腦科學、教育學習、與模式外推：以大腦科學為基礎的教育暨學習之研究

Brain Science, Education and Learning, and Model Extrapolation: A Brain-Science-Based Study of Education and Learning

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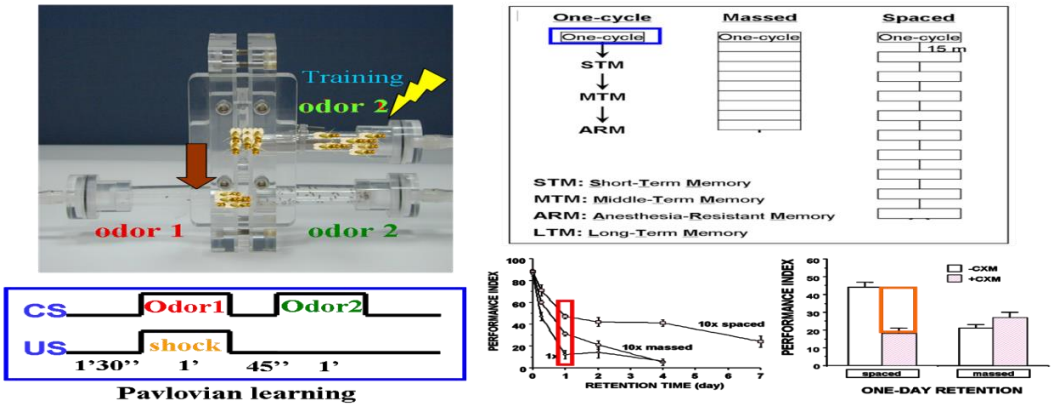
By referring to the result derived from Professor Ann-Shyn Chiang's experiment on training drosophila's olfactory associative memory with punishment, we find that there is a correlation between the formation of drosophila's long-term memory and the performance of drosophila's learning. This experimental result is insightful in that it implies that, as for the case of human being's learning, we can also improve our performance in learning by regulating the formation of our long-term memory. The experiment follows Pavlov's classical conditioning on associative learning. In drosophila's case, drosophila is trained by pairing the odor with the electric shock so as to make the drosophila to form an impression of the connection between the odor and the shock. After repetitive training, the drosophila exhibits a conditioned response to the conditioned stimulus (the specific odor) when the conditioned stimulus is presented alone—that is, even when unconditioned stimulus (the shock) is not administered. The experimental result shows that, after drosophila going through an "uninterrupted continuous training and learning" process, a short-term memory that links the smell and the pain of electric shock will be lost after less than a day; but if going through an "intermittent (spaced) training and learning" process, drosophila instead produces a long-term memory that links the smell and the pain of electric shock, and this memory can last for several days and is not easy to be erased.

Compared with the problem of ineffective implementation of teaching methods and learning strategies, the implication indicated in the experimental results of Professor Chiang's team on drosophila's associative learning is: by referring to the learning pattern of model organisms generated from the experiment—especially the pattern of how these model organisms enhance the regulatory mechanism of their long-term memory, we may be able to develop teaching and learning models and textbooks so as to be able to find more effective solutions to many nowadays teaching and learning problems.

As for the evaluation of performance in learning, we apply the spatial-temporal structure (hereafter, s-t-s) theory of the brain, which is proposed by a Germany-born Canadian brain scientist and psychiatrist Georg Northoff, as the fundamental brain theory to do the job. The s-t-s theory of the brain is originally used for detecting a

person's psychiatric condition, but, by following the similar pattern of detection, it can also be used for evaluating the effectiveness in learning. According to the s-t-s theory, the brain can transform the relevant spatial-temporal (s-t, hereafter) information of the world in order to pair this piece of information with the s-t information of the brain itself. If there is an incongruent or an-isomorphic relation between these two pieces of s-t information—that is, if there is incongruence between the world's status and the brain's status, then the status of the person's mind is in a mal-functioning condition; and if there is a congruent or isomorphic relation between the world's and the brain's statuses, then the status of the person's mind is in a good condition. As a consequence, mind is regarded as nothing but the manifestation of the corresponding status between the world's s-t structure and the brain's s-t structure. A psychiatrically healthy person can align smoothly the s-t-s of his/her mind to that of world, many mental disorder cases show that the patients suffer the mal-functioning of the alignment mechanism. As for evaluating the effectiveness of learning, we can postulate that, when a learner is in a good learning condition, the s-t-s of the learner's brain should somehow be able to align with the s-t-s of the learning object, otherwise it would show that the learner's learning is not in an acceptable condition.



Olfactory associative long-term memory experiment on *Drosophila*: the odor/shock learning experience obtained from spaced training is more likely to form protein-synthesis-dependent long-term memory than massed training does.

Prof. Northoff presenting his s-t-s theory in a workshop **Prof. Northoff in his new book launch event** **Prof. Eifring presenting his research project**