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Semiotic modeling and education

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Abstract: Within the rich legacy left by Thomas Sebeok, there is a critical concept of semiotic modeling that directly addresses the core of the philosophy of education in the light of semiotics and affords valuable implications for the nascent interdisciplinary field of inquiry of *edusemiotics* or *educational semiotics*, essentially a philosophy of human knowing. The present paper argues that the concept of modeling as in Modeling Systems Theory has elevated us above the long-standing debate over nature versus nurture in the discussions of education and sheds light on the dynamic co-shaping relationship between the modeling subject and its models, as well as the fact that human brain function bio-culturally, as is evidenced by a crucial concept in the field of neurophysiology known as "neuroplasticity" and relevant experiment findings from neurophysiological and cognitive researches over the past few decades. It further claims that life-long education is not just something educators and educatees should keep advocating, but more of a *de facto* state of human existence. It concludes by confirming that in future edusemiotic studies more attention can and should be directed to the determination of the subject's semiosic stage, for which the semiosic capacities of the subject are to be further explored, tested and facilitated.

Keywords: education, edusemiotics, modeling, Sebeok, semiotics

1 Introduction

When Thomas Sebeok passed away at the beginning of this century, he left behind a rich legacy of crucial thoughts that have been affording to this day most profound implications in the interdisciplinary studies of philosophy, culture, language, communication, biology, and cognition, in addition to an unprecedentedly wide international semiotic web he created and helped create of semioticians and "crypto-semioticians" (Sebeok 1979: 9).

Whereas the enormous potential of all these thoughts is to be further exploited, an equally important yet largely understudied lesson from Sebeok is his greatest contribution to methodological studies in the field of education,

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which, as in many other fields, was made through his innovative ideas in the inquiry of semiotics (Petrilli and Ponzio 2005: 224; cf. Danesi 1998, 2000). The culminating point of these ideas is the critical Sebeokian concept of *semiotic modeling*, which directly addresses the core of the philosophy of education in the light of semiotics.

2 Semiotic modeling

The meaning assigned to the Sebeokian concept of modeling has undergone some fundamental changes over the years. Sebeok's first mentioning of modeling in the written form appeared in his paper "Semiotics: A survey of the state of the art" (1974: 211–264), although he addressed the then-Soviet notions of secondary modeling system and model in as early as August 1970 (Sebeok 1988: 15). He construed it in 1974 as follows:

> The notion of a secondary modeling system, in the broad sense, refers to an ideological model of the world where the environment stands in reciprocal relationship with some other system, such as an individual organism, a collectivity, a computer, or the like, and where its reflection functions as a control of this system's total mode of communication. A model of the world thus constitutes a program for the behavior of the individual, the collectivity, the machine, etc., since it defines its choice of operations, as well as the rules and motivations underlying them. A model of the world can be actualized in the various forms of human behavior and its products, including linguistic texts – hence the emphasis on the verbal arts – social institutions, movements of civilization, and so forth. (Sebeok 2001: 139)

Over the following thirty years, Sebeok was successful in devising his own "model" of modeling systems and, in cooperation with Marcel Danesi, perfecting it into a three-tiered *Modeling Systems Theory*, or simply known as *MST* (Sebeok and Danesi 2000). By this stage of theorization, not only modeling had been redefined as "the innate ability to produce forms to stand for objects, events, feelings, actions, situations, and ideas perceived to have some meaning, purpose, or useful function. The form may be imagined, in which case it is called a *mental image*, or it may be something externalized, in which case it is called a *representation*" (Sebeok and Danesi 2000: 1, 196), but the term "model" had also been singled out and defined, for the purpose of MST analysis, as follows:

> a model can be defined as a form that has been imagined or made externally (through some physical medium) to stand for an object, event, feeling, etc., known as a referent, or for a class of similar (or related) objects, events, feelings, etc., known as a referential domain. An imagined form can be called, simply, a mental form; a form made externally to stand for a referent can be called an externalized form. (Sebeok and Danesi 2000: 2)

In this new framework of MST, the four traditional basic types of forms that can be identified as "(1) signs (words, gestures, etc.); (2) texts (stories, theories, etc.); (3) codes (language, music, etc.); and (4) figural assemblages (metaphors, metonyms, etc.)" (Sebeok and Danesi 2000: 1) have been incorporated and recast under the rubric of "forms of meaning" or simply models. In accord with these critical developments of conception, the central topic of contemporary semiotics, the Peircean *semiosis*, was also redefined in a fairly acceptable manner:

> The ability to make models is, actually, a derivative of semiosis, defined simply as the capacity of a species to produce and comprehend the specific types of models it requires for processing and codifying perceptual input in its own way. Semiosis is a capacity of all life forms; representation, on the other hand, is a unique capacity of the human species, which develops during the neonate and childhood periods. (Sebeok and Danesi 2000: 5)

Before MST was officially put forth in 2000, Sebeok's semiotics had already highlighted two crucial point in relation to education. First, learning and semiosis are as co-occurring and complementary as life and semiosis are converging; second, all types of human learning, which are life-long processes that are coupled with life-long education, are modeling processes than can be understood as natural "flows" from iconicity, that is, primary modeling, to cultural symbolism, to wit, tertiary modeling. They all happen in the cultural context. Children are exposed to all types of education available and thus model their knowledge and skills that are gradually acquired first through the body in an iconic manner, followed by the indexical and symbolical ways as they grow into adults and become older (Danesi 1998: 61). In this sense, it is rightful to claim that Sebeok's typology of human modeling is pivotal to the semiotics of education (Petrilli and Ponzio 2005: 225).

It is clear that MST is inherently congenial to what is now known as *edusemiotics* (Semetsky 2010, 2015; Semetsky and Stables 2014; Stables and Semetsky 2015), or *educational semiotics*, an interface between theoretical semiotics and the philosophy of education. As it turns out, semiotic modeling can prove to be extremely informative, if not only echoing, to the studies of this nascent yet groundbreaking field of inquiry, which was officially launched as such at the 12th World Congress of the IASS/AIS in Sofia, Bulgaria in 2014 (Semetsky 2015: 130).

3 Edusemiotics as philosophy of human knowing

Granted, it is noticeable that relating semiotics to education is not a completely new practice, as is evident in quite a number of programmatic articles, state-of-

the-art reports, collective volumes and special issues of journals of semiotics, education, and philosophy (cf. Nöth 2010; Stokoe 2000; Nuessel 2007; Augustyn 2012), but what should also be noted about edusemiotics is that it is more of a deep connection between semiotic philosophy and the foundation of education than a practical application of semiotics into education. In this sense, MST, the theory about the nature of semiosis pertains more to the central theme of edusemiotics than "semiotics in education." Only in this light can we argue that "the main implication of Sebeok's modeling theory for education is of a *methodological nature*" (Petrilli and Ponzio 2005: 229).

What should be added at this point is that, if semiotics can be rightfully understood to be naturally cognitive, then edusemiotics should also be rightfully understood as the philosophical foundation of education. This peculiar relevance of semiotics to education was aptly described by Sydney Lamb in his dialogue with Sebeok and John Regan in an interview on the theme of "Semiotics in Education" at a seminar at the Claremont Graduate School in the spring of 1987. He remarked that "obviously education is information processing par excellence; therefore, education is right at the heart, or should be right at the heart, of semiotics. Education is a process in which the educatees, students, are building information structures within their minds" (Sebeok et al. 1988: 9). These information structures within minds are exactly what are defined as internal models, to wit, mental images or internal forms of meaning in MST.

It is worth noting, however, that the title of this interview article risks being misleadingly convenient and also contradictory to the fundamental messages it has actually succeeded in transmitting, which confirm an *de facto* nature of today's edusemiotics, that is, it is a field of inquiry that combines theoretical semiotics and the philosophy of education, instead of being something as simple as an application of semiotics in education, which is a frequently seen idea but would no doubt undermine what should be rightly understood about edusemiotics. Given its content as such and very likely for want of a better term at the time when it was written and published, it now seems fairly reasonable for us to change the title of this article to "Semiotics and Education," or even "Education in Semiotics" as clearly pointed out by Lamb, which would capture the due significance of semiotics in relation to education.

According to Danesi (1998: 61), the principle of natural learning flow implies that the semiosic capacities of the subject, to wit, the learner, and the determination of the subject's semiosic stage – rather than what is to be learned – should therefore be the focus of education. The question then is: what is so special about human semiosis? Or, what sets human semiosis apart from that of other animals? Is it culture? Or is it nature?

4 Semiosis above the nature versus nurture debate

It is common sense that education change people and make them as they are and what they will become. It is mainly from this conviction that arise the power and civil expectations of education. Appealing as this statement may sound, it does border on a blank-slate empiricism if no circumference is placed upon it.

In 2013, I published some results of my then ongoing research as "Human Brains Function Culturally: Semiosis under the Culture-driven View" in the *American Journal of Semiotics* (Yu 2013). In it I claim that, based on empirical studies on the differences of neural activities pertaining to distinct cultural modeling systems, we have "clear evidence that the human brain exists in an adaptive relation to the corresponding culture, in which semiosis proves to be one of the fundamental mechanisms of how culture exerts its influence" (Yu 2013: 135). At the present stage, while maintaining the same stance, I believe it is reasonable to highlight another dimension to this title, which would otherwise risk being criticized as supporting an "empiricist" point of view, despite the fact that that paper "proposes a co-shaping interactive relation between the human brain and culture" (Yu 2013: 135).

Compared with "culturally" alone, "bio-culturally" is likely to serve the purpose much better. At the very least, it bypasses the long-standing and unnecessary bickering between rationalism and empiricism when it comes to the matter of education and focuses on the role that is played by the factor of "change," as in "habit-change" developed by Semetsky (2015), in the developmental process of human understanding. Ultimately, the validity of the long-existing yet unwarranted distinction between nature and culture will therefore be problematic.

The main reason for this claim lies in the critical element that gives semiotics a transdisciplinary nature: semiosis. The semiosic process, in our present case edusemiosis, or educational semiosis, unfolds in and only in relations, instead of any personal agency. MST posits that in the origin of all human representational activities there is a sense-inference and that "all model-making efforts in infancy and childhood are initially grounded in the experiential realm of the senses … this initial stage of knowing can be called a cognizing stage, while the stage when the sensory units of knowing are transformed into representational forms can be called the recognizing stage" (Sebeok and Danesi 2000: 174, 199). Therefore, when processes of teaching and learning take place, we can observe that on the external side, representations from outside the subject compose a necessary, if not sufficient, sine qua non for the unfold of any

subsequent semiosic relation; whereas on the internal side, the subject's psyche partially structured by its genetic make-up comes in an interactive play with the input. Partiality for either nature or nurture simply cannot provide the complete picture.

Edusemiotics strongly rejects anthropocentrism (Semetsky 2015: 137), but what separates human semiosis from that of other animals, provided that the "embodied mind" is not an exclusively human trait in the light of biosemiotics?

In most introductory course books on linguistics, the distinctive features that are summarized to set human language apart from animal communication include such properties as arbitrariness, duality or double articulation, cultural transmission, displacement, and productivity or creativity, among some others. Of all those listed, perhaps the least controversial distinctive feature is productivity, which "essentially means that the potential number of utterances in any human language is infinite," whereas the others are more or less involved in unsolvable debates over the difference of degrees. Not only that, linguistic creativity also refers to the fact that meanings in human language are not deadlocked or fixed. If we test this unique property against semiotics, it can still be established that creativity, particularly the pluralistic nature of meaning generation or interpretation is what can distinguish human semiosis from that of other animals, and human education from animal teaching and learning as well. For humans, "meanings are evolving" (Semetsky 2015: 135).

5 A dialectical "subject-model" relation

Human meaning generation is a rather complex process yet remarkable achievement, which unfolds in the form of internal model constructions, which in turn have profound impacts on the subject per se. It is a matter of common sense that when we are perceiving and understanding certain works of art, other people and even our own comportment as models, we, as the involved subjects, can indisputably feel certain impacts, at least in the form of psychological or emotional arousal or stirring. The question is: what is the underlying mechanism for this arousal or stirring? In other words, what is the relation between the subject and its models in meaning generation?

In Sebeok's semiotics, the world of the subject, or the Umwelt, is always in a process of becoming and constantly changing through the process of semiosis on the basis of the species-specific senses. In time, the subject undergoes a two-tiered development on the biological level and the semiotic level and an unavoidable process of aging. The subject is never static, but only lives through a continuation of internal and external changes. On the one hand, there is the

temporal evolution; on the other hand, the inevitable movement in space. These two types of inseparable changes the human subject has to go through exist in a relation of reciprocal causation, inhibiting or promoting one another. Semiotic modeling is in fact a process of subjective creation that has combined biological properties and the semiotic ones. In this process, the subject will construct and shape various types of intricately connected internal and external models, which as a result will exert direct and/or indirect influences on the subject per se, an effect that I call "counteractive shaping." This effect is not only on the psychological level but also on the physiological level, for they are like the two sides of the same piece of paper, simply inseparable. It is in this continuously changing relation of co-shaping that the subject changes the self. In other words, the subject and its models co-shape each other dynamically in the process of meaning generation.

What MST implies is a dialectical "subject-model" relation. On the one hand, it is the modeling subject. Once a subject stops modeling, it stops living and learning. The construction of models is the essential way that the subject comes to know and grasp reality. "These make it possible for humans not only to represent immediate reality, but also to frame an indefinite number of possible worlds" (Sebeok and Danesi 2000: 187). These possible worlds include not only myriads of novel external models that are created by humans, but also the semi-autonomous and even completely autonomous semiosic processes in the domain of the human mind (Yu 2012). As for the latter case, Sebeok had a particular fondness of using the examples of Einstein (Sebeok 2001: 148), Mozart and Picasso (Sebeok and Danesi 2000: 187) to demonstrate the internal working of human visual and auditory modeling processes in the mind that transcend logocentrism. These aspects have great implications for education in that they imply the open-endedness, rather than fixed purposes, of the educational process.

On the other hand, it is the subject's modeling. Both internal models and external models appertain to the subject, or are created by the subject intentionally or unintentionally. Every type of model can be used and reshaped as a form of meaning by the subject. Although in the Moscow – Tartu school of semiotics, modeling is "understood in the cybernetic sense of von Neumann's formulation that the world can be considered as the passive memory of a machine" (Zaliznjak et al. 1977: 47), the receiving ends, to wit, human beings, are not machines. Instead, they are born with subjectivity as specific members of specific species defined by their genome. In terms of development, an individual's subjectivity tends to exist in a dynamic evolutionary process along with the changes of the biological structure, particularly the neurological mechanisms, until the death of the individual. It is this dynamism that has bestowed

upon the subject a type of naturally innate plasticity and provided the conditions for the modeling process and the shaping effect of models on the subject.

6 The basis of the shaping effect: Neuroplasticity of the subject

In all imaginable educational processes, the dynamic co-shaping relation between the subject and models is an essential discussion of a philosophical nature, for which we are able to find substantial relevant evidence from neurocognitive sciences that can well justify the validity of the co-shaping effect. The most typical evidence is a crucial concept in the field of neurophysiology, known as "neuroplasticity," which refers to the "capacity of neurons and neural networks in the brain to change their connections and behavior in response to new information, sensory stimulation, development, damage, or dysfunction."[1]

Before the 1970s, it was scientific dogma that the human brain was a static organ with certain regions so hard-wired as to be responsible for certain fixed functions. Accordingly, the understandings of the function of education could easily fall into the abyss of radical rationalism that partially fixated on the innateness of human learning, at the expense of human experience. However, with the advancement of neurological technology and the increasingly sophisticated equipment over the past four decades, people have started to realize that the human brain actually keeps changing in the entire course of the individual's life. Factors such as external information, human behavior, environment, neurological processes, bodily structures, and so on will directly induce changes in neurological circuits and neurons.

Since the nineteenth century, neurocognitive scientists have believed that it is these neurological circuits and neurons that contain unique core information about the individual, such as memory, emotion, personality, thought, and so on. There are more one hundred billion neurons in the human brain, and the number of interconnections, known as synapses, on and between neurons amounts to tens of thousands times more. This is much more complex than the contents of the human genome. However, this astronomical neurological network as such does not come at birth. Nor is it formed overnight. The reason is that the entire cerebral system is always in a dynamism of change. In terms of ontogeny, it takes time for this dense network to form even a considerable size.

1 Neuroplasticity. *Encyclopædia Britannica Online*. http://global.britannica.com/science/neuroplasticity (accessed 12 December 2016).

The first few years of life witness the most rapid growth of neurons, which send out multiple branches, ultimately forming too many synapses.[2]

At birth, the human infant has already possessed a highly complex synaptic system in the brain regions that are responsible for such advanced cerebral functions as emotion, thought, reasoning, memory, and spontaneous motor actions. Each neuron in the cerebral cortex has around 2,500 synapses. By the time when an infant is two or three years old, the number of synapses even amounts to approximately 15,000 per neuron, about twice that of the average adult brain. Those connections that are not reinforced by sensory stimulation, which is often afforded by external models, eventually weaken, and the connections that are reinforced become stronger. What is remarkable about the power of human education, understood in the broad sense of the term, is that, since the very beginning, it has kept playing a critical role of reinforcing the synaptic connections in its cultural contexts.

When the number of neurons and synapses reaches its peak, it starts to decline. Neurons themselves change in size. Old neurons are replaced by new ones and the synapses that connect neurons inevitably undergo a massive process known as neuronal pruning, or synaptic pruning, which is the most direct exhibition of neuroplasticity. Efficient pathways of neural connections are eventually carved out. Throughout the life of a human individual, these neural connections keep being fine-tuned through the subject's interactions with its environment, or its Umwelt to be specific. During a certain time period of the subject's early childhood, which is also known as the critical period, the nervous system of the individual must receive certain sensory inputs in order to develop properly, as formulated by the sense-inference hypothesis in MST[3] (cf. Sebeok and Danesi 2000: 174, 199). When the critical period ends, there is a precipitous drop in the number of synaptic connections that are maintained. The ones that do remain are the ones that have been strengthened by the appropriate sensory experiences, in particular through processes of culture-specific education.

It is worth noting that even long after the critical period in the subject's life, this massive "pruning back" of excess synapses also frequently occurs during adolescence.[4] Moreover, recent studies have further shown that mechanisms of neuroplasticity change over the entire life span, that is, during developmental

2 Neuroplasticity. *Encyclopædia Britannica Online*. http://global.britannica.com/science/neuroplasticity (accessed 12 December 2016).

3 Aging. *Encyclopædia Britannica Online*. http://global.britannica.com/science/aging-life-process (accessed 12 December 2016).

4 Neuroplasticity. *Encyclopædia Britannica Online*. http://global.britannica.com/science/neuroplasticity (accessed 12 December 2016).

and aging years, both in health and in disease (Pascual-Leone et al. 2011; Feinberg and Campbell 2013). Normally, when having developed to a certain extent, the human subject, like most species of mammals, will have to face a currently irreversible process of natural aging of the neural system. In time, not only neurons will atrophy and die, but blood flow to the brain will also decline. The latter may further the decline of oxygen supply to the brain, which will have a direct impact on the construction of the subject's Umwelt. Moreover, it slows down the syntheses of protein that is involved in the establishment of memory traces and may lead to deficits of learning and memory in the elderly. However, the silver lining is that the aging brain does also form new synapses, which helps to compensate for the neuronal loss and serves as the direct evidence that aging of the human brain entails both degeneration and neuroplasticity. It is based on this piece of evidence that we can rightfully argue for the validity of life-long education.

Over the past four decades since the 1970s, the concept of neuroplasticity has replaced the static view of the brain and cognition, and gained wide acceptance as a complex, multifaceted, fundamental property of the human brain throughout the scientific community. This new favorable stance has obviously afforded considerable support and a reasonable point of departure for our inquiries in edusemiotics. The input and processing of external and internal information acquired in education have a direct shaping effect on the human subject. According MST, it is through the perception and working of internal and external models, to wit, signs, texts, codes, and figural assemblages, that all the above-mentioned information is perceived and processed by the subject and serves as the source of stimulation to the subject. The direct shaping effect that models and their modeling processes, including meaning generation by means internal model constructions, have on the human subject help create its identity, which, again, is a dynamic state of existence that is subjected to constant change.

7 Conclusion: Inevitability of life-long education

While we keep advocating the necessity of life-long education, a point that has been missed is that it may be an inevitable process already. The reason lies in the unstoppable constancy of neurological change during the life span of the subject. The brain simply "does not remain static but, instead, continues to change as the obligatory consequence of each sensory input, motor act, association, reward signal, action plan, and awareness" (Pascual-Leone et al. 2005). In this light, life-long education is not just something educators and educatees

should keep advocating. Suffice it to say that life-long education is simply a *de facto* state of human existence.

Implied by MST, knowledge in the form of external and internal models, shaped by human beings, are not free from change. External models, for instance the common ones that we use in educational activities, a painting, a gesture or even a facial expression, can be easily altered by any perceivable representational actions of the subject. It is simply a matter of common sense. What is truly remarkable is the change of internal models.

As materials and contents of human thought and cognition, internal models are also highly pliable, which gives meaning generation a property of being shapeable. A very important reason for this pliability can be found in the changeability and instability of memory. Implied by MST, internal models are cognized and/or recognized semiotic imprints founded upon the subject's experience. That is to say, memory is the essence of an internal model. Various experiments in modern neurophysiology and social psychology have revealed that human memory and cognitive contents are alterable, even distorted and unreliable in many situations. The reasons are many, ranging from the influence of authoritative figures, implications and guidance of religious convictions, to the subject's subconscious attempts of self-changing to erase early traumatic experiences (Festinger and Carlsmith 1959; Aronson 1999; Defeldre 2005; Steffens et al. 2007). The purpose also varies, but is two-fold on the whole. It is either to dismiss the pain or uneasiness that arise from what is knowns as cognitive dissonance (Aronson 1999; Hart et al. 2009), or to create and increase cognitive harmony and blissfulness, known as synthetic happiness or synthesized happiness (Gilbert 2006; cf. 2007).

Some may argue that not all models are pliable and certain models are relatively fixed and endure across time, but it must be noted that, as a result of human semiosic creativity that is typically exhibited in the activities of teaching and learning, the meanings interpreted out of these "endurable" models may also vary and can be open-ended (cf. Sebeok and Danesi 2000: 105–107).

Since the subject and the models it creates are both changeable, if we can justify the constant shaping effect of modeling (verbal and non-verbal) on the identity of the subject, even after it is already established, in the process of meaning generation in educational activities across the life-span of the subject, it will certainly be a significant enhancement of the principle of neuroplasticity and validate the dynamism of the co-shaping effect between the subject and its models.

The effect of verbal modeling on the human subject can be well summarized by a noteworthy comment from the evolutionary biologist Mark Pagel. According to him, human language is actually a kind of neural audio technology for

rewiring other people's minds and can be used to alter the settings inside someone else's brain to suit the speaker's interests in much the similar way to using the remote control device to alter the internal settings of the television to suit the watcher's mood (Pagel 2011; cf. Pagel 2013). If the semiosic process involved in the verbal communication loop has this deep shaping power, what of the effect of non-verbal modeling on the human subject? Is there a similarity?

A case study that confirms this similarity is about what is termed "power posture" (Carney et al. 2010). Choosing this study as a case in point echoes with fact that the semiosis of non-verbal models was a crucial part in Sebeok's semiotics and can bring to light the fundamental aspect of pedagogy concerning the value of multi-modality. Power posture studies touch on the central essence of self-education and have been attested by interdisciplinary research methods and empirical evidence. Through experiment measurements and contrastive analyses, the researchers have found that the subject, by forcing upon itself a powerful dominant posture, for instance, an opening and expanding gesture, is able to achieve a sense of being powerful and an experience of dominance. Over long terms of repeated conscious practices of using power gestures will eventually change the personality of the subject. To sum up, there is a shaping force in the "language" of the body. Power gesture has actually surpassed the levels of thought and emotion and permeated into physiological structures and functions and influenced the behavior of the subject. New identities both on the physiological level and on the psychological level are forged through the using of a few simple non-verbal behavioral models of power gesture. This process is reported to not only give the subject a sense of being powerful but also induces biological changes to the subject's body, as is evidenced by the records of relevant indexes of the endocrine system of tested subjects. Subsequent experiments have also confirmed the findings (Huang et al. 2011; Stel et al. 2012; Allen et al. 2013; Galinsky et al. 2014).

In terms of internal models, the case is similar, that is, the operational processes of internal models also have a lasting shaping effect on the subject. Take meditation for instance. Neurological experiments in the recent decade have uncovered that long-term meditation, regardless of the types of internal models in the minds of the meditators, can alter the physiological structure of the brain, including the thickness of the cortices and the density of the gray matter, and have permanent influence on brain functions (Lutz et al. 2004; Lazar et al. 2005; Frith 2007). In much the similar way to the effect that physical exercise can enhance the overall functions of the human body, including the brain itself, a long-term appropriate amount of mental labor can also be expected to optimize the physiological mechanism of the brain and improve its functions.

To sum up, the exposure to changing models as well as a changing environment is simply inevitable and the shaping effect of models on the subject is ubiquitous in a continuous process. It not only happens in the neuronal pruning at the early stage of life, but also exists across the entire life-span. Both the subject and its models are highly pliable and shapeable. They are coupled in a dynamic co-shaping relationship on both the physiological level and the psychological level. The notions of a static and stable identity and models of the subject are only of a relative nature. It, therefore, makes perfect sense that in future edusemiotic studies more attention can and should be directed to the determination of the subject's semiosic stage, for which the semiosic capacities of the subject are to be further explored, tested and facilitated.

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