Synapse formation, function, and development of the retinotectal map

Talk by Martin Meyer (MRC Centre for Developmental Neurobiology, Kings College, London) on 16/03/10 hosted by Dr. Will Wood

During development, the nervous system produces many more neurons than needed in adulthood. These neurons are then paired down until the connections are very refined. This refinement allows our sensory organs to transmit vital information to the brain, and for it to be processed and understood. Neurons from the retina send axons into the brain to make synapses (connections between neurons) in a region called the Thalamus. This pathway is commonly called the optic nerve, and its connection means that light hitting the retina is represented in the brain. How these connections form in such fine detail has been of great interest to scientists for many years.

Martin Meyer from the MRC Centre for Developmental Neurobiology, King's College London has utilised two existing techniques to study this delicate process. Using the Zebrafish as a model, he fluorescently tagged two molecules; a protein in the axons was labelled red, and a synapse related protein was labelled green. When viewed under fluorescent light, and in combination with time lapse microscopy, this allowed retinal axons and their new connections during development to be seen.

Most of the connections made didn't last very long; the average life span of a new axon branch was only 19 minutes, and less than 20% of the branches lasted for over three hours. This raised an interesting question: what caused one branch to persist, when another was destroyed? To answer this question, Meyer looked at the process of events that lead to the formation of a stable axon branch. The most stable branches were those where the machinery to form synapses was laid down quickly after a branch was made. This seemed to give branches a 'foundation' upon which a long

lasting neuron could grow. Those branches which didn't first form a synapse were more likely to be retracted and degraded.

Before Meyers work, axon stabilisation during development appeared to be a random and variable process. The use of well established techniques such as fluorescent tagging, in combination with newer technologies such as time lapse microscopy has enabled a whole new view of the field. This work could prove indispensible in applying our knowledge of neural development to regenerative medicine, in particular, targeted re-growth of axons after disease or injury.

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