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How experiences shape the developing brain and impact neurological diseases

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ABOUT THE LECTURE

The brain has approximately one billion neurons, which form thousands of connections with each other as we develop, learn and age over our lifetimes. In her lecture, Hollis Cline shared the ways her lab is uncovering how our visual experiences influence the developing brain, as well as neurological diseases. She discussed how our genes and environment continually interact with each other to shape neural development, including the specific genes and proteins that allow the brain to form new connections.

TOP TAKEAWAY POINTS

1. When we experience something new, neurons start passing electrical signals along different routes in the brain. Over time, these routes become more fixed, and surrounding brain cells and connections start to change in lasting ways. This is called brain plasticity, or the ability of the mind to adapt and reorganize itself. Brain plasticity has been shown to decline as we age, as well as in neurological diseases.
2. Hollis Cline and her lab are interested in how nature and nurture (genetics and the environment, respectively) impact the developing brain and plasticity. They are specifically studying the brain's visual system, which helps the mind with navigation, visuo-motor coordination, facial recognition and much more.
3. Cline and her colleagues studied tadpoles to better understand how visual activity influences growing neurons—all in real-time. By introducing visual stimulation to the tadpoles, they confirmed that visual experience was critical for the development of individual neurons and connections within the visual system.
4. The Cline lab is also interested in understanding the genes and proteins that enable this visual development, which could help uncover therapeutic targets for different brain diseases. They discovered a gene—called plasticity gene number 15—that is important in helping neurons form more and stronger synaptic connections. Then, in conducting additional protein screens, they confirmed that visual experience does increase the expression and synthesis of plasticity proteins.
5. As Cline and her colleagues continue to synthesize key visual proteins, they have made another critical discovery about the most highly expressed plasticity protein. Her team found this protein relied on visual stimulation to become activated, while also blocking other proteins from being synthesized while it was active. Cline highlighted that this allows the cell to have control over the flood of new proteins, which can be used to build new connections and refine the connections triggered by the visual experience.