

Optogenetics

Optics: The scientific study of sight and the behavior of light, or the properties of transmission and deflection of other forms of radiation.

Genetics: The study of heredity and the variation of inherited characteristics.

What is Optogenetics?:

- Experimental biological research.
- Control the cell of living animal tissues.
- Used to control behaviour in animals (trigger or blocking fear or pain responses). They allow researchers to use light to turn cells on/off. With remarkable precision and resolution (down to individual cells or even regions of cells) in living, freely moving animals.
- Optogenetics research is new.
- 2004-2009 were the years that it was a huge study today we are doing more advanced research.
- Usually found in neuroscience. Can be found in cardiac tissue, stem cells and the development of organisms.

Technology:

- Genes from single- celled organisms, certain algae, and bacteria are used to study specific behaviours in animals. This known as microbial opsins, produce proteins that function as light- sensitive pumps, activating the production of electrical current in cells by directing the movement of charged ions across the cell membrane in response light.
- Genetic tools are used to target the opsin gene to certain cells. Targeting ensures that the opsin proteins are made only in specific kinds of cells.
- Cells in the brain that are not targeted to receive opsin genes will not produce opsin proteins thus the non-targeted brain cells will remain unresponsive to direct light.
- Optics are used to aim precisely timed pulses of light at specific cells. This is preformed while subject carries out a behaviour of interest the electrical current activates the targeted cells. Researchers can the determine whether specific kinds of electrical activity in cells produce the behaviour of interest.

Application:

- Behaviour and physiology, providing insight into movement, navigation, learning, memory, metabolism, hunger, thirst, respiration, sleep, blood pressure, reward, motivation, fear, and sensory processing.
- Clinical discoveries have also been made helping to shed light on cellular activities associated with conditions such as Epilepsy, Parkinson disease, Huntington disease, stroke, chronic pain, obsessive-compulsive disorder, drug addiction, depression, social dysfunction, anxiety.

-Determined which cells and connections across the brain were important in defining and assembling the different features of anxiety, including respiratory-rate changes and risk avoidance, into a distinct behavioural state.

-The emergence of optogenetics as a research tool also helped, national- scales brain- research projects, such as the Brain Research Through Innovative Neurotechnology's aka (BRAIN) initiative, which was launched in the United States in 2013

Ethical consideration:

-Design of a first-in-human optogenetics experimental trial has already begun for the treatment of blindness.

-Invasive genetic and electronic interventions that results in irreversible and permanent modifications of an individual's nervous system

-Uncertain benefit to patients

-Risk of irreversible physiological alterations optogenetics requires a reassessment of the ethical challenges for protecting human participants in clinical trials, particularly at formative stages of clinical evaluation. This study explores the evolving ethical issues surrounding optogenetics' potential harm to participants within trial design, especially focusing on whether phase one trials should incorporate efficacy as well as safety endpoints in ways that are fair and respectful to research trial participants