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Science Parks and talent attraction management: university students as a strategic resource for innovation and entrepreneurship

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ABSTRACT
This paper aims to expand our understanding of talent attraction management in Science Parks with a specific interest in university students/alumni as a human and strategic resource. The underlying rationale is how the links with universities can be supported and how the Science Park management can contribute to successful relationships with universities and university students/alumni, in order to develop tenant firms and the park itself. A questionnaire was sent out in 2018–120 parks. This study includes 25 variables, and four significant regression models are presented. The main finding is that Science Park talent attraction activities act as a mediating variable, which affects the informal and formal partnerships between students and firms/universities as well as how the park management can contribute to successful relationships. By attracting students, tenant firms can have a positive impact on their performance as well as Science Park development.

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Talent attraction management; Science Park; university; students

1. Introduction

Over the last several decades, scholars have undertaken many studies regarding Science Parks' relevance, networks, and performance from mainly the park, firm, and regional perspectives. One aspect of developing a park that is gaining attention is the attraction of talent, which may include attracting specific knowledge that facilitates the establishment and creation of companies; or reaching skilled workers such as university students. The characteristics of the attracted talent affect the performance of the Science Park, and park managers need to understand the firms' needs better to attract talent effectively (Cadorin, Klofsten, & Löfsten, 2019a). Universities are the primary source of talent; thus, informal and formal cooperation with universities is an important dimension (Bergegal-Mirabent, Ribeiro-Soriano, & García, 2015; Cadorin, Germain-Alamartine, Bienkowska, & Klofsten, 2019b; Hu, 2008).

Although there is no major definition of a Science Park, some concepts describe the phenomenon such as Research Park, Technology Park, Business Park, and Innovation

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Centre (Eul, 1985; Guadix, Carrillo-Castrillo, Onieva, & Navascues, 2016; Monck, Porter, Quintas, Storey, & Wynarczyk, 1988). This study follows the International Association of Science Parks and Areas of Innovation (IASP) definition, which states that a Science Park is 'an organisation managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions'. Feldman (2007) underlines that large firms, as well as incubator-linked Science Parks, represent different kinds of 'innovative platforms'.

Academic literature addresses the definition of talent mainly as objects (characteristics of people) or as subjects (people): 'Object approach includes the ability, capacity, capability, commitment, competency, contribution, experience, knowledge, performance, and potential, patterns of thought, feeling or behaviour, and skills that are related to the characteristics of people' (Gallardo-Gallardo, Dries, & González-Cruz, 2013, p. 293). The subject approach assesses talent by considering either all people in the organization or just an elite subset of the organization's population (Gallardo-Gallardo et al., 2013). Meyers, van Woerkom, and Dries (2013) defined talent through five approaches: giftedness, strength, (meta-) competencies, high potential, and high performance. However, there are several problems in defining talent (Lewis & Heckman, 2006; Thunnissen, Boselie, & Fruytier, 2013). Talent concept comprises people with specific experiences and abilities (Gagné, 2004; Saddozai, Hui, Akram, Khan, & Memon, 2017). Talents are often interested in developing a corporate culture, social networks and organizational structure, all of which are difficult for competitors to copy (Barney, 1995). Talent skills include potential, performance, creativity, competence, and leadership abilities (Saddozai et al., 2017) that can achieve unusual results (Gagné, 1985; Gallardo-Gallardo et al., 2013; Saddozai et al., 2017; Tansley, 2011). High performers or high potential candidates can only be considered talents if they also have exceptional abilities (Thunnissen & Van Arensbergen, 2015).

According to McDonnell, Collings, Mellahi, and Schuler (2017), there is a growing body of literature on talent management. The increasing internationalization of small- and medium-sized firms further increases the competition for talent, especially for individuals with the ability to make accurate judgements and quick decisions (Tarique & Schuler, 2010). There has also been an on-going debate regarding talent management in the academic literature (Boudreau & Ramstad, 2007; Collings & Mellahi, 2009; Groysberg, 2010; Lewis & Heckman, 2006; McDonnell, 2011). Talent management encompasses managing the supply, demand, and flow of talent, and, according to McDonnell et al. (2017), its growing significance appears premised on the assumption that efficient talent management is a key source of competitive advantage.

Cadorin, Johansson, and Klofsten (2017) found that Swedish Science Parks had developed several tools for attracting talent, independently or in collaboration with stakeholders. Despite the interest in Science Parks among researchers, practitioners, and policymakers to promote innovation, entrepreneurship, and regional development, a few studies have focused on Science Park development from the perspective of talent attraction management and the collaboration that occurs in the talent attraction processes (Bellavista & Sanz, 2009; Bonacina Roldan, Hansen, & Garcia-Perez-de-Lema, 2018). In this paper, the underlying rationale is how the links with universities can be supported and how the Science Park management can contribute to successful relationships with universities and university students/alumni, in order to develop tenant firms and the Park itself. For this aim, our research question is:

> ***RQ:*** *how can talent attraction management developed by Science Parks build successful partnerships with students/alumni and universities/firms?*

This study investigates Science Parks in Europe and Brazil to expand our understanding of talent management in the fields of innovation and human and strategic management. We analysed 59 Science Parks in 2018: five parks in Brazil and 54 parks in Europe. A sample of 59 parks positioning this paper in the top 20 percentile of earlier conducted studies using the Science Park as a unit of analysis. All the parks surveyed were IASP full-members, and total employment (among the firms and park management) was 217,055. In the parks surveyed, the number of park management employees ranged from 3 to 108, with a mean of 23 employees. This study contributes to the literature on Science Parks and talent management and addresses policy issues on park management.

This paper is structured as follows. Section 2 presents the literature review, hypotheses and research model. Section 3 describes the sample, methodology, and type of investigation. Section 4 presents the analysis and empirical findings. Section 5 discusses the patterns of the linkages between talent attraction activities of the Science Park management and students and outlines limitations and directions for future studies. Section 6 concludes.

2. Literature review and hypotheses

Collings and Mellahi (2009) develop a theoretical model of strategic talent management that provides a view of talent management, which includes integrated and interrelated processes. However, talent management does not have a clear definition in the literature, and there are several arguments around the types, processes, and elements of talent management. Nevertheless, talent management is a strategic and holistic approach to human resources, business planning, and strategic management. Lewis and Heckman (2006), criticize the variety of definitions that increase confusion around original findings, conclusions, and the purpose of talent management. Boudreau and Ramstad (2005) argue that differential investment in working groups with the term 'pivotal talent' is strategically important and necessary for the organization. Lawler (2008) underlined that talent is critical for innovating, changing, and achieving high performance. Thus, acquiring the right talent is essential as a source of competitive advantage for firms.

The firm's competitive advantage relies mainly on its ability to innovate and its human resources, and Science Parks have a high concentration of resources (Cheba & Hołub-Iwan, 2014; Ferguson & Olofsson, 2004; Holland, Sheehan, & De Cieri, 2007; Siegel, Siegel, & Macmillan, 1993). In order to meet company needs, human resource management introduced a new strategic level named talent management, which focuses on this special group of people rather than the entire company (Saddozai et al., 2017). The main objective of talent management practices is 'to attract, develop, motivate and retain talent' (Thunnissen et al., 2013, p. 1752). However, previous research has been criticised for being fragmented with a narrow focus on human resource activities. Moreover, an analysis that considers human resources as a system is still unusual in the research literature (Lau & Ngo, 2004; Laursen & Foss, 2003). In organizations, developing business strategies, directing and acting, arranging conditions to compete, and making the right decisions depend on owned talent and the efficiency of their competencies. Business accomplishments and the creating and executing of strategies depend on the depth and quality of the talent in the organization (Collins, 2001).

According to Phan, Siegel, and Wright (2005), company maturity imposes different talent needs. More mature firms demand a wide-ranging of talents (Siegel et al., 1993) to improve existing processes through contact with innovative ideas of young mindsets (Klofsten & Jones-Evans, 1996), and the park and its local university offer a continual flow of graduates (Etzkowitz, 2008; Florida, 1999). The assessing of academic knowledge is a fundamental principle of Science Parks (Lindelöf & Löfsten, 2005; Löfsten & Lindelöf, 2002). Younger companies often lack technical or managerial competence in their teams (Bøllingtoft & Ulhøi, 2005), relying more on Science Park support to find professionals with specific skills, managers or CEOs (Zhu & Tann, 2005). Experienced entrepreneurs provide the skills needed to strengthen the academic spin-off team in its early stages of development (De Cleyn, Braet, & Klofsten, 2015). Understanding the nature of talent and selecting those appropriate for organizations has become critical to business survival. (Cappelli, 2008; Thunnissen et al., 2013). Svensson, Klofsten, and Etzkowitz (2012) explore the dynamics of change among the triple helix actors that involves building consensus within the city and with its neighbouring city.

The concept of linkage among universities, academic research, and firms is central to the Science Park model (Albahari, Klofsten, & Rubio-Romero, 2019; Quintas, Wield, & Massey, 1992). Science Parks are important actors in entrepreneurial ecosystems because they establish a mixture of stakeholder relationships among universities, firms, governmental agencies, incubators, and other parks (Albahari et al., 2019; Cadorin et al. 2019a). In addition, the environment provided by Science Parks is conducive for companies to build a collaborative network and maximize the results of their talent management activities (Hu, 2008; Schweer, Assimakopoulos, Cross, & Thomas, 2012), which contributes to the park's talent attraction factor.

Science Parks support and stimulate the exchange of knowledge and talent between tenant companies and the local university (Cadorin, Klofsten, Albahari, & Etzkowitz, 2019c). In fact, Colombo and Delmastro (2002) and Westhead (1997) note that Science Parks should focus on the establishment of connections with universities to facilitate access to skilled human capital, such as students with innovative ideas, and academics (Martin-Rios, 2014; Mellander & Florida, 2011; Vedovello, 1997). Hypothesis 1 is therefore formulated as:

H1: *Networking and attracting dimensions is positively related to Science Park talent attraction activities*

Studies have contributed to the knowledge of the positive relationship between human resources and firm performance (Alagaraja, 2013; Jiang, Wang, & Zhao, 2012) and the link between innovation and human resource activity has also been addressed (Beugelsdijk, 2008; Ceylan, 2013; Chang, Gong, Way, & Jia, 2013; Jiang et al., 2012; Jiménez-Jiménez & Sanz-Valle, 2005; Lau & Ngo, 2004). Cooke (2007) underlines that entrepreneurship and talent variables have been understated in the research literature and categorizes regional innovation systems according to the stability of these variables. However, Hommen, Doloreux, and Larsson (2006) found that the entrepreneurial university basically was 'absent from the scene', mainly in the early days of the Science Park.

Hogan (1996) divides performance of Science Parks into two different categories: (i) intrinsic, those related to the attainment of technological synergy, and (ii) extrinsic, related to economic development. Albahari, Catalano, and Landoni (2013), Guadix et al. (2016) and Lee and Yang (2000) discuss other performance dimensions such as years of operation, R&D expenditures, the incomes and the innovation outcomes of the tenant firms, and linkages with local universities and research centres. Bigliardi, Dormio, Nosella, and Petroni (2006) and Guy (1996) highlight the network of partners has a significant impact on Science Park performance. Cadorin et al. (2019a) underlines a major advantage of Science Parks is that the parks offer services that firms find difficult to provide in collaboration with other stakeholders, such as networks with educational and research entities; assist in the subsequent exchange of knowledge; build strategic alliances; attract talent; and discover partners in contracts and agreements. Through the Science Park´s broad network and collaboration with students, researchers, and firms, a Science Park often functions as a mediator between students and firms, such as teaming up students with entrepreneurial ventures for writing theses, internships and job recruitments. Important objectives for the park management is hence to extend the exchange of knowledge and development of joint projects between tenant firms and the university and to enhance informal and formal relationships between students and firms in the Science Park.

In this study, we focus on the characteristics of the relationship among the talents, the park management, and universities/firms and how the talent attraction activities of the Science Parks' management can increase the partnerships (performance) with students and firms/universities. This means that the Science Park talent attraction activities is the focus of our analysis. We hypothesize that Science Park talent attraction activities explain the relationship among the other factors in this study. First, we explicitly focus on Science Park talent attraction activities and suggest that *Networking and attracting dimensions* will foster a fruitful environment and affect talent attraction activities in the Science Park (Hypothesis 1). Second, we propose that Science Park talent attraction activities foster partnerships between talents and universities and/or firms. The process of mediation is defined as the intervention caused by this mediator variable: Science Park talent attraction activities. Hypotheses 2 and 3 can, therefore, be formulated as:

H2: *Science Park talent attraction activities is positively related to Partnerships with talents and firms/universities.*

and

H3: *Science Park talent attraction activities will positively intermediate the relationships among Networking and attracting dimensions and Partnerships with talents and firms/universities.*

The arguments outlined in hypotheses 1, 2, and 3 clarifying that the variable Science Park talent attraction activities serves as a link between H1 and H3 (see Figure 1). Thus, the research model suggests a mediating role for Science Park talent attraction activities and the main objective in the forthcoming analysis is to confirm that this variable functions as a mediating variable.

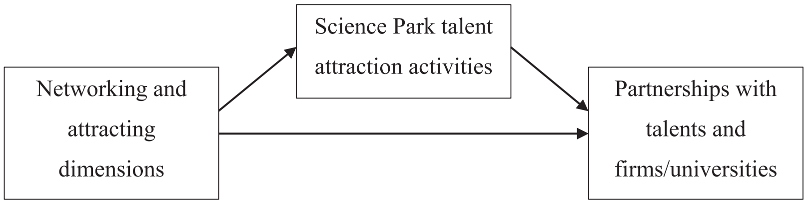

Figure 1. Research model.

3. Sample and method

3.1. Sample of Science Parks

This research is part of the bilateral strategic cooperation agreement between Brazil and Sweden and aims to analyse the development of Science Parks from the perspective of talent attraction management. One aim of this cooperative agreement is to encompass different contexts: economic, political, and cultural. A questionnaire was sent out in June 2018–120 parks in Brazil and Europe, which are IASP full-members and, hence, active Science Parks. The survey remained available until September 2018. After discussions with the IASP team, it was agreed that our questions would be part of the '2018 IASP General Survey on Science and Technology Parks and Areas of Innovation', including an entire section on talent attraction. The goal was to ensure a relevant Science Park population and to get a better response rate by having the IASP team support. IASP was created in 1984 and today has 345 members around the world. IASP has three membership options: full-member, affiliate, and associate. The first considers Science Parks in operation; the second Science Parks under construction; and the third is for those who are not Science Parks.

The sampling resulted in a response of 59 parks of which five in Brazil, one in Austria, one in Bulgaria, two in Denmark, two in Estonia, one in Finland, six in France, two in Germany, two in Greece, four in Italy, one in Latvia, one in Lithuania, two in Poland, three in Portugal, one in Serbia, one in Slovenia, six in Spain, five in Sweden, one in Switzerland, two in the Netherlands, six in Turkey, and four in United Kingdom. Table 1 shows a 50.4 per cent response rate. The oldest park started in 1983, and the youngest park in 2015. Most parks have some sort of collaboration with a local university.

Among those not responding parks (58), three parks were not valid: two were incubators, and one was only a 'general contact'. To ensure the sample did not show any significant differences between Science Parks founded in different years, having a differing number of firms, number of employees, and park management in each park, we conducted an independent sample t-test to compare the means between two unrelated groups of the same variable (Levene's test for equality of variances and t-test for equality of means, sig. two-tailed). To conclude, the only significant difference between responding and non-responding parks was the founding year (significant at the 0.05 level).

The 59 respondent Science Parks host mainly micro or small firms (1–49 employees: 86.2 per cent), being micro firms (<10 employees) accounting for 55 per cent of the total. However, some large firms (>249 employees) are located in the parks as well: 3.46 per cent. The local firms are active in the technology sectors, electronics, biotechnology, energy, chemistry and chemicals, electrical power, computer science and hardware,

Table 1. Descriptive statistics of the surveyed Science Parks, 2018.

1. Science Parks – sample and response rate:							
N (population): 120	No valid Science Parks: 3						
n (response): 59	Response rate (%): 50.43						
No response: 58							
2. *Science Parks – business data*							
	Response 59 parks			No response 58 parks			
	N	Mean	Std	N	Mean	Std	Sig. (2-tailed)
Science Park start year	59	1997.64	8.92	56	2001.75	10.96	0.029*
Total number of firms in each park	59	157.88	129.92	55	358.15	1706.01	0.370
Total number of employees in each park	58	3742.33	5188.57	33	3335.48	4788.97	0.713
Park management in each park[1]	59	22.85	22.29	34	17.38	25.10	0.280

3. Science Park location and university collaboration		
Your Park/Area is located[2]:	*Mean*	*Std*
On a university (or other Higher Education Institution) campus:	0.27	0.45
On land or premises owned by a government:	0.30	0.46
On land or premises owned by a private firm:	0.14	0.35
Other:	0.29	0.46
Incubator localized in the Science Park[2]:	0.77	0.43
Research institute localized in the Science Park[2]:	0.08	0.27
The Science Park´s core activity is business incubation[2]:	0.27	0.45
The incubator in the Park/Area supports its start-ups in the search for qualified professionals[3]:	3.54	1.13
Collaboration with universities[2]:		
Scientific infrastructure	0.61	0.49
Common services	0.58	0.50
Research groups	0.61	0.49
Formal agreements	0.83	0.38
No relationship	0.03	0.18

Notes: * = $p < 0.05$.
[1] = Number.
[2] = Yes (1), No (0).
[3] = 1–5.

information and communication technology, health and pharmaceuticals, consulting and advice, environment, micromachines and nanotechnology, software engineering, manufacturing and automation technologies, optics, military and defence, and food sciences.

3.2. Data collection and study design

The research team developed a questionnaire in two steps before finalizing it. First, we discussed our model and how to measure the questions quantitatively. Then, the questionnaire was pretested by the current and former CEO of the Mjärdevi Science Park in Sweden to identify uncertainties and avoid misunderstandings in the final survey. We asked the CEOs to verify the questions because the research objective is to capture park level responses. Thus, we expected respondents to be at a level equivalent to a park director, president, or manager. After the results and adjustments in the pre-test, we contacted IASP to request support in the execution of the survey. The first meeting was held on

December 2017 via Skype with the director-general and the chief operations officer of IASP participating. In this first meeting, we presented our survey proposal and the desired objectives. Because of the alignment of our research with park needs, IASP agreed to support the study. Then, our questions were reviewed and verified by IASP professionals to be approved and integrated into the annual IASP questionnaire. IASP then sent a link to the online survey with our questions to its full-member parks in Brazil and Europe. The questionnaire remained open for answers from June to September 2018. IASP was responsible for reminders and contacts with park managers until the end of the survey.

While questionnaires tend to be reliable, the artificiality of the survey format reduces validity. This study includes responses from 59 Science Parks; however, the sample was biased once not all Science Parks were objectively represented through random sampling and in such a statistical sample of a population, not all participants are equally represented (i.e. sample selection bias may be present). Sampling bias undermines the external validity of a test, namely, in this case, the ability to generalize the results to apply to the full population of the 345 IASP full-member Science Parks in 2018. Selection bias mainly addresses internal validity relating to the differences and similarities found within the sample.

When self-report questionnaires are used to collect data at the same time from the same respondents, common method variance may be a concern, which is strongest when both the dependent and explanatory variables are perceptual measures derived from the same participant (Podsakoff & Organ, 1986). Podsakoff, MacKenzie, Lee, and Podsakoff (2003, 2012) analyse some general sources of common method variance: the use of a common rater, the way items are presented to respondents, the context in which items in a questionnaire are placed, and the contextual influences. Our study reduces the risk of common method bias by using different headings and sections among the different items in the questionnaire. Harman's single factor score, in which all items (measuring latent variables) are loaded into one common factor, is also used. If the total variance for a single factor is less than 50 per cent, it suggests that common method variance does not affect the data. However, Harman's approach is to test for common method bias, but not to control for it. None of the factors in our study exceed 50 per cent (one factor: 32.840 per cent).

This study considers 25 variables, including four control variables (see Table 2). Most items are measured according to a five-point Likert-type scale. Since Science Park managers' perceptions are difficult to capture in terms of dichotomies, such as 'agree/disagree', 'support/oppose', 'like/dislike', or Likert scales, the measures are only approximate indicators. Both reflective and formative measures can be associated with a construct (Fornell & Bookstein, 1982). Furthermore, factor analysis assumes a reflective scale model and does not test for an alternative model for inter-item relations. This model was chosen over a formative model because belief clusters are often inter-related.

The 21 variables in Table 2 representing Partnerships with talents and firms/universities, Science Park talent attraction activities and Networking and attracting dimensions are responsible for measuring the influence of (i) talent attraction activities of the Science Park management, (ii) triple helix actors such as local governments and universities (including student communities and alumni networks), and (iii) dimensions for students to remain in the Science Park after graduation, such as opportunities to start businesses and innovative environments. Table 2 presents a summary of the three theoretical

Table 2. Variables used in the study.

(i) Partnerships with talents and firms/universities
Cadorin et al. (2019a) underlines that a major advantage of Science Parks is that the parks offer services that firms find difficult to provide in collaboration with other stakeholders, such as networks with educational and research entities and firms and discover partners in contracts and agreements (partnerships). Science parks are an instrument of interaction between firms and universities, facilitating links to the training and recruitment of qualified manpower for park firms (Vedovello, 1997). Also, park's incubator supports entrepreneurial academics (Huffman & Quigley, 2002) offering facilities (Etzkowitz & Klofsten, 2005; Walcott, 2002; Westhead & Storey, 1995) and business advice (Albahari, Barge-Gil, Pérez-Canto, & Modrego, 2018; Cadorin et al., 2017). In addition, Cadorin et al. (2019b) show that the exchange of knowledge and talent between universities and park companies is one of many activities that parks perform.

(ii) Science Park talent attraction activities
Science Parks offer a favourable environment for firms to adopt a collaborative network improving their talent management practices (Hu, 2008; Schweer et al., 2012). Younger and mature firms benefit from talent activities undertaken by Parks. The former relies on the park's support to recruit skilled professionals to fill the expertise gap of their team (Albahari et al., 2018; Phan et al., 2005). The latter demands a broad spectrum of talents (Siegel et al., 1993) and the park and its local university offer a continual flow of graduates (Etzkowitz, 2008; Florida, 1999).

(iii) Networking and attracting dimensions
The network of relations with universities and its students involves, for example, the promotion of recruitment fairs and events to attract the university alumni network (Cadorin et al., 2019a), as well as the integration between young talent and the management of parks and their tenant companies (Cadorin et al., 2019b). Environmental factors related to the quality of life, such as pleasant and affordable housing and good school options (Lecluyse, Knockaert, & Spithoven, 2019), along with working conditions and opportunities for relationships with other fellow workers (Thunnissen & Van Arensbergen, 2015) are crucial in attracting talent to Science Parks.

Variables	Mean	Std	Measure
1. The management team carries out activities in partnership with the university to enhance informal relationships between students and firms in the Science Park	4.29	0.70	1–5
2. The management team carries out activities in partnership with the university to enhance informal relationships between faculty and firms in the Science Park	4.29	0.70	1–5
3. The management team provides services to promote the exchange of knowledge and the development of joint projects between tenant firms and the university	4.29	0.72	1–5
4. The management team develops specific activities to support the talent-attracting activities of tenant firms	4.10	0.76	1–5
5. The management team is directly or partially involved in the management of the Science Park firms	3.51	1.12	1–5
6. The management team offers services and facilities for incoming firms and their employees, in order to assist them in resolving legal and family issues (housing, schools, medical assistance etc)	3.24	1.10	1–5
7. Attracting prominent firms to the Science Park is an efficient way to attract talent	4.19	0.71	1–5
8. The management team count on university student collaboration in the decision-making process	3.08	1.02	1–5
9. The management team cooperates with student organizations in order to get fresh ideas and spread park information among students	3.85	0.81	1–5
10. The management team develops activities to promote and support entrepreneurial students and researchers	4.36	0.64	1–5
11. The management team develops activities to attract senior professionals to the park tenants	3.71	0.95	1–5
12. The management team works to create a positive flow of foreign talents into the Science Park	3.85	0.96	1–5
13. The management team promotes activities to reach out and attract former university students (alumni network)	3.61	1.00	1–5
14. Influencing students to remain in the park after graduation is an efficient way to attract talent	3.80	0.85	1–5
15. The events and activities promoted by the management team play a relevant role in attracting talent to the Science Park	4.25	0.68	1–5
16. Support and encouragement to start a new business	4.46	0.57	1–5
17. Opportunities to work in an innovative environment	4.66	0.51	1–5
18. Opportunities to work with excellent professionals	4.46	0.60	1–5
19. Opportunities to work in prominent firms	4.36	0.69	1–5
20. Better opportunities to find a job	4.32	0.71	1–5
21. Quality of life facilities, e.g. parks and social meetings places	4.19	0.71	1–5
Control variables			
22. Science Park – age	20.17	8.86	Years
23. Science Park – number of firms	157.89	129.92	Number
24. Science Park – park management	22.85	22.29	Number
25. Science Park – total number of employees	3678.90	5166.67	Number

constructs together with the measures applied in the study, and references to previous studies. The focus of this study is to understand the constructs and the interplay between the constructs stated in hypotheses 1–3 and the main objective is to clarify if Science Park talent attraction activities is a mediating variable. The four control variables are included to isolate the effects of Science Park age and size. These consist of measures of alternative data from IASP regarding Science Park age, the number of firms in the Science Park, park management (number), and the total number of employees in the Science Park (size).

The statistical analysis consists of: (i) factor analysis (principal axis factoring) to convert potentially correlated variables into linearly uncorrelated factors (see Table A1), and to test whether measures selected for each construct exhibited sufficient convergent and discriminating validity; the Kaiser–Meyer–Olkin measure is calculated to determine sampling adequacy; (ii) a correlation analysis (both on the variable level and the factor level) to identify statistically significant measures (factors and control variables), and (iii) four regression analyses to test the links between the factors.

4. Analysis

4.1. Factor and correlation analysis

Considering that there are only 59 observations in this analysis, it is difficult to establish an adequate sample. Analysts sometimes use rules of thumb like the factor analysis requiring 5–10 times as many subjects as variables. However, some studies suggest that the required sample size depends on the number of factors, the number of variables associated with each factor, and how well the set of factors explains the variance in the variables (Bandalos & Boehm-Kaufman, 2009). For example, Preacher and MacCallum (2002) obtained good results with tiny sample sizes ($p > n$); however, Mundfrom, Shaw, and Ke (2005) found some cases where a sample size of $n > 100p$ was necessary. They found that if the number of underlying factors stayed the same, more variables and not fewer, as implied by guidelines based on the observations-to-variables ratio, could lead to better results with small samples of observations. In sum, if the conditions are good, fewer observations can be accepted.

This study uses factor analysis with principal axis factoring (varimax). Exploratory procedures are more accurate when each factor is represented by multiple measured variables in the analysis, with an ideal value of between three to five measured variables per factor (MacCallum, 1990; Safón, 2009). The Kaiser-Meyer-Olkin (KMO) measure is also calculated to determine sampling adequacy. The factor analysis reveals four latent variables (see Table A1). The four strong latent variables are: (1) *Involving tenant firms/students and attracting former students (alumni)* ($\alpha = 0.818$); (2) *Dimensions for students to remain in the Science Park after graduation* ($\alpha = 0.814$); (3) *Informal and formal partnerships with students and firms/universities* ($\alpha = 0.822$); and (4) *Science Park talent attraction activities* ($\alpha = 0.784$).

Although there is no agreement on the lower limit for Cronbach's alpha value, Hair, Anderson, Tatham, and Black (1995) state that 0.700 is the generally accepted value, and this may decrease to 0.600 in exploratory research. Bartlett's test of sphericity is also calculated. These tests provide a minimum standard before conducting a factor analysis (see note c in Table A1). Two factors are dropped from further analysis because they only contain one variable (variable 9: 'The management team cooperates with student organizations in order to get fresh ideas and spread park information among students' and variable 20: 'Support and encouragement to start a new business').

In the second step, we build a correlation matrix using Pearson correlation at the variable level (25 variables) to check the initial correlations (see Table A2 for correlations at the variable level). Then a correlation analysis at the factor level (see Table 3) was performed to identify the statistically significant factors (at least at the 0.05 level). The control variable *Science Park–age* has a statistically significant correlation with *Informal and formal partnerships with students and firm/university*. There are significant correlations between *Science Park talent attraction activities* and *Involving tenant firms/students and attracting former students (alumni)*, *Dimensions for students to remain in the Science Park after graduation,* and *Informal and formal partnerships with students and firms/universities.*

To estimate the degree to which any two measures are related, typically, researchers use the correlation coefficient. Correlations between theoretically similar measures should be 'high' while correlations between theoretically dissimilar measures should be 'low'. However, one problem with convergent-discrimination arises from the definitions of 'high' and 'low'. In Table 3, there are high correlations among three of the four factors. We can state here that we have convergent validity and high internal consistency (based on Cronbach's alpha).

4.2. Regression analysis

Regression analyses are applied to test the relationships (H1–H3) among the links in the research model (see section 2). Regression analyses are based on latent variables, which are constructed from the aggregated means of the underlying measures. Since all measures are expressed in Likert-type five-point scales, there is little risk of aggregated means being affected by extreme values. In our data analysis, the first step was the factor analysis; the second step was the correlation analysis, and then the third step is to test whether networking and attraction dimensions will have a positive effect on Science Park attraction activities (H1). However, according to the factor analysis, Hypothesis 1 (Networking and attracting dimensions is positively related to Science Park talent attraction activities*)* is modified and can be divided into two hypotheses: H1a and H1b:

Table 3. Correlation matrix: four factors and four control variables.

	1.	2.	3.	4.	5.	6.	7.
1. Involving tenant firms/students and attraction of former students (alumni)							
2. Dimensions for students to remain in the Science Park after graduation	.216						
3. Informal and formal partnerships with park management and students	.380**	.457**					
4. Science Park talent attraction activities	.566**	.486**	.544**				
5. Science Park – age	-.033	-.173	-.312*	-.034			
6. Science Park – number of firms	-.020	.169	.080	.143	.328*		
7. Science Park – park management	-.409**	.000	.003	-.255	.070	.127	
8. Science Park – total number of employees	.052	.123	.055	.143	.036	.539**	.065

Notes: *$p < 0.05$, ** $p < 0.01$.

H1a: *Involving tenant firms/students and attracting former students (alumni)* is positively related to *Science Park talent attraction activities*.

H1b: *Dimensions for the students to remain in the Science Park after graduation* is positively related to *Science Park talent attraction activities*.

Hypotheses H2 and H3 are slightly modified according to the factor analysis:

H2: *Science Park attraction activities* is positively related to *Informal and formal partnerships with students and firms/universities*.

H3: *Science Park talent attraction activities* will positively intermediate the relationships among *Involving tenant firms/students and attracting former students (alumni)*, *Dimensions for students to remain in the Science Park after graduation* and *Informal and formal partnerships with students and firms/universities*.

In general, the mediation model examines the relationships between the independent variables and the dependent variable, the relationships between the independent variables and the mediator variable, and the relationship between the mediator variable and the dependent variable. Multicollinearity is typically expected in the analysis of the mediator variable and the dependent and the independent variables and, therefore, is difficult to be avoided by the researcher. Although the mediation caused by the variable is challenging to predict statistically, statistics can be utilized to assess the assumed mediational model developed by the mediator variable.

Baron and Kenny's (1986) procedure is in this study applied to test the mediating effect of *Science Park talent attraction activities* and the four regression models are presented in Table 4. In fact, model 1 shows a positive and significant relationship between each dependent factor and the independent factor. The regression model is supported at the 0.05 significance level, namely, a strong regression model. Both latent variables (factors) in the model are supported at the 0.05 significance level. Hypotheses 1a and 1b are, therefore, supported. The next step is to test the relationship between *Science Park talent attraction activities* and *Informal and formal partnerships with students and firms/universities*. We hypothesize that the former will have a positive effect on the latter (H2). The results are presented in model 2 and show that the independent factor has a strong significant and positive effect on the dependent factor; thus, Hypothesis 2 is supported. The model is supported at the 0.05 significance level. We also hypothesize that *Involving tenant firms/students and attracting former students (alumni)* and *Dimensions for the students to remain in the Science Park after graduation* are positively and significantly related to *Informal and formal partnerships with students and firms/universities* (H3). Model 3 is significant at the 0.05 level, and both the independent factors are positively significant.

When the *Science Park talent attraction activities* is introduced in the regression analyses, the two independent factors weaken and *Involving tenant firms/students and attracting former students (alumni)* is not significant. However, the mediating variable is positive and significant, and the model is strongly significant. Thus, Hypothesis 3 is also supported. In sum, conditions 1 and 2 are met (see models 1 and 2), as are conditions 3 and 4 (see models 3 and 4). The analysis shows that the mediating variable (*Science Park talent attraction activities)* represents a partial mediation and it happens when the mediating variable is responsible for a part of the relationship between the independent and the dependent variables. However, Baron and Kennýs four steps (requirements) are met.

Table 4. Regression analyses. Unstandardized coefficients beta and standard errors (in parentheses).

	Model 1[a]	Tolerance	VIF	Model 2[b]	Tolerance	VIF	Model 3[c]	Tolerance	VIF	Model 4[d]	Tolerance	VIF
Involving tenant firms/students and attraction of former students (alumni)	0.312*** (0.065)	0.953	1.049				0.165* (0.065)	0.953	1.049	0.072 (0.074)	0.675	1.482
Dimensions for the students to remain in the Science Park after graduation	0.343*** (0.091)	0.953	1.049				0.308** (0.090)	0.953	1.049	0.205* (0.097)	0.759	1.318
Science Park talent attraction activities				0.474*** (0.097)	1.000	1.000				0.300* (0.128)	0.540	1.850
Intercept	1.722 (2.401)			9.644 (1.566)			6.360 (2.932)			5.843 (2.312)		
Adjusted R square	0.440			0.284			0.266			0.321		

* $p < 0.05$, **, $p < 0.01$, ***$p < 0.005$

[a] = Sig. 0.000***, dependent factor: Science Park talent attraction activities.

[b] = Sig. 0.000***, dependent factor: Informal and formal partnerships with students and firm/university.

[c] = Sig. 0.000***, dependent factor: Informal and formal partnerships with students and firm/university.

[d] = Sig. 0.000***, dependent factor: Informal and formal partnerships with students and firm/university.

Moreover, in terms of the R-square adjusted scores, there are differences in models 1–4. In model 1, the adjusted R-square is 0.44. The R-square of 1.0 indicates a perfect fit of a regression line's approximation of real data points and, consequently, Models 1 and 4 (Adjusted R square: 0.321) show a better fit than model 2 and 3 (Adjusted R squares: 0.284 and 0.266, respectively). It is, however, difficult to directly compare several regressions this way unless the same independent variables are used. Adding a new independent variable typically improves the R-square, but this addition is an optimization that may reduce the contribution of another variable.

According to the correlation matrix (Table 3), there is only one relationship among the four control variables and the latent dependent variable, the control variable *Science Park age* that is negatively associated with *Informal and formal partnerships with students and firms/universities*. If we include the control variable *Science Park age* in model 4, the control variable is negatively significant at the 0.05 level (0.017), and the adjusted R square is 0.378. The model is significant at the 0.001 level, and the only significant factor is the mediating variable.

We conduct a test for collinearity to check the findings further because highly collinear- or linear-related variables can cause problems with regression coefficient estimates. Multicollinearity is a statistical problem that occurs in regression analysis when there is a high correlation between at least one independent variable and a combination of the other independent variables (see the correlation matrix in Table 3 and Table A2). A VIF greater than five is generally considered evidence of multicollinearity, and a tolerance below 0.20 a cause for concern. We could not find any indication of multicollinearity in the statistical analysis (See Table 4).

5. Discussion and implications

This study contributes to the literature concerned with how talented people at universities can lay the foundation for the future performance of local firms. These implications are important for policymakers and Science Park managers who select and support local firms based on their business and innovation dimensions and support a firm´s development through the Science Park. Talent, in the form of graduate students, should be attracted to the Science Park for future development and performance. The proximity to universities and incubators and Science Park status and recruitment are also important factors in business location attraction (Löfsten, 2016). However, over the years, several researchers have questioned policies encouraging the clustering of firms as not being in the best interest of the regional economy (Bezdek, 1975; Galbraith, 1985: Lai, Hsu, Lin, Chen, & Lin, 2014). Hu (2006) found that spatial proximity of firms clustering within the Hsinchu and Tainan Science-based Industrial Park increases the interaction among high-tech personnel and the expansion of professional networks. Jonsson (2002) found that proximity is important; however, not for all firms, to different degrees and for a variety of reasons.

The main finding in this study is that we provide evidence that supports *Science Park talent attraction activities* as a mediating variable, enabling Science Parks to combine *Involving tenant firms/students and attracting former students* (alumni) and *Dimensions for students to remain in the Science Park after graduation* with *Informal and formal partnerships with students and firms/universities*. Our finding is particularly important in the sense that the Science Park management can use this evidence to develop actions that support the talent management activities of tenant firms, thereby enticing prominent firms and foreign talent to the Science Park through events and networking activities. One of the main objectives of Science Parks is to provide a sort of catalytic 'incubator environment' to transform science at universities into commercial innovations (Deeds, Decarolis, & Coombs, 2000; Moon, Mariadoss, & Johnson, 2019). Accordingly, it is desirable that the location of the Science Park is close to universities or academic research institutes. As such, the formal relationships can include patents, licensing, and cooperative alliances while the informal ones can include the mobility of scientists and engineers, social meetings, and discussions (Deeds et al., 2000; Pouder & St John, 1996).

Many studies in the area of talent management underpin the resource-based theory, which states that a firm´s specific competencies build its competitive advantage through the adaptation of human resource systems (Lado & Wilson, 1994). Several studies, relevant to the resource-based theory (Barney, 1991; Barney & Wright, 1998), provide results investigating human resources in the context of a firm's strategy to gain a competitive advantage. However, due to a lack of similarity in definition and theoretical framework, talent management gathers perspectives and practices from several fields such as human resource management, resource-based theory, and capabilities (Sparrow, Scullion, & Tarique, 2014). Competitive advantage can, hence, be obtained from talent management practices, which include attracting, developing, and retaining talent (Heinen & O'Neill, 2004). To gain a competitive advantage, first Science Parks need to increase their productivity by recruiting the right people to the park management team and assessing the relevant competencies based on the strategic goals of the park.

The talent attraction process starts with identifying talented people by assessing their potential and performance (Ross, 2013). Once the best people are identified and attracted, the challenge is to make it easier for companies to recruit and develop them, increasing company performance. Although many firms ensure excellent development opportunities, it is difficult to sustain this commitment over the long term (Younger, Smallwood, Group, & Ulrich, 2007). Developing talent should not be concentrated solely on skills for job performance.

At the process level, Science Park managers should encourage the development of social meetings, which are informal face-to-face meetings, as well as time spent discussing suggestions and ideas (personal interaction) with other people in the same business. By attracting students, tenant firms can have a positive impact on their performance as well as Science Park development. As the creation of an innovative environment and the development of opportunities for students result (at least partly) from the efforts of Science Park management, talent attraction activities also result (at least partly) from active management.

As in most research, this study has limitations, which offer avenues for future research. For example, researchers should investigate the relationship between Science Park talent attraction activities and informal and formal partnerships with students and firms/universities across a broader range of parks and settings. The survey data in this study captures only a single year. Future research could explore the multidimensionality of the interaction processes and capture them over a more extended period. Longitudinal qualitative studies can be conducted to allow a better understanding of the interplay between the independent and dependent factors. These processes evolve through a process of interaction, which this study could not capture. Thus, future research could explore changes in the mediating variable over time.

The government and local authorities play a role in demanding some directions in the orientation of the Science Parks and the lack of accuracy regarding the objectives and goals of Science Parks limits the possibility to evaluate and compare the parks. Previous research has been criticised for being disintegrated with a narrow focus on human resource activities and an analysis that considers human resources as a system is still unusual in the research literature. However, there are several general problems in defining talent and making the right business decisions depend on owned talent and the efficiency of their competencies which is difficult to measure. Talent must also include the drive to perform and be motivated at a high level.

6. Conclusions

This paper investigates European and Brazilian Science Parks to expand the understanding of talent attraction management in the context of innovation, human resource management, and strategic management. The analysis investigates how the mediating variable, Science Park talent attraction activities of the Science Park management, affects the Informal and formal partnerships between students and firms/universities. The analysis is based on a sample of 59 Science Parks and results in a model that includes four significant factors. These findings offer opportunities for Science Parks' management to analyse how the links between Science Parks and universities can be supported. Specifically, we identify how the management team can contribute to successful relationships among university, students/alumni, other academia, and firms to further develop the Science Parks.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix

Table A1. Factor analysis: Principal axis factoring with Varimax rotation (rotated factor matrix) [abc].

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5 [d]	Factor 6 [d]
Factor names	Involving tenant firms/students and attraction of former students (alumni)	Dimensions for the students to remain in the park after graduation	Informal and formal partner-ships with students and firms/ university	Science Park talent attraction activities		
Cronbach α	$\alpha = 0.818$	$\alpha = 0.814$	$\alpha = 0.822$	$\alpha = 0.784$		
Variable						
1.	0.039	0.220	**0.659**	0.370	0.187	-.0.056
2.	0.160	0.248	**0.808**	0.168	0.033	−0.159
3.	0.320	0.135	**0.543**	0.089	−0.166	0.233
4.	0.169	0.133	0.222	**0.522**	0.411	−0.099
5.	**0.717**	0.004	0.147	0.058	−0.178	-.0.01
6.	**0.656**	0.093	−0.063	0.335	0.129	−0.282
7.	−0.043	**0.506**	0.266	0.367	0.218	−0.014
8.	**0.710**	0.072	0.084	0.108	0.341	−0.062
9.	0.362	0.111	0.430	0.133	**0.541**	0.045
10.	0.086	0.150	**0.726**	0.047	0.145	0.048
11.	**0.439**	0.153	0.254	0.141	0.049	−0.584
12.	0.481	0.087	0.049	**0.641**	0.082	−0.097
13.	**0.746**	0.022	0.267	0.155	0.115	0.197
14.	0.338	0.268	0.297	**0.615**	−0.013	0.202
15.	0.129	0.337	0.442	**0.535**	−0.174	0.059
16.	0.063	0.266	0.100	0.049	0.031	**0.408**
17.	0.061	**0.657**	0.199	0.039	−0.334	0.152
18.	0.059	**0.764**	0.162	0.086	−0.166	−0.049
19.	0.027	**0.498**	0.224	0.235	0.086	−0.096
20.	0.004	**0.696**	0.186	0.056	0.306	0.122
21.	0.172	**0.621**	−0.049	0.119	0.335	0.181

Notes: [a] = Cumulative variance 59.826%.
[b] = (Cronbach α) > 0.500.
[c] = KMO = 0.668 and Bartlett's test of sphericity = 0.000.
[d] = Only one variable. It will be excluded from further analysis.

Table A2. Correlation matrix on the variable level between the 25 variables in the study (SP = Science Park).

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
1. The man – between students and firms in the SP																								
2. The man – between faculty and firms in the SP	.751*																							
3. The man team provides services to promote	.416*	.485**																						
4. The man team develops specific activities to	.531**	.368**	.103																					
5. The man team is directly or partially involved	.107	.240	.317*																					
6. The man team offers services and facilities for	.179	.246	.108	.382**	.457**																			
7. Attracting prominent firms to the SP is an	.415**	.345**	.198	.382**	-.008	.163																		
8. The man team count on university student coll	.232	.232	.200	.322*	.490**	.639**	.145																	
9. The man team cooperates with student organis	.418**	.418**	.315*	.477**	.244	.216	.354**	.540**																
10. The man team develops activities to promote	.504**	.659**	.411**	.245	.135	.074	.386**	.165	.477**															
11. The man team develops activities to attract	.285*	.389**	.124	.257*	.361**	.462**	.236	.435**	.348**	.287*														
12. The man team works to create a positive flow	.299*	.273*	.214	.494**	.317*	.603**	.271*	.382**	.326*	.146	.424**													
13. The man team promotes activities to reach out	.263*	.337**	.517**	.326*	.571**	.476**	.080	.522**	.481**	.276*	.316*	.529**												
14. Influencing students to remain in the park after	.511**	.423**	.437**	.355**	.322*	.385**	.439**	.359**	.384**	.265*	.227	.597**	.455**											
15. The events and activities promoted by the man	.495**	.495**	.408**	.414**	.257*	.170	.506**	.190	.290*	.422**	.274*	.400**	.248	.626**										
16. Support and encouragem to start a new busin	.141	.097	.052	.090	.102	-.066	.171	.170	.080	.257*	-.167	.035	.138	.269*	.184									
17. Opportun to work in an innovative environ	.182	.327*	.316*	.002	.093	.084	.321*	-.043	-.002	.271*	.115	.138	.074	.236	.447**	-.113								
18. Opportun to work with excellent professionals	.341**	.341**	.250	.162	.175	.042	.408**	.077	.112	.108	.207	.094	.102	.324*	.428**	-.021	.134							
19. Opportun to work in prominent firms	.322*	.358**	.207	.292*	.058	.159	.393**	.103	.224	.256*	.265*	.240	.130	.392**	.353**	-.146	.214	-.009						
20. Better opportunities to find a job	.369**	.369**	.187	.228	-.083	.122	.465**	.153	.300*	.278*	.064	.124	.205	.371**	.184	-.210	.151	.028	.090					

(*Continued*)

Table A2. Continued.

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
21. Qual of life, e.g. parks and soc meeting places	.204	.134	.130	.318*	.058	.208	.447**	.264**	.354**	.118	.082	.246	.227.	.237	.257*	-.140	.035	-.172	.155	.257*				
Control variables																								
22. Science Park – age	-.204	-.218	.281*	-.167	.040	-.008	-.104	-.089	-.243	-.310*	-.019	.110	-.057	.002	-.098	-.163	-.113	-.021	-.146	-.210	-.140			
23. Science Park – number of firms	.135	.006	.061	.127	-.151	.119	.166	-.007	-.162	.055	.056	.108	-.087	.090	.131	-.082	.004	.1234	.214	.152	.035	.328*		
24. Science Park – park management	.022	-.004	-.012	-.307*	-.215	-.170	.051	-.393**	-.283*	.004	-.352**	-.293*	-.455**	-.070	-.114	-.104	.027	.095	-.009	.028	-.172	.070	.127	
25. Science Park – total number of employees	.102	-.025	.108	.131	-.087	.218	.114	.059	.033	-.014	.062	.175	-.051	.121	-.009	-.143	-.070	.090	.112	.090	.155	.036	.539**	.065

Notes * = Correlation is significant (0.05-level), 2-tailed,** = Correlation is significant (0.01-level), 2-tailed.