BOĞAZİÇİ UNIVERSITY
SUMMER TERM

PSY 101.01 Introduction to Psychology

Summer term 2025

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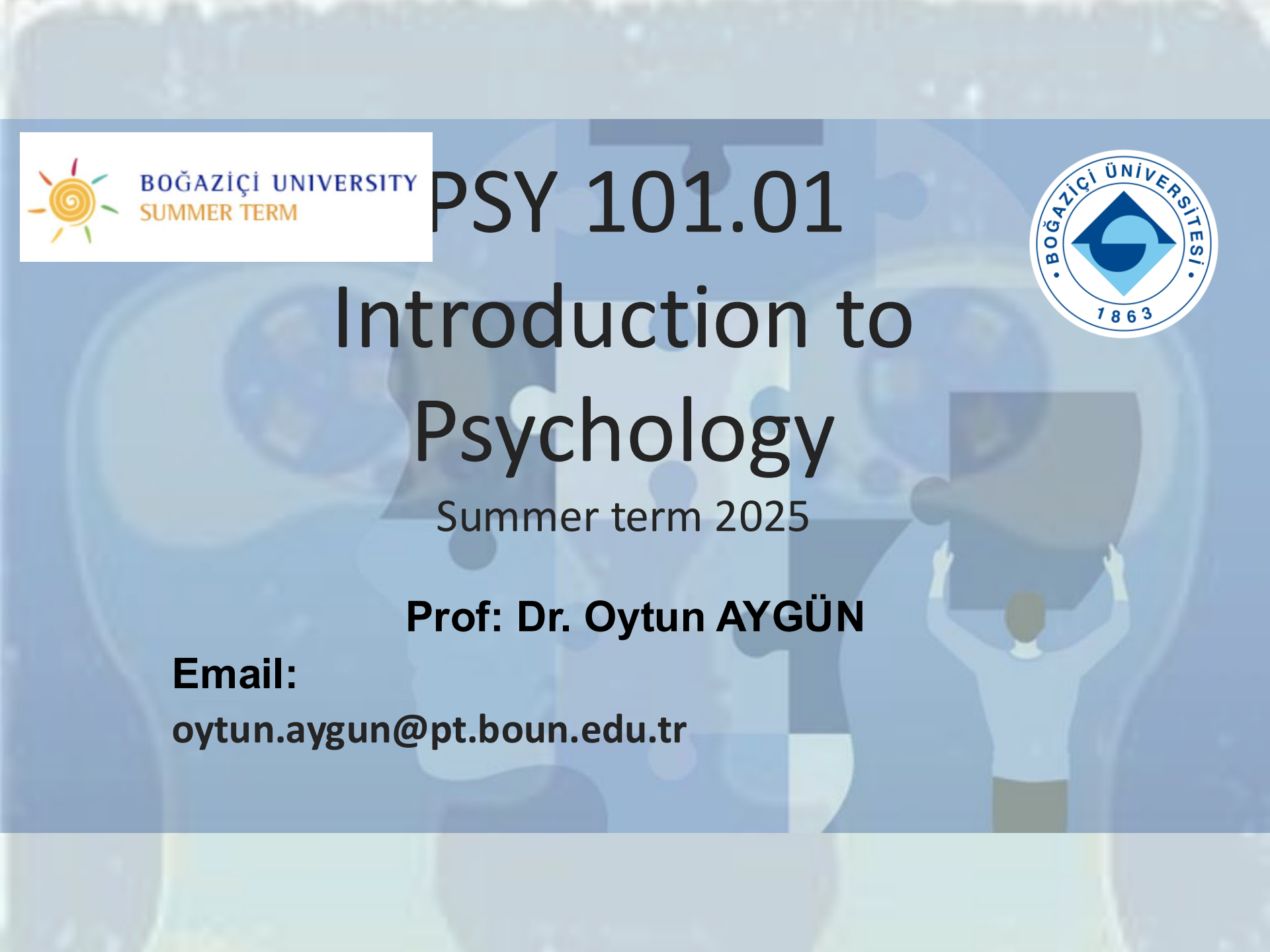


PSY 101.01
Introduction to Psychology

Let's Begin

…with breathing

PSY 101.01

Introduction to Psychology

Topics in Cognitive Psychology

THE EXECUTIVE FUNCTIONS

PLAN

What are executive functions?

A. Definitions
B. Development

I. Inhibition
II. Cognitive flexibility
III. Working memory
+ Planning and others

I. What are executive functions?

A. Definitions

- "*...The set of cognitive processes involved in maintaining appropriate information in order to achieve a particular goal*". (Luria, 1973;Shalice, 1982).

- "*...Central executor of the information processing system*". (Anderson,Northam,HendyAndWrenall, 2001).

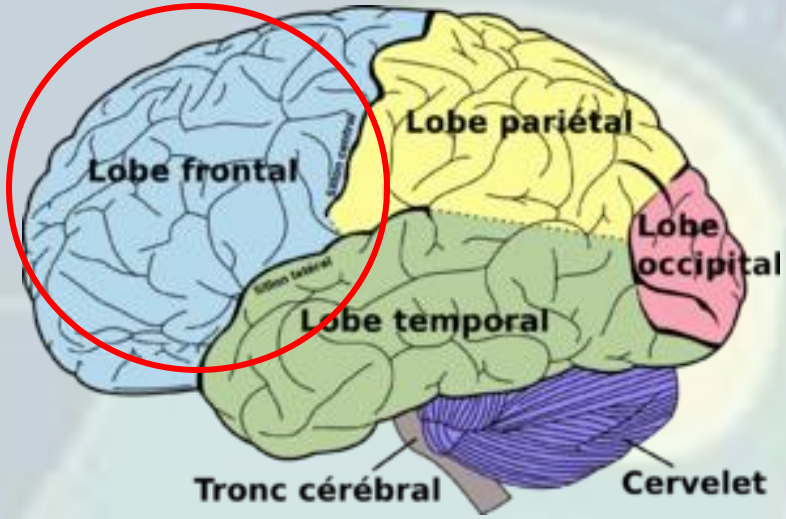
- "*... Ability to retain one's response and maintain or shift one's attention so that one can adjust one's priorities to the many stimuli in the environment*". (castellanos,1999).

I. What are executive functions?

A. Definitions

Executive functions

Frontal lobe



Frontal patients = difficulties in complex, new situations, requiring the implementation of new strategies

I. What are executive functions?

A. Definitions

Executive functions→ What uses?

- Enable the execution of a cognitive action: daily use
- Allow the individual to adapt his behavior to the goal he is pursuing
- Allow regulation of thoughts, gestures, speech, facial expressions, etc.

I. What are executive functions?
B. Development

3 years: Able to successfully complete tasks that have 2 rules.

Example : if you see a red apple on the screen, press this button, if you see a green apple, press this one.

4 years: several representations for the same object possible.

I. What are executive functions?

B. Development

5 years: the child can inhibit a rule to activate another one.

Example:if the red object is round, press this button; if the red object is square, press it.

The executive functions of the 7-year-old child gradually approach those of the adult but continue to develop until the end of adolescence.

I. What are executive functions?

B. Development

5 years: the child can inhibit a rule to activate another one.

Example:if the red object is round, press this button; if the red object is square, press it.

The executive functions of the 7-year-old child gradually approach those of the adult but continue to develop until the end of adolescence.

videos / audios

- Introduction (English)
- https://www.youtube.com/watch?v=efCq_vHUMqs
- Gregoire Borst: 5.50 on (French) (intro)https://www.youtube.com/watch?v=1gaIdC1IMK4

I. What are executive functions?

B. Development

No perfectly unanimous definition

Three components are regularly distinguished in the literature (Miyakeet al., 2000):

A. Inhibition
B. Mental flexibility (or alternation)
C. Working Memory
D. [Some models add planning]

Their mutual independence remains controversial

II. Inhibition

- Allows you to temporarily suppress a habitual, dominant, over-learned or automated response

- Block out irrelevant stimuli

➔ Active process of suppression of an excitatory action (Boujon, 2002).

II. Inhibition

There are four types of tasks measuring inhibition in children:

- Remove Dominant Behavior
- Defer a reward
- Initiate a non-dominant response in conflict with a spontaneous response
- Produce a response on a single category of stimuli among several

II. Inhibition

Defer a reward

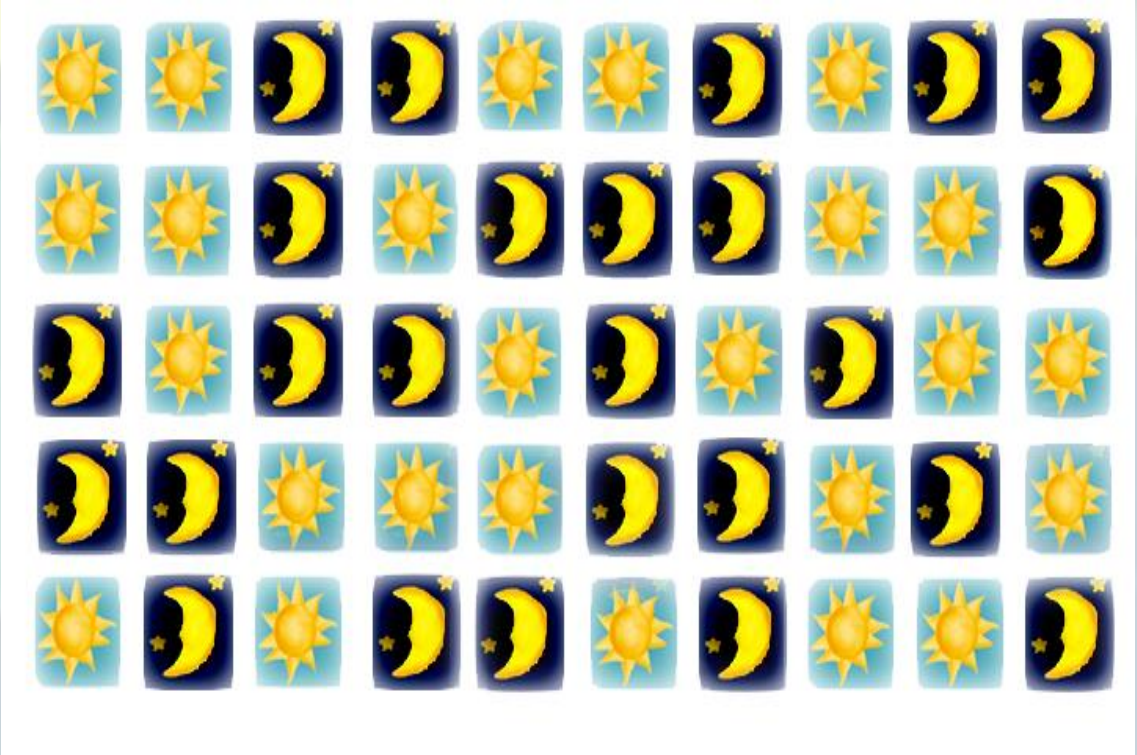
Marshmallow Task: evaluates the ability to delay obtaining gratification in children.

https://www.youtube.com/watch?v=QX_oy9614HQ

II. Inhibition

Initiate a non-dominant response in conflict with a spontaneous response

day/night task:



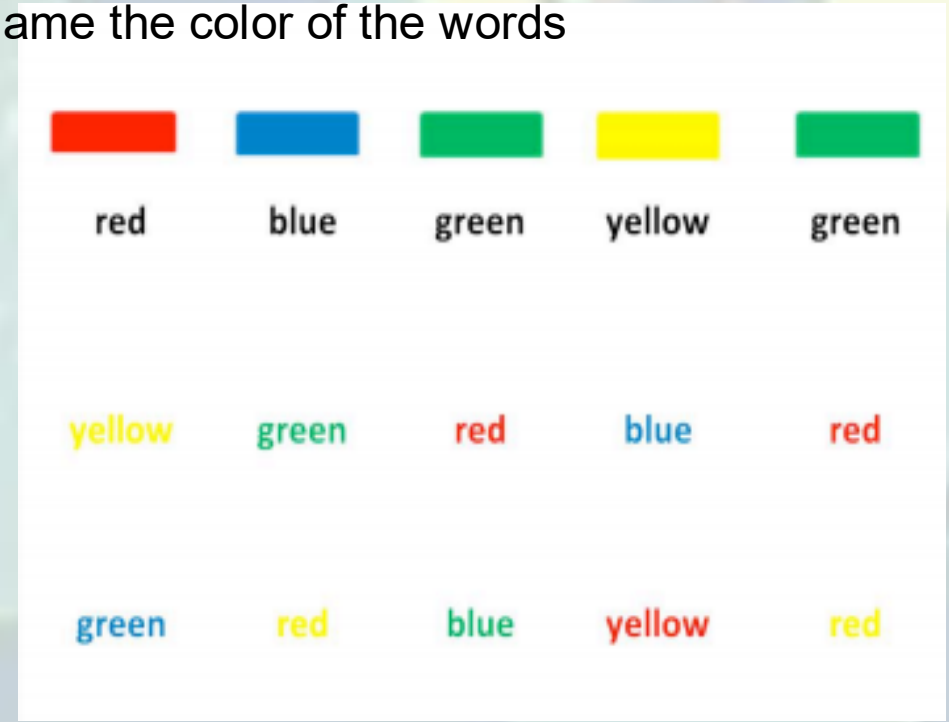
II. Inhibition:Stroop

Initiate a non-dominant response in conflict with a spontaneous response

asking the subject to name the color of the words

Stroop task:

https://www.psytoolkit.org/experiment-library/stroop.html



Stroop Testi

MAVİ YEŞİL KIRMIZI SARI

YEŞİL MAVİ SARI KIRMIZI

SARI KIRMIZI YEŞİL MAVİ

KIRMIZI YEŞİL MAVİ SARI

MAVİ SARI KIRMIZI YEŞİL

YEŞİL MAVİ SARI KIRMIZI

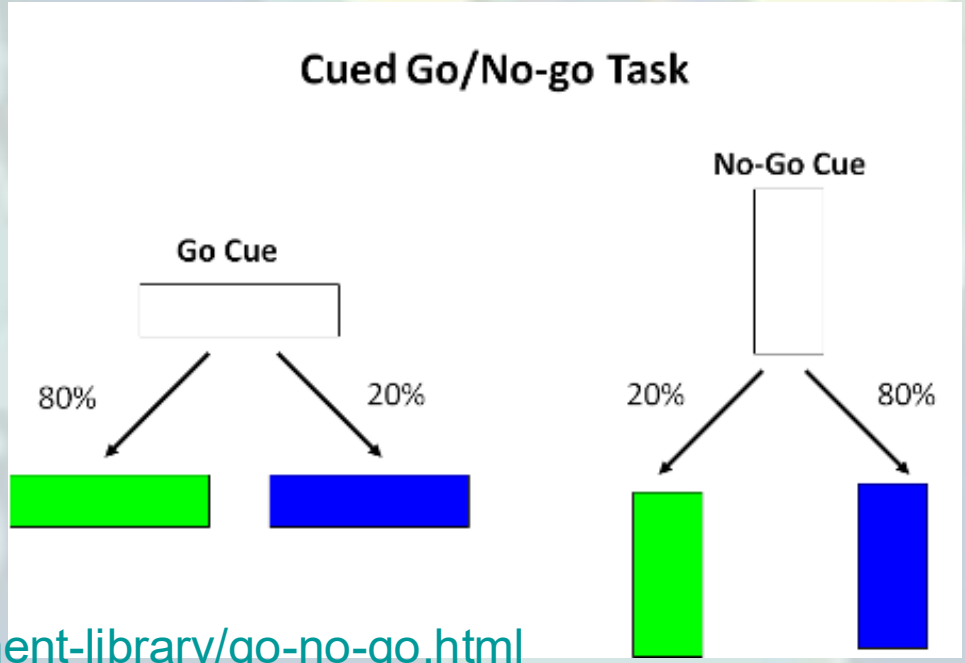
II. Inhibition: Go/No go

Produce a response on a single category of stimuli among several

Go no go task:

Act = Go

Do not act = no Go

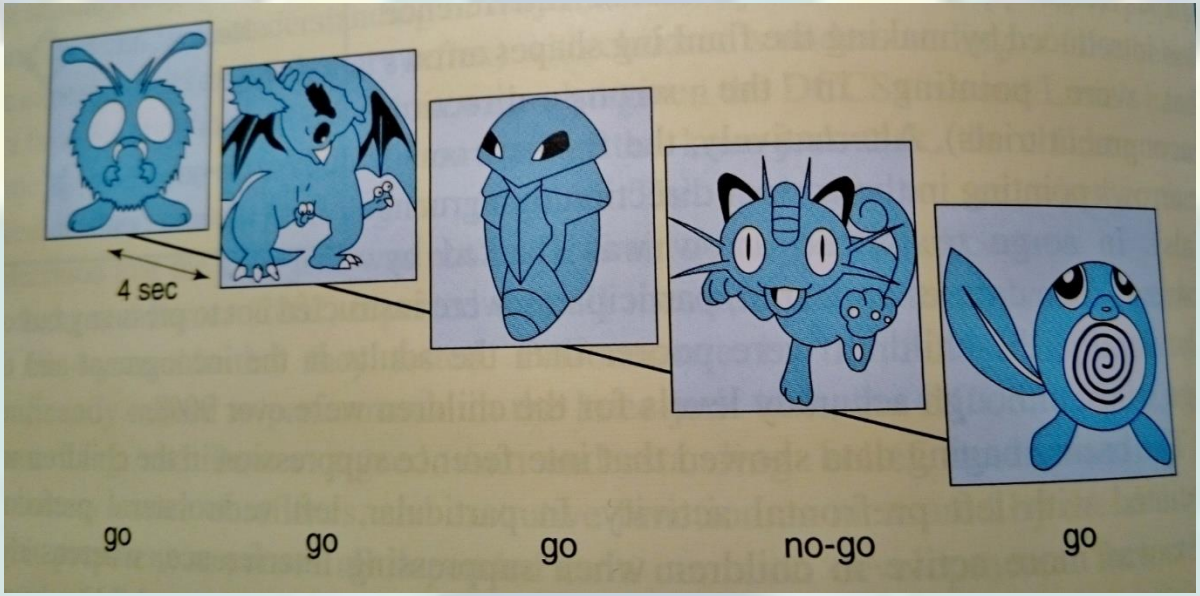


https://www.psytoolkit.org/experiment-library/go-no-go.html

II. Inhibition

Produce a response on a single category of stimuli

The “go/no go” paradigm



II. Inhibition

Produce a response on a single category of stimuli

The “go/no go” paradigm

- Stain "pokemon»
- = self-control

III. Cognitive flexibility

- "*... Ability to reorient the contents of thought and action in order to be able to perceive, process and react to situations in different ways*". (EslingerAndGrattan, 1993)

- "*Flexibility is the ability to dynamically alternate between different tasks, different operations, or different mental registers*» (monette, 2008)

III. Cognitive flexibility

Cognitive flexibility→ what uses?

- Direct attention to only relevant elements.
- To be able to pass from one mode of reasoning to another, from one representation to another.
- Disengage your attention from one aspect of the information in order to be able to focus on another element.
- Change categorization criteria to another when the first does not work.

B. Test mental flexibility

Classification tasks:

- DCCS:Dimensional Exchange Card Sorting (card sorting with dimension change)

III. Cognitive flexibility

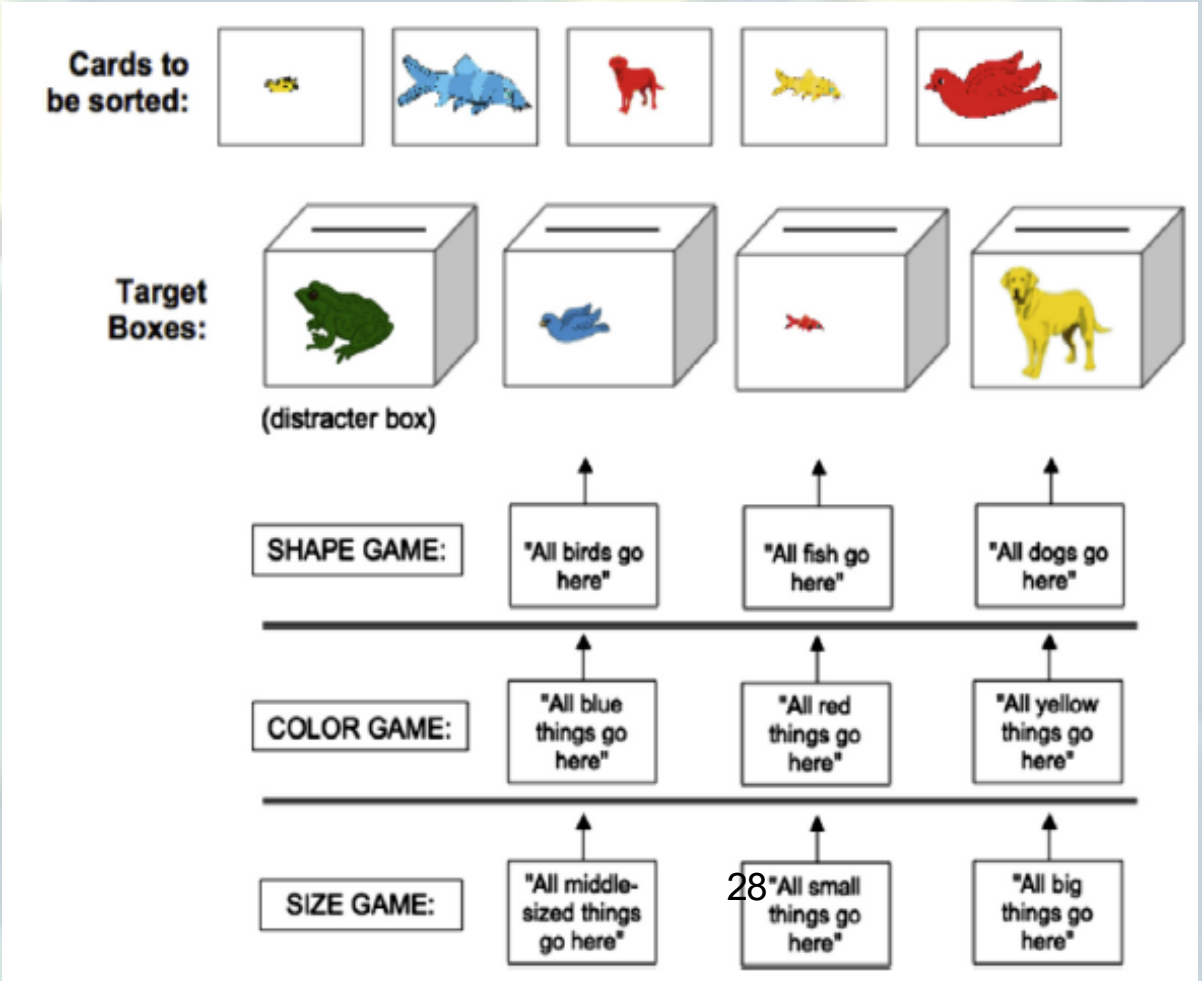
Cognitive flexibility→ how to measure it?

Classification task

DCCS children:

Dimensional Exchange Card Sorting

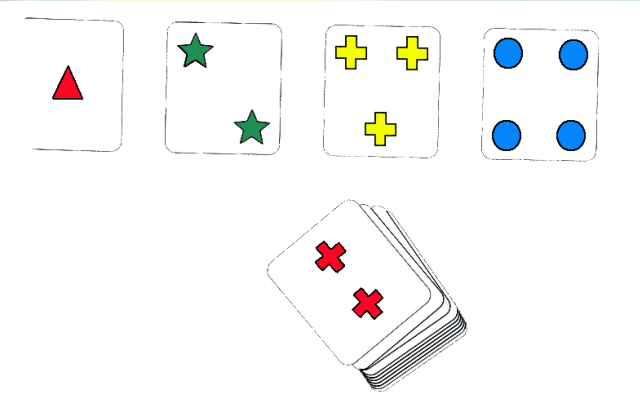
https://www.youtube.com/watch?v=0L7xzcvJzZc

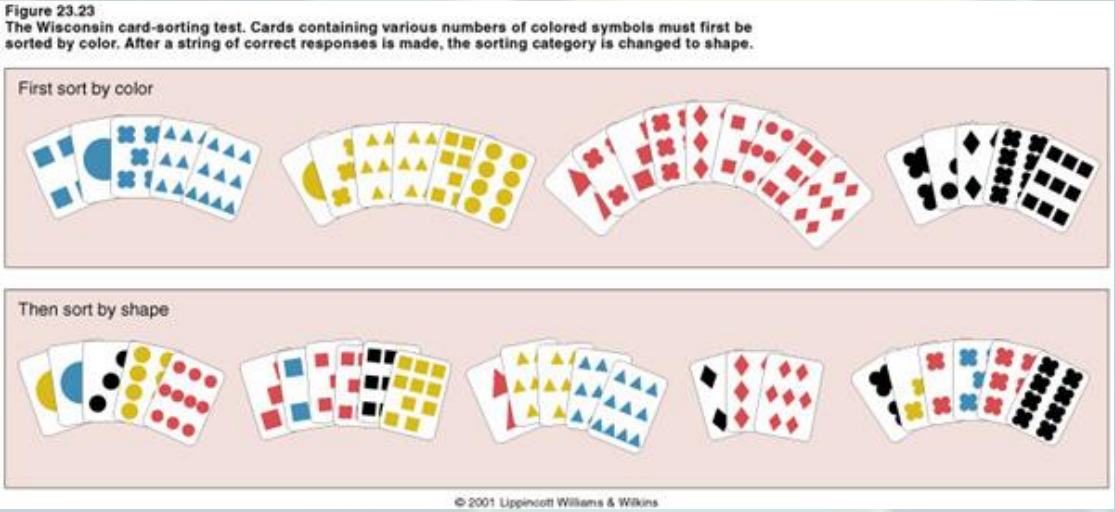


B. Test mental flexibility

Classification tasks:

- WCST: Wisconsincard Sorting task (Wisconsin Map Grading Task)





https://www.youtube.com/watch?v=JSDVmfAz-tE

IV. Updating in working memory

Consistent process:

- retain information in short-term visual or auditory memory,

- To eliminate irrelevant information,

- To perform transformations on this information

IV. Updating in working memory

Updating in working memory→ how to measure it?

span tasks:

- Backwards
- of enumeration
- completed sentences

Ordre direct

Item/Essai		Réponse	Note (0 ou 1)
1.	Essai 1	1-7	
	Essai 2	6-3	
2.	Essai 1	5-8-2	
	Essai 2	6-9-4	
3.	Essai 1	6-4-3-9	
	Essai 2	7-2-8-6	
4.	Essai 1	4-2-7-3-1	
	Essai 2	7-5-8-3-6	
5.	Essai 1	6-1-9-4-7-3	
	Essai 2	3-9-2-4-8-7	
6.	Essai 1	5-9-1-7-4-2-8	
	Essai 2	4-1-7-9-3-8-6	
7.	Essai 1	5-8-1-9-2-6-4-7	
	Essai 2	3-8-2-9-5-1-7-4	
8.	Essai 1	2-7-5-8-6-2-5-8-4	
	Essai 2	7-1-3-9-4-2-5-6-8	

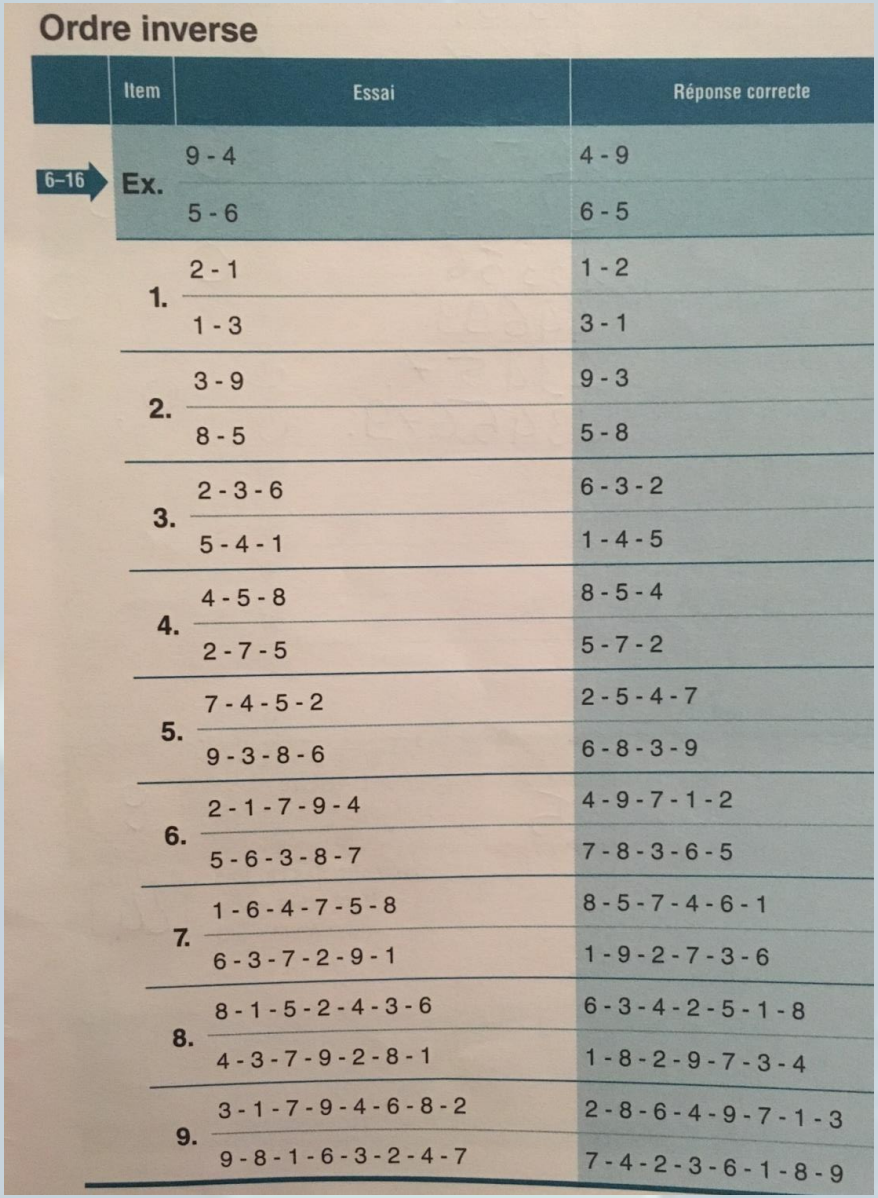
Note totale Ordre direct (Max = 16)

IV. Updating in working memory

Updating in working memory→ how to measure it?

span tasks:

- Backwards
- of enumeration
- completed sentences



Ordre inverse

	Item	Essai	Réponse correcte
6–16	Ex.	9 - 4	4 - 9
		5 - 6	6 - 5
	1.	2 - 1	1 - 2
		1 - 3	3 - 1
	2.	3 - 9	9 - 3
		8 - 5	5 - 8
	3.	2 - 3 - 6	6 - 3 - 2
		5 - 4 - 1	1 - 4 - 5
	4.	4 - 5 - 8	8 - 5 - 4
		2 - 7 - 5	5 - 7 - 2
	5.	7 - 4 - 5 - 2	2 - 5 - 4 - 7
		9 - 3 - 8 - 6	6 - 8 - 3 - 9
	6.	2 - 1 - 7 - 9 - 4	4 - 9 - 7 - 1 - 2
		5 - 6 - 3 - 8 - 7	7 - 8 - 3 - 6 - 5
	7.	1 - 6 - 4 - 7 - 5 - 8	8 - 5 - 7 - 4 - 6 - 1
		6 - 3 - 7 - 2 - 9 - 1	1 - 9 - 2 - 7 - 3 - 6
	8.	8 - 1 - 5 - 2 - 4 - 3 - 6	6 - 3 - 4 - 2 - 5 - 1 - 8
		4 - 3 - 7 - 9 - 2 - 8 - 1	1 - 8 - 2 - 9 - 7 - 3 - 4
	9.	3 - 1 - 7 - 9 - 4 - 6 - 8 - 2	2 - 8 - 6 - 4 - 9 - 7 - 1 - 3
		9 - 8 - 1 - 6 - 3 - 2 - 4 - 7	7 - 4 - 2 - 3 - 6 - 1 - 8 - 9

V. Planning

- Mentally developing a plan to solve a problem.
- Related to the concept of working memory
- Related to the concept of inhibition

V. Planning

"*We call planning the temporal organization of a succession of steps to arrive at a goal.*»(Mazeau, 2013).

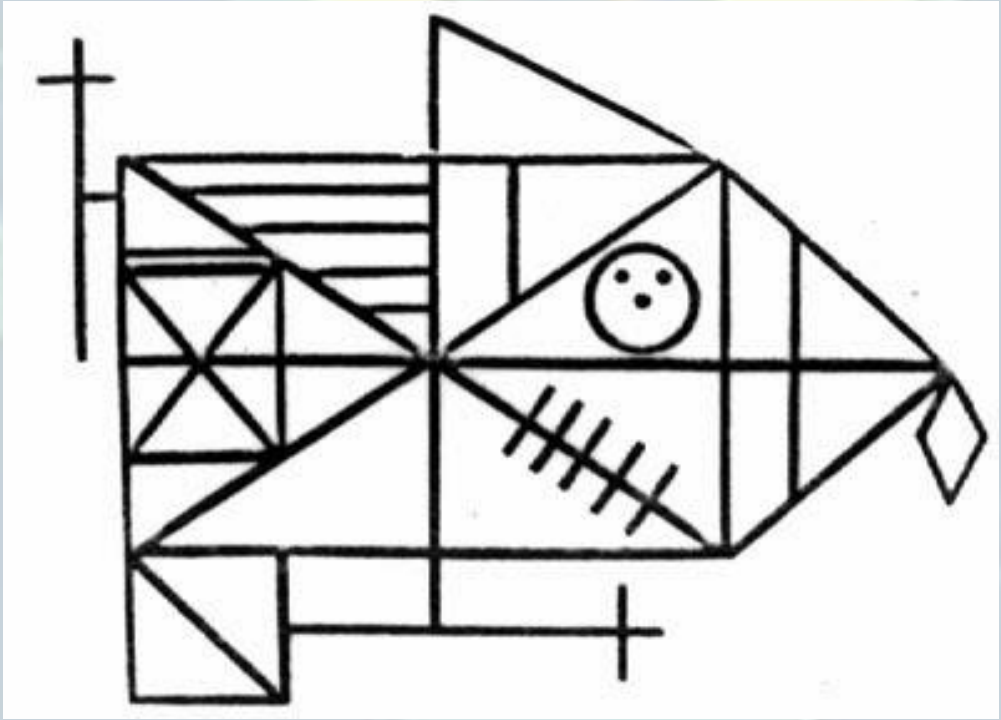
- Ability to **develop a strategy**, which is broken down into different stages:
  - the search for the goal
  - developing a plan
  - implementation of the plan
  - the cheking process.

Concretely, it corresponds to the ability to**organize and structure information to achieve an objective**.

D. Test of drawing

There are several tasks to test schedule control:

- Rey's figure

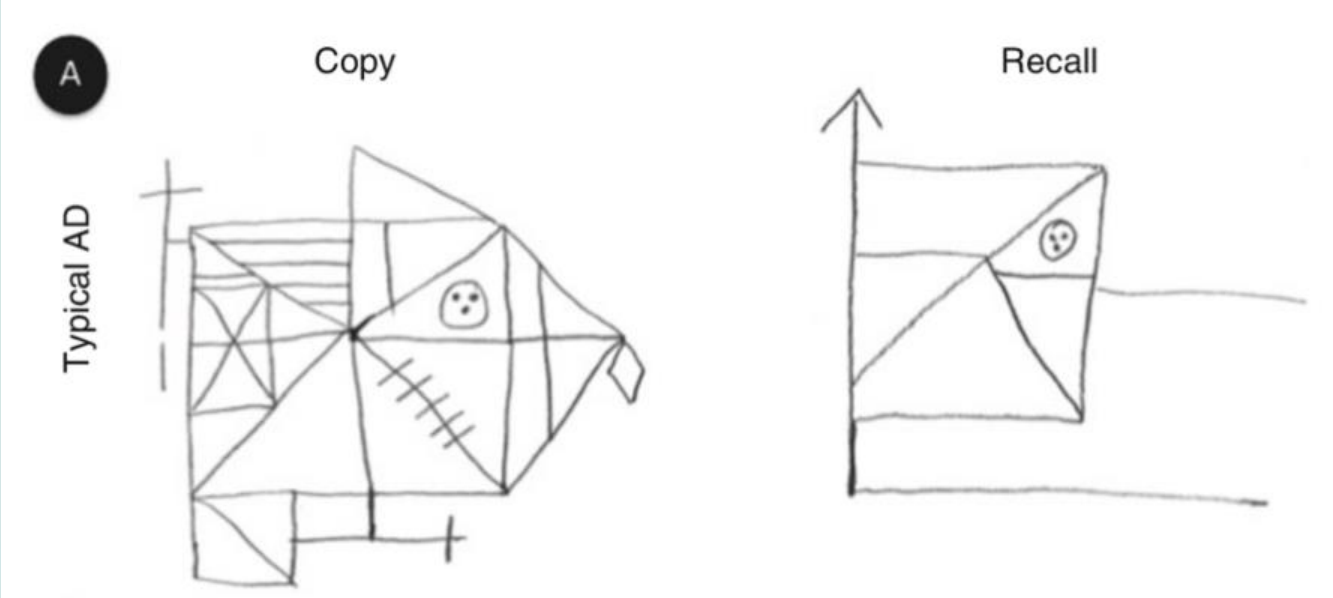


D. Test the schedule

There are several tasks to test schedule control:

- Rey's figure

Alzheimer's disease (AD)



D. Test of drawing

Figure A can be used from the age of 6 (primary school) and Figure B from 3-4 years (in kindergarten).

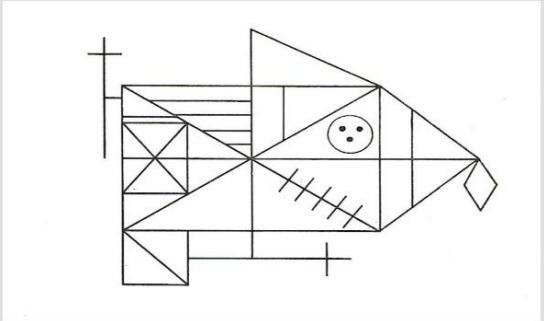


Figure A de Rey. Copyright © ECPA Paris, reproduction interdite

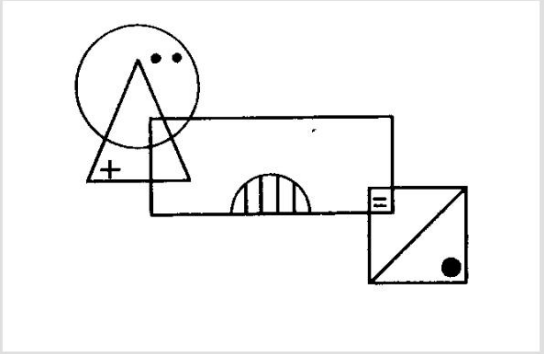
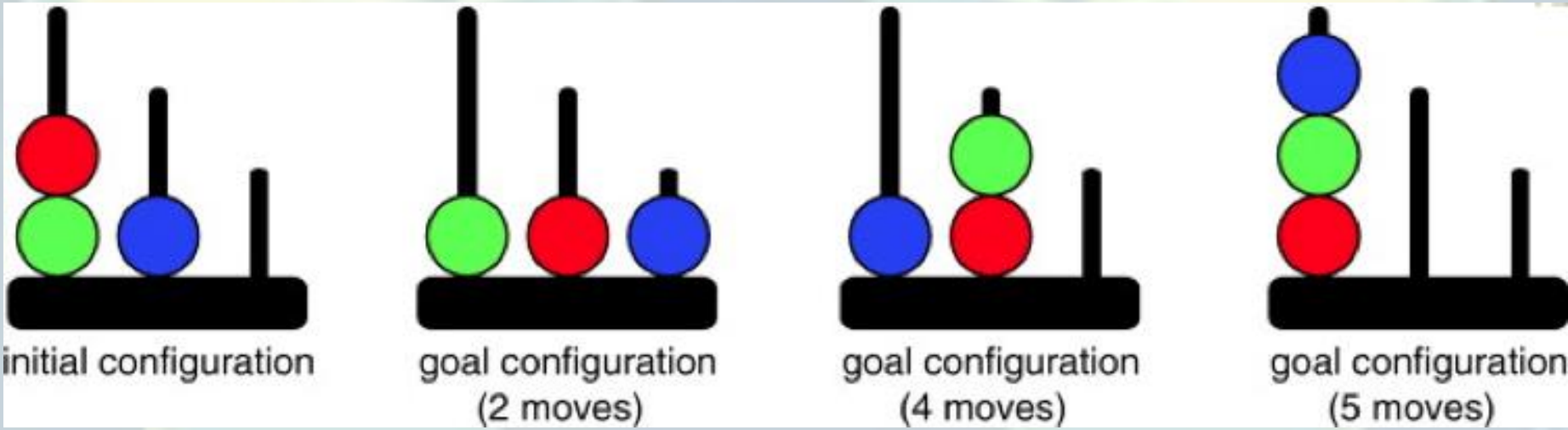


Figure B de Rey. Copyright © ECPA Paris, reproduction interdite

V. Planning

Planning→ How to measure it?

The tower of London:



https://www.youtube.com/watch?v=pzlkuMzLzoQ

V. Planning

Planning→ How to measure it?

The Tower of Hanoi:

V. Planning

Planning→ How to measure it?

Labyrinth:

The child must draw a path using a pencil to get out of a maze.

Methodological issues:

- The 3 (+1) components of executive control are never perfectly isolated in the tasks presented
- The tasks therefore involve several components in varying proportions.
- An inhibition task can be successful at one age (eg “Day/Night”) without necessarily implying success at the same age on the other tasks (eg “Contrary worlds”, more difficult).

➢ It is therefore difficult to precisely date the mastery of the various components of executive control.

Development of Executive Control

- First signs would appear from early childhood (9 months)
  - Search for object after movement -> inhibition
- Then progressive appearance between 18 and 30 months of behaviors testifying to a certain executive control
- Several periods are marked by changes in executive functions:
  - Between 3 and 4 years old
  - Between 4 and 5 years old
  - Around 8 years old
  - Around 12 years old

Development of Executive Control

There are different rates of development between the various components of Executive Control:

- The components of **inhibition** and of **working memory management** seem to evolve faster than the others.
  Adult performance is reached earlier.

- There **mental flexibility** (or alternation) progresses more slowly.
  12-year-old children still show perseverance behaviors on complex tasks.

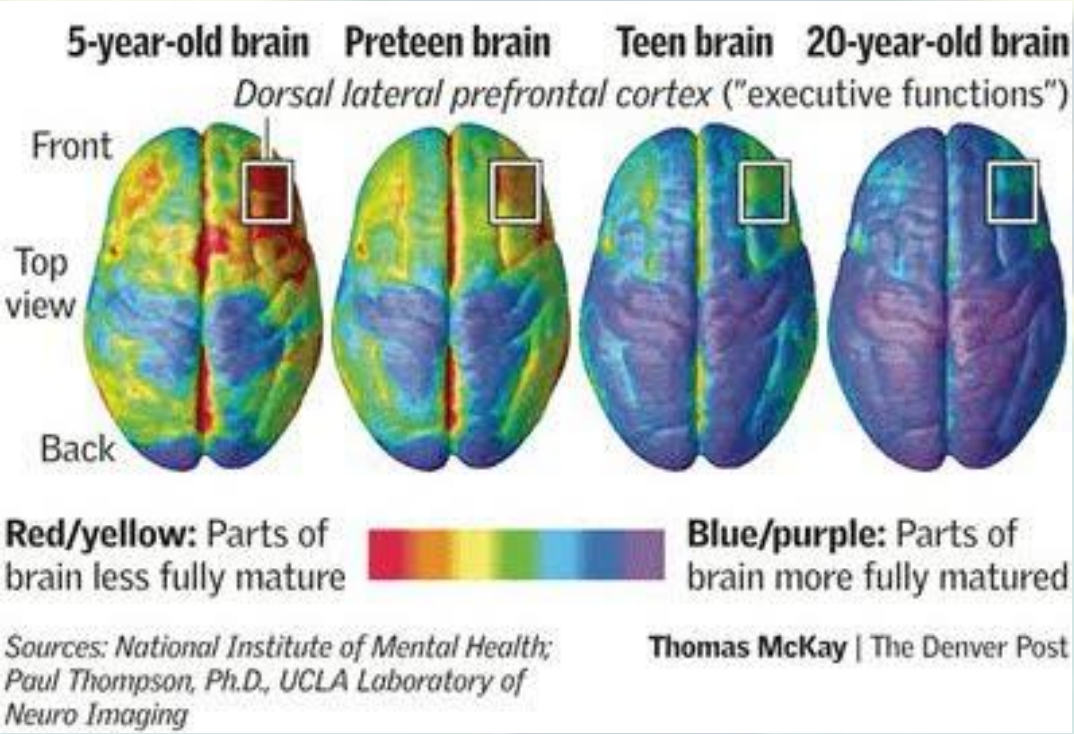
- There **planning** would grow even more slowly.
  The progression of this component would be accentuated especially from the age of 8 years.

Development of the prefrontal cortex

- It was previously considered that the prefrontal cortex was not functional before 4-7, even 12-15 years.
- Today, it is thought to be functional at the end of infancy.

- PFC lesions during childhood have a behavioral impact.
- Identical lesions at different times do not have the same consequences.
- Postnatal myelination for PFC until adulthood

Development of the prefrontal cortex



Gogtayet al. (2004)

Development of the prefrontal cortex

The development of executive functions is linked to the maturation process of the frontal lobes, from childhood to adolescence.(Cummings, 1993;Rabinowicz, 1976;Reiss,Abrams, Singer, Ross andDenckla, 1996,Yakovlevand Lecours, 1967).

There is heterogeneity in the development of the main executive functions which can be linked to different phenomena including:

- Growth spurts in the frontal lobes at 6, 10 and 12 years old.
- Lags in the maturation process of the areas that make up the frontal lobes.

Difficulties of executive functions

- Troubles spécifiques des apprentissages
- Trouble déficitaire de l'attention avec hyperactivité (TDAH)
- Déficience intellectuelle
- Troubles du spectre de l'autisme (TSA)
- Syndrome Gilles-de-la-Tourette
- Troubles psychotiques/ schizophrénie
- Syndrome d'alcoolisation fœtale
- Diabète
- Traumatisme crânio-cérébral
- Tumeur au cerveau
- Négligence et abus
- Dépression
- Troubles d'anxiété
- Problèmes de consommation d'alcool ou de drogues
- Etc.