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Biological Phenomena in Search of a Meaning

The Concept of Brain Plasticity as a Back-and-Forth Between Biology, Politics and Culture

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Introduction

The popularity of brain plasticity is a good example of how an epistemic shift can affect cultural discourses, whose reinterpretations can in turn affect the meaning of the original scientific notion. Relying on an ongoing study of the cultural reception and diffusion of this notion in French-speaking countries, today I will show the emergence of the concept of brain plasticity in neuroscience has had various translations in the world of ideas which illustrate on one hand the multiple ways scientific knowledge can be reappropriated by society, and on the other hand the metaphorical basis making possible these reappropriations.

I would like to stress on three basic ideas: *first*, I'll introduce the concept of brain plasticity, a somewhat metaphorical concept; *second*, it's a concept which spread widely for two reasons: its vagueness and its epistemic scope; *third*, it spread especially in the cultural field, where it has been revamped to promote a specific conception of the individual and the self.

1. A somewhat metaphorical concept...

As a concept, brain plasticity emerged in late 19th century. There seems to be a consensus among historians of neuroscience to mention William James as the first to have proposed the concept in his *Principles of psychology*:

“Plasticity, then, in the wide sense of the word, means the possession of a structure weak enough to yield to an influence, but strong enough not to yield all at once. Each relatively stable phase of equilibrium in such a structure is marked by what we may call a new set of habits. Organic matter, especially nervous tissue, seems endowed with a very extraordinary degree of plasticity of this sort; so that we may without hesitation lay down as our first proposition the following, that the phenomena of habit in living beings are due to the plasticity of the organic materials of which their bodies are composed.” (2007 ed., p. 64)

Following him, several researchers also evoked it, in various meanings. Then the notion lost its appeal, before the beginning of a revival at the end of the 1940s, a real scientific legitimization in the 1960s. Since then, the notion gained more and more attention. In the last quarter of century, the notion of

cerebral plasticity turned to be in common use and the fields that use it range from neuroscience to psychology, including neurology, neuropsychiatry, and education sciences.

However, its definition does not seem to be self-evident. In neuroscience alone, several orientations can be traced. In a recent book, it is described as "the capacity of the central nervous system to undergo modifications in its structure and/or its functioning to ensure the development of the individual and to allow it to react to the internal or external constraints it undergoes, whether it is the result of an accident or of a change in the environment (...)" (Allart, Daveluy and Devanne 2017, p. 19).

But along with this very general description, one must realize that brain plasticity refers to at least three types of biological phenomena. One speaks of plasticity linked to experience and training; developmental plasticity, during the development of the individual from childhood to adulthood; and post-injury plasticity (*Ibid.*, pp. 20-21).

These different types of plasticity are based on mechanisms located on several levels: cortical organisation (cortical maps, functional connectivity of networks, etc.), cellular organisation and structure, synaptic organisation and structure, neurogenesis, molecular expression, and gene expression (Allart et al., p. 21). Within these multiple levels, synaptic plasticity is considered to be the central feature of brain plasticity. (*ibid.*, p. 23)

Other texts diverge in the emphasis to be placed on either the modalities or the functions of cerebral plasticity. As a matter of fact, the notion appears to refer to quite varied and different biological realities. These multiple definitions explain why some authors consider the issue of brain plasticity as "complex and ambiguous" (Privat 1994, p. 93).

Besides, the notion has even been deemed problematic almost from the very beginning of its scientific revival, mainly because of its metaphoric dimension. According to Paillard (1976), on one hand, we have a meaning referring to "structuring, organisational forces, generating and creating order, and therefore plastic in the etymological sense of the term" and on the other hand, we have a meaning of "malleability", of "the faculties of adaptation, of accommodation to the constraints of the environment that living organizations express", i.e. the property of irreversible deformability (*Ibid.*, 35) According to him, this second meaning is a figurative one, a metaphor, whose use seemed growing at his time and in which he saw a "source of confusion in interdisciplinary exchanges."

However, despite its apparently ambiguous epistemic status, the concept of plasticity raises scientific and epistemological issues which can explain its appeal.

2. ... which spread widely for two reasons: its vagueness and its epistemic scope...

One can consider the somehow metaphorical flavor of the concept of plasticity as a good example of a rather common phenomenon in the history of life science (think of the metaphor of the mind as a

computer)¹. Plasticity appears to be a kind of conceptual metaphor, as defined by George Lakoff as a generalization “governing polysemy” (Lakoff 1993, 205). In the case of brain plasticity, there is a conflation between several meanings already mentioned and maybe the sensory-motor experience that we have of plastic material. All of this must be processed when it comes to understand the appeal of such a word.

To explain why plasticity so easily diffused in many social spaces, we must also mention the narrative that this conceptual metaphor enabled. The morphological and functional phenomena implied by the idea of brain plasticity challenge the idea of an immutable brain. It implies that the brain is malleable, if not in constant reconfiguration, and that it is possible to bring change in something that seemed fixed or determined, whether during the lifetime or after accidents like strokes.

Such a conception of plasticity has not always been dominant in neuroscience. In French speaking countries, it is only by the end of the 1980s that we can read about it in science essays and popular science. In French neuroscience, one of the first scientists to mention it is Alain Prochiantz, who would become later professor and even head of the Collège de France. In his 1989 essay *La construction du cerveau*, Prochiantz asserts forcefully that plasticity is “one of the major characteristics of the nervous system” (Prochiantz 1989, 66). His advocacy of plasticity goes hand in hand with a defense of epigenetics and a clear opposition to biological reductionism (ibid., pp. 79 ff). In the afterword to the second edition of the book in 1993, he makes clear that his endorsement of plasticity opposed certain preconceived ideas in research, such as the fixist views about brain processes (p. 122).

He is followed a few years later by Marc Peschanski, a specialist in neurons transplants to treat spinal cord injuries, who proposes a definition which allows us to understand the popularity of plasticity as a reaction to a more static and mechanistic conception of the human being:

“Neuroplasticity, this capacity of cells and nervous circuits to perpetually remodel themselves according to experience, places this debate of innate and acquired in a much more attractive biological framework.” (Peschanski 1993, p. 131, my translation).

All this must be put into perspective in the French context, where discussions about biological determinism, along with controversies about sociobiology or about scientist assertions concerning biological influence on human behaviors and societies, have flourished since the end of the 1970s. This provides the background of the growing interest for plasticity in the public sphere at the turn of the century (Lemerle 2013). The promotion of plasticity showed that neuroscience could be the subject of a plurality of discourses, and that it is not condemned to oppose the humanities and the social sciences, insofar as it establishes the importance of the cultural and social environment in the shaping of individuals.

Brain plasticity has been then a topic heavily promoted by prominent neuroscientists since the beginning of the 21st century in France. As a concept, brain plasticity appeared to have a real impact on society. It stemmed from its reappropriation by psychologists, self-help practitioners, public intellectuals, politicians, and all kinds of medical/para-medical agents from the 2000s onwards. I do not have the time

¹ Other examples in molecular biology in Fox Keller 1995, 2002

to describe how each milieu used it for its own purposes and I will focus now on how it has circulated between intellectual, artistic and scientific fields in the last 20 years with a few examples

3. ... and is used to promote a specific conception of the individual and the self.

In French-speaking countries, by diffusing in heterogenous cultural spaces (the media, the intellectual field, the entertainment industry, and so on), the notion of plasticity has turned into a popular catchword, a metaphor directed against the idea of determinism, especially biological but not only, and grounding the celebration of the fundamental freedom of the human being. In the intellectual world, this interpretation owes much to the philosopher Catherine Malabou, a doctoral student of Jacques Derrida, and a specialist of Hegel, who wrote in 2004 *Que faire de notre cerveau ?*, translated into German in 2006 and in English in 2009. In her book, Malabou alternates between plasticity as a capacity to be manipulated and plasticity as a potential for freedom and action (2011, p. 10) Her interpretation has also a postmodernist tone in the sense that, for her, “The death of the symbolic is precisely what invites us to think of plasticity as the impossibility of dividing biological and spiritual life.” (Ibid., p. 33) Malabou sets a definition of plasticity full of political potentialities:

“It (*plasticity*) commonly refers to flexibility, adaptability, the ability to evolve. In fact, according to its etymology - the Greek *plassein*, to model - the word "plasticity" has two fundamental meanings: it designates both the capacity to receive form (...) and the capacity to give form (as in the arts or plastic surgery). To speak of brain plasticity is therefore to consider the brain as a modifiable, 'formable' and formative body. (...) But it should be noted that plasticity refers to the capacity to annihilate the form it is capable of receiving or creating. Let us not forget that "plastic", from which comes "*plastique*" (ie *bombing*), "*plastiquer*" (*to make explode with plastic explosive*), is an explosive substance based on nitroglycerine and nitrocellulose capable of causing violent detonations. (...) Therefore, to speak of the plasticity of the brain is to see it not only as a creator and receiver of form, but also as a factor of disobedience to all constituted form, a refusal to be subjected to a model.” (Malabou 2011, p. 43-44, my translation)

The modernity of the concept of plasticity lies in the fact that it designates both the subject's personal heteronomy and its power of emancipation regarding determinants of all kinds, biological or political:

“The plasticity of the brain constitutes a margin of possible improvisation in relation to genetic necessity. (...) We are living in an age of neuronal liberation and we don't know it.” (Ibid., p. 49)

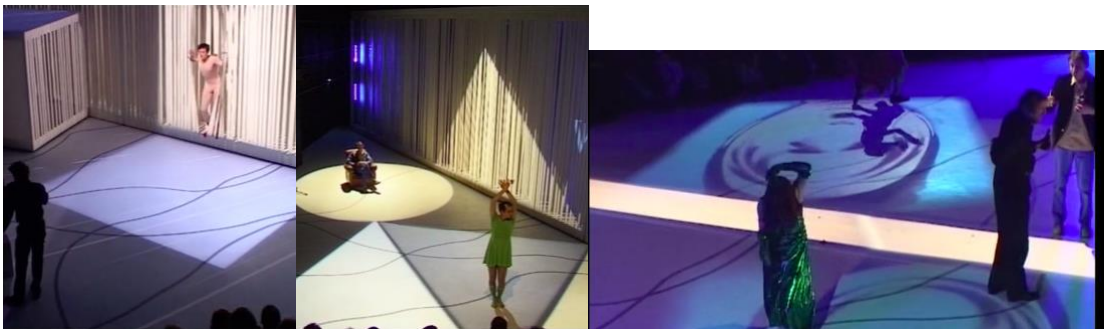
While Malabou distanced herself from neuroscience in the 2010s, this political discourse on plasticity has been being taken up by neuroscientist Catherine Vidal in a slightly different way. Reflecting the concerns of the time, Vidal's more mainstream books make plasticity the basis of her critique of ideology, as well as her constructivist approach to gender and gender inequality. Plasticity is one of her fundamental arguments of her progressive and feminist agenda (Vidal 2010, 2015). She keeps on repeating her anti-fixist and anti-deterministic point of view over her books along with a general political, humanistic message:

“Nothing is ever fixed in our brains, whatever the age of life. The old theories that claimed that everything was played out very early, before the age of six, are over. (...) The future of our neurons is not inscribed in the genetic program. (...) At all ages of life, through encounters and experiences, the brain's plasticity allows us to change our habits, to acquire new talents, to choose different life paths. The diversity of our life stories means that each of us will forge our own way of living our lives as women or men. (Vidal 2015, p. 24, 25, 30)

Although she is criticized by some sharp-tongued scholars and right-wing intellectuals, Vidal's high media profile helped to further establish the presence of neuroscience in the intellectual world and the public arena. Critics and hot exchanges may be displayed in the columns of newspapers or on the internet, but the background of these debates is now the same, which is no small evolution in a country like France.

Another world where plasticity has made a remarkable appearance is the cultural field, in theatre for instance, where we can spot three ways of staging brain plasticity.

In 2002, Prochiantz created *La génisse et le pythagoricien* (*The Heifer and the Pythagorean*) with theatre artist Jean François Peyret. It is a set of variations on Ovid's *Metamorphoses*, with a pinch of neuroscience. The play is based on the principle of quotation, discontinuity, and collage of references (ancient, scientific, philosophical), all of this accompanied by contemporary music, in a minimal setting. The very notion of plasticity influences the project in an indirect and pervasive way.



“The development of life, an unpredictable creation of form. But in reality, the body changes form at any moment. Or rather, there is no form, since form is motionlessness and reality is movement. What is real is the continuous change of form: form is only a snapshot taken on a transition.” (Peyret & Prochiantz 2002, p. 234)

The staging, the scenography and the subject itself do not obey any fixed form and the overlapping of situations, discourses and postures are the very expression of the notions of metamorphosis, transformation and plasticity, fundamental processes of life that the creators want us to feel rather through the theatrical form than through an explicit discourse. This creation expresses Peyret's postmodern observation on the culture of his time in the preparatory notes of the play:

“Science, and these days biology in particular, brings disorder to the age. In this sense, it dominates the intellectual scene, if there is still a scene; literature is behind us, politics is realized, so 'realized' that it no

longer even needs to be realistic (the most liar wins), official philosophy is soluble in the ministries, etc.”
(*Ibid.*, p. 11)

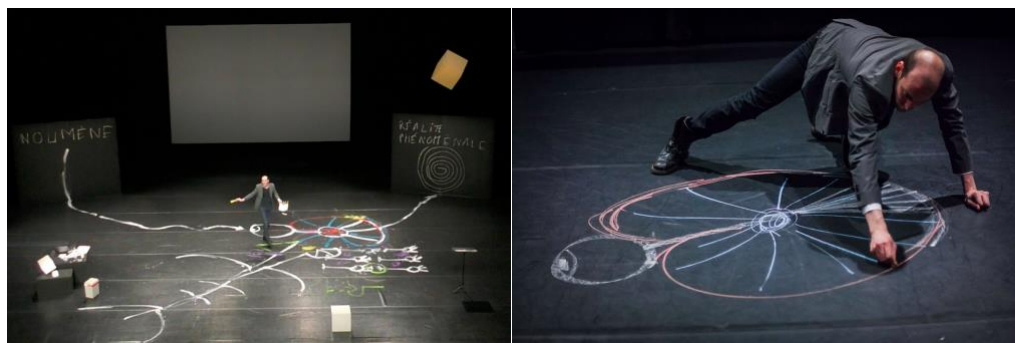
To him, biology seems to be the new horizon to recover a sort of grand narrative. He described his work in the perspective of a postmodern theatre, reluctant to traditional narration and dialogue:

“We are in... the monstrous outgrowths of the unfulfilled consequences of epic theatre in the postmodern era... No, I'm not kidding. (*Contained laughter from the assembly*) (...) So, it implies a certain abstraction. (...) What is the relevance of this approach now in 2002? (...) It's true that this is what interests me in the theatre, but I feel more and more alone.” (*Une Génisse en gésine*, documentary film, 2003)

As for Prochiantz, theatre is important as another way to think about and keep on running his scientific research:

« I think that Prochiantz has always been clear on this point: he comes to the theatre to work, and the work for him can only be scientific work. He simply considers that this displacement is salutary for his research, that one thinks differently in a theatre than in a laboratory (...). » (Peyret & Prochiantz 2005, p. 203)

This rather highbrow approach to science in theatre differs from other uses of plasticity on stage. Yvain Juillard is a Belgian author who founded a theatral company which intends to “integrate the field of cognitive neuroscience into theatrical creation.” First staged in January 2015 in Brussels, the main work to date of Juillard, *Cerebrum le faiseur de réalités* is a “lecture-show on the very nature of our realities, in order to better grasp the disturbing workings of our brain...” (4th cover of Juillard 2021). The narrator is alone in front of the audience, using a few objects (paintbrushes and paint pots, video screen), and delivers a text mixing popular science, anecdotes, and playful experiments.



The set-up is completely different from that of Peyret and Prochiantz's, more straight-forward and relying on almost exclusively scientific references and playing very little on literary allusion.

Concerned about the state of society, Juillard sees plasticity as a reason for hope. The concept is mentioned in the final part of the play, in a long passage focused on a synaptic definition of plasticity with the related dimensions of learning and influence of the socio-cultural environment:

“when parents approach their child and ask: "say 'daddy'", "say 'mommy'", without knowing it, they allow their child to appropriate this way of articulating and integrating the first codes of the human community that welcomes them.” (Juillard 2021, p. 141)

From this evocation of brain plasticity, Juillard draws psycho-sociological conclusions with poetic overtones: “We absorb each other because of our brain plasticity and our mimetic capacities.” (*Ibid.*, p.

142) Increasingly broadening the perspective, he then talks about societies and cultures and his description of the brain turns into a form of political utopia:

“And if our brain is plastic, it means that it can also unlearn some of our socio-cultural conditioning and learn new ones. (...) Our brain is a population of interconnected cells that, while each works to maintain the whole organism, work together for their own well-being, their own survival, a kind of ideal society and, extraordinarily, without hierarchy.” (Ibid., p. 150)

According to him, the solution to save ourselves lies in education, that is, in his perspective, knowledge of the brain:

“Our brain is the most conditioned and most subversive thing in the world, because it is driven as much by experience as by chance. Without this learning and chance, no living species would have survived until now. We are manipulated by our brain because of its plasticity, just as we are able to learn to manipulate it because of its plasticity.

But in order to play with this organ, which can also play with us, which is us, and above all in order not to be the plaything of those who can play with it and therefore with us, what other choice do we have today than to learn to get to know it better, just as we learn to read, write and count at school.” (Ibid., p. 154)

A third approach can be studied with the play *1300 grammes* by French-Swiss author Léonore Confino. Created in 2017, the play is very different, both in its set-up and in its philosophy, from the other shows. At the time of *1300 grammes*, Confino is already a well-known author, although not for her interest in scientific ideas. Unlike previous creators (apart from Peyret), Léonore Confino does not have neuroscientific background.

The play describes three characters (a physician, a director, a politician) in the midst of existential crisis, with aside a neuropsychologist explaining how the brain is supposed to work.



Such a narrative device can make us think of Alain Resnais' film *My American Uncle*, which also tells a story of individuals in crisis along with the insertion of explanations by a scientist, a real one in Resnais' case. In Confino's play, the inextricable moral crisis in which one of the characters is immersed finds its resolution in literally incorporating the notion of plasticity. This character undergoes a conversion by applying the notion to himself, used as a synonym for self-reinvention, and transforming himself into a superhero called Elasti-Man:

“Mr GRACH (*banging his head against the door*). When you left, I found myself alone, cut in two, lost, nervous, anxious, bossy, irascible, medicated, powerless and irredeemably bald.

(...) I am not finished. My brain is plastic. Elastic... (*The drums wake up, unleashed. Mr Grach climbs up onto the toilet and takes off his tie*). Yeah, me, Jean-Michel Grach, I'm elastic. My neurons stretch to infinity. And I can prove it. The deputy is no more! I'm still alive ! I'm... I'm... (*He takes off his shirt, we discover his black latex suit*.) Elasti-man! The man with the plastic brain! Elasti-Maaaaan!" (Confino 2018, my translation)

There is no epistemological or political aim here: in Confino's work, plasticity makes possible a reform of oneself, in the service of an ethic of love, of oneself and of loved ones. The use of the notion of plasticity acts as a helper, to use Greimas' actantial model, as a helping element in the quest of the three main characters towards a better life (Greimas 1966). Neither epistemological nor political, Confino's proposal is based on a moral approach influenced by a biologised positive psychology.

As we can see, Confino's play differs from the work of Peyret and Prochiantz, where plasticity functions as an implicit principle and especially regarding its very structure and aesthetics, and from *Cerebrum*, where plasticity plays explicitly at the level of the message. However, Confino's attitude towards scientific discourse shares with *Cerebrum* some essential characteristics: the fostering of a belief in the perfectibility of the individual and the hope that comes with it: "This plasticity, this capacity to muscle, to actively modify our neuronal matter, seemed to us to carry hope." (Léonore Confino, interview with S. Lemerle, March 2023)

Conclusion

To conclude, I would propose two take-away from all of this. First, the popularity of brain plasticity can only be understood, both within and outside the scientific field, in relation to the context in which the concept is employed and deployed, notably the debates on biological determinism and/or fixism. In France at least, the notion of brain plasticity has emerged in a context where deterministic, fixist conceptions of the brain (computers, programs, information processing, etc.) have been very visible since the early 1980s. My hypothesis is that this notion has changed the cultural and social image of neuroscience compared to the 80s and 90s and reconciled it with more relativistic and/or constructivist approaches.

Second, the current moral/psychological and political views on brain plasticity appear to associate it with ideas of hope, project, emancipation, freedom. As Hans Blumenberg wrote, "Every thinker has metaphors that seem to belong more to his time than to himself."² This social and cultural popularity of brain plasticity has been explained from a Durkheimian point of view by sociologist Alain Ehrenberg, who sees it as an expression of a social belief and of a social aspiration. Brain plasticity is a concept that seems to provide a scientific basis for the ideal of individual autonomy which, according to him, is characteristic of large sections of contemporary European and North American societies:

"On it (*plasticity*) will be invested a fundamental social value of autonomy: the infinite capacity of the individual to be the agent of his own change. Synaptic plasticity is the crossroads concept where the most

² *Die Sorge geht über den Fluss / Care crosses the river*

convincing achievements of biological research and the collective representations of the man of autonomous action converge." (Ehrenberg 2018, p. 217 - my translation)

In the French context, I would also see it as a kind of a biologized existentialism: thanks to plasticity, one is able to choose oneself, that is, to choose man (Sartre). Other more critical interpretations consider the diffusion of the notion of plasticity as an expression of neoliberal views of human nature: the idea of a never-ending adaptability (Malabou, Bolstanski).

The metaphorical underpinnings of the concept (i.e. the malleability of the brain) facilitate its understanding, acceptance, desirability and reappropriation. But there is more. When the notion is used in public or even academic spaces, this metaphorical dimension is often doubled with an insistence on of one's will: the appeal of the metaphor of the malleability of the brain relies on the fact that it suggests the brain can be manipulated to reach certain goals, hopefully for the better but also for the worse.

Behind all this also lies a vision of the social environment to which the human being is required to adapt. Although the authors' focus on the human subject often leads them to leave their conception of the world in the background, we get the idea of an ever-changing world, perceived as unstable, often worrying, even threatening, where the individual evolves as a sort of elementary particle and where collectives and institutions seem to play almost no role. Hence, the popularity of brain plasticity, an epistemic game-changer with strong metaphorical potentialities, reveals not only a cerebral conception of the individual and the self (the individual as a brain immersed in and reacting to the cultural and social environment) but also a certain vision of the social totality.