



# Functional Updates in Brain Sulci and Gyri

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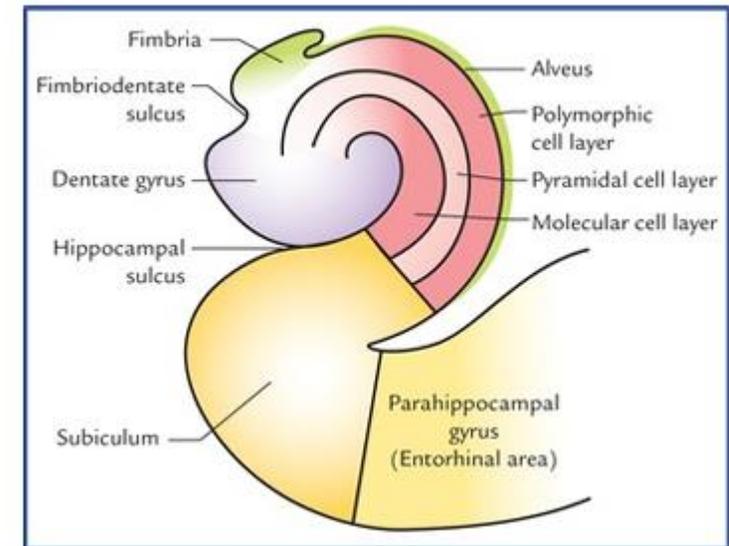
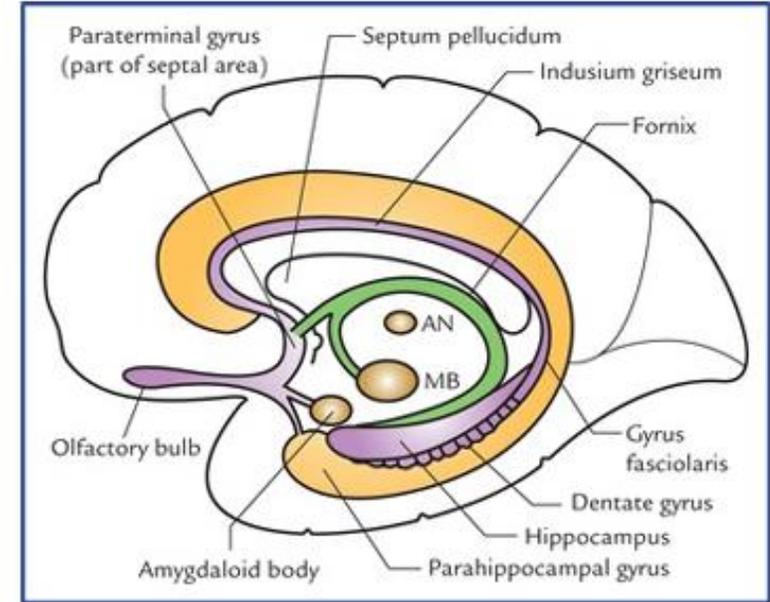
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# Hippocampus formation

- Hippocampal formation which includes hippocampus, dentate gyrus, gyrus fasciolaris and indusium griseum.
- Hippocampus is an area of cerebral cortex which has rolled into the floor of the inferior horn of the lateral ventricle during fetal life. In adult brain it forms a longitudinal elevation in the floor of inferior horn of the lateral ventricle and is continuous medially with the para-hippocampal gyrus. The name 'hippocampus' meaning 'sea horse', is derived from its appearance in coronal section



# Adult hippocampal neurogenesis for systems consolidation of memory

- The hippocampus (HPC) is required for the initial process of permanent memory formation. After memory acquisition, HPC-dependency of memory recall gradually decreases with time, whereas cortical-dependency of memory recall increases.
- The hippocampus (HPC) is a critical brain region for the formation of episodic memories.
- Damage to the HPC results in the almost complete loss in the ability to form new memories, although previously acquired memories remain intact.

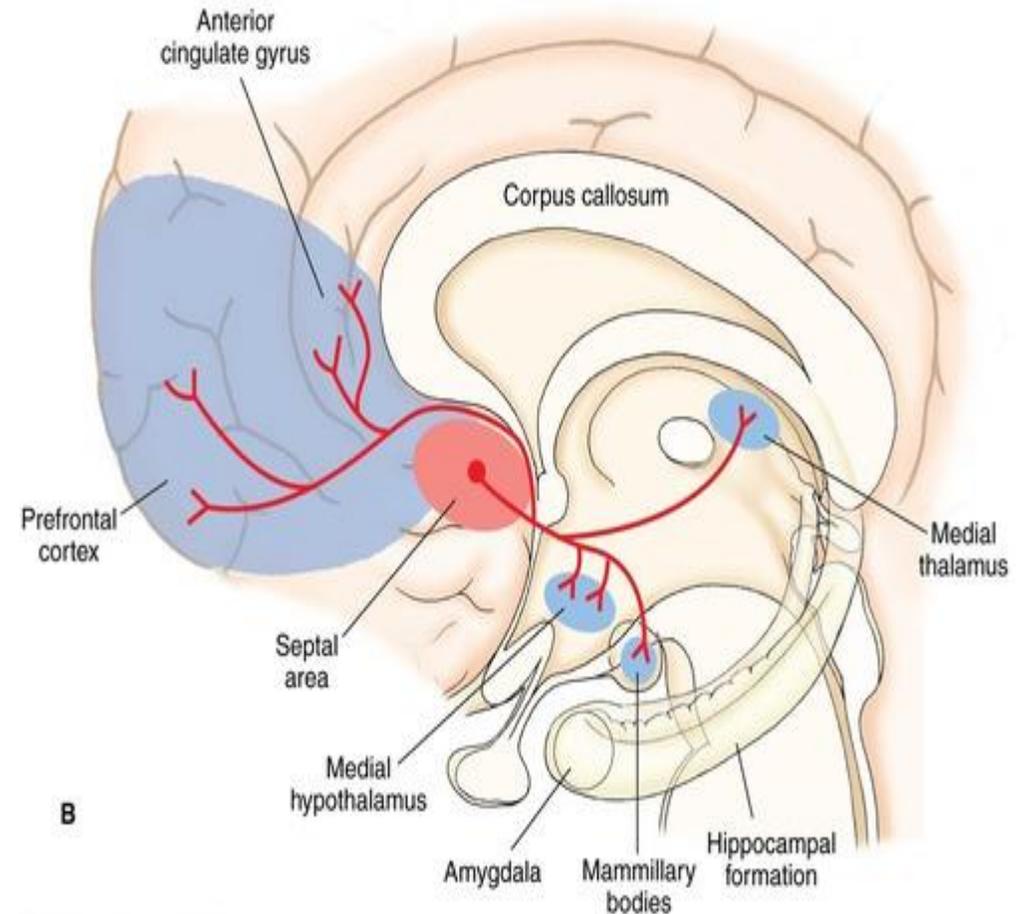
Monkeys that undergo HPC lesions can recall long-term memories but demonstrate severe impairment in their ability to form new memories .

Bilateral removal of the medial temporal lobe in humans, which contains a major portion of the HPC, results in profound anterograde amnesia for new memories and temporally graded retrograde amnesia for previously acquired memories.

The neural mechanisms that underlie how the HPC contributes to acquisition and consolidation of episodic memories, particularly the spatial, temporal, and associative components of episodic memory, has been rigorously studied in rodents.

- In contextual fear conditioning, a behavioral model of associative learning and memory, rodents learn to associate a specific context with an aversive stimulus (i.e. foot-shock). Rats in which the HPC is lesioned 1 day after contextual fear training (1-day post-training is considered recent memory) do not retain the contextual fear memory .
- However, rats in which the HPC is lesioned 28 days after contextual fear conditioning (28-days post-training is considered remote memory), retain the fear memory , indicating that the HPC is crucial for the recall of recent memory, and that HPC-dependency of memory gradually reduces with time. Whereas the HPC is required for the recall of recent memory, the storage and recall of remote memory primarily occurs within a distributed cortical network.
- Pharmacological inactivation of cortical subregions such as the medial prefrontal cortex (mPFC) and anterior cingulate cortex (ACC) impairs the recall of remote memory .

- The cingulate gyrus is a 'satisfaction centre' of brain and associated with the feeling of satisfaction after a meal or after sexual intercourse.
- The septal region is on the medial aspect of the frontal lobe beneath the genu and rostrum of corpus callosum and in front of the lamina terminalis.
- The cerebral cortex in this region is called septal area.
- The septal area has been shown to be a pleasure zone of brain in rats.





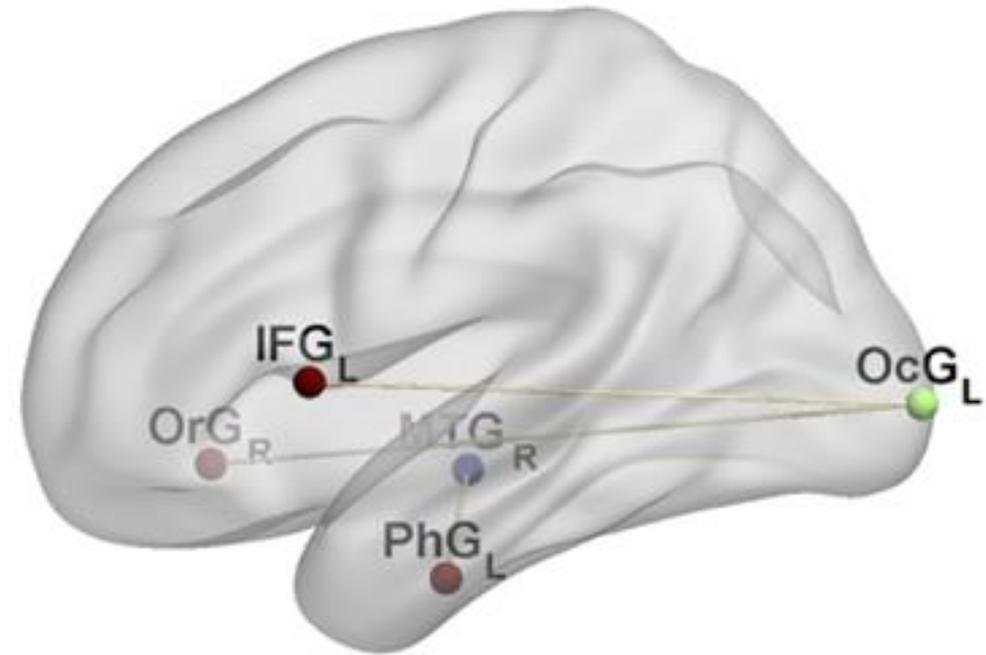
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## **Functional connectivity between the parahippocampal gyrus and the middle temporal gyrus moderates the relationship between problematic mobile phone use and depressive symptoms**

- Problematic mobile phone use (PMPU) is prevalent and increases the risk for a variety of health problems. However, few studies have explored the neural mechanisms that might render adolescents more or less vulnerable. Here, we aimed to identify whether PMPU is associated with depressive symptoms and whether this relationship is moderated by intrinsic functional connectivity (iFC) which is associated with PMPU.
- A growing number of studies are focusing on brain structure and function in addictive behaviors to define neural mechanisms based on advancements in neuro imaging techniques. Emerging evidence suggests that gray matter volume (GMV), cortical thickness and intrinsic functional connectivity (iFC) are altered in addictive behaviors, such as internet gaming disorder.
- A study initially recruited 574 college freshmen from five different majors in Anhui Medical University at baseline, and progressively assess behaviors and mental health 1 year later.

## Results

- For iFC analysis, we found that iFC of the left inferior frontal gyrus (IFG)-left occipital gyrus (OcG), right orbital gyrus (OrG)-left OcG and left parahippocampal gyrus (PhG)-right middle temporal gyrus (MTG) increased in the PMPU group compared with college students without PMPU.



*Fig. 3.* Intrinsic functional connectivity (iFC) of whole brain analysis between college students with PMPU and without PMPU. PMPU students showed increased iFC of left inferior frontal gyrus (IFG) to left occipital gyrus (OcG), right orbital gyrus (OrG) to left OcG and left parahippocampal gyrus (PhG) to right middle temporal gyrus (MTG) than college students without PMPU ( $P_{\text{FDR}} < 0.05$ ). PMPU, problematic mobile phone use

A moderate analysis found that iFC between the left PhG and right MTG played a key role in the association between PMPU and depressive symptoms. The results suggest a neural basis for understanding how PMPU is associated with depressive symptoms in college students.



Abnormalities in gray matter volume in the IFG, lateral orbitofrontal cortex and left parahippocampal cortex in PMPU students compared to those in controls.



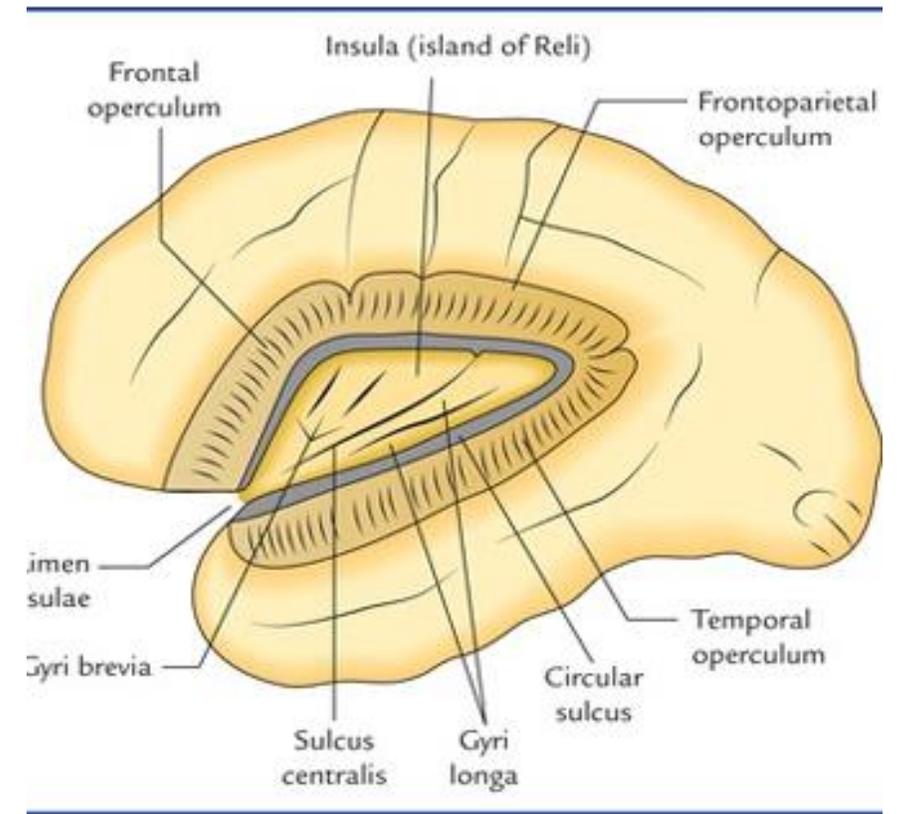
Impairment of the function/ structure of the IFG is associated with executive control and has served as behavioral disinhibition, which is related to the maintenance and exacerbation of addiction behaviors.



The OrG is correlated with decision-making. Thus, it seems that interference with decision-making results due to abnormalities in the OrG and dysfunction of decision-making have been related to addiction behaviors .

# Insula/island of Reil

- The insula or Island of Reil based on its initial discovery by Johann Christian Reil in 1809, is the submerged (hidden) portion of the cerebral cortex in the floor of the lateral sulcus. It has been submerged from the surface during development of brain due to the overgrowth of the surrounding cortical areas and can be seen only when the lips of the lateral sulcus are widely pulled apart. It is triangular in shape and surrounded all around by a sulcus, the circular sulcus except Antero inferiorly at its apex called limen insulae which is continuous with the anterior perforated substance.



# Functions of Insula

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- a sensorimotor region located in the mid-posterior insula.
- a central-olfacto gustatory region.
- a socio-emotional region in the anterior-ventral insula.
- a cognitive anterior-dorsal region.

# Functions of Insula

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- Empathy and social cognition—Empathy is the ability to perceive, understand and experience others' feelings in relation to oneself, implying an emotional and cognitive response.
- Somatic processing and pain—Somatosensory manifestations represent a large proportion of responses elicited by electrical stimulation of the insular cortex in humans. These include paresthesia such as tingling, electric, warm, cold, shiver, and constriction sensations, predominantly in the contralateral face and arm regions. Painful somatic sensations tactile and painful stimulation lead to insular activation.
- Hyperacusis (i.e., increased sensitivity to sounds), as revealed by decreased loudness discomfort levels, was also documented after isolated insular stroke and following insular resection as part of epilepsy surgery
- The primary gustatory area in nonhuman primates is located in the anterior insula and adjoining frontal operculum

