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Thesis title:

THREE ESSAYS ON USER AND MARKET KNOWLEDGE

PhD in	Business Administration & Management
Cycle	XXIII
Candidate's tutor	Giovanni Valentini
Year of discussion	2012

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Martina Pasquini

Ai miei genitori e a Lucia,
per il loro costante supporto,
per non avermi mai impedito di seguire le mie aspirazioni,
anche se questo ha voluto dire allontanarci.

A Lorenzo,
per la sua immancabile pazienza,
per la sua calma e positività che ha voluto trasmettermi ogni giorno.

THREE ESSAYS ON USER AND MARKET KNOWLEDGE

A dissertation presented

by

Martina Pasquini

In partial fulfillment of the requirements for the Degree of
Doctor in Business Administration & Management

Dissertation Committee:
Franco Malerba, Myriam Mariani, Giovanni Valentini, and Gianmario Verona

Bocconi University
January 2012

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INTRODUCTION

My dissertation is composed by three distinct but related essays, seeking to understand how knowledge sources might affect innovation and entrepreneurship processes.

Understanding how user and market knowledge affect the two processes has rich theoretical and practical implications. First, as the typical targets of new products or innovations, users are increasingly involved by companies in their innovation activities. This is because users can cooperate directly with the company to develop technologies that better fit their needs. Second, user and market knowledge are closer to existing needs and might anticipate new trends. Their exploitation is likely to both create successful innovations on the marketplace and to allow the entrepreneurs to discover attractive opportunities to the market. Finally, although user and market knowledge might have positive consequences on innovative ideas, they are costly and difficult to transfer because of their sticky nature and thus, scholars should pay particular attention on how they can be more efficiently transmitted.

In my dissertation, I particularly focus on the role played by user or market knowledge on innovative outcomes and on entrepreneurs' new opportunities. In order to provide a comprehensive picture, I focus on different levels of analysis and I contribute in two research fields.

In the first essay of my dissertation (coauthored with Franco Malerba) we construct a theoretical framework on the role of users across different sectoral systems. The core idea is that users differ and they contribute differently to the innovation process. We thus distinguish different categories of users, namely active knowledgeable users, innovative users, lead users, experimental users, user entrepreneurs, and vertically integrated users, according to the level of involvement in innovation processes and innovative outcomes. Second, we choose a small sample of sectoral systems (e.g. extreme sports, food, surgeon and medical precision instruments, chemical process, software, and semiconductors) and describe the peculiarities of user innovation across the sectoral systems chosen by highlighting the diverse roles that users cover. As final point, we attempt to explain differences in users' roles by considering the diverse facets constituting a sectoral system, namely the knowledge type, the level of knowledge appropriability, the proximity among users, the market structure, the innovation costs, and the industry life cycle. We argue that the different combination of these elements – for example, the combination of application with technical knowledge, the combination of different industry life cycle stages with innovation costs, or the combination of IPR regimes with investing costs- could explain the presence of certain users with respect to others in a certain sectoral system. We conclude, for instance, that user entrepreneurs or experimental users are highly influenced by the stage of industry life cycle: they are more likely to be present in the early stage of an industry, when the market is more segmented. Moreover, user entrepreneurs will enter the market if costs will not exceed benefits; by contrast, experimental users are not sensitive to high costs, since their main purpose is developing niche technologies despite high initial investments.

In the second essay of my dissertation, which constitutes the basis of my job-market paper, I explore whether the likelihood of patent commercial exploitation is associated to the type of knowledge sources exploited by the inventor during the invention process. I analyze the role of market knowledge with respect to patent commercialization, by pointing out how this source is not sufficient in this context. More particularly, I hypothesize that it is the combination of market knowledge (coming from users, competitors, and suppliers) and scientific knowledge (coming from knowledge developed in R&D labs, technical literature, and conferences) to increase the probability of the patents to be commercially exploited. The merging of market and scientific knowledge in the invention makes it both technologically advanced and close to market needs, and therefore more likely to be commercialized. In order to reinforce this hypothesis, I also hypothesize that two types of inventor, which embody respectively market and scientific knowledge, need to recombine the knowledge they do not possess in order to increase the probability of patent commercialization. I manage to distinguish two categories of inventors labeled as professional and non-professional. The first ones are scientists, whose main job is inventing, while the others are not hired to invent and they typically work in marketing or production departments. To test the theory, I use PatVal-EU data, including data on European inventors and patents granted by EPO between 1993-1998. In this dataset I managed to distinguish information at inventors' level (age, gender, education, experience), information about invention process (i.e. knowledge exploited by the inventors during the patenting process), about working context and finally, whether the patent has been exploited or not commercially (I exclude forms of licensing). My sample consists of more than 5,500 patents. Empirical findings are mainly consistent with theory and show that combination of knowledge sources has a positive effect on patent commercialization likelihood. Empirical evidence also shows that inventors combine the knowledge they embody with the one they lack of to improve patent marketability.

Finally, last essay of my dissertation (coauthored with Gianmario Verona and Emanuela Prandelli) builds on the psychological theory of perspective-taking (i.e., PT) to show how this cognitive tendency has relevant consequences if it is applied in entrepreneurial contexts. User PT can be a useful mechanism to overcome the stickiness of users' knowledge and positively affects entrepreneurs who take effort to put themselves in the shoes of users. Here we test its effect on entrepreneurial motivations, self-efficacy, and creativity. As sustained by seminal works (Mead 1934; Piaget, 1932), empathy is composed by an emotional side (i.e. emotional empathy) and a cognitive side (i.e. perspective-taking). Hence, PT is the ability to infer others' thoughts, understanding others' thinking, by putting ourselves in others' shoes. We select users as the main target of PT process because users are both a target of entrepreneurial innovations and a knowledgeable source that can populate the entrepreneur's information corridors. We explore this cognitive tool as a mechanism to overcome the stickiness of user knowledge and to affect entrepreneurial attitudes and behaviors. We choose three variables –intrinsic motivations, self-efficacy, and creativity- considered drivers of opportunity recognition and factors influencing opportunity exploitation - and we test the effect of User PT on them. In a first experimental study, which draws from psychological literature the main aspects to develop its design, we test these hypotheses using MBAs students. In a second study, we try to disentangle the consequences of User PT targeted either on ordinary users or lead users. Empirical findings suggest that User PT is a cognitive tendency that positively affects entrepreneurial motivations to act, the perception of self-efficacy, and the level of creativity. In addition, User PT targeted on different user types influences the level of the variables considered. Taking the perspective of lead users has a higher influence than entering the mind of ordinary users. Thus, User PT could be a fungible way to align with users' needs and absorb their knowledge. Implications can be in terms of cognitive studies, knowledge transmission, entrepreneurial success, and liability of newness of start-ups with respect to incumbents.

The Role of Sophisticated Users in Innovation and Creation of Entrepreneurial Opportunities: Differences across Sectoral Systems

Abstract

The literature on user innovation highlights the presence and the heterogeneity of user innovators across several sectors. In this paper, our attempt is twofold. First, starting from existing studies, we disentangle the roles of users classifying them according to their involvement in the innovative process. We identify six categories of users: active knowledgeable users, innovative users, lead users, experimental users, user entrepreneurs, and vertically integrated users. Each category refers to a precise user's role. Second, we try to explain the variance of users' innovation rate and the different role that they cover across a sample of sectors (e.g. extreme sports, food, medical devices, motor-auto vehicles, chemical processes, and semiconductors) by employing sector specific variables. We consider variables usually characterizing the heterogeneity of the sectoral systems, such as the type of knowledge, IPR, relational links among agents, innovation costs, market structure, and industry life cycle. We elaborate theoretically our interpretation by combining the variables chosen. We highlight that context-related variables determine the involvement of users in the innovation process and thus, that certain users with respect to others are more likely to be present if the sectoral system displays some particular characteristics.

1. INTRODUCTION

Several works extensively document the diffusion of user innovation (von Hippel 2005, von Hippel, 1988) indicating users and customers as one of the principal sources of innovation. Hence, collaborative forms of innovation have increasingly become an organizational practice (Sawhney, Verona, and Prandelli, 2005). Several studies conducted across diverse sectors document the active role of users in innovative processes, indicating as well their different level of involvement.

This work has the principal purpose to build a theoretical framework regarding the phenomenon of user innovation in order to understand how users differentiate across sectoral systems. First, by reviewing the existing literature, we define diverse categories of users depending on their level of involvement in innovation. We classify them into one of the following groups: active knowledgeable users, innovative users, lead users, experimental users, user entrepreneurs, and vertically integrated users. For each category, we identify a precise role that spans from feedback provision, innovation development or improvement, experimentation of new technologies and the commercialization of the user innovation. Second, we select a sample of sectoral systems identified in the literature as relevant with regards to users as innovators (Malerba, 2002). We include in our sample extreme sports, food, medical devices, motor and auto vehicles, software, and semiconductors. We describe the peculiarities of users' innovative activities across sectoral systems by pointing out the diverse roles that users may cover. Finally, we attempt to explain the variance of users' innovative activities across sectoral systems by employing context-specific variables. Since sectoral systems are a multifaceted construct, we disentangle its dimensions - namely knowledge type, relational links among agents, market structure, and sector dynamic - to show that differences in user innovation across sectoral systems can be driven by the features of the sector itself. To do so, we combine different facets of the sectoral systems (technical knowledge with application knowledge, technical knowledge with innovation costs, technical knowledge with IPR, supplier industry life cycle with user market structure) and we show that for each combination, certain user categories are more likely to be present with respect to others. Moreover, we find that technical knowledge, innovations costs, and IPR are three factors that 'enable' users to innovate across sectors. Although we lack data to validate our reasoning (a limitation of this study), we also claim that this study is one of the first attempts to link user innovation with the literature on sectoral systems and could be perceived as an interesting framework to interpret the role of users across diverse sectors.

The reminder of this paper is organized as follows. In the next section, we introduce the topic of user innovation. Then we present the categories of users followed by their description across our sample of sectoral systems. Finally, in the last part we elaborate our framework and show how different combinations of sectoral systems characteristics may determine the presence of some categories of inventors with respect to others.

2. BACKGROUND LITERATURE AND DEVELOPMENT OF THE CONCEPTUAL FRAMEWORK

2.1 What We Know About User Innovation

Scholars have usually investigated technical change by stressing two opposed forces: the technology and the demand. Demand is an incentive stimulating the rate of innovation (Schmookler, 1966; Gillfillan, 1935), generally different from science and technology (Rosenberg, 1982; Freeman, 1974). Over time, an increasing number of evidence has pointed out the shift from a manufacturer-active-paradigm to a customer-active-paradigm (von Hippel, 1978). Hence, users passed from an innovation incentive into active economic agents both suggesting improvements to existing products and creating new ones (von Hippel, 1988; 1982). This evidence includes various product ranges such as scientific instruments (von Hippel 2005; 1988), surgeon precision instruments (von Hippel 2005; 1988), outdoor products (Lüthje, 2004), extreme sports equipment (Franke and Shah, 2003; Shah, 2000), and software (Morrison, Roberts and von Hippel, 2000; von Hippel, 2001). Users are also shown to be active in chemical processing (von Hippel 1988, 2005; Enos, 1962), semiconductors (Fontana and Malerba, 2010), and the radar industry (Haefliger, Jäger, and von Krogh, 2011). More recently, studies highlight that users might also commercialize their innovations and start new ventures (Baldwin, Hienerth, and von Hippel, 2006; Shah and Tripsas, 2007). User knowledge is influential in entrepreneurial dynamics as well, as described by Fontana and Malerba (2010) using the case of the semiconductor industry, where it is shown that spin-offs coming from 'demand side' with a background in application sectors have better chanches of survival.

Furthermore, two additional important remarks regarding the phenomenon of users as innovators deserve attention. The first one regards the recurrent presence of the user community and its role in supporting both the knowledge exchange among peer practitioners and the diffusion of innovations developed (Franke and Shah, 2003; Jeppesen, 2005). The second one concerns the importance of the Web in connecting demand and supply. Actually, the Web creates several advantages as it decreases the search information costs of the manufacturer (Prandelli, Verona, and Raccagni, 2006) and it provides a platform supporting the development of new prototypes or the product customization through toolkits (Franke and von Hippel, 2003). Strictly related to these two factors, the most recent trend is the increasing attention towards the communities of crowd-sourcing (Howe, 2006), as they are important to develop new business models.

2.2 Different Types of Users

We recognize that users contribute differently and their activity spans from the provision of feedback, passing from the customization of products or the construction of prototypes as far as the commercialization of their own innovation. However, the existing research does not differentiate them and the general label 'users' is typically employed to describe all of them. Only a recent study (Flowers, von Hippel, de Jong, and Sinozic, 2010) presents a first attempt to measure user innovation by distinguishing two main categories, namely users that modify and users that create.

Similarly, we aim at classifying the users according to their role in innovation processes according to the level of their involvement and their outcomes. We proceed as follows: we review the existing literature of user innovation and we analyze the process and the relations between the users and the manufacturers. We also check whether some user categories are distinguishable in relation to their innovative outcome. We individuate six categories of users and label them as: active knowledgeable users, innovative users, lead users, user entrepreneurs, experimental users, and vertically integrated users.

To the best of our knowledge, these categories are collectively exhaustive since we do not identify other forms of users. At the same time, they are also mutually exclusive because each one has some distinguishing features that do not overlap with the others.

Below, we report their descriptions and point out their main features.

Active Knowledgeable User. Active knowledgeable users represent the initial step of users as innovators. This category of users positions at the border between the marketing literature and that of user innovation, since active knowledgeable users are not active innovators yet, but they suggest ways to improve the product. They are mainly a source of innovation, because their involvement in the manufacturing/service process consists of feedback provisions to the manufacturer, similar to the customers present in marketing studies who only indicate a better orientation for market needs. Their main task is to suggest to the manufacturer what the market wants and how to improve certain products, even if they do not innovate on their own. Since active knowledgeable users are practitioners and are guided by high use experience, they have a deep understanding of product usability and thus, can provide insightful feedbacks to manufacturer by filling the existing gap between the "need information" and the "solution information" (Thomke and von Hippel, 2002). We can summarize their role by borrowing a general definition from Lüthje and Herstatt (2004), which sums up this position: "Innovators are essentially people who are in a suitable position to suggest good ideas for new products" (Lüthje and Herstatt, 2004).

Innovative User. "Users that innovate can develop exactly what they want, rather than relying on manufacturers to act as their agents" (von Hippel, 2005: 1). This statement describes the role of innovative users. Differently from active knowledgeable users, innovative users contribute directly and personally to the innovation process by improving products for their personal use or by constructing simple prototypes in order to directly tap their personal needs. Innovative users have also technical competences and this characteristic allows them to improve products or construct customized prototypes (Thomke and von Hippel, 2002). Modifications of products by innovative users regard both industrial products (CAD software, library information systems, surgical equipment, and pipe hanger hardware) and consumers' products (outdoor products, and extreme sports equipment). The main advantage between the active knowledgeable user and the innovative user is the lack of costly and time consuming iterations between users and manufacturers (due to users' sticky knowledge) that last as far as the users' need is fulfilled (von Hippel, 1994).

Lead User. Lead users are characterized by two features distinguishing them from the average customer: they are both 'need driven' and 'ahead of the market' (von Hippel, 1986; Urban and von Hippel, 1988). "Lead users face needs that will be general in the marketplace, but face them months or years before the bulk of the marketplace encounters them and are positioned to benefit significantly by obtaining a solution to those needs (von Hippel, 1986: 797)". Thus, lead users are generally pushed to find superior solutions due to their urgent needs, which could potentially become future market needs. The early development of the lead user method and the lead user construct are related to their strength in forecasting market trends (Urban and von Hippel, 1988). Later, with the purpose of understanding what distinguishes lead users from mainstream customers, the lead user construct has been often at the centre of many studies. According to Morrison, Roberts, and Migdley (2004), 'lead userness' might be operationalized by the so-called leading edge status (LES). The presence of high leading edge status distinguishes the lead user from the ordinary innovative user. High leading edge status is characterized by a high level of benefits expected as well as by a higher level of dispositional innovativeness (Morrison et al., 2004), which is an innate personal trait. In this stream of studies, also Schreier and Prügl (2008) show that some individual characteristics, such as consumer knowledge, the high use experience, the locus of control, and the innovativeness personality affect the development of "lead userness", which can also induce the user to be an early product adopter (Schreier and Prügl, 2008). Moreover, lead userness influences the nature of innovative outcomes. Innovations by lead users are more likely to be successful (Morrison et al., 2000; Schreier, Oberhauser, and Prügl, 2007) and widely spread in the marketplace (Schreier and Prügl, 2008). Empirical results demonstrate that innovations developed by lead users are commercially more attractive (Franke, von Hippel, and Schreier, 2006). Thus, lead user theory not only points the "forecasting nature" of these users, but also their strong ability to innovate. Briefly, they are considered the major source of user innovation (Schreier and Prügl, 2008).

Experimental User. Experimental users are "customers who attribute an intrinsic merit to a product simply because it embodies the new technology" (Malerba, Nelson, Orsenigo, and Winter, 2007: 18). Through these customers, the market may "break the lock-in and allow the new technology to take off" (Malerba *et al*., 2007:18). Hence, experimental users are niche users who are willing to experiment a new technology incurring high costs in the present but with the expectation of higher benefits, represented by improved products and advanced technology. In this sense, experimental users are not "mainstream" customers because they do not accept or use the dominant technology, but they would prefer an emergent one even if it is not perfect and it requires initial investment costs.

User Entrepreneur. User entrepreneurship is defined as "the commercialization of a new product and/or service by an individual or group of individuals who are also users of that product and/or service" (Shah and Tripsas, 2007: 124). Alternatively, it can be defined as "the individual-level activity by which innovating users move beyond product or service invention to manufacturing and the establishment of new organizations to capture value created with their activity" (Frederiksen, Dahalander, and Autio, 2008). Although classical entrepreneurship theory underlines the role of personal and cognitive traits in recognizing new potential opportunities associated with foundation of a new venture (Baron, 2006; Shane and Venkatamaran, 2000), user entrepreneurship is almost a need driven phenomenon.

This process can be explained by the combination of entrepreneurial cognitive characteristics with the necessity to fulfill an untapped need. With respect to the classical entrepreneurial process, the presence of a supportive user community (Shah and Tripsas, 2007) characterizes the user entrepreneur. The community in fact supports the user entrepreneur from diverse perspectives. First, community members provide feedback about innovation improvements, their usefulness, and their quality. Second, it strengthens the perception of the 'future user entrepreneur' as a successful innovator. The more the community appreciates the innovation, the more likely the user could decide to commercialize it. User community, therefore, might shape the personality of the user entrepreneur and her self-perception by playing the role of an institutional motivator to pursue commercialization activity. For instance, as described by Friederiksen et al. (2008), if the 'future' user entrepreneur plays an active role in the user community as an opinion leader, she can also develop strong beliefs about her innovation competencies. Consequently, the probability she could venture around her innovation increases. Apart from the sectors we are going to consider, user entrepreneurship has been investigated in the ice harvesting industry (Utterback, 1994), the juvenile products industry (Shah and Tripsas, 2007), and the radar industry Haefliger, Jäger, and von Krogh (2011).

Vertically Integrated User. We define vertically integrated users as organizations where the user and the producer are within the same boundaries of the firm. According to the theory of transaction cost economics (Williamson, 1975), the basic choice regards 'making' or 'buying' in relation to the level of market hazard. A vertically integrated user produces and innovates its components within the organizational boundaries without recurring to external specialized suppliers, making the 'firm' the successful form of coordination. However, uncertainty of the market cannot completely explain this choice (Jacobides and Nelson, 2003), and the resource-base of the firm may complement it. Therefore, vertical (dis)integration and specialization depend on the existence of certain competencies and their choice may change in function to the evolution of firm capabilities (Cacciatori and Jacobides, 2005; Malerba et al., 2008). On the one side, the user and manufacturer may decide to integrate in order to have a higher level of coordination with respect to a turbulent market and therefore, saving on transaction costs. Decreasing costs may have a positive impact on innovation costs. On the other side, a vertically integrated user is pushed towards integration by the need of complementary specialized assets. As sustained by Teece (1986) “innovation requires access to complementary assets for commercial success” (Teece, 1986: 296). As a practical example, we consider the case of IBM in the industry of computer and semiconductors (Bresnahan and Malerba, 1999; Malerba et al., 2008). The history of the computer industry can be framed into three major eras, each one punctuated by the introduction of a new technological discontinuity (mainframe, integrated circuits, and microprocessors), which had impact both on the structure of the industry and on firm innovation capabilities. In different moments, IBM passed from vertical integration to other disintegration strategies to imitate other PC producers and particularly, to search for market alliances and external capabilities.

Briefly, the generality of the term ‘user’ includes diverse forms of manufacturer-user interaction or relation, which are summarized in Table 1.

Insert Table 1 about here
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3. Linking User Innovation to Sectoral Systems

A sectoral system is a multifaced concept (Malerba, 2005) that considers the industrial sector as a multidimensional construct, which integrates diverse facets giving the sectors a dynamic perspective (Malerba, 2002; Malerba, 2005). A sectoral system is defined as “a set of new and established products for specific uses and the set of agents carrying out market, and non-market interactions for the creation, production, and sale of those products” (Malerba, 2002: 250). This concept draws from basic elements of evolutionary innovation theory and aspects of the innovation system approach such as the products, the agents, the knowledge, the technologies, and complementarities as well as institutions together with several others. A sectoral system undergoes change and transformation through the co-evolution of its various blocks (Malerba, 2002).

Here, we suppose that the characteristics of a sector drive the difference of innovative activities as well as the user's role. To elaborate our framework, we focus specifically on four distinct blocks of the sectoral systems: the level of technical and application knowledge across sectoral systems, the relations among agents indicated by the proximity of their relations, the level of innovation costs, the supplier market concentration (a representation of the market structure), and the industry life cycle (which stands for market dynamics). In the last part, we show that the different combination of these variables enables or hampers the presence of some users with respect to others.

Type of Knowledge and Capabilities. The role of knowledge is central in innovation and production development, since technology evolves through knowledge accumulation and learning, typically affecting the technological regimes across sectoral systems (Nelson and Winter, 1982; Winter, 1984). The knowledge belongs to two domains. One domain concerns the technical fields at the base of innovation, while the other refers to its applicative use. "Technical knowledge consists of know-how concerning the product architecture, the used materials, and the applied technologies in a product category" (Lüthje and Herstatt, 2004: 560), while application knowledge concerns the use experience and needs and indicates the understanding of how the product or service create value for users (Lüthje and Herstatt, 2004; Magnusson, 2009). We suppose that innovation across sectors is characterized by a different degree of these two knowledge forms. This distinction allows us to characterize the diverse figures of users, as evidence in the fields of new product development and technology-based innovations show that technical knowledge or application knowledge might affect the newness, the usefulness and the technicality of the innovation (Magnusson, 2009).

Appropriability. Another important point regards the degree of external or internal knowledge accessibility. The regime of appropriability intended as "the environmental factors, excluding firm and market structure that governs an innovator's ability to capture the profits generated by an innovation" (Teece, 1986: 287) has legal instruments of protections such as patents, trade secrets, or copyrights. Appropriability typically generates two distinct effects: an incentive and an efficiency effect (Cohen and Levinthal, 1990). On the one hand, high appropriability regimes stimulate agents to innovate since they benefit from innovation rents. On the other hand, the argument goes in the opposite direction, pointing out that due to lower appropriability, information flows and knowledge exchange are easier and they determine more diffused innovation activities. In literature, there is no concensus regarding their link with the innovation rate (Winter, 1984; Mazzoleni and Nelson, 1998) and, especially for our case, there is not much evidence about their relation with user involvement and innovation. However, users' innovation activities might depend on the ability to appropriate benefits from innovation (von Hippel, 1982). Since tacit knowledge and use experience characterize the underlying innovation generated by the users, it is not surprising that protection mechanisms like trade secrecy laws and social norms constitute an alternative mechanism of patenting or licensing innovation establishing rules and levels of property rights (Fauchard and von Hippel, 2008).

Proximity. Within sectoral systems, agents are connected in various ways: market versus non-market relationships, informal interactions or co-operations. Networks and links may integrate knowledge complementarities and knowledge specialization. The structure of the relationships shapes learning processes and basic technologies. Physical proximity, more than geographical proximity, affects the information flow because it gathers different agents, and enables the transmission of tacit knowledge as well (Coccia, 2008; Weterings and Boschma, 2009). Thus, proximity between users and manufacturers or simply between users might affect knowledge transfer and accumulation. Indeed, users' knowledge being essentially tacit, its creation and transmission requires closeness between agents to increase the imitation rate (Nonaka, 1994). In line with this point, we try to disentangle the role of proximity across users' type to determine if proximity really affects user innovation.

Industry Life Cycle (ILC) and Market Structure. Industry life cycle, intended as the early or the late stage of sectors, generally affects the number of entrants and the type of innovation introduced. In the early stage, for instance, entries are higher and innovations are likely to be disruptive or radical as far as the industry stabilizes around a dominant design technology (Geroski, 1995; Klepper, 1997). Market structure - intended as “sectoral structure” including the concentration/diversification, and the level of innovation costs - can have some close relations to this evidence. Markets are typically more fragmented at the beginning and the presences of niches where new entrants can find their place to innovate are more probable. Thus, the presence of some users might be influenced by the stage and the structure of the market. Although there is no empirical evidence connecting user innovation with market concentration and the ILC, we try to elaborate our reasoning and attempt to connect these two concepts with existing evidence.

4. User Innovation across Sectoral Systems

First, we analyze a small sample of sectoral systems highlighting the contributions from users and their recurrent roles. In the second stage, we attempt to explain why certain users are more recurrent with respect to others in certain sectors.

More precisely, we focus on the following sectoral systems: extreme sports, food, auto and motor vehicles, medical devices, chemical processes, software, and semiconductors, which cover the distinct typologies of innovation systems. We chose them because on the one side, user innovation is largely documented and the literature has consistently indicated their relevance in supporting innovative processes. On the other side, even if there is a lack of empirical research, market knowledge and user knowledge are considered one of the main forces driving the sectoral system (for example in the case of the food sectoral system).

Extreme Sports Equipment. This sectoral system is widely explored in the literature. The typical user innovators are young, passionate, and practitioners whose innovations evolve via learning-by-doing and their main motivation to innovate is outperforming (Shah, 2000). Kitesurfing, mountain-biking, kayaking, snowboarding, skateboarding, windsurfing, and sailplaining are typically indicated as extreme sports

(Shah, 2000; Schreier et al. 2006). In this sectoral system, the most frequent figure is the innovative user. Her innovations are usually minor improvements to sports accessories, such as changing the design, the material, the comfort, or the technical details of the equipment aiming at advancing their performance. For instance, in kite surfing, the kiters search for continuous ways to improve radical jumps or to be suspended in the air as long as possible (Franke et al, 2006; Schreier et al., 2007). In mountain-bike cycling the users innovate to ride in the snow or in the dark (Lüthje, Herstatt, and von Hippel, 2005). Similarly, in snowboarding, innovative users devised different boots and bindings to be more stable during competitions (Shah, 2000; Franke and Shah, 2006). It might happen that some of these technical improvements developed by a single innovative user might be considered very useful and attractive by most of the others users and therefore, the manufacturer can decide to commercialize them. Generally, the most successful innovations likely to be spread on the market are developed by lead users who are very recurrent in the context of sports (Schreier et al., 2007). Although the major innovations are incremental, innovative users can also radically innovate. For instance, there is the case in sailplane sports where users managed to devise a new and different ventilation system (Franke and Shah, 2003). Finally, in this sectoral system, there is also evidence of user entrepreneurship in rodeo kayaking. Here, users concentrated their efforts in rendering the boats more mobile by making them shorter, with less volume, or with sharper edges (Baldwin et al., 2006; Hienerth, 2006). The users commercialized their prototypes opening their own businesses based on their innovations (Baldwin et al., 2006).

Food. Very few studies relate the users' activities to this sectoral system. The evidence suggests that users as innovators are mainly active knowledgeable users whose purpose to innovate is not merely associated to the satisfaction of certain needs. We can consider different levels of analysis and heterogeneous patterns of user-manufacturer relations (Harmsen, Grunert, and Declerck; 2000), which in all cases describe the user as an agent useful to give suggestions or feedback, but who cannot innovate on her own. For instance, we might have the case where the user needs a product customization in terms of ingredients, packaging, or labels to be more responsive to the local market (Harmsen et al., 2000). Here, the manufacturer supplies different products according to the changes required by the retailer. In other cases, the final user is directly involved to test products in order to improve food texture and flavor before the final launch. Manufacturers choose small restaurants to test products before their launch, searching for feedback for a final improvement (Harmsen et al., 2000).Though directly involved, users limit their contribution to give suggestions to the manufacturer. Here, there is also the possibility that the user and the manufacturer could collaborate through innovation toolkits. A well-known example is the International Flavor and Fragrances (IFF) reported by Thomke and von Hippel (2002) and von Hippel and Katz (2002). IFF is a global supplier of flavor to companies and multinationals like Nestlé, which has elaborated a sophisticated system of creating food flavors, through an innovative internet-based toolkit, endowed by an enormous database of flavor profiles. Through this mechanism, it is easy for the manufacturer to shift innovation activities to customers. By toolkit support, users can be indirectly involved in the production process and flavor modifications or adjustments are suggested to the producers. In few cases, users could also experiment with new flavors, but they can be developed only with the support of the manufacturers.

Auto and Motor Vehicles. This sectoral system shows some interesting peculiarities. Users are generally hobby practitioners sharing either the same passion for motors or autos, or their sense of affiliation to a certain brand by building up user communities. The presence of virtual communities aggregating users is the crucial aspect of this sectoral system. Virtual communities are the places where users and enthusiasts share their knowledge and passion. For instance, in the virtual community of Harley Davidson, enthusiasts share their ideas about motorcycle modifications both for aesthetic and/or for performance preferences. Particularly, through virtual communities, users become an important source of innovation for the firm (Muniz and O'Guinn, 2001; Mc Alexander, Schouten, and Koening et al., 2002) such that manufacturers encourage users to participate and take part in them

(Algesheimer, Dholakia, and Herrmann, 2005; Füller, Matzler, and Hoppe, 2008; Mc Alexander et al. 2002). It is not by chance that many famous manufacturers - think of Audi or Ducati for instance - have institutionalized virtual communities on their corporate web site (Algesheimer et al., 2005; Füller et al., 2008), because it is a platform where manufacturers can collect information from users about their knowledge on certain products or unsatisfied needs. Thus, users mainly cover the role of active knowledgeable users who can suggest ideas for new products or simply ways to solve frequent problems. In other words, user knowledge turns into a tool to check tendencies, users' needs and preferences (Sawhney, Verona, and Prandelli, 2005). In this sense, Ducati has developed the 'Tech Café 'on its corporate web platform, which is a forum where expert practitioners share and exchange technical information about Ducati products. Slightly different are the projects 'Virtual Lab', 'Virtual Team', or 'Next Bike', developed respectively on the websites of Ducati and Audi, through which the companies simulate new product development and can collect technical information from expert users.

Medical Devices. This sectoral system is one of the most investigated along with extreme sports. Medical devices are the medical and precision instruments used by scientists to collect or analyze data, to examine the surface of solid materials or change medical equipment technology (von Hippel, 1976; 1988; Lettl, Herstatt, and Gemuenden, 2003; Lüthje, 2003). They include a large variety of instruments such as gas chromatograph, magnetic resonance spectrometer, ultraviolet absorption spectrophotometer or electron microscope. Users are one of the most important innovation sources, and in fact, the technology commercialized by the manufacturer is often the one developed in earlier prototypes by the users. This points out that manufacturers are likely to incorporate feedbacks and ideas from users/scientists in their production process (von Hippel, 2005). Typical users are scientists or scientific technicians who innovate their devices to improve the quality of their working performance or to have higher benefits from the instruments they use. Their motivation to innovate is related to their need to increase their reputation in the scientific community and therefore to contribute to scientific advancement (Riggs and von Hippel, 1984). Users cover usually two roles: as active knowledgeable users and innovative users. Innovative users can typically introduce minor and major innovations. The first ones are incremental and concern the development of functional utilities of the device, while the second ones are radical changes to the product, likely to open new markets and to be commercialized (Riggs and von Hippel, 1984; von Hippel, 1988; von Hippel, 2005). Frequently medical doctors are sources of very innovative and radical ideas. As described by von Hippel (1988) and Lettl et al. (2003) neurosurgeons or orthopedic surgeons are used to devise very new ideas and specialized equipments, but they can manufacturer them only with the support of a third part because they lack of complementary assets.

Chemical Process. Concerning the sectoral system of chemical process, little evidence documents the role of users. Here we can distinguish two different users: users as organizations and users as individuals. In the first case, users mainly provide feedback on how to adjust or improve certain manufacturing processes. The most famous and quoted reference is by Enos (1962) who described several process improvements such as the CO combustion promoter, SO reducing catalyst, regenerators, and extraction of aluminum mainly originated by engineering companies in the oil industry. Improvements were typically cooperative experimentation with direct user firms (i.e., engineering firms and catalyst manufacturers) were at the basis of process design improvements in oil industry. Innovators were specialized firms in the industry, in some cases allied to complement their competencies.

The second case involving individual users, the role covered by users is generally the one of innovative users. They are incentivized to innovate by the need of finding new products or new instruments that facilitate and speed their tasks. Von Hippel and Finkelstein (1978) report and describe the activities of chemical analyzer users in clinical laboratories. Each analyzer tool usually performed only one type of blood test analysis: to satisfy their heterogeneous needs, the users therefore devised extended functionalities of the analyzer, also inventing new ones not available on the market. However, users had the capability to innovate, and the product modifications were also facilitated or hampered by the product design developed by the manufacturer[1]. Innovative users can also be found in the field of drug experimentation since through the combination of their knowledge-on-the-field and their scientific knowledge they managed to experiment new off-label drugs in pharmaceutical contexts (Demonaco, Ali, and von Hippel, 2006).

Software. The sectoral system of software is largely explored and several include the role that users can cover. Among the software industry, we distinguish customized software from open source system (OSS). With the expression ‘customized software’, we intend for instance, OPAC software that is a computerized information search system used by libraries developed to replace the “card catalog” (Urban and von Hippel, 1988; Morrison et al., 2000). Users are usually innovative users who, exploiting the flexibility of the program, manage to customize and add developed functionalities, especially when “user adjustable parameters” are incorporated by the manufacturer to the software in order to facilitate the users to customize the product (Morrison et al., 2000). Innovations are incremental and very heterogeneous and they span from capability search to library management, inclusion of access to other library’s catalogues, and the addition of multilingual formats or other navigation aids (Morrison et al., 2000). In some cases, the modifications are so attractive and with great potential, such that software developers might decide to further develop them. This innovation type is generally devised by lead users (Morrison et al., 2000). The second category of software comprehends software organized in the logic of open source such as Linux, Stata, Fetchmail, and so on. The Open Source project is defined as any group of people developing software and pounding results to the public under open source licensing and therefore, it follows a private-collective model of action. This means that the open

[1] Comparing three important brands of clinical analyzers (Dupoint – Technicon – Abbott), the authors conclude that the degree of users’ modification does not depend exclusively on the users’ knowledge or experience, but it lies as well in the ease with which the innovative user can modify a product (i.e. an easy-to-modify product only facilitates the modification activity of user, but it does not impact on the interest of modifying a product).

source software improves because innovators “freely reveal” proprietary information rendering them a public good. Thus, the invention developed in OSS can be labeled as ‘collective invention’ (von Krogh and von Hippel, 2003; von Hippel and von Krogh, 2006). Apache software system is the most popular Web server software (Franke and von Hippel, 2003; Harhoff, Henkel, and von Hippel, 2003; Lakhani and von Hippel, 2003; Roberts, Hanny, and Slaughter, 2006) which has become sophisticated through the contribution of the virtual community of users. The innovation process is shifted directly to users because software can be directly manipulated by the user herself at low costs and therefore, innovative users are very recurrent figures, rather than active knowledgeable users. Still here, innovations are predominantly incremental of many server functionalities such as client authentication or e-commerce related functions (Franke and von Hippel, 2003). The community has an influential role: in case it becomes supportive towards certain users and socially recognizes the importance of their suggested solutions, the innovative users might turn into a user entrepreneur. The user can increase her self-perception and might venture around her own innovation (Frederieksen et al., 2008).

Semiconductors. Here, user innovation activities regard the production of silicon-based semiconductors and the assembly of printed circuit boards (von Hippel, 1988). Users are innovative users, who represent a source for major or minor improvements. It is well documented that innovative users develop their own system pushed by the desire of “achieving better performance than commercially available products in several areas: high routing density, faster tournaround, time to meet market demands, better compatibility with manufacturing, and improved ease of use for less experienced users” (Urban and von Hippel, 1988: 573). The tendency of users is increasing the “density” of the printed circuit boards, because it allows the mounting of more electronic components. However, the activity of innovation results are rather complicated because the software requires a series of complicated tasks such as component placement, signal routing, editing and checking, documentation and interfacing to manufacturing and it includes algorithms and sophisticated graphics (von Hippel, 1988; Urban and von Hippel, 1988). The sectoral system of semiconductors includes the unique example we collected about experimental users (Malerba et al., 2007), and the possibility of a particular type of user entrepreneur. As shown by Fontana and Malerba (2010), spin-offs from demand side, with very successful survival rate, are likely semiconductor sector.

A brief overview of the sample of our sectoral systems with the recurrent users is reported in Table 2.

Insert Table 2 about here
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4. Discussion on The different Users' Role: Our Framework

Users that can innovate: The Distinction between Application and Technical Knowledge

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Insert Figure 1 about here

By definition, users embody application knowledge, accumulated by user experience and by iterative learning. The level of technical knowledge discriminates between the users that can innovate on their own from the users who can only provide feedback. A higher level of technical knowledge characterizes innovative users who can build new prototypes as well as lead users, who are characterized by specialized domain-specific knowledge. Similarly, user entrepreneurs are supposed to embody technical knowledge, and they are thus able to innovate without limiting giving suggestions to the manufacturer. Differently from all the other categories, the active knowledgeable user does not own high level of technical knowledge. This hampers her personal ability to innovate products or services and forces her to recur to the intermediary of the manufacturer when she needs a customized product. Active knowledgeable users are likely to suggest more innovative and creative improvements, but given the lack of understanding of the underlying technology, the suggestions might be not feasible (Magnusson, 2009). An experimental user is typically identified with organizations involved in the development of disruptive technologies. Application knowledge is generally lower and it is represented by day-by-day routines. High level of technical and scientific knowledge are essential and in line with the purpose to turn niche technologies into dominant ones.

The Combination of Technical Knowledge and Innovation Costs

Although technical knowledge is a necessary condition to make users innovate, in some sectoral systems like auto-motor vehicle, users' activities might be hindered more by high innovation costs rather than by the lack of technical knowledge. The presence of high costs generally hampers users' active contributions. Though users embody high technical knowledge, they cannot innovate because of the presence of high costs. We could distinguish between two cases. First, in the sectoral system of food, users are unlikely to develop their own innovations because the level of technical knowledge required is very sophisticated as well as the innovation costs very high. Experimenting new textures, flavors or packages for mass-market products are in fact relatively high and even if users could have the necessary knowledge, they are hampered by the presence of costs. Second, in the sectoral system of motor and auto vehicles, users are likely to have the technical knowledge sufficient to innovate products or to construct prototypes, but it is mainly the presence of high innovations costs (e.g., initial investments or expensive complementary assets) their significant obstacle. Thus, here active knowledgeable users do not innovate because they are hindered by high costs. Similarly, it happens in the sector of medical devices as documented by Lettl et al. (2003). Medical surgeons could have great ideas and the essential knowledge to innovate their equipment, but they lack complementary assets. Therefore, the necessity of high initial investment costs might hamper them to create their own innovation. By contrast, in presence of low innovation costs, we can find either active knowledgeable users (low costs combined with low technical knowledge) or innovative users (low costs combined with high technical knowledge), since the small amount of cost investments can create incentives to innovate. As well, the likelihood of becoming a user entrepreneur depends on the level of technology costs and the amount of costs of ownership concerning purchasing, handling, and maintaining the goods (Baldwing et al., 2006). Finally, the presence of high innovation costs and high technical knowledge together might be associated with the presence of vertically integrated users since the integration is a typical advantage in presence of relatively high costs because it leads to efficient exploitation of complementary assets and economies of scale.

Insert Figure 2 about here

Technical Knowledge and IPR

Since user innovation is a need driven phenomenon, correlated to the benefits of rents appropriation, we also investigate whether the diverse IPR might influence the activity of users. Sectoral systems characterized by the presence of high technical knowledge protected by strong IPR instruments, like patents, favor the activities of experimental users. In this case, the niche technology can be developed and at the same time protected as far as it becomes a profitable dominant technology accepted by the market. Conversely, user entrepreneurs have more incentives when IPRs are low: in presence of a weaker market for technology, they can decide to commercialize their innovation and launch it on the market to gain profits (Shah and Tripsas, 2004). In high IPR regimes, the commercialization is only an alternative and the inventor can gain from licensing or from keeping the patent as strategic assets to prevent other competitors to enter in the same technological area. Active knowlegeable users and innovative users are still more likely to be frequent in sectors where IPRs are weak because their innovation incorporates especially tacit knowledge and therefore, the mechanism that better suits their protection is trade secrecy. As described by von Hippel and Finkelstein (1979), the underlying technology and the design of the instruments sometimes can hinder the ability of users to modify and innovate the product and the chemical processes.

Insert Figure 3 about here

Supplier Industry Life Cycle and User Market Structure

Industry life cycle of the supplier is a determinant for at least two users: the user entrepreneur and the experimental user. In the early stages of the industry and in presence of a high number of niches, the experimental user can pursue her investment activities and try to develop disruptive technologies. Similarly, when the supplier market is more segmented, it is more likely that the user entrepreneur can enter the market through a niche, usually easier to serve due to size and specific needs to serve. As well, the phenomenon of user entrepreneurship is more likely when the user market is not concentrated and users are heterogeneous individuals who try to satisfy various needs. The same conditions of user entrepreneurs may hold for innovative users. Even if there is no tested evidence regarding this relation, we suppose that under these conditions users are more likely to innovate because the product is still new and users have more options to improve and customize it. By contrast, active knowledgeable users are likely in late stage of the industry, when the technology has arrived to a dominant design and innovating is more difficult and costly. Users can still have useful suggestions for further improvements, but they are less likely to be active in doing so. As documented by Fontana and Malerba (2010), 'spin offs' from the demand side are also a possible phenomenon, especially when the user market structure is highly concentrated. We suggest they are likely in early stages, when the technology is not consolidated and new entrants still have some advantages. Finally, vertically integrated users are more likely to be observed in the later stages of a market if innovation costs are higher and the user and manufacturer decide to exploit economies of scale.

Insert Figure 4 about here
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5. Conclusions

This work is the first effort to create a general framework on the process of user innovation. We thus contribute mainly to the literature of user innovation.

The evidence that users are active and important agents, increasingly involved in heterogeneous innovation processes, is well consolidated. However, the need for a systematization of all findings is required. Accordingly, we categorized users in relation to their involvement and contribution to innovative dynamics and we individuated the six categories of users labeled as active knowledgeable users, innovative users, lead users, experimental users, user entrepreneurs, and vertically integrated users. Their major distinguishing feature is the type of knowledge they embody because users that can innovate and are active innovators are characterized by high technical knowledge. Users characterized by application knowledge only have great use experience but will not be able to customize their own products. To this point, we highlighted that the combination of technical and application knowledge is essential because it enables users to invent and construct prototypes that tap users' needs.

Second, we also contribute to innovation management literature by showing how the features of sectoral systems could influence the change of users' role. The role of users differs especially in relation to innovation costs, IPR, and industry life cycles. The general idea is that innovation costs hinder user innovations, different IPR instruments favor it, and finally, the early stage of industry life cycle increases the activities of users. We also noted that proximity between users and also proximity between users and manufacturers are not relevant dimensions, since the transfer of user knowledge and suggestions are usually overcome respectively by the presence of virtual communities and through the employment of toolkits.

Finally, we are aware that this work has many limitations, since it is theoretical and it elaborates a framework drawing conclusions starting from existing studies. We tried to validate our conclusions through the Community of Innovation Surveys data, which would allow us to distinguish clearly the sectors. However, lack of distinction across users and very few items dedicated to the user innovation process did not help us. This is another reason why we suppose that the contribution of this work is original in the understanding of users and their contributions, but it clearly requires further investigation at the empirical level.

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Table 1. Different Roles of Users: A General Overview

Type of User	Definition	Main Features	Innovation Characteristics	Main References
Active Knowledgeable User	"People who are in a suitable position to suggest good ideas for new products" (Lüthje & Herstatt, 2004)	Use experience and practical knowledge	Feedbacks provision	von Hippel, 1988
Innovative User	"Users that innovate can develop exactly what they want, rather than relying on manufacturers to act as their agents" (von Hippel, 2005: 1)	Practical and Technical Knowledge	Innovations to customize a product/ service, or manufacturing of prototypes in order to solve a personal untapped need	von Hippel, 1982/2005, Magnusson, 2009
Lead User	"Lead users face needs that will be general in the market place, but face them months or years before the bulk of the marketplace encounters them, and are positioned to benefit significantly by obtaining a solution to those needs"(von Hippel, 1986: 797)	Ahead of the market, need driven, innovativeness personality trait. Combination of practical and technical knowledge	Very likely successful and widespread innovations	von Hippel, 1986; Urban & von Hippel, 1988; Schreier *et al*., 2008
Experimental User	"Customers who attribute an intrinsic merit to a product simply because it embodies the new technology" (Malerba et al., 2007: 18)	Not mainstream customers. Prefer emergent and not perfect technology. Prevalence of technical knowledge	Break the lock-in of old technology and allow the new technology to take off	Malerba *et al*., 2007
User Entrepreneur	"The commercialization of a new product and/or service by an individual or group of individuals who are also users of that product and/or service" (Shah & Tripsas, 2007: 124)	Need Driven, Lead User perception of se, Cumulative and Creative Innovation. Practical, and Technical Knowledge. Importance of user community to identify commercial opportunity	Innovation and later commercialization	Baldwin *et al*., 2006; Hienerth *et al*., 2006; Shah & Tripsas, 2004; Shah & Tripsas, 2007
Vertically Integrated User	We can define vertical integrated user as the user and the producer active within the same boundaries of the firm	Presence of complementary assets to exploit. Decreasing in coordination and innovation costs. Exploitation of knowledge rather than exploration	Incremental and path dependent innovations	Williamson, 1975; Malerba *et al.* 1999, 2008

Table 2. Sample of Sectoral Systems chosen

Sectoral System	Recurrent Users' Role	Innovation Type	Main References
Extreme sports	Active Knowledgeable User Innovative User Lead User User Entrepreneur	Incremental and Radical Innovations. Likelihood of commercialization of products innovated by users	Shah, 2000; Franke & Shah, 2003, Lüthje& Herstatt, 2004; Franke *et al.* 2006; Schreier *et al*. 2007;
Food	Active Knowledgeable User	Incremental Innovations	Harmsen *et al*., 2000; Grunert *et al*., 2008; Fauchart & von Hippel, 2008.
Auto and Motor vehicles	Active Knowledgeable User	Incremental Innovations	McAlexander *et al.* 2002; Sawhney *et al*. 2005; Fuller *et al.* 2008.
Medical Devices	Active Knowledgeable User Innovative User	Incremental and Radical Innovations	von Hippel, 1988; Riggs & von Hippel, 1994;
Chemical	Active Knowledgeable User Innovative User	Incremental Innovations	Enos, 1962; von Hippel, 1988; DeMonaco *et al*., 2006.
Software	Active Knowledgeable User Innovative User Lead User User Entrepreneur	Incremental Innovations Likelihood of commercialization of products innovated by users	Urban & von Hippel, 1988; Franke & von Hippel, 2003; Morrison *et al*. 2000.
Semiconductors	Innovative User Experimental User User Entrepreneur Vertically Integrated User	Incremental and Disruptive Innovations	von Hippel, 1988; von Hippel, 2005; Fontana & Malerba, 2010

Figure 1: Application Knowledge & Technical Knowledge

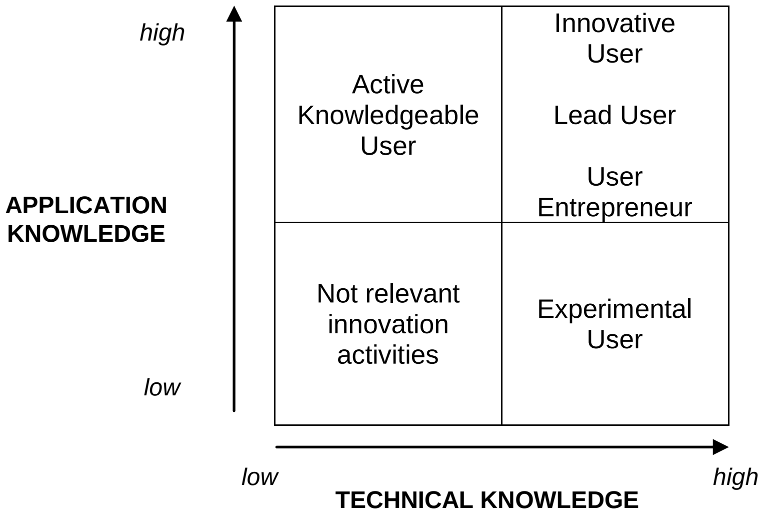
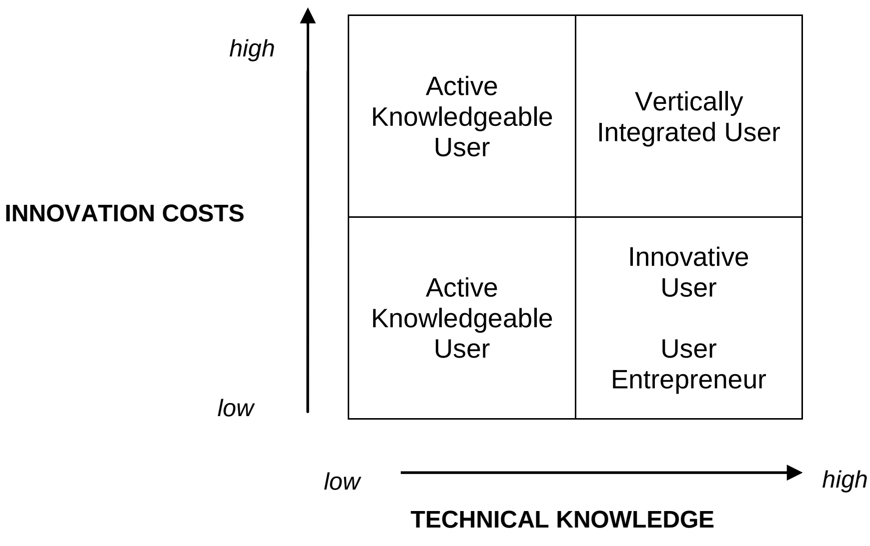


Figure 2: Technical Knowledge & Innovation Costs



(Keeping Application Knowledge High)

Figure 3: Technical Knowledge & IPR

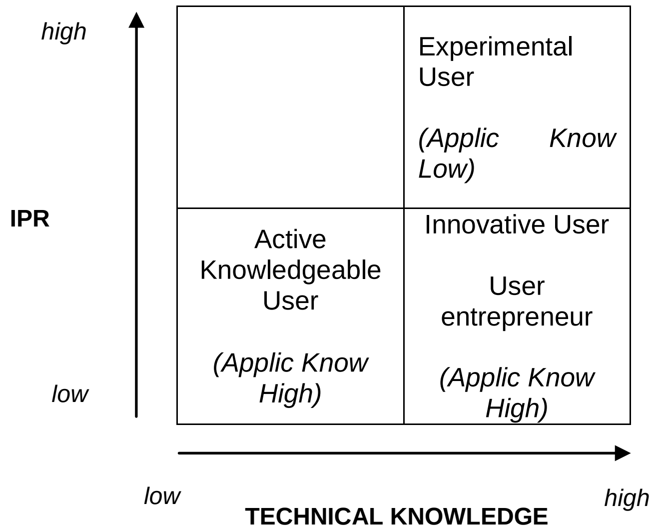
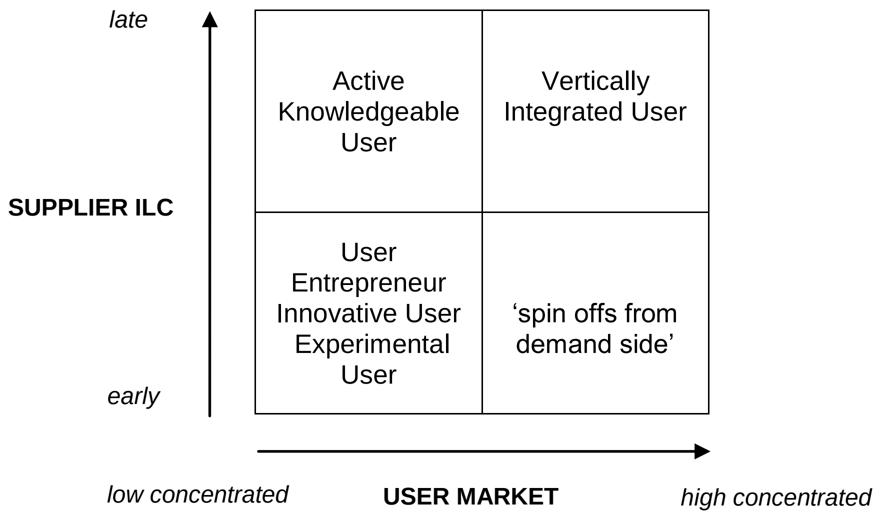


Figure 4: Supplier ILC & User Market Structure



Market and Science:
Combining Knowledge Sources for Patent Commercialization

ABSTRACT

Although patent commercialization is a desirable outcome, a high rate of patents remains sleeping because of organizational or strategic reasons. In this work, we posit that patent features might explain the odds of patent commercialization. In particular, we investigate whether the knowledge sources used by the inventor during the process that lead to the patent can be associated to a more probable commercial exploitation of the patents. First, we argue that the joint use of market knowledge with scientific knowledge is associated to a higher probability of patent commercialization as patents should merge market acceptance with scientific advancement. Second, we also contend that professional and non-professional inventors - defined depending on whether their main job-task is inventing or not, and who have, respectively, stronger background in scientific and market knowledge - are more likely to produce commercially exploitable patents if, during the invention process, also rely on the type of knowledge they have less experience with. We use PatVal-EU dataset, including information on more than 9000 patents data granted by EPO between 1993-1998. Our empirical findings support both hypotheses highlighting the positive combined effect of market and scientific knowledge on patent commercialization.

1. INTRODUCTION

Though commercialization can represent a desirable outcome for a patent, a high rate of patents is not brought to the market and rests sleeping or unutilized. In the past, it has been calculated that multinational firms like Procter & Gamble and Dow Chemical have commercialized only 10% and 19% of their patents, respectively (Chesbrough, 2006). Similarly, Palomeras (2003) reports evidence indicating that Siemens, IBM, and Philips use less than half of their intellectual property portfolios. More broadly, Giuri et al. (2007), using data from a survey on 9,017 European patents, show that 36% of these patents are not used; about half of them are blocking patents, and the other half sleeping patents.

Why do firms produce inventions that then they do not use? On the one hand, there might be strategic motivations, whereby patents are developed simply to prevent competitors from entering a given technological area and overcome initial market uncertainties (e.g. Giuri et al., 2007; Palomeras, 2003; Hopenhayn & Mitchell, 1999; Takalo & Kanniainen, 2000). On the other hand, this might be due to organizational factors, such as the lack of complementary assets to bring the invention to the market, or the loose-fit between firms' R&D activities and their business model (e.g. Chesbrough, 2006; Shane, 2001).

While prior studies analyzing the odds of technology commercialization have largely focused on the relationship between a patent and a firm's downstream assets, capabilities, and markets, in this study we examine whether the knowledge sources used by the inventor during the invention process are associated with the likelihood of patent commercial exploitation. Specifically, following inter alia Mowery & Rosenberg (1979) and Freeman (1982), we consider two main types of knowledge inventors may rely upon in the innovation process. First, they can use *market* knowledge, i.e. knowledge on downstream markets usually drawn from users, competitors, and suppliers; second, inventors can exploit *scientific* knowledge, i.e. knowledge developed in R&D laboratories or elaborated from the scientific literature, and that pushes and extends the technological frontier. Although it is often argued that there exists a tension between these two domains of knowledge, whereby market knowledge leads the inventors to develop products closer to market expectations but not necessarily at the frontier of science (e.g. von Hippel, 2005), whereas scientific knowledge improves inventions' underlying technology even at the cost of neglecting market needs, the main contention of this study is that the *joint* utilization of these two sources of knowledge in the inventive process is positively associated with the later commercial exploitation of a patent. In other words, we posit that using *both* market *and* scientific knowledge increases the odds of a patent's commercial exploitation.

By the same token, we contend that inventors with stronger background in one of the two knowledge types, are more likely to produce commercially exploitable patents if, during the invention process, also rely on the type of knowledge they have less experience with. More specifically, we consider two distinct categories of inventors, which we label as "professional" and "non-professional". They are respectively scientists / inventors employed in R&D departments whose main job is precisely that of inventing, and occasional inventors, whose main task is not inventing, but who rather typically work in the marketing or production departments. Indeed, these two types of inventors differ in working experience, educational background and, particularly, in the knowledge they embody (see Allen (1977) as the seminal reference on inventor types). Professional inventors, being most likely scientists, are predominantly the repository of scientific knowledge; conversely, non-professional inventors have acquired a deeper market-related *know-how*, being more often in contact with market agents. Our theoretical framework therefore would suggest that a patent produced by each of these two types of inventors is more likely commercialized if the inventor also draws upon the body of knowledge she lacks.

To test our hypotheses, we use a unique and extensive dataset from the PatVal-EU survey, which includes data on more than 9,000 patents granted by the European Patent Office (EPO) in Denmark, France, Germany, Hungary, Italy, the Netherlands, Spain or the UK with priority date between 1993-1998. Most importantly, this dataset contains particularly fine-grained information on the patent and the invention process, such as the eventual use of a patent as well as the knowledge sources the inventor has used to develop the patent.

Our empirical results show that indeed the combination of market and scientific knowledge increases the probability that a patent finds commercial exploitation; this result is robust even when controlling for endogeneity. Moreover, in line with our expectations, we find that a patent is more likely commercial exploited when professional inventors search and recombine market knowledge, and vice versa. These results thus strengthen the previous hypothesis according to which a balanced combination of market and scientific knowledge produces an invention that meets market needs along with a significant technical development and hence, is more likely to be commercially exploited.

Examining the factors that drive successful patent commercialization contributes to a better understanding of the innovation process, and of how this can actually contribute to firms' competitive advantage, and offers theoretical and practical implications from the perspectives of innovation management, technology strategy, and knowledge management.

The remainder of the paper is organized as follows. The next section outlines our hypotheses and the logic that supports them. We then describe the data and the empirical strategy, and report the results of our econometric analyses. We conclude discussing our findings.

2. HYPOTHESES DEVELOPMENT

Since the long-standing debate on whether innovation is primarily technology-pushed or market-pulled, market knowledge and scientific knowledge have been generally understood as the main types of knowledge sources fostering innovation (e.g., Freeman, 1982; Mowery & Rosenberg, 1979). Scientific knowledge broadly refers to basic science, developed in large R&D labs or assimilated by scientific literature. Its purpose is fostering technological progress, though it is usually disconnected from market dynamics (Fleming & Sorenson, 2004). Conversely, the character of market knowledge is more applicative, since it aims at tapping and solving existing users' problems (Lüthje, Herstatt, & von Hippel, 2005). It is unlikely to generate radical innovations, but it is the major source of innovative ideas (Cohen, Nelson, & Walsh, 2002; von Hippel, 2005). Market knowledge acquisition takes frequently the form of repetitive collaborations or interactions with market-oriented agents such as customers, suppliers, and competitors.

This suggests that using the two knowledge sources independently, inventors might create either inventions very close to market needs and trends if they exploit market knowledge, or they might develop technologically advanced devices not necessarily considering market trend or needs if during the inventive process they mostly employ scientific knowledge.

Though market and scientific knowledge may have different and to some extent opposite effects on the characteristics of a resulting invention, our main hypothesis is that their *joint* utilization is beneficial to patent commercialization, as to achieve this outcome inventions should merge technological potentiality with a marketable use (Fleming, 2002). Commercialization success is in fact a function of both scientific and market elements: new technologies should fit with the market needs, and clients requirements should be met with novel means (e.g., Nevens, Summe, & Uttal, 1990).

Hence, blending market and scientific knowledge in the inventive process can influence the patent marketability:

Hypothesis 1. The combined use of market and scientific knowledge is positively associated with the commercial exploitation of a patent.

To provide further evidence to support our hypothesis, we exploit the idea that two different "types" of inventors, embodying respectively market and scientific knowledge, need to recombine their specific expertise and know-how with the *other* knowledge form to achieve patent commercialization. Results would demonstrate that the combination of market and scientific knowledge in patenting process increases the likelihood of the patent to be exploited on the marketplace.

Recent studies have shown that productive inventors might also be 'hobbyists', and that valuable inventions, such as the Post-it Notes, might have been the result of leisure time activities (Dahlin, Taylor, & Fichman, 2004; Davis, Davis, & Hoisl, working paper; Lettl, Rost, & von Wartburg, 2009).

More broadly, though most of the inventions firms produce are the output of dedicated projects and specific human resources, it might happen that also employees whose primary task is not that of inventing turn out to constitute valuable sources of new inventions. Investigating nineteen parallel R&D projects in a large organization, Allen (1977) described that inventors or scientists, hired to invent, are not the unique agents committed to invention activities. The study pointed out that, despite several differences in motivations, goals or endeavors to invent[2], both scientists and engineers might become active inventors. Scientists and engineers belong to different subcultures, have a different perception about their purpose in the firm and are shaped by different background studies. As a consequence, they are characterized by different *know how*: scientists cultivate scientific knowledge to support the advancement of basic science, attempting to generate and test theories explaining why something is happening. By contrast, engineers have a more practical understanding of phenomena; they often embody market knowledge, as they are used to consult customers or personal contacts to solve technical problems (Allen, 1977).

While Allen (1977) referred to these two categories of inventors as scientists and engineers, we could more generally label them as "professional" and "non-professional", depending on whether their main job is inventing or not. We posit that professional inventors can be assimilated with the figure of scientist, while non-

[2] As practical example, we elaborated some information from Allen (1977) and we report here some of the differences emerged from the survey conducted by the author to understand the work goals of the two categories. On their side, scientists assert that their purpose is principally working on projects originated by them, gaining and establish their own reputation outside the company as authorities in their fields, and finally publishing articles in technical journals. With respect to scientists, engineers' responses about their goals are closer to business profits and practices. Hence, they state that their working purposes are related to the opportunity to help the business to increase the profit, to gain knowledge of company management policies and practices, and to participate in decisions that affect the future business of the company.

professional with the one of engineer.

According to our previous arguments, patent commercialization is more likely when inventors exploit both scientific and market knowledge. We therefore argue that professional and non-professional inventors need to recombine their specific expertise and *know-how* with the other knowledge type – respectively, market and scientific knowledge – so that they can increase the probability of their patents to be commercially exploited.

On the one hand, scientific knowledge is a map that allows the inventor to perceive possible solutions or support her to eliminate wasting efforts and useless costs of search (Fleming & Sorenson, 2004). Non-professional inventors are therefore supposed to use scientific knowledge, since it represents a theoretical guidance to understand how to use different pieces of information and how to combine them to build inventions. On the other hand, professional inventors work in R&D labs and operate at the frontier of science, and are generally distant form market understanding. Hence, they need practical market *know-how* to interpret and reinterpret their research activities to properly match customers' expectations (Jensen, Johnson, Lorenz, & Lundvall, 2007). Hence, we propose the following hypotheses:

Hypothesis 2a. Non-professional inventors using scientific knowledge increase the likelihood to commercialize their patents

Hypothesis 2b. Professional inventors using market knowledge increase the likelihood to commercialize their patents

3. METHODS

3.1 Data and Sample

The unit of analysis of this study is the patent. We study the factors that explain the probability of a given patent to find a commercial exploitation. In order to test our hypotheses, we employ a unique and extensive dataset drawn from the PatVal-EU survey, which collected data on 9,550 patents (out of 28,470 submissions) granted by European Patent Office (EPO) between 1993 – 1998. Compared to the previous patent surveys, PatVal-EU survey was designed to represent the complete universe of European patents in countries such as Denmark, France, Germany, Hungary, Italy, the Netherlands, Spain, and UK. The survey covers all technological fields, includes profit and non-profit applicants, and small, medium, and large organizations. Finally, it collects data at very micro level, including information about the individual inventor (i.e. age, gender, education, motivation to invent, motivation to patent, mobility) and inventive process. More details about the survey, the issues concerning the sampling and the questionnaire, as well as the final descriptive statistics are extensively described in Giuri et al. (2007).

Since professional and non-professional inventors have been usually distinguished and identified in private firms, and academic patents commercialization follows different norms, we exclude patents developed by universities and non-profit organizations from our sample.

3.2 Measures

Dependent Variable

The dependent variable of the models estimated in this paper is the commercial exploitation of the patent (i.e. c*ommercialized patent*), meaning whether the patent has ever had a commercial or industrial application and thus, it has generated economic revenues. In the survey, this variable is the outcome of inventors' response to the following question: *"Does the inventor/owner have ever used the patent for commercial or industrial purposes?"* The PatVal-EU survey offered three responses: "Yes", "No", and "No, I am still investigating the possibilities". To have a clear-cut definition, we use the answers "Yes" and "No"[3], and we exclude the patents with an answer "No, I am still investigating the possibilities".

Explanatory Variables

The survey contains fine-grained information about the knowledge sources

[3] We effectively measure whether the patent has had a commercial exploitation on the market and we exclude the form of licensing, as form of patent commercialization (Teece, 1986).

inventors used to develop a given patent. From this information, we built the measures of our main explanatory variables.

Market Knowledge. We define market knowledge the *know-how* derived from informal sources of knowledge such as the users/customers, competitors, and suppliers, who are generally agents close to the market. We measure it by employing three questions in PatVal-EU questionnaire asking the inventor to rate singularly the importance of users (customers)/competitors/suppliers as sources of knowledge for the research that lead to the patented invention. Responses were originally given following a Likert scale from 0 (“I did not use this source”) to 5 (“very important source”). In order to a have a unique measure, we sum up the three sources of knowledge.

Scientific Knowledge. We define this variable as the knowledge generated in R&D laboratories, coming from scientific and patent literature, as well as from technical conferences. In order to measure this variable, we employ the use of questions present in the PatVal-EU survey asking the inventor to rate independently the importance of laboratories/ patent literature/scientific literature/ technical conferences as sources of knowledge for the research that lead to the patented invention. Responses were given following a Likert scale from 0 (“I did not use this source”) to 5 (“very important source”). Also in this case, we sum up all the four sources of knowledge so that we have one measure.

Professional and Non-professional Inventors. We define professional inventors the ones whose main working task is researching and inventing in an institutionalized project in the firm where they work. Differently, non-professional inventors do not research or invent as primary task in the firm where they are employed. Thus, we create a dummy indicating these two alternatives, as reported by the inventors in the survey.

Control Variables

We control for a series of variables at the individual level, including inventor’s age, level of education, and gender. All these data are derived from the PatVal-EU survey.

Furthermore, we control for the size of the firm where the inventor was/is employed (i.e. large, medium and small firm) and the inventor's team type (we created a dummy indicating if the inventor was a single inventor or not when developing the focal patent). Both variables may be a proxy for the resources available to the inventor during her patenting process. Finally, because time-varying and technology-specific factors may influence the invention process, we include dummies for 30 technological classes and the calendar application year, which are common to all our variables.

Table 1 lists the main variables with the corresponding short definitions. Table 2a provides descriptive statistics for the main variables, and table 2b pairwise correlations. The large number of observations reduces concerns about multicollinearity that rises in case of high correlation between explanatory variables.

Insert Tables 1, 2a and 2b about here

3.3 Statistical Approach

Given the binary nature of our dependent variable, we employ a probit model to explore the effect of our explanatory variables on the likelihood to commercialize a patent. The probability of observing a commercialized patent is thus modeled as follows:

$$
\begin{aligned}
&Pr(Commercialized\ Patent = 1 |\ x) \\
&\quad = \Phi\Big(\beta_0 + \beta_1 market\ knowledge + \beta_2 scientific\ knowledge \\
&\quad + \beta_3\ market \text{ x } scientific\ knowledge + \beta_4\ non\ professional \\
&\quad + \beta_5 non\ professional \text{ x } scientific\ knowledge \\
&\quad + \beta_6\ professional \text{ x } market\ knowledge\ + \beta_{7,1}\ control_1\Big)
\end{aligned}
$$

4. RESULTS

Results of the probit analyses aimed at estimating the probability of a given patent to find a commercial application are reported in tables 3.1, while the marginal effects are reported in tables 3.2[4]. Different specifications are presented: the first specification contains only the control variables, we then gradually include all the explanatory variables used to test our theory.

Insert Tables 3.1 and 3.2 about here

As expected in hypothesis 1, the positive and significant parameter estimate of the interaction between market and scientific knowledge indicates that combined use of the two types of knowledge increases patent commercialization likelihood. Keeping constant scientific knowledge, a one standard deviation increase in market knowledge raises the probability of patent commercial exploitation by almost 0.5%. Similarly, one standard deviation increase in scientific knowledge increases the patent commercialization by 0.4%, keeping market knowledge constant.

To corroborate our results, we then moved to test if different type of inventors (professional vs non-professional) should combine their specific know-how (scientific knowledge and market knowledge, respectively) with the type of knowledge they lack. We start by showing that the two type of inventors are actually different, in particular with respect to the knowledge they rely upon. To this end, we ran a logit analysis – where the dependent variable takes the value of 1 if the inventor is non professional and 0 otherwise – to check which attributes distinguish one group from the other. Results are reported in table 4.1. Non-professional inventors are less educated, on average, than professional, they particularly value intrinsic rewards in inventing[5], they are more likely to be single inventors, and they are mainly present in

[4] Marginal effects are computed at the mean of each variable, except for dummies, where they are computed according to the discrete change from 0 to 1.

[5] We identify the rewards to invent in PatVal-EU survey questionnaire where inventors are asked to indicate the rewards coming from patenting, which include both monetary and not monetary rewards. As stated in the questionnaires, inventors rated on a Likert scale from 1(not important) to 5 (very important) the rewards for patenting, which includes: monetary rewards, career advances, prestige/reputation, increase the organizational performance, personal satisfaction to show that something is technically possible, and benefits in terms of working conditions.

small and medium firms[6]. Non-professional inventors are generally graduated, but a few own a PhD, which typically characterizes the educational profile of professional inventors (36% of professional inventors in our sample hold a PhD with respect to the 13% of non-professional inventors). Although the rate of BA is high in both categories (53% of professional inventors, 55% of non-professional inventors), non-professional inventors are majored in engineer disciplined, while professional inventors have more often a degree in life sciences. Most importantly, the empirical evidence illustrates that the two types of inventor are characterized by different knowledge bases. The main features of the two groups are summarized in table 4.2. The descriptive of the educational background are reported in figures 1.a and 1.b.

Insert Tables 4.1, 4.2, 5.1 and 5.2 about here

Insert Figures 1.a and 1.b about here

Having established the difference between professional and non professional inventors, we moved to testing hypotheses 2a and 2b. Results of these probit analyses are reported in table 5.1 and 5.2. The empirical evidence supports also hypotheses 2a and 2b, that is, non-professional inventors increase the likelihood of inventing a marketable patents if they use scientific knowledge, and vice versa. A standard deviation increase of scientific knowledge allows non-professional inventors to increase by 0.2% the probability of commercially exploit their patents. Similarly, a standard deviation increase of market knowledge allows professional inventor to raise the probability of commercialize their patent by 0.6 %.

[6] In our sample, the two categories of inventors are distributed in all types of firms. In large firms non- professional are 32%, while professional 68%. In medium firms, non-professional are 45% and professional 56%. Finally, in small firms non-professional are half of the inventors (51%) and the rest 49% is professional inventors.

The parameter estimates of control variables reveal other important information regarding inventive process around patent commercialization. The starting point concerns the ‘status’ of non-professional: being professional or non-professional inventor is not always significantly correlated with the commercial exploitation of an invention. We could explain this result by recalling Teece (1986) and Nerkar & Roberts (2004), who pointed out the fundamental role of complementary assets in order to commercialize a technology. The status of professional inventor is even less likely to affect the commercialization rate, with respect the non-professional one, and maybe it is due to the underlying motivations of professional inventors: they also research for the sake of researching. We also notice that the employer size (small, medium or large) has a certain weight in explaining the variance of the likelihood of commercialization. In particular, small and medium firms are more likely to commercialize patents, perhaps because they have fewer resources to invest in strategic patenting and need revenues to cover research costs. Finally, a patent developed by an inventor holding a PhD has a lower probability of being commercialized. Prior literature has usually stressed the importance of education in relation to the *value* of a patent (e.g. Gambardella, Harhoff, & Verspagen, 2008), but, first, we are not dealing with patent value, but with commercialization; second, we could explain our result considering that since the PhD is a specialized educational degree, it is closer to science than to the market, so it might have an effect very similar to that of scientific knowledge and therefore, might decrease the likelihood of patent commercialization.

In all the probit specifications we presented, the coefficients of the interaction between market and scientific knowledge are statistically significant, but since the probit is a non-linear model, interactions require a cautious interpretation (Ai & Norton 2003; Hoetker, 2007; Greene 2010). As recently argued by Zelner (2009), in order to properly evaluate an interaction effect, researches should assess the predicted probabilities[7] of the variables of interest at different levels and then, provide

[7] $\Delta\hat{y} = \hat{y}\left(x_j^{'} + \Delta x_j, \bar{x}_{i\neq j}\right) - \hat{y}\left(x_j^{'}, \bar{x}_{i\neq j}\right)$

a graphical representation of the results. This is very useful to portray the differences in predicted probabilities because it depicts how the predicted probability of the dependent variable changes with respect to the combination of different levels of the interaction term variables. The entire range values of one interaction term are reported on the *x*-axis, while the other interaction term is splitted in high and low values (or values of interest) and its predicted values are surrounded by 95 percent confidence intervals.

Insert Figures 2.a, 2.b, and 2.c about here

However, a graphical representation solves the interpretation issue, but does not help with the problem of significance (e.g. the figure cannot indicate if the combination of different levels of the key variables is associated to a statistical significant change of the dependent variable). Thus, according to this point, we provide a graphical representation of differences in predicted probabilities also including confidence intervals (Zelner, 2009). This methodology helps us to discern the significance level of an interaction effect in a non-linear model. In order to understand when the difference in predicted probability is different from zero, we constructed a 95 percent confidence interval around the predicted values and we assessed whether this difference includes the zero or does not. Confidence intervals are calculated using a simulation-based approach (King, Tomz, & Wittenberg, 2000) by setting the values of the independent variables, except the ones of our interest, equal zero. Then, this would provide a useful illustration of how a predicted probability of $\hat{y}$ may change according only to the variability of the interaction values. In figure 3.a, 3.b, 3.c we provide graphs showing the predicted probabilities of patent commercialization (*y*-axis) explained by the interaction of market with scientific knowledge (3.a), non-professional with scientific knowledge (3.b), and professional with market knowledge (3.c). The figures 3.a, 3.b, and 3.c depict the change in predicted probability of our dependent variable according to the changes of scientific and market knowledge and according to the changes of market (or scientific) knowledge in presence of professional (or non-professional) inventors.

Insert Figures 3.a and 3.b, and 3.c about here

Results are significant where they are different from zero and therefore, where the confidence intervals do not include the zero line (in the figures above the bold black line). Our hypotheses hold although, the simulations indicate clear threshold levels (for hypotheses 2a and 2b) above which the interaction terms in non-linear model turn out to be significant.

Robustness Checks

We also conducted other analyses to validate our results. First, there is an obvious concern of endogeneity, whereby inventors that ex-ante decide to commercialize an invention rely upon specific and different types of knowledge. To address this issue, we exploit a specific question of the survey. From the dataset, we in fact can differentiate between patents that are the outcome of purposeful research projects, and patents that result from serendipitous individual creative processes. Thus, we estimate the probit analysis only on the sub-sample of commercialized patents deriving from a serendipitous process (n=1,608), and we examine the impact of the combination of market and scientific knowledge on the probability of commercialization only on this sub-sample of patents. Hence, in this way we can control for the intentionality of the inventors in using different knowledge sources for the purpose of commercialization and exclude that the *ex ante* decision to commercialize could be associated to the knowledge sources chosen. Results of this regression are reported in table 6.1 and show coefficients consistent with the ones reported in the previous section. We also checked the significance of the interaction term through the simulation based approach: the results hold also with this methodology (a graphical representation is reported in figure 4.a).

Insert Table 6.1 and Figure 4.a about here

Second, we observed that non-professional inventors are more likely to be employed in small and medium firms, whereas professional ones are more present in large firms, as these firms allow for specialization and have institutionalized R&D laboratories. To check for potentially different effects depending on firm size, we then conducted a probit analysis splitting the sample according to size of the employer: one sample includes large firms that are companies with more than 250 employees (n= 4,320), whereas the other sub-sample (n= 1,360) includes small and medium sized firms (employing respectively less than 100 employees and a range of 100-250 employees). Results of the large firms sub-sample are consistent with our hypotheses (see tables 7.1), while by contrast, the results of the analysis of the sub-sample of small and medium firms did not give support to our hypotheses (see tables 7.2). This may be due to the lack of a real division between professional and non-professional inventors in small e medium firms. Small or medium firms are less likely to have internal R&D labs, and thus, a distinction between professional and non-professional inventors cannot be so evident. Hence, in this case, a clear division of labor could be a fundamental boundary condition to our study.

Insert Table 7.1, and 7.2 about here

The last robustness check considers how the results can be sensitive to a different measure of patent commercialization. PatVal-EU questionnaire offers three distinct answers (e.g. “Yes”, “No”, “No, I am still investigating”) to the question whether the patent has been exploited for commercial purposes. In previous analyses we have excluded the uncertain answer “No, I am still investigating” from the operationalization of the variable. Hence, to have a different measure of our dependent variable, we constructed a dummy with value one including the answers “Yes” and zero including both answers “No” and “No, I am still investigating”. We ran a probit analysis with this new measure and results hold for our hypotheses (results are reported in table 8.1).

Insert Table 8.1,about here
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5. DISCUSSION AND CONCLUSION

In this work, we showed that knowledge sources exploited by inventors during the patenting process might influence the nature of inventions and the probability that patents are commercially exploited. In particular, we showed that the likelihood of patent commercialization is associated to the joint use of market and scientific knowledge, which allows coupling market needs with scientific advancements. In line with these findings, we also show that two inventor types, professional and non-professional, characterized respectively by scientific and market knowledge background, should rely upon the knowledge type they do not embody to be able to develop inventions more likely marketable.

A number of limitations of this study are worth noting. First, self-reported measures through ordinal Likert scales and the use of dummy variables might increase the problem of unexplained variance. Second, we just have cross-sectional data and cannot fully control for inventors fixed effects. Third, we have the information on whether a patent has been commercially exploited and has had some market application, but we do not have any evidence of performance about its success on the market. It could be therefore interesting also to investigate whether the two knowledge sources might be correlated with the success of the patent over time, for instance, in terms of sales.

Notwithstanding these limitations, this work offers some relevant contributions to prior literature. Existing research has extensively focused on the role of organizational competences as the main driver of successful technology commercialization (Nerkat & Roberts, 2004; Mitchell & Singh, 1996; Zahra & Nielsen, 2002). By contrast, in this study we consider inventions' features, and concentrate on the knowledge sources used to develop a patent. We add to the literature by showing that patents presenting specific characteristics are more likely to have market application. In other words, the study points out that the technology commercialization process might not depend exclusively on the strategy implemented by the firm or on the capabilities developed by the organization to sustain such process, but some intrinsic characteristics of the patent can help to explain its likelihood of being commercialized. Moreover, the few studies that have considered patent characteristics have mainly focused on classical patent features, such as their breadth, the value, the innovativeness degree, to predict certain patent outcomes (Chatterjii & Fabrizio, 2011; Nerkar & Shane, 2007; Palomeras, 2003). We also contribute to this literature by considering as explanatory factor of patent outcome also the underlying process leading to patented invention. The possible use of a patent might also depend on the previous choices made by the inventor, like the dynamics of choosing different knowledge to generate an idea.

Second, this study offers some implications to the technology strategy literature. An efficient technology strategy with the purpose of creating marketable patents might complement own R&D with the co-development of ideas and solutions with the final users or the downstream market companies. Our results indicate that market and external agents are not only sources for ideas generation but they could be beneficial also for the development of technologies.

Third, we contribute to the literature of knowledge management by showing that different inventors should rely upon different knowledge. Literature points out that inventors' knowledge background and expertise affect their inventive outcome (Chase & Simon, 1973; Chua & Iyengar, 2008), but it is silent on how and whether it needs to be recombined with respect to specific purposes. Through this work, we highlight that in the case of patent commercialization, the combination of distant knowledge sources, both market and scientific oriented, are necessary. With the support of the two categories of inventor, which exemplify the market and the scientific knowledge, we demonstrate that their personal know how is not sufficient and it must be complemented with other knowledge sources. The evidence that inventors need distant knowledge types to create novel outputs suggests that inventive processes inside organizations might be more distributed, rather than concentrated in a unique department. Our findings would therefore suggest that policies to incentivize information and ideas sharing across organizational departments and with external agents could be beneficial to improve the organizational innovative process.

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Table 1. Variable Definitions

Variable	Definition
COMMERCIALIZED PATENT	Dummy = 1 if, as stated in the formulation of the questionnaire in the survey the patent has been exploited for commercial or industrial purposes
MARKET KNOWLEDGE	Sum of the score (b/w 0-15) to three PatVal-EU questions regarding the importance of three sources of knowledge, namely users (customers), ii) suppliers, iii) competitors, during the inventing process
SCIENTIFIC KNOWLEDGE	Sum of the score (b/w 0-20) to four PatVal-EU questions regarding the importance of four sources of knowledge, namely i) laboratories, ii) patent literature, iii) scientific literature, iv) technical conferences, during the inventing process
NON-PROFESSIONAL	Dummy = 1 if, as stated in the formulation of the question in the survey i) “the idea for the invention was directly related to the inventor’s normal job (which is not inventing), and was then further developed in a (research) project; ii) the idea for the invention came from pure inspiration/creativity or from your normal job (which is not inventing), and was not further developed in a (research or development) project (was patented without further research or development costs)”
PROFESSIONAL	Dummy =1 if, as stated in the formulation of the question in the survey i)“the invention was the targeted achievement of a research project; ii) the invention was an expected by-product of a research project, not directly related to the main target of the project; iii) the invention was an unexpected by-product of a research project, not directly related to the main target of the project”
AGE	Age of the inventor
EDUCATION	Educational degree of the inventor. 1= Up to lower secondary school; 2 = Upper secondary school; 3 = Tertiary Education (BA and Master); 4 = PhD
GENDER	Dummy = 1 if the inventor is male
EMPLOYER SIZE	Type of firm. 1= Large firm (more than 250 employees); 2 = Medium firm (100-250 employees); 3 = Small firm (< 100 employees)
SINGLE INVENTOR	Dummy = 1 if the inventor is a single inventor
APPLICATION YEAR	Year when the applicants applied for the patent
TECHNOLOGICAL CLASS	ISI INPI OST Technological Classes

Table 2.1: Descriptive Statistics

	n	Mean	St. Dev.	Min	Max
Dependent variable					
COMMERCIALIZED PATENT	5,683	0.721	0.448	0	1
Explanatory Variables					
MARKET KNOWLEDGE	5,683	6.795	4.086	0	15
SCIENTIFIC KNOWLEDGE	5,683	7.759	5.100	0	20
NON PROFESS. INVENTOR	5,683	0.360	0.480	0	1
PROFESSIONAL INVENTOR	5,683	0.640	0.480	0	1
Controls					
AGE	5,683	44.80	9.473	20	78
EDUCATION					
LOW SCHOOL	5,683	0.036	0.186	0	1
UPPER SECOND. SCHOOL	5,683	0.177	0.338	0	1
BA and MASTER	5,683	0.549	0.498	0	1
PHD	5,683	0.221	0.415	0	1
GENDER	5,683	0.974	0.158	0	1
SINGLE INVENTOR	5,683	0.403	0.490	0	1
EMPLOYER SIZE					
SMALL FIRM	5,683	0.143	0.350	0	1
MEDIUM FIRM	5,683	0.097	0.296	0	1
LARGE FIRM	5,683	0.760	0.427	0	1

Table 2.2: Correlation Matrix

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	*Commercialized Patent*	**1.000**														
2	*Market Knowledge*	.130	**1.000**													
3	*Scientific Knowledge*	-.084	0.306	**1.000**												
4	*Non-Professional*	.081	-.017	-.235	**1.000**											
5	*Professional*	-.081	.017	.235	-1.000	**1.000**										
6	*Age*	.090	-.051	-.079	.142	-.142	**1.000**									
7	*Low School*	.038	-.020	-.126	.120	-.120	.080	**1.000**								
8	*Second. School*	.079	.040	-.231	.127	-.127	.098	-.090	**1.000**							
9	*BA& Master*	.045	-.023	-.021	-.012	.012	-.073	-.213	-.512	**1.000**						
10	*PhD*	-.155	-.002	.302	-.171	.171	-.043	-.103	-.248	-.588	**1.000**					
11	*Gender*	-.016	.012	.057	-.020	.020	-.125	-.019	-.034	.028	.013	**1.000**				
12	*Single Inventor*	.090	-.028	-.019	.164	-.164	.106	.085	.103	.038	-.184	-.033	**1.000**			
13	*Small Firm*	.122	.012	-.114	.128	-.128	.077	.166	.126	-.070	-.109	.004	.199	**1.000**		
14	*Medium Firm*	.060	.035	-.081	.062	-.062	.019	.032	.072	-.008	-.077	-.019	.062	-.134	**1.000**	
15	*Large Firm*	-.142	-.035	.150	.148	-.148	-.077	-.159	-.154	.064	.143	.001	.199	-.728	-.583	**1.000**

Table 3.1: Results (coefficients)

	Commercialized Patent		
	(1)	(2)	(3)
Explanatory variables			
Market Knowledge		0.051***	0.030***
		(0.005)	(0.009)
Scientific Knowledge		-0.018***	-0.035***
		(0.004)	(0.007)
Interaction Market*Scientific			0.003***
			(0.001)
Controls			
Age	0.009***	0.011***	0.010***
	(0.002)	(0.002)	(0.002)
Education (Upper 2nd level)	0.012	0.009	0.018
	(0.098)	(0.100)	(0.099)
Education (BA and Master)	-0.111	-0.079	-0.066
	(0.090)	(0.092)	(0.092)
Education (PhD)	-0.529***	-0.424***	-0.409***
	(0.095)	(0.098)	(0.098)
Gender	-0.048	-0.013	-0.001
	(0.115)	(0.114)	(0.114)
Single Inventor	0.079*	0.066	0.065
	(0.041)	(0.041)	(0.041)
Employer Size (Medium)	0.302***	0.255***	0.257***
	(0.066)	(0.067)	(0.067)
Employer Size (Small Firm)	0.467***	0.437***	0.433***
	(0.062)	(0.062)	(0.062)
YEAR DUMMIES	Yes	Yes	Yes
COUNTRY DUMMIES	Yes	Yes	Yes
TECHNOLOGY CLASS DUMMIES	Yes	Yes	Yes
Constant	0.384*	0.037	0.134
	(0.223)	(0.227)	(0.229)
Observations	5,683	5,683	5,683
log likelihood	-3184.665	-3130.018	-3125.610
chi-square	332.002	427.923	440.453

Robust Standard Errors are in parentheses; *p< .10. **p< .05. ***p< .001

Table 3.2: Results (marginal effects)

	Commercialized Patent		
	(1)	(2)	(3)
Explanatory variables			
Market Knowledge		.017***	.010***
		(.001)	(.003)
Scientific Knowledge		-.006***	-.011***
		(.001)	(.002)
Interaction Market*Scientific			.001***
			(.000)
Controls			
Age	.003***	.003***	.003***
	(.001)	(.001)	(.001)
Education (Upper 2nd level)	.004	.003	.006
	(.032)	(.032)	(.032)
Education (BA and Master)	-.037	-.026	-.021
	(.030)	(.030)	(.030)
Education (PhD)	-.187***	-.148***	-.142***
	(.035)	(.036)	(.036)
Gender	-.015	-.004	-.001
	(.038)	(.037)	(.037)
Single Inventor	.026**	.022	.021
	(.013)	(.013)	(.013)
Employer Size (Medium Firm)	.091***	.078***	.078***
	(.018)	(.019)	(.019)
Employer Size (Small Firm)	.136***	.127***	.127***
	(.015)	(.016)	(.016)
YEAR DUMMIES	Yes	Yes	Yes
COUNTRY DUMMIES	Yes	Yes	Yes
TECHNOLOGY CLASS DUMMIES	Yes	Yes	Yes
Observations	5,683	5,683	5,683
log likelihood	-3184.6654	-3130.020	-3125.610
chi-square	332.00	427.92	440.45
Pseudo R-square	.053	.071	.071

Robust Standard Errors are in parentheses;
*p< .10. **p< .05. ***p< .001

Table 4.1: Main Characteristics of Non-professional Inventors

Non-professional	
Explanatory Variables	
Market Knowledge	0.012**
	(0.005)
Scientific Knowledge	-0.047***
	(0.004)
Age	0.014***
	(0.002)
Secondary School	-0.322***
	(0.087)
BA and Master	-0.438***
	(0.080)
PhD	-0.724***
	(0.090)
Gender	-0.128
	(0.117)
Single Inventor	0.256***
	(0.039)
Medium Firm	0.190***
	(0.060)
Small Firm	0.275***
	(0.053)
Constant	-0.369*
	(0.202)
Observations	5,683
log likelihood	-3347.19
chi-square	671.13

Robust standard errors are in parentheses
*p< .10. **p< .05. ***p< .001

Table 4.2: Non-professional and Professional Inventors: Distinguishing Characteristics

	N	Percentage	Type of Knowledge Used	Education Type	Rewards to Invent
Non-professional	5,683	36,02%	Market Knowledge	i. Secondary School (25%) ii. BA & Master (55%) iii. PhD (12%)	Personal Satisfaction
Professional	5,683	63,98%	Scientific Knowledge	i. Secondary School (14%) ii. BA & Master (56%) iii. PhD (28%)	Improving Organizational Performance

Table 5.1: Results (coefficients)

	Commercialized Patent				
	(4)	(5)	(6)	(7)	(8)
Explanatory variables					
Market Knowledge	0.051*** (0.005)	0.051*** (0.005)	0.051*** (0.005)	0.034*** (0.008)	0.026*** (0.008)
Scientific Knowledge	-0.017*** (0.004)	-0.023*** (0.005)	-0.017*** (0.004)	-0.017*** (0.004)	-0.026*** (0.005)
Non-professional	0.041 (0.041)	-0.089 (0.070)			0.077 (0.083)
Professional			-0.041 (0.041)	-0.204*** (0.075)	
Interact_NonProfess*Science		0.018** (0.008)			0.028*** (0.008)
Interact_Profess*Market				0.025*** (0.010)	0.037*** (0.010)
Controls					
Age	0.010*** (0.002)	0.010*** (0.002)	0.010*** (0.002)	0.010*** (0.002)	0.010*** (0.002)
Education (Upper 2nd level)	0.013 (0.100)	0.006 (0.100)	0.013 (0.100)	0.015 (0.100)	0.006 (0.099)
Education (BA and Master)	-0.072 (0.092)	-0.083 (0.092)	-0.072 (0.092)	-0.068 (0.092)	-0.083 (0.092)
Education (PhD)	-0.414*** (0.099)	-0.418*** (0.099)	-0.414*** (0.099)	-0.409*** (0.099)	-0.412*** (0.099)
Gender	-0.014 (0.114)	-0.015 (0.114)	-0.014 (0.114)	-0.015 (0.114)	-0.016 (0.115)
Single Inventor	0.063 (0.042)	0.064 (0.042)	0.063 (0.042)	0.062 (0.041)	0.063 (0.042)
Employer Size(Medium Firm)	0.252*** (0.067)	0.255*** (0.067)	0.252*** (0.067)	0.250*** (0.067)	0.254*** (0.067)
Employer Size (Small Firm)	0.434*** (0.063)	0.436*** (0.063)	0.434*** (0.063)	0.433*** (0.063)	0.435*** (0.063)
YEAR DUMMIES	Yes	Yes	Yes	Yes	Yes
COUNTRY DUMMIES	Yes	Yes	Yes	Yes	Yes
TECHNOLOGY CLASS DUMMIES	Yes	Yes	Yes	Yes	Yes
Constant	0.024 (0.227)	0.093 (0.229)	0.065 (0.229)	0.163 (0.232)	0.037 (0.230)
Observations	5,683	5,683	5,683	5,683	5,683
log likelihood	-3129.512	-3126.860	-3129.512	-3126.115	-3120.381
chi-square	428.273	435.126	428.273	438.207	451.017

Robust standard errors are in parentheses
*p< .10. **p< .05. ***p< .001

Table 5.2: Results (marginal effects)

	Commercialized Patent				
	(4)	(5)	(6)	(7)	(8)
Explanatory variables					
Market Knowledge	.017***	.017***	.017***	.012***	.008***
	(.002)	(.002)	(.002)	(.003)	(.003)
Scientific Knowledge	-.006***	-.008***	-.005***	-.005***	-.008***
	(.001)	(.002)	(.002)	(.001)	(.002)
Interaction Market*Scientific					
Non-professional	.013	-.030			.025
	(.013)	(.023)			(.027)
Professional			-.013	-.065***	
			(.013)	(.023)	
Interact_NonProfess*Science		.006**			.009***
		(.003)			(.003)
Interact_Profess*Market				.008***	.012***
				(.003)	(.003)
Controls					
Age	.003***	.003***	.003***	.003***	.003***
	(.001)	(.001)	(.001)	(.001)	(.001)
Education (Upper 2nd level)	.004	.002	.004	.005	.002
	(.032)	(.032)	(.032)	(.032)	(.032)
Education (BA and Master)	-.023	-.027	-.023	-.022	-.027
	(.030)	(.030)	(.030)	(.030)	(.030)
Education (PhD)	-.144***	-.145***	-.144***	-.142***	-.143***
	(.036)	(.036)	(.036)	(.036)	(.036)
Gender	-.004	-.005	-.005	-.005	-.005
	(.037)	(.013)	(.037)	(.037)	(.037)
Single Inventor	.020	.021	.020	.020	.020
	(.013)	(.013)	(.013)	(.013)	(.013)
Employer Size (Medium Firm)	.077***	.078***	.077***	.076***	.077***
	(.019)	(.019)	(.019)	(.019)	(.019)
Employer Size (Small Firm)	.127***	.127***	.127***	.126***	.127***
	(.016)	(.016)	(.016)	(.016)	(.016)
YEAR DUMMIES	Yes	Yes	Yes	Yes	Yes
COUNTRY DUMMIES	Yes	Yes	Yes	Yes	Yes
TECHNOLOGY CLASS DUMMIES	Yes	Yes	Yes	Yes	Yes
Observations	5,683	5,683	5,683	5,683	5,683
log likelihood	-3129.511	-3126.860	-3129.511	-3126.115	-3120.380
chi-square	428.27	435.13	428.27	438.21	451.02
Pseudo R-square	.070	.071	.070	.071	.073

Robust Standard Errors are in parentheses;
*p< .10. **p< .05. ***p< .001

Table 6.1: Robustness Checks Results – Serendipity sub-sample

	Commercialized Patent		
	(1)	(2)	(3)
Explanatory variables			
Market Knowledge		0.027***	-0.001
		(0.009)	(0.015)
Scientific Knowledge		-0.007	-0.035**
		(0.008)	(0.014)
Interaction Market*Scientific			0.004**
			(0.002)
Controls			
Age	0.004	0.004	0.004
	(0.004)	(0.004)	(0.004)
Education (Upper 2nd level)	-0.038	-0.034	-0.022
	(0.164)	(0.165)	(0.164)
Education (BA and Master)	-0.295**	-0.282*	-0.252*
	(0.149)	(0.151)	(0.151)
Education (PhD)	-0.584***	-0.534***	-0.498***
	(0.163)	(0.168)	(0.169)
Gender	0.199	0.220	0.255
	(0.276)	(0.273)	(0.272)
Single Inventor	-0.073	-0.079	-0.084
	(0.073)	(0.073)	(0.073)
Employer Size(Medium Firm)	0.352***	0.338***	0.339***
	(0.114)	(0.114)	(0.121)
Employer Size (Small Firm)	0.621***	0.612***	0.614***
	(0.120)	(0.120)	(0.114)
YEAR DUMMIES	Yes	Yes	Yes
COUNTRY DUMMIES	Yes	Yes	Yes
TECHNOLOGY CLASS DUMMIES	Yes	Yes	Yes
Constant	0.711	0.560	0.650
	(0.447)	(0.449)	(0.451)
Observations	1,608	1,608	1,608
log likelihood	-933.849	-929.545	-926.540
chi-square	144.269	149.200	156.884

Robust Standard Errors are in parentheses;
*p< .10. **p< .05. ***p< .001

Table 7.1: Robustness Checks Results – Large Firms sub-sample

	Commercialized Patent						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Explanatory variables							
Market Knowledge		0.028***	0.054***	0.054***	0.054***	0.030***	0.019**
		(0.010)	(0.005)	(0.006)	(0.005)	(0.009)	(0.010)
Scientific Knowledge		-0.041***	-0.020***	-0.027***	-0.020***	-0.020***	-0.031***
		(0.008)	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)
Interaction Market*Scientific		0.003***					
		(0.001)					
Non-professional			0.038	-0.119			0.099
			(0.047)	(0.083)			(0.097)
Professional					-0.038	-0.265***	
					(0.047)	(0.085)	
Interact_NonProfess*Science				0.021**			0.035***
				(0.009)			(0.010)
Interact_Profess*Market						0.035***	0.050***
						(0.011)	(0.012)
Controls							
Age	0.011***	0.012***	0.012***	0.012***	0.012***	0.012***	0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Education (Upper 2nd level)	0.087	0.081	0.072	0.065	0.072	0.080	0.072
	(0.128)	(0.128)	(0.128)	(0.128)	(0.128)	(0.128)	(0.127)
Education (BA and Master)	-0.053	-0.008	-0.019	-0.029	-0.019	-0.008	-0.021
	(0.117)	(0.118)	(0.118)	(0.118)	(0.118)	(0.117)	(0.117)
Education (PhD)	-0.497***	-0.375***	-0.382***	-0.387***	-0.382***	-0.372***	-0.374***
	(0.121)	(0.123)	(0.123)	(0.123)	(0.123)	(0.123)	(0.123)
Gender	-0.106	-0.044	-0.059	-0.060	-0.059	-0.061	-0.063
	(0.129)	(0.127)	(0.127)	(0.127)	(0.127)	(0.127)	(0.128)
Single Inventor	0.040	0.016	0.016	0.016	0.016	0.015	0.014
	(0.046)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
YEAR DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TECHNOLOGY CLASS DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.208	-0.026	-0.160	-0.082	-0.122	0.013	-0.159
	(0.258)	(0.265)	(0.262)	(0.264)	(0.264)	(0.268)	(0.264)
Observations	4,320	4,320	4,320	4,320	4,320	4,320	4,320
log likelihood	-2578.159	-2523.923	-2528.120	-2525.413	-2528.120	-2523.102	-2516.447
chi-square	212.471	314.604	305.417	311.024	305.417	314.694	325.523

Robust Standard Errors are in parentheses;
*p< .10. **p< .05. ***p< .001

Table 7.2: Robustness Checks Results – Small & Medium Firms sub-sample

	Commercialized Patent						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Explanatory variables							
Market Knowledge		0.033*	0.041***	0.041***	0.041***	0.044***	0.044***
		(0.017)	(0.011)	(0.011)	(0.011)	(0.016)	(0.017)
Scientific Knowledge		-0.013	-0.004	-0.005	-0.004	-0.004	-0.004
		(0.016)	(0.009)	(0.012)	(0.009)	(0.009)	(0.012)
Interaction Market*Scientific		0.001					
		(0.002)					
Non-professional			0.044	0.032			0.006
			(0.089)	(0.134)			(0.170)
Professional					-0.044	-0.007	
					(0.089)	(0.160)	
Interact_NonProfess*Science				0.002			0.000
				(0.017)			(0.018)
Interact_Profess*Market						-0.006	-0.005
						(0.021)	(0.022)
Controls							
Age	0.003	0.005	0.005	0.005	0.005	0.005	0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Education (Upper 2nd level)	-0.128	-0.102	-0.100	-0.101	-0.100	-0.100	-0.100
	(0.159)	(0.161)	(0.162)	(0.162)	(0.162)	(0.162)	(0.162)
Education (BA and Master)	-0.231	-0.210	-0.207	-0.207	-0.207	-0.206	-0.207
	(0.147)	(0.150)	(0.149)	(0.149)	(0.149)	(0.150)	(0.150)
Education (PhD)	-0.467***	-0.370*	-0.371*	-0.371*	-0.371*	-0.372*	-0.372*
	(0.180)	(0.192)	(0.193)	(0.193)	(0.193)	(0.193)	(0.193)
Gender	0.048	0.036	0.034	0.035	0.034	0.036	0.036
	(0.282)	(0.286)	(0.286)	(0.286)	(0.286)	(0.286)	(0.286)
Single Inventor	0.237***	0.252***	0.244***	0.244***	0.244***	0.244***	0.244***
	(0.089)	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)
YEAR DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TECHNOLOGY CLASS DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.232**	0.898*	0.850	0.857*	0.893*	0.874*	0.868*
	(0.505)	(0.519)	(0.518)	(0.521)	(0.518)	(0.520)	(0.524)
Observations	1,360	1,360	1,360	1,360	1,360	1,360	1,360
log likelihood	-576.071	-569.119	-569.197	-569.192	-569.197	-569.162	-569.162
chi-square	77.428	86.858	85.151	85.199	85.151	85.096	85.301

Robust Standard Errors are in parentheses;
*p< .10. **p< .05. ***p< .001

Table 8.1: Robustness Checks Results – Different Measure of Dependent Variable

	Commercialized Patent						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Explanatory variables							
Market Knowledge		0.030*** (0.009)	0.051*** (0.005)	0.051*** (0.005)	0.051*** (0.005)	0.034*** (0.008)	0.026*** (0.008)
Scientific Knowledge		-0.035*** (0.007)	-0.017*** (0.004)	-0.023*** (0.005)	-0.017*** (0.004)	-0.017*** (0.004)	-0.026*** (0.005)
Interaction Market*Scientific		0.003*** (0.001)					
Non-professional			0.041 (0.041)	-0.089 (0.070)			0.077 (0.083)
Professional					-0.041 (0.041)	-0.204*** (0.075)	
Interact_NonProfess*Science				0.018** (0.008)			0.028*** (0.008)
Interact_Profess*Market						0.025*** (0.010)	0.037*** (0.010)
Controls							
Age	0.009*** (0.002)	0.010*** (0.002)	0.010*** (0.002)	0.010*** (0.002)	0.010*** (0.002)	0.010*** (0.002)	0.010*** (0.002)
Education (Upper 2nd level)	0.012 (0.098)	0.018 (0.099)	0.013 (0.100)	0.006 (0.100)	0.013 (0.100)	0.015 (0.100)	0.006 (0.099)
Education (BA and Master)	-0.111 (0.090)	-0.066 (0.092)	-0.072 (0.092)	-0.083 (0.092)	-0.072 (0.092)	-0.068 (0.092)	-0.083 (0.092)
Education (PhD)	-0.529*** (0.095)	-0.409*** (0.098)	-0.414*** (0.099)	-0.418*** (0.099)	-0.414*** (0.099)	-0.409*** (0.099)	-0.412*** (0.099)
Gender	-0.048 (0.115)	-0.001 (0.114)	-0.014 (0.114)	-0.015 (0.114)	-0.014 (0.114)	-0.015 (0.114)	-0.016 (0.115)
Single Inventor	0.079* (0.041)	0.065 (0.041)	0.063 (0.042)	0.064 (0.042)	0.063 (0.042)	0.062 (0.041)	0.063 (0.042)
Employer Size (Medium Firm)	0.302*** (0.066)	0.257*** (0.067)	0.252*** (0.067)	0.255*** (0.067)	0.252*** (0.067)	0.250*** (0.067)	0.254*** (0.067)
Employer Size (Small Firm)	0.467*** (0.062)	0.433*** (0.062)	0.434*** (0.063)	0.436*** (0.063)	0.434*** (0.063)	0.433*** (0.063)	0.435*** (0.063)
YEAR DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes	Yes
COUNTRY DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TECHNOLOGY CLASS DUMMIES	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.384* (0.223)	0.134 (0.229)	0.024 (0.227)	0.093 (0.229)	0.065 (0.229)	0.163 (0.232)	0.037 (0.230)
Observations	5,683	5,683	5,683	5,683	5,683	5,683	5,683
log likelihood	-3184.665	-3125.610	-3129.512	-3126.860	-3129.512	-3126.115	-3120.381
chi-square	332.002	440.453	428.273	435.126	428.273	438.207	451.017

Robust Standard Errors are in parentheses;
*p< .10. **p< .05. ***p< .001

Figure 1a : Education Non-professional

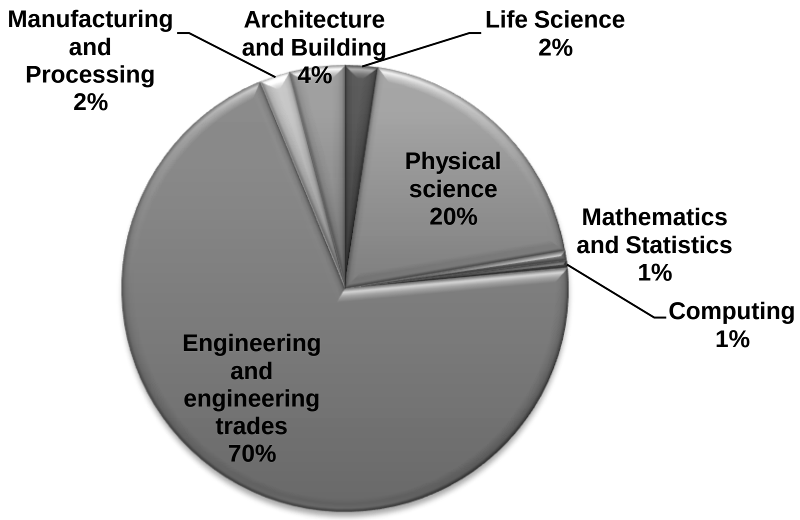


Figure 1b: Education Professional

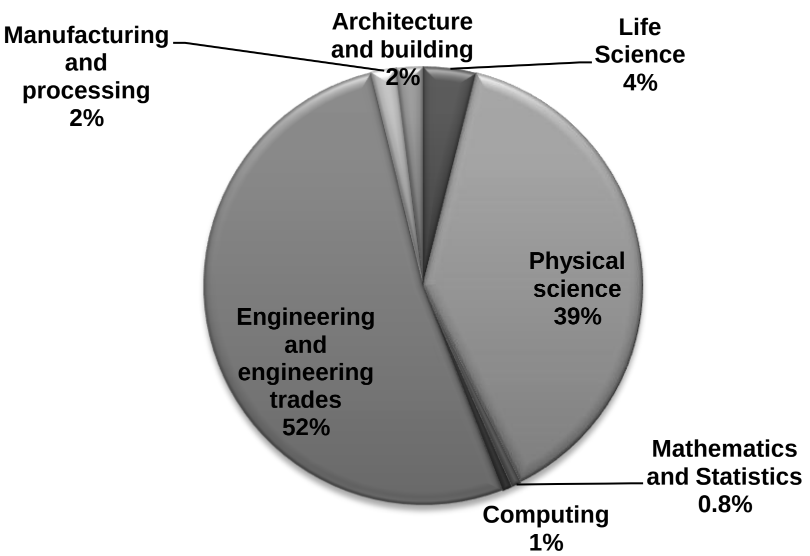


Figure 2a: Simulation of Interaction Effect in a Non Linear Model -Interaction Scientific Knowledge*Market Knowledge (α=.01)-

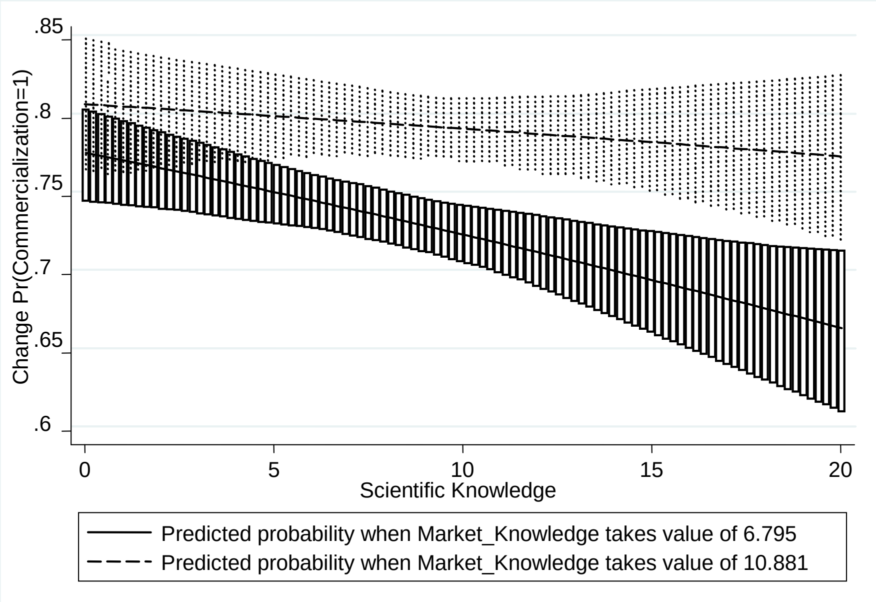


Figure 2b: Simulation of Interaction Effect in a Non Linear Model Interaction: Scientific Knowledge*Non-professional (α=.05)

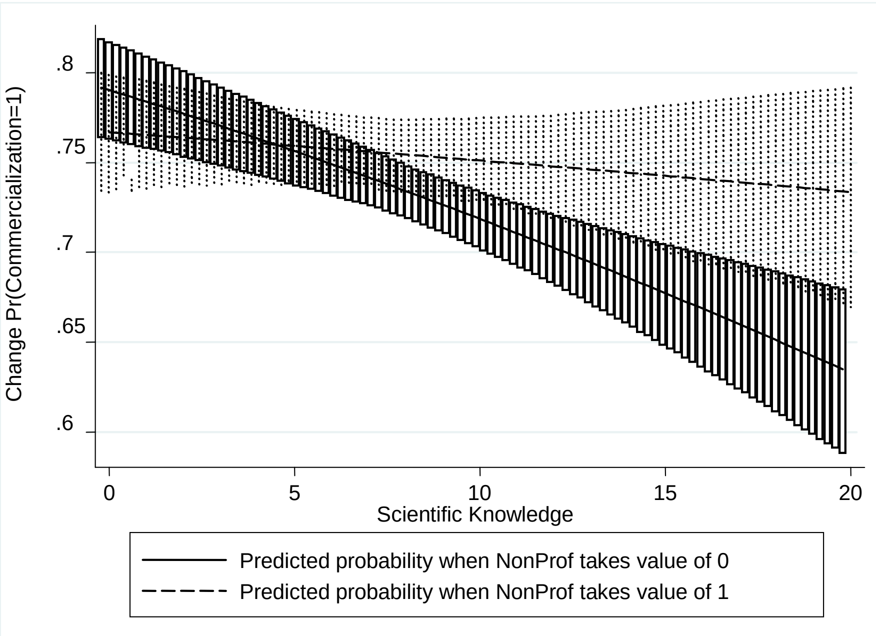


Figure 2c: Simulation of Interaction Effect in a Non Linear Model
Interaction: Market Knowledge*Professional (α=.10)

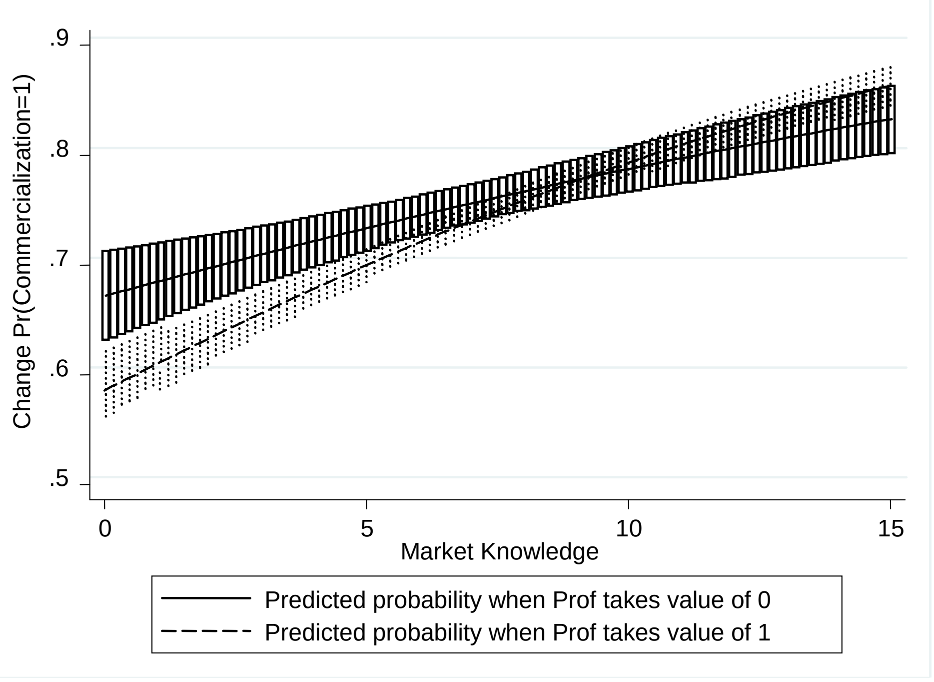


Figure 3a: Simulation of Interaction Effect in a Non Linear Model Interaction Scientific Knowledge*Market Knowledge (α=.01)

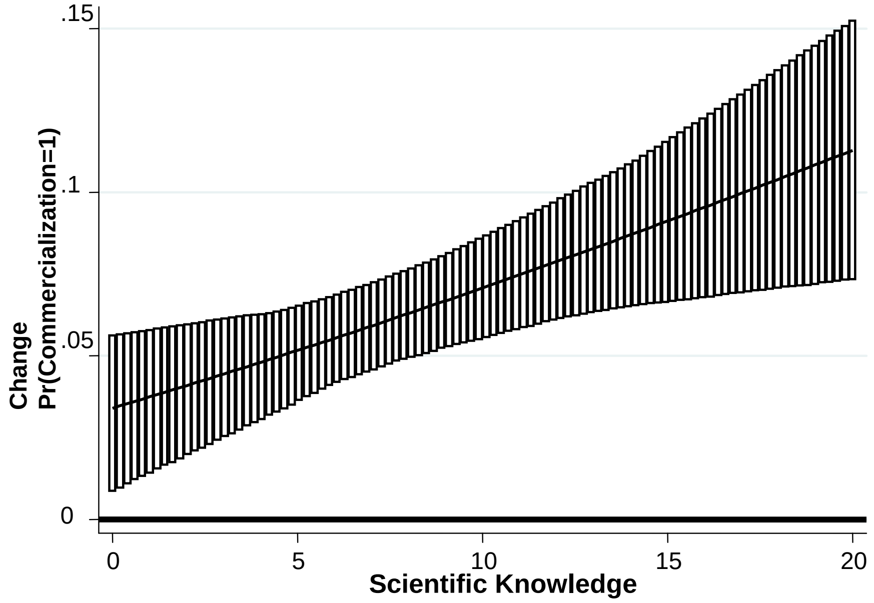


Figure 3b: Simulation of Interaction Effect in a Non Linear Model Interaction: Scientific Knowledge*Non-professional (α=.05)

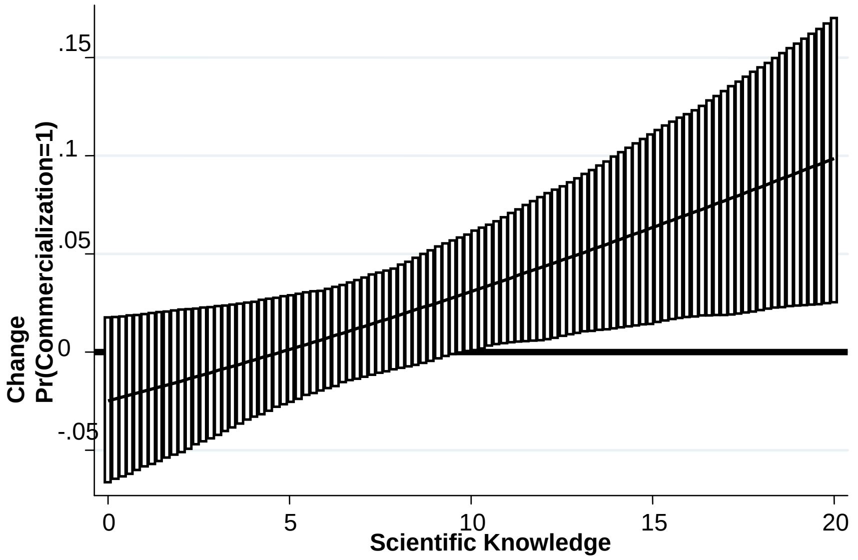


Figure 3c: Simulation of Interaction Effect in a Non Linear Model - Interaction: Market Knowledge*Professional (α=.10)

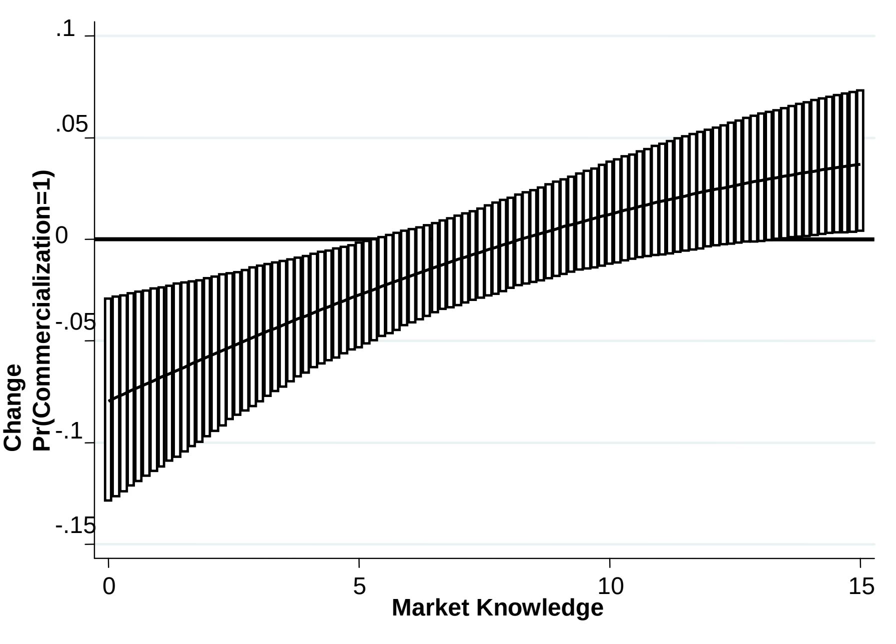
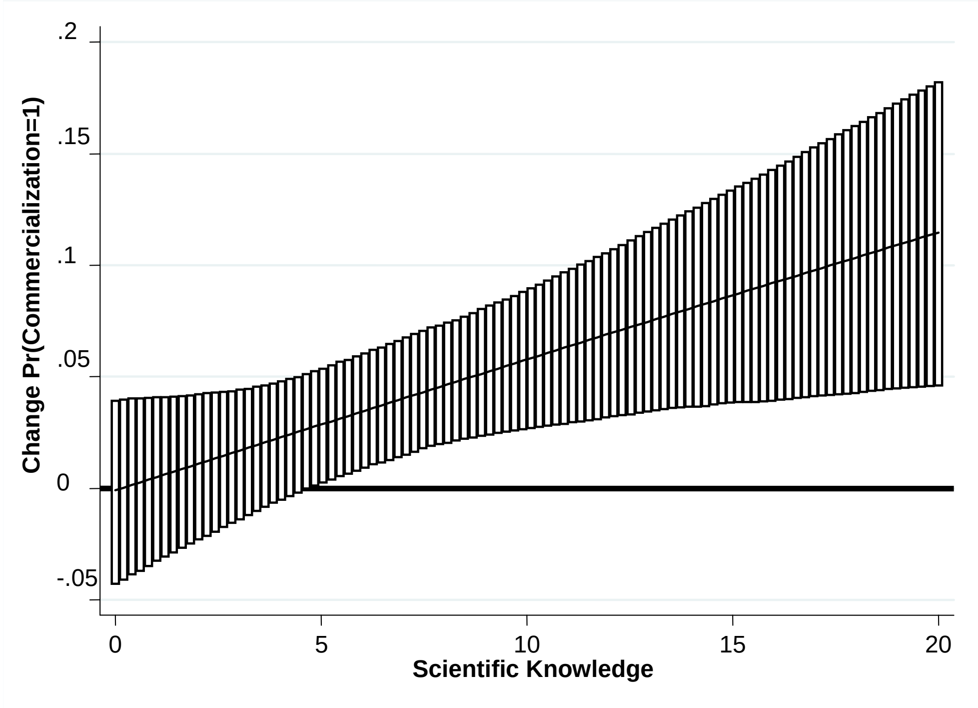


Figure 4a: Robustness Checks Interaction Market Knowledge*Scientific Knowledge in serendipity sub-sample (α=.05)



Taking The Perspective of the User: Untangling The Role of Empathy and User Knowledge in Entrepreneurship Research

Abstract

Perspective-taking (henceforth, PT) is the cognitive skill that enables one to consider and understand another person's psychological viewpoint. Since PT requires a target, i.e., the one whose perspective is taken, we select users as a crucial entrepreneurial target. Users can in fact be an information source that can populate the information corridors of the entrepreneurs as well as the target of innovations introduced by entrepreneurs. In this paper, we show how User PT can impact the intrinsic motivations, creativity, and self-efficacy of entrepreneurs. In order to test our intuition we set up two experimental designs with MBA students. The first study confirms a positive effect of User PT on intrinsic motivations, creativity, and entrepreneurial self-efficacy. The second design disentangles the role of different users: the effect of User PT on the dependent variables is higher if the entrepreneur takes the viewpoint of lead users with respect to ordinary users. We conclude our work by suggesting promising venues for future research in the fields of entrepreneurship and user innovation.

1. INTRODUCTION

Perspective taking (henceforth, PT) is the cognitive skill that enables one to consider and understand another person's psychological viewpoint (e.g., Batson, 1991; Davis, 1980). Originating in the cognitive developmental research field, an extensive body of literature has shown the importance of PT in empathizing with the feelings and pain of others and in reducing the use of stereotypes when forming impressions (Parker and Axtell, 2001). Empirical evidence suggests that one of the main benefits of PT is to support the coordination of social goals, thereby creating social bonds (Galinsky, Ku, and Wang, 2005); on the contrary, the particular perspectives that different groups generate create major cognitive barriers if not combined with PT capabilities (Carlile, 2004; Dougherty, 1992). In this paper, we show how the cognitive process of PT can impact the intrinsic motivation, creativity, and self-efficacy of entrepreneurs -- namely, three constructs that are at the basis of entrepreneurial opportunity identification and exploitation (Shane and Venkataraman, 2000).

Since PT requires a target, i.e., the one whose perspective is taken (Parker and Axtell, 2001), we selected users as a crucial entrepreneurial target. Despite the fact that information corridors based on market knowledge are acknowledged as a fundamental driver of opportunity recognition (Baron, 2006; Shane and Venkataraman, 2000), user knowledge as a lever to discover and exploit opportunities seems to have been overlooked in entrepreneurship research. In point of fact, the strategy and entrepreneurial processes of value creation and capture can be substantially informed by a consumer-based perspective (Priem, 2007). For instance, Virgin CEO Richard Branson (2009) claims that: "When we start a new venture, we base it on hard research and analysis. Typically, we review the industry and put ourselves in the customer's shoes to see what could make it better*".* Similarly, chef Gordon Ramsay (2007), famous worldwide for his hit TV series Hell's Kitchen, remarked: "The secret of a successful chef is to put himself in the customer's position. By that I mean thinking about what they want".

In this paper, we first of all deduce specific hypotheses that untangle how user PT impacts the cognitive processes of entrepreneurship. We will particularly highlight how putting oneself in the shoes of the user enhances the inherent propensities and dispositional traits of self-efficacy, intrinsic motivation, and creativity and thus becomes an important venue for opportunity recognition. While deducing our hypothesis we note that the process of PT can be particularly valuable in contexts of opportunity creation in which it is the actions of entrepreneurs that enact the environmental opportunities and require a recursive learning with the outside environment (see, e.g., Alvarez and Barney, 2007). In our model, we also pay attention to different types of users -- namely, more mainstream and ordinary users vis-à-vis lead users. Lead users are a peculiar target because they themselves can ideate and develop innovations (von Hippel, 1986). Though infrequent, they can even decide to start new ventures to commercialize the products and services they have invented (Baldwin, Hienerth, and von Hippel, 2006; Shah and Tripsas, 2007). Building on lead user research, we hypothesize that assuming the perspective of different types of users -- specifically lead users compared to ordinary users -- might produce effects of different intensity on the intrinsic motivation, creativity and self-efficacy of entrepreneurs.

In order to test our intuitions we set up two studies based on an experimental design. The main results confirm a positive effect of user PT on self-efficacy, intrinsic motivations, and creativity. These effects become even stronger when the target of the PT process is a lead user instead of an ordinary user. We conclude our work by discussing our results, the limitations of our study, and by providing some suggestions about possible promising venues for future research in the fields of entrepreneurship, user innovation, and PT.

2. BACKGROUND LITERATURE AND THEORY

2.1 An Overview of PT

PT is “the ability to infer other individuals’ mental states, to consider their perspective, and thereby to interpret and predict their actions” (Wu and Keysar, 2007: 600). PT is the cognitive component of empathy, stemming from the seminal contributions of Mead (1934) and Piaget (1932). Empathy refers to the reactions of an individual to the observed experiences of another and is composed of two dimensions: an emotional or instinctive component -- primarily devoted to explaining the process of emotion sharing -- and an intellectualized or cognitive component, related to the accuracy of the perceptions of others (Davis, 1980). The two components are interdependent and reliable scales have been developed and tested to measure them separately (e.g., Coke, Batson, and McDavis, 1978). As observed by Parker and Axtell (2001), PT is a relevant concept in the study of human development and has been used to understand individuals both in their interpersonal and affective relationships and in their business and organizational ones.

PT abilities present two fundamental outcomes (Parker and Axtell, 2001). First of all, when people engage in active PT, they are more likely to empathize with the target -- e.g., by showing higher understanding and acceptance. Second, when individuals take the perspective of the target, they tend to ascribe positive attributes to the target’s behaviours. For instance, they can more easily recognize that external situations might justify the negative outcomes of the target and internal factors such as individual ability might explain success, while the usual self-service bias tends to make people attribute their own success to internal factors and failure to external ones. Hence, PT reduces such a bias and enhances positive attributes to others’ behaviours.

Interestingly, it has been proved that people do not abandon their own perspective when adopting another’s, but instead use it as an initial anchor and proceed to serially adjust it (Epley *et al.*, 2004). Following this line of reasoning, Gehlbach (2004) distinguishes between the propensity (i.e., motivation) and the ability (i.e., accuracy of inference) to take the other’s perspective which can also depend on the specific characteristics of the situation (e.g., decipherability and familiarity of the target, duration of the relationship) and the context (e.g., level of cooperativeness and presence of distractors). Scholars have made a distinction between possessing PT abilities and using them (Keysar, Lin, and Barr, 2003). In fact, PT can be considered as both a dispositional trait, assuming that it is a relatively stable ability of people, and a cognitive-affective experience that varies with the situation and is a determinant of contextual performance. This means that organizational factors can shape PT by exposing people to different contexts and relationships or to different training mechanisms.

PT has recently been in the foreground of some works in marketing and organization researches. Specifically, marketing scholars have applied and tested the relationship between the PT construct and the outcome variables of sales and marketing performance. In one of these contributions, higher levels of customer needs knowledge, driven by higher levels of cognitive empathy or PT abilities, are associated with higher levels of customer satisfaction and willingness to pay (Homburg, Wieseke, and Bornemann, 2009). Other studies have instead explored the extent to which higher PT abilities can reflect higher customer orientation, especially at the individual service worker level (e.g., Rupp *et al*., 2008), salesperson level (e.g, Aggarwal *et al.*, 2005; Giacobbe *et al.*, 2006; McBane, 1995) and frontline employee level (Homburg, Wieseke, and Bornemann, 2009). PT has, for instance, been identified as a determinant of adaptive selling: "Salespeople high in perspective-taking are better able to understand and meet the special needs of each customer. On the other hand, salespeople who are low in perspective-taking have difficulty understanding the customer's needs and viewpoints, making customers appear to be fickle or hard to please" (Widmier, 2002: 610). Overall, salespersons that have stronger PT abilities are equipped to better understand customer needs and hence potentially satisfy the customer better (Sager and Ferris, 1986).

Instead organization scholars have been attracted by PT as a possible determinant of knowledge integration and organizational capabilities. In a work on communities of practice, Boland and Tenkasi (1995: 362) come to the conclusion that "representations of ways of knowing from members in one community can then be exchanged with members of another, who, having themselves engaged in an effort to make rich representations of their understandings, can now engage in communication about the perspectives of another. This taking of the other into account, in light of a reflexive knowledge of one's own perspective, is the PT process". By applying PT to the relationship between employees and suppliers, Parker and Axtell (2001) demonstrate that PT is associated with cooperative and helping behaviours towards the same supplier. More recently, PT has been envisioned as an organizational capability. Indeed PT facilitates "both seeing and believing" (Litchfield and Gentry, 2010: 195) and helps capture others' perspectives in un unbiased way. In their conceptual model, Litchfield and Gentry (2010) show how PT could be a crucial facilitator of the knowledge integration processes that enable organizational learning and innovation.

To sum up, while psychology studies have discovered, explained, and refined the core dimensions behind PT, business studies in marketing and organization behaviour have highlighted how PT can contribute to marketing performance and to organizational alignment. In the following sections, we will extend the PT findings mentioned above and show how PT can provide a valuable contribution to a better understanding of the cognitive processes of entrepreneurs.

2.2 PT and Entrepreneurship

Entrepreneurship has been defined as the field of opportunities (Shane and Venkatamaran, 2000) and as a "process of becoming rather than a state of being" (Bygrave, 1989: 21). Studies of entrepreneurship have therefore shown the importance of the cognitive traits of entrepreneurs as antecedents of new market opportunities. For instance, alertness (namely, the ability to recognize opportunities when they emerge) is a fundamental trait of successful entrepreneurs (Ardichvili, Cardozo, and Ray, 2003; Kirzner, 1979). Baron (2008) shows that affect (in terms of feeling and emotions) contributes positively to the process of opportunity recognition. Cardon *et al.* (2009: 517) have studied the importance of entrepreneurial passion as a driver of opportunity recognition and define it as "consciously accessible, intense positive feelings experienced by engagement in entrepreneurial activities associated with roles and meanings that are salient to the self-identity of the entrepreneur". Hmieleski and Baron (2009) demonstrate how dispositional optimism is negatively related to the performance of their new ventures; they also show how this relationship is strengthened when moderated by industry dynamism and past experience.

Recently, the emergence of an opportunity creation theory of entrepreneurship has further enhanced the importance of cognitive and dispositional traits. As in the metaphor of "mountain building" rather than "mountain climbing" (Alvarez and Barney, 2007:11), if entrepreneurial opportunities do not exist, regardless of the perceptions of entrepreneurs, the contribution of cognitive mechanisms becomes crucial to enacting the entrepreneurial environment and consequent opportunities. In this line of research, PT can therefore be another valuable construct that helps untangle the cognitive processes behind entrepreneurship. Specifically, we claim that taking the perspective of users can enhance the self-efficacy, intrinsic motivation, and creativity of entrepreneurs. In the next pages, for each of the three constructs we provide a definition and a brief review of past studies, and specifically focus on why PT can be an important antecedent by inferring a formal hypothesis. We eventually attempt to understand whether the ability to assume the perspective of a specific type of user -- namely, a lead user -- might lead to different consequences compared to an ordinary user.

2.3 Self-efficacy

Self-efficacy is defined as "the belief in one's ability to muster and implement the necessary personal resources, skills, and competencies to attain a certain level of achievement on a given task" (Shane *et al.*, 2003: 267). It is considered a "generalized trait consisting of one's overall estimate of one's ability to effect requisite performances in achievement situations" (Eden and Zuk, 1995: 629). According to Bandura (1997), self-efficacy is the cognitive ability to fulfill roles and responsibilities. Empirical findings show that self-efficacy is a cognitive trait which is likely to belong to entrepreneurs rather than other agents. For instance, Chen, Green, and Crick (1998) demonstrated that many individuals might shun entrepreneurial activities not because they actually lack the needed skills but because they believe they do so. Specifically, it has been demonstrated that the entrepreneur's perception of self-efficacy enhances opportunity discovery (Krueger and Dickson, 1994). Entrepreneurial self-efficacy is related to the expected ability to develop new products, identify opportunities, initiate investing relations, and organize human resources (DeNoble, Jung, and Ehlrich, 1999). More broadly, self-efficacy is a driver of the likelihood of venturing (Lee *et al.*, 2011; Markman, Balkin, and Baron, 2002; Wilson, Kickul and Marlino, 2007).

Among the antecedents of self-efficacy, User PT can be particularly valuable in the case of entrepreneurs. Understanding customers is a crucial information corridor (Shane and Venkataraman, 2000) because demand is the bedrock of entrepreneurial success (Priem *et al.*, *forthcoming*). As Thomas Alva Edison (1997), one of the greatest inventors and most famous entrepreneur of all time, once put it: “Anything that won’t sell I do not want to invent. Its sale is proof utility and utility is success”. Trying to put oneself in the shoes of the users can enhance the self-efficacy of the entrepreneur’s actions because he feels more confident of what he is doing. Therefore, since he is convinced of his strong affinity with the users, an entrepreneur can feel more confident in understanding the complexity of market heterogeneity (Adner, 2002) and can be better able to interpret how markets react to his actions and hence create new opportunities (Alvarez and Barney, 2007). Thus we propose the following:

H1: User PT increases the entrepreneur’s perception of self-efficacy.

2.4 Intrinsic Motivations

Motivations are a crucial trait of entrepreneurs (Edelman *et al*., 2010; Shane *et al.*, 2003). Literature usually distinguishes intrinsic from extrinsic motivations (Deci and Ryan, 1985). Extrinsic motivations drive actions that lead to a separable outcome -- they tend to be associated with a monetary or symbolic reward, such as success, fame, or visibility; instead, intrinsic motivations represent an engagement in an activity for its own sake and are not related to monetary rewards. Both intrinsic and extrinsic motivations have been proved to have important effects on threshold performance and the likelihood of enterprise survival. For instance, DeTienne, Shepherd, and Castro (2008) show that individual differences in extrinsic motivations might explain why threshold performance among entrepreneurs could be different. Similarly, Gimeno, Folta, and Cooper (1997) suggest that intrinsic motivations are negatively correlated to the probability of exiting a business because intrinsic motivations play the role of a psychic income. Indeed, it is intrinsic motivations that represents a crucial psychological trait: it spurs the desire to do something because it is considered interesting and enjoyable (Deci, 1971). In this respect, several individual traits explain intrinsic motivation, such as the need for achievement, risk taking, tolerance for ambiguity, and locus of control (Shane *et al.*, 2003). Thus, motivations explain why entrepreneurs pursue opportunities and also why some entrepreneurs are more able than others. Dyer, Gregersen, and Christensen (2008: 330) reach the conclusion that “They [entrepreneurs] are less susceptible to the status quo bias and more likely to be motivated to change the world”.

In line with the idea that individual entrepreneurs pragmatically and creatively make sense of the world surrounding them (Weick, Sutcliff, and Obstefeld, 2005), PT processes can stimulate the entrepreneur’s intrinsic motivation to enact a consistent environment. Goals can be considered mental representations of possible future scenarios, thus enabling individuals to persist (e.g., Bagozzi and Dholakia 1999; Perwin 2003). According to Carsrud and Brännback (2011), this behavior is typical of many entrepreneurs, but the strength to activate the goals depends on the strength of their motivation. We argue that user PT can significantly help reinforce this strength.

Since assuming the perspective of a specific target enhances cooperation between perspective-takers and those whose perspectives are taken (Galinsky *et al.*, 2005), it increases the motivation to find ad-hoc solutions to the target’s needs. This appears to be even more relevant when the target is represented by a user, whose needs have to be understood better than the competitors, in order to unveil promising entrepreneurial opportunities. Hence, User PT can contribute to enhancing the entrepreneur’s intrinsic motivation to find innovative solutions to the selected user’s needs, in coherence with the well-rooted assumption that demand must not be considered as a given, but as a subjective opportunity to be shaped by the entrepreneur (Penrose, 1959; Priem *et al.*, *forthcoming*), consistent with the creation theory of entrepreneurial action (Alvarez and Barney, 2007). Thus we propose that:

H2: User PT increases the entrepreneur's intrinsic motivations.

2.5 Creativity

Creativity refers to the generation of novel and useful ideas concerning work methods, products, processes, and services (Amabile, 1997). Although it is associated with some individual traits (Costa and McCrae, 1992), personal emotions and emotional ambivalence (George and Zhou, 2002) and situational factors (Amabile, 1997; Oldham and Cummings, 1996), it also requires underpinning cognitive mechanisms that improve it, since it is not a static trait and requires social interactions (Perry-Smith, 2006; Shalley and Perry-Smith, 2008). Like other cognitive abilities, creativity could explain the generation of ideas and the recognition of opportunities. "Creativity is the lifeblood of entrepreneurship" (Ward, 2004: 174) and entrepreneurs must be creative "to generate new opportunities and big ideas" (Zhou, 2008:24).

We argue that User PT might represent a process enabling a positive impact on entrepreneurs' creativity. Shane (2000) and Hmieleski and Baron (2009) proved that entrepreneurial success in a specific market can be related to the entrepreneur's prior experience with the users because of his superior ability to develop ad hoc idea sets. In this respect, User PT can also represent an alternative pattern to developing market-specific idea sets in the absence of direct market experience. Indeed User PT seems particularly effective since the PT process does not mean abandoning the perspective of the self but rather implies adding the perspective of the others -- in our case, the users. This would mean extending the self knowledge of the entrepreneur and recombining it with important intuitions that might lead to different venues of creativity. While this process is generally relevant in a kirznerian world of opportunity discovery, it seems particularly coherent in an opportunity creation world characterized by knightian uncertainty (Alvarez and Barney, 2007) where the entrepreneur is not only required to respond to changes in the business environment but can also promote change (Alvarez *et al.*, 2005). User PT can be the process that helps the entrepreneur to further enhance his "entrepreneurial imagination" (Kor, Mahoney, and Michael, 2007) and especially his ability to create economically profitable opportunities by interacting with customers. User PT allows the entrepreneur to go far beyond analogies and put himself in the user's shoes, thereby increasing his own abilities to develop entrepreneurial bricolage, i.e. combining existing resources in new ways to serve existing markets (Baker and Nelson, 2005). Thus we maintain that:

H3: User PT increases the entrepreneur's creativity.

2.6 Mainstream and Lead Users

Extensive work done on business markets by von Hippel (1986) investigated the presence and main characteristics of users that have superior abilities to innovate -- called lead users. Lead users are innovative and knowledgeable customers who tend to be ahead of market trends -- i.e. who have product or service needs going beyond what is currently available in the mainstream market. They have consequently been considered potentially relevant sources of commercially attractive and highly novel product ideas (e.g., Lilien *et al.* 2002; Morrison, Roberts, and von Hippel, 2000). This also implies that lead users might provide possibly precious solutions to those companies able to identify and connect with them. For instance, Gruner and Homberg (2000) demonstrate that the companies that collaborate with lead users show a significantly increased rate of new product success, while Lilien et al. (2002), by studying the 3M case, argue that concepts developed by lead users have a sales potential eight times higher than those developed traditionally.

Lead users have two traits: they are highly motivated to solve a problem related to a need: they anticipate other customers and producers in the marketplace in identifying solutions to that problem (von Hippel, 1986). In other words, they innovate in order to find the right solution to a problem of theirs rather than to sell a product or service. To this end, they tend to combine and integrate any type of prior knowledge that might contribute to a solution better suited to their own needs (von Hippel, 2005).

Since lead users not only contribute new ideas, but also use new prototypes and products before mainstream customers, they might help catalyze the diffusion of innovations. Moreover, being ahead of the market, they might also act as opinion leaders or role models because they are ahead of the mass market (Urban and von Hippel, 1988). Because of their unique characteristics of representing relevant sources of commercially attractive innovation, acting as opinion leaders in their own markets, and anticipating a new product's market success, lead users might represent an even more relevant target of user PT than mainstream users in enhancing the entrepreneur's self-efficacy, intrinsic motivation, and creativity. We thus propose the following hypotheses:

H4: Lead user PT increases the entrepreneur's perception of self-efficacy more than ordinary user PT.

H5: Lead user PT increases the entrepreneur's intrinsic motivation more than ordinary user PT.

H6: Lead user PT increases the entrepreneur's creativity more than ordinary user PT.

3. METHODS

STUDY 1

Method

Design and Procedure. In order to test our hypotheses H1, H2, and H3, we set up an initial experimental design. We devised one factorial between-subjects design with one experimental and one control group and adapted instructional sets from previous researches on PT (e.g., Davis *et al.*, 1996; Galinsky and Moskowitz, 2000;

Galinsky *et al.*, 2008) by manipulating the intensity of user PT, from full perspective-taking to zero PT (pure user watching). The paper-based experiment was divided into two parts. The first included a list of controls, the second included instructions with the stimulus plus manipulation checks and other control variables. A few weeks before carrying out the experiment, we ran a pilot study to test whether the questionnaire was understandable and could be completed in the required time. We first pretested it on a random sample of 54 students from a Master of Science class in strategy field in a leading private business school. In a second step, 98 MBA students from a leading private business school participated in our experiment (n= 98; 66% men, 44% women -2 missing values-; mean age 28.6). We decided to involve MBA students since it is consistent with entrepreneurship research which has investigated the entrepreneurial decision-making style (e.g., Dew *et al.*, 2009) or the development of entrepreneurial intentions (e.g., Kickul *et al.*, 2009; Wilson *et al.*, 2007; Zhao *et al.*, 2005). However, since we realized that this could represent a limitation to our study, we also reran our analysis on two sub-samples. The first was composed of “real” entrepreneurs -- i.e., who, in the last control questions, stated they had been either self-employed at least once, or had started up at least one new venture or taken action to transform their ideas into a new business (n= 50; 76% men, 24% women, mean age 28.5). The second sub-sample was composed of those who rated high entrepreneurial intentions (n= 54; 68% men, 32% women; mean age 28.7). See the Appendix for details.

In our experiment, participants were randomly assigned to one of the two groups and they all ran individually. Following Davis *et al.* (1996) and Galinsky and Moskowitz (2000), we manipulated the intensity of user PT from zero (pure observation of a user we called “Mr. Jackson”) to full PT (“put yourself in the shoes of Mr. Jackson”). More specifically, the instructions relating to the “User PT” scenario (Group 1; n=46) were the following: “You are now going to read a brief story about Mr Jackson and his passion for mountain biking. Like many other riders, Mr Jackson has needs and problems with his mountain-bike. As you read this story, please take the perspective of Mr Jackson and enter his mind in order to understand what he may think and believe. While you are reading the story, concentrate on Mr Jackson and try to put yourself in his shoes in order to figure out his thoughts and solve his problems. Concentrate on Mr Jackson and on his experience. Imagine his viewpoint as clearly and vividly as possible when he encounters a problem, like the one described below". Unlike the first group, the second one (n = 52) was exposed to the same introduction about Mr. Jackson, but participants were recommended to purely "watch" the user, reading his story carefully and objectively.

After getting the instructions, participants were exposed to our stimulus, which consisted of a brief story. We prepared a scenario where the user named Mr. Jackson faces a new need and an unsolved problem during his frequent mountain-biking activities. We chose this setting because several past empirical investigations showed that the extreme sports contexts were characterized by a relevant role played by the users. In fact, in sport contexts such as mountain-biking, kite surfing, canoeing, and kayaking (see, for instance, Luthje *et al.*, 2005; Baldwin *et al.*, 2006), the user is likely to devise and develop prototypes or incremental innovations related to the sport equipment, sometimes even commercialized by the manufacturer (Franke, von Hippel, and Schreier, 2006). We therefore chose a context where users might play an active role in the innovation processes. Indeed, from the entrepreneur's viewpoint, it might be relevant to assume the user's perspective in order to better understand customer needs and deal with them appropriately since this would make the entrepreneur feel more efficient and/or successful.

Measures. In order to check the effectiveness of our manipulation in an entrepreneurial context, we asked participants to complete the questionnaire post stimulus as if they were an entrepreneur taking the perspective of (or simply watching) the user described in the text. We measured our dependent variables with self-reported measures by using the already tested seven-point Likert scales (1= strongly disagree and 7= strongly agree). We adapted all the scales to fit our purpose. Self-efficacy was measured using the Cassar and Friedman (2009) scale. The reliability of the scale is 0.84. Sample items included: "I am confident I can make the effort needed to find a solution to Mr Jackson's problem" and "If I work hard, I can successfully help Mr Jackson".[8] Intrinsic motivations were measured using the Situational Motivational Scale by Guay, Vallelard, and Blanchard (2000), also used by Rich, Lepine, and Crawford (2010). Sample items are the following: "I would feel good if I could find a solution to Mr Jackson's problems" and "I think that helping Mr Jackson is an interesting activity". The reliability of this scale is 0.90.[9] Finally, creativity was measured using the scale by Zhou and George (2001), ("I could generate novel and useful ideas in order to solve Mr Jackson's problem", "I will demonstrate originality in my work to solve Mr Jackson's problems", and "I could creatively solve this problem that causes difficulty for Mr Jackson").The alpha for the scale is 0.92.

Findings

Control variables. We employed a series of ANOVAs to analyze whether the two groups differed with regard to our control variables (Table 1). Specifically, we adopted controls for age, gender, personal background, entrepreneurial experience in the industry, possible "lead userness" of the participants in the mountain-biking sector (scale by Franke *et al.*, 2006), entrepreneurial intentions (measure from Linan and Chen, 2009), Big 5 personality traits (TIPI scale by Goslin *et al.*, 2003), individual PT tendency (IRI Index by Davis, 1980), and personal innovativeness (scale by Baumgartner and Steenkamp, 1996). We found that the two groups did not exhibit significant differences in their individual characteristics. This means that any differences in the dependent variables can be attributed to our manipulation rather than differing sample characteristics (see Table 1). In this way, we ruled out compatible explanations that could influence variations in results. At the end of our questionnaire we also asked participants if they were (or had ever been) entrepreneurs. Since the definition of entrepreneurship is not univocal, we used the questions by Nicolau *et al.* (2008) to investigate if the respondent had ever been an

8 We also adopted a second scale by Jones (1986) and results hold also with this alternative measure. For sake of simplicity, we have chosen to show only one scale.
9 As specified for the scale of self-efficacy, we also adopted a second measure for intrinsic motivations by Tierney, Farmer, and Graen (1999). The previous reasoning applies here.

entrepreneur, namely, if he had ever started a business, been a self-owner operator, or ever taken any action to venture around his own business idea.

More specifically, participants were asked “to what extent did you imagine how you would behave and think if you were the person in the story?” and “to what extent did you try to carefully and objectively read Mr Jackson’s story?”. Answers are rated on a seven-point Likert scale (1=Not at all, and 7= very much). The second manipulation check asks the respondent to rate the following statement. “I have taken the perspective and put myself in Mr Jackson’s shoes” or “I have objectively read the story described**”.** Answers are again rated on a seven-point Likert scale (1= strongly disagree, and 7= strongly agree).

Insert Table 1 about here

Manipulation check and key findings. We used ANOVA analysis to test our hypotheses. We found support for hypotheses H1, H2, and H3, meaning that User PT has a positive effect on self-efficacy, intrinsic motivations and creativity (see Table 2). In fact, respondents in the user PT group display higher self-efficacy (User PT Mean= 5.483) compared to those in the Watch group (Watch Mean= 4.490). Participants in the user PT group also showed significantly higher levels of intrinsic motivation (User PT Mean= 5.592) than those in the Watch group (Watch Mean= 4.657). Finally, this evidence holds for the difference in creativity between the two groups: User PT mean= 5.451 and Watch mean= 4.892. In the Appendix, we show how the results of the sub-sample of participants with a strong entrepreneurial experience are confirmed by the significant mean differences shown across the two groups.

Insert Table 2 about here

In other terms, we can state that an entrepreneur who puts himself in the shoes’ of the user by taking his perspective can: (a) perceive himself as more efficient and able to respond to users' problems, (b) be more motivated to act even without monetary incentive because of his intrinsic motivation to solve users' problems, and (c) be more creative by observing and experiencing problems from another standpoint. User PT allows the entrepreneur to connect with the demand's needs and improves entrepreneurial performance in terms of novelty and usefulness.

STUDY 2

Method

Design and Procedure. In order to test hypotheses H4, H5, and H6, we developed a second experimental design. We again devised one factorial between-subjects design where we manipulated the object of User PT (ordinary users versus lead users). More specifically, some participants were asked to take the perspective of an ordinary user (Group 1; n=33) and others the perspective of a lead user (Group 2; n=39). A total of 72 students from a post-experience master program of a leading private business school were enrolled in this second experiment. Participants were randomly assigned to one of the two groups and they again ran individually. Following Davis *et al.* (1996) and Galinsky and Moskowitz (2000), we adapted the instructions of PT and added the different object of the user PT process. More specifically, the instructions given to the "Ordinary User PT" scenario were the following: "Mr Jackson is an ordinary user but he is not a lead user. It means that he cannot anticipate market trends since he cannot envision new needs before other users and cannot propose solutions that are likely to be commercialized". Instead, the instructions given to the "Lead User PT" scenario were expressed as follows: "Mr Jackson is not an ordinary user but he is a lead user. It means that he has often anticipated market trends since he can envision new needs before other users and can propose personal solutions that are likely to be commercialized". After reading the instructions, participants were exposed to our stimulus, which was still related to a user called Mr. Jackson, who faces a new need and an unsolved problem concerning mountain-biking activities.

Measures. As in the first experiment, we asked participants to complete the questionnaire post stimulus as if they were an entrepreneur taking the perspective of the type of user described in the text. As previously specified, we measured our dependent variables with self-reported measures, using the seven-point Likert scales. We measured self-efficacy, intrinsic motivations, and creativity using the same scales applied in Study 1. The alpha for the scales is in this case, respectively, 0.86, 0.88, and 0.92.

Findings

Control variables. As in Study 1, we also controlled for age, gender, personal background, and entrepreneurial experience in the industry. Moreover, as in the first study, we had controls for possible lead userness of the participants, entrepreneurial intentions, individual PT tendency, Big 5 personality traits, and personal innovativeness (these controls were measured using the scales previously mentioned). As in the previous study, we conducted analysis of variance (ANOVAs) to check whether the two groups differed in terms of control variables. Results show that even in this second study, no significant differences exist between the two groups (Table 3). Again we can assume that any variations in the dependent variables can be attributed to our manipulation. At the end of the questionnaire, we included two kinds of manipulation checks. In the first, participants were asked to rate to what extent they took the user's perspective. In the second, they were asked whether the user described in the text was an ordinary or lead user.

Insert Table 3 about here

Manipulation check and key findings. We employed a two-way ANOVA analysis to test our hypotheses H4, H5, and H6. Results support all three hypotheses. As shown in Table 4, there is a significant effect induced by the type of user. In other words, taking the perspective of a lead user drives to higher significant outcomes compared to the perspective of an ordinary user. Respondents in the Lead User PT group display higher self-efficacy (Lead User PT Mean= 5.919) compared to those in the Ordinary User PT group (Ord. User PT Mean= 4.766). A similar increase in the mean is also significant for the variables intrinsic motivations (Lead User PT

Mean= 5.532; Ord. User PT Mean= 4.894) and creativity (Lead User PT Mean= 5.621; Ord. User PT Mean= 4.436).

Insert Table 4 about here

We can deduce from the empirical results of this second study that user PT is not only a cognitive mechanism leading the entrepreneur to “merge” with users and improve opportunity recognition and performance, but also that different types of users (different PT targets) might influence the final outcomes. From our evidence, we can assert that an entrepreneur can improve his performance more significantly whether he enters the mind of a user with innovative features (like a lead user). Experiencing problems from a lead user’s perspective could enable the entrepreneur to ascribe himself higher self-efficacy, intrinsic motivation and creativity compared to the effects experienced when assuming the perspective of an ordinary user.

4. DISCUSSION AND CONCLUSIONS

Cognitive perspectives are considered promising venues that highlight key aspects of entrepreneurship research (Hmieleski & Baron, 2009). In fact research on cognition provides the only compelling systematic difference between the entrepreneurs and non-entrepreneurs (Businetz and Barney, 1997). In this work we have shown how three inherent propensities and dispositional traits of the entrepreneur, namely, self efficacy, intrinsic motivation, and creativity that lead to opportunity recognition and creation could be enhanced by PT. We have particularly focused on users, because understanding customers and markets is crucial to the entrepreneurial activity since it helps fill the entrepreneur’s information corridors with sparkling ideas (Priem *et al.*, *forthcoming*; Shane and Venkataraman, 2000). Our experimental designs allowed us to validate our intuitions and show how lead users PT can enhance the main effects we hypothesized.

We believe that our study makes three contributions to entrepreneurship and innovation research. First of all, we believe that User PT represents a new and powerful cognitive variable. As noted by Shane and Venkatarman (2000: 218), in order to let the entrepreneurship field develop and evolve, one has to try to explain "why, when, and how some people and not others discover and exploit these opportunities". In this respect, the understanding of how people develop different beliefs regarding market opportunities is crucial (Kirzner, 1997). While entrepreneurship studies have started highlighting cognitive properties that characterize the entrepreneur's alertness, we note that user PT can add an important new dimension. Taking the perspective of the user might especially help entrepreneurs to perceive higher self-efficacy and intrinsic motivation and hence seize opportunities with a stronger psychological commitment. It would also enhance their creativity in identifying and better addressing latent user needs by recombining and integrating their previous knowledge. This process seems particularly relevant under the conditions of Knightian uncertainty theorized in a world of opportunity creation (Alvarez and Barney, 2007). In these contexts, where the opportunities do not exist ex ante, user PT becomes essential. In fact, since the entrepreneur himself has to create the opportunities, his convictions and commitment play a fundamental role in enacting the right opportunities. Interestingly, User PT does not make the entrepreneur abandon his own perspective and espouse that of the target subject but instead implies merging his own perspective with that of the target subject. Integrating the perspectives assumed by entering the user's shoes with his own individual perspective can make the entrepreneur more self-effective, motivated, and even more creative. In these cases, user PT helps the entrepreneur to progressively fine-tune trial and error efforts by better understanding the reactions of different user targets to specific innovative solutions.

Second, we believe that our work provides an explanation of how startup firms could overcome the liability of newness related to the entrepreneur's limited knowledge of the market with respect to incumbents. Works on discontinuous innovation have demonstrated that incumbent firms have the burden of competences which does not let them develop discontinuous innovations (Tushman and Anderson, 1986). Even when they are able to overcome the rigidity of their core competences (Leonard Barton, 1992), they have shown limitations in following the disruptive needs of emerging market segments (Christensen and Bower, 1996) or in cognitively understanding what the market actually wants (Tripsas and Gavetti, 1997). In this respect, entrepreneurs have an advantage over incumbents. Start-ups can in fact more easily target emerging segments (Adner, 2002). However, in doing so, they have the liability of newness, which takes several forms including scant knowledge of the market. User PT therefore represents a potential solution to overcoming the limitations of such a liability. By putting themselves in the shoes of the users, entrepreneurs can enhance their motivation, self-efficacy, and creativity of solutions provided to the market. They can also go beyond dominant market stereotypes, thus further enhancing their advantage compared to incumbents embedded in a well established market perspective.

Third, we believe that our work also provides an important contribution to user innovation literature. Von Hippel (1994) shows that, due to its tacitness, user information can be highly idiosyncratic and costly to transfer and adapt. Since it is “sticky”, it can only be untangled by the manufacturer through a process of continuous iteration (von Hippel and Tyre, 1995). Indeed, by overcoming cognitive barriers and knowledge transfer and enabling the discovery of new opportunities for the market, user PT could be a fungible way to connect the figure of the entrepreneur with the user. More broadly, the process of customer knowledge absorption is filtered through mental models that impede a neat understanding of the potential opportunity. PT can therefore help entrepreneurs innovate in sectors/areas where they have no direct experience as users. Obviously, if the entrepreneur has previously been a user, he will find it easier to understand the needs of the same target. However, our contribution shows that, even if this direct experience is missing, the individual propensity and ability to take the user perspective under different contingencies can enhance opportunity recognition and increase the chance to create new ventures that might match specific market preferences.

Our work is not without limitations. Particularly, two of them could be targeted by future research. First, the informants in our laboratory experiment were MBA students. This represents a common practice in business and entrepreneurship research (e.g., Kickul *et al.*, 2009; Wilson *et al.*, 2007; Zhao *et al.*, 2005). In addition, we re-ran the analysis and confirmed our findings with two sub-samples relative respectively to MBA students with a high entrepreneurial orientation and those with entrepreneurial experience (see again the Appendix). Still, future research could try to replicate the study with entrepreneurs. Second, in our work we did not analyze a performance measure of effectiveness such as opportunity recognition or creation. Trying to develop a link with performance measures could help overcome a limitation of this study.

In addition to this, we believe that there might be three other promising research paths for future development. The first path involves a deeper understanding and articulation of empathy and, more precisely, the role of emotional empathy in enhancing opportunity recognition. Baron (2008) focused on the role of affect in entrepreneurship, Cardon *et al*. (2009) on the benefits provided by passion. However, empirical evidence provides mixed results regarding the role of the emotional or instinctive component of empathy on customer knowledge absorption and performance. For instance, Homburg *et al.*, (2009) show that although cognitive empathy is a core antecedent of customer knowledge absorption, the emotional aspects of empathy do not seem to impact the generation of customer knowledge needs. Similarly, although Sparks and Hunt (1998) in their study: PT -- and the affective dimension of empathy -- termed as emotional contagion -- hypothesise that both the cognitive dimension of empathy are related positively to the ethical sensitivity of marketing researchers, they find that only PT is significantly correlated with ethical sensitivity; in fact, emotional contagion is not related to it. It might therefore be interesting to further explore the specific role that emotional empathy might have on the constructs analysed in our study.

The second path refers to a better understanding of the activities and mechanisms that support the process of PT. In fact, one could argue that it is hard for an entrepreneur to put himself in the shoes of a user if he himself is not one. More in general, it might be hard to do so if the individual does not have a spontaneous propensity to assume the other’s perspectives. At the same time, one could also consider PT as the outcome of contextual factors. Hence it is not only an innate trait but could also be trained (Shalley and Perry-Smith, 2008). Results in this area are still controversial. While some authors suggest that user PT capabilities can be enhanced through role-playing mechanisms (e.g., Bettencourt and Gwinner, 1996; Szymanski, 1988; Shalley and Perry-Smith, 2008), others demonstrate that PT training does not enhance the effect of cognitive empathy on the ability to absorb customer needs knowledge (Homburg et al., 2009). Hence further investigation into the role of training mechanisms in enhancing the user PT of entrepreneurs might be carried out in order to enrich our current understanding of the possibilities to induce PT processes.

The third path for future research development involves extending PT to other useful actors. As noted by Dean and Snell (1991), PT is useful for modern organizations because traditional boundaries are blurred and the need to collaborate is becoming more salient. This seems to be particularly true in the case of the process of innovation and entrepreneurship where increasingly customers, partners, and networks, are urging firms to adopt a more open and collaborative approach (Chesbrough, 2003; von Hippel, 2005). Indeed, the role of empathy in entrepreneurial cognition goes beyond the absorption of customer knowledge and can relate to other important knowledge sources. A classic distinction in technology entrepreneurship refers to scientists (with a PhD) and managers (with an MBA). Indeed, putting a scientist-entrepreneur in the shoes of a venture capitalist may force him to refine innovative ideas in ways that are more marketable and satisfy market needs. Similarly, entrepreneurs or venture capitalists that want to stimulate entrepreneurship might probably increase opportunity recognition through a PT process that makes them think like a scientist in order to identify and better understand what the real technological opportunities.

Overall, we hope our initial analysis of PT will open doors to further investigation and extensions that can contribute to further developing the complex and fascinating process of opportunity recognition in entrepreneurship research.

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Table 1. Study 1: Control Variables

Control variables	Group 1 ***“Take the perspective of a user”*** (n=46) M(SD)	Group 2 ***“Watch a user”*** (n=52) M(SD)	Differences (ANOVA) F-(p-)value
Extroversion	4.60 (1.32)	4.45 (1.30)	.349 (.56)
Agreeablness	5.03 (.98)	5.07 (.93)	.032 (.86)
Consciousness	5.40 (1.01)	5.38 (1.10)	.016 (.90)
Emotional Stability	5.34 (.98)	5.49 (1.35)	.507 (.48)
Openness to Experience	5.49 (.97)	5.40 (1.18)	.185 (.67)
Innovativeness	4.43 (.97)	4.65 (.80)	1.451 (.23)
Individual PT tendency	5.18 (.93)	5.07 (.89)	.34 (.56)
Entrepreneur. Intentions	4.78 (1.39)	5.06 (1.41)	1.129 (.29)
Lead Userness	2.38 (1.26)	2.29 (1.25)	.601 (.44)
General experience in mountain-bike industry	.00(.00)	.00(.00)	.
Entrepr. experience (or parents') in mb industry	.00 (.00)	.20	1.132 (.29)
Age	28.53 (2.30)	28.66 (2.32)	.071 (.79)
Gender	.69 (.47)	.67 (.48)	.053 (.82)
New venture opened	.21 (.44)	.24 (.43)	.014 (.91)
Being self-owner operator	.14 (.35)	.22 (.42)	1.174 (.28)
Actions taken to open a new venture	.51 (.50)	.51 (.51)	0 (.99)

Table 2. Study 1: Manipulation Check and Findings

	Group 1 (n= 46)	**Group 2 (n= 52)**			**Overall (n=98)**
Manipulation	*"Take the perspective of a user"*	*"Watch a user"*			
Dependent Variables	**Mean (SD)**	**Mean (SD)**	**F-test**	**Signif.**	**Mean (SD)**
Intrinsic Motivations	5.592 (0.665)	4.657 (1.243)	20.742	.000	5.096 (1.113)
Creativity	5.451 (0.610)	4.892 (1.047)	10.072	.002	5.154 (0.910)
Self-Efficacy	5.483 (0.765)	4.490 (1.335)	19.695	.000	4.957 (1.208)

Table 3. Study 2: Control Variables

Control variables	Group 1 *"Take the perspective of an ordinary user"* (n=33) M(SD)	Group 2 *"Take the perspective of a lead user"* (n=39) M(SD)	Differences (ANOVA) F-(p-)value
Extroversion	4.62 (1.86)	4.94 (1.20)	1.232 (.27)
Agreeablness	5.04 (1.03)	5.11 (1.34)	.060 (.81)
Consciousness	5.77 (1.00)	5.45 (1.18)	1.537 (.22)
Emotional Stability	4.59 (1.24)	4.92 (1.31)	1.176 (.28)
Openness to Experience	5.17 (.98)	5.23 (1.26)	.056 (.81)
Innovativeness	4.40 (1.08)	4.66 (1.14)	.924 (.34)
Individual PT tendency	4.63 (.73)	4.80 (.92)	.778 (.38)
Entrepreneur. Intentions	5.30 (1.09)	5.42 (1.43)	.150 (.70)
Lead Userness	1.43 (.94)	1.32 (.75)	.148 (.70)
General experience in mountain-bike industry	.00 (.00)	.05 (.22)	1.681 (.20)
Entrepr. experience (or parents') in mb industry	.00 (.00)	.00 (.00)	.
Age	32.00 (5.77)	30.82 (5.04)	.681 (.41)
Gender	.53 (.50)	.41 (.49)	1.020 (.32)
New venture opened	.133 (.34)	.069 (.25)	.654 (.42)
Being self-owner operator	.13 (.34)	.17 (.38)	.169 (.68)
Actions taken to open a new venture	.40 (.49)	.55 (.50)	1.346 (.25)

Table 4. Study 2: Manipulation Check and Findings

	Group 1 (n= 33)	**Group 2 (n= 39)**			**Overall (n=72)**
Manipulation	*"Take the perspective of an ordinary user"*	*"Take the perspective of a lead user*			
Dependent Variables	**Mean (SD)**	**Mean (SD)**	**F-test**	**Signif.**	**Mean (SD)**
Intrinsic Motiv.	4.894 (1.160)	5.532 (1.442)	4.171	.045	5.234 (1.350)
Creativity	4.436 (1.141)	5.621 (1.112)	6.600	.012	5.307 (1.173)
Self-Efficacy	4.766 (1.226)	5.919 (0.953)	19.868	.000	5.399 (1.222)

APPENDIX

One of the main limitations of this study is recruiting MBAs instead of entrepreneurs for our experiments. Although MBAs could be considered 'novice' entrepreneurs, compared to the more experienced entrepreneurs (Dew *et al.*, 2009) and more likely to start a new business as some empirical evidence on entrepreneurial intentions point out (Kickul *et al.*, 2009; Wilson *et al.*, 2007; Zhao *et al.*, 2005), we tried to verify the persistence of our main effect on a sub-sample composed of real entrepreneurs. We selected the participants who stated in the last control questions that they had been self-employed at least once, had started at least one new venture or taken action to turn their ideas into a new business (n= 50; 76 men, 24 women, mean age 28.5). In other words, from the overall sample we selected participants with experience as entrepreneurs and checked the effect of user PT. Results confirmed our findings, by displaying significant mean differences across the two groups.

Insert Table A1 and A2 about here

We also ran the last analysis, by focusing on the sub-sample of participants who rated high entrepreneurial intentions (n= 54; 37 men, 17 women; mean age 28.7). We selected all the participants with entrepreneurial intentions higher than 4.92 (i.e. the mean of the variable) and tested if the user PT was still significant on the three dependent variables. Even in this case, our hypotheses were confirmed and the means of self-efficacy, intrinsic motivations, and creativity were significantly higher in the user PT group compared to the Watch one.

Insert Tables A3 and A4 about here

Insert Figure A1, A2, A3 about here

Table A1. Control Variables: Sub-sample with Experience as Entrepreneur (Study 1)

Controls	Sum of Squares	Df	Mean Square	F	Sig.
Extroversion	1.194	1	1.194	.641	.427
Agreeableness	.046	1	.046	.054	.817
Consciousness	.584	1	.584	.472	.495
Emotional Stability	.302	1	.302	.231	.633
Openness to Experience	2.549	1	2.549	2.246	.141
Innovativeness	.246	1	.246	.439	.511
Individual PT tendency	.004	1	.004	.005	.946
Entreprenerial Intentions	.009	1	.009	.006	.939
Lead Userness	.631	1	.631	.370	.546
General experience in mountain-bike industry	.000	1	.000	.	.
Entrepr. experience (or parents') in mb industry	1.755	1	1.755	1.085	.303
Age	2.003	1	2.003	.375	.543
Gender	.123	1	.123	.657	.422
New venture openend	.022	1	.022	.083	.774
Being self-owner operator	.271	1	.271	1.189	.281
Actions taken to open a new venture	.022	1	.022	1.085	.303

Table A2. Manipulation Check and Findings: Sub-sample with Experience as Entrepreneur (Study 1)

	Group 1 (n= 24)	**Group 2 (n= 26)**			**Overall (n=50)**
Manipulation	*"Take the perspective of a user"*	*"Watch a user"*			
Dependent Variables	**Mean (SD)**	**Mean (SD)**	**F-test**	**Signif.**	**Mean (SD)**
Intrinsic Motivations	5.635 (.703)	4.711 (1.119)	11.972	.001	5.155
Creativity	5.672 (.661)	4.990 (.961)	8.385	.006	5.317
Self-Efficacy	5.671 (.585)	4.779 (1.334)	9.115	.004	5.207 (1.128)

Table A3. Control Variables: Sub-sample with High Entrepreneurial Intention (Study 1)

Control	Sum of Squares	df	Mean Square	F	Sig.
Extroversion	.169	1	.169	,099	.754
Agreeablness	.015	1	.015	,020	.888
Consciousness	.498	1	.498	,388	.536
Emotional Stability	.476	1	.476	,362	.550
Openness to Experience	.728	1	.728	,867	.356
Innovativeness	.129	1	.129	,184	.670
Individual PT tendency	.150	1	.150	,156	.694
Entrepreneurial intentions	.168	1	.168	,358	.552
Lead Userness	1.190	1	1.190	,783	,380
General experience in mountain-bike industry	.000	1	.000	.	.
Entrepr. experience (or parents') in mb industry	2.357	1	2.357	1,589	.213
Age	.104	1	.104	,022	.884
Gender	.012	1	.012	,053	.819
New venture opened	.059	1	.059	,256	.615
Being self-owner operator	.398	1	.398	2.282	.137
Actions taken to open a new venture	.184	1	.184	.783	.380

Table A4. Manipulation Check and Findings: Sub-sample with High Entrepreneurial Intention (Study 1)

	Group 1 (n= 21)	**Group 2 (n= 33)**			**Overall (n=54)**
Manipulation	*"Take the perspective of a user"*	*"Watch a user"*			
Dependent Variables	**Mean (SD)**	**Mean (SD)**	**F-test**	**Signif.**	**Mean (SD)**
Intrinsic Motivations	5.512 (.673)	4.846 (1.325)	4.536	.038	5,105 (1.157)
Creativity	5.554 (.608)	5.098 (.889)	4.223	.045	5.275 (.817)
Self-Efficacy	5.488 (.718)	4.750 (1.294)	5.686	.021	5.037 (1.568)

Figure A1. Intrinsic Motivations in the Three Subsamples (Study 1)

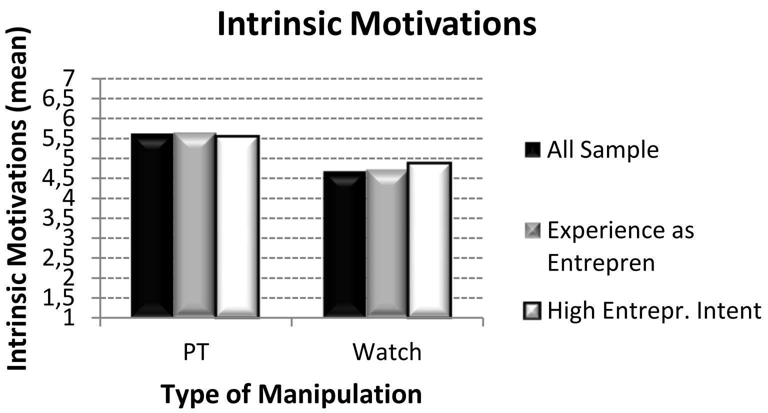

Figure A2. Creativity in the Three Subsamples (Study 1)

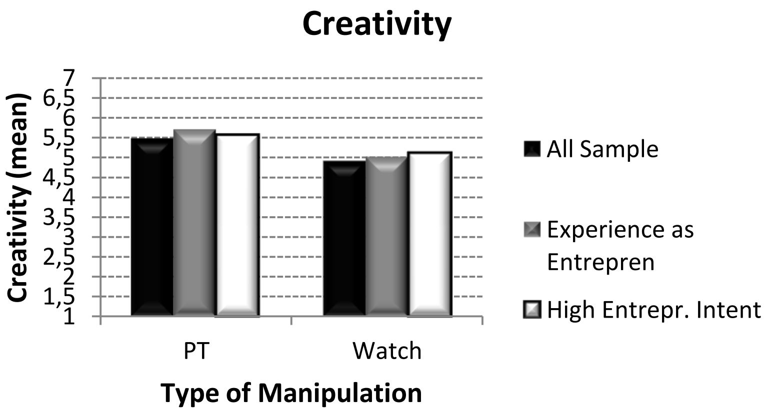

Figure A3. Self-Efficacy in the Three Subsamples (Study 1)