit, memory is the unconscious storage and recollection of information (Foerde & Poldrack, 2009). An example of a non-declarative process would be the unconscious learning or retrieval of information by way of procedural memory, or a priming phenomenon (Eysenck, 2012; Foerde & Poldrack, 2009; Tulving & Schacter, 1990). Priming is the process of subliminally arousing specific responses from memory and shows that not all memory is consciously activated (Tulving & Schacter, 1990), whereas procedural memory is the slow and gradual learning of skills that often occurs without conscious attention to learning (Eysenck, 2012; Foerde & Poldrack, 2009).

Memory is not a perfect processor, and is affected by many factors. The manner information is encoded, stored, and retrieved can all be corrupted. The amount of attention given new stimuli can diminish the amount information that becomes encoded for storage (Eysenck, 2012). Also, the storage process can become corrupted with physical damage to areas of the brain that are associated with memory storage, such as the hippocampus (Squire, 2009). Finally, the retrieval of information from long-term memory can be disrupted because of decay within long-term memory (Eysenck, 2012). Normal functioning, decay over time, and brain damage all affect the accuracy and capacity of memory.

From an information processing perspective there are three main stages in the formation and retrieval of memory:

- *Encoding* or registration: receiving, processing and combining of received information
- *Storage*: creation of a permanent record of the encoded information in short term or long term memory
- *Retrieval*, *recall* or *recollection*: calling back the stored information in response to some cue for use in a process or activity

The loss of memory is described as forgetfulness or amnesia.



Overview of the forms and functions of memory in the sciences

Sensory memory

Main article: Sensory memory

Sensory memory holds sensory information less than one second after an item is perceived. The ability to look at an item and remember what it looked like with just a split second of observation, or memorization, is the example of sensory memory. It is out of cognitive control and is an automatic response. With very short presentations, participants often report that they seem to "see" more than they can actually report. The first experiments exploring this form of sensory memory were precisely conducted by George Sperling (1963) using the "partial report paradigm". Subjects were presented with a grid of 12 letters, arranged into three rows of four. After a brief presentation, subjects were then played either a high, medium or low tone, cuing them which of the rows to report. Based on these partial report experiments,Sperling was able to show that the capacity of sensory memory was approximately 12 items, but that it degraded very quickly (within a few hundred milliseconds). Because this form of memory degrades so quickly, participants would see the display but be unable to report all of the items (12 in the "whole report" procedure) before they decayed. This type of memory cannot be prolonged via rehearsal.

Three types of sensory memories exist. Iconic memory is a fast decaying store of visual information; a type of sensory memory that briefly stores an image which has been perceived for a small duration. Echoic memory is a fast decaying store of auditory information, another type of sensory memory that briefly stores sounds that have been perceived for short durations. Haptic memory is a type of sensory memory that represents a database for touch stimuli.

Short-term memory

Main article: Short-term memory

Short-term memory is also known as working memory. Short-term memory allows recall for a period of several seconds to a minute without rehearsal. Its capacity is also very limited: George A. Miller (1956), when working at Bell Laboratories, conducted experiments showing that the store of short-term memory was 7±2 items (the title of his famous paper, "The magical number 7±2"). Modern estimates of the capacity of short-term memory are lower, typically of the order of 4–5 items; however, memory capacity can be increased through a process called chunking. For example, in recalling a ten-digit telephone number, a person could chunk the digits into three groups: first, the area code (such as 123), then a three-digit chunk (456) and lastly a four-digit chunk (7890). This method of remembering telephone numbers is far more effective than attempting to remember a string of 10 digits; this is because we are able to chunk the information into meaningful groups of numbers. This may be reflected in some countries in the tendency to display telephone numbers as several chunks of two to four numbers.

Short-term memory is believed to rely mostly on an acoustic code for storing information, and to a lesser extent a visual code. Conrad (1964) found that test subjects had more difficulty recalling collections of letters that were acoustically similar (e.g. E, P, D). Confusion with recalling acoustically similar letters rather than visually similar letters implies that the letters were

encoded acoustically. Conrad's (1964) study, however, deals with the encoding of written text; thus, while memory of written language may rely on acoustic components, generalisations to all forms of memory cannot be made.

Long-term memory

Main article: Long-term memory

Olin Levi Warner, *Memory* (1896). Library of Congress Thomas Jefferson Building, Washington, D.C.

The storage in sensory memory and short-term memory generally has a strictly limited capacity and duration, which means that information is not retained indefinitely. By contrast, long-term memory can store much larger quantities of information for potentially unlimited duration (sometimes a whole life span). Its capacity is immeasurable. For example, given a random seven-digit number we may remember it for only a few seconds before forgetting, suggesting it was stored in our short-term memory. On the other hand, we can remember telephone numbers for many years through repetition; this information is said to be stored in long-term memory.

While short-term memory encodes information acoustically, long-term memory encodes it semantically: Baddeley (1966) discovered that, after 20 minutes, test subjects had the most difficulty recalling a collection of words that had similar meanings (e.g. big, large, great, huge) long-term. Another part of long-term memory is episodic memory, "which attempts to capture information such as 'what', 'when' and 'where'". With episodic memory, individuals are able to recall specific events such as birthday parties and weddings.

Short-term memory is supported by transient patterns of neuronal communication, dependent on regions of the frontal lobe (especially dorsolateral prefrontal cortex) and the parietal lobe. Long-term memory, on the other hand, is maintained by more stable and permanent changes in neural

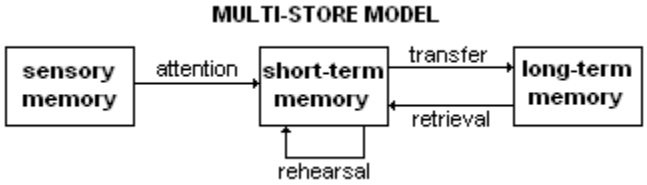
connections widely spread throughout the brain. The hippocampus is essential (for learning new information) to the consolidation of information from short-term to long-term memory, although it does not seem to store information itself. It was thought that without the hippocampus new memories were unable to be stored into long-term memory and that there would be a very short attention span, as first gleamed from patient Henry Molaison after what was thought to be the full removal of both his hippocampi. More recent examination of his brain, post-mortem, shows that the hippocampus was more intact than first thought, throwing theories drawn from the initial data into question. The hippocampus may be involved in changing neural connections for a period of three months or more after the initial learning.

Models

Models of memory provide abstract representations of how memory is believed to work. Below are several models proposed over the years by various psychologists. Controversy is involved as to whether several memory structures exist.

Atkinson–Shiffrin

See also: Memory consolidation



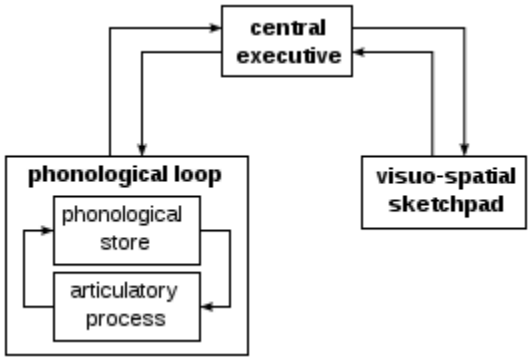
The multi-store model (also known as Atkinson–Shiffrin memory model) was first described in 1968 by Atkinson and Shiffrin.

The multi-store model has been criticised for being too simplistic. For instance, long-term memory is believed to be actually made up of multiple subcomponents, such as episodic and procedural memory. It also proposes that rehearsal is the only mechanism by which information eventually reaches long-term storage, but evidence shows us capable of remembering things without rehearsal.

The model also shows all the memory stores as being a single unit whereas research into this shows differently. For example, short-term memory can be broken up into different units such as visual information and acoustic information. In a study by Zlonoga and Gerber (1986), patient 'KF' demonstrated certain deviations from the Atkinson–Shiffrin model. Patient KF was brain damaged, displaying difficulties regarding short-term memory. Recognition of sounds such as spoken numbers, letters, words and easily identifiable noises (such as doorbells and cats meowing) were all impacted. Interestingly, visual short-term memory was unaffected, suggesting a dichotomy between visual and audial memory.

Working memory

Main article: Working memory



The working memory model

In 1974 Baddeley and Hitch proposed a "working memory model" that replaced the general concept of short-term memory with an active maintenance of information in the short-term storage. In this model, working memory consists of three basic stores: the central executive, the phonological loop and the visuo-spatial sketchpad. In 2000 this model was expanded with the multimodal episodic buffer (Baddeley's model of working memory).

The central executive essentially acts as an attention sensory store. It channels information to the three component processes: the phonological loop, the visuo-spatial sketchpad, and the episodic buffer.

The phonological loop stores auditory information by silently rehearsing sounds or words in a continuous loop: the articulatory process (for example the repetition of a telephone number over and over again). A short list of data is easier to remember.

The visuospatial sketchpad stores visual and spatial information. It is engaged when performing spatial tasks (such as judging distances) or visual ones (such as counting the windows on a house or imagining images).

The episodic buffer is dedicated to linking information across domains to form integrated units of visual, spatial, and verbal information and chronological ordering (e.g., the memory of a story or a movie scene). The episodic buffer is also assumed to have links to long-term memory and semantical meaning.

The working memory model explains many practical observations, such as why it is easier to do two different tasks (one verbal and one visual) than two similar tasks (e.g., two visual), and the aforementioned word-length effect. However, the concept of a central executive as noted here has been criticised as inadequate and vague.[*citation needed*] Working memory is also the premise for what allows us to do everyday activities involving thought. It is the section of memory where we carry out thought processes and use them to learn and reason about topics.

Types

When talking about types of memory, it is important to have in the back of the mind that these are constructs. That is, idealized hypothetical conceptual models of memory processes. These constructs have arisen from interpretation of scientific evidence and is tested experimentally, but since this is, as you know, psychology, which is a soft science, so it is based on inference and opinion to a greater degree than the hard sciences.

Researchers distinguish between **recognition** and **recall** memory. Recognition memory tasks require individuals to indicate whether they have encountered a stimulus (such as a picture or a word) before. Recall memory tasks require participants to retrieve previously learned information. For example, individuals might be asked to produce a series of actions they have seen before or to say a list of words they have heard before.

By information type

Topographic memory involves the ability to orient oneself in space, to recognize and follow an itinerary, or to recognize familiar places. Getting lost when traveling alone is an example of the failure of topographic memory.

Flashbulb memories are clear episodic memories of unique and highly emotional events. People remembering where they were or what they were doing when they first heard the news of President Kennedy's assassination, the Sydney Siege or of 9/11 are examples of flashbulb memories.

Anderson (1976) divides long-term memory into *declarative (explicit)* and *procedural (implicit)* memories.

Declarative

Main article: Declarative memory

Declarative memory requires conscious recall, in that some conscious process must call back the information. It is sometimes called *explicit memory*, since it consists of information that is explicitly stored and retrieved.

Declarative memory can be further sub-divided into semantic memory, concerning principles and facts taken independent of context; and episodic memory, concerning information specific to a particular context, such as a time and place. Semantic memory allows the encoding of abstract knowledge about the world, such as "Paris is the capital of France". Episodic memory, on the other hand, is used for more personal memories, such as the sensations, emotions, and personal associations of a particular place or time. Episodic memories often reflect the "firsts" in life such as a first kiss, first day of school or first time winning a championship. These are key events in one's life that can be remembered clearly. Autobiographical memory - memory for particular events within one's own life - is generally viewed as either equivalent to, or a subset of, episodic memory. Visual memory is part of memory preserving some characteristics of our senses pertaining to visual experience. One is able to place in memory information that resembles objects, places, animals or people in sort of a mental image. Visual memory can result in priming

and it is assumed some kind of perceptual representational system underlies this phenomenon.[*citation needed*]

Procedural

In contrast, procedural memory (or *implicit memory*) is not based on the conscious recall of information, but on implicit learning. It can best be summarized as remember how to do something. Procedural memory is primarily employed in learning motor skills and should be considered a subset of implicit memory. It is revealed when one does better in a given task due only to repetition - no new explicit memories have been formed, but one is unconsciously accessing aspects of those previous experiences. Procedural memory involved in motor learning depends on the cerebellum and basal ganglia.

A characteristic of procedural memory is that the things remembered are automatically translated into actions, and thus sometimes difficult to describe. Some examples of procedural memory include the ability to ride a bike or tie shoelaces.

By temporal direction

Another major way to distinguish different memory functions is whether the content to be remembered is in the past, retrospective memory, or in the future, prospective memory. Thus, retrospective memory as a category includes semantic, episodic and autobiographical memory. In contrast, prospective memory is memory for future intentions, or *remembering to remember* (Winograd, 1988). Prospective memory can be further broken down into event- and time-based prospective remembering. Time-based prospective memories are triggered by a time-cue, such as going to the doctor (action) at 4pm (cue). Event-based prospective memories are intentions triggered by cues, such as remembering to post a letter (action) after seeing a mailbox (cue). Cues do not need to be related to the action (as the mailbox/letter example), and lists, sticky-notes, knotted handkerchiefs, or string around the finger all exemplify cues that people use as strategies to enhance prospective memory.

Techniques for studying memory

Researchers use a variety of tasks to assess older children and adults' memory. Some examples are:

- **Paired associate learning** – when one learns to associate one specific word with another. For example, when given a word such as "safe" one must learn to say another specific word, such as "green". This is stimulus and response.
- **Free recall** – during this task a subject would be asked to study a list of words and then later they will be asked to recall or write down as many words that they can remember, similar to free response questions. Earlier items are affected by retroactive interference (RI), which means the longer the list, the greater the interference, and the less likelihood that they are recalled. On the other hand, items that have been presented lastly suffer little RI, but suffer a great deal from proactive interference (PI), which means the longer the delay in recall, the more likely that the items will be lost.

- **Cued recall** – one is given significant hints about the information. This is similar to fill in the blank assessments used in classrooms.
- **Recognition** – subjects are asked to remember a list of words or pictures, after which point they are asked to identify the previously presented words or pictures from among a list of alternatives that were not presented in the original list. This is similar to multiple choice assessments.
- **Detection paradigm** – individuals are shown a number of objects and color samples during a certain period of time. They are then tested on their visual ability to remember as much as they can by looking at testers and pointing out whether the testers are similar to the sample, or if any change is present.
- **Savings method** – compares the speed of originally learning to the speed of relearning it. The amount of time saved measures memory.

Failures

- **Transience** – memories degrade with the passing of time. This occurs in the storage stage of memory, after the information has been stored and before it is retrieved. This can happen in sensory, short-term, and long-term storage. It follows a general pattern where the information is rapidly forgotten during the first couple of days or years, followed by small losses in later days or years.
- **Absentmindedness** – Memory failure due to the lack of attention. Attention plays a key role in storing information into long-term memory; without proper attention, the information might not be stored, making it impossible to be retrieved later.

Aging

Main article: Memory and aging

One of the key concerns of older adults is the experience of memory loss, especially as it is one of the hallmark symptoms of Alzheimer's disease. However, memory loss is qualitatively different in normal aging from the kind of memory loss associated with a diagnosis of Alzheimer's (Budson & Price, 2005). Research has revealed that individuals' performance on memory tasks that rely on frontal regions declines with age. Older adults tend to exhibit deficits on tasks that involve knowing the temporal order in which they learned information; source memory tasks that require them to remember the specific circumstances or context in which they learned information; and prospective memory tasks that involve remembering to perform an act at a future time. Older adults can manage their problems with prospective memory by using appointment books, for example.

Improving

Main article: Improving memory

A UCLA research study published in the June 2006 issue of the American Journal of Geriatric Psychiatry found that people can improve cognitive function and brain efficiency through simple

lifestyle changes such as incorporating memory exercises, healthy eating, physical fitness and stress reduction into their daily lives. This study examined 17 subjects, (average age 53) with normal memory performance. Eight subjects were asked to follow a "brain healthy" diet, relaxation, physical, and mental exercise (brain teasers and verbal memory training techniques). After 14 days, they showed greater word fluency (not memory) compared to their baseline performance. No long term follow up was conducted, it is therefore unclear if this intervention has lasting effects on memory.

There are a loosely associated group of mnemonic principles and techniques that can be used to vastly improve memory known as the art of memory.

The International Longevity Center released in 2001 a report which includes in pages 14–16 recommendations for keeping the mind in good functionality until advanced age. Some of the recommendations are to stay intellectually active through learning, training or reading, to keep physically active so to promote blood circulation to the brain, to socialize, to reduce stress, to keep sleep time regular, to avoid depression or emotional instability and to observe good nutrition.

Memorization is a method of learning that allows an individual to recall information verbatim. Rote learning is the method most often used. Methods of memorizing things have been the subject of much discussion over the years with some writers, such as Cosmos Rossellius using visual alphabets. The spacing effect shows that an individual is more likely to remember a list of items when rehearsal is spaced over an extended period of time. In contrast to this is cramming: an intensive memorization in a short period of time. Also relevant is the Zeigarnik effect which states that people remember uncompleted or interrupted tasks better than completed ones. The so-called Method of loci uses spatial memory to memorize non-spatial information.

Levels of processing

Main article: Levels-of-processing effect

Craik and Lockhart (1972) proposed that it is the method and depth of processing that affects how an experience is stored in memory, rather than rehearsal.

- **Organization**: Mandler (1967) gave participants a pack of word cards and asked them to sort them into any number of piles using any system of categorisation they liked. When they were later asked to recall as many of the words as they could, those who used more categories remembered more words. This study suggested that the organization of memory is one of its central aspects (Mandler, 2011).
- **Distinctiveness**: Eysenck and Eysenck (1980) asked participants to say words in a distinctive way, e.g. spell the words out loud. Such participants recalled the words better than those who simply read them off a list.
- **Effort**: Tyler et al. (1979) had participants solve a series of anagrams, some easy (FAHTER) and some difficult (HREFAT). The participants recalled the difficult anagrams better, presumably because they put more effort into them.

- **Elaboration**: Palmere et al. (1983) gave participants descriptive paragraphs of a fictitious African nation. There were some short paragraphs and some with extra sentences elaborating the main idea. Recall was higher for the ideas in the elaborated paragraphs.

Construction for general manipulation

Although people often think that memory operates like recording equipment, it is not the case. The molecular mechanisms underlying the induction and maintenance of memory are very dynamic and comprise distinct phases covering a time window from seconds to even a lifetime. In fact, research has revealed that our memories are constructed: "current hypotheses suggest that constructive processes allow individuals to simulate and imagine future episodes, happenings, and scenarios. Since the future is not an exact repetition of the past, simulation of future episodes requires a complex system that can draw on the past in a manner that flexibly extracts and recombines elements of previous experiences - a constructive rather than a reproductive system." People can construct their memories when they encode them and/or when they recall them. To illustrate, consider a classic study conducted by Elizabeth Loftus and John Palmer (1974) in which people were instructed to watch a film of a traffic accident and then asked about what they saw. The researchers found that the people who were asked, "How fast were the cars going when they *smashed* into each other?" gave higher estimates than those who were asked, "How fast were the cars going when they *hit* each other?" Furthermore, when asked a week later whether they have seen broken glass in the film, those who had been asked the question with *smashed* were twice more likely to report that they have seen broken glass than those who had been asked the question with *hit*. There was no broken glass depicted in the film. Thus, the wording of the questions distorted viewers' memories of the event. Importantly, the wording of the question led people to construct different memories of the event – those who were asked the question with *smashed* recalled a more serious car accident than they had actually seen. The findings of this experiment were replicated around the world, and researchers consistently demonstrated that when people were provided with misleading information they tended to misremember, a phenomenon known as the misinformation effect.

Interestingly, research has revealed that asking individuals to repeatedly imagine actions that they have never performed or events that they have never experienced could result in false memories. For instance, Goff and Roediger (1998) asked participants to imagine that they performed an act (e.g., break a toothpick) and then later asked them whether they had done such a thing. Findings revealed that those participants who repeatedly imagined performing such an act were more likely to think that they had actually performed that act during the first session of the experiment. Similarly, Garry and her colleagues (1996) asked college students to report how certain they were that they experienced a number of events as children (e.g., broke a window with their hand) and then two weeks later asked them to imagine four of those events. The researchers found that one-fourth of the students asked to imagine the four events reported that they had actually experienced such events as children. That is, when asked to imagine the events they were more confident that they experienced the events.

Sleep

Making memories occurs through a three-step process, which can be enhanced by sleep. The three steps are as follows:

1. Acquisition which is the process of storage and retrieval of new information in memory
2. Consolidation
3. Recall

Sleep does not affect acquisition or recall while one is awake. Therefore, sleep has the greatest effect on memory consolidation. During sleep, the neural connections in the brain are strengthened. This enhances the brain's abilities to stabilize and retain memories. There have been several studies which show that sleep improves the retention of memory, as memories are enhanced through active consolidation. System consolidation takes place during slow-wave sleep (SWS). This process implicates that memories are reactivated during sleep, but that the process doesn't enhance every memory. It also implicates that qualitative changes are made to the memories when they are transferred to long-term store during sleep. When you are sleeping, the hippocampus replays the events of the day for the neocortex. The neocortex then reviews and processes memories, which moves them into long-term memory. When you do not get enough sleep it makes it more difficult to learn as these neural connections are not as strong, resulting in a lower retention rate of memories. Sleep deprivation makes it harder to focus, resulting in inefficient learning. Furthermore, some studies have shown that sleep deprivation can lead to false memories as the memories are not properly transferred to long-term memory. Therefore, it is important to get the proper amount of sleep so that memory can function at the highest level. One of the primary functions of sleep is thought to be the improvement of the consolidation of information, as several studies have demonstrated that memory depends on getting sufficient sleep between training and test. Additionally, data obtained from neuroimaging studies have shown activation patterns in the sleeping brain that mirror those recorded during the learning of tasks from the previous day, suggesting that new memories may be solidified through such rehearsal.

Influencing factors

Interference can hamper memorization and retrieval. There is retroactive interference, when learning new information makes it harder to recall old information and **proactive interference**, where prior learning disrupts recall of new information. Although interference can lead to forgetting, it is important to keep in mind that there are situations when old information can facilitate learning of new information. Knowing Latin, for instance, can help an individual learn a related language such as French – this phenomenon is known as positive transfer.

Effects of physical exercise

Main article: Neurobiological effects of physical exercise § Long-term effects

Physical exercise, particularly continuous aerobic exercises such as running, cycling and swimming, has many cognitive benefits and effects on the brain. Influences on the brain include increases in neurotransmitter levels, improved oxygen and nutrient delivery, and increased

neurogenesis in the hippocampus. The effects of exercise on memory have important implications for improving children's academic performance, maintaining mental abilities in old age, and the prevention and potential cure of neurological diseases.

Active recall

Active recall is a principle of efficient learning, which claims the need to actively stimulate memory during the learning process. It contrasts with passive review, in which the learning material is processed passively (e.g. by reading, watching, etc.). For example, reading a text about George Washington, with no further action, is a passive review. Answering the question "Who was the first US President?", is active recall. Active recall is very efficient in consolidating long-term memory.

Thus there is much support that active recall is better than rereading text for enhancing learning. In fact, Karpicke, et al. (2009) believe that students get "illusions of competence" from rereading their notes and textbook. One reason for this illusion is that the text contains all the information, so it is easy to glance over it and feel as if it is known well, when that is not the case at all. Better put: in the text, the cue and corresponding target are both present, which is not the case during testing. The results of their study showed that retrieval as a study strategy is rare among students. They prefer to reread instead.

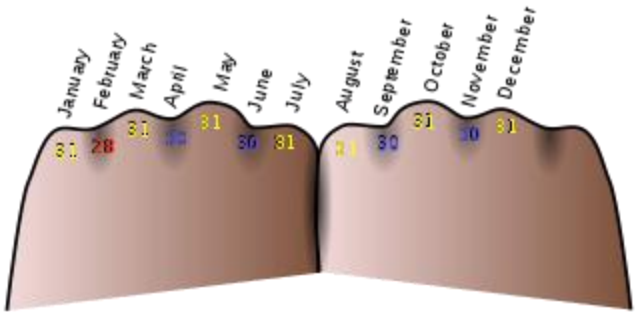
Testing effect

The **testing effect** is the finding that long-term memory is increased when some of the learning period is devoted to retrieving the to-be-remembered information through testing with proper feedback. The effect is also sometimes referred to as **retrieval practice**, **practice testing**, or **test-enhanced learning**.

It is useful for people to test their knowledge of the to-be-remembered material during the studying process, instead of solely studying or reading the material. For example, a student can use flashcards to self-test and receive feedback as they study. The testing effect provides the largest benefit to long-term memory when the tested material is difficult enough to require effort, the retrieval success is high, and feedback with correct answers is given after testing.

"On the matter of sheer repetitive drill there is another principle of the highest importance: Active repetition is very much more effective than passive repetition. ... there are two ways of introducing further repetitions. We may re-read this list: this is passive repetition. We may recall it to mind without reference to the text before forgetting has begun: this is active repetition. It has been found that when acts of reading and acts of recall alternate, i.e., when every reading is followed by an attempt to recall the items, the efficiency of learning and retention is enormously enhanced." In other words, the testing effect shows that when material is reviewed, the reviewer actively challenges their memory to recall than when re-reading or re-studying the materials. This is called active recall.

Mnemonic



Knuckle mnemonic for the number of days in each month of the Gregorian Calendar. Each knuckle represents a 31-day month.

A **mnemonic device**, or **memory device,** is any learning technique that aids information retention in the human memory. Mnemonics make use of elaborative encoding, retrieval cues, and imagery as specific tools to encode any given information in a way that allows for efficient storage and retrieval. Mnemonics aid original information in becoming associated with something more meaningful—which, in turn, allows the brain to have better retention of the information. Commonly encountered mnemonics are often used for lists and in auditory form, such as short poems, acronyms, or memorable phrases, but mnemonics can also be used for other types of information and in visual or kinesthetic forms. Their use is based on the observation that the human mind more easily remembers spatial, personal, surprising, physical, sexual, humorous, or otherwise "relatable" information, rather than more abstract or impersonal forms of information.

Ancient Greeks and Romans distinguished between two types of memory: the "natural" memory and the "artificial" memory. The former is inborn, and is the one that everyone uses instinctively. The latter in contrast has to be trained and developed through the learning and practice of a variety of mnemonic techniques.

Types

1. Music mnemonics
   Songs and jingles can be used as a mnemonic. A common example is how children remember the alphabet by singing the ABC's.
2. Name mnemonics
   The first letter of each word is combined into a new word. For example: VIBGYOR (or ROY G BIV) for the colours of the rainbow or HOMES for the Great Lakes.
3. Expression or word mnemonics
   The first letter of each word is combined to form a phrase or sentence -- e.g. "Richard of York gave battle in vain" for the colours of the rainbow.
4. Model mnemonics
   A model is used to help recall information.
5. Ode mnemonics
   The information is placed into a poem or doggerel, -- e.g. 'Note socer, gener, liberi, and Liber god of revelry, like puer these retain the 'e *(most Latin nouns of the second declension ending in -er drop the -e in all of the oblique cases except the vocative, these are the exceptions).*

6. Note organization mnemonics
   The method of note organization can be used as a memorization technique.
7. Image mnemonics
   The information is constructed into a picture -- e.g. the German weak declension can be remembered as five '-e's', looking rather like the state of Oklahoma in America, in a sea of '-en's'.
8. Connection mnemonics
   New knowledge is connected to knowledge already known.
9. Spelling mnemonics
   An example is "*i* before *e* except after *c* or when sounding like *a* in *neighbor* and *weigh*".

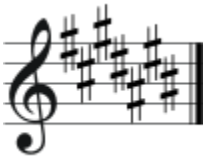
Applications and examples

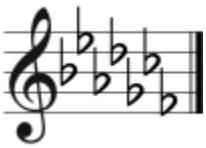
Main article: List of mnemonics

A wide range of mnemonics are used for several purposes. The most commonly used mnemonics are those for lists, numerical sequences, foreign-language acquisition, and medical treatment for patients with memory deficits.

For lists

A common mnemonic for remembering lists is to create an easily remembered acronym, or, taking each of the initial letters of the list members, create a memorable phrase in which the words with the same acronym as the material. Mnemonic techniques can be applied to most memorisation of novel materials.





Key signatures of C♯ major or A♯ minor (left) and C♭ major or A♭ minor (right)

Some common examples for first letter mnemonics:

- "Memory Needs Every Method Of Nurturing Its Capacity" is a mnemonic for spelling 'mnemonic.'
- The order of sharps in key signature notation is F♯, C♯, G♯, D♯, A♯, E♯ and B♯, giving the mnemonic "Father Charles Goes Down And Ends Battle". The order of flats is the reverse: B♭, E♭, A♭, D♭, G♭, C♭ and F♭ ("Battle Ends And Down Goes Charles' Father").

- To memorise the colours of the rainbow: the phrase "Richard Of York Gave Battle In Vain" - each of the initial letters matches the colours of the rainbow in order (Red, Orange, Yellow, Green, Blue, Indigo, Violet). Other examples are the phrase "Run over your granny because it's violent" or the imaginary name "Roy G. Biv".
- To memorise the North American Great Lakes: the acronym HOMES - matching the letters of the five lakes (Huron, Ontario, Michigan, Erie, and Superior)
- To memorise colour codes as they are used in electronics: the phrase "Bill Brown Realised Only Yesterday Good Boys Value Good Work" represents in order the 10 colours and their numerical order: black (0), brown (1), red (2), orange (3), yellow (4), green (5), blue (6), violet or purple (7), grey (8), and white (9).
- To memorise chemical reactions, such as redox reactions, where it is common to mix up oxidation and reduction, the short phrase "LEO (Lose Electron Oxidation) the lion says GER (Gain Electron Reduction)" or "Oil Rig" can be used - which is an acronym for "Oxidation is losing, Reduction is gaining".
- To memorise the names of the planets, use the planetary mnemonic: "My Very Educated Mother Just Served Us Nachos" or "My Very Easy Method Just Speeds Up Naming Planets" - where each of the initial letters matches the name of the planets in our solar system (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, [Pluto]).

For numerical sequences

Mnemonic phrases or poems can be used to encode numeric sequences by various methods, one common one is to create a new phrase in which the number of letters in each word represents the according digit of pi. For example, the first 15 digits of the mathematical constant pi (3.14159265358979) can be encoded as "Now I need a drink, alcoholic of course, after the heavy lectures involving quantum mechanics"; "Now", having 3 letters, represents the first number, 3. Piphilology is the practice dedicated to creating mnemonics for pi.

Another is used for "calculating" the multiples of 9 up to 9 × 10 using one's fingers. Begin by holding out both hands with all fingers stretched out. Now count left to right the number of fingers that indicates the multiple. For example, to figure 9 × 4, count four fingers from the left, ending at your left-hand index finger. Bend this finger down and count the remaining fingers. Fingers to the left of the bent finger represent tens, fingers to the right are ones. There are three fingers to the left and six to the right, which indicates 9 × 4 = 36. This works for 9 × 1 up through 9 × 10.

For foreign-language acquisition

Mnemonics may be helpful in learning foreign languages, for example by transposing difficult foreign words with words in a language the learner knows already, also called "cognates" which are very common in the Spanish language. A useful such technique is to find linkwords, words that have the same pronunciation in a known language as the target word, and associate them visually or auditorially with the target word.

For example, in trying to assist the learner to remember *ohel*, the Hebrew word for *tent*, the memorable sentence "*Oh hell*, there's a raccoon in my *tent*" can be used. Also in Hebrew, a way

to remember the word, bayit (bahy- it), meaning house, one can use the sentence "that's a lovely house, I'd like to bayit." The linguist Michel Thomas taught students to remember that *estar* is the Spanish word for *to be* by using the phrase "to be a star".

Another Spanish example is by using the mnemonic "Vin Diesel Has Ten Weapons" to teach irregular command verbs in the you form. Spanish verb forms and tenses are regularly seen as the hardest part of learning the language. With a high number of verb tenses, and many verb forms that are not found in English, Spanish verbs can be hard to remember and then conjugate. The use of mnemonics has been proven to help students better learn foreign languages, and this holds true for Spanish verbs. A particularly hard verb tense to remember is command verbs. Command verbs in Spanish are conjugated differently depending on who the command is being given to. The phrase, when pronounced with a Spanish accent, is used to remember "Ven Di Sal Haz Ten Ve Pon Sé", all of the irregular Spanish command verbs in the you form. This mnemonic helps students attempting to memorize different verb tenses. Another technique is for learners of gendered languages to associate their mental images of words with a colour that matches the gender in the target language. An example here is to remember the Spanish word for "foot," *pie,* [pee-ay] with the image of a foot stepping on a pie, which then spills blue filling (blue representing the male gender of the noun in this example).

Effectiveness

Academic study of the use of mnemonics has shown their effectiveness. In one such experiment, subjects of different ages who applied mnemonic techniques to learn novel vocabulary outperformed control groups that applied contextual learning and free-learning styles.

Mnemonic learning strategies require time and resources by educators to develop creative and effective devices. The most simple and creative mnemonic devices usually are the most effective for teaching. In the classroom, mnemonic devices must be used at the appropriate time in the instructional sequence to achieve their maximum effectiveness.

Studies (notably "The Magical Number Seven, Plus or Minus Two") have suggested that the short-term memory of adult humans can hold only a limited number of items; grouping items into larger chunks such as in a mnemonic might be part of what permits the brain to hold a larger total amount of information in short-term memory, which in turn can aid the creation of long-term memories.

Læringsprosessen

Rehearsal

A **rehearsal** is an activity in the performing arts that occurs as preparation for a performance in music, theatre, dance and related arts, such as opera, musical theatre and film production. It is undertaken as a form of practising, to ensure that all details of the subsequent performance are

adequately prepared and coordinated. The term "rehearsal" typically refers to ensemble activities undertaken by a group of people. For example, when a musician is preparing a piano concerto alone in their music studio, this is called "practicing", but when they begin to practice the concerto with an orchestra, this activity is called a "rehearsal". The music rehearsal takes place in a music rehearsal space.

While the term is most commonly used in the performing arts to refer to preparation for a public presentation or show, the term is also used to refer to the preparation for other anticipated activities, such as wedding guests and couples practicing a wedding ceremony, paramedics practicing responding to a simulated emergency, or army troops practicing for an attack using a mock-up of the building they will be assaulting.

Dress rehearsal

The **dress rehearsal** is a full-scale rehearsal where the actors and/or musicians perform every detail of the performance. For a theatrical performance, cast members wear their costumes. The actors may use props and backdrops; they do not use scripts, although the stage manager and director might.

For a musical performance, the dress rehearsal does not require wearing formal concert outfits (e.g., tuxedos and gowns). In music, the dress rehearsal is the final rehearsal before the performance;[1] while initial rehearsals will often involve working on challenging sections of the piece or pieces, during the dress rehearsal, the entire piece (or pieces) are typically played in their entirety.

In other contexts

The use of rehearsals and dress rehearsals extends beyond the performing arts. When an organization has to learn how to implement a new process, it may rehearse the activity beforehand. Emergency-planning organizations often rehearse their preparations for responding to civil disasters; in some cases, there may even be actors playing the role of "injured people", so that emergency workers can learn how to provide assistance. Armies that are planning an attack on a certain target may create a mock-up of the target and rehearse the attack. The Israeli Defence Force used this approach in planning for the Raid on Entebbe, which freed air hijacking hostages. An accurate model of the airport building where the hostages were being held by gunmen was recreated so that the commandos could practice their attack maneuvers.

The introduction of major changes to complex industrial and technical fields, such as information systems is often rehearsed, particularly where this requires multiple activities to be coordinated and completed within time constraints. Many companies undertook major initiatives with their computer staff to rehearse the changes associated with the Year 2000 problem and the economic and monetary union of the European Union.

Common types of practice

Some common ways practice is applied:

- To learn how to play a musical instrument (musical technique)
- To improve athletic or team performance
- To prepare for a public performance within the performing arts
- To improve reading, writing, interpersonal communication, typing, grammar, and spelling
- To enhance or refine a newly acquired skill
- To maintain skill
- To learn martial arts; kata and sparring are common forms of practice
- To master tasks associated with one's occupation (e.g. a cashier using a POS system)

How well one improves with practice depends on several factors, such as the frequency it is engaged in, and the type of feedback that is available for improvement. If feedback is not available (either from an instructor or from self-reference to an information source), then the practice tends to be ineffective or even detrimental to learning. If a student does not practise often enough, reinforcement fades, and he or she is likely to forget what was learned. Therefore, practice is often scheduled, to ensure enough of it is performed to reach one's training objectives. How much practice is required depends upon the nature of the activity, and upon each individual. Some people improve on a particular activity faster than others. Practice in an instructional setting may be effective if repeated only 1 time (for some simple verbal information) or 3 times (for concepts), or it may be practised many times before evaluation (a dance movement).