**INTRODUCTION: THE BRAIN AND BRAIN SCIENCE**

The video starts by elaborating on the difference between the brain and the mind. The mind comprises ideas and purpose, much of the psychological aspect. On the other hand, the brain is looked at from a psychological aspect. The electric and chemical composition of the brain. We are then taught about the localization of the different sections of the brain with respect to the function they need to perform. Moving on, we were taught about the basic structure of the brain the neuron, and its structure for a better understanding of the synapse. Dale’s dogma suggests that a neuron can make an excitatory or inhibitory synapse. The connectivity of the brain occurs due to the neocortex, which in its human form is the most complex. It has layers that transfer information to each other and to other neurons. Research shows that the number of neurons does not determine the complexity of the brain, it is the number of synapses that really sets humans at the top. Neurons have two types of connectivity, first the local connectivity and other the large-scale connectivity. Further, we have different ways to know about the brain and its function. We can perform the behavior-behavior experiment where the external behavior is controlled and the responsive behavior is studied(psychology), similarly behavior- brain activity and brain-brain activity.

**HUMAN PSYCHOPHYSICS**

The "Human Psychophysics" is an overview of the relationship between stimulus and sensation, and how psychophysics can be used to measure perception in humans. Psychophysics was previously described as an "exact science of the functional or dependence relationships between bodies and souls," and now it is basically how physical stimuli affect our subjective experiences and perceptions.

The video explains that humans can perceive stimuli within a certain range of intensities, and discusses the visual display and the level of detail and color that can be perceived. The contrast sensitivity function is introduced as a measure of the ability to detect differences in brightness or contrast. Trichromacy, the idea that three primary colors can be used to create all other perceptible colors, is also discussed. Psychophysics is presented as a powerful tool for making accurate predictions, as seen with trichromacy.

The importance of precise measurement of perception is emphasized, as it can help to examine the underlying neural workings of the brain. The Weber-Fechner law and the just-noticeable difference (JND) are explained, along with how the relationship between JND and baseline stimulus intensity suggests a logarithmic encoding of stimulus intensity.

The video also covers methods for conducting psychophysics experiments, such as the 2-interval forced choice detection task, which eliminates the requirement for decision criteria and allows the quantification of performance by a single value - the threshold. The methods of constant stimuli and the staircase technique are also discussed as ways to measure threshold and improve efficiency- The method of constant stimuli involves taking multiple values at different stimuli and plotting a smooth graph, but it can be inefficient due to the large number of required trials.  In contrast, the staircase technique is a more efficient method for determining threshold levels. It involves first figuring out roughly where the threshold is and then focusing the trials on that specific range by adjusting the intensity accordingly. By using the staircase technique, researchers can save time and resources while still accurately determining threshold levels for various stimuli.

It  covers the 2-interval forced choice discrimination task, which measures the point of subjective equivalence and the just-noticeable difference. Perceptual biases are also discussed, and it is explained that the point of subjective equivalence may not necessarily be equal to the point of objective equivalence. Overall, the "Human Psychophysics" video provides a detailed introduction to the field of psychophysics and the methods used to measure perception in humans. The importance of precise measurement and the rigorous techniques developed to avoid confounds due to decision criteria or response bias are emphasized throughout the video.

**BEHAVIOURAL READOUTS**

In typical neuroscience experiments, it is common to study animal behavior in order to understand the strategies they use for decision making, the types of memories they form, and the qualities of those memories, as well as how they perceive sensory information, among many other things. As neuroscientists, the goal is often to relate behavior to neural activity.

The behavioral readouts in neuroscience vary depending on the species being studied and the specific research question being addressed. For example, reading out swimming behavior from fish is very different from reading out flying behavior from flies. Neuroscientists also care about different levels of granularity depending on the questions being asked. Sometimes they only need to know what decision a monkey is making, while other times they want to know about tiny little nose twitches it's making.

Behavioral readouts can be used to study decision making, complex movements, learning and memory, and internal state. A common behavioral paradigm to study decision making is the Two Alternative Forced Choice Task, where animals have to make a decision between two choices, but they cannot verbally communicate their choice. Therefore, researchers must develop a behavioral readout to determine the animal's decision.

One example of a behavioral readout for the Two Alternative Forced Choice Task in mice is to have them turn a wheel one way if the grating is on the left side and the other way if it's on the right. Another example is to have two spouts and have mice lick at one or the other to indicate their decision. Monkeys, on the other hand, often use a joystick to indicate their decision or look to the left or right.

In a study, mice were recorded while performing a delayed 2AFC test. During the task, the mice were presented with stimuli on one side or the other, and after a one-second delay, they licked one spout or the other to indicate their decision. The delay was implemented to segregate the act of perceiving the stimulus from the act of making a decision.

**LIVE IN LAB**

Decision-making in animals is studied in this video. The entire video has been filmed in a lab and various instruments have been explained by the instructor. Two different ways to analyze the decision-making in animals are ephys and wide-field imaging. In the wide field, of the imaging experiment the computer rig sensors that deliver both auditory and visual stimuli. In the wide-field imaging technique, the behavior of the mouse has been controlled. A combination of blue and violet led has been used to excite the GCaMP, which in turn sends the green light. This green light is detected and sensed by the camera. There are several techniques used to synchronize the data and display it in a form experts can infer.

**SPIKING ACTIVITY**

The neurons are the basic unit of the nervous system. The spikes are the outputs that we get from the neurons. The various spike patterns in spikes arise due to the properties of neurons. The properties of these neurons are subject to change depending upon the situation. The term "spiking activity," also known as "action potential," describes the electrical activity of brain cells. When a neuron receives enough information, it produces an action potential, also known as a spike, which is a quick, transient shift in electrical potential. The neuronal networks that underpin many cognitive and behavioral processes are created as a result of this electrical spike, which enables neurons to communicate with one another. A neuron's membrane rapidly depolarizes during an action potential, which causes voltage-gated ion channels to open and let positively charged ions like sodium (Na+) flood the cell. The neuron is further depolarized by this inflow of positive ions, and this leads to a positive feedback loop that raises the membrane potential to its maximum. The membrane repolarizes and returns to its resting potential when the membrane potential reaches a particular point at which voltage-gated potassium (K+) channels open, enabling K+ ions to leave the cell. The spiking activity of the neuron is very crucial for a lot of activities like doing involuntary actions like perception, motor control, and cognition.

**Summary by: Srishti Chandra and Manasvi Nidugala**