Multisensory Integration:

A Neurophilosophical account of Biology of Perception and Loss of Self-evidence in disorders of disintegration

Abstract

We perceive the environment and ourselves through the sensory system (Gallagher , 2005; Gallese and Sinigaglia , 2011; Damasio , 2012). The multisensory integration with the environment relates to the various aspects of self-experience, body recognition, actions, imagination, memory and consciousness (Gallagher , 2000; Damasio, 2001).

We Share with humans, and even some animals, the images in which relies our concept of the world and which seems to imply perception, memory and reasoning. The images are directly based on neural representations and they are topographically organized (Damasio, 2011). These are formed, or under the control of sensory receptors or under the control of dispositional representations contained in the brain cortical and subcortical regions and nuclei. These neural representations have to be correlated, on an essential way, from moment to moment, constituting the basis for cognitive self-awareness. The "I" that is the author of thoughts, emotions, body and actions, and is continuously informed by multisensory inputs and the results of this mental impression are presented in the form of a perception as a whole (Gallagher, 2005; Zahavi, 2005; Gallese and Sinigaglia, 2011; Blanke, 2012; Damasio, 2012).

The perceptual inconsistency is analogous to the inconsistency of self-experience described by Sass and Parnas (2001, 2003) as disorders of the self. Loss of association between thoughts, feelings and actions described by Bleuler (1911) or loss of self-evidence described by Blankenburg (1971).

This paper will try to present the neuro-cognitive basis for the refutation of the "Cartesian Theater" defending the hypothesis that mental images are constructions of the brain from a fragmented activity in an integrated mind, and that an inconsistency at this level results from an inability integration of sensory-perceptual, which seems to be revealed in integration disorders such as schizophrenia.

Keywords: Perception; Mental Image; multisensory integration; self-disorders; proprioception; Interoception.

1. Why the "Mental Image" is not a *Cartesian Theatre*

The central nervous system is connected to every part of the rest of the body by nerves whose totality constitutes the peripheral nervous system. The nerves carry impulses from the brain to the body and the body to the brain. Furthermore, the body and

brain are also molecules chemically bonded by, for example, hormones, which are released in the brain or body and moving into the body or the brain through the blood stream.

There are billions of neurons in the brain in our local circuits arranged that , in turn , form the core or cortical regions. The cortical regions and the cores are connected together to form systems and systems of systems in progressively higher levels of complexity. In terms of scale, all neurons and local circuits are microscopic while cortical regions, and cores are macroscopic systems. Neurons have three major components: the cell body, the output fiber, the axon and dendrites or input fibers.

The neurons are connected in circuits in which there are conductors as axons and synapses which constitute the points at which the axons establish contact with the dendrites of other neurons. When neurons start into action, that is, when "fire", there is an electrical current that travels through the axon. When this current reaches the synapse causes the release of chemical molecules known as neurotransmitters.

The concerted interaction of many neurons − whose synapses are adjacent and may or may not release their own transmitters − decides whether the next neuron fires or not, i.e. whether it produces its own action potential, which will releases their own neurotransmitters, and so on. Synapses can be strong or weak. It is the synaptic strength that determines whether or not the impulses propagate, and the ease with which they do it the following neuron.

To this extent, the activity of circuits in modern sectors of the brain such as neocortex is essential for the production of neural representations that are based on the mind and intentional actions. However, the neocortex cannot produce images of the underground fashioned brain (hypothalamus, brainstem) is not intact and cooperative.

Recent data seem to indicate that the construction of images occur from an integrated mind that results from an integrated activity (Damásio, 2011). That is, multiple lines of experienced sensory processing in mind, such as images, sounds, flavour and aroma, texture, shape , are sensory aspects that match. A hypothesis that contradicts the idea - widely discussed by Daniel Dennett on *Consciousness Explained - Cartesian Theater*.

According to Damasio (2000, 1995), there is not a single region of human brain equipped to simultaneously process all representations of sensory modalities that are active when we experienced at the same time, for example, sound, motion, shape, colour, a temporal registration and perfect space, a kind of synchronization. If the activity occurs in anatomically separate brain regions, but this activity takes place within approximately the same time interval, it is still possible to connect separate parts, creating the illusion that it befalls at the same location. If this is a valid explanation, does not cease to run its risks, as the de-synchronization, which seems to have happened in the cases of psychopathology such as schizophrenia, for as long as connection requires mechanisms of attention and working memory.

The factual knowledge that is needed for reasoning and decision making comes to mind in the form of imagery. What is the neural substrate of these images? Any thought consists of images, whether comprised mainly of shapes, colours, movements, and sounds

or spoken or omitted words. These images − which while occurring invoke memory, are known as evoked images (unlike pictures of the perceptive type).

By using evoked images, one can retrieve a particular kind of image of the past, which was formed when we planned something that has not happened yet but we expect to happen. As the planning process unfolded we were forming images of objects and motions and consolidating the memorisation of this fiction in our minds: the memory of a possible future and not the past that was.

2. Senses Synchrony

The dynamic map of the whole organism − a body schema and anchored in their respective border − could not be achieved in a single area of the brain, but in several, through patterns of neural activity temporally coordinated.

When special senses are involved in perception, they produce a double set of signals. The first set comes from the body and has its origin in the particular location of the special sensory organ (eyes in vision, hearing in ears) and it is transmitted to the somatosensory and motor complex that dynamically represents the entire body as a functional map.

The brain processes signals from the organism involved, this is, a reference to the body and on visual determinations of whatever it is that excites the retina. It is therefore appropriate to describe the vision as "when body feels, this is what it sees". When we touch an object we receive two sets of local signals from the skin. One regards to the shape and texture of the object, while the other relates to the body site which has been activated by contact with the object.

According to this idea, the primary representations of the action body imply a spatial and temporal environment based on the anatomy of the body and the patterns of motion in the environment. Indeed, on the one hand there seems to be an external reality that seems to get through the body in action, i.e., their representations and their disorders. Nevertheless, we can never know to what extent our knowledge of reality is trustworthy. What we have seems to be a remarkable consistency in the construction of reality created and shared by the brains of each of us (Damásio, 2000, p. 302-303).

These primary representations of the action body may play a role in consciousness, considering that they allow a core for the neural representation of the self, and thus, a natural way to what happens in the body reference within and outside its borders. This is a reference that eliminates naturally the generation of subjectivity by the Cartesian Theatre's homunculus. Successive states of the organism occur, each on a new neural representation, on multiple concerted maps that provide moment by moment the existence of the self in a given time.

3. Loss of Self-evidence in Schizophrenia

According to Blankenburg, in "The Natural Loss of self-evidence", in schizophrenia normal loss of reality occurs, that is, the direction of the unquestionable-

challenging environment that generally allows a person to take for granted the social and practical world elements.

It occurs as we may describe as a dysfunction of the normal capacity or proportions between the obvious meaning and its absence.

> "The object seen can be either visual (eye) impressions, which are communicated to the rays when my eyes are open, or images which I can cause at will on my inner nervous system by imagination, so that they become visible to the rays" (Schreber, 1955, p.148).

In Blankenburg empirical studies, it is proven that schizophrenic patients can perform surprisingly well tasks that require logical and abstract thinking, and have particular difficulties with problems of common sense, especially in relationship to the social world (Murphy & Cutting, 1988, 1990). This loss of self-consciousness seems to show both positive and disorganized symptoms. Patients complain of the difficulty of putting into words what most ails them. Given that it is not an object, but an abstraction in the horizon of possibilities for a certain type of experience, it is everywhere and nowhere[1]:

> "Again it is extremely difficult to describe these changes in words because matters are dealt with which lack all analogies in human experience and which I appreciated directly only in part with my mind's eye (…)" (Schreber, 1955, p.117).

> "To make myself at least somewhat comprehensible I shall have to speak much in images and similes, which may at times perhaps be only approximately correct" (Schreber, 1955, p. 41).

In disorders of Self-disintegration, it seems to occur a "loss of association" which leads many researchers to relate the sensory dysfunction with schizophrenia, since it occurs a sensory disintegration related to an ego-disintegration.

The " I" that is the author 's thoughts , emotions , body and action is continually informed by multisensory inputs, which is essential to self-experience (Gallagher , 2005; Zahavi , 2005; Gallese and Sinigaglia , 2011; Blanke , 2012; Damasio 2012).

The multisensory integration is the process that involves all the senses and that starts with the detection of input via specific receptors that translate modal stimuli (light, sound , chemical, mechanical , temperature) on neural activity. The results of this mental impression are presented in the form of a perception as a whole (Postmes , L. et al , 2013; . Ernst and Bülthoff, 2004; Ayres et al , 2005; . Lou et al, 2010.). In this perception, one must be able to differentiate between sources (inside/ outside), self/non-self, and between imagination/reality.

All senses contribute to a normal sense of self: an inability to multisensory integration is a perceptual incohence that can be induced by conflicting sensory inputs or unbalanced between the various types of input, i.e., a sensory-motor conflict so that the information cannot be gathered into a single perception; leading thus to an incoherent self-experience.

[1] See Heidegger discussion about the being that announces himself by the withdrawal.

Psychoses may have two interdependent components: 1) hyper-rationality, the inner processes such as thinking or perceiving that normally occur without conscious and tasks that need to be mechanically driven by the loss of conscious thought field , i.e. decrease between focus and context: "my soul is in my heels , every step I take, I step on it" ; "I am looking for arguments to make sense . Nothing has a meaning or purpose" ; 2) and decreased presence: an alien experience that results in a reduced recognition of the body, bodily disintegration and reduction interoception: "losing this sense of being me , not being able to make sense of what happens to me , being unable to connect with others , makes me feel unhumane " , " i know this is my body and face, but does not feel it that way. It's scary ".”I think I am dissolving" (Postmes et al, 2013). Also results in a distortion of first person perspective: "I know they are my thoughts, but I do not feel they are mine". In short, perceptual inconsistency can cause depersonalization, tenuous borders, and/or decreased sense of ownership and agency: in all these diminished perception of themselves manifestations are similar to a reduced sense of presence (Sass and Parnas, 2003; Gallagher, 2005).

Conclusion

Perceptual incoherence is analogous to the incoherence of self-experience described by Sass and Parnas as disorders of the self. The loss of association between thoughts, feelings and actions described by Bleuler or loss of self-evidence described by Blankenburg. According to these authors, the disorders themselves are the core deficit in schizophrenia.

The pattern of multisensory integration or environment involvement in body perception in schizophrenia needs further investigation. Further research on sensory mechanisms may increase our understanding of schizophrenia. A greater understanding of perceptual incoherence and self-disorders as incoherent perception can increase the recognition of high-risk individuals and earlier recognition of the disorder. The hypothesis of perceptual inconsistency can offer a plausible explanation of the disorders themselves and prevent patients from seeking clarifications in the formation of delusions. Some patients may notice that their strategies for monitoring delirium aggravate their perceptual inconsistency. Thus, therapies can decrease the perceptual inconsistency and relieve themselves of the incoherent experiences.

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