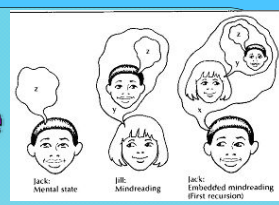


# Role of default network in the understanding of subjectivity of desire

Mai Nguyen, Osaka University



**Abstract** - Theory of mind is considered a cognitive ability that belongs only to humans, and particularly over-4-year-olds. But before they can pass the Sally and Anne test, children can already begin to understand other people's mind. Repacholi & Gopnik[1997] have shown that infants can understand the subjectivity of desire from the age of 18 months, while they can not at the age of 14 months. During this age therefore, a development in the ability of mentalizing, the attribution of mental states to the other, based on one's self knowledge, takes place. It also happens that this period is strongly characterized by the acquisition of self-consciousness, which indicates that mentalizing and self-consciousness are strongly correlated both in respect to time, and in respect to their processes. The third correlation is their neural substrates. Both self-referential thoughts and mentalizing tasks activate default network regions. The default-network, first observed in adults, has recently been investigated in younger infants. Whereas the default network in 2-year-olds resembles that of adults, the 1-year-olds' primitive default network activates a large number of regions and connectivity. Therefore, we make the hypothesis that the symbiotic development of the mentalizing ability and self-consciousness makes a big leap around 18 months of age. We introduce a model where the default network, through mentalizing tasks, grows more specialized and enables infants to realize that the other may have likes and dislikes different from them.

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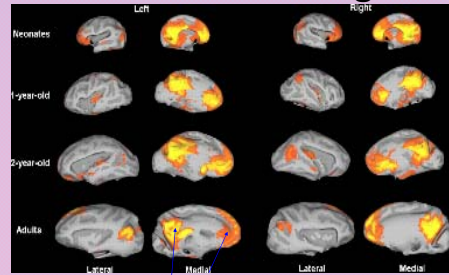
## Self-referential thought and mentalizing: Definition

The **default network** is active during the brain rest which is: during passive, undirected mental states, or self-referential thoughts. The neurological substrate is highly active in the resting brain with a high degree of functional connectivity between regions, but is deactivated during goal-directed task performance, independently of the nature of the task.

**Mentalizing or theory of mind** refers to the ability to attribute to people of mental states such as emotions, beliefs, intentions or desires. Subjects are considered to have a human-adult like understanding if the mind if they can pass the false-belief test. Children can only pass the test at 4 years of age, but it is a distortion to think they don't understand others' mental lives. They gradually come to understand emotions, perceptions, desires, intentions, pretences and beliefs.

According to the **simulation theory** of the theory of mind, self-referential thought and mentalizing are both based on the knowledge of the self, as we mentally simulate others' thoughts, processes and feelings, using our own mental state. **Both therefore share common functions to access self-knowledge.**

## Self-referential thought and mentalizing: Development



Development of the default network measured by fMRI

- 0 y Distinguish between happy and sad faces (2-3 days)  
mimic the emotional facial expression of the caregivers (2-4 months)
- 1 y Triadic interaction, joint attention (9-12 months)  
Understand the directedness of emotion signals (14 months)  
Differentiate between intentional and unintentional acts (18 months)
- 2 y Understand the subjectivity of desires (18 months)  
Self-conscious: rouge mirror test, use of personal pronouns (I, me)  
Talk about the different desires of different people
- >3 y Children know that people have incompatible desires (3 years old)  
Pass Sally and Anne test (4 years old)  
Attribute to people mental states such as emotions, intentions, desires and beliefs.

Both the development of the default network recruited for self-referential thought and the development of theory of mind in infants show that the period between 1 year and 2 years of age is decisive in child development. From 9 to 14 months, babies **understand perceptions of others**, and between 18 months to 24 months, they come to understand **desires and intentions**. As for the default network, it is in a very primitive form at birth and involves very large brain regions, before organizing itself at 2 years of age, around two hubs, the posterior cingulate cortex and the medial prefrontal cortex. **The 2-year-old brain has grown into an adult-like brain.** Both points of view highlight the cognitive developments between 1 and 2 years of age.

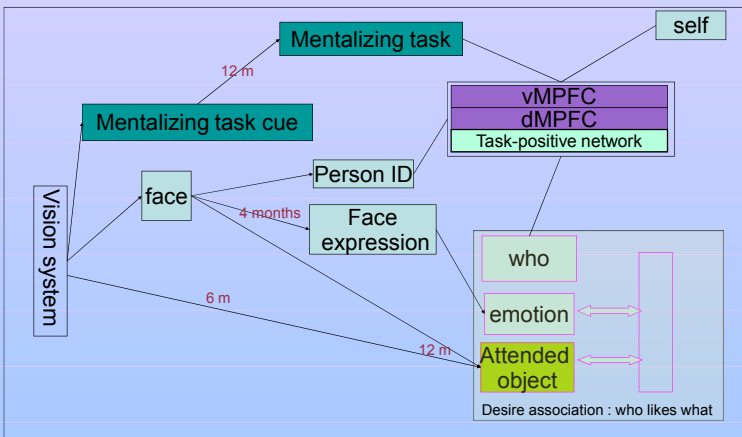
## Self-referential thought and mentalizing: Brain regions

**Common brain substrate** for self-consciousness and mentalizing:

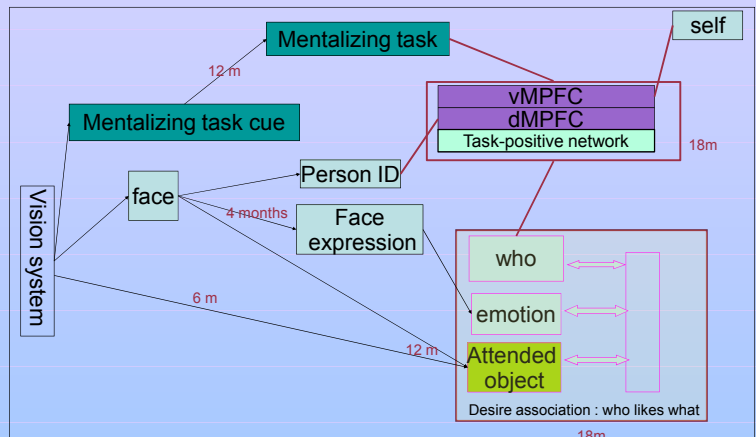
- vMPFC (ventral medial prefrontal cortex): self-referential processing
- dMPFC (dorsal medial prefrontal cortex): simulation about the other
- PCC (posterior cingulate cortex): declarative memory

## The specialization of the brain regions of the state default network goes through weakly supervised learning

Double learning between 12 months and 18 months: **Desire association of who likes what** and **Which mentalizing task activates which region**



**Functional model for 12-month-olds** : children do not understand yet the subjectivity of desire, and think that everybody has the same desire as his. In young children, the desire association between the subject, the emotion and attended object is not yet well learned. Moreover, the brain activation by the mentalizing task is not acquired either. Brain regions do not activate specifically to mentalizing task.



**Functional model for 18-month-olds** : children understand the subjectivity of desire, and know that the other may have desires different from his. The desire association between the subject, the emotion and attended object is mapped. Moreover, the brain activation by the mentalizing task is acquired. Brain regions activate specifically: vMPFC for self-referential processing, mPFC for the simulation about the other, and task-positive network for goal-oriented task.