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Maria Cecilia Flores
University of Bologna, Italy
mariacecilia.flores@unibo.it

Daniela Bolzani
University of Bologna, Italy
daniela.bolzani@unibo.it

Federico Munari*
University of Bologna, Italy
federico.munari@unibo.it

Rosa Grimaldi
University of Bologna, Italy
rosa.grimaldi@unibo.it

ABSTRACT

Motivated by the need to rethink the studies and the policies on academic entrepreneurship (Siegel and Wright, 2015), this study assesses the impact of receiving proactive communication and entrepreneurial support by the University Knowledge Transfer Office (KTO) on the awareness of entrepreneurship by graduate students (including doctoral and master's degree students). Through a randomized control study of 158 master's and PhD students from the University of Bologna, our analyses show positive and significant improvements in the awareness of university initiatives in support of entrepreneurship and in the perception of the university environment as favorable for entrepreneurship among those graduate students who were randomly assigned to receive proactive support and communication by the KTO. Our findings thus shed new light on the role of KTOs and university proactive policies in establishing an entrepreneurial climate within universities.

Keywords: student entrepreneurship; knowledge transfer offices; support policies; randomized controlled trials

JEL Codes: O3

*Corresponding Author
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The contents of this publication are solely the responsibility of the authors.

1 Introduction

The enhancement of knowledge transfer between public research institutions and industry has become a fundamental area for policy actions from national governments and regional authorities (Etzkowitz et al., 2000). Therefore, a wide array of public interventions have been implemented in this area in several countries and often addresses university Knowledge Transfer Offices (KTOs) as critical components of the entrepreneurial ecosystem. KTOs are boundary-spanning units that operate as supportive mechanisms for a smooth transition of research from academia to industry (Siegel et al., 2003), by providing technical advice, market expertise, networks and management of the commercialization processes related to patenting, licensing and creation of start-up companies (O'Shea et al., 2005; Phan & Siegel, 2006; Powers & McDougall, 2005). Although there has been a significant number of studies that have analysed the role of KTOs in different types of commercialization mechanisms – patents, licenses, spin-off creations, industry-university collaborations, and contracts (Link and Scott, 2005; Lockett and Wright, 2005; Siegel et al., 2007) - and the associated organizational structures typically adopted by KTOs (Bercovitz et al., 2001; Debackere and Veugelers 2005), we still know very little about the activities implemented by KTOs that can be associated with academic entrepreneurship (Balven et al., 2018).

Among such actions, communication and educational support activities play an important but often undervalued role. In line with Balven et al. (2018), we define communication and educational support efforts by KTOs as actions that are undertaken by the KTO to increase awareness of the university's internal entrepreneurial ecosystem, and awareness of the institutional bridging units that support science commercialization and entrepreneurship (including KTOs themselves) and their services for faculty members and students. Such proactive actions encompass a wide range of activities – such as direct mailing and

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communication campaigns, the organization of scouting events, seminars and workshops, face-to-face meetings on commercialization issues with researchers and students, and training courses - aimed at facilitating the flow of information, raising awareness and incentivising researchers and students to disclose new ideas and engage in their commercial valorization, thus contributing to a growing interest in entrepreneurship and technology transfer at the university level. Balven et al. (2018) argue that the extent to which the KTO attempts to promote the education of faculty members or students with regard to the university entrepreneurial ecosystem and the mechanisms of technology transfer could affect their decisions to pursue (or not) commercialization and entrepreneurship actions, as well as the type of pathway that they might use for this pursuit. However, to the best of our knowledge, no previous attempt has been made in the literature to assess the impact of this effort on the side of KTOs towards the academic engagement of students and faculty in entrepreneurship.

In addition, most of the literature has investigated the relationships between KTOs and university faculty and staff members, which is seen as the primary (if not unique) target group of the effort and policies for technology transfer. However, more recently, several studies in the field of academic entrepreneurship have highlighted that start-ups created by university graduates and students represent an important engine of university-based entrepreneurial activity. Start-ups created by students outnumber new ventures created by faculty and staff (Astebro et al, 2012). Nevertheless, there is still limited understanding of the most effective policy actions that can be implemented at the university level to enhance the participation of graduate students in entrepreneurial activity. Moreover, there is almost no evidence of the role that can be played by university KTOs in stimulating student entrepreneurship.

In this paper, we intend to provide a contribution to such important and undervalued issues by addressing the following research questions: “What is the impact of entrepreneurial communication and educational support implemented through university KTOs on the entrepreneurial awareness of graduate students and on their perception of the university as a context conducive to entrepreneurship?”. Moreover, we are also interested in assessing the role of contextual influences in moderating the relationships (Autio et al., 2014; Roach and Sauermann, 2010), to understand whether this impact varies according to the characteristics of the graduate students (comparing, in particular, master’s students and PhD students) and the institutional contexts (the university department) in which they operate. We focus on the students’ awareness of entrepreneurship support institutionalized at universities as outcome of interest since it represents an important trigger of the pre-startup and early phases of the venture creation process, positively related to the perceived supportive climate of the institution (Bergmann et al., 2018), that, in turn, affects entrepreneurial intentions (e.g., Huyghe and Knockaert, 2015).

To address such questions, we conducted a randomized controlled trial (RCT) in collaboration

with the Knowledge Transfer Office of the University of Bologna, in Northern Italy. A set of 411 master's and PhD Students of the University of Bologna in STEMM disciplines (Science, Technology, Engineering, Mathematics and Medicine) were randomly assigned to two groups: a group that received direct communication and educational support on entrepreneurship issues by the university KTO staff (in the form of personalized mailing on support initiatives offered for entrepreneurship, direct face-to-face advising in ad hoc scouting events and subsequent individual guidance activities), and a control group that did not receive this type of treatment but was exposed to business as usual. This RCT was to assess the impact of receiving this form of entrepreneurial support by the KTO on outcome variables related to the initial start-up formation process, namely the awareness of university initiatives in support of entrepreneurship and the perception of the university environment as conducive towards entrepreneurship. Such outcomes were assessed through a survey (both pretreatment and post-treatment) delivered to students in the treated and control group.

Our results, based on 158 responses to the post-treatment survey, suggest a positive improvement after the intervention in the awareness of university initiatives in support of entrepreneurship and in the perception of the university environment as favorable for entrepreneurship among those graduate students that were randomly assigned to receive proactive support and communication by the KTO. Such results, despite being strictly dependent on the specific context in which the intervention took place and based on a small sample, might be useful to suggest indications for the optimal design of university policies to proactively foster the engagement of students in the creation and management of new ventures, which we discuss in the final part of this paper.

The remainder of this paper proceeds as follows. Section 2 introduces the background literature on KTO activities and student entrepreneurship. Section 3 describes the research methodology and the data collection process centred on the RCT approach. Section 4 presents the variables and the estimation approach. Section 5 presents summary statistics and analyses of attrition. Finally, Section 5 discusses the main regression results, and Section 6 summarizes the conclusions and policy implications.

2 **Theoretical Background**

2.1 University role in fostering academic entrepreneurship

Universities are well known for facilitating job and wealth creation in an entrepreneurial society (Audretsch, 2014). As such, the enhancement of knowledge transfer between public research institutions and industry has been increasingly considered to be an important area of attention for national governments and regional authorities (Etzkowitz et al., 2000). Universities are facing a growing pressure to become "entrepreneurial" and to take a more active role in

developing new business activities to generate socioeconomic impact (Foss and Gibson, 2015). In this regard, university research has proven to be a rich source of new science and technology-based business activities (Audretsch, 2014; Colombo et al., 2010).

Technology transfer offices (TTOs) in universities are endowed with the task of bridging the gap between the research and business spheres, promoting the commercialization of research results (Siegel and Wright, 2015; Villani et al., 2017) and providing diverse types of entrepreneurial support to enhance science commercialization and technology transfer processes (Bolzani et al., 2020; Bae et al., 2014). Scientific articles that examine TTOs have typically focused on modelling and explaining TTO performance, especially in terms of generating 'measurable outcomes', including patents, licenses and spin-offs (Giuri et al., 2020; Siegel et al., 2003). Moreover, previous studies have mostly focused on the role of TTOs in the support of research-based commercialization activities by faculty members. The attention to student entrepreneurship is more recent (Wright et al., 2019). Universities have developed new strategies in support of student entrepreneurship, and parts of these strategies are implemented through KTOs, which have been the object of important organizational changes to address this new function (Siegel and Wright, 2015; Boh et al., 2016). In this sense, we propose to reconsider the role of TTOs in proactively supporting students' engagement in entrepreneurship.

2.2 Student involvement in entrepreneurship activity

Student entrepreneurship has become a matter of debate among scholars, practitioners and policymakers, not only because of its potential to exert a significantly positive effect on the economy (Åstebro et al., 2012) but also because it appears to be affected by an individual's perception of the entrepreneurial climate (Bergmann et al., 2018) and requires specific training that involves, ultimately, the development of an entrepreneurial character (Åstebro & Hoos, 2020).

Universities have been paying increasing attention to student entrepreneurship (Åstebro et al., 2012; Bergmann et al., 2018; Siegel and Wright 2015) and to the definition of strategies and organizational conditions to foster it (Rasmussen and Sørheim 2006). This change is also a consequence of the rising awareness that start-ups created by recent university graduates in general outnumber faculty spin-offs by at least an order of magnitude and that entrepreneurship among graduate students is a widespread phenomenon that is multidisciplinary, occurs throughout a wide set of disciplines and is not limited to a specific category of schools (Åstebro et al., 2012).

There are different actions to support student entrepreneurship: pushing entrepreneurial education and favouring the development of specific skills and competence on the side of students is key. As Åstebro & Hoos (2020) note, this support is especially important for Western countries, in which entrepreneurship training is mostly aimed at offering students an alternative career path or, more generally, at promoting entrepreneurial skills and intentions. Nevertheless, the effect of such educational effort can vary depending on other university-level contextual characteristics, including social influences and organizational culture (Bercovitz and Feldman, 2008). Moreover, the ultimate effect is also influenced by the perceived behavioural control of aspiring student entrepreneurs (Ajzen, 1991), e.g., the perception of the support that they are going to receive along the process, should they decide to be seriously engaged with entrepreneurship.

For this reason, the university's climate, active policies, and support interventions are key to explaining successful student entrepreneurship. The creation of an entrepreneurial supportive environment (e.g., Bercovitz & Feldman, 2008; Bergmann et al., 2018; Siegel and Wright, 2015) is relevant to helping students to increase their awareness of their entrepreneurial potential, to identify new entrepreneurial opportunities, to develop the necessary competencies to exploit them (Bae et al., 2014), to shape their initial ideas and to transform them into viable business plans. Along this process, university KTOs can play a central role. In many circumstances, they are in charge of implementing all of these support interventions, and therefore, they have a role in the creation of a fertile environment and supportive context that can help students throughout their entrepreneurial journey.

2.3 The role of KTOs' proactive policies in stimulating student entrepreneurship

KTOs are known for being critical components of the entrepreneurial ecosystem (Rasmussen et al., 2006). However, research on them has mostly focused on the role of TTO support for faculty and staff (Bergmann et al., 2018), and there is scant evidence about their role in providing entrepreneurial support policies for graduate students. In this respect, a limited number of recent studies have highlighted that KTOs can be the channel to reach out to graduate students through the implementation of training courses, seminars on entrepreneurship and commercialization issues (Bolzani et al., 2018).

The creation of an entrepreneurial culture or climate aims to enhance science commercialization and technology transfer processes (e.g., Bergmann et al., 2018), which is also intended for students (Siegel and Wright, 2015). Among the initiatives that are aimed at creating such an entrepreneurial climate, universities are increasingly offering curricular programs and extra-curricular initiatives - such as seminars, inspirational talks, face-to-face scouting and ad hoc thematic events. In many cases, KTOs are involved as partners or are directly in charge of the implementation of such initiatives. The survey by Bolzani et al. (2018)

covers 176 university TTOs in 28 European countries and shows that the vast majority (approximately 76%) of universities offer some types of training programs on issues related to science and technology entrepreneurship, which are organized with the direct involvement of the KTO. According to the survey responses, most KTOs conduct training activities that target doctoral and post-doctoral researchers (90%) and faculty members (82%), but undergraduate and master's students represent significant target groups as well (62%), although on a more limited basis. In this sense, the efforts of KTOs can be seen as being complementary to curricular programs in supporting new venture formation (Wright et al., 2009; Nelson and Monsen, 2014).

Nevertheless, there are studies that show that a significant share of university commercialization effort by faculty members bypasses KTOs (Fini et al., 2010). Additionally, there is evidence of frequent cases where scientists and students have scant knowledge and awareness of KTOs, of their work and of their existence (Huyghe et al., 2016), which is not desirable, in consideration of the important role that KTOs can play in supporting academic entrepreneurship.

In this sense, previous work has highlighted that KTOs should do a better job at making themselves more visible within academia, increasing awareness of the university entrepreneurial ecosystem, the office and its services (Balven et al., 2018). In line with this view, several KTOs are increasingly implementing specific proactive policies, that we define as communication and educational support actions, to proactively support the development of entrepreneurial skills among faculty members, as well as PhD, master's and bachelor's students. Such communication and educational support actions encompass a variety of activities that are aimed at reaching out to researchers and students. They include a) direct mailing communication towards students with entrepreneurial-related content (for instance related to: events and training courses on entrepreneurship available within the university or the local environment; availability of funding instruments or prizes to encourage entrepreneurial activities; stories and narratives of successful entrepreneurs); b) organization of ad hoc inspirational events on (such as training days, guided visits to laboratories and makerspaces, and face-to-face meetings with students aimed at identifying promising opportunities for forming new firms); c) the provision of advice and feedback in the early steps of the start-up idea development.

Such proactive communication effort has the objective of make the students aware of the entrepreneurial opportunities available within the university, providing them updated and systematic information on their organization and increase their perception of the university environment as conducive to innovation, experimentation and entrepreneurship. Their positive influence on entrepreneurial awareness is likely to be stronger as the communication effort is direct (able to directly reach out individual students, rather than being generically posted on a university website), specific (centered on topics and activities that can

be of direct interest of the student), and personalized (directly addressed to the individual student, in an emotional and customized way, rather than be impersonal and generic). To the best of our knowledge, no attempt has been made to assess the effectiveness of such activities in stimulating awareness and a positive perceived support for entrepreneurship, in particular among graduate students. This goal is the aim of our empirical study, which we describe in greater detail below.

In line with policy making research on entrepreneurial intention and behavior, we focus on all activities leading to an increase in the number of capable entrepreneurs within a population. In research aiming at students' adoption of an entrepreneurial path (e.g. Mok, 2005; Siegel and Wright, 2015), awareness of entrepreneurship as a desirable and feasible career orientation appears as a fundamental building block. We adopt Lundstrom & Stevenson's (2005: 42) definition of awareness as "the process whereby individuals become aware of business ownership as an option or viable alternative, develop ideas for businesses, learn the processes of becoming an entrepreneur, and undertake the initiation and development of a business". In this sense, motivation to startup a venture is affected by the social legitimacy perceived -in the university context- that can be increased through information, exposure and role models (Lundstrom & Stevenson, 2005). In line with this approach, awareness of entrepreneurship support institutionalized at universities has been positively related to the perceived supportive climate of the institution (Bergmann et al., 2018), that, in turn, affects entrepreneurial intentions (e.g., Huyghe and Knockaert, 2015) and takes an important role in increasing self-efficacy in public policy initiatives (Schmutzler et al, 2019). In addition to that, visible university led initiatives aimed at students, like business plan competitions, increase the awareness of the possibility of an entrepreneurial career among them (Fini et al., 2011). Therefore, awareness represents a very important variable to be studied in terms of entrepreneurial research and policy making, that stands as especially relevant on the pre-startup and first stages of venture creation (Hill and Leich, 2005).

3 Research Design

This study implements a RCT that is intended to assess the impact of receiving proactive communication and direct entrepreneurial support from the KTO on master's and PhD students' awareness of entrepreneurship policies at their *alma mater*[1], and on their perception of the university environment as conducive to entrepreneurship. The research design comprises the following steps: (1) data collection (baseline) from a wider population of graduate students

[1] In additional analyses we also investigate the effects of the intervention on an additional set of secondary outcome variables, such as the students' entrepreneurial intentions and their antecedents, their subsequent actual involvement in entrepreneurship-related activities, such as participation in acceleration/incubation programs and start-up formation.

with positive attitudes towards in entrepreneurship at the time of the intervention; (2) sample selection and randomization; (3) intervention implementation; (4) data collection (outcomes) after the intervention; and (5) analyses. In the following section, we describe in detail each of these steps. Figure 1 presents an overview of the process. During the process, the KTO was assisted and supported by our research team and specifically by a junior research fellow, who provided research advise and support in the design of the experiment and in its implementation.

Insert Figure 1 about here

3.1 Pre-treatment data collection: Baseline survey

The trial took place at the University of Bologna (www.unibo.it), which was founded in 1088 and is one of the most important higher education institutions across Europe. The trial was targeted to graduate students (Master and PhD) of STEMM Schools of the University of Bologna, with a particular focus to those showing a predisposition for entrepreneurship, as better explained in section 3.2. A set of STEMM master's and PhD Students of the University of Bologna were randomly assigned into two groups (with an allocation ratio of 1:1): a group that received direct communication and support on entrepreneurship issues by the university KTO staff, and a control group that did not receive this kind of treatment, being rather exposed as business as usual. The unit of randomization and analysis was therefore at the individual level (i.e., graduate student).

The baseline data collection was designed as an online questionnaire delivered by the KTO among master's and PhD students from STEMM (Science, Technology, Engineering, Mathematics, and Medicine) Schools. The main objective of this data collection was to obtain the baseline information on the variables of interest.

To administer the survey to a representative sample of the University's population in STEMM schools, we obtained data about the number of enrolled students in each school and identified relevant master's courses and doctoral programs where we could survey students. We selected, identified and contacted the in-charge professors of 9 courses within the University's STEM disciplines, attended by first year master's students enrolled in the 2018-2019 academic year[2]. For master's students, a member of the KTO staff visited each course in November-December 2018 and asked the students to fill out the questionnaire in their presence, presenting it as part of a research project implemented by the Department of Management and the KTO of the University of Bologna. For PhD students, the KTO staff got in touch in May 2019 with the PhD program coordinators of all PhD programs in STEMM areas of

the University of Bologna and asked them to circulate the survey on their behalf[3]. In total, we were able to obtain responses from 15 out of 27 STEMM PhD programs of the University of Bologna.

In this baseline data collection exercise, we collected a total of 482 responses to the baseline questionnaire from master's students and 161 responses from PhD students[4].

3.2 Sample selection and randomization

As a subsequent step, we screened the answers to the baseline survey and selected the set of respondents to participate our RCT based on the following criteria. An "attitudinal" criterion was adopted as screening criterion (in addition to inclusion criteria previously mentioned: being a Master or PhD student at the University of Bologna in STEMM schools), according to which students had to show an interest toward entrepreneurship, as measured by a response provided to a specific

[2] We carefully collected the data in terms of the number of expected students in each course, to estimate the representativeness validity of the sampling compared to the overall University's population representation of each of the chosen courses' schools.

[3] The different timings of the two surveys are due to their having a different calendar for academic activities in master's and Doctoral courses. While for the master's students, the academic activities start in late September, for Ph.D. students, they typically start in late January.

[4] The analyses of this set of responses to the baseline survey show a good level of representativeness with respect to the real distribution of master's and PhD students across the STEMM Schools of the University of Bologna.

Likert scale question of the survey[2] Indeed, previous research has clearly shown that entrepreneurial attitudes strongly influence students' intent to start a new business (Lüthje &Franke, 2003), suggesting that interventions aimed at fostering awareness about entrepreneurship support should prioritize these students. Based on these criteria, we identified 411 graduate students that were eligible and agreed to take part in the study, of which 328 were from master's and 83 from doctoral courses. We then implemented a stratified randomized experiment (Athey & Imbens, 2017), where we used the distinction between the master's and doctoral level as the covariate of interest[3]. We thus applied a 1:1 randomization within the two sampling strata (master's/PhD), in such a way that half of the selected respondents from each stratum were randomized to be in the treatment group and the other half were randomized to be in the control group. The random assignment to treatment and control groups was conducted using the functions provided for this purpose by Microsoft Excel.

Our sample is therefore composed of 164 master's students in the treated group and 164 master's students in the control group, in addition to 42 PhD students in the treatment group plus 41 PhD students in the control group. Overall, the two arms of our RCT involve a total of 206 treated graduate students who were exposed to the intervention (communication and educational support activities implemented by the KTO), and 205 graduate students who were not involved in the intervention.

As we will describe later, the design of the RCT involved direct communications between the KTO and the treated students, which were via e-mails and direct meetings. The design of the trial therefore minimized the overall risk of contamination because different behaviors were held by KTO staff with respect to treated and control students. However, we do not exclude some contamination taking place between students because treated students could inform control students about the received communications and invitations to events. To account for the potential problem of interactions between students and spillover effects on students of the control group, in the post-treatment survey, we asked students to report where they got the information about any event about entrepreneurship that they attended since the start of the treatment. Our data show that no student in the control group declared having received information from the KTO staff, contrarily to students in the treatment group.

The trial was carried out according to the rules for ethics in research and relationships with the

[2] More precisely, we analysed the responses (on a 1 to 6 scale) that were provided to the survey question: "Would you be interested in participating in the future in UNIBO activities/initiatives to support entrepreneurship and business creation?", and we considered only those graduate students who responded from 4 (Somewhat) to 6 (Very much), thus showing some interest for entrepreneurial activities.We thus considered this threshold to identify the sample to be randomized.

3 Indeed, in general terms, we expect that PhD students should be more aware of the opportunities in support of entrepreneurship available within the university ecosystem, due to the fact that they have a longer academic experience and they are more embedded in such system. We thus expect that the impact of receiving proactive communication and entrepreneurial support by the KTO should be more pronounced for Master students, as compared to PhD students.

students of the University of Bologna[4]. The data were collected in accordance to the General Data Protection Regulation, for what concerns the collection, management, conservation and use of data for research purposes. Only students providing their consent for the participation in the research project and providing their consent for the use of data at the moment of the pre-test questionnaire were included in the study and in the subsequent analyses[5].

3.3 Intervention

The communication and educational support activities in entrepreneurship, which constituted the treatment in our RCT, were conducted by selected staff of the University's KTO. The intervention started soon after the collection of baseline pretreatment questionnaires and the randomization of individuals to experimental arms, which was in December 2018 (M0) for master's students and May 2019 for PhD students. Clearly, only graduate students included in the treated group were involved in such activities, which were implemented ad hoc from the KTO for only such students.

The intervention followed a predetermined protocol organized around three phases and the following types of support activities: awareness-raising; direct contact; and ad hoc guidance. During the awareness-raising phase (which was undertaken for a period of 12 months), the staff of the KTO, which was always assisted and supported by the research team of the Department of Management, systematically informed, through personalized emails, the treated students on events or opportunities on entrepreneurship issues, which were organized within the University of Bologna (e.g., seminars, events, calls, courses, and more) and which could be useful for the development of their entrepreneurial ideas and competences. The emails also systematically reminded the students of the availability of the KTO to support the students. The KTO experts systematically tracked the responses to such emails by recipients.

To implement the "Contact phase" for the master's and PhD students, within the research project, we specifically designed and organized five scouting events in collaboration with the KTO staff. This Contact Phase, centered on the scouting events, was implemented over the period going from month M4 for Master students and M6 for PhD students to month M18, in partial temporal overlap with the awareness-raising phase described in the previous paragraph.

4 The Director of the Department of Management of the University of Bologna (on behalf of the Department, the Institution of the research team promoting the project) has approved the project, envisaging no ethical risks connected to the project.

5 The questionnaire included an initial consent form where the participant's consent were asked for processing their personal data, specifying that data would have been processed only for research purposes, not shared with third parties and reported only in aggregate to ensure anonymity. Consent for processing personal data needs were systematically recorded and documented.

Two scouting events were held at the central premises of the KTO: one event was held at the Incubator for the University of Bologna, Almacube, and two events were held at the Makerspace of the University of Bologna, AlmaLabor. Only students in the treated group received an invitation by email by the KTO to participate in such events, which lasted two hours each. Different experts from the KTO and from the University Incubator were involved in such events. They represented an opportunity to get in contact and directly interact with students who were interested in topics related to entrepreneurship[6]

Finally, in the "Ad hoc guidance" phase, the treated graduate students who participated in the events organized in the "Contact Phase" had the opportunity to directly meet and interact with experts from the KTO, to receive feedback on their entrepreneurial idea/project, address issues or problems, and create connections with other experts. This third phase was implemented after the second "Contact Phase", and partially overlapping with it over the period going from month M10 to month M18. Our research team participated to all of the meetings, providing advice and support.

3.4 Post-treatment data collection: final survey and objective outcomes

The collection of outcome data was carried out in two ways. First, we designed a dedicated online post-treatment survey for graduate students who were included in the treated group and in the control group. Similarly to the baseline survey, the KTO staff visited master's students' classes in October and November 2019 (in the subsequent academic year), asking the students to fill in the post-treatment questionnaire. With respect to the baseline data collection, this resulted to be a more difficult task, due to the fragmentation of master students across elective courses, rather than compulsory courses such as the previous academic year. Therefore, for the students who were not found in this way, the KTO staff sent them personal e-mails with a link to the questionnaire. For the doctoral students, data were collected by sending e-mails in May 2020 to PhD students who were included in the treated and in the control group, asking them to complete the new survey. For both groups of students, we carried out two additional rounds of recall. We received 158 complete responses to the post- treatment survey (78 by treated students and 80 by control students), of which 131 were from master's students (63 in the treated group, 68 in the control group) and 27 were from PhD students (15 in the treated group, 12 in the control group).

4 Variables and analytical strategy

[6] Each event lasted approximately two hours. The first part encompassed a brief presentation of the KTO, its services and the different support actions on entrepreneurship available within the University. This part was then followed by a session of discussion and Q&A of specific issues in science commercialization and new venture creation, such as IP protection, new venture formation, funding sources for start-up companies

4.1 Measurement of outcomes

Table 1 describes the main variables adopted in our analyses. The communication and support actions that were implemented as an intervention by the KTO had the goal of raising awareness among graduate students on entrepreneurship-related activities that were available in the university ecosystem. This was the primary outcome variable of interest of the study. To this purpose, *Aware* is a measure of the students' awareness of the University's initiatives to foster entrepreneurship, measured in the post-treatment survey on a scale that ranged from 1 (not at all) to 6 (very much)[7].

We also adopted a second dependent variable related to the perception of the university as an environment conducive to entrepreneurship, given that an additional objective of the intervention was that of increasing it among graduate students. In this sense, *Uni_entenv* is a variable measured as the students' perceived entrepreneurial environment at their university, based on a 3-item, 7-point Likert scale (anchored 1=strongly disagree; 7=strongly agree), adopted from Shirokova et al. (2015)[8]. The variable is construed as a factor score, which was built as the average score on all of the items. Cronbach Alpha for this variable is 0.90. See

[7] In the initial design of our research project and in the construction of the first survey, we maintained an open approach using several potential outcome variables (more precisely, 11 variables) that have been previously adopted by the literature on student entrepreneurship in order to capture intentions and behaviours connected to university students' involvement in entrepreneurial activities. In the course of the analysis process, and as a consequence of the interactions we had with the KTO, we realized that our intervention was more meaningful in relation to the initial objective to diffuse knowledge about the initiatives available in support of entrepreneurship within the university, so to stimulate the perception of a favourable environment for entrepreneurship, rather than to have a direct effect on actual engagement in entrepreneurship. For this latter type of objectives, the KTO highlighted that the support activities should have included additional time and resources to help students in navigating the entrepreneurial ecosystem outside the university (e.g., funding and legal advice to establish the company; search for partners), which was something out of its possible commitment to the project. We thus decided to narrow down the focus of our analyses to two primary outcome variables – *Aware and Uni_entenv* – which have a direct influence on entrepreneurial awareness and mindset. We maintained however a selected set of secondary outcomes variables in the analyses (more precisely, 4 secondary outcome variables), to give a more complete account of our empirical and analytical contribution.

[8] Since the initial design of the research project and the registration of the trial at the AEA RCT Registry, we also performed slight changes to some of the variables we mentioned in the Registry, for the reasons described in footnote 7. More precisely: A) there was a change in measurement approach for the *Uni_entenv* variable. Although we initially planned to construct this variable as 1-item scale about the perceived efficacy of university initiatives to support entrepreneurship, we then adopted a 3-item scale, replicating the construction of this variable from the highly influential article by Shirokova et al. (2015) on the intention-behavior link in student entrepreneurship; B) moreover, in the registration of the trial at the AEA RCT Registry, we also mentioned 3 outcome variables taken from the paper by Kautonen et al. (2015) – Entrepreneurial Intentions, Entrepreneurial Awareness, Entrepreneurial Feasibility – that we then exclude in the final analyses, due to the desire to focus on entrepreneurial awareness directly influenced by the university environment, as explained in footnote 7; C) finally, in the Registry we mentioned two variables (Participation in incubation or acceleration programs; Participation in business start-up creation) to be constructed recurring to objective data collected by internal sources of the KTO. For the sake of simplicity, in the implementation of the trial and in the data collection process, we decided to construct such two variables recurring to self-declared responses of the students in the survey.

Table 1 for a more detailed explanation of this variable.

In additional analyses, we also identified secondary outcomes, additional changes caused by the program that we were interested in observing, more related to increasing the involvement of graduate students in entrepreneurship-related actions. They are described in more detail in Table 1. A first set of variables refer to students actual participation (in the course of the previous year) in any university activity in support of entrepreneurship (*Particp_uni*), or to the intention to do so in the future (*Interest_particip_uni*)[9]. A second set of variables capture the student involvement, in the course of the previous year, in gestation activities for a potential new business (*Prep_actions*) or in any activity of planning, creation or management of a start-up (*Start-up*)[10]. All such variables were taken from the post-treatment survey, and are described in more detail in Table 1.

Insert Table 1 about here

4.2 Analytical strategy

For the evaluation of the effectiveness of the intervention, we are cautious about making a stable unit value assumption and instead account for the possible presence of interactions between students in each stratum of the sample (Athey & Imbens, 2017). In addition, we are concerned about possible non-compliance, in that treated students might not have fully received the treatment, for example, due to non-systematic management of their e-mail accounts and received e-mails, or lack of participation in educational events. We therefore employ intention-to-treat (ITT) regressions as modelled by the following model:

$$Y_i = \alpha + \beta_1 Treatment + \delta Y_{i,b} + \varepsilon_i \qquad (1)$$

where Y_i is the outcome for student *i* after the intervention (I.e., data collected in the post-treatment survey). Depending on the type of dependent variable (e.g., dichotomous, continuous

[9] More precisely, *Particip_uni* is a dichotomous variable that takes on the value 1 if students declared in the post-treatment survey that they had participated in any university initiative to support entrepreneurship and start-up creation in the course of the previous year, and it is 0 otherwise. *Interest_particip_uni* is a measure of the student's interest in participating in the University's initiatives to support entrepreneurship and start-up creation in the future, according to a scale anchored from 1 (1=not at all) to 6 (very much).

[10] More precisely, *Start-up* is a dummy variable that is 1 if a student declared in the post-treatment survey that they had been involved in any activity of planning, creation or management of a start-up over the previous year, and 0 otherwise. *Prep_actions* is a measure taken from the post-treatment survey that we adapted from Kautonen et al. (2015) and Shirokova et al. (2015), which refers to gestation activities for a potential business carried out during the previous year. It considers 10 different types of gestation activites (see Table 1 for their description).

discrete count), we implement different regression models to account for the linear model normality assumptions. The variable *Treatment* is a dummy variable that takes the value of 1 when a student was randomly assigned to the treated group (and therefore involved in the communication and educational support activities implemented by the KTO specifically for the research project), and a value of 0 for students who were randomly assigned in the control group (and not involved in the support activities). The pretreatment baseline value of the dependent variable ($Y_{i,b}$) is also inserted as a control in the equation. Robust standard errors are reported in all regression specifications.

n addition, as shown in Eq. (2), we account for some covariates that might influence the precision of the estimates (d_{is}), such as students' demographic characteristics (such as gender, nationality, entrepreneurial family) and university status (master's vs PhD; University Department of reference). We estimate the following regression:

$$Y_i = \alpha + \beta_1 Treatment + \sum y_s d_{is} + \delta Y_{i,b} + \varepsilon_i \qquad (2)$$

Table 1 reports a more detailed description of the control variables that are included in our models.

5 Summary statistics and randomization checks

5.1 Pre-treatment differences between treatment and control groups

As a first step in our analyses, we checked whether randomization was effective through comparing all of the pre-test treated and non-treated students (n=411) across the baseline outcome variables and student background characteristics, as shown in Table 2, columns A-D. In this respect we found no relevant differences between the treated and non-treated students in the sample as randomized ($p<0.05$). In this respect, no differences between the treated and non-treated students were found across master's and doctoral students in the two sub-samples as randomized (Table A 1 , Appendix).

Insert Table 2 about here

5.2 Attrition bias

As explained in section 3.4, our research team faced substantially more difficulties with respect

to planning in identifying students for the post-treatment data collection. Therefore, overall attrition was significant in our study. The high level of attrition (and consequently the limited sample size) is a typical problem that characterizes research based on experimental approaches conducted in the field of academic entrepreneurship (i.e. Oosterbeck et al., 2010; Eesley and Wang, 2017; Graff Zivin and Lyons, 2020). Nevertheless, in our study differential attrition (i.e., the difference in attrition between the intervention and the comparison group) was very low, around 1%. In this regard, similarly to in Oosterbek et al. (2010), we checked for any pretreatment differences (t=0) on a range of relevant variables for those responding both in the baseline and in the post-treatment survey (i.e., the analytical sample), as shown in Table 2, columns E-H (see also Table A3 in Appendix). We did not detect significant pretreatment differences (at $p<0.05$) in the two arms of the final sample. Therefore, despite the high overall attrition rate, our study shows limited differential attrition and baseline equivalence of the control and treatment group.

Second, we formally test for non-response to the post-treatment overall survey, by running a probit regression on the full pretreatment sample. For a dependent variable, we use a dummy variable that takes the value of 1 if the student filled in the final post-treatment survey and is 0 otherwise. For the independent variables, similarly to in Åstebro and Hoos (2020), we use all of the available students' characteristics and the treatment condition. The results (Table A2, Appendix) confirm that none of these characteristics affect the probability of responding in the post-treatment survey. Therefore, attrition in our study seems not correlated with the treatment being evaluated. We discuss at more length in the Results and in the Conclusion sections the implications of high level of overall attrition for our estimates.

5.3 Descriptive statistics of the final analytical sample

Concerning the general characteristics of our final sample, 53% of the graduate students included in our final sample are drawn from engineering and ICT programs (51% of master's and 59% of PhD students), 17% from medicine-related programs (16% of master's and 22% of PhD students), and 30% from science-related courses (33% of master's and 19% of PhD students).

In the final sample, 58% of the students were male (61% among master's and 48% among PhD students). The majority is Italian (overall, 96%; 98% among master's and 85% among PhD students). Approximately one-third of the students come from a family that is experienced in running a business (34% of master's and 33% of PhD students). Given that interest in entrepreneurship might be linked to personal attitudes toward risk, we collected data to measure students' tolerances for ambiguity (*tol_ambig*), using the four-item scale originally developed by Lorsch and Morse (1974) and later used by Gupta and Govindarajan

(1984) (α = 0.82)[11]. Students present an intermediate value score on this scale (overall, 2.99 over 6).

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6 Results

6.1 Treatment effects

To analyse the effects of our intervention, we first analyzed mean differences in the values for the primary outcome variables post-treatment. In Table 3, we show the mean values for the outcome variables for both the treated group (column 1) and the control group (column 2) in the post-treatment phase. From an inspection of these results, we first noticed that awareness of entrepreneurial initiatives and participation in university initiatives increased during the period of the intervention.

Insert Table 3 about here

Insert Table 4 about here

This Table shows that, after the scouting intervention, the awareness of the university initiatives in support of entrepreneurship is higher in the group of treated students compared with the control group (p-value < 5%). On the other hand, the perception of the university environment as supportive for entrepreneurship has slightly higher mean levels in the group of treated students as compared to the control group, but that this difference is not statistically significant. Concerning the analyses for the secondary outcome variables, the variable that captures the attitudes toward entrepreneurship is significantly higher in the group of treated students after the treatment. We do not find, however, statistically significant differences that concern the other secondary outcome variables (see Table 4).

The results from the regression models are reported in Table 5, where we show different columns for the different primary outcome variables, both without and including controls. For the

[11] The scale is rated using a 1 (strongly disagree) to 6 (strongly agree) point structure about the following statements: (1) I am not willing to take risks when choosing a job or a company to work for; (2) I prefer a low risk/high security job with a steady salary over a job that offers high risks and high rewards; (3) I prefer to remain in a job that has problems that I know about rather than take the risk of working at a new job that has unknown problems, even if the new job offers greater rewards; and (4) I view risk in a job situation to be avoided at all costs.

control variables, we account for the following individual- and course-level characteristics:

- student's gender (1=male; 0=female) (variable *male*)
- student's nationality (1=Italian; 0=foreigner) (variable *Italian*)
- student's family entrepreneurial background (1=yes; 0=no) (variable *entr_family*)
- students' tolerance for ambiguity (factor score ranges from 1=low to 6=high) (variable *tol_ambig*)
- students' embeddedness in an entrepreneurial university department, measured as the number of spin-offs created by researchers in the departments where students' courses are embedded (*n_spinoffs*), based on information provided by the university's KTO.

Considering the results of the analyses without control variables, we note that our treatment has a positive and significant impact on students' awareness of the university's initiatives to foster entrepreneurship ($p<0.05$) and on perceived university entrepreneurial environment ($p<0.10$). Considering the models that included the control variables, our treatment positively increases, at conventional statistical levels, the students' awareness of the university's initiatives to sustain entrepreneurship ($p<0.05$) and the perceived university entrepreneurial environment ($p<0.10$).

Insert Table 5 about here

We should highlight however that our estimates are affected by low statistical power due to high overall attrition, then the evidence in this regard cannot be interpreted as conclusive. Nevertheless it provides initial insight on the positive role that proactive policies might have for entrepreneurial awareness of university students.

We also estimated additional regression models related to the set of the secondary outcome variables. The results of these models (not reported here, but available on request from the Authors) do not show a statistically significant impact of the treatment dummy variable on other (self-reported and objective) outcomes, such as those that capture actual involvement in activities related to designing, creating and managing a new venture, or those that capture participation in university initiatives that support entrepreneurship. We also performed additional analyses exploiting our survey data including information for both master's and PhD students, by running separate analyses for these two groups. Although the number of responses is too low to draw definitive conclusions (expacially for what concerns PhD students), the results of such analyses suggest that the main results reported above might be mainly driven by the positive impact of the intervention on master's students. Indeed, we do not find a statistically significant effect of the treatment variable on the outcomes in the sub-sample of PhD students. A possible

way to interpret such results could refer to a higher sensitivity of master's students to awareness-raising support initiatives, given their lower seniority and knowledge of the university environment, and possibly also because most PhD students look forward to having a career in science. However, given the small number of doctoral students that were included in our final sample, the null results for this group of PhD students might also be explained by the lack of statistical power of our analyses. Such findings can only be interpreted as speculative, as they should be investigated in more detail by future studies.

6.2 Additional analyses: Heterogeneous treatment effects

As shown in the models presented in Table 5, adding control variables usually improved the explanatory power of the models, and it also had some significant impacts on the outcome variables. We therefore conducted some additional analyses, similarly to in Huber et al. (2014), by considering the interactions of the treatments with a set of dichotomized control variables, as follows:

- student's gender (1=male; 0=female; variable *male*)
- student's nationality (1=Italian; 0=foreigner; variable *Italian*)
- student's family entrepreneurial background (1=yes; 0=no; variable *entr_family*)
- student's tolerance for ambiguity (1=high; 0=low; variable *h_ambig*; created from the median split of the variable *tol_ambig*)
- student's embeddedness in an entrepreneurial university department (1=highly entrepreneurial department; 0=otherwise; variable *h_entdep*; created based on the median split of the variable *n_spinoffs*).

These analyses reveal that some covariates, such as gender, tolerance to ambiguity, nationality, and the extent of entrepreneurship in the course's department, can have some influence on the results, for example, with respect to the participation in university events for entrepreneurship and the engagement in entrepreneurial preparatory actions, in addition to influencing entrepreneurial attitudes, subjective norms, perceived behavioural control, and the perception of the university as an environment that is supportive toward entrepreneurship (for details, see Table A3, Appendix).

7 Discussion and conclusions

Based on a RCT study of 158 graduate students from the University of Bologna, our study provides an assessment of the impact of communication and educational support activities implemented by University KTOs on students' awareness of entrepreneurship support institutionalized at universities. This variable has been positively related to the perceived supportive climate of the

institution (Bergmann et al., 2018), that, in turn, affects entrepreneurial intentions (Huyghe and Knockaert, 2015), thus playing an important role in increasing self-efficacy in public policy initiatives. This paper contributes to the literature on the role and operation of KTOs and to the literature on how student entrepreneurship can be enhanced. With regard to the role of KTOs, we have highlighted that graduate students can represent an important target group for the support services of the university knowledge transfer office, which is traditionally more focused on activities related to the university faculty and staff. We have also shed light on the importance of communication and educational support activities implemented by KTOs, thus responding to a specific call for a deeper understanding of the micro-processes associated with academic entrepreneurship, as formulated by Balzen et al. (2018). We also contribute to the rapidly growing literature on student entrepreneurship (Astebro et al., 2011; Wright et al., 2015), because we show the importance of university initiatives and policies (and in particular, those coordinated by KTOs) that are undertaken to reinforce the entrepreneurial intentions of graduate students and contribute to the creation of a positive perception of a climate conducive for entrepreneurship. Such elements represent important preconditions to activate those entrepreneurial spiral dynamics (Sheperd et al., 2010), which can lead in the long term to the emergence of promising new start-ups and spinoffs in the university environment.

Our findings presents signs of improvement in the awareness of university initiatives in support of entrepreneurship and in the perception of the university environment as favorable for entrepreneurship among those graduate students that were randomly assigned to receive proactive support and communication by the KTO. Even though our intervention was limited to communication issues and preliminary educational support by the KTO, it appears to have some initial influence on the “entrepreneurial mindset” in terms of awareness, a concept that has been positively linked by previous research to attitudes towards entrepreneurship and perceptions of an entrepreneurial university environment. This finding is encouraging, given that several studies have highlighted that the decision to engage in entrepreneurial activities is influenced by the perceived behavioural control of aspiring student entrepreneurs, e.g., the perception of the support that they are going to receive along the process, should they decide to be seriously engaged with entrepreneurship.

However, it is important to highlight that our intervention is strictly dependent on the specific context in which it took place and based on a small sample. Therefore its results should be interpreted with caution. Rather than provide a definitive answer on this policy-relevant issue, they could provide insight and inspiration for other studies, conducted in other contexts and possibly with an experimental approach, in order to reach a broader and more robust set of conclusions.

The implementation of our intervention indeed faced a set of difficulties and execution problems that limit the extent of drawing strong inferences from the results. A first execution problem that we faced in the implementation of the intervention consisted in the scope and intensity of communication and educational activities conducted, as intervention, in collaboration with the KTO

of the University. Although the collaboration between the research team and the KTO was very positive, the possibility to conduct more impactful communication and scouting activity, based on face-to-face interactions with target beneficiaries, was constrained by the limited amount of staff and time that the KTO could devote to this type of experiment. We therefore decided to resort to less demanding and time-consuming communication activities based on email delivery, although this could have certainly reduced the impact of the treatment. support activities.

The second execution problem that we faced regards the means of communication that we decided to use to get in touch with graduate students. We used the institutional (university) email to inform master's and PhD students on the support opportunities available at the university level in the entrepreneurship domain and in the scouting events that we specifically organized for the project for the treated students. However, we realized during the project, also through a set of interviews that we performed with a limited number of students involved in the intervention, that students tend to use their own personal email more frequently (and, more than that, social media), whereas their use of the institutional email is limited. Communications sent via the institutional email can be perceived as a "cold", "administrative" message, and not considered to be important by students. At the same time, it is at risk of being lost in a set of many other communications of the University. Thus, the effectiveness of the intervention could have been improved by using communication tools that are more in line with students' use of social media. This represented however an important lesson-learned from this pilot intervention, that can inspire per se future managerial actions within the KTO. Indeed, the KTO is interested in exploring this option in the future, attempting increasingly to reach out to students through social media platforms that are widely used by students, such as Facebook, Twitter or Instagram. This approach represented an important lesson-learned from the project, providing both implications for communication policies of the KTO and suggestions for future research.

The third, and more critical, execution problem that characterized our study regards the attrition in survey responses. A key concern for our trial is represented by the relatively modest sample size, which is however a recurring issue in experimental-based research conducted in the field of academic entrepreneurship (Eesley and Wang, 2017; Graff Zivin and Lyons, 2020). Overall attrition was significant in our study, as we faced more difficulties than expected in identifying students for the post-treatment data collection. In this respect, it should be noted that the value of differential attrition in the study is low, as the difference in attrition rates between the treated and control groups is just 1%. At least, our study ensures baseline equivalence of treated and control groups and that attrition is not correlated with the treatment being evaluated. The high level of overall attrition poses however a critical issue of low power for our study. This rises the concerns that we falsely accept the null hypothesis of no treatment effect because of low statistical power[12]. Due to the small sample size, results are therefore only suggestive, yet they are important for

[12] In addition to that, the presence of low power raises also concerns about the estimated size of the treatment effect being exaggerated (Gelman & Carlin 2014).

understanding better the potential of proactive support activities for entrepreneurship and its implications.

A fourth difficulty in the execution of our trial was related to the potential influence of contamination effects. We are quite confident that our approach ruled out the possibility that KTO staff could generate contamination effects via interacting with students in the control group, given that they were extremely careful in this respect and paid a lot of attention in taking note of every interaction (in person or by email) with students in both the treated and in the control group (and in the latter case no significant interactions emerged). However, we are not in the position to assess the existence (or not) of specific spillover of information among treated and non-treated students. In fact, students in the control group reported in the post-treatment survey having received information from classmates, professors, or other institutional communications by the University. This signals that all students could potentially receive from other sources at least part of the information that were provided by KTO staff to treated students only. However, looking at the responses of the survey, the indication of the KTO as a relevant source of information is almost absent in the group of control students (differently from the case of treated students), thus providing a hint of the influence of our intervention.

Finally, the intervention in our project was restricted to a limited set of support activities implemented by the KTO, namely, communication activities and preliminary educational support on entrepreneurship issues. We expect that students' actual engagement in entrepreneurial behaviour is ultimately influenced by more intensive support policies at later stages of the process. We hold here that the organizational climate and the perception of a supportive context within academia are relevant. However, at later stages along the process, more ad hoc forms of intervention (specific training programs that support business plan development, the contributions of incubators, mentoring services, proof-of-concept funding, vertical- and domain-specific initiatives that target students from different disciplines) become key in explaining actual entrepreneurial entry and progression.

In this respect, it is plausible that there is a reaction time between the forms of institutional intervention and the observations of entrepreneurial behaviour. In this sense, for example, Fini et al. (2020) looked at faculty members' science-based entrepreneurship in the context of Italian universities and specifically at the effects of the introduction of spin-off regulations on their engagement in spin-off creation. The analyses are based on a longitudinal dataset with information on the 64 Italian STEMM universities (Science Technology, Engineering, Mathematics, and Medicine), their 1,213 departments, and 611 spin-offs between 2002 and 2012. The results show that there is a lag of 4 years between the institutional intervention (introduction of a regulation providing incentives and, among other things, spreading entrepreneurial culture in the university

context) and the maximum effect on spin-off creation on the faculty side13. This finding suggests that students might be willing to leverage on the 'entrepreneurial mood' and potential that they have developed while at the university, later on in their career. It would therefore appear as interesting for future research to extend this type of assessment, also encompassing additional support activities and observing outcome variables on a longer time span and with a longitudinal approach.

The results from the RCTs that we report should therefore be interpreted in light of the challenges outlined above. Taking in mind such limitations, there are some policy and managerial implications that emerge from our experimental study that can be useful for the design and implementation of support actions for student entrepreneurship. Our study suggests that communication and educational support actions of this type might be important for university and KTO managers and policy-makers interested in raising the perceived "desirability" of entrepreneurship as a career choice or as something that the university is offering to students. There is ample space for university KTOs to adopt a proactive role in systematically reaching out not only to faculty members but also to graduate students, in order to raise awareness, create a climate of reciprocal trust and establish a two-way communication process. Missed opportunities associated with a lack of information on the university internal ecosystem, the KTO and the full range of its services are frequently reported as a hurdle for academic entrepreneurship (Huyghe et al., 2016). Several university KTOs, for example, have included in their organizations specific figures that are dedicated to such tasks. For example, innovation scouts are KTO experts who are assigned full-time or part-time to the task of undertaking idea scouting activities and gathering information about new ideas and technologies that are emerging from researchers and students. They systematically and proactively monitor the research and commercialization output of the university and reach out to researchers and students via direct and face-to-face meetings, to identify promising opportunities for valorization and advise them in the early steps of the valorization process.

A different (and complementary) approach would be to engage university professors of specific schools or disciplines as ambassadors and gatekeepers to reach out to graduate students and their faculty colleagues on issues related to entrepreneurship and science commercialization. The experience that we had in our experiment with the first contacts by the KTO with students for our pre-test survey, visiting them directly during their courses or their PhD classes, showed us that the professors of MSc courses or the directors of the PhD program are very effective gatekeepers at managing the relationships with the students and facilitating their interests toward entrepreneurship-related activities. A limited number of professors/PhD directors, who are more directly involved in science commercialization activities, could be identified to play a gatekeeping

[13] With specific regard to student entrepreneurship, the recent analyses at the Italian national level conducted by Sobrero et al. (2019) show that 23.7% of student entrepreneurs founded their companies during their studies, 27.0% within three years after graduation, and 35.9% sometime afterwards.

role, by linking together the KTO staff with students and colleagues from their schools/departments, which are interested in engaging in entrepreneurial activities.

The collaborative implementation itself of the RCT was a mutual and beneficial exchange between our research team and the KTO staff, and it generated a set of valuable learning inputs that can be further exploited in the future for the activation of new and improved services. The KTO staff was satisfied with the results of our study. They stressed that raising awareness of entrepreneurship should be part of the institutional mission of aspiring 'entrepreneurial' universities, which was for them the most important outreach. In fact, there is general awareness that only a share of students will be engaged and involved in the process of starting up a new venture. What is important, however, is that as many students as possible are exposed to a context that is supportive to entrepreneurship and develop awareness, which might be conductive to entrepreneurial behaviour in the future and more generally to a more open-minded approach.

The KTO appreciated the scientific support throughout the process of the trial implementation, and at the same time, they gave us the possibility of participating in and running this experiment; they devoted time to our issues and showed a genuine interest in our experimental approach. For example, the direct interactions that we had with master's/PhD students in the phase of delivery of the pre-test questionnaire suggested to us that the physical presence in the places where students attend lessons and spend most of their time is a powerful way to establish direct links and increase their participation in the intervention. In a similar way, the intervention was also extremely useful for the KTO to have a deeper understanding of the main themes that attract the interests of students with respect to technology commercialization activities. The KTO systematically kept track of the requests by the students involved in the intervention for the whole duration of the scouting activities. This activity was also useful for the KTO because it provided a direct insight into some of the key problems or curiosities perceived by graduate students.

In conclusion, it is important to point out some limitations of this study, which also suggest new avenues for future research. Our analyses compared master's and PhD students and highlighted the existence of some differences between the two groups in terms of effectiveness of communication and educational support activities. However, our sample size for the doctoral students was too small to allow strong conclusions or explanations in this respect (the limited overall sample size being in general a key constraint of our study). The comparison of differences between Master and PhD students represents a promising area for future research. Similarly, we focused our analyses on STEMM students, although recent studies show significant dynamics of new venture creation among graduate students in the social sciences and humanities as well. A more detailed comparison of the effectiveness of support initiatives in different teaching domains is therefore needed. Covariates such as gender, nationality, tolerance to ambiguity, and entrepreneurship appear to be relevant in making the estimates more precise. While our study provides some preliminary evidence in this regard, future studies should better understand the nuanced effects of these variables.

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FIGURES AND TABLES

Figure 1 – Overview of the research design and timeline of the RCT

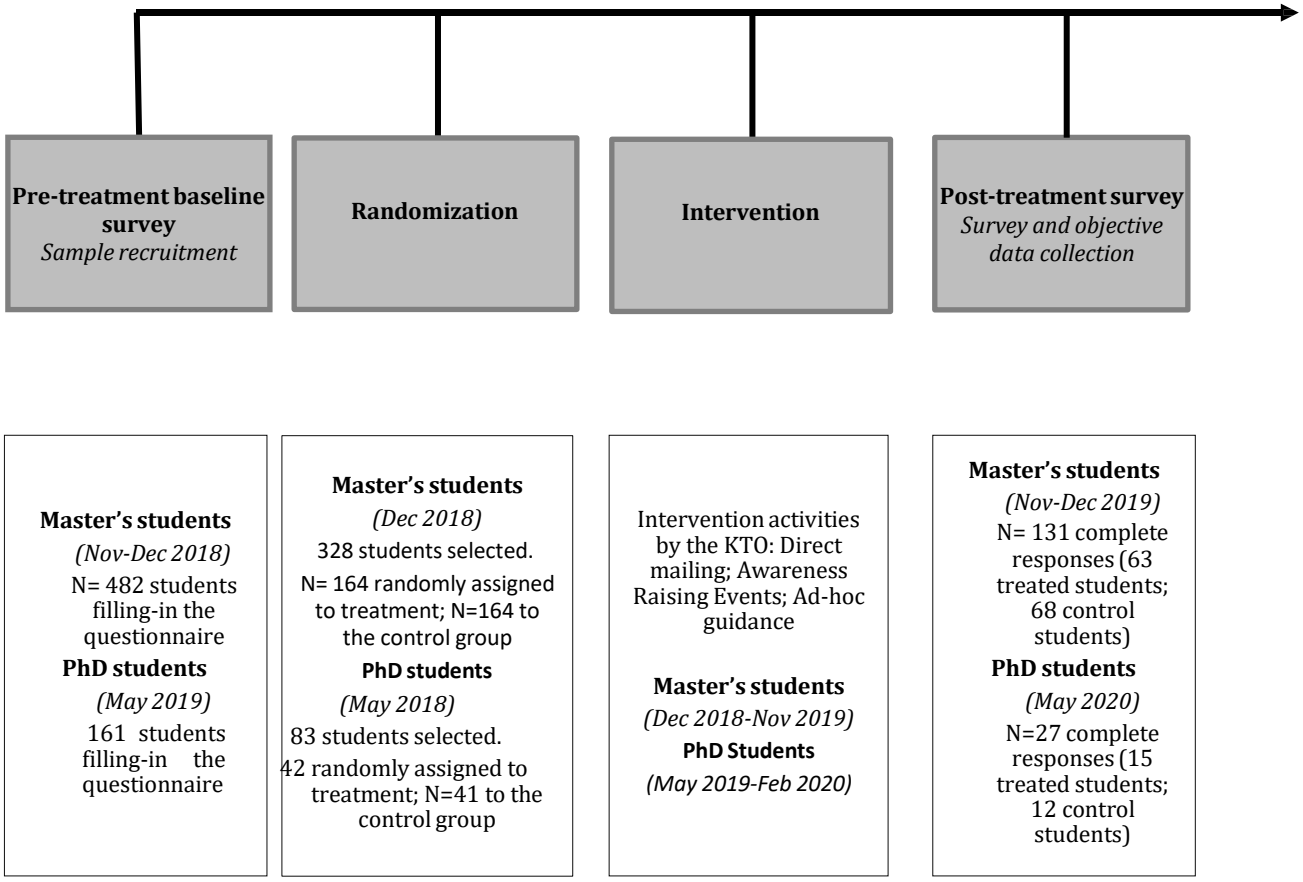

Table 1 – Description of the variables

Variable name	Source of data	Description	Measure
Dependent variables (primary outcome)			
Aware	Self-reported, post-treatment survey	Extent of student's knowledge of University's initiatives to support entrepreneurship and startup creation	1-6 Likert scale (1=not at all; 6=very much)
Uni_entenv	Self-reported, post-treatment survey	Perception of the university as a favorable environment for entrepreneurship, based on the following items: 1) At my university students are encouraged to engage in entrepreneurial activities; 2) The atmosphere at my university inspires me to develop ideas for new businesses; 3) There is a favorable climate for becoming an entrepreneur at my university	3 items measured on a 1-7 Likert scale (1=strongly disagree; 7=strongly agree) and aggregated as a factor score
Dependent variables (secondary outcome)			
Particip_uni	Self-reported, post-treatment survey	Participation to any University initiative to support entrepreneurship and startup creation	Dichotomous variable (1 = yes; 0 = no)
Interest_particip_uni	Self-reported, post-treatment survey	Extent of student's interest in participating to University's initiatives to support entrepreneurship and startup creation in the future	1-6 Likert scale (1=not at all; 6=very much)
Prep_actions	Self-reported, post-treatment survey	Participation to any of the following activities over the previous year: (1) developed a business plan or a business model canvas; (2) developed a product or service; (3) planned or started marketing or commercial efforts; (4) talked with potential customers; (5) collected information about markets or competitors; (6) approached financial institutions or other people for funds; (7) acquired equipment, supplies, premises, or other concrete things; (8) filed documents for patents, trademarks, copyrights or other IPRs linked to the business; and (9) dealt with administrative issues related to starting a business; and 10) sold products or services	Summative index of the 10 actions (0-10)
Start-up	Self-reported, post-treatment survey	Participation to planning, creation, or management of a start-up	Dichotomous variable (1 = yes; 0 = no)
Independent variable			
Treatment	Intervention	Involvement of the graduate student in the intervention (awareness raising activities	Dichotomous variable (1 for treated graduate

		implemented by the KTO)	students, and 0 for graduate students in the control group)
Control variables			
Gender	Self-reported, post-treatment survey	Gender of the graduate student (Male or Female)	Dichotomous variable (1 for man, and 0 for women)
Italian	Self-reported, post-treatment survey	Nationality of the graduate student (Italian)	Dichotomous variable (1 for Italian, and 0 for other nationality)
Ent-family	Self-reported, post-treatment survey	Primary family of the graduate student (father, mother, brother, sister) with entrepreneurial experince of running a business	Dichotomous variable (1 if at least one of the primary family with experience of running a business, 0 otherwise)
Master	Self-reported, post-treatment survey	University status of the student (Master vs PhD)	Dichotomous variable (1 if Master student, 0 if PhD student)
Tol_ambig	Self-reported, post-treatment survey	Students' tolerance for ambiguity	4 items scale originally developed by Lorsch and Morse (1974)
H_entrdep	Secondary data provided by the University KTO	Students' embeddedness in an entrepreneurial University Department	Dichotomous variable (1=highly entrepreneurial department; 0=otherwise); Variable created based on the median split of the number of spin-offs created by researchers in the departments where students' courses are embedded

Table 2 – Full sample pre-treatment differences between the treatment and the control group

	FULL SAMPLE				FINAL SAMPLE			
	(A) Treated Mean (s.d.) n=206	(B) Control Mean (s.d.) n=205	(C) Difference [p-value]	(D) SE	(E) Treated Mean (s.d.) n=78	(F) Control Mean (s.d.) n=80	(G) Difference [p-value]	(H) SE
Outcome variables								
Primary outcome variable								
Aware	1.85 (0.94)	1.88 (0.95)	-0.03 [0.760]	0.093	1.92 (0.98)	1.86 (0.91)	0.06 [0.687]	0.150
Uni_entenv	3.57 (1.27)	3.63 (1.28)	-0.06 [0.637]	0.126	3.58 (1.18)	3.53 (1.24)	0.05 [0.822]	0.194
Secondary outcome variables								
Particip_uni	0.03 (0.18)	0.06 (0.24)	0.03 [0.166]	0.021	0.01 (0.11)	0.04 (0.19)	-0.03 [0.327]	0.025
Interest_particip_uni	4.58 (0.71)	4.51 (0.66)	0.07 [0.298]	0.067	4.69 (0.74)	4.53 (0.66)	0.16 [0.135]	0.111
Prep_actions	0.33 (1.20)	0.44 (1.33)	-0.11 [0.383]	0.125	0.40 (1.31)	0.59 (1.53)	-0.19 [0.404]	0.227
Start-up	0.09 (0.28)	0.12 (0.33)	-0.03 [0.253]	0.030	0.12 (0.32)	0.16 (0.37)	-0.04 [0.396]	0.055
Background characteristics								
Male	0.59 (0.49)	0.60 (0.49)	0.01 [0.794]	0.048	0.60 (0.49)	0.58 (0.50)	0.02 [0.727]	0.079
Italian	0.93 (0.24)	0.94 (0.23)	0.01 [0.693]	0.023	0.95 (0.22)	0.98 (0.16)	-0.03 [0.391]	0.031
Entr_family	0.28 (0.45)	0.34 (0.48)	0.06 [0.191]	0.046	0.32 (0.47)	0.36 (0.48)	-0.04 [0.581]	0.076
Tol_ambig	2.86 (1.00)	2.89 (0.87)	-0.03 [0.718]	0.093	2.81 (1.07)	3.09 (0.86)	-0.28 [0.076]	0.155

Table 3 – Final sample: post-treatment differences between the treatment and the control group (primary outcomes)

	(1) Treated Mean (s.d.) n = 78	(2) Control Mean (s.d.) n = 80	(3) Difference [p-value]
Primary Outcomes			
Aware	2.55 (1.14)	2.20 (0.96)	**0.35 [0.037]**
Uni_entenv	3.55 (1.33)	3.21 (1.39)	0.34 [0.124]

Table 4 – Final sample: post-treatment differences between the treatment and the control group (secondary outcomes)

	(1) Treated Mean (s.d.) n = 78	(2) Control Mean (s.d.) n = 80	(3) Difference [p-value]
Secondary outcomes			
Particip_uni	0.07 (0.27)	0.11 (0.32)	-0.04 [0.449]
Interest_particip_uni	3.87 (0.93)	3.81 (1.06)	0.06 [0.709]
Start-up	0.14 (0.35)	0.19 (0.39)	-0.05 [0.434]
Prep_actions	0.46 (1.46)	0.80 (2.07)	-0.34 [0.239]

Table 5 – Treatment effects: Regression results on the Primary Outcome

	(1) Aware		(2) Uni_entenv	
	(1a)	(1b)	(2a)	(2b)
Treatment	0.327*	0.309*	0.307#	0.322#
	(0.157)	(0.157)	(0.179)	(0.182)
Baseline dependent variable	0.392***	0.375***	0.627***	0.649***
	(0.090)	(0.092)	(0.069)	(0.069)
Control variables		Yes		Yes
R-sq / Pseudo R-sq	0.148	0.184	0.325	0.341
Sample size	158	158	158	158

Notes:
Models (a) do not include control variables; (b) include control variables.
Estimation methods: Models (1) (2), via OLS regression (same results confirmed by ordered logit regression).
Robust standard errors in parentheses.
**** p<0.001, ** p<0.01, * p<0.05, # p<0.1, two sided*

APPENDIX

Table A1 – Full sample: Pre-treatment differences between the treatment and the control group, master vs. doctoral student sub-samples

	Master students (full sample)				Doctoral students (full sample)			
	(A) Treated Mean (s.d.) n = 164	(B) Control Mean (s.d.) n = 164	(C) Difference [p-value]	(D) SE	(A) Treated Mean (s.d.) n = 42	(B) Control Mean (s.d.) n = 41	(C) Difference [p-value]	(D) SE
Primary Outcome variables								
Aware	1.72 (0.87)	1.76 (0.89)	-0.04 [0.661]	0.097	2.38 (1.03)	2.37 (1.04)	0.01 [0.947]	0.228
Uni_entenv	3.61 (1.28)	3.59 (1.23)	0.02 [0.881]	0.139	3.38 (1.23)	3.76 (1.47)	-0.38 [0.210]	0.297
Secondary Outcome variables								
Particip_uni	0.02 (0.15)	0.05 (0.22)	-0.02 [0.241]	0.207	0.07 (0.26)	0.12 (0.33)	-0.05 [0.442]	0.065
Interest_particip_uni	4.59 (0.73)	4.49 (0.62)	0.10 [0.221]	0.075	4.57 (0.63)	4.58 (0.81)	-0.01 [0.930]	0.158
Start-up	1.93 (0.25)	1.89 (0.31)	0.04 [0.174]	0.031	1.83 (0.38)	1.83 (0.38)	0.00 [0.962]	0.083
Prep_actions	0.26 (1.09)	0.42 (1.32)	-0.16 [0.221]	0.134	0.64 [1.51]	0.54 (1.36)	0.10 [0.738]	0.316
Background characteristics								
Male	0.60 (0.49)	0.60 (0.49)	0.00 [0.911]	0.054	0.57 (0.50)	0.61 (0.49)	-0.04 [0.726]	0.109
Italian	0.98 (0.15)	0.97 (0.15)	0.01 [0.993]	0.017	0.79 (0.42)	0.83 (0.38)	-0.04 [0.620]	0.088
Entr_family	0.30 (0.46)	0.34 (0.47)	-0.04 [0.478]	0.052	0.31 (0.42)	0.37 (0.49)	-0.16 [0.131]	0.099
Tol_ambig	2.91 (0.99)	2.98 (0.84)	-0.07 [0.464]	0.102	2.69 (1.01)	2.55 (0.91)	0.14 [0.525]	0.212

Table A2 – Full sample: Probit regression results on probability of survey response

Variables	**(1)**
Male	-0.07
	(0.137)
Italian	0.34
	(0.303)
Entr_family	0.15
	(0.138)
Tol_ambig	0.09
	(0.070)
Treatment	0.03
	(0.128)
Master	0.17
	(0.172)
Engineering	0.01
	(0.147)
Medical	-0.14
	(0.193)
Constant	-1.02*
	(0.417)
Observations	413

Robust standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05, # p<0.1, two sided

Table A3 – Treatment effects: Heterogeneity of results (ITT)

	Uni_entenv	Particip_uni	Prep_actions	Ent_attitudes	Ent_subjnorms	Ent_pbc
Treatment	1.750*	-1.876#	0.075	0.028	2.167***	-0.154
	(0.785)	(1.121)	(0.667)	(0.241)	0.511	(0.175)
Baseline dependent variable	0.634***	2.100	1.146***	0.233**	0.443***	0.537***
	(0.067)	(1.316)	(0.084)	(0.083)	(0.081)	(0.086)
Gender		-1.681*				
		(0.804)				
*Treatment * gender*		2.868*				
		(1.404)				
Tol_ambig			0.376*			-0.286
			(0.183)			(0.185)
*Treatment * tol_ambig*			-0.445*			0.623*
			(0.184)			(0.286)
H_entrdep				-0.332		
				(0.237)		
*Treatment * h_entrdep*				0.613#		
				(0.348)		
Italian	0.742*				-0.393**	
	(0.376)				(0.136)	
*Treatment * Italian*	-1.501#				-2.077***	
	(0.806)				(0.547)	
R-sq / Pseudo R-sq	0.336	0.109	0.856	0.107	0.268	0.288
Sample size	158	158	158	158	158	158