

Brain Areas and Their Function

1. Prefrontal Cortex (PFC) — *Cognitive functions*

Function

- Executive functions: planning, decision-making, attention, inhibition, working memory
- Regulation of emotion and behavior
- Integration of cognitive and emotional information

Relationship

- Acts as the *top-down regulator* of subcortical and limbic structures (amygdala, hippocampus, thalamus)
- Includes specialized regions such as the **dorsolateral** and **medial** prefrontal cortex

2. Dorsolateral Prefrontal Cortex (DLPFC) — *cognitive control*

Function

- Working memory
- Logical reasoning and problem-solving
- Cognitive flexibility and goal-directed behavior
- Sustaining attention

Relationship

- A subdivision of the PFC
- Works closely with the **hippocampus** for organizing and manipulating memories
- Exerts regulatory influence over emotional signals from the **amygdala**
- Receives sensory and associative information relayed through the **thalamus**

3. Medial Prefrontal Cortex (MPFC) — *emotional and social regulation*

Function

- Emotional regulation
- Self-referential thinking
- Social cognition and moral judgment
- Fear extinction and emotional learning

Relationship

- Strongly interconnected with the **amygdala**
- Modulates emotional responses and stress reactions
- Interfaces between emotional memory (hippocampus) and emotional salience (amygdala)

4. Hippocampus — *memory and context*

Function

- Formation of new declarative (episodic) memories
- Spatial memory
- Contextualizing experiences (time, place)

Relationship

- Works with the **PFC** to support memory-guided decision-making
- Provides contextual information to the **amygdala** (e.g., whether a threat is real or remembered)
- Highly sensitive to stress hormones released during amygdala activation

5. Amygdala — *emotional salience and threat detection*

Function

- Processing of emotions, especially fear and threat
- Emotional learning and conditioning
- Assigning emotional significance to stimuli

Relationship

- Receives fast sensory input via the **thalamus**
- Influences memory consolidation in the **hippocampus**
- Regulated by top-down control from the **PFC** (especially mPFC)
- Hyperactivity occurs when PFC regulation is weakened (e.g., stress, trauma)

6. Lateral Nucleus of the Thalamus — *sensory relay*

Function

- Relays sensory information (especially visual and somatosensory) to the cortex
- Enables rapid processing of incoming stimuli

Relationship

- Sends sensory input to both:
 - **Amygdala** (fast, emotional “low road”)
 - **Prefrontal cortex** (slower, cognitive “high road”)
- Acts as a gateway allowing emotion and cognition to be processed in parallel

How They Work Together (Big Picture)

1. **Thalamus** receives sensory input and rapidly forwards it.
2. **Amygdala** quickly assesses emotional significance (especially threat).
3. **Hippocampus** provides contextual memory (Has this happened before? Where?).
4. **Prefrontal cortex** evaluates the situation and regulates response.
 - **DLPFC** handles reasoning and planning.
 - **mPFC** modulates emotional reactions and social meaning.

In short:

- **Thalamus** = relay
- **Amygdala** = emotion
- **Hippocampus** = memory/context
- **PFC** = control
- **DLPFC** = thinking
- **mPFC** = emotional regulation