

NEUROSTRATEGY: AN ADVANCE THROUGH THE PARADIGM EPISTEMOLOGICAL IN STRATEGIC MANAGEMENT?

David Ascher, Pontifical Catholic University of Paraná
Wesley Vieira da Silva, Pontifical Catholic University of Paraná
Jan Polowczyk, Poznan University of Economics and Business
Eduardo Damião da Silva, Pontifical Catholic University of Paraná
Claudimar Pereira da Veiga, Federal University of Parana

ABSTRACT

This paper investigates the changes in strategic management with emphasis to neurostrategy, which recently appeared in the scientific research as a new way to evaluate and discuss the decision-making in strategic management. Using the epistemological review based on Kuhn models of scientific revolutions, this study proposes, through a systematic review in journals from 2006 until now, proper division and approach to use neuroscience within strategic management. The conclusion is that tools of neuroscience are promising in the strategic management, but there is still much misunderstanding about what would be neuroscientific research and behavioral research and the contribution to these new fields of studies on strategic management lies on a proposition to a better classification of them. As a novelty, we propose a discussion to define possible new epistemological paradigms which neuroscience brings to the field of study about strategic management.

Keywords: Decision-Making, Cognitive Neuroscience, Systematic Review, Behavioral Strategy, Epistemology.

INTRODUCTION

The strategic management has passed through a revolution in the last 10 years with the introduction of new analytical tools in the decision-making process, many of them coming from neuroscience and that promise to revolutionize the way to see the strategic decision-making from economic models to an individual model and these advances could allow further study in several fields within the applied social sciences. Together with this, a new approach has been used in strategy management, the "neurostrategy" (Powell, 2014; Cristofaro, 2017). According to Powell (2011), it is a new way to analyze the behavior of human beings, by the use of neuroeconomics approach, which is leading business schools to conduct many types of research in marketing, economics, finance, leadership and human resource management and finally the strategic management.

The term neurostrategy is relatively recent and it appeared firstly in scientific journals by Powell (2011) and until now there is no significant amount of researches done on the subject, which opens paths for a limited interpretation of what means neurostrategy-related studies. Since strategic management theories focused on the economic vision of the company, this type of

research (neurostrategy) in decision-making is a fresh air once it brings a look back not only to the individuals but also to their brains (Polowczyk, 2012).

The economic vision adopted widely by researchers in strategic management set the organization as the unit of analysis and has four fundamental paradigms: (i) based on the Porterian view of industry and economy and the competitive forces (Porter, 2004), where the industry is who determines the strategy of the company; (ii) the paradigm which covers the transaction costs, using the transaction theory of Williamson (1979) rooted in Coase (1937) along with the Theory of Agency by Jensen & Meckling (1976); (iii) the resource-based view (Peteraf, 1993; Rumelt, 1997; Wernerfelt, 1984) which comes from Penrose (1959); (iv) the vision linked to evolutionary innovation and entrepreneurship. As Polowczyk (2012), these four basic theories of strategic management do not explain the inhomogeneity of human behavior.

Teece et al. (1997) remain open this discussion, raising the fifth paradigm in decision-making expressed as dynamic capabilities (Prahalad & Hamel, 1990). Differently, from others, the dynamic capability approach based on a Schumpeterian overview, but it also does not take into consideration the usage of psychological, behavioral and neurological issues on decision-making. In addition, Powell (2014) explains that, in spite of the organizations being populated by living creatures and sentimental thinking, theories around the strategic management are interpersonal, such as those linked to the dynamic capabilities, even when their results point to an individualization instead of standardization, those strategic management theories still treat people through a massification and homogeneous way.

It is vital to seek out for new forms of study of decision-making on strategic management to allow new answers to challenges that remain without a more scathing confirmation, such as: Why have the same strategy different results when various managers apply it? Why do entirely different strategies bring the same effect? Why the strategy did does not follow the plan, the organization remains succeeds?

These questions, commonly done with the organizations as a unit of analysis set, seem to become increasingly close to finding their answers in the individuals and now, together with the advances highlighted by neuroscience, within the brains of these people. This paper aimed to bring significant contributions to the field of neurostrategy and strategic management by three main contributions: (i) the most critical stands out for the relevance of the topic, because it is a new approach to strategic management that uses the most modern tools to study the brain and unlike the others, it uses the brain as the object of study; (ii) by expanding studies over the recent scientific literature, in order to reduce the gap on the neurostrategy, turning it into an important pathfinder to new researchers who want to start studies in neurostrategy and: (iii) bringing new concepts from other areas, such as neurobiology, neurochemistry and cognitive processes, as further technical frameworks, which could highlights new paradigms in the field of study of decision-making on strategic management by correlating this area to the cognitive neuroscience.

Based on the research contributions the following research question was prepared: Which were the approaches to neurostrategy or cognitive neuroscience and decision-making on strategic management found in the context of the research published in international journals and relevant studies?

Thus, this study analyzed the approaches on articles which use "neurostrategy" and other keywords such as "cognitive neuroscience", "decision-making" and "strategic management", in the context of research published in international journals. It is important to note that because of the novelty of the subject, the previous search did not find articles with the same evaluation proposal or some systematic review about neurostrategy, which consolidated the originality of

this theme. However, this paper used as a primary approach for new study fields on applied science done by Gippel (2013) which explores the topic neurofinance and other new sciences in the area of finance.

To reach the main objectives, it presents a systematic review process that sought to revisit and organize the concepts underlying to cognitive neuroscience and decision-making on strategic management, exploring the confluence of these two important science fields. Together with this, the creation of essential theoretical background for new researchers in decision-making on strategic management using the tools and theories presented by cognitive neuroscience was another important aspect of this work.

This study is divided into six sections: (i) this introduction; (ii) the theoretical fundamentals analyzing the etymology of neurostrategy term and the main concepts that pervade this new study; (iii) the methodological procedures used to do this review of articles; (iv) the differences between behavioral strategy and neurostrategy in the light of their epistemological developments, seeking to understand the limits of neurostrategy and behavioral strategy fields; (v) additional analysis addressing the paths and challenges of neurostrategy as a field of study in strategic management and; (vi) conclusions and recommendations of this work for future studies in neurostrategy.

THEORETICAL BACKGROUND

Decision-Making in the Strategic Management: The Rational to the Quasi-Rational and Emotional

Decision-making on strategic management is a cognitive process and leading to a choice and a renounced by the agent. Within this context, a decision should be guided by the premise of bounded rationality (Simon, 1947). With the advances in the study of strategic management, it is still accepted that two agents, where both have similar information and knowledge, take the expected (and similar) rational decisions. As proof of the immutability of this precept, in the paradigms of the strategy proposed by Teece et al. (1997), the rationality is given as a premise and not as a parameter, which reinforced the concept that rationality should always be present in strategic decision-making.

Authors like Klein (1999); Eisenhardt (1989) had already written about elements that affect the rationality in the process, among them the intuition. Even Herbert Simon (1986) sought to understand the heterogeneity of decisions by putting issues of complexity, of interpretation and of reflection, to give a personal character to the decision-making process. Chandler (1962) had already included the intuition as a form of behavior that distinguished the performance of executives. However, he named intuition as a "functional" about a management view.

Other relevant focus about decision-making on strategic management seeks to understand of heterogeneous behavior through the analysis of the mental processes using studies of heuristics and biases of decision-making (Tversky & Kahneman, 1974), where the different decisions happen due to the individual construction of mental shortcuts and cognitive biases, which is the basis of Prospect Theory (Kahneman & Tversky, 1979) with a focus on cognitive limitation of the person? The strategic management is an integrated and coordinated set of commitments and actions intended to explore the essential skills for a competitive advantage (Hitt, Hockinsson & Ireland, 2011). To Powell (2011) "strategic management rests on the assumption that the thoughts, feelings and social relations of general managers influence the activities and performance of firms."

Despite the administrative processes and their respective studies exist since the 19th century, according to Chandler (1962), only after WWII, by the necessity for better and faster answers within a sophisticated, integrated and dynamic business community, the study of strategic management took place as a necessary discipline in the management schools.

The decisions are pillars of the strategy (Powell, 2011) and the history of decision-making on strategic management is surrounded of impersonality, both in the questions as the answers (Laureiro-Martínez et al., 2015; Powell, 2014).

The expected bounded rationality of decision-makers links to the core concept of Homo Economicus, Stuart Mill (19th century), where men seek to maximize the return of their actions and to minimize the risk linked to this. For decision-making, rationality is a term that has many meanings, but for philosophy, it means the conscious use of reason and logic (Da Rocha & Rocha, 2011) and as a process of rational decision-making, it should be grounded in logic, objectivity and obedience to imposed rules. Thus, the homogeneity of the behavior of all agents is also one of the premises the Homo Economicus. Researchers of the rationality brought the idea of a “straw man” (Eisenhardt & Zbaracki, 1992) as a way to develop models and to fit this expected rational behavior into some mathematical model which allows the generalization of the relationship between cause and effect.

The limitation of access to the internal and external information to decision-making allowed Herbert Simon (1947) to introduce the concept of bounded rationality, where the inability of the agent, both cognitive as by the access to information, imposes a limitation (bound) on rationality level used for decision-making, but even with this argument bounded rationality theories still continue abstracting reason and emotion (Da Rocha & Rocha, 2011). Evidence of research in psychology has shown that people do not always act rationally as the Homo Economicus advocates (Annen, 2003; Powell, 2017).

Seminal studies on dynamic capabilities (Prahalad & Hamel, 1990; Teece et al., 1997) sought coherence in decision-making by a view to the rational premise, with Ricardian origin, of resource-based view-RBV (Penrose, 1959; Rumelt, 1997; Teece, 1984; Wernerfelt, 1984), but it could not explain the success of some strategies and the failure of so many others. Even so, Teece et al. (1997) divide the paradigms in strategy into four excellent perspectives, including the perspective of dynamic capabilities, but none of them questioned the rationality in decision-making, leaving the issue of rationality as a manager’s premise. The evolution of cognitive psychology, which starts with Tversky & Kahneman (1974), studied models for decision making and they found a number of personal factors that influence how the agents are acting (Kahneman & Tversky, 1984), including many internal and external variables not linked the decision itself which can affect the decision-making, the way that mental processes occur (Kahneman & Tversky, 1979) and the cognitive limits of the individual (Kahneman, 2003b).

Another factor which contributes to a discussion over rational decision-making model is the difficulty to be reach by executives (Miller, Hickson & Wilson, 1999) and can receive several influences from factors related to intuition during the decision process (Harper, 1988; Hodgkinson et al., 2009; Kahneman & Klein, 2009; Kahneman, 2003a). In addition, the heuristic perspective (Tversky & Kahneman, 1974), where the individual makes decisions based on cognitive shortcuts based on experiences and limitations, the decision is rational sometimes but not in others, just emerging and bringing a new different approach against the rational tradition, resulting in a multidimensional model which looks how the agent actually make a decision. (Eisenhardt & Zbaracki, 1992).

All these processes are tied to the individual perception of each human being, together with her experience and her way of interacting with the environment. Those generate many variables and the researchers in applied social sciences need to control each one under penalty of having mixed results. Taking that into account, until a few years ago, studies on strategic management avoided to include emotions into decision-making model, because their subjective features turned out as a negative factor "that prevents a more rigorous formalization of decision-making models" (Da Rocha & Rocha, 2011), this would initiate a search for new options of decision-making (De Jong & Veijer, 2014).

Strategic management is 75% personal, 25% impersonal. Nearly all of the impersonal part (physiology, neuroscience, geography, randomness) and some of the personal (social behavior, emotions), can be studied and modeled using rigorous scientific methods borrowed from other sciences" (Powell, 2014).

Also, researchers in strategic management are not leaving out the strict form of strategic behavior study (Powell, 2014 & 2017) by the changing of paradigms and research methods, but considering only a small portion of what is a decision in their models. Thaler (2000) deals with the figure of a "quasi-rational" man, who is someone who tries to be rational but undergoes to a systematic error of judgment and this type of agents are present together with those more rational. Within the strategic management, these "near-rational" individuals are also present in decision-making valuation, but his behaviors are difficult to be incorporated into mathematical models precisely because they are erratic's. By the way, it can be solved, in part; by studies involving cognitive neuroscience, since this phenomenon, the "quasi-rationality" can be highlighted and explained with these tools. Last but not least, the emotional man will turn the researchers back their studies to emotions and feelings (Thaler, 2000) in decision-making, but together with modern tools to explore the mind functioning both physiological, psychological, as biological and with the help of neuroscientists the "Homo Economicus will evolve into Homo Sapiens" (Thaler, 2000).

Origin and Etymology of the Word Neurostrategy

The word "neurostrategy" was coined by Powell (2011) and remain underused in the academy since then. It is part of a portmanteau of the words: from strategy, within the field of management knowledge, the strategic management and from neuroscience which is characterized by the study of the nervous system. Noteworthy, that neuroscience is an interdisciplinary science and there are several disciplines within neuroscience which may and in some cases or may not, have a direct relationship to the issue of strategic management field. However, within the framework of neuroscience given by Lent (2010), there is a field of study particularly relevant to strategic management, the Cognitive Neuroscience.

"The cognitive neuroscience addresses the more complex mental abilities, generally typical of the man, such as language, the self-consciousness, memory, etc. Can also be called Neuropsychology" (Lent, 2010). Even with this limitation apparently plausible, these boundaries between the fields of neuroscience are not entirely clear, causing for some researches, the necessity of unification to other sub-disciplines of neuroscience, for a complete view of the cause-and-effect relation.

Neurostrategy relies on strategy's long-standing emphasis on general managers. The Academy of Management defines business policies and strategies as "the field concerned with the roles and problems of general managers and those who manage multi-business firms or multifunctional business units."(Powell, 2011).

About the methods to study and understand the psychological and neurological mechanisms of potential interest to the social sciences and management (Powell & Puccinelli, 2012; Laureiro-Martínez et al., 2015) among them we can list neurological equipment, such as Functional Magnetic Resonance Imaging (fMRI), Electroencephalography (EEG), Magneto Encephalography (MEG), Transcranial Magnetic Stimulation (TMS) and the Positron Emission Tomography (PET), together with psychophysiological equipment such as Electrocardiogram (ECG or EKG), Galvanic Skin Response (GSR) and the eye tracking. As occurred with the strategic management in the past, today neurostrategy is still undergoing a consolidation process to be a new discipline within the strategic management and is consolidating its place with new technologies and discoveries about brain which is incorporated in its set of findings.

MATERIAL AND METHODS

To perform the initial article searching for the neurostrategy theme, structured research in the available literature around the strategic management field of study within international repositories of scholarly articles. This review used the model proposed by Neuman (1997) which is more useful when researchers seek to summarize the current knowledge on a particular subject. The research remains concentrated in the following repositories of international academic articles: Web of Science®, Scopus®, Science Direct® and Google Scholar®. The appropriately limit the focus of this research, all search concentrated on the financial affairs, business administration and accounting.

The search using the word "Neurostrategy" made on February 10th, 2018 into the journals repositories Web of Science® and Scopus® resulted in only four articles (Powell, 2011) entitled "Neurostrategy" and "Strategic Management and the Person". However, both articles are theoretical reviews. As indicated in Table 1, on Google Scholar®, using the keyword "neurostrategy" resulted in 104 results with different themes linked to directly or indirectly to neurostrategy.

Table 1				
SURVEY DATA PERFORMED IN ACADEMIC JOURNALS PORTALS TO NEUROSTRATEGY				
Search Findings Academic Database	Site	Keyword	Login @ PUC-PR Search by	Results
Web of Science	http://apps.webofknowledge.com	Neurostrategy	Topic	2
Scopus	http://www.scopus.com	Neurostrategy	Title/Abstract/Keyword	2
Science Direct	http://www.sciencedirect.com/	Neurostrategy	All fields	3
Periódicos Capes	http://www.periodicos.capes.gov.br	Neurostrategy	Term	2
Google Scholar*	http://scholar.google.com.br/	Neurostrategy	Word	58

Source: Research data

On the search results summarized in Table 1 stand out searches performed on Google Scholar® were refined, following a suitable model of empirical research made by David & Han (2004) to ensure that only relevant articles or directly related to the subject were correctly identified. The matching between the different journals portals showed that all articles from other portals were the result of Google Scholar® results. After a visual review, by reading all abstracts, title and keywords, there was excluded all papers not related to management, business and finance, which reduce the number of 47 articles, working papers, theses and dissertations which address to neuroscience as part of studies strategic management and/or decision-making in the

organizations. Table 2 shows the refinement made following the procedure of David & Han (2004).

Type	Quantity
Books	13
Links and articles not related to Management	13
Nonscientific links	3
Articles of Neuromarketing	3
Articles of Neurofinance	2
Citations on Neurostrategy	6
Articles of Neurostrategy	10
Articles of Behavioral Strategy	8
Total	58

Source: Research data

In order to bring additional articles about neurostrategy, another search with the terms "cognitive neuroscience", "strategic management" and "decision-making" within business and economics fields was set to the same journal repository portals on February 10th, 2018. As indicated in Table 3 this research brought 17 results, but 9 results, are connected in a certain way to neurostrategy or behavioral strategy. Over these 9 results in the second search, only three (Nagel, 2016; Basel & Brühl, 2013; Hodgkinson & Healey, 2014) did not appear in the primary search.

Search Findings Academic Database	Site	Keyword	Login@PUC-PR Search by	Results
Web of Science	http://apps.webofknowledge.com	"Cognitive Neuroscience" AND "Decision Making" AND "Strategic Management"	Topic	3
Scopus	http://www.scopus.com	"Cognitive Neuroscience" AND "Decision Making" AND "Strategic Management"	Title/Abstract/Keyword	3
Science Direct	http://www.sciencedirect.com/	"Cognitive Neuroscience" AND "Decision Making" AND "Strategic Management"	All fields	9
Periódicos Capes	http://www.periodicos.capes.gov.br	"Cognitive Neuroscience" AND "Decision Making" AND "Strategic Management"	Term	3
Unrepeated		"Cognitive Neuroscience" AND "Decision Making" AND "Strategic Management"		12

Source: Research data

After a consolidation of all relevant articles, excluding all overlaps and repetitions, it remains with 50 articles, theses, dissertations and scientific texts which somehow address to neurostrategy and/or the application of cognitive neuroscience on decision-making in strategic management, but four of them are just papers with a small link to neurostrategy and/or behavioral strategy. As can be noted in Table 4 there are many articles using the term "Behavioral Strategy," this shows the need for a proper division of these papers by comparing methodologies and unit of analysis. Studies with the theme behavioral strategy are, to some extent, as large as the neurostrategy studies, totalizing eight relevant papers on behavioral strategy against ten on neurostrategy.

Table 4
DETAILS OF ARTICLE SEARCH RESULTS

Web of Science	Scopus	Database Science Direct	Google Scholar*	Periódic os Capes	Type	Title	Year	Journal	JCR
		X	X		Behavioral	The influence of network effects on SME performance	2014	Industrial Marketing Management	1.820
X	X		X	X	Neurostrategy	Strategic management and the person	2014	Strategic Organization	1.400
X	X		X	X	Neurostrategy	Neurostrategy	2011	Strategic Management Journal	3.341
			X		Neurostrategy	Nowe wyzwania-strategie: behawioralna i neurostrategia	2012	Przegląd Organizacji	
		X	X		Related	Reading between the lines: Learning as a process between...org	2014	Industrial Marketing Management	1.820
		X	X		Related	Re-assessing value (co)-creation and cooperative advantage...in in	2014	European Management Journal	1.220
			X		Neurostrategy	Biology, neuroscience and entrepreneurship	2013	Journal of Management Inquiry	1.446
			X		Neurostrategy	Neuroscience and organizational behavior: Avoiding both...neu	2014	Journal of Organizational Behavior	3.038
			X		Neurostrategy	The Seductive Allure of Neuroscience Explanations	2008	Journal of Cognitive Neuroscience	4.085
			X		Behavioral	Behavioral Strategy	2011	Strategic Management Journal	3.341

Table 4
DETAILS OF ARTICLE SEARCH RESULTS

			X		Related	The use of neurodiagnostic technologies in the 21st century...n	2015	The Neurodiagnostic Journal	-
			X		Behavioral	Opening the black box of heterogeneous value creation: ...	2014	Doctoral Dissertation	-
			X		Behavioral	Managers' Decisions In The Context Of Environmental Factors...An	2013	Global Business & Economics Anthology	-
			X		Related	Brains and games applying neuroeconomics to organizational...res	2012	Organizational Research Methods	4.148
			X		Behavioral	Cooperative Behavior In Strategic Decision Making: Human...Cap	2013	Emerging perspectives	-
			X		Behavioral	Coming in from the cold: The psychological foundations of...radi	2014	Industrial Marketing Management	1.820
			X		Behavioral	Entrepreneurial Failure: Statistical and Psychological...	2015	Strategic Management Journal	3.341
			X		Neurostrategy	Understanding the exploration-exploitation dilemma: An fMRI...	2015	Strategic Management Journal	3.341
			X		Neurostrategy	Rethinking the philosophical and theoretical foundations of...or	2014	Human Relations	2.398
			X		Neurostrategy	An Overview of Organizational Neuroscience.		Essay	
			X		Neurostrategy	Cognitive Neurosciences And Strategic Management: ...	2015	Advances in Strategic Management	0.682
			X		Behavioral	Estratégia Comportamental com Estudo Exploratório: Uma...	2013	Mastering Dissertation	

Source: Research data

Additionally, Figure 1 shows a graph of the articles by publication year, which showed rapid growth, 2014 onwards, the number of papers related to this subject. In 2014 the number of papers leapt to 11 and backed to 8 publications in 2017.

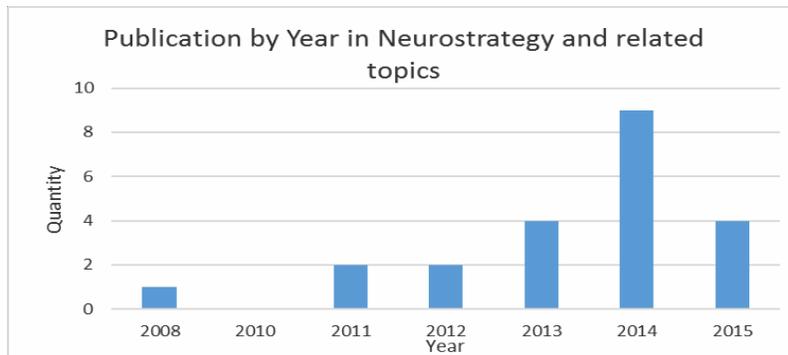


FIGURE 1
THE SUBJECTIVE CATEGORIZATION OF ARTICLES AND STUDIES IN
NEUROSTRATEGY AND RELATED PAPERS

This graph represents the number of the last articles by year of publishing. There is an increase of publication from 2014, totalizing 34 articles (from 50) between 2014 and 2017.

Considering the 47 studies in this review, 27 were in journals with Impact Factor (IF) on Journal Citation Reports (JCR) from Thompson Reuters. The average IF these 27 articles was 3.11, considering the final classification of the journals in 2016 (last evaluation). In Table 5 shows the relation of journals which were found in JCR with the respective IF for each one.

Table 5
LIST OF JOURNALS WITH ARTICLES ABOUT NEUROSTRATEGY AND RESPECTIVE SJR
CLASSIFICATION OF 2016

Journal	Quartile	IF
Strategic Management Journal	6.28	Q1
Strategic Management Journal	6.28	Q1
Strategic Management Journal	6.28	Q1
Strategic Management Journal	6.28	Q1
Organizational Research Methods	5.71	Q1
Strategic Organization	2.73	Q1
Journal of Cognitive Neuroscience	2.71	Q1
Journal of Organizational Behavior	2.41	Q1
Human Relations	2.12	Q1
Industrial Marketing Management	1.41	Q1
Industrial Marketing Management	1.41	Q1
Industrial Marketing Management	1.41	Q1
European Management Journal	0.82	Q1
Journal of Management Inquiry	0.81	Q1
Advances in Strategic Management	0.24	Q3
The Neurodiagnostic Journal	0.16 Average	Q4 Median
Total 16 Articles in SJR Journals	2.94	Q1

Source: Research data

Note: Some journals appear more than once due to the publication of two or more papers which concern directly or indirectly about neurostrategy

Tenuous Division between Neurostrategy and Behavioral Strategy

The review of the articles showed misconception when strategic management uses neuroscience and psychology; the first is undoubtedly the inclusion of the term “behavioral strategy”. The advances in neuroscience allowed the progress of studies on “behavioral strategy”, but researchers can not consider them as neurostrategy studies, once it has different units of analysis and different methodologies.

In the scientific community, there is an understanding that research using neuroscience equipment are somewhat complementary to behavioral strategy studies (Laureiro-Martínez et al., 2015; Waldman, Wang & Fenters, 2016; Cristofaro, 2017), but there may be a particular vagueness about what are neurostrategy studies and studies in behavioral strategy. Naudé et al. (2014) exemplify this uncertainty when they assume that “in the neurostrategy research, a particular stream focuses on the role of the CEO's emotional intelligence and external networking behavior.” In fact they are not mistaken about it, but to perform it, should be take into consideration the use of neuroscience methods (TMS, EEG and fMRI) as exemplified by Powell (2011) and consider the brain, not the agent, as unit of analysis due to the methods employed (Gippel, 2013).

A Proper Behavioral Strategy Approach

To Powell et al. (2011), “behavioral strategy merges cognitive and social psychology with strategic management theory and practice”, looking for better integration between the process of strategic management and human factors such as social interaction, emotion and cognition. These conditions were not entirely neglected in previous studies of strategy (Hodgkinson & Healey, 2011; Hodgkinson et al., 2009), which had already addressed the unification between cognitive psychology and strategic management. However, it is interesting to note the connections to neuroeconomics concepts (Loewenstein, Rick & Cohen, 2008), but without a proper use of the behavior strategy paradigm, because “the term behavioral strategy is not widely used and means different things to different people” (Powell et al., 2011).

Thus, “behavioral strategy aims to bring realistic assumptions about human cognition, emotions and social behavior to the strategic management of organizations and thereby, to enrich strategy theory, empirical research and real-world practice” (Powell et al., 2011), applying social and cognitive psychology to the challenges of management to override some empirical contradictions (De Jong & Veijer, 2014). The behavioral strategy goals are very similar to the aims of the neurostrategy, but the difference remains the methods and the unit of analysis, as discussed above. The behavioral strategy is set in psychological cognition and decision biases (Gippel, 2013; Powell et al., 2011) and it is linked to the analysis of the individual, through design of experiments, surveys and using mathematical modeling, but without using the neurological and psychophysiological equipment, which belong to neuroscience and hence neurostrategy.

A Proper Neurostrategy Approach

Neurostrategy is an interdisciplinary joint that evaluates the nervous system and the brain of the individuals by studying the brain regions used in the time when individuals make decisions, through brain mapping or psychophysiological equipment. According to Polowczyk (2012), researchers can use the strategy models and tools of cognitive neuroscience, which deals

with decision making, learning and perception as a way of answering questions about latent decision-making.

A way to combine the achievements of social research with Neuroscience is developing a mental construct associated (e.g., aversion to loss, defense of status quo, etc.) with physiological events in the brain [...] with the use of the Magnetic Resonance Equipment (fMRI) can be observed that the aversion to loss probably is neurologically encoded in the prefrontal cortex. Polowczyk (2012).

Since neurostrategy is a recent term, it is necessary to put this in the title, keywords or abstract, in studies which use brain mapping equipment or psychophysiological, to facilitate the search, systematic review and data comparison for meta-analysis. As an example, the articles of Laureiro-Martínez et al. (2015); Elnaby, Abdel & Said (2017); Ashkanasy et al. (2014), tools of neuroscience were part of the experiments, such as fMRI, without mention of the term neurostrategy in your keywords or title. There are also articles using the term “organizational neuroscience” (Brusoni & Rosenkranz, 2014; Healey & Hodgkinson, 2014; Ward, Volk & Becker, 2015), which can be interpreted as a portmanteau of neuroscience and the study of organizations.

Organizational neuroscience uses the same tools of the neurostrategy, but the difference is the cause and effect interaction since organizational neuroscience deals with organizational phenomena as a whole (Ward et al., 2015) and not the decision-making by the individuals on strategic management process. So, the use of the organizational neuroscience term is appropriate to research about organizations because those have a different unit of analysis. Meanwhile, it concluded that the citation from Powell (2011) made in the article by Ward et al. (2015), which defines the boundaries of neuroscience, eventually could include the neurostrategy a phylum of neuroscience.

Neurostrategy and Behavioral Strategy: An Epistemological Analysis of its Fields of Study

Since "the epistemology proposes to define both a general theory of knowledge as a more limited study of the genesis and structure of science. [...], so the survey of new structures must be performed whenever new methods are embedded in any branch of science" (Serva, Dias & Alperstedt, 2010). Management is a science connected to positivism that uses concepts from various fields, where the knowledge comes from results achieved, linked to a utilitarian view of the facts, where the truth is given using scientific criteria, so at the end; it is a science that adopts a functional standard.

Under the functionalist paradigm, theorists of organizations often address their object from a structure of references based on assumptions not discussed and to the extent that these assumptions are reinforced and restated continuously for several researchers, this vision of an orthodox world is now assumed to be unique and unquestionable (Serva et al., 2010).

This concept about paradigms around the ideas of Thomas Kuhn (1970) who conceives the paradigm as a fundamental premise among researchers that shares. "In that sense, researchers who share the same standard underwent a similar education and professional initiation, absorbing the same technical literature and removing the same lessons" (Serva, Dias & Alperstedt, 2010). As the research is the central element of the management's study, Bunge (1980) states that it is necessary to establish specific criteria to justify a research field: (i) a philosophical basis or world overview; (ii) a formal basis or set of logical and mathematical theories; (iii) the specific basis of their field retrieved from other areas of research; (iv) a knowledge of its field obtained in the past; (v) a domain of its particular area and background knowledge; (vi) the set of problems

related to this domain; (vii) the set of goals and research related to it and; (viii) the set of regular methods to address their problems.

Bunge (1980) realized that the creation of science is stringent since it is necessary that all these criteria should be present in the field of study. Consequently, a scientific achievement universally accepted becomes a scientific paradigm (Kuhn, 1970). Neurostrategy and the behavioral strategy are still embryonic and require further development and understanding on the part of the scientific community linked to strategic management for this moment be considered a time when the strategy is entering a period of extraordinary science (Kuhn, 1970), where new paths for questions that remained unanswered by the models and current theories are tested and answered by means of new points of view, optical technologies or in a different from usual.

Thus, due to these new criteria and concepts, to provide a clear overview of what is neurostrategy is not neurostrategy, a rearrangement of these units of analysis, methodologies, theories and methods need a better definition mainly because the proximity and nevertheless, the mix of various concepts, in relation to studies of behavioral strategy. In this Kuhnian vision of scientific revolutions, new models and theories emanating from the paradigms created within theories and models currently used to demonstrate new effects on issues and concerns which remain unresolved or misunderstood by current theories. The construction of knowledge within the field of cognitive neuroscience decision-making on strategic management depends on firstly on reformulation and organization of knowledge and techniques in evidence.

In this way, Gippel (2013) proposed an application model to new sub-disciplines in finance (ex. neurofinance), which addresses the Kuhnian perspective of scientific revolutions, including new models to analyze rational expectations in finances through new spectra (neuroscience, sociology, psychology and evolutionary biology) as multidisciplinary components in the formation of new extraordinary science, including neurofinance (finance+neuroscience) and behavioral finance (finance+psychology). Using the same approach of Gippel (2013), this study made some adjustments to adapt it to the research mainstream, putting into perspective the fields of neuroscience and psychology at the portion of strategic management that deals with decision-making.

In Figure 2, there is the rise of two emerging sub-disciplines within the strategic management, but the relationships are more complex than illustrated since areas like psychology can have ramifications in anthropology, sociology and economics also (Gippel, 2013). Furthermore, the cluster “organizational neuroscience” (Ward et al., 2015) was incorporated, being neurostrategy a phylum of this group, where all aspects of the organization are studied through the tools of neuroscience.

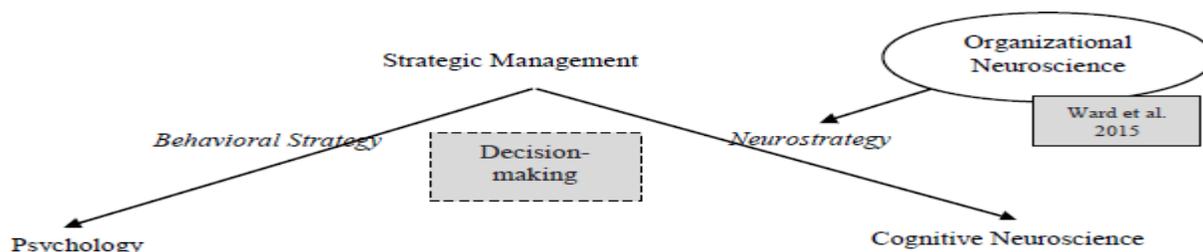


FIGURE 2
EMERGING SUB-DISCIPLINES OF STRATEGIC MANAGEMENT

Source: Adapted from Gippel (2013); Ward et al. (2015)

From the emanation of paradigms in strategic management "[...] the third class of experiments and observations exhausts the collection of facts activities in normal science" (Kuhn, 1970). This third class is the most important, which ultimately bring new answers and solutions to continuing problems that could not be solved using current tools, but through new technologies, models and ideas from other clusters of science, such as applications of neuroscience concepts within the strategic management. The appearance of sub-disciplines characterizes this change from normal science to the extraordinary and therefore; these new approaches could represent a revolution than just a change in normal science (Gippel, 2013; Kuhn, 1970). Table 6 provides a similar base for analysis "regarding epistemological characteristics and some regulatory implications for each approach" (Gippel, 2013) showing both the behavioral strategy and neurostrategy as two extraordinary sciences.

<p align="center">Table 6 COMPARISON OF CHARACTERISTICS OF TRADITIONAL AND EMERGING RESEARCH APPROACHES ONSTRATEGIC MANAGEMENT</p>			
	Normal science	Extraordinary science	
	Decision-making in strategic management	Behavioral strategy	Neurostrategy
Unit of analysis	Organization/Individual (Homogeneous)	Organization/Individual (Homogeneous)	Brain: Multiple observations (across time) for each brain
Methodology Theory	HD and OD Neoclassical rational expectations	HD and OD Behavioral and cognitive psychology.	HD Must be consistent with physical and chemical laws
Methods	Mathematical modeling/empirical testing/survey	Experimental mathematical modeling and testing	Experimental/brain imaging in lab
Rationality	Assumed	Bounded	Observed
Normative Implication	Improve decision-making efficiency	Provide education	Improve efficient Information processing.
Power	All agents equal	All agents equal	N/A

Source: Adapted from neurofinance through Gippel (2013) approaches

Notes: HD: Hypothetic Deductive; OD: Observational-Deductive

The neurostrategy separates from the normal, primarily because the rationality or bounded rationality is no longer assumed but obtained or observed by laboratory proceedings, the unit of analysis is the brain no longer the organization or individual, the tools including machines for brain synapses measurements (fMRI, EEG, TMS etc.) or psychophysiological measurements (ECG, GRS etc.) and methods, due to the tools and unit of analysis become only "hypothetical-deductive" (Gippel, 2013). However, it is important to note that, within the logic of Kuhn (1970), the extraordinary science arises at a time of crisis, when normal science loses power for the extraordinary science. Thereby, changing the paradigms of science and the efforts of researchers in general. It still does not happen with by both neurostrategy and behavioral strategy due to the newness of their studies and the little relevance of these within the decision-making studies in strategic management.

It is important to note that this vision linked to cognitive biases is attached within the reductionist school with philosophical foundations based on positivism and objectivism. (Powell et al., 2011). As a form of a suitable work to the processes defined in neurostrategy, but without discrediting previous work, this research list the work of Laureiro-Martínez et al. (2015) as a

robust technical and methodological framework for the use of neuroscience tools in organizational and management studies, even it has not focused on strategic management.

ANALYSIS AND DISCUSSIONS

According to Powell (2011) "in strategic management, some scholars may wonder whether processes within the individual brain can inform research that takes the firm and industry as its primary units of analysis". Although remarkable advances in neuroscience, there are some skepticism about its relevance and the use still pervades the discussion and the publication of articles (Ashkanasy et al., 2014; Weisberg, Keil, Goodstein, Rawson & Gray, 2008) around the use or not of neuroscience in strategic management and other applied social sciences. Despite this debate, it is a visible "neuroscientific wave" within the strategic management; the proof is in the number of citations in Google Scholar® the work of Powell (2011) related to neurostrategy (70) and Behavioral strategy (377), respectively. Several researchers "predict a bright future for interdisciplinary neuroscience [...] at the same time, some social scientists remain unconvinced". (Powell, 2011). In contrast, Ashkanasy et al. (2014) state that researchers should be cautious in neuroscience approach within organizations due to the reductionist features of their application in organizations.

The most detailed knowledge of brain functioning by strategy researchers can allow new researches and responses. Powell (2011) points out that the investigation using FMRI brought some promising answers to explain psychological foundations of attributive errors. For example, many psychologists consider aggression and passivity as the extreme behavior of the spectrum, but others view them as separate things. This debate could not be easily solved by traditional means, but FMRI mapping showed evidence that the decisions to approach (aggression) and scurry (passive) involve different parts of the brain, providing support to the latter view.

However, the strategic management problems require some simplification (reductionism) for a "friendlier format for the cognitive neuroscience" (Laureiro-Martínez et al., 2015), in addition, to correctly identify neural correlation to variable in vogue and due to the exhaustive research process to the candidates, the participant need some real incentives to predispose to accept and accomplish the task (Laureiro-Martínez et al., 2015).

The neuroscience methods can also help to a better understanding of what, in fact, means strategy. On the one hand we have the strategy management as something substantial, formulated and adopted to circumstances (behavioral approach) and on the contrary we have the strategy as a single decision, observing the brain's manager when he/she takes a decision, which can generate a conflict with the results obtained from analysis of the psychological, behavioral continuous point of view (Laureiro-Martínez et al., 2015). Therefore, a correct division between them then uses the neuroscience tools and how the phenomenon should be addressed are critical standpoints to avoid the research classified as a behavioral strategy when in fact it is dealing with the problem through neuroscience tools.

Neuroscience still has many limitations, such as: is filled with reverse inference problems involving the association of a mental state and activation of a brain region, subsequently causing the researcher presume that there is the presence of this mental state when the same activation in this brain region is detected (Nicolaou & Shane, 2014), so the logical deduction cannot be fully applied if there is no control of all the variables that can cause false results. Another issue is the inclusion of brain scans replacing answers already found in previous studies of strategic management for satisfactory answers in neuroscience, without checking other conditions and determining variables that were considered in the earlier study without the aid of neuroscience.

Weisberg et al. (2008) did an article only to demonstrate how the use of neuroscience explanations can lead new students a more favorable conclusion to inadequate description of phenomena, leading them to misinterpretation.

But in the same study Weisberg et al. (2008) indicates that the use of neuroscience, when made by a well-defined criteria and the utilization of experienced researchers can confirm findings come from and behavioral models or even within the normal science, also bringing robust additional explanations and knowledge which indeed fetch benefits and answers to the scientific community and businesses. The value for neuroscience research is the opportunity to examine carefully the decisions taken by managers employing a behavioral lens, although it is done in environments and simulated contexts or laboratories (Laureiro-Martínez et al., 2015). The costs to use neuroscience tools are also a limiting factor to perform research on this theme. These costs vary from laboratory to another but will not be less US\$ 100.00 and could reach several hundred dollars (Laureiro-Martínez et al., 2015) depending on what you want to search, doing a search with costly neuroscience tools. However, there are ways to mitigate these costs by unifying several different types of research to a single-use process, sharing the cost between many types of research (Laureiro-Martínez et al., 2015).

Other neuroscience limitations lie in restlessness around the neuroscience tools, the problematic merger between neuroscience and administration and the question of practical applicability of neuroscience (Ward et al., 2015). Thus, the lack of knowledge about how to analyze the brain scans results and how to merge these results within management theories are the main uncertainties to incorporate neuroscience organizationally, academic research or practitioners. Ward et al. (2015) pointed that the results in the neuroscience cause immediate impact on the public and the press, because they are imbued in a more robust scientific criteria, even if the readers don't have full knowledge of about the topic, generating heightened expectations, which leads some fallacy on neuroscience which sometimes point out that a small region of the brain as a source of some cognitive processes, giving a simplistic view of brain functioning, even within the scientific community, which confusing the a function of a portion of the brain with the whole (mereological view) even with the common knowledge by the neuroscientists about the pitfalls in the interpretation of neuroscience tools data (Bennett & Hacker, 2003).

There is also the discussion about how to view the brain in the context of organizations. Instead of seeing the brain as the cause of human behavior in organizations, we should study how the brain function may be influenced by "organizational socialization" of the individual (Hodgkinson & Healey, 2014), which has not been the focus of the current analysis. Finally, some authors (Bennett & Hacker, 2003; Laureiro-Martínez et al., 2015) address the issue of ethical boundaries around the researches in neuroscience. Some examples could include: the accidental discovery of brain abnormalities during mapping procedures; the absence of proper preparation for researchers to deal with those problems; the study of people with behavioral abnormalities; the generalization the results of a sample to the whole; the use of these results as a tool choice of individuals for hiring or firing; and the media's self-interest that generalizes the findings by the fascination he has with the brain.

CONCLUSION AND RECOMMENDATIONS

This paper aims to understand the main contributions of neurostrategy and cognitive neuroscience for decision-making in strategic management by a review of international journals. The conclusion of this review evidenced that, despite the limited quantities of scientific studies

around neurostrategy (50 by the final parameters), the work done by Powell in 2011, although theoretical, was the starting point to raising the number of other articles in the last seven years, indicating a promising beginning to this field of study. The lack of experiments, however, evidences the difficulty of applying the tools of neuroscience in strategic management, which makes this review also call for unification between strategy and neuroscientists researchers.

Supporting that, Powell (2011) address that neurostrategy can contribute to the strategic management if researchers in strategy are close with neuroscientists on specific research problems for which brain imaging and other neuroscientific methods can provide behavioral insights. Regarding the relevance of a Kuhnian perspective, neurostrategy cannot changes entirely the focus of studies in strategy, but it could be an alternative way to deal with some phenomena in a strategy using new tools and that can bring additional answers to results already found by normal science in strategy. According to Laureiro-Martinez et al. (2015), cognitive neuroscience is an alternative way to use neuroscience researches in strategic management to measure the individual history of strategic decision-making and indirectly the performance of this decision. In other words, brain mapping could provide some exact measurements of how the brains of managers are activated in the presence of the stimulus and not only while they are making a specific decision, but also in creating a meaningful strategic action comprehensively.

Despite all the positive aspects, neuroscience and its methodologies should not be used because managers are individuals and therefore can be "studied". They should be utilized because researchers believe that, in the long term, significant strategic decisions is a comprise of series of small choices repeatable (Laureiro-Martínez et al., 2015) which can be studied by neuroscience tools to bring significant findings that would not be possible without the application of these methods. Thaler (2000) also points that economists (and consequently strategists) should create new theories that provide a certain way human behavior in a quasi-rational way rather than focusing strictly on rationality and on this matter the neuroscience can give help to researchers in strategic management (Laureiro-Martínez et al., 2015).

Another contribution of this work was a suggestion, due to the novelty of the theme, for an epistemological division to provide a crystal clear separation of tools and approaches to neurostrategy and laterally, to behavioral strategy, where the first take, as unit of analysis, the brain, the second uses the human being, both contrasting with the vision of the organization/individual as the object of analysis in decision-making studies in management strategy. As recommendations, researchers in applied social sciences need to delve deeper to understand the human biology, physiology, the minds constitution and different ways of thinking, but as stated by Ashkanasy (2014) it is necessary that the ethical rules and practical development of neuroscientific technologies be adjusted in order to maintain the most stringent scientific standards within the research in neurostrategy.

Lastly, as a limitation of this investigation and a suggestion for future researchers, the criteria for defining the scope of the research should be emphasized. Despite the effort to seek all available information on this topic, the limitation is still under the use of keywords as an eliminatory criterion of the research process. Without a proper definition of the research and a correct set of their methodologies, application and tools to turn not only the search easily but could facilitate the comparison between current and future studies due to a correct epistemological framework.

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