A Testable Application of Nonlinear Whole Neurobiology: Possible Transformation among Vision and Other Sensations

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ABSTRACT

Different sensation systems are usually independent each other. Our collective open out the potential of blind children, and found through a period training of time, some children by touch or nose or ear can distinguish different colors, even simple figure and numbers. From this and other research, we propose a hypothesis: The neural excitable cell is continuously induced and excited, and then grow out new synapse and dendrite, and the feeling system, hearing system, smell system, etc., may joint to visual system, and form a new neural network, and achieve finally a transformation among vision and other sensations. Further, we propose some possible tests, for example, for trained mammal, etc., and research possible theories. It is a testable application of the nonlinear whole neurobiology. This may build a bridge between modern science and traditional culture, religion.

Key Words: neurobiology, vision, nonlinearity, sensation, transformation

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1. Introduction

Usual biology based on the anatomy takes much great successes (Tuchwell, 1988; Squire *et al.,* 2008). But it is mainly a reductionism of continuous subdivision. So far, various sensation systems are generally independent each other. A very important sensation is vision, which is widely investigated (Marr 1983; Farah 1990).

Granit, Hartline and Wald investigated the basic physiological and chemical process of vision. Hubel and Wiesel (1962; 1963; 1965) investigated the information processing, binocular interaction and the functional architecture in the visual cortices. These investigations are all world-famous great contributions.

The computer vision is researched (Hopfield, 1982; Jain *et al.,* 1991). Dronkers, *et al.,* (1996) discussed a new brain region for coordinating speech articulation. Finney, *et al.,* (2001) searched visual stimuli activate auditory cortex in the deaf.

Based on the inseparability and correlativity of the biological systems, we proposed the nonlinear whole biology and four basic hypotheses. It may unify reductionism and holism, structuralism and functionalism (Chang, 2001; 2012a). We discussed the nonlinear whole medicine (Chang, 2012a). In this paper, based on our practice, a testable supposition on transformation among vision and other sensations is researched.

2. Our Practice, Some Strange Phenomena and General Vision

In 2012 and 2013 summers, our collective opens out the potential of blind children for 9 person-times. By using a combining method between scientific and special ways (Chinese traditional Qigong), we found training through a period of time, and then some children by

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touch or nose or ear can distinguish different colors, even recognize simple figures and numbers. Moreover, the Research Institute of Somatic Science of Yunnan University and searchers of Chinese somatic science already had hundreds experiments of "know words by ear", even found some other "special functions".

In fact, the Six Sense-organs Inter substitution on eye-ear-nose-tongue-body-thinking in Buddhism as a type of functions is not strange. Christianity, Islam, Taoism and some religions have many similar descriptions.

Usual vision transfer system is the two channels: 1) retina→lateral geniculate nucleus (LGN)→superior colliculus→area pretectalis →visual cortex. 2) retina→colliculus→ pulvinar thalamus→visual cortex (Nieuwenhuys *et al.,* 1979; Shou, 2010).

Primary cortex in brain is called striate cortex. It is known that 30 fields in cortices relate to vision, and these structures and functions of visual cortices are very complex. The macrocircuit interacts of these cortices, and within which more microcircuits divide the work and together, then form vision. In region of higher visual cortices the visual channel becomes very complex. Thirty cortices regions project parallel processing almost unlimitedly each other (de Yoe *et al.,* 1987; Livingstone *et al.,* 1988).

Color of objects depends on strength of light. Relative brightness is also different for different colors. If strength is very weak, object will be not color (Feynman *et al.,* 1964). When the brightness of object lies in lower scotopic region, only rod works. The visual sensitivity of rod is the highest, and its reactive threshold is lowest, and low thousands than cone. It corresponds to human visual adjustment in dark section. This is namely blind for complete dark.

Hearing of brain relates to nuclei of lateral lemniscus (NLL), inferior colliculus (IC) and thalamus. When mammals grow up, their audition frequency becomes higher from low, and narrower from wide. Infancy mammal tunes audition only for low frequency. Their hearing function has plasticity. Winberger (1998) researched physiological memory, characteristic and mechanisms in primary auditory cortex on the receptive field (RF). It is closely related with NMDA (N-methy1-D-Asperate). Probably, the visual frequency is also different, such baby may see, we cannot see. Visual systems of higher animal differentiate more careful, reversely, visual systems of lower animal differentiate more rough, so they show some special functions.

3. Various Sensations and Our Hypothesis

Based on the practice and research, we propose a hypothesis: Assume that the neural excitable cell is continuously induced and excited, and get into an excited state or stimulated state, and then cell may transform structure due to information and energy, and grow new synapse and dendrite. Further, from this the feeling system, hearing system, smell system, etc., may joint to visual system, and form a new neural network (Hopfield, 1982; Rumelhart *et al.,* 1986).

Somatic sensations include feeling, in which sensitivity of extremity is high than trunk, and sensitivity of finger is higher. Many researches shown that the potential of finger open easily. Various sensations achieve finally thalamus, which is an important relay station of much sensory fibers projected to cortices, and may make primary analyze and synthesis for various sensations.

We should investigate the relations among vision, feeling, hearing, smell and other systems. We think, different sensations may possibly joint, transform each other under a certain condition.

This hypothesis is based on the synaptic plasticity (Hammond, 2008), and general plasticity of visual system for very young mammal, for which there has a critical period (Hubel *et al.,* 1962). Further, the adult mammal has also the visual plasticity (Yinon *et al.,* 1985; Fregnac *et al.,* 1988). Zohary, *et al.,* (1994) and Thoenen (1995) investigated neuronal plasticity.

Chino, *et al.,* (1992) discussed four possible neural joints of visual system. But, these joints all originate from retina. Synaptic responses undergo short- and long-term potentiation (LTP) of long-term changes of synaptic efficacy (Squire *et al.,* 2008).

It is known that in the forepart brain grows to form new synapse, and for baby this jointed numbers are very big than adult. Then these synapses have an elimination period, or a shear period and some superfluous joints

will die out. In 1970s, Huttenlocher collected various postmortem brains of different ages, and observed that prefrontal cortex for baby is different with callan. The synaptic number of brain sensation regions for small-fry metaphase achieves mature level, and synaptic number of prefrontal cortex increases continuously, and then begins decrease. But, S. Blackmore pointed out: recent scientists found some brain regions, in particular, prefrontal cortices (PFC) grow still for youth hood even then, and they will come through great change for former twenty-thirty years of life (Toga *et al.,* 2006).

This is related to the mechanism of information processing by visual cortex. Pessoa *et al.,* (2008) subdivide visual processing into low-level, intermediate-level, and high-level components. Long-term potentiation (LTP) is a persistent increase in synaptic strength, and occurs in a variety of neural synapses. It possesses "classical" properties: cooperatively, associativity and input specificity (Brown *et al.,* 1990; Bliss *et al.,* 1993).

According to the areas of cerebral cortices (Felleman *et al.,* 1991; Shou 2006), the sensation cortices include visual cortex (17, 18, 19, etc., area), hearing cortex (41, 42 areas), taste cortex (43 area), olfactory cortex (28 area), body sensation cortex (1, 2, 3 areas). It is a linear reductionism that different areas are absolutely distinguished.

In brain optic nerve and suprachiasmatic connection to olfactory bulb and hypothalamus. Olfactory nerve joints with optic nerve, and vestibulocochlear nerve relates to hearing. Gustation and olfaction are related closely. Gustation relates to thalamus, hypothalamus and amygdala, and they relate also to channel of olfaction into nerve center.

Based on various known characters of brain, we conjecture that the key regions of the transformation among vision and other sensations are cortex and its hippocampus, which connect to olfactory cortex.

Some regions of total visual system are damaged or blocked, their results are visual barrier. But, it is usually unable that total system, in particular, brain part, destroys. Majority of blind originates from retina damaged. Therefore, the damaged parts are different, the cure ways and training effects are also different.

Under inducement or outside excitation various sensation systems may joint each other. Their basic principle of internal growth is the biological power of self-adjustment, self-repair and self-organization, especially for children. They all are nonlinear interactions. It corresponds also to the adaptability of brain. In physiology this are the transforms of different receptors of special senses for changed energy and coding. For example, fingers may have visual cells. Distances between ear, nose and eye are closer. Their nerves may probably joint to visual system, and produce visual effect. We may excite the corresponding auditory system by music and song, etc.

The robustness of brain may keep the whole and colligation of various sensations (hearing, vision, etc.), and derives a unified conclusion. Usual channel of sensation systems is labeled line. But, some concrete cases are not very clear. But only retina irradiated by light may produce vision, and neuron by mechanical or electric excitations in visual channel may also produce vision, but it is distorted. Coding process and adaptive mechanism of receptor are all very complex. For instance, the adaptation of rod and cone is related to change of their chemical elements, and adaptive production is related to change of some functions of synaptic transmission and sensory center in the channel.

It corresponds to that sodium channel excited by action potential make an activation state from standby state. Adult corresponds to no-live state, so their some functions lose.

Continuous training is also a learning and memory process. Probably, this will change some channels of neural networks. The training corresponds to learning theory (Squire *et al.,* 2008) and the nonlinear mechanism of memory (Chang, 2012b), and repeated practice may form new crunode, structure and network.

4. Some Possible Tests and Theories

A testable experiment is: Scientists may train the blinded animal, for example, a set of young mammal, then dissect their brain, and compare their different functions and different results. And these results may compare with shark and mole, etc. This test should be easy.

Children are lovely angels. Their growth is not completely to finalize the design,

so their potentials open out easily. But, it must exist in a certain threshold, *i.e.,* the training and excitation need a certain time. We think that it should be universality, and is independent of nation, country, etc. Adult growth is already to finalize the design, and various sensation systems are sclerosis and separated, so their potentials open out hardly. But a few adult has some joints among different sensory systems, congenial or through hard training. This suggests a possible application for blind agedness.

Moreover, some children train together, effect will be better. It corresponds possibly to the population oscillation among neurons. There are the phenomena of synchronous oscillation among the visual cells.

We may explore these structures of brains for trained men and some men with special functions. Further, if we collect various postmortem brains of these men, dissections will be able to test our hypothesis.

This research is more general development in neurobiology. If this hypothesis is affirmed, it may even undergo surgery on the joint.

So far, visual mechanism is not very clear. Hartline nonlinear equations describe the visual lateral inhibition phenomena. Further, the phenomena are found not only in visual, and in hearing, feeling and other sensation systems. This is a commonness of various sensation systems.

The hypothesis is a testable application of the nonlinear whole neurobiology. It is also a synergetics (Haken, 1983; 1985; 1990; 1996) among different sensation systems. Such we may apply various synergetic equations, for example, the basic equations for phases of two coupled neurons (Haken, 2002):

$$\ddot{\varphi}_1 + \gamma\dot{\varphi}_1 = Af(\varphi_2) + C_1, \quad (1)$$

$$\ddot{\varphi}_2 + \gamma\dot{\varphi}_2 = Af(\varphi_1) + C_2. \quad (2)$$

Some possible theories are nonlinear equations, network, Hodgkin-Huxley equations and so on. Hopfield (1982) nonlinear equations are:

$$C_i \frac{du_i}{dt} = -\frac{u_i}{R_i} + \sum_{j=1}^{n} T_{ij} f_j[u_j] + I_i. \quad (3)$$

Here i=1,2,...n, $f_j[u_j]$ is the nonlinear function. They describe the dynamic neurons. From the equations Arbib and Amari described the network of neurons with competition and cooperation, which has a character of "winner taking all". When visual system is linearization, eye is first and engrosses vision. By a similar Hopfield method, the dynamical behavior of neural network combines the associated memory, and hearing, feeling, olfaction, etc., are combined to an attractor (e.g. apple), so the same result (apple) will be observed. It is also the parallel distribution processing (PDP) researched by Rumelhart, McClelland, Hinton, *et al.,*, in which the activation rule and change of coupling mode are consistent.

Hartline nonlinear equations are extended, and may probably be used to vision and other sensations, and their transformations. McCulloch-Pitts neuron network may simulate the conditioned reflex.

Theoretical basis of this hypothesis is possibly the nonlinear Schrödinger equation. Tarlaci (2005) discussed quantum brain dynamics, general quantum neurodynamics, quantum field theory and consciousness. Haken (2002) discussed that the mesoscopic neuronal cooperatively and some fundamental experimental results on the synchronization among groups of neurons correspond to the quantum entangled functioning state of neurobiology. Erol (2010) researched basics and concise relations between Schrödinger wave equation and consciousness/mind. It is also analogous with a quantum entangled state.

It may apply the complex networks of modern physics and chemistry (Strogatz, 2001; Albert *et al.,* 2002; Boccaletti *et al.,* 2006). In this case the neural network may produce new joints, and may introduce nonlinear interactions.

It relates to perception and spatial cognition. Both cognition processes of computer and children by other sensation systems are very consistent: from local to total. Combining the computer vision technology, we may develop the n-dimensional space to n sensory systems. Further, it may connect memory and consciousness from vision proposed by Crick (1994).

According to the Chinese traditional medicine and Five Element Theory, the five colors (green, red, yellow, white and black) for eye correspond to the five tastes (sour, bitter, sweet, hot and salty) for nose and the five

musical scales for ear. It is a special relation among vision, olfaction, hear. According to modern physics, light of different colors has different energies, wavelengths and frequencies, and possible different sounds. Therefore, their sensations should be different. A possible mechanism is that light shines color of figure, and emit light wave, then hear and receipt different frequencies. Such this should relate to light of ambience, and frequency is obvious for brightness condition.

5. Conclusion

This is the whole sensation systems, which are related by nonlinear interactions each other, and is similar with the nonlinear mechanism of memory (Chang, 2012b). It forms possibly new dendrite for closer neurons, and forms new axon for far side neurons. They transmit the corresponding electric signal to visual center of brain, and form together a shape, which is synthesis even from hearing, feeling and olfaction, etc.

After, our collective will remain to open out the potential of blind children. It is propitious to improve the life quality of these blind children. Therefore, this gained wide support for most in all society. Of course, it is oppugned normally by some men. If this hypothesis is approved, it will be benefit to society and humankind.

If this hypothesis based on some practices is validated, it will be a pierce into various sensation systems separated absolutely in present physiology, be also an explanation for some strange phenomena in Buddhism, various religions and so on.

Further, this may build a bridge between modern medicine and traditional culture, and between science and religion.

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