



"What we are doing is trying to understand how the normal development of the brain happens in an embryo, what are the genetic mechanisms required to bring about all the various stages, and once we know how a normal brain works, we are better able to understand why a certain disorder might occur."

Shubha Tole

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Prof. Shubha Tole's elegant work on the mammalian nervous system provides a solid foundation for future studies aimed at understanding human behavior, cognition and emotions. Her research uncovers the genetic mechanisms that shape the development of the hippocampus, cortex and amygdala, the memory, cognition and emotion center of the brain.



Uncovering the mysteries of mammalian brain development

As you read this, your brain is processing incredible amounts of information from the page and from your environment. If you're listening to music as you read, your brain is making sense of it. If you're tapping your feet, it's because your brain has signaled them to do so. The brain as you probably realize is a complex organ. And how it works is inextricably dependent on how it is formed in the first place.

Our thinking, feeling, abilities and inabilities are all because of the circuitry in our brain. Prof. Shubha Tole studies how the brain's wiring diagram is designed and implemented. The "how it's designed" is a question of evolution. The "how it's implemented" is studied in development.

The mammalian brain consists of several highly specialized parts. The cortex is where cognitive functions – perception, understanding, making connections between sensations, language – are controlled. The hippocampus is responsible for recording memories and a structure called the amygdala mediates our emotional responses. Prof. Tole studies these three structures and has discovered common programs that control their development.

Disorders in any of these structures lead to learning disabilities, behavioral problems and abnormal emotional responses. Scientists have been trying for decades to understand these disorders. However, in order to understand what goes wrong, they need to first figure out how it's all put together in the first place, during normal development.

Prof. Tole has tried to do exactly this. She went back to the beginning, to when the brain starts to form in the mammalian embryo. What she discovered, both for the evolution and the development of the brain, is fascinating. She examined embryonic mice, but the insights would be expected to apply to human development also.

Her discovery was that a protein called Lhx2, acts as the "creator of the cortex". Without this protein, the cortex simply can't be formed. She also discovered a signaling center, a "lighthouse" in the brain, which signals nearby cells in the embryo's brain to become the hippocampus, the recorder of memories. Her work tells us why this amazing structure forms where it does, and what signals are needed for it to form. Tole's discovery is pretty amazing because we have now begun to understand the blueprint of the most complex computer we know, the brain!