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PhD holders at the boundaries and knowledge brokering

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ABSTRACT

Over the past decade, there has been an increase in the number of PhDs pursuing careers at the boundaries between academic and non-academic sectors, particularly with multiple transitions and dual appointments. However, the professional links that PhD holders pursuing non-academic careers maintain with academia and how these relate to different knowledge brokering activities across sectors remain unexplored. To fill this gap, 39 PhD holders working beyond academia in Spain in the fields of Social Sciences, Humanities, and STEM were interviewed. The results revealed that PhD holders navigate diverse professional links with academia, including both organisational and individual-based links, and are involved in a variety of knowledge brokering activities gathered in four distinct qualitative profiles: the professional co-creator, the valuable knowledge holder, the bridge builder, and the knowledgeable associate lecturer. The profiles highlighted a complex relationship with academia, suggesting that in some cases deploying academic links does not secure or explain brokering activities. Moreover, results underscore the influence of career factors such as the organisational culture and support, the research performance in their primary job position, and the disciplinary background. Several research and practical implications of the study are discussed.

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Introduction

PhD holder career trajectories have experienced a noticeable shift in the last two decades, mainly towards an increasing, either consolidated or emergent, variety of non-academic options. While academia remains the preferred sector for PhD candidates (Main, Prenovitz, and Ehrenberg 2019), those pursuing, either forced or by choice, careers beyond academia are growing across disciplines and contexts. The average number of PhD holders employed beyond academia exceeds 50% in European countries such as Finland (60%; Aarresari 2022), the Netherlands (70%; Van der Weijden et al. 2017), and Spain (70%, AQU 2023; Sala-Bubaré et al. 2024). In addition, careers at the boundaries are becoming popular. These careers straddle sectors, with continuous transitions between academic

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and non-academic sectors and simultaneous jobs in and out of academia (Cañibano et al. 2019; Cattaneo, Horta, and Meoli 2019). The European DocEnhance project[1] reported that approximately 30% of individuals with PhDs held multiple jobs, with over 50% of them combining both academic and non-academic sectors, and 17% expressing their intentions to pursue mixed careers (Boman et al. 2021).

Many authors and international organisations argue that PhD holders who pursue careers at the boundaries are well placed to be knowledge brokers, i.e. experts who interact, communicate, facilitate learning, share, and create knowledge across sectors (Neal, Neal, and Brutzman 2022; Neal, Posner, and Brutzman 2023). Knowledge brokering may be facilitated not only by the position across various sectors and by being potentially skilled for this role (Meagher, Lyall, and Nutley 2008; Pérez-Rojas et al. 2022), but also by the job satisfaction and working conditions of those whose primary job is outside academia (Cattaneo, Horta, and Meoli 2019; Sala-Bubaré et al. 2024). Knowledge brokering is crucial to improve cooperation between sectors and strengthen research and innovation environments (OECD 2012; 2021), while moving towards open and citizen science to address complex societal challenges (Hecker et al. 2018; European Parliament 2000).

However, previous studies suggest that pursuing careers at the boundaries does not always guarantee knowledge brokering, as it can be influenced by contractual status, institutional cultures, or knowledge field (Cattaneo, Horta, and Meoli 2019; Millard 2018; OECD 2021). Moreover, different professional links across sectors can have distinct effects on knowledge sharing, learning, and creation between sectors (Cattaneo, Horta, and Meoli 2019; Hecker et al. 2018; OECD 2021). What remains unclear is why and under what conditions PhD holders at the boundaries can develop knowledge brokering activities and what are the characteristics of those activities. Exploring those issues is relevant considering the simplistic and unverified view of knowledge brokering in the policy and career development literature and the role it may play in moving forward a skilled and sustainable society (European Parliament 2000; Hecker et al. 2018; OECD 2012; 2021).

Among the different links PhD holders at the boundaries can develop, we focused on their position at the intersection between academic and non-academic sectors and the type of links those working in non-academic contexts maintained with academia. We assume that PhD holders at the boundaries who maintain links with academia are well positioned to do meaningful and transformative knowledge brokering activities, as they can facilitate practical implementation of academic knowledge and provide professional expertise to academia. Consequently, we aimed to uncover the relationship between the professional links that PhD holders maintain with academia and the knowledge-brokering activities they carry out. Advancing knowledge on those aspects might contribute to the development of a consistent and evidence-based framework for research career development and inform policymakers and educators in support of PhD holders' careers, especially those at the boundaries (European Parliament 2000; OECD 2012; 2021).

Specifically, our research questions were:

(1) What kind of professional links did PhD holders working beyond academia have with academia?
(2) What knowledge brokering activities do PhD holders carry out?
(3) What are the relationships between PhD holders' professional link with academia and their knowledge-brokering activities?

PhD holders pursuing careers at the boundaries

The increasing popularity of PhD education is mirrored in the expanding body of literature on PhD trajectories (Castelló, McAlpine, and Pyhalto 2015; McAlpine, Castello, and Pyhaltö 2020; Cronshaw, Stokes, and McCulloch 2022; Elliot 2022; Pyhältö, Tikkanen, and Anttila 2023; Sala-Bubaré, Castelló, and Rijlaarsdam 2021). Over the last ten years, a special interest has grown in those PhD trajectories beyond academia, with a focus on job satisfaction and working conditions (Guerin 2020; Sala-Bubaré et al. 2024), PhD value and job skills mismatch (Marini and Henseke 2023; McAlpine and Inouye 2022), and transitions (Galimberti 2023; Skakni, Inouye, and McAlpine 2022).

Recent studies have revealed that current PhD trajectories transcend the academic *vs.* non-academic career binarism (Boman et al. 2021; Cattaneo, Horta, and Meoli 2019; Millard 2018). The pioneering work of Lam (2007) showed that some academics, known as linked scientists, started moving into industry by engaging in collaborative projects across sectors. In more recent contributions, the diversity of careers at the boundaries has become visible, including linked scientists but also mixed careers (Cañibano et al. 2019; Herke et al. 2021), hybrid careers (Boman et al. 2021; Cañibano et al. 2019; McAlpine, Skakni, and Inouye 2021) and researchers working in hybrid research organisations (Cañibano et al. 2019; Pablo-Hernando 2015). Mixed careers involve continuous alternation of research positions across sectors (Cañibano et al. 2019; Herke et al. 2021), while hybrid careers refer to those that take place concurrently in multiple organisations of different types, such as academic and non-academic institutions (Boman et al. 2021; Cañibano et al. 2019; McAlpine, Skakni, and Inouye 2021).

Within this diversity, we can distinguish between careers that are primarily constructed through individual choices, such as mixed and hybrid careers, and those that are established as part of the professional responsibilities within a professional organisation, such as research careers in hybrid organisations, that is, organisations that connect academic and non-academic sectors, such as research institutes and technology centres (Pablo-Hernando 2015).

Knowledge brokering

The concept of *knowledge brokering* holds promise in offering an interdisciplinary lens for examining how PhD holders can contribute to fortifying science and innovation environments by establishing bridges across sectors. Knowledge brokering involves employing strategies and actions to engage, communicate, facilitate learning, and share knowledge among organisations, sectors, and stakeholders. Its ultimate goal is to enhance organisational and individual practices and contribute to informed policy decision-making (Neal, Neal, and Brutzman 2022). Moreover, it is not linear or static but a dynamic and multidirectional process in which knowledge is formally and informally created, adapted, and refined across sectors (Glegg and Hoens 2016; Meagher, Lyall, and Nutley 2008).

A recent literature review of empirical, theoretical and review papers aimed at clarifying the meaning and scope of knowledge brokering (Neal, Neal, and Brutzman 2022), found the term *broker* or *brokerage* was mainly used to describe a person engaged in multiple activities, including knowledge dissemination, capacity-building and relationship

building. Knowledge dissemination relates to identifying relevant knowledge created in one context and transferring it to stakeholders with the aim of informing decision-making processes and disseminating evidence. In this process, knowledge appears to be critically appraised, synthesised and adapted to align with the cultural codes of each context (Bornbaum et al. 2015; Glegg and Hoens 2016). Capacity-building activities include individual training, mentoring, facilitating learning, and skill acquisition, and promoting organisational development (Glegg and Hoens 2016; Hurtubise et al. 2016). Finally, relationship building fosters networking and problem-solving between people with shared interests (Glegg and Hoens 2016; Hargadon 2002).

Complementarily, other reviews and studies specifically focused on brokering strategies, collaborative research, and innovative eco-systems have revealed knowledge co-creation as a significant activity. Knowledge co-creation, or co-production, implies collaboration with different stakeholders across the entire research and innovation cycle, such as problem evaluation, data collection, funding and human resources, and evaluation of potential solutions (Adelle et al. 2019; Jütting 2020; Neal, Posner, and Brutzman 2023). Thus, co-creation also encompasses enhancing capacities and promoting knowledge sharing (Abbate and Coppolino 2011). Its implementation may challenge power dynamics towards integrated, creative, and participatory forms of knowledge generation (Carayannis and Campbell 2019), and usually aligns with the requirements of Open Science (Hecker et al. 2018) and integrated and participatory forms of research (Adelle et al. 2019).

The revised studies ground the assumption that PhD holders are particularly skilled and trained to be knowledge brokers (Abbate and Coppolino 2011; Adelle et al. 2019). However, only a few studies have explored their contribution to knowledge brokering regarding their links with academia. Those studies suggest that PhD holders at the boundaries may have an important role, but they did not explore knowledge brokering activities other than dissemination and capacity building in specific scenarios (Pablo-Hernando 2015; Pérez-Rojas et al. 2022; Trusson, Rowley, and Bramley 2019).

We assume that PhD holders at the boundaries may be well positioned for enhancing brokering activities between academic and non-academic sectors. This study aimed to further explore PhD holders' perceptions regarding the nature and scope of knowledge brokering activities they develop. More precisely, we delved into understanding the relationships between the professional links they have with academia and their knowledge brokering activities.

Doctoral education in Spain

The number of PhD students in Spain has gradually increased since Spain joined the European Union and subsequently aligned with the EHEA, with 11,344 dissertations defended in 2021. In the last two decades, PhD education in the country has undergone several reforms to adjust doctoral programmes to European regulations, the Bologna framework, and the EHEA guidelines, as outlined in Royal Decrees (RD) 99/2011 and 576/2023. These reforms have impacted the structure, duration, orientation, and outcomes of PhD training (Castelló et al. 2023). Regarding structure, traditional PhD programmes have moved from offering compulsory towards elective and personalised courses to tailor training to the needs and expectations of PhD students and to meet

the requirements of employers and the labour market (Castelló et al. 2023; Germain-Alamartine and Moghadam-Saman 2020). Moreover, flexible models that integrate non-academic sectors, such as industrial or professional PhD programmes, have been incipiently implemented with differences among regions (Castelló et al. 2023). Regarding duration, PhD programmes must be fulfilled in 3 or 4 years for full-time students or 5 years for those enrolled part-time. Furthermore, there has been a considerable emphasis on internationalisation within all PhD programmes.

Statistics have shown that most PhD candidates in Spain submit their thesis before turning 35, predominantly in the age range of 30–34 (Ministerio de Universidades 2023). They usually enrol in PhD programmes after finishing their master's degree. A minimum of 60 credits from a Master is a mandatory requirement for admission to PhD programmes.

Method

Procedure and participants

PhD holders working beyond academia in Spain were contacted from October to December 2021. We addressed various stakeholders, such as universities, R + D + I companies, and professional associations, to request their collaboration in distributing a form to collect potential participants. Moreover, we used our personal and social networks, in particular LinkedIn and Twitter. We addressed Spanish PhD holders who graduated ten years prior[2] to the interview. The inclusion criteria were (1) obtaining the PhD in the last ten years, (2) having the main job beyond academia, and (3) having a Spanish job contract. Unemployed PhD holders were excluded since the unemployment national rate is low and study's focus and interests on real work activities (AQU 2023).

The final sample comprised 39 PhD holders, 19 men and 20 women. Most of them were in the 30–40 range age. They were distributed between Social Sciences ($n = 15$), STEM ($n = 14$), Humanities ($n = 10$). They had been working in non-academic careers for an average of 6 years. Less than a quarter of participants began their non-academic careers before or during their PhD studies. They were employed across sectors: public administration ($n = 14$), private companies ($n = 21$), non-profit organisations ($n = 3$), and one self-employed. They were working at least in one Spain-based institution.

Data collection

Semi-structured online interviews were conducted. Participants filled out a pre-interview survey with demographic data, their academic and professional background, and current job conditions. This survey served us to identify if they were holding multiple jobs at the moment of the interview, and to adjust interview protocol to each participant. A career timeline was created from pre-interview survey data, which was ratified and discussed during the interview.

The interviews[3] lasted between an hour and an hour and a half and covered the following topics: current job characteristics and tasks, trajectory and factors in the career trajectory – impact of the PhD, motivations and career objectives, networking, and personal factors-, career satisfaction and expectations, and a personal appraisal of the

received PhD training. Knowledge brokering activities came up when participants explained their daily professional tasks, but no specific question was asked during the interview.

Participants gave their consent to participate according to the ethics clearance procedures of the authors' institution. The aims and procedures of the study were approved by the ethics committee and the data protection delegate of our institution.

Data analysis

We drew on a thematic analysis[4] (Braun and Clarke 2006) to identify the themes mentioned in the interviews regarding the two dimensions of analysis: (1) professional links with academia, and (2) knowledge brokering activities. First, the first author iteratively read the interview transcriptions to identify emerging patterns and create preliminary codes. Then, the initial themes and codes were discussed, reviewed, and refined with all the authors until consensus. Once the code system was established, two authors -the first author and a non-author researcher- independently coded 6 interviews to assess the reliability of the code system, resulting in a kappa index of 0.81. After the reliability of the code system was established, the first author coded the rest of the interviews. Data analysis was carried out through the support MAXQDA 20.

Codes of both dimensions emerged from the interviews and their final labelling was inspired by previous research. Only explicit brokering activities were coded, i.e. activities in which knowledge brokering was of a conscious, tangible, visible, and perceivable nature (Gamble 2020). Any activity was considered knowledge brokering when participants specified that academic knowledge crossed boundaries into non-academic sectors or vice versa. Therefore, tacit translations of PhD competences to their job position were excluded.

Finally, to explore the relationships between professional links with academia and knowledge brokering, we first analysed them for each participant, resulting in an individual characterisation. The goal of this step was to define each participant in terms of their main type of knowledge brokering activity and their main type of link with academia. This was a challenging and sensitive part of the analysis. While some participants mentioned only one category within each dimension, others mentioned several either in their academic links or knowledge brokering activities. We decided the main type of knowledge brokering activity for each individual based on the activities they mentioned more frequently and whether participants considered them a priority. Still, some specific brokering activities were mentioned as part of another knowledge brokering activity (e.g. knowledge dissemination as part of knowledge co-creation). In these instances, priority was placed on the integrative activity. For this analysis, PhD holders who did not report participating in any brokering activities were not taken into consideration.

Individual characterisations of the relationship between professional links with academia and knowledge brokering were then grouped into profiles based on similar patterns. We created qualitative labels for each resulting profile to help us to describe and inform the included participants shared characteristics. To obtain a comprehensive understanding, participants' research performance within their main job positions and their disciplinary backgrounds were included as additional variables.

Results

Links PhD holders maintained with academia

Most of the participants ($n = 27$) indicated maintaining sustained and regular professional links with academia, with different intensity and dedication. While some of them utilised their free slots in their daily routines to engage in academic tasks, for others, these tasks were integrated as an essential part of their job responsibilities. Notably, two main types of links emerged from their accounts: *individual-based* and *organisational-based links*.

Individual-based links

PhD holders who maintained *individual-based links* mentioned having professional academic responsibilities *apart* from their main job position outside academia ($n = 20$). They held teaching, supervising, researching, and managerial positions within universities, often as associate lecturers[5] ($n = 18$), as explained by Aloi:

> I am coordinating a subject of a master's degree. Therefore, I teach. You could say that, in the end, because I am a PhD, I have joined the University. I am an associate lecturer here and at another university. (Aloi, 94)

For most of them, this status was enjoyable but precarious and often hard to balance with their main job. As Gàl·lia explained, these conditions led them to contemplate leaving their academic responsibilities:

> If they paid me better and I could work less hours somewhere else … But you feel precarious. And, of course, sometimes it's a little repetitive. So, my link [with academia], I like to keep it. But I don't know … Every year I think 'Do I continue or not?' (Gàl·lia, 268)

Organisational-based links

PhD holders who exhibited *organisational-based links* made explicit in their comments that establishing and maintaining links with academia was part of their main job ($n = 14$). Some of them were engaged in research projects with academic partners within hybrid organisations and research consortiums ($n = 6$), that is, collaborative research initiatives resulting from the agreement of multiple academic and non-academic organisations. Bea provided an example when stating: 'We organise our work into work packages and within these work packages, there are different institutions. At the moment, I have collaborated directly with other universities or research institutes' (Bea, 22).

Other PhD holders showed *organisational-based links* as they were required to network with academia, and assess, manage, and supervise academic affairs ($n = 8$). They were employed in private firms, public administration and non-profit organisations. A representative example come from Hardo, who worked in a non-profit organisation and networked with various stakeholders:

> So basically, we [contact] with universities and researchers. On the other hand, with educational centres and school management teams, the public administration, and some non-profit organisations also like ours in the educational field. (Hardo, 38)

Finally, one quarter of participants indicated not maintaining professional links with academia ($n = 10$). Underlying reasons included a lack of work-life balance and well-being, academic opportunities, career support, and academic socialisation. Nibam shared her personal experience when stating:

> Already in the third or fourth year of my thesis, I saw very clearly that no … No, no, no. That I was burnt out, that I didn't want to continue researching and that I wanted to change. (Nibam, 262)

PhD holders' knowledge brokering activities

Four types of knowledge brokering activities were established from the participants' comments: *knowledge translation*, *knowledge co-creation*, *network promotion*, and *capacity-building*.

Knowledge translation was the most frequently mentioned activity among the participants ($n = 20$). It was related to the use, adaptation, and sharing of academic knowledge to a non-academic audience, aiming to disseminate such knowledge to wider audiences, improve professional activities and organisational performance, or raise funding.

Some participants reported *knowledge translation* through oral communication activities, e.g. conferences or meetings, and various forms of written output, e.g. reports, books, or web page entries. Subjecte explained his experience with oral communication to wider audiences:

> And then I have also had to make massive communications with an audience, let's say, more related to the field of practice, which would be the people from the professional community. That then requires abandoning all the jargon, all the technical terms, and translating the research you have just done into very practical and very clear terms, right? (Subjecte, 66)

Other participants, such as ACS, explained that they translated the knowledge into tangible products, practices and proposals within their respective workplaces, aiming to enhance their organisation's performance:

> I am doing laboratory practices with professors with those who were in the department when I was doing my thesis. And I have been talking to them and I have informed them that I am now at [organisation's name], that I was working at [topic], and of course they themselves were letting me know things that they thought were not correct from it or things that could be new. (ACS, 5)

These activities were multidirectional yet hierarchical in nature. As evidenced by the previous segments, knowledge was not simply transferred from one sector to another; instead, PhD holders played a crucial role in selecting, modifying, and tailoring knowledge to specific contexts. Thus, responses, needs and demands were a crucial part of how dissemination evolved. Moreover, this process appeared to be asymmetrical and hierarchical, as PhD holders were the ones who possessed the knowledge that was considered relevant to the others.

The second more frequent knowledge brokering activity was *knowledge co-creation* ($n = 9$). It involved the collaborative creation of research outcomes, including project designs and papers, through ongoing intersectoral partnerships. In contrast to *knowledge translation*, this process was characterised by a higher level of complexity and distributed nature.

Knowledge co-creation required a continuous negotiation process, involving agreements and effective communication among stakeholders. Relevant knowledge was sourced and shared across sectors, with each stakeholder contributing to the creation of new knowledge. Fracsanto provided an example that illustrated this process:

> We collaborate with many groups; we are doing this project with 7 or 8 other research groups. So, we have to coordinate a lot when we send samples or if they ask us to analyse some of their data. It takes a lot of coordination between the groups, because it is a Consortium and there are a lot of people. […] There are groups from universities and groups from private companies, and other groups that are in the universities but are spin offs. (Fracsanto, 36)

Thirdly, *network promotion* ($n = 9$) was related to expanding previous networks and supporting other professionals across sectors. Purposes for network promotion were diverse, including providing evidence-based knowledge, better informing research on stakeholder needs, or securing funding and support. It emerged as a requirement for *knowledge translation* and *knowledge co-creation*, but also as a consequence of these activities.

Pizarnik exemplified how networks were established for *knowledge translation*: 'One of the projects includes contact with university professors because we want to have references […] that can contribute to us. And we use them for different purposes: to make training videos, interviews, online webinars (Pizarnik, 4)'. On the other hand, Blein illustrated how networks were a prerequisite for engaging in *knowledge co-creation*: 'Most of my time is spent trying to get everyone to do research, to look for collaborations with these institutions and collaborations with individuals' (Blein, 17).

Finally, *capacity-building* ($n = 7$) was concerned with the integration of academic knowledge and professional expertise to facilitate skill development and enhance the competencies of students and other professionals. *Capacity-building* was mainly mentioned by PhD holders who held teaching responsibilities at universities. However, it was also observed among those who provided training for other organisations, as DOO exemplified:

> They are calling me from everywhere to give conferences, to give lectures, to sporadically give classes in other universities, or to give training to entities. Precisely because I am a profile that brings together transfer. (Doo, 76)

Knowledge brokers' profiles

Four distinct qualitative profiles emerged from the analysis, characterising the landscape of participants□□□ relationship between their academic links and knowledge brokering activities: the *professional co-creator*, the *valuable knowledge holder*, the *bridge builder*, and the *knowledgeable associate lecturer* (Figure 1).

The professional co-creator

PhD holders gathered into this profile are graduates predominantly from STEM disciplines (5 = STEM; 3= HASS) who held research job positions within research performing organisations (RPO) closely connected to academia. They maintained *organisational-based academic links* and were actively engaged in *knowledge co-creation* with diverse partners across sectors as a core task of their job. Thus, they were required to negotiate

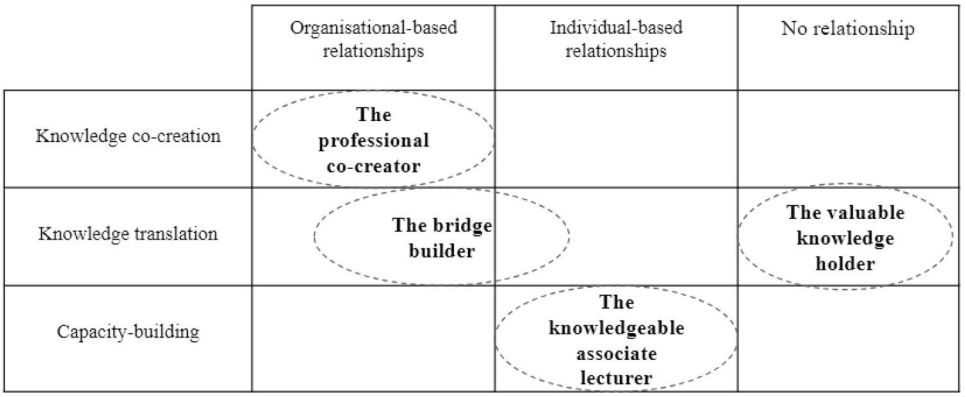

Figure 1. Knowledge brokers' profiles.

and reach agreements with cross-sectoral stakeholders, e.g. with public research institutions, universities, private firms, or SMEs, as Bea's quote illustrated:

> There is a general framework, […], but it is a very big project that has to be defined. And I do not define it alone, far from it, but as I said in collaboration with these diverse nineteen institutions. It is very important to communicate constantly with the partners of the other European institutions and see how we can proceed. (Bea, 78)

In an interesting contrast, PhD holders from Social Sciences included in this profile were not employed by RPO. Instead, they worked for organisations that collaborated with academic partners on specific research and innovation projects. Consequently, these individuals, employed as professional experts, collaborated with academics on various research activities, such as collaborative research design or data dissemination. Reme explained her participation in a collaborative research project as a representative of an organisation in the education sector:

> In purely research activities, when [organisation's name] has participated in some research where they thought it was important to have the presence of someone from the internal team to disseminate the knowledge, they have invited me. Now, for example, my organisation is currently conducting a joint research with the university and, especially in the initial sessions, where we were thinking more about the contents for the focus groups, they invited me to participate from my organisation. (Reme, 104)

PhD holders in this profile were key professionals in generating multidirectional, complex, integrated, and distributed knowledge. They explained the convergence of distinct cultures and interests for approaching a common concern, and the negotiation and dialogue required for creating situated knowledge for a concrete context, as Blein exemplified:

> It is a negotiation with the research institute or with the corresponding institution, in which we talk about what we are interested in as an institution. And they tell us what they do or the line of research that fits well with them. So, if we find a way to align the two sides, then we work together to provoke, well, produce publications and knowledge in this area. It has happened many times that we are not able to align our line of research with the line of research of this institution. And then, we simply collaborate with individuals. (Blein, 32)

The bridge builder

The participants included in this profile consist mostly of graduates from HASS disciplines (HASS = 6, STEM = 1) who were employed in private firms, public administration, and non-profit organisations. Bridge builders were PhD holders mainly performing *knowledge translation* who maintained an *organisational-based link* with academia, usually combined with an individual one. Their respective organisations invested in academic knowledge and networks; thus, *knowledge translation* and *network promotion* were crucial parts of their job responsibilities.

They mentioned the multidirectional nature of *knowledge translation*. They explained the selection, adaptation, and communication of relevant academic knowledge to different needs and demands of different audiences, including non-academic colleagues, external professionals, or policy makers. They also reported translating academic knowledge into concrete proposals and actions within their workplaces to justify and advise on organisational performance. Aloi elaborated on his engagement in such *knowledge translation* activities:

> I have a second line that is more about dissemination outside academia, which I like very much and I enjoy it very much. And then I have my cooperative […], with some strategic lines that many of them are inspired by the knowledge I have as a PhD holder […]. And the qualitative leap we are making, to a great extent, can be understood because of the last three to four years because … Not only mine, eh? But part of it, without any doubt, we are applying to […] some precepts that come directly from what I have learned in my research and in my research as a PhD. (Aloi, 94)

As mentioned, these professionals mostly combined their main job with a position as associate lecturers with only teaching responsibilities at universities ($n = 5$). Aloi's reflection captures his dual position: 'We associate, never better said, associate to the university to contribute what comes from the industry' (Aloi, 142). He translated his academic knowledge to professional practice and his professional expertise to academia.

The valuable knowledge holder

PhD holders included in this profile are mostly graduates from STEM disciplines (6 = STEM, 1 = Social Sciences), working in jobs related to research, development, and innovation, e.g. as data analysts or research consultants, and performing *knowledge translation*.

Unlike *the professional co-creator*, valuable knowledge holders did not directly collaborate with academia. Instead, they actively engaged in the translation of academic knowledge within their workplaces. Their academic background provided them with the necessary skills and knowledge to access academic literacy, disseminate it to broader audiences, and bring it into dialogue with the concerns of their organisations and clients. Montero exemplified promoting academic literacy at his organisation:

> I started learning sessions, which are every two weeks. Someone prepares a session to learn about everything. But to learn amazing things that we can apply. That was the condition they gave me [for starting the sessions]. And now we have started to propose articles to read and comment on. Like … I don't know if you did it, but in academia they also made discussions on an article to see what we thought and so on. (Montero, 158)

As opposed to *the bridge builders*, they did not use to hold teaching or research responsibilities at universities.

The knowledgeable associate lecturer

This profile comprises mostly PhD holders from HASS (4 = HASS, 1 = STEM) who held part-time teaching appointments at university as associate lecturers, maintaining *individual-based relationships* with academia. They were actively engaged in *capacity-building*.

Knowledgeable associate lecturers started teaching at university during their PhD, and later combined it with jobs aligned with their undergraduate studies, e.g. social worker. They emphasised their engagement in *capacity-building*, highlighting the significance of their professional expertise as a meaningful contribution to academia. They found that their experience enriched and gave meaning to the learning of university students, and that their dual position fostered a dialogue between academic knowledge and real-world professional experience. As Do exemplified:

> I humbly tell you, if you ask the students what they prefer, they prefer a teacher who has worked previously than a purely academic profile, who knows a lot of scientific literature, but who at least in the social field does not need it. […] Why? Because when I talk about children's rights or when I talk about a case, for example, I think of cases that are 'mine'. (Do, 84)

Interestingly, they mentioned that their professional practice often benefited from the content they taught, as it allowed them to be updated in their respective fields. However, these benefits were not always appreciated by the organisation, as Do related: 'Sometimes the workplace didn't want me to give classes or lectures' (Do, 118). This lack of recognition had negative repercussions on balancing work and family life and combining both positions.

Discussion

The present study aimed to explore the links that PhD holders at the boundaries maintain with academia, and their involvement in knowledge brokering activities across disciplines. The final purpose was to explore the extent to which different academic links account for knowledge brokering activities to gain deeper understanding of the contemporary trajectories of PhD holders, particularly those who pursue careers at the boundaries between academic and non-academic sectors.

Overall, the results show that PhD holders employed in non-academic sectors navigate diverse professional links with academia, including both *organisational* and *individual-based links*. On the one hand, *organisational-based links* reflect the evolving landscape of science and innovation (OECD 2012; 2021), where PhD holders contribute to intersectoral interactions and collaborations, often bridging the gap between academic and non-academic sectors. On the other hand, PhD holders with *individual-based links* represent the emergence of hybrid careers (Boman et al. 2021; Cañibano et al. 2019; McAlpine, Skakni, and Inouye 2021), which are increasingly popular in a context characterised by academic precarity and the search for career opportunities across sectors (Cattaneo, Horta, and Meoli 2019; McAlpine, Skakni, and Inouye 2021; William-Stoten 2023). These links provide evidence of the agency of PhD holders in engaging with multiple sectors, despite a lack of organisational support or resources to do so.

Regarding the nature and scope of PhD holders in brokering activities, we provide evidence of how they perceived their involvement in activities related to *knowledge co-creation*, *knowledge translation*, *capacity-building*, and *network promotion*. We

found that participants accounted for the multidirectional processes that occur in *knowledge translation* and *capacity-building* activities to ensure the effectiveness and applicability of knowledge in practical and specific contexts (Hargadon 2002; Mayer 2010). Moreover, they account for the distributed, creative, and integrated nature of *knowledge co-creation* (Carayannis and Campbell 2019). This distributed mode of knowledge differed from the asymmetrical and hierarchical processes that emerged in *knowledge translation* and *capacity building,* where PhD holders described themselves as playing a central role in facilitating the adaptation, relevance, and utility of translated knowledge.

One of the main contributions of the study lies in the emergence of four qualitative profiles of knowledge brokers exhibited by participants. Both *knowledge co-creators* and *bridge builders* maintained professional links with academia and performed organisational-based knowledge brokering activities, that is, as part of their organisational roles. Nonetheless, their activities differed significantly. Participants in the first profile were involved in co-creation with external academic institutions, whereas *bridge builders* were involved in translating academic knowledge to a diverse range of stakeholders. The latter also frequently engaged in capacity-building, as they taught in academia holding individual-based links with it. *Valuable knowledge holders*, on the other hand, were not required nor involved in maintaining any professional link with academia, although they actively responded to the demands and needs of their non-academic organisations for academic knowledge translation. Finally, PhDs included in the *knowledgeable associate lecturer* profile were the only ones whose academic links and knowledge brokering activities were mainly individual-based and teaching-oriented.

These profiles reveal a complex relationship between PhD holders' links with academia and the knowledge-brokering activities they carry out (see Figure 1). Although academic links can act as a catalyst for knowledge brokering, we provided evidence that some PhD holders act as brokers without maintaining links with academia, and others do not actively engage in knowledge brokering despite their academic links. These findings suggest that knowledge brokering is related not only to the link with academia but also to other career factors; for instance, the organisational culture and support, research performance in the primary job position, and disciplinary backgrounds (Cattaneo, Horta, and Meoli 2019; Millard 2018; Pablo-Hernando 2015), as well as PhD holders' agency and motivation to contribute to their professional fields (Pérez-Rojas et al. 2022).

According to our findings, PhD holders were more likely to develop knowledge brokering activities when such activities aligned with their organisations' mission, received adequate support, and conducted research as part of their main job. STEM participants, who were mainly *knowledge co-creators and valuable knowledge holders*, were the most likely to be employed under these conditions and, thus, to be involved in *knowledge co-creation.* This may be considered the highest level of knowledge brokering (Abbate and Coppolino 2011; Carayannis and Campbell 2019) and the basis for the co-production of valuable evidence for innovation and policymaking (Adelle et al. 2019; Jütting 2020).

Conversely, other PhD holders were less likely to develop knowledge brokering despite maintaining links with academia. This was particularly the case for *knowledgeable associate lecturers*, who held academic precarious contracts mainly focused on teaching. These conditions limited their possibilities to establish research collaborations between both sectors, particularly when their academic links and knowledge brokering efforts

were solely individual-based, thus, not part of their organisation's mission. This typically aligns with non-research-oriented job positions and was more common among HASS PhD holders, which may be related to a lower demand for researchers beyond academia in these areas. Surprisingly, however, HASS PhD holders acting as *bridge builders and co-creators* illustrated an emerging shift in the type of academic links and knowledge brokering activities in their disciplines, which has not been mentioned in previous research. According to our data, some organisations related to these disciplines are shifting towards more based research and innovation practices, thus asking PhD holders to maintain academic links and lead translation and capacity building across sectors (Figure 2).

Several implications can be drawn from the study. The results challenge the traditional binary narrative of career trajectories as being solely 'within or beyond' academia, urging us to further explore the life-career trajectories of PhD holders at the boundaries between sectors (Cañibano et al. 2019; Lam 2007; Pablo-Hernando 2015). As these careers reside in interaction between sectors, we suggest that future studies explore bounded cases of PhD holders and knowledge brokering across organisations, not only by exploring the perceptions of PhD holders themselves but also those of their colleagues, supervisors, and the outcomes of the activities. Additionally, it may be pertinent to address past experiences, future aspirations, and personal values related to these careers, as well as their inclination towards knowledge brokering.

Additionally, the study results have implications for current debates on the direction of PhD training and expansion of PhD graduates. On the one hand, they support the need to move beyond the debates on the academic vs. market PhD orientation towards a broad consideration of the principles of responsible research and innovation

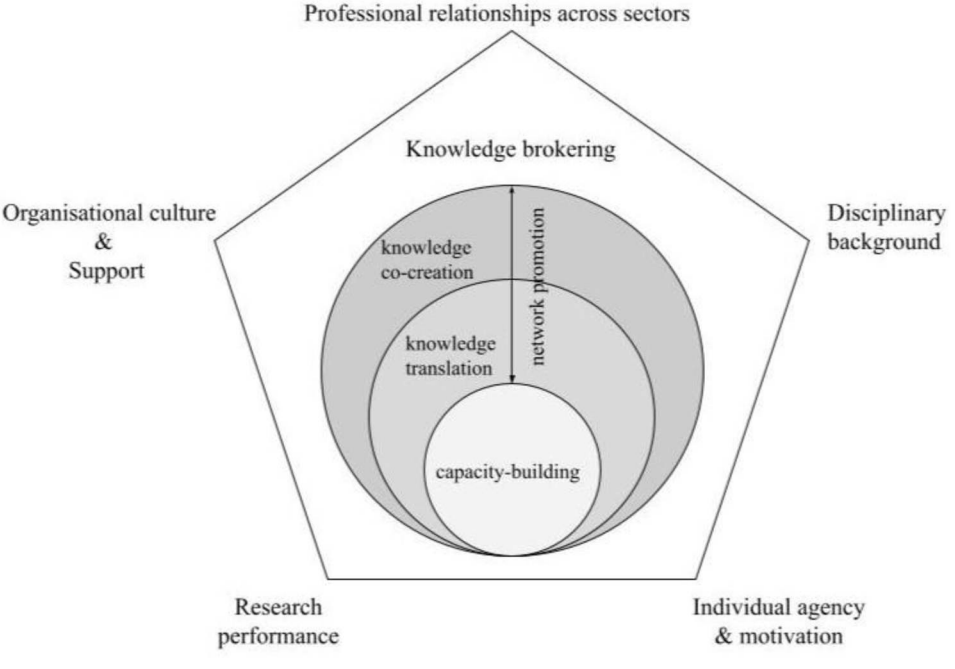

Figure 2. Complex relationship of PhD holders performing knowledge brokering.

as drivers of reforms affecting doctoral education and the particular characteristics of doctoral programmes. Equipping PhD candidates with transversal and soft skills, including effective communication and teamwork, to facilitate knowledge brokering across various contexts and stakeholders is required. Consistently, PhD programmes must provide flexible, open, and individualised training, including opportunities for co-creation and translation of research across sectors.

On the other hand, our results underscore the imperative for policymakers and stakeholders to formulate targeted and systematic policies aimed at fostering, endorsing, and sustaining knowledge brokering activities, also for those PhD holders who navigate careers at the boundaries, and not only in research-based companies, usually from STEM, but also in other companies engaged with innovation or capacity building, most frequent in HASS. Institutions should actively encourage both financial and non-financial incentives to encourage and facilitate knowledge brokering, ultimately leading to the advancement of scientific and innovative environments.

Nevertheless, the study is not without limitations. First, we acknowledge the possibility that participants may not have mentioned certain knowledge brokering activities since we did not explicitly mention them during the interviews. Instead, we asked them about the daily work activities they consider relevant because we wanted those that emerged to be relevant and accurate in their careers. That emergence led us to focus on this type of activity. Second, research conceptions and values attributed to knowledge brokering were not either explored and, according to previous research, they may function as mediators of the knowledge brokering activities they carry out or mention (Li and Horta 2023) and of the professional identity they develop (Giralt-Romeu, Liesa, and Castelló 2021, 2024). This is something we started to analyse throughout our data to complement the current results. Despite these limitations, findings are unique, especially in the Spanish context, and, besides providing valuable insights into the complex dynamics of PhD holders' career paths, can ground future studies to delve further into the role of PhD holders as knowledge brokers.

Notes

1. European project funded from the European Union's Horizon 2020 Science with and for Society programme aimed to enhance PhD training programs and foster a culture of co-operation across sectors (https://docenhance.eu/).
2. Although there is no general agreement on defining who can be considered an early career researcher, we applied the EU ten years threshold to guarantee they all obtained their PhD after the doctoral education reform in Spain and their labour market conditions shared similar socio-economic structural characteristics and time-constraints (Castelló, McAlpine, and Pyhalto 2015; https://euraxess.ec.europa.eu/jobs/hrs4r).
3. Interview protocol available at https://www.researcher-identity.com/single-post/ecrid-interview-protocol.
4. The interviews were transcribed verbatim, with essential clarifications added in brackets to ensure comprehension. The transcriptions were made using SONIX online software and then translated from Spanish into English. The personal names and confidential data have been anonymized following ethics clearance procedures.
5. Associate lecturers are university teaching staff hired on a temporary, part-time basis (https://eurydice.eacea.ec.europa.eu/national-education-systems/spain/conditions-service-academic-staff-working-higher-education).

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