ASJP Algerian Scientific Journal Platform

Afak For Sciences Journal
Issn: 2507-7228 – Eissn: 2602-5345
https://www.asjp.cerist.dz/en/PresentationRevue/351

Volume: 09/ N°: 04 (2024), P 436-448

Executive functions and their disorders

-A neuropsychological approach-

*Laouzai razika**
Akli Mohand Oulhadj Bouira University, (Algeria)
r.laouzai@univ-bouira.dz

Sedkaoui Amina
Lounisi Ali Blida University 2, (Algeria)
a.sedkaoui@univ-blida2.dz

Abstract

In this article, we discuss executive functions and their disorders within the framework of neuropsychology, as these functions are considered to monitor all cognitive processes. They also coordinate, organize, plan, monitor, inhibit, and modify all neural communications in the brain, and between all its overlapping and interconnected parts, and this is what leads to the individual's adaptation to His environment.
This term is linked to the concepts of who we are, how we plan our lives, and how we plan to implement our goals. Therefore, the importance of executive functions in daily life activities, and the related planning, problem solving, and social communication, appears to be based on many cognitive functions such as attention, perception, memory, and language. People who suffer from executive functioning disorder face difficulties in dealing with new situations and adapting to family, social, and professional settings. Therefore, through this article, we are trying to know the nature of these functions, and the tasks they perform in the brain, in addition to revealing their importance for mental and intellectual processes. We will also explain the situations in which they interfere, and the most important disorders they cause at the behavioral and cognitive levels, and the causes that lead to them. How to evaluate them, which allows us to care for individuals who suffer from disorders in these functions.

Article info

Received
January 17 ;2024
Accepted
July 18 ;2024

Keyword
- ✓ *Executive fonctions*
- ✓ *Disorders*
- ✓ *neuropsycholgy*
- ✓ *The frontal lobe*

**Corresponding author*

1. *Introduction*

Thinking includes a group of cognitive functions such as calculation, inference, judgment, concept formation, abstraction, generalization, discrimination, planning, and organization. Such processes bring us closer to the concept of executive functions.

Executive functions include the ability to initiate or stop actions, monitor behavior and change it when necessary, and plan future behavior when facing new tasks or situations.

Such functions help us anticipate the results of our behavior and adapt to changing situations (Abdel-Qawi, 1996). It is also associated with advanced cognitive functions, and interferes with goal-directed behavior, in addition to non-routine activities, and is also known as monitoring functions.

These functions include the frontal brain areas, especially the prefrontal cortex. In this context, Luria (1973) revealed the role of these structures in planning, organizing and monitoring behaviors, and these structures also play a role in organizing social and personal behaviors (Siksou, 2005).

Among the functional difficulties that cases face when presenting with an executive disorder, we find the difficulty of adapting to new and complex situations.

The theoretical approaches allowed for an organization of executive processes, through clinical approaches that allowed for the diagnosis and evaluation of executive disorders. In addition to the qualitative evaluation of some behavioral and cognitive disorders in this disorder, and their diagnosis, prediction, and treatment, as frontal disorders often have multiple and diverse clinical manifestations, which, according to what the research team on executive functions (Grefex) reported, are the syndrome of inability to execute behaviour, And the syndrome of inability to perform cognitive implementation.

In this context, (godefroy et al, 2004) explained that at the diagnostic level the presence of behavioral disorders can reveal the presence of some diseases, especially since the dominant lesion is in the medial frontal regions (fronto-temporal dementia, A frontal tumor (or allows confirmation of the presence of complications of the disease known under the name (rupture of aneurysm of the anterior communicating artery), or a cerebro vascular accident, or a cerebral shock. As for the level of prediction, the presence of behavioral disorders leads to a disturbance in the totality of activities Daily life, including relational and

professional life, reflects negatively on the individual's independence.

Therefore, we aim, through this topic, to introduce executive functions and highlight their components. We will also discuss their importance and the relationship between them and the brain, in addition to mentioning the situations in which they intervene, their relationship to working memory, and the most important theories explaining them. We also try to focus on the most important Its disorders, the causes responsible for them, and how to evaluate them from a neuropsychological standpoint.

2. Definition of executive functions

Noël Pascale Mari defined it as "the functions that cover the totality of processes that intervene in organizing and controlling behavior, and specifically they intervene in the work of non-routine situations that require planning, organizing, and evaluating a plan and perhaps correcting it, in order to ultimately reach a specific goal." (Noël and Censabella, 2007, p.117).

As defined by Bernard, Le Chevalier et Francis Eustache and Fausto Viader, it is "higher functions that manage and supervise other cognitive functions; they also allow a good adaptation of the individual within his surroundings." (Lechevalier & al, 2008, p. 344).

It is also known, according to Dubois, as "the sum of processes that monitor and regulate other cognitive processes."

While (Rabbit) believes that executive functions include five functions, which are:

-Adapting to new situations.

-Planning and starting to implement new strategies.

- The ability to retain information to modify the answer.

- The ability to suppress inappropriate information to accomplish the task. (Rabbit, 1997)

According to (Abdel-Qawi, 1996), he believes that the definitions provided by researchers in the field of executive functions emphasize the following elements

- Preparing and planning future goals and actions.

- Planning to achieve these goals, remembering the appropriate procedures for this task, and moving in an organized manner towards solving the problem.

- Initiating the necessary steps to achieve the goal and moving between them, while noting what happens to the plan in terms of partial achievement of the goals.

- Maintaining this plan in working memory while performing the task, and until it is completed.

- Organizing emotional responses and attention to achieve flexibility in achieving the plan.

- Evaluate the results of behavior to use this plan in similar future activities.

- Maintaining mental preparedness To solve future problems, and establish a balance between current situations and short- or long-term future goals.

- Self-monitoring to identify the progress you are making towards the desired goal.

- The ability to adjust the activation and deactivation behavior of non-goal-related responses during the sequence of one's responses

-Skillful use of strategies and plans (Abdel-Qawi, 1996).

Executive functions, then, are the functions that allow the individual to plan, organize, and monitor his behavior, and help him adapt to new situations (meaning non-routine situations), which do not include a solution available for implementation at the time.

3. Executive components

The executive functions perform several functions, including:

3.1-Inihibition

It is the ability to prevent the production of an automatic response, stop the production of an effective response, and remove inappropriate stimuli to activate its effect.

It puts into effect mechanisms that allow preventing non-routine information from entering working memory, and deleting previously appropriate information that becomes inappropriate.

3.2. The update

It relates to the ability to activate the content of working memory, taking into account the new information that is conveyed to it.

3.3. Mental flexibility

It relates to the ability to move from one behavior to another according to the requirements of the environment. They are also necessary for the adaptation of movement schemes.

3.4. Active retrieval of information from memory

It relates to the ability to actively and effectively search for information in memory.

3.5. Divided attention

It is the ability in which a person is alert to two activities at the same time, and this allows him to accomplish them in parallel.

3.6. Planning

It is the ability to organize a group of activities in an appropriate manner, to achieve a goal. (Deyiorgio et al,. http //www.crfna.be).

4. Executive functions and the brain

These functions are not located in a single brain structure, but are the result of the interaction of many cortical and subcortical neural systems. The frontal lobes play a major role in executive functions, but they do not intervene in isolation, as they must be in contact with other structures, for example the parietal lobe (parietal lobe), which intervenes in spatial attention, as it manages and organizes focus on the most important stimuli, The hippocampus (the hypocompus), which can be viewed as an executive connectivity system, links representations between cortical arenas. The frontal lobes also establish relationships with the base nodules (ganglions de la base) and the cerebellum (cerebellum), and this has sparked great interest among researchers who have concluded that the base nodules and cerebellum can form, with the prefrontal cortex, a complete network that includes executive functions (Michael S, et al., 2000, p. 441-442).

5. Importance of executive functions

According to Skoff, executive functions play an important role in an individual's life, as they allow thinking before acting and planning, as the individual's working memory provides current information and plans along with previous information in order to determine the most accurate one for the activity to be implemented. It also has a role in social interactions, and the continuous evaluation of situations and people with whom we interact. It is also related to awareness, learning and academic achievement, and plays an important role in managing complex cognitive processes and controlling emotions (p. 2004, Skoff).

6. When do executive functions intervene?

According to Rabbit (1997), executive functions are involved in the following situations

- In a new situation This is done through forming the goal, planning, choosing the means to achieve the goal, comparison, evaluation, and implementation.

- When the situation requires attention This is what allows conscious searching in memory for information, initiating new behaviors, and stopping habitual answers.

- To prevent the production of an inappropriate answer in a particular context.

- To run two tasks in parallel.

- To take into account the requirements of the two tasks separately.

- In order to discover errors.

- To change the chart.

- To find suitable opportunities.

7. The relationship between working memory and executive functions

Vallat-Azouvi et al. (2007) believe that the first theories in the field of executive functions considered the controlled attentional system or the executive center to be the center of executive control.

Baddeley is considered the first to address the idea of executive system dysfunction. He assigned four functions to the executive center: focusing attention, distributing attention, shifting attention, and connecting the content of working memory with long-term memory.

Baddeley believes that the executive center is not a single unit, but rather represents a sum of control functions called “executive functions,” and each of them can operate independently, but there is an interconnection between them. Most of the components of executive functions are processing processes in working memory. We find that flexibility, inhibition, selective attention, planning updating processes, and distributed attention are all linked to the executive center of working memory.

The researchers also touched on the relationship between these different functions, such that Miyake and others (2000) conducted a study in which they attempted to determine whether the executive functions (plasticity, inhibition, and the updating process in working memory) are the same or diverse. They concluded that executive functions are separate but that they establish relationships between them.

At the anatomical level, Van der Linden et al. (2007) believe that working memory and executive functions have common brain regions. The prefrontal and frontal regions and the posterior associative cortical regions are activated by presenting tasks that put executive functions and working memory into effect.

Godefroy et al. (2002) also demonstrated that frontal disease leads to disruption of executive control and executive center, particularly the ability to coordinate two tasks, the selection and suppression of inappropriate information (Godefroy et al., 2002).

Based on several studies and models, working memory has become known as a memory system that stores and processes various information. It also includes interference with the executive processing process, such as stopping, updating, planning, distributed attention, and selective attention.

This allows working memory to be an executive function, interfering in many cognitive functions such as language and

communication. Its disturbance will have an impact on these tasks.

8. Executive Function Theories

8.1. Luria's theory

Luria (1973) considered the frontal lobe as the third basic unit of the brain, responsible for programming, monitoring and regulating human behavior. So that its prefrontal cortex monitors the general state of the brain, which is considered the basis of mental activity in humans. According to Luria, one of the important functions of the frontal lobes is to compare the results of an activity with the intention of "authorizing the activity." He also demonstrated the importance of the prefrontal regions in forming plans and organizing their executive activity.

When damage to the frontal cortex hinders or stops complex activity programs, it compensates with simpler behaviors or stereotyped behaviors, which are considered inappropriate in this case.

Luria also considered that according to the structures related to the frontal injury, the symptoms could be more motor after the lateral frontal injury, or related to emotions after injury to the areas connected to the limbic cortex and the reticular formation.

8.2. Norman and Shallice model (1986)

This model is based on the Luria model, and proposes distributing the mechanisms involved in cognitive monitoring of activity into two systems

The conflict regulation path (Goc), and the attentional supervisor (Sa).

The conflict management process monitors the implementation of activities, routines, or skills. As for the attentional monitor, it works on the conscious attentional monitoring necessary to change the characteristic of performance, and it can also be used for unusual (non-routine) activities.

It also works to organize adequate monitoring, as it prevents the selection of plans for two competing activities that require the same methods or sources.

The role of the attentional observer is to improve the selection of the activity plan through the course of conflicts. Also, the role of the attentional observer is necessary in situations that require planning and decision-making, correcting errors, poorly learned and unfamiliar answers, and stopping the usual answers.

A frontal injury leads to the failure of one or more of these mechanisms. The attentional observer is a multi-component system. This model is well applied in explaining usage behavior. (Siksou, 2005, p.83).

8.3. The theory de Rolls (1990-2000)

This theory seeks to explain the neural bases of emotion.

The role of the orbito-frontal cortex in this aspect was demonstrated.

This theory considers emotions as states resulting from performative reinforcement stimuli. Some stimuli are unlearned reinforcements (pain, taste of foods), and others become reinforcements due to their association with primary reinforcements, and are called secondary reinforcements.

Positive reinforcement is linked to reward, and negative reinforcement is linked to punishment, deletion, or stopping positive reinforcement.

Rolls assumes that damage to the frontal lobe leads to a failure to react normally in the absence of reward in a different context. Also, when answers are not supported, inappropriate answers emerge. The orbito-frontal cortex corrects associations, reinforcement and warning when they are inappropriate. Its damage leads to difficulty in choosing the appropriate answer (Siksou, 2005, p. 84).

9. Damage to the executive system

People who suffer from damage to the executive system face daily difficulties in adapting at the family, social, and professional levels, and in managing new situations.

These disorders can occur in people without any brain injury, but to a minimal extent.

Below we will explain the executive difficulties that people may encounter as a result of a cerebro-vascular accident, traumatic brain injury, or developmental disease of the central nervous system.

9.1. Damage of inhibition

It is characterized by difficulties in preventing the production of inappropriate activities.

Example: There is a person in a restaurant with his wife, planning a vacation, and many times this person interferes in the conversation of the people at the opposite table.

9.2. Damage of ability to update

It is characterized by replacing old, absent information with new information in working memory. Information stored in this memory for a few seconds before is replaced with current information. In this case, the person continues to react to the old information, not the new one.

Example: A person received a phone call from his friend who gave him an appointment for next Saturday at 19 30. He talked to him about his son's sports activities, but he remembered that he had to go look for his son, who was training with the basketball team. He suggested postponing the appointment until 20 00. After he hung up, he recorded in his diary the time at 19 30.

9.3- Damage of to mental flexibility

It is characterized by difficulties in transitioning from one behavior to another, de pending on the requirements of the environment.

Example 1: A person participated in a meeting, and when the discussion began, he became unable to follow the thread of the conversation, as a result of the rapid change of speaker.

Example 2: On Saturday evening, a person went to the city to buy, visited several stores, and each time paid the amount by bank card. Finally, after the evening, he returned to the market and extended his bank card, knowing that payment is only made in cash in the market.

9.4. Damage to active retrieval of information from long-term memory

It is characterized by great difficulties in recalling facts that occurred in the past, often the recent past. While laxatives can create these facts that the person can recall. These difficulties may relate to general knowledge acquired in the past.

Example: A husband is talking to his wife, and she remembers last weekend in the mountain with the family. The husband says he doesn't remember it, and the wife describes the house they rented for the occasion. This way the husband can remember who was there, what did they eat...etc.

9.5- Distributed attention damage

It is characterized by difficulties in achieving or doing two tasks at the same time.

Example: A mother went to the park with her children, sat on a bench while her children were playing, and was watching them. Then a woman came and sat in front of her and started talking to her. Within 10 minutes, the mother realized that she did not see what her children were doing.

9.6- alteration of the organization

It is characterized by difficulties in organizing a series of activities into an appropriate goal-directed sequence.

These disorders can exist at several levels:

- Keeping the goal

A person went to the kitchen to prepare a meal, looked out the window and discovered that the green grass was not long in the ground, took out the cuttings and cut the grass.

- Pre-planning and choosing various activity plans that allow reaching the goal

A person was involved in an accident and since then has been unable to plan his appointments, does not set his alarm correctly according to the first activity of the morning, and is unable to calculate the time necessary to be ready on time.

- Choose the best activity plan

Someone started preparing the basic dish, which takes 25 minutes to prepare and 60 minutes to cook. While cooking, instead of preparing the appetizers, he waited until the 60 minutes were over and prepared them (Deyiorgio et al,. http //www.crfna.be).

Executive functions therefore intervene in a variety of situations, and are necessary for living an independent life. People who suffer from executive function disorder face difficulties in managing new situations and adapting at the family, social, and professional levels.

10. Causes of executive function disorder

According to (Godefroy et al, 2004), executive ability disorder syndrome can occur after the occurrence of various undesirable situations, including:

- Cerebro-vascular diseases such as (stroke, blood clotting,...).

- Focal lesions such as (tumors, cysts), dementia such as (Alzheimer's disease, Parkinson's disease dementia)

- Brain trauma.

- Inflammatory diseases such as multiple sclerosis, AIDS, etc.)

- Hydrocephaly. Aurelia., 2008)

11-Behavioral and cognitive disorders presenting as inability to implement

11.1. Behavioral disorders

- Lack of general movement accompanied by dullness (aboulia) lack of feeling (apathy)/or lack of spontaneity.

- Excessive movement, accompanied by distraction, impulsiveness, or hand disturbance.

- Continuity and stereotyping.

- Show dependency on the surroundings.

-Delirium (confabulation).

- (Reduplicative paramnesia).

- (Anosognosia).

- (Anosodiaphoria).

- Emotional disorders and social behavior disorders.

- Eating behavior disorders.

- Sexual disorders.

- Urination disorders.

In parallel with these behavioral changes we find

11.2. Cognitive disorders

The most common executive process disorders are the following

-Disorder of initiative and cessation of movement.

- Disorder in distributing attention and linking two tasks.

- Information generation disorder.

- Disorder, problem analysis, deduction, retention

- Accident memory disorder.

This clinical classification allows the diagnosis to be determined, even if executive function disorders include a wide variety of disorders. (Sophie J.C, 2008).

12. Evaluation of executive functions

Evaluating executive functions remains difficult, so it must take into account the environment, the internal level, possible injuries that are common with executive functions, and normal functioning in daily life.

Clinical examination, often directed at executive functions, allows for observation of the condition, questioning (looking for behavioral disorders, searching for language disorders), questioning the surroundings (comparing behavior before the condition), and detecting the condition (grasp reflex, sucking, use and imitation behaviors).

Some tests can be used to determine detection, such as the MMSE test, the Folstein et al. 1975 test, and the rapid battery of frontal assessment (BREF).

Neuropsychological tests and behavioral questionnaire allow for a closer evaluation of the disorder in the ability to implement. (Sophie J.C, 2008).

We also find other neuropsychological tests, such as the Halstead Sorting Test, the Wisconsin Card Sorting Test, the Raven Test, the Raj Formal Fluency Test, in addition to the Porteus Maze Test and the horoscope test.)

Studies in this field have shown recording disorders in the executive aspects of cognitive control, such as planning, sequential organization, and selectivity, as demonstrated through the use of the “Stroop” color-naming test, which measures the ability to suppress interferences, the failure of those with disorders in the functions of the frontal lobes. Luria used the Go No Go test to measure persistence and inability to stop behavior (Ben Qasmiya, 2007-2008, p. 43)

He also recently demonstrated the importance of evaluation in an environmental situation using the task of six elements, the task of multiple commissions, the task of organizing a trip, the task of organizing an evening , the task of the printer.

The use of these conditions remains difficult for the majority in terms of organizing them and putting them into effect due to their material requirements.

Therefore, diagnosing executive function disorder remains very difficult, but it must

form an integral part of every neuropsychological evaluation, by adapting the evaluation according to the individual clinical situation of the case.

The specialist must give importance to behavioral, cognitive and ecological assessment, using honest and consistent methods (Sophie J.C, 2008).

13. Conclusion

It is clear from the above that executive functions are an integral part of the higher functions of the brain, and the latter controls several functions, including: setting and planning goals, determining and directing action, self-control, selective attention and desistance, and coordination between complex cognitive and motor functions.

It also represents the sum of the functions of monitoring knowledge and behavior, and is widely used in daily life activities. If it is disturbed, the individual will face difficulties in adapting, especially to new, unfamiliar and complex situations, and its disorder has become known in many brain diseases. Therefore, an accurate and strict evaluation of these executive functions is necessary to establish security, and in order to contribute to the diagnosis of some diseases.

What we conclude this topic with are some recommendations that we include as follows:

- Conduct more research on executive functions, in order to understand, predict, diagnose and treat them.

- The need to build tests to diagnose executive functions and adapt them to the Algerian social and cultural environment.

- Early detection of executive function disorders and developing a treatment plan adapted to the difficulties experienced by the cases.

- Building treatment programs based on neuropsychological foundations to treat the inability to implement syndrome.

References:

- Geyiorgio, c., Ferry, p., Polus, b., Watelet a. (no year). understanding executive functions, crfn neurological functional rehabilitation center, erasme-u.l.b hospital.Taken from the site http://www.crfna.be/Portals/0/fonctions%20ex%C3%A9cutives.pdf

- Rabbit, P. (1997). Methodology of frontal and executive function, Psychology Press.

-Aurélie, D. (2008). Fonctions executives or the capacity to adapt to new technologies. Taken from the site https://www.geh-asbl.be/wp-content/uploads/2021/03/Revivre-Fonctions_executives.pdf /

-Bin Qasmiyeh, M A. (2007). The relationship of the regulatory role of language to executive functions among kindergarten children. Unpublished master's thesis, Faculty of Humanities and Social Sciences, University of Algiers.

-Deslandre E., Lefebure G., Girardc., Lemarchand M., Mimouni A., (2004). les fonctions executives, neuropsychological evaluation, elsevier Masson, vol 4, n 19.

-Le Chevalier, B ., Eustache, F., Viader, F. (2008). Treatise on Neuropsychological Clinic. 1st Edition. Brussels. Belgium: Edition De Boeck.

- Siskou, M., Noel. M.P., and Censabella, s. (2005). Introduction to the neuropsychologie clinic»., Dunod, Paris, 2005, p.81-82.

-Michael S. Gazzaniga, Richard B. Ivry, George R. Mangun (2000). Neuroscience cognitives, The biology of l'esprit. France: De Boeck Superior.

- Noel, M.P., and Censabella, S. (2007). Child Neuropsychology Assessment; Evaluation, Measurement, Diagnosis. Belgium: Edition Mardaga.

- Courtois, S.J.,(2018). Executive functions: cognitive appropriation and compliance with dysexecutive syndrome. Taken from the site https://slideplayer.fr/slide/520665.