Proposal for a "gliocentric" brain philosophy

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Present "philosophical foundations of neuroscience" (Bennett and Hacker 2003) are exclusively based on the functions of the neuronal system. But the first and elementary philosophical question should be: why has nature created our brain with a double structure consisting of both the neuronal system and the glial system? Therefore, a real natural philosophy of the brain must refer to the structures and functions of both cell types or systems.

Starting out with the axiomatic assumption that our brain embodies and generates subjectivity, one has to define what we understand by subjectivity: "subjectivity is a phenomenon that is distributed over the dialectic antithesis of the Ego as the subjective subject and the Thou as the objective subject, both of them having a common mediating environment" (Guenther 1976). Admittedly, to transfer this definition of subjectivity to glial-neuronal interactions is a great challenge that I will briefly try to cope with.

I hypothesize that a tripartite synapse may embody a candidate model of subjectivity. In that case we are principally faced with the problem if it is possible to localize in a tripartite synapse at least two different regions where subjective subjectivity (Ego) and objective subjectivity (Thou) may be generated. According to my theoretical model of a tripartite synapse, I suppose that in the panglial syncytium intentional programs are generated and transferred via astrocytes to the synapse (Mitterauer 2006). Therefore, one can delimit an anatomical-physiological region of intentional information processing. Since subjective systems like humans are essentially intentional systems, the glial part of a tripartite synapse could embody the structure and functions of subjective subjectivity.

What the neuronal part of a tripartite synapse concerns, it is connected via sense organs with the environment. Considering that an objective subject represents a distinct (individual) part of the environment, it seems to be reasonable to interpret the neuronal part of a tripartite synapse as a mechanism that could embody a kind of objective subjectivity. In parallel, the synaptic mediation between the subjective and objective subjectivity occurs by means of the environmental information. The environmental information is decisive if an intentional program is computable in the neuronal network and feasible in the environment or not.

It is experimentally verified that glia (astrocytes) exert a modulatory function on neurotransmission (information processing) in tripartite synapses (Auld and Robitaille 2003). In my view, the most comprehensive and experimentally based model of a tripartite synapse has been proposed by Smit and coworkers (2001). Here, the modulatory function of astrocytes is achieved by glial binding proteins that are produced in the synaptic cleft and ready for occupancy of neurotransmitters. If this process is finished, then this astrocytically determined mechanism negatively feeds back to the presynapse, temporarily turning off neurotransmission. After acceptance of environmental information dependent on the occupancy of the set of receptors on the glial binding proteins, postsynaptic receptors are also occupied and further neurotransmission is temporarily rejected. Now synaptic transmission can start again.

Logically speaking, communication between a subjective subject and an objective subject in a specific environment occurs in an interplay between acceptance and rejection. The capacity of acceptance means adaptability, the capacity to reject what is not intended or unfeasible, makes us so unique and individual. One can also say that our capacity of rejection is an "index of subjectivity" (Guenther 1962). An impressive example is visual perception. To generate a meaningful picture of an object of the environment, we must reject more than 90 % of the information. A comparable mechanism may be at work in tripartite synapses.

In this context, let me briefly discuss the chaos-theoretical approach to brain theory which is formally based on nonlinearity. In contrast, glia may exert a spatiotemporal boundary-setting and information structuring function (Mitterauer 1998), so that the brain is structured in dynamic domains or compartments. Within these domains, nonlinearity may be valid in the sense of a physico-mathematical information processing. Here, we have a special kind of quantitative computing. However, our brain is also capable of generating intentional programs and a meaning of thoughts and perceptions. This requires a qualitative computing, which is what glia actually may be doing (Mitterauer 2006). In any case, chaos theory cannot explain human intentionality or subjectivity (Werner 2004). Doesn't the mind work that way? (Fodor 2000).

Finally, I see an exciting parallel between basic genetic research and glia based brain research. Recently, hidden functions of the so-called non-coding segments (introns) of a gene have been detected (Ponting and Lunter 2006). The same scientific adventure is going on in glial research. Only in considering the double structure and its distinct functions of these systems, we may reach out for what is hidden. Then we also philosophically deal with the brain as a subjective mind producing machine.

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