Who Wrote the Article?

Ensaio

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Introduction

The title of this paper is intentionally ambiguous, reflecting the crucial connections that exist between higher-order mental processes and brain activity, that is, the correlation between mental states and their neuronal basis. These are of such importance as to raise questions about the consciousness of the author in producing a text or, in this case, an article.

Indeed, it is no exaggeration to see neuroscience as a kind of fifth scientific revolution, as argued by the leading neuroscientist Ramachandran,[1] especially since the fundamental discovery of mirror neurons by an Italian research group at the University of Parma in the 90's (see Rizzolatti and Sinigaglia). Neuroscience is not only spreading to an increasing number of fields of knowledge, but it is also celebrated somewhat triumphantly at a popular level, thanks to the well-documented proof provided by *neuroimaging* or *brain imaging*. In fact, the seductive colorful maps which emerge can be extremely persuasive. Nevertheless, non-invasive functional neuro magnetic resonance (fNMR) experiments only show the functions of certain areas of the brain, and many objections have been raised.[2]

These recent developments in neuroscience have lead directly and/or indirectly to a substantial modification regarding the traditional sectors of culture. In viewing this new framework, we can identify forms of new interdisciplinarity, bridging the gap between the so-called "two cultures", and perhaps definitively ending the rift between them by envisioning a "third" or a "fourth culture" .[3]

Indeed, the relationship between neuroscience and the humanities in general is a fascinating issue. Naturally, a dialogue between philosophy and neuropsychology might be seen as one of the more consolidated sectors involved, although radical disagreements and clashes of opinion often characterize the mind-

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body debate.[4] Nevertheless, new disciplines are evolving, particularly neuroaesthetics, neuro-ethics and, neuroeconomics. Additionally, other sectors, especially law and the social sciences, are implementing the advantages of the new scientific revolution, even leading some to speak of "neuromania" (see Legrenzi and Umiltà).

In this paper we argue that the complex procedure of writing an article is a privileged subject of reflection, casting light upon a variety of issues. We intend to examine the process involved in producing a short essay, which, hypothetically, could be a piece of literary criticism. In the present case, even if we are referring to the humanities, the term "scientific article" is used, given that it is an academic contribution to a journal, part of a collection of essays or a conference paper, perhaps proposing a relatively new point of view supported by rigorous documentation, but where a high level of creativity and innovation are not necessarily at stake.

In this way we are positioning ourselves at a complex crossroads in many respects: first of all, we assume that it is an embodied process because of the neurons and neural architectures of the brain determining the writing of the article, and, in particular, because of the (often neglected, but fundamental) haptic implications of the writing process. Despite the involvement of many different cognitive mental activities, such as perception (attention), memory and imagination, it is apparently only a semi-creative process in the sense that it is an ordinary everyday exercise for academics, often part of the usual routine of tasks to accomplish. In addition, writing must be considered an important linguistic activity.[5] This raises several questions, e.g. whether the left, right, or, in all probability, both hemispheres are involved, and even how language is conceptualized, not from an abstract, but from a neuroscientific embodied point of view. This issue is thus situated at the meeting of several old and new disciplines in the humanities, from literature and literary criticism to neuroethics, neuroaesthetics, and so on.

Last but not least, the methodological aspect itself is extremely controversial, as in principle, neuroscience requires scientific observation in the third person, while examining the writing of an academic article favors a more humanistic "soft" method.[6] In our case, we propose to follow the process of writing an article by trying to reconcile a first-person analysis of mental states with the fundamentals of neuroscience, discussed with the layman in mind, and supported by some fundamental references.

The traditional, dramatic problem of the relationship between introspection in the first person singular, on the one hand, and the third-person objectivity required by rigorous scientific investigation, on the other, is linked to the rift between hard sciences and the humanities and also characterizes the various theorizations of psychology itself. And yet, perhaps that divide is not so great, especially when considered in the light of proposals for a solution, authoritatively put forward by the neuroscientist Antonio Damasio. As Damasio states, "The idea that subjective experiences are not scientifically accessible is nonsense" (309), and he adds, therefore, that the knowledge gathered from subjective observations can inspire objective experiments while subjective experiences can be explained on the basis of scientific knowledge (309).[7]

After these brief preliminary remarks, we now intend to follow the process of writing an article, discussing the various stages, and the different alternating states of mind involved, from its genesis to its completion. This will also reveal some unexpected features. The conclusion will return to the initial problem raised in the title, and examine the responsibility and consciousness of the author. A new horizon thus emerges which leads us from the embodied process of writing an article to a view of a potential "extended mind" which ultimately goes beyond the text of the article itself.

Genesis and Neural Architectures

The beginning of an article is apparently indefinite and imprecise, even if it is usually triggered by external stimuli, such as a discussion with a colleague or an official call for papers. In some cases, however, it may arise spontaneously as part of a chain of circumstances and/or to an inner, and, to a greater or lesser extent, non-rational need on the part of the scholar at that particular moment.

It is useful at this point to recall the incredible number of neurons in the brain (around 100 billion) as well as the brain's great synaptic plasticity: there are approximately 10 trillion synaptic connections and their complex architecture involves a plurality of levels, such as neurons, local circuits and subcortical nuclei, connecting systems and systems of systems. The central nervous system, whose main component is the *cerebrum*, is linked to every point of the body by bundles of axons which originate in the cell body of neurons (Damasio 331, 325).[8] The English terms *to fire* and *firing* (like the German *feuern*) with their loaded metaphorical associations – much more expressive when compared to the less connoted Italian term "attivarsi", to become active – convey this rapid, diffuse activation of neurons. Moreover, according to the basic Hebbian theory already formulated in 1949, neurons that fire together wire together; that is, due to synaptic plasticity, the more often that A and B fire together, the stronger the synapsis is in forming links in the circuit.[9]

In a sense, the origin of the writing process can be compared to the situation when a functional magnetic resonance experiment begins, i.e. with the contested problems regarding the activity and activation of the so-called *resting brain* (Boella 23). Even if the subject is in a state of relaxation, the stimulus is probably coupled with pre-existing, particularly strong, neural architecture, so that a simple stimulus, such as a call for papers, can have unpredictable consequences, going far beyond its restricted target and spreading like a flame to the various areas of the brain involved.

In a broader conceptualization of neuroscience, factors such as environment and education, but also age, memory and attention level all combine to determine the architecture. In particular, even if a detailed discussion is beyond the scope of the present paper, it should be underlined how memory, in its flexibility and its various typologies, is involved in our neural and mental experience. To again quote Damasio, "All of our memory, inherited from evolution and available at birth, or acquired through learning thereafter, in short, all our memory of things, of properties of things, of persons and places, of events and relationships, of skills, of biological regulations, you name it, exists in dispositional form (a synonym for *implicit*, *covert, nonconscious*), waiting to become an explicit image or action. Note that dispositions are not words. They are abstract records of potentialities" (Damasio 332).

In fact, when writing an essay we are often aware of our explicit short-term working memory and we exploit its mechanisms; on the contrary, we are not aware of the hidden world of implicit memory and can be influenced by a past experience without being conscious of remembering it (Schacter 169). One curiosity regards the humanities in particular: even the deep structures of lines of poetry learnt by heart in the past become associated with rhythm and can play an important role in the writing process. Stimulus can also be ignited by taste (even if smells and perfumes are probably more likely to do this). The case of Proust's madeleines is paradigmatic, as their enjoyment triggered the whole cycle of novels comprising *À la recherche du temps perdu*: in the overture of *Du côté de chez Swann* the accent is on "involuntary" memory, taken as an autobiographical memory based on an association with everyday life.[10]

Without delving into the specialist field of literary studies, the importance of metaphor should be highlighted. It is associated with higher-order human consciousness and therefore coupled with language, but at the same time works on a non-linguistic, unconscious level, no doubt mediating between the two cultures.[11]

Specific Embodiment

In recent decades, there has been much talk about a so-called "second orality" (Ong 136), but, in spite of general expectations, a new, omnipresent era of writing is also appearing on the horizon (see Dehaene; and Ferraris). This is a moment of continual technological innovation and probably also of transition: already an increasing number of children first learn writing by using a QWERTY keyboard on a screen, and only subsequently take up a pen. Indeed, in spite of touch screens and voice controls, we can see that there is still some attachment to the layout of the traditional QWERTY keyboard even in this digital age. Moreover, as regards embodiment, new performances are continually being adopted, especially gestures linked to the new way of touching screens, such as tablets and smart phones, rather than traditional computers. These practices determine novel and interesting associations and, from an evolutionary viewpoint, are probably an unpredictable factor in development for both brain and mind. Writing is a complex cognitive procedure and material support is a fundamental choice, loaded with consequences. The opening words of an article can be scribbled on a piece of paper, written in more or less legible handwriting, typed on a computer or casually noted down on a tablet. The implications are quite different in each of these cases: "the switch from pen and paper to mouse, keyboard and screen entails major differences in the haptics of writing, at several distinct but intersecting levels" (Mangen and Velay).

Writing is also technology: in our opinion the old question of technologies discussed by the German philosophical anthropologist Arnold Gehlen in his interpretation of culture as human prostheses (9-34) is reflected today in the controversial term the "extended mind" (Clark and Chalmers 10-23; Menary 1-25). In a nutshell, the issue raised by this theory is "Where does our mind stop and the rest of the world begin?" On the one hand, after the long supremacy of rationalist

and positivistic beliefs stressing cold cognitive processes, embodiment nowadays is taken for granted, along with pertaining feelings and emotions. On the other hand, decisive external manipulations also intervene. Menary refers to our very case, writing an essay, noting that this process would be impossible if limited to our minds alone, while "Stable and enduring external written sentences allow for manipulations, transformations, re-orderings, comparisons, and deletion of text that are not available to neural processes" (240). Certainly, it can be objected that the writing system, less evident with handwriting, is now also an overt coercive conditioning, a pattern, a grid. It is not only the determining influence of the writing system; there is now, through the new media, something closely related to globalized patterns, for example the dominant Word system or the prevailing Times New Roman font. It reminds us of Dehaene's provocative thesis, according to which our brain is not constructed for reading, but adapts the existing neuronal systems of primates, which are far from being a *tabula rasa*, to our own visual limitations (7).

If, as is known, the reading and comprehension of the written word stimulates the left occipital-temporal area of the brain, less is known about the actual production of writing.

Stages in the Writing Process

Often motivated by an initial stimulus as well as by past reading, the scholar perhaps reacts with a slight shudder and a thrill of anticipation when faced with the task that is about to be undertaken. And yet they are on their guard, aware and apparently conscious, usually at the beginning, although in some cases not immediately, that a rational stage is developing, when they feel that they are in control of the subject matter and try to structure it, often drawing up a "rationale", a list of points and/or dividing the work into sections.

Each new stage in the writing process is accompanied by alternating positive and negative attitudes and feelings, and embodiment, even if it is not perceived as

such, is a fundamental issue throughout. Moments of satisfaction and well-being can be associated with the sensation of being practically ready to continue writing the article, although these may be replaced by moments of despair. It is telling that those moments of self-reassurance are often coupled with a sigh of relief.

The writing process is also sometimes a process of suffering, of confusion and a feeling that work is not progressing. This is particularly true if we find ourselves thinking about the relatively high rate of productivity of our American colleagues who since college, as they tell us, have been accustomed to writing a paper with one hand and carrying out various other tasks with the other. Such a comparison might drive us to the deepest despair.

The intermediate stages in the writing process are often mainly unconscious. The unexpected sound of a pop song sung softly to ourselves is a sign that we are relieved, although we do not know why we decided to sing and the choice of our cheerful tune remains a mystery. No experiment is ever going to reveal such mechanisms.

It is well known that sleep has a fundamental function regarding memory in that it consolidates, stabilizes and re-consolidates. Even during the night, from evening through to morning, various changes can occur. In fact, a large number of neural connections is made in the brain during sleep, determining new judgments and considerations related to the writing of the article.

Waking up can be accompanied by the sensation of having a steady brain and clear mind, as if they were bright and new. This can happen once or several times during the writing of the article. Even after pausing for several days or a week, the author on returning to the article has the vague impression that old and new neural architectures have been activated.

Moreover, a scientific work such as an article is often left to lie dormant for some days or weeks, either by desire or due to circumstances beyond the author's control. Even during this abandoning of the manuscript, however, an idea which

pertains to it can rise to the surface with immediacy, for example while one is swimming in the sea or in a pool. The state of being rocked by the particular amniotic materiality of water might well produce a worthwhile and far-reaching solution to problems.

We know that many brain processes are involved in various ways in the small enterprise of writing an article. Occasionally, however, particularly with more creative, more immediate activities, the author may be faced with a dangerous sense of void. A short poem by the Austrian poet Ernst Jandl comes to mind, which encapsulates our understanding and is emblematic of the whole process. Here, the poetic "I" initially feels he is in a position between "nothing" and "something" and sits down at his typewriter with a blank sheet of paper in front of him and apparently "nichts im kopf" [nothing in his head]; nevertheless, he manages to stand up later and read "als text/ etwas aus meinem kopf" [as text something out of my head] (175). This stimulating poem is food for thought, all the more so as nowadays our computer, which has completely substituted the typewriter, implies a complicated, interior mental process with regard to computationalist cognitivism and second AI. We are beyond the confutation of computationalism formulated by Searle in the 80's with his Chinese room argument; the apparent "nothing" of the brain coupled with the machine has given birth to a new product, in this case a poetic one, a complete written text.

Neuroenhancement

"Any of several techniques or systems intended to enhance the ability to think either by use of prosthetics or by use of electrical or chemical stimulation" (*Wiktionary*). Accepting this broad definition, neuroenhancement is an increasingly common concept and even traditional stimulants can be considered from this viewpoint. The environmental and physical context is also a determining factor for the scholar and is largely under her/his control: the time of day may be more or

may be less conducive to writing, not to mention the lighting conditions. Furthermore there is also a close interrelation with our own well-being, for example, with our digestive processes, which determine how much attention we pay to the exercise. The limbic system is particularly sensitive: the unexpected stimulation provided by a pen or a finger unconsciously caressing the writer's upper lip or nose can also have an impact on production. As is well known, perfumes and odors can act as important stimulants – and they do not need to be particularly refined. The case of the German poet Schiller is well known: he needed to have a supply of rotten apples placed all around him and in the drawers of his desk in order to compose his works. In many cases, an acceleration in the writing process can simply be induced by a cup of tea or coffee, a glass of wine or a cigarette, which can facilitate and encourage. It is common knowledge that the stimulation provided by nicotine is particularly effective. The Nobel prize winner Daniel Bovet highly appreciated its effects, despite the unfortunate fact that its negative and dangerous side effects remain.

In addition, more and more neuropharmacological products have been used in recent years by college students and young professionals, whose use and abuse raises serious ethical questions (Boella 5-6). This is not to mention the use of actual drugs, controlled and monitored to a greater or to a lesser extent by their users.

Neuroethics

The development of neuroscientific research involving the relationship between brain and mind touches upon some of the most profound aspects of human existence. In the first instance it has led to problems linked to the ethics of this particular field, that is, to bioethics. In the last decade, advances in manipulating the brain and brain imaging have raised an increasing number of ethical challenges, particularly regarding the moral limits of the use of such technology, resulting in the new discipline of neuroethics. Here the culture of bioethics blends with both old

and new philosophical questions concerning, for example, consciousness, personal identity, freedom and free will (Boella XVII-XVIII).

The case of Schiller also leads in a certain sense to the question of neuroethics. This writer is of course one of the 'greats' of world literature, but calling him to mind is also useful if we consider the more modest exercise of writing of a scientific article. In the short story *Schwere Stunde*, Thomas Mann describes Schiller, ill and struggling with the creative process in the dead of night, with due emphasis on the ethics of writing. Mann writes, "Und es wurde fertig, das Leidenswerk. Es wurde vielleicht nicht gut, aber es wurde fertig. Und als es fertig war, siehe, da war es auch gut" [The work of suffering became finished. It was possibly not good, but it was finished. And when it was finished, look, it was also good] (190-6). In the end "fertig" (finished) correlates with "gut" (good). In fact, the '"Protestant ethic" of a job well done is only a surface reading of the process; for contemporary scholars it is also probably linked to more specific 'academic' ethics which have accompanied them since their college years. We thus need to go beyond Mann's consequential ethical formulation. In terms of pervasive neural architectures, this is not a linear process as such, but a continuous semi-conscious and unconscious development of "morale prima della morale" ("the moral before the moral", as in Boella's subtitle). Indeed, what kinds of reassuring neural architectures are activated by the knowledge of having accomplished a task and done one's duty? Of course, many issues are raised and these need to be formulated.

Conclusion

To sum up, we have seen that the writing of a simple article is an extremely complicated issue. Moreover, there is no substantial difference between the neural processes of a mediocre scholar and those of a genius, even if writing for the latter is possibly less tiring, less time-consuming and more creative: the neural basis,

involving many different areas of the brain, is irremissible for all, without exception. Even if our author is not aware of it, the conclusion of her/his article is explicitly embodied, even though at most s/he will be aware of that sigh of relief and the sensation of being free of a burden, and perhaps ready for a new task. It is as if all questions are reconciled: in this moment of harmony the neurons in the brain and the actual result of the writing system (usually black upon white) correlate, at least at the level of the finished product, the text.

At this point we return to the initial question regarding the responsibility of the author of the article, and to issues strictly related to the problem of identity and closely connected to important moral concerns. The simple question "Who wrote the article" (including *this* article) has revealed a multilayered process, and forces within us which are neither those of a massive ego nor completely obscure and zombie-like. In the light of a partial reorganization of consciousness, the full significance of the final product is still to be explored; we need to go beyond the consciousness that the inadequate framework of phenomenal experience provides.

Therefore we now arrive at the definitive conclusion of our paper, moving towards a second stage, which is difficult to describe in a few lines and risks becoming a few hasty final conjectures. On the one hand, social and cultural aspects cannot be neglected. On the other hand, a possible solution could be found in a formulation based on extended mind theory in its milder version. According to arguments which have been defined as second-wave cognitive integration, physical manipulations of external vehicles are explained in the sense that they are different, but also complementary, to internal processes, as Menary (227-243) and Sutton (189-225) suggest. In terms of text, the metaphor of a collective cyberworld evoked by the cloud (which has already become a technical term) can also be cited. A line by Emily Dickinson, "The brain is wider than the sky" – NB the brain, not the mind – is particularly apposite. In fact, today it seems that the sky has already been

conquered and is scattered with clouds. This, however, leads to a new line of argument which goes well beyond the modest limits of the present article.

[1] As a fundamental handbook of neuroscience, *Principles of Neural Science* (Kandel et al.) remains valid.

[2] The dangers of a flat physicalist reading have been discussed, for example, by Alberto Oliverio in *Prima lezione di neuroscienze* and the limited localization and artificiality of experiments when compared with the complexity of the human mind have been studied by Laura Boella, in *Neuroetica. La morale prima della morale*.

[3] In general terms, Snow's *The Two Cultures* is still a useful reference. For an updated position regarding a "third" or a "fourth culture" with art even anticipating scientific discovery, see e.g. Jonah Lehrer's *Proust was a Neuroscientist*. The problem has been raised extensively in terms of neuroaesthetics and the aesthetics of reception. In particular a debate has begun regarding the transfer of knowledge in literature. See Lauer 137-165; Koepsell and Spoerhase 363-374; and Salgaro 137-167.

[4] For a balanced view of approaches such as radical reductionism and eliminativism, see Searle 19-20.

[5] We are not specifically taking a linguistic approach, but would like to recall that important changes in the field of embodied linguistics have taken place; see Gallese and Lakoff 455-479.

[6] It is assumed that *brain imaging* cannot record a long, evolving complex process lasting at least several weeks; the findings would be limited, even if such experiments might well cast some light on individual aspects of the mental process. Some experiments could be set up incorporating fMRI, perhaps in combination with other non-invasive techniques.

[7] Two German neuroscientists have recently proposed "First-Person-Neuroscience", an "investigation of neuronal states under guidance of and on orientation to mental states" (Northoff and Heinzel).

[8] See also Gerald Edelman's *Wider than the Sky: The Phenomenal Gift of Consciousness*.

[9] As Lakoff puts it, "We are born with neural circuitry that effectively activates a "map" of one part of the brain in another part of the brain".

[10] Apart from this and other cases concerning novels, poetic structures have recently been explored in relation to neuroscience: in a book co-authored by a poet and by a neuroscientist, it is even claimed that poetry is the only literary genre in a position to represent the dense complexity of how the brain elaborates the world around us (Schrott and Jacobs 8). More focused on aspects of reception is the *Wirkungsaesthetics* of the German poet Durs Grünbein who links poetry and neural maps through the introduction of the so-called N 400 factor, distinguishing the unforeseen nature of poetic expression from ordinary language (Salgaro 49-62).

[11] Lakoff considers his prior theorization of metaphor (see Lakoff and Johnson) still valid, although he more recently states that neural theory represents an advance in understanding how thought and language work and "how metaphorical thought fits into the picture" (Lakoff, *The Neural Theory of Metaphor*). Of the different types of metaphor, Hans Blumenberg's so-called absolute metaphor should be mentioned. This denotes a figure or a concept that cannot be reduced to, or substituted by, mere conceptual thought and language.

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