Time: Monday, November 9, 2015　13:30-15:10
Place : NIG B202 (Library 2F), sent via remote lecture system
Title: Developmental Biology IV / Integrated Brain Science I,II
Topic: Hebb's rule for synaptic plasticity
Lecturer: Akira MUTO

Article:
Zhang LI, Tao HW, Holt CE, Harris WA, Poo M.
A critical window for cooperation and competition among developing retinotectal synapses.
Nature. 1998 Sep 3;395(6697):37-44.
http://www.nature.com/nature/journal/v395/n6697/pdf/395037a0.pdf

神経系の発生では、どの神経細胞同士が結合するかどうかはシグナル分子によっておおまかに規定されますが、さらに神経細胞の活動にも依存して正確な結合が確立すると考えられています。神経細胞の活動が神経細胞同士の結合の強さを変化させる現象（シナプスの可塑性）は、また、学習・記憶の基礎としても非常に重要です。神経細胞同士の結合の強さの変化が活動依存的であることを端的に表す言葉として、"Cells that fire together, wire together."（「同時に発火した神経細胞同士が結合する」）というものがあります。これは、1949 年にヘブが提唱した概念で、ヘブ則（Hebb's rule)として知られます。ヘブ自身はもう少し詳しく、"When an axon of cell A is near enough to excite a cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that As efficiency, as one of the cells firing B, is increased."（「細胞 A の軸索が細胞 B を発火させるのに十分近くにあり、繰り返しあるいは絶え間なくその発火に関与するとき、なんらかの成長過程や代謝変化が一方あるいは両方の細胞に生じ、細胞 B を発火させる細胞の 1 つとして細胞 A の効率が増加する」）と著書で述べています。
　今回紹介するこの論文は、発生時期にあるアフリカツメガエルのオタマジャクシの網膜神経節細胞（＝細胞 A)と視蓋神経細胞（＝細胞 B)との結合に焦点を当てて、実際に両者の間でヘブ則が成立することを示しています。さらに細胞 A と細胞 B の発火のタイミングが逆になってしまうと結合が弱まるということを示し、タイミングの重要性を説いています。今回の授業では、ヘブ則という重要な仮説を支持し、さらに時間のパラメータの重要性にまで言及した重要な実験結果を読み解きたいと思います

In neural development, signal molecules roughly determine which neurons should be connected. Further refinement of the connections requires neuronal activity between the two

neurons to be connected.

Activity-dependent changes in the strength of neuronal connections (synaptic plasticity) are of the central importance in learning and memory as well as during developmental of the nervous system. This activity-dependent neuronal wiring is known as "Cells that fire together, wire together." This is a simplified saying of what Hebb proposed in 1949. In his book, he stated, "When an axon of cell A is near enough to excite a cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that As efficiency, as one of the cells firing B, is increased."

The study presented in this paper shows Hebb's rule exists between the retinal ganglion cells ("cell A") and the neurons in the tectum ("cell B"). Furthermore, they found that the timing of cell A's activity and cell B's activity is crucial and determines whether the connection between cell A and cell B will be strengthened or weakened. Thus, timing is everything. In this lecture, we would like to read one of the seminal papers and appreciate the experimental results that not only support the Hebb's postulate but also further provide the important temporal parameter to quantitatively describe the postulate.