

Organizational studies and Neuroscience: approaches in relation to the Concepts of Creativity and Innovation

Estudos organizacionais e Neurociências: aproximações em relação aos conceitos de Criatividade e Inovação

Dusan Schreiber ¹, Ivan Antônio Pinheiro ²

¹ Universidade FEEVALE, Novo Hamburgo, Rio Grande do Sul, Brasil. ² Universidade Federal do Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brasil.

Abstract

Both business study and practice have historically used the knowledge developed in other domains such as Biology, Psychology, and Psychiatry, among others. Analysis of general behaviors (leadership, motivation, consumer, etc.), identification and quantification of a tendency to take risks and make decisions, cognitive mechanisms adjacent to creative generation (essence of innovation), the role of elderly people in the organizational productive environment, among others, are examples of administrative applications that require a new approach and a new attitude. Reorganization of neurons, maps and neural signatures, mirror neurons, plasticity, brain-machine interfaces, the role of neurotransmitters and modulators in the teaching-learning process and in the control of emotions, among others, are concepts whose domain will soon be required from managers because they are needed to future management practices. Thus, this study proposes to fill this current gap through a technical-scientific essay based on bibliographical references, establishing a bridge for reflection and problematizations within the field of the organizational studies (Management, Economy, Organizational Communication, and other related), through suggestions, the new field that now unfolds to business research and practice.

Palavras-chave: Creativity; innovation; management; neurosciences; organizational practices.

Resumo

Historicamente, tanto as pesquisas acadêmicas como as práticas organizacionais, tem se utilizado do conhecimento de outras áreas de conhecimento, como a Biologia, Psicologia e Psiquiatria, entre outros. Análise de comportamentos gerais (liderança, motivação, de consumo, etc.), a qualificação de tendências a assumir riscos e tomar decisões, mecanismos cognitivos adjacentes a geração criativa (essência da inovação), entre outros, são exemplos de aplicações administrativas que exigem uma nova atitude. Reorganização de neurônios, mapas e assinaturas neurais, os neurônios-espelho, plasticidade, interfaces cérebro-máquina, o papel dos neurotransmissores e moduladores do processo de ensino-aprendizagem e no controle das emoções, entre outros, são conceitos que futuramente deverão ser dominados pelos gestores organizacionais. Assim, este estudo se propõe a preencher esta lacuna corrente, estabelecendo uma ponte para reflexões e problematizações dentro do campo dos estudos organizacionais (Administração, Economia, Comunicação Organizacional e outros relacionados), através de um ensaio técnico-científico com base em referências bibliográficas, para evidenciar o novo campo que agora se desdobra para a pesquisa e as práticas organizacionais.

Keywords: judgment; audit; behavior.

Autores de Correspondência:

D. schreiber – e-mail: dusan@feevale.br; I.A. Pinheiro – e-mail: iapinheiro@ea.ufrgs.br

Introduction

It is well known how much Administration is tributary from knowledge generated in other areas. Because of this it is classified in Brazil as being an applied social science. Nevertheless, perhaps what better identifies the administrator's work is his ability to apply knowledge, scientific or otherwise, as is the case with the techniques developed in the most diverse fields of knowledge such as Anthropology, Psychology, Philosophy, Political Science, among many others. Having been initially systematized as a distinct field of knowledge and application from the studies and reflectivities of engineering, as is the case of Taylor (1990) and many others, it is not of less relevance the contributions of the differing domains of Mathematics, and its spinoffs as in the case of Cybernetics.

The organic perspective introduced by Fayol (1990), another engineer, has motivated both Administration theorists and practitioners alike to search for analogies in the Biology field as well as to have as a question of principle that the organization constitutes, in general, an open system (Emmery, 1969). Thus, Administration is, by its own origin, a multi and intra-disciplinary field.

More recently, administrators are ever more taking advantage of the advances in the also ample field known as New Communication and Information Technologies (NCIT). These new advancements are so encompassing that nowadays, irrespective of the organization size, a great many types of hard and software, internal and external and ready to use, so that they are called "friendly", are being put to use to achieve higher orders of management efficiency, efficacy and effectiveness. Nevertheless, the same frantic publishing drive has not been observed concerning the knowledge generated in one of the areas which, in recent years, has registered significant scientific advancements: the Neurosciences. That is why they are this paper's theme.

Highlighting this topic relevance is the fact that the 90's have been dubbed as the Brain Decade, which lead to the occurrence of several events, to an increase in the moneys for research, both public and private, to the upstart of new lines of research and experiments, and to an increase in universities enrollment. As a result,

the knowledge in these domains has enlarged the frontiers and in some cases, broken paradigms.

It is believed that the advancements in the Neurosciences state-of-the-art will, sooner or later, greatly influence the management ways and the organizational ambient, as well as up and down stream of them, i.e., the market relationships. The recruiting and selection techniques, the capacitating and training programs in leadership, decision-making, etc., the design of motivation strategies for personnel and consumers, and the generation of ideas are the more evident areas of application, but, of course, not exclusively.

It would not be proper in a text like this one to discuss at length the advancements in the Neurosciences. Contrariwise, our focus is on how the knowledge coming from this field may contribute to the administrative theory and practice, be it having in sight the amelioration of the individuals' welfare as well as the attainment of organizational results. Thus, among the field researched there is one which appears to merit a special attention from Administration: The one dealing with the memory processes, if not because of the progresses registered but by the fact of they being the starting point of almost everything.

The following citation from Izquierdo (2010, p. 14) gives the exact dimension of the importance of the memory:

We are what we keep in our memory; we are no longer that which we have forgotten, neither can we be what we yet do not know. Whatever has disappeared from our brain, or that that has never been there, is not ours. That why it is so despairing to loose memories; and worries us so much: because we have lost part of that pertaining to us, part of ourselves. (author's translation)

In summary, along with our emotions and reason, we are what we are able to register and accumulate as conceptual and empirical knowledge – the memories. Thus, any reflection on capacitating, training and ideas generation has to take into account the processes which are at the origin of the creation, consolidation, recuperation, modification and extinction of memories. So, when organizations refer to

someone's competences, they are referring, firstly and over all, to the memory processes and, secondly, to the capacity of transforming in act the knowledge (the memory) which rests as potency.

Therefore, this paper, as already mentioned, has the Neurosciences as the background theme, memory as focus and the question we hope to answer is: How Administration may get hold, with benefices, of the knowledge generated by the Neuro sciences in general and by the advances achieved by the memory studies in particular.

As a valid research source the authors have used published works by notorious researchers in the Neurosciences, complemented with articles published in one of the oldest and

reputable review of scientific divulgation: The Brazilian version of *Scientific American*. Because strangers to the managers community, when referred to, the Neurosciences researchers have been duly qualified and their areas of research and the institutions they belonged to have also been identified. As it is also an essay, the authors have made use of their accumulated expertise in management in order to make the analyses, establish analogies, inferences and suggestions, in order do establish a bridge for reflection and problematizations within the field of the organizational studies (Management, Economy, Organizational Communication, and other related)

The Neurosciences and the Technological Advancements

The expression neuroscience has been used to define a set of disciplines which add contributions to a better understanding about the workings of the brain and the mind, i.e., of the hard and the software responsible for the human attitudes and behaviors. Every day the investigative lines incorporate new fields which, put together, amplify, the existing knowledge on the mind and the brain, as is the case with Molecular Biology, Physiology, Anatomy, Chemistry, among others. Following the example of other research projects, the studies in the area have been developed through large cooperative nets and interchange among countries, as well as have benefitted from the huge existing capacity for processing and computational analysis of data.

The history of the brain evolutionary Biology may be found, among others, in Rose (2006). Nevertheless, it is in Nicolelis (2011) that the history of neuroscience will be found. It can be said that Hippocrates triggered the field of study whose trajectory includes what we call neurosciences when in the 4th century B.C. he stressed that it is in the brain, not in moods or in other organs, that our pleasure and joy, as well as pain and sadness take place. Natural difficulties, such as difficult access due to lack of technology, and cultural difficulties, including matters of faith and religion, and tough disputes between the great paradigms guiding research explain away why studies do not always advance linearly. However, since the 18th and 19th centuries, new scientific developments in Physics, Chemistry,

Biology, Natural History, and their technological applications in creative and daring experiments have widened the possibilities of knowing how the brain and the mind function.

During the 30's and 40's of the last century, the emergence and rapid diffusion of a new practice of introducing micro-electrodes in the brain capable of detecting the action potentials produced by the neurons has contributed to new and meaningful advances in the studies aiming at mapping the neural correlates of the physical, emotional and psychological behaviours, first in guinea-pigs and afterwards in humans. A fact worth mentioning is that the transfer of information among the neurons leave marks - Nicolelis (2011) call them "neural signatures" - which can be captured and transformed into digital data, be presented and visualized as a form of sound or as images. The new technologies have made it possible to map the brain functioning's using illustrations evermore complex, rich in content and growing discriminating clearness. Furthermore, with the support of the biochemical analyses techniques at the cellular level the knowledge about the brain and the mind have soared to prior unthinkable levels. Besides, the digitalized data enable processing in search of "electric space-temporal patterns" (Nicolelis, 2011) and of associations among variables, which has proportionate important discoveries about the existing relationships among behaviour manifestations such as to sleep, think, decide, perceive, feel, observe, read, etc., and the brain

areas which, *pari passu*, are activated.

The ones hard work and the technological offer allied to the investigative creativity of others have lead to successive knowledge accumulation. For instance, there is a vast literature dealing with the functional specialization of the brain hemispheres. Nevertheless, the net which identifies the brain in action encompass the collaboration of neurons from both the hemispheres, and that, when overloaded, one may request help from the other as well as, if not properly demanded, to cede the hardware so that the other hemisphere execute its own software, i. e., an applicative supposedly exclusive, up to now, to the side which has ceded the hardware. The consequences of this new knowledge to Administration are enormous: Knowledge acquired and not explored gets lost, and we do not refer here to the day-to-day exigencies, but, for instance, the complex processes of decision-making which involves doubts, risks, tensions and, within organizations, punishments and rewards, as well as the creative processes (Schiavon et al, 2013).

Nicolelis (2011), Strauch (2011), and Doidge (2012), among others, emphasize that if the neurons are not exercised they become

Memory

After all, what is memory? According to Rose (2006, p. 178), memory “[...] is the propriety which defines us the best; above all, it constitutes our individuality, provides our lives trajectory with an autobiographic continuity, so that we appear to be apt, even at the eightieth and ninetieth decades of our life, to remember episodes of our infancy [...]”. Thus, as the memory is the set of our experiences, the more sensible, as Izquierdo (2002, p.16) puts it, is “to talk about memories and not about memory”. The memory, while a physical object, concrete, as something to which we are used in our everyday lives, does not exist or, if it does, we do not know yet how to isolate and capture it, and neither can we say that it is at some specific place. On the other hand, the intensive use of the brain, that is, of the memory, provokes modifications at the cellular level which means physical modifications in the neurons, this being justifiable to say that “the memory is there”.

accommodated to the point of losing their efficacy, a situation which do occur when requested and used for other functions. For lacking of exigency there is a lot of creative potential lost. The bilateralism and the almost simultaneous involvement of multiple brain areas are present in most of the phenomena resulting in the consciousness state, of the perception of the ego. Nicolelis (2011, p. 417) says that

The way in which the brain answers as a whole, be it in response to a sensorial stimulus, be it to produce a particular motor behaviour, depends, at every moment, on its internal global state, i.e., the continuous cerebral dynamics is essential to define the optimal solution which the brain finds to the generation of any behaviour. (author’s translation)

Because it is impossible to be exhaustive in the description of the Neurosciences state-of-the-art, some themes have been highlighted in order to give the needed support to the subsequent section, as well as to the relationship we pretend to establish: The repercussion of the advancements in the Neurosciences upon the administrative practice.

In this perspective, several areas of the brain are involved with the processes related to memorizing such as the limbic system, the cerebellum and the cortex. Nevertheless, it should be stressed that these areas are not exclusively activated during the processes related to memory. The cerebellum, for instance, is very much involved with the processes dealing with motor coordination, the equilibrium and muscular tonus, whereas the limbic system is activated when the emotions dominate the process (fear, frustration, anxiety, happiness, etc.). But, if we remember that we are the result of our memories, the activation of any area, most of the times, implies evoking an already lived event. Nevertheless, it must be pointed out that there would be no memory at all without the action of certain chemical substances as the hormones, the transmitters, receivers and modulators among other elements which, when cited are preceded by the prefix “neuro”.

These substances, sometimes referred to as “the body chemical messengers”, are effectively responsible for the synapses, that is, for the transfer of data (electrochemical signals) among

neurons, thus establishing the neurons network which, connected and activated, constitute the memory.

Types And Forms Of Memory

According to Izquierdo (2002), there are four types of memories. The first one the so called “work memory” which leaves few neurochemical traces and, contrariwise the others, does not produces files (behaviour profiles), being kept in the conscience for only a few seconds, at most for three minutes. Because of this trait it is also called immediate memory. The second type is the “declarative (or explicit) memory” which registers facts, events or knowledge accumulated along our existence and which can tell how they have been acquired. The third type is the “procedural memory” which is related to the motor or sensorial capabilities or abilities. These are generally called “habits” (riding a bicycle, swimming, jumping, among many others). It is difficult to declare that we have them because to demonstrate that we really have we have really to ride a bicycle, swim. This memory is not affected by emotions or animus states. Finally, the fourth type is “priming” (memory acquired and evocated by means of an image fragment – the first word in a poem, certain gestures, odours

or sounds.

Not all the phenomena to which we are daily submitted stay registered are memories, i.e., they move from the work memory to the other types of memories. Besides reason, that is, the intention of registering certain information or events, the circumstances may also facilitate, or not, that they will be available for future use. We also know, from experience, that memories are not eternal, as well as that they may be modified via a critical analysis *vis-à-vis* new information or through a deliberate interference. How to manage memories creating conditions which facilitate, or not, their consolidation for future evocation will be discussed in the next session, since it is a theme more closely related to this paper purpose (Villagra, 2014).

We hope that this brief presentation about the brain and the memory in particular, suffices to establish the correlates which, in he following, we intend to deal in relation to some management topics.

The Neurosciences and Management

Kandel, cited by Dobbs (1998, p. 8), stated that “we are what we are because of that which we learn and remember.” In the same sense, there is the phrase “Education is that which remains after we forget everything that has been taught us at school”, which is attributed to Einstein. Independently of authorship, there is no doubt that they are well established by empirical evidences, since be it at the individual as well as the organizational level, one of our permanent objectives is to remember register, to accumulate and, when necessary, to remember everything that has been learned. When in the market to get a job we, to a certain extent, stick to the social norms taught and reproduced through a long cultural process which we

remember in order to be accepted in selective processes, to solve professional problems through redeeming the teachings learned at school, or even through practice. Therefore, it should be of interest, mainly to organizations and especially to managers, to know (not forget!) how people memorize the batch of information they receive relative to professional activities, to experiences, to common uses and customs. Thus, the more immediate synapse, that is, the first repercussion of the Neurosciences field upon the management area is in the ambit of both personnel selection and training programs which are a critical resource to organizational creativity.

The Middle (Or Third) Age

Maybe with some exaggeration, since the number of elderly people is steadily growing, it may be said that contemporary society is youth's society in which everything which is youthful is overvalued. To be young is the objective, the fair model and ideal to be preserved, cultured, and almost worshiped. This standpoint results from the belief that, although since the 90's we know it to be false, with the advancement of age there is a progressive loss of neurons and, consequently, of capacities in general. We know today that in several aspects the body ages before the brain, i.e., some functions such as looks, eyesight, endurance, etc., have their efficacy declined as time pass; nevertheless, the same does not occur with the brain. In this sense, Strauch (2011, pp. 11-16) affirms that

[...] the middle-age brain gets over the confusion and goes straight to the solutions, it knows who and what to ignore [...]. But, at the same time, our capacity to establish exact judgements about people, jobs, finances [...] grows and becomes stronger. [...] the greasy and white layer called myelin keeps growing till an advanced stage of the middle-age. As it grows, myelin establishes connections which help us to understand that is around us [...] we are learning with precision in which ways it physically alters the brain, what types of experiences modify it to the better, and what means, de facto, be a competent administrator, a prudent pilot or a talented teacher [...] middle-age people start using both brain's hemispheres instead of one – a resource called bi-lateralization [...]. (author's translation)

Hasher (*apud* Strauch, 2011, p. 110), a neuroscientist at Toronto University, follows this same line saying that “[...] if part of the creativity consists in joining normally dissociated ideas, the older brain could, almost by its own nature, be more prone to produce something peculiar, new and even beautiful [...]” Also Smith (*apud* Strauch, 2011, p. 111), at Michigan University, says that “[...] in the right context, the tendency to dispersion may lead to marvellous things [...] when thinking about

various different things at the same time, there are moments in which may discover new associations [...] this is the divergent thinking, is the creative thinking [...]”

In the light of these findings, the society which praises the young and values the precocious certificates and diplomas, should also (re)value the middle-age experience and expertise, giving then the due importance in the directives, programs and management initiatives, having them as allies to be attracted and kept in the organization. Therefore, excepting those activities in which the physical vigour and acuity, more than necessary, do make a difference, there is no organizational ambient in which the middle-age professional can not bring relevant contributions, beginning by the area and the professional responsible for recruiting and selecting personnel whose ability in personal relationships must be singular. Besides, at the level of the personal relationships, one of the desirable abilities is to create empathy, attitude explained today by the activation of the so called mirror-neurons, (Rizzolatti; Fogassi; Gallese, 2006), an attitude which not everybody is able to develop and those who achieve it do it only with the passing years.

Finally, Zalinski (*apud* Strauch, 2011, p. 38), a researcher at the University of Southern California who studies the aged, stated that the new discoveries “have very interesting future implications, above all in terms of employment.” Also Kramer (*apud* Strauch, 2011, p. 40), a psychologist and neuroscientist at Illinois University, after examining flight controllers made the following question: “[...] it may be that, when forcing retirement at 55 years of age we are not losing our best brains – adult brains – who could let us be more safe?” A similar debate has taken place recently in Brazil when some members of the Supreme Court have been compulsorily retired at 70 years of age. This happening caused a large debate in the media, having been suggested that leaving should be a personal criterion.

The Learning And Training Neural Correlates

As have been discussed, we initially apprehend the world from the senses, and conscience and reason complement the reality's framework and confer to each one the sense of "me" x the external world. According to Nicoletis (2011, p. 336), "[...] the somesthetic cortex is the storehouse of past impressions from which a model of the reality is created, frequently below the level of consciousness." It is apparent that this is of interest to the organizations, since it should occur from the first contact on, not only the memories (mainly the declarative-semantic) recuperation and evocation, but also that determined facts and information, more than the fugal existence of the work memory, be consolidated in the form of declarative memories and sometimes as procedural memories. After all, what is the sense in having a program or capacitating course if, after some time, the participants would no longer remember it? As already mentioned, we are what we are because of our memories. The sense of what is logical, as well as of what is rational, guards a straight relationship with the standards and the experiences registered in the format of memories.

Thus, some questions arise: How to convert potency into act, that is, how to make that the acquired (memorized) learning be transformed into action favouring the organizational interests? And how the administration may act to leveraging this process? To answer these questions it is needed, first of all, to verify how the memories are consolidated.

In relation to time, memories can be of short or long duration, as well as remote, those which resist to the action of time. Glassman and Hadad (2008, pp. 182-185) inform that

The short term memory (STM) refers to the retention during time intervals relatively briefs – 15 seconds. In contrast, the long term memory (LTM) refers to the retention over relatively long periods – hours, days, weeks or longer yet. The general model assumes that the two types reflect distinct processes [...] the STM is very limited in relation to the quantity of information it can hold [...] A Chunk is the basic measure of the STM, representing a meaningful unit, as letters, numbers or

random words. On the other hand, the LTM seems to be practically unlimited in its capacity [...]. What determines that which we remember and what is retained? The cognitive psychologists refer to the basic processes as codification [related to the functioning of the STM] and storage [related to the functioning of the LTM]. (author's translation)

Therefore, one of the first functions of the brain is to select the information which move us, interests, attention, needs (expectations of rewards, survival, etc.) as well as check their congruence, or not, in regard to other already stored information (semantic memory), thus, how much more and how much earlier a person is exposed to a variety of information, more easily the new recordings will be assimilated, actualized, reinforced in the form of memory (Gallegos, 2013). According to James (*apud* Macknik, Martinez-Conde, 2011, p. 68), "Everybody knows what attention is. It is the appropriation by the mind, in a clear and vivid way, of one among those which appear to be simultaneously possible diverse objects or lines of reasoning. [...] Consciousness implies repelling something to deal in an effective way with other things."

Macknik and Martinez-Conde (2011, p. 283) complement by saying that

[...] your visual system has a focus of attention. It is the region of the visual perception in which you highlight everything which occurs. This principle is valid to hearing, touch and other sensorial systems and even to the cognitive functions – for everything that the brain does [...] but, the attention also exerts other effect on the brain. Besides augmenting the neural signals in the center of the focus, it represses the activity in the surrounding region. (author's translation)

Therefore, certain practices (unfortunately) common in the class room such as using cell phones, being connected to the Internet to actualize posted messages or to consult subjects strange to the theme being discussed go against the true purposes of teaching. In these cases, the exposure to too many data (cell phones, e-mails, etc.) activates the natural filter that can

exclude the essential in favour of the superfluous, resulting in the latter being registered instead of the former. Grüter (2009, p. 44), a M.D. expert in memory disturbances, discussing Tulving's findings at the University of Toronto, says that

[...] each time we remember something, we recombine mnemonic marks, a kind of memory threads called engramas, and we return to memorize the result [...] the brain records personal information in the episodic memory. It is as if we memorized short clips of odours, images, sounds and related feelings. When we remember something, the cerebral system activates these elements and regroups them. Thus, the engramas and their references return to the conscience and are recombined. Memory, therefore, works in a constructive way, generating patterns of remembrance. (author's translation)

Among the associations, one of the most effective to memory consolidation is the semantic coding. The case of the word *rose* is a good example. When confronting (or using) this expression, the meaning that comes to mind transcends the mere ordinate position of the letters which gives sense to it, since it also includes the form, the color, the odours, sometimes the environment or the moment to which its expression, for some reason, is associated. An analogous case is presented by Damásio and Damásio (2009) who take coffee (no wordplay!) as an example. Who, when listening to a music has not associate it and felt transported to another ambient and in company of other people?

Therefore, in the case of a course, if the attention to the contents quality is necessary, it is not sufficient to guarantee its recovery and later application to the practical case. It is known that the information is stored in the brain according to their source – hearing, sight, taste, etc. Thus, while the sensation of color is stored in one area, that of an odour is in another, the same occurring with the other elements which, activated in networks, establish our perception of what is a rose. The imprinting (the memory consolidation) in networks favours its evocation from any one of the elements, which stresses the importance of creating and enriching, at the origin, details associated to the central message to, more than simply be remembered, be evoked from all the

dimensions translated by the meaning. In this sense, to build chronological narratives, to put the information in context, as well as to establish hyperlinks which bond the themes, as in the case of the creation of conceptual maps, are initiatives that contribute not only to consolidate the LTM, as well as qualify them and, above all, to facilitate their evocation because they exponentially multiply the synapses creating, modifying or consolidating the neural networks.

Ross (2006) has shown that to overcome the limit of recordings which most people are able to process in the operational (work) memory, persons like the chess masters group the moves in great information blocks as in the openings (French, Ruy Lopes, among others), but also in models of middle and end game. As each opening has basic characteristics and principles that make them singular, a "memory unit" instead of working with dozens of moves and their combinations, it rescues associated information, which in turn considerably increases both the velocity and the creative reasoning capacity. Regarding capacitating programs, to integrate similar contents and identify the contact points among supposedly distinct modules are practices to be explored.

Some teachers and students, when dealing with those disciplines involving formulae create code-words, some times as acrostics to facilitate the mnemonic processes. The remembering of jokes is a good example of priming (evocation through tips). Very few are those who at any moment have ready repertoire of joke; but if "A" tells the first, this one may activate "B's" memory, thus originating a chain reaction which activates the memories of "C" and "D". The use of priming may be planned and introduced at the moment of learning, as is the case with persons who through their lives learn to establish their own network of tips, fragments which, through associations, facilitate the evocation of memories. Great writers, be them poets or dramaturges, as Tolstoi, Dostoyevsky, Shakespeare, Érico Veríssimo, Neruda, Machado de Assis, among other literature exponents, do have a great ability in using priming to rescue remote memories and compose their opera.

The practices described above should, adapted to the context and where and when possible, be explored by manage. In this sense,

Ruas (2005), as well as Pinheiro, Vieira and Motta (2010), present strategies for developing plasticity and bilateralism. The first explores dramatization in the process of managerial training, whilst the latter have found many similarities among the situations present in literary oeuvres and the reality of organizational ambient. Complementing this, Rose (2006, p 117) introduces the relevance of emotions by saying that

[...] brains/minds do not deal only with information. They are preoccupied with live meanings [...]. The key here is emotion since that that distinguishes brains/minds from computers is yours/our capacity to experience and express sentiments [...] Emotions are evolved proprieties, and several neuroscientists have dedicated considerable attention to the mechanisms and advantages to emotion survival [...] feelings, the mental states which are associated to emotions, are exclusive to human beings [...]. Contrariwise, affection and cognition are inseparably involved in all the brain and mind processes, creating meaning to the information – just one more reason why brains are not computers. (author's translation)

It has also to be borne in mind that there are a variety of biochemical processes involving memories formation. These substances are involved with the emotional state and contribute to our level of attention, degree of anxiety and animus, conditions intervening in the memory modulation processes (Turner, 2014). The stresses caused by excessive competition, by organizational changes, especially those which may, and usually do, create frustrations in the individuals' expectations. The neurosurgeon Paul Niemeyer Filho (Revista Eletrônica Poder, 2011) says that "[...] If you are depressed, with a low self-esteem, the first thing that happens is the memory to go away; 90% of the complains for lack of memory are due to depression, disenchantment, lack of stimuli. For the brain to work better, you have to have motivation."

The importance of the emotions on the memorization process may well be evaluated from the writings of E. Kendel, Nobel Prize in Medicine for his studies concerning memory. In his autobiography, Kendel (2006) describes that it was for some traumatic events which occurred in his infancy that have taken him to ask: Why do

we forget some facts and not others? Besides the emotional state, other factors, if not properly dealt with, may compromise the memorization of what has been learned. Some of such factors may be linked to some of the celebrations which occur at the end of a course or training activity. Good examples of this situation are the alcohol consumption and the exposure to a new and unexpected situation, say, an artistic presentation. Because of this unexpectedness there is the risk of the persons remembering more about the show than of what have been the learning contents.

Nevertheless, not everything which affects memory occurs during the information gathering process, or immediately after, as is the case of the, alcoholic or not, celebrations. According to Doidge (2012, p. 257), "Many studies show that sleeping helps us to consolidate the learning and the memory, and effectuates plastic changes. When we learn some ability during the day, we will be better the following day if we have had a good night sleep." Also Stickgold, professor of Medicine at Harvard, and Ellenbogen, researcher at the Massachusetts General Hospital, stress the relevance of sleeping to memory, and, consequently, to the learning process (Stickgold; Ellenbogen, 2008). "Lose a night, and the daytime memories may be compromised - a perturbing finding in a society where the privation of sleep spreads in epidemic proportions." (Stickgold; Ellenbogen, 2008, p. 37). Also in this case, the elders or those who are capable of living away from the accelerated urban life and keep the *siesta* habit seem to have come to sapience before the knowing of science. But, if taking a nap is important, the profound sleep is essential to the hippocampus memory consolidation.

As have already been seen, the LTM consolidation is a process which demands time. Thus, the physical-chemical reactions and plastic alterations at the neurons level continue during the sleep time. Therefore, contrariwise to common sense, instead of being still, resting, the brain activates areas that are no involved in the waking state, creates new synapses and strengthens the connexions network activated in the memories consolidation and evocation. Literally, during the sleeping time the brain thinks for us, separates the chaff from the wheat, and identifies that which, consciously, we had no idea whatsoever. Besides, in the threshold

of consciousness, free of the logic deadlocks, recuperates those information rejected by the work memory because contradictory, as has been stressed by Johanson (2011).

The question that now arises is: Apart from celebrations animated through a few doses of alcohol and the eventual exhibition of something interesting, is it common to rest after the capacitating and training programs, or even during these in the case of being too long? It is very probable that the answer is in the negative, independently of where and when the samples might have been collected. It is also known that at the end of some training activity the participants have to undergo long and exhausting trips which injure the indispensable rest.

In another direction, Grüter (2009) when stressing the role of the emotions to the cognitive and mnemonic processes, calls attention to an important strategy which contributes to memory consolidation: Mental exercises. The author also stresses the role played by the emotions in the cognitive and mnemonic processes by saying that “[...] imagining a scene almost always awakes sentiments. Many a time we imagine the future only to see what we would feel in a specific situation. Therefore, we not only preview, but also pre-feel” (Grüter, 2009, p 50). In this same line of discussion, Doidge (2012, p. 219) has observed that “[...] the mental practice is an effective way to prepare to learn a motor ability with a minimum of physical exercise.” And the author ends by stressing that “[...] both in action and imagination many identical regions of the brain are activated” (Doidge, 2012, p. 221). This, if adequately explored, could result in great savings and even costs reduction. Curiously, once more literature brings us examples on the theme: “[...] we understood more through imagination than by what we were seeing” (Dostoiévski, 2010, p. 181).

Training (sports, mounting and dismantling equipments, surgical interventions, etc.) and simulations (piloting, military operations, business games, etc.) not only affect the motor abilities, but they extend over to the neurons, activating new synapses and changing the neurons’ structure. At the threshold, already in a state of proficiency we are capable to react almost as automata, without thinking, thus with much more ability and swiftness than others (as is the case with elite

shooters), because the brain incorporates new dimensions into the body. Nicoletis (2011, pp. 350-351), when discussing this subject says that

[...] our sense of ego is not limited to the last layer of epithelium that covers our moral body [...] to most of us the sense of ego clandestinely takes over, during the whole life, of the technological tools which we intimately get involved with – things like cars, bicycles [...] golf clubs, soccer balls, joysticks, mouses [...] being a specialized proficiency, this sense of ego may expand to incorporate a musical as a violin, [...] a medical instrument [...] this is the reason why A. Santos Dumont with his adventures with his dirigible balloons [...] started to feel as his own the movements of his equipments [...] the sensation, he used to say, was very different from those he experienced as a passive passenger.
(author’s translation)

Nicoletis (2011) goes on with other examples (Pelé, Ayrton Senna) to whom other virtuosos with very high levels of performance, as the case with *wushu* practitioners. But, in these cases, if, on the one hand, there is uncertainty as to the contribution of some genetic trait, on the other there is the certainty that they only achieved such performances after many an hour of physical and mental training, which have made them to incorporate, as an extension of their own body, the objects (ball, car, etc.) which identify them as singularities.

The advancements in the Neurosciences which may be apprehended by Administration, appropriated and manifested in organizational results do not exhaust themselves in the highlighted aspects. Fields (2006, 2006a), Caplan (2008), and Haier (2009), for instance, stress that the ingestion of substances which modulate animus states amplifies the cognition and the LTM capacity. In this sense Callegaro (2005) has put forward a book whose title is very self-explanatory: *A Mente Criativa – a aventura do cérebro bem nutrido* (The Creative Mind – the adventure of the well nurtured brain). The role of nutrients (mineral salts, antioxidants, etc.) has also been discussed by Horstman (2010) and by the neuroscientist Bickford (*apud* Strauch, 2011, p.171) who says that “the brain does not have an exclusive sensibility, but is sensitive to what we eat, [...] and now we perceive, evermore, that

what we eat may affect our cognition.”

As important as to consolidate the memories is to continuously evoke them, contrariwise, there is the real risk that they may be lost, since the synapses (and the neurons) not activated as evidence of remembering tend to be activated to register new facts. Furthermore, the benefices of neurogenesis will be lost if the new neurons will no be effectively activated (Satruach, 2011; Shors, 2009). In this sense, the analogy with the physical activity is total. The knowledge that is not reiteratedly put into practice, renewed, tends to be lost, since the brain’s areas will be occupied (activated) to perform other functions which, reiterated, will erase the previous memories. Erasing registers is a natural procedure to the brain, but the capacity to retain information is almost infinite. The question, now recurrent, is: In this sense, what have the organizations been doing, mainly those who have invested a lot of money in capacitating programs?

Finally, Macknik and Martinez-Conde (2011, p. 12), who at the Barrow Institute

of Neurology, in Phoenix, Arizona, research perception phenomena, the effects of perspective (of color – *sfumato* – geometric), anamorfismo and other cognitive illusions (conflict among the expected, the logic-rational and the perceived by the senses) which occur during magic sessions, say that “By understanding how the magician fools our brain, we become more apt to understand how the same cognitive tricks operate in the advertising strategies, in the commercial negotiations and in every type of interpersonal relationships.” The design projects, one of the main areas for innovation (furniture, shoe ware, clothes, decorative objects, utensils in general, etc.) may be enriched by exploring the illusions promoted by the combined use, for instance, form and color, resulting in objects which appear to be larger than what they really are, or apparently without imperfections because undesirable details have been turned invisible to the eyes (Carvajal, 2013). The field of illusions (paradoxes to logic) is ample and open to organizational exploration, mainly, but not exclusively, by the marketing area.

Final Considerations

The unfolding and the impact of the Neurosciences, although restricted, are already realities which have affected the social relationships and, by extension, although imperceptibly, organizational life. Nevertheless, although it is already possible to observe some initiatives, generally characterized by expressions such as neuromarketing, neuroeconomics and others, there are no news that Administration, in its varied fields, has been taking hold, with strategic intention, of the advancements in the Neurosciences.

It is worth mentioning that most of the texts dealing with the management of innovation suggest that the starting point is in the person’s creativity – the ideas generation genuine source. Creativity is innate or can be acquired and developed? Whether it can be developed, is there anytemporal window, in respect to age, considered to be the most favourable? And, in this case, if there is, which are the best strategies to develop it? Creative ideas are the result of an individual endeavour or result from a collective effort? The incidence of creativity is greater among experts, or the laymen or generalists of every order also

manifest themselves with creativity?

Unfortunately, from the standpoint of the academic research, reality presents at least a good example for each one of the questions, which explains the profusion of titles that put together the most convenient cases to the thesis claimed, thus suggesting the discovery of the Holly Grail or of the Philosophical Stone. The infantile prodigies such as Mozart, Gauss and several chessmen (“Bobby” Fischer, Capablanca, and others) would, prove the innate creativity thesis which manifests itself in several areas of knowledge, independently of formal apprenticeship, experience or culture. On the other hand, during their youth, nothing pointed to the late geniality presented by either Darwin or Einstein, both resulting from original reflections coming from accumulated knowledge.

One of humanity greatest geniuses, Leonard da Vinci, is the contra-example of those defending that creativity emerges from a specialized knowledge in only one area. Shakespeare is also a contra-example of those defending that it is necessary to have a formal education. In this case, how somebody without a due formation could have produced so

genial works? Einstein's Theory of Relativity is acknowledged as being one of the greatest advances that individual creativity may attain. On the other hand, Quantum Mechanics is a good example of what the collective efforts of M. plank, N. Bohr, E. Schrödinger, W. Eisenberg, to name but a few, have lead to. Finally, those that stress the role of culture and of institutional support cite the Greek forerunners and assert as well that the renaissance artists' talents would not have flourished without the support of the wealthy and that Modernity would not have happened in England if a favourable ambience towards critical investigation, knowledge recognition and valorization were lacking.

Thus, there is no lacking of examples to prove whatever one wants, which lead us to conclude for the phenomenon complexity and multidimensional characteristics. If there are consistent evidences about one of the creativity dimensions, this does not recommend the phenomenon's composition as a whole. In this context, Kaufman and Sternberg (2006) have shown the influence of both culture and formal schooling upon creativity, and Boden (1999) presented a collection of studies dealing with the diverse dimensions of creativity. In this same wave, when working with creativity and innovation, Glover, Ronning and Reynolds (1989) have collected texts dealing, among others, with questions related to rationality, cognition, memory, intelligence, evaluation and applications. Treading this same path, Gardner (1994), Csikszentmihalyi (1997), as well as Sternberg (2000) and Wechsler (2002) have dealt with a correlative theme: Intelligence. Finally, there are more operational texts, of the type "how to do it", as is the case of Savransky (2000), Dombroski (2000), De Bono (1994, 2002) and HBR (2003).

Stein (1989) has pointed out that the contradiction between creativity, which suggests innovation, and memory is just apparent since there are positive, as well as negative, aspects. The key rests on how people recuperate the memories judged to be associated to the problem they are facing and use them in a creative way. The adequate strategy would be to, from the learning process on, facilitate the future spontaneous transfer. How? Enriching the learning process through associations (concepts, ideas, etc.) and the creation of a sense of utility (to imagine

application contexts, perform simulations) so as to facilitate memorization. Nevertheless, the associations should not be limited to the competences of one of the brain's hemispheres. They should combine the typical specializations of each, thus enlarging the net of synapses, i.e., creating bilateral semantic networks.

At Kansas University, Chrysikou (2012), psychologist and a studios of cognitive neuroscience and creative cognition, has pinpointed that, as a result of her researches, the creative persons present a characteristic: Cognitive flexibility, i.e., an aptitude to regulate the cognitive control system in response to the exigencies of each situation. Besides the traditional Stroop Test, her experiments have measured the emitted frequencies from determined brain areas whilst the volunteers were submitted to tasks demanding differing degrees of cognitive control. While the Beta waves (15-20 hertz) were associated to problem solving which demanded attention and concentration, the Alfa (8-12 hertz) were linked to those tasks which could be done in a relaxed vigil state and of diffused attention. Paralleling this, it has been observed that the subjects who presented the more common solutions have also evidenced an intense activity in the pre-frontal cortex, which is the area involved with the planning and control activities, and also in the work memory. On the other hand, the non usual solutions, also recognized as the more creative, evidenced the activation of other areas and the cortex in a state of relaxed vigil. The association of creativity with the cognitive relaxation, i.e., the lesser degree of logical censorship and the exigency of conformity to the established patterns is immediate.

Benefiting Administration, studies and researches tend to corroborate Thomas Edison: "The first step is an intuition and it comes in an explosion, afterwards come the difficulties [...] months of observation, intensive study and work before the commercial success – or failure – will be achieved" (Friedel; Israel, *apud* Schaffer, 1999, p. 27). Remembering Picasso, Einstein and Edison, Johansson (2004) states that "The most successful innovators produce and realize an incredible number of ideas". That is, much, much work is needed to accumulate specific knowledge (according to Herbert Simon, cited by Ross (2006), at least 10 years are needed to dominate

an area of knowledge) as to be exposed to varied range of information, everything in a continuous and planned way. But, no less important is, also frequently, to access the knowledge stock as well as to practice the opening of windows in the logic filters which, by nature, tend to frame every new information in an already pre-existing organized structure.

The advancements in Medicine, in general, and in the Neurosciences, in particular, suggest more than reflections, but that the administrative practice introduces effective changes, initially in an experimental character, certainly aided by academia, in the selection, training and evaluation procedures of its cadres. The new technologies favour the creation of new scales to calibrate and

follow in a longitudinal perspective, for instance, the decision capacity and the creative potential, as well as to better the process involved in one of the perennial Administration's objectives: To put the right person in the right place, i.e., without harming his/her affective and professional realization. In this sense, the differences, ranges and possibilities regarding genre, not explored in this text and not long ago treated as joking stock, today are confirmed realities confirmed by the cerebral imaging and which could, for instance, be reunited in a proper corpus, the one of Genre Administration, thus representing a theoretical contribution, thus establishing a bridge for reflection within the field of the organizational studies.

References

- Boden, M. A. (Org.) (1999). *Dimensões da Criatividade*. Porto Alegre: Artmed.
- Callegaro, J. (2005). *Mente Criativa – a aventura do cérebro bem nutrido*. Porto Alegre: Nova Prova.
- Caplan, A. (2008). *Cérebros turbinados*. Scientific American Brasil. Coleção: Mente & Cérebro, Ano XVI, n. 200, pp. 48-51, dez. São Paulo: Duetto Editorial.
- Carvajal, B. C. (2013) Creatividad e intuición em la praxis metodológica, reflexión a la luz de la neurociencia cognitiva. *Telos*, vol. 15, núm. 1, enero-abril, pp. 77-90
- Chryssikou, E. G. (2012). *Mente criativa em ação*. Scientific American Brasil. Coleção: Mente & Cérebro, Ano XIX, n. 234, ago., pp. 30-39. São Paulo: Duetto Editorial.
- Csikszentmihalyi, M. (1997). *Creativity – flow and the psychology of discovery and invention*. NY: Harper Perennial.
- Damásio, A.; Damásio, H. (2009). *O Cérebro e a Linguagem*. Scientific American Brasil. Coleção: Mente & Cérebro, Ed. Especial (8): Como o Cérebro Aprende. São Paulo: Duetto Editorial, pp. 60-67.
- De Bono, E. (1994). *Thinking Course*. NY: Facts ON File, Inc.
- De Bono. (2002). *O Pensamento Lateral*. 3ª ed. Rio de Janeiro: Record: Nova Era.
- Dobbs, D. A. (1998). *A arte de fazer nós*. Scientific American Brasil. Coleção: Mente & Cérebro, Ed. Temática (1): A Neurociência de Eric Kandel – ganhador do Prêmio Nobel de Medicina em 2000. São Paulo: Duetto Editorial.
- Doidge, N. (2012). *O Cérebro que se Transforma – como a neurociência pode curar as pessoas*. Rio de Janeiro: Record.
- Dombroski, T. W. (2000). *Creative Problem-Solving: the door to progress and change*. Canada: toExcel.
- Emmery, F. F. (Org.). (1969). *Systems Thinking*. Great Britain: Richard Clay (The Chaucer Press).
- Fayol, H. (1990). *Administração industrial e geral*. 10ª ed. São Paulo: Atlas.
- Fields, R. D. (2006). *Lembranças que ficam*. Scientific American Brasil. Coleção: Mente & Cérebro, Ano XIV, n. 162, jul., pp. 39-47. São Paulo: Duetto Editorial.
- Fields, R. D. (2006a). *Apagando memórias*. Scientific American Brasil. Coleção: Mente & Cérebro, Ano XIV, n. 162, jul., pp. 49-53. São Paulo: Duetto Editorial.
- Friedrich, G.; Preiss, G. (2006). *Ciência do Aprendizado*. Scientific American Brasil. Coleção: Mente & Cérebro, Ed. Especial (8): Como o Cérebro Aprende. São Paulo: Duetto Editorial, pp. 7-11.
- Gallegos, W. L. A. (2013). Teoría de la Inteligencia: una aproximación neuropsicológica desde el punto de vista de Lev Vigotsky. *Cuadernos de Neuropsicología*. Volumen n 7. Numero 1. Julio 2013.
- Gardner, H. (1994). *Estruturas da Mente – a teoria das inteligências múltiplas*. Porto Alegre: Artmed.
- Glassman, W. E.; Hadad, M. (2008). *Psicologia –*

- abordagens atuais*. 4ª ed. Porto Alegre: Artmed.
- Glover, J. A.; Ronning, R. R.; Reynolds, C. R. (Ed.) (1989). *Handbook of Creativity*. NY: Plenum Press.
- Grüter, T. (2009). *O amanhã começa ontem*. Scientific American Brasil. Coleção: Mente & Cérebro, Ed. Especial (34): Cérebro – muito mais que a máquina perfeita. São Paulo: Duetto Editorial.
- Haier, R. (2009). *A neurociência da inteligência*. Scientific American Brasil. Coleção: Mente & Cérebro, Ano XVII, n. 200, set., pp. 44-51. São Paulo: Duetto Editorial.
- HBR. (2003). *Managing Creativity and Innovation*. Massachusetts: Harvard Business School Press.
- Horstman, J. (2010). *24 Horas na Vida do seu Cérebro*. Scientific American Brasil. Parte I. São Paulo: Duetto Editorial.
- Izquierdo, I. (2002). *Memória*. Porto Alegre: Artmed.
- Izquierdo. (2010). *Nós e nossa memória*. Porto Alegre: Zero Hora, 08.02.10, p. 14.
- Johansson, F. (2004). *The Medici Effect*. Boston: HBS.
- Kaufman, J. C.; Sternberg, R. J. (Ed.) (2006). *The International Handbook of Creativity*. USA: Cambridge University Press.
- Kandel, E. (2006) Em busca da Memória. DVD – Documentário Mente & Cérebro. DTT 017. Duração: 93 min. São Paulo: Duetto Editorial.
- Macknik, Stephen L.; Martinez-Conde, Susana. (2011). *Truques da Mente*. Rio de Janeiro: Zahar.
- Nicolelis, M. (2011). *Muito Além do Nosso Eu – a nova neurociência que une o cérebro e máquinas - e como ela pode mudar nossas vidas*. São Paulo: Cia. das Letras.
- Pinheiro, I. A.; Vieira, L. J. M.; Motta, P. C. D. (2010). *Construindo Pontes Entre Saberes: da literatura à gestão*. Organizações & Sociedade (Impresso), v. 7, pp. 341-351.
- Revista Eletrônica Poder. (2011). *Entrevista: Paulo Niemeyer Filho*. Parte I. Disponível em: <http://ciclofemini.com.br/ciclofemini/dicas-esportivas/por-dentro-do-cerebro-entrevista-com-o-neurocirurgiao-dr-paulo-niemeyer-filho-revista-eletronica-poder/>. Acesso em: 25.12.12.
- Rizzolatti, G.; Fogassi, L.; Gallese, V. (2006). *Espelhos na mente*. Scientific American Brasil, Ano 5, N. 55, dez., 2006, p. 44-51. São Paulo: Duetto Editorial.
- Rose, Steve. (2006). *O Cérebro do século XXI – como entender, manipular e desenvolver a mente*. São Paulo: Globo.
- Ross, P. E. (2006). *Mentes brilhantes*. Scientific American Brasil, Ano 5, n. 52, set., 2006, p. 60-67. São Paulo: Duetto Editorial.
- Ruas, R. L. (2005). *Literatura, dramatização e formação gerencial: a apropriação de práticas teatrais ao desenvolvimento de competências gerenciais*. Salvador, Organizações & Sociedade, v. 12, pp. 121-142.
- Savransky, S. D. (2000). *Engineering of Creativity – introduction to TRIZ Methodology of inventive problem solving*. USA: CRC Press.
- Schaffer, S. (1999). *Caracterizando a descoberta*. In: BODEN, M. A. (Org.) *Dimensões da Criatividade*. Porto Alegre: Artmed. pp. 23-58.
- Schiavon, B. K.; Vieira, B. S.; Viola, T. W.; Souza, L. S. A.; Rigoli, M. M.; Fonseca, R. P.; Oliveira, R. G. (2013) Rehabilitation Of Executive Functions: Implications And Strategies. *Avances En Psicología Latinoamericana*. Bogotá (Colombia). Vol. 31(1)/ Pp. 110-120/2013/Issne2145-4515.
- Shors, T. J. (2009). *Estimulado, o cérebro produz e preserva novas células nervosas*. Scientific American Brasil. Ed. Especial (40) – Em Busca da Consciência. São Paulo: Duetto Editorial, pp. 62-69.
- Sternberg, R. J. (2000). *Psicologia Cognitiva*. Porto Alegre: Artes Médicas.
- Stickgold, R.; Ellenbogen, J. M. (2008). *Dormir e Lembrar*. Scientific American Brasil. Coleção: Mente & Cérebro, Ano XVI, n. 191, dez., pp. 30-37. São Paulo: Duetto Editorial.
- Strauch, B. (2011). *O Melhor Cérebro da sua Vida – segredos e talentos da maturidade*. Rio de Janeiro: Zahar.
- Taylor, F W. (1990). *Princípios de Administração científica*. 8ª ed. São Paulo: Atlas.
- Turner S. (2014) Teoria Social e Neurociência. *Tempo Social, revista de sociologia da USP*. Volume n. 26. Número 2.
- Villagra, O. A. R. (2014) Modelos cognitivos formales: Una herramienta para la integracion del conocimiento en psicologia cognitiva y neurociencia cognitiva. *Actualidades en Psicología*. 28 (117). 79-91
- Wechsler, S. M. (2002). *Criatividade – descobrindo e encorajando*. 3ª ed. Campinas: Livro Pleno.