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# Academic entrepreneurship through technology transfer: exploring doctoral students' motivation, social context, and entrepreneurial decision patterns

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**Abstract**
This paper focuses on technology transfer through academic entrepreneurship, exploring how doctoral students' motivations, social context, and institutional environment influence their entrepreneurial decisions to launch a business, thereby contributing to research-driven innovation. Through semi-structured interviews with 28 doctoral students who have launched ventures, this study identifies two distinct entrepreneurial decision-making patterns among doctoral students: the 'inner push', driven by intrinsic motivation and personal ownership of ideas, and the 'social pull', shaped by external influences such as supervisors and peer networks. By examining the interplay of personal and social influences, we advance the understanding of academic entrepreneurship and doctoral students' role in technology transfer. It demonstrates how different patterns encourage entrepreneurial behavior, with an emphasis on the "inner push" from personal motivations. Our findings suggest that universities need to develop support tools to nurture the early stage of doctoral students' entrepreneurial process, starting with the recognition of the importance of their motivations and the social context in which they operate. Creating an environment conducive to technology transfer enables doctoral students to translate research into ventures, contributing to societal progress and economic growth.

**Keywords** Doctoral students · Academic entrepreneurship · Technology transfer · Entrepreneurial behavior · Venture creation · University support

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## 1 Introduction

Academic entrepreneurship is central to how universities drive economic growth by transforming research into science-based innovations (Guerrero et al., 2014; Park et al., 2023; Shane, 2004; Wood, 2011). For this reason, universities' technology transfer policies have focused on mechanisms such as the foundation of academic spin-offs to entrepreneurially exploit academic knowledge and license patents derived by research, mostly led by tenured faculty (Kochenkova & Grimaldi, 2016; Siegel et al., 2003a, b; Fini et al., 2018). Nevertheless, doctoral students, who are involved in cutting-edge research, are increasingly playing a vital role in technology transfer by leveraging their research for ventures beyond academic outputs (Hayter et al., 2017; Muscio et al., 2021; Boh et al., 2016; Klofsten et al., 2021).

For this reason, universities now recognize the importance of fostering entrepreneurship in doctoral education (Klofsten et al., 2021; Rippa et al., 2022). However, the decisions of doctoral students to commercialize research or create ventures are shaped by an interplay of individual-level factors and institutional framework (Feola et al., 2019; Opizzi et al., 2024). Technology transfer mechanisms like policies, funding, and IP regulations are key in shaping doctoral students' action (Guerrero & Urbano, 2019; Poyago-Theotoky et al., 2002), but these mechanisms do not always align with their needs, raising questions about their effectiveness in supporting technology transfer throught PhD-driven entrepreneurship (Bienkowska & Klofsten, 2012). In addition to institutional frameworks, social context (including networks of mentors, peers, and industry actors) plays a significant role in shaping doctoral students' entrepreneurial behavior. Faculty mentorship, exposure to role models, and informal support networks often exert a greater influence than formal institutional structures (Bergmann et al., 2018; Fernández-Esquinas et al., 2016). These networks help students apply their research and view entrepreneurship as a career path (Mason & Brown, 2014). Not less importantly, personal motivation is critical in the technology transfer process, with the desire to address societal challenges and apply research to real-world contexts fueling doctoral students' entrepreneurial intentions (Mars & Moravec, 2022). However, personal motivation or institutional support alone often are not enough without the right combination of both, making it essential to understand how these factors interact to help students contribute to technology transfer through entrepreneurship (Opizzi et al., 2024). While much of the existing research focuses on institutional mechanisms, recent studies suggest that entrepreneurship among doctoral students is more influenced by informal networks and personal motivations than by formal institutional support (Muñoz et al., 2020; Fernández-Esquinas et al., 2016). This challenges the assumption that formal technology transfer mechanisms alone foster innovation, calling universities to adopt technology transfer policies that better align with the needs of early-career researchers (Roncancio-Marin & Guerrero, 2024).

This study explores the dynamics connecting personal motivations, social context, and institutional environment that influence doctoral students' entrepreneurial decisions to contribute to research application by launching a business. In addressing this research purpose, the study is guided by two main questions: *Which (individual-level and context-level) factors affect doctoral students' decision to engage in academic entrepreneurship? Which dynamics explain the interplay of factors that lead doctoral students to engage in academic entrepreneurship?*

To answer these questions, we conducted 28 semi-structured interviews with doctoral students involved in entrepreneurship. Using grounded theory (Gioia et al., 2013), this study

identifies two distinct entrepreneurial decision-making patterns among doctoral students: the 'inner push', driven by intrinsic motivation and personal ownership of ideas, and the 'social pull', shaped by external influences such as supervisors and peer networks.

These findings extend multi-level analyses (e.g., Feola et al., 2019; Opizzi et al., 2024) of academic entrepreneurship by doctoral students, showing that personal motivations and informal support often outweigh institutional mechanisms in doctoral students' entrepreneurial decision-making process. It offers a fine-grained view of how personal, social, and institutional factors influence entrepreneurial engagement by doctoral students and, consequently, their technology transfer trajectories (Bienkowska & Klofsten, 2012).

The article proceeds by discussing the entrepreneurial role of doctoral students, outlining the research design and findings, and concluding with key theoretical and practical implications.

## 2 Theoretical background

Doctoral students are increasingly recognized as significant contributors to the development of academic entrepreneurship, an activity that implies technology transfer through involving the entrepreneurial translation of scientific knowledge into practical applications (Roach & Sauermann, 2010; Treanor et al., 2021). As early-career researchers, doctoral students are at the forefront of scientific discovery, generating ideas and results with the potential for both commercialization and societal impact (Cyranoski et al., 2011; Enders, 2002; Thune, 2009). They are often expected to contribute to the innovation landscape while simultaneously facing growing pressure to explore alternative career paths due to the uncertainty of academic job markets (Baker & Lattuca, 2010; Sweitzer, 2009). The combination of deep disciplinary knowledge and professional uncertainty positions doctoral students in a unique situation: they possess valuable scientific expertise while remaining open to career opportunities beyond traditional academic roles (Pretorius & Macaulay, 2021; Fogelberg & Lundqvist, 2013). This dual aspect of their professional identity makes doctoral students particularly relevant when examining the evolving role of individuals in academic entrepreneurship (Muscio & Kitagawa, 2024; Treanor et al., 2021).

Universities today are tasked not only with producing scientific knowledge but also with contributing to societal and economic development (Guerrero et al., 2016; Hayter et al., 2023; Klofsten et al., 2024). Within this context, technology transfer is increasingly recognized as a process that encompasses a broader set of activities, including networking, training, and enabling researchers to engage with external stakeholders to address societal challenges (Fini et al., 2018; Perkmann et al., 2013; Poyago-Theotoky et al., 2002). As Roncancio-Marin and Guerrero (2024) argue, universities must strengthen their ability to sense opportunities, mobilize resources, and adapt their internal structures to stay relevant and effective in contributing to innovation. This broader mission has significant implications for how doctoral education is designed and supported (Klofsten et al., 2021; Thune, 2009). These expectations have a direct impact on how doctoral students participate in academic entrepreneurship (Muscio & Ramaciotti, 2019), particularly as technology transfer expands beyond commercialization mechanisms traditionally based on academic spin-offs and patents (Bengoa et al., 2021; Siegel & Wright, 2015).

There is a growing interest in doctoral students as academic entrepreneurs within technology transfer research (see Appendix A for a literature review on the topic), with most of the research having tried to understand what shapes their intention to become entrepreneurs. Scholars like Feola et al. (2019); Baena-Luna et al. (2022a, b), for instance, have explored how personal attitudes, educational background, and previous experiences influence students' perceptions of entrepreneurship as a viable career path. Previous entrepreneurial experience and exposure to start-up environments (Erikson et al., 2015) have been identified as key factors that influence the decision to pursue entrepreneurial ventures. However, focusing primarily on individual traits offers a limited understanding of how entrepreneurial action unfolds (Klofsten & Jones-Evans, 2000). The process of creating new ventures is also shaped by institutional frameworks, the availability of support mechanisms, and the nature of the doctoral work environment (Hayter, 2015; Huyghe & Knockaert, 2015). Muscio and Ramaciotti (2019) highlight that university-level factors, such as innovation policies and local collaborations, significantly influence when and how doctoral students engage in entrepreneurship. They found that such factors are closely tied to how technology transfer is practiced and prioritized within the university context.

A second stream of research has addressed the active vs. passive role of doctoral students in the process of venture creation, challenging the assumption that students merely support the initiatives of others and demonstrating that doctoral students have an active role in the entrepreneurial landscape (Rizzo, 2015; Thune, 2009). Some spin-offs originating from research-intensive work have emerged directly from doctoral students' research without significant involvement from faculty members (Boh et al., 2016). In a similar vein, Hayter et al. (2017) point out that doctoral students often serve as catalytic agents in translating research into practical applications. In some cases, the constraints of academic employment or limited funding opportunities have led students to explore entrepreneurship as a means of continuing their research under new organisational forms (Rizzo, 2015).

Finally, another stream of research has looked at the factors affecting doctoral students' decision to engage in entrepreneurial activities. At the individual level, doctoral students bring specialized knowledge, aspirations, and motivations shaped by their academic training (Bienkowska & Klofsten, 2012). At the organisational level, universities influence entrepreneurship through the design of doctoral programs, reward systems, and innovation infrastructure (ibid.). The external environment, encompassing regional economic dynamics, access to finance, and industry collaborations, also plays a crucial role by creating (more or less) favorable conditions for technology transfer through academic entrepreneurship (Bienkowska et al., 2016). Each of these factors influences how doctoral students perceive their role in academic entrepreneurship and how they navigate the broader innovation system (ibid.). In this context, technology transfer is not limited to formal mechanisms such as patents or spin-offs but also includes more subtle forms of engagement, such as the development of new tools, prototypes, or processes that can be adopted by non-academic stakeholders (Klofsten & Jones-Evans, 2000; Mars & Rios-Aguilar, 2010).

A last emerging research stream has examined how the support system of universities (in terms of support provided) impacts the entrepreneurial activities of academic actors, including doctoral students. Siegel et al. (2003a, b) have shown that access to mentors, flexible procedures, and alignment between academic incentives and commercialization goals can make a significant difference in students' entrepreneurial success. Similarly, Roncancio-Marin and Guerrero (2024) argue that universities must reconfigure their support structures

to support more experimental, open, and inclusive forms of technology transfer. When doctoral students are provided with opportunities to collaborate across disciplinary and organizational boundaries, engage with external partners, and address real-world problems, they are more likely to view entrepreneurship as a meaningful part of their academic trajectory (Bienkowska et al., 2016).

Overall, these results suggest that doctoral students' decision to become entrepreneurs is a complex phenomenon, driven by individual and organizational factors, and shaped by institutional expectations, available resources, social connections, and the evolving nature of academic work, all of which can be meaningfully understood through the lens of technology transfer (Bercovitz & Feldman, 2008). However, by reviewing the existing body of knowledge, it is unclear how individual and organizational drivers interact and whether there is or not a prevailing force that causes the PhD career paths from academia to entrepreneurship. For this reason, we argue that more research is needed to investigate how various individual and organizational conditions combine and interact to shape doctoral students' entrepreneurial decision-making, responding to recent calls to observe academic entrepreneurship through a more holistic perspective (Treanor et al., 2021).

In alignment with this call, this study explores the underlying dynamics that characterize the interplay between personal motivations, social context, and university support structures in shaping doctoral students' decisions to engage in academic entrepreneurship. Understanding these dynamics is key for universities facing increased pressure to contribute to societal and economic progress, since doctoral students might have a critical role in realizing these societal goals (Mars & Moravec, 2022; Thune, 2009).

## 3 Research methodology

### 3.1 The context

This research involves students who have been enrolled in Italian doctoral programs at the time of their decision to engage in academic entrepreneurship. As demonstrated by the multiplicity of published research in academic entrepreneurship based on Italian data (e.g., Fini et al., 2020; Muscio & Ramaciotti, 2019; Rizzo, 2015), this empirical context is representative of similar Western countries, since Italy is aligned with the European scenario for its institutional setting (Fini et al., 2020; Muscio et al., 2016). First, the role of universities in fostering innovation has been reinforced by legislative frameworks such as the Italian Law No. 240/2010[1], which, through a university reform, mandated universities to pursue third mission as a priority (Conti et al., 2012); after the enactment of this law, all the universities were obliged to revise their statutes and introduce the third mission among their mission statements (Loi & Di Guardo, 2015). Not less importantly, most Italian universities are endowed with a technology transfer office to support knowledge valorization (Cesaroni & Piccaluga, 2016).

[1] Law No. 240 of 30 December 2010, *Norme in materia di organizzazione delle università*, Gazzetta Ufficiale della Repubblica Italiana No. 10, 13 January 2011. Retrieved from: https://www.gazzettaufficiale.it/gunewsletter/dettaglio.jsp?service=1&datagu=2011-01-14&task=dettaglio&numgu=10&redaz=011G0009&tmstp=1295259517551.

Overall, Italy is propelled by institutional willingness to promote technology transfer from universities. Last report[2] published by the Italian university consortium Netval highlights that all Italian universities are equipped with a technology transfer office, and the personnel employed in these structures was growing in quantity and quality until a few years ago. The existence itself of a formalized partnership between Italian universities, focused specifically on technology and knowledge transfer, denotes that this is a priority not only for each higher education institution but also for regional and national policymakers. Its existence is part of a wider trend towards joining forces to leverage public research, supported by other examples, such as the French Réseau C.U.R.I.E.[3] and the TechnologieAllianz[4] in Germany. Furthermore, data from GEM (Global Entrepreneurship Monitor 2021) support the existence of a favorable institutional setting: the scores obtained by Italy for entrepreneurship education in higher education and research transfer (respectively 4.28 and 3.92) are in line with other comparable European countries, such as France (respectively 5.52 and 4.06) and Sweden (respectively 4.08 and 4.32) - see Table in Appendix B for a comprehensive overview.

Not less importantly, Italy, with the enactment of Law No. 102 on July 24, 2023[5], has aligned with the global trend of transferring initial ownership rights, a shift that began with the Bayh-Dole Act[6] in 1980 in the United States. This paradigm change reshaped technology transfer by granting universities ownership of federally funded research, catalyzing academic entrepreneurship, fostering institutional support systems, and redefining universities' roles in innovation and economic development (Grimaldi et al., 2011). As a result, Italy now represents a comparable context to other European countries that have adopted similar approaches (Geuna & Rossi, 2011).

The entrepreneurial orientation of Italian Ph.D. graduates further underscores this readiness. Italian doctoral education aligns with European trends, with about 31,533 doctoral students in 2021, representing 1% of the population[7]. Recognizing the importance of Ph.D. graduates, policies like Decree Law 179/2012 mandate that at least one-third of shareholders in innovative start-ups hold a Ph.D. However, only 40.9% of Ph.D. holders remain in academia (ISTAT, 2018), and 93.8% of graduates secure employment within a year, signaling that doctoral qualifications open pathways beyond academia (Almalaurea, 2022). Many Ph.D. graduates view entrepreneurship as a viable alternative, as limited tenure-track positions drive them to explore new opportunities (Muscio & Ramaciotti, 2018).

Notably, Italy's experience mirrors broader European and Western trends in academic entrepreneurship. Similar to Italy, countries like Germany, France, and the UK have implemented policies to foster university-industry collaboration and encourage academic spin-

[2] Rapporto Netval 2024. Retrieved on 16.06.2025 from: https://netval.it/rapporti-netval/rapporto-netval-2024.

[3] https://www.curie.asso.fr/.

[4] https://www.transferallianz.de/en/.

[5] Decreto-Legge 18 ottobre 2012, n. 179, convertito con modificazioni dalla Legge 17 dicembre 2012, n. 221, *Ulteriori misure urgenti per la crescita del Paese*, Gazzetta Ufficiale Serie Generale n. 294, 18 dicembre 2012. Retrieved from: https://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2012-12-18&atto.codiceRedazionale=12A13277.

[6] https://www.govinfo.gov/content/pkg/USCODE-2011-title35/html/USCODE-2011-title35-partII-chap18.htm.

[7] Eurostat online database. Retrieved from: https://ec.europa.eu/eurostat/databrowser/view/EDUC_UOE_ENRT01__custom_3910843/default/table?lang=en.

offs (Kochenkova & Grimaldi, 2016). Moreover, as seen in other Western contexts, Italian universities operate within a framework that emphasizes the commercialization of research, often through the establishment of technology transfer offices and incubators (Clarysse et al., 2005). Moreover, structural challenges, such as limited R&D investment by private firms, are also shared with several Southern European nations, making the Italian case particularly relevant for drawing generalizable conclusions (Coccia, 2010). While recognizing potential variations across Italian universities, the data provided above emphasize the readiness of the Italian institutional context to facilitate knowledge transfer from universities through entrepreneurship.

### 3.2 Sampling

The sample comprises 28 entrepreneurs based in Italy who started a process of venture creation during their doctoral studies. As suggested by the most recent guidelines for qualitative research (e.g., Wutich et al., 2024), iterative data collection and coding were conducted to achieve theme saturation. Since research suggests that theme saturation typically occurs within 20–30 interviews to ensure sufficient depth and variability (Wutich et al., 2024; Guest and Johnson 2006), our sample of 28 interviews provides a robust foundation for developing a comprehensive theoretical model.

During data collection, 15 respondents were currently enrolled in a doctoral program, while the remainder had already completed it. Of the total respondents, 16 identified themselves as male, with the remaining 12 as female. Nearly half of the informants ($N=13$) were either currently enrolled or had graduated from universities in central Italy. Conversely, others were affiliated with northern ($N=7$), southern, and insular regions ($N=8$) of Italy.

Not less importantly, respondents represented a broad range of fields, including engineering disciplines (e.g., industrial, communication, and medical engineering), life sciences (e.g., biology, biotechnology, and health sciences), and computer science, as well as social sciences and humanities (e.g., history and archaeology, political science, law, and media and communication). The balance in our sample between STEM disciplines and social sciences and humanities is supported by policy reports (e.g., OECD[8]) and reflects broader national trends in Italy, where STEM fields account for a significant proportion of doctoral graduates. This is also supported by empirical works highlighting that STEM graduates are more likely to engage in entrepreneurial ventures due to the practical applicability of their research and closer university-industry linkages (Muscio et al., 2021). However, the present study aims to explore PhD entrepreneurship in its entirety, without assuming that the phenomenon must be confined (albeit prevalent) to STEM departments. This diversity in academic disciplines ensures that the perspectives of doctoral students and graduates from both STEM and humanities fields are captured, allowing for a nuanced understanding of their entrepreneurial behaviors. This diversity ensures that the perspectives of doctoral students and graduates from both STEM and humanities fields are captured, allowing for a more nuanced understanding of their entrepreneurial behaviors.

See Table 1 for an overview of the sample.

All the interviewees were selected on LinkedIn®, which is recognized for its professional focus, enabling efficient access to highly educated, niche groups like PhD entrepreneurs and

[8] OECD (Organization for Economic Cooperation and Development) - Tertiary graduates by field. Retrieved on January 16th, 2025 from https://www.oecd.org/en/data/indicators/tertiary-graduates-by-field.html.

**Table 1** Description of participants

| RESPONDENT | UNIVERSITY | RESEARCH AREA | AREA (MIUR) | DURATION (min) |
|---|---|---|---|---|
| Riccardo | University of Rome "La Sapienza" | Media and Communication | Center | 30:08 |
| Luca | Politechnical University of Turin | Communication Engineering | North-West | 29:27 |
| Sergio | University of Bologna | Software Engineering | North-East | 51:05 |
| Michele | University of Brescia | Information Engineering | North-West | 25:17 |
| Andrea | University of Cagliari | Environmental Biotechnology | Islands | 49:15 |
| Eraldo | Scuola Normale Superiore in Pisa | Medical Engineering | Center | 18:12 |
| Irene | University of Cagliari | Biological Science | Islands | 61:01 |
| Giulia | University of Rome "La Sapienza" | History and Archeology | Center | 45:37 |
| Danila | University of Salerno | Medical Biotechnology | South | 18:16 |
| Marco | University of Bologna | Industrial Engineering | North-East | 21:26 |
| Antonio | Marche Polytechnic University | Biological Science | Center | 27:41 |
| Marta | University of Genua | History and Archeology | North-West | 20:37 |
| Luigi | Scuola Superiore Sant'Anna | Medical Engineering | Center | 36:54 |
| Mario | Marche Polytechnic University | Electronic Engineering | Center | 18:32 |
| Silvio | University of Cagliari | Telecommunication Engineering | Islands | 45:16 |
| Maurizio | University of Rome "La Sapienza" | Energy Engineering | Center | 47:52 |
| Giada | University of Milan | Veterinary Science | North-West | 25:07 |
| Amelia | University of Rome "Tor Vergata" | History and Archeology | Center | 20:36 |
| Giovanni | Scuola Superiore Sant'Anna | Software Engineering | Center | 35:20 |
| Lavinia | University of Rome - "Roma 3" | Political Science | Center | 38:38 |
| Tommaso | University of Sannio - Benevento | Law | South | 21:27 |
| Francesca | University of Sassari | Biological Science | Islands | 19:19 |
| Ludovica | University of Florence | History and Archeology | Center | 23:27 |
| Chiara | University of Rome - "La Sapienza" | Health Science | Center | 30:11 |
| Emanuele | Marche Polytechnic University | Mechanical Engineering | Center | 19:04 |
| Giorgia | University of Venice "Ca' Foscari" | Law | North-East | 32:14 |
| Serena | University of Cagliari | Computer Science | Islands | 45:00 |
| Mattia | University of Naples - "Federico II" | Industrial Engineering | South | 54:19 |

for its real-time messaging that supports timely and personalized engagement with this specific target (Stokes et al., 2019). This type of e-sampling is particularly useful for accessing hard-to-reach target groups (Chitac & Knowles, 2019). Recent publications have employed similar methods on Facebook® (e.g., Baltar & Brunet, 2012; Chitac, 2023), but we chose LinkedIn® because it provides detailed professional information. We used the keywords *Ph.D.* and *founder*, or *dottorando*[9] and *founder*, through purposive sampling. This approach is recommended in the methodological literature when it is important to carefully select participants to ensure that those with specific characteristics essential for addressing the research objectives are to be included (Palinkas et al., 2015; Campbell et al., 2020). This

[9] Italian for doctoral student.

method enables researchers to intentionally target individuals with direct experience in the phenomenon under study, making it particularly well-suited to qualitative studies exploring nuanced areas, as is the case of entrepreneurship by doctoral students. By focusing on participants with relevant experiences, purposive sampling aligns with the study's aims, allowing for a comprehensive exploration of complex themes (Coyne, 1997; Robinson, 2014). Data collection continued until theme saturation was reached, as suggested in methodological contributions for qualitative research (Tracy, 2020), between December 2021 and March 2022.

### 3.3 Data collection

Interviews are chosen for data collection as this methodology allows participants to freely express their experiences (Barribal & While, 1994; Dulini & Patriotta, 2020). They provide in-depth insights into the roots of entrepreneurial decisions to create a new venture (as supported by methodological literature such as Neergaard & Ulhøi, 2007; Rubin & Rubin, 2011; Tracy, 2020), focusing on specific events to mitigate retrospective bias (Glick et al., 1990; Kriz & Welsh, 2018).

An interview protocol was established by the authors before engaging with the sample (see Appendix C), to align questions and structure with the research goals (Castillo-Montoya, 2016). Each interview commenced with an ice-breaking question prompting informants to discuss their entrepreneurial projects and the decision-making process behind their entrepreneurial behavior. Subsequently, the interviewer delved into the topics outlined in the protocol. All interviews were conducted in Italian via Zoom®, a platform recognized for its efficacy in remote qualitative data collection (Archibald et al., 2019). Interview lengths ranged from 25 to 55 min, and all sessions were digitally recorded with participant consent. Although the duration of the interviews was variable, methodological literature indicates that data quality depends more on the alignment of questions with research goals and the structure of the protocol than on the duration of the interview (Bearman, 2019; Kirkevold & Bergland, 2009). Not less importantly, this argument is supported by recently published works based on interviews of varying duration (e.g., Chen et al., 2024).

### 3.4 Data analysis

The data analysis adopted a narrative approach based on NVivo11® - which is recognized by many scholars, such as Brandão (2015), Kikooma (2010), and Siccama and Penna (2008) as one of the best software for qualitative data analysis. Following the procedure proposed by Gioia et al. (2013), the analysis aimed at discerning meaningful storylines from the informants' experiences and unfolded in three steps:

(i) First-order concepts: Twenty-two meaningful codes were identified from interview transcripts, reflecting informants' shared experiences and highlighting the favorable conditions that shaped their entrepreneurial endeavors. These codes were named descriptively, aligning closely with the interviewees' phrasal descriptors.
(ii) Second-order themes: The concepts were examined to identify specific patterns, and the number of first-order concepts was decreased to a manageable threshold on the basis of

recurring phrasal descriptors. The concepts were then utilized as inputs to obtain a set of seven second-order themes.

(iii) Aggregate dimensions: the authors elaborate on the second-order themes by identifying three theoretical aggregate dimensions: "individual", "context", and "individual-idea nexus".

The first author autonomously conducted the coding procedure, while the second author acted as a confirmability auditor (Lincoln & Guba, 1985). As outlined in Table 2, the coding process adhered to established methodological guidelines for qualitative research (Braun & Clarke, 2006; Gioia et al., 2013; Saldaña, 2021) and was conducted in four key steps: (i) open coding, carried out independently by two researchers to minimize bias; (ii) harmonization meetings, during which the two researchers discussed and refined their coding structures, supported by a third scholar who acted as a confirmability auditor; (iii) iterative refinement to ensure consensus and alignment between researchers; and (iv) the development of a thematic synthesis, organized into first-order concepts, second-order themes, and aggregate dimensions.

Research's trustworthiness is ensured by an authentic interaction with the informants, whose narratives can be trusted based on the relationship created with them (Pratt et al.,

**Table 2** Detailed coding procedure

| | | | |
|---|---|---|---|
| 1. Open coding | Two of the three researchers independently performed open coding to prevent bias and maintain inter-coder reliability<br>Themes and patterns were identified separately, ensuring diverse perspectives in the analysis | Two different (but similar) coding structures, reflecting individual perspectives on the data, ensuring diversity of interpretation | Lincoln and Guba (1985)<br>Saldaña (2021) |
| 2. Harmonization meetings | The initial coding structures were compared and harmonized through two in-person meetings to resolve discrepancies.<br>A third researcher served as a confirmability auditor to ensure the final coding framework was objective and consistent | A unique and harmonized coding structure, ensuring consistency and transparency in data interpretation | Lincoln and Guba (1985)<br>Saldaña (2021) |
| 3. Iterative refinement | The harmonized coding framework was iteratively refined | A refined coding framework | Braun and Clarke (2006)<br>Saldaña (2021) |
| 4. Thematic synthesis | Validated codes were categorized into first-order concepts, second-order themes, and aggregate dimensions<br>This final coding framework provided a clear structure for the study's theoretical development | Finalized coding structure that shows first-order concepts, second-order themes, and aggregate dimensions | Braun and Clarke (2006)<br>Gioia et al. (2013) |

2020). The interviewer and the interviewees were both academics; therefore, the researchers were regarded as peers. Anonymity has been guaranteed by using pseudonyms to identify each informant in the interviews' transcripts and presentation of the results.

## 4 Findings

Three primary findings emerged, which concern: (i) the factors influencing doctoral students' decisions to contribute to research application by engaging in academic entrepreneurship, (ii) the dynamics underlying their decision to engage in academic entrepreneurship, and (iii) the driver(s) of the abovementioned dynamics.

### 4.1 Factors influencing the decision to engage in academic entrepreneurship

As shown in Fig. 1, the emerging coding structure highlights a set of factors that correspond to the aggregated dimensions: (i) the individual, (ii) the context, and (iii) the individual-idea nexus.

#### 4.1.1 The individual

This aggregate dimension reflects the distinctive combination of motivational drivers, prior experiences, and personal backgrounds that shape each individual's trajectory towards entrepreneurship. While the motivations expressed are diverse, a recurring theme is the desire to translate research into broader societal value. For example, Giulia (History and Archeology– University of Rome "La Sapienza") expressed her wish to *'bring to society a unique contribution'*, which illustrates this orientation.

Another influential factor is the perception of academia as an uncertain or limited career path, which motivates some doctoral students to explore alternative avenues. *'The first reason was that I wanted to carve out a chance to go beyond academia; after three years of doctorate, I can say to be aware of the limitations and difficulties of the academic career'* (Antonio– Biological Science– Marche Polytechnic University).

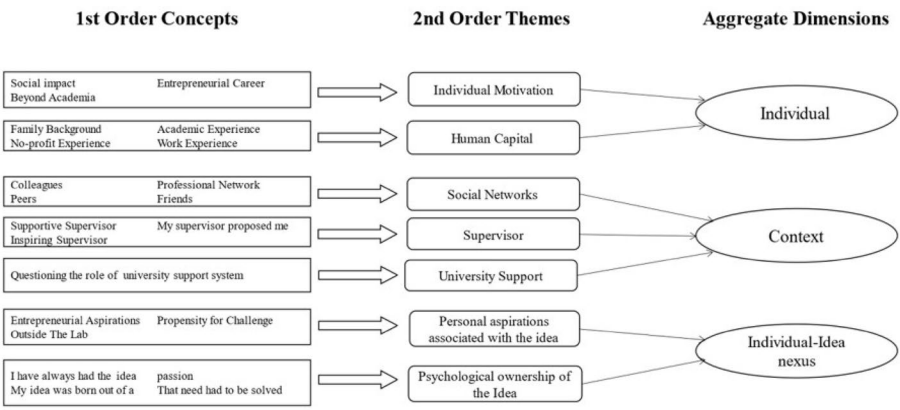


**Fig. 1** Coding structure

Interestingly, some interviewees explicitly stated that their motivation to become entrepreneurs drove them to pursue a doctorate. This perspective positions doctoral experience as a strategic pathway to develop specific competencies and professional networks critical for launching their entrepreneurial ventures. The insight by Riccardo (Media and Communication– University of Rome "La Sapienza") exemplifies this link:

For me, a Ph.D. is a tool for facilitating the possibility of opening a business.

Prior work experience plays an important role in shaping the academic entrepreneurship of doctoral students, providing both valuable skills and opportunities to build partnerships that facilitate their entrepreneurial transition. Giorgia (Law - University of Venice "Ca' Foscari") exemplified this connection, recalling how she met a friend during their fellowship and how, together, they *'started to think about an organization like this one'*. Similarly, prior volunteering experience has proven influential in nurturing their entrepreneurial transition. Sergio (Software Engineering– University of Bologna) shared how co-founding an NGO before starting his Ph.D. provided him with critical soft skills that proved useful in his journey: *'This experience endowed me with several soft skills which have been useful for me'*.

Family background also plays a significant role, as seen in both parents' political involvement– *'My parents had some political experience at the local level*, *and there is a lot of political talk in my house'* (Lavinia– Political Science– University of Rome "Roma 3")—and entrepreneurial experience– '*My father is an entrepreneur*, *and I think it facilitated my mental predisposition to put myself out there'* (Antonio– Biological Science– Marche Polytechnic University). These narratives suggest that personal histories can influence doctoral students' decision to engage in academic entrepreneurship indirectly, by shaping values, attitudes, and predispositions.

Importantly, the ventures initiated by the participants are not always direct extensions of their doctoral research. Instead, they often reflect the cumulative effect of personal experiences (whether professional, voluntary, or familial) that transcend disciplinary boundaries. This underscores the multifaceted and often non-linear nature of doctoral students' paths toward entrepreneurship. Such complexity highlights the importance of analyzing academic entrepreneurship not merely through institutional structures but through the personal trajectories and contexts that inform each individual's decision-making process.

### 4.1.2 The context

Our informants' accounts demonstrated that the surrounding context can be both an obstacle and an enabler for entrepreneurial action. This aggregate dimension is manifested as three second-order themes: the social networks, the supervisor, and the university support. The social networks imply a peer-to-peer relationship with other actors inside and outside the university. Specifically, our interviewees recognize a prominent role for colleagues and friends; thus, the importance of both formal and informal relationships is recognized. The quote below perfectly synthesizes how friends might influence the academic entrepreneurship of doctoral students:

*'We were neighbors*, *therefore a wonderful friendship was born*, *[.]she had a similar idea'* (Amelia– History and Archaeology– University of Rome "Tor Vergata").

The influence of the supervisors, although multifaceted, appears to be significant for the academic entrepreneurship of doctoral students. Supervisors come into play in three main ways (Fig. 2). In the first scenario, they provide tangible or intangible support for an essentially individually driven process. In the second scenario, the supervisors act as sources of inspiration, while in the third case, they are the most determinant push factor toward academic entrepreneurship of doctoral students.

Despite this, most informants reported limited or passive engagement with institutional support systems. Rather than catalyzing their ventures, university structures were often perceived as disconnected from their specific needs or timelines. For example, Marco (Industrial Engineering– University of Bologna) remarked: *'Everything came from me. The university setting didn't hinder me*, *but it didn't support me either'* (Marco– Industrial Engineering– University of Bologna). This evidence emerges consistently, regardless of the research area to which the interviewed doctoral students belong (i.e., STEM, social sciences, or humanities). As a result, our data converged on a unique first-order concept that describes how university support affects doctoral students' entrepreneurial journey, labelled as entrepreneurial support from the university. Strikingly, university infrastructures such as incubators or start-up competitions were rarely the early cradle of doctoral students' decision to engage in academic entrepreneurship. Instead, they played a confirmatory or marginal role, often accessed after the venture concept was already developed. For instance, Michele noted that their idea was "too niche" to be supported, illustrating a gap between generic institutional offerings and the specificity of doctoral research ventures. Francesca's experience echoed this sentiment:

> *'University incubators were not useful for the creation of the start-up […] we were incubated when we already were a company'* (Francesca– Biological Science– University of Sassari).

Moreover, some participants highlighted exclusionary features in university programs that disproportionately favored technological ventures. Giorgia, whose motivation centered on leveraging legal expertise for social impact, noted:

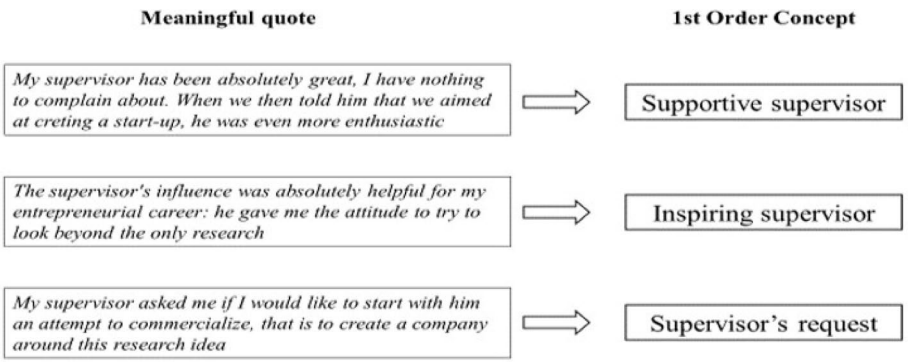


**Fig. 2** Different role of the supervisor in doctoral students' entrepreneurial transition

*'These courses are too focused on science disciplines, and they leave out all those who do not come from that world. That's why I didn't finish that course'* (Giorgia– Law– University of Venice "Ca' Foscari").

These narratives collectively suggest that, while doctoral students do not operate in isolation, the institutional context (particularly university-based entrepreneurship support) is often misaligned with their specific trajectories. This raises important considerations for technology transfer policies that rely on formal infrastructure as the primary enabler of early-stage academic entrepreneurship.

#### 4.1.3 Individual-idea nexus

The analysis highlighted a third aggregate dimension that describes the nexus between the entrepreneurs and the idea behind their action, which is formed of two second-order themes: the psychological ownership of the idea and doctoral students' personal aspirations associated with the idea.

Psychological ownership is the mental condition in which entrepreneurs believe that their idea is 'theirs' (Pierce et al., 2001), serving as an indicator of how closely they identify with and feel connected to their idea. It is formed of three first-order concepts that represent (i) doctoral students' conviction of having had the idea a long time before their entrepreneurial action took place (i.e., before founding a new organization), (ii) the link between the entrepreneurial idea and doctoral students' passion for that topic, and (iii) Ph.D. entrepreneurs' awareness that a specific need had to be addressed.

Our findings reveal a spectrum of psychological ownership among participants. For some, the idea was a natural extension of long-standing interests and convictions. For others, it was more circumstantial, shaped by external input or opportunity. Riccardo (Media and Communication– University of Rome "La Sapienza"), for instance, showed strong ownership: *'There has always been the idea of a business start-up in this field'*.

The narrative of Serena (Computer Science– University of Cagliari) is a completely opposed example, having weak psychological ownership. She has been involved in an entrepreneurial project to exploit a specific research result, which appeared to be promising. However, as she claimed, she would never have had the idea without the supervisor's insistence– *'If he [i.e., my supervisor] had not insisted, I would never have done it*.

Personal aspirations form the last second-order concept, being the intrinsic reason why doctoral students decided to leverage one business idea and not another. In this vein, the need that entrepreneurs feel to not stay just within academia is meaningful. Such aspirations help explain why students may choose to engage in entrepreneurship even when their academic trajectory does not overtly lead in that direction. Andrea (Environmental Biology– University of Cagliari) noted:

I've always been interested in being an entrepreneur, and in having an impact on my local area.

The propensity to look outside the lab is another element that moved entrepreneurs to make an effort to assess whether their research might solve any kind of social or economic issue

by constantly looking outside the laboratory they were working in, and being aware of what priorities deserve to be addressed. This aspect is highlighted by Danila's account:

> *'We had already analyzed the problems*, *and the issues related to the circular economy were already in our minds– more specifically*, *the problem of food waste'* (Danila– Medical Biotechnology– University of Salerno).

### 4.2 The dynamics underlying doctoral students' decision to engage in academic entrepreneurship

Looking at the interaction among the key factors, we identified two general patterns that characterize doctoral students' decision-making process towards academic entrepreneurship. These patterns reflect the relative influence of individual agency versus contextual forces.

The first is the "inner push" pattern, where individual-level motivations emerge as the dominant drivers of entrepreneurial behavior, and the surrounding context, including supervisory or institutional inputs, plays a secondary role. This pattern is marked by a strong desire to generate societal impact through research and by a conscious pursuit of career alternatives beyond academia. What distinguishes this dynamic is not only the presence of motivation but its deep alignment with the individual's broader life orientation. The narrative by Serena (Computer Science– University of Cagliari) illustrates this dynamic. Her motivations were rooted in a desire to create impact with her expertise, underpinned by formative personal experiences. Similarly, Amelia (History and Archaeology– University of Rome "Tor Vergata") reflects a value-driven outlook that reinforces this "inner push":

> I feel bad if I have to stay only within academia. Especially since I deal with contemporary issues in my research, I firmly believe that the most sensible thing for me is to put my knowledge to use.

In contrast, the "social pull" pattern emerges when contextual elements, especially supervisors or peer networks, play a central role in guiding or initiating the entrepreneurial process. In these cases, doctoral students are often invited into ongoing projects or encouraged by mentors to pursue opportunities they had not independently conceptualized. While individual motivations are not entirely absent, they tend to be secondary and more career-oriented than purpose-driven. Silvio's (Telecommunication Engineering– University of Cagliari) experience exemplifies this pattern. His venture was catalyzed primarily by his supervisor's initiative and by the needs expressed by external stakeholders:

> *'The supervisor has been the driving force for everything'*, he remarked. Nonetheless, an individual aspiration for collaborative work remained: *'The idea of bringing together a group of people working in a coordinated way to achieve a common goal [.]'* is something that has always fascinated him.

In both dynamics, university-based entrepreneurial support structures appear to play a limited role. Technology transfer offices and incubators are rarely described as foundational. Rather, they tend to engage with students' ventures at more advanced stages, often serving

as validation platforms rather than initiators. This is illustrated by Michele's experience (Information Engineering– University of Brescia):

> *'We tried to propose ourselves at an accelerator run by the university, but we immediately realized that it was not useful for us because we were too niche'.*

Similarly, Francesca (Biological Science– University of Sassari) emphasized the belated utility of such institutional mechanisms:

> *'University incubators were not useful for the creation of the start-up […] we were incubated when we already were a company'.*

These observations reinforce the notion that while universities may provide structural resources, the initial entrepreneurial momentum often arises either from within the individual or through proximate social influences (particularly from supervisors) rather than through formal institutional channels.

### 4.3 The driver(s) of the underlying dynamics

In interpreting the results, it was evident that the nexus between the individual and the entrepreneurial idea was a critical issue that differentiated the "inner push" pattern from the "social pull" pattern (see Fig. 3).

When this nexus is strong, meaning that the individual deeply identifies with the idea, has nurtured it over time, or sees it as tightly linked to their personal values, the "inner push" dynamic tends to dominate. In such cases, the decision to engage in entrepreneurship stems from a strong personal drive, with the individual dimension acting as the principal force shaping entrepreneurial behavior. Conversely, when the nexus is weak—such as when the idea is externally introduced or only loosely connected to personal aspirations—the "social

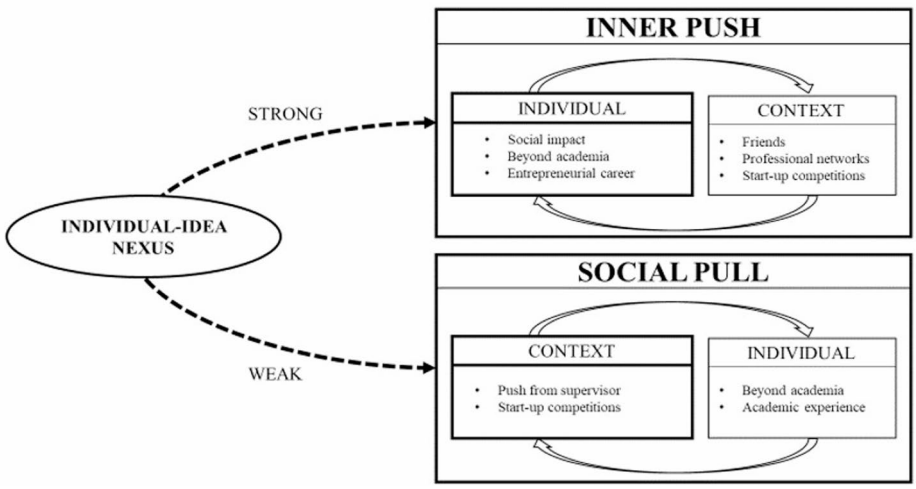


**Fig. 3** The two patterns of doctoral students' entrepreneurial transition

pull" pattern emerges. Here, the decision to pursue entrepreneurship is primarily shaped by contextual influences, especially the involvement or encouragement of supervisors.

Crucially, this distinction helps clarify how entrepreneurial trajectories are formed—not simply as a product of isolated motivation or support, but through the interaction between personal commitment and idea ownership. Regardless of the strength of the nexus, however, university support appears to be a marginal factor across both patterns. The entrepreneurial journey is most often navigated through the interplay of individual agency and proximal social influences, particularly supervisory relationships.

Figure 4 illustrates this dynamic through two contrasting examples: Irene (Biological Science– University of Cagliari) and Marta (History and Archeology– University of Genoa). Irene demonstrated a strong individual-idea nexus, expressing a clear aspiration to translate research into societal benefit:

> I would have always liked to be able to valorize that research to make it available for society.

Her motivation was intrinsically driven, as she noted:

> The idea of going outside the research environment to make this new technology usable for others inspired me.

In her case, the supervisor and research group provided passive encouragement - *'Both the supervisor and the research team enjoyed my entrepreneurial idea*, *and they supported us'* - but were not instrumental in the initiation. University support was similarly limited in the early stages, although later participation in a start-up competition helped validate the initiative.

On the other hand, Fig. 5 exposes Marta's journey towards creating her academic spin-off. She showed a weak nexus with the entrepreneurial idea– *"I was interested in the topic I was studying*, *but I was not considering leveraging it entrepreneurially"*. As a result, the suggestion of starting a spin-off originated from her supervisor– *"When he– i.e.*, *the supervisor– proposed this opportunity*, *I thought of starting a spin-off"*. Consequently, the indi-

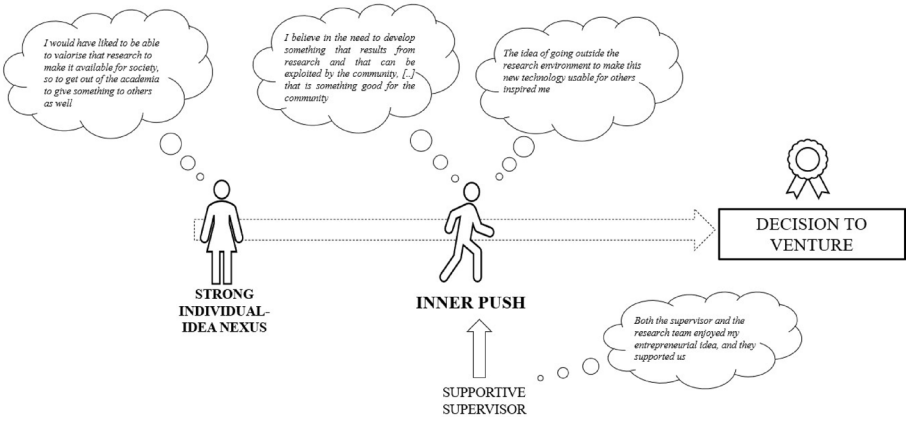


**Fig. 4** Meaningful example of "inner push" (Irene)

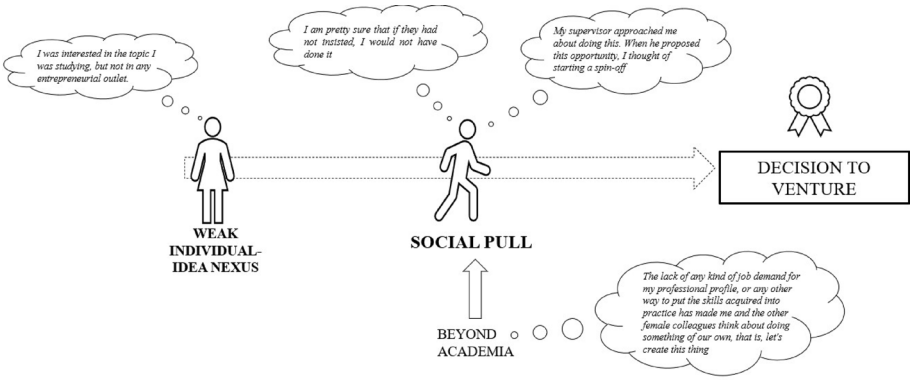


**Fig. 5** Meaningful example of "social pull" (Marta)

vidual dimension has been overall marginal in her entrepreneurial journey. Unlike Irene, Marta's entrepreneurial endeavor did not come from a personal motivation but rather from external encouragement, and she did not mention the support from the university as having any utility in her entrepreneurial journey. Instead, her path was significantly shaped by the guidance and encouragement of her supervisor, highlighting a different dynamic where external influence played a crucial role.

## 5 Discussion

This study focused on doctoral students as key entrepreneurial actors in the implementation of technology transfer activities. The findings highlighted that doctoral students' decision-making process towards academic entrepreneurship is realized through two distinct patterns: the "inner push", driven by personal motivation, and the "social pull", shaped by relational influences - most notably supervisors and peer networks. These patterns underscore the interplay between micro-level agency and macro-level institutional structures in shaping doctoral students' entrepreneurial decision-making. While the 'inner push' pattern highlights individual motivations and human capital, the 'social pull' dynamic reflects how institutional actors (especially supervisors) activate entrepreneurial pathways. This interplay suggests that technology transfer should not be viewed solely as a policy or institutional function, but as a relational process shaped by how individuals navigate and respond to institutional environments (Opizzi et al., 2024).

Overall, this study has four theoretical implications. First, by centering on doctoral students, it enriches the understanding of their active and agentic role as potential academic entrepreneurs. Unlike prior studies that have often portrayed them as peripheral actors (e.g., Hayter et al., 2017; Rizzo, 2015), our findings underscore their capacity to initiate and shape entrepreneurial ventures independently, thus extending research on student-led innovation within universities. Second, we unpack the dynamic interplay between individual and contextual factors, revealing that their relative importance varies depending on doctoral students' psychological ownership of their idea. This perspective enriches debates in the literature that have reported contrasting findings on the role of institutional support (e.g.,

Bienkowska et al., 2016; Muscio & Ramaciotti, 2019), by showing that these elements are contingent on doctoral students' relationship with their entrepreneurial idea.

Third, diverging from the prevalent focus on entrepreneurial intentions (e.g., Erikson et al., 2015; Feola et al., 2019), our study investigates actual entrepreneurial behavior, engaging with doctoral students who have launched ventures. This behavioral orientation allows us to more accurately capture the complexity of entrepreneurial decision-making processes, thereby advancing research that seeks to understand entrepreneurial actions rather than intentions alone. Finally, and in line with the previous point, our findings delineate fine-grained patterns of entrepreneurial behavior, identifying underexplored antecedents such as the role of the supervisor and prosocial motivation.

### 5.1 Theoretical implications

This work offers two key theoretical contributions. First, it enhances the understanding of the role of doctoral students in academic entrepreneurship as claimed in recent research (Hayter et al., 2017) by investigating factors such as university policies, peer networks, and supervisor's support, and uncovering the multi-level dynamics influencing their decisions to engage in entrepreneurial activities. This approach provides deeper insights into the decision-making processes that lead doctoral students to engage in entrepreneurial activities. By doing so, the study shows that doctoral students, driven by personal motivations and shaped by institutional environments, are not passive participants but active agents of innovation.

Second, this study contributes to the body of knowledge on entrepreneurial universities by shedding new light on the role of university support, as claimed by recent research (Muscio & Kitagawa, 2024). We critically re-evaluate the role of entrepreneurial support as it is currently designed for doctoral students. Our findings indicate that doctoral students, irrespective of their field of study, make limited use of university-provided support structures, such as technology transfer offices. When they do engage with these resources, it typically occurs at a later stage of the entrepreneurial process, which is primarily initiated by individual motivations and influenced by their social context.

Ultimately, our findings extend recent conceptualizations of academic entrepreneurship (e.g., Feola et al., 2019; Guerrero & Urbano, 2019; Bienkowska & Klofsten, 2012) by proposing a multi-level framework that considers both individual-level and organizational-level factors while keeping a solid focus on doctoral students as entrepreneurial agents within universities.

### 5.2 Limitations and future research

This study is not without limitations, and it opens avenues for future research on technology transfer through academic entrepreneurship by doctoral students. First, the research is situated exclusively within the Italian context, which may limit the transferability of findings. Italy's academic and entrepreneurial landscape is characterized by distinctive institutional features, such as mandated technology transfer frameworks and formalized support mechanisms for doctoral students. To build a more nuanced and generalizable understanding of PhD entrepreneurship, future studies should investigate how doctoral students engage with technology transfer across varied national settings, both within and beyond Europe. Comparative research could illuminate cross-cultural differences and commonalities by examin-

ing university support systems, entrepreneurial ecosystems, and socio-economic factors that shape PhD entrepreneurship globally.

Second, the study is based on 28 semi-structured interviews. While data collection was guided by the principle of theme saturation (Wutich et al., 2024; Guest and Johnson 2006), that is widely recognized in qualitative research as sufficient for capturing core themes considering that the goal is not to reach statistical generalizability but rather theory building through its in-depth understanding, we acknowledge that the sample size may nonetheless constitute a limitation. That said, we encourage future research to engage with larger and more heterogeneous samples to enrich the empirical basis for understanding PhD entrepreneurship. Third, participant recruitment relied solely on LinkedIn®, which may have introduced selection bias. This approach potentially overrepresents individuals who are active in professional digital spaces, thereby excluding PhD entrepreneurs who operate informally or do not publicly disclose their ventures. Future studies may benefit from using complementary recruitment strategies, such as snowball sampling or collaborations with university incubators and entrepreneurship centers.

Finally, although our sample is diverse in terms of disciplinary backgrounds and reflective of the broader national academic landscape, we did not explicitly analyze interdisciplinary differences or the distinct characteristics of academic entrepreneurship ecosystems across universities. These institutional variations could significantly influence doctoral students' entrepreneurial pathways. Additionally, future research could explore how individual and contextual factors, particularly the role of digital transformation and emerging technologies (e.g., AI-driven incubation platforms, virtual mentoring networks), are reshaping the entrepreneurial experiences and strategic orientations of doctoral students.

### 5.3 Practical implications

This study provides actionable insights for universities, policymakers, and ecosystem actors seeking to foster entrepreneurial behavior among doctoral students. First, the identification of distinct entrepreneurial patterns (i.e., the "inner push" and the "social pull") highlights the need for differentiated support strategies. Universities should design flexible mechanisms that accommodate diverse entrepreneurial trajectories, tailoring support not only to individuals' motivational profiles but also to the stage of venture development.

Second, our findings underscore the critical influence of supervisors and the quality of mentorship on entrepreneurial outcomes. Institutions should invest in training and incentivizing academic supervisors to actively support and guide doctoral entrepreneurship. This may include incorporating entrepreneurial mentorship into evaluation metrics and fostering co-creation opportunities between doctoral candidates and faculty.

Third, the recognition of pro-social motivation as a driver of academic entrepreneurship calls for a rethinking of valorization strategies. Universities and technology transfer offices should broaden their understanding of value creation beyond economic returns to include societal impact, thus making entrepreneurial pathways more attractive and legitimate for mission-driven PhD candidates.

Lastly, by focusing on actual entrepreneurial behavior rather than mere intentions, our findings advocate for a stronger integration of experiential learning within doctoral programs. Embedding entrepreneurship in doctoral curricula through hands-on projects, incuba-

tor access, and interdisciplinary collaboration can significantly enhance the entrepreneurial capacity of universities and contribute to more robust knowledge transfer mechanisms.

## Appendix A

Literature review on the early stage of doctoral students' entrepreneurship.

| Articles | Why studying doctoral students | Research results | Future research |
|---|---|---|---|
| Baena-Luna et al., (2022). To what extent are PhD students intrapreneurs? A study from a gender perspective. *Strategic Change*, *31*, 211–218. | Doctoral students have high potential as specialized workers beyond academic career | They demonstrated the existence of a gender difference (females vs. male) along all the elements of doctoral students' intrapreneurial intentions | Further research on university factors affecting doctoral students' intrapreneurial intentions<br>To dig deeper into how public policy might affect P.h.D. entrepreneurship |
| Bienkowska et al., (2016). PhD Students in the Entrepreneurial University - Perceived Support for Academic Entrepreneurship. *European Journal of Education*, *51*(1), 56–72. | Doctoral students conduct a large part of university research, and they are the new generation of academics<br>Because of their increasingly positive attitude towards industry collaborations, doctoral students are a promising bridge between university and industry | The perception of university support changes depending on faculties and hierarchical level<br>Collaboration with industry positively affects doctoral students' perception of support | The role of research team and supervisor on doctoral students' entrepreneurial process should be studied further<br>The multifaceted role of university policies at different levels should be investigated |
| Boh, W.-F., De-Haan, U., & Strom, R. (2016). University technology transfer through entrepreneurship: faculty and students in spinoffs. *The Journal of Technology Transfer*, *41*(4), 661–669. | Student entrepreneurship (not precisely defined) plays a vital role on for technology transfer<br>Doctoral and post-doctoral students are strategic (co) players of spin-off<br>University spin-offs are concrete career options for doctoral students (oversupply of PhD graduates) | Four different entrepreneurial pathways are identified, three of which involve doctoral students<br>While university spin-offs might emerge from partnerships between faculties and doctoral students, there is also the case of pure initiative arising from doctoral students<br>By implementing entrepreneurship ecosystems, universities can encourage doctoral students to consider entrepreneurship as viable and appealing career option | Three main tools to foster spin-off development are identified, that are suggested to be studied in future research: (i) Fostering the fit of the aims of the university, TTO, faculty, and doctoral students; (ii) exploiting universities' resources for technology transfer; (iii) Encourage doctoral studentsl students to consider technology commercialization by means of spin-off as a viable career option |

| Articles | Why studying doctoral students | Research results | Future research |
|---|---|---|---|
| Dooley, L., & Kenny, B. (2015). Research Collaboration and Commercialization: The PhD Candidate Perspective. *Industry and Higher Education*, *29*(2), 93–110. | Doctoral students have an important role in knowledge transfet, due to the fact that some of them will not work inside the academia, thus valorizing their specific competencies in the industry<br>They might contribute to reinforcing the link between universities and industry<br>Having less commitment compared to tenured academic staff, they are more likely to entrepreneurially exploit their knowledge | Overall, doctoral students have positive attitudes towards research commercialization<br>Family background positively affects doctoral students' attitudes towards research commercialization | |
| Erikson, T., Knockaert, M., & Foo, M. Der. (2015). Enterprising scientists: The shaping role of norms, experience and scientific productivity. *Technological Forecasting and Social Change*, *99*, 211–221. | Doctoral students are studied jointly with postdoctoral researchers as promising academic entrepreneurs | Previous start-up experience positively affects doctoral students' and postdoctoral researchers' enterprising aspirations (start-up aspirations)<br>Enterprising norms do not affect their enterprising aspirations (start-up aspirations) | Investigating further the individual and organizational determinant behind young scientists' entrepreneurial aspirations |
| Feola, R., Vesci, M., Botti, A., & Parente, R. (2019). The Determinants of Entrepreneurial Intention of Young Researchers: Combining the Theory of Planned Behavior with the Triple Helix Model. *Journal of Small Business Management*, *57*(4), 1424–1443. | Doctoral students conduct a significant portion of university research<br>They show a propensity to interact with industry<br>Doctoral students as "**natural channels**" for knowledge transfer processes | University support fosters doctoral students' entrepreneurial intentions through attitudes toward entrepreneurship<br>Industrial and financial support affects their entrepreneurial intentions<br>The predictors of TPB (attitudes, perceived behavioral control, social norms) influences doctoral students' entrepreneurial intentions | Testing the models on a wider sample of doctoral students<br>Considering the role of culture in the formation of doctoral students' entrepreneurial intentions<br>An in-depth investigation of the dynamics throught which university support system affects the formation of doctoral students' entrepreneurial intentions |
| Hayter, C. S., Lubynsky, R., & Maroulis, S. (2017). Who is academic entrepreneur? The role of graduate students in the development of university spinoffs. *The Journal of Technology Transfer*, *42*(6), 1237–1254. | Students are more likely to create new ventures than faculty<br>They are heavily involved in the development and running of university spin-offs<br>Doctoral students have a "**catalytic role**" in academic entrepreneurship | Doctoral students are leading players in the early stage of the spin-off emergence process, as well as in spin-off growth (they are the more active players in university spin-off lauch)<br>Doctoral students face struggles associated with their academic and entrepreneurial role, mostly due to conflicts with tenured faculty | Further inquiry on success factors of student entrepreneurship (with a main focus on doctoral students)<br>More research on the role of doctoral students as entrepreneurs **beyond spin-offs affiliated with universities** |

| Articles | Why studying doctoral students | Research results | Future research |
|---|---|---|---|
| Klofsten et al., (2021). Teaching science and technology PhD students in entrepreneurship - potential learning opportunities and outcomes. *The Journal of Technology Transfer*, *46*(2), 319–334. | Doctoral students are one of the largest targets of researchers, as well as a highly produtive target<br>They are future tenured scholars whose actions will affect knowledge production and valorization in the next future | Doctoral students' attitudes towards entrepreneurship largely depend on the social norms of their research group (supervisors have great influence in this sense)<br>Close peers and co-workers might significantly affect doctoral students' entrepreneurial attitudes and behaviors<br>Boundary-spanning initiatives are vital for doctoral students to breack their isolation and become more entrepreneurial | n/a |
| Muscio and Ramaciotti (2019). How does academia influence Ph.D. entrepreneurship? New insights on the entrepreneurial university. *Technovation*, *82–83*, 16–24. | Doctoral students are more motivated than tenured faculties to create new ventures, although the new ventures are less likely to be university spin-offs (they are younger and more propense to risk)<br>PhD entrepreneurship has a promising effect on local development (it is an effective tool of university third mission)<br>doctoral students are more likely than faculty to overcome the hurdles inherent in the entrepreneurial process | More emphasis on the institutional-level factors that affect Ph.D. entrepreneurship<br>Longitudinal study to test the causal relationship between variables | University-level and course-level factors positively affect Ph.D. entrepreneurship.<br>• The factors are: (i) entrepreneurial environment; (ii) a university policy specifically devoted to entrepreneurship; (iii) applicability of Ph.D. research to the market; (iv) collaboration with industry as part of the Ph.D. program; (v) existence of entrepreneurship courses during Ph.D. |
| Muscio, A., & Vallanti, G. (2022). The gender gap in Ph.D. entrepreneurship: How do students perceive the academic environment? *PLoS ONE*, *17*(4 April), 1–15. | Doctoral students are more motivated than tenured faculties to create new ventures<br>They are younger, more risk propense, and have a relatively short job contract which makes them less constrained that tenured faculty<br>They do not need a "**genetic mutation**" to perform well in entrepreneurship<br>Ph.D. entrepreneurship is vital for generating knowledge-based ventures and driving knowledge-based local growth | Women face greater constrain than men in founding a new venture<br>The main driver of female doctoral students' entrepreneurial initiatives is having the possibility to work in a gender-balanced environment in which they can find same-sexed role models and peers | To dig deeper into the causes of gender gap in Ph.D. entrepreneurship |

| Articles | Why studying doctoral students | Research results | Future research |
|---|---|---|---|
| Rizzo (2015). Why do scientists create academic spin-offs? The influence of the context. *The Journal of Technology Transfer*, *40*, 198–226. | In general terms, doctoral students are promising academic entrepreneurs beside tenured faculty (institutional theory, self-efficacy theory and human capital theory) | Doctoral students (and graduates) might be pushed towards entrepreneurship by the constraints of the institutional environment | Extending the research to other institutional settings to further explore the relationship between the institutional factors (mostly constrains) and academics' entrepreneurial motivations<br>Disentangling the multi-level contingencies behind doctoral students' behind academics's entrepreneurial action |

## Appendix B

Overview of European countries in terms of entrepreneurship education and R&D transfer[10]

| Economy | Post-school entrepreneurial education and training | *R*&D transfer |
|---|---|---|
| Austria | 3.82 | 4.38 |
| Canada | 4.84 | 4.73 |
| Croatia | 3.77 | 3.36 |
| Cyprus | 4.34 | 3.91 |
| France | 5.52 | 4.06 |
| Germany | 4.92 | 4.90 |
| Greece | 4.02 | 4.93 |
| Hungary | 4.38 | 4.42 |
| **Italy** | **4.28** | **3.92** |
| Latvia | 5.22 | 4.98 |
| Lithuania | 5.36 | 5.31 |
| Luxembourg | 5.49 | 4.94 |
| Netherlands | 5.90 | 5.51 |
| Norway | 5.46 | 4.55 |
| Poland | 3.06 | 2.83 |
| Romania | 4.72 | 3.29 |
| Serbia | 3.53 | 3.88 |
| Slovak Republic | 4.16 | 3.23 |
| Slovenia | 4.55 | 4.10 |
| Spain | 5.12 | 3.39 |
| Sweden | 4.08 | 4.32 |
| Switzerland | 5.68 | 6.02 |
| United Kingdom | 4.87 | 4.28 |

[10] Source: Global Entrepreneurship Monitor.

## Appendix C

**Interview protocol**.

1. **Introduction**:

- The researchers introduce themselves and the research project and explain the purpose of the interview.
- The researchers obtain consent to record the interview.

2. **Introduction of the Informant**:

- The informant is asked to briefly introduce themselves, including their name, academic background, and current research focus.

3. **Entrepreneurial Idea (Warm-Up)**:

- The informant is asked to describe their entrepreneurial idea.

4. **Decision to Become Entrepreneur**:

    - The informant is asked to describe in detail the process behind their decision to venture into entrepreneurship and which factors have influenced it, including:

        – Individual factors.
        – Social factors.
        – Institutional factors/university support.

5. **Follow-Up Questions**:

    - The informant is asked to elaborate on any challenges faced during this decision-making process.
    - The informant is asked how their academic research contributed to their entrepreneurial idea.

6. **Conclusion**:

- The participant is thanked for their time and insights;
- The participant is asked if they have any additional comments or thoughts they would like to share;
- The researchers inform the participant about the next steps in the research process and how the findings will be used;

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## References

Almalaurea, C. I. (2022). Condizione Occupazionale dei Dottori di Ricerca.

Archibald, M. M., Ambagtsheer, R. C., Casey, M. G., & Lawless, M. (2019). Using zoom videoconferencing for qualitative data collection: Perceptions and experiences of researchers and participants. *International Journal of Qualitative Methods*, *18*, 1–8. https://doi.org/10.1177/1609406919874596

Baena-Luna, P., Sánchez-Torné, I., Pérez-Suárez, M., & García-Río, E. (2022a). To what extent are phd students intrapreneurs? A study from a gender perspective. *Strategic Change*, *31*, 211–218. https://doi.org/10.1002/jsc.2490

Baena-Luna, P., Peña-Legazkue, I., & Sánchez-Preciado, S. (2022b). University entrepreneurial ecosystems and students' entrepreneurial intentions. *International Entrepreneurship and Management Journal*, *18*(1), 123–146.

Baker, V. L., & Lattuca, L. R. (2010). Developmental networks and learning: Toward an interdisciplinary perspective on identity development during doctoral study. *Studies in Higher Education*, *35*(7), 807–827. https://doi.org/10.1080/03075070903501887

Baltar, F., & Brunet, I. (2012). Social research 2.0: Virtual snowball sampling method using Facebook. *Internet Research*, *22*(1), 57–74. https://doi.org/10.1108/10662241211199960

Barribal, K. L., & While, A. (1994). Collecting data using A semi-structured interview: A discussion paper. *Journal of Advanced Nursing*, *19*, 328–335. https://doi.org/10.1111/j.1365-2648.1994.tb01088.x

Bearman, M. (2019). Focus on methodology: Eliciting rich data: A practical approach to writing semi-structured interview schedules. *Focus on Health Professional Education: A Multi-Professional Journal*, *20*(3), 1–11.

Bengoa, A., Maseda, A., Iturralde, T., & Aparicio, G. (2021). A bibliometric review of the technology transfer literature. *The Journal of Technology Transfer*, *46*(5), 1514–1550. https://doi.org/10.1007/s10961-019-09774-5

Bercovitz, J., & Feldman, M. (2008). Academic entrepreneurs: Organizational change at the individual level. *Organization Science, 19*(1), 69–89. https://doi.org/10.1287/orsc.1070.0295

Bergmann, H., Geissler, M., Hundt, C., & Grave, B. (2018). The climate for entrepreneurship at higher education institutions. *Research Policy, 47*(4), 700–716. https://doi.org/10.1016/j.respol.2018.01.018

Bienkowska, D., & Klofsten, M. (2012). Creating entrepreneurial networks: Academic entrepreneurship, mobility and collaboration during PhD education. *Higher Education, 64*(2), 207–222. https://doi.org/10.1007/s10734-011-9488-x

Bienkowska, D., Klofsten, M., & Rasmussen, E. (2016). Ph.D. students in the entrepreneurial university-perceived support for academic entrepreneurship. *European Journal of Education*, *51*(1), 56–72. https://doi.org/10.1111/ejed.12160

Boh, W. F., De-Haan, U., & Strom, R. (2016). University technology transfer through entrepreneurship: Faculty and students in spinoffs. *The Journal of Technology Transfer*, *41*(4), 661–669. https://doi.org/10.1007/s10961-015-9399-6

Brandão, C. (2015). Qualitative data analysis with NVivo. *Qualitative Research in Psychology*, *12*(4), 492–494. https://doi.org/10.1080/14780887.2014.992750. 2nd ed.

Braun, V., & Clarke, V. (2006). Qualitative research in psychology using thematic analysis in psychology using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.

Campbell, S., Greenwood, M., Prior, S., Walkem, K., Young, S., & Bywaters, D. (2020). Purposive sampling: Complex or simple? Research case examples. *Journal of Research in Nursing*, *25*(8), 652–661. https://doi.org/10.1177/1744987120927206

Castillo-Montoya, M. (2016). Preparing for interview research: The interview protocol refinement framework. *Qualitative Report*, *21*(5), 811–831. https://doi.org/10.46743/2160-3715/2016.2337

Cesaroni, F., & Piccaluga, A. (2016). The activities of university knowledge transfer offices: Towards the third mission in Italy. *The Journal of Technology Transfer*, *41*, 753–777. https://doi.org/10.1007/s10961-015-9401-3

Chen, Z., Little, V. J., & Thuan, N. H. (2024). The evolving role of technology transfer offices in the entrepreneurial university: Go-betweens or playmakers? *The Journal of Technology Transfer*, 1–20. https://doi.org/10.1007/s10961-024-10123-4

Chitac, I. M. (2023). Identity is a matter of place: Intersectional identities of Romanian women migrant entrepreneurs on the Eastern-Western European route. *International Journal of Entrepreneurial Behaviour and Research*. https://doi.org/10.1108/IJEBR-10-2022-0897

Chitac, I., & Knowles, D. (2019). Accessing the inaccessible: e-sampling via Facebook (867). In *British Academy of Management Conference 2019 (BAM 2019)*. British Academy of Management.

Clarysse, B., Wright, M., Lockett, A., Velde, E. Van De, & Vohora, A. (2005). Spinning out new ventures: A typology of incubation strategies from European research institutions. *Journal of Business Venturing, 20*, 183–216. https://doi.org/10.1016/j.jbusvent.2003.12.004

Coccia, M. (2010). Public and private investment in R&D: Complementary effects and interaction with productivity growth. *European Review of Industrial Economics and Policy*, *1*.

Conti, G., Granieri, M., & Piccaluga, A. (2012). *La gestione Del Trasferimento tecnologico: Strategie, modelli e strumenti*. Springer.

Coyne, I. T. (1997). Sampling in qualitative research. Purposeful and theoretical sampling; merging or clear boundaries? *Journal of Advanced Nursing*, *26*, 623–630. https://doi.org/10.1046/j.1365-2648.1997.t01-25-00999.x

Cyranoski, D., Gilbert, N., Ledford, H., Nayar, A., & Yahia, M. (2011). Education: The ph.d. factory. *Nature*, *472*, 276–279. https://doi.org/10.1038/472276a

Dulini, F., & Patriotta, G. (2020). Us versus them': Sensemaking and identity processes in skilled migrants' experiences of occupational downgrading. *Journal of World Business*, *55*(4), 101109. https://doi.org/10.1016/j.jwb.2020.101109

Enders, J. (2002). Serving many masters: The ph.d. On the labour market, the everlasting need of inequality, and the premature death of Humboldt. *Higher Education*, *44*(3), 493–517. https://doi.org/10.1023/A:1019850524330

Erikson, T., Knockaert, M., & Der-Foo, M. (2015). Enterprising scientists: The shaping role of norms, experience, and scientific productivity. *Technological Forecasting and Social Change*, *99*, 211–221. https://doi.org/10.1016/j.techfore.2015.06.022

Feola, R., Vesci, M., Botti, A., & Parente, A. (2019). The determinants of entrepreneurial intention of young researchers: Combining the theory of planned behavior with the triple Helix model. *Journal of Small Business Management*, *57*(4), 1424–1443. https://doi.org/10.1111/jsbm.12361

Fernández-Esquinas, M., Pinto, H., Yruela, M. P., & Pereira, T. S. (2016). Tracing the flows of knowledge transfer: Latent dimensions and determinants of university–industry interactions in peripheral innovation systems. *Technological Forecasting and Social Change, 113*, 266–279. https://doi.org/10.1016/j.techfore.2015.07.013

Fini, R., Rasmussen, E., Siegel, D., & Wiklund, J. (2018). Rethinking the commercialization of public science: From entrepreneurial outcomes to societal impacts. *Academy of Management Perspectives*, *32*(1), 4–20. https://doi.org/10.5465/amp.2017.0206

Fini, R., Grimaldi, R., & Meoli, A. (2020). The effectiveness of university regulations to foster science-based entrepreneurship. *Research Policy*, *49*(10), 104048. https://doi.org/10.1016/j.respol.2020.104048

Fogelberg, H., & Lundqvist, M. A. (2013). Integration of academic and entrepreneurial roles: The case of nanotechnology research at Chalmers university of technology. *Science and Public Policy*, *40*(1), 127–139. https://doi.org/10.1093/scipol/scs074

Geuna, A., & Rossi, F. (2011). Changes to university IPR regulations in Europe and the impact on academic patenting. *Research Policy, 40*(8), 1068–1076. https://doi.org/10.1016/j.respol.2011.05.008

Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational Research Methods*, *16*(1), 15–31. https://doi.org/10.1177/1094428112452151

Glick, W. H., Huber, G. P., Miller, C. C., Doty, D. H., & Sutcliffe, K. M. (1990). Studying changes in organizational design and effectiveness: Retrospective event histories and periodic assessments. *Organizational Science*, *1*(3), 293–312. https://doi.org/10.1287/orsc.1.3.293

Grimaldi, R., Kenney, M., Siegel, D. S., & Wright, M. (2011). 30 years after Bayh–Dole: Reassessing academic entrepreneurship. *Research Policy, 40*(8), 1045–1057. https://doi.org/10.1016/j.respol.2011.04.005

Guerrero, M., & Urbano, D. (2019). Effectiveness of technology transfer policies And legislation in fostering entrepreneurial innovations across continents: An overview. *The Journal of Technology Transfer*, *44*(5), 1347–1366. https://doi.org/10.1007/s10961-019-09736-x

Guerrero, M., Urbano, D., Cunningham, J., & Organ, D. (2014). Entrepreneurial universities in two European regions: A case study comparison. *The Journal of Technology Transfer*, *39*(3), 415–434. https://doi.org/10.1007/s10961-012-9287-2

Guerrero, M., Urbano, D., Fayolle, A., Klofsten, M., & Mian, S. (2016). Entrepreneurial universities: Emerging models in the new social and economic landscape. *Small Business Economics*, *47*, 551–563. https://doi.org/10.1007/s11187-016-9755-4

Guest, G., & Johnson, L. (2006). How many interviews are enough?? An experiment with data saturation and variability. *Field Methods*, *18*(1), 59–82. https://doi.org/10.1177/1525822X05279903

Hayter, C. S. (2015). Public or private entrepreneurship? Revisiting motivations and definitions of success among academic entrepreneurs. *The Journal of Technology Transfer*, *40*(6), 1003–1015. https://doi.org/10.1007/s10961-015-9426-7

Hayter, C. S., Lubynsky, R., & Maroulis, S. (2017). Who is academic entrepreneur? The role of graduate students in the development of university spinoffs. *The Journal of Technology Transfer*, *42*(6), 1237–1254. https://doi.org/10.1007/s10961-016-9470-y

Hayter, C. S., Link, A. N., & Schaffer, M. (2023). Identifying the emergence of academic entrepreneurship within the technology transfer literature. *The Journal of Technology Transfer*, *48*(5), 1800–1812. https://doi.org/10.1007/s10961-023-10026-w

Huyghe, A., & Knockaert, M. (2015). The influence of organizational culture and climate on entrepreneurial intentions among research scientists. *The Journal of Technology Transfer*, *40*(1), 138–160. https://doi.org/10.1007/s10961-014-9333-3

ISTAT. (2018). L'inserimento professionale dei Dottori di ricerca. In L'inserimento professionale dei dottori di ricerca.

Kikooma, J. F. (2010). Using qualitative data analysis software in a social constructionist study of entrepreneurship. *Qualitative Research Journal*, *10*(1), 40–51. https://doi.org/10.3316/QRJ1001040

Kirkevold, M., & Bergland, Å. (2009). The quality of qualitative data: Issues to consider when interviewing participants who have difficulties providing detailed accounts of their experiences. *International Journal of Qualitative Studies on Health and Well-Being*, *2*(2), 68–75. https://doi.org/10.1080/17482620701259273

Klofsten, M., & Jones-Evans, D. (2000). Comparing academic entrepreneurship in Europe—The case of Sweden and Ireland. *Small Business Economics*, *14*, 299–309. https://doi.org/10.1023/A:1008184601282

Klofsten, M., Jones-Evans, D., & Pereira, L. (2021). Teaching science and technology ph.d. Students in entrepreneurship—Potential learning opportunities and outcomes. *The Journal of Technology Transfer*, *46*(2), 319–334. https://doi.org/10.1007/s10961-020-09784-8

Klofsten, M., Brem, A., Guerrero, M., & Urbano, D. (2024). Intrapreneurial universities in digital times-New ways of thinking and future challenges. *Technovation*, *135*, 103069. https://doi.org/10.1016/j.technovation.2024.103069

Kochenkova, A., & Grimaldi, R. (2016). Public policy measures in support of knowledge transfer activities: A review of academic literature. *The Journal of Technology Transfer*, *41*(3), 407–429. https://doi.org/10.1007/s10961-015-9416-9

Kriz, A., & Welch, C. (2018). Innovation and internationalisation processes of firms with new-to-the-world technologies. *Journal of International Business Studies*, *49*(4), 496–522. https://doi.org/10.1057/s41267-018-0147-7

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Loi, M., & Di Guardo, M. C. (2015). The third mission of universities: An investigation of the espoused. *Science and Public Policy*, *42*(6), 1–16. https://doi.org/10.1093/scipol/scv012

Mars, M. M., & Moravec, B. G. (2022). PhD students as boundary spanning agents: An exploration of student values, goals, and agency in the era of cross-sector permeation. *Studies in Graduate and Postdoctoral Education*, *13*(2), 205–220. https://doi.org/10.1108/SGPE-08-2021-0057

Mars, M. M., & Rios-aguilar, C. (2010). Academic entrepreneurship (re)defined: Significance and implications for the scholarship of higher education. *Higher Education*, *59*, 441–460. https://doi.org/10.1007/s10734-009-9258-1

Mason, C., & Brown, R. (2014). Entrepreneurial ecosystems and growth oriented entrepreneurship. *Final Report To OECD Paris*, *30*(1), 77–102.

Muñoz, C. A., Guerra, M. E., & Mosey, S. (2020). The potential impact of entrepreneurship education on doctoral students within the non- commercial research environment in Chile. *Studies in Higher Education*, *45*(3), 492–510. https://doi.org/10.1080/03075079.2019.1597036

Muscio, A., & Kitagawa, F. (2024). Heterogeneity in PhD entrepreneurship: Strategic alignment of institutional, organisational, and individual factors. *Small Business Economics, 64*(2), 489–510. https://doi.org/10.1007/s11187-024-00916-0

Muscio, A., & Ramaciotti, L. (2018). Dataset from a qualitative survey on ph.d. Entrepreneurship in Italy. *Data in Brief*, *18*, 1272–1276. https://doi.org/10.1016/j.dib.2018.03.116

Muscio, A., & Ramaciotti, L. (2019). How does academia influence ph.d. Entrepreneurship?? New insights on the entrepreneurial university. *Technovation*, *82*, 16–24. https://doi.org/10.1016/j.technovation.2019.02.003

Muscio, A., Quaglione, D., & Ramaciotti, L. (2016). The effects of university rules on spinoff creation: The case of academia in Italy. *Research Policy*, *45*(7), 1386–1396. https://doi.org/10.1016/j.respol.2016.04.011

Muscio, A., Shibayama, S., & Ramaciotti, L. (2021). Universities and start-up creation by ph.d. Graduates: The role of scientific and social capital of academic laboratories. *The Journal of Technology Transfer*, *47*(1), 147–175. https://doi.org/10.1007/s10961-020-09841-2

Neergaard, H., & Ulhøi, J. P. (2007). *Handbook of qualitative research methods in entrepreneurship*. Edward Elgar Publishing.

Opizzi, M., Loi, M., & Macis, O. (2024). Entrepreneurship by Ph.D. students: intentions, human capital and university support structures. *Journal of Small Business and Enterprise Development, 31*(2), 325–349. https://doi.org/10.1108/JSBED-12-2022-0525

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Mixed Method Implementation Research. *Administration and Policy in Mental Health and Mental Health Services Research*, *42*, 533–544. https://doi.org/10.1007/s10488-013-0528-y. Purposeful Sampling for Qualitative Data Collection and Analysis in.

Park, A., Maine, E., Fini, R., Rasmussen, E., Di-Minin, A., Dooley, L., Mortara, L., Lubik, S., & Zhou, Y. (2023). Science-based innovation via university spin-offs the influence of intangible assets. *R&D Management*, *54*(1), 178–198. https://doi.org/10.1111/radm.12646

Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., Fini, R., Geuna, A., Grimaldi, R., Hugher, A., Krabel, S., Kitson, M., Llerena, P., Lissoni, F., Salter, A., & Sobrero, M. (2013). Academic engagement and commercialization: A review of the literature on university–industry relations. *Research Policy*, *42*(2), 423–442. https://doi.org/10.1016/j.respol.2012.09.007

Pierce, J. L., Kostova, T., & Dirks, K. T. (2001). Toward a theory of psychological ownership in organizations. *The Academy of Management Review*, *26*(2), 298–310. https://doi.org/10.2307/259124

Poyago-Theotoky, J., Beath, J., & Siegel, D. S. (2002). Universities and fundamental research: Reflections on the growth of university–industry partnerships. *Oxford Review of Economic Policy, 18*(1), 10–21. https://doi.org/10.1093/oxrep/18.1.10

Pratt, M. G., Kaplan, S., & Whittington, R. (2020). Editorial essay: The tumult over transparency: Decoupling transparency from replication in Establishing trustworthy qualitative research. *Administrative Science Quarterly*, *65*(1), 1–19. https://doi.org/10.1177/0001839219887663

Pretorius, L., & Macaulay, L. (2021). Notions of human capital and academic identity in the ph.d.: Narratives of the disempowered. *Journal of Higher Education*, *92*(4), 623–647. https://doi.org/10.1080/00221546.2020.1854605

Rippa, P., Landi, G., Cosimato, S., Turriziani, L., & Gheith, M. (2022). Embedding entrepreneurship in doctoral students: The impact of a T -shaped educational approach. *European Journal of Innovation Management*, *25*(1), 249–270. https://doi.org/10.1108/EJIM-07-2020-0289

Rizzo, U. (2015). Why do scientists create academic spin-offs? The influence of the context. *The Journal of Technology Transfer*, *40*, 198–226. https://doi.org/10.1007/s10961-014-9334-2

Roach, M., & Sauermann, H. (2010). A taste for science? PhD scientists' academic orientation and self-selection into research careers in industry. *Research Policy*, *39*(3), 422–434. https://doi.org/10.1016/j.respol.2010.01.004

Robinson, O. C. (2014). Sampling in interview-based qualitative research: A theoretical and practical guide. *Qualitative Research in Psychology*, *11*(1), 25–11. https://doi.org/10.1080/14780887.2013.801543

Roncancio-Marin, J., & Guerrero, M. (2024). University technology transfer offices' capabilities in responding to societal challenges: Lessons from an exploratory study during the COVID-19 pandemic. *The Journal of Technology Transfer*, *49*, 2135–2158. https://doi.org/10.1007/s10961-024-10120-7

Rubin, H. J., & Rubin, I. S. (2011). *Qualitative interviewing: The Art of hearing data*. Sage.

Saldaña, J. (2021). *The coding manual for qualitative researchers* (4th ed.). SAGE.

Shane, S. (2004). *Academic entrepreneurship: University spinoffs and wealth creation*. Edward Elgar Publishing.

Siccama, C. J., & Penna, S. (2008). Enhancing Validity of a Qualitative Dissertation Research Study by Using NVIVO. *Qualitative Research Journal, 8*(2), 91–103. https://doi.org/10.3316/QRJ0802091

Siegel, D. S., & Wright, M. (2015). Academic entrepreneurship: Time for a rethink? *British Journal of Management*, *26*(4), 582–595. https://doi.org/10.1111/1467-8551.12116

Siegel, D. S., Waldman, D. A., Atwater, L. E., & Link, A. N. (2003a). Commercial knowledge transfers from universities to firms: Improving the effectiveness of university–industry collaboration. *The Journal of High Technology Management Research*, *14*(1), 111–133. https://doi.org/10.1016/S1047-8310(03)00007-5

Siegel, D. S., Waldman, D., & Link, A. (2003b). Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: An exploratory study. *Research Policy*, *32*(1), 27–48. https://doi.org/10.1016/S0048-7333(01)00196-2

Stokes, Y., Vandyk, A., Squires, J., Jacob, J. D., & Gifford, W. (2019). Using Facebook and linkedin to recruit nurses for an online survey. *Western Journal of Nursing Research*, *41*(1), 96–110. https://doi.org/10.1177/0193945917740706

Sweitzer, V. (2009). Towards a theory of doctoral student professional identity development: A developmental networks approach. *Journal of Higher Education*, *80*(1), 1–33. https://doi.org/10.1353/jhe.0.0034

Thune, T. (2009). Doctoral students on the university-industry interface: A review of the literature. *Higher Education*, *58*(5), 637–651. https://doi.org/10.1007/s10734-009-9214-0

Tracy, S. J. (2020). *Qualitative research methods*. Wiley.

Treanor, L., Noke, H., Marlow, S., & Mosey, S. (2021). Developing entrepreneurial competences in biotechnology early career researchers to support long-term entrepreneurial career outcomes. *Technological Forecasting and Social Change*, *164*, 120031. https://doi.org/10.1016/j.techfore.2020.120031

Wood, M. S. (2011). A process model of academic entrepreneurship. *Business Horizons*, *54*, 153–161. https://doi.org/10.1016/j.bushor.2010.11.004

Wutich, A., Beresford, M., & Bernard, H. R. (2024). Empirical Guidance, and Next Steps. *International Journal of Qua*, *23*, 1–14. https://doi.org/10.1177/16094069241296206. Sample Sizes for 10 Types of Qualitative Data Analysis: An Integrative Review,.