# What is visual imagery?

Visual imagery is the ability to imagine some kind of representation without any stimulus from the environment, because of this visual imagery is top-down. Visual imagery is different from hallucination in many aspects: hallucination is also top-down but instead of visual imagery we believe that what we pretend to see is actually there. An example of imagery is when you imagine your bedroom: you know you are not actually in your bedroom, instead, hallucination is when you are for example watching a movie and you see in the row in front of view a elephant sitting on a chair, but you actually believe it is there, even if is not true.

There are two main theories of visual imagery: the first one proposed by Kosllin states that visual imagery is the same as perception, the only difference is that perception is bottom-up and visual imagery is top-down. He states that visual images are depictive representations. Pylyshyn's theory states instead that imagery and perception are completely different and that when we save information in our brain we think is spatially arranged but instead it is saved in a text form

# What theories are about motion perception?

There are 3 important theories concerning motion perception:

* Direct perception (Gibson)
* Lee theory - time to contact
* Glover theory - Planning and control

The first theory focuses on the idea that we don’t need to do all the complex brain computations to elaborate motion perception. Motion perception can be done thanks to optic flow, that is the change of the properties and path of the light reaching our eye, it contains all the necessary information. Furthermore there is the focus of expansion that is the centre of the image. It is an unchanging point and all the objects in the image move further away from it and, depending on their distance, faster or slower (closer points move slower). Of course, this theory have some limitations: like that fact that it de-emphasises top-down process and that motion perception is drastically more difficult.

Lee's time to contact theory states that it is possible to calculate tau which is the ratio of the object's retinal image expansion divided by the rate of the expansion. Τau is an indicator that gives us an idea of how much time to contact we have with an object moving closer to us. Τau-dot is actually used by drivers when they need to break by observing the car in front of them and how much space available there is. This theory has some important limitations since it works only when an object’s speed is constant and when the object is not accelerating or decelerating. Also, tau-dot depends on several other factors like the breaks quality of the car, the distance between the car and if the driver like a gradual deceleration or a faster one.

The last theory is Gibson’s theory which is based on planning and controlling. In the first part, we decided our intention and what to do and also take time and is influenced by individual goals. We select an object (like an apple) and we decided how to grasp it and what to do. While in the second part we compute the motion and we control if the movement is correct and correct it if necessary to do so. In reality, control does not only happen after the planning, it is possible that it happens during or before it. Also if we need to correct our movement it would require some time because we would need to start from the beginning. But in reality when we plan what to do we actually create different possible plans in such a way that, if one is wrong, we can just select a new one and avoid losing time. This theory also de-emphasises the decision-making process and in reality planning and control are intermixed

# What is biological motion and what is about?

Biological motion is a particular set of motion that is related only to animals and individuals. Biological motion is innated and even 5 months old children are able to recognise is. One particular set of biological motion is human biological motion: our movement. In some sense, human biological motion is special because not only do we have to deal with it a lot in our everyday life, but it can not only be perceived but also reproduced and in the end there are some specific brain areas active in human biological motion. Biological motion is also influenced by expertise: this is because we are more able to recognise a movement of a friend rather than a stranger's movement, on the other hand, this question is still open: we don't understand how dog experts are better in biological dog motion but horse experts no. Biological motion also can tell us many things about individuals: from their motion, we can understand if an individual is happy, sad, excited and so on, and we are able to understand their emotions. To conclude it has been found a relationship between motion perception and the execution of motion: patients with Parkinson's have some impairments related on motion detection and this influenced their ability to perform the motion, an important role is played by mirror neurons: particular neurons that are active when we see somebody performing an action and when we are doing an action, in reality, this is not completely accurate because it has been confirmed the presence of mirror neurons in monkeys but not in human where we identify some areas but not neurons. Mirror neurons don’t provide us with the exact motoric coding but rather a general structure of it

# Focused auditory attention

Focused auditory attention is the general process in which we focus on a precise auditory stream. There are two main steps: sound segregation and source selection. Sound segregation is the process in which, when we are listening we are able to differentiate which sound goes together. This is because what we hear is an overlapping mixture of all the sounds. Source selection is the second step in which we shift our attention to one specific source. Both these processes are more effective in some specific conditions. If we are able to discriminate the sound by one (or more) feature we are more able to select it later. Also if we hear that voice in isolation we are better and visual information (like lip-reading) can also help us.

Cherry decided to focus on the cocktail party problem, which is how we select an auditory stream when several ones are present. He found out that the unattended input is not processed and so there must be some sort of bottleneck where we filter auditory information.

Broadbent’s idea is that the bottleneck is located at the beginning of the process and so there is little or no processing on the unattended input, but this theory is too rigid, while Treisman’s theory is more flexible and there is a flexible filter than can allows us to process some information of the unattended input. Deutch and Deutch's theory instead imagined that the unattended input is completely processed like the attended one and that only in the end there is a selection between them and the most important stimuli determine our response. All these three theories resulted too rigid from some point of view. In reality, there is some process of the unattended input because, if we hear in the unattended stimulus our name that information is coded and reaches consciousness, there are some words that are important for us that we code, also they de-emphasized top-down process.

# Focused visual attention

Focused visual attention can be divided into 2 subsets. Covert visual attention and over visual attention. Over visual attention is when you move your attention to another part and that this movement is fully visible. Covert attention is instead when you can not perceive any biological change.

Distributed attention: when you put your attention in a specific limited area

Spatial attention: when you are focusing on a bigger and more general area

Focused visual attention can be of three types: object base, space base or feature base. Object base is when you are focusing only on one object. Space base is when you focus on one area and feature base is instead when you focus on features (like when you focus on people only wearing red t-shirts). Object base and space base attention coexist and even if all three are supposed to be independent of each other, in reality, it has been seen that object base is also helped by space base and feature base attention. Attention and gaze move together but is possible to separate them

# Disorder of visual attention

There is two main disorders of visual attention: neglect and extintion.

Neglect is based on the inability of detecting stimuli on the opposite side of the damaged brain, while it is possible to detect them on the same side of the damaged brain. Extinction is instead when you are unable to report a presence of stimuli on the opposite side of the brain-damaged when it is present another stimulus on the same side of the brain damage.

Neglect can be furthermore categorised in space-neglect and object base neglect. Space base neglect is the inability to detect stimuli in an area while object base neglect is the inability to detect one side of the object.

It is interesting to notice that these types of disorders are not equally proportional between the left and right sides. It is more common than the disorder is about the right side of the obejcts (that is the left visual field). Neglect and extinction can definitely coexist. It is hard to produce relevat theories because there are incredible big individual differences.

# Focused visual attention

There are three main theory about focused visual attention: Treismann - Feature integration theory, Wolfe - Dual path theory and Rosenhotlz - Texture and tiling model.

Treismann theory has two main components: pre-attentive and attentive stage. The pre-attentive stage is the first step. The target can be disinguished by just one feature from the distractors and the time require to this distinction (reaction time) does not depends on the number of distractors. As the name suggests, in this stage we don’t use attention and we are very fast and recognise the targert, we talk about the pop-out effect, that is given because we see the target almost instanteneously.

The attentive stage instead required that to disitnguished the target from the distractors we need to use attention, this is the case when the target is made of a combination of features of the distractors. The attentive stage is dependent on the number of distractors, there is as a linear grought of time needed to recognise the target that increase with the number of distractors present in the set. Treismann feature integration theory have some limitations: this theory does not discuss the fact the similar target and distactors can increase or decrease the timining needed to recognise the target. Also searching is not complitely random, if we need to find the tv-remote we will never look on the ceelling but rather in position where it actually might be.

The dual path theory of Wolfe describes two pathway: a non-selective and a selective pathway that works in parallel. The first pathway focus in general on the scene and elaborate the gist of the image, it very fast and general. While the second one focuses on objects more in details and anlayse only one object at the time and has limited capacity. In reality is not fully understanded how twe use the gist of a scene to reduce the search areas.

The dual path theory of Wolfe and the Feature integration theory of Treismann have a limitation due to the focus only on attention and not on also perception. Rosenholtz instead shifted focused visual attention also more on perception.

The Rosenholtz texture and tiling model instead focus on the idea that also perception is needed to do focused visual attention and that when we are focusing on one object we are not only focusing on it but rather also the area around it. With an eye-tracker this theory have been proved becuase the number of eye movement required to code the obejct that we see is more or less close to the number of objects. In reality this theory de-ephansise attention and does not specify how observer decides that no target is present.

# Automatic processing

Some process becomes automtatic tanks to prolunghed practice. There are two main theory that discuss atomatic processing. Shiffrin’s traditional apprach and Moors’ 4 feature theory. Shiffrin thery is based on a subdivision of automatic and controlled processed that are cleary distincited and separate. Controlled process are process that requires attention and can be performed only one by one and are very flexible and have limited capacity. Automatic process are process that do not require attention to be performed and can be done while doing something else. Also automatic prcessing are very rigit and even a slight change on the procedure may require time and multiple trials before performing it correclty. One of the limitations of this theory is the fact that this theory is too rigid and there can be an overlapping mixture of automatic and non automatic processing. Also increasing automaticity leads to reduce activiation in areas associated with conscious awarenss.

Moorse 4 feature suggest that there are 4 characteristic shared by all the autoamtic processing. They all are fast, not goal-directed (do not epends on our goals), efficient (can be done while doing somethign else) and require few attention (unconscious). Even if it might be that some automatic processing share all these characteristic in reality they might not happen all toghter, and there might be less of them.

# Serial vs parallel processing

There are two different processing: serial and parallel processing.

Serial processing is a type of process where we switch between one task and another. It is consider to be the most effective way to do two process at the time but in reality we need to know also when it is appropriate to switch between two tasks, becase if we do it every possible time we decrease our performance drastically. Parallel processing is a type of processing where we do two tasks actually at the same time (it is the real multitasking) and, depending on the brain activiation there can be three different possibility where the areas activiate are the exact sum, less or more of the sum of the areas active when performing the two task separstely.

The spider model of fischer focus on processing of one task while driving. This model suggest that driving while using the phone lead to a massive decrease of our ability of driving. This is due because while using the phone we only focus on the central part of the visual field and not the peripheral (where we know that we have worst visual processing). Also we scann less the enviorment for potential treads and we have inattetional bliness. The spider model have some limitations because it does not focus on the different possible use of the phone. There is a difference in texting while driving and speaking while driving. Also the spider model suggest that doing two task at the same time will always decrease our ability at driving but this is incorrect becuase listening to high-temp musinc while driving on a monotomic road can help us stay awake.

# Multistore model

The multistore model is based on the idea that there are three different type of memory: sensory memory, short time memory and long time memory.

Sensory memory is the memory than contains the information coming from the senses. It has unlimited capacity and it codes everything for a short time. The multistore model disinguished between echoic and iconic memory. Iconic information of the sight that comes from the eyes. It is codes very brielfy and it stays in the sensory memory for few milliseconds while echoic memory is the memory of auditos that cames from the ears and it stays longer than iconic memroy (this is due becuase we neeed to understand what a person is saying a little a part of the auditory streams, while for depiciting soemthing we can just look at a photo)

After the sensory memory there is the short time memory, which contains only the important information passed from the sense memory Short timem memory have a limited capacity, the digit spam test (that tells us how many numbers we can repeat in a row) shows tha the average is about 7. In reality the performance on this type of task can be increase by chunking that is the practice of dividing information in block that are easier to remember. Chunking depends on our ability to find patterns and on the information containted in long time memory.

Only trught reversal the information of short time memory can reach long time memory. Here the capacity is huge and information can be maintainted for decades. But naturllay we forget information and this is due becuase of decay, inference, displacement. Decay is the most easy one and is when we don’t repeat the information store in long time memory, it happens usually while sleeping and remove details. Inference is when the inforamtion that we want to remember enter in conflict with another informationatio and displacement is when the curreny object is replaced with a new one.

The multistore model have some limtiations: it does not focus on implicit emory (learning without beeing aware of this) and in reality there is no just rehersal as possible way to move infroamtion from short term memory to long term memory but there are different and more efficient way to do so. Also there is no just echoich and icoic memory but multiple one for all the senses

# Unitary-store model

This model focus on similary between long time and short time memory. It describes short time memory as an activiation of long time memory. Furthermore short time memory is not only a temporal store between sesnory memory and long time memory because we use it for many fundamental things like decision making. Becuase of this short time memory is renamed in working memory. Working memory is not unitary but it is made of different parts. In the first unitary store model there are distingished 3 parts: central executive, phonolgicial loop and visual spatial sketchpad.

The central executive is by far the most important component of the working memory. It decides where and which information should go where and it use the slave system on phonoglical loop and visual spatial sketchpad. Furthermore, the central executive have no memory storage and lesion to this area leads to an impairment in decision making.

The phonoligical loop is the compoenent of the working memory that deals with auditroy information (is called loop becuase information here can be repeated). There are two main component of the phonoligical loop: one for speech perception (passive store) and one for speech production (articulatory control process). Also there is the word-length effect: there is a worst performance with similar words rather than dissimilar one.

The visual-spatial skecthcpad focuses on the process of visual information and, like the pohnoligicial loop shares a small and very limited memory storage. It is about the manipulation of visual patterns and spatial movements and is composed by visual cache (store inforamtion about form and color what) and inner scribe that process spatial movement informatio where.

Since there is not actually any storage in the unitary stroage model it has been added in a second version oft the model the episodic buffer, which is a memory storage and create connection between the phonogical loop and the visual spatial sketchpad. Of course this model have some limitations and it de-emphasise top-down processing and there is component of the unitary store model for the others senses and is unclear how information from phonological loop and visual spatial sketchpad is combined.

# Semantic memory

Information is store in the brain not randomly but with criteria.

Semantic memory is the memory that does not contains details about location and time and is about the meaning of concepts.

There are different theories that try to give an explanation on how the memory is organised.

The heirchicial concept theory suggests that concepts are saved in a hierchical structure based on superordinates categories, basic leveland subordinate categories. Superordinares concepts are general (like animals) while basic concepts are the one moslty used by us (as an example dog) because it gives us more information and are more interesting, while subordinate are very specific (like rotviller). A larger number of individuals tends to use basic concepts, while if I present to you different pictures of dog and I ask what is this you start using subordinate concepts becuase you are not confordable answer dog all the times. Expertise also influence hierchical concepts becuase dog experts tends to be more specific and use subordinates concepts rather than basic one. The limination of this theory is that it is too rigid. Some of the liminations of this theory focus on the fact that is too inflexibile and it exaggeraters how information is stored in semantic memory.

Semantic organization theory is an evolution of hierchical concept theory and underline the idea that concepts are organised in semantic distance between them. As an example, there is a bigger difference if I ask you to memorize *dog-house* rather than *dog-cat*. This is because the nodes about dog and cat are relatively close by and when one is activie it activiates the close by nodes. This theory is based on the spreading activation theory that suggest that when a concept is activie the nodes close by are also activite. But even this theory is imperfect because the same concept can have multiple activation depending on the context, there are different representation of the same concept in semantic memory. This hyothesisi led to the creation of the hub-and-spoke model of patterson that shows that each concept have an single hub that is rigid, unflexible and contains the enchoclopedic information about a concept. But the hub is connected also to spokes, which are activation of a concept depeding on the general context.

The hub and spoke model have a limation related to the fact that it does not deal with relations between concepts.

# Episodic memory

Episodic memory, as the name suggest is aobut episodes or events and, instead of semantic memory, it saves information about time and space. Episodic memory is error prone, this is because when we want to access the gist of past experience we omits the details and usually later we add non-existing details. There are different types of methods in which I can recoll information: there is free recalled, serialrecalled, and cued recall. Our system is not made to reproduce exaclty what we have seen or heared. Free recall is based on recalling items that you are asked to memorize in any particular order, while serial recall is based on repeating the itemns in the sequence that was presentend at the beginning and by so it is harderd to compute, on the other hand cued recall is based on suggestion or hints that helps us faciliatating the items.

Recognition instead is of two types: yes-no recogntion and forced choice recogntion. In yes-no recognition you are asked to tell if one item was or was not in the list while on **forced recogntion** you have to select which among two itemsn was in the list.

Recogniton is also influenced by recollection (when you know eaxaclty that the item was in the list, you remember not only it but also others inforamtion like location on the first or second colum) while familiairy you are not 100% sure that that word was there.

The limiaitions are that “item” reuquire a more precise defintion while there are more brain mechanism involve in recogntion memory.

# Problem solving

Problem solving are goal directed situations that we usually face dealing. Problem solving depends on individuals since a problem is when an individual does not have in that specific moment a representation in the knowledge on how to solve the task. Problem solving are also influenced by experience since solving a math equation can be a problem for a student while for a mathematical expert it can be easy to find the solution. Problem are divided in knowledge rich problem and knowledge lean problem. The first one are problems that to be solve require a huge knowledge of that field, while the second are problems that do not require any particular knowledge. Problems can also be well define or ill define prolem, well defined problem are problem that are strucutre in a clear precise way, where you know exaclty what to do, while ill define problem are problems not defined in a clear way like (*What to do to become happy?*) and while do it you usually don’t know if you are going in the right or wrong direction, these kind of problems are the one that we usually have to deal a lot in our daily life.

Gestald problem solving apporach focused on the idea that a model to be solve requires inshight that is a suddent realization of how to solve the problem thanks to restructoring. Also the gestaldn approach suggested that is not important to decompose things in their parts but instead is much important the general global point of view. The main limitation of this model is the fact that insight is not actually always correct. The first thing that comes in our mind might not be the correct solution.

The second theory (representational change theory) suggests that first we are stuck and unable to find a soltuion we reach an impasse due to the wrong representation and that to find the solution we need to restrucure the knowledge to allow insight to happen. We need to relax the constraints, collection all the information about the problem, and re-encode the problem in a complitely different way. Only after the impasse we can find the solution of the problem.

Incubation and hints also can help us and faciliates inshight.. Incubation is a moment in which, after an impasse or before starting to solve the problem, we focus on a different task and this allows our brain to run in the background and keep working on finding the solution. Hints instead are suggestion that can help us to understand the right direction but sometimes we might be going in the opposide direction.

# Expertise

During the lectures we focused on chess expertice and medical expertice. Expertise depends striclty on experience and with prolunged practice we can become experts. Chess expertise it useful to study because it has a strict ranking system that is able to distinguish who is actually an expert. Chess board experience leads also to a better mathematical experience. The first theory suggests that expertise create more templates (which are abstract representations of the chessboard) than non expert chess players, but later it has been found that the number of templates is on average the same, the difference is that templates of experts are bigger and more detailed. Chess experts are also better at rememebring the location of chess pieces if the chessboard is shown for few milliseconds.

Medical expertice can be studied throught the use of eye tracking and by studying where the medical is looking at. If is asked to a medical expert to look at different images on radiografy of patients and detect the presence of tumors it has been shown that there are three possible conditions of why an expert do not detect a tumor. The first one is based of the fact tha the doctors never looked at that position is the detective error, while the second one is when the eye tracker show that the medical expert looked at that position but did not detect the tumor (recognition error) while the last is when you are undecide if there is a tumor or not but in the end you say that there is no tumor (judmental error).

Medical expert different from non expert also how where they look and for how long. Medical expert go directyl on location where the tumor should be without taking into account the non important position (detect-then-search) loo stright right away where the stimulus is. Non medical expert instead start by coding the entire image and remove step-by-step the non influential elements (search-then-detect). Not expert perform better with verbal description, while non expert perform better without verbal description.

Chess experts and medical expert share that to become expert they need a lot of practice. But medical expertise is more visual while chess expertice is instead more abstract.