

# Neuromanagement: the scientific approach to contemporary management

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**Abstract.** *The last years have been marked by the attempts to approach the management discipline from a new, innovative perspective, in accordance with the present times, marked by complex challenges and highly increased competition. Given the importance and impact of scientific advances and also the explosion of research in the field of neuroscience, management had to be redefined and its critical variables had to be analyzed from a different perspective. An interdisciplinary vision was needed to enable future researches and explanations of the decision-making processes, leadership practices, change management, innovation, creativity, human resources performance, engagement of people and emotions. Literature review has been made, from the classical management theories and models, the historical concepts of man, to the new, full of perspectives spectrum of neuroscience, brain functioning and, its infinite potential, that opened new horizons, uncovered resources and tools to face the realities of the new business world. The main purpose of this article is to overview the transition from management to neuromanagement, from leadership to neuroleadership, the role and impact of these concepts on the holistic approach of management science. This evolution allows not only the confirmation of a set of assumptions but also access to a wide range of knowledge, with multiple possibilities of applications in organizational management and opens avenues for future researches.*

**Keywords:** Neuromanagement, neuroleadership, neuroscience, brain activity, emotions, technology, performance.

## Introduction

Management researchers have the mission to discover new horizons. The management activity, as we have known it so far, has supported its functioning in theories, models, and tools of ‘external application’ (Braidot, 2008, p.27), management models that have been previously thought,

reflected and applied later. At the moment, however, the management discipline needs new resources and tools to face the realities of the business world.

Global economic trends and the digital revolution have stimulated the organizational and entrepreneurial environment, transforming it into an extremely complex and increasingly competitive ecosystem. All organizations are facing challenges and trying to discover or maintain their competitive advantages, to improve organizational performance. Given the importance and impact of scientific progress and digitization, management had to be redefined, and its variables had to be analyzed from a different perspective. An interdisciplinary vision was needed to enable the research and explanation of the decision-making processes and the development of strategic plans, which would lead to the performance of the organizations.

This new approach is called Neuromanagement, being the challenge of the new millennium and opening the horizon of new possibilities, a new world to be explored and discovered. The association of the discipline with the term 'neuro' indicates that the discipline is not completely new, but the difference is in the approach and the tools used in its analysis, developed due to increase of effervescence in neuroscience research and progress of technology.

The brain has become the most important platform for the generation, development and implementation of new interdisciplinary management tools of organizations and opens new perspectives that are not outside of us, but inside, in the infinite potential of the brain, in the neural circuits that nourish all our decisions (Braidot, 2008). The broad spectrum of neuroscience is a major topic in recent years and a continuously challenge for many researchers. This science is analyzing the functioning of the nervous system as a whole. In order to strengthen the research of this discipline, neuroscience experts must think from the molecular level to the human behavioral level. Important progress in neuroscience, information and discoveries about the brain and neural processes, open important perspectives for the future.

The vast arena of neuroscience and its applications, facilitated the transition, evolution from economics, management, leadership and marketing to neuroeconomics, neuromanagement, neuroleadership and neuromarketing which allows the access to a broad spectrum of knowledge, that confirms or denies hypothesis and assumptions, with various possibilities of application in organizational management.

## **Literature review**

### ***The Neuro concept. Overview.***

The 'neuro' concept, applied in the economic, management and business area, developed rapidly, given the volume of research conducted by scientists and researchers. The concept of neuroeconomics is now definitively established as part of economics, being officially used in 2004 (Glimcher et al., 2008). The neuroeconomics has developed from the awareness that due to the dynamism of the technological development of the last years, we can analyze the part that defines the human nature, the brain and we can extract information and images, which generate important discoveries, insights regarding new perspectives on human behavior, that can reform the existing opinion on the economy and economic interactions. Neuroeconomics represents the science of human behavior involved in economic decision making process, applying the insights, methodology and perspectives from neuroscience (Camerer et al., 2004; Camerer et al., 2005; Glimcher et al., 2008). Due to the evolution of research in neuroscience, new disciplines have developed in the latest years, such as neuromarketing, neuromanagement and neuroleadership, neurofinance, neurocoaching, neurostrategy and neurocommunication.

The initial approach in the development of the 'neuro' concept, applied in the economic and management field had, as a starting point, the outline of the new perspective of man, in the context of the historical evolution of its development, which allows us to understand the current position we are in today and how the future evolution of economic thinking can be influenced in the future. Research in neuroscience have also influenced the definition of human nature, the concept of man, the vision on the human being and their motivations. Historically, we can identify four distinct stages of human perception: homo economicus - the economic man, homo sociologus – the social man, self-actualising man - the man with self-actualisation needs and complex man and also a fifth developing phase, brain directed man.

The concept of homo economicus, was first used by critics of Mill's works on political economy (Persky, 1995), in which he mentioned that man is a being who wishes to possess fortune (Mill, 1848). 'The respect for own interest' represents the moment that marked the development of the modern figure of homo economicus (Smith, 1904, p.238). Taylor's theories were based on the hypothesis that man was interested only in economic advantage and could only be motivated by financial means (Taylor, 1911). The movement of human relations (Bruce, 2006), brought the employee into the foreground, being recognized as a social being and the importance of interpersonal relations in the workplace was stated. The man had become a social being that responds to social stimuli, and the employee was now a social machine. The man with needs for self-actualisation follows his own system of self-development, seeks to satisfy his higher needs and to become a better human being. This was strongly determined by the work of Maslow and the Pyramid, the schematic representation of his work (Maslow, 1943). The complex man can be attributed to the work of Schein, who analyzed previous perspectives about man: the "nature of human nature" (Schein, 1980, p.4). The complex man is constantly changing; he can learn and will change his behavior depending on the current situation and the environment, can change motivations in the short term depending on external circumstances (Lieberman, 1956). Kahneman's work also addresses a more irrational and flexible model of human nature (Kahneman & Tversky, 1979).

Therefore, the historical concept of man and his motives are reformed by science, and the brain directed man phase is being shaped. The brain is the subject of daily research, in a variety of contexts, and this rich and extensive research has generated ideas that offer a concrete understanding of human behaviors such as: the brain generates the human behavior, emotions are the drivers of human behavior, basic human needs are essential for employee satisfaction, behaviors create brain circuits, the human basic needs are at the core of the interaction of human behaviors and the environment. The results of the researches become indispensable to organizations and management (Ghadiri et al., 2013).

### ***The Brain. The central element in neuroscience.***

The brain plays the fundamental role in neuroscience. The brain is a complex system, with billions of neurons and brain cells, which are connected to each other in different regions and formations. Although biologically we are talking about five brain regions, the three-layer model, the triune brain - Triune Model - is the most popular (MacLean, 1990). The three brain theory has grouped different formations of the brain into regions that perform particular tasks: the reptilian brain, the limbic system and the neocortex. According to the model, the three brains are relatively independent and interconnected, depending on their age and the importance of their functions for the survival of the human beings.

From the evolutionary perspective, the reptilian brain is the oldest structure of the brain that performs the basic and most important functions that ensure the immediate survival. The limbic system is the emotional mechanism of our brain that processes a broad spectrum of emotions (Bruce & Braford, 2009; Isaacson et al., 2001; LeDoux, 1996; Ploog, 1980). The study of the system of emotions, originated in the research conducted by Paul Broca in 1878 (Schiller, 1990). The linkage between amygdala and neocortex represents the center of cooperation and struggles agreements between thought and feeling, head and heart (Goleman, 1995). Complex behaviors, such as emotion, do not settle in one region of the brain, but in the conjunction of different areas. (Davidson et al., 2000). The neocortex represents the most recent structure in the evolution of the human brain and is responsible for the most complex and refined functions. In MacLean's opinion, the neocortex is the symbol of the rationality of our nervous system, which allowed the emergence of systematic, logical thinking, which exists independently of the emotions and behaviors programmed by human genetics. Neocortex is considered the crowning glory of brain evolution.

The last years have been marked by an increased effervescence in the neuroscience research, given the development of imaging technology that has allowed the analysis of the nervous system, brain and mental processes. The most relevant insights for neuromanagement and neuroleadership are brain plasticity, the reward system and mirror neurons.

Plasticity is the brain's ability to continuously develop, retrieve and reform its connections, functions and determines brain development and all learning processes, being the center of learning and memory (Shaw & McEachern, 2001; Kolb & Whishaw, 1998). Emotions play an essential role in change processes (Rolls, 2001). The activation of the reward system in the brain, can stimulate mechanisms that can significantly improve the learning process, the formation of habits and positive, constructive emotions in the brain (Nakatani et al., 2009). The reward system is a complex connection of brain regions, the system that generates positive feelings, through the dopamine system - the "happiness hormone" of the brain (Arias-Carrio et al., 2010). According to researchers, reward and pleasure have a wide range of complex connections and associations (Kringelbach & Berridge, 2009). Mirror neurons, "neurons that shaped civilization", represent that network of neurons in the brain that reflect others actions and show that we are interconnected at a level that was not believed to be possible (Ramachandran, 2009). Mirror neurons are instrumental in learning processes, and also in reading and recognizing emotions and empathy. We are connected to the world around us and live by the actions, emotions and intentions we perceive (Rizzolatti & Fabbri-Destro, 2010). Mirror neurons are neurons that help us connect with each other and facilitate inter-brain synchronization throughout social interaction (Dumas et al., 2010).

The brain is a complex structure and the spectrum of variations in human behavior represents an endless ocean of subtle differences (Ghadiri et al., 2013). This represents a real challenge in trying to find clear answers about human behavior, in any context, but, specifically, in the context of professional activity and business management. It is imperative to know which are the basic human needs, from the point of view of neuroscience and how they influence subsequent motivational behaviors and interaction with the world around us.

Grawe formulated a unified theory of basic needs of human beings and motivational schemes (Grawe, 2006), based on Epstein's cognitive-experimental theory, which presents the four basic needs, the core of human nature (Epstein & Weiner, 2003). This basic needs model is of particular relevance in neuromanagement and neuroleadership, since in the management and leadership contexts we deal with people, their ability to be motivated, to perform and to get involved in professional activity, and if we can understand how the human mind works and the basis of human interactions, then we can understand where to apply the point of leverage. This is

related to three knowledge fields and their dynamics (Bratianu & Bejinaru, 2019; Bratianu & Bejinaru; 2020).

There are four fundamental human needs: attachment, guidance and control, respect and self-esteem, pleasure and avoidance of pain, that are closely linked and the satisfaction of one of them will influence the others (Bowlby et al., 1992; Cast & Burke, 2002; Gyurak et al., 2011).

### ***Neuromanagement and Neuroleadership. Conceptualization and contextualization.***

Management is considered a 'liberal art'. It is an art, because management means practice and application, and also liberal, because management considers the fundamentals of knowledge, self-knowledge, wisdom and leadership (Drucker, 1988). Progress in social neuroscience and neuromanagement, have generated new knowledge that can be used by organizational leaders to better coordinate the teams they work with, to communicate more efficiently, to perform.

Evolution means change, and this demands the development of flexibility, adaptability, integrity, dynamics and vision. The changes that take place at the global level require organizations to develop new strategies to cope with the current challenges.

The concept of Neuromanagement was first conceptualized by Qingguo Ma, director of the Neuromanagement Laboratory of Zhejiang University specialized in researching the micromechanics of management activities, in an interdisciplinary field that integrates management science, economics and cognitive neuroscience (Ma & Wang, 2006). Neuroeconomist Paul J. Zak used the term Neuromanagement to describe how neuroscience findings can be used to create organizational cultures that motivate employees, cultivate trust, positive experiences, and generate a high level of organizational performance (Zak, 2004).

Neuromanagement is a scientific approach of management, which explores the managerial, economic and behavioral processes, from the perspective of the brain's activity and the way it reacts, of the mental processes. Neuromanagement is a subdiscipline of neuroscience and aims to explore the activities of the human brain and mental processes when people face management situations, using cognitive neuroscience, in conjunction with other scientific disciplines and technology, to analyze economic and managerial issues. Research in the field of neuromanagement concerns research areas such as decision-making neuroscience, which offers a new perspective and new insights into human decision-making and general social behaviors, and how they impact management and economic processes.

The first formal paper in neuromanagement was published in 2001 in the Journal Neuron (Breiter et al., 2001). This represented the efforts of the collaboration between Breiter, Shizgal and Kahneman, who combined the theory of the psychological perspective of the decision-making process (Kahneman & Tversky, 1979) and brain scanning, an experiment that demonstrated certain assumptions about the activation of the brain involved in the decision-making process. Camerer, Loewenstein and Prelec published Neuromanagement: How neuroscience can inform management (Camerer et al., 2005).

As long as an organization works with people, we have to deal with emotions, and these emotions will influence the results of the company to a lesser or greater extent. By facilitating access to neuromanagement information and the practical application of discoveries, ideas, organizations can manage how these emotions affect the results and activity of organizations. With the support of the latest brain research and studies, people can understand the challenges and causes that affect their emotional state, attitude and mood, reactions to stress and change, and can learn techniques to effectively manage emotions and uncertainty, to perform at a higher level.

Neuromanagement is designed around the way the human brain is structured and its functions, for a better management of oneself and others, in order to obtain a superior performance, for generating the involvement, motivation, collaboration and communication relationships. Unlike traditional management methods that try to use reason and authority to control people's behaviors and results, through strict discipline and rules, neuromanagement acts through emotions, respect, involvement and motivation. Neuromanagement is designed to connect with the emotional brain of people, to create social connections, to build trust and to connect with the motivational factors of human beings. The principles of neuromanagement are designed to use internal motivations and reward systems to achieve superior performance, to make decisions and to solve problems more efficiently and to obtain positive emotions, for the benefit of organizations, employees and management. Neuromanagement is a science applied to real problems in organizations.

Neuromanagement can be defined as an interdisciplinary, developing field that uses neuroimaging techniques to identify the neural substrates associated with decisions about people, human resources and associated behaviors, in organizational activity (Zak, 2004).

Neuroscience is one of the areas of research that has experienced an accelerated development in contemporary science. Neuroleadership refers to the application of findings in the field of neuroscience, in the field of leadership (Lafferty & Alford, 2010). The term neuroleadership was patented by David Rock, in 2006, in the American publication *Strategy + Business*, through *The Neuroscience of Leadership*.

Neuroleadership is a relatively recent field of study, based on the scientific study of the brain and mental processes, with the aim of improving quality, developing leadership and targeting four leadership activities: how leaders make decisions and solve problems, how they manage their emotions, collaborating with others and facilitating change (Rock, 2006). Neuroleadership focuses on the application of neuroscience in leadership development, management training, education and change management consulting and how the concept of neuroleadership can improve management practices, change management, innovation, creativity and employee involvement (Schaufenbuel, 2014). Neuroleadership is based on neuroscience and considers how the concept and results of research can be applied in the broad field of management. The main areas they target are making decisions, trust, self-management, social interaction, collaboration, influence, strategy, organizational behavior.

In most organizations, efficient decision-making processes are considered to have a rational foundation. Neuroleadership opens the perspective for change and the paradigm shift, exploring how emotions are involved in decision making. Our whole body is connected to the brain, and understanding how it works is certainly extremely useful to better understand human behavior. The general principles behind which the brain works, according to neuroscience research, indicate the following: the brain is a structured organ, is focused on survival, it likes the rewards, the unconscious is much stronger than the conscious side, the emotions are an integral part of the brain, the experiences drive our behavior, the brain behaves logically inside, which may seem illogical on the outside. All this supports the development of more effective strategies to perform.

According to David Rock, neuroleadership represents a developing field that links neuroscientific knowledge with leadership, management, change management, consulting and coaching (Rock, 2006). Ringleb and Rock clarifies the importance of understanding the role of neuroscience in a variety of leadership characteristics, for improving collaboration, managing emotions, influence, and facilitating change (Ringleb & Rock, 2008). Neuroleadership goes beyond theory, in order to incorporate the fundamental principles based on how the brain works, which underlie the success or failure of any leadership style and its behavior, allowing for in-depth

knowledge and efficient implementation. Neuroleadership, unlike many leadership theories, allows for a holistic approach, with an impact on employees, partners, but mainly on one's own.

Neuroleadership research will continue to organize and disseminate neuroscience discoveries applicable to effective leadership practice and support leaders, practitioners, in personal development and leadership efforts. David Rock mentions that by decoding the way the brain works, we can describe mental, behavioral and relational experiences, in order to increase performance (Rock, 2006).

The neuroscience applied in management and leadership represents a relatively recently developed theme, but there is already an important number of approaches, with direct applicability at organizational and management level, relevant to leadership and business management.

David Rock's SCARF model is based on the fact that, in general, the brain is focused on sustaining and increasing rewards and avoiding negative actions and experiences (Rock, 2008). Focusing on reward and avoiding negative experiences develops different behaviors and motivations in the workplace. The model targets five such categories, as follows: status, certainty, autonomy, relatedness, fairness.

The Herrmann Brain Dominance Instrument was built following research conducted in the 1970s, especially the concept of lateralization of the brain (Sperry, 1961; Gazzaniga, 1998; Gazzaniga, 2005). The instrument places the participants in four categories: rational, experimental, safety-based and sentiment-based, defining four ways of thinking based on a regional representation of the brain: left, right, up and down.

Huther's research, the architect of the Supportive Leadership model, addresses various organizational issues that are needed for a work environment that supports performance, and also what qualities a true leader should support for their people which develops the potential of its subordinates, instead of using authority and repression. Huther offers a set of rules for designing a neurobiologically appropriate work environment that will facilitate the development of organizational performance (Huther, 2009), as follows: creating new challenges, knowledge network within the organization, develop a positive culture of error, create space for positive experiences.

Elger defines four basic systems at the brain level: the reward system, the emotional system, the memory system and the decision-making system (Elger, 2009). Elger developed seven basic principles of neuroleadership: the reward system, correctness and feedback, influence through information, each brain is unique, actions are generated by emotions, experience defines behavior, situational dynamics.

Pillay is one of the researchers in neuroscience, with an important contribution in neuromanagement and neuroleadership, related to self-control and fear control or how the brain works in certain situations (Pillay, 2010). He provides details related to brain functioning in professional life and addresses issues such as: positive and negative thinking, social intelligence and effective relationships, innovation and intuitive, formation of action oriented ideas, area formation of actions oriented towards change, training certain regions of the brain and mental processes (Pillay, 2011).

The digital era places us in a context characterized by the complexity of new globally scenarios and the progress made in the field of neuroscience is an extraordinary tool for thinking and designing new forms of management and leadership in this new context.

## Conclusion

The current context is marked by an extremely complex and dynamic economic reality, felt on all levels of activity. Organizational performance is directly influenced by organizational management and the levers identified to stimulate people's behaviors in order to generate individual performance and thus, global performance.

The evolution of the new brain imaging technologies in the last years, has stimulated the research in neuromanagement by analyzing the mental processes and the functioning of the brain and its connection with the broad spectrum of decision-making processes. Certainly, the coming years will fundamentally reform the way we think, reflect and model the decision-making process, in all its aspects.

Given the progress made in all areas of activity, without innovation, reformation of economic and management theories, the future challenges that the companies will have to face, will not be solved. The economic mechanisms can only be changed by ideas, innovative concepts, which generate new economic paradigms. The identification of new approaches to organizational management has become an imperative necessity for the performance of organizations at national and international level. Organizations need visionary, flexible and adaptable management and leadership, reforming the way they make decisions, new efficient methods to activate, an organizational culture in which the employee and his emotions are in the foreground, to create a solid system of communication and innovation, in order to be able to elaborate optimal solutions to the complex problems that they face.

Applying the fundamental knowledge of neuroscience in the activity of an organization, in business, means a real progress in improving the organizational performance. By helping people better understand what's going on in their brain and giving them practical ideas and approaches that can help them deal more effectively with people at all levels of an organization, neuromanagement is capable of creating lasting change at the organizational level.

Neuromanagement is a new management approach, designed to clarify the functioning of the human being, its brain and its behaviors in different professional situations and to facilitate its reaching the maximum potential. In this regard, the knowledge of the new techniques of neuroscientific study is mandatory, in order to open new, scientifically sound perspectives, which will facilitate the prior testing and validation of the good management practices. The use of the findings in the field of neuromanagement and neuroleadership is necessary in the extremely dynamic and competitive organizational scene, considering their positive influence on both the individual performance and the overall organizational performance.

## References

- Arias-Carrío, O., Stamelou, M., Murillo-Rodríguez, E., Menendez-Gonzalez, M., & Poppel, E. (2010). Dopaminergic reward system: A short integrative review. *International archives of medicine*, 3(1), 24.
- Backhouse, R. E., & Medema, S. G. (2009). Defining economics: The long road to acceptance of the Robbins definition. *Economica*, 76, 805–820.
- Bernard, C. (1948). *Organization and Management*. Cambridge, Harvard University Press.
- Bowlby, J., Ainsworth, M., & Bretherton, I. (1992). The origins of attachment theory. *Developmental Psychology*, 5, 759–775.
- Braidot, N. P. (2008). *Neuromanagement : cómo utilizar a pleno el cerebro en la conducción de organizaciones*. Ed. Buenos Aires: Granica.
- Bratianu, C., & Bejinaru, R. (2019). The theory of knowledge fields: A thermodynamics approach. *Systems*, 7(2), 20, 1-12.



- Bratianu, C., & Bejinaru, C. (2020). Knowledge dynamics: A thermodynamics approach. *Kybernetes*, 49(1), 6-21.
- Breiter, H.C., Aharon I., Kahneman D., Dale A., & Shizgal, P. (2001). Functional imaging of neural responses to expectancy and experience of monetary gains and losses. *Neuron*, 30(2), 619-639.
- Bruce, L. L., & Braford, M. R. (2009). Evolution of the limbic system. *Encyclopedia of Neuroscience*, 43–55.
- Bruce, K. (2006). Henry S. Dennison, Elton Mayo, and Human Relations historiography. *Management and Organizational History*, 1(2), 177-199.
- Camerer, C. F., Loewenstein, G., & Prelec, D. (2004). Neuroeconomics: Why economics needs brains. *Scandinavian Journal of Economics*, 106(3), 555–579.
- Camerer, C., Loewenstein, G., & Prelec, D. (2005). Neuroeconomics: How neuroscience can inform economics. *Journal of Economic Literature*, 43(1), 9–64.
- Cast, A. D., & Burke, P. (2002). A theory of self-esteem. *Social Forces*, 80(3), 1041–1068.
- Collins, J. (2005) Level 5 leadership. The triumph of humility and fierce resolve. *Harvard Business Review*, 79(1), 66–76.
- Davidson, R. J., Jackson, D. C., & Kalin, N. H. (2000). Emotion, plasticity, context, and regulation: Perspectives from affective neuroscience. *Psychological Bulletin*, 126(6), 890-909.
- Drucker, P.F. (1988). The Coming of the New Organization. *Harvard Business Review*, 66, 45-53.
- Dumas, G., Nadel, J., Soussignan, R., Martinerie, J., & Garnero, L. (2010). Inter-brain synchronization during social interaction. *Plos One*, 5(8), e12166.
- Elger, C. E. (2009). *Neuroleadership*. Planegg /Munich: Haufe.
- Epstein, S., & Weiner, I. B. (2003). Cognitive-experiential self-theory of personality. In Lerner, M.J. (Ed.). *Comprehensive handbook of psychology volume 5 personality and social psychology* (pp. 159–184). Hoboken: Wiley.
- Gazzaniga, M. S. (1998). Brain and conscious experience. *Advances in Neurology*, 77(6), 181–192.
- Gazzaniga, M. S. (2005). Forty-five years of split-brain research and still going strong. *Nature Reviews Neuroscience*, 6(8), 653–659.
- Ghadiri, A., Habermacher, A., & Peters, T. (2013). *Neuroleadership: A journey through the brain for business leaders*. Springer Science & Business Media.
- Glimcher, P.W., Camerer C.F., Russell E.F., & Poldrack A. (2008). *Neuroeconomics: Decision Making and the Brain*. London: Academic Press.
- Goleman, D. (1995). *Emotional Intelligence: Why It Can Matter More Than IQ*. Bantam Books.
- Grawe, K. (2006). *Neuropsychotherapy: How the neurosciences inform effective psychotherapy*. Mahwah: Lawrence Erlbaum Associates.
- Gyurak, A., Hooker, C. I., Miyakawa, A., Verosky, S., Luerssen, A., & Ayduk, O. N. (2011). Individual differences in neural responses to social rejection: the joint effect of self-esteem and attentional control. *Social Cognitive and Affective Neuroscience*, 19(3), 279–280.
- Huther, G. (2009). Wie gehirngerechte Führung funktioniert: Neurobiologie für Manager. *Manager Seminare*, 130, 30–34.

- Isaacson, R. L., Smelser, N. J., & Baltes, P. B. (2001). Limbic System. In Smelser, N.J., Baltes, P.B. (Eds.). *International encyclopedia of social behavioral sciences* (pp. 8858– 8862). Amsterdam: Elsevier.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2), 263–291.
- Kolb, B., & Whishaw, I. Q. (1998). Brain plasticity and behavior. *Annual Review of Psychology*, 49(1), 43–64.
- Kringelbach, M. L., & Berridge, K.C. (2009). Towards a functional neuroanatomy of pleasure and happiness. *Trends in Cognitive Sciences*, 13(11), 479–487.
- Lafferty, C. L., & Alford, K.L. (2010). NeuroLeadership: sustaining research relevance into the 21st century. *SAM advanced management journal*, 75(3), 32-40.
- LeDoux, J. (1996). *The Emotional Brain*. New York: Simon and Schuster.
- Lieberman, S. (1956). The effects of changes in roles on the attitudes of role occupants. *Human Relations*, 9(4), 385–402.
- Ma, Q., & Wang, X. (2006). Cognitive neuroscience, Neuroeconomics, and Neuromanagement. *Management World*, 10, 139-149.
- MacLean, P. D. (1990). *The triune brain in evolution: Role in paleocerebral functions*. New York: Springer.
- Marshall, A. (1924). *Principles of Economics, 8 th edition*. London: Macmillan.
- Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, 50(4), 1–21.
- Mill, J.S. (1848). *Principles of Political Economy with Some of their Applications to Social Philosophy, 1 (1 ed.)* London: John W. Parker.
- Nakatani, Y., Matsumoto Y., Mori Y., Hirashima D., Nishino H, Arikawa K., & Mizunami, M. (2009). Why the carrot is more effective than the stick: different dynamics of punishment memory and reward memory and its possible biological basis. *Neurobiology of Learning and Memory*, 92(3), 370–380.
- Persky, J. (1995). Retrospectives: The Ethology of Homo Economicus. *The Journal of Economic Perspectives*, 9(2), 221–231.
- Pillay, S. S. (2010). *Life unlocked*. New York: Rodale Books.
- Pillay, S. S. (2011). *Your brain and business*. New Jersey: FT Press.
- Ploog, D. (1980). Emotions as products of the limbic system. *Medizinische Psychologie*, 6, 7–19.
- Ramachandran, V. (2009). *Versus ramachandran: The neurons that shaped civilization*. TEDcom Retrieved from [http://www.ted.com/talks/vs\\_ramachandran\\_the\\_neurons\\_that\\_shaped\\_civilization.html](http://www.ted.com/talks/vs_ramachandran_the_neurons_that_shaped_civilization.html).
- Ringleb, A., & Rock, D. (2008). The emerging field of NeuroLeadership. *NeuroLeadership Journal*, 1, 3-19.
- Rizzolatti, G., & Fabbri-Destro, M. (2010). Mirror neuron mechanism. In Koob, G.F., Moal, M.L., Thompson, R.F. (Eds.). *Encyclopedia of behavioral neuroscience* (pp. 240–249). Burlington: Academic.
- Rock, D. (2006). *Quiet leadership: Six steps to transforming performance at work*. New York: Collins.
- Rock, D. (2008). SCARF: a brain-based model for collaborating with and influencing others. *NeuroLeadership Journal*, 1(1), 1–9.
- Rock, D. (2009). *Your Brain at Work*. Harper Business.
- Rock, D. (2010). Impacting Leadership with Neuroscience, *People and Strategy, suppl. Special Issue: Leading in a Time of Uncertainty*, 33(4), 6-7.

- Rolls, E.T. (2001). Emotion, neural basis of. In Smelser, N.J., Baltes, P.B. (Eds.). *International encyclopedia of social behavioral sciences* (pp. 4444–4449). Oxford: Pergamon.
- Schaufenbuel, K. (2014). *The Neuroscience of Leadership: Practical Applications*. UNC Executive Development.
- Schiller, F. (1990). *Paul Broca, explorateur du cerveau*. Editions Odile Jacob, Paris.
- Schein, E.H. (1980). *Organizational psychology (3rd ed.)*. Eaglewood Cliffs: Prentice-Hall.
- Shaw, C. A., & McEachern, J.C. (2001). *Toward a theory of neuroplasticity*. Philadelphia: Psychology Press.
- Smith, A. (1904). *An inquiry into the nature and causes of the wealth of nations (5th ed.)*. London: Methuen & Co., Ltd..
- Sperry, R.W. (1961). Cerebral Organization and Behavior: The split brain behaves in many respects like two separate brains, providing new research possibilities. *Science*, 133(3466), 1749–1757.
- Taylor, F.W. (1911). *Principles of Scientific Management*. New York: Harper & Brothers.
- Zak, P.J. (2004). Neuroeconomics. *Philosophical Transactions of the Royal Society London. Series B, Biological Sciences*, 359(1451), 1737-1748.