

BRAIN AND EDUCATION

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Education is a natural and universal function in humans. It cannot be dissociated from culture, which is defined as the collective behaviors (or actions) and representations shared by a community, and which are transmitted from generation to generation in the form of units which, by analogy with genes, are called 'memes' (Dawkins). To go even further in this analogy, we could say that education is to memes what reproduction is to genes.

There are a large number of definitions of education, but Durkheim's is probably the simplest: actions carried out by adults **ON** and **WITH** children in order to integrate them into their community and to transmit their culture to them.

To educate therefore consists in giving a child a life model in conformation with the culture of our own community.

Education is as old as the human race, and is as young as every child who has to be educated.

The human being is a social animal in the most extreme form when we consider that every dimension of his or her being belongs more or less in the social domain.

In what I call the central fluctuating state that defines the animal as a subject, the extracorporal space of the human animal is carved out by 'others'.

The apparition of education in the evolution of species is contemporaneous with the apparition of community life, with work, with art: in other words, with the birth of the social aspect of humanity.

Education has no precise origin and belongs to no culture in particular. The human being is a construction of the human being: an autopoietic process.

As Kant said, man is born twice; the first time as an animal (natural birth) and the second time as a cultured being. We can therefore say that man is an educated animal, a proposition which is fundamentally contra-

dictory since the object of education is to reduce our animality. Man is an animal that is not or is no longer an animal.

To paraphrase Kant once more, Man can only become Man by education. He is only what education makes of him. We should note that man is educated only by other men who have themselves been educated.

Education comports a negative aspect as the discipline which removes the excess of animality. As Kant (once more) remarks, man is an animal that, from the moment he lives with other members of his species, needs a master as he is certain to abuse his liberty with respect to his equals.

This absence of a finite natural definition of the human is apparent in the nature of this strange animal, a need equivalent to the need for food, water, oxygen or certain vitamins, it is the *need for others*.

Man cannot get by without man. Each man lives in the hearts of others. This ability for mutual understanding (which Rousseau calls mutual interpenetration) belongs only to the human race and I call it compassion. It is in place right from birth; little by little it allows the newborn baby to penetrate its mother's heart and install itself within by its cryings and tears, and the mother, in return installs herself in the baby's heart.

Compassion means suffering for the sufferings of others, or enjoying their pleasure. In a wider perspective, it means feeling in one's self the passions of others. Compassion requires the effective and affective presence of another person.

It seems to me that compassion is fundamental to education as it implies an exchange of sense with another being. The other, who thinks in me, and in whose place I think.

According to popular opinion, an act or a behavior is apparently a pure reaction by which the organism responds to things happening in its environment. For my part, I consider that the act results from an expressive movement which is secondary to the affective state.

In order words the state or affect precedes the action.

Pleasure and suffering make up a pair which is under the influence of the deep structures of the brain and on which all of our deeds and thoughts are structured.

One cannot confuse compassion and strength of being, but maintain a dialectic relationship. In terms of ontology, compassion is the power of giving and abandonment or the capacity of receiving the other as another. 'Reason is neither the first or the last instance in a human existence' says the philosopher Jean Ladrière.

The most basic experience is found in sensation:

– *Sentio ergo sum*

The knowledge that comes with education is what allows us to build up the mind, in other words the 'me' (I am self).

– *Scio ergo sum*

The heart is often referred to as the organ of compassion. It has long been known that it now ought to be replaced by the brain 'a heart so white' as Shakespeare said.

The human brain shows extraordinary development of its associative areas in comparison with those of other primates, i.e. the parietal and temporal cortices, and most notably the prefrontal, constitute the parts of the brain which attribute values (positive and negative), and discipline: the inhibition and the control of our actions.

The perception of space and environment need to be associated with the active motor explanation of that environment.

The brain is the organ of thought. What does that actually mean? By using the term 'thought', I make no reference to the spirit, I designate solely the processes of categorisation and instrumentation that an animal carries out on its world. There is nothing in that definition which demarcates the human being. The knowledge that the animal has of its extracorporeal space (environment) is registered in its brain in the form of representation and its modalities of intervention are inscribed as schemes for action.

I have proposed the term of 'representaction' to designate these groupings of perception and action.

Action is inseparable from representation. I cannot have a representation of the world without action or without imagining (representing to myself) my action on it.

The human being is characterised by the extraordinary richness and abundance of his or her representactions. These are made in areas of the brain which are more or less specialised according to the information which is transmitted to them. By the interactions of his neuronal networks, the subject discovers the world and representacts it to himself.

Thought is made up of representations, conscient or not.

Language, which is unique to humans, is a group of representactions.

Language represents three functions as a means of communicating with others:

- the *expressive* function, which serves to express emotions and thoughts;
- the *unjunctive* function, to warn or call;
- the *descriptive* function.

The first two functions of language exist in animals, but the third (descriptive) is exclusively human. It is one of the functions of language used in education.

We must also underline two other functions of language which are exclusively human:

- The *argumentative* function
- The *empathic* function

This last is essential as it permits the sharing of affect between two individuals. *Education*, which allows the transfer of representations from the master to the pupil depends on the bidirectional exchange of affect and particularly on the empathic function of language.

There is no form of education that is neutral from the point of view of affect.

In the past ten years, research in neurobiology has been focused on the motor theory of human cognition following the remarkable discovery of the so called ‘mirror neurones’ in the premotor cortex in non-human primates (Rizzolatti *et al.*) and the discovery of an equivalent mirror system in humans. The goal of the motor theory of human cognition is to derive human social cognition from human motor cognition.

Briefly the theory of simulation based on the imitation of the other’s brain activity furnishes physical grounds for compassion and thus allows us to understand not only the sense of the movements carried out by the other but also the affective support for those movements. The brain of the observer could understand the actions of the other by simulating them in his brain without actually carrying them out, and simulates the same sentiments without actually feeling them by activating the same brain structures (example of bilateral lesions of the amygdala after which the subject feels no fear, but also is incapable of recognising the expression of fear on the face of someone else).

Human language represents apparently just one example of mirror motor cognition.

Another important point for education which needs to be discussed here is brain *plasticity* and *implicit learning*. Briefly, research on implicit learning has shown that the brain processes information that is neither attended to or noticed.

Plasticity can be demonstrated in the brain of animals as it plays a major role in memory, particularly in the processes of acquisition and conservation of new information arriving from sensory organs.

In our laboratory, with Pierre-Marie Lledo, we have shown the role of stem cells in the olfactory memory of the mouse. An increase in incoming

sensory information is translated by an increase in the migration of newly formed neurones and this is translated in behavioral terms by an improved memory of odors.

Plasticity exists in the brains of children but also in adults. One particular deep structure of the brain, the hippocampus, is particularly implicated in factual memory and in spatial memory. The hippocampus possesses so-called 'place cells' which are at specific locations suggesting that the HPC creates and stores spatial maps.

Recently, using functional RMN, researchers have studied the brain of people who are experts in spatial navigation, namely London taxi drivers: their brains were scanned whilst they described a complex route they would take to get from one area of London to another. The hippocampus was dramatically activated, and a significant difference was found in the size of the hippocampus between taxi drivers and non taxi drivers.

Other studies have shown the same type of plasticity in the human motor system during the acquisition of new fine motor skills, i.e. the area responsible for finger movement is enlarged and becomes more active after piano exercises in a beginner.

FMNR (functional magnetic nuclear resonance) studies have shown the effects of rehearsal of items i.e. specific verbal information on brain activity in the left inferior parietal cortex, and in the left inferior prefrontal cortex in rote learning. Mental exercises activate the same areas as those that are active for actually carrying out real actions. There is also interesting data concerning the role of linguistic culture in the activation of different brain areas during reading.

One of the most important conclusions of these experiments on plasticity: it is never too late to start learning.

To conclude this too rapid review, I would like to particularly insist on the role of affect and emotions in the quality of learning. Compassion and bidirectional exchanges between the pupil and the master are the cornerstones of learning.

From a strictly bio-anthropological point of view, I shall just make a few remarks.

The classical dichotomy between thought modes is not relevant in terms of biology. Each individual human brain is unique, resulting from not only his genes but also his experience in his environment. There is only one model of human brain.

The universal developmental stages are correlated with critical periods for fundamental acquisitions which are the same for all children.

The acquisition of sensorial capacity (skin) is inseparable from motor experience.

Verbal supports, and particularly their affective components are indispensable in all forms of teaching/learning.

Conclusions

The problems of children at school in the occidental world today, and particularly in France, are based on a misunderstanding of affect, problems of identification with others. Children suffer from a lack of identity; they are not able to forge a personal identity strong enough to allow them to confront the world of others. Children have difficulty in integrating the things they have to learn concerning their own life. The first difficulty is well upstream of actually acquiring any knowledge. Is later learning therefore condemned to impotency? Yes, unless there is an investment in affect, which effectively represents a risk. For this reason, one of the keys for reforming our school system resides in the formation of the teachers. In Africa, because there are no teachers, and particularly in Europe, because the formation period of the teachers is too short, too theoretical whilst at the same time teaching conditions are becoming more and more difficult. The result is clear today in the events in the French suburbs. And it is true to say that when there is no joy in teaching, there can never be a desire to learn.