WHY CHINESE ARE THINKING DIFFERENTLY?(CULTURAL AND NEUROLOGICAL CASE-STUDY)

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Abstract

Are Chinese students using different "mental program"? Have their performances natural causes or educational causes? The goal of the present article was to investigate the neural correlates of Chinese mind-brain and how it works and notice the importance of all these for education. We were focused in some relation between language, mathematic and music as activities and try to find scientific explanations at the brain's functional level. We were particularly interested in awareness of educationist about the role of cultural background to improve semantic memory in their teaching. We try to show some recent outcomes of neurosciences studies about functional locations and brain's areas that are mostly activated during accomplishing different tasks. Educationists already empirically knew that children like music and also teachers insist on semantic memory in their teaching, but they lack the scientific explanation of the process and how important could be the results of neurosciences researches for their activities **[10].**

Keywords: Brain's function, cognitive neurosciences, education, memory, mathematic, music

Introduction

Pragmatic explanation leads us to focus on local area using tacit values and assumptions. In such a case accepting cultural and anthropologic guides it maybe the better way to understand what's going on in a different cultural process of learning. Neurosciences showed us that if we study different cultures with their mental programs, we can find different functional structures of the brain. There are some possible questions we can put and try to find out more about how other cultures can work well.So, by example, are Chinese students using different "mental program" and are their brain really working differently? Are their performances (or failures) due to native structure or could have educational causes? In order to clarify we need to mixt anthropologic method of observation with recent modern technology used for study brain's function.

We started this study guided by the philosophical framework of Chinese culture, more precisely the *holistic presupposition* in which "everything is connected with everything else". First of all, let have a look in their beliefs and models of learning. It is quite obviously that Chinese students are good in mathematic. The explanation regarding this fact must be more that they have a very diligent behavior and they have the habit to study very hard. If we try to check their ancestral believes we will learn from their anecdotic stories that people act and think about themselves as being connected to everything and their activities are also related each other's. Chinese people believe that human beings must be conceived as a total entity and never look only a part of it. All activities they are doing (some of them very different) seems to improve each other's. The

tasks like doing music, writing, or playing swords all can improve their rational acts like counting, planning, doing business.

After we observed and find that they are deeply embedded in their cultural environment we take into consideration also some lectures from cognitive neurosciences and recent results of modern technology. Recent studies claim that even brain is such complex organ it is possible, using modern investigation like fMRI (*functional Magnetic Resonance Imaging*) to identify brain's areas that are activated when people are accomplishing different tasks **[21]**. Some questions arose when we try to understand Chinese style of learning. How is possible to solve tasks which request cognitive logic/mathematical skills by the agents with Asian cultural background? That kind of background embedded contextual language, non-monotonic logics, and holistic philosophy of daily life. Are there may be some scientific proves at neural/functional level which can explain Chinese style of learning?However we are not actually producing here a medical rigorous study, but using their results we can make new connections between medical researches and education.

After we had some observation for a while on Chinese culture and languages (during our stay in China, when we were working with students, learning Chinese, practicing T'ai chi quan) and corroborate them with recent cognitive neuroscience, we emphasize the following hypothesis: *The itinerary (and localization) of the neural - information is shorter in Chinese's brain than in Westerner's brain.* This is possible because since the beginning the Chinese characters are embedded by meaning as everybody knows well. The habit, that Chinese have to practice instrumental music at a very early age, develop intuition and increase speed of understanding something new, like new theories or new subjects. Both language and music require more semantic memory. We call "itinerary", the chemical and electronic processes during activities that can be detected by modern methods (fMRI, PET).

Recent researches in cognitive neurosciences show that musical education can improves the semantic memory, and reduces visual memory **[5], [20], [3].** That must be a confirmation for the hypothesis which claims: The same anatomical brain can function differently in a different culture and create different patterns as "learning program".

If we wonder why Chinese can perform so well mathematics (and many other activities) we can find out that their education as cultural background (natural language) an, as well as, the official present curriculum in nowadays, are interested in improving the semantic memory.

At the beginning we have kept in our mind the presumption that there is a *functional equivalence* between mental and al brain's function (mind-brain) **[7]** and we have selected some outcomes from science and neurosciences regarding the architectural neuronal function and mental organization as cognitive patterns.

So, if we have a look in the history of science we can find that like in others sciences, by example in medicine or psychiatry, in psychology researchers were focused mostly in anomalous or dysfunctions of human behavior, but meanwhile it becomes relevant also for normal people. This was indeed the case for explanation of *dyslexia*, disability in reading. (Malfunctions need explanation and good practice to help people. Another reason why scientific research had target human dysfunctions is that professional ethics not allow us to use in experiments normal persons.)

Following this topic of neuroscience confirmation for educational area, we found sources which can show some clues for learning process, knowledge as activation of different parts of brain, neuro-cognitive patterns.

Some relevant researches about language

In 1929,Orton (1929) [15] emphasizes that *dyslexia* is due to a kind of neuronal organization in patient's brain.

Briefly, he just pointed out that all difficulties in reading, we are talking about, are blocked paths of *visual neuronal information* from **right hemisphere** to the **lefthemisphere**, where images and sounds should be decoded and, become meaningful. He asserted that the left hemisphere can't take control on this process. Also, he explains the case of *ambidextrous* whose can use successfully both hands, as a process due to the fact that none hemisphere is taking control in order to become dominant.

According to Orton, the path (itinerary) of information in human brain use for process of reading is this:

1. Visual representation of the letter;
2. Representation of the sound associate with the letter;
3. Representation of this combination as a meaning decode.

This point of view was taken by some researchers, from Georgetown University in Washington, D. C. whose have designed new experiments, using modern methods like fMRI (*functional Magnetic Resonance Imaging*). *http://www.humanities.uchicago.edu*

Nowadays, in neurosciences is frequently used fMRI, or PET (*Emission of Positrons Tomography)*. With fMRI, we can measure cerebral process in a high resolution allows us to see the metabolic changes, like regional consume of oxygen or glucose during motors or cognitive activities.

So, to measure the sanguine flow in brain during activities, scientists have selected a group of 41 youngsters, between 6 and 22 old ages. That group was relatively homogenous as level of intelligence and has the ability to read capitals, simple words and group of letters without meaning. Researchers have been focused on patients who can't read properly and try to observe the itinerary of sanguine flow between cerebral hemispheres. They could observe an increase of the quantity sanguine flow in a **left hemisphere** during *visualization of letters*. This fact shown, in their opinion, that patients have a dysfunction as an interrupted sanguine flow and that is possible the cause of *dyslexia*. Also, they had noted that, even there are some variations from languages (French, English and Italian) the area of brain, where *dyslexia* is located, is in the same part of brain, **left lobe behind parietal**.

Another experiment designed by Paulesu and al., (2000) **[16**] showed that this disability is bigger for Italian patients than for English ones. That could happen because Italian is more phonetic language than English. Italian language presents more identity between letter and sound than other European languages. However the location is settled as being in the **left lobe behind parietal zone**. It seems that it is already known and nothing could be done forward **[6].**

But, surprisingly, this point of view has been not confirmed by a new experiment designed by **Li Tai Han (**http://www.sciencenews.org).**Li Tai Han** and his colleagues emphasizethat disability to read has *different* location for people who spoke a language which is not phonetic at all! At first, in his experiment **Li Tai Han**, has used as patients a group contain 16 students from a primary school in Beijing, and later he enlarged that group at 65 students. During experiment, designed in the same way that others have been before, they had discovered that the part of brain (of Chinese dyslectic children) a *small activationand less sanguine irrigation* in the **left hemisphere**, **[6]** but in **vertical sub-frontal area**, not **behind parietal**! It seemed be very surprising knowing that zone is for decoding meanings **[8].** In the brains of all these patients, the meaning is *built not unifying the letter with a sound like in European languages, but directly in* **vertical sub-frontal area**! **[2]**

However, that apparently was not such a big deal, because obviously, the Chinese character-word dissociation view has over-emphasized the visual-orthographic property of

Chinese characters but ignored other dimensions. Tan, (2000), **[24]** Written Chinese is a morphemic system that is based on the association of meanings with graphic forms. Moreover, all Chinese characters are pronounceable units. Cognitive research on Chinese reading has well documented that, during identification of a Chinese character, both its visual-orthographic component and its phonological and semantic attributes are activated quite rapidly. **[17], [18], [19], [24]**.**Tan** designed some experiments and dissociate single character (with precise meaning) and composed words (two characters with vagueness meaning) in order to establish if they have different locations and activation in the brain map, respectively right hemisphere and left hemisphere. The results were astonishing. After they use fMRI they concluded that the left frontal regions are relevant to the semantic activation of both Chinese single characters and two-character words. Peak activations were localized within the **left prefrontal** region (BA 9) for single-character as well as two-character words, implicating that common regions are recruited to maintain access to semantic information in reading Chinese. The results of researches do not support that the Chinese character word dissociation hypothesis that assumes **right lateralization** in recognizing single characters and **left lateralization** in recognizing two-character words. There was no dissociation between the regions responsible for isolated characters and the regions responsible for two-character words. Tan (2000), **[24]**

So, even it is about character with precisely meaning (single character) it is also decoded by Chinese brain in the left hemisphere, **[4]** not in the right, in occipital (responsible for visual representation of letter like our phonemes). Why this really is happening, might be explained by studying carefully the structure of language as a mind organizer. In Chinese languages the mostly characters (which are not "letter", phoneme) has at the very beginning, more or less, a definite meaning. Furthermore, we can see that *the path of neuronal information* could be shorter and it is attending directly the area responsible for decoding meaning, precisely ***left hemisphere, left prefrontal vertical sub-frontal*** zone**.**

Our comment here could be this one: If things are happening in this way, all this researches lead as to the idea that their mind works differently and they use a specific *neuronal network as functional correspondent for knowledge patterns*. Accepting the cultural anthropologic explanation we must use the native language as an important clue for pragmatic explanation and understand that Chinese brain's function is really different than ours.

When Western children learn and understand mathematic concepts and operation, neural information use in their brain the itinerary shown before. All mathematical signs should be „translated" and transferred as neuronal information from **right** to **left**; from **right hemisphere, occipital** (area responsible for representation of letter or digit), to **temporal**, (for sounds), to the **left**in**vertical behindparietal**, and finally, to **verticalsub-frontal**. Chinese children/people use to understand quickly because neuronal path of information shouldn't pass all these zones through the area called ***vertical behind parietal*** as Westerners are doing, the path is directly to **vertical sub-frontal** zone, that one responsible for meaning.

We can see that experiments were designed before with the presumption: *path of neuronal information in reading (letter, digit) process is visual itinerary and that pattern must be considerate as universal*. Precisely, learning math is grounded in *visual/linguistic intelligence*. **[9]** And it is, apparently, the neuronal pattern for European style of learning process, but not for other people from other cultures.

Nevertheless, we can emphasize that Eastern, Chinese children has a different itinerary (may be Asian has kinesthetic intelligence) in order to lead to a meaningful sign. And this should be a biological and cultural advantage. For learning mathematic, is important to give a contextual meaning for every sign we are using in exercises. Anytime when we solve mathematic exercises, signs are connected to a *context, by example,* digit 1, 2, 3...must

be substantial quantities, or orders, or elements, aspects of real, concrete world. Also, it is assumed that notation in geometry (A, B) could be read as a sentence like „let's take a line A, B between..." If for us, Westerners to learn math symbol is like a re-re-contextual signification and long itinerary, for Chinese and for any Asian who speak a non-phonetic language is easier to decode directly in frontal, because they are used to do so in their native language! More than, we can assume that any neuronal process used in learning math are similar to learning language, but depend on language. Not all language can help and find quickly the meaning. As cognitivists emphasized before, single signs (letter, digit) are not producing automatic semantic topics. Syntax alone cannot produce automatically a semantic, as Searle (1991), **[22]** emphasized before.

Again, we can pointed out that a contextual language become a cultural advantage and can constructs *neuronal and mental patterns* that can be easier activated during tasks in classroom. Corroborations of observed facts with modern technology must go further and accept the framework of pragmatic explanation that stipulate the role of local culture as "mind-brain sculpture". It enable researchers to take in consideration *cultural background* which can explain better the process of leaning mathematic or other possible subject which require *semantic decoder, because of natural language.*

Musical cognition

Neurosciences researchers found also that musical cognition can improve the *semantic memory*Creutzfeldt(1989), **[5];**Rauscher, (1993/1995), **[20];** Burbaud, (2003), **[2].**

For Chinese,all these happen because language is not only contextual one, but also tonal language. Discussions about the role of music and musical cognition are larger then we can quote here. We can point out only some of them like experiment called *Mozart Effect* which settled that music can improve some ability to solve problems tasks Cuevas, Bridgett, (2000), **[1].** Some researchers go forward and claim also, using modern methods that the surface of the activated areas is quite larger for musicians than for non-musicians.If *Mozart Effect* experiment wasn't very clear (may be not properly designed) other laboratory experiments showed that is very important for mind organization to practice instrumental music, not only to listen music. (http://www.sciencenews.org)

Zones, apparently not connected with musical center in the brain, like motor center, emotional center could be improved by playing violin or piano. Researchers found that during this kind of practice, spatial orientation, speed and intuition could be developed, too. **[20]** The good function of all this brain's areas seems to be also very important in increasing the ability to operate with mathematical concepts. Bridgett, Cuevas, (2000) **[1];** Schmithorst, Holland, (2004) **[23]**New experiments and researches designed with *aphonic* people by **Gomez,** Peretz, Danuser (2007), **[11]** emphasis that disability to make distinctions between sounds is located in **interior frontal gyros**, but not in **right cortex** comparing with normal musical persons. More than, they settled that emotions activation, strong related with music, are located in **prefrontal cortex, ventral-medial** in **amygdaloidal** zone. (www.BRAMS.org)In other words, doing music, practice of it, could be, according neuroscientists, an excellent way to improve all systems, groups of neurons, and patterns for cognition. Music seems to be a real **meta-program** to re-set sub-programs or increase their functions.

Music and semantic memory

Schmithorst and Holland **[23]** wrote in 2004 a very interesting article „The effect of musical training on the neural correlates of math processing: a functional magnetic resonance imaging study in humans". Their approach has as a main topic the possible relation between music and the success in solving mathematical tasks. Using fRMI method, for two adult groups, musicians and non-musicians, they observe that during practicing instrumental music,

*semantic memory is increasing and visual memory is decreasing***.** It makes possible the ability to operate easier calculus and to have much intuition speed of correct equality. Summarizing their approaches about the role of instrumental music and long practice of music, it looks like this:

1. The *increase* of cerebral activity in **gyros, left hemisphere** and **prefrontal cortex**;

2.The *decrease* of visual associations, **primary cortex** and **left inferior parietal** zone;

3. Development of semantic memory and ability for abstract, intuitive representation of numerical quantities during practice of instrumental music.

In short, we can accept that all differences observed by using fRMI shown us that, there is an architectural organization and function of brain and it is connected to the cultural context. It is relevant if we practice instrument music from early childhood or not, in family or not, daily or occasionally.China everybody use to play an instrument, especially in family, practice a kind of traditional sports, and kept all them in classroom, in official curriculum**.** However, we understand why Chinese children and people are practicing music gladly in classrooms but we can also get the importance of it. So far, many authors have studied how music is made in different countries taking as example Korea, Japan or China Gregersen et al. (2000), **[12]** During listening and during practicing instrumental music many areas of brain are suddenly activated and enlarged: **auditory temporal cortex, visual primary cortex, motor cortex, frontal gyros**. Music is an excellent way to improve all system. It is like brain knows how to re-start himself and correct his activities, if it is necessary. Music is more than a *meta-program* which processes like a driver in computer; even brain is not at all a computer. May be there are many other meta-programs as life-philosophy, therapeutic sessions which could have similar roles**.**

Educational considerations

What kind of implication could rise from all these for our education?

If Chinese characters have meaning and it is always decoded from the left hemisphere directly to frontal zone that means the semantic memory is much more used than visual memory. Practice of instrumental music is activating many other zones of the brain. Music, tonal language, and semantic memory at least these kinds of activities can lead us to a better understanding of Chinese mind as different learning program and different neural architecture. Educationist must be opened to such kind of topics, accept and enhance their teaching with totally awareness of similarities or diversities of brain's function. Some authors believe that there could be many others, not only for semantic memory and intuition, but also for cognitive metaphoric knowledge, emotional equilibrium which can improve brain's function. [Ja¨ncke, Shah, Peters (2000), **[13];**Khalfa et al. (2000), **[14];** Gomez, Peretz, Danuser(2007), **[11]** Regarding music we can ask as teachers: What kind of music should we use in the classroom? Can music make our students better, or more, treat mental diseases? Can we borrow from other culture good practices if they are?

Summarizing, we can explain better Chinese accomplishments in mathematic learning, not only due to their diligent behavior, but also due to their culture and school culture which facilitate semantic memory, using different neural and mental programs. (We can talk also about traditional sports, cut/paper or other activities they are mixing, but it wasn't, in fact, the topic of this article, and need another possible approach.) All thisexplain how cultural background could produce a different functional architecture of brain and mind (program) and we can call this perspective of knowledge neuroconstructivism. This new perspective needs, of course, a new method. If neuroscience researches are related to cultural anthropologic observation, we can assume that this kind of explanation is not pure biologic explanation. They must be correlated with social explanation. It might be fruitful to ask

ourselves more about what subject, what method, what kind of tasks are appropriate to children in primary and secondary schools in order to make them better.

We conclude that researchers about Chinese brain' function found that is apparently different. It was only a case-study in one possible different culture that are using a non-phonetic language and music. May be we can find also differences for other possible languages and cultures. So far, we hope that more trans-cultural researches will be developed in future. Neuro-constructivistapproaches **[25]** must be designed into interdisciplinary perspective in order to become fruitful**.**

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