Module V

Cognitive, social, communication, language and cognitive development and early intervention (I)

Dra. María Consuelo Sáiz Manzanares
Universidad de Burgos

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1. **Synaptic development.**

2. **Theories of human development.**

3. **Sensorimotor developmental milestones.**

4. **Pre-operational developmental milestones.**

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General structure of a neuron

Soma

Core

Axon
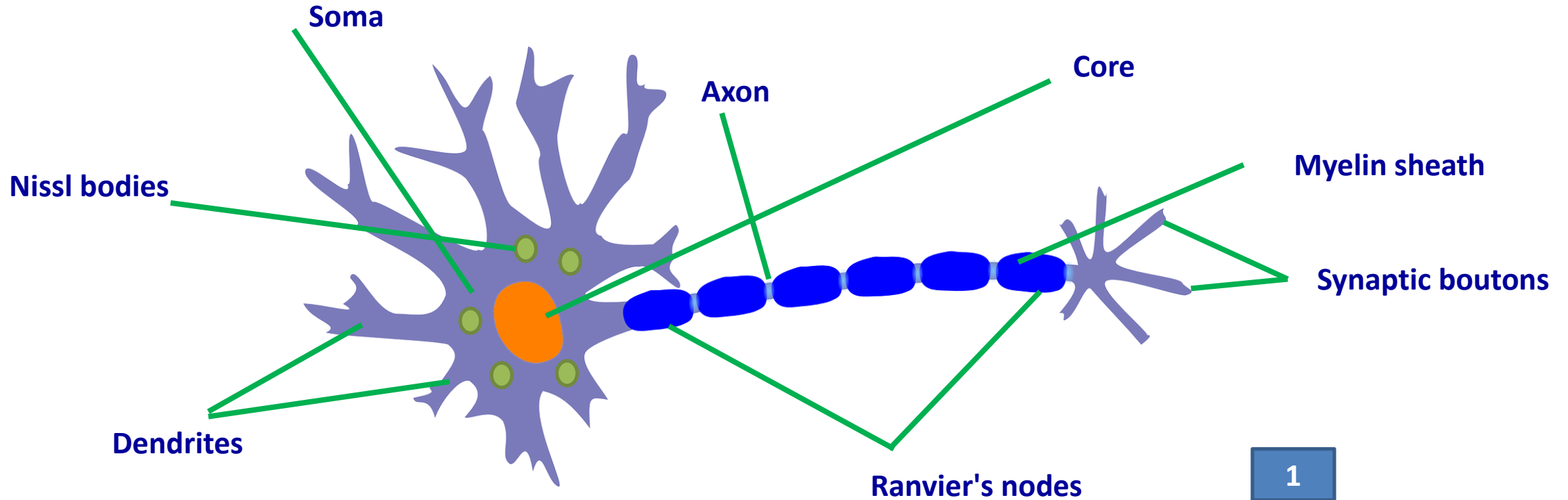
Myelin sheath

Nissl bodies

Synaptic boutons

Dendrites

Ranvier's nodes

1

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1. Synaptic development

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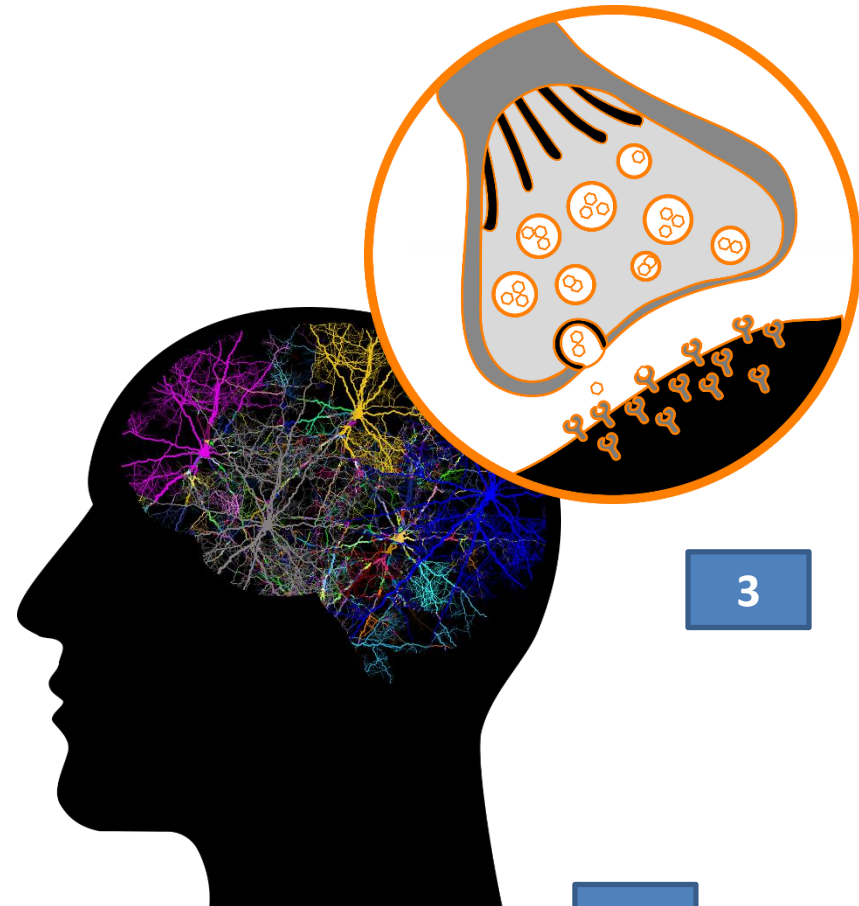## Brain Functionality

1. **Maturational development**

2. **Interactive specialisation**

3. **Learning strategies**

how to measure it?

1. **Electroencephalography**

2. **Magnetic resonance imaging**

3. **Evoked potentials**

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Analysis of brain activation in different cognitive actions
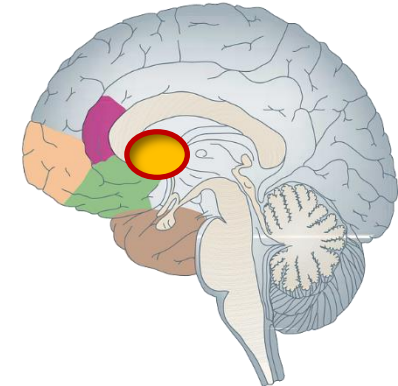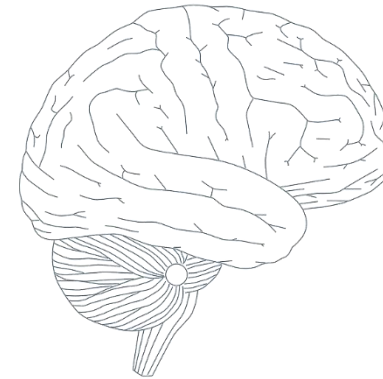
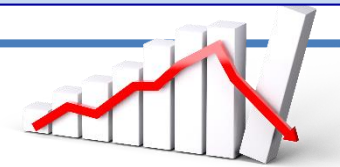**Functional development theories according to Haan & Martinos (2008) p.4**

a) Maturation

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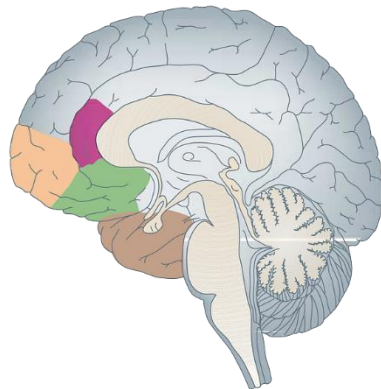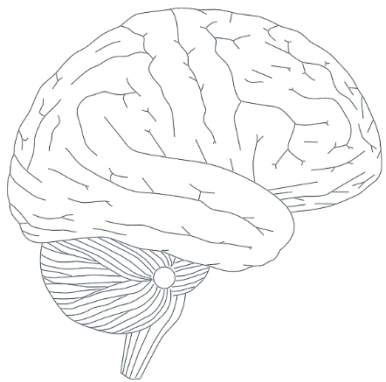
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Before recalling an object or situation

After recalling an object or situation

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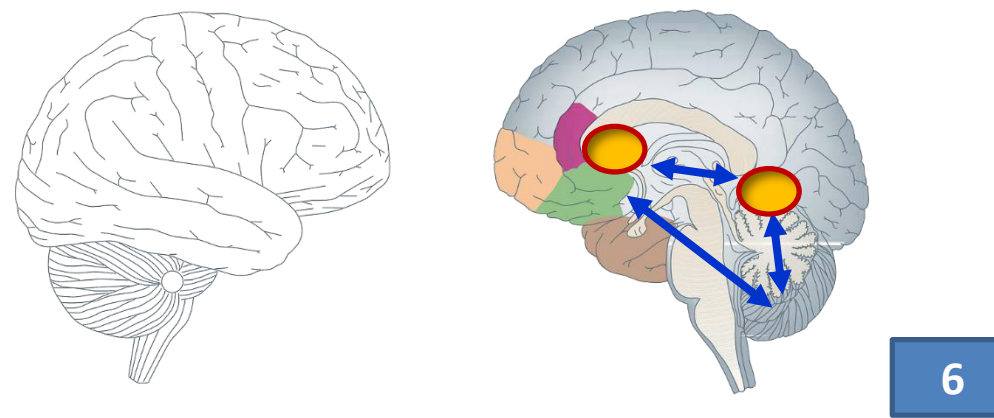
Análisis de la activación cerebral en distintas acciones cognitivas

b) Interactive specialisation

6

6
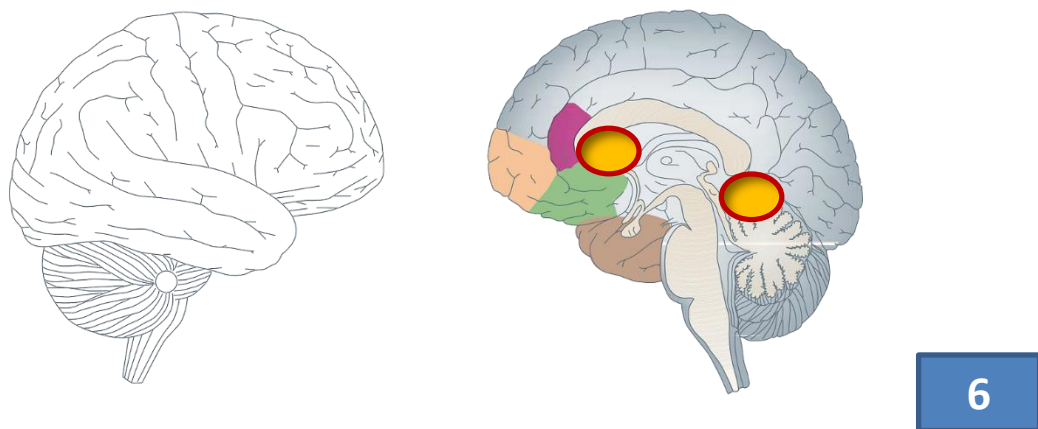
Prior to satisfactory development:
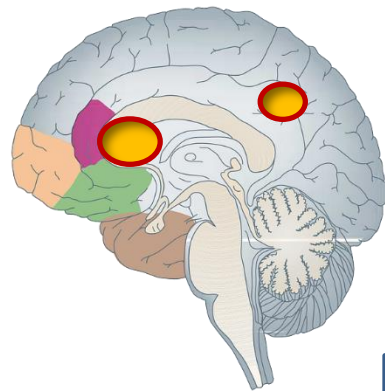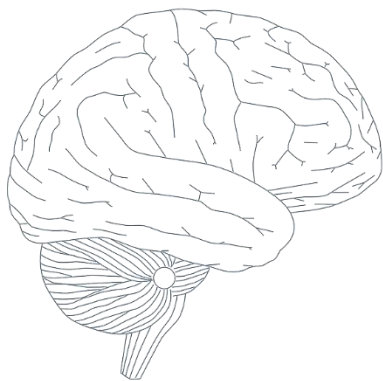**poor organisation in the interaction between areas**

Prior to successful development:
Correct interaction relationships

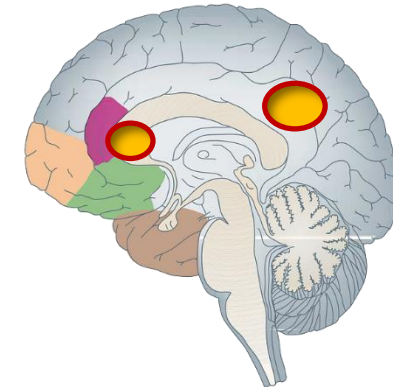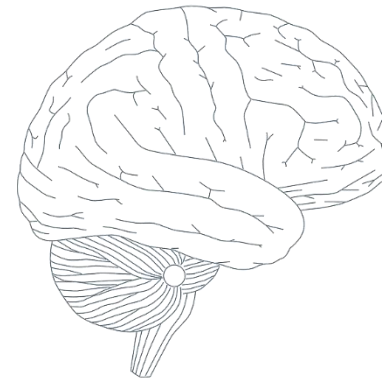# Análisis de la activación cerebral en distintas acciones cognitivas

c) Learning strategies

**During strategy acquisition:
increased activation of frontal regions**

**After strategy acquisition:
increased activation of posterior regions**

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During development, frontal and prefrontal areas are activated in the development of learning skills

Face processing

According to Morton and Johnson's theory (according to Haan and Martinos, 2008) newborns' preference for orienting faces is determined by a subcortical system called "Conspec", this would be a reflex with which the newborn is born and which orients faces in the first weeks of life, This would then be accompanied by a face-oriented visual input that slowly provides an input to the cortical system in the "Conlern", which initially functions as a general visual object processing system and with the help of the "Conlern", would function as a specific cortical face processing system:

1) The areas involved would respond more specifically to faces.
2) The area responding to faces becomes more focal.

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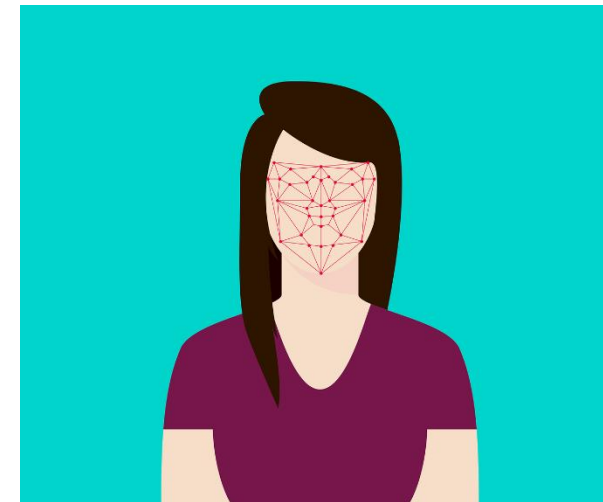
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During development, frontal and prefrontal areas are activated in the development of learning skills

Face processing

The instruments used for these analyses in adults fMRI seems not to be specifically suitable for the study in children, the only system that seems more advisable is PET (positron emmison tomography).
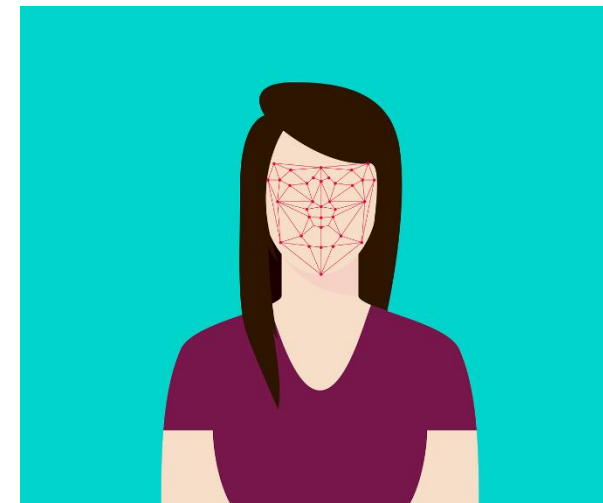
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During development, frontal and prefrontal areas are activated in the development of learning skills

Face processing

At around **two months** of age, infants begin to focus on faces but also on other objects, but there does not seem to be a specification in processing until the age of 10 years.

There is talk of a **visual processing system** from 6 to 9 months that coincides with the **6 and 9 month revolution**, face human processing strategy.

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Desarrollo cognitivo, social y de la comunicación y del lenguaje e intervención temprana (I)

During development, frontal and prefrontal areas are activated in the development of learning skills

Working memory

Prefrontal cortex, a region in which high-level processing develops, is an area of slow or slower maturation than others, and its functioning in neural activity is situated around the middle of the first year of life.

During development, frontal and prefrontal areas are activated in the development of learning skills

Working memory

The medial temporal lobe is located

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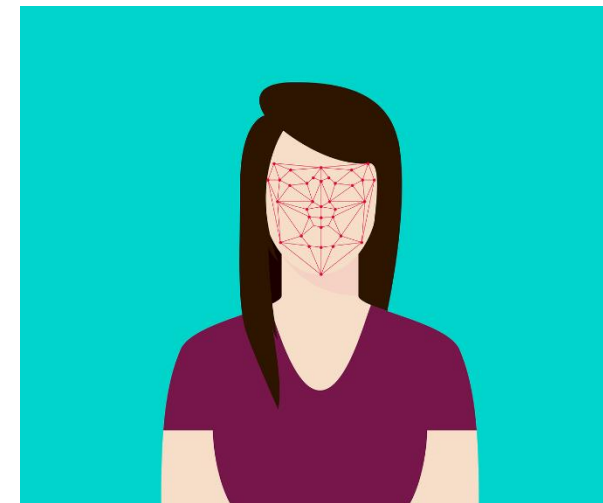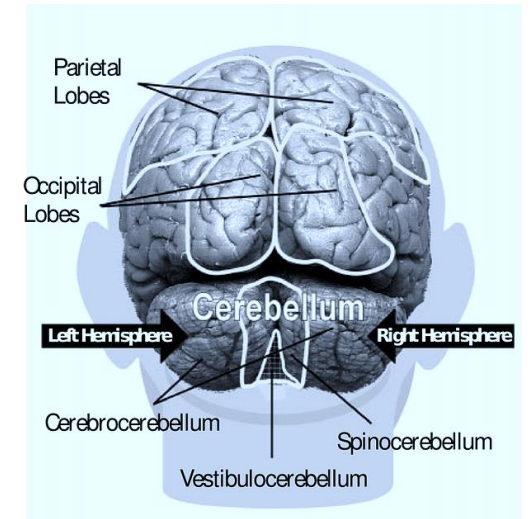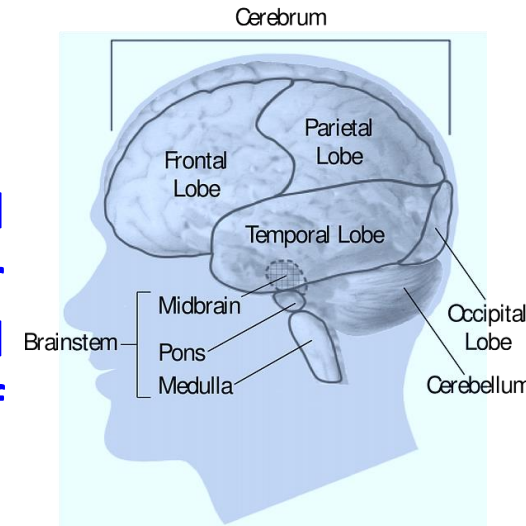**During development, frontal and prefrontal areas are activated in the development of learning skills**

Working memory

Recent studies indicate that infants during **the first three months** initiate the **development of medial temporal lobe memory systems** (MTLs). The period from **6 to 24 months is referred to as the period of recognition, storage, processing and recall of information.** All these developments are related to the **revolution at 6, 9 and the emergence of representation at around 18 months. Anticipatory behaviours and serial patterns of execution**.
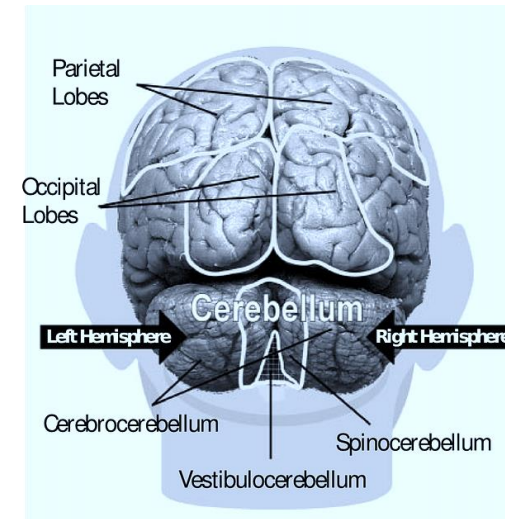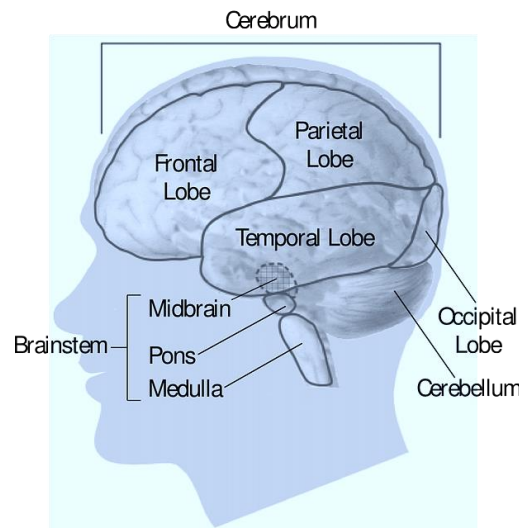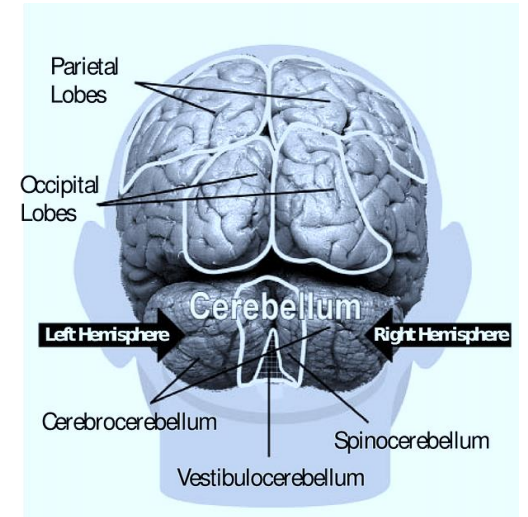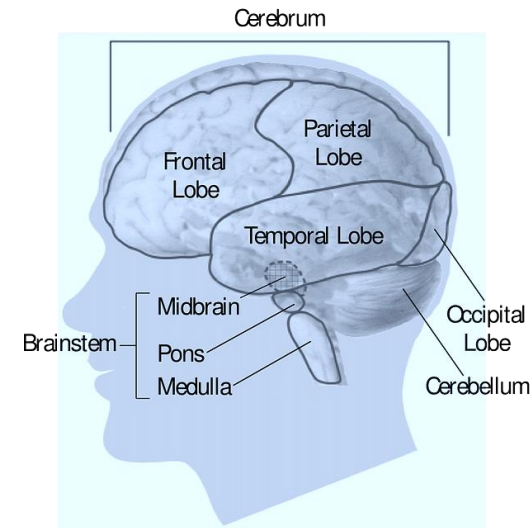

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During development, frontal and prefrontal areas are activated in the development of learning skills

Language **Broca Area** **Wernicke Area**

Broca's and Wernicke's área

Milestones
- 6-8 months
- 10-12 months
- 3 years
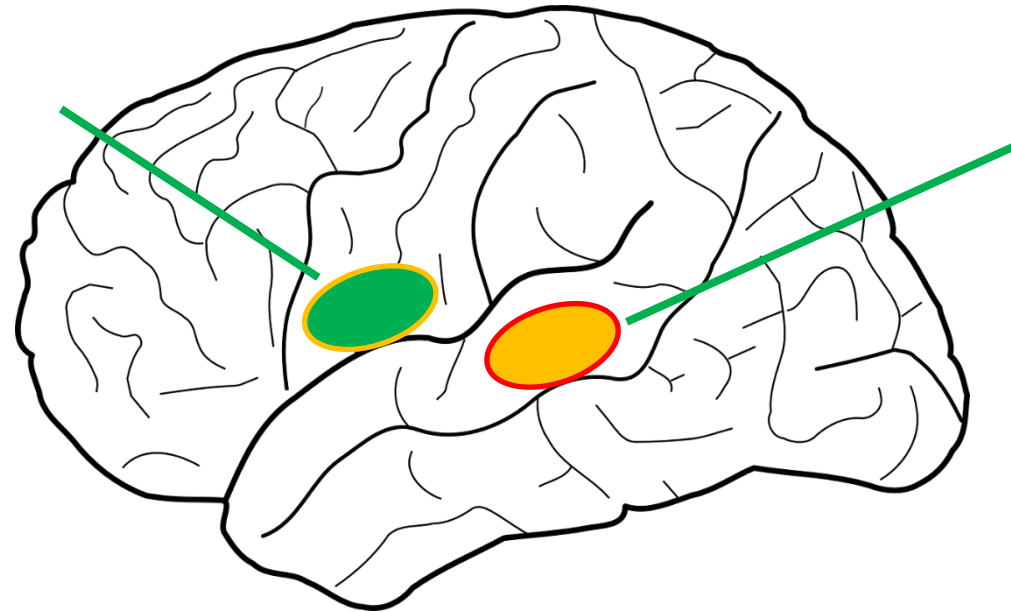
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- By **22 weeks gestation**, projections from the thalamus, basal forebrain and brainstem are occurring.

- Cortical layers mature in the **perinatal period**, as do transient synaptic contacts.

- **Neocortical differentiation** of areas corresponds to certain aspects of maturation: sensory, motor and cognitive.

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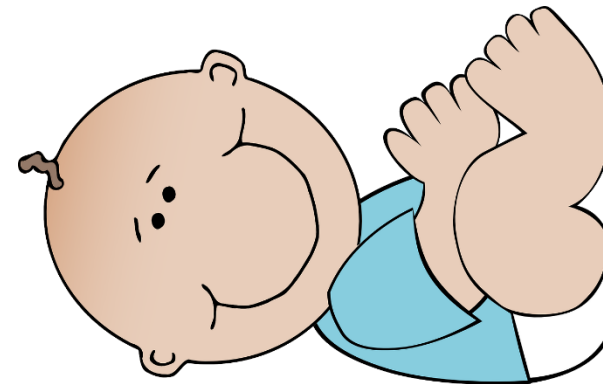
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It appears that brain growth is not linear, with the **maximum growth rate occurring around the age of 6** years, where the brain is approximately 95% of adult brain size, this growth is due to:

- **An increase in synapses and dendrites.**
- **The process of myelination.**
- **The production of new neurons.**

Fair & Schlaggar (2008)
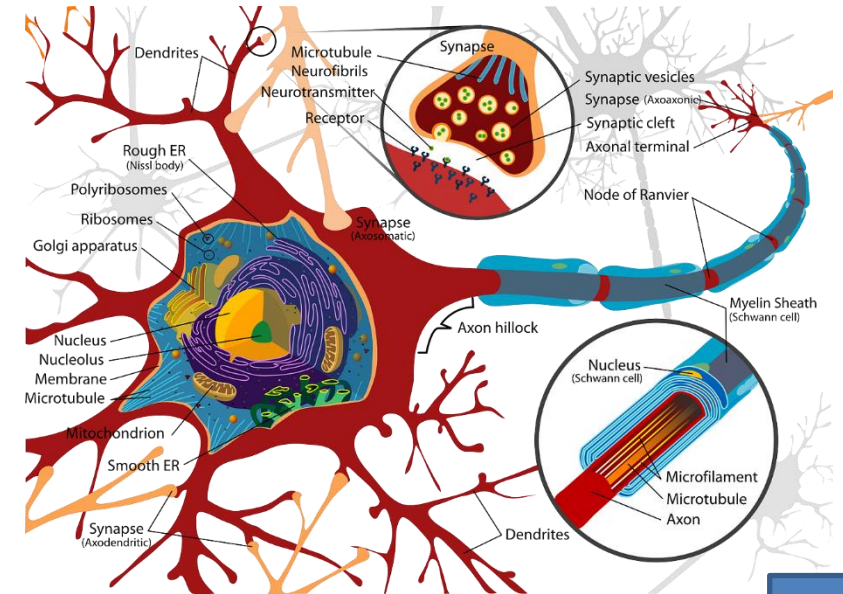
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- Synaptogenesis and intra-cortical connections. At **about 30 weeks** and up to **two years** of age there is **substantial growth in synaptic contacts**.

- There are discrepancies as to whether growth is homogeneous in this period in all areas or not.

Fair & Schlaggar (2008)
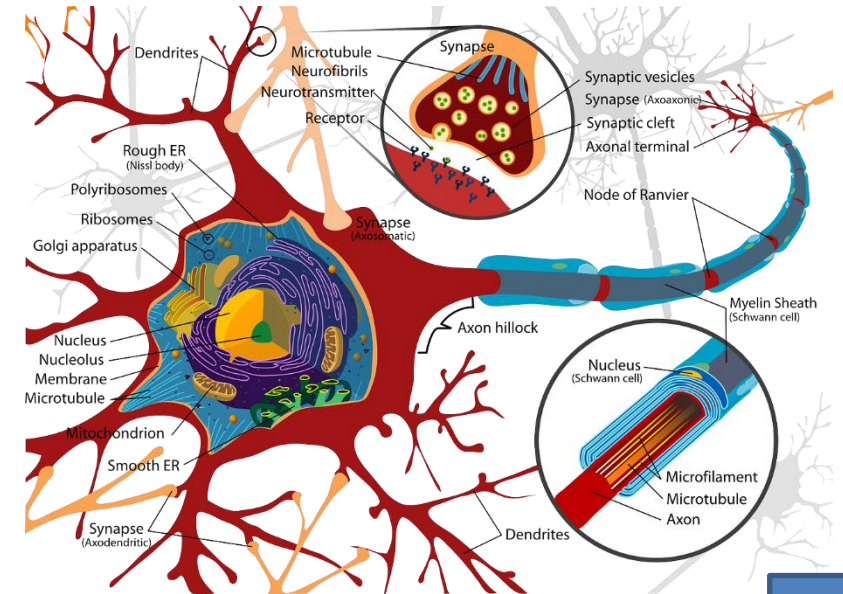
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- At around **9 months of age**, connections increase.

- The same hierarchical organisational structure is observed in the **visual area** as in the adult brain.

Fair & Schlaggar (2008)

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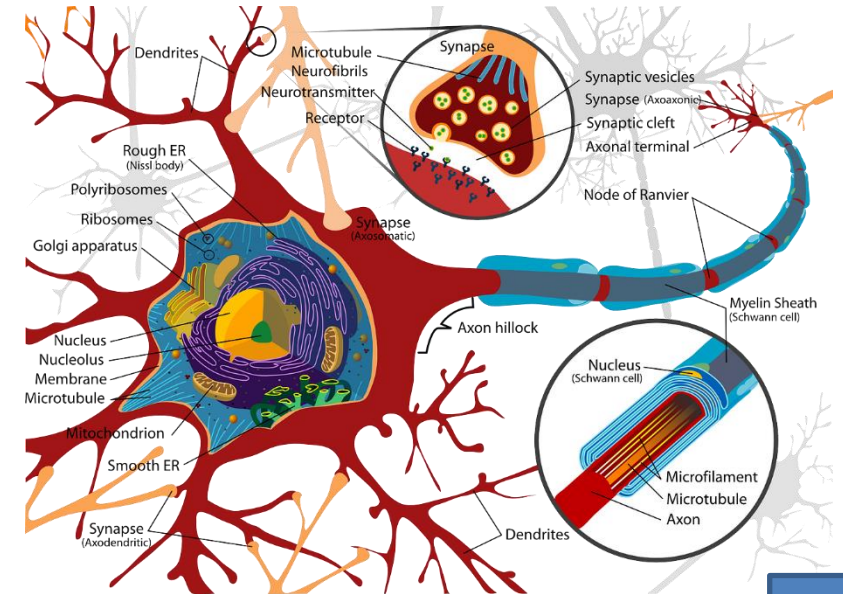
Different **types of synapses** are differentiated:

Excitatory and inhibitory.
In connections (intracortical, thalamocortical, cortico-cortical including feedforward (compensatory signal) and feedback.

Different types of connections with different trajectories are found.

Fair & Schlaggar (2008)
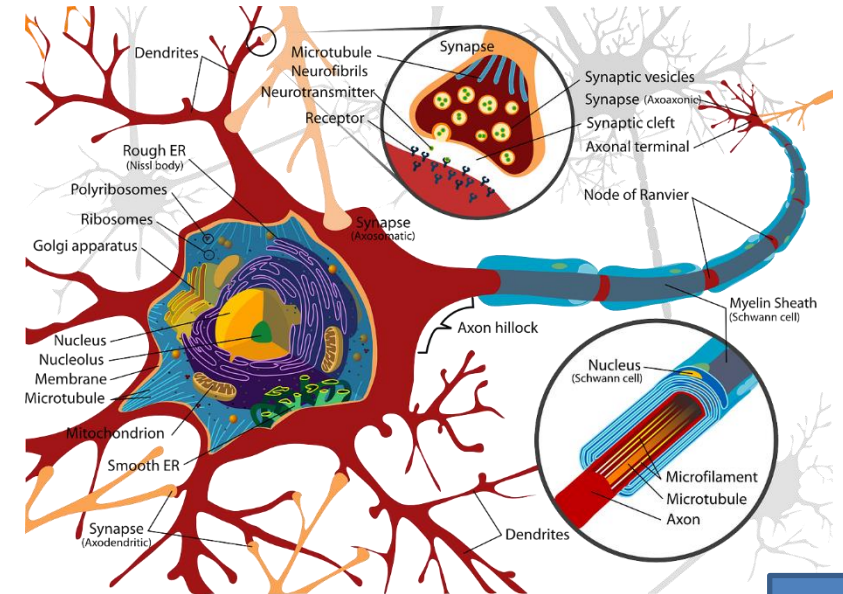
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Stage 1. 0-1 month

Reflections **15**

Scheme accommodation **16**

Non-specific linkage **17**

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Stage 2. 1-4 months

Suction coordination | 16

Coordination vision | 18

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Social smile
Primary intersubjective behaviours
Protoconversations

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Stage 3. 4-8 months

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Means-ends diagrams
Secondary circular reactions

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Object permanence

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Anticipatory behaviours

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Stage 4. 8-12 months

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Means-ends diagrams

Secondary circular reactions

24

Protoimperative

25

Social smile

Primary intersubjective behaviours

Protoconversations

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Stage 5. 12-15 months

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Half-finish schemes

Tertiary triangular reactions

Experimentation

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Increasingly complex games

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Stage 6. 12-18 months

Mental combinations 29

Protodeclarative 30
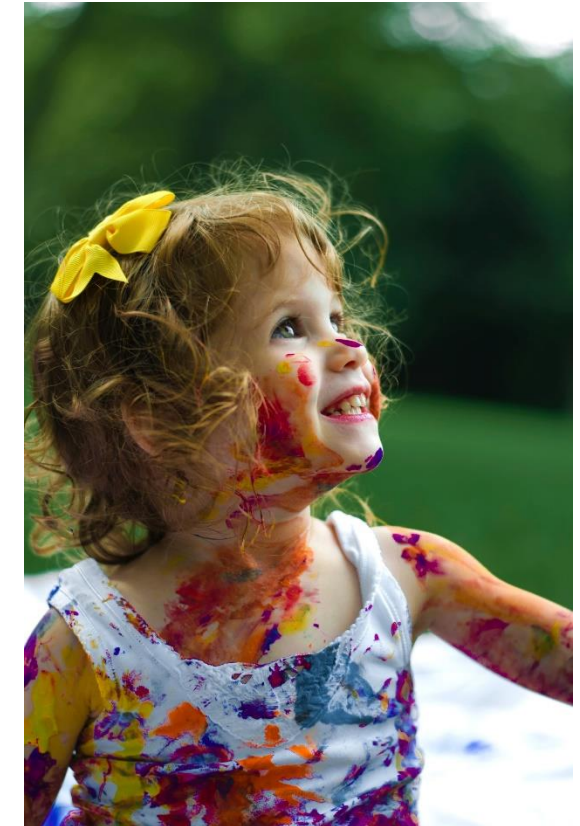
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Mental representation

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TRIANGULAR REACTIONS

From eight to twelve months, relationships between the child, adults and objects are established.

Protoimperative

Protodeclarative

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Protodeclarative gestures are understood as more complex communicative behaviours than protoimperative gestures, as they require **metarepresentational abilities**. The behaviours of mentally sharing a situation with another involve being aware that the other has a mind that can share that situation with one's own mind, which involves second-order representations or representations of the mental experiences of others and therefore a more complex cognitive understanding (Gómez, Sarriá and Tamarit. 1993).

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TRIANGULAR REACTIONS

From eight to twelve months, relationships between the child, adults and objects are established.

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Primary intersubjectivity

Secondary intersubjectivity

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- Trevarthen (1982, 1989) differentiated between primary intersubjectivity, face-to-face reactions with nurturing figures in which infants would manifest different expressions and would develop from two to four or five months of age, and secondary intersubjectivity, the child's deliberate motivation to share interests and experiences with other people and would be manifested around the first year of life.

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TRIANGULAR REACTIONS

From eight to twelve months, relationships between the child, adults and objects are established

Gestural communication. Gestures can be used either to make requests of objects to others (protoimperative) or to show situations (protodeclarative). The difference between the two types of gestures lies in the fact that the latter consider the person as the object of interaction and not only as a means of achievement. Therefore, prelinguistic intentional communication seems to indicate that there is some kind of understanding of the mental processes of others. These early communicative behaviours would be the initial manifestations of theory of mind (Wellman, 1993).

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PRECURSORS OF THEORY OF MIND

Social perception in infancy (birth to 8 months)

- Imitation
- Smile and dyadic vocalisation
- Joint attention (following others by pointing and looking). Seeking the attention of others by pointing and looking (social referencing).
- Discrimination of animate versus inanimate objects.
- Discrimination of goals.
- Awareness of others' emotional state.

Astington & Dack (2008) p. 7

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Taken from Sáiz-Manzanares (2003)

Developmental ages and their relationship to the stages of the sensorimotor period	Sensorimotor intelligence	Cognitive intervention strategies
Stage I (0-1 months)	- Development of reflexes. - Signs of accommodation of perceptual selection schemes (attunement to attachment figures). - Beginning of non-specific linkage.	- Develop visual tracking of objects. - Facilitate sucking-pausing relationships between mother and baby. - Enable breast-shaking or feeding-pause container relationships. - Implement rocking-pause relationships.
Stage II (1-4 months)	- Primary circular reactions. - First adaptations acquired. - First scheme co-ordinations. - Beginning of the social smile. - Emergence of primary intersubjectivity. - Start of proto-conversations.	- Develop sucking and grasping coordination. - To facilitate vision-hearing coordination. - To develop phonation-audition coordination. - Enabling the elicitation of social smiles. - Facilitating the development of primary intersubjective behaviours. - Implement the development of contingency awareness. - Develop circular games. - Facilitate the development of proto-conversational patterns between infant and nurturing figures.
Stage III (4-8 months)	- Secondary circular reactions. - Full coordination of vision and grasping. - Beginning of the means-ends differentiation. - Anticipatory behaviours.	- Facilitating the development of vision-impairment coordination. - Enable the development of the beginnings of means-end differentiation. - Facilitate the development of the search for partially hidden objects. - Enable the development of anticipatory behaviours.

3. Sensorimotor developmental milestones

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Developmental ages and their relationship to the stages of the sensorimotor period	Sensorimotor intelligence	Cognitive intervention strategies
Stage IV (8-12 months)	- Coordination of secondary schemes. - Pursuit of ends using others as means. - Reciprocal assimilation of means-ends. - Progressive differentiation of means-ends. - First acts of practical intelligence. - Occurrence of intentional behaviours. - Beginning of the development of proto-imperative behaviours.	- Facilitating the pursuit of ends by using other schemes as a means. - Search for completely hidden objects that have just been hidden. - Enable situations in which the child has to communicate and reinforce intentional communication behaviours. - Facilitate the development of proto-imperative behaviours.
Stage V (12-15 months)	- Circular tertiary reactions. - New media are discovered by experimentation and known patterns are differentiated.	- Facilitate the search for the object in different places where it can be hidden.
Stage VI (15-18 months)	- Use of new media by mental combination. - Occurrence of proto-declarative behaviours. - Object permanence. - Start of the performance.	- Present problem situations in which the child has to develop mental combination. - Facilitate situations in which the child has to develop proto-declarative behaviours. - Facilitate the search for objects in all locations. - Facilitate the development of representative behaviour.

3. Sensorimotor developmental milestones

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Developmental ages and their relation to the stages of the pre-operational period	Practical intelligence	Cognitive intervention strategies
From 2 to 3 1/5 or 4 years old	- Appearance of the symbolic function and beginning of the internalisation of action schemas in representation. - Appearance of symbolic function in different acquisitions: language, symbolic play, deferred imitation, beginnings of internalised imitation. - Initial plane of representation (difficulty in non-immediate space, non-present time and in carrying out causal actions).	- Facilitating role-play situations, e.g. games with puppets and marionettes. - Use language regulation from modelling and moulding in fiction games, in drawing activities. - Include pictograms sequentially representing the parts in the execution of an action. Such pictograms may be on cards or included on tables, table-top or mobile devices.
From 4 to 5 1/5 years old	- Representative organisation in static configurations	- Through games show the child how the processes of transformation of substance, quantity, etc. are carried out. Step by step and have them carry them out themselves in order to internalise the action schemes.
From 5 years 1/5 to 7 or 8 years old	- Intermediate phase between conservation and non-conservation. - The child achieves semi-reversible properties. - Semi-logical phase	- Show the child through games how the processes of transformation of substance, quantity, etc. are carried out. Step by step and have them carry them out themselves so that they can internalise the action schemes. Carry out the sequences from start to finish and from finish to start so that the child can mentally acquire the reversibility of the processes.

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During the **preoperational period**, the child consolidates a series of skills initiated in the sensorimotor period while acquiring new ones. As we have seen at the end of this period, the child has acquired the **ability to represent**, although its development is not complete, as it will need other systems of representation, such as language, to consolidate itself.
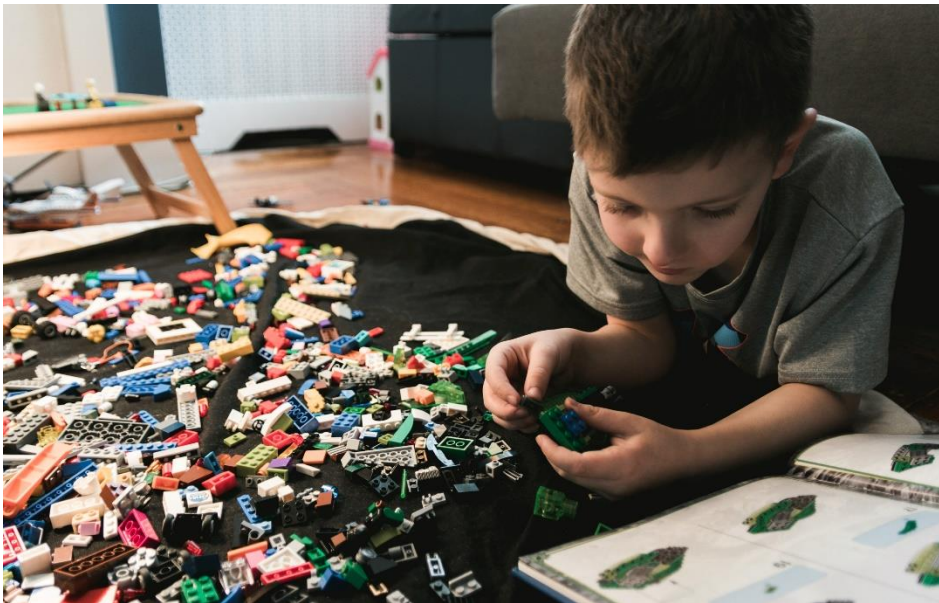
Cognitive, social, communication, language and cognitive development and early intervention (I)

At the same time as he acquires the notion of **identity of objects**, he develops relationships of functional dependence, which implies that some events are associated with others and that a modification in the first one produces a change in the next one. As in the case of the concept of invariant, the acquisitions are of a qualitative nature (Delval, 1996).

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THEORY OF MIND

Acquisition of theory of mind in the pre-operational period

There is a relationship between the **development of metarepresentational ability** in different domains:

fictional play, language acquisition especially semantic and pragmatic function

and theory of mind. The first to introduce the concept of theory of mind
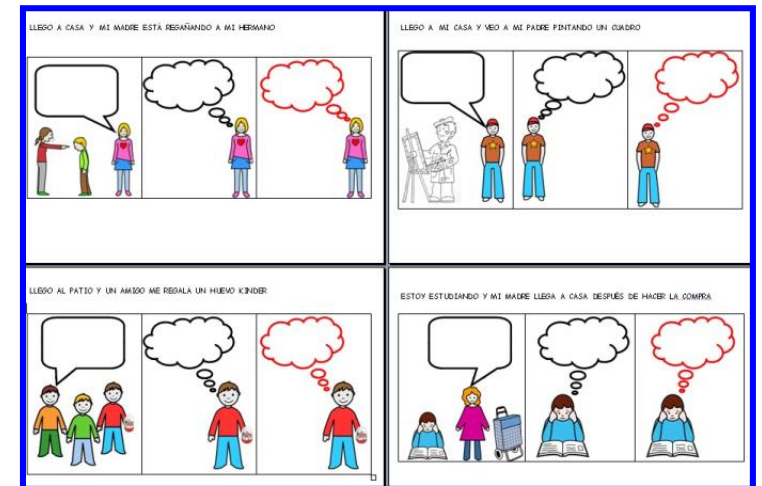
were Premack and Woodruff (1978) in their work with non-human

primates and later Wimmer and Perner (1983) would use it in their work

with humans. The mind could be defined as a set of

desires, beliefs, emotions or intentions, **the interaction** of which would form

so-called states of mind whose interaction would form the so-called **mental states or mental representations**.

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THEORY OF MIND

Metal states such as beliefs, desires are representations that mediate the interaction of the human subject in the environment, they are also called **intentional states**. This implies that they are always about something. Such states have a propositional **content**, which implies with the development of **predictive and causal thinking**.

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THEORY OF MIND

One of the most significant achievements in this period is the development of **language** and above all its insertion into the subject's own actions and those of others. In **Vygotskian** terms, language is **a privileged vehicle of cognition** and will allow the subject to open up to the world of knowledge with an important tool. This acquisition will facilitate the child's passage from the world of **experimentation** to the world of **deduction**. However, although from the Piagetian point of view, thought still has to make important conquests, among which we highlight the **theory of mind**. In the **sensorimotor period** we have seen the development of the precursors and now we are going to see how it continues to evolve during the pre-operational period.

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THEORY OF MIND

Language and the **development of theory of mind** are two directly related aspects, although as Rivière and Nuñez (1996) point out, this does not mean that they are homologous systems, but it is a fact that the acquisition of **linguistic skills** will enable a greater understanding of **conceptual systems of intentions, beliefs and desires** (which is what is meant by **theory of mind**). The absence of language or the inhibition of language can lead to not really understanding the **world of representations of others**.

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THEORY OF MIND

Children may understand **mental representation** in a partial way and understand that **beliefs** and **desires** are **mental entities** that are separate from reality. As they evolve in their concept of mind, they will discover **representation** in its dual sense of **mental entity** and **mental activity**. That is to say, the mind will be able to develop beliefs about the beliefs of others and differentiate them from its own, and it will also have the ability to predict something based on these **attributed beliefs** and differentiate them from its own. This is why psychologists chose situations of deception as the most appropriate to see whether or not a subject has developed **theory of mind**.

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desires

beliefs

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intentions

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THEORY OF MIND

According to Rivière and Nuñez (1996), Peskin's studies (1992) differentiate three evolutionary moments in **tacit deception**. At around the age of three, children seem to have difficulties in using it. At a second stage, around the age of four, they do not yet use tacit deception strategies as such, although they may be able to elaborate them on the basis of experience, and a third stage in which deception is used in a more fluid way.

Thus, it seems that by the age of five the **theory of mind** has developed in an evolutionarily "normal" process that over the years will be refined with respect to its conceptual elements of **power and recursivity** that is manifested in tasks involving **second-order skills**: the child must infer one subject's **false belief** about what another subject holds, i.e. represent a representation about another representation.

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Theory of mind in 4-year-olds	Theory of mind in 5-year-olds
Understanding false belief in oneself and others	Understanding second-order ToM
Understanding disappointment	Reorganising and interpreting diversity
Distinguishing between appearance and reality	Understanding indirect speech
Understanding aspects of knowledge acquisition	Be aware of lying and persuasion
Differentiating between desire and intention	Understanding inference, ambiguity and referential opacity
Understanding intentional causation	
Understanding emotion-based belief	Being aware of consciousness and introspection

Astington & Dack (2008) p. 8

Astington & Dack (2008) p. 9

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These aspects are concretised in the resolution of different types of tasks. At a first stage in the process of acquiring **theory of mind**, the child will be able to solve false **belief tasks**. In these tasks, a story is staged in which the protagonists are two children, one of whom has an attractive object (e.g. a marble, a doll...) that he/she keeps in a specific place (e.g. a box, a basket...). At a certain moment this child (whom we will call Juan) will leave and the other child (whom we will call Luis) will be left alone in the room, then Luis will take the object (marble, doll...) and move it to another place (put it in another box, in another basket...), then Juan will return and we will ask the experimental child "Where is Juan going to look for the marble, (the doll...)? This is when he should put himself in the other's place and differentiate between what he knows has happened and what Juan really knows.

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Later on, they will be presented to solve second-order tasks, in which the child will have to infer the **false belief** of one subject about what another subject has. The experiment is similar to the previous one with the difference that the first character, John, on leaving the room has the possibility of seeing through a window what is really happening and then he no longer has a false belief about what has happened but a **true belief**. Now the questions asked of the experimental child are: "Where does David think the marble is?" (this question implies a **true belief**) and another "Where does Charles think David will look for the marble?" (a question that implies a **false belief**). The latter question involves a high degree of **recursivity** and is adequately answered by children at about six and a half years of age (Rivière and Nuñez 1996).

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In conclusion, the mind can be understood as a construct that is itself representational. Therefore, having a mind is equivalent to having representations and attributing a mind implies attributing representations to others. Thus the intentional recursivity of subjects uses language on many occasions to try to modify the mental worlds of others. From this approach, theory of mind would be directly related to pragmatic skills that allow forms of interaction and communication from a **declarative function** (Rivière and Nuñez, 1996; Happé, 1998). **This ability can be understood as an ability or set of cognitive skills that will allow the development of interaction and communication processes between human beings and facilitate the development of adaptive behaviours to the environment according to their acquisition dynamics.**

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Author: Dr. María Consuelo Sáiz Manzanares
Developmental and Educational Psychology Area
Faculty of Health Sciences
University of Burgos