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ORIGIN AND DEVELOPMENT OF ENTREPRENEURIAL COGNITION: A UNIVERSITY EMBEDDEDNESS PERSPECTIVE

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EXECUTIVE SUMMARY

To explain what drives entrepreneurial action, a fundamental question of the entrepreneurship research field, the study of individual's cognition has emerged as a promising perspective, as it describes the mental processes through which individuals identify and take decisions about entrepreneurial opportunities. Most of this research has emphasized the consequences of cognition on entrepreneurial action, highlighting that individuals need the proper knowledge and motivation to identify and act upon entrepreneurial opportunities. However, less is known about the mechanisms through which these cognitive dimensions can be developed through individuals' exposure to their social context. This is surprising as entrepreneurship is a socially embedded phenomenon and entrepreneurs are social embedded: literature has acknowledged that elements of the social context in which individuals grow up (e.g., family and early life experiences) and to which individuals are attracted later in life (e.g., workplace, friends, education) play a central role in cultivating and developing their predispositions towards entrepreneurship.

The aim of the present thesis is to address this gap by concentrating on university as social context and its role in nurturing entrepreneurial cognition. University is chosen because it represents a context, which provides opportunities of learning and socialization, as well normative frames that shapes the cognition, aptitudes and beliefs of its members, students and scientists. Specifically, the three missions of university – education, research and commercialization – together concur to the development of its members' entrepreneurial thinking and acting.

The first paper focuses on the university education mission and its effects on students' entrepreneurial knowledge adopting a learning perspective. It illustrates the extent and the circumstances under which students' exposure to different entrepreneurial education offerings produces entrepreneurial learning outcomes.

The second paper focuses on the university research mission and its effects on scientists' success in commercializing innovations adopting an imprinting perspective. It illustrates the mechanisms through which the career imprints – which scientists internalize in the research lab – translate into open innovation behavior by their innovative startups. In turn, open innovation is shown to represent the mediating mechanism that

explain why ventures founded by scientists have an advantage over other innovative startups in the commercialization of new products or services.

The third paper focuses on the university commercialization mission and on how this element of university culture affects the well-being experience of student entrepreneurs. Adopting an identity perspective, it illustrates that the effect of different dimensions of firm performance (e.g., financial, social) on student entrepreneurs' psychological well-being is contingent to the entrepreneurial culture of their university.

On the basis of these studies, the thesis moves towards a process-based framework that illustrates the mechanisms and circumstances under which individuals who select themselves in the university social context develop the cognitive dimensions which, in turn, influence their entrepreneurial actions and outcomes. This framework provides the opportunity to discuss a research agenda and formulate practical implications for entrepreneurs, educators and policy-makers.

1. INTRODUCTION

In the last decade *entrepreneurial cognition* has emerged as a promising perspective to explain entrepreneurial action, described as the identification and exploitation of new business opportunities through venture creation (Omorede et al., 2015). Entrepreneurial cognition is defined as "the knowledge structures that people use to make assessments, judgments, or decisions involving opportunity evaluation, venture creation, and growth" (Mitchell et al., 2002: 97). It comprehends the set of mental processes which support individuals in identifying and act upon new business opportunities (Grégoire et al., 2011). The study of *entrepreneurial cognition* (Mitchell et al., 2007), offers several opportunities to the field of entrepreneurship (Baron, 2004). In particular, it explains that the mental processes leading individuals to identify and act upon opportunities require both knowledge and motivation (McMullen and Shepherd, 2006): on one hand, entrepreneurs need proper information, skills and mental shortcuts to identify and form expectations about opportunities (i.e., knowledge); on the other hand, they also require the proper beliefs, desires and conviction (i.e., motivation) to search and act on those opportunities. To date research has the merit to have conceptualized and tested the consequences of individuals' cognition on entrepreneurial action, but less is known on how individuals develop that cognition (Mitchell et al., 2007; Omorede et al., 2015).

In particular, it is not clear to what extent can individuals prepare their minds for entrepreneurship as they are embedded in social contexts, particularly if the context is not the one of venture creation and development (Cope, 2005). This is surprising as the mental processes and predispositions of individuals approaching entrepreneurship are based on socialization, experiences and education that are offered in a variety of situations and contexts encountered during their lives (Aldrich and Yang, 2014; Grégoire et al., 2011). Entrepreneurship scholars have for long debated "whether eventual entrepreneurs are simply endowed with preferences or innate abilities that prompt them to select entrepreneurship, or whether eventual entrepreneurs experience environmental conditions that prompt or enable entrepreneurship" (Elfenbein et al., 2010: 661), but plenty of evidence has shown that contextual factors do play a role in this regard (e.g., Elfenbein et al., 2010; Kacperczyk, 2013; Kacperczyk and Marx, 2016; Lyons and Zhang, 2018). Indeed, individuals predisposed to entrepreneurship tend to be attracted to these contexts and situations (Özcan and Reichstein, 2009), such that their social embeddedness is not the result of a random process; however research has also acknowledged that

individuals can experience environmental conditions through which they can further cultivate and grow the knowledge and motivation that lead towards entrepreneurship (Elfenbein et al., 2010). As a result, the influence of the context in which individuals are embedded on the development of entrepreneurial mental processes and on its behavioral outcomes represents a central avenue to further advance research on entrepreneurial cognition (Omorede et al., 2015).

The objective of this doctoral dissertation is contributing to such advancement by addressing the following research questions: "What are the elements of the social context individuals can take advantage of to develop entrepreneurial cognition? What are the mechanisms whereby individuals develop entrepreneurial cognition through the embeddedness in their social context? What are the entrepreneurship-related outcomes resulting from such development?"

To do so, *university* is adopted as context in which individuals are socially embedded. University represents an appropriate research setting for studying how entrepreneurship is stimulated (Agarwal and Shah, 2014; Audretsch, 2014). Individuals socially embedded in the university context are subject to different types of influences which can profoundly affect their ways of thinking. University members have access to resources such entrepreneurial and technological knowledge that assist them in identifying and acting upon new business opportunities (Shah and Pahnke, 2014); university also represents a fertile ground for social interactions through which knowledge and motivation towards entrepreneurship are transmitted (Aldrich and Yang, 2014; Kacperczyk, 2013); finally, at university individuals are exposed to normative frames that condition their dispositions towards entrepreneurship (Huyghe and Knockaert, 2015). Additionally, since university in our society has the mandate to mold entrepreneurial individuals, able and motivated to think and act entrepreneurially (Audretsch, 2014), the three missions of university, *teaching*, *research* and *commercialization* are orchestrated to enable its members to develop an entrepreneurial cognition.

Accordingly, the research presented in this dissertation focuses on two types of actors who are embedded at university and whose cognition can evolve in response to the exposure to three missions of university: *students* and *scientists*. From a methodological point of view, the papers of this thesis build on established theories which have been used in entrepreneurship research to conceptualize the mechanisms through which entities evolve through the exposure to contextual influences (Bercovitz and Feldman, 2008; Elfenbein et al., 2010; Huyghe and Knockaert, 2015; Martin et al., 2013). Therefore, a theory-testing, rather

than a theory-building, research approach is employed. Accordingly, papers are quantitative (Shah and Corley, 2006): they develop hypotheses which are tested on survey-based data, which resulted more appropriate to measure the phenomena under investigation.

Concerning the mission of teaching and its influence on students, the first works of this thesis is aimed at illustrating to what extent and under which circumstances university can offer students the knowledge and skills to act entrepreneurially by adopting a *learning* perspective. It explores how the impact of an increasing exposure to entrepreneurship education on students' entrepreneurial knowledge is shaped by students' previous exposure to entrepreneurship, by the type of pedagogy employed and by national entrepreneurial activity.

The second paper presented in this dissertation concerns scientists and how their mindset is imprinted by the research mission. Adopting the theoretical lens of *imprinting* (Marquis and Tilcsik, 2013; Simsek et al., 2015), it illustrates to what extent and under which circumstances the career imprints, which scientists internalize during socialization in the research lab, contribute to the performance of innovative startups. Scientists' involvement in the founding team of innovative startups is shown to affect venture performance to the extent it contributes to firm open innovation. The extent of such contribution is contingent upon the commercial logics adopted by the venture: level of strategic planning and importance of noncommercial goals.

The third and last paper concentrates on the commercialization or "third mission" as element of university culture and its effects on student entrepreneurs. More specifically, the objective of the third paper is to illustrate how the culture manifested in the university social context acts as boundary condition that influences the relationships between different types of student entrepreneurs' attainments and their well-being. In fact, to act entrepreneurially, individuals not only need appropriate capabilities; they also need the predisposition to tolerate poor financial results and to appreciate non-economic reward of business activity (Amit et al., 2001; Schjoedt, 2009; McMullen and Shepherd, 2006; Uy et al., 2013). In this respect university is shown to play an important role. A university culture which emphasizes the third mission and frames entrepreneurship as a mean to commercialize innovation affects the extent to which student entrepreneurs obtain psychological well-being as they use their business to create private wealth rather than value for the market and society. The mechanism underlying this relationship is explained through the theoretical lens of *identity theory*, according to which individuals' well-being depends from the extent to which their behaviors match the ideal self-concept imposed by the social context (Akerlof and Kranton, 2000).

Taken together, the studies of this dissertation make offer the possibility to establish a process-based framework which describes a *university embeddedness* perspective. The framework conceptualizes the elements of the social contexts that support individuals in the development of entrepreneurial cognition as well the mechanisms through which socially embedded individuals cultivate their cognition; the framework also illustrates the outcomes of social embeddedness on entrepreneurial cognition and action as well the boundary conditions that regulate such outcomes. First, it shows that individuals embedded at university can develop entrepreneurial mental processes through the mechanisms of learning, imprinting and social identity. Second, these mechanisms are triggered by the provision of resources in form of knowledge, by career socialization and by institutional frames in form of culture. Third, outcomes are contingent to a variety mirco-, meso- and macro-level contextual factors (e.g., individuals' background, ventures' characteristics, national entrepreneurial activities). In turn, the effects of university on students' and scientists' minds have important consequences on entrepreneurial behavior (e.g., starting a business) and outcomes (e.g., commercialization and psychological well-being). Of course the framework illustrated in this thesis and its description of how the social context supports individuals' in nurturing entrepreneurial cognition is far from exhaustive. For this reason, an agenda is formulated to address the research directions opened by this thesis, with the hope to stimulate further research that increases our understanding on how individuals develop mental process useful for entrepreneurship. Specifically, the process framework is focusing only on the process whereby individuals who chose to embed themselves in a social context are "treated" and stimulated to change their mental processes; future research can integrate this framework by conceptualizing and testing also the mechanisms which lead individuals to embed themselves in contexts where they can further cultivate their cognition.

2. LITERATURE REVIEW

2.1 The study of cognition in the entrepreneurship field

The field of entrepreneurship is fundamentally concerned with understanding the entrepreneurial process, that is understanding how new business opportunities are 'discovered, created, and exploited, by whom, and with what consequences' (Venkatamaran, 1997: 119). Since the entrepreneurial process is undertaken by individuals (McMullen and Shepherd, 2006), the entrepreneur as an individual assumes a central position in entrepreneurship research (Shane, 2001; Shane and Venkatamaran, 2000). To quote Baron (2004: 222) 'trying to understand the entrepreneurial process without considering entrepreneurs is like trying to bake bread without yeast – an essential ingredient that makes the entire process happen is missing'. In appreciating the key role of the individual in the entrepreneurial process, initially researchers have attempted to identify the unique traits that distinguish entrepreneurs from other individuals and drive the outcomes of their action. This *trait* or *personality* approach (Cope, 2005) has been to large extent inconclusive because its findings substantially failed to provide satisfactory answers to the fundamental questions of entrepreneurship on what distinguish entrepreneurs from non-entrepreneurs and successful entrepreneurs from unsuccessful entrepreneurs (Venkatamaran, 1997). This perspective has been heavily criticized by Gartner (1988) and subsequently by Cope (2005). These authors questioned the static nature of the personality approach because its assumptions preclude the possibility for individuals to become entrepreneurs. Moreover, the trait approach was criticized because it somewhat neglected entrepreneurial *action* (i.e., the identification and exploitation of new business opportunities) which represents the essence of entrepreneurship (Shepherd and McMullen, 2006). In response to the limitations of the trait approach scholars began to embrace a *behavioral* approach (Cope, 2005; Omorede et al., 2015), according to which research should move from asking *who* entrepreneurs are to concentrating on *what* entrepreneurs do (Gartner, 1988). In illustrating how entrepreneurial action proceeds from individuals' minds, the *cognitive* perspective can complement these efforts to understand how individuals act entrepreneurially and thus be highly useful to the field of entrepreneurship. In fact, the search for new business opportunities and whether, how and with which results these opportunities are exploited are influenced by individuals' mental processes (Shepherd and McMullen, 2006; Venkatamaran, 1997). By emphasizing the attention on how individuals think entrepreneurially (Mitchell et al., 2007), the cognitive perspective can help

scholars to find answers to three basic questions which are of central importance in the entrepreneurship research field (Baron, 2004: 223): (i) 'Why do some persons but not others choose to become entrepreneurs?'; (ii) 'Why do some persons but not others recognize opportunities for new products or services that can be profitably exploited?'; and (3) 'Why are some entrepreneurs so much more successful than others?'.

2.2 A review and research agenda of the cognitive perspective in the field of entrepreneurship

In the entrepreneurship field, research on cognition concentrates on all psychological processes through which individuals search, identify, evaluate and decide to exploit new business opportunities by creating and growing new ventures (Omorede et al., 2015). Central to the cognitive perspective is the belief that these psychological processes describe the knowledge- and motivation-related factors at the basis of entrepreneurial intentions, actions and success (McMullen and Shepherd, 2006; Omorede et al., 2015). In particular, two sets of *cognitive factors* have been conceptualized as key drivers of human action (Grégoire et al., 2011). A first set of cognitive factors is described by individuals' *cognitive resources* such desires, 'skills, abilities, and other predispositions that proceed from one's lifetime of learning and experiences' (Grégoire et al., 2011: 1448). For example, how individuals approach the entrepreneurial tasks are influenced by habits. Habits represent 'dispositions to act in particular ways under certain conditions' and are developed over a lifetime (Aldrich and Yang, 2014: 62). They condition how entrepreneurs respond to the challenges encountered in creating and organizing ventures. Indeed, these tasks are characterized by high degrees of uncertainty and complexity and individuals tend to face such challenges drawing on habitual ways of responding in a sort of automatic fashion dictated by previous life experiences (Aldrich and Yang, 2014).

A second set of cognitive factors comprehends individuals' *mental representations*, which are those human mind's processes that relate to one's immediate circumstances (Grégoire et al., 2011). These describe how individuals perceive, interpret and feel about the particular moment and context in which action takes place. Even though individuals often rely on habits and are constrained by their life experiences, they still have many opportunities to make conscious choices about immediate circumstances. How choices are made can be explained thanks to heuristics: these describe the mental shortcuts used by individuals who are forced to make

key decisions in conditions of uncertainty (Aldrich and Yang, 2014). In such circumstances they tend not to use all available information to make decisions, but might rely on overconfidence in their abilities, knowledge and beliefs.

Guided by the assumption that cognitive factors drive action, to date research rooted in the cognitive perspective has illustrated the consequences of cognition on the entrepreneurial process (Mitchell et al., 2007). Entrepreneurs are alert to opportunities and decide to act upon them after evaluation. To do so they are guided essentially by motivation- and knowledge-related cognitive factors (Venkatamaran, 1997; McMullen and Shepherd 2006). Within the process of opportunity identification entrepreneurs are motivated and willing to search for opportunities; they also need knowledge, information and cognitive frames to identify them. The identification of opportunities, in the first place, involves motivation and predisposition to search and discover new opportunities (McMullen and Shepherd, 2006). It also requires prior information that allows to be alert and recognize potential opportunities and frameworks through which informational cues are connected (Busenitz and Arthurs, 2007; Mitchell et al., 2007). After identifying an opportunity, entrepreneurs must be able to assess what to do in order to act upon them. In this process they can take advantage of mental shortcuts and other cognitive resources. Often the evaluation of opportunities is guided by heuristic-based logics and cognitive biases, such illusion of control, planning fallacy and avoidance of sunk costs (Mitchell et al., 2007). Entrepreneurs must be also willing and motivated to face the uncertainty associated to opportunity exploitation. For example, through an effectuation approach, entrepreneurs quit to predict the future and rather attempt to control the situation as the venture creation process unfolds (Sarasvathy, 2001).

Research like this builds on the idea that individuals act entrepreneurially because they think "differently" and are endowed with unique knowledge and motivation. As a results, entrepreneurship scholars have adopted a cognitive perspective to uncover the distinctive characteristics and processes of the entrepreneurial mind. However, while most of this literature has focused on the consequences of certain cognitive resources and mental representations on entrepreneurial action, less research has studied the antecedents of entrepreneurial cognition (Grégoire et al., 2011; Mitchell et al., 2007; Omorede et al., 2015). In other words, while we know extensively how individuals' mental processes lead to entrepreneurship, less is known about the mechanisms and circumstances through which these cognitive factors are acquired and developed by individuals.

This is surprising as the cognitive resources required to act entrepreneurially are not conceptualized as static traits (Aldrich and Yang, 2014; Cope, 2005). By contrast, since Gartner's seminal article in 1988 one key question arising from the attention on entrepreneurial action concerns individuals' acquisition of the predispositions and skills to act entrepreneurially. In fact, knowledge and motivation are thought not to be innate, but can be acquired in relation to the context in which individuals are embedded. In order to affect entrepreneurial cognition, the context does not necessarily need to be the entrepreneurial context of venture creation and development (Mitchell et al., 2007). For example, there are contexts (e.g., hobbies, workplace, family, cf. Mathias et al., 2015) that stimulate the motivation to search for new business opportunities, thereby affecting the cognition of individuals before they discover opportunities and actually become nascent entrepreneurs.

Indeed, individuals can develop cognitive resources that prepare them to the entrepreneurial process before actually engaging in the venture creation process (Aldrich and Yang, 2014). This process of development has both a personal and a social dimension and unfolds over the entire life of the individuals since its early stages (Cope, 2005). In his seminal article Cope described it as 'anticipatory socialization', defined as 'the collective prior experiences and learning that prepares an individual for an entrepreneurial career and shapes the individual's attitudes, beliefs and abilities' (Cope, 2005: 378). In a similar vein Aldrich and Yang (2014) argued that individuals develop the predispositions, mental processes and knowledge to act entrepreneurially through a life-long learning process that proceeds from family in childhood and adolescence and later involves education and work experiences (Harvey and Evans, 1995). Engaging in socialization with parents, friends, teachers, and colleagues, individuals acquire, learn and develop cognitive factors, such habits and heuristics (Aldrich and Yang, 2014). Even though these are not acquired in an entrepreneurial context of doing business, some of them may prepare individuals as they engage into entrepreneurship (Cope, 2005).

The role played by the context in the development of entrepreneurial cognition has been explicitly recognized in recent reviews on research about cognition in entrepreneurship (cf. Grégoire et al., 2011; Mitchell et al., 2007; Omorede et al., 2015). In particular, scholars have been recommended to have the context in which individuals are embedded more tightly interwoven in research. This would allow to 'pay attention not only to the consequences of relevant cognitive variables, but also to the *origins and development* of such variables […]' (Grègoire et al., 2011: 1456). For example, Grégoire et al. (2011: 1462), in delineating future

research directions, propose to study how one's unique family, educational background or social institutions influence the development the acquisition and development of 'cognitive aptitude, abilities, knowledge or representations that appear to aid individuals, teams, firms, and/or societies in their entrepreneurial endeavours'. In particular, one central question concerns what and how individuals can learn and acquire cognitive resources that prepare them to entrepreneurship through socialization that occurs outside the entrepreneurial context of venture creation and development (Cope, 2005).

Addressing this question is important not only for theoretically advancing the research field of entrepreneurial cognition and, more in general, entrepreneurship. It is also relevant for society. As noted by Aldrich and Yang (2014: 76) 'while the celebration of entrepreneurship produces a large number of startups, cultural codes embedded in social institutions don't give nascent entrepreneurs very much on which to base their actions'. Therefore, it is fundamental importance to understand how the social context in which individuals are embedded affects the cognitive factors that prepare them to entrepreneurship.

This represents the objective of this thesis, which, as explained in the following paragraph, focuses on university as key context that influence entrepreneurial cognition.

2.3 University: a social context for entrepreneurial cognition

University in the last decades has undergone profound changes that have transformed it into an institution of fundamental importance to entrepreneurship (Audretsch, 2014). There is no doubt that university is pervasive to entrepreneurial activities in our society, as demonstrated by some evident facts: university represents a source of new technologies and innovations commercialized by new ventures (Agarwal and Shah, 2014; Shah and Pahnke, 2014); university provides infrastructures and resources that support technology transfer in the form of new businesses (Rothaermel et al., 2007; Saeed et al., 2015); firms started by university students and graduated or, to a lower extent, by academic scientists have a meaningful impact on national economies and innovation systems (Åstebro et al., 2012; Wennberg et al., 2011; Wright et al., 2017). Not surprisingly, the research field of university-based entrepreneurship has exponentially grown in the last decade (Bergmann et al., 2016; Schmitz et al., 2017; Wright et al., 2017).

The decision of concentrating the attention of this thesis on the development of entrepreneurial cognition in the *university* context is driven by its practical and theoretical relevance. From a theoretical point

university embeds a culture through which normative and cognitive structures are transmitted to its members (Huyghe and Knockaert, 2015), thereby affecting how they think and make decisions. In fact, organizational members tend to conform to organizational culture regarding entrepreneurship in a university context (Friedman and Silberman, 2003). Moreover, university embeds those critical learning experiences through which individuals acquire the knowledge, skills, values, frames of reference that prepare towards entrepreneurship: socialization, education, work experiences and start-up phases (Aldrich and Yang, 2014; Kacperczyk, 2013). The socialization with entrepreneurially-inclined peers represents a source of interpersonal influence through which entrepreneurial motivations, norms, knowledge and information can be transmitted and internalized (Kacperczyk, 2013) both for students (Falck et al., 2012) and for scientists (Aschhoff and Grimpe, 2014). For example, the presence of entrepreneurial role models legitimizes entrepreneurship within the university and increases its desirability (Bergmann et al., 2016; Huyghe and Knockaert, 2015). In addition, university represents an educational institution which in the last years has been progressively incorporated the mandate of helping students to build the unique knowledge, traits, skills and values that characterize an entrepreneurial mindset (Neck and Greene, 2011; Mustar, 2009; Kuratko, 2005), emphasizing entrepreneurship as a way of thinking and behaving (Leitch et al., 2012; Kirby and Ibrahim, 2011). Besides providing learning experiences in form of educational offerings, university constitutes also a work environment for scientists which, as they acquire experiences and socialize within the research lab, develop unique motivations, values and cognitive frames that condition their actions as they engage into entrepreneurship (Aschhoff and Grimpe, 2014; Colombo and Piva, 2012; Jain et al., 2009; Lam, 2011). Finally, university embeds the early stages of ventures founded by students (Nielsen et al., 2015; Wright et al., 2017) and scientists (Rasmussen, 2011). Balancing a dual status, as entrepreneur and as member of university, represents a potential source of tensions at the individual level (Ambos et al., 2008) which might induce profound self-reflection and changes in the mind-set, self-conception and dispositions that guide entrepreneurial action (Jain et al., 2009; Nielsen et al., 2015).

From a practical point of view, university has always been seen as one of the main stakeholders of entrepreneurship research (Venkatamaran, 1997). A better understanding of the fundamental questions of entrepreneurship presents huge potential in helping universities to form entrepreneurial individuals. Indeed, university represents in our society the institution with the mandate to foster 'entrepreneurship capital'

(Audretsch, 2014), that is preparing individuals to think and act entrepreneurially. Historically, in western countries the role of university has progressively incorporated entrepreneurship within the scope of its mission, as explained by Audretsch (2014). After the second world war, the Humboldt model, which emphasized the creation of 'knowledge for its own sake' evolved and university became an important source of economic knowledge, that generated practical applications. Subsequently, to ensure that the knowledge generated at university would be commercialized and drive economic growth, university added to the traditional missions of teaching and research a "third mission", concerned with the transfer of technology, for example through licensing of patents and creation of startups. However, in our society where entrepreneurship represents a driving force of economic growth, the mandate of university cannot be limited to commercialization of university research and generating new ventures; university should also provide its members a fertile environment for developing entrepreneurial thinking (Audretsch, 2014). To this aim, even those parts of universities that are not directly engaged into commercialization cannot remain alienated to this mission and should rather participate to the promotion of entrepreneurship capital.

2.4 Summary of Contributions and Research Design

In order to generate an environment that helps its members to internalize entrepreneurial thinking, universities are required to connect *teaching*, *research* and *commercialization* functions (Urbano and Guerreo, 2013). There are different theoretical perspectives that entrepreneurship research has adopted to explain how contextual factors influence entrepreneurship. These can be applied also to conceptualize the mechanisms whereby individuals socially embedded within the university context evolve in response to the exposure to the three missions.

First, the context can provide individuals with *resources* that facilitate entrepreneurial action, for example in form of information about unexploited opportunities (Elfenbein et al., 2010; Kacperczyk, 2013). Literature offers several examples that illustrate how university can provide to its members technological and entrepreneurial knowledge to identify and act upon new business opportunities (Powers and McDougall, 2005; Shah and Pahnke, 2014; Saeed et al., 2015). In this respect the *teaching mission* plays a key role, because education can offer to students the entrepreneurial knowledge and the motivation that allows them to act entrepreneurially (Shah and Pahnke, 2014; Souitaris et al., 2007).

Second, the context represents an opportunity to build *social relationships* through which individuals develop a mindset that leads them to identifying and acting upon new business opportunities (Cirillo et al., 2014; Giannetti and Simonov, 2009; Falck et al., 2012). The social relationships established between university members, in particular, enable the exchange of information and the transmission of norms that facilitate entrepreneurial action (Kacperczyk, 2013). For example, scientists who are involved in the *research mission* during their career build a network of relationship that constitutes an "invisible college" (Murray, 2004). This enables not only an exchange of valuable information and technical as well scientific knowledge (Luo et al., 2009). It also imprints scientists with a unique mindset that conditions their entrepreneurial behaviors (Aschhoff and Grimpe, 2014; Bercovitz and Feldman, 2008; Colombo and Piva, 2012; Jain et al., 2009).

Third, the context can act as an *institution* that imposes norms which to its members have to conform (Dokko et al., 2009). University, in particular, imposes norms that condition members' motivation and predisposition to engage into commercial endeavors (Ambos et al., 2008; Bercovitz and Feldman, 2008; Ensley and Hmieleski, 2005). For example, scientists who strictly adhered to Mertonian norms of science which have dominated the academic community for many years appear often reluctant to engage with industry and be involved in entrepreneurial behaviors (Jain et al., 2009; Lam, 2011). On the other hand, when the university culture shows appreciation for the *commercialization mission*, university members tend to perceive institutional norms as favorable towards entrepreneurship (Huyghe and Knockaert, 2015). As a result, they are more likely to develop the motivation and knowledge required to act entrepreneurially (Franke and Lüthje, 2004).

Starting from the premise that the three university missions together allow its members' cognition to evolve, the papers of this thesis concentrate on how university members can take advantage of these three different missions of university to develop and cultivate entrepreneurial cognition. More specifically, as anticipated above, the thesis considers two types of university members whose cognition can evolve through exposure to higher education institutions: *students* and *scientists*. Both represents key actors in the technology transfer process through which knowledge generated at university can be commercialized and disseminated: when they found a venture they can bring on the market new technologies and innovations developed in the scientific labs university (Shah and Pahnke, 2014).

Table 2.1 illustrates how the papers of this thesis are organized. The rows describe the mission of university on which each papers focuses. The columns describe the actors which are at the center of each paper. It should be noted that, since the three missions in entrepreneurial universities are tightly interconnected and together are aimed to develop the entrepreneurial capabilities of its members (Audretsch, 2014), it is hard to completely exclude from each paper the other two missions. For example, the second paper is focused on the research mission as socialization context that imprints scientist founders. On the other hand, it studies also the consequence of such imprint on scientists' firms, which represent a manifestation of the third mission. Additionally, it is not claim of this thesis that there is no literature that has already addressed research questions that could be located in the boxes of Table 2.1. However, as illustrated more in detail in each paper, the pieces of research here presented tackle some relevant and still persisting literature gaps. In doing so they contribute to advance the knowledge about the effect of the three missions on the development of entrepreneurial cognition by student and scientists.

Table 2.1 Summary of the papers in the thesis

	Students	Scientists
Teaching	'Entrepreneurial learning at universities: exploring multilevel contingencies'	
Research		'From the lab to entrepreneurship: how imprinting of scientists affects the open innovation and performance of innovative startups'
Commercialization	'How the value created by student entrepreneurs affects their psychological well-being: a social identity perspective'	

The research methodology adopted for the papers is based on theory testing rather than theory building. As suggested above, the entrepreneurship research can already benefit from several theories that have the potential to explain the theoretical mechanisms whereby the context exercises its influence on individuals and affects

entrepreneurship. In this respect, resource-based view, social embeddedness and institutional theory offer sound theoretical explanations. For this reason, rather than building new theory, the papers of this thesis aim at applying and extending existing theories to shed light on how individuals embedded in the university social context cultivate and develop entrepreneurial cognition. Accordingly, research hypotheses that build on existing theoretical perspectives are developed and tested through quantitative methods, which is usually preferred over qualitative methods for theory testing for its generalizability (Shah and Corney, 2006). Indeed, researchers usually rely on self-report and correlational methodologies to uncovering generalizable relationships among entrepreneurship variables (Hsu et al., 2017). The data required to quantitatively test hypotheses in this thesis come prevalently from survey data, as they were more suitable to assess the entrepreneurship phenomena and variables of interest. Appropriate measures were taken in order to ensure the validity and reliability of self-reported measures, as described more in detail in each paper.

The first paper, entitled 'Entrepreneurial learning at universities: exploring multilevel contingencies', is focused on the *teaching* mission and, in particular, of the effect of entrepreneurship education on *students*' entrepreneurial knowledge. Despite the worldwide increase in entrepreneurship education offered at universities, there is an ongoing debate whether and under which conditions this type of education contributes to students' entrepreneurial learning (Fayolle, 2013; Martin et al., 2013; Nabi et al., 2017). We build on human capital theory to hypothesize that the exposure to various entrepreneurship education initiatives has an inverted U-shaped relationship with entrepreneurial learning outcomes. We also argue that this relationship is moderated by the entrepreneurial experience of the students, the teaching pedagogy applied in entrepreneurial initiatives offered at the university and the prevalence of opportunity-driven entrepreneurship in the country. A multi-level analysis on a cross-country sample of 87,918 students resulting from GUESSS ('Global University Entrepreneurial Spirit Students´ Survey') strongly confirms our hypotheses, and allows us to discuss implications for researchers, educators and policy makers with respect to the nature of entrepreneurial learning, the design of entrepreneurial education programs, as well as the contextual conditions that impact entrepreneurial learning outcomes. Adopting a *learning* perspective, the aim of this work is to show to what extent and under which circumstances university can offer students the knowledge to act entrepreneurially.

The second paper entitled 'From the lab to entrepreneurship: how imprinting of scientists affects the open innovation and performance of innovative startups' is focused on the *research* mission. The main

argument of this thesis is that *scientists* during their career in the research lab develop a unique imprint as result of the socialization in their occupation. The paper then studies the mechanisms and circumstances through which such imprint provides a performance advantage to the innovative startups founded by scientists. To date, most studies on academic scientists, rooted in a resource-based view (Powers and McDougall, 2005) or institutional perspective (Fini and Toschi, 2016), have tried to explain which university characteristics such entrepreneurial culture (Huyghe and Knockaert, 2015) or the presence of entrepreneurship-dedicated infrastructures (Clarysse, Tartari and Salter, 2011) foster scientists to become entrepreneurs and support the success of their ventures. However, much is still to discover about what drives the success and failure of businesses founded by scientists (Knockaert et al., 2011). In the paper of this thesis we respond to this gap by studying how scientist founders contribute to the performance of innovative startups. Building upon imprinting theory, we hypothesize and find that scientists provide an advantage to innovative startups to the extent that they stimulate firm's open innovation behavior (i.e., search breadth and depth). For this to effectively occur, the involvement of multiple scientist founders is needed, so that their distinctive career imprints internalized in the labs is transferred to the firm. Moreover, if the firm embraces business practices (i.e., strategic planning), or departs from scientific logics (i.e., noncommercial goals), scientists' contribution becomes even stronger. By analyzing a sample of 211 Italian innovative startups with and without scientists, our work contributes to literature on commercialization of innovations and to imprinting theory.

The third paper, entitled 'How the value created by student entrepreneurs affects their psychological well-being: a social identity perspective', concentrates on the *third mission* of commercialization as an element of university culture that produces institutional pressures on *students* that run their own business. The core idea of the third paper is that the commercialization mission conditions student entrepreneurs' beliefs about appropriate dimensions of value created by their ventures. To act entrepreneurially, individuals not only need appropriate capabilities; they also need aptitudes and mindset that prepare them to tolerate the stress and appreciate the rewards associated to entrepreneurial endeavors (Schjoedt, 2009). Accordingly, research on psychological well-being (PWB), a fundamental indicator of individuals' mental health, has gained importance in the entrepreneurship field (Shepherd and Haynie, 2009; Uy et al., 2013). In this respect, the aim of the third paper is showing to what extent the impact of firm's value creation on PWB is affected by the culture of the social context in which entrepreneurs are embedded. To do so, we pick university as social context because

educational institutions are known to shape the well-being of its members and because university's culture sets values and behavioral patterns with respect to entrepreneurship to which its members conform. Student entrepreneurs, in particular, have to find a match between their entrepreneurial role as value creators and their belonging to the university social context in order to preserve their PWB. Accordingly, we hypothesize that three different dimensions of value creation – for oneself, for customers, for society – contribute to their PWB, but that the extent of such contribution is influenced by university's engagement in the third mission, a visible component of university's culture. More specifically, where the third mission is emphasized, cultural norms imposed by the university present ventures as a tool to commercialize innovations that lead to societal improvements rather than private earnings or mere market success. In support to this view, our results on a sample of 138 student entrepreneurs indicate that, when students are embedded at universities whose culture emphasizes the third mission, they obtain less PWB by creating private value and value for customers. Conversely, they obtain more PWB by creating value for society as a whole. Our findings extend research on entrepreneurs' PWB and student entrepreneurship and allow to formulate practical implications for entrepreneurs, educators and policy-makers.

3. ENTREPRENEURIAL LEARNING AT UNIVERSITIES: EXPLORING MULTILEVEL CONTINGENCIES

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3.1 Introduction

Entrepreneurship Education (EE), encompassing the pedagogical courses, programs and processes offered to students to develop or strengthen their entrepreneurial traits, attitudes and skills (Bae et al., 2014; Fayolle et al., 2006), belongs to a broad set of initiatives that have been adopted by educational institutions and are stimulated by policy makers in response to the widespread belief that entrepreneurship acts as an engine for economic prosperity (Laukkanen, 2000; Shah and Pahnke, 2014). Universities, in particular, are challenged to prepare students for a labour market where the ability of behaving and thinking in an entrepreneurial and proactive way is a key driver of success (Audretsch, 2014; Urbano and Guerrero, 2013). While initially the main objective of EE was encouraging students to create new ventures, more recently there has been a shift in focus to a broader concept which emphasizes entrepreneurship as a way of thinking and behaving (Leitch et al., 2012; Mustar, 2009). In fact, in a report on entrepreneurship in higher education, the European Commission (2008: 7) emphasizes that 'the benefits of entrepreneurship education are not limited to startups, innovative ventures and new jobs' but rather to 'an individual's ability to turn ideas into action and it is therefore a key competence for all, helping young people to be more creative and self-confident in whatever they undertake'. Therefore EE should aim at stimulating entrepreneurial learning (EL) (Neck and Greene, 2011).

Building on the conceptual arguments of Politis (2005) we define EL as the key process through which students develop the entrepreneurial knowledge that facilitates them to identify and act upon entrepreneurial opportunities. Entrepreneurial knowledge is a multidimensional concept, which includes the *understanding* of actions to start a business, and of typical attitudes, values and motivation of entrepreneurs, as well as the *development* of practical skills, abilities and resources to identify an opportunity and act upon it (Neck and Greene, 2011; Souitaris et al., 2007). Research has challenged the view that individuals are simply genetically endowed with entrepreneurial knowledge and has suggested that people develop it as an *outcome* of the EL process in the course of their entire lives, involving a variety of life experiences that are not limited to founding a new firm (Cope, 2005). EL can be experienced by individuals even before being directly engaged into start-up activity (Haase and Lautenschläger, 2011), for instance through education (Unger et al., 2011). In fact, the context in which individuals develop entrepreneurial knowledge has been illustrated to be, at least partially, replicable in an educational setting (Pittaway and Cope, 2007b). As a result, the outcome of the EL process at universities is supposed to increase student's stock of entrepreneurial knowledge (Haase and Lautenschläger, 2011; Souitaris et al., 2007).

Despite the importance of EE in the political agenda, the growing number, heterogeneity in content and pedagogies of EE offerings, and the recommendations on EE curricula formulated by many academics (Fayolle, 2013; Pittaway and Cope, 2007a), research has largely failed to provide a clear answer to the question 'to what extent and under which circumstances do students learn from the exposure to EE' (Fayolle and Gailly, 2015; Martin et al., 2013). Reported effects among EE studies vary considerably (Naia et al., 2014). Whereas most studies hint to a positive link between EE and EL outcomes, showing that EE improves students' entrepreneurial skills (DeTienne and Chandler, 2004; Sànchez, 2011 and 2013) and beliefs (Peterman and Kennedy; 2003; Volery et al., 2013; Walter and Dohse, 2012, among others), others have found mixed (Oosterbeek et al., 2010; Von Gravenitz et al., 2010), statistically non-significant (Souitaris et al., 2007) or even negative relationships (Mentoor and Friedrich, 2007). Moreover, in many cases the benefits of EE have been misinterpreted due to methodological weaknesses in the research design (Fayolle, 2013; Rauch and Hulsink, 2015). Beyond the empirical limitations, this literature suffers from several theoretical shortcomings: a lack of understanding of the mechanisms that explain the evolution of students' entrepreneurial knowledge caused by EE; a limited conceptualization of the impact caused by EE, which mostly considers whether EE

has been imparted or not and neglects the effect of increasing exposure to additional EE initiatives; and scarce knowledge of the contingent factors that shape EE outcomes (Bae et al., 2014; Martin et al., 2013).

Building on human capital theory (Becker, 1964), a perspective identified as a useful lens to analyse the impact of EE (Bae et al., 2014; Martin et al., 2013; Volery, 2013), our study extends research executed in this field by (i) measuring the extent to which the various EE initiatives university students are exposed to affects their EL outcomes, and (ii) adopting a contingent approach to find out how the impact of these initiatives is moderated by the student's entrepreneurial experience; the universities' entrepreneurial teaching pedagogy; and the diffusion of opportunity-driven entrepreneurial activity in the country. Researchers have emphasized the importance of such multilevel perspective as crossing multiple levels of analysis yields a more holistic understanding of the effect of EE (Bae et al., 2014).

We test our hypotheses on a sample drawn from the GUESSS 2011 ('Global University Entrepreneurial Spirit Students´ Survey'), which is an international research project that biannually collects data on about 100,000 university students in different study fields and at different higher education levels (e.g., undergraduate, graduate, PhD), and this from 26 countries and 489 universities. Multilevel regression analysis is used to test (1) the effect of the various EE initiatives students are exposed to on EL outcomes and (2) the moderating effect of the characteristics of the individual, the university offering and the national context on the EE-EL relationship. The strong advantage provided by the GUESSS survey is that it ensures rigour in the causal association of EE and EL outcomes, as the respondents specifically attribute their evaluation to the university EE.

Our findings illustrate that the exposure to additional EE initiatives contributes to an increase in students' EL outcomes, but only up to a certain threshold, beyond which students cannot further develop or actively 'construct' (Mueller and Anderson, 2014) their level of entrepreneurial knowledge. Beyond that point, the EE-EL relationship turns negative because taking more EE makes students more critically aware of their learning gaps and causes them to question and 'depreciate' (Parker, 2013) the value of what has been learnt at university. Second, students' previous entrepreneurial experience, as well as a practice-oriented university teaching pedagogy, prepare students to benefit more from additional EE initiatives, thus respectively retarding and displacing the inflection point where the EE contribution to EL outcomes turns negative. Finally, the diffusion of opportunity-driven entrepreneurial activity in the country acts as a negative moderator (i.e., anticipates the

inflection point), as in these countries students know that entrepreneurship may require higher skills and requirements and thus they depreciate more severely their human capital obtained from education.

The findings of this paper are important for theory, research and practice. First, we contribute to the understanding of EL by exploring the extent and circumstances under which students are able to construct entrepreneurial knowledge. Second, by studying the transformation of exposure to EE initiatives into learning outcomes, a central issue of EL theorizing (Politis, 2005), our paper advances the understanding of the transformation of additional investments in human capital (EE) into human capital assets (EL outcomes) (Martin, 2013; Unger et al., 2011). Third, by focusing on learning as a result of EE we make an important contribution to the literature that discusses EE programs. We suggest that the exposure to additional EE initiatives – besides growing students' entrepreneurial knowledge – stimulates self-reflection and makes students more critically aware of their EL outcomes. Fourth, from an applied research point of view, this study supports the value of adopting a holistic and multilevel perspective to understand EE and students' EL (Saeed et al. 2015; Walter and Dohse, 2012). Finally, this work has some important practical implications as our insights will help educators and policy makers to take decisions regarding the overall amount of EE initiatives and the related pedagogies based on contingencies such as the audience addressed and the dominant type of entrepreneurial activities in a country.

3.2 Conceptual development

To explain the EL process, or the transformation of EE into entrepreneurial knowledge, we build on human capital theory. In its original formulation, human capital is defined as the set of skills and knowledge that individuals acquire through investments in schooling, on-the-job training, and other types of experience (Becker, 1964). It highlights that the acquisition of human capital is a learning process whereby life experiences are transformed into knowledge and skills (Marvel et al., 2016). In the field of entrepreneurship research, a dynamic view of human capital has been used in order to distinguish human capital investments from human capital assets (Martin et al., 2013; Unger et al., 2011). While the former refers to the 'experiences such as education and work experience that may or may not lead to knowledge and skills', the latter are 'acquired knowledge and skills' (Unger et al., 2011: 343). Analysing the results of EE through the lens of human capital theory implies exploring the outcomes of the human capital acquisition process and, in

particular, to what extent the educational experiences (EE as investment in human capital) become entrepreneurial knowledge (EL outcomes or human capital assets) (Martin et al., 2013; Volery, 2013).

The effect of entrepreneurship education at universities on entrepreneurial learning

In today's globalized and competitive environment, knowledge, innovation and entrepreneurship are crucial to economic and societal development (Audretsch, 2007). As a consequence, universities play a central role in economic systems (Guerrero et al., 2015) as they generate and transfer new knowledge, develop qualified human capital and foster the development of an entrepreneurial society (Audretsch, 2014). In particular, universities are seen as a favourable environment to stimulate EL and support students in the development of entrepreneurial knowledge (Haase and Lautenschläger, 2011; Souitaris et al., 2007). Modern universities have therefore extensively included EE in their curricula (Fayolle, 2013).

Given our definition of EE (i.e., pedagogical courses, programs and processes offered to students to develop or strengthen their entrepreneurial traits, attitudes and skills in general), we specifically refer to programs whose *scope* is to develop entrepreneurial knowledge (cf. Souitaris et al., 2007). The challenge of EE is to offer both codified and tacit elements that constitute entrepreneurial knowledge and are a result of the EL process (Haase and Lautenschläger, 2011). While classic education is more likely to provide the codified elements of entrepreneurial knowledge (e.g., hard facts about business creation), concrete experiences gained through entrepreneurial practices or practical education programs usually act as a source of tacit knowledge (e.g., entrepreneurial practical skills and abilities). In general, the *audience* of EE programs at university consists of university students. Given that EE is widespread throughout campuses, students at any level and of all fields of study are now increasingly exposed to EE. It is worth mentioning that these students may include, but are not necessarily limited to, actual or even prospective entrepreneurs. In order to connect conceptual knowledge to a range of entrepreneurial skills EE adopts a wide range of *methods* – such as conventional lectures, seminars, and workshops, focus groups, teaching of peers etc. (Gibb, 1996) – and disciplines (Pittaway and Cope, 2007a). Since entrepreneurship is a multi-disciplinary field, EE programs embrace a variety of *topics* and themes, such as innovation, finance, team building and leadership (Edelman et al., 2008; Mustar, 2009).

Investments in human capital such as EE result in the absorption and combination of new knowledge, which in turn enables students to better engage in the process of opportunity-seizing and to be more motivated to act upon them (Bae et al. 2014; Souitaris et al., 2007). Based on this, a number of studies have found a positive effect of EE on EL outcomes such as understanding of key concepts of entrepreneurship (Volery et al., 2013), abilities to discover new opportunities (DeTienne and Chandler, 2004) and positive attitudes towards entrepreneurship (Peterman and Kennedy, 2003; Walter and Dohse, 2012). Martin et al. (2013) report extensive evidence about this relationship; the authors also commend future studies to address not only the effect of EE as such, but also of the degree of exposure to EE, on EL outcomes. This resonates with empirical studies that recognize the benefits of offering an increasing and articulated amount of EE initiatives to students (Saeed et al., 2015; Walter et al., 2013).

However, next to the positive effect of EE, the literature recognizes the existence of ambiguous effects on EL outcomes, showing mixed, statistically non-significant or even negative relationships with both EE (Mentoor and Friedrich, 2007; Oosterbeek et al., 2010) and the level of EE exposure (Menzies and Paradi, 2003). Human capital theory offers theoretical lenses to explain the downsides of this process. First, even if the learning opportunities to which students are exposed in an educational context contribute to the acquisition of entrepreneurial knowledge, human capital acquired merely from EE may be subject to diminishing returns, reaching a saturation point (Becker, 1964). Individuals keep learning as long as they are exposed to novel events and are able to interpret and build knowledge on them thanks to the cognitive abilities acquired by previous experience (Morris et al., 2012). Building on this argument we suggest that the extent to which EL outcomes are achievable at university through EE is restricted. Despite the fact that EE initiatives offered in an educational setting can be very diversified and can get very close to the entrepreneurial experience, they simulate the complexity and uncertainty of the entrepreneurial process only up to a certain level (Chrisman et al., 2005; Pittaway and Cope, 2007b). More specifically, it is hard to recreate those affective and socialization processes that are so important to the achievement of EL outcomes (Morris et al., 2012; Pittaway and Cope, 2007b). Therefore, the extent to which students develop entrepreneurial knowledge relying only on EE may be imperfect (Mueller and Anderson, 2014), resulting in a learning saturation point. At that point students do not have the means to further ‘construct’ (Mueller and Anderson, 2014) entrepreneurial knowledge, without being directly engaged into entrepreneurial practice.

Second, whereas the human capital perspective (Becker, 1964) provides a clear argumentation on how education generates learning (Martin et al., 2013), at the same time it discusses an opposing effect, as the *value* of what has been learnt can be subject to a process of *depreciation*; this indicates the loss of value of human capital assets (Parker, 2013). In economic theory, this is due, for example, to job requirement changes or restructuring within the firm or the sector (De Grip and Van Loo, 2002). In these situations, the stock of learning possessed by the individual loses value as it becomes inadequate to cope with new emerging features of the surrounding environment. In a similar vein, from a learning perspective, the environment challenges the individual and forces him/her to question the adequacy of what has been learnt (Piaget, 1950). Through metacognition, i.e., the reflection upon learning (Haynie et al., 2010), the learner evaluates the consistency between the experiences from real life and his/her previous assumptions. According to Piaget, this phenomenon is at the basis of learning since it stimulates individuals to construct knowledge by adapting the acquired cognitive schemas to aspects of the reality never experienced before. For students exposed to EE, this reflection represents itself as a learning action, as it motivates them for further learning and makes them aware of their skills and limitations (Mueller and Anderson, 2014).

Building on this, it has been suggested that EE enables students to realize when they are not yet ready to engage in entrepreneurship (Oosterbeek et al., 2010; von Graevenitz et al., 2010). The exposure to an increasing number of EE initiatives encourages students to reflect on their cumulated stock of entrepreneurial knowledge and helps them in recognizing what still has to be learnt (Mueller and Anderson, 2014). As students attend additional EE initiatives, their learning needs evolve, but the classroom cannot satisfy their matured cognitive expectations (Honig, 2004). At this point, engaging in more EE may negatively affect students' evaluation of their EL outcomes. It is worth mentioning that this may not necessarily be an undesirable outcome from EE, if it helps students to realize that they need further life and work experience before engaging into entrepreneurial activities. Delaying entrepreneurial effort might be an appropriate result of EE; in fact, as shown by Wennberg et al. (2011) graduates that start a business after being employed in incumbent firms tend to found better-performing businesses.

For these reasons based on human capital theory, we offer a conceptual reconciliation of ambiguity in the relationship between EE and EL outcomes and argue that such relationship is non-linear. More specifically, EE increases learning until a saturation point is reached, and decreases afterwards.

Hypothesis 1: The relationship between the exposure to various EE initiatives and EL outcomes is curvilinear (inverted U-shape).

Contingencies of entrepreneurial learning at universities

Following the call of Marvel et al. (2016), our study adopts a multilevel approach to assess the transformation of human capital investments in assets. Multilevel models allow a comprehensive understanding of EL in an educational setting as the researchers can control for the characteristics of the individual and the social context, as well as the way the individual learns (Fletcher, 2007). As recommended by Martin et al. (2013) we include a number of relevant multilevel moderators, namely: (a) an *individual*'s entrepreneurial background; (b) the entrepreneurial teaching pedagogy as an attribute of the *education*; and (c) the entrepreneurial activity in a country as a *national* contextual factor (Bae et al., 2014). *Taken together*, as shown in Figure 3.1, these moderators allow taking into account the effect of micro-, meso-, and macro-level contingencies of the EE-EL relationship that correspond respectively to the individual, university, and national level of analysis. The influence of these factors is discussed next.

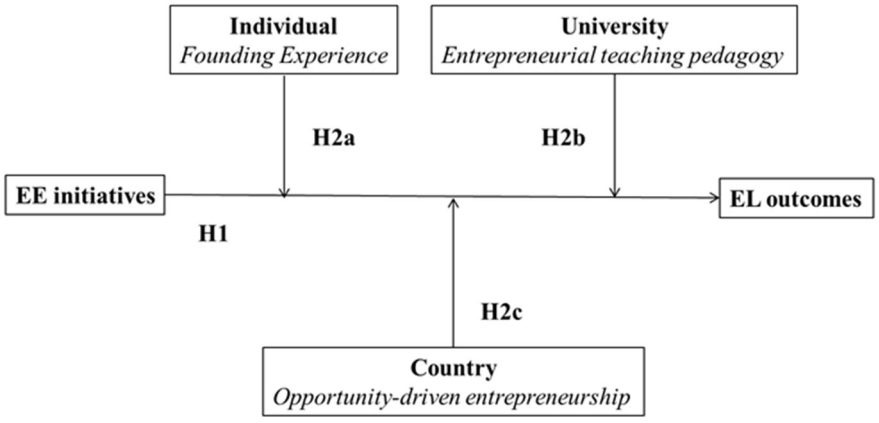

Figure 3.1 Conceptual framework

Individual's background

As specified above, the individual and his cognitive abilities are of primary importance in understanding the extent to which he is able to accumulate human capital assets from investments such as experience and

education (Martin et al., 2013; Unger et al., 2011). The learner fulfils a central role with regards to the outcomes of EE (Löbler, 2006; Mueller and Anderson, 2014). The stock of previous experience affects an individual's ability to transform experiences into entrepreneurial knowledge (Marvel et al., 2016; Politis, 2005).

Literature considers various forms of previous experiences of entrepreneurship, such as: (i) entrepreneurial experience within the family; (ii) a contact with relatives or close friends who are entrepreneurs; (iii) a work experience in a small firm; and finally, (iv) having started an own business (Peterman and Kennedy, 2003). Among these, we focus on the last form as it refers to entrepreneurship experience directly accumulated by the individual and thus is more likely to represent an asset that is valuable to EL (Neck and Greene, 2011; Politis, 2005). Founding a business is a critical event within the EL process (Cope 2005); therefore students that have started a venture are expected to build entrepreneurial knowledge in a different way than students without such experience. In particular, we expect founding experience to alter the mechanisms that determine the inflection point of EL as hypothesized above.

First, founding experience is expected to mitigate the 'diminishing return of education' mechanism hypothesized above, because it helps to better elaborate human capital investments and transform them into knowledge (Morris et al, 2012; Toft-Kehler et al., 2014). Students that have founded a business, in fact, can apply and test in their professional life what has been learnt from EE. By doing so they connect knowledge from teaching with knowledge from practice, which can serve as an additional stimulus to learn (Van de Ven and Johnson, 2006). Thus the saturation point is likely to occur only at a higher exposure to EE initiatives, all else being equal.

The second mechanism, i.e., 'depreciation of human capital asset', should also be mitigated in students with founding experience: they are more likely to appreciate the value of EE because they can understand its application to everyday practice. All aspects discussed in the educational setting make them reflect on their own practical experiences. Indeed, entrepreneurial expertise results from an integration of explicit knowledge obtainable from education and tacit knowledge developed through founding experiences (Unger et al., 2011); when combined with the latter, the former is more effective in conferring students the ability required to take more complex decisions in managing their venture (Dutta et al., 2011; Martin et al., 2013).

Based on these considerations we formulate the following hypothesis:

Hypothesis 2a: Founding experience moderates the relationship between exposure to various EE initiatives and EL outcomes in such a way that the positive side of the inverted U-shape will become larger for students with founding experience.

Entrepreneurial teaching pedagogy

The effects of investments in human capital largely depend on the type of investments made (Marvel et al., 2016). In the field of EE, this implies that we may expect that the features of EE programs affect the extent to which students learn from education (Martin et al., 2013). In particular, pedagogy has been acknowledged to be a key driver of the effectiveness of EE programs (Béchard and Grégoire, 2005). Broadly speaking, EE pedagogies can be classified into 'practice-oriented' or 'theoretical-oriented' (Piperopoulos and Dimov, 2015). While in the latter the student is a passive recipient of knowledge and the teacher initiates the learning process, in practice-oriented EE the student is responsible for constructing learning through experience. Rather than imparting knowledge, teachers adjust their training in relation to their students' needs (Honig, 2004; Mustar, 2009). Many authors have emphasized that EE should adopt a learner-centred perspective, where students are encouraged to directly experience entrepreneurship in order to learn (Béchard and Grégoire, 2005; Fletcher, 2007; Löbler, 2006).

Through experiential learning, educators help students to develop the tacit knowledge, which entrepreneurs normally acquire from experience (Honig, 2004; Walter and Dohse, 2012) and that formal education may struggle to deliver (Politis, 2005). To achieve this goal EE can assume a 'practice-oriented' approach aimed at recreating – in an educational setting – the context in which entrepreneurs learn. For example, simulations are designed to replicate entrepreneurial practice in the context of EE programs (Pittaway and Cope, 2007b). Since simulations help students to connect course contents with practical knowledge (Zantow et al., 2005), learners are facilitated in acquiring expertise from additional EE activities. Thus we may expect that if EE is imparted mainly by adopting a 'practice-oriented approach', students will benefit from attending additional EE initiatives in a similar fashion, as do students with founding experience. Furthermore, this approach offers the opportunity to appreciate in concrete applications the value of what has been learnt (Mueller and Anderson, 2014). For these reasons we may expect that a practice-oriented pedagogy will help students to better learn when they are exposed to an increasing number of EE initiatives.

Besides providing students with a surrogate of entrepreneurial experience, practice-oriented pedagogies prevent students from depreciating the stock of knowledge acquired from education. When the focus of

education is mainly on imparting hard facts on business creation, students will be more likely to perceive their knowledge as inadequate: such education is necessary to provide a general understanding of entrepreneurship phenomena, but has a lower effect on the development of the student's entrepreneurial skills and abilities. On the other hand, if the pedagogy is more practice-oriented, students will perceive to have a more complete understanding of entrepreneurship (Piperopoulos and Dimov, 2015). Based on these considerations, we formulate the following hypothesis:

> *Hypothesis 2b: Entrepreneurial teaching pedagogy moderates the relationship between the exposure to various EE initiatives and EL outcomes in such a way that the positive side of the inverted U-shape will become larger if the pedagogy is more practice-oriented rather than theoretical-oriented.*

National entrepreneurial activity

Finally, human capital theory predicts that the competencies acquired through education are economic assets whose value is determined by the market (Becker, 1964). In line with this argument it has been suggested that students' evaluation of EE benefits is affected by what they believe an entrepreneurship career requires in terms of skills and competences (Lee et al., 2005). Such beliefs are context-specific because they are rooted in cultural views about entrepreneurship resulting from the environment in which students are embedded (Bae et al., 2014). In particular, since cultural aspects are determined at national level, the beliefs about entrepreneurship career requirements are country-specific (Boissin et al., 2009; Carayannis et al., 2003), as cross-country comparisons suggest (Giacomin et al., 2011).

Building on previous studies suggesting that the type of entrepreneurial activities, to which individuals are exposed, influences their beliefs about entrepreneurship (Kirby and Ibrahim, 2011; Lee et al., 2005), we propose that the cultural view of entrepreneurship can be captured by the distinction between *necessity*- and *opportunity-driven* entrepreneurship. This describes what motivations and expectations most likely drive individual's entrepreneurial activities within a country (Koellinger, 2008). Necessity-driven entrepreneurship is pushed by the lack of better job opportunities, while opportunity-driven entrepreneurship is pulled by perceived opportunities; the latter is frequently associated with high technology, high-growth oriented firms and is more diffused in developed, high-income countries (Hechavarria and Reynolds, 2009). In these countries, students typically have as a reference point growth-oriented entrepreneurs who use to face a complex, fast-changing and uncertain environment in order to pursue an attractive business opportunity

(Koellinger, 2008; Levie and Autio, 2008). However, the extent to which the knowledge, merely obtained by EE and without first-hand experience of industry and markets, is adequate for students to engage with environmental uncertainties is limited (Chrisman et al., 2005; Honig, 2004). Based on these arguments, we suggest that, in countries where opportunity-driven entrepreneurship is more diffused, students realize the limitations of the entrepreneurial knowledge acquired in the classroom more quickly, i.e., after being exposed to less EE initiatives. Therefore, for these students 'depreciation' of the EL outcomes will occur earlier. Conversely, where necessity-driven entrepreneurship is more diffused, entrepreneurial career requirements are lower and we expect the learning obtained from a given exposure to EE initiatives to be more positively evaluated.

One could argue that the diffusion of opportunity-driven entrepreneurship in a country provides students the opportunity to complement EE with the exposure to vicarious examples of high-growth entrepreneurs who are also more likely to be involved in the classroom (Levie and Autio, 2008; Walter and Dohse, 2012). However, the stories and cases of entrepreneurs students are exposed to confront them also with requirements and challenges of entrepreneurship (Minniti, 2005). As a consequence students might become increasingly aware of the classroom's limitations in preparing to the risks and uncertainties faced by growth-oriented entrepreneurs (Chrisman et al., 2005; Honig, 2004). Previous empirical evidence points in this direction (Lee et al. 2005). Based on these considerations we formulate the following hypothesis:

> *Hypothesis 2c: National entrepreneurial activity moderates the relationship between exposure to various EE initiatives and EL outcomes in such a way that the positive side of the inverted U-shape will become smaller in countries where opportunity-driven entrepreneurship is more diffused.*

3.2 Method

Sample and procedure

The student-level data for the empirical validation of the hypotheses comes from the GUESSS survey of 2011 ('Global University Entrepreneurial Spirit Students' Survey'), while the data for country entrepreneurial activity results from GEM ('Global Entrepreneurship Monitor'). The GUESSS project is coordinated at global level by the Swiss Research Institute of Small Business and Entrepreneurship at the University of St. Gallen (KMU-HSG) in Switzerland. Full description of the GUESSS project is available at the website www.guesssurvey.org. The number of works based on the GUESSS project and published in entrepreneurship

journals has been growing in recent years (e.g., Bergmann et al., 2016; Sieger et al., 2016; Sieger and Minola, 2016; Minola et al., 2016). For each participating country a representative is responsible to engage and coordinate the research amongst the universities of that country. The sample was gathered through a non-random process in which universities were autonomous in defining the breadth of classes and schools involved in the survey. Students received the questionnaire (web-based or paper-based) through social networks, email or in the classroom. The complete GUESSS data set for 2011 includes information from 93,265 respondents across 26 countries. It includes higher education students of different fields of study and different education levels (e.g., undergraduate, graduate, PhD) from the countries listed in Table 3.1. The sample of our study has already been checked for non-response bias (Bergmann et al., 2016). We have also examined the data for missing values. 4,347 out of 93,265 (about 5% of the sample) have not answered to all questions needed to build the variables of interest, which represents no serious concern. By excluding from the sample respondents for which we could not build the variables of interest, the final sample size consists of 87,918 students from 25 countries at different levels of economic development and with heterogeneous institutional contexts. Whereas in their extensive meta-analytical review of the studies on EE impact Bae et al. (2014) and Martin et al. (2013) concluded that most of the studies have small samples, our sample can be classified as large (N>500). Coupled with the variety of countries included, our research contributes to the generalizability of the obtained results (Martin et al., 2013).

Table 3.1 Countries, Universities and Respondents of the GUESSS 2011

Country	# of Universities	# of responses
Argentina	23	1,660
Austria	17	4,553
Belgium	11	188
Brazil	43	28,186
Chile	5	1,244
China	22	868
Estonia	21	1,874
Finland	12	1,437
France	17	1,498
Germany	46	12,469
Greece	7	454
Hungary	23	5,677
Ireland	8	332
Japan	4	561
Liechtenstein	1	220
Luxembourg	2	444
Mexico	3	556
Netherlands	56	13,121
Pakistan	12	321
Portugal	14	1,020
Romania	33	849
Russia	23	2,882
Singapore	8	2,391
South Africa	15	697
Switzerland	44	8,115
UK	19	648
TOTAL	**489**	**93,265**

Estimation technique

The combination of individual-level and group-level variables within a single model might be problematic since within-group individual observations are not random; this might yield biased and inefficient estimations. Since our sample is made up of individual-level observations, which are clustered within countries, we follow a multi-level mixed-effects regression approach (both random and fixed effects) (Rabe-Hesketh and Skrondal, 2008). In EE, research multilevel estimation has been used for example by Walter and Dohse (2012) and Minola et al. (2016) who collected individual level and regional/country level data to study EE and students' entrepreneurship.

Measures

Dependent Variable

Our measure of *EL* is based on the conceptualization of Laukkannen (2000), who claims that the learning objectives to be achieved by EE initiatives are the provision of an appropriate *know-what* and *know-how* (Hood and Young, 1993), *know-who* (Gibb 1996), and *know-why* and *know-when* (Johannisson 1991). Based on this conceptual classification of learning, Souitaris et al. (2007) developed a perceptual scale to measure learning from entrepreneurship programs and courses, which we use to examine the learning impact of university offerings. As the variable is measured at the individual level, each student has been asked the following five questions and had to answer them on a 7-point Likert scale (1=strongly disagree 7=strongly agree): '*The university offerings I attended (1) increased my understanding of the attitudes, values and motivation of entrepreneurs (i.e., why do entrepreneurs act?); (2) increased my understanding of the actions someone has to take in order to start a business (i.e., what needs to be done?); (3) enhanced my practical management skills in order to start a business (i.e., how do I start the venture?); (4) enhanced my ability to develop networks (i.e., who do I need to know)?; (5) enhanced my ability to identify an opportunity (i.e., when do I need to act?)*'. The scale proved to be reliable ($\alpha>0.70$) and one-dimensional (all five items loaded on a single factor). One of the limitations of previous studies researching the impact of EE is the research design, that is often not fully suited to examine the causality between EE and its effect on students (Fayolle, 2013). Our measure addresses this limitation by capturing the evolution of students' entrepreneurial knowledge obtained specifically *from* university.

Independent Variable

To measure exposure to various EE initiatives, we applied the approach of Dutta et al. (2011) and Minola et al. (2016), namely counting the different EE initiatives that have been attended by students. We relied upon the GUESSS survey in which 14 different EE initiatives were identified and categorized. Since the variable is measured at the individual-level, for each initiative, the respondent was asked whether he had attended that activity. Exposure to EE initiatives, labelled *EE*, is then calculated as the total number of various initiatives that the respondent had participated to. The university initiatives of the questionnaire belong to three categories: (i) lectures/seminars, (ii) network and coaching offerings, and (iii) provision of resources for

founders/entrepreneurs. The first category covers a wide range of contents including (1) entrepreneurship in general; (2) family firms; (3) financing entrepreneurial ventures; (4) technology entrepreneurship; (5) social entrepreneurship; (6) entrepreneurial marketing; (7) innovation and idea generation; and (8) business planning. This variety of contents corresponds to a large extent to the three teaching contents identified by Walter et al. (2013). Offerings in this first category provide students with techniques to generate and market business ideas, to develop business plans and to analyse markets, and to acquire resources and manage a new venture. The coaching and networking category refers to those industry or business context linkages and access, which are explicitly provided to students as part of the educational offering (Walter et al., 2013). In our study we identify the following initiatives pertaining to the networking/coaching category: (1) workshops/networking with experienced entrepreneurs; (2) contact platforms with potential investors; (3) business plan contests/workshops; (4) mentoring and coaching programs for entrepreneurs; and (5) contact points for entrepreneurial issues. Finally, we have a single-item measure on efforts and resources deployed by the university in order to support the development of business ideas. In particular, students can learn about newest technological opportunities and access research resources thanks to their university affiliation (Souitaris et al., 2007; Walter et al., 2013).

Our independent variable ranges from 0 to 14; this is because our sample also includes students who were not exposed to any EE initiative. This means that our research design and results benefit from a control group, i.e., a group of students that has not been 'treated' by EE. On the one hand, this is coherent with the literature on impact studies in general (see for example Origo, 2009), which often employ a non-treated sample to isolate spurious effects and to have a more rigorous measure of the treatment effect, in our case EL outcomes caused by education. On the other hand, for the specific case of our work, this allows us to control for the possible impact of other types of university offerings (e.g., management or economic courses) on EL outcomes and interpreting the coefficient of our estimations as a more rigorous and correct assessment of the *net* EE effect.

Moderating Variables

In order to measure the founding experience of students we have created the dummy individual-level variable *founder* that takes the value 1 if the respondent has founded a business before attending the university he was enrolled in at the time of the survey. The nature of the entrepreneurial teaching pedagogy (labelled *pedagogy*),

whether theoretical- rather than practical-oriented, has been measured at the individual level by asking each student to assess on a single-item 7 points Likert scale where '1' indicated that classes or training in entrepreneurship that they have had, were mainly on imparting knowledge, while '7' indicated that students could work on own entrepreneurial ideas. At the country-level the diffusion of national opportunity-driven entrepreneurship (labelled *opportunity*) was gathered from GEM data. By interviewing a representative sample of a country's population, the GEM survey provides a reliable indicator of the diffusion of opportunity-driven entrepreneurship at national level (Bowen and Declerq, 2008; Hechavarria and Reynolds, 2009; Levie and Autio, 2008). For each country we have considered the average level of improvement-driven opportunity (IDO) entrepreneurship in the years 2009, 2010 and 2011 to approximate the type of entrepreneurial activity witnessed by students during the years in which they attended university. The level of IDO activity is defined as the percentage of individuals over the total the population of entrepreneurs who have started a venture to either earn more money or to be more independent.

Control Variables

We control for a selection of individual-level influences that are often associated with entrepreneurship (Grilo and Irigoyen, 2006; Grilo and Thurik, 2008; Minniti and Nardone, 2007; Shinnar et al., 2009; Van der Zwan et al., 2013): (i) gender, (ii) age, (iii) education, (iv) field of study and (v) whether the student's parents were entrepreneurs. First, we control for *gender*, measured with a dummy where '1' indicates female and '0' male. Most studies find that men have a higher probability of engaging in entrepreneurship than women (Grilo and Thurik, 2008). Indeed gender has been found to influence entrepreneurial behavior and learning at different stages of the process (Van der Zwan et al., 2013). Second, we control for *age* measured in years, because it has been suggested that age may influence individuals' predisposition to learn (Minola et al., 2014; Wilson and McCrystal, 2007). Third, we control for level of *education* of the interviewee: undergraduate (Bachelor); graduate (Master); PhD/doctorate; faculty/post doc; or MBA/Executive Education. Generic education may stimulate EL fostering opportunity recognition and improving the ability to successfully start and manage a new firm as well as grow an established business (Cope, 2001). We also control for respondents' field of study. Despite the growing importance of EE in university departments focused on Social Sciences and Science/Engineering (Souitaris et al., 2007; Walter et al., 2013), business students place more emphasis on

learning about entrepreneurship (Shinnar et al., 2009). In our study we grouped the field of study in four broad areas: (1) *business and economics*, (2) *natural sciences*, (3) *social sciences*, and (4) *other*. We have created a dummy variable for each study area with the exception of 'other' which has been considered as the reference category. Finally, we control for student's parent entrepreneurship using the dummy *parent,* which is equal to '1' if at least one of the individual's parents is or has been an entrepreneur ('0' otherwise). This form of exposure to entrepreneurship is suggested to affect EL (Fayolle and Gailly, 2015; Walter and Dohse, 2012).

3.4 Results

The means, standard deviations, and correlations of the variables in this study can be found in Table 3.2.

We standardized all interaction variables to reduce multicollinearity problems. We also checked for multicollinearity by examining the variance inflation factors (VIFs). All of the VIF values remain below 5, indicating that multicollinearity is not a problem in our analyses (Kennedy, 2008).

The results from our main regression analyses can be found in Table 3.3 (panel A and B). The parameters of fit of all models can be found in Table 3.4.

Table 3.2 Descriptive Statistics and Correlations

Variable	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10	11
1. EL	4.143	1.516											
2. EE	2.761	3.062	0.443**										
3. Age	25.104	6.257	-0.033**	-0.027**									
4. Gender	0.551	0.497	-0.060**	-0.067**	-0.064**								
5. Education	0.301	0.716	-0.040**	-0.018**	0.247**	-0.015**							
6. Social sciences	0.153	0.360	-0.173**	-0.161**	0.042**	0.152**	0.037**						
7. Business economics	0.297	0.457	0.258**	0.301**	-0.056**	-0.005	-0.001	-0.276**					
8. Natural sciences	0.327	0.469	-0.115**	-0.138**	-0.016**	-0.167**	0.008*	-0.296**	-0.453**				
9. Parent	0.455	0.498	0.077**	0.092**	-0.011**	-0.018**	-0.031**	-0.044**	0.034**	-0.016**			
10. Founder	0.022	0.148	0.008*	0.009**	0.128**	-0.052**	0.033**	-0.011**	0.009**	-0.011**	0.031**		
11. Pedagogy	3.668	1.836	0.594**	0.348**	-0.031**	-0.041**	-0.039**	-0.106**	0.150**	-0.062**	0.063**	0.014**	
12. Opportunity	50.532	8.135	-0.136**	-0.050**	-0.012**	-0.007*	0.106**	0.111**	0.006	-0.074**	-0.067**	-0.023**	-0.101**

N = 87,918, * $p < 0.05$, ** $p < 0.01$

Table 3.3 Main Regression Analyses (Panel A)

Dependent Variable: EL						
Independent variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Age	-0.009***	-0.007***	-0.007***	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Gender	-0.169***	-0.098***	-0.098***	-0.070***	-0.071***	-0.071***
	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.008)
Education	0.016**	0.010	0.010	0.014**	0.014**	0.014**
	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)
Social Science[a]	-0.414***	-0.303***	-0.282***	-0.242***	-0.242***	-0.242***
	(0.016)	(0.015)	(0.015)	(0.013)	(0.013)	(0.013)
Business Economics[a]	-0.617***	-0.336***	-0.300***	-0.246***	-0.246***	-0.246***
	(0.014)	(0.013)	(0.013)	(0.011)	(0.011)	(0.011)
Natural Science[a]	-0.238***	-0.172***	-0.165***	-0.140***	-0.140***	-0.140***
	(0.013)	(0.012)	(0.012)	(0.011)	(0.011)	(0.011)
Parent	0.076***	0.024***	0.016*	0.007	0.007	0.007
	(0.010)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)
EE		0.546***	0.693***	0.461***	0.462***	0.463***
		(0.005)	(0.007)	(0.006)	(0.006)	(0.006)
EE squared			-0.096***	-0.085***	-0.085***	-0.086***
			(0.003)	(0.003)	(0.003)	(0.003)
Founder				-0.035	-0.035	-0.035
				(0.036)	(0.036)	(0.036)
Opportunity				-0.022	-0.021	-0.059*
				(0.026)	(0.026)	(0.033)
Pedagogy				0.725***	0.725***	0.725***
				(0.004)	(0.004)	(0.004)
EE x founder					-0.012	-0.067*
					(0.023)	(0.037)
EE squared x founder						0.035*
						(0.018)
Constant	4.424***	4.350***	4.433***	4.327***	4.327***	4.328***
	(0.080)	(0.065)	(0.064)	(0.048)	(0.048)	(0.048)
Variance of the random intercept	0.377	0.300	0.296	-0.212	0.212	0.212
	(0.054)	(0.044)	(0.043)	(0.032)	(0.032)	(0.031)

N = 87,918, Number of groups=25
standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1,

[a] 'others' is the suppressed comparison category

Table 3.3 Main Regression Analyses (Panel B)

Dependent Variable: EL				
Independent variables	Model 7	Model 8	Model 9	Model 10
Age	-0.004***	-0.003***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Gender	-0.066***	-0.065***	-0.068***	-0.068***
	(0.008)	(0.008)	(0.008)	(0.008)
Education	0.015***	0.015***	0.014**	0.015***
	(0.006)	(0.006)	(0.006)	(0.006)
Social Science[a]	-0.233***	-0.221***	-0.235***	-0.234***
	(0.013)	(0.013)	(0.013)	(0.013)
Business Economics[a]	0.243***	0.239***	0.245***	0.246***
	(0.011)	(0.011)	(0.011)	(0.011)
Natural Science[a]	-0.138***	-0.138***	-0.138***	-0.138***
	(0.011)	(0.010)	(0.011)	(0.011)
Parent	0.008	0.008	0.007	0.007
	(0.008)	(0.008)	(0.008)	(0.008)
EE	0.467***	0.495***	0.461***	0.462***
	(0.006)	(0.006)	(0.006)	(0.006)
EE squared	-0.049***	-0.123***	-0.081***	-0.085***
	(0.003)	(0.004)	(0.003)	(0.003)
Founder	-0.031	-0.031	-0.043	-0.018
	(0.037)	(0.036)	(0.035)	(0.035)
Opportunity	-0.021	-0.028	-0.027	-0.026
	(0.026)	(0.026)	(0.026)	(0.026)
Pedagogy	0.723***	0.608***	0.724***	0.724***
	(0.004)	(0.005)	(0.004)	(0.004)
EExpedagogy	-0.121***	-0.283***		
	(0.004)	(0.006)		
EE squared x pedagogy		0.126***		
		(0.003)		
EE x opportunity			0.053***	0.089***
			(0.004)	(0.005)
EE squared x opportunity				-0.027***
				(0.003)
Constant	4.319***	4.377***	4.325***	4.329***
	(0.049)	(0.048)	(0.047)	(0.047)
Variance of the random intercept	0.218	0.211	0.206	0.206
	(0.032)	(0.031)	(0.031)	(0.031)

N = 87,918, Number of groups=25

standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1,

[a] 'others' is the suppressed comparison category

Table 3.4 Parameters of fit

	Model 1	Model 2	Model 3	Model 4	Model 5
Log likelihood	-154622	-148630	-148235	-135028	-135028
Wald χ^2	7203***	21099***	22082***	60645***	60645***
LR test vs. linear regression $\chi 2^{a}$	5237.13***	3220.82***	3222.26***	1154.74***	1154.56***
LR test of model fit: $\chi 2^{b}$	6922.62***	11985.6***	789.12***	26413.58***	0.24
Error variance	1.970	1.719	1.704	1.262	1.262
R2	0.076	0.194	0.201	0.408	0.408

N = 87,918; * p < 0.1, ** p < 0.05, ***p < 0.01

[a] Statistical significance confirms that the country-level variance component is important.

[b]LR test performed between Models *n* and *n-1* using maximum-likelihood estimates (MLE). Statistical significance confirms that model n adds explanatory power to model n-1. Note that models 5, 7 and 9 are compared to model 4 and model 1

Model 1 contains all control variables. All entered variables show significant coefficients and the Wald χ^2 statistic also shows significance of the model (see Table 3.4). Specifically, the coefficient of *Age* is negative and significant, supporting the idea that the effect on EL outcomes is stronger for younger students. The coefficient of gender is also negative and significant, suggesting that male students report better EL outcomes than females. The positive and significant coefficient of education suggests that students at a higher level of general education have developed more entrepreneurial knowledge (Cope, 2001). All coefficients of the field of study dummies are significant, but only the one associated to business and economics is positive. The coefficient of *parent* is positive and significant, suggesting that students whose parents are (or have been) entrepreneurs report more positive perceptions of their EL outcomes.

In model 2, the coefficient of the independent variable EE is significantly positive (β =0.546, $p<0.01$). However, as we hypothesized a curvilinear relationship between EE and EL outcomes, model 3 also contains the quadratic term of EE. The coefficient of EE is significantly positive (β = 0.693, $p<0.01$) and the coefficient of the quadratic term is significantly negative (β =-0.096, $p < 0.01$). Hence, our results suggest the existence of an inverted U-shaped relationship between EE and EL outcomes, providing support for Hypothesis 1. Both in Models 2 and 3, the coefficient of the control variable *education* turns non-significant.

In model 4 all moderating variables are added. The interaction term EE x founder, added in model 5 shows a negative but insignificant coefficient. In model 6, the product between EE squared and founding experience is entered. The coefficient of this interaction term is positive and marginally significant (β=0.035, $p<0.1$). This result is in support of Hypothesis 2a, proposing that founding experience moderates the relationship between exposure to EE initiatives and EL outcomes. To better interpret this result, Figure 3.2 shows a graphical representation of the curvilinear relation between EE and EL outcomes for students with and without founding experience.

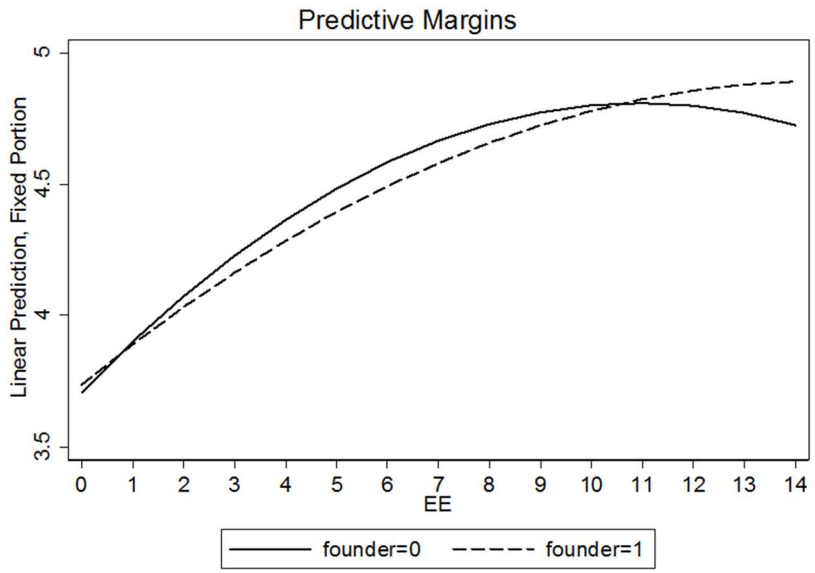

Figure 3.2 The effect of exposure to EE initiatives on EL outcomes for students with and without founding experience

As shown in Figure 3.3, the dotted line, representing the relationship for students with founding experience, becomes wider and has a higher peak compared to the full line, which represents the relationship for students with no founding experience. The figure suggests that the relationship between EE and EL is less strong for students with founding experience compared to those without this experience at when they are exposed to less EE initiatives. However, students with founding experience are in the condition to achieve higher levels of entrepreneurial knowledge when they attend additional EE initiatives.

Model 7 (Table 3.3, panel B) includes all control variables, all moderators, the independent variable EE, EE squared and the interaction term EE x pedagogy. The coefficient of this interaction term is negative and significant (β =-0.121, $p<0.01$). This result provides already some indication of a moderating effect of the entrepreneurial teaching pedagogy on the relationship between EE and EL. However, to test for a curvilinear moderating effect, as is proposed in Hypothesis 2b, the introduction of the interaction between EE squared and pedagogy to the model is needed. Hence, in the next step, model 8 additionally includes the EE squared x pedagogy interaction term. The coefficient of this variable is significant and positive which is in line with Hypothesis 2b (β =0.126, $p<0.01$). Figure 3.3 shows a graphical representation of the relationship between the amount of EE initiatives and EL outcomes for both high and low levels of a practical teaching pedagogy.

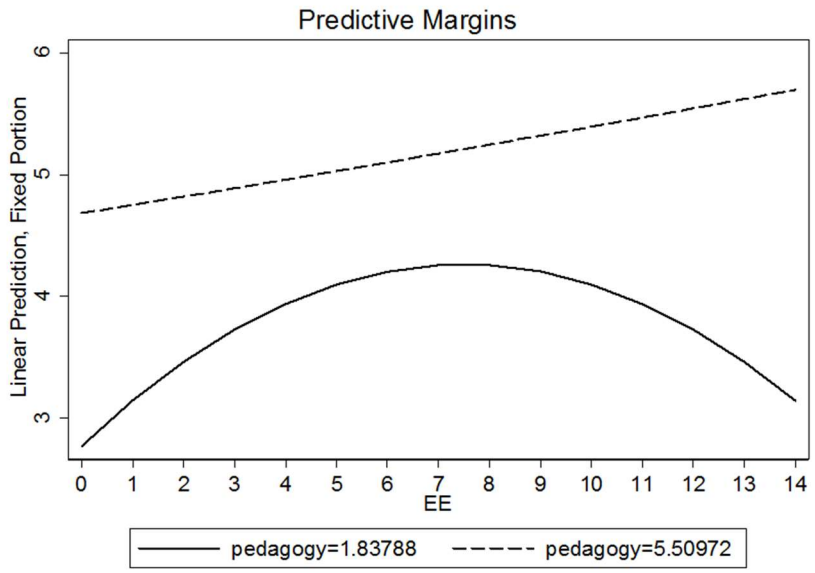

Figure 3.3 The effect of exposure to EE initiatives on EL outcomes for different levels of practical-oriented teaching pedagogy

The dotted line represents the relationship between EE and EL for a high degree of practice-oriented teaching, whereas the full line represents a low degree of practice-oriented pedagogy. As proposed in Hypothesis 2b, when the entrepreneurial teaching pedagogy is more practice-oriented, the interval of EE in which the inverted U-shaped curve is positive becomes larger and the maximum amount of EL outcomes that can be reached increases. Moreover, as the dotted line is situated above the full line for the entire range of EE, EL outcomes are always higher when a practice-oriented entrepreneurial teaching pedagogy is used. In addition, when considering the full range of EE, the curvilinear relationship with practical-oriented pedagogy gets closer to a linear, positive and monotonic one; while for the case of a more theoretical-oriented pedagogy the curvilinear effect remains.

Model 9 includes all control variables, the independent variable EE, all moderators and the interaction term EE x opportunity. The coefficient of the interaction term is positive and significant (β =0.053, $p<0.01$). As indicated before, this result only provides support for a linear moderating effect, whereas we want to test a curvilinear moderating effect. Therefore, model 10 introduces the interaction term EE squared x opportunity. The coefficient of this interaction term is significantly negative (β =-0.027, $p<0.01$), which provides support for Hypotheses 2c. To better interpret this result, a graphical representation of the relationship between

exposure to various EE initiatives and EL outcomes for different levels of opportunity entrepreneurship is provided in Figure 3.4.

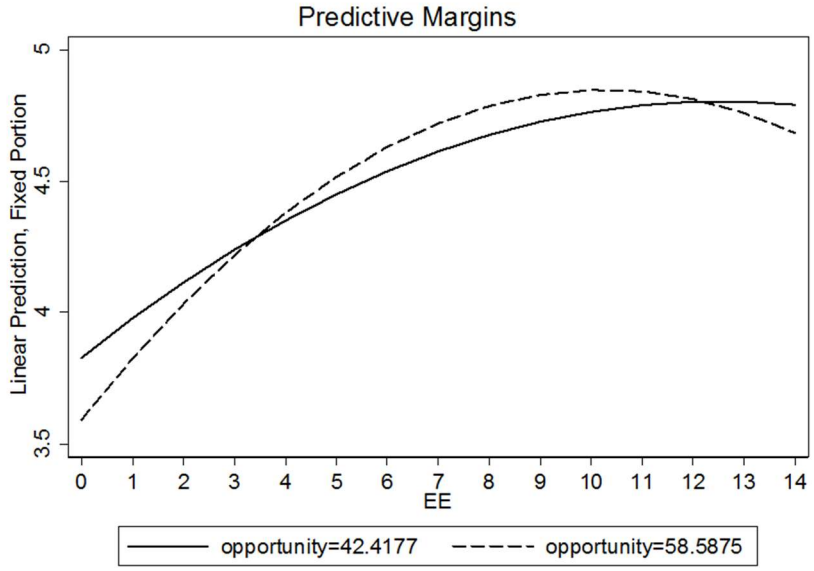

Figure 3.4 The effect of exposure to EE initiatives on EL outcomes for different national levels of opportunity-driven entrepreneurship

The dotted line represents the relationship between exposure to EE initiatives and EL outcomes in countries where opportunity-driven entrepreneurship is more diffused, whereas the full line shows this relationship for countries with lower levels of opportunity-driven entrepreneurship. As the dotted line is narrower compared to the full, the maximum level of EL outcomes is reached sooner in countries where high opportunity-driven entrepreneurship is more diffused. That is, when students are educated in such context, they will reach their maximum EL outcomes after attending a lower number of EE initiatives, making additional EE less effective. This result provides support for Hypothesis 2c.

Table 3.4 shows significant Wald χ^2 for all models of our analyses. Additionally, Table 4 includes the results from the likelihood ratio (LR) comparing the fitted mixed models to standard regressions with no group-level random effects. As the tests are significant for all models, we can reject the null-hypotheses that all random-effects parameters of the mixed models are equal to 0. The next row in Table 4 shows the results of the LR test of model fit. Comparing models *n* to models *n-1* suggests that the variables added in each step improve the explanatory power of the models ($p<0.01$). Only for model 5, in which the interaction term EE x founder is entered, the test becomes not significant, but in model 6, which includes also the quadratic

interaction term EE squared x founder, the test turns marginally significant. This serves as an indication that contributes to rule out possible issues related to small effect size in large samples (Combs, 2010). Testing alternatives to the multi-level mixed-effects regression models can serve as additional robustness tests; we therefore run a linear regression without considering the fact that data are country-clustered, and introducing country dummies. The results remained stable. Finally, we also run our models for two sub-samples (in particular the first sub-sample was identified by including only students whose level of EE was between 1 and 14, while for the second EE was equal to 8 or higher. This verifies the robustness with respect to the non-normal distribution of our independent variable. Again, our results did not differ.

3.5 Discussion

Theoretical contributions

Our work contributes to the fields of research on entrepreneurship, EE and EL by showing to what extent and under which circumstances exposing students to an increasing number of EE initiatives supports them in developing entrepreneurial knowledge. Through the lenses of human capital theory, our findings illustrate that the relationship between the amount of attended EE initiatives and EL outcomes is curvilinear; students learn from additional exposure to EE initiatives until a certain threshold level is reached. Behind this point the learning resulting from education decreases. Moreover, this inverted U-shaped relationship is moderated by three contingent factors. Having previous founding experience strengthens students' EL from EE, retarding the point at which the EE-EL relationship turns negative. Moreover, the level of EL outcomes achieved by students is consistently higher and grows monotonically when universities use a more practictal-oriented rather than theoretical-oriented pedagogy. Finally, also entrepreneurial activity in a country has an impact on the EE-EL relationship, as in nations where opportunity-driven entrepreneurship is more diffused, students' EL outcomes start declining sooner, i.e., when students are exposed to a lower number of EE initiatives.

The results relative to our control variables extend and reinforce our understanding on the determinants of EL outcomes at university. In line with earlier research of Minola et al. (2014) suggesting that the plasticity of individual cognition is higher at very young age, we found that younger students are more predisposed to EL. Alternatively, the effect could be (partly) ascribed to the tendency of younger students to overestimate their EL outcomes due to higher levels of optimism and self-assessment (You et al., 2009). Male students

ascribe more value to their EL outcomes possibly because they tend to be more self-confident about their entrepreneurial skills (Minniti and Nardone, 2007). The positive impact of the level of general education on EL outcomes suggests that education may enhance the cognitive skills to recognize and act on opportunities (Cope, 2001). Concerning field of study, our results suggest that traditional business and economics education, though distinct from EE, provides some forms of entrepreneurial knowledge (Haase and Lautenschläger, 2011). Finally, we discover that students whose parents are (or have been) entrepreneurs report more positive perceptions of their EL outcomes. A common explanation is that students grown up in a family of entrepreneurs are more predisposed to entrepreneurship (Peterman and Kennedy, 2003).

Our work offers three main contributions to theory and research. First, the paper extends our knowledge on the complex process of EL by conceptualizing and testing its antecedents and moderators in an educational context. Previous studies have highlighted that individuals develop the broad set of values, motivations and competencies to act entrepreneurially in the course of their entire life (Aldrich and Yang, 2014; Harvey and Evans, 1995) and that education can play an important role in such process (Unger et al., 2011). Building on this literature our study focuses on students' educational experiences at university and explores more in depth the mechanisms and conditions under which students can actually engage in the EL process. Extending this literature, our study confirms that EL can occur even before actual engagement in entrepreneurship as a profession. By advancing our understanding of the transformation of experience into knowledge, a central issue of EL theorizing (Politis, 2005), this research project also contributes to human capital theory applied to the field of entrepreneurship. We illustrate that investment in human capital, represented in this study by EE, can result in human capital assets, or entrepreneurial knowledge (EL outcome) and we highlight the conditions under which this occurs.

Second, our work also provides theoretically grounded and empirically robust evidence contributing to the vivid debate on the 'teachability' of entrepreneurship (Haase and Lautenschläger, 2011; Neck and Greene, 2011) that discusses the possibility of achieving EL outcomes through exposure to EE. We extend previous research on the topic by offering a more nuanced view on the impact of EE on students' EL outcomes. Indeed, exposure to various EE initiatives helps students to develop entrepreneurial knowledge, but to realize its full potential EE needs to be complemented with practical experience, acquired by students either during prior entrepreneurial efforts or through practical-oriented EE activities. Moreover, we suggest that EE is valuable

as it enriches students' human capital, but also encourages them to critically reflect about their acquired entrepreneurial knowledge, its value, limitations and adequacy to the perceived needs.

Finally, by illustrating the significant impact of three contingent factors at the individual-, university-, and country-level of analysis, this research effort confirms the value of multilevel research in the field of entrepreneurship (Autio et al., 2013; Walter and Dohse, 2012). The conceptualization and testing of micro-, meso- and macro-level moderators provides a higher explanatory power to our baseline empirical model, resulting in more fine-grained understanding of the EE-EL relationship.

Practical implications

Our work offers four main practical implications for the design and assessment of EE offerings at universities. First, based on the main conclusions of this study suggesting that the marginal increase of entrepreneurial knowledge due to additional EE initiatives is not constant and that it is shaped by contingent factors, we overall recommend to monitor the design of the amount of entrepreneurship topics or classes offered to students and complement it with the evaluation of their EL outcomes on a regular basis. To do this, educators could introduce learning portfolios or personal development plans (PDP) to their students. A PDP is a written or electronic record that has to be developed by the students to provide evidence of the acquisition of skills, knowledge and competencies (Brown, 1995; Redman, 1994). Research has illustrated that introducing these plans can help people to learn better (Beausaert et al., 2011). At the same time, it would make it easier to track the development of the competencies needed to develop the entrepreneurial mindset (Toutain and Fayolle, 2008).

Second, our results confirm earlier suggestions of Pittaway and Thorpe (2012), indicating that the individual learning response to a course might differ depending on the individual's stock of entrepreneurial experience. The possibility to offer more flexible curricula adapted to students' prior experience would be a way to take advantage of these differences. For example, one could think about mechanisms to incentivize students with some entrepreneurial experience to take additional courses, as these students are particularly prepared to benefit from them. Practical ways to get them engaged into additional courses would be to allow them to take entrepreneurship classes from other curricula or to link other classes in their curriculum, for example through exams, project works or case studies, to their experience as entrepreneur.

Third, by pointing out that EE produces higher EL outcomes when it is imparted through a practical-oriented pedagogy, our study supports the recommendations made by previous research (e.g., Neck and Greene, 2011) to provide students with some forms of entrepreneurial experiences as part of the educational offering (e.g., business simulation, games, or fieldwork). Problem-based learning and learning experiences attached to business internships in entrepreneurial firms could also be offered as an additional option to the traditional apprenticeship offered to students. The role of the teacher can be regarded in a different way, too: our work encourages instructors to provide more space for active experiences and reflection, rather than simply passing on information (Mueller and Anderson, 2014). However, even though innovative and participative pedagogies are fascinating, university managers should be aware that implementing such pedagogy requires additional resources (e.g., cultural and institutional changes, new programs implementation, more skilled instructors, coordination mechanisms, costs to organize events and business plan competitions). Given that the situation of higher education institutions is characterized by scarcity of resources and changing legislative contexts, especially in Europe, educators, university managers and policymakers should carefully consider the trade-off between investment and cost saving related to important aspects such as the development of students' entrepreneurial knowledge.

Finally, by showing that students in countries with lower levels of opportunity entrepreneurship find it more beneficial to attend additional EE initiatives, our results support the suggestions advanced by Meccheri and Pelloni (2006) who recommend EE as a vehicle to overcome the scarce learning opportunities in less developed regions with low endowments of entrepreneurship capital. At the same time, in countries with higher levels of opportunity entrepreneurship, universities should even more carefully consider the extent to which EE is actually transforming into positive EL outcomes and be more prepared to integrate traditional EE with advanced educational tools and innovative pedagogies.

On a lesser note the positive perceptions of younger students about acquired entrepreneurial competencies endorses the implementation of EE activities also at lower level of studies (e.g., bachelor) where students are more predisposed to learn. Educators could implement some mechanisms to address the low self-confidence of female students about their acquired entrepreneurial knowledge. For example, the involvement of female entrepreneurs as positive role models in EE offerings (e.g., keynotes) could enhance the self-confidence of female students. The lower level of EL outcomes reported by students in natural and social sciences areas

compared to business and economics students points out that imparting additional EE initiatives may be particularly urgent to technical and humanistic faculties. While in business and economics faculties business knowledge is conveyed through other courses, in other faculties EE may represent the only possibility for students to acquire entrepreneurial knowledge. Providing entrepreneurial knowledge to students with scientific and technical competencies is important because they often lack the business skills to turn their ideas in viable businesses (Mustar, 2009; Shinnar et al., 2005).

Limitations and future research directions

This works opens an avenue for future research suggesting that besides growing students' entrepreneurial knowledge, EE may encourage students to realize the limitations of the acquired knowledge and that much still has to be learnt. This may constitute a form of 'higher order learning', a particular form of learning that occurs when the individual questions the 'underlying assumptions and values that guide one's actions' (Cope, 2005: 382), revises his convictions and is motivated to further learning. We invite future research to explore more in depth the implications of such reflection on students' cognition and, in turn, their threshold of learning. To that purpose we recommend the use of qualitative studies as empirical research approach coupled with a constructivist theoretical lens (e.g., Mueller and Anderson, 2014). This type of work has been shown to provide a fine-grained description on the evolution of students' beliefs and identity. Overall, research in this field would benefit from more longitudinal studies that can monitor the consequences of EL outcomes on an individual's professional life: as an entrepreneur or as employee in an entrepreneurial firm. It would be of particular interest to examine to which extent EE effects persist over time or how much time it takes until these outcomes become manifest. How long does it take for students that attended EE to start entrepreneurial activities if they opt for a career as an entrepreneur and why? In what circumstances do they prefer to delay entrepreneurial activities and to first gain experience working in their parents' business or being an employee elsewhere before starting their own business? Could EE encourage them in delaying entrepreneurial activities, based on a critical reflection of the obtained entrepreneurial competencies?

A second limitation of this study is related to the measurement of exposure to EE, operationalized as the count of the various entrepreneurial initiatives attended by students. Having further information about the EE process (e.g., knowing the overall number of hours taken by each student) would allow some robustness tests

on the validity of this measure. While our proxy adds some information compared to previous studies on the impact of EE, in which this variable is often operationalized with a dichotomous variable (see Naia et al., 2014 for a review), future research could use more elaborated measures of EE (e.g., weighing each offering by number of credits attached). Furthermore, we did not have the possibility to distinguish between mandatory and elective entrepreneurship offerings or the diversity of offerings; future research should control for these choices, as it might impact the perceived learning outcomes of the students (Rauch and Hulsink, 2015).

More in general, albeit survey data provides the possibility to test our research hypotheses on a huge and unique multi-country sample, there are some limitations to using this type of data. For example, more fine-grained information on the university offerings attended by students could allow researchers to control for social and team-based learning as important means to acquire entrepreneurial knowledge (Pittaway and Cope, 2007b). Even though entrepreneurship and EL are social and often-team based processes, in particular when considering practice-oriented pedagogy, we do not explicitly control for this in our study. Moreover while we measured the diffusion of opportunity entrepreneurship at country level we acknowledge that having data at the regional level would provide a more fine-grained understanding on the implications of contextual factors on EE impacts (Dodd and Hynes, 2012; Leitch, 2012). To address this limitation, future studies could include information about the proximity of university to business incubators or accelerators, a natural environment that nurtures growth-oriented and innovative entrepreneurs.

Finally, a more nuanced view of EE could derive from a configurational view of the EE contribution to EL. For example, as suggested by Fayolle (2013), we still lack sufficient knowledge about the best fit between methods and audiences. A three-way interaction between EE, pedagogy and founding experience could be interesting to further discuss the effect of practical pedagogy. In a similar vein, Walter and Dohse (2012) argued that pedagogy should be matched to the contextual level of entrepreneurial activity.

3.6 Conclusion

This study acknowledges that students are able to develop entrepreneurial knowledge through EE but only to a certain extent. Human capital theory allows us to predict and interpret this limit, through the mechanisms of saturation and depreciation of human capital asset. This approach also suggests that the extent to which EE produces these outcomes is contingent on their entrepreneurial experience, the pedagogy of EE and the national

context. These results contribute to the conceptualization of EL antecedents, moderators and outcomes in the context of EE; they also offer a set of practical implications for the design and assessment of EE programs and open avenues for future research on EL and EE.

4. FROM THE LAB TO ENTREPRENEURSHIP: HOW IMPRINTING OF SCIENTISTS AFFECTS OPEN INNOVATION AND PERFORMANCE OF INNOVATIVE STARTUPS

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4.1 Introduction

Innovative startups, which are new ventures based on the commercialization of science and technology, are important to economic growth, the emergence of new products, services and industries, and wealth creation (Colombelli et al., 2016; Colombo et al., 2006; Heirman and Clarysse, 2004). With innovative startups’ tendency to rely on scientific and technological discoveries, over the last decade many scientists have shifted their careers from laboratories to entrepreneurship (Shah and Panke 2014; Knockaert et al., 2011). Although the norm of ‘open science’ historically discouraged scientists from commercializing their innovations, more recently scientists, as well as their academic and research institutions, have acknowledged the benefits of

commercialization to society and the economy (Bercovitz and Feldman, 2008; Jain et al., 2009). Since their involvement in startups represents a key mechanism through which the commercialization of science occurs, scientists' role in entrepreneurship has attracted growing attention (Mosey and Wright, 2007; Rasmussen et al., 2011; Wright, 2014). However, much of the research to date has focused on why scientists decide to start a business (Fini and Toschi, 2016; Powers and McDougall, 2005), rather than the consequences of scientists' involvement in startups (Rasmussen et al., 2011). As such, we know little about what drives the success of innovative startups founded by scientists and if scientist founders provide an advantage (Knockaert et al., 2011; Visintin and Pittino, 2014; Wright, 2014). Our study seeks to fill this gap in the literature by proposing a framework that explains how scientists shape their innovative startup's behavior and performance.

In developing our framework, we draw from imprinting theory which explains how founders transfer norms and behaviors from their previous career to their startups (Bryant, 2014; Marquis and Tilcsik, 2013; Simsek et al., 2015). The theory highlights how career imprints come to reflect a mindset about the world which, in turn, serves to shape a startup's structure, culture and routines (Schein, 1983). The uniqueness of the scientist career imprint, with its focus on open science and a mindset that values the discovery of new knowledge, has been acknowledged in the careers (Aschhoff and Grimpe, 2014; Bercovitz and Feldman, 2008) and entrepreneurship literatures (Hoang and Gimeno, 2010; Jain et al., 2009), and yet, research has not fully considered how the scientist career imprint transfers to an innovative startup. In their work in research labs, scientists typically develop a career imprint (Aschhoff and Grimpe, 2014; Bercovitz and Feldman, 2008) that is characterized as valuing diverse sources of information and encouraging the search for external information to advance their knowledge (Fleming and Sorenson, 2004; Friesike et al., 2015). If scientists' willingness to seek and integrate new knowledge can be transferred to their innovative startups, research suggests that an advantage could be achieved in commercializing their innovations (Knockaert et al., 2011; Rasmussen et al., 2011). Indeed, research suggests that it would be wise for innovative startups to seek information and knowledge from external sources (Sapienza et al., 2004), a process referred to as open innovation (Chesbrough, 2003), because it could help solve innovation and commercialization problems (Keupp and Gassmann, 2010; Lee et al., 2010). However, despite the advantages that open innovation is believed to provide innovative startups facing 'liabilities of newness and smallness' (Gassmann et al., 2010; van de Vrande et al., 2010), the apparent reluctance of entrepreneurs to embrace the process has led some scholars to argue that entrepreneurs

need to possess the right mindset in order to create an organizational culture that seeks external information and knowledge (Classen et al., 2012; Gassmann et al., 2010). We argue that the scientist career imprint with its emphasis on open science provides the mindset needed to foster open innovation thereby contributing to firm performance.

Furthermore, we build on research that suggests that multiple scientists in an innovative startup may be necessary for the startup to fully benefit from their knowledge and behaviors (Knockaert et al., 2011) by proposing that the number of scientist founders has a positive impact on open innovation. In other words, the legacy effect of a scientist career imprint is likely to be more prominent as the number of scientist founders increase. As such, we extend imprinting theory by explaining how a norm associated with a previous career imprint is tailored to a new career context. Additionally, in line with research that recognizes how some scientist founders develop a business mindset while others attempt to fully preserve their scientific mindset by stressing noncommercial goals (Ambos et al., 2008; Jain et al., 2009), we consider how a practice rooted in the business world (i.e. strategic planning) and one rooted in the scientific world (i.e. pursuit of noncommercial goals) affect whether a greater number of scientist founders leads to more or less open innovation. Therefore, in recognizing how the business and scientific worlds collide for scientist founders, our framework not only recognizes that the scientist career imprint may provide an advantage for innovative startups with a greater number of scientist founders, but also that their career imprint can serve as a rigidity if the startup emphasizes noncommercial goals.

Accordingly, this paper offers three main contributions. First, we contribute to the vibrant research on the involvement and consequences of scientists to the success of commercialization activities by proposing that open innovation is a key mechanism through which scientists contribute to the performance of innovative startups. Further, in considering how a career imprint can provide an advantage in a new career (Higgins, 2005) or be a source of 'baggage' due to cognitive and normative rigidities (Dokko et al., 2009), we investigate how strategic planning and noncommercial goals modify the extent to which the number of scientist founders affects open innovation. Second, by demonstrating that the number of scientist founders positively affects open innovation and thus firm performance, we show that entrepreneurship has much to learn from scientists who have founded innovative startups. To overcome liabilities of newness (Stinchcombe, 1965) and smallness (Aldrich and Auster, 1986), innovative startups are advised to broaden their knowledge search by seeking

advice and information from sources external to the firm (Colombo et al., 2006; Sapienza et al., 2004). By emulating scientists' willingness to embrace open innovation, or involving more scientists on their founding team, innovative startups are likely to experience greater success. Finally, we contribute to imprinting theory by explaining how behaviors from a previous career can be tailored to fit a new context. Specifically, we argue that the scientist career imprint with its emphasis on open science translates to the embrace of open innovation in the entrepreneurship context. Additionally, we highlight how the transfer of a career imprint to a new career context is not guaranteed; rather, multiple founders who share a career imprint may be necessary for the values and behaviors from a previous career to take hold in a new context. Therefore, for innovative startups to gain the benefits of the scientist career imprint, multiple scientist founders are necessary.

4.2 Theory and hypotheses

Founders' career imprints

Imprinting theory explains the enduring impact of prior history on individual and organizational outcomes (Marquis and Tilcsik, 2013; Simsek et al., 2015). At the individual level, imprinting theory has been applied to explain how early experiences in one's career have an enduring impact on cognition, values and behaviors (Higgins, 2005; Marquis and Tilcsik, 2013). As individuals are socialized into a specific occupation or job, they learn what skills and behaviors are expected and come to internalize the values and cognitive frames that are typical of their occupation (Dokko et al., 2009; Simpson, 1967). As a result, individuals in the same occupation share common characteristics due to shared occupational norms and similar experiences. Additionally, individuals carry career imprints with them as they move across organizational boundaries (Higgins, 2005; McEvily et al., 2012).

In the context of entrepreneurship, imprinting theory highlights how the formative career experiences of a founder transfer to his/her new venture (Baron et al., 1999; Mathias et al., 2015). Founders stamp on their firm career imprints that they retain from their work experiences in other organizations (Higgins, 2005; Philipps, 2005). In developing their new ventures, founders start with a mindset that reflects their assumptions about the world which, in turn, influences the firm's structure, culture and routines (Bryant, 2014; Schein, 1983). For example, research shows that founders who had been employed in organizations that strongly promoted female leadership tend to internalize that value, and as a consequence, actively promote women to

prominent positions in their own ventures (Phillips, 2005). Research like this therefore suggests that the characteristics of founders – such as their vision, beliefs, cognition, and identity – play a major role in determining the behaviors, development and subsequent performance of their new ventures (Johnson, 2007; Simsek et al., 2015). However, research is still needed on how founders' career imprints impact the course of action and behaviors adopted by their new ventures (Mathias et al., 2015). Our study seeks to address this issue by investigating the effect of scientist founders on their innovative startup's success.

The scientist imprint on innovative startups

In the last decade, the role of scientists in our society has evolved from mere generators of new scientific knowledge to active actors in the process of commercialization of such knowledge (Murray, 2004). Because of the strong emphasis that their occupation places on the pursuit of scientific advancement and experimentation, the uniqueness of a scientist career imprint has been acknowledged in the careers (Aschhoff and Grimpe, 2014; Bercovitz and Feldman, 2008) and entrepreneurship literatures (Hoang and Gimeno, 2010; Jain et al., 2009). During their scientific careers, scientists are embedded in a highly institutionalized context with strong traditions and well-established norms of behavior, which have a significant impact on their persona (Aschhoff and Grimpe, 2014). As a result of their research activities and emphasis on discovering new knowledge, scientists are characterized by a mindset that values search, guided by the persistent belief that better solutions should exist (Fleming and Sorenson, 2004). Scientists, defined as individuals involved in research and scientific work at university and research institutions, undergo arduous training and lengthy socialization (van Maanen and Schein, 1979). As in previous research (Fryges and Wright, 2014; Stephan, 2014) we consider a broad spectrum of institutions where scientists do research before founding a business. These institutions include not only university settings but also research institutes and labs, including independent and non-profit research institutions and governmental scientific research organizations. Scientists are socialized in a context that emphasizes Mertonian norms and open science that thereby encourage the wide dissemination of information, resources and methods (Merton, 1968; Jain et al., 2009). These norms, which can be seen as reflecting the scientist career imprint, are often argued to be at odds with entrepreneurship (Ambos et al., 2008; Aschhoff and Grimpe, 2014; Etzkowitz, 1988). Indeed, in a study of university technology transfer it was found that academic scientists strive to preserve their academic identity during the

commercialization process (Jain et al., 2009). Research also acknowledges the difficulties scientists have in launching an innovative startup since the demands of entrepreneurship significantly contrast with the norms of the scientific community which stress open science, including the wide dissemination of findings and collaborative research (Ambos et al., 2008; Bercovitz and Feldman, 2008; Rasmussen et al., 2011).

However, rather than study what prevents scientists from turning their innovations into startups, instead we explore how the scientist career imprint traverses to the entrepreneurship context. Additionally, we explore the additive effect of having multiple scientists on the founding team, thus highlighting how the interaction among founding team members is important in shaping the outcomes of founders' imprinting (Bryant, 2014; Simsek et al., 2015). Specifically, more than one scientist may be necessary to influence the behaviors of an innovative startup since research on the founder's imprint suggests that founders must share a common mindset in order for them to create a cohesive team that develops a consistent pattern of values and behaviors (Schein, 1983). As such, we argue that to fully understand how the scientist career imprint traverses from the research setting to an innovative startup, it is necessary to consider the number of scientists on the founding team since a greater number of scientists should result in stronger behaviors that are rooted in the norm of open science. Below, we propose that the scientist career imprint, which emphasizes norms associated with open knowledge and collaboration, is adapted to the entrepreneurship context through an emphasis on open innovation.

Open innovation

In contrast to innovation practices that are predominantly situated within the boundaries of the firm, open innovation recognizes the importance of external sources of knowledge and information to the development of new products and services (Chesbrough, 2003). As firms differ in the number of external sources they draw upon as well as the frequency with which they collaborate with each external source, open innovation is captured by two components (Keupp and Gassmann, 2010): search breadth and search depth. Following the established approach set forth by Laursen and Salter (2006), we define search breadth as the variety of external knowledge sources used by a firm for innovation purposes and search depth as the number of different sources from which a firm draws knowledge through frequent and sustained interactions.

Although startups often lack knowledge and other resources that contribute to business success, many entrepreneurs are reluctant to utilize external sources (Classen et al., 2012; Gassmann et al., 2010; Zhang et al., 2006). Research on cognitive biases suggests that firm leaders tend to rely on information that is easily retrieved and most in line with their current beliefs, thus limiting their search for new information and different perspectives (De Carolis et al., 2009; Gassmann et al., 2010; Leiponen and Helfat, 2010). Indeed, research suggests that entrepreneurs tend to be reluctant to seek assistance or utilize external sources of support (Audet et al., 2007; Audet and St. Jean, 2007). Many entrepreneurs lack a mindset that values outside competence and knowledge (Gassmann et al., 2010) and instead, possess an illusion of control that prevents them from reaching out to others and seeking assistance (De Carolis et al., 2009). Research also shows that entrepreneurs are often unlikely to recognize a gap in their knowledge (Chrisman and McMullan, 2004) and that their reluctance to share information with parties external to their startup prevents them from seeking advice from external sources (Chrisman et al., 2012). Proponents of open innovation have therefore argued that entrepreneurs may need to possess the right mindset in order to create an organizational culture that values outside competence, information, and know-how (Brunswicker and Vanhaverbeke, 2015; West and Bogers, 2014). We argue that the scientist career imprint may provide an innovative startup with the mindset to encourage open innovation.

The scientist career imprint generates a mindset that values the search and discovery of new information (Jain et al., 2009). The approach of scientific research towards framing problems encourages the search for information since it provides a 'map' that guides scientists through complex knowledge structures (Fleming and Sorenson, 2004). During their careers in research, scientists are socialized to appreciate new and diverse knowledge (Merton, 1968) and to feel comfortable relying on others who have different skill sets (Jain et al., 2009). Scientists are also encouraged to share and combine information with colleagues from different disciplines (Friesike et al., 2015) and to seek in-depth knowledge from various sources so as to fully understand the properties of a phenomenon (Fabrizio, 2009). In the context of an innovative startup, the scientist career imprint should therefore encourage scientist founders to search for external knowledge that can assist in bringing their innovation to market. In other words, the norm of open science is expected to translate to open innovation when scientists launch innovative startups.

While imprinting theory supports the argument that a scientist career imprint transfers to an innovative startup, it has been suggested that the lack of multiple scientists on a founding team may reduce the contribution

of scientists' involvement in new ventures (Knockaert et al., 2011). Hence, by borrowing from literature on science-based firms, we further extend imprinting theory by arguing that having more scientists on the founding team is necessary in order for the scientist career imprint to make a significant impact, and thus, increase search breadth and depth.

A 'critical mass' of scientists may be necessary for a firm to benefit from their knowledge and ways of doing things (Knockaert et al., 2011) since scientists may adapt to localized norms if they feel the norms from their prior experiences do not match those of the dominant group (Aschhoff and Grimpe, 2014). More specifically, research on university technology transfer has shown that when a scientist feels tension between beliefs instilled through professional imprinting and norms supported by current peers, s/he will tend to conform to the norms of current peers in order to reduce discord (Bercovitz and Feldman, 2008). Indeed, it appears that early imprints can weaken or be supplanted when they are seen as incompatible with a new environment (Kimberly, 1979) and there are pressures to conform (Simsek et al., 2015). In turn, as founders develop rules, norms and structures for their startups, their interactions lead them to make choices that are most aligned with their shared values and preferences (Beckman, 2006; Bryant, 2014). In this way, the presence of only a single scientist founder may not ensure greater search breadth and depth since the scientist may either conform to the norms of fellow nonscientist founders or be overruled by other founders who may not value external sources of information.

As the number of scientist founders increases, however, we expect greater search breadth and depth. This argument is in line with research on faultlines that suggests that a critical mass of individuals who share a common background is often necessary for their attitudes and values to have a significant effect on group behaviors (Li and Hambrick, 2005). With an increase in scientific founders there is likely to be shared cognition and mental models that support, and even amplify, the transfer of the scientist career imprint to the innovative startup. Because of their common career imprint, scientists will mold their innovative startups to reflect the norm of open science and thus, embrace open innovation through greater search breadth and depth. For example, because a challenge associated with pursuing search breadth centers on the willingness to draw information and specialized knowledge from diverse external sources, firm leaders need to be comfortable with new perspectives, sharing knowledge, and experimentation (Laursen and Salter, 2006) – characteristics associated with open science. Similarly, innovative startups with a greater number of scientists may be more

comfortable increasing search depth because they have been socialized to develop strong relationships when collaborating and to value a thorough and deep understanding of a phenomenon (Fleming and Sorenson, 2004). A shared career imprint can therefore be seen as facilitating mutual understanding and communication among founders that thereby ensures that the norms of the career imprint transfer to the startup. Taken together, we propose that the number of scientists on a founding team is positively related to the innovative startup's search breadth and depth.

Hypothesis 1a: The number of scientists on an innovative startup's founding team is positively related to search breadth.

Hypothesis 1b: The number of scientists on an innovative startup's founding team is positively related to search depth.

Boundary conditions in the career imprint from the scientific to the business world

When scientists start their own ventures, they face conflicting pressures that originate from the diverse normative cultures and mindsets of the scientific and business worlds (Jain et al., 2009; Visintin and Pittino, 2014). Because of the inherent tensions between the demands of scientific research and those of commercialization, when they engage in commercialization activities such as founding a business, scientists' startups appear to differ in the degree to which they embrace the principles of business or remain anchored to scientific norms (Knockaert et al., 2011; Visintin and Pittino. 2014). Accordingly, we explore how the worlds of science and commerce collide in innovative startups founded by scientists and how a startup's affinity for these two 'worlds' affects the outcomes from their founders' scientist career imprint.

Exploring when the scientist career imprint provides the greatest benefit to a new startup is important given recent advances to imprinting theory that have acknowledged how the advantages of transferring a career imprint to a new context can be particularly beneficial in certain circumstances but limiting in others (Marquis and Tilcsik, 2013). That is, while a previous career imprint can provide an advantage in a new career, it can also be a source of 'baggage' due to cognitive and normative rigidities that are ill-suited to the new context (Dokko et al., 2009). In developing our framework on how the scientist career imprint fosters open innovation and performance of innovative startups, we therefore explore how a practice rooted in the business world (i.e. strategic planning) and a logic rooted in the scientific world (i.e. pursuit of

noncommercial goals), modify the extent to which the number of scientist founders on a startup team encourages search breadth and depth.

Figure 4.1 provides a graphical representation of this conceptual framework.

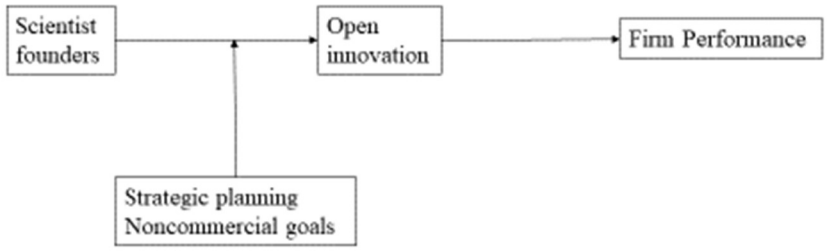

Figure 4.1 Conceptual framework

The Moderating Effect of Strategic Planning

Strategic planning captures the extent to which the founders of a new venture have envisioned the design of the business, identified a target market, and planned marketing and production efforts (Covin et al., 2006). In the context of innovative startups strategic planning can facilitate the anticipation of bottlenecks and problems that may arise in commercializing new products and services (Shane and Delmar, 2004) and helps entrepreneurs develop steps to achieve firm objectives (Brinckmann et al., 2010). Although strategic planning represents a practice rooted in the business world, more and more businesses founded by scientists are believed to participate in strategic planning either because the scientists were educated in business principles while pursuing their scientific degree and training (e.g., through more diffused entrepreneurship education programs) or because a business stakeholder or partner pushed the startup to do so (Patzelt and Shepherd, 2009; Rasmussen et al., 2011). Therefore, while strategic planning may not be typically associated with the scientist career (Jain et al., 2009), for those innovative startups with multiple scientist founders that participate in strategic planning, the 'best of both worlds' may be achieved whereby emphasis is placed on both the innovation and the business.

Strategic planning assists entrepreneurs in identifying information that is required for the business by helping them to better understand gaps in their knowledge and to process external information that comes from unfamiliar domains (Delmar and Shane, 2003; Dencker et al., 2009; Ketokivi and Castaner, 2004). Since

scientists are typically less familiar with the business domain and commercial side of innovation (Colombo and Piva, 2012; Mosey and Wright, 2007), strategic planning can make them more effective in identifying the industry and market knowledge required for successful commercialization. In turn, since scientists like to address problems by searching for greater information (Fleming and Sorenson, 2004), strategic planning should inspire founding teams with more scientists to search for various sources of external knowledge, thus leading to an increase in search breadth. Additionally, because scientists often seek in-depth insight when their perspective is challenged (Fleming and Sorenson, 2004), we expect strategic planning to increase the likelihood that the scientists will see a need for more in-depth information and want to develop strong relationships with parties that can provide guidance to their innovative startup. Accordingly, strategic planning should heighten the positive relationship between the number of scientist founders and search depth.

In contrast, when an innovative startup lacks strategic planning, scientist founders are less likely to identify gaps in their commercial knowledge and see the importance of gathering such information from business-related sources, thus limiting the extent to which the number of scientist founders increases search breadth and depth. From an imprinting perspective, our framework therefore suggests that the degree to which the scientist career imprint translates to search breadth and depth will be strengthened as strategic planning increases in innovative startups with more scientist founders.

Hypothesis 2a: Strategic planning positively moderates the relationship between the number of scientists on an innovative startup's founding team and search breadth.

Hypothesis 2a: Strategic planning positively moderates the relationship between the number of scientists on an innovative startup's founding team and search depth.

The moderating effect of noncommercial goals

Noncommercial goals capture the importance a startup places on the development of a technology and socio-emotional achievements related to the scientific community and society (Hayter, 2011). Existing research has shown that the goals pursued by innovative startups led by scientists often vary because the scientist founders differ in their attachment to the traditional norms of science (Huyghe et al., 2016; Lam, 2011). While some scientist founders appear to embrace the norms of entrepreneurship (Jain et al., 2009) and emphasize commercialization success over recognition from the scientific community (Lam, 2011), other scientists see their startups as a tool to advance research and gain a strong reputation in the scientific community (Hayter,

2011). As such, although an increasing number of scientists are choosing to start their own ventures, some of these innovative startups appear to prioritize noncommercial goals (Lam, 2011) such as concerns about the progress of a certain technology/innovation and its benefits to society (Jain et al., 2009).

In turn, the degree to which an innovative startup pursues noncommercial goals is expected to affect the extent to which a greater number of scientist founders increases search breadth and depth. In innovative startups with a strong emphasis on noncommercial goals, a greater number of scientist founders may not increase open innovation as much since the interaction among the scientist founders will be dominated by the discussion of noncommercial pursuits and efforts, rather than identifying the needs of the marketplace (Ensley and Hmieleski, 2005; Knockaert et al., 2011). In such a scenario, the value of external knowledge to their innovation's success in the marketplace is likely to be low (Lam, 2011). By emphasizing noncommercial goals, innovative startups with multiple scientist founders may also fail to identify the need for different types of information and knowledge related to the commercialization of their innovation (Knockaert et al., 2011; Rasmussen et al., 2011). Therefore, as noncommercial goals are prioritized by an innovative startup, the positive relationship between the number of scientist founders and search breadth should dampen since less external sources with information and knowledge about the industry and market will be sought.

Additionally, scientist founders who strongly emphasize noncommercial goals often lack appreciation for gaining business and commercialization knowledge and often avoid getting deeply involved with the business community (Jain et al., 2009; Lam, 2011). In turn, scientists who emphasize scientific-related attainments often struggle to develop relationships with business partners who could assist with commercialization pressures (Bruneel et al., 2015). Therefore, when innovative startups led by an increasing number of scientist founders prioritize noncommercial goals, they are less likely to build strong and frequent relationships with partners from the business world. This will limit the variety of external sources a startup intensely draws upon, thus limiting search depth. As a result, when noncommercial goals are emphasized, the positive relationship between number of scientist founders and search depth is expected to diminish.

Conversely, in startups with low emphasis on noncommercial goals, scientist founders are less likely to remain anchored to 'the pursuit of science for science's sake,' and instead should look to form relationships in the business community that can offer information and knowledge to guide their startups, thus increasing search breadth and depth. From an imprinting perspective, our framework therefore suggests that the degree

to which the scientist career imprint translates to search breadth and depth will be lessened as noncommercial goals are emphasized in startups with more scientist founders. These arguments lead to the following hypotheses:

Hypothesis 3a: Noncommercial goals negatively moderate the relationship between the number of scientists on an innovative startup's founding team and search breadth.

Hypothesis 3a: Noncommercial goals negatively moderate the relationship between the number of scientists on an innovative startup's founding team and search depth.

Open innovation and firm performance

In developing our framework on how the scientist career imprint fosters open innovation and success, we argue that an increase in search breadth and depth explains why the number of scientist founders has a positive effect on innovative startups' performance. Since relationships with external sources can help startups develop and market new products and services (Marion et al., 2015), we suggest that the benefits offered by search breadth and depth provide innovative startups with a performance advantage. More specifically, we propose that search breadth and depth help innovative startups to generate sales from the commercialization of their new products and services. Our study focuses on startup sales which is regarded as a key performance measure for innovative startups as it captures the success of commercializing innovations (Gilbert et al., 2006; Marion et al., 2015).

Through search breadth, innovative startups interact with a variety of external actors who have access to different knowledge sets that may not be available from internal sources, but are required for commercializing their innovations (Classen et al., 2012; Grandi and Grimaldi, 2005). Drawing on diverse sources of information, a startup can reference a larger pool of solutions to challenges that arise during the process of developing an innovative product or service for the market (Leiponen and Helfat, 2010). The innovative startup is thus more likely to obtain a variety of information that can be exploited in selling its innovation. For example, while technological information can help a venture generate sales by adding value to its new products and services, knowledge about customers can help the venture to identify and reach a target market for its innovation (Sapienza et al., 2004). Accordingly, in the commercialization of new products and services, search breadth is proposed to facilitate innovative startups in generating sales.

Similarly, we expect search depth to positively affect an innovative startup's performance. To fully take advantage of their interactions and exchanges with a variety of external sources, firms need to establish

deep relationships with at least some of these external sources (Grandi and Grimaldi, 2005; Laursen and Salter, 2006). Strong and frequent contact with external sources facilitates the transfer of specialized, tacit and fine-grained knowledge, which is expected to support the process of commercializing innovations (Chen et al., 2011; Chiang and Hung, 2010). For example, gaining in-depth knowledge from a customer group about their unmet needs helps an innovative startup to better target that customer group and penetrate the market (Sapienza et al., 2004). Moreover, sustaining a pattern of frequent interactions with external partners is believed to help a venture incorporate external information into its knowledge stock (Laursen and Salter, 2006; Sofka and Grimpe, 2010). Therefore, innovative startups with intense interactions with external sources should experience an increase in sales. In sum, these arguments lead us to formulate the following hypotheses:

Hypothesis 4a: Search breadth positively affects innovative startup's performance.

Hypothesis 4b: Search depth positively affects innovative startup's performance.

According to the previous hypotheses, the number of scientist founders in an innovative startup is expected to increase search breadth and depth, which in turn, are expected to positively affect startup performance, as captured by sales. We further propose that search breadth and depth mediate the relationship between the number of scientist founders in an innovative startup and the startup's performance. In other words, open innovation represents the *generative mechanism* (Baron and Kenny, 1986) through which scientist founders contribute to the performance of their innovative startups. Our conceptualization of open innovation as the generative mechanism that explains why innovative startups with scientist founders may gain a performance advantage over those that lack scientist founders is in line with research on cognitive biases. This research suggests that firm leaders tend to rely on information that is easily retrieved and most in line with their current beliefs, thus limiting their search for new information and different perspectives (De Carolis et al., 2009; Gassmann et al., 2010; Leiponen and Helfat, 2010). Hence, although entrepreneurs could benefit from the knowledge gained from search breadth and depth in commercializing their innovations (Chen et al., 2011; Eftekhari and Bogers, 2015), many are reluctant to seek information and assistance from external sources (Audet et al., 2007; Audet and St. Jean, 2007; Gassmann et al., 2010). This may explain their performance shortfalls (Hung and Chiang, 2010; Lee et al., 2010; Zhang et al., 2006). Proponents of open innovation have therefore argued that entrepreneurs may need to possess the right mindset in order to create an organizational culture that values outside competence, information, and know-how (Eftekhari and Bogers, 2015; West and

Bogers, 2014). We contend that the presence of multiple founders with a scientist mindset offers the 'right mindset' to encourage open innovation, thereby contributing to the performance of innovative startups. Therefore, we predict that as the number of scientists on a founding team increases, the greater the search breadth and depth, which in turn, lead to an increase in innovative startup's sales. This leads us to formulate the following hypotheses:

Hypothesis 5a: Search breadth positively mediates the relationship between the number of scientists on an innovative startup's founding team and innovative startup's performance.

Hypothesis 5b: Search depth positively mediates the relationship between the number of scientists on an innovative startup's founding team and innovative startup's performance.

4.3 Research methodology

Sample and data collection procedure

To test our research hypotheses, we draw on a sample of Italian innovative startups that started business activity in 2014 and were interviewed in 2015. We did so following the design of the Kauffmann Firm Survey (KFS, see for example Coleman and Robb, 2009). KFS is administrated yearly to a stratified cohort of US startups founded in 2004 and interviewed for the first time in July 2005. By focusing on a single cohort of startups interviewed in the founding period, the research design overcomes the problems of survivorship and retrospective biases (Heirman and Clarysse, 2004).

The sample for this study was identified drawing on a Register issued in 2012 by the Italian Government (Law 221/2012) to support innovative startups. This registry has recently been used to conduct research on the phenomenon of innovative startups (Colombelli, 2016; Ghio et al., 2016). We employed this registry for two key reasons. First, to be included in this registry startups have to focus on the development, production and commercialization of innovative products or services with high technological value. Following Colombelli (2016) and Ghio et al. (2016), the use of this registry therefore allowed us to limit our sample to genuine innovative startups, as defined in the literature. Second, a database of enterprises requesting government support represents an efficient way of identifying the population of interest (Heirman and Clarysse, 2004). In fact, Italian innovative startups have strong incentives to subscribe to the register, as they obtain several tax benefits and are subject to favored regulation.

Of the 4,787 innovative startups listed in the register in November 2015 we focused on the 1,471 that started their activities in 2014. We were able to collect the contact information (i.e., phone number) from 837 of these innovative startups, mainly from their websites and other online repositories. In 2015 we administrated a phone survey which resulted in responses from 380 innovative startups and a 45% response rate.

Survey data were collected though the phone survey using Computer-Assisted Telephone Interview (CATI). Following Colombo and Grilli (2010) we used χ^2 tests to show that there are no statistically significant differences between the distributions of the sample firms across size (measured as asset size category), sector and geographical area and the corresponding distribution of the population of 1,471 firms from which the sample was drawn. As usual in surveys of startups (e.g., Clarysse, Wright and Van de Velde, 2011), we targeted the entrepreneur leading the founding team (i.e., CEO or President), as s/he typically possesses the most complete information on the startup (Carter et al., 1994).

We also obtained secondary data related to firm performance from information contained in the registry and from balance sheets available through *Bureau van Dijk*. To collect longitudinal information on the startups' development, in 2017 we updated the database with information about financial performance from the last available fiscal year (i.e. balance sheets from December 2015).

In order to focus our analysis on innovative startups that were in the initial stage of the commercialization process, we selected startups that – at founding – did not already have a market-ready product or service. After removing outliers and missing values, we ended up with a final sample of 211 innovative startups, of which 95 have at least one scientist in the founding team. Also for this subsample we used $\chi 2$ tests to show that there are no statistically significant differences between the distributions of the sample firms across size (measured as asset class), sector and geographical area and the corresponding distribution of the population of 1,471 firms from which the sample was drawn. On average the innovative startups were founded by 2.9 entrepreneurs, with 23 innovative startups founded by solo-entrepreneurs.

Dependent variables

We used *sales* as our dependent variable since it is commonly used to capture a startup's success in commercializing a new product or service (Marion et al., 2015) and indicates the extent to which a startup has developed an innovation that is market-ready and attracts customers (Gilbert et al., 2006). Although sales

presents some limitations in capturing the value generated and appropriated by startups (Davidsson et al., 2009), it also possesses some important advantages since it reflects the successful commercialization of an innovative startup's first new product or service, which is critical to its survival (Marion et al., 2012) and profitable growth (Clarysse, Bruneel and Wright, 2011). For our empirical analysis the variable sales was computed as the natural logarithm of the revenues generated by the innovative startup one year after founding. As we calculated the natural logarithm of sales, we added the value of one to the value of sales, to account for cases where sales were zero (Visintin and Pittino, 2014). In our sample we had 42 innovative startups with 0 sales one year after founding, indicating that their innovative core product or service was not yet ready to be sold.

To measure the firm's open innovation behaviors, we employed Laursen and Salter's (2006) operationalization of the 'breadth' and 'depth' dimensions of open innovation. In a first step, we asked how frequently the innovative startup collaborates on innovation-related activities with each of the following different types of sources: customers, suppliers, competitors, universities or research organizations, public agencies. The frequency ranges from 'never' to 'daily' interactions (between the two extremes the respondent could answer 'less than once a year', 'yearly', 'once every four months', 'monthly', 'once every two weeks', 'weekly'). 'Breadth' measures how many external knowledge sources the firm integrates in its innovation processes (e.g., Leiponen and Helfat, 2010; Classen et al., 2012). To obtain the variable *search breadth* each knowledge source is assigned a binary variable, scoring 1 when the knowledge source was used and 0 elsewhere. *Search breadth* is then computed by summing up these scores and ranges from 0 to 5: 0 indicates that the startup does not use any external knowledge source, while 5 means that the startup uses all types of knowledge sources. *Search depth* measures how many of these 5 sources are frequently interacted with, in the firm's innovation processes (Keupp and Gassmann, 2010; Laursen and Salter, 2006). In this case, we created a binary variable for each source, taking the value of 1 when the given source is used to a high degree (i.e., at least monthly interactions), and 0 otherwise. Then the 5 sources were summed to create a score for *search depth*. Scores for search depth range from 0, whereby no knowledge source is deeply integrated within the startup's innovation process to 5, whereby the startup draws intensely upon all 5 types of external partners.

Independent variables

Scientist founders is the number of founders that were involved in research at a university or other research institution before starting the venture. Since the same number of scientist founders might impact startups differently depending on the founding team size, as a robustness check we also computed the ratio of scientist founders on a startup team as an alternate measure.

S*trategic planning* was measured with a multi-item scale that captures the strategy formation mode. We asked the entrepreneurs to answer three questions inspired by Chandler et al. (2011): 'The following questions deal with your process of starting the business. Please indicate your level of agreement with the following statements on a 1 to 5 Likert-type scale, where 1 indicates no agreement and 5 indicates full agreement: (1) Business had been designed and planned; (2) Target market had been researched and selected and a competitive analysis had been carried out; and (3) Production and marketing efforts had been designed and planned'. The variables show an inter-item reliability of 0.70 as measured by the Cronbach's Alpha, thus corresponding to the required threshold of 0.70 indicated by Nunnally (1978). Following Clarysse, Wright and Van de Velde (2011), we also checked convergent validity using Fornell and Larcker's (1981) internal consistency measure. We obtained a composite reliability index of 0.95 indicating that the measure is highly reliable. Therefore, we averaged the three items to obtain the variable *strategic planning*. A higher score on this scale indicates that the entrepreneurial strategy was planned in advance rather than having emerged over time (Mintzberg and Waters, 1985).

The measure of *noncommercial goals* was obtained by asking the importance of a set of objectives related to social rewards and intrinsic motivations to advance knowledge, as identified in science-based entrepreneurship research (Hayter, 2011; Jain et al., 2009; Lam, 2011). This literature emphasizes that founding a startup might be seen by scientists as a way to '(1) complete the development of a technology; (2) obtain reputation in the scientific community; (3) provide a public service to the society; and (4) create interesting and well-paying jobs for highly skilled people'. Respondents rated the importance of these objectives on a 1 to 5 Likert-type scale. After checking that the Cronbach's Alpha and composite reliability for the four items were 0.72 and 0.96 respectively, we averaged the four items to obtain a measure of noncommercial goals.

Control variables

We controlled for the startups' human, financial and technological resources, since resources at founding influence the development of a startup (Heirman and Clarysse, 2004). Information about the founding team were obtained by the respondent of the survey. More specifically, we controlled for the size of the founding team by including the variable *team size* (Colombo and Piva, 2012) to isolate the effect of multiple founders on open innovation and firm performance. To rule out possible alternative explanations in our empirical model, in particular the possibility that search was induced by a lack of human capital in the founding team, we controlled for founders' *management experience* and *sector experience*. Following the approach of Heirman and Clarysse (2004), startups' *management experience* is the years of experience in management positions of the founder with the highest level of such experience; and *sector experience* is the years of experience in the sector in which the startup operates of the founder with highest level of such experience.

The registry of innovative startups used to build the sample provides data on the value of the startups' assets coded into 8 financial classes. We used an ordinal variable ranging from 1 to 8 to capture the *class of capital* (Heirman and Clarysse, 2004) and control for the possible size-related emphasis on search.

We included the dummy variable *platform*, which takes the value of 1 if the respondent indicated that the startup's technology represents the base for several products or services, and 0 if it supports a specific product/service (Heirman and Clarysse, 2004), as this might affect open innovation and firm performance. As the knowledge structure of the technology in which the firm operates might contribute to the extent of collaboration, we control for appropriability of a firm's technology in two ways (Gans and Stern, 2003; Laursen and Salter, 2014). To capture whether the startup owns some form of technology protection, we include a dummy variable taking the value of 1 if the startup possesses *intellectual property* (0 otherwise). We also include a measure of *tacitness* of knowledge as the basis for the startup's innovation. Since tacit knowledge cannot be easily codified and communicated, it is more difficult to expropriate. The measure builds on the three indicators of tacitness developed by Karnani (2013). It ranges from 0 to 3, based on the number of tacitness indicators that apply to a firm's technology, according to the respondent who answered the following question: 'Which of the following statements applies to the type of knowledge that was the basis for the startup? (1) It was not documented or only documented incompletely; (2) It was personal practical knowledge, which was only known to me and/or a few other persons (e.g. members of a work group); and (3) It was a non-documented experience'.

Finally, since service firms have been found to operate differently from manufacturing firms with respect to open innovation (Mina et al., 2014), we controlled for the startup's sector. Based on the classification reported in the registry we created the dummy variable *services* (manufacturing being the base case).

4.4 Results

The means, standard deviations, and correlations of the variables in this study can be found in Table 4.1. As some of our variables are derived from survey data, we took several measures to mitigate concerns of common method bias (cfr. Kammerlander et al., 2015). First, in designing the survey, we decreased the respondents' motivation to provide answers driven by social desirability by assuring strict confidentiality. Furthermore, questions related to our variables were embedded in a more comprehensive survey so that respondents were unlikely to anticipate researchers' propositions. Second, after collecting data, we conducted an exploratory factor analysis that revealed no dominant factor explained variance in our sample (which would indicate the presence of common method bias). The analysis of our data revealed four factors with eigenvalues greater than one, which together accounted for 65% of the total variance. The largest factor explained only 58% of the variance. Further, a confirmatory factor analysis showed that the data structure proposed in the study ($\chi 2(51)= 77.78$, RMSEA = 0.05, CFI = 0.92) fit the data significantly better ($p<0.005$ as revealed by Chi-squared test) than a model with only one dominant factor ($\chi 2(54)= 224.72$, RMSEA = 0.12, CFI = 0.51).

Table 4.1 Construct-level descriptive statistics and correlation of constructs

Variable	*Mean*	*SD*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*
1. Startup sales	2.80	2.05	1														
2. Search breadth	3.51	1.17	0.20	1													
3. Search depth	2.80	1.16	0.21	0.74	1												
4. Scientist founders	0.84	1.22	-0.05	0.25	0.26	1											
5. Strategic planning	3.57	0.95	0.02	0.09	0.08	-0.05	1										
6. Noncommercial goals	3.95	0.79	-0.07	0.15	0.18	0.10	0.07	1									
7. Sales at founding	1.48	1.80	0.71	0.15	0.13	-0.03	0.01	0.03	1								
8. Team size	2.86	1.25	0.01	0.04	0.04	0.40	0.01	-0.07	-0.01	1							
9. Sector experience	8.51	6.62	0.04	0.05	0.11	0.16	0.06	-0.02	0.02	0.19	1						
9. Management experience	7.58	6.56	0.02	0.01	0.03	-0.08	0.02	-0.07	-0.01	0.00	0.20	1					
11. Platform	0.45	0.50	0.04	0.05	0.06	0.04	0.06	0.00	0.05	-0.01	0.09	-0.09	1				
12. Intellectual property	0.28	0.45	-0.01	0.05	0.02	0.15	-0.02	0.07	-0.07	0.19	-0.06	0.05	-0.03	1			
13. Tacitness	1.32	0.61	0.06	0.13	0.04	0.06	0.02	0.12	0.06	-0.08	0.00	-0.14	0.00	0.03	1		
14. Class of capital	3.13	1.08	0.00	0.03	0.07	0.02	0.11	-0.03	0.10	0.25	0.08	0.22	-0.04	0.02	-0.11	1	
15. Services	0.77	0.42	0.08	0.13	0.01	-0.04	0.04	-0.03	0.06	-0.06	-0.03	-0.12	0.10	0.06	0.08	-0.22	1

N=211

Absolute values of pairwise correlations above 0.14 are significant at the $p<0.05$

Our theoretical model depicts a moderated-mediation model with an indirect effect of number of *scientist founders* on *sales growth* via *search breadth* and *search depth* that varies in strength depending on the level of *strategic planning* and *noncommercial goals*. Before computing interaction terms, we standardized the independent variable and moderators, a procedure commonly employed to avoid multicollinearity issues (Aiken and West, 1991). After this operation, we checked for multicollinearity by examining the variance inflation factors (VIFs). All of the VIF values were below 2, indicating that multicollinearity is not a problem in our analyses (Kennedy, 2008). Additionally, we made our standard errors robust to heteroskedasticity where indicated by the Breush-Pagan/Cook-Weisberg test which we performed before running the regression models. Table III presents the results of the hierarchical moderated regression analyses used to examine the effect of the number of scientist founders on search breadth and depth, as well as the moderating effect of strategic planning and noncommercial goals on these relationships, as predicted by Hypotheses 1-3. Model 1 and Model 2 in Table III have search breadth and depth, respectively, as dependent variables. In Step 1 of both models, only control variables are entered accounting for 6% and 4% of the variance (R^2=0.06 for Model 1, R^2=0.04 for Model 2). Sales at founding ($\beta = 0.09$, $p < 0.05$), tacitness of startup's technology ($\beta = 0.24$, $p < 0.10$) and service industry ($\beta = 0.34$, $p < 0.10$) positively relate to search breadth.

The number of scientist founders, entered in Step 2, has a significant and positive effect on both search breadth ($\beta = 0.32$, $p < 0.01$) and search depth ($\beta = 0.33$, $p < 0.01$), providing support for Hypothesis 1a and Hypothesis 1b. In other words, at mean level of the moderators an increases of one scientist founders by a standard deviation (1.22 in this sample) causes an increase of 0.32 in search breadth and 0.33 in search depth, which correspond respectively to 0.27 and 0.28 of their standard deviation. The implication of such effect on actual firm performance is discussed below.

In Step 3, the interaction terms scientist founders x strategic planning and scientist founders x noncommercial goals are entered to test the predictions of Hypotheses 2-3. The interaction term scientist founders x strategic planning shows a positive and significant coefficient for both search breadth ($\beta = 0.13$, $p < 0.05$) and search depth ($\beta = 0.15$, $p < 0.05$), as predicted by Hypothesis 2a and Hypothesis 2b. We computed simple slopes at one standard deviation above and below the mean (Hayes, 2013). Results indicate that the simple slope for high strategic planning ($\beta = 0.48$, $p < 0.01$ for breadth; $\beta = 0.50$, $p < 0.01$ for depth) is stronger than that for low strategic planning ($\beta = 0.22$, $p < 0.10$ for breadth; $\beta = 0.19$, $p < 0.10$ for depth). Additionally,

we used the regions of significance approach (Preacher et al., 2007) to compute under what values the simple slope is no longer significant at $p<0.05$. This test showed that when strategic planning falls below -0.99 and -0.89 the simple effect of the number of scientist founders slope on search breadth and depth respectively becomes nonsignificant. To better interpret these results, we created a graphical representation of the relationships between number of scientist founders and search breadth (Figure 4.2) and number of scientist founders and search depth (Figure 4.3) at *high* and *low* levels of strategic planning (i.e., one standard deviation below and one standard deviation above the mean). The plots shown in Figures 4.2 and 4.3 graphically illustrate that the positive effect of number of scientist founders on search breadth and search depth becomes stronger at higher levels of strategic planning.

Regarding Hypothesis 3a and Hypothesis 3b, the coefficient of the interaction term scientist founders x noncommercial goals is negative and significant for search breadth ($\beta = -0.28$, $p < 0.01$) and is negative and marginally significant for search depth ($\beta = -0.17$, $p < 0.10$), thus providing support for Hypothesis 3a and Hypothesis 3b. Following the procedures outlined above we computed simple slopes of search breadth and depth on number of scientist founders for low and high values of noncommercial goals as well as the regions of significance. At low levels of noncommercial goals the effect of scientist founders on search breadth ($\beta = 0.62$, $p < 0.01$) and depth ($\beta = 0.52$, $p < 0.01$) is stronger than that for high noncommercial goals ($\beta = 0.07$, $p > 0.10$ for breadth; $\beta = 0.18$, $p > 0.10$ for depth). Moreover, the regions of significance reveals that the simple effect of the number of scientist founders slope on search breadth and depth remains positive and significant when noncommercial goals take values below 0.57 and 0.79, respectively. These results are graphically represented in Figures 4.4 and 4.5 whereby *low* and *high* noncommercial goals are depicted at one standard deviation below and one standard deviation above the mean. The plots reported in Figures 4.4 and 4.5 show that an increasing emphasis on noncommercial goals lessens the positive effect that the number of scientist founders has on both search breadth and search depth.

Table 4.2: Results of Hierarchical Moderated Regression Analysis for Search Breadth and Search Depth

	Model 1: Search Breadth			Model 2: Search Depth		
Independent Variables	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
Step 1: Controls						
Sales at founding	0.09**	0.09**	0.09**	0.07	0.08*	0.07*
	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)
Team size	0.03	-0.06	-0.05	0.01	-0.08	-0.07
	(0.07)	(0.08)	(0.07)	(0.07)	(0.07)	(0.07)
Industry experience	0.01	0.00	0.00	0.02	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Managerial experience	0.01	0.01	0.01	0.00	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Platform	0.07	0.05	0.04	0.12	0.09	0.08
	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)	(0.16)
Intellectual Property	0.12	0.03	0.00	0.06	-0.03	-0.07
	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)
Tacitness	0.24*	0.18	0.18	0.07	0.00	-0.01
	(0.13)	(0.12)	(0.12)	(0.13)	(0.13)	(0.13)
Class of capital	0.04	0.05	0.06	0.05	0.07	0.07
	(0.08)	(0.07)	(0.07)	(0.08)	(0.08)	(0.08)
Services	0.34*	0.38**	0.36**	0.04	0.09	0.07
	(0.19)	(0.18)	(0.18)	(0.20)	(0.19)	(0.19)
Step 2: Main Effects						
Scientists		0.32***	0.35***		0.33***	0.35***
		(0.08)	(0.08)		(0.09)	(0.09)
Strategic planning		0.10	0.10		0.08	0.06
		(0.07)	(0.07)		(0.08)	(0.08)
Noncommercial goals		0.13	0.07		0.17**	0.13
		(0.08)	(0.08)		(0.08)	(0.08)
Step 3: Interactions						
Scientists X Strategic planning			0.13**			0.15**
			(0.06)			(0.07)
Scientists X Noncommercial goals			-0.28***			-0.17*
			(0.08)			(0.10)
Constant	2.42***	2.73***	2.81***	2.14***	2.45***	2.52***
	(0.42)	(0.39)	(0.37)	(0.41)	(0.41)	(0.40)
R^2	0.06	0.14	0.18	0.04	0.13	0.16
ΔR^2		0.08	0.04		0.09	0.03
F		4.67***	3.83**		7.29***	2.90*

N=211; Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

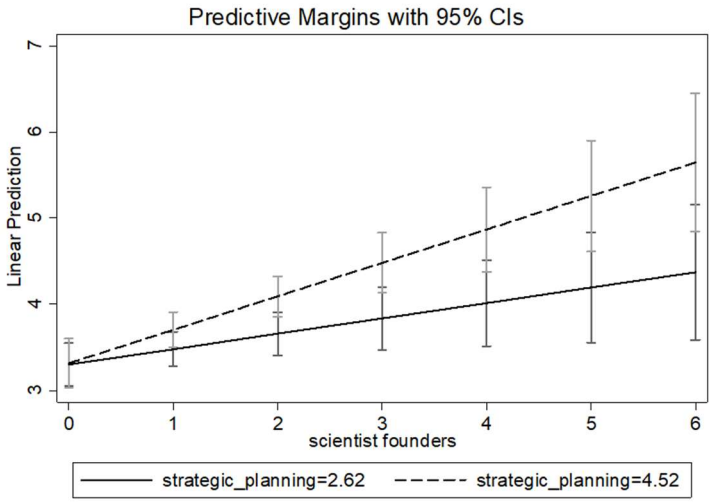

Figure 4.2 Relationship between scientist founders and search breadth at low and high level of strategic planning

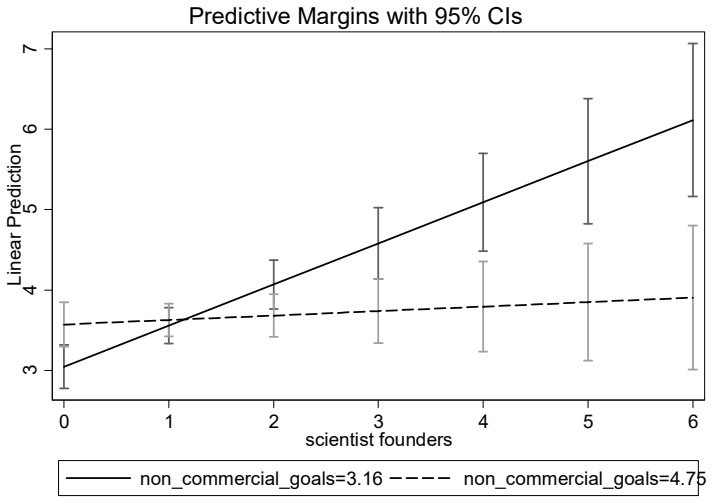

Figure 4.3 Relationship between scientist founders and search depth at low and high level of strategic planning

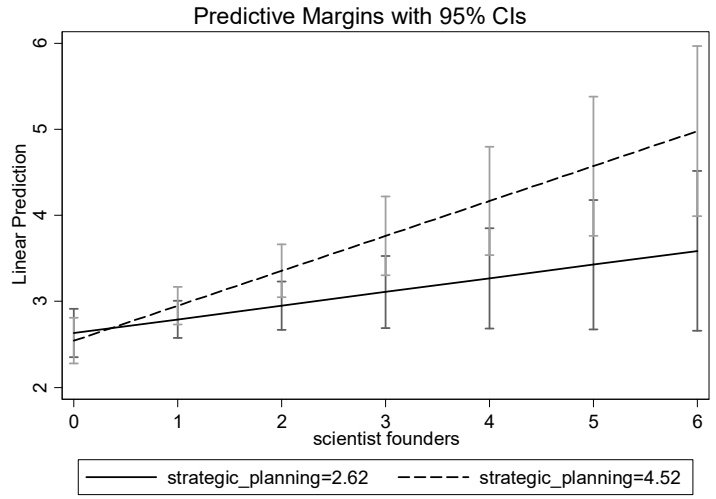

Figure 4.4 Relationship between scientist founders and search breadth at low and high level of noncommercial goals

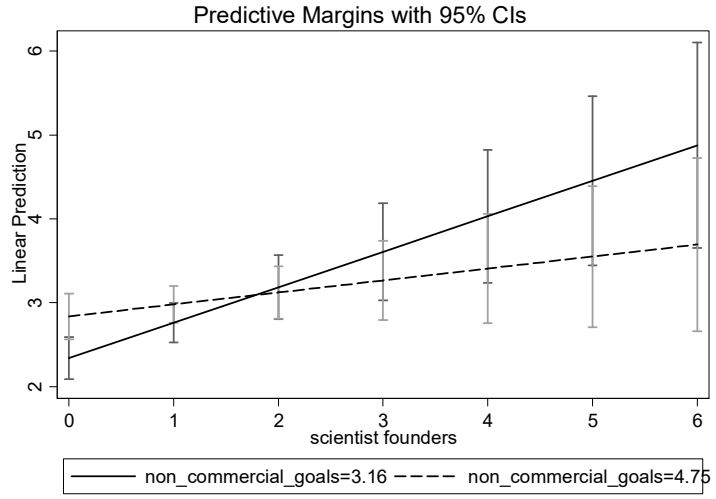

Figure 4.5 Relationship between scientist founders and search depth at low and high level of noncommercial goals

Table 4.3 presents the results of the hierarchical regression analysis used to test Hypotheses 4a and 4b (predicting that search breadth and depth positively affect sales). In step 1, we entered the control variables, of which only sales at founding is statistically significant ($\beta = 0.84$, $p < 0.01$). In steps 2 and 3, search breadth and depth were entered. The coefficients of both search breadth ($\beta = 0.20$, $p < 0.05$) and depth ($\beta = 0.23$, $p < 0.05$) are positive and strongly significant, supporting Hypotheses 4a and 4b.

Table 4.3: Results of Hierarchical Regression Analysis Predicting Startup Sales

Independent Variables	Step 1	Step 2	Step 3
Step 1: Controls			
Sales at founding	0.84***	0.83***	0.83***
	(0.06)	(0.06)	(0.06)
Team size	0.05	0.06	0.06
	(0.09)	(0.09)	(0.09)
Industry experience	0.01	0.00	0.00
	(0.02)	(0.02)	(0.02)
Managerial experience	0.02	0.02	0.02
	(0.02)	(0.02)	(0.02)
Platform	0.12	0.10	0.12
	(0.24)	(0.24)	(0.24)
Intellectual Property	0.00	-0.05	-0.03
	(0.18)	(0.18)	(0.18)
Tacitness	-0.06	-0.11	-0.11
	(0.22)	(0.22)	(0.22)
Class of capital	-0.17	-0.19*	-0.19*
	(0.11)	(0.11)	(0.11)
Services	0.09	0.01	0.07
	(0.26)	(0.26)	(0.26)
Step 2: Mediator			
Search breadth		0.20**	
		(0.09)	
Step 3: Mediator			
Search depth			0.23**
			(0.09)
Constant	1.66***	1.17**	1.19**
	(0.55)	(0.59)	(0.58)
R^2	0.51	0.52	0.52
$\Delta R^{2\,a}$		0.01	0.01
F		5.39**	4.97**

N=211; Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

[a] The difference ΔR^2 is computed with respect to Step 1

Mediation analysis (Hayes, 2013) is used to examine Hypotheses 5a and 5b, which predict that search breadth (i.e., Hypothesis 5a) and depth (i.e., Hypothesis 5b) mediate the relationship between scientist founders and the innovative startup's sales. Traditionally, the Baron and Kenny's (1986) stepwise approach has been adopted to test mediation. However, to properly utilize this stepwise approach requires several assumptions and conditions that are not always appropriate. In particular, the stepwise approach assumes that indirect effects are normally distributed although they often are not and it often fails to detect actual and significant

mediation effects ((see Hayes (2013) for an extensive treatment)). Specifically, the indirect effect of the independent variable on the dependent variable (and thus mediation) can exist in the absence of a significant total effect of the independent variable on the dependent variable, a prerequisite in the Baron and Kenny (1986) stepwise approach. Therefore, to test mediation, we followed a bootstrapping approach endorsed by Hayes (2013), because it overcomes the limitations of Baron and Kenny's (1986) stepwise method. By repeatedly resampling the gathered data thousands of times, the bootstrapping technique estimates confidence intervals of indirect effects without assuming normal distribution as in Baron and Kenny's (1986) stepwise method. An indirect effect is statistically significant at $p < 0.05$ when the 95% bias-corrected bootstrap confidence interval is entirely above or entirely below zero (Hayes, 2013). Table 4.4 presents the direct, indirect, and total effects for the mediation decomposition (Preacher and Hayes, 2004). The indirect effects of number of scientist founders on innovative startup sales via search breadth and depth were both significant, thus demonstrating mediation and providing support for Hypotheses 5a and 5b. Table 4.5 also shows that the direct effect of number of scientist founders on innovative startup sales is non-significant, suggesting *full mediation* (i.e., there is no unmediated effect of the independent variable on the dependent variable). Additionally, we computed 95% bootstrap confidence intervals for the indirect effects of the number of scientist founders on innovative startup sales via search breadth and depth. As shown in Table 4.5, 0 falls outside of these intervals, thus demonstrating that the examined indirect effects are significantly different from zero at $p < 0.05$, providing further support for Hypotheses 5a and 5b.

Table 4.4: Table IV: Effect Decomposition for Mediation

	Effects of Scientists on Startup Sales				
Mediator	Direct: Unmediated	Indirect: Mediated by Search	Total	R^2	F
Search Breadth	-0.14 (0.12)	0.07** (0.04)	-0.07 (0.11)	0.52	18.07***
Search Depth	-0.16 (0.12)	0.09** (0.04)	-0.07 (0.11)	0.52	18.07***

N=211; Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
The analysis was controlled for controls and main effects

Table 4.5: Bootstrap Results for Indirect Effects of Scientists on Startup Sales

	Bias-Corrected Confidence Intervals	
Mediator	Lower	Upper
Search Breadth	0.01	0.16
Search Depth	0.03	0.18

N=211; 95 percent confidence; number of bootstrap samples used: 10,000
If the confidence interval does not include zero, the indirect is significantly different from zero at p< .05 (two-tailed test)

We also computed the indirect effects of number of scientist founders on innovative startup sales via search breadth and search depth at different levels of the moderators drawing on the bootstrapping technique recommended by Hayes (2013). Table 4.6 shows results. These indicate that the indirect effect of number of scientist founders on innovative startup sales via search breadth and depth is stronger at high strategic planning ($\beta = 0.10$, $p < 0.05$ for search breadth; $\beta = 0.12$, $p < 0.05$ for search depth) rather than low strategic planning ($\beta = 0.05$, $p < 0.05$ for search breadth; $\beta = 0.05$, $p < 0.05$ for search depth). Additionally, the indirect effect of number of scientist founders on innovative startup sales via search breadth and depth is stronger at low noncommercial goals ($\beta = 0.12$, $p < 0.05$ for search breadth; $\beta = 0.13$, $p < 0.05$ for search depth) rather than high noncommercial goals ($\beta = 0.01$, $p < 0.10$ for search breadth; $\beta = 0.04$, $p < 0.10$ for search depth).

Since sales has been log-transformed and the variable number of scientist founders has been standardized, the value of the bootstrap coefficient can be interpreted as the percentage increase of startup sales for an increase by one standard deviation of the number of scientist founders (which corresponds to 1.22 in our sample). At the mean levels of strategic planning and noncommercial goals, the indirect effects of 1 standard deviation increase in the number of scientist founders on sales via search breadth and search depth are 7% and 9% respectively. These effects increase up to 10% and 14% respectively at *high* levels of strategic planning and up to 12% and 13% at *low* levels of noncommercial goals. Additionally, indirect effects of number of scientist founders on startup sales via search breadth and search depth are reduced to 5% at *low* levels of strategic planning, and to 1% and 4% at *high* levels of noncommercial goals. These findings demonstrate the practical significance of our findings concerning the positive influence the number of scientist founders has on innovative startup performance due to their support for open innovation. The findings also demonstrate the relevance of the moderators in shaping the extent to which the number of scientist founders contribute to their innovative startup performance.

Table 4.6: Results of Moderated Mediation Analysis of the Effect of Strategic Planning and Noncommercial Goals on the Scientists–Search–Startup Sales Relationship

Mediator: Search breadth	Indirect Effects	Bias-Corrected Confidence Interval[a]	
		Lower	Upper
Low Strategic Planning	0.05** (0.03)	0.01	0.13
High Strategic Planning	0.10** (0.05)	0.01	0.22
Low Noncommercial Goals	0.12** (0.03)	0.01	0.27
High Noncommercial Goals	0.01* (0.05)	-0.02	0.08
Mediator: Search depth	**Indirect Effects**	**Bias-Corrected Confidence Interval[a]**	
		Lower	Upper
Low Strategic Planning	0.05** (0.03)	0.01	0.14
High Strategic Planning	0.14** (0.06)	0.05	0.27
Low Noncommercial Goals	0.13** (0.06)	0.03	0.27
High Noncommercial Goals	0.04* (0.03)	-0.00	13

N=211; Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The analysis was controlled for controls and main effects

[a] 95 percent confidence; number of bootstrap samples used: 10,000

If the confidence interval does not include zero, the indirect is significantly different from zero at p< .05 (two-tailed test)

Robustness checks

We performed several robustness checks. First, we tested the robustness of our results in regards to the choice of econometric specification, employing a fractional logit model and a negative binomial as alternative estimation methods. Because the variables *search breadth* and *search depth* are counts of scores and take on integer values ranging between 0 and an upper bound (5 is the maximum of sources), they can be transformed to proportional variables and thus, analyzed with a fractional logit model (Papke and Wooldridge, 1996; Laursen and Salter, 2014). Additionally, as search breadth and depth are count data with a limited number of zeros, Poisson or negative binomial regression also represent appropriate statistical analysis tools to use. The results of these estimation methods are in line with the results shown in the third step of Model 1 and Model 2 of Table III.

The second robustness check focused on the operationalization of our independent variable: number of *scientist founders*. As alternatives, we ran our model (1) using an independent variable that captured the proportion of scientists involved as founders in an innovative startup; and (2) using a dummy variable taking

the value of 1 if at least one scientist founded the innovative startup. In both cases results remained substantially unchanged with the only exception being that the moderator strategic planning was reduced in significance. Additionally, since our framework suggests that multiple scientist founders may be necessary to encourage open innovation, we explored whether having only one scientist founder is associated with greater search breadth and depth in comparison to innovative startups with no scientist founders. To do so, we estimated a model where we replaced number of scientist founders with a set of two dummy variables: one taking the value 1 if the innovative startup has no scientist founders (0 otherwise); the other taking the value of 1 if the innovative startup has at least two scientist founders (0 otherwise); innovative startups with only one scientist founder representing the base case. In both models with search breadth and search depth as the dependent variables, the dummy variable indicating 0 scientist founders was not significant, while the dummy variable associated with at least two scientist founders was positive and significant. The results of this test show that innovative startups with only one scientist founder do not engage in more search breadth or search depth than those with no scientist founders. However, as the number of scientist founders increases, so too does the innovative startup's search breadth and depth, thus supporting our framework.

Third, we tested our research hypotheses in a sample where we removed innovative startups founded by solo-entrepreneurs (23 innovative startups, corresponding to about 11% of our sample). Results using this reduced sample continued to provide support for our hypotheses. We also tested an alternative model where we used the square of the variable number of scientist founders to test for the possible presence of curvilinear effects; however, no such effect was found. Additionally, since previous research (Laursen and Salter, 2006) identified an inversed U-shaped relationship between open innovation and sales, we tested a model with the square of search breadth and search depth. Here, we also did not find a curvilinear effect.

Finally, we tried different measurements of our mediator and dependent variables. As an alternative dependent variable we utilized profitability, captured by ROA, because the entrepreneurship literature views profitability as a key measure of sustainable business success (Davidsson et al., 2009). We found that search breadth and depth are positively and significantly related to ROA, and that search breadth and depth mediate the effect of number of scientist founders on ROA.

Regarding our mediator variables, a different specification of our mediator variables was obtained by excluding from the computation of search breadth and search breadth 'universities or research organizations'

as knowledge sources. We used this robustness check to see if our findings are driven by a tendency for scientists to collaborate with universities or research institutions. Again, the results remain consistent and unchanged.

Another approach we used to account for the possibility that an innovative startup overly targets specific knowledge sources was based on the study of Köhler et al. (2012). After a principal component factor analysis on the frequency of interactions with different partners was performed, two individual factors emerged. The first factor, which we call business-driven search, corresponds to interaction with firms (i.e. suppliers, customers and competitors). The second factor, science-driven search, corresponds to interaction with universities and research institutes as well as public agencies. The number of scientist founders was found to have a positive and significant effect on science-driven search, but a non-significant direct effect on business-driven search. On the other hand, the interaction terms number of scientists x strategic planning and number of scientists x noncommercial goals were both found to be strongly significant with a positive and negative sign, respectively. In other words, for the effect of number of scientist founders on business-driven search to be positive and significant, high levels of strategic planning and low levels of noncommercial goals are needed.

4.5 Discussion

Over the last decade, research has acknowledged the increasing role of scientists in the commercialization of new technologies and science-based discoveries (Ambos et al., 2008; Shah and Panke, 2014). While scientists were once bound to their labs, many are now venturing into the world of entrepreneurship as they seek to commercialization their innovations. With this shift in scientists' role from mere generators of innovations to active actors in the commercialization of such innovations (Murray, 2004), studies have sought to explain why some scientists decide to start a business (Aschhoff and Grimpe, 2014; Fini and Toschi, 2016; Powers and McDougall, 2005). We build on this vibrant stream of research by exploring how scientists' involvement in innovative startups contributes to firm performance.

Drawing from imprinting theory, our framework proposes that the number of scientists on a founding team positively contributes to firm performance because the scientist career imprint, which reflects norms of open science, translates to an embrace for open innovation in the entrepreneurship context. Moreover, building on research that suggests the need for scientists interested in commercialization to develop a business mindset

and deemphasize noncommercial goals (Ambos et al., 2008; Bercovitz and Feldman, 2008; Knockaert et al., 2011), our framework takes into account how strategic planning and noncommercial goals affect the way in which the number of scientists on a founding team contributes to open innovation and thus firm performance.

Our study, which included innovative startups founded by one to multiple scientists as well as those that did not include scientist founders, provides strong support for our framework. As the number of scientists on a founding team increased, so too did the innovative startup's search breadth and depth. In turn, both search breadth and depth were shown to increase firm performance. Results from our robustness tests further revealed that simply having one scientist on a founding team is not sufficient in encouraging search breadth and depth. From an imprinting perspective, our study therefore suggests that the scientist career imprint has a unique influence on innovative startup's behavior. Specifically, we argued that the scientist career imprint, which is characterized as upholding norms associated with open science (Bercovitz and Feldman, 2008; Jain et al., 2009), translates to an appreciation for open innovation in the entrepreneurship context. As such, open innovation, assessed via search breadth and depth, serves as a mechanism through which scientists have an imprinting effect on firm performance. However, for the scientific norm of open science to translate to open innovation in an innovative startup, multiple scientists on a founding team are needed. Thus, while our findings demonstrate how scientists can be instrumental in the successful commercialization of innovations, they also contribute to imprinting theory by suggesting that the transfer of a career imprint to a new career context is not guaranteed. Rather, multiple founders who share a career imprint appear necessary for the values and behaviors from the previous career to take hold in a new context.

Additionally, we extend research that recognizes how some scientist founders develop a business mindset while others attempt to fully preserve their scientific mindset (Jain et al., 2009) by demonstrating that strategic planning, a practice rooted in the business world, and the pursuit of noncommercial goals, a practice rooted in the scientific world, affect the extent to which the number of scientist founders increase search breadth and depth. Results indicated that a high level of strategic planning significantly increases the search breadth and depth of innovative startups with a greater number of scientist founders. For startups that lacked scientist founders, strategic planning had much less of a positive effect on search breadth and depth. Regarding noncommercial goals, our results revealed that as the number of scientist founders increased, high emphasis on noncommercial goals dampened, and low emphasis on noncommercial goals heightened search breadth and

depth. Thus, in taking into account how the business and scientific worlds collide for scientist founders, our study highlights the need for scientists to adapt to the business world by participating in strategic planning and downplaying the pursuit of noncommercial goals, particularly as the number of scientists on a founding team increases. From an imprinting perspective, it therefore appears that scientists working together on a founding team who incorporate a business mindset into their startup's practices are best poised to embrace search breadth and depth, which in turn, contribute to their startup's performance.

This paper also adds to literature on open innovation antecedents and outcomes, which to data has tended to focus on established firms (Brunswicker and Vanhaverbeke, 2015; Classen et al., 2012; Lee et al., 2010). Our study shows that open innovation is beneficial to the commercialization activities undertaken by innovative startups. The positive effect of search breadth and search depth on startup's sales underscores that the number and frequency of interactions with external sources in regards to innovation are critical in the performance of innovative startups. Moreover, by illustrating scientist founders' proclivity to pursue open innovation, we offer novel insight into why many firms appear reluctant to increase their search breadth and depth; their startups do not possess the shared career imprint of multiple scientist founders. Thus, although many entrepreneurs appear unwilling to seek information from external sources (De Carolis et al., 2009; Gassmann et al., 2010; Lee et al., 2010; Zhang et al., 2006), our findings indicate that if entrepreneurs were to involve multiple scientists in their startup teams, or perhaps emulate the scientist career imprint which reflects norms of open science, they may be more likely to participate in open innovation and thus, improve their chances for success.

Contributions and implications for imprinting theory

By proposing that the scientist career imprint leads to an appreciation for open innovation, our framework explains how a career imprint from a previous non-entrepreneurial career can be tailored to the entrepreneurial context. In doing so, we respond to the recent call by Marquis and Tilcsik (2013) for a more nuanced theory of imprinting that explains how imprints developed in relation to specific tasks from a previous context can be translated to a different environment. By taking advantage of the specific case of scientist founders and the related literature, we hypothesized that the scientist career imprint translates to an appreciation for open innovation in innovative startups. This has important implications for research that calls attention to the

important ways that entrepreneurs' life experiences affect their business decisions (Bryant, 2014; Mathias et al., 2015). We further illustrate that to understand the consequences of imprints internalized by entrepreneurs prior to founding their ventures, it is important for researchers to consider the number of founders who possess a specific career imprint. In this way, we respond to the recent call by Simsek et al. for imprinting research to provide "insight into *why* and *when* certain characteristics are imprinted" and the "organizational factors that predict the extent and potency of imprinting" (2015: 306). By sharing a career imprint, founders may be more comfortable maintaining norms from their previous profession and tailoring accepted behaviors from that profession to their startups.

Finally, by showing that open search behaviors imprinted by scientists on innovative startups fully mediates the positive relationship between number of scientist founders and firm performance, we extend the limited imprinting research on the specific mechanism through which founder's imprinting affect firm outcomes such as financial performance (Marquis and Hoang, 2010; Simsek et al., 2015). Therefore, to have a more fine-grained understanding of the impact of founders' previous life or career experiences on the performance of their ventures, future research should explore the specific career imprints possessed by founders and how they transfer, adapt and modify to the entrepreneurship context. imprinted behaviors or characteristics whereby founders affect performances. This could inform, for example, research showing that imprints from a parent company may be detrimental or beneficial to corporate spinoffs (Chatterij, 2009).

Limitations and future research directions

Notwithstanding its contributions, our study has some limitations which offer opportunities for further investigation. First, albeit longitudinal, our study covers a limited time span. Future research using data collected longitudinally over more years would provide further contribution to imprinting theory by shedding light on the persistence and evolution of imprinted behaviors and subsequent organizational performance (Marquis and Tilcsik, 2013; Simsek et al., 2015).

A second limitation of this study is that we had not the possibility to interview separately each founding member. Therefore, despite accounting for the industry and management experience of the team, we did not directly measure the specific career experiences of each founder. For example, having detailed information about the scientific career of founders (e.g., inter- and multi-disciplinary, collaborations, industry ties etc.)

before they started their venture, could further inform the transfer and adaptation of their career imprints to entrepreneurship. Future research with more information on the entire career histories of each individual founder could add valuable insights to the imprinting perspective by showing how 'intersecting' career imprints at the individual- and team-levels affect startups' behaviors and performance (Marquis and Tilcsik, 2013). Additionally, future research could take advantage of surveying each founders to assess inter-rater reliability of firm-level variables.

Finally, in this study we focused only on a cohort of Italian innovative startups. While this type of research design is quite common (e.g., Clarysse, Wright and Van de Velde, 2011), future studies using a larger dataset comparing the impact of scientists' imprinting among firms from different institutional contexts and also at different stages of the developmental life cycle would be useful in extending the generalizability of our findings.

Practical implications

By illustrating how scientist founders contribute to the commercialization success of innovative startups, this study offers several managerial and policy implications. First, since the number of scientists was shown to positively influence open innovation, managers and entrepreneurs should consider taking advantage of the positive contributions that scientists make to the innovation process. In the context of startups' formation, entrepreneurs should consider involving several scientists in the startup's foundation or learn to emulate their appreciation for external sources of information. To the extent that established firms engage in corporate entrepreneurship, managers should foster greater interaction among scientists and research departments responsible for the delivery of ready-to-market innovations. They should also seek scientists' advice and assistance in identifying gaps in knowledge and developing strategies to gather new and diverse information. If entrepreneurs and managers can act more like scientists by appreciating the viewpoints and knowledge of external sources, their firms may accrue advantages in the commercialization of innovations.

Second, the idea that the scientist career imprint supports open innovation which, in turn, benefits the performance of innovative startups, offers insight for entrepreneurship education. In particular, entrepreneurship education often struggles to identify approaches, tools and learning experiences that prepare potential entrepreneurs to overcome liabilities of newness and smallness encountered at founding (Chrisman

et al., 2004; Honig, 2004; Politis, 2005). Our results suggest that scientists are more willing to search for external knowledge, a key feature of opportunity recognition. Despite the remarkable achievement of entrepreneurship education as a discipline, the value of imitating the scientific norm of open science has not been stressed. We hope the findings from our study encourage educators to see that there is much to learn from scientists who venture into the world of entrepreneurship.

Finally, the finding that the number of scientist founders increases search breadth and depth, especially for those startups engaged in greater strategic planning and limit the importance of noncommercial goals, has important implications for the design of policy programs that support and prepare scientists to commercialize their innovations. Scientists should be trained to develop strategic plans for a business through entrepreneurial education, entrepreneurship centres and incubators. Additionally, even though scientists' commercialization activities are becoming more legitimate in the scientific community, efforts are still needed to make scientists feel rewarded and satisfied from the commercial application of science (Ambos et al., 2008; Jain et al., 2009). Engaging with peers who have already transitioned to entrepreneurship might serve as an effective source of support and inspiration for scientists contemplating starting their own ventures (Aschhoff and Grimpe, 2014; Bercovitz and Feldman, 2008).

4.6 Conclusion

In conclusion, by extending imprinting theory to the study of innovative startups we developed a framework that proposes that the scientist career imprint translates to an appreciation for open innovation in the entrepreneurship context which thereby contributes to firm performance. Our research illustrates the advantages that the scientist career imprint can bring to an innovative startup and the importance of involving multiple scientist founders if the firm is to benefit from the scientist career imprint. Our study therefore offers theoretical contributions to imprinting theory and increases our understanding of how norms associated with a previous career imprint can be tailored to a new context. Findings further indicate that much strategic planning and little emphasis on noncommercial goals augment the positive relationship between number of scientist founders and open innovation. Therefore, while a greater number of scientists on a founding team enhances open innovation, our findings suggest that those startups that temper the scientific mindset with a business mindset will have an advantage in commercializing their innovations.

5. HOW THE VALUE CREATED BY STUDENT ENTREPRENEURS AFFECTS THEIR PSYCHOLOGICAL WELL-BEING: A SOCIAL IDENTITY PERSPECTIVE

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5.1 Introduction

Entrepreneurial activity represents a source of both stress and reward that can have a profound impact on the entrepreneurs' *psychological well-being* (PWB) (Andersson, 2008; Carree and Verheul, 2012; Shepherd and Haynie, 2009a), here defined as the mental health and overall psychological condition of an individual required for effective human functioning (cf. Uy et al., 2013; Uy et al., 2017). Understanding why and how entrepreneurs preserve well-being in spite of the obstacles and pitfalls of the entrepreneurial process has been a central question in entrepreneurship research because it provides an opportunity to illuminate why some individuals persist in their efforts to create and develop new ventures (Bradley and Roberts, 2004; Schjoedt, 2009; Sexton and Smilor, 1997). Recently PWB has been indicated as a "valuable dependent variable in its own right" (Shepherd and Haynie, 2009a: 330). This demonstrates a growing interest of entrepreneurship

scholars for the health of the individual entrepreneur in addition to the functioning of the venture (Uy et al., 2017).

To date research has widely supported the idea according to which venture's performance represents a fundamental determinant of entrepreneurs' well-being (Carree and Verheul, 2012). The strong relationship between firm's and entrepreneur's functioning is rooted in founders' tendency to identify themselves with their ventures (Fauchart and Gruber, 2011; Shepherd and Haynie, 2009a) and to consider their business as a 'baby' (Cardon et al., 2005). For example, many studies empirically show the positive consequences of the *economic value* created by the venture for the entrepreneur on job and life satisfaction (Binder and Coad, 2013; Cooper and Artz, 1995; Kautonen and Palmroos, 2009; Lange, 2012), a central element of human well-being (Andersson, 2008; Binder and Coad, 2013; Hmieleski and Corbett, 2008). Next to private wealth, there are other performance dimensions which are meaningful to entrepreneurs and which relate to creating wealth for others (Hitt et al., 2011; Rindova et al., 2009; Venkatamaran, 1997). For example, entrepreneurs' main concern is often about creating something new (Amit et al., 2001; Corman et al., 1988) thereby making the difference for their community of target customers (Fauchart and Gruber, 2011; Powell and Baker, 2014) and generating *community value*. In other cases, entrepreneurs mainly care about *societal value* (Fauchart and Gruber, 2011), that is contributing to society as a whole, for example by addressing environmental issues or societal challenges such poverty and hunger (Austin et al., 2006; Cohen et al., 2008). It appears from extant literature that aspects of the individual entrepreneur represent an important contingency in the relationships between these three types of value (i.e., economic, community, social) and PWB. For example, it has been shown that the impact of monetary gains to entrepreneurs' satisfaction with their job is affected by individual's pecuniary motivations (Cooper and Artz, 1995; Kautonen and Palmroos, 2009). Fauchart and Gruber (2011) have illustrated that the extent to which economic, community and societal value creation matter for entrepreneurs depends from their identity, which they try to express through their ventures. On the other hand, in economic theory of well-being the prescriptions imposed by the culture social environment represent a key boundary condition in the relationship between the well-being obtained by individuals and the outcomes of their actions (Akerlof and Kranton, 2000; Diener and Seligman, 2004). More specifically, in the entrepreneurship field, it has been suggested that founders base their self-evaluation on the extent to which the outcomes of their action conforms to behavioral patterns and values imposed by the social groups they are member of (Fauchart and Gruber,

2011). In fact, entrepreneurs derive a sense of well-being when the value created by their firm matches specific social identities they aspire to (Powell and Baker, 2014) such that their role as entrepreneur is reconciled with a sense belonging to social groups (Shepherd and Haynie, 2009a). To date, however, research has to large extent neglected aspects of the social context in which entrepreneurs are embedded in discussing the influence of firm's value creation on PWB. Accordingly, the objective of this paper is to investigate how the behavioral prescriptions imposed by social context entrepreneurs are exposed to affects the impact of the economic, community and societal value created by the firm on entrepreneurs' PWB.

To do so, we focus on student entrepreneurs defined as university students who develop a business alongside their university studies (Bergmann et al., 2016; Nielsen et al., 2015). Student entrepreneurship provides a valuable research setting to study the influence of the social context on the relationship between the outcomes of business activity and entrepreneurs' PWB. University culture is known to impose norms and behavioral prescriptions that condition its members' behaviors, beliefs and feelings (Aschhoff and Grimpe, 2014; Huyghe and Knockaert, 2015). Students, in particular, are strongly influenced by the university institution in their entrepreneurial endeavors (Bergmann et al., 2016; Nielsen et al., 2015). One reason for university's importance for students is that, pupils' sense of belonging and identification with their educational institution is crucial to their well-being (Bizumic et al., 2009; Cameron, 1999).

Building on these arguments, in this paper we propose that aligning students' actions to university's culture is central to their PWB. More specifically, we take advantage of social identity theory (Stets and Burke, 2000) and its recent applications to entrepreneurship research (e.g., Powell and Baker, 2014; Yitschaki and Kropp, 2016) to study how the relationship between economic, community and societal value created by the ventures of student entrepreneurs and their PWB is affected by university's engagement in commercialization mission. Also known as the "third mission", this represents a visible dimension of its culture with respect to entrepreneurship (Huyghe and Knockaert, 2015). Theories of identity come at help because they provide theoretical lens that explain the gain and losses in well-being resulting from congruence and incongruence between individual's behavior and the prescriptions imposed by relevant social groups (Akerlof and Kranton, 2000; Stets and Burke, 2000). In the specific case of student entrepreneurs, we expect that different dimensions of value creation associated to their entrepreneurial role, match to a different extent the behavioral prescription expressed by a university culture focused on the third mission, which views venture creation and development

as a tool to turn scientific knowledge into commercially viable innovations valuable for the society (Jain et al., 2009; Visintin and Pittino, 2014). We therefore hypothesize and test on a sample of 138 student entrepreneurs how the university's involvement in the commercialization mission moderates the relationship between different dimensions of value created by student' ventures and their PWB.

This paper provides several contributions to extant literature. First we contribute to research on PWB by conceptualizing different types of value created by ventures that can impact entrepreneurs' PWB and test their impact on PWB simultaneously. Second we examine the contingent role of the entrepreneurs' social context in the relationship between venture's performance and PWB, thereby highlighting the multilevel nature of entrepreneurs' well-being in response to value creation. Finally, we contribute to literature on student entrepreneurship showing that university can do more than instilling into students the knowledge, the ideas and the intentions to start a business, as shown by previous research (Shah and Pahnke, 2014; Souitaris et al., 2007). University can also create an environment that affects the extent to which student entrepreneurs obtain well-being from the value created by their firms.

5.2 Theory and hypotheses

In order to frame the influence of the university social context on the relationship between the different types of student entrepreneurs' attainments and their PWB we draw on *social identity theory* (Tajfel and Turner, 1979). It postulates that individual's self-concept derives from the knowledge of being part of a social group which imposes certain behavioral prescriptions (Akerlof and Kranton, 2000; Stets and Burke, 2000). Social identity theory has its roots in social psychology. Subsequently it has been adopted by economists to explain why individuals obtain well-being from non-economic attainments (Akerlof and Kranton, 2000; Falck et al., 2012). This extends the basic assumptions of standard economic theory of utility which presumes perfectly rational individuals who respond only to economic incentives. When individuals perceive that their behaviors conform to the set of expectations associated to the social groups they belong to, they increase their self-esteem and self-worth (Stets and Burke, 2000), thereby experiencing a positive psychological state of relief. As a result, humans gain well-being, when they perceive that their actions match their social identity (Akerlof and Kranton, 2000). Conversely, when there is incongruence between individual's behavior and his/her self-concept, the individual experiences stress and mental strain which negatively affect his/her PWB.

In the context of entrepreneurship, social identity theory has been used to explain why entrepreneurs respond to economic and non-economic incentives. For example, it illustrates that the presence of entrepreneurially engaged peers in the social context enhances social desirability of an entrepreneurial career up to the point the individuals are willing to accept lower expected earnings compared to job alternatives (Giannetti and Simonov, 2009; Falck et al., 2012). Additionally, drawing on identity theories scholars have shown that founders strive to find a match between what they do as entrepreneurs the social position they aim to occupy, i.e., social identity aspiration (Powell and Baker, 2014). Research like this suggests that entrepreneurs gain PWB when their actions as entrepreneurs allow them to achieve the sense of 'belonging' associated with social identity (Shepherd and Haynie, 2009a).

There are reasons to believe that student entrepreneurs, i.e., students who run a venture while attending university (Bergmann et al., 2016), are particularly concerned with social identity considerations because, along creating and developing their own business, they are members of the university social group (Nielsen et al., 2015). For example, drawing social identity theory, Falck et al. (2012) have shown that being embedded in a social context with peers that have a positive inclination towards entrepreneurship increases the utility students derive from being entrepreneur. They suggested that having entrepreneurial intentions strengthens students' sense of belonging to social groups of entrepreneurially-inclined school peers, because it is consistent with the expectations associated to being member of that group. University students, in particular, obtain psychological relief and social support when they can benefit from a social identity as university students; without a sense of belonging and identification with university their PWB is diminished (Bizumic at al., 2009; Cameron, 1999). More specifically, student entrepreneurs are exposed to the behavioral prescriptions imposed by the university entrepreneurial culture, which conditions the entrepreneurial actions of university members (Ensley and Hmieleski, 2005; Huyghe and Knockaert, 2015). Universities differ in the extent to which they embrace entrepreneurship within its culture. While traditional university education has been designed to prepare students to wage-payed jobs, educating about and for entrepreneurship is becoming more diffused in higher education (Fayolle, 2013; Mayhew et al., 2016). Moreover, the traditional mission of generating scientific knowledge – historically viewed as incompatible with commercialization – has been integrated within university's active engagement in business activities at many universities, although at different degrees (Ambos et al., 2008; Murray, 2004). The extent to which students' actions as entrepreneurs match their

membership to university is likely to determine the well-being of student entrepreneurs. Accordingly, drawing on social identity theory, we speculate that the well-being student entrepreneurs obtain from their achievements as entrepreneurs depends on the behavioral prescriptions manifested through university' entrepreneurial culture. If their achievements match the university culture and lead to an increased sense of belonging to the university social context, student entrepreneurs enact their social identity and enjoy a greater PWB.

Firm's value creation and psychological well-being of student entrepreneurs

Because of the importance of PWB as measure of entrepreneurial success, it is not surprising that it has attracted the interest of entrepreneurship scholars (Shepherd and Haynie, 2009a; Uy et al., 2013; Uy et al., 2017). It has been recognized that firm performance represents a pivotal antecedent of entrepreneurs' PWB (Carree and Verheul, 2012). In particular, considering the wealth generated by the venture for the owner as measure of firm's *economic value* (Hitt et al., 2011), several studies show a positive relationship between earnings and satisfaction (Benz and Frey, 2004; Kautonen and Palmroos, 2010; Lange, 2012 among others), which represents a central component of entrepreneurs' well-being (Andersson, 2008). This is in line with the positive effect of pay on job satisfaction (Gazioglu and Tansel, 2006) and more in general with the well-known positive income-happiness relationship in economics (Diener and Seligman, 2004). Entrepreneurship literature also shows that accumulating personal wealth or improving income represent important attainments for many entrepreneurs (Austin et al., 2006; Fauchart and Gruber, 2011). The assessment of their business' profitability represents a key dimension upon which entrepreneurs base their self-evaluation as founders (Fauchart and Gruber, 2011). Making money is associated to the traditional view of the entrepreneurial role which is diffused among founders (Baker and Pollock, 2007; Powell and Baker, 2014). According to economists, the function of entrepreneurs is to earn profits by pursuing economically rewarding business opportunities (Casson, 1982; Kirzner, 1973; Schumpeter, 1934; Knight, 1921). In evaluating themselves as occupants of this entrepreneurial role, founders enhance their self-efficacy and self-worth (Stets and Burke, 2000) when they perceive to grow a financially rewarding business (Fauchart and Gruber, 2011). This is likely to be translated in a positive psychological state that contributes to PWB.

University students, in particular, have invested in higher education and thus present high opportunity costs in becoming entrepreneurs, because they give away potential rewarding wages they could earn from

being employed (Block et al., 2013). Therefore, in order to found a business, they need to view entrepreneurship as a rewarding activity for them (Khelil, 2016) and require an acceptable level of income to feel psychologically rewarded from being entrepreneur (Gimeno et al., 1997). For example, the prospect of entering a financially rewarding career has been suggested to facilitate students' entry into entrepreneurship (Criaco et al., 2016). Moreover, by developing a profitable business, student entrepreneurs gain financial autonomy and distinguish themselves from peers to which they can even become a role model (Walter and Dohse, 2012). By creating a business that generates private wealth student entrepreneurs have the opportunity to satisfy their need of acquiring independency by becoming a competent professional (Sieger et al., 2016). We therefore hypothesize

> *Hypothesis 1a: The perceived economic value generated by the firm for its founder is positively related to student entrepreneur's PWB.*

Since financial wealth represents only one dimension individuals seek to maximize (Jensen and Meckling, 1994), in entrepreneurship research it has been proposed to adopt a more comprehensive view of value creation, not limited to the creation of economic value (Cohen et al., 2008). Accordingly, while firm's economic value is expected to be positively related to PWB of student entrepreneurs, we do not limit us to consider this type of firm performance as driver of entrepreneurs' PWB. Despite earnings are of central importance for entrepreneurs, there are other attainments entrepreneurs care about (Amit et al., 2001; Rindova et al., 2009; Roberts, 1991). This idea has been corroborated by several studies which, on samples from different countries, have shown that entrepreneurs enjoy higher job satisfaction than employees though they have, on average, lower earnings (Andersson, 2000; Binder and Coad, 2013; Blanchflower, 2004; Hamilton, 2000; Lange, 2012 among others). Because entrepreneurs associate to their business a variety of meanings, they care about firm performances that not necessarily relate to making profits and accumulating personal wealth (Cardon et al., 2009; Fauchart and Gruber, 2011). Surprisingly, despite the importance of non-pecuniary performance for entrepreneurs has been widely acknowledged (e.g., Austin et al., 2006; Hitt et al., 2011), extant research has overtly concentrated on wealth creation via new ventures (Rindova et al., 2009). Therefore, we have scarce knowledge about the consequences of non-financial firm performances as determinant of entrepreneurial PWB.

In particular, besides generating value for themselves in form of financial profits, entrepreneurs through their business generate value for others (Cohen et al., 2008; Hitt et al., 2011; Rindova et al., 2009). It also appears that the motivation of changing society and making world a better place is diffused among student entrepreneurs who attend university (Alsos et al., 2016; Sieger et al., 2016). Since generating benefits for others is important for student entrepreneurs, it might positively affect their PWB (Fauchart and Gruber, 2011). This is in line economic theory of happiness where making good and supporting other social members is seen as a determinant of individuals' satisfaction with their lives (Diener and Seligman, 2004).

From an identity perspective, entrepreneurs base their self-evaluation as founders not only on the assessment of their business' profitability, but also on other dimensions of performance (Fauchart and Gruber, 2011). A peculiar characteristic of the entrepreneurial role is contributing to members of their community and society while pursuing profitable business opportunities (Schumpeter 1934; Venkatamaran, 1997). Generating value for a specific community or for the society as a whole represent behaviors which often become part of entrepreneurs' identity (Powell and Baker, 2014) and which are internalized within entrepreneur's basic motivation (Fauchart and Gruber, 2011; Yitshaki and Kropp, 2016). Accordingly, we hypothesize that entrepreneurs' perceptions of the value generated by their business for customers and society are central to their PWB.

Concerning the creation of *community value*, entrepreneurs can contribute to a specific community of customers by developing innovations which impact it positively. For example, entrepreneurs can be the first to introduce new inimitable products or services that addresses specific needs of its customers (Fauchart and Gruber, 2011). In doing so, entrepreneurs' PWB benefits in two ways. First, when they feel making the difference for their community and supporting its development, they make sure to behave according to the entrepreneurial role of innovator and 'community patron' (Powell and Baker, 2014; Yitshaki and Kropp, 2016). Some entrepreneurs view as more meaningful for themselves introducing their innovation into the marketplace rather than becoming rich thanks to it (Amit et al., 2011; Corman et al., 1988). Among university students, in particular, being creative and creating something new that corresponds to a basic motivation that drives them towards becoming entrepreneurs (Sieger et al., 2016). By creating new products of services that satisfy the needs of a customer groups they have the opportunity to take advantage of their creative needs and

satisfy their need to innovate. For example, research suggests that one determinant of graduates' career choice is the possibility to work creatively on their ideas (Roach and Sauermann, 2010).

Second, by giving something of unique to their community entrepreneurs receive social recognition which is likely to be translated into self-esteem and a more positive psychological state (Fauchart and Gruber, 2011; Stets and Burke, 2000). In this way entrepreneurs also satisfy the human need of belonging which is important to individuals' PWB. At the same time, the belief of creating things that others could not for their community entrepreneurs can affirm the distinctiveness of their identity, thereby increasing its meaningfulness and obtaining a psychological sense of well-being (Shepherd and Haynie, 2009a). Peer recognition is particularly important for university students and represents one motivation that induces them to become entrepreneurs (Bergmann et al., 2016; Kacperczyk, 2013). Research has also suggested that, in planning their career, graduate and PhD students take into account the social recognition they might achieve by contributing to innovation (Roach and Sauermann, 2010).

Taken together, these arguments suggest that the perception of creating value for a community of customers is likely to enhance entrepreneurs PWB, leading us to formulate the following hypothesis.

> *Hypothesis 1b: The perceived value generated by the firm for its customers is positively related to student entrepreneur's PWB.*

Creating *societal value* along developing a business has also been associated to the entrepreneurial role (Powell and Baker, 2014; Venkatamaran, 1997). For example, entrepreneurs develop and commercialize solutions to a number of environmental, societal and health problems (Adner and Kapoor, 2016; Hitt et al., 2011). Entrepreneurial firms might also raise public awareness about unaddressed societal needs and induce other companies to embrace more sustainable practices (Fauchart and Gruber, 2011). Even though in many cases making profits and creating wealth is the main aim of business owners, there is anecdotal and empirical evidence that even for entrepreneurs who found a business to accumulate wealth creating societal value for the public good represents a driving motivation too (Amit et al., 2001; Austin et al., 2006). At the extreme case, there are social entrepreneurs who start a business with the specific aim to address societal needs (Zahra et al., 2008), such as helping underprivileged members of society (Kistruck et al., 2011). More in general, even though at different degrees, societal performance represents a firm outcome that is valued by entrepreneurs, even by those ones that are mainly driven by financial motives (Austin et al., 2006).

The positive feeling of creating societal value can enhance entrepreneurs' PWB because it produces emotional payback as a consequence from pro-social behavior (Yitshaki and Kropp, 2016). This generates passion and reinforces entrepreneurs' adherence to the role of social entrepreneur, thereby increasing his/her PWB. The belief of acting consistently with such role can represent a source of self-esteem and self-efficacy with positive consequences on PWB as this role is salient for the individual (Powell and Baker, 2014; Stets and Burke, 2000). Moreover, by offering unique solutions to societal issues, entrepreneurs can leave a mark; showing that doing business can be reconciled with sustainable practices and public good, they can stand out from other businesses (Fauchart and Gruber, 2011; Yitshaki and Kropp, 2016). In doing so, entrepreneurs raise their sense of distinctiveness thereby enhancing PWB (Shepherd and Haynie, 2009a). In addition, by acting as a role model for society, entrepreneurs can gain the trust and approval from other members of society who are enthusiast about the societal value created by the business (Yitshaki and Kropp, 2016). This can satisfy entrepreneurs' need of belonging with positive consequences on their PWB (Shepherd and Haynie, 2009a).

University students, in particular, can be committed to social causes for different reasons. For example, if they benefit from parents' wealth and can take advantage of economic leeway, they are more likely to be attracted by the idea of developing a venture with societal aims (Sieger et al., 2016). Moreover, addressing societal issues often requires to develop organizational or institutional types of innovation which challenge students' imagination and satisfy their need of being creative, a key determinant of students' career choice (Sieger et al., 2016).

In sum, the perception of creating value of society is expected to positively affect entrepreneurial satisfaction of student entrepreneurs. We thus hypothesize

> *Hypothesis 1c: The perceived value generated by the firm for society is positively related to student entrepreneur's PWB.*

While creating value (economic, community and societal) is hypothesized to contribute to student entrepreneurs' PWB because it allows to affirm their distinctive role identity as entrepreneurs, we also expect that such contribution is contingent to the culture of social context in which they are embedded. As entrepreneurs, they derive PWB from balancing their achievements with the sense of belonging to social groups (Shepherd and Haynie, 2009a) obtained from the enactment of a social identity (Powell and Baker, 2014). Moreover, as students, they derive PWB from social identification with their educational institution

(Bizumic et al., 2009; Cameron, 1999). Building on these arguments – drawn from identity theory applied to research on students' and entrepreneurs' well-being – we advance that the PWB obtained by student entrepreneurs from the perception of creating economic, community and societal value depends from the extent to which these dimensions of the entrepreneurial role match their membership to university by conforming with its culture. To describe this aspect, we consider a visible element of university culture with respect to entrepreneurship, since visible elements are more likely to influence how organizational members perceive and feel (Huyghe and Knockaert, 2015). In particular, following Huyghe and Knockaert (2015) we consider university's involvement in the *third (or commercialization) mission* through *academic entrepreneurship* as key visible element of university culture. We use a common indicator for university's engagement into commercialization activities that characterize the third mission (Clarysse et al., 2011; Powells and McDougall, 2005): the number of startups founded on the basis of university research, also called *university spinoffs*.

The conceptual framework of this paper is illustrated in Figure 5.1.

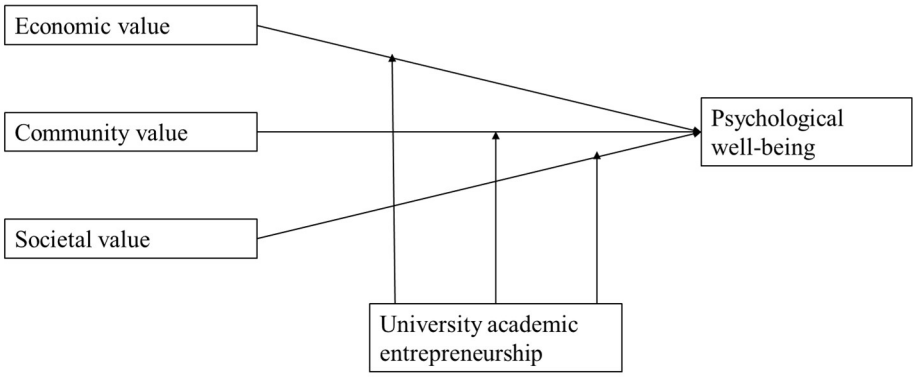

Figure 5.1 Conceptual framework

University culture and the PWB obtained by student entrepreneurs from value creation

Concerning the creation *economic value*, even though earning money is viewed as a reward for the entrepreneurial function, it can also represent a cost when it is incongruent with the expression of founders' social identity (Powell and Baker, 2014). We suggest that this can be the case of student entrepreneurs who are embedded in an university whose culture actively promotes commercialization through academic entrepreneurship. In the university context, commercialization efforts are aimed at achieving non-economic attainments, such completing the development of an innovation, testing and finding practical applications for

scientific knowledge and allowing the society to benefit from research discoveries (Hayter, 2011; Jain et al., 2009; Lam, 2011). By contrast, commercialization with the mere aim of making private financial profits is not included among the key purposes of the commercialization mission (Ambos et al., 2008; Visintin and Pittino, 2014). University members actively engaged into entrepreneurship tend to downplay the importance of earning money from their entrepreneurial activities (Lam, 2011). Based on these arguments, students whose business is perceived as successful in generating private wealth might experience a misalignment between their achievements as entrepreneurs and their membership to a university whose culture rewards academic entrepreneurship. The resulting stress and mental strain will thus reduce the PWB they obtain by earning money through their business. By contrast, when the commercialization mission is not prioritized as much, making money is more likely to be aligned with behavioral prescriptions imposed by university, where students are expected to become competent professionals capable of finding and performing a financially rewarding job (Elwick and Cannizzaro, 2017; Sieger et al., 2016). In sum, we expect that in universities whose culture emphasizes the commercialization mission student entrepreneurs will enjoy less PWB from making monetary gains. This leads to the following hypothesis.

> *Hypothesis 2a: The relationship between the perceived economic value generated by the firm for its founder and student entrepreneurs' PWB is negatively moderated by their university's involvement in academic entrepreneurship.*

In creating *community value* entrepreneurs develop and commercialize innovations that contribute to a community of target customers. This matches to some extent the purposes of the commercialization mission, which is focused on launching on the market cutting-edge technologies developed in the research labs of university (Jain et al., 2009; Lam, 2011; Visintin and Pittino, 2014). In this sense, generating value for customers shares with academic entrepreneurship an emphasis on commercializing innovative solutions. University spinoffs are founded with the purpose to turn innovative ideas into marketable products or services that address the needs of a specific market niche (Knockaert et al., 2011). By launching innovation on the market, the founders of university spinoffs have also the opportunity to gain reputation among peers and fuel their sense of belonging and prominence within the scientific community (Hayter, 2011; Lam, 2011). In a similar fashion, by turning creative ideas into new products and services, entrepreneurs are able to commercialize new solutions which address the particular needs of a group of target customers and which bring reputation and social recognition in that specific community (Fauchart and Gruber, 2011). Based on

these arguments, we expect that student entrepreneurs whose business generates community value perceive a match between their achievements and the culture of universities engaged in the third mission. In this context they will experience a higher sense of belonging to university, thereby obtaining more PWB. Conversely, at universities which do not embrace the third mission as much, there is less reward for entrepreneurial activities aimed at commercializing innovative solutions and allowing potential customers to enjoy the benefits of scientific discoveries (Ambos et al., 2008). Based on these considerations, we expect that at universities actively engaged in the third mission student entrepreneurs will enjoy higher levels of PWB as they commercialize innovative solutions for their customers. Accordingly, we formulate the following hypothesis.

> *Hypothesis 2b: The relationship between the perceived value generated by the firm for its customers and student entrepreneurs' PWB is positively moderated by their university's involvement in academic entrepreneurship.*

We suggest that in creating *societal value*, which contributes to society as a whole, student entrepreneurs engage into behaviors that are aligned to the culture manifested through academic entrepreneurship, whose aim is often to commercialize innovations that can improve social wealth (Hayter, 2011; Jain et al., 2009). One goal that legitimizes the involvement of university members into university spinoffs is discovering practical applications of scientific knowledge that might contribute to solve societal issues (Lam, 2011). Therefore, at a university actively engaged into the third mission, when student entrepreneurs perceive to create value for society their achievements are more likely to match the culture of university. The resulting sense of membership to university generates a positive mental state that positively contributes to students' PWB (Cameron, 1999; Stets and Burke, 2000). Without enjoying this match – in universities not engaged into academic entrepreneurship – we expect that student entrepreneurs will experience less PWB from creating societal value. The emotional payback student entrepreneurs obtain when they feel contributing to public good (Yitshaki and Kropp, 2016) will be lower when their pro-social behaviors are not aligned to the objectives actively pursued by their university. At the extreme case, student entrepreneurs who generate societal value could suffer because their efforts to change society do not correspond to active efforts of their university, which represents the social group they belong to (Bliuc et al., 2011; Cameron, 1999). This might frustrate entrepreneurs who aim at inducing societal changes in ways that positively affects others' well-being (Fauchart and Gruber, 2011; Rindova et al., 2009). More in general, individuals might experience a loss of utility (and well-being) when the outcomes of their action are not internalized as prescription within the social group they

belong to (Akerlof and Kranton, 2000). In sum, we expect that the PWB student entrepreneurs obtain from the perception of creating societal value is higher when they are embedded in an university which pursues the third mission. This leads to following hypothesis

> *Hypothesis 2c: The relationship between the perceived value generated by the firm for society and student entrepreneurs' PWB is positively moderated by their university's involvement in academic entrepreneurship.*

5.3 Data

Sample

We test our hypotheses on a sample of Italian student entrepreneurs. Specifically, the empirical analysis of this paper is based on survey-data, which come from the GUESSS survey of 2016 ('Global University Entrepreneurial Spirit Students' Survey'). The GUESSS survey has already been described in Chapter 3. The complete GUESSS data set for 2016 records the answers from 122,000 students from 50 countries and more than 1,000 universities. It includes higher education students of different fields of study and different education levels (e.g., undergraduate, graduate, PhD).

For the present study, we rely on data collected among 4,486 university students in Italy because a question on PWB was included only in the Italian questionnaire. Of these students, we included only questionnaires of the 185 students who reported to be active entrepreneurs by responding 'yes' to the following question of the survey: 'Are you already running your own business / are you already self-employed?'. After excluding respondents for which we could not build one or more of the variables included in our analysis, the final sample size consists of 138 student entrepreneurs from 11 universities, as reported in Table 5.1.

Table 5.1 Distribution of students and universities in the sample

	Students			Academic entrepreneurship	
University	Survey respondents	Active entrepreneurs	Active entrepreneurs in the final sample	Spinoffs	Patents
Politecnico di Torino	516	19	16	79	246
Università degli Studi del Molise	17	5	3	7	4
Università degli Studi di Bergamo	519	19	14	9	14
Università degli Studi di Modena e Reggio Emilia	787	42	32	26	13
Università degli Studi di Napoli "Federico II"	386	28	23	0	12
Università degli Studi di Padova	112	4	3	57	111
Università degli Studi di Pavia	30	1	1	22	23
Università degli Studi di Torino	888	43	29	30	57
Università degli Studi di Udine	283	13	7	37	35
Università degli Studi di Verona	123	2	2	15	11
Università della Calabria	208	9	8	24	27

This sample has been controlled for a non-response bias by dividing early and late respondent for every participating university (according to the time when they filled in the questionnaire). Early and late respondents were then compared using t-tests for equality of means (for continuous variables) or chi-square test (for categorical or dummy variables). Since non-respondents are assumed to be more similar to late respondents than to early-respondents, the absence of significant differences between early and late respondents mitigates the risk of having non-response bias (Oppenheim 1966). We found no statistically significant differences concerning the variables used in this study.

Measures

Dependent Variable. To measure *PWB* we used 12 items of the General Health Questionnaire (Goldberg, 1978), recently used in entrepreneurship research (Uy et al., 2013; Uy et al., 2017). Examples of the items include ‘Have you recently been feeling reasonably happy?’ and ‘Have you recently felt constantly under strain?’ (reverse-coded). Items were evaluated on a scale ranging from 1 (not at all) to 5 (more than usual). The reliability of the scale was tested by computing Cronbach Alpha, which resulted 0.85, above the recommended value of 0.7 (Nunnally, 1978). The scores of the 12 items were thus averaged to compute the variable labelled *PWB* in the following empirical analysis.

Independent Variables. To measure firm's *economic value* respondents were asked to evaluate on a 7-points Likert scale (1=not at all; 7=very much) how well his/her business performed in creating personal wealth for himself/herself as the entrepreneur. This represents a qualitative measure of the income earned by the entrepreneur from the business in line with previous research on the determinants of entrepreneurial satisfaction (Kautonen and Palmroos, 2010). Additionally, Cooper and Artz (1995) already used the money taken by entrepreneurs from their business as measure of firm performance which could affect job satisfaction, a dimension of entrepreneurial well-being (Andersson, 2008).

In order to measure firm's *community value* student entrepreneurs were asked to answer – on a 7-points Likert scale (1=not at all; 7=very much) – to the following questions concerning their firm's performance: (i) 'Creating the possibility to socialize with your target customers'; (ii) 'Sharing information or knowledge with your target customers'; (iii) 'Allowing you to attain strong social recognition among your target customers'; (iv) 'Helping your target customers to distinguish themselves from other consumers or groups'; and (v) 'Being the first mover in addressing the needs of your target customers'. These items describe the attainments pursued by entrepreneurs whose basic social motivation is to contribute to a specific community they identify with (Fauchart and Gruber, 2011). The Cronbach Alpha of this measure is 0.87. The variable labelled *community value* was computed as the average of the 5 items.

Firm's *societal value* has been measured by asking student entrepreneurs to evaluate on 7-points Likert scale (1=not at all; 7=very much) how well their business performs in the following five aspects: (i) 'Developing a new solution to a specific problem existing in society'; (ii) 'Changing other companies' practices'; (iii) 'Being a role model for other businesses'; (iv) 'Raising public awareness about a specific societal problem'; and (v) 'Inducing regulatory changes'. These correspond to the objectives pursued by entrepreneurs who aim to change society to a better place (Fauchart and Gruber, 2011). Cronbach Alpha of this measure resulted 0.87. The variable labelled *societal value* is the average of the 5 items.

Moderating Variables. In order to capture university's involvement into *academic entrepreneurship* we collected information about the number of university spinoffs of students' universities, a common proxy for academic entrepreneurship (Clarysse, Tartari and Salter, 2011; Powers and McDougall, 2005). To do so we

draw upon the publicly available data provided from by Netval association, a network of Italian universities and research centres. In the Italian context a university spinoff is defined as a company based on the results of the academic scientific research, for whom the University authorizes participation of its academic personnel and provides other forms of support and services to facilitate the firm's development.

Control Variables. We control for a selection of firm- and individual-level influences which are potentially related to PWB. At the firm-level, following Uy et al. (2013) we control for the age and the size of the business. *Firm age* is measured in years; *firm size* is the number of employees.

At the individual level we control for gender, age and level of education of the entrepreneur (Uy et al., 2013). We also control for characteristics specific to student entrepreneurs (field of study and the reason for choosing the university) and for the meaning the entrepreneurs associates to her business.

Gender, measured with a dummy where '1' indicates female and '0' male. *Age* is a continuous variable measured in years. We also control for level of *education* of the student entrepreneur: undergraduate (Bachelor); graduate (Master); PhD/doctorate; faculty/post doc; or MBA/Executive Education. We control for student's field of study, since the climate for entrepreneurship might vary across disciplines. To do so, we have grouped the field of study in four broad areas: (1) *business and economics*, (2) *natural sciences*, (3) *social sciences*, and (4) *other*. We have created a dummy variable for each study area with the exception of 'other' which has been considered as the reference category. Since students might select themselves in universities that support entrepreneurship, we control whether their choice of the university was driven the entrepreneurial reputation of the university. The dummy variable *reputation* has been coded 1 if students agreed with the statement 'I chose to study at this university mainly because of its strong entrepreneurial reputation'.

Finally, since our analysis is focused on the impact of firm's economic, community and societal performances on entrepreneurs' PWB, we control whether entrepreneurs emphasize economic, community-related or societal objectives. Entrepreneurs who associate to new firm creation traditional business-oriented meanings and are driven by the motivation to accumulate wealth and become rich are characterized by a darwinian identity; founders that strive to contribute to a specific community of target customers possess a communitarian identity; finally, entrepreneurs who see their ventures as a vehicle to change society and pursue the objective of making world a better place possess a missionary identity (Fauchart and Gruber, 2011).

Founders' identity type is captured by the 15-items scale recently developed and tested by Sieger et al. (2016) on an international sample of nascent student entrepreneurs drawn from the 2013 Guesss sample. Each of the identity types is associated to five items of the scale. Following the procedure suggested by Sieger et al. (2016) respondents have been assigned an identity when their agreement to all items of the related identity type was 5 or higher (on a 1-7 scale), with no such agreement to other identity types. Accordingly, we created a dummy labelled *darwinian*, coded 1 if the entrepreneur has a darwinian identity (0 otherwise); the dummy *communitarian* was coded 1 if the entrepreneur holds a communitarian identity; the dummy *missionary*, was coded 1 if the entrepreneur exhibits a missionary identity (0 otherwise).

5.4 Results

The means, standard deviations, and correlations of the variables in this study can be found in Table 5.2.

As the variables we draw upon for the empirical analysis come from survey data, it is necessary to take steps in order to minimize common method bias concerns (cf. Kammerlander, Burger, Fust and Fueglistaller, 2015), which we did in the following analysis. To do so we applied an exploratory factor analysis to our data which revealed that no dominant factor explained variance in our sample (which would indicate the presence of common method bias). The analysis of our data revealed six factors with eigenvalues greater than one, which together accounted for 68% of the total variance. The largest factor explained only 15% of the variance. In addition, as shown a by a confirmatory factor analysis, a model with only one dominant factor has a lower fit ($\chi2(230)= 1041.20$, RMSEA = 0.16, CFI = 0.41) with the data than the data structure proposed in the study ($\chi2(204)= 556.35$, RMSEA = 0.11, CFI = 0.74), as revealed by Chi-squared test ($p<0.001$). Moreover, as in Sieger and Minola (2016), the long GUESSS survey allows to alleviate social desirability concerns because it assures respondents strict confidentiality and because the variable of this research are dispersed throughout the questionnaire such that respondents are not likely to anticipate researchers' objectives, which could influence their answers (Podsakoff et al. 2003).

After standardizing the independent variables and moderators, a procedure commonly employed to avoid multicollinearity issues when computing interaction terms (Aiken and West, 1991), the variance inflation factors (VIFs) remain below 5, indicating that multicollinearity is not a problem in our analyses (Kennedy, 2008).

Table 5.2 Descriptive Statistics and Correlations

Variable	*Mean*	*Std. Dev.*	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*	*(16)*
1. Firm age	2.09	2.52	1															
2. Firm size	2.29	2.80	0.07	1														
3. Gender	0.74	0.44	-0.16	0.10	1													
4. Age	25.19	4.46	0.39	-0.13	-0.05	1												
5. Education	1.46	0.64	0.17	0.01	0.04	0.46	1											
6. Business and economics	0.20	0.40	-0.07	0.15	0.00	-0.07	-0.10	1										
7. Natural sciences	0.52	0.50	-0.07	0.04	0.36	-0.19	0.12	-0.52	1									
8. Social sciences	0.17	0.37	0.09	-0.16	-0.31	0.24	-0.02	-0.22	-0.47	1								
9. Darwinian	0.12	0.32	-0.09	-0.05	0.11	0.01	0.02	0.11	-0.15	0.02	1							
10. Communitarian	0.05	0.22	-0.10	0.04	0.06	0.01	-0.01	0.05	-0.04	-0.01	-0.08	1						
11. Missionary	0.12	0.33	-0.02	-0.17	0.02	0.07	-0.16	-0.07	-0.04	0.13	-0.14	-0.09	1					
12. Economic value	4.46	1.53	-0.04	0.03	0.07	0.00	0.04	0.04	-0.01	-0.06	0.17	0.04	-0.10	1				
13. Community value	5.15	1.20	-0.04	0.17	0.15	-0.03	-0.04	-0.04	0.04	0.08	-0.11	-0.02	-0.01	0.23	1			
14. Societal value	4.46	1.34	-0.07	0.21	0.10	0.06	0.01	-0.08	0.08	-0.07	-0.11	-0.07	0.00	0.02	0.41	1		
15. Academic entrepreneurship	27.44	22.57	0.06	0.00	-0.01	-0.10	-0.05	-0.07	0.11	-0.06	-0.06	0.09	0.06	0.07	0.01	-0.02	1	
16. Psychological well-being	4.09	0.67	-0.07	-0.02	0.06	-0.07	-0.11	0.08	-0.16	0.07	-0.01	0.01	-0.05	0.14	0.29	0.07	0.05	1

N=138

Absolute values of pairwise correlations above 0.17 are significant at the $p<0.05$

Since our data is made up of individual-level observations nested within universities, we took advantage of clustered standard errors in all our models, as in previous studies based on GUESSS data (Minola et al., 2016).

Table 5.3 contains the results from our main regression analyses. In model I the dependent variable is PWB and it contains only control variables. The coefficient of *gender* (β=0.25; $p<0.05$) is positive and significant, indicating that female student entrepreneurs have on average a better mental state than their male counterparts.

In model II, the independent variables *economic value*, *community value* and *societal value* are entered, thereby increasing the explanatory power of the model of about 8%, compared to model I. The F-test, which allows to assess the incremental model fit, shows that adding predictors significantly improves the model fit ($p<0.01$). While economic value and societal value are not significant predictors for PWB, community value is positively and significantly related to PWB (β=0.18; $p<0.01$). Therefore, H2a and H2c are not supported, but H2b receives support from our data. The moderating variable *academic entrepreneurship* added to model III has no significant impact on PWB and does not significantly increase the explanatory power as compared to model II. By contrast, the addition of the interaction terms *economic value* x *academic entrepreneurship*, *community value* x *academic entrepreneurship* and *societal value* x *academic entrepreneurship* significantly ($p<0.01$) increase the explanatory power of the model by 11% as compared to models III and II. The interaction terms of spinoffs with both economic and community value are negative and significant (β=-0.19; $p<0.01$ and β=-0.10; $p<0.01$ respectively). Therefore, H2a is confirmed, but results go in the opposite direction as predicted by H2b; in contrast, the term societal value x spinoffs exhibits a positive and significant impact (β=0.10, $p<0.01$), as predicted by H2c.

Table 5.3 Main Regression Analyses

Dependent variable: Psychological well-being Independent variables	Model I	Model II	Model III	Model IV
Firm age	-0.01	-0.01	-0.01	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)
Firm size	-0.01	-0.02	-0.02	-0.02
	(0.04)	(0.04)	(0.04)	(0.03)
Gender	0.25**	0.17*	0.17*	0.08
	(0.09)	(0.09)	(0.09)	(0.10)
Age	-0.01	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Educaction	-0.07	-0.06	-0.06	-0.07
	(0.12)	(0.09)	(0.09)	(0.07)
Business Economics[a]	-0.12	-0.12	-0.12	-0.07
	(0.20)	(0.193)	(0.19)	(0.18)
Natural Sciences[a]	-0.38	-0.39*	-0.39*	-0.34
	(0.21)	(0.20)	(0.20)	(0.19)
Social Sciences[a]	-0.00	-0.10	-0.09	-0.10
	(0.21)	(0.22)	(0.22)	(0.21)
Darwinian	-0.17	-0.12	-0.12	-0.13
	(0.24)	(0.21)	(0.22)	(0.21)
Communitarian	-0.07	-0.04	-0.06	0.00
	(0.20)	(0.20)	(0.21)	(0.17)
Missionary	-0.20	-0.16	-0.18	-0.05
	(0.16)	(0.14)	(0.15)	(0.16)
Economic value		0.05	0.05	0.05
		(0.08)	(0.08)	(0.06)
Community value		0.18***	0.18***	0.17***
		(0.05)	(0.05)	(0.02)
Societal value		-0.02	-0.02	-0.02
		(0.04)	(0.04)	(0.03)
Academic entrepreneurship			0.04	0.07
			(0.07)	(0.06)
Economic value X academic entrepreneurship				-0.19***
				(0.05)
Community value X academic entrepreneurship				-0.10***
				(0.03)
Societal value X academic entrepreneurship				0.10**
				(0.04)
Constant	4.60***	4.66***	4.63***	4.82***
	(0.25)	(0.30)	(0.28)	(0.32)
R^2	0.07	0.15	0.16	0.27
ΔR^2		cf. Model I	cf. Model II	cf. Model III
		0.08	0.00	0.11
F-statistic		3.86***	0.58	6.12***

N = 138

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1,

[a] 'others' is the suppressed comparison category

In order to further demonstrate that the simple slopes of the dependent variable on the independent variables vary at different levels of our moderator we compute simple slopes tests using the delta method. Results are reported in Table 5.4 and show the simple slope of economic, community and societal value at *low* (i.e., one standard deviation below the mean), *mean* and *high* (i.e., one standard deviation above the mean) level of university academic entrepreneurship, as well as 95% confidence intervals. Concerning economic value, the simple slope is significantly positive ($\beta=0.24$, $p<0.05$), non-significant and significantly negative ($\beta=-0.14$, $p<0.05$) respectively at low, mean and high levels of the moderator. The opposite occurs for societal value, whose simple slope is significantly negative ($\beta=-0.12$, $p<0.10$) at low level of the moderator, non-significant at mean level and significantly positive ($\beta=0.07$, $p<0.05$) at high level. Finally, the simple slope of community value is positive and significant on PWB for all levels of the moderator, but its magnitude decreases when the moderator increases ($\beta=0.27$, $\beta=0.17$, $\beta=0.07$ for low, mean, high university spinoffs respectively, $p<0.05$).

As in Sieger and Minola (2015), we present a plot of our significant interaction term in order to facilitate the interpretation of our results, as shown in Figures 5.2, 5.3 and 5.4. Figure 5.2 depicts the relationship between economic value and PWB at *low* and *high* university's involvement into academic entrepreneurship, proxied through number of university spinoffs. It appears that at low levels of academic entrepreneurship economic value has a positive relationship with student entrepreneurs' PWB; however, this positive relationship becomes weaker at higher level of academic entrepreneurship up to becoming negative. As a result, student entrepreneurs who report to badly perform in terms of economic value have better mental state when their university is actively engaged into academic entrepreneurship; on the other hand, student entrepreneurs who are declare to be successful in generating private wealth for themselves obtain more PWB when they study at a university whose culture does not embrace academic entrepreneurship. The strong interaction between university's academic entrepreneurship and economic value depicted in Figure 5.2 also explains why we found a non-significant direct effect of economic value on PWB. Whether its impact is positive or negative is contingent upon students' university.

Table 5.4 Simple slopes

Economic value → Psychological well-being				***Community value → Psychological well-being***				***Societal value → Psychological well-being***			
Academic entrepreneurship	β (boot SE)	LLCI	ULCI	*Academic entrepreneurship*	β (boot SE)	LLCI	ULCI	*Academic entrepreneurship*	β (boot SE)	LLCI	ULCI
Low	0.24** (0.10)	0.05	0.43	Low	0.27*** (0.05)	0.18	0.36	Low	-0.12* (0.07)	-0.25	0.02
Mean	0.05 (0.06)	-0.08	0.17	Mean	0.17*** (0.02)	0.12	0.22	Mean	-0.02 (0.03)	-0.09	0.05
High	-0.14** (0.06)	-0.25	-0.03	High	0.07*** (0.02)	0.02	0.11	High	0.07** (0.03)	0.01	0.14

Note: Delta method CI, 95 percent confidence; normal-based approach

As shown in Figure 5.3, which graphically illustrates the relationship between community value and PWB and low and high university's academic entrepreneurship, the positive impact of community value on PWB is greater at universities not actively engaged into entrepreneurship. Student entrepreneurs, whose business is not perceived to perform well in term of community value, are better off when they attend universities which have many spinoffs. However, when the perceived community value generated by the firm increases, its positive impact on PWB is stronger for students at universities whose culture does not emphasize academic entrepreneurship.

Finally, Figure 5.4 shows the graphical relationship between societal value and student entrepreneurs' PWB at low and high levels of university's academic entrepreneurship. While this relationship is positive at high levels of university's academic entrepreneurship, it turns negative at low levels. As for the case of economic value, whether the impact of societal value on PWB is positive or negative depends on student entrepreneurs' university such that the direct effect of societal value results non-significant.

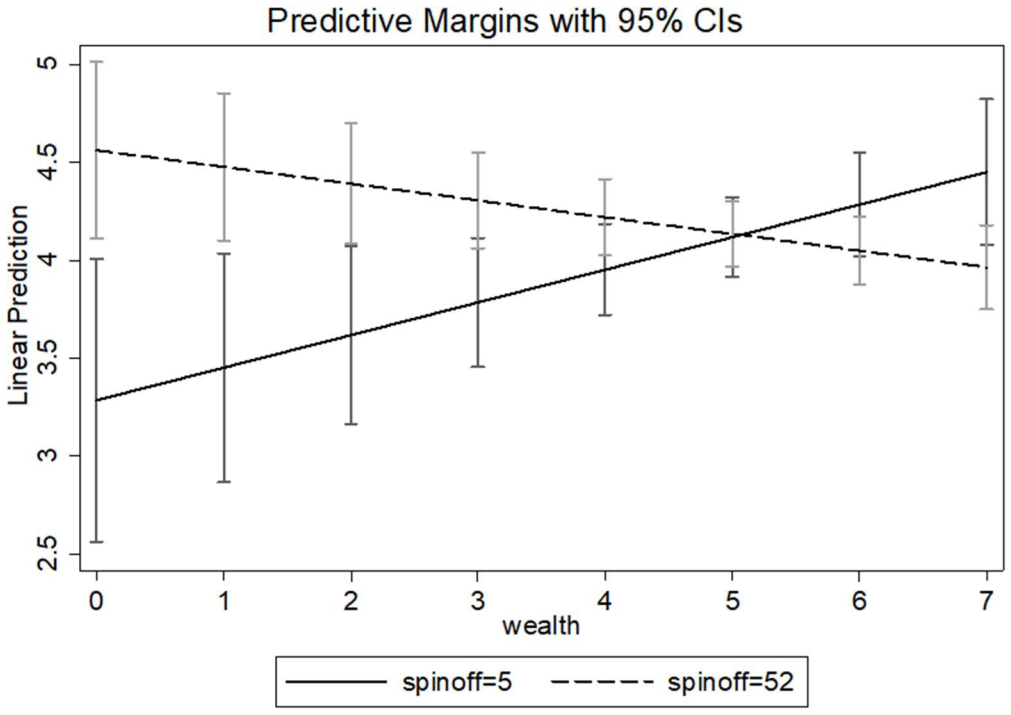

Figure 5.2 relationship between firm's economic value and student entrepreneurs' PWB at low and high levels of university's academic entrepreneurship measured as number of academic spinoffs

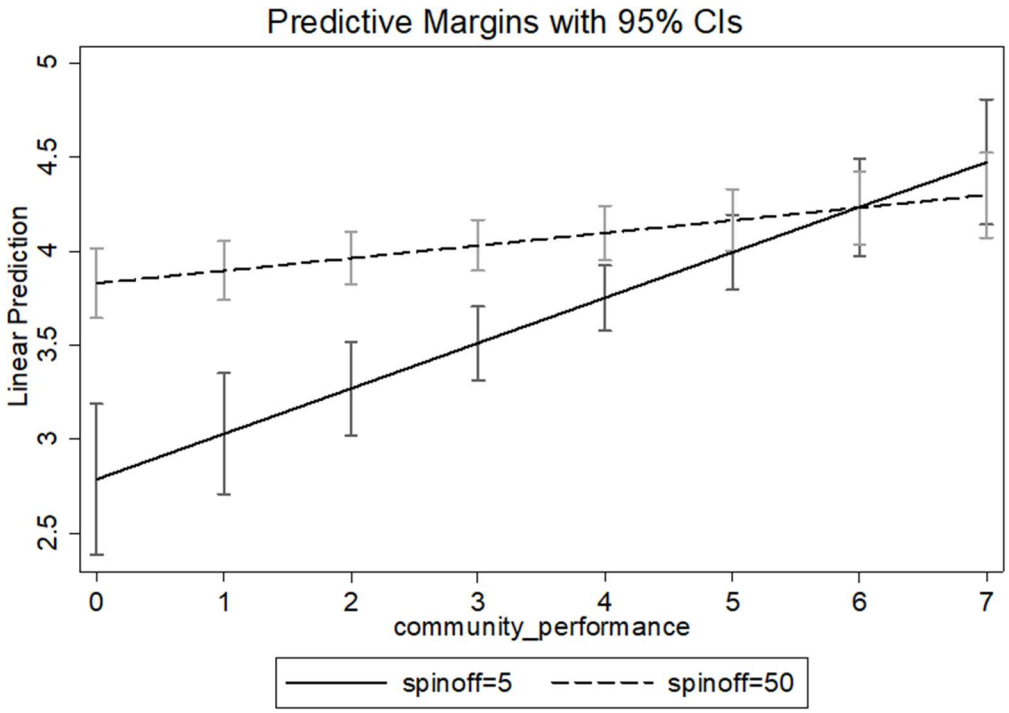

Figure 5.3 relationship between firm's community value and student entrepreneurs' PWB at low and high levels of university's academic entrepreneurship measured as number of academic spinoffs

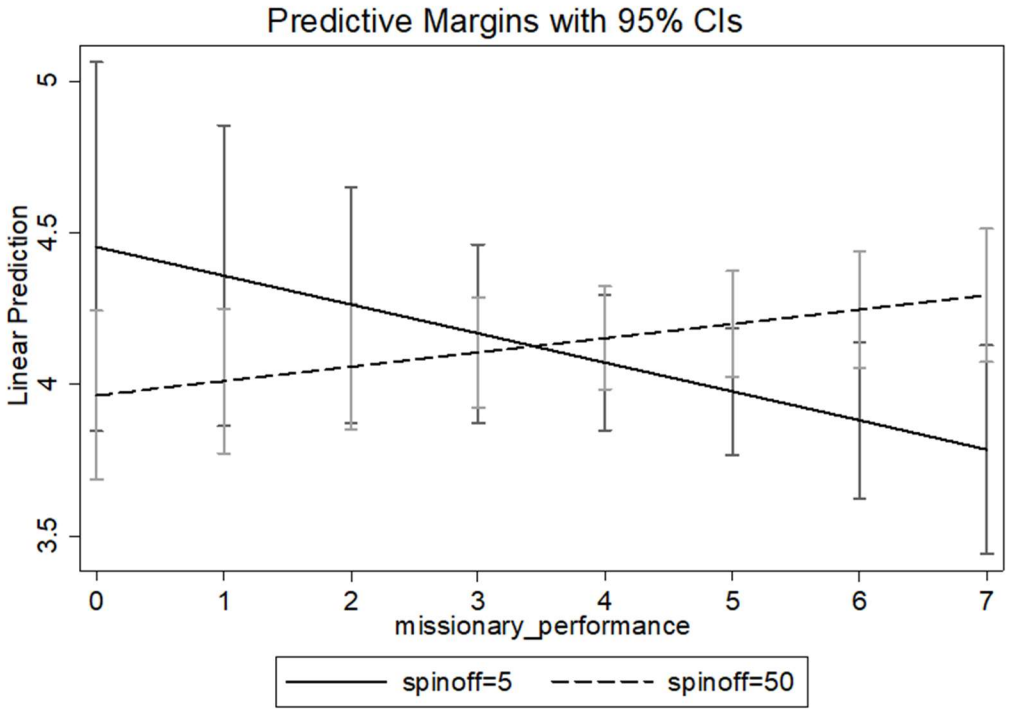

Figure 5.4 relationship between firm's societal value and student entrepreneurs' PWB at low and high levels of university's academic entrepreneurship measured as number of academic spinoffs

Post-hoc analysis

To get a more comprehensive understanding of the findings presented in the main model several additional analyses were performed. First, we controlled for other manifestations of an entrepreneurial culture: besides fostering university spinoffs, some universities invest resources in entrepreneurship education to encourage and guide entrepreneurial behaviors of its students (Fayolle, 2013; Nabi et al., 2017). To control for this aspect, we run the full model splitting the sample into two subsamples: one taking entrepreneurship education, the other not. Results of this exercise show that the hypothesized negative moderation of academic entrepreneurship on the economic value-PWB relationship becomes stronger in magnitude when student entrepreneurs received entrepreneurship education. Results also indicate that the hypothesized positive moderation effect on community value-PWB relationship is significant only for students that have attended entrepreneurship education. Taken together, these results suggest that the objectives associated to the third mission (i.e., ventures not as tool to make privately money, but to develop and test commercial and social relevant application for knowledge that can turned into business ideas), are more strongly internalized by student entrepreneurs who attended entrepreneurship education.

Second, as the third mission is associated to the commercialization of knowledge discovered at university (Audretsch, 2014), we test the model taking into account whether student entrepreneurs are likely to have beeen exposed to some form of scientific knowledge. To do so, we run the full model separating students who were enrolled in natural sciences from other students, since students in natural sciences play a central role in the commercialization of new technologies generated at universities (Mustar, 2009; Shah and Pahnke, 2014). Results of this exercise suggest that student entrepreneurs of natural sciences, in contrast to students from other fields, experience the hypothesized positive moderation of academic entrepreneurship on the community value-PWB relationship. A possible explanation is that natural sciences students are embedded in an environment rich of technological opportunities, where knowledge generated in scientific laboratories offers potential commercial applications. Therefore, turning innovations into marketable products of services and creating value for customers is more likely to be perceived as aligned with the university third mission, thereby contributing to students' PWB to a larger extent.

Finally, since student entrepreneurs are involved in other relevant activities (i.e., studying) or can count on other sources of wealth (e.g., money from parents), the importance of their achievements as entrepreneurs

to their PWB might be reduced. For this reason, we run the model splitting the sample into two parts, one having full ownership of the venture, the other one only a partial stake in the company. The rationale behind this exercise is that student who entirely possess their business are more likely to depend on it and on its outcomes. Results indicate that in the sample of student entrepreneurs with full ownership university culture does not significantly moderate the effect of economic and community value on PWB; by contrast the positive moderation of the societal value-PWB is significant and higher in magnitude. A possible explanation is that student entrepreneurs who fully own their ventures care about the value created by the business for themselves and for their customers independently from their university social context. On the other hand, social identity considerations become particularly important for these students when it comes to gaining PWB from societal value. Without the behavioral prescriptions imposed by university culture they might care exclusively on the value created for themselves and their customers and forgo the value created for society.

Robustness checks

As first robustness check we compute the simple slope tests using the bootstrapping approach (cf. for example Kollmann, Stöckmann and Kensbock, 2017). Using this method, even when the sample size is small, it is possible to estimate the indirect effects with 95% confidence intervals (Hayes, 2013) by repeatedly resampling the gathered data 5000 times. Table 5.5 shows the coefficients and bootstrap confidence intervals of all simple slopes. The results of this exercise are substantially aligned with the outcomes reported in Table 5.3, with the notable exception of societal value: the confidence interval of the simple slope of societal value does not lie entirely above or below 0 for all levels of the moderator. Moreover, the confidence interval of the slope of economic value does not lie entirely below 0 at high levels of the moderator, while the confidence interval of the slope of community value does not lie entirely above 0 when the moderator is 1 standard deviation above its mean.

Second, as an alternative measure of university's involvement into academic entrepreneurship we collected information about the number of patents filed by university (Huyghe and Knockaert, 2015) from Scopus. Using this measure as moderator instead of university spinoffs our results hold.

Third, we run our model using alternative economic specifications. A multi-level mixed-effects regression approach (Rabe-Hesketh and Skrondal, 2008) can be used when individual-level data are nested in

groups (cf. Sieger and Minola, 2016; Uy et al., 2017). A likelihood ratio test comparing the linear regression with the multilevel regression did not allow to reject the null hypothesis that a multilevel regression is more appropriate to our data (chibar2=0.15; $p>0.35$). In any case, results of the multilevel regression were substantially aligned with the ones shown in Table 3, with the exception that the interaction of spinoffs with community and societal value was only weakly significant ($p<0.10$). Moreover, in order to control for unobserved heterogeneity among universities, we run a linear regression with clustered standard errors in which we included fixed effects for each university. Again results remained substantially unchanged.

Finally, to mitigate the risks of biases introduced by selecting only student entrepreneurs' into the sample (e.g., they might choose universities with strong entrepreneurial culture) we applied a Heckman two-step procedure. First, we estimated on the full sample a probit model on student' probability of not being entrepreneur using well-known antecedents of entrepreneurship reported in the survey (i.e., student's age, gender and having parent entrepreneurs) as independent variables (cf. Grilo and Thurik, 2006). Second, based on these estimates we computed the inverse Mill's ratios and verified that the results of the main model were robust when including these ratios as a control variable.

Table 5.5 Bootstrapped simple slopes

Economic value → Psychological well-being				***Community value → Psychological well-being***				***Societal value → Psychological well-being***			
Academic entrepreneurship	β (boot SE)	LLCI	ULCI	*Academic entrepreneurship*	β (boot SE)	LLCI	ULCI	*Academic entrepreneurship*	β (boot SE)	LLCI	ULCI
Low	0.24 (0.09)	0.07	0.41	Low	0.27 (0.09)	0.10	0.44	Low	-0.12 (0.09)	-0.31	0.07
Mean	0.05 (0.06)	-0.08	0.15	Mean	0.17 (0.06)	0.05	0.27	Mean	-0.02 (0.06)	-0.14	0.09
High	-0.14 (0.11)	-0.36	0.07	High	0.07 (0.10)	-0.17	0.24	High	0.07 (0.09)	-0.12	0.25

Bias corrected bootstrap CI, 95 percent confidence; number of bootstrap samples used: 5000

5.5 Discussion

With the aim to extend our knowledge on the determinants of entrepreneurs' PWB, in this paper we explored the influence of different types of value created by new ventures on their founders' PWB and how this relationship is affected by the social context in which entrepreneurs are embedded. To do so, we focused on student entrepreneurship and investigated how the impact of economic, community and societal value on PWB is moderated by university culture. Our findings provide three main contributions to extant research.

First, we conceptualized different dimensions of value creation that relate to PWB and which are not limited to the creation of private financial wealth, often framed as the main outcome that matters to entrepreneurs (Cohen et al., 2008; Rindova et al., 2009). To date, we knew from extant literature that financial gains represent only one of drivers of entrepreneurial efforts (Amit et al., 2001; Austin et al., 2006) and satisfaction (Block and Koellinger, 2009; Schjioedt, 2009). The value created by entrepreneurial ventures comprehends not only the creation of financial wealth for business owners, but also the contribution to the wealth of others – a specific community of customers or, more in general, the society – (Powell and Baker, 2014). We took advantage of this insight to inform research on entrepreneurs' PWB and proposed an expanded view of the dimensions of value creation that matter to entrepreneurs' psychological state. In doing so we respond to the call of a more holistic/comprehensive view of value creation in field of entrepreneurship (Cohen et al., 2008; Hitt et al., 2011; Rindova et al., 2009). In particular, we found a direct and significantly positive effect on PWB of the value created by the venture for the community of its customers. This finding corroborates previous research on entrepreneurs' motives suggesting that many founders care more about creating something new for the market than about money (Amit et al., 2001; Mathias et al., 2015; Yitshaki and Kropp, 2016). Concerning economic and societal value creation, we found that the sign of their impact on PWB is contingent on the culture of the university attended by student entrepreneurs.

This represents the second main contribution of this paper and relates to the pivotal role played by founders' social context in determining the relationship between value creation and PWB. Adopting the theoretical lens of social identity theory (Stets and Burke, 2000), we have speculated that creating value generates a positive mental state for founders to the extent that it conforms to the culture of relevant social groups (Powell and Baker, 2014), thereby satisfying their need of belonging (Shepherd and Haynie, 2009a). According to our theorization, the PWB of student entrepreneurs depends from the match between their

achievements as entrepreneurs and their university's culture, expressed by the involvement into the third mission. Indeed, we found that the PWB students obtain from creating different types of value as entrepreneurs is contingent to the extent to which their university actively pursues the commercialization mission through academic entrepreneurship. In particular, we found that university academic entrepreneurship negatively moderates the impact of the perceived economic value on PWB: the impact of economic value on PWB is positive for students embedded at universities scarcely engaged into academic entrepreneurship and turns negative at universities which actively pursue the third mission. In this context university's culture, with its focus on the third mission, does not endorse the creation of private financial wealth through entrepreneurship. The resulting mismatch with university's behavioral prescriptions compromises student entrepreneurs' PWB. The impact of the perceived community value on PWB was found to be positive and significant at both low and high levels of university's academic entrepreneurship. However, contrary to our expectations, the impact of community value on PWB was found to decrease at higher levels of university's academic entrepreneurship. A possible explanation is that students' ventures which generate community value are excessively business and commercial-oriented with respect to the logics inherent in academic entrepreneurship: even those university spinoffs whose founding team is endowed with a business mindset, in fact, view entrepreneurship and commercialization as mean to apply and test scientific knowledge rather than an end itself (Knoackaert et al., 2011; Lam, 2011). Conversely, student entrepreneurs who generate community value by commercializing innovation for its customers might see the satisfying the community of target customers as main goal (Sieger et al., 2016), thereby determining a perceived misalignment with university's behavioral prescriptions associated to the third mission. Partially supporting to this argument, our post-hoc analysis revealed that student entrepreneurs of natural sciences or who received entrepreneurship education experience an increase of PWB in response to community value if they are embedded in a university that pursues the third mission. In this context, are more likely to use their ventures as a tool to commercialize the knowledge acquired at university (Mustar, 2009; Shah and Pahnke, 2014). Concerning societal value, a positive moderation of university's academic entrepreneurship was found for the relationship between societal value and PWB. While societal value resulted negatively related to PWB for student entrepreneurs attending universities with low engagement into academic entrepreneurship, this impact was found to be positive at universities actively involved in the third mission. This suggests that here the creation of societal value allows student entrepreneurs

to enact a role that is perfectly congruent with university's commitment to society realized through academic entrepreneurship. The resulting match allows student entrepreneurs to use their entrepreneurial achievements to nurture their sense of membership to university, thereby creating a positive psychological state.

Finally, this paper contributes to the vibrant and growing research stream on student entrepreneurship (cf. Åstebro et al., 2012; Bergmann et al., 2016; Wright et al., 2017). While to date most studies have focused on the mechanisms through which university can develop entrepreneurial knowledge, attitudes and intentions among students (cf. Nabi et al., 2017), we know less about the influence of university on students who pursue entrepreneurial activities along their studies (Nielsen et al., 2015). Moreover, research has overly focused on the impact of specific educational initiatives on student entrepreneurship, but has to large extent neglected other institutional mechanisms through which university can exercise influence on its entrepreneurially active members (Bergmann et al., 2016; Saeed et al., 2015; Wright et al., 2017). Our study contributes to extend this literature, showing that the university context matters not only for encouraging students to become entrepreneurs (cf. Bergmann et al., 2016), but also has important consequences on the mental health of students who already started an entrepreneurial career. Since PWB represents a key measure of success for the individual entrepreneur (Shepherd and Haynie, 2009a), this provides a more comprehensive understanding of influence of university on student entrepreneurship beyond the start-up phase. In particular, we showed that research can take advantage by considering the reciprocal influences of two manifestations of university entrepreneurship – pursued either by academic scientists or by students – which are commonly perceived as separated and investigated in different research streams. To date there is already anecdotal and empirical evidence that student entrepreneurship might support entrepreneurial activities of faculty who can resort on entrepreneurially active student to commercialize innovation (Jain et al., 2009; Nielsen et al., 2015); in this paper we showed that also entrepreneurial activities pursued by faculty exercise important influence on the entrepreneurial journey of students.

Limitations and future research directions

Before illustrating the practical implications which derive from this study, we describe its limitations and the opportunities for future research arising from these limitations. First, the focus on student entrepreneurs represents a boundary condition of this study. This restricts the empirical generalizability of our findings to

other types of founders even if this paper's results are based on theoretical assumptions valid for all entrepreneurs. For example, one limitation of students' sample is that their PWB might be depend to a greater extent to social factors because they care less about the business results of their ventures. In fact, student entrepreneurs are involved in other important activities such studying and are at very early stages of their career thus having high flexibility to change their career choices. Partially supporting this argument, we found in a post-hoc analysis that for students fully owning their ventures (and thus more likely to care about its outcomes), the influence of the business outcomes of economic and community value creation on PWB does not depend on their university culture. Given this limitation, we recommend studies that focus on entrepreneurs at other stages of their careers and lives. Moreover, future research could explore how the relationship between value creation and PWB is influenced by other types of social contexts or institutions in which entrepreneurs are embedded. For example, family often generates role conflicts between entrepreneurial identity and membership to family (Shepherd and Hayinie, 2009b). How do the characteristics of founders' family affect the relationship between value creation and PWB? Remaining in the context of academic entrepreneurship future studies could investigate whether the findings of this study hold also for scientist entrepreneurs, as they experience tension between their identities as entrepreneurs and as scientists (Jain et al., 2009). As in the case of student entrepreneurs, this tension might determine the impact of value creation on PWB.

A second important limitation of this study concerns the limited size of our sample and the scarce number of universities attended by the surveyed student entrepreneurs. To overcome this limitation future studies could be based on cross-country samples. This would allow to have a larger number of student entrepreneurs grouped in more universities.

Third, the research design of this study is cross-sectional, which limits the possibility of ensuring a causal effect of value creation on PWB. However, while the PWB items capture the very current mental state of student entrepreneurs, the evaluation of firm performances is likely to be formed over a larger time span. Therefore, it can be reasonably excluded that performance proceeds PWB. To further alleviate concerns of reverse causality future research could adopt longitudinal research designs or experience sampling methodology which requires participants to provide reports of their momentary PWB on a constant basis over a period of time (cf. Uy et al., 2017).

Finally, even though quantitative research allows to empirically test hypotheses on larger samples, it limits the possibility to describe the processes behind our results. A qualitative case-study approach could complement the present study by shedding light on the cognitive process that lead to our observed outcomes.

Practical implications

The findings of this study can be useful for entrepreneurs, educators and policymakers. Entrepreneurs can take advantage of the awareness that aligning their achievements with the culture of the social groups they belong to is critical for maintaining a well-functioning mental state.

Educators can learn from this study that the educational context, besides teaching entrepreneurship and pushing students to become entrepreneurs, can help student entrepreneurs to obtain PWB from the outcomes of their business activities. Creating a culture at university where the entrepreneurial outcomes are appreciated can help student entrepreneurs to enjoy their journey as founders while continuing to study at university. The prospect of an enjoyable entrepreneurial career, that improves founders' PWB, might also motivate more students of a university to become entrepreneurs (Bradley and Roberts, 2004).

Finally, policy-makers can take advantage of this research to understand how institutions can help entrepreneurs to enjoy the benefits of a socially well-performing firm, while at the same time avoiding the emotional downsides of a financially poorly performing firm. For example, taking measures that support the image of socially-engaged entrepreneur could increase the PWB founders gain from acting for the public good. This important because psychological distress in response to business failure can represent a cost for society and entrepreneurship has an immense potential to solve unaddressed needs of society (Hitt et al., 2011).

5.6 Conclusion

PWB represents a fundamental measure of success for the individual entrepreneur. In this paper we showed that the value created by the firm represent key antecedents of PWB, but the culture of founders' social context plays a pivotal role in determining the impact of value creation on PWB. While this study is based on student entrepreneurs, whose embeddedness at university is critical for their PWB, we suspect that the influence of founders' social context on the PWB obtained by value creation is determinant also for other types of socially embedded entrepreneurs. In fact, finding a match between the outcomes of the own behaviors and the culture

of relevant social groups represents a need that is shared among founders and, more in general, among human beings.

6. DISCUSSION

The main goal of this thesis has been contributing to the growing research on entrepreneurial cognition by studying the mechanisms through which socially embedded individuals develop knowledge- and motivation-related cognitive dimensions that prepare them towards entrepreneurship. To do so, we concentrated on individuals – students and scientists – embedded at *university*. This social context, in fact, offers resources, socialization and norms, which constitute unique opportunities for its members to nurture and develop their cognitive endowments.

The papers contained in this thesis conceptualize, illustrate and empirically test different mechanisms and circumstances through which university members develop cognitive factors that can assist them in the entrepreneurial process. A first mechanism is (entrepreneurial) *learning*, that is the acquisition of entrepreneurial knowledge (Politis, 2005). The first paper showed the extent and the circumstances under which university's teaching mission contributes to increase the perceived entrepreneurial knowledge of students. Findings suggest that through the exposure to entrepreneurial education initiatives students can increase the confidence in their knowledge required to identify and act upon new opportunities, but only up to a certain point. Without directly experiencing the entrepreneurial process, such learning outcome is constrained. In fact, student with previous founding experience were found to benefit more from entrepreneurship education; and practice-oriented pedagogies were more effective in helping students to increase their perceived entrepreneurial knowledge. Finally, in countries where opportunity-driven entrepreneurship prevailed and where the knowledge requirements for entrepreneurship might be more demanding, the learning outcomes perceived by students were limited. Overall, this paper illustrates the potential of the university teaching mission in developing entrepreneurial knowledge which prepares students' mind to entrepreneurial action; it also reveals that there are boundary conditions to be taken into account for understanding the extent of entrepreneurial education impact.

The second mechanism explored in this thesis is (career) *imprinting*, that is the internalization of cognitive and normative structures in response to the socialization as workers in an organization (Cirillo et al., 2014; Dokko et al., 2009). The second paper of this thesis showed how the career imprints scientists internalize while participating to the research mission contribute to the success of the innovative startups they join as

founders. Results revealed that the unique attitudes towards search that scientist entrepreneurs develop during their career in the lab are transmitted to their ventures and positively affect their open innovation behavior. In turn, open innovation is shown to account for why innovative startups with scientists outperform other ventures in terms of sales. However, the extent to which the open mindset internalized by scientists in the lab can be translated into firm's open innovation to benefit commercialization, is limited if (i) only few scientists join the innovative startups; and (ii) when the innovative startup does not embrace business practices and when it remains anchored to the logics of the scientific world. The results of this paper suggest that working on the traditional research mission of university helps scientists to develop unique attitudes towards openness and collaboration that become part of their mindset when they become entrepreneurs and influence the behaviors and success of their innovative startups. Therefore, being imprinted in the research lab, appears to provide unique advantages to founders provided that they embrace logics of the business world.

The final mechanism explored in this thesis is (entrepreneurial) *identity*, which describes what behaviors individuals consider as appropriate for themselves in a particular context, thereby increasing their well-being and self-worth (Gruber and MacMillan, 2017). It is employed to explain how the commercialization mission of university, a visible element of its culture, influences the psychological well-being student entrepreneurs obtain from different performance dimensions of their business. The well-being student entrepreneurs obtain from creating value for themselves, for their customers and for society was found to vary to the extent that these dimensions of performance matched university culture. More specifically, university culture oriented emphasizing the third mission negatively moderated the impact on student entrepreneurs' psychological well-being of creating value for themselves and for their customers, but positively moderated the impact of societal value creation. This paper shows how university members can develop idiosyncratic ways to enjoy the journey as entrepreneurs in response to the emphasis of university culture on the commercialization of scientific knowledge through entrepreneurial ventures.

Taken together, the studies of this dissertation help to answer a fundamental question in entrepreneurship cognition on how individuals develop the cognitive factors that guide entrepreneurial action (Grégoire et al., 2011; Mitchell et al., 2007). By doing so, several contributions to the literature streams on entrepreneurial cognition and social embeddedness are offered. First, the findings extend the debate on the possibility to develop entrepreneurial cognition (Cope, 2005; Omerede et al., 2015) showing that

entrepreneurial cognition is not only innate or created during the childhood; it can be also nurtured by individuals in later stages of their lives (i.e, while studying at university or during their career experiences). Second, the papers of this thesis contribute to research on social embeddedness in entrepreneurship (Bird and Wennberg, 2014; Dahl et al., 2010) by illustrating that the influence on cognition represents a key mechanism through which social relationships influence entrepreneurship: in other words, the importance of social embeddedness to entrepreneurial processes is not limited to facilitating the acquisition and deployment of resources. In this respect, the papers present different mechanisms through which socially embedded individuals nurture their entrepreneurial cognition taking advantage of their context: learning, career imprinting and social identification. Moreover, they illustrate that for each of these mechanisms there are boundary conditions that have to be taken into account to fully grasp their outcomes. For example, learning outcomes are conditioned by the previous experiences of individuals; the outcomes of career imprinting reflect not only the career of a single individual but of the entire founding team; social identity considerations produce different outcomes depending on the cultural frames imposed by the context. Moreover, the outcomes of social embeddedness are not deterministic but depends to some extent to individual agency. Indeed, it should be noted that it is up to individuals to select themselves in the first places in social context where they can nurture and further develop their predisposition towards entrepreneurship (Elfenbein et al., 2010).

Additionally, this dissertation contributes to the vibrant research stream of university entrepreneurship (Kacperczyk, 2013). An interpretation of the research presented in the dissertation offers the possibility to establish a *university embeddedness* perspective on entrepreneurial cognition (Figure 6.1) to explain how individuals acquire entrepreneurial ways of thinking in an institution which offers opportunity of learning and socialization outside the context of venture creation and development. Just as the concept of *family embeddedness* (Aldrich and Cliff, 2003) encouraged scholars to consider the family institution as deeply interconnected with the process of new venture creation, university and its members' entrepreneurial thinking (and acting) are closely related. The family embeddedness perspective on new venture creation was developed by Aldrich and Cliff (2003) with the aim to describe how the socio-historical transformations investing the family institution in the last decades have created new possibilities for individuals to identify and act upon new business opportunities. In a similar vein, university in the last decades has undergone profound changes that have transformed it into an institution of fundamental importance to entrepreneurship (Audretsch, 2014). A

university embeddedness perspective invites scholars to consider that the impact of the university institution on entrepreneurship transcends the well-known third mission of active engagement into entrepreneurship (just as a family embeddedness perspective stresses that family's involvement intro entrepreneurship is not limited to family businesses): university can have a profound effect on individuals helping them to think and act entrepreneurially. To this end, all three missions of university (teaching, research and commercialization) can play a fundamental role.

Figure 6.1 depicts a conceptual framework that illustrates how a university embeddedness perspective can be adopted to guide research on the antecedent and outcomes entrepreneurial cognition.

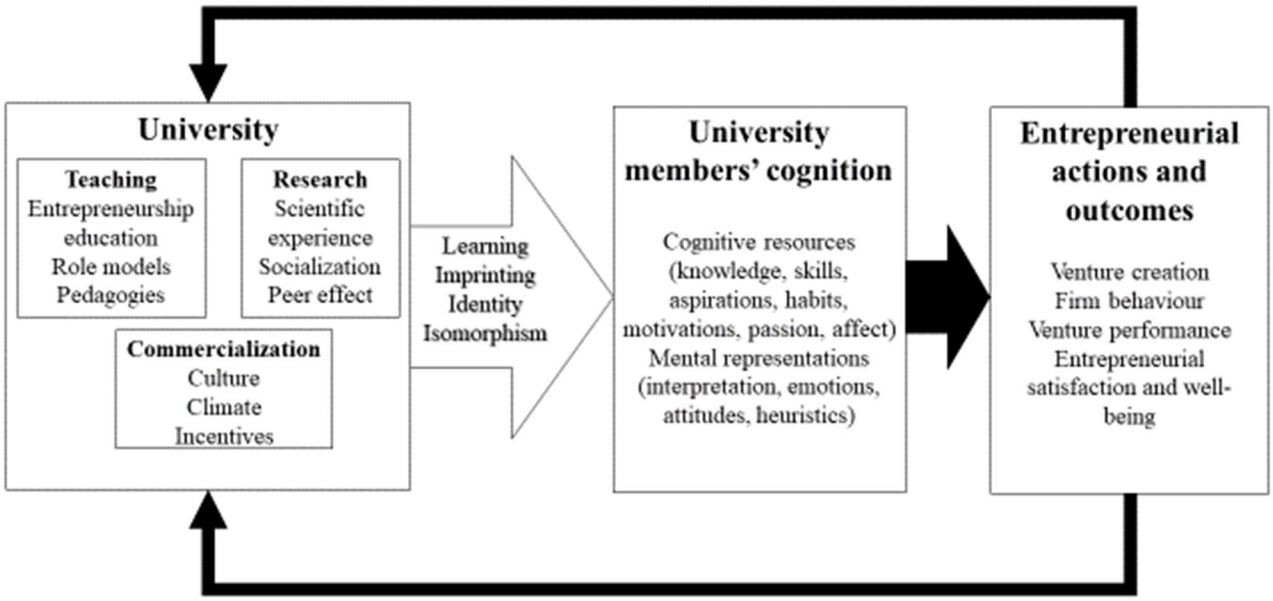

Figure 6.1 A university embeddedness perspective on entrepreneurial cognition

On the left it shows that the three missions of university together influence the cognition of its members (i.e., students and scientists) via different mechanisms (e.g., learning). In turn, the cognition of university members produces entrepreneurial action and affects its success. Finally, the entrepreneurial behaviors and outcomes of university members might have an impact on the extent and the ways in which university enacts the three missions. By illustrating how entrepreneurial cognition proceeds from the social context and affect action, the framework follows the call of Grégoire et al. (2011) who lamented the lack of a *process* perspective in entrepreneurship cognition. A process perspective studies how social influences affect individual's mind and in turn action.

Some of the relationships depicted in the left-hand side of the framework were derived from the papers in this dissertation. For example, the first paper showed the impact of entrepreneurship education on the entrepreneurial knowledge of university students through learning. Other relationships on the left-hand side of the framework were not derived directly from the papers of this thesis but are supported existing research on higher education and entrepreneurial cognition. For example, in entrepreneurship research it is widely acknowledged that entrepreneurial thinking is characterized by unique ways to process information (Aldrich and Yang, 2014; Baron, 2004) that allow individuals to make unique associations and identify opportunities invisible to other who lack this ability. Doing research provides scientists the opportunity to develop unique ways to process and connect information because science provides a framework to systematically identify opportunities to develop solutions to technical problems (Fleming and Sorenson, 2004). Entrepreneurial education programs have been also shown to positively affect students' ability to identify opportunity (DeTienne and Chandler, 2004), suggesting that university teaching mission can influence the individuals' effectiveness in processing and connecting information. Entrepreneurship education can also provide students inspiration towards entrepreneurship (Souitaris et al., 2007), which could fuel passion, a central aspect of entrepreneurs' way of reasoning and acting (Cardon et al., 2009). Moreover, we explored only some of the mechanisms through which university can affect the cognitive factors of its members. For example, also institutional mechanisms, such isomorphism, have been shown to drive university members' adherence to particular cognitive and normative structures (Ensley and Hmieleski, 2005).

Moving to the right-side of the framework, the relationships here illustrated describe the impact of cognitive factors university members acquire at university on their actions and performance. For example, the second paper showed that the career imprints internalized by scientists in the form of open attitudes towards search affected the open innovation of their startups and, in turn, performance. Other relationships are not directly derived from the empirical findings presented in the papers of this thesis, but can be reasonably assumed on the basis of extant literature and on the arguments here described. For example, cognitive resources that can be acquired by university members have the potential to drive entrepreneurial action. Venture creation, in fact, requires individuals' motivation, knowledge and ability to search and interpret information to identify opportunities and then act upon them (McMullen and Shepherd, 2006).

Finally, even though not explicitly tested in this thesis, we suggest that not only university drives its members' entrepreneurial thinking and acting, but also entrepreneurial action and outcomes of university members will affect university. That is, the extent to which students and scientists engage in entrepreneurial behaviors and obtain success, will influence how university enacts the three missions of teaching, research and commercialization. For example, students that have been successful in starting and running their business can become role models for other pupils and influence the effectiveness of educational programs on learning outcomes (Walter and Dohse, 2012). In a similar vein the exposure to peers who actively pursue entrepreneurial behaviors changes the business and academic logics scientists internalize as result of their career imprinting (Aschhoff and Grimpe, 2014). Finally, the success of commercialization activities of university members can induce university to a higher commitment to the third mission which might become more tightly intertwined with its culture and systems of incentives.

The university embeddedness perspective depicted in Figure 6.1 also provides the basis for a number of research questions that are discussed in the following section.

6.1 Limitations and research agenda

In discussing a non-exhaustive set of possible research directions generated from the conceptual framework here presented, this paragraphs concentrates on those research opportunities offered by the limitations of this thesis. Limitations of each papers have already been discussed in the precedent chapters. Here attention will be given to those limitations that affect the thesis as a whole. First, as reported in Table 6.1, the research questions of the three papers did not explored the impact of the teaching and commercialization mission on scientists and of the research mission of students. This leaves gaps that can be addressed in future research; in some cases, scholars have already answered research questions that relate to the cells not filled by the papers of this thesis. For example, while research often looks at the effects of entrepreneurship education of students' cognition, less is known about the effect of teaching on faculty's cognition. Since previous literature suggested that the research orientation of departments may affect students' entrepreneurial intention (Walter et al., 2013), future research could also study how different measures of research quantity, quality e variety affect the cognition of students. Finally, since the propensity of academic scientists to become entrepreneurs is conditioned by the extent to which their university or department enacts the third mission (Ambos et al., 2008;

Aschhoff and Grimpe, 2014; Huyghe and Knockaert, 2015), future research might study how university third mission influences a wider range of scientists' cognitive factors that relate to entrepreneurship.

Table 6.1 Summary of the papers in the thesis and research agenda

	Students	Scientists
Teaching	'Entrepreneurial learning at universities: exploring multilevel contingencies'	*Does teaching entrepreneurship affect faculty's entrepreneurial skills and motivations?*
Research	*Does the production of scientific knowledge affect students' alertness to opportunities?* (cf. Walter et al., 2013)	'From the lab to entrepreneurship: how imprinting of scientists affects the open innovation and performance of innovative startups'
Commercialization	'How the value created by student entrepreneurs affects their psychological well-being: a social identity perspective'	*Does a university culture which emphasizes the commercialization mission affect scientists' entrepreneurial motivations and skills?* (cf. Aschhoff and Grimpe, 2014; Huyghe and Knockaert, 2015)

Note: in italic examples of potential research questions not addressed in this paper; in parenthesis related literature

Second the papers of this thesis focus on a narrow set of cognitive factors measured on the basis of perceptions obtained from survey-data. The use of other data collection procedures would allow to study the effect on a much broader variety of mental representations and cognitive structures. For example, the use of experimental design or experience-based sampling data collection methodologies permits researchers to observe individuals' behaviors and capture some cognitive variables that cannot be easily reported in surveys (e.g., cognitive biases, effectual reasoning, inspiration).

A third limitation that characterizes this thesis is the use of cross-sectional data (first and third paper) or data collected over a limited time-frame (2 years for the second paper). This limits the possibility to explore the right-hand side of the framework presented in Figure 6.1. Longitudinal and process-oriented research designs would allow to assess the effect of cognitive factors developed at university on the careers and lives

of students and scientists. For example, little is known on how acquiring entrepreneurial ways of thinking at university affects the job performance in wage-payed jobs or as researchers; or how it affects happiness, life satisfaction and other social outcomes (e.g., family, friendship), in addition to career success (Nabi et al., 2017). Longitudinal research designs would also allow extend the left-side of the framework including the determinants of individuals' selection into university. By doing so, it would be possible to better disentangle selection from treatment effects caused by the university social context. Moreover, longitudinal research designs based on data collected over longer time frames would offer the opportunity to study how the cognition and actions of university members transform university, as it takes much time for institutions to change (cf. Simsek et al., 2015).

To this end, also in-depth qualitative or ethnographic research (cf. Aldrich and Cliff, 2003) could add further insight on how institutional arrangements proceeds bottom-up, from organizational members up to university. Research like this would allow to recognize the importance of agency in studying socially embedded individuals: besides being influenced by their context, individuals can also change their social context. Qualitative research also offers other advantages that could complement the quantitative research presented in this thesis. For example, it could shed light on the thoughts and reflections of university members exposed to the social environment, which in the present thesis are often reconstructed on the basis of theory. Coupled with a interpretivistic rather than positivistic research epistemiology (Packard, 2017) such qualitative research approaches would also allow to explain more in-depth why individuals respond differently, even if they are embedded in the same social context. For example, individuals might have different thoughts and reactions to environmental stimuli, depending on their innate characteristics and previous life experiences.

Finally, even though this thesis focused on university as context where cognitive factors that predispose individuals to entrepreneurial action are originated, there might be other context worth of investigation in this respect: for example, in family and established businesses individuals can be exposed to life and work experience that affect their ways of thinking and behaving as they become entrepreneurs (Aldrich and Yang, 2014; Mathias et al., 2015). The work of Aldrich and Cliff (2003) has already been mentioned: in their essay they illustrated how the norms, attitudes and values of the family system affects new venture creation processes – including opportunity recognition – and outcomes. Concerning organizations, in their conceptual paper Sørensen and Fassiotto (2011) described the mechanisms through which companies shape

the entrepreneurial process: these include the transmission of knowledge, skills, values and beliefs. Based on this literature, one might advance the idea that family and firms represent *functional equivalents* of university in their impact on entrepreneurial cognition. This opens a number of research questions on the comparison of the effects on cognitive variables caused by these institutions (cf. also Agarwal and Shah, 2014). For example, how do the cognitive resources and mental representations developed at university differ from those ones developed in family or in corporations? What are the distinctive contributions of these cognitive variables to the entrepreneurial process? Future research might also evaluate the effect on entrepreneurial cognition that arises from the joint influence of more institutions. For example, are there complementarities between the cognitive resources and mental presentation acquired at university and, subsequently, from working in established firms? How do these complementarities affect entrepreneurial action and outcomes?

6.2 Practical implications

Besides those practical implications reported at the conclusion of each paper, this paragraph summarizes some general implications for potential or actual entrepreneurs, educators and policymakers that can be formulated on the basis of the overall message of this thesis.

First, potential entrepreneurs can learn that, to have the mental predisposition to identify and act upon new opportunities, besides genetic characteristics and actual founding experience, also socializing in contexts which develop and form individuals' mind is of fundamental importance. For example, before engaging in an entrepreneurial career, prospective founders can take specific education, meet with experienced and motivated entrepreneurs or engage into jobs which require creative thinking and mental processes required for productive entrepreneurship. In this thesis we showed that university represents one possible context that provides many of these opportunities for personal development.

Second, actual entrepreneurs can take advantage of the key findings of this thesis in order to improve their likelihood of successfully navigating the entrepreneurial process. While the success of entrepreneurs is commonly associated to specific founding experience or genetic dispositions, the finding of this thesis indicate that entrepreneurs might learn from a variety of backgrounds and contexts. In this respect we showed that research experience as scientist can provide unique mental dispositions that boost firm performances. For example, meeting individuals with different backgrounds and view of the world in classrooms or other contexts

of socialization (e.g., in business incubators or accelerators) can broaden the perspectives embraced by new venture founders.

Third, educators can profit from this thesis by acknowledging that, besides formal education, there are different mechanisms to mold entrepreneurial individuals at university. This thesis illustrated the downsides of theory-oriented pedagogies in entrepreneurial education and invites to complement formal lectures with practice-oriented offerings such as games, simulations and problem-based learning. These pedagogies can also have the advantage to stimulate creativity and curiosity (DeTienne and Chandler, 2004; Piperopoulos and Dimov, 2015). As suggested by the second paper, where research experience is found to contribute to entrepreneurial success, experiences that instill curiosity and open attitudes into individuals represent an advantage for entrepreneurial activity. In addition to education specifically aimed at teaching entrepreneurship, also university culture can influence the entrepreneurial experience of its students: as seen in this thesis, it shapes the well-being experience of students who run a business. Educators can contribute to the creation of a university culture whose manifestations support entrepreneurship. To do so, for example they might reward, incentivize and encourage students' entrepreneurial efforts (Huyghe and Knockaert, 2015) or invite to lectures prominent entrepreneurs as guest speakers (Walter and Dohse, 2012).

Finally, policymakers can build on some key findings of this dissertation to embed in social institutions arrangements that facilitate the development of entrepreneurial cognition. Formal institutions and policies that foster the founding and financing of startups need to be complemented with cultural codes that give nascent entrepreneurs the possibility to learn effective cognitive structures on which to base their action (Aldrich and Yang, 2014). Rather than simply inducing more individuals to become entrepreneurs and found startups (Shane, 2009), institutions in an entrepreneurial society are required to offer individuals the possibility to acquire an entrepreneurial way of thinking that assist them in the entrepreneurial process or, more in general, in their careers and lives (Audretsch, 2014). To this end, we showed that university institution could proceed along several fronts. For example, educational policy could embed entrepreneurial education in many disciplines starting from earlier years of education. Adolescents' cognition has more plasticity and can be more easily formed through learning and socialization experiences (Falck et al., 2012). University's policies that support entrepreneurship could also contribute to create a culture among students and scientists that motivate them towards adopting entrepreneurial ways of thinking and acting (Huyghe and Knockaert, 2015). Outside

university, there are other arrangements through which policy can induce individuals to go through socialization and learning experiences. For example, labor market policies could incentivize programs that allow employees to participate to activities, meetings and training that encourage creativity and induce them to engage in mental processes that characterize entrepreneurship (Aldrich and Yang, 2014).

7. CONCLUSION

This thesis has studied how individuals can take advantage of their social context to develop cognitive endowments that can assist them in entrepreneurial action. Focusing on university as a context in which individuals are socially embedded, the papers presented in the dissertation conceptualized and tested different mechanisms (i.e., learning, imprinting and identity) whereby university members (i.e., students and scientists) nurture and develop entrepreneurial cognition under the influence of the three missions of university (i.e., teaching, research, commercialization). These results contribute to literature streams on cognition and social embeddedness in the entrepreneurship field and lead to the conceptualization of a process framework of university embeddedness, on the basis of which a research agenda and practical implications can be formulated.

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