Neuroscience approach for management and entrepreneurship: a bibliometric analysis

Valentina Cucino
Institute of Management and Department EMbeDS, Scuola Superiore di Studi Universitari e di Perfezionamento Sant'Anna, Pisa, Italy
Mariacarmela Passarelli
Department of Law and Business Science, University of Calabria, Rende, Italy
Alberto Di Minin
Institute of Management and Department EMbeDS, Scuola Superiore di Studi Universitari e di Perfezionamento Sant'Anna, Pisa, Italy, and
Alfio Cariola
Department of Business and Law, University of Calabria, Rende, Italy

Received 15 January 2021
Revised 8 May 2021
Accepted 30 June 2021

Abstract

Purpose – This study focuses on the role of individuals in the innovation management process, by concentrating on leaders and associated behaviors. Specifically, Entrepreneurial Leadership (EL) represent one of the most important fields of innovation management that has become increasingly multifaceted and interdisciplinary with its evolution. Thus, the purpose of this study is to examine a newly emerging research trend with a new lens that is "neuroscience".

Design/methodology/approach – This paper finds an evidence-based roadmap by reviewing the literature with a quantitative Bibliometric Analysis (BA) employing Co-Citation (Co-C) and bibliographic coupling analysis (BcA) to find linkages between the leadership and entrepreneurship literature and the neuroscience literature.

Findings – This study identifies five promising groups of research areas such as the organizational approach, the biological approach, the cognitive approach, the emotional approach and it identify five future research topics such as dynamic skills in innovation exploitation process, the human aspect of leadership, the building process of leadership, the biological perspective of leadership and the application of neuroscience in the ecosystem. Moreover, we find an evidence-based roadmap for stimulating focused EL within the broad topic of innovation management research, to move the field forward.

Originality/value – Although the past few years have observed the necessity of review studies on the subsets of biological factors, no reviews have sought to bring those different subsets together into a broader biological perspective. This study provides important indications on the interdisciplinary developments between the neuroscience aspects and EL, as a new emerging paradigm within the broad field of innovation management.

Keywords Bibliometric analysis, Biology, Entrepreneurs, Leadership, Neuroscience, Innovation management

Paper type Research paper

The authors thank Dr Sebastiano Massaro for providing very useful feedbacks to a previous version of the present study.

European Journal of Innovation Management
Vol. 25 No. 6, 2022
pp. 295-319
Emerald Publishing Limited
1460-1060
DOI 10.1108/EJIM-01-2021-0015

1. Introduction

Innovation management is driven by the realization that innovation is a key factor in the competitiveness and survival of an organization (Akbari *et al.*, 2020b; Ort and van der Duin, 2008). Indeed, it is an organizational activity relates to changes, where managers establish new processes and new activities, while leaders define new directions and motivate people (Hamel, 2006; Kotter, 2008). In this study, we focus on the role of individuals in innovation management processes, by concentrating on leaders and associated behaviors (Sjödin *et al.*, 2019; Zuraik and Kelly, 2019). Due to their prominent role within organizations, in fact, leaders affect organizational conditions under which innovation management may be generated and implemented (Crossan and Apaydin, 2010; Alblooshi *et al.*, 2020). Innovation management and entrepreneurship are a combination of the two is vital to organizational success and sustainability in today's dynamic and changing environment. Innovation and entrepreneurship are not confined to the initial stages of a new venture, rather, they are dynamic and holistic processes in entrepreneurial and innovative organizations (Zhao, 2005).

In this perspective, various studies have considered leadership as one of the organizational attributes underlying change and innovation (Alblooshi *et al.*, 2020; Kremer *et al.*, 2019; Zuraik and Kelly, 2019). Leaders may impact innovation management by reducing uncertainty and complexity associated with its pursuit (Birkinshaw *et al.*, 2008; Zuraik and Kelly, 2019) by improve employees' innovation work behavior in the context of knowledge-based firms (Bagheri *et al.*, 2020) by communicating a shared vision, supporting change, and innovation climate (Afsar and Umrani, 2020). Leaders are key individuals within organizations that are instrumental in identifying new trends in the environment and needs within the organization for which innovation management may be desirable (Bagheri *et al.*, 2020). They would also be particularly important in supporting initiatives related to changing practices, processes, or structures (Alblooshi *et al.*, 2020). Thus, the role of leadership has been found to be relevant in different fields, especially in entrepreneurship.

Within the wide literature of innovation management, several authors have focused on the concept of Entrepreneurial Leadership (EL). EL is "leadership role performed in entrepreneurial ventures, rather than in the more general sense of an entrepreneurial style of leadership" (Leitch *et al.*, 2013, p. 348). EL is an emerging paradigm that has received increased attention from both scholars and professionals due to its importance in improving innovation, competitiveness, success and growth of public or private organizations (Akbari *et al.*, 2020a; Bagheri and Akbari, 2018; Bagheri *et al.*, 2020; Iqbal *et al.*, 2020; Leitch *et al.*, 2013). Fontana and Musa (2017) analyze how EL fosters all elements in the intellectual property (i.e. idea generation, idea development or idea diffusion). Bagheri *et al.* (2020) argue that CEOs' EL improves their employees' innovation work behavior through enhancing their individual and team creativity self-efficacy. More concretely, an organization with EL would have a more effective innovation process (Bagheri and Akbari, 2018; Bagheri *et al.*, 2020).

In turbulent and uncertain environments, entrepreneurial leaders recognize new opportunities and drive firms innovation and growth (Akbari *et al.*, 2020a). However, in addition to the ability to transform these opportunities into innovative ideas, entrepreneurial leaders manage innovation the process of recognizing opportunities in their business, thus overcoming the challenges of the context (Bagheri, 2017; Bagheri and Akbari, 2018; Bagheri *et al.*, 2020). Indeed, EL is a unique leadership style that focuses on making heterogeneous talents work in an organization more creatively and innovatively in collective processes to respond to an uncertain business environment (innovation management process) and to create coherent strategies and novel outcomes (innovation management performance) (Fontana and Musa, 2017).

The cross-disciplinary research and practice in innovation management are imperative to productively and efficiently contribute to the overall firm's activities (Ort and van der Duin, 2008). It is recognized in the innovation management literature that entrepreneurial leaders

have distinctive attributes and qualities that derive from individual characteristics (Bagheri and Harrison, 2020). Thus, as suggested by some studies, research on EL could be enriched by an interdisciplinary approach (Harrison *et al.*, 2018; Stead and Hamilton, 2018). More concretely, in this context, neuroscience studies could advance research on EL because it manages to explore the neurophysiological substrates of mental processes and corresponding behaviours (Massaro *et al.*, 2020). In particular, neuroscience studies could link unobserved mental constructs (e.g. loss aversion with physiological events) (Powell, 2011) through new methodologies (Waldman *et al.*, 2017; Lerner *et al.*, 2020).

The literature on neuroscience applied to entrepreneurship is extensive and several studies on the subject can be found in many journals and business subfields (Nofal *et al.*, 2018; Shane, 2009; Shane *et al.*, 2010; Nicolaou and Shane, 2014) including EL. However, most studies based on different methodologies have a variety of views. In fact, these studies cannot generate an overall analysis of the topic and they do not allow to identify in a structured way the different future research trends in the field of managerial innovation. However, most studies based on different methodologies have a variety of points of view. For example, some studies only conducted brain research. In particular, Massaro *et al.* (2020) using functional neuroimaging to study entrepreneurial behaviors leaving out the biological approach while Powel (2011) analyze the potential contributions of brain research to strategic management but not in the specific field of entrepreneurship. Similarly, although Waldman *et al.* (2017) discussed leadership in neuroscience through qEEG assessment an extensive review on the topic is still missing.

Furthermore, other studies have used genetic predispositions. For example, Nicolaou and Shane (2014) investigate how genetic factors may influence the tendency of people to engage in entrepreneurial activity. Johnson (2009) and Nicolaou and Shane (2009) examined genetic predispositions to activity entrepreneurship through quantitative genetic studies on twins only. However, these studies are exploratory and consider a single aspect of the neuroscience domain.

Finally, Nofal *et al.* (2018) carry out a critical review of the intersection of biology and management, but it is not exhaustive regarding entrepreneurship field.

Moreover, as mentioned by Shane (2009, p. 67): "*Much of this research has been published in journals that management scholars do not routinely follow and the different studies themselves have been isolated from each other*" so it is it became problematic to interpret the results of the studies. Consequently, the literature needs a deep theoretical analysis to explores EL from the point of view of neuroscience, investigating its development in the entrepreneurship literature (Moore *et al.*, 2019).

Therefore, to fill this gap in the literature, this study uses bibliometric methods and visual maps to show an extensive structured review of the literature on EL and neuroscience. More concretely, the aim of this study is to examine the main works investigating EL and neuroscience literature in order to identify the new emerging research trend by proposing an evidence-based roadmap for stimulating research on EL in innovation management research.

Based on these arguments, this study addresses two research questions:

RQ1. What main research areas are covered by the literature focusing on neuroscience and EL, within the management field?

RQ2. What are/should be the theoretical foci for the current/future literature on EL, within the management field?

To achieve our goals, we conduct a quantitative Bibliometric Analysis (BA) employing co-citation (CoC) and bibliographic coupling analysis (BcA) to find linkages between the leadership and entrepreneurship literature and the neuroscience literature. BA is a tool that complements systematic reviews of the literature. BA, through objective analysis techniques,

strengthens the systematic analysis. This type of analysis enables an in-depth assessment of the advanced literature and has been used in entrepreneurship (Lampe *et al.*, 2019) and leadership fields (Alblooshi *et al.*, 2020; Iqbal *et al.*, 2020). However, according to our knowledge a literature lack of a BA combining the literature on entrepreneurship and neuroscience. Standing form this gap our review analyzed the two different literatures with the leans of neuroscience. More concretely, through the CoC we identify five research areas that we strengthen through the BcA analysis. More concretely, by applying BcA analysis we deepen the analysis of our first clusters related to CoC analysis and thus we identify five future research clusters.

Thus, our analysis highlighted a considerable number of research on the neuroscientific aspects of leadership in entrepreneurship, identifying (1) five clusters representative of current research arears of interest, mainly related to the studies of the nervous system in EL research, such as *organizational approach, the biological approach, the cognitive approach, the emotional approach*; and (2) five promising groups of research topics such as the *dynamic skills in innovation exploitation process, the human aspect of leadership, the building process of leadership, the biological perspective of leadership and the application of neuroscience in the ecosystem.*

The remainder of this paper is organized as follows. Section 2 describes the theoretical background of the study, illustrating the relevance of neuroscience in entrepreneurship studies. Section 3 provides details on the study's research strategy and design. Section 4 reports the study's findings. Section 5 provides our concluding remarks, envisioning an agenda for further research.

2. Neuroscience in entrepreneurial leadership

Research in the innovation management field has adopted in the last ten years (2010–2020) an individual-based perspective by applying the organizational neuroscientific approach to entrepreneurial decisions. Indeed, although a first line of this research began examining genetic predispositions to entrepreneurial activity through quantitative genetic studies of twins in 2009 (Johnson, 2009; Nicolaou and Shane, 2009), the first associations that analyze how biological parameters can influence the identification of the opportunity or starting a business are made in 2010. Thus, since 2010, the integration of these research fields has generated new strands of research in various management sub-fields (e.g. Nicolaou *et al.*, 2011; Waldman *et al.*, 2011b; Wernerfelt *et al.*, 2012).

More concretely, neuroscience contributes to innovation management research and in particular in entrepreneurship field in several ways (de Holan, 2014; Nicolaou and Shane, 2014). First, neuroscience may help us understand how rational and emotional aspects of entrepreneurs' decision-making are related to the functioning of entrepreneurs' brain (Nicolaou and Shane, 2014). By investigating neural mechanisms based on decisions (Mitchell *et al.*, 2014), neuroscience addresses the individual level of entrepreneurship. In particular, it analyzes how entrepreneurs think, and identify and manage opportunities (Mitchell *et al.*, 2007). Second, neuroscience helps us clarify how emotional elements such as "passion" or "volition" influence entrepreneurs' decision-making (Hikkerova *et al.*, 2016), entrepreneurs' behavior (Foo, 2011), identification of new entrepreneurial opportunities (Baron and Ensley, 2006; Patel and Fiet, 2011), and how the entrepreneurial cognitive process is carried out (Hayton and Cholakova, 2012; Moore *et al.*, 2019). Third, neuroscience through neurofeedback interventions (Waldman *et al.*, 2011a) can advance the study of leadership for a better understanding of the different leadership styles (Waldman *et al.*, 2020) and the cognitive mechanisms that underlie a leadership style (Bagheri *et al.*, 2020; Iqbal *et al.*, 2020), also helping the understanding of ethical dynamics (Lindebaum, 2013). Fourth, neuroscience addresses various aspects of the biological perspective (Bönte *et al.*, 2016), helping scholars

understand how genetic components impact both the identification of business opportunities (Nicolaou *et al.*, 2009) and the tendency to set-up a business (Bönte *et al.*, 2016; Nicolaou *et al.*, 2008). Moreover, physiologic approach, which examines the role of hormones, helps management researchers explore how individual differences in testosterone levels are correlated with, for example, innovation management and entrepreneurship (Bönte *et al.*, 2016).

Therefore, further research is required in the innovation management literature to investigate possible future developments in neuroscience research combining entrepreneurship and leadership (Figure 1).

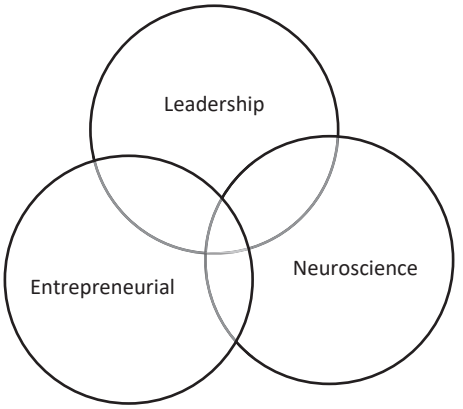

Figure 1.
The role of neuroscience

The contributions of neuroscience in management have questioned the various scholars on the different hypotheses of use of neuroscience (Massaro *et al.*, 2020) and in particular whether the use of neuroscience in entrepreneurship research must be considered a field in its own right (Krueger, 2007), if instead the use of neuroscience must be considered a field within the biology of the business framework (Nofal *et al.*, 2018), or whether it is to be incorporated into organizational neuroscience (Waldman *et al.*, 2017). Thus, this study aims to reduce the fragmentation in innovation management and entrepreneurship research by highlighting the relevant evidence in research on entrepreneurship and future lines of research.

3. Bibliometric analysis

3.1 Methodology

Our paper adopts a BA to answer the proposed research questions. Several scholars in the field of innovation management (Akbari *et al.*, 2020b; Suominen *et al.*, 2019), entrepreneurship (Ferreira, 2018; Lampe *et al.*, 2019), and neurosciences (Gómez *et al.*, 1990) have recognized the importance of BA. More concretely, BA is a tool that complements systematic reviews of the literature. BA, through objective analysis techniques, strengthens the systematic analysis.

BA allows us to identify influential authors and reveal their interrelationships (Ferreira, 2018). This approach is based on the statistical analysis of scientific documents and relative citations. This type of analysis allows us to identify the level of expansions in a specific research field and future research trajectories. More concretely, there are two different methods of analysis of citations are used to identify publications in a specific research field.

The first method is CoC analysis, which is employed when two documents are cited independently in one or more documents (Small, 1973).

The second method is BcA, which is used when two documents refer to a third common documents in their bibliographic graphs, indicating the probability that these documents linked topic. The "coupling strength" of two given documents is greater according to the number of citations to other documents they share (Ferreira, 2018; Kessler, 1963; Martyn, 1964).

BcA and CoC analysis are complementary. More concretely, the simultaneous use of BcA and CoC allows a more accurate analysis of the literature. Indeed, in a database where links are restricted, BcA analysis clustering the latest documents and only a limited number of very old papers, while CoC clustering clusters the eldest documents, without clustering newer documents that have not yet been cited.

3.2 Data collection

We have created an ad hoc protocol to perform BA (Ferriera, 2018). The selection of articles occurred in three steps. First, we selected the query. The proposed search strategy was based on a structured query, implemented using an extensive citation database. The query was designed to meet the purpose of this paper. Second, the database was selected. The citation database required for the purposes of our research was mindfully selected to reduce the risk of neglecting any pertinent scientific contribution. We used Elsevier's Scopus because (1) it is one of the largest citation databases in the world; (2) it indexes around 70 million documents since 1788 and (3) covers various subject areas, ranging from biological sciences to management and social sciences (Cavallone and Palumbo, 2020). Moreover, the Scopus database includes data on academic publications, including affiliations and citations. The authors referred to Scopus because it includes the greatest number of indexed publications. The query was adapted to the certain attributes of the search engines included in each scientific database. Specifically, the query (TITLE-ABS-KEY ("neuroscience" AND "entrepreneur*") OR TITLE-ABS-KEY ("neuroscience" AND "leadership") OR TITLE-ABS-KEY ("neuroscience" AND "management")) was searched in the Scopus database. This search strategy identified 3,394 articles (2020, October).

Third, we set the exclusion criteria. We imposed no limitation in the research strategy relating to the year of publication or classification of document. This criterion was adopted by the authors to be exhaustive in the search for scientific contributions. The only two limitations allowed were the choice of language and categories. The English language was chosen because it is the official language for research that meets the international standards. This search strategy identified 3,262 articles. The categories "social science", "management" and "business" were used because they best describe the field of investigation. The final sample comprised 396 scientific articles. Thus, following Ferreira (2018) and we present a BA based an analysis of 396 documents.

More concretely, our analysis aims to identify (1) the main articles relating to neuroscience in entrepreneurship; (2) the most influential players in the sector; (3) the respective networks of authors; and (4) possible future research developments in the field.

3.3 Data analysis

The first step of BA is identifying the tools. Two tools were used in this study. The first was the VOSviewer software (www.vosviewer.com). VOSviewer allows the construction and visualization of bibliometric networks, with magazines, researchers, based on common citations, BcA, or paternity relationships (Van Eck *et al.*, 2010). VOSviewer builds a map based on a three-phase recurrence matrix: (1) a "similarity matrix", to apply mapping method (Waltman *et al.*, 2010) using the strength of the association; (2) a mapping method, to build a

map that reflects the extent of similarity between objects (Van Eck *et al.*, 2010); and (3) translation, rotation, and reflection, to correct the optimization problem described in the literature (O'Connell, 1999).

The second tool was Bibliometrix, an *R* package for running extensive science mapping analysis which allows authors to perform analyses and graphs for sources, author, and document level and for conceptual, intellectual and social knowledge structures (Aria and Cuccurullo, 2017).

4. Findings

4.1 Descriptive analysis

In the following section we report the descriptive statistics of the database obtained from Bibliometrix. The database includes 424 documents for a total of 848 authors (2.4 authors per document). The database comprises articles (256), books (30), book chapters (46), conference papers (297), and conference reviews (4). To avoid excluding potentially essential documents (even if unpublished), short surveys (1), notes (8), and reviews (41) were also included. The reference period covers 2010 to 2020 (Table 1).

Since the 2000s, topics such as education, mental health services, and methodological issues have received increasing attention. However, since 2010, the most widely covered topics have converged toward cognitive, managerial, and decision-making issues. Thus, the integration of these research fields has generated new strands of research in various management sub-fields (e.g. Nicolaou *et al.*, 2011; Waldman *et al.*, 2011b; Wernerfelt *et al.*, 2012). Moreover, in those

Description	Results
Documents	424
Sources (journals, books, etc.)	291
Keywords plus (ID)	1,327
Author's keywords (DE)	1,132
Period	2010–2020
Average citations per documents	13.2
Authors	923
Author appearances	1,073
Authors of single-authored documents	143
Authors of multi-authored documents	780
Single-authored documents	166
Documents per author	0.459
Authors per document	2.18
Co-authors per documents	2.53
Collaboration index	3.02
Document types	
ARTICLE	256
BOOK	30
BOOK CHAPTER	46
CONFERENCE PAPER	29
CONFERENCE REVIEW	4
DATA PAPER	1
EDITORIAL	4
ERRATUM	2
LETTER	2
NOTE	8
REVIEW	41
SHORT SURVEY	1

Table 1.
Documents description

years, a study of Cropanzano and Becker (2013) was published that analyzed organizational neuroscience by analyzing three aspects (1) the contemporary technical state of modern neuroscientific tools (2) the ethical implications of future investigations, including the possibility that neuroscience can enrich and improve life of people and (3) a more open ethical aspect that considers not only the pros but also the cons of neuroscientific analyzes.

4.2 Co-citation analysis

From the 396 sampled articles, we obtained 25,215 cited references. In line with Eom (2009), we used a minimum threshold of four citations of a cited reference, obtaining 87 articles, five clusters, and 852 links. The CoC analysis reveals five clusters that represent the research topics of interest (see Figure 2).

4.2.1 Red cluster – "organizational approach". Studies related to this cluster explore behaviors within organizations through the lens of neuroscience. More concretely, the application and implications of brain science are being studied to analyze behavior (Becker and Cropanzano, 2010; Becker and Menges, 2013; Raichle and Snyder, 2007) and strategies (Powell, 2011) in organizational settings. Organizational neuroscience holds great promise for the advancement of organizational research and practice (Lee *et al.*, 2012; Powell, 2011; Senior *et al.*, 2011) because it investigates the neural mechanisms involved in perception, attention, categorization, memory, attitudes, language, emotional regulation, executive function, decision making (Cacioppo *et al.*, 2008) Although it has developed rapidly, it is the subject of methodological challenges that must be considered when conducting research in neuroscience applied to organizational behavior, such as the need to address the methodological and technological challenges of research (Ashkanasy *et al.*, 2014). However, several studies nowadays have focused on applying neuroscience to organizational theories. This phenomenon has generated a substantial increase in the number of applications of neuroscience to organizational contexts (Becker, 2011; Senior *et al.*, 2011), in particular on leadership. In particular, several studies have addressed the role of leaders in firms through the lens of neuroscience (Lee *et al.*, 2012). Some studies have analyzed the visionary behaviors of leaders through the quantitative electroencephalogram (Waldman *et al.*, 2011a). The use of the electroencephalogram has become widespread due to its temporal accuracy.

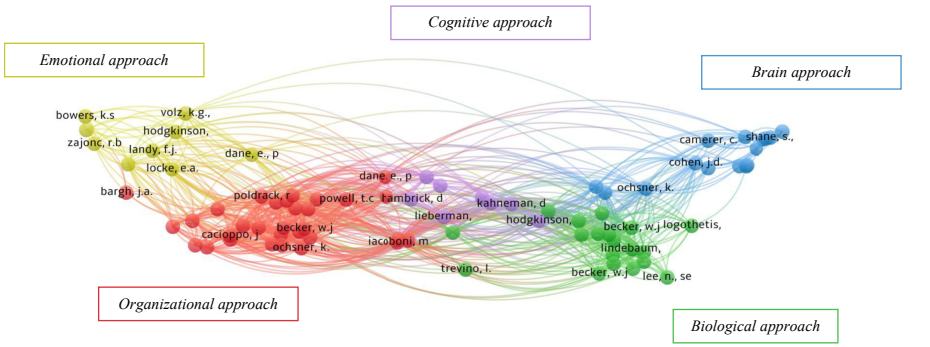

Figure 2.
Co-citation analysis

Other studies have extensively analyzed the implementation of neuroscience as a tool for human resource leadership, particularly with regards to the behavior of human resources in innovation management (Becker *et al.*, 2010, 2011). Other studies analyzed the genetic influences of leaders and found that we found that genetic influences are stronger for those twins who had relatively poorer social environments (Zhang *et al.*, 2009).

4.2.2 Green cluster – "new emerging paradigm on leadership research: the biological approach". Studies within this cluster analyze insights from social neuroscience to explore new paradigms in leadership research. Indeed, insights from social neuroscience may offer a more embodied and socially situated view of cognition in leadership (Healey and Hodgkinson, 2014; Senior *et al.*, 2011). The human ability to make decisions and implement long-term goal-oriented behaviors depends on the planning system (Becker *et al.*, 2011), which can select the action that should produce the expected results (Becker and Cropanzano, 2010). Conversely, habit-based decision making resides in older brain structures and involves much slower learning. Indeed, habit systems push managers to continue past entrepreneurial behaviors and give up new innovative actions (Becker and Cropanzano, 2010) because this system automatically matches situations to actions based on previous experience. However, some neuroscience studies show how to overcome these entrepreneurial difficulties. For example, Becker and Cropanzano (2010) suggest reversing the "status quo" to start a conscious planning system. Indeed, the achievement of challenging objectives can undermine the status quo by modifying the decision-making process and the habits of the entrepreneurial system (Becker and Cropanzano, 2010).

The second area of research focuses on the relationship between intuition and decisions that guide behavior. Authors within this group seek to link different discourses, ideas, methods and discoveries that contain analyzes of cognitive neuroscience and organization theory (Bulter and Senior, 2007; Senior *et al.*, 2011). Indeed, within these studies, new approaches emerge ranging from ethical studies to biology studies to explain the implications that neuroscience has in leadership (Lee *et al.*, 2012; Farah *et al.*, 2005). In particular, some studies have analyzed the role of neuroscience in influencing inspirational leadership (Waldman *et al.*, 2011a), premature leadership (Lindebaum and Zubdel, 2013) and the differences between transformational and non-transformational leaders (Balthazard *et al.*, 2012).

Although within this cluster the potential of neuroscientific methodologies is highlighted (Aston-Jones and Cohen, 2005) some authors advise caution in the use of neuroscience as an application to evaluate the behavioral and decision-making processes of entrepreneurs due to moral problems related to "application of neuroscience in leadership studies" (Ashkanasy *et al.*, 2013, 2014).

4.2.3 Purple cluster – "cognitive approach". In the purple cluster, neuroscience is studied as a tool for analyzing the decision-making process of entrepreneurial leaders. In particular the studies in this cluster the decision-making process is understood as the decisions that affect the organizational results, the strategic choices and the performance levels of innovation managers and leaders (Hambrick and Mason, 1984). More concretely, all choices aimed at identifying new opportunities and organizing themselves effectively and efficiently to welcome them fall within the notion of decision-making process (Teece, 1997). In this cluster, three areas of interest to both economists and psychologists are examined through innovation management research: (1) decision making under risk conditions (Loewenstein *et al.*, 2008) and uncertainty (2) intertemporal and social choice (Lieberman, 2000, 2007) and (3) decision making (Loewenstein *et al.*, 2008; Kahneman and Klein, 2009). In particular, some studies highlight the potential of the study of neuroscientific research with respect to psychological applications (Hodgkinson and Healey, 2011) by emphasizing the application of neuroscience as an evolutionary tool for the psychological analysis of individuals (Hodgkinson *et al.*, 2009).

4.2.4 Yellow cluster – "emotional approach". Although we have identified a specific cluster in the study of emotions in entrepreneurial processes, the central focus of the yellow cluster is the study of cognitions in the entrepreneurial decision-making processes of leaders.

Decisions in a complicated situation require explicit reasoning and guided decision making (Bechara *et al.*, 1997). However, explicit reasoning is preceded by an unconscious phase that uses neural systems other than those that support declarative knowledge. In other words, reasoning is knowledge-driven (Dane and Pratt, 2007).

Cognitions play an important role in influencing the behavior and characteristics of leaders and are believed to influence organizational learning, tacit learning, information seeking, entrepreneurial decision making, creativity, and innovation management. Understanding how cognitions work can help leaders make more appropriate decisions in management (Hodgkinson and Sparrow, 2002; Zajonc, 1980; Ericsson and Charness, 1994).

In the field of cognition, some studies have focused on the role of bias and how it can help decision-making by ensuring beneficial behavior (Bechara *et al.*, 1997), others have focused on intuitions as a guide to judgment (Bowers *et al.*, 1990). Other studies have focused on the role of emotional intelligence, highlighting its potential for behavioral choices (Landy, 2005) but also underlining its inadequacy for leadership studies (Locke, 2005).

Finally, other studies have discussed how cognitions drive insights (Bowers *et al.*, 1990). In this case, we define intuition as "the ability to understand or know something immediately, without conscious reasoning" (Oxford English Dictionary). In this area, some authors investigate how insights drive decision making (Dane and Pratt, 2007), while others discuss how insights lead to informed judgment in the context of discovery (Volz and Cramon, 2006).

4.2.5 Blue cluster – "brain approach". The main focus of the purple cluster is the EL in neuroeconomic experimental study. Several studies have proposed a neural model for economic decisions (Bechara and Damasio, 2005). Neuroeconomics uses knowledge of brain mechanisms to inform economic analysis and fuses economics with biology (Ochsner and Lieberman, 2001).

Neuroscientists use various tools to provide behavioral explanations, including brain imaging, animal behavior, and recording of individual neuronal activity (Posner and Petersen, 1990; Rizzolatti and Craighero, 2004). Many authors use functional neuroimaging techniques (eg, BrainMap) to better understand the functioning of the brain in the cognitive process (Poldrack, 2006), predict decision-making processes (Knutson *et al.*, 2007), study how emotions affect the decision-making and behavior (Foo, 2011). Other authors emphasize the role of biological applications in influencing entrepreneurial innovative actions in conditions of uncertainty (Shane and Venkataraman, 2000). Within this cluster, some studies have discussed how neuroscience can take part in economic research. Indeed, Camerer *et al.* (2005) discuss how simple rational choice models are useful for understanding the Bayesian integration of sensorimotor information, while Cohen (2005) discusses applications to game theory. Finally, other studies have suggested neuromarketing as an application for managerial practice (Hubert and Kenning, 2008).

4.3 Bibliographic coupling analysis

CoC data were used to identify scientific publications and research trends (Ferreira *et al.*, 2018) interrelated with neuroscience, entrepreneurship and management. However, to provide future research directions, we strengthen our first CoC results through the BcA analysis. Studies show that BcA techniques can be used to identify "hot" research topics (Glänzel and Czerwon, 1996). Therefore, the second step of the analysis was to perform BcA.

In line with Di Stefano *et al.* (2010), we applied a minimum number of citations of 20 documents. From 424 documents in our database, the software extracted 66 documents. In the network, 16 documents were not connected to each other. The largest set of connected

items consisted of 49 documents. The total strength of the bibliographic links coupled with other documents was evaluated. Documents with the maximum total link strength were selected.

In particular, Figure 3 provides a detailed description of research trends. More concretely, we have clustered the 396 identified articles into five broader research fields based on their theoretical approach and research aims. In Figure 3, the results show five larger research areas (Glänzel and Czerwon, 1996).

4.3.1 Purple cluster – "dynamic skills in innovation exploitation process". The purple cluster includes studies that cover the strategy creation and exploitation process within the innovation management perspective. Some studies provide an understanding of how managers' minds manage the exploration-exploitation dilemma (Laureiro-Martínez *et al.*, 2010).

The ability to detect, capture and transform knowledge requires that managers have cognitive and emotional skills (Hodgkinson and Healey, 2011). Understanding dynamic skills in terms of entrepreneurial cognition and motivational antecedents and how individual action and interactions affect performance is at the heart of this cluster (Foss and Pedersen, 2016). In the strategic management literature, for example, the cluster highlight that the executive judgment and strategic decision making have foundations in psychology (Hodgkinson *et al.*, 2009). The use of neurostrategies to explain behavioral dynamics in the formation of the strategy and dynamic skills of leaders plays a fundamental role in the innovation management literature (Foss and Pedersen, 2016). Powell (2011) analyzes the intersection between strategy and neuroscience highlighting its potential, while Hodgkinson and Healey (2014) analyze the implications of neuroscience arguing that dynamically capable leaders succeed in stimulating radical innovation. However, most current studies are based on a cold logic that downplays the significance of cognitive processes for strategic adaptation (Hodgkinson and Healey, 2011).

Due to the increased use of neurophysiology techniques in psychology and economics and the continued use of functional magnetic resonance, several researchers have begun to discuss the implications of neuroscience for entrepreneurial and innovation management studies (Healey and Hodgkinson, 2014).

Through these techniques and a multidisciplinary approach, various studies belonging to this cluster propose a different way of combining research in neuroscience, psychology and

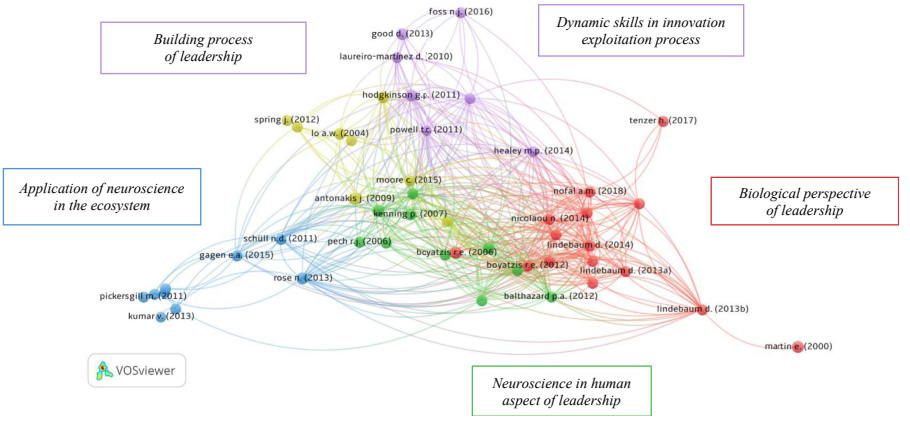

Figure 3.
Bibliographic coupling analysis

management to advance knowledge of the micro-foundations of managerial decision-making (Laureiro-Martínez *et al.*, 2010).

4.3.2 Green cluster – "neuroscience in human aspect of leadership". The red cluster highlights the human approach of leadership by focusing on the study of emotions. Studies within this cluster emphasize the role of affect and cognition as an integral part of entrepreneurial rationality (Hayton and Cholakova, 2012; Kenning *et al.*, 2007) in innovation management (Pech and Cameron, 2006) and analyze the neuroscience perspective to support analysis (Becker and Cropanzano, 2010; Lee *et al.*, 2012). Through traditional methodological tools, it is not possible to understand how the mind of the leader transforms knowledge or experience into decisions, or how such knowledge may or may not lead to actions, happy or not (de Holan, 2014). One solution could be to use the tools of neuroscience and in particular the brain to examine how leaders use their knowledge and experience to make decisions (de Holan, 2014; Beugré, 2009). Through a multidisciplinary approach, some studies show that a greater understanding of tacit knowledge can be achieved by integrating neuroscience, evolutionary biology and psychology (Waldman *et al.*, 2011a, b). For example, by integrating affective neuroscience and biology, some authors offer a more holistic approach to leadership development, showing how leaders should emphasize coaching as a fundamental part of their role and behavioral habits (Boyatzis *et al.*, 2006, 2012). Other studies use neuroscience to investigate the cognitive processes underlying the recognition of entrepreneurial opportunities (Pech and Cameron, 2006). Finally, some studies focus on the emotional intelligence of entrepreneurs to identify links between the emotional intelligence of leaders and the results of followers (Antonakis *et al.*, 2009).

4.3.3 Yellow cluster – "building process of leadership". The leadership training process is studied within the yellow cluster. More concretely, within this cluster, neuroscientific theories are analyzed to understand the formation of the decision-making process of leaders both from a managerial and organizational point of view (Hodgkinson *et al.*, 2009). In particular, to understand the formation of decision making, the neuroscientific and evolutionary basis of the behavior of leaders (Lo, 2004) and the behavior of leaders from a biological point of view are analyzed through advances in cognitive neuroscience (Lee, 2012). Further studies instead focus on tacit knowledge. In particular, Bennet and Bennet (2008) explores the concept of tacit knowledge by providing a new model of information and knowledge consistent with neuroscience. Other studies analyze what pushes leaders to make a moral choice and to put it into practice (Moore and Gino, 2015). Moore and Gino (2015) in particular highlight how intuition, affection, physiology and identities support and inform a more deliberative reasoning process in the construction and implementation of moral behavior and we then describe how these processes affect the choices of leaders in carrying out their actions. Finally, a group of studies analyzes the effects of neuroscience through studies on the brain (Spring, 2012).

4.3.4 Red cluster – "biological perspective of leadership". Neuroscience can significantly aid the advancement of organizational research and practice. However, its rapid development has also generated technological and methodological challenges. Therefore, the red cluster seeks to sensitize researchers to the moderate use of neuroscience techniques to study the leadership dynamics and behavioral habits of leaders within organizations (Lindebaum and Jordan, 2014). Therefore, (Ashkanasy *et al.*, 2014), propose a roadmap to enable researchers to advance multidisciplinary research on organizational behavior through a neuroscientific approach based on the moderate use of neuroscience techniques. In this cluster, we consider the ethical implications of future investigations of innovation management (Lindebaum and Zundel, 2013) through a constructive approach, considering the possibility that neuroscience can enrich and improve the lives of leaders (Cropanzano and Becker, 2013).

Studies within this cluster emphasize the applications of neuroscience to the study of premature leadership (Lindebaum *et al.*, 2013), the differences between resonant and

dissonant leaders (Boyatzis *et al.*, 2012) and encourage interaction with neuroscience for a Greater understanding of international affairs (Tenzer *et al.*, 2017).

Within this cluster emerges a new approach to the study of neuroscience for innovation management studies. The new approach is a biological approach, an approach that analyzes biological dynamics through the study of the hormones of leaders (Nicolaou *et al.*, 2018; Butler *et al.*, 2016; Nofal *et al.*, 2018). In particular, research in this regard has begun to investigate the influence of testosterone, which is known to be associated with aggression and proactivity (Nicolaou *et al.*, 2018) highlighting how testosterone is associated with the likelihood of undertaking an entrepreneurial activity (Nicolaou *et al.*, 2018). Other studies have looked at testosterone prenatals in same-sex and opposite-sex twins. Other research has instead analyzed the interaction of cortisol and epinephrine in business leaders (Wolfe and Patel, 2017). Finally, other studies have examined how the creativity of business leaders increases with physiological recovery during nocturnal sleep (Weinberger *et al.*, 2018).

4.3.5 Blue cluster – "application of neuroscience in the ecosystem". The future trend emerging from the blue cluster is related to the application of neuroscience to the social sciences. The study of brain sciences is influencing the current understanding of human behavior by bringing out a neurobiological "colonization" of social and human sciences (Rose and Rached, 2013). New neuroscience-based thinking styles create different applications in the social and political context (Rose and Rached, 2013). Neuroeconomic neuropsychiatry, neurotheology and neuroesthetics are just some of the possible applications of neuroscience.

On the social side, some studies focus on personality disorders (Pickersgill, 2011), highlighting the potential of neuroscience to translate and improve also clinical practice. Other studies analyze the role of empowerment, self-realization and discipline as dynamics that influence leadership behaviors (Thornton, 2011). Finally, some researches address neuromarketing (Kumar *et al.*, 2013), highlighting how neuroscience is increasingly considered a possible basis for new business and management practices (Schneider and Woolgar, 2012), especially in the innovation management field.

Within these studies, the development of new types of digitally mediated "biopedagogies" of body optimization, "psychopedagogies" of emotional maximization and "neuropedagogies" of brain enhancement emerge (Williamson, 2016).

From a political point of view, some studies use the neuroscience lens to understand neurobiological language within specific political contexts (Broer and Pickersgill, 2015), highlighting how neurobiological concepts can be used to construct and support a particular imaginary of citizenship and the role of the state.

5. Discussion and conclusions

Bibliometric analyzes allowed us to answer our research questions (RQ1: *What main research areas are covered by the literature focusing on neuroscience and EL, within the management field?* RQ2: *What are/should be the theoretical foci for the current/future literature on EL, within the management field?*). More concretely, several studies have considered leadership as one of the organizational attributes underlying change and innovation management (Elenkov *et al.*, 2005; Peters and Waterman, 1984). Indeed, an organization with EL have a more effective innovation process (Bagheri and Akbari, 2018; Bagheri *et al.*, 2020). EL is a quite promising paradigm that has been applied to beat the dynamic evolving of innovation ecosystem (Leitch and Volery, 2017; Bagheri and Akbari, 2018). EL has got consideration of both scholars as a crucial factor in innovation management strategies (Fontana and Musa, 2017; Bagheri, 2017; Bagheri and Akbari, 2018; Akbari *et al.*, 2020a; Bagheri *et al.*, 2020; Iqbal *et al.*, 2020).

Leadership studies has become increasingly multifaceted and interdisciplinary with its evolution (Perruci and McManus, 2012; Yammarino, 2000). Among the various sciences that can enrich the understanding of the role of leadership, one that is still little researched is that

of neuroscience. In particular, the basis for a new school of thought that incorporates neuroscience in the field of EL needs to be investigated (Nofal *et al.*, 2018; Shane, 2009; Nicolaou and Shane, 2014; Shane *et al.*, 2010).

This study used BA to investigate how neuroscience contributes to the field of EL, and more generally to the field of innovation management, by addressing the subfield of entrepreneurship and the process that encourages engagement in entrepreneurial actions. In particular, the proposed approach is in line with Moore *et al.* (2019), investigating how neuroscience contributes to the field of EL and more generally to the field of innovation management. Research and interdisciplinary practice in innovation management are indispensable to help productively and efficiently the overall functioning of a company (Ort and van der Duin, 2008). Thus, this study proposes a new approach that combines physiology and psychology to understand the fundamental and emergent properties of the brain. These highlights are consistent with the view proposed by Kandel *et al.* (2012) that the biological basis of learning, memory, behavior, perception, and consciousness represents the "ultimate challenge" for the biological sciences. During the 20th century, neuroscience began to be recognized as a distinct academic discipline, with relationships with biology and psychology. The modern neuroscience approach (Kandel and Squire, 2001) includes the emergence of the cellular and molecular neuroscience of signaling, a mechanistic view of brain development, the impact of neurology and psychiatry, a new alignment of neuroscience and psychological science, the neuroscience of cognition, and the bridging of cognitive neuroscience with molecular biology in the study of memory storage. In line with this modern approach, the analysis of BcA identifies new trends related to the application of biology to management and entrepreneurial issues. Future research will aim to conduct an explanatory study.

To the best of our knowledge, this is the first work to attempt to systematize the literature on neuroscience and EL, within the field of innovation management, by using BA. Specifically, by using CoC analysis, this study identifies the past trends in the literature in specific fields of neuroscience and entrepreneurship (Figure 2). By applying the BcA technique, the main research streams are consolidated, and new trends of investigation in the research field are identified (Figure 3).

To improve the current understanding of EL with the neuroscience lens, we synthesized the different ways through which previous research has conceptualized entrepreneurial organizations and analyzed how these are reflected in the literature through a BA.

5.1 Implications for researchers

This study contributes to EL and innovation management literature in different ways. First, by employing a BA, it contributes systematic insights into the evolution of neuroscience in EL and management field. This is the first study to propose a literature review that combines neuroscience and management literature using specific BA techniques recognized in several management disciplines (Akbari *et al.*, 2020b; Suominen *et al.*, 2019). Mapping the literature allows key research areas in the field to be identified, as well as the authors working in the field. This information is of great interest to both new and existing researchers, as it guides them in directing their work. The study consolidates the main research streams, providing a comprehensive overview of the field. It then attempts to identify the multifaceted and interconnected nature of the research area, outlining new emerging trends, thus encouraging further research advancements.

Second, it highlights several trends consolidated in the literature by using CoC analysis. Some consolidated trends emerge from the analysis of CoC and the temporal analysis. Five clusters are identified representing the current topics of interest, mainly related to studies of the nervous system in EL research, such as neurology, cognition processes, and brain mechanism processes.

Third, this study provides novel insights into the perspectives of the neuroscience field applied to entrepreneurship as a key driver for innovation management. More concretely, in this study we answer our RQ1 (i.e. *What main research areas are covered by the literature focusing on neuroscience and EL, within the management field?*) by identifying five main research areas covered by the literature focusing on neuroscience and EL in the management field. In particular, through the CoC we identify five research areas that we strengthen through the BcA analysis. Thus, we first identify five promising groups of research areas such as *the biological approach, the brain approach, the social approach, the cognitive approach and the emotional approach*. Moreover, as suggested by some authors (Bönte *et al.*, 2016; Lerner *et al.*, 2020), we have also applied neuroscience to EL and we discover future research trends More concretely, by applying BcA analysis we deepen the analysis of our first clusters related to CoC analysis and thus we identify five future research clusters. In Table 2, we identify five hot research topics (Glänzel and Czerwon, 1996).

Thus, from the BcA, a multidisciplinary trend emerges, related to the application of the individual approach of neuroscience within the innovation management literature. Specifically, it comes out a specific cluster devoted to the application of neuroscience to the EL across the exploration-exploitation process of innovation (i.e. *Dynamic skills in innovation exploitation process*). The EL concept, in fact, could be considered a crucial aspect in all the organizations that deal with innovation management strategies as the study of

Research topic	Short description	Representative articles
Dynamic skills in innovation exploitation process	These studies focus on the use of neurostrategy to explain the managerial behavioural dynamics in the innovation exploitation process	Foss and Pedersen (2016), Powell (2011), Hodgkinson and Healey (2011), Hodgkinson *et al.* (2009), Healey and Hodgkinson (2014), Laureiro-Martínez *et al.* (2010), Hodgkinson and Healey (2011)
Neuroscience in human aspect of leadership	These studies focus on the role of emotions and cognition as an integral part of entrepreneurial leadership	Hayton and Cholakova (2012), Kenning *et al.* (2007), Becker and Cropanzano (2010), Bennet and Bennet (2008), Waldman *et al.* (2011a), Waldman *et al.* (2011a, b), Boyatzis *et al.* (2012), Antonakis *et al.* (2009)
Building process of leadership	These studies focus on the use of neuroscience tools to study how entrepreneurs use their knowledge and experience to make decisions	Hodgkinson *et al.* (2009), Lo (2004), Lee (2012), Bennet and Bennet (2008), Moree and Gino (2015), Spring (2012)
Biological perspective of leadership	These studies focus on the use of biological perspective of entrepreneurship by examining the role of hormones	Lindebaum and Jordan (2014), Boyatzis *et al.* (2006), Ashkanasy *et al.* (2014), Lindebaum and Zundel (2013), Cropanzano and Becker (2013), Lindebaum *et al.* (2013), Boyatzis *et al.* (2012), Tenzer *et al.* (2017), Nicolau *et al.* (2014), Butler *et al.* (2016), Nofal *et al.* (2018)
Application of neuroscience in the ecosystem	These studies focus on brain sciences influencing understanding in the entrepreneurial ecosystem in terms of social and political context	Rose and Rached (2013), Rose and Rached (2013), Pickersgill (2011), Kumar *et al.* (2013), Schneider and Woolgar (2012), Thornoton *et al.* (2011), Williamson (2016), Broer and Pickersgill (2015)

Table 2.
Future research trends

neuroscience can also support the study of the emotions and cognitions of leaders (i.e. *Neuroscience in human aspect of leadership*).

Moreover, the application of neuroscience can involve leaders operating in firms and in technology transfer offices. New insight can be offered, to define new exploitation strategies for knowledge, technologies and research result, and to enhance innovation performance. Furthermore, the application of neuroscience can support the leader in understanding the social context and, more generally, the ecosystem of the company or organization (i.e. *Application of neuroscience in the ecosystem*).

Thus, this study provides also important indications on the interdisciplinary developments between the biological aspects and EL as a new emerging paradigm of innovation management strategies (i.e. *Biological perspective of leadership*). In particular, the application of neuroscientific cognitive techniques to leadership research is one of the future trend topics that emerge most prominently in the BcA. Several studies have addressed the behavior of leaders from a biological point of view through the progress of cognitive neuroscience (Bönte *et al.*, 2016; Lee, 2012).

Finally, from a broad innovation management perspective, this study systematizes the research in the field, allowing current and potential entrepreneurs to access this knowledge and translate it into practice more easily (i.e. *Building process of leadership*). Future developments in research on innovation management may be achieved, with a focus on the role of EL across the innovation process phases (idea generation, selection, development and diffusion).

5.2 Managerial implications

The neuroscience perspective has also practical implications. First, it improves our understanding of how psychological traits influence entrepreneurs' minds handle the exploration–exploitation dilemma that is a crucial issue in the innovation management field (Greve, 2007).

Second, it also enhances our understanding of the antecedents of cognition and motivational factors by showing that these are often influenced by neuroscience factors (Foss and Nicolai, 2016). The neuroscience perspective has some important implications also on the links between the emotional intelligence of leaders and the results of followers, through the innovation process (Antonakis *et al.*, 2009).

Other implications consider the biological perspective to examine the role of hormones in entrepreneurial decisions. Indeed, through the measurement of cortisol and functional magnetic resonance imaging, some authors analyze how the interactions of explicit and implicit processes is linked to modeling emotions, attitudes, and behaviors. This line of research would also have the potential to answer various enquiries in the opportunity recognition among academic entrepreneurs and innovation managers, to exploit new technologies and generate innovation from their research results.

Finally, neuroscience has several implications also on social and political science. Indeed, new styles of thinking based on neuroscience create different behaviors in the social context (Rose and Rached, 2013). From a political point of view, neuroscience can help to understand how neurobiological concepts can be used to build and support a particular imaginary of citizenship in pushing inventions across the innovation process (Broer and Pickersgill, 2015).

5.3 Future research directions

The research in this area is still puzzling. Neuroscience combines physiology, anatomy, molecular biology, developmental biology, cytology, mathematical modeling, and psychology to understand the fundamental and emergent properties of neurons and neural circuits. The understanding of the biological basis of learning, memory, behavior, perception, and consciousness, coherently with Kandel *et al.* (2012) affects all aspects of our behavior,

including our work. By ignoring our neuroscience aspects, management researchers are missing an important part of the explanation for managerial and entrepreneurial behaviors.

Scholars will need to address these issues in their study designs to encourage empirical researches able to improve the understanding of the neuroscience influences on entrepreneurial forward. This review has systematically provided a summary of what has been achieved in this area of research and has offered several directions to take the field forward. This area of research proposes several challenges: the challenges of conducting interdisciplinary research, the challenges to propose experimental researchers in the field of management and entrepreneurship, the challenge to propose specific researchers in the field of entrepreneurship, by using the different lenses of neuroscience (e.g. physiology, anatomy, molecular biology).

On this perspective, driven by the goal of responding to our RQ2 (i.e. *What are/should be the theoretical foci for the current/future literature on EL, within the management field?*), our review suggests several areas for future research.

First, more *explanatory factors* and more *outcome variables* should be examined empirically. The review shows that research in this area is characterized mainly by theoretical studies with limited empirical evidence. It is time to extend this area of research by proposing more empirical investigations, especially in the field of innovation management.

Second, in entrepreneurship, employing a *biological viewpoint*, is needed also to examine topics such as motivation (Krueger, 2007; Sarasvathy, 2004), entrepreneurial intention (Hayton and Cholakova, 2012; Lerner *et al.*, 2020; More *et al.*, 2019), entrepreneurs' thinking styles, skills, and goal commitment (Bönte *et al.*, 2016), innovation management and exploitation of technologies (Greve, 2007).

Third, it is doubtful that much entrepreneurial behavior is explained exclusively by human neuroscience. Most entrepreneurial actions are generated also by the interaction of human neuroscience variables and other exogenous factors (e.g. ecosystem); thus, further research should empirically explore how *exogenous and neuroscience variables interact*, to influence entrepreneurial behaviors.

Lastly, along with the individual level of analysis, additional research should also consider neuroscience techniques into the study of *entrepreneurial teams and innovation development teams*. Researchers are encouraged to use neuroscience techniques, such as qEEG, to examine the relations among entrepreneurs, such as their interpersonal conflicts and negative/positive affect (Waldman *et al.*, 2017).

Nevertheless, limitations are taken into our study. The study covered a broad scope of literature with a neuroscience approach based on a specific search query. However, including additional keywords in a search query may help build a more comprehensive dataset, thus providing additional empirical insights. Nevertheless, a small literature now shows that brain function is associated with entrepreneurial behavior, as demonstrated by neuroscience studies in leadership, decision making, entrepreneurship.

References

Afsar, B. and Umrani, W.A. (2020), "Transformational leadership and innovative work behavior: the role of motivation to learn, task complexity and innovation climate", *European Journal of Innovation Management*, Vol. 23 No. 3, pp. 402-428, doi: 10.1108/EJIM-12-2018-0257.

Akbari, M., Bagheri, A., Imani, S. and Asadnezhad, M. (2020a), "Does entrepreneurial leadership encourage innovation work behavior? The mediating role of creative self-efficacy and support for innovation", *European Journal of Innovation Management*, Vol. 24 No. 1, pp. 1-22.

Akbari, M., Khodayari, M., Khaleghi, A., Danesh, M. and Padash, H. (2020b), "Technological innovation research in the last six decades: a bibliometric analysis", *European Journal of Innovation Management*, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/EJIM-05-2020-0166.

Alblooshi, M., Shamsuzzaman, M. and Haridy, S. (2020), "The relationship between leadership styles and organisational innovation: a systematic literature review and narrative synthesis", *European Journal of Innovation Management*, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/EJIM-11-2019-0339.

Antonakis, J., Ashkanasy, N.M. and Dasborough, M.T. (2009), "Does leadership need emotional intelligence?", *The Leadership Quarterly*, Vol. 20 No. 2, pp. 247-261.

Aria, M. and Cuccurullo, C. (2017), "Bibliometrix: an R-tool for comprehensive science mapping analysis", *Journal of Informetrics*, Vol. 11 No. 4, pp. 959-975.

Ashkanasy, N.M. (2013), "Neuroscience and leadership: take care not to throw the baby out with the bathwater", *Journal of Management Inquiry*, Vol. 22 No. 3, pp. 311-313.

Ashkanasy, N.M., Becker, W.J. and Waldman, D.A. (2014), "Neuroscience and organizational behavior: avoiding both neuro-euphoria and neuro-phobia", *Journal of Organizational Behavior*, Vol. 35 No. 7, pp. 909-919.

Aston-Jones, G. and Cohen, J.D. (2005), "An integrative theory of locus coeruleus-norepinephrine function: adaptive gain and optimal performance", *Annual Review of Neuroscience.*, Vol. 28, pp. 403-450.

Bagheri, A. (2017), "The impact of entrepreneurial leadership on innovation work behavior and opportunity recognition in high-technology SMEs", *The Journal of High Technology Management Research*, Elsevier, Vol. 28 No. 2, pp. 159-166, doi: 10.1016/j.hitech.2017.10.003.

Bagheri, A. and Akbari, M. (2018), "The impact of entrepreneurial leadership on nurses' innovation behavior", *Journal of Nursing Scholarship*, John Wiley and Sons, Vol. 50 No. 1, pp. 28-35, doi: 10.1111/jnu.12354.

Bagheri, A., Akbari, M. and Artang, A. (2020), "How does entrepreneurial leadership affect innovation work behavior? The mediating role of individual and team creativity self-efficacy", *European Journal of Innovation Management*, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/EJIM-07-2020-0281.

Bagheri, A. and Harrison, C. (2020), "Entrepreneurial leadership measurement: a multi-dimensional construct", *Journal of Small Business and Enterprise Development*, Vol. 27 No. 4, 2020, pp. 659-679.

Balthazard, P.A., Waldman, D.A., Thatcher, R.W. and Hannah, S.T. (2012), "Differentiating transformational and non-transformational leaders on the basis of neurological imaging", *The Leadership Quarterly*, Vol. 23 No. 2, pp. 244-258.

Baron, R.A. and Ensley, M.D. (2006), "Opportunity recognition as the detection of meaningful patterns: evidence from comparisons of novice and experienced entrepreneurs", *Management Science*, Vol. 52 No. 9, pp. 1331-1344.

Bechara, A. and Damasio, A.R. (2005), "The somatic marker hypothesis: a neural theory of economic decision", *Games and Economic Behavior*, Vol. 52 No. 2, pp. 336-372.

Bechara, A., Damasio, H., Tranel, D. and Damasio, A.R. (1997), "Deciding advantageously before knowing the advantageous strategy", *Science*, Vol. 275 No. 5304, pp. 1293-1295.

Becker, W.J. and Cropanzano, R. (2010), "Organizational neuroscience: the promise and prospects of an emerging discipline", *Journal of Organizational Behavior*, Vol. 31 No. 7, pp. 1055-1059.

Becker, W.J. and Menges, J.I. (2013), "Biological implicit measures in HRM and OB: a question of how not if", *Human Resource Management Review*, Vol. 23 No. 3, pp. 219-228.

Becker, W.J., Cropanzano, R. and Sanfey, A.G. (2011), "Organizational neuroscience: taking organizational theory inside the neural black box", *Journal of Management*, Vol. 37 No. 4, pp. 933-961.

Bennet, D. and Bennet, A. (2008), "Engaging tacit knowledge in support of organizational learning", *VINE: The Journal of Information and Knowledge Management Systems*, Vol. 38 No. 4, pp. 255-260.

Beugré, C.D. (2009), "Exploring the neural basis of fairness: a model of neuro-organizational justice", *Organizational Behavior and Human Decision Processes*, Vol. 110 No. 2, pp. 129-139.

Birkinshaw, J., Hamel, G. and Mol, M.J. (2008), "Management innovation", *Academy of Management Review*, Vol. 33 No. 4, pp. 825-845.

Bönte, W., Procher, V.D. and Urbig, D. (2016), "Biology and selection into entrepreneurship – the relevance of prenatal testosterone exposure", *Entrepreneurship Theory and Practice*, Vol. 40 No. 5, pp. 1121-1148, doi: 10.1111/etap.12165.

Bowers, K.S., Regehr, G., Balthazard, C. and Parker, K. (1990), "Intuition in the context of discovery", *Cognitive Psychology*, Vol. 22 No. 1, pp. 72-110.

Boyatzis, R.E., Smith, M.L. and Blaize, N. (2006), "Developing sustainable leaders through coaching and compassion", *Academy of Management Learning and Education*, Vol. 5 No. 1, pp. 8-24.

Boyatzis, R.E., Passarelli, A.M., Koenig, K., Lowe, M., Mathew, B., Stoller, J.K. and Phillips, M. (2012), "Examination of the neural substrates activated in memories of experiences with resonant and dissonant leaders", *The Leadership Quarterly*, Vol. 23 No. 2, pp. 259-272.

Broer, T. and Pickersgill, M. (2015), "Targeting brains, producing responsibilities: the use of neuroscience within British social policy", *Social Science and Medicine*, Vol. 132, p. 54.

Butler, M.J. and Senior, C. (2007), "Toward an organizational cognitive neuroscience", *Annals of the New York Academy of Sciences*, Vol. 1118 No. 1, pp. 1-17.

Butler, M.J., O'Broin, H.L., Lee, N. and Senior, C. (2016), "How organizational cognitive neuroscience can deepen understanding of managerial decision-making: a review of the recent literature and future directions", *International Journal of Management Reviews*, Vol. 18 No. 4, pp. 542-559.

Cacioppo, J.T., Berntson, G.G. and Nusbaum, H.C. (2008), "Neuroimaging is a new tool in the toolbox of psychological science", *Current Directions in Psychological Science*, Vol. 17 No. 2, pp. 62-67.

Camerer, C., Loewenstein, G. and Prelec, D. (2005), "Neuroeconomics: how neuroscience can inform economics", *Journal of Economic Literature*, Vol. 43 No. 1, pp. 9-64.

Cavallone, M. and Palumbo, R. (2020), "Debunking the myth of industry 4.0 in health care: insights from a systematic literature review", *The TQM Journal*, Vol. 32 No. 4, pp. 849-868.

Cohen, J.D. (2005), "The vulcanization of the human brain: a neural perspective on interactions between cognition and emotion", *Journal of Economic Perspectives*, Vol. 19 No. 4, pp. 3-24.

Cropanzano, R. and Becker, W.J. (2013), "The promise and peril of organizational neuroscience: today and tomorrow", *Journal of Management Inquiry*, Vol. 22 No. 3, pp. 306-310.

Crossan, M.M. and Apaydin, M. (2010), "A multi-dimensional framework of organizational innovation: a systematic review of the literature", *Journal of Management Studies*, Vol. 47 No. 6, pp. 1154-1191.

Dane, E. and Pratt, M.G. (2007), "Exploring intuition and its role in managerial decision making", *Academy of Management Review*, Vol. 32 No. 1, pp. 33-54.

de Holan, P.M. (2014), "It's all in your head: why we need neuroentrepreneurship", *Journal of Management Inquiry*, Vol. 23 No. 1, pp. 93-97.

Di Stefano, G., Peteraf, M. and Verona, G. (2010), "Dynamic capabilities deconstructed: a bibliographic investigation into the origins, development, and future directions of the research domain", *Industrial and Corporate Change*, Vol. 19 No. 4, pp. 1187-1204.

Elenkov, D.S., Judge, W. and Wright, P. (2005), "Strategic leadership and executive innovation influence: an international multi-cluster comparative study", *Strategic Management Journal*, Vol. 26 No. 7, pp. 665-682.

Eom, S.B. (2009), *Author Cocitation Analysis: Quantitative Methods for Mapping the Intellectual Structure of an Academic Discipline*, Information Science, Hershey, Pennsylvania.

Ericsson, K.A. and Charness, N. (1994), "Expert performance: its structure and acquisition", *American Psychologist*, Vol. 49 No. 8, pp. 725-747.

Farah, M.J. (2005), "Neuroethics: the practical and the philosophical", *Trends in Cognitive Sciences*, Vol. 9 No. 1, pp. 34-40.

Ferreira, F.A. (2018), "Mapping the field of arts-based management: bibliographic coupling and co-citation analyses", *Journal of Business Research*, Vol. 85, pp. 348-357.

Fontana, A. and Musa, S. (2017), "The impact of entrepreneurial leadership on innovation management and its measurement validation", *International Journal of Innovation Science*, Vol. 9 No. 1, pp. 2-19.

Foo, M.-D. (2011), "Emotions and entrepreneurial opportunity evaluation", *Entrepreneurship Theory and Practice*, Vol. 35 No. 2, pp. 375-393.

Foss, N.J. and Pedersen, T. (2016), "Microfoundations in strategy research", *Strategic Management Journal*, Vol. 37 No. 13, pp. 22-34.

Glänzel, W. and Czerwon, H.J. (1996), "A new methodological approach to bibliographic coupling and its application to the national, regional and institutional level", *Scientometrics*, Vol. 37 No. 2, pp. 195-221.

Gómez, I., Sanz, E. and Méndez, A. (1990), "Utility of bibliometric analysis for research policy: a case study of Spanish research in neuroscience", *Research Policy*, Vol. 19 No. 5, pp. 457-466.

Greve, H.R. (2007), "Exploration and exploitation in product innovation", *Industrial and Corporate Change*, Vol. 16 No. 5, pp. 945-975.

Hambrick, D.C. and Mason, P.A. (1984), "Upper echelons: the organization as a reflection of its top managers", *Academy of Management Review*, Vol. 9 No. 2, pp. 193-206.

Hamel, G. (2006), "The why, what, and how of management innovation", *Harvard Business Review*, Vol. 84 No. 2, p. 72.

Harrison, R.T., Leitch, C.M. and McAdam, M. (2018), "Breaking glass: towards a gendered analysis of entrepreneurial leadership", *Journal of Small Business Management*, Vol. 53 No. 3, pp. 693-713.

Hayton, J.C. and Cholakova, M. (2012), "The role of affect in the creation and intentional pursuit of entrepreneurial ideas", *Entrepreneurship Theory and Practice*, Vol. 36 No. 1, pp. 41-67.

Healey, M.P. and Hodgkinson, G.P. (2014), "Rethinking the philosophical and theoretical foundations of organizational neuroscience: a critical realist alternative", *Human Relations*, Vol. 67 No. 7, pp. 765-792.

Hikkerova, L., Ilouga, S.N. and Sahut, J.M. (2016), "The entrepreneurship process and the model of volition", *Journal of Business Research*, Vol. 69 No. 5, pp. 1868-1873.

Hodgkinson, G.P. and Healey, M.P. (2011), "Psychological foundations of dynamic capabilities: reflexion and reflection in strategic management", *Strategic Management Journal*, Vol. 32 No. 13, pp. 1500-1516.

Hodgkinson, G.P. and Healey, M.P. (2014), "Coming in from the cold: the psychological foundations of radical innovation revisited", *Industrial Marketing Management*, Vol. 43 No. 8, pp. 1306-1313.

Hodgkinson, G.P. and Sparrow, P.R. (2002), *The Competent Organization: A Psychological Analysis of the Strategic Management Process*, Open University Press, Maidenhead.

Hodgkinson, G.P., Sadler-Smith, E., Burke, L.A., Claxton, G. and Sparrow, P.R. (2009), "Intuition in organizations: implications for strategic management", *Long Range Planning*, Vol. 42 No. 3, pp. 277-297.

Hubert, M. and Kenning, P. (2008), "A current overview of consumer neuroscience", *Journal of Consumer Behaviour: An International Research Review*, Vol. 7 Nos 4-5, pp. 272-292.

Iqbal, A., Nazir, T. and Ahmad, M.S. (2020), "Entrepreneurial leadership and employee innovative behavior: an examination through multiple theoretical lenses", *European Journal of Innovation Management*, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/EJIM-06-2020-0212.

Johnson, W. (2009), "So what or so everything? Bringing behavior genetics to entrepreneurship research", *Journal of Business Venturing*, Vol. 24, pp. 23-26.

Kahneman, D. and Klein, G. (2009), "Conditions for intuitive expertise: a failure to disagree", *American Psychologist*, Vol. 64 No. 6, p. 515.

Kandel, E., Schwartz, J., Jessell, T., Siegelbaum, S. and Hudspeth, A.J. (2012), *Principles of Neural Science*, 5th ed., McGraw-Hill Education, New York.

Kandel, E.R. and Squire, L.R. (2001), "Breaking down scientific barriers to the study of brain and mind", *Annals of the New York Academy of Sciences*, Vol. 935, pp. 118-135.

Kenning, P., Plassmann, H. and Ahlert, D. (2007), "Applications of functional magnetic resonance imaging for market research", *Qualitative Market Research: An International Journal*, Vol. 10 No. 2, pp. 135-152.

Kessler, M.M. (1963), "Bibliographic coupling extended in time: ten case histories", *Information Storage and Retrieval*, Vol. 1 No. 4, pp. 169-187.

Knutson, B., Rick, S., Wimmer, G.E., Prelec, D. and Loewenstein, G. (2007), "Neural predictors of purchases", *Neuron*, Vol. 53 No. 1, pp. 147-156.

Kotter, J.P. (2008), *Force for Change: How Leadership Differs from Management*, Simon and Schuster, New York.

Kremer, H., Villamor, I. and Aguinis, H. (2019), "Innovation leadership: best-practice recommendations for promoting employee creativity, voice, and knowledge sharing", *Business Horizons*, Vol. 62 No. 1, pp. 65-74.

Krueger, N.F., Jr (2007), "What lies beneath? The experiential essence of entrepreneurial thinking", *Entrepreneurship Theory and Practice*, Vol. 31 No. 1, pp. 123-138.

Kumar, V., Chattaraman, V., Neghina, C., Skiera, B., Aksoy, L., Buoye, A. and Henseler, J. (2013), "Data-driven services marketing in a connected world", *Journal of Service Management*, Vol. 24 No. 3, pp. 330-352.

Lampe, J., Kraft, P.S. and Bausch, A. (2019), "Mapping the field of research on entrepreneurial organizations (1937–2016): a bibliometric analysis and research agenda", *Entrepreneurship Theory and Practice*, Vol. 44 No. 4, pp. 784-816.

Landy, F.J. (2005), "Some historical and scientific issues related to research on emotional intelligence", *Journal of Organizational Behavior*, Vol. 26 No. 4, pp. 411-424.

Laureiro-Martínez, D., Brusoni, S. and Zollo, M. (2010), "The neuroscientific foundations of the exploration–exploitation dilemma", *Journal of Neuroscience, Psychology, and Economics*, Vol. 3 No. 2, pp. 95-115.

Lee, N., Senior, C. and Butler, M. (2012), "Leadership research and cognitive neuroscience: the state of this union", *The Leadership Quarterly*, Vol. 23 No. 2, pp. 213-218.

Leitch, C.M. and Volery, T. (2017), "Entrepreneurial leadership: insights and directions", *International Small Business Journal*, Vol. 35 No. 2, pp. 147-156.

Leitch, C.M., McMullan, C. and Harrison, R.T. (2013), "The development of entrepreneurial leadership: the role of human, social and institutional capital", *British Journal of Management*, Vol. 24 No. 3, pp. 347-366.

Lerner, D.A., Alkærsig, L., Fitza, M.A., Lomberg, C. and Johnson, S.K. (2020), "Nothing ventured, nothing gained: parasite infection is associated with entrepreneurial initiation, engagement, and performance", *Entrepreneurship Theory and Practice*, pp. 1-26, doi: 10.1177/1042258719890992.

Lieberman, M.D. (2000), "Intuition: a social cognitive neuroscience approach", *Psychological Bulletin*, Vol. 26 No. 1, p. 109.

Lieberman, M.D. (2007), "Social cognitive neuroscience: a review of core processes", *Annual Review of Psychology*, Vol. 58, pp. 259-289.

Lindebaum, D. (2013), "Pathologizing the healthy but ineffective: some ethical reflections on using neuroscience in leadership research", *Journal of Management Inquiry*, Vol. 22 No. 3, pp. 295-305.

Lindebaum, D. and Jordan, P.J. (2014), "A critique on neuroscientific methodologies in organizational behavior and management studies", *Journal of Organizational Behavior*, Vol. 35 No. 7, pp. 898-908.

Lindebaum, D. and Zundel, M. (2013), "Not quite a revolution: scrutinizing organizational neuroscience in leadership studies", *Human Relations*, Vol. 66 No. 6, pp. 857-877.

Lo, A.W. (2004), "The adaptive markets hypothesis", *The Journal of Portfolio Management 30th Anniversary Issue*, Vol. 30 No. 5, pp. 15-29.

Locke, E.A. (2005), "Why emotional intelligence is an invalid concept", *Journal of Organizational Behavior*, Vol. 26 No. 4, pp. 425-431.

Loewenstein, G., Rick, S. and Cohen, J.D. (2008), "Neuroeconomics", *Annual Reviewer of Psychology*, Vol. 59, pp. 647-672.

Martyn, J. (1964), "Bibliographic coupling", *Journal of Documentation*, Vol. 20 No. 4, p. 236.

Massaro, S., Drover, W., Cerf, M. and Hmieleski, K.M. (2020), "Using functional neuroimaging to advance entrepreneurial cognition research", *Journal of Small Business Management*, pp. 1-29, doi: 10.1080/00472778.2020.1824527.

Mitchell, R., Busenitz, L., Bird, B., Marie Gaglio, C., McMullen, J., Morse, E.A. and Smith, J.B. (2007), "The central question in entrepreneurial cognition research", *Entrepreneurship Theory and Practice*, Vol. 31 No. 1, pp. 1-27.

Mitchell, J., Mitchell, R. and Randolph-Seng, B. (2014), *Handbook of Entrepreneurial Cognition*, Edward Elgar Publishing, Cheltenham.

Moore, C. and Gino, F. (2015), "Approach, ability, aftermath: a psychological process framework of unethical behavior at work", *Academy of Management Annals*, Vol. 9 No. 1, pp. 235-289.

Moore, C.B., McIntyre, N.H. and Lanivich, S.E. (2019), "ADHD-related neurodiversity and the entrepreneurial mindset", *Entrepreneurship Theory and Practice*, Vol. 45 No. 1, pp. 64-91.

Nicolaou, N. and Shane, S. (2009), "Can genetic factor influence the likelihood of engaging in entrepreneurial activity?", *Journal of Business Venturing*, Vol. 24, pp. 1-22.

Nicolaou, N., Patel, P.C. and Wolfe, M.T. (2018), "Testosterone and tendency to engage in self-employment", *Management Science*, Vol. 64 No. 4, pp. 1825-1841.

Nicolaou, N. and Shane, S. (2014), "Biology, neuroscience, and entrepreneurship", *Journal of Management Inquiry*, Vol. 23 No. 1, pp. 98-100.

Nicolaou, N., Shane, S., Adi, G., Mangino, M. and Harris, J. (2011), "A polymorphism associated with entrepreneurship: evidence from dopamine receptor candidate genes", *Small Business Economics*, Vol. 36, pp. 151-155.

Nicolaou, N., Shane, S., Cherkas, L., Hunkin, J. and Spector, T.D. (2008), "Is the tendency to engage in entrepreneurship genetic?", *Management Science*, Vol. 54 No. 1, pp. 167-179.

Nicolaou, N., Shane, S., Cherkas, L. and Spector, T.D. (2009), "Opportunity recognition and the tendency to be an entrepreneur: a bivariate genetics perspective", *Organizational Behavior and Human Decision Processes*, Vol. 110 No. 2, pp. 108-117.

Nofal, A.M., Nicolaou, N., Symeonidou, N. and Shane, S. (2018), "Biology and management: a review, critique, and research agenda", *Journal of Management*, Vol. 44 No. 1, pp. 7-31.

Ochsner, K.N. and Lieberman, M.D. (2001), "The emergence of social cognitive neuroscience", *American Psychologist*, Vol. 56 No. 9, p. 717.

Ortt, J.R. and van der Duin, P.A. (2008), "The evolution of innovation management towards contextual innovation", *European Journal of Innovation Management*, Vol. 11 No. 4, pp. 522-538.

O'Connell (1999), "Modern multidimensional scaling: theory and applications", *Journal of the American Statistical Association*, Vol. 94 No. 445, pp. 338-339.

Patel, P.C. and Fiet, J.O. (2011), "Knowledge combination and the potential advantages of family firms in searching for opportunities", *Entrepreneurship Theory and Practice*, Vol. 35 No. 6, pp. 1179-1197.

Pech, R.J. and Cameron, A. (2006), "An entrepreneurial decision process model describing opportunity recognition", *European Journal of Innovation Management*, Vol. 9 No. 1, pp. 61-78.

Perruci, G. and McManus, R.M. (2012), "The state of leadership studies", *Journal of Leadership Studies*, Vol. 6 No. 3, pp. 49-54.

Peters, T.J. and Waterman, R.H. (1984), "In search of excellence", *Nursing Administration Quarterly*, Vol. 8 No. 3, pp. 85-86.

Pickersgill, M. (2011), "Promising Therapies: neuroscience, clinical practice, and the treatment of psychopathy", *Sociology of Health and Illness*, Vol. 33 No. 3, pp. 448-464.

Poldrack, R.A. (2006), "Can cognitive processes be inferred from neuroimaging data?", *Trends in Cognitive Sciences*, Vol. 10 No. 2, pp. 59-63.

Posner, M.I. and Petersen, S.E. (1990), "The attention system of the human brain", *Annual Review of Neuroscience*, Vol. 13 No. 1, pp. 25-42.

Powell, T.C. (2011), "Neurostrategy", *Strategic Management Journal*, Vol. 32 No. 13, pp. 1484-1499.

Raichle, M.E. and Snyder, A.Z. (2007), "A default mode of brain function: a brief history of an evolving idea", *Neuroimage*, Vol. 37 No. 4, pp. 1083-1090.

Rizzolatti, G. and Craighero, L. (2004), "The mirror-neuron system", *Annual Review of Neuroscience*, Vol. 27, pp. 169-192.

Rose, N. and Abi-Rached, J.M. (2013), *Neuro: The New Brain Sciences and the Management of the Mind*, Princeton University Press, Princeton, New Jersey.

Sarasvathy, S.D. (2004), "Making it happen: beyond theories of the firm to theories of firm design", *Entrepreneurship Theory and Practice*, Vol. 28 No. 6, pp. 519-531.

Schneider, T. and Woolgar, S. (2012), "Technologies of ironic revelation: enacting consumers in neuromarkets", *Consumption Markets and Culture*, Vol. 15 No. 2, pp. 169-189.

Senior, C., Lee, N. and Butler, M. (2011), "Perspective-organizational cognitive neuroscience", *Organization Science*, Vol. 22 No. 3, pp. 804-815.

Shane, S. (2009), "Introduction to the focused issue on the biological basis of business", *Organizational Behavior and Human Decision Processes*, Vol. 110 No. 2, pp. 67-69.

Shane, S. and Venkataraman, S. (2000), "The promise of entrepreneurship as a field of research", *Academy of Management Review*, Vol. 25 No. 1, pp. 217-226.

Shane, S., Nicolaou, N., Cherkas, L. and Spector, T.D. (2010), "Genetics, the big five, and the tendency to be self-employed", *Journal of Applied Psychology*, Vol. 95 No. 6, pp. 1154-1162.

Sjödin, D., Frishammar, J. and Thorgren, S. (2019), "How individuals engage in the absorption of new external knowledge: a process model of absorptive capacity", *Journal of Product Innovation Management*, Vol. 36 No. 3, pp. 356-380.

Small, H. (1973), "Co-citation in the scientific literature: a new measure of the relationship between two documents", *Journal of the American Society for Information Science*, Vol. 24 No. 4, pp. 265-269.

Spring, J. (2012), *Education Networks: Power, Wealth, Cyberspace, and the Digital Mind*, Routledge, New York.

Stead, V. and Hamilton, E. (2018), "Using critical methodologies to examine entrepreneurial leadership", in *Research Handbook on Entrepreneurship and Leadership*, Edward Elgar Publishing, pp. 87-105.

Suominen, A., Seppänen, M. and Dedehayir, O. (2019), "A bibliometric review on innovation systems and ecosystems: a research agenda", *European Journal of Innovation Management*, Vol. 22 No. 2, pp. 335-360.

Teece, D.J., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18 No. 7, pp. 509-533.

Tenzer, H., Terjesen, S. and Harzing, A.W. (2017), "Language in international business: a review and agenda for future research", *Management International Review*, Vol. 57 No. 6, pp. 815-854.

Thornton, D.J. (2011), "Neuroscience, affect, and the entrepreneurialization of motherhood", *Communication and Critical/Cultural Studies*, Vol. 4 No. 8, pp. 399-424.

Van Eck, N.J., Waltman, L., Dekker, R. and Van den Berg, J. (2010), "A comparison of two techniques for bibliometric mapping: multidimensional scaling and VOS", *Journal of the American Society for Information Science and Technology*, Vol. 61 No. 12, pp. 2405-2416.

Volz, K.G. and Von Cramon, D.Y. (2006), "What neuroscience can tell about intuitive processes in the context of perceptual discovery", *Journal of Cognitive Neuroscience*, Vol. 18 No. 12, pp. 2077-2087.

Waldman, D.A., Balthazard, P.A. and Peterson, S.J. (2011a), "Leadership and neuroscience: can we revolutionize the way that inspirational leaders are identified and developed?", *Academy of Management Perspectives*, Vol. 25 No. 1, pp. 60-74.

Waldman, D.A., Balthazard, P.A. and Peterson, S.J. (2011b), "Social cognitive neuroscience and leadership", *The Leadership Quarterly*, Vol. 22 No. 6, pp. 1092-1106.

Waldman, D.A., Siegel, D.S. and Stahl, G.K. (2020), "Defining the socially responsible leader: revisiting issues in responsible leadership", *Journal of Leadership and Organizational Studies*, Vol. 27 No. 1, pp. 5-20.

Waldman, D.A., Wang, D., Hannah, S.T. and Balthazard, P.A. (2017), "A neurological and ideological perspective of ethical leadership", *Academy of Management Journal*, Vol. 60 No. 4, pp. 1285-1306.

Waltman, L., Van Eck, N.J. and Noyons, E.C. (2010), "A unified approach to mapping and clustering of bibliometric networks", *Journal of Informetrics*, Vol. 4 No. 4, pp. 629-635.

Weinberger, E., Wach, D., Stephan, U. and Wegge, J. (2018), "Having a creative day: understanding entrepreneurs' daily idea generation through a recovery lens", *Journal of Business Venturing*, Vol. 33 No. 1, pp. 1-19.

Wernerfelt, N., Rand, D.G., Dreber, A., Montgomery, C. and Malhotra, D.K. (2012), "Arginine vasopressin 1a receptor (AVPR1a) RS3 repeat polymorphism associated with entrepreneurship", available at SSRN 2141598.

Williamson, B. (2016), "Coding the biodigital child: the biopolitics and pedagogic strategies of educational data science", *Pedagogy, Culture and Society*, Vol. 24 No. 3, pp. 401-416.

Wolfe, M.T. and Patel, P.C. (2017), "Two are better than one: cortisol as a contingency in the association between epinephrine and self-employment", *Journal of Business Venturing Insights*, Vol. 8, pp. 78-86.

Yammarino, F.J. (2000), "Leadership skills: introduction and overview", *Leadership Quarterly*, Vol. 11 No. 1, pp. 5-9.

Zajonc, R.B. (1980), "Feeling and thinking: preferences need no inferences", *American Psychologist*, Vol. 35 No. 2, pp. 151-175.

Zhang, Z., Ilies, R. and Arvey, R.D. (2009), "Beyond genetic explanations for leadership: the moderating role of the social environment", *Organizational Behavior and Human Decision Processes*, Vol. 110 No. 2, pp. 118-128.

Zhao, F. (2005), "Exploring the synergy between entrepreneurship and innovation", *International Journal of Entrepreneurial Behavior and Research*, Vol. 11 No. 1, pp. 25-41.

Zuraik, A. and Kelly, L. (2019), "The role of CEO transformational leadership and innovation climate in exploration and exploitation", *European Journal of Innovation Management*, Vol. 22 No. 1, pp. 84-104.

About the authors

Valentina Cucino is a Postdoctoral Scholar at Scuola Superiore Sant'Anna, Pisa, Italy. She got a PhD in Management Innovation, Sustainability and Healthcare at Scuola Superiore Sant'Anna in Pisa. Her main research streams are technology transfer, entrepreneurship and purpose-driven innovation. Valentina Cucino is the corresponding author and can be contacted at: valentina.cucino@santannapisa.it

Mariacarmela Passarelli is an adjunct professor of Management and Technology Transfer at the University of Calabria. She got a PhD in Economics and Management at Sant'Anna School of Advanced Studies (Pisa, Italy) and she was visiting scholar at HAAS Business School (Berkeley). She worked also as an expert for exploitation research activities with international players (AREA Science Park, Ernst and Young and PricewaterhouseCoopers). She is also an expert on European Founds. Her main research streams are technology transfer, innovation in the SMEs and entrepreneurship. She published several articles and papers on international journals and magazines.

Alberto Di Minin is Full Professor of Management at the Institute of Management of the Scuola Superiore Sant'Anna in Pisa. Alberto is also Research Fellow with the Berkeley Roundtable on the International Economy (BRIE), University of California–Berkeley and Social Innovation Fellow with the Meridian International Center of Washington, DC. Alberto deals with Open Innovation, appropriation of innovation and science and technology policy. I also work on technology transfer, intellectual property and R&D management.

Alfio Cariola graduated with honors in Engineering and Ph.D. in Management, is full professor of Economics and Business Management at the University of Calabria. Since 2018 he has been Director of the Department of Business and Legal Sciences and member of the Academic Senate. He is author or coauthor of various books and international and national publications on Business Planning, Financial Valuation of companies and investments (also in Project Financing and for the Public Private Partnership), Corporate Finance, Performance Measurement and Management and Operations Management. He is also speaker in national and international conferences, teacher in Master's and consultant.