

Logics, Leaders, Lab Coats: A Multi-Level Study on How Institutional Logics are Linked to Entrepreneurial Intentions in Academia

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ABSTRACT

Situated in the context of academia, this study integrates ideas from institutional theory, person-environment fit theory and leadership research to conceptualize and examine the cross-level link between the organizational-level institutional logic of research commercialization and the entrepreneurial intentions of researchers. Multi-level analyses based on a sample of 254 researchers working for 85 research group leaders in 49 German research institutes reveal that two distinct attributes of research group leaders—that is, their track records of entrepreneurial behaviour and their entrepreneurial intentions—play a significant role in transmitting the organizational-level logic to the individual level. We also observe a complementary interaction between organizational-level commercialization logic and the entrepreneurial track records of leaders. We discuss how these findings advance our understanding of science commercialization through academic entrepreneurship and how they inform institutional theory and theory development in other domains of entrepreneurship research. (140 words).

Keywords: Academic Entrepreneurship; Leader Characteristics; Institutional Theory; Multi-level Theory; Person-Environment Fit.

INTRODUCTION

Academic entrepreneurship is an individual-level endeavour aimed at evaluating and exploiting scientific knowledge to create commercial goods and services (Fini et al., 2018; Shane, 2004). Entrepreneurial intentions are the most proximal predictor of individual academics' engagement in entrepreneurship (Prodan and Drnovsek, 2010). Given the importance of research commercialization through academic entrepreneurship for improving the economic and social welfare of societies, a still-growing body of research has sought to identify factors that contribute to explaining entrepreneurial intentions and behaviours in academia (Wright and Phan, 2018).

While prior research has identified a variety of contextual factors at the group, organizational, community, field and societal levels that foster academic entrepreneurship (Hmieleski and Powell, 2018; Perkmann et al., 2013; Wright et al., 2007), we still know little about the interplay of these influences emanating from different levels. This issue is an important one because lower-level contextual conditions are typically nested in higher-level contextual structures (Kim et al., 2016; Mathieu et al., 2008b). Thus, solely focusing on contextual conditions at one particular level of analysis provides only a limited theoretical account (Hitt et al., 2007). Specifically, studies that focus on the effects of meso-level factors overlook the macro-level roots from which those effects may originate (Hitt et al., 2007). Conversely, research that concentrates on the influences of macro-level factors will fail to identify the meso-level pathways that transmit their influence to the individual level (Kim et al., 2016). Consequently, scholars have called for research to adopt a multi-level lens that allows for a more complex understanding of phenomena of interest in research on entrepreneurship (Kim et al., 2016) and other domains (Hitt et al., 2007).

Institutional theory features prominently in entrepreneurship research in general (Su et al., 2017) and in research on academic entrepreneurship (Fini and Toschi, 2016) in particular. Until now, research in this domain has predominantly been focused on tracing entrepreneurial

activities back to differences in institutional environments at the societal, field, population or organizational levels of analysis (Bruton et al., 2010; Su et al., 2017; Tolbert et al., 2011). While this research has generated valuable insights, our knowledge of the pathways that link higher-level institutions to the individual-level intentions that eventually generate entrepreneurial activities is still sparse (Kim et al., 2016). A similar scarcity of studies addressing how institutions influence individual-level phenomena can be seen in other research domains of institutional theory (Luo, 2007; Zilber, 2002), sparking calls from researchers to mitigate the macro-micro divide (Aguinis et al., 2011). The present study responds to these calls by developing and testing multilevel theory to answer the following research question: *Which actors and mechanisms constitute the cross-level link between the organizational-level institutional logic of science commercialization and the entrepreneurial intentions in academia?*

For several reasons, academia offers a particularly fruitful setting for elaborating on the complex cross-level link between organizational-level institutional conditions and individuals' entrepreneurial intentions. First, prior research (Bercovitz and Feldman, 2008; Fini and Toschi, 2016) suggests that the context of academia is a fruitful one for illuminating contextual drivers of entrepreneurship at different levels. Second, in order to foster entrepreneurship in academia, funding institutions worldwide have sought to add to an already established institutional logic of open science (Merton, 1973) an institutional logic of research commercialization. This logic comprises rules, norms and cognitions that foster science commercialization by encouraging patent filing, cooperation with industry, licensing or starting new businesses (Abreu and Grinevich, 2013; Haeussler and Colyvas, 2011; Sauermann and Stephan, 2013). Yet the degree to which the commercialization logic has been adopted in academia varies considerably (Brettel et al., 2013; Haeussler and Colyvas, 2011). This variability may be because across levels, actors in academia enjoy considerable freedom from higher-level interference. Perhaps the greatest freedom exists at the level of research organizations. In Germany, for instance, freedom of the

arts, science, research and teaching is constitutionally protected by law in Article 5(3) (Grundgesetz für die Bundesrepublik Deutschland; Artikel 5). Therefore, no public or private funding institution can dictate to research organizations what and how they should conduct their scientific activities. This freedom also extends to research group leaders, who are largely free to decide which research endeavours to pursue. Perhaps the comparatively lowest degree of freedom exists at the level of individual researchers, as supervisors influence their work activities. Overall, however, academia constitutes a setting where actors at each level enjoy considerable autonomy.

As our baseline hypothesis, we first propose that the degree to which a research organization embodies the institutional logic of research commercialization will be reflected in the entrepreneurial intentions of researchers working in that particular research organization. Complementing institutional theory with ideas from person-organization fit theory (Edwards, 2008; Kristof, 1996), we argue that attraction, selection and attrition (ASA) processes (Schneider et al., 1995) as well as organizational socialization processes (Van Maanen and Schein, 1979; Wanous, 1992) effectuate the link between an organizational level institutional logic of research commercialization and researchers' entrepreneurial intentions. We identify research group leaders as meso-level actors who contribute to enacting these linking mechanisms. On the one hand, leaders are an important key element in creating a fit between subordinates and their work environment (Jansen and Kristof-Brown, 2006). On the other hand, leaders are embedded in organizations that represent the context for their behaviour (Porter and McLaughlin, 2006). Based on these notions, and drawing on an emerging stream of research showing that leaders in academia can inspire entrepreneurial intentions and activities among their subordinate researchers (Bercovitz and Feldman, 2008; Brettel et al., 2013; Krabel and Schacht, 2014), we propose that research group leaders' track records of entrepreneurial behaviour as well as their own entrepreneurial intentions will mediate the link between the organizational-level logic of research commercialization and their researchers' entrepreneurial

intentions. Building on the notion of a compensatory relationship between dimensions that are consequential for the fit between individuals and their work environment (Jansen and Kristof-Brown, 2006), we further suggest that there are negative interactions between an organizational-level commercialization logic and leaders' entrepreneurial track records as well as their entrepreneurial intentions.

We test these hypotheses using a sample of 254 researchers working for 85 research group leaders in 49 German research institutes. Our evidence supports our baseline hypothesis. Moreover, our data substantiate the idea that research group leaders transmit an organizational-level commercialization logic to the individual level. Contrary to our expectations, however, we find that an organizational-level commercialization logic strengthens the link between research group leaders' entrepreneurial track records and researchers' entrepreneurial intentions.

The present study showcases the potential of research at the intersection of different academic fields (Zahra and Newey, 2009). Specifically, the present study expands and qualifies existing theory (Colquitt and Zapata-Phelan, 2007; Makadok et al., 2018) in the domain of academic entrepreneurship and informs theorizing in other domains. A number of entrepreneurship scholars (Kim et al., 2016; Su et al., 2017) as well as scholars in other domains of institutional theorizing (Aguinis et al., 2011; Luo, 2007; Zilber, 2002) have called for research to illuminate the largely unexplored cross-level pathways that link macro-level institutional contexts to individual-level intentions and behaviours. Responding to these calls, this study contributes to theory development in three main ways. First, it recognizes leaders as crucial meso-level actors who transmit organizational-level institutional logics to the individual level. The present study further adds to theory by highlighting ASA (Schneider et al., 1995) and socialization (Van Maanen and Schein, 1979) processes as key mechanisms that effectuate the cross-level links between institutional logic, leader characteristics and individuals' entrepreneurial intentions. Second, this study identifies organizational-level institutional logics

as contextual conditions that shape leaders' influences and additionally serve as contingencies for these influences. In doing so, the present study expands our knowledge of the role of leaders in fostering entrepreneurship in academia (Bercovitz and Feldman, 2008; Johnson et al., 2017) and other settings (Phan et al., 2009). Third, by providing theory and evidence of a complex interplay of influences that emanate from different contextual levels, our study informs research in the field of academic entrepreneurship and in other fields on how our understanding of phenomena of interest can be enriched by multi-level theorizing (Hitt et al., 2007; Kim et al., 2016).

THEORY AND HYPOTHESES

Academic Entrepreneurship

Academic entrepreneurship is an individual-level behaviour that is inherently intentional (Bird, 1988; Katz and Gartner, 1988). Entrepreneurial intentions thus constitute an essential precondition for entrepreneurial behaviour in academia (Prodan and Drnovsek, 2010) and in other settings (Kautonen et al., 2015; Lee et al., 2011; Van Gelderen et al., 2015).ⁱ In seeking to explain entrepreneurial intentions and activities in academia, a growing body of research has identified a variety of factors that exist at the micro, meso and macro levels. On the micro level, the dominant studies (Hmieleski and Powell, 2018) have been those addressing the impact of individual characteristics, such as human and social capital (Goethner et al., 2012; Krabel and Mueller, 2009) or entrepreneurial capacity (Clarysse et al., 2011). However, scholars have also acknowledged the importance of contextual conditions on the meso and macro levels when explaining academic entrepreneurship (Autio et al., 2014). For instance, studies have scrutinized the effects of leaders (Bercovitz and Feldman, 2008) and peer groups (Obschonka et al., 2012). Other research has addressed the impact of organizational-level support structures (Clayton et al., 2018), such as accelerators (Clarysse et al., 2015) or technology transfer offices (Siegel et al., 2007). Also, prior research has examined the role of economic circumstances (e.g. Gulbrandsen and Smeby, 2005; Harmon et al., 1997) and governmental policies (e.g. Mowery

et al., 2001; Mustar and Wright, 2010; Rasmussen, 2008). Lately, the implications of institutional logics for the entrepreneurial intentions and behaviours of academics have received particular attention (Fini and Lacetera, 2010; Fini and Toschi, 2016). The present study contributes to expanding this research stream.

Institutional Logics in Academia

Institutional theory offers an established framework for theorizing and examining the contextual drivers of entrepreneurship in academia and other settings (Bruton et al., 2010; Su et al., 2017). An institutional logic is reflected in coherent sets of regulative, normative and cultural-cognitive elements that provide actors with meaning and designate what is considered legitimate within a particular domain (Friedland and Alford, 1991; Thornton et al., 2012).

For decades, academia has been dominated by the Mertonian logic of open science (Stuart and Ding, 2006). According to this logic, it is legitimate, appropriate and normal for researchers to expand the existing stock of human knowledge in a communal way, openly disseminating their discoveries within the scientific community. In exchange, researchers are rewarded in the form of citations and academic merit (Merton, 1973). To this established logic has been added a commercialization logic aimed at fostering research commercialization and exploiting related business opportunities (Murray, 2010; Sauermann and Stephan, 2013). Governments and funding bodies worldwide have introduced policies clearly intended to promote such activities (Rasmussen, 2008; Wright et al., 2007). Even within a particular national context, however, it is unlikely that an institutional logic, such as the commercialization logic in academia, will be uniformly embraced by all organizations (Kraatz and Block, 2008). As prior research has shown, organizations in the same field tend to react differently to the introduction of any new institutional logic (Lander et al., 2013). While some organizations will readily accede to newly established expectations, some will only partially adopt it and others will resist and avoid adopting that logic entirely (Besharov and Smith, 2014; Schildt and Perkmann, 2017). In line with this notion, organizations in academia have been

found to differ with respect to the degree to which they have adopted a logic that emphasizes goals, values and practices of research commercialization (Perkmann et al., 2013; Sauermann and Stephan, 2013).

Taking this as a point of departure, the present study complements prior research on the influence of institutional logics on academic entrepreneurship (Fini and Toschi, 2016). Specifically, we develop multilevel theory on how leaders—as crucial meso-level actors—and ASA and socialization mechanisms (Schneider et al., 1995; Wanous, 1992) can help explain the cross-level link between the organizational-level institutional logic of science commercialization and the entrepreneurial intentions of researchers. Figure 1 summarizes our conceptual model.

INSERT FIGURE 1 ABOUT HERE

Organizational-Level Commercialization Logic and Researchers' Entrepreneurial Intentions

When research organizations display a strong commercialization logic, their regulative, normative and cultural-cognitive institutional elements will convey the legitimacy of entrepreneurial activities among researchers. In such research organizations, commercialization activities, such as engaging in cooperation with industry and founding new businesses, are firmly integrated into mission statements (Colyvas and Powell, 2007). Regulative institutional elements, including formal hiring policies and procedures for performance assessments, are in place to buttress and incentivize research commercialization (Fini and Lacetera, 2010). Normative institutional elements such as espoused norms and values that define work roles (March and Olsen, 2008) further emphasize that commercialization activities are expected within the organization (Nelson, 2014; Nicolaou and Souitaris, 2016). Finally, cultural-cognitive elements such as shared beliefs and prevalent assumptions (Grégoire et al., 2011)

signal that commercialization activities are normal and even taken for granted (Colyvas and Powell, 2006).

Person-environment fit theory suggests there will be a correspondence between the fundamental characteristics of an organization, such as prevalent values, norms and reward systems and the characteristics of the individuals within that organization (Kristof, 1996). This correspondence results from two sets of complementary mechanisms: ASA (Schneider et al., 1995) and socialization processes (Van Maanen and Schein, 1979). Jointly, these two sets of mechanisms help us to understand why an organizational-level commercialization logic will be reflected in the entrepreneurial intentions of researchers within that organization.

Generally, individuals prefer—and choose—to work for organizations that fit with their attitudes and self-concepts (Schneider et al., 1995). Also, organizations tend to hire individuals whose preferences and inclinations fit what is valued, appreciated and expected in that organization (Schneider et al., 1995). When applied to the context of academic research organizations, these tendencies suggest that researchers who are more entrepreneurial will more likely choose to work for, and also be selected by, research organizations that are characterized by a stronger commercialization logic.

The congruence between an organizational-level institutional logic and researchers' entrepreneurial intentions will likely be further intensified by socialization processes (Van Maanen and Schein, 1979).ⁱⁱ Within a research organization, newcomers as well as incumbents will learn which behaviours are considered desirable and legitimate by noting what is emphasized by organizational practices and artefacts such as onboarding programs, organizational publications and definitions of task and work roles, as well as in ongoing interactions with other organization members (Chao et al., 1994; Wanous, 1992). From these experiences, individuals develop cognitive and attitudinal patterns that reflect the ones prevalent within their organization (Jokisaari and Nurmi, 2009). In research organizations with a strong commercialization logic, newcomers as well as incumbent researchers will be

confronted with a wide array of practices, artefacts and interactions that convey an appreciation for research commercialization and entrepreneurial activities (Colyvas and Powell, 2007). This focus will result in those researchers developing higher levels of entrepreneurial intentions.

Summing up, due to ASA as well as socialization processes, we expect researchers' entrepreneurial intentions to reflect the degree to which a commercialization logic is embodied within their research organization. We thus propose:

Hypothesis 1: The degree to which a research organization displays a commercialization logic positively relates to the entrepreneurial intentions of the researchers within that particular research organization.

The Role of Leaders in Transmitting an Institutional Logic

Research group leaders act as supervisors in their research organizations (Bercovitz and Feldman, 2008). They fund, steer, review and evaluate the work of their subordinate researchers and thus influence researchers' work activities. Prior research suggests that research group leaders can inspire their subordinate researchers to engage in academic entrepreneurship (Brettel et al., 2013; Johnson et al., 2017). Yet, our understanding of the contextual antecedents of such leader behaviour remains limited.

Drawing on person-environment fit theory (Jansen and Kristof-Brown, 2006), the present study addresses this issue. In particular, we portray research group leaders as meso-level actors who contribute to enacting the mechanisms that link the organizational-level commercialization logic to researchers' entrepreneurial intentions. We thus acknowledge that supervisors are embedded in organizations that represent the context for their behaviour (Porter and McLaughlin, 2006). Also, we recognize that supervisors are important for creating a fit between subordinates and their work environment (Jansen and Kristof-Brown, 2006). Based on these ideas, the next section develops the rationales leading to Hypotheses 2a to 2d and Hypothesis 3. Specifically, we follow a step-by-step approach to argue why we expect research group leaders' track records of entrepreneurial behaviours and their entrepreneurial intentions

to mediate the relationship between an organizational-level logic of research commercialization and individual researchers' entrepreneurial intentions.

Organizational-Level Commercialization Logic and Leaders' Entrepreneurial Track Records and Intentions. Individuals who fit in with what is appreciated and valued within an organization are rewarded with status, reputation and support (Bretz and Judge, 1994). In research organizations with a strong commercialization logic, individuals who commercialize research results through entrepreneurial endeavours will be held in high regard and receive recognition and support. Because of that recognition, individuals who are currently involved in and/or have track records of entrepreneurial behaviours will stand a better chance of being promoted and assuming a leadership role (Schaubroeck and Lam, 2002). In fact, an entrepreneurial track record or entrepreneurial intentions can even become a requirement for professional advancement and assuming a leadership position within a research organization that champions activities related to research commercialization and entrepreneurship (Colyvas and Powell, 2007).

The alignment between organizational-level commercialization logic and leaders' entrepreneurial track records and entrepreneurial intentions is further fuelled by organizational socialization processes (Jokisaari and Nurmi, 2009; Weiss, 1977). Just like their subordinate researchers, supervisors are subject to organizational socialization (Porter and McLaughlin, 2006). When commercialization activities are emphasized in the means and measures of personnel development and performance appraisals and also acknowledged in publications and contests within a research organization, then leaders will more likely develop their own entrepreneurial intentions and engage in entrepreneurial activity. In line with these arguments and observations, we propose:

Hypothesis 2a: The degree to which a research organization displays a commercialization logic positively relates to its leaders' track records of entrepreneurial behaviour.

Hypothesis 2b: The degree to which a research organization displays a commercialization logic positively relates to its leaders' entrepreneurial intentions.

Leaders' Entrepreneurial Track Records and Intentions and the Entrepreneurial Intentions of Researchers. Supervisors are not only embedded in the context of their research organization (Porter and McLaughlin, 2006), they also serve as important points of reference for the fit between researchers and their work environment (Jansen and Kristof-Brown, 2006).

Individual researchers are attracted to work environments that align with their preferences. A supervisor with a track record of entrepreneurial behaviour has accumulated related knowledge and skills (Rauch and Rijdsdijk, 2013) and likely backs entrepreneurial activities. From such a supervisor, researchers can reasonably expect encouragement and meaningful support for their own entrepreneurial endeavours (Rasmussen et al., 2014). Researchers with higher levels of entrepreneurial intentions who are pondering their career choices will thus more likely feel inclined to work for a supervisor who has showcased entrepreneurial behaviour in the past.

Serving as agents in the socialization of their subordinates (Jokisaari and Nurmi, 2009; Weiss, 1977), leaders with entrepreneurial track records will also likely stimulate the entrepreneurial intentions of their researchers. Organization members learn and adjust to expectations by observing and imitating the behaviour of others who function as role models (Bandura, 1977; Jokisaari and Nurmi, 2009). Because supervisors have a high status, they are credible sources of information about what is appreciated and can be achieved in that organizational context (Settoon and Adkins, 1997; Weiss, 1977). Thus, leaders with entrepreneurial track records will serve as entrepreneurial role models for their subordinate researchers (Johnson et al., 2017; Van Auken et al., 2006).

Together, these arguments suggest that researchers' entrepreneurial intentions will reflect the track records of entrepreneurial behaviour of their research group leaders. We thus propose:

Hypothesis 2c: Leaders' entrepreneurial track records positively relates to the entrepreneurial intentions of their researchers.

Similar to leaders' track records of entrepreneurial behaviour, we expect leaders' entrepreneurial intentions to also be reflected in the entrepreneurial intentions of their researchers.ⁱⁱⁱ

Leaders in academia tend to involve researchers in entrepreneurial activities, such as searching for new business opportunities and developing contacts for science commercialization (Colyvas and Powell, 2007). Leaders with entrepreneurial intentions will also indicate to their researchers that related activities are legitimate within their organizational context. Serving as role models (Johnson et al., 2017; Van Auken et al., 2006), such leaders are likely to fuel their researchers' entrepreneurial intentions. Leaders' entrepreneurial intentions—similar to their entrepreneurial track records—will thus also likely influence researchers' entrepreneurial intentions by means of socialization.

Also, we expect leaders' entrepreneurial intentions to influence ASA processes. However, they will affect the attraction and selection of researchers in a different way than leaders' entrepreneurial track records. Compared to their track records of entrepreneurial behaviour, leaders' entrepreneurial intentions are hardly visible from the outside of the organization. Thus, they will unlikely be consequential for attracting researchers with entrepreneurial intentions. In contrast, decisions about whether such researchers are selected into a research organization will more likely depend on leaders' entrepreneurial intentions than on their entrepreneurial track records. This is because, just like other supervisors (Van Vianen, 2000), research group leaders will tend to favour hiring researchers with attitudes and intentions that are similar to their own (Jansen and Kristof-Brown, 2006; Schaubroeck and Lam, 2002).

Based on these arguments suggesting how leaders' entrepreneurial intentions influence socialization and ASA processes, we thus propose:

Hypothesis 2d: Leaders' entrepreneurial intentions positively relate to the entrepreneurial intentions of their researchers.

Taken together, the lines of reasoning presented above suggest Hypothesis 3:

Hypothesis 3: Leaders' entrepreneurial track records and intentions will mediate the relationship between the degree to which a research organization displays a commercialization logic and its researchers' entrepreneurial intentions.

The Interaction between Commercialization Logic and Leaders' Entrepreneurial Track Records and Intentions

Our reasoning leading to Hypothesis 3 suggests a fit between organizational-level commercialization logic and research group leaders' entrepreneurial track records and intentions. However, ASA and socialization processes will often not result in a perfect match between leaders and their organizational context. Notwithstanding the arguments presented above, if two researchers are embedded in the same organizational context—with either a strong or a weak commercialization logic—these researchers may have leaders that differ in their entrepreneurial track records and intentions. Thus, it is reasonable to theorize the interaction between the organizational-level commercialization logic and the leaders' two different characteristics.

When the commercialization logic is weak within a research organization, institutional elements will provide little indication that commercialization activities are legitimate. Nevertheless, researchers with strong entrepreneurial intentions will be attracted to that organization, if they see the opportunity to work for a research group leader with a strong entrepreneurial track record. Similarly, when organization-wide hiring policies place no particular emphasis on research commercialization, researchers with strong entrepreneurial intentions will only be systematically hired into that research organization when supervisors with strong entrepreneurial intentions are present. Moreover, when organization-wide onboarding procedures and other formal and informal socialization practices are not facilitating

research commercialization, the question whether socialization processes strengthen the entrepreneurial intentions of researchers will largely hinge on whether leaders with track records of entrepreneurial activity and/or entrepreneurial intentions are present that serve as role models (Van Auken et al., 2006). Summing up, we expect leaders' entrepreneurial track records and intentions to be clearly reflected in their researchers' entrepreneurial intentions whenever the commercialization logic is weak within a research organization.

In contrast, research group leaders' entrepreneurial track records and intentions will be less consequential for the entrepreneurial intentions among their researchers when the organizational-level commercialization logic is strong. Irrespective of research group leaders' track records of entrepreneurial behaviour, individual researchers with strong entrepreneurial intentions will likely feel attracted to a research organization when job descriptions, publications and awards signal a legitimacy and clear appreciation for commercialization activities. Further, the influence of research group leaders on whether researchers with strong or weak entrepreneurial intentions are hired will lessen when organization-wide hiring policies clearly favour researchers with entrepreneurial intentions. Finally, when organization-wide onboarding programs and other formal and informal socialization practices strongly indicate that commercialization activities and entrepreneurship are appreciated and legitimate within that research organization, the question of whether leaders serve as potential role models for entrepreneurship will be less relevant for whether socialization processes within the organization serve to stimulate researchers' entrepreneurial intentions.

Summing up, we suggest that the effects of leaders' entrepreneurial track records and their entrepreneurial intentions will likely be stronger when the logic of research commercialization is weak rather than strong within a research organization. In line with person-environment fit theory—which suggests a compensatory relationship between dimensions that are relevant for a fit between individuals and their work environment (Jansen

and Kristof-Brown, 2006)—and recognizing that such a relationship is statistically reflected in a negative interaction, we thus submit:^{iv}

Hypothesis 4a: There will be a negative interaction effect between the organizational-level commercialization logic and leaders' entrepreneurial track records on researchers' entrepreneurial intentions.

Hypothesis 4b: There will be a negative interaction effect between the organizational-level commercialization logic and leaders' entrepreneurial intentions on researchers' entrepreneurial intentions.

METHOD

Sample

Our hypotheses address three levels of analysis; namely, individual researchers (L1) supervised by leaders (L2) within research organizations (L3). To reflect this structure, we collected data from scientists (L1) working for research group leaders (L2) in research institutes (L3). These research institutes belong to two of the most important and prestigious research associations in Germany, the Max Planck Society (MPS) and the Helmholtz Association (HA). As these research institutes autonomously set and pursue their research agendas and receive their own publicly funded budgets, they are effectively independent organizations.

In using data from MPS and HA, our study follows earlier research on academic entrepreneurship (e.g. Goethner et al., 2012; Krabel and Mueller, 2009; Krabel and Schacht, 2014; Perkmann et al., 2013). In total, the MPS and HA comprise 299 research institutes that conduct basic as well as applied research. Of these research institutes, 74 percent belong to the HA, and 26 percent to MPS. About 56 percent perform research in the natural sciences, 38 percent in the life sciences and about 7 percent in the social and human sciences (Helmholtz Association, 2015; Max Planck Society, 2015).

For our study, we collected data from the MPS and HA institutes located in three regions in Germany: Cologne, Goettingen and Magdeburg. We focused on these three regions for two

reasons: First, in these regions we could administer the questionnaire in person, which we expected would increase response rates. Second, secondary data analysis revealed that by focusing on these three regions we would obtain a fairly representative sample of the full population of MPS and HA research institutes in Germany. In fact, similar to the overall population of MPS and HA research institutes in Germany, 76 percent of the research institutes in our sample belong to the HA and 24 percent belong to the MPS. Also similar to the overall population, 59 percent of the research institutes in our sample are active in the natural sciences, 37 percent in life sciences and 4 percent in the social and human sciences fields.

To collect our data, we took the following steps. First, we contacted by telephone a random sample of 250 research group leaders from 89 research institutes in all three regions and asked them to participate in our study. Then, we personally handed questionnaires to 201 research group leaders and left questionnaires with return envelopes for 805 researchers who were working in these leaders' research groups. In total, 110 leader questionnaires (54 percent) and 339 researcher questionnaires (42 percent) from 66 research institutes (74 percent) were returned. We tested for non-response bias by comparing the answers of early and late respondents (Armstrong and Overton, 1977) and found no significant differences between these groups.

After dropping unmatched responses, our data set included 254 researchers working for 85 research group leaders in 49 research institutes. Researchers in our sample were, on average, 36 years old, and group leaders were, on average, 52 years old. Similar to the percentage of male and female researchers working in public research institutes in Germany (Federal Ministry of Education and Research, 2012), 70 percent of the researchers and 93 percent of the research group leaders in our sample were male. In terms of nationality, 72 percent of the researchers and 84 percent of the research group leaders were German citizens.

Measures

Our study rests on multiple data sources, thus effectively alleviating concerns related to common method variance (Podsakoff et al., 2003; Siemsen et al., 2010). Research group leaders (L2) provided information on our mediator variables—leaders’ entrepreneurial track records and intentions—and all leader-related control variables. Complementarily, researchers (L1) provided data on the dependent variable of our study—researchers’ entrepreneurial intentions—and all researcher-related controls. Both the research group leaders and the researchers reported on the institutional logics (L3) characterizing their research organizations. All organization-related (L3) control variables were collected from archival data.

Our survey scales are reported in Appendix A. To ensure the validity of our data, whenever possible, we used established scales that have been validated in prior research. English survey items were translated into German and then back-translated, following the procedures described by Brislin (1980). We also took several steps to ensure validity when developing the scales to capture commercialization logic and open-science logic.^v

Researchers’ Entrepreneurial Intentions (L1). To capture *researchers’ entrepreneurial intentions*, we relied on a six-item scale developed by Thompson (2009) that has proven its reliability and validity in prior research (De Jong et al., 2015; Mathieu and St-Jean, 2013). These six items formed a single scale (Cronbach’s alpha = .85).

Leader’s Entrepreneurial Track Record and Intentions (L2). To capture leader’s *entrepreneurial track record*, we used the number of businesses a research group leader had established (Krabel and Mueller, 2009). To capture leaders’ *entrepreneurial intentions*, we used the exact same scale used to capture researchers’ entrepreneurial intentions; that is, the six-item scale developed by Thompson (2009). These six items formed a single scale (Cronbach’s alpha = .80).

Organizational-level Commercialization Logic (L3). To capture the extent to which a research institute embodies a *commercialization logic*, we developed a 15-item scale. Theory

suggests that institutional logics provide a coherent set of organizing principles for a particular societal domain, and are reflected in normative, cognitive and regulative institutional elements (e.g. Friedland and Alford, 1991; Scott, 2014; Thornton et al., 2012). Based on prior research (Aldridge and Audretsch, 2011; Haeussler and Colyvas, 2011; Krabel and Mueller, 2009), we identified a list of five commercialization activities: patenting, licensing, founding activities, industry co-operation and membership on firm advisory boards or boards of directors. We asked respondents (i.e. researchers as well as research group leaders) to indicate for each of the five commercialization activities the extent to which pursuing the respective activity a) is appreciated within their research institute (normative), b) is taken for granted/considered to be normal within their research institute (cognitive) and c) is encouraged and rewarded based on that institute's formal rules and policies (regulative). Response scales for the 15 items ranged from 1, "not at all", to 7, "to a very large extent". Factor analyses revealed that the 15 items formed a single scale (Cronbach's alpha = .91), which is consistent with the notion that an institutional logic is coherently reflected in cognitive, normative and regulative elements (Friedland and Alford, 1991; Greenwood et al., 2017; Thornton et al., 2012).

To establish whether our commercialization-logic measure reflects an organizational-level (L3) construct, we assessed the level of inter-rater agreement among those individuals working within the same research institute and tested for significant between-institute variance (Bliese, 2000; James et al., 1984; Lindell et al., 1999). Median $r_{wg(j)}$ tests (James et al., 1984; LeBreton and Senter, 2008) revealed strong within-institute agreement ($r_{wg(j)} = .88$). One-way ANOVA further established significant between-institute variance ($F = 1.73$, $p = .00$), which was confirmed by intra-class correlation analyses. Specifically, we found an ICC1 value (ICC1 = .11) that exceeds the commonly applied threshold of .05 (Bliese, 2000), and an ICC2 value (ICC2 = .46) that suggests the appropriateness of aggregating the data to the organizational level (L3) (Čerme et al., 2014; Cole et al., 2012).

Control Variables (L3, L2, L1). We included several control variables to rule out alternative explanations for our results. At the organizational level (L3), we took into account the fact that researchers' inclinations for academic entrepreneurship may differ across disciplines (D'Este et al., 2012) by controlling for whether the respective institutes were active in the *life sciences*, *natural sciences* or *social and human sciences*. Further, we controlled for the different *regions* where we collected our data as well as for the two different research associations (*MPS* and *HA*) to which the research institutes belong. Following earlier research (D'Este et al., 2012; Krabel and Schacht, 2014), we also controlled for the *size* of the research institutes in terms of the number of research groups within the institute. We further accounted for the extent to which research institutes embodied the *open science logic*. To do this, we developed 12 items that reflect the degree to which activities related to publishing articles, participating in conferences, receiving scientific awards and seeking research grants from public institutions are appreciated (normative), taken for granted (cognitive) and/or formally encouraged and rewarded (regulative) within a research institute (Lam, 2011; Siegel et al., 2007). These 12 items formed a single scale (Cronbach's alpha = .82), and median $r_{wg(j)}$ tests revealed strong within-institute agreement ($r_{wg(j)} = .86$). However, a one-way ANOVA revealed no significant between-institute variance ($F = 0.90, p = .66$).

At the level of research group leaders (L2), we controlled for leaders' *age*, as research has shown that age may have an effect on entrepreneurial activity (Haeussler and Colyvas, 2011). As prior research has found that females and males differ with regard to entrepreneurial activity and intentions (Perkmann et al., 2013; Prodan and Drnovsek, 2010), we also controlled for research group leaders' *gender*. Previous research has revealed a link between citizenship and entrepreneurship (Siegel et al., 2009), thus we further controlled for leaders' *citizenship*. Finally, we included a dummy variable that indicates whether leaders were *institute heads*.

At the researcher-level (L1), we accounted for individual characteristics such as *age*, *gender* and *citizenship*. Additionally, we controlled for whether researchers had a *PhD* and a

permanent contract, as prior research has suggested that researchers pursuing their doctorate and who do not have an indefinite work contract are more likely to engage in entrepreneurial activities (Goethner et al., 2012).

Analytical Approach

Our data comprised three levels of analysis—organization (L3), leader (L2) and researcher (L1). Following prior research (Liu et al., 2012), we ran null models to estimate the variance in researchers' *entrepreneurial intentions* residing at the leader level as well as at the organizational level. Results indicate that significant variance in researchers' *entrepreneurial intentions* resides at the leader level ($\chi^2_{(84)} = 133.602$, $p = .00$; ICC1 = .17 [indicating 17 percent of variance resides between leaders]) as well as at the organizational level ($\chi^2_{(48)} = 74.620$, $p = .01$; ICC1 = .10 [indicating 10 percent of variance resides between organizations]). These results strongly suggest the use of multilevel modelling.

For our analyses, we used HLM 7 (Raudenbush and Bryk, 2001), one of the most commonly used software packages for multilevel modelling in the social sciences (Galecki and West, 2013; Garson, 2013).^{vi} Our theoretical reasoning suggests a model in which the independent variable also serves as the moderator for the effects of our mediators. To test our hypotheses, we closely followed procedures utilized in prior three-level moderated mediation studies (Chen et al., 2015; Yang et al., 2010; Zohar and Luria, 2005).

RESULTS

Table I displays the descriptive statistics and correlations of our study variables.^{vii}

 INSERT TABLE I ABOUT HERE

As to be expected, correlation analyses revealed that the *commercialization logic* is weaker among research institutes active in *social and human sciences* ($r = -.320$, $p = .03$). In addition, we observed significant differences in *commercialization logic* between research institutes located in the different *regions* covered by our study. Correlations further revealed leaders'

entrepreneurial track records and *entrepreneurial intentions* to be moderately, but significantly, interrelated ($r = .350, p = .00$). In line with observations made by prior research (Goethner et al., 2012; Krabel and Mueller, 2009; Lee et al., 2011), correlations also showed a negative link between *gender* and researchers' *entrepreneurial intentions* ($r = -.194, p = .00$). Moreover, we observed a relationship between researchers' *citizenship* and their *entrepreneurial intentions* ($r = -.217, p = .00$), which is in line with the notion that researchers with foreign citizenship may have a stronger incentive to commercially exploit the knowledge they generate (Siegel et al., 2009).

Hypotheses Testing

Table II depicts the results of our multi-level analyses.

 INSERT TABLE II ABOUT HERE

Model 1 provides support for Hypothesis 1 by suggesting that the degree to which a research organization displays a *commercialization logic* positively relates to the *entrepreneurial intentions* of researchers within that research organization. ($\gamma = .45, p = .03$).

Our data also support Hypotheses 2a and 2b, which state that the degree to which a research organization displays a commercialization logic positively relates to leaders' *entrepreneurial track records* and *entrepreneurial intentions*. Specifically, we find positive relationships between organizational-level *commercialization logic* and leaders' *entrepreneurial track records* ($\gamma = .43, p = .00$, Model 2) as well as *commercialization logic* and leaders' *entrepreneurial intentions* ($\gamma = 1.03, p = .00$, Model 3).

Hypotheses 2c and 2d propose that leaders' *entrepreneurial track records* as well as their *entrepreneurial intentions* positively relate to their researchers' *entrepreneurial intentions*. Our data support both of these hypotheses. Regarding Hypothesis 2c, Models 4 and 6 reveal positive relationships between leaders' *entrepreneurial track records* and their researchers' *entrepreneurial intentions* ($\gamma = .48, p = .00$ and $\gamma = .24, p = .05$, respectively). As

for Hypothesis 2d, Models 5 and 6 reveal positive relationships between leaders' *entrepreneurial intentions* and researchers' *entrepreneurial intentions* ($\gamma = .34, p = .00$ and $\gamma = .30, p = .00$, respectively).

Building on Hypotheses 2a to 2d, Hypothesis 3 suggests that leaders' *entrepreneurial track records* and their *entrepreneurial intentions* mediate the relationship between the organizational-level *commercialization logic* and researchers' *entrepreneurial intentions*. To test this hypothesis, we followed earlier research (Yang et al., 2010; Zohar and Luria, 2005) and examined whether our data met the three criteria for mediation that were established by Baron and Kenny (1986) and described by Mathieu and Taylor (2007) for mediation in multilevel models. The first criterion demands that the independent variable must significantly relate to the mediators. As described above (Hypothesis 2a and 2b), our data meet this criterion. To meet the second criterion, the mediators must significantly relate to the dependent variable. As evident from the results described above (Hypotheses 2c and 2d), our data also meet this second criterion. The third criterion demands that the relationship between the independent and dependent variable must substantially decrease in magnitude when the mediators are included in the equation. A comparison of Models 1 and 7 reveals that our data also meet this criterion. Specifically, including leaders' *entrepreneurial track records* and *entrepreneurial intentions* in the equation considerably reduces the effect of *commercialization logic* (from $\gamma = .45, p = .03$, in Model 1 to $\gamma = -.00, p = .99$ in Model 7).

To probe this result, we followed methodological recommendations (Preacher and Selig, 2012; Selig and Preacher, 2008) and prior research (Chen et al., 2015) suggesting to utilize a Monte Carlo re-sampling approach to obtain bias-corrected confidence intervals for the indirect effects of *commercialization logic* on researchers' *entrepreneurial intentions* via leaders' *entrepreneurial track records* and *entrepreneurial intentions*. To do that, we entered the above coefficients in the R script developed by Preacher and Selig (2012) and requested 20,000 re-samples. In support of Hypothesis 3, these tests showed positive indirect effects of

commercialization logic on researchers' *entrepreneurial intentions* mediated by leaders' *entrepreneurial track records* ($\rho = 0.11$, at $p < .10$; CI: LL: 0.013 UL: 0.228) and leaders' *entrepreneurial intentions* ($\rho = 0.30$, at $p < .05$; CI: LL: 0.099 UL: 0.569). Figure 2 below summarizes these results.^{viii}

 INSERT FIGURE 2 ABOUT HERE

Hypotheses 4a and 4b posit negative interaction effects between *commercialization logic* and leaders' *entrepreneurial track records* as well as their *entrepreneurial intentions*, respectively. Following earlier research (Eisend, 2014; Luo et al., 2016), we set off to conduct our moderation analyses by adding the interaction terms one at a time.

As shown in Model 8, our data did not support Hypothesis 4a. Contrary to our expectation, we observed a positive interaction between *commercialization logic* and leaders' *entrepreneurial track records* ($\gamma = .33$, $p = .02$, Model 8). We probed this surprising result by using simple slopes analyses (Aiken and West, 1991; Preacher et al., 2006). Specifically, we computed the conditional effects of leaders' *entrepreneurial track records* on researchers' *entrepreneurial intentions* at low and high levels of *commercialization logic* (that is, one standard deviation below the mean and one standard deviation above the mean). These analyses revealed that the effect of leaders' *entrepreneurial track records* on researchers' *entrepreneurial intentions* is non-significant when *commercialization logic* is low ($\gamma = -.14$, $p = .48$), but positive and significant when *commercialization logic* is high ($\gamma = .25$, $p = .03$). Figure 3 illustrates this result.

 INSERT FIGURE 3 ABOUT HERE

As evident from Model 9, we found no support for Hypothesis 4b, as the interaction effect of organizational-level *commercialization logic* and leaders' *entrepreneurial intentions* was not significant ($\gamma = .07$, $p = .18$, Model 9).

Model 10 includes both interaction terms. This model continues to show an insignificant interaction between organizational-level *commercialization logic* and leaders' *entrepreneurial intentions* ($\gamma = -.03$, $p = .72$). Also, adding this insignificant interaction term decreased the p -value of the interaction between organizational-level *commercialization logic* and leaders' *entrepreneurial track records* from $p = .02$ (Model 8) to $p = .11$ (Model 10). Given the significant correlation between the two interaction terms ($r = .42$, $p = .00$), this decrease most likely follows from increased collinearity, which reduces efficiency and increases the risk of Type II error (Wooldridge, 2012; York et al., 2017). Additional analyses support this assessment.^{ix} Against this backdrop, we are confident that it is reasonable to interpret the positive interaction effect between organizational-level *commercialization logic* and leaders' *entrepreneurial track records*, as observed in Model 8. We will return to this finding in our Discussion.

Post-hoc Analyses

We conducted a number of post-hoc analyses to scrutinize the robustness of our findings, better understand the mechanisms driving our results, and address potential endogeneity concerns.^x

The theoretical reasoning presented above utilizes person-environment fit theory (Edwards, 2008; Kristof, 1996) to suggest that two sets of mechanisms contribute to the potential effects of a *commercialization logic* on leaders' *entrepreneurial track record and intentions* and thus ultimately, on researchers' *entrepreneurial intentions*: ASA processes (Schneider et al., 1995) and socialization processes (Van Maanen and Schein, 1979). To shed more light on the relative contribution of these two sets of mechanisms to the results presented above, we first re-ran our analyses and included additional control variables to uncover whether individual researchers tended toward entrepreneurial and commercialization activities prior to entering their respective research organizations. Specifically, we added into our models variables that captured individual researchers' *years of work in industry*, *years of self-employment*, *prior patenting experience* and *founding experience* prior to entering their

respective research organizations. Furthermore, we included the researchers' general *risk-taking propensity* and a variable indicating their *parental founding experience*.^{xi} Including these variables into our analyses partials out effects related to ASA processes (Schneider et al., 1995), such as self-selection or being selected into a research institute (H1) or a particular research group (H2c, H2d).

 INSERT TABLE III ABOUT HERE

As depicted in Table III, when including these additional controls in our models testing Hypotheses 1, 2c and 2d (i.e. Table II, Models 1, 4, 5 and 6), the effects observed for organizational-level *commercialization logic* barely changed (from $\gamma = .45$, $p = .03$, Model 1 to $\gamma = .43$, $p = .01$, Model 1ASA). We observed slightly more substantive changes in the relationship between leader's *entrepreneurial track record* and researchers' *entrepreneurial intentions* (from $\gamma = .48$, $p = .00$, Model 4 to $\gamma = .37$, $p = .00$, Model 4ASA and from $\gamma = .24$, $p = .05$, Model 6 to $\gamma = .17$, $p = .13$, Model 6ASA). We did not observe substantive changes in the relationship between leaders' *entrepreneurial intentions* and researchers' *entrepreneurial intentions* (from $\gamma = .34$, $p = .00$, Model 5 to $\gamma = .30$, $p = .00$, Model 5ASA and from $\gamma = .30$, $p = .00$, Model 6 to $\gamma = .27$, $p = .00$, Model 6ASA). Overall, these results suggest that our findings as presented above result—to a significant extent—from socialization processes, and not just from ASA processes.^{xii}

DISCUSSION

Situated at the intersection of academic fields (Zahra and Newey, 2009), our study contributes to theory development by combining and synthesizing ideas (Makadok et al., 2018) from institutional theory, person-environment fit theory and leadership research in the field of science commercialization (Wright and Phan, 2018). Specifically, we developed multi-level theory (Hitt et al., 2007) to conceptualize and examine the largely unexplored mechanisms and

processes (Colquitt and Zapata-Phelan, 2007) that constitute the cross-level link between organizational-level institutional context and the entrepreneurial intentions of academics.

In line with our reasoning, we found that researchers' entrepreneurial intentions reflect the commercialization logic of the research organizations they work for. This finding underscores the idea that macro-level institutional structures play a significant role in explaining science commercialization through academic entrepreneurship (Balven et al., 2018). Highlighting that differences in institutional logics—which are consequential for individual-level entrepreneurial intentions—also exist at the organizational-level, our study further complements prior research on how the field-level institutional logic in academia contributes to explaining how entrepreneurship is enacted (Fini and Toschi, 2016). Delineating how institutional theory may be fruitfully complemented by ideas on how ASA and socialization processes establish person-environment fit (Edwards, 2008; Kristof, 1996), our study further advances our understanding of the cross-level mechanisms involved in academic entrepreneurship (Balven et al., 2018; Hmieleski and Powell, 2018). Our study further provides theoretical arguments and empirical evidence to suggest that research group leaders are an important link between the organizational-level logic of research commercialization and the entrepreneurial intentions of their researchers. Identifying leaders as meso-level actors who are crucial for transmitting the organizational-level commercialization logic to the individual level, the present study enriches our understanding of how the multi-layered social structures in which individual researchers are embedded help to explain science commercialization through academic entrepreneurship (Balven et al., 2018; Kim et al., 2016).

Furthermore, our study qualifies existing theory on the role of leaders for academic entrepreneurship (e.g. Bercovitz and Feldman, 2008; Brettel et al., 2013; Johnson et al., 2017; Krabel and Schacht, 2014). Prior research has established that academic leaders are crucial for science commercialization, as they may inspire their researchers to engage in academic entrepreneurship. Based on multi-level theorizing spanning three levels, this study offers two

important extensions of this prior research and contributes to expanding theory on leadership in the domain of academic entrepreneurship (Balven et al., 2018). Specifically, we expand extant theorizing by identifying regulative, normative and cognitive institutional elements as important contextual roots from which leaders' influence on academic entrepreneurship originates. Moreover, our study contributes to extending our knowledge by highlighting organizational-level logics as an important boundary condition (Colquitt and Zapata-Phelan, 2007; Makadok et al., 2018) that may strengthen or weaken leaders' influence.

While our analyses do not support the proposed compensatory relationship between commercialization logic and leaders' entrepreneurial track records, we do find that these two variables reinforce each other's influence. As noted before, leaders with track records of entrepreneurial behaviour have accumulated knowledge and skills (Rauch and Rijdsdijk, 2013) that can support researchers in their entrepreneurial endeavours and thus stimulate entrepreneurial intentions. Against this backdrop, one reason for our unexpected finding of a complementary relationship between commercialization logic and leaders' entrepreneurial track records could be that subordinate researchers feel more confident about asking for their supervisor's advice and support when there are institutionalized rules, norms and practices clearly geared towards fostering research commercialization. In addition, when organizational contextual conditions signal that commercializing research results is legitimate, leaders with entrepreneurial track records will feel more empowered to provide meaningful support to their researchers' entrepreneurial endeavours. However, future research is needed to elaborate on this reasoning in greater detail.

Illustrating the fruitfulness of theory-building at the intersection of academic fields (Zahra and Newey, 2009), we believe that the insights generated in the present study may also inform theory building and development in other domains of entrepreneurship and institutional theory and thus stimulate future research in these domains (Colquitt and Zapata-Phelan, 2007; Makadok et al., 2018).

Implications for General Entrepreneurship Research

Given the importance of entrepreneurship in general, numerous studies have sought to identify those contextual factors that foster entrepreneurial intentions and behaviours in settings other than academia, such as in corporations (Phan et al., 2009), social enterprises (Dacin et al., 2010) and regions (Spigel and Harrison, 2018) or nations (Ács et al., 2014). Similar to prior research on academic entrepreneurship, these studies have mostly concentrated on identifying contextual drivers at one particular level, such as the group (Anderson and Miller, 2003; Zapkau et al., 2015), the organization (Foss et al., 2015), the community (Hopp and Stephan, 2012) or the society (Autio et al., 2013).

Our study showcases how models of entrepreneurship that link macro-level institutions to micro-level individual intentions and activities can be enriched by acknowledging and integrating meso-level social structures and related processes (Kim et al., 2016). In this way, our study may inspire future entrepreneurship research informed by institutional theory (Su et al., 2017). For instance, Audretsch et al. (2013), have delineated how religious logics can help to explain the likelihood of individuals becoming self-employed. Inspired by our study, future research may want to elucidate the meso-level processes and specific actors that contribute to enacting the link between macro-level religious logics and individual career choices. Similarly, future research could elaborate on the potential interplay between influences of culture that emanate from different levels, such as the societal-level (Autio et al., 2013) and the community-level (Hopp and Stephan, 2012).

Conversely, our study also illustrates that considering the higher-level contextual roots of influences emanating from meso-level social structures, such as leaders, may contribute to a better understanding and a fuller theoretical account of entrepreneurship phenomena. Inspired by our study, future research in domains such as corporate entrepreneurship (Phan et al., 2009), for instance, may thus want to elucidate whether the influences of relevant meso-level actors,

such as peers and colleagues (Obschonka et al., 2012), may be traced back to higher-level contextual conditions, such as the company's top management team (Srivastava and Lee, 2005).

Implications for Institutional Theory Research in Other Domains

Our study may also inform research on institutional theory in other domains. So far, this research has mainly focused on the emergence of institutional logics and their diffusion among organizations (Zietsma et al., 2017). Thus, we are only beginning to understand the cross-level mechanisms that can explain how institutional logics are transmitted to the individual level (Luo, 2007; Zilber, 2002). The present study highlights meso-level actors and cross-level mechanisms that might be conducive to understanding how institutional logics are transmitted to the individual level. First, this study suggests that person-environment fit theory (Edwards, 2008; Kristof, 1996) provides a fruitful theoretical bridge linking the level of institutional logics with that of individual intentions and subsequent behaviours. Second, our study underscores the idea that supervisors and other meso-level actors can play a significant role in enacting these mechanisms, thus serving as agents in the transmission of an institutional logic.

On this basis, our research may inform future studies on institutional theory in research domains such as health care (Muzio et al., 2013) or accounting (Lander et al., 2013). For instance, prior research has examined the question of how accounting firms react when confronted with a shift in emphasis from trustee logic to commercial logic (Lander et al., 2013). This research found that while some firms readily adopted the new logic, others resisted completely and most did not choose a single, consistent strategy. To better understand how such differences in firm-level adoption may affect the professional services that accountants provide to their clients, future research may want to consider the role of supervisors as well as ASA and socialization processes. In a similar way, our study could inspire further research to elaborate on how the attributes and behaviours of meso-level actors, such as senior physicians, can help to explain whether and why a newly added managerial logic is enacted in hospitals (Adler and Kwon, 2013).

Practical Implications

Our findings also have practical implications for the field of science commercialization, and perhaps beyond academia. First, in order to foster entrepreneurial intentions and activities in academia, it is not sufficient for policy-makers to propagate a commercialization logic at the field-level, such as through national policies or sector-specific educational programs (Grimaldi et al., 2011). Rather, the challenge lies in convincing organizations in the field to adopt and institutionalize this logic. Further, research organizations need to be aware of the central role that research group leaders play in transmitting the commercialization logic within their research organization to the individual level. Thus, the selection and socialization of leaders who share and endorse that commercialization logic is crucial.

While we derived our insights from the context of research organizations in academia, they may also have practical implications for business organizations. In such organizations, management often seeks to promote entrepreneurship in its workforce in order to mitigate some of the limitations of bureaucracy (Kuratko et al., 2004). While such promotion may be comparably less challenging than introducing the commercialization logic in academia, our arguments and findings on the crucial role of leaders as well as selection and socialization processes may still hold true in the context of business organizations. However, as our study results underscore the idea that context matters (Johns, 2006), future research may want to replicate our findings in the business context to substantiate this notion.

Limitations and Additional Avenues for Future Research

When interpreting the results of this study, readers should bear in mind certain additional limitations. We acknowledge that, even when considering the remedies described in the results section, the cross-sectional nature of our study does not allow for strong causality inferences. We thus encourage future research to revisit the relationships observed in our study using longitudinal research designs. Our study focuses on the entrepreneurial intentions of researchers. While entrepreneurial intentions are the most proximal and important predictor of

engagement in entrepreneurial behaviour in academia (Prodan and Drnovsek, 2010) and other settings (Kautonen et al., 2015; Lee et al., 2011; Van Gelderen et al., 2015), future research may want to address how the studied variables contribute to explaining entrepreneurial activities and their outcomes. Our limited sample size, particularly at the organizational level, restricted the power of our analyses. Therefore, it is possible that we might not have detected certain effects that would have been significant had our sample been larger. While we show that and why an organizational-level institutional logic of research commercialization is consequential for entrepreneurial intentions, we did not directly measure the corresponding practices, such as onboarding programs or hiring procedures. Future research could therefore scrutinize these manifestations of institutional logics.

We indicated that in academia the institutional logic of research commercialization has joined the long-prevalent institutional logic of open science. Scholars have noted that while two or more institutional logics may exist at the same time, they oftentimes compete, as they place different demands on the individuals exposed to them (Jaskiewicz et al., 2016; Reay and Hinings, 2009; Souitaris et al., 2012). Our results do not indicate that the open-science logic prevalent in the studied research organizations has implications for researchers' entrepreneurial intentions. However, future research might want to address in detail whether a strong commercialization logic impedes other science-related outcomes that are relevant in the context of academia, such as publication output or grant applications.

Despite these limitations, we are confident that our multi-level theorizing at the intersection of different academic fields (Zahra and Newey, 2009) has generated valuable insights that enrich our understanding of science commercialization through academic entrepreneurship while at the same time informing theory-building and development in the fields of entrepreneurship and institutional theory.

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Table I. Means, Standard Deviations and Correlations

	Mean	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.
Organizational Level (L3)											
1. Commercialization Logic	2.97	.59									
2. Open Science Logic	5.18	.41	.121								
3. Association (0=MPS; 1=HA)	.76	.43	.211	.023							
4. Life Sciences	.37	.49	.160	.243	.139						
5. Natural Sciences	.59	.50	-.028	-.238	.010	-.918**					
6. Social and Human Sciences	.04	.20	-.320*	.000	-.362*	-.157	-.248				
7. Cologne Region	.69	.47	-.367**	-.098	.240	-.045	-.011	.137			
8. Goettingen Region	.27	.45	.369**	.065	-.303*	-.074	.123	-.124	-.905**		
9. Magdeburg Region	.04	.20	.031	.082	.117	.271	-.248	-.043	-.311*	-.124	
10. Size	6.59	6.88	.159	.210	-.055	.475**	-.410**	-.139	-.105	.104	.012
Leader Level (L2)											
1. Entrepreneurial Track Record	.24	.72									
2. Entrepreneurial Intentions	3.15	1.39	.350**								
3. Age	52.06	8.32	.181	-.042							
4. Gender (1=Female)	.07	.26	-.091	.104	-.057						
5. German Citizenship	.84	.37	-.031	-.088	-.028	.122					
6. Head of Institute	.26	.44	.106	.084	.207	-.163	.045				
Researcher Level (L1)											
1. Entrepreneurial Intentions	2.59	1.39									
2. Age	35.79	9.11	-.030								
3. Gender (1=Female)	.31	.46	-.194**	-.226**							
4. German Citizenship	.72	.45	-.217**	.197**	-.099						
5. Permanent Contract	.26	.44	-.064	.621**	-.161*	.229**					
6. PhD	.61	.49	-.054	.547**	-.121	-.097	.211**				

Notes: * $p \leq .05$, ** $p \leq .01$. N(L3) = 49; N(L2) = 85; N(L1) = 254.

Table II. Results of Hierarchical Linear Model Regression Analysis for Researchers' Entrepreneurial Intentions (Model 1, and Models 4 to 10), Leaders' Entrepreneurial Track Records (Model 2) and Leaders' Entrepreneurial Intentions (Model 3)

	<u>Model 1:</u> Entrepreneurial Intentions (Researcher)	<u>Model 2:</u> Entrepreneurial Track Record (Leader)	<u>Model 3:</u> Entrepreneurial Intentions (Leader)	<u>Model 4:</u> Entrepreneurial Intentions (Researcher)	<u>Model 5:</u> Entrepreneurial Intentions (Researcher)	<u>Model 6:</u> Entrepreneurial Intentions (Researcher)
Organizational Level (L3)						
Intercept	2.51 (.09)**	.21 (.06)**	3.03 (.12)**	2.56 (.09)**	2.55 (.08)**	2.56 (.08)**
Commercialization Logic	.45 (.20)*	.43 (.14)**	1.03 (.33)**			
Open Science Logic	-.21 (.21)	-.08 (.14)	-.75 (.27)**	-.15 (.20)	.06 (.19)	.06 (.18)
Association (0=MPS; 1=HA)	-.55 (.23)*	-.47 (.15)**	-.10 (.26)	-.20 (.25)	-.48 (.19)*	-.37 (.20) ⁺
Life Science	-.48 (.25) ⁺	.44 (.21)*	.60 (.28)*	-.62 (.23)**	-.79 (.24)**	-.85 (.22)**
Social and Human Science	-.47 (.46)	.60 (.30) ⁺	1.00 (.58) ⁺	-.94 (.46)*	-.90 (.36)*	-1.00 (.39)*
Cologne Region	-1.14 (.40)**	.42 (.25) ⁺	-.05 (.26)	-1.24 (.36)**	-1.25 (.39)**	-1.28 (.39)**
Goettingen Region	-1.40 (.38)**	.23 (.24)	.46 (.37)	-1.38 (.35)**	-1.65 (.38)**	-1.68 (.39)**
Size	.02 (.01)*	-.01 (.01)	-.01 (.02)	.03 (.01)**	.04 (.01)**	.04 (.01)**
Leader Level (L2)						
Entrepreneurial Track Record				.48 (.12)**		.24 (.12) ⁺
Entrepreneurial Track Record x Commercialization Logic					.34 (.05)**	.30 (.06)**
Entrepreneurial Intentions Commercialization Logic						
Age	-.01 (.02)	.02 (.01)	-.00 (.02)	-.02 (.02)	-.01 (.01)	-.02 (.01)
Gender (1=Female)	.14 (.29)	-.57 (.27)*	.63 (.43)	.47 (.29)	.06 (.22)	.23 (.21)
German Citizenship	-.06 (.26)	-.06 (.27)	-.34 (.35)	-.15 (.26)	-.01 (.23)	-.05 (.24)
Head of Institute	-.01 (.25)	.13 (.21)	.54 (.32)	-.07 (.22)	-.19 (.22)	-.21 (.22)
Researcher Level (L1)						
Age	.00 (.02)			-.00 (.02)	.01 (.02)	.01 (.02)
Gender (1=Female)	-.58 (.15)**			-.61 (.17)**	-.54 (.16)**	-.57 (.16)**
German Citizenship	-.67 (.17)**			-.69 (.17)**	-.50 (.17)**	-.54 (.17)**
Permanent Contract	-.06 (.26)			-.08 (.26)	-.13 (.25)	-.13 (.24)
PhD	-.44 (.23) ⁺			-.35 (.22)	-.40 (.23) ⁺	-.37 (.22) ⁺
Deviance Score	830.34	193.14	280.31	823.73	809.25	806.03

Notes: ⁺ p ≤ .10, *p ≤ .05, **p ≤ .01, two-tailed, robust standard error in parentheses. N(L3) = 49; N(L2) = 85; N(L1) = 254. The control variables "Natural Sciences" and "Magdeburg Region" serve as baseline categories for Sciences ("Natural Sciences") and Regions ("Magdeburg Region") and were thus excluded from all models.

Table II. Results of Hierarchical Linear Model Regression Analysis for Researchers' Entrepreneurial Intentions (Model 1, and Models 4 to 10), Leaders' Entrepreneurial Track Records (Model 2) and Leaders' Entrepreneurial Intentions (Model 3) (continued)

	Model 7:		Model 8:		Model 9:		Model 10:	
	Entrepreneurial Intentions (Researcher)		Entrepreneurial Intentions (Researcher)		Entrepreneurial Intentions (Researcher)		Entrepreneurial Intentions (Researcher)	
Organizational Level (L3)								
Intercept	2.56	(.08)**	2.53	(.08)**	2.54	(.08)**	2.54	(.08)**
Commercialization Logic	-0.00	(.16)	-0.03	(.16)	-0.00	(.16)	-0.04	(.16)
Open Science Logic	.06	(.18)	.05	(.17)	.06	(.18)	.05	(.17)
Association (0=MPS; 1=HA)	-.37	(.21) ⁺	-.31	(.20)	-.35	(.21) ⁺	-.31	(.20)
Life Science	-.85	(.22)**	-.86	(.21)**	-.86	(.22)**	-.85	(.21)**
Social and Human Science	-1.00	(.42)*	-.95	(.36)*	-1.05	(.40)*	-.91	(.36)*
Cologne Region	-1.28	(.39)**	-1.26	(.37)**	-1.27	(.40)**	-1.27	(.37)**
Goettingen Region	-1.68	(.39)**	-1.66	(.38)**	-1.68	(.40)	-1.66	(.37)**
Size	.04	(.01)**	.04	(.01)**	.04	(.01)**	.04	(.01)**
Leader Level (L2)								
Entrepreneurial Track Record	.25	(.13) ⁺	.06	(.14)	.22	(.12) ⁺	.04	(.16)
Entrepreneurial Track Record x Commercialization Logic			.33	(.13)*			.39	(.24)
Entrepreneurial Intentions	.30	(.06)**	.30	(.06)**	.29	(.06)**	.30	(.06)**
Entrepreneurial Intentions x Commercialization Logic					.07	(.05)	-.03	(.10)
Age	-.02	(.01)	-.02	(.01)	-.02	(.01)	-.02	(.01)
Gender (1=Female)	.23	(.21)	.24	(.21)	.21	(.21)	.25	(.22)
German Citizenship	-.05	(.24)	-.02	(.24)	-.05	(.24)	-.01	(.24)
Head of Institute	-.21	(.22)	-.27	(.22)	-.23	(.22)	-.27	(.22)
Researcher Level (L1)								
Age	.01	(.02)	.00	(.02)	.00	(.02)	.00	(.02)
Gender (1=Female)	-.57	(.16)**	-.60	(.16)**	-.56	(.16)**	-.57	(.16)**
German Citizenship	-.54	(.18)**	-.57	(.18)**	-.55	(.18)**	-.57	(.18)**
Permanent Contract	-.13	(.24)	-.12	(.24)	-.12	(.24)	-.13	(.24)
PhD	-.37	(.23)	-.36	(.22)	-.36	(.22)	-.36	(.22)
Deviance Score	806.03		804.10		805.53		804.03	

Notes: ⁺ p ≤ .10, *p ≤ .05, **p ≤ .01, two-tailed, robust standard error in parentheses. N(L3) = 49; N(L2) = 85; N(L1) = 254. The control variables "Natural Sciences" and "Magdeburg Region" serve as baseline categories for Sciences ("Natural Sciences") and Regions ("Magdeburg Region") and were thus excluded from all models.

Table III. Additional Analysis: Results of Hierarchical Linear Model Regression Analysis with ASA Controls

	Model 1ASA: Entrepreneurial Intentions (Researcher)		Model 4ASA: Entrepreneurial Intentions (Researcher)		Model 5ASA: Entrepreneurial Intentions (Researcher)		Model 6ASA: Entrepreneurial Intentions (Researcher)	
Organizational Level (L3)								
Intercept	2.53	(.08)**	2.58	(.08)**	2.56	(.08)**	2.57	(.08)**
Commercialization Logic	.43	(.16)*						
Open Science Logic	-.16	(.20)	-.12	(.19)	.07	(.18)	.08	(.18)
Association (0=MPS; 1=HA)	-.55	(.20)*	-.23	(.21)	-.43	(.17)*	-.35	(.17)*
Life Science	-.44	(.22)*	-.54	(.21)*	-.70	(.22)**	-.74	(.20)**
Social and Human Science	-.82	(.41) ⁺	-1.22	(.42)**	-1.16	(.32)**	-1.23	(.34)**
Cologne Region	-1.07	(.35)**	-1.16	(.33)**	-1.17	(.35)**	-1.19	(.36)**
Goettingen Region	-1.35	(.40)**	-1.30	(.34)**	-1.55	(.35)**	-1.57	(.34)**
Size	.02	(.01)*			.03	(.01)**	.03	(.01)**
Leader Level (L2)								
Entrepreneurial Track Record			.37	(.12)**			.17	(.11)
Entrepreneurial Intentions					.30	(.05)**	.27	(.06)**
Age	-.01	(.01)	-.01	(.01)	-.01	(.01)	-.02	(.01)
Gender (1=Female)	.10	(.28)	.37	(.28)	.04	(.22)	.16	(.20)
German Citizenship	.04	(.23)	-.04	(.24)	.09	(.21)	.07	(.21)
Head of Institute	-.10	(.21)	-.14	(.19)	-.27	(.20)	-.29	(.19)
Researcher Level (L1)								
Age	.01	(.01)	.00	(.01)	.01	(.01)	.01	(.01)
Gender (1=Female)	-.42	(.16)**	-.46	(.17)**	-.41	(.17)*	-.43	(.17)*
German Citizenship	-.60	(.18)**	-.61	(.18)**	-.48	(.19)*	-.50	(.19)**
Permanent Contract	-.22	(.23)	-.22	(.24)	-.25	(.22)	-.24	(.22)
PhD	-.41	(.21) ⁺	-.30	(.20)	-.33	(.22)	-.30	(.21)
<i>Risk Propensity</i>	.20	(.08)*	.19	(.08)*	.19	(.08)*	.19	(.08)*
<i>Years of Work in Industry</i>	-.00	(.00)	-.00	(.00)	-.00	(.00)	-.00	(.00)
<i>Years of Self-employment</i>	.00	(.00)*	.00	(.00) ⁺	.00	(.00)*	.00	(.00) ⁺
<i>Prior Patenting Experience</i>	-.01	(.04)	.02	(.04)	-.02	(.04)	-.02	(.04)
<i>Founding Experience</i>	.78	(.27)**	.75	(.27)**	.70	(.28)*	.68	(.28)*
<i>Parental Founding Experience</i>	.01	(.19)	.07	(.19)	.04	(.17)	.07	(.17)
Deviance Score	798.70		796.52		781.30		779.66	

Notes: ⁺ p ≤ .10, *p ≤ .05, **p ≤ .01, two-tailed robust standard error in parentheses; N(L3) = 49; N(L2) = 85; N(L1) = 254. The control variables “Natural Sciences” and “Magdeburg Region” serve as baseline categories for Sciences (“Natural Sciences”) and Regions (“Magdeburg Region”) and were thus excluded from all models.

Figure 1. Conceptual Model

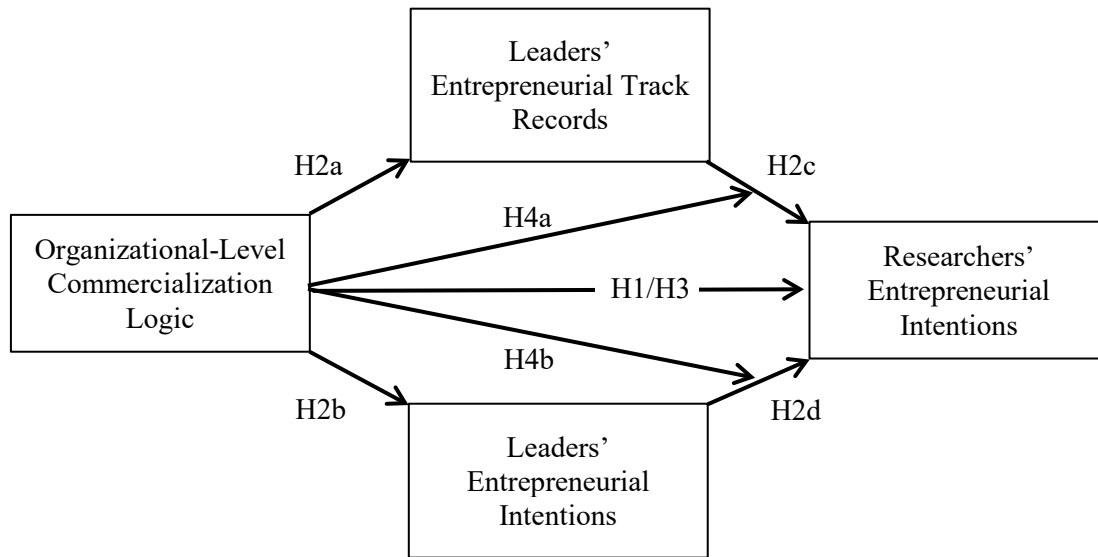


Figure 2. Summary of Cross-Level Direct and Indirect Effects

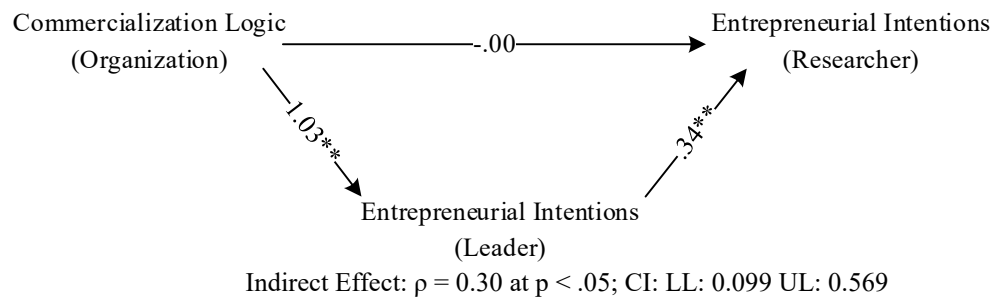
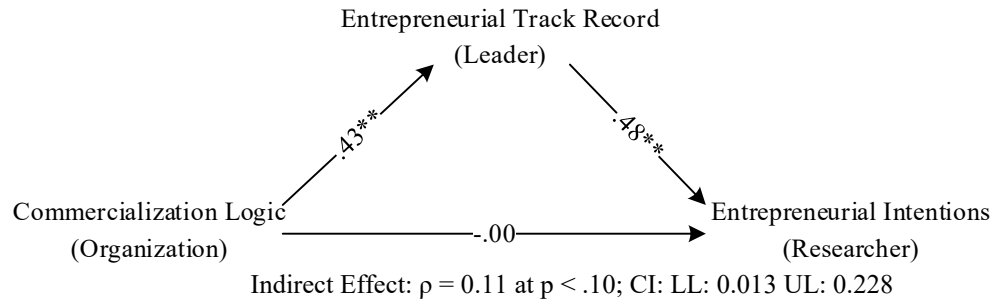
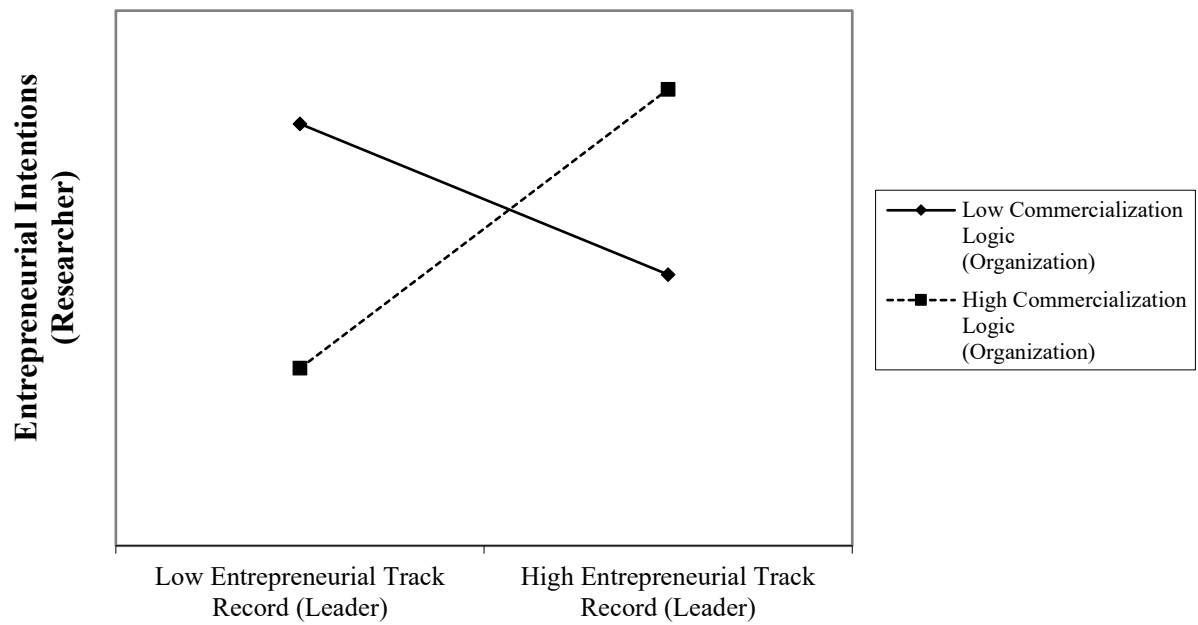


Figure 3. Interaction of Leaders' Entrepreneurial Track Records and Commercialization Logic



Appendix A. Scales

<i>Dependent Variable (Level 1)</i>	
Researchers' Entrepreneurial Intentions	Six items, seven response options (from 1 – not at all to 7 – completely) 1) I intend to set up a company in the future 2) I will never search for business start-up opportunities (reverse coded) 3) I am saving money to start a business 4) I do not read books on how to set up a firm (reverse coded) 5) I have no plans to launch my own business (reverse coded) 6) I spend time learning about starting a firm
<i>Explanatory Variable (Level 2)</i>	
Leaders' Entrepreneurial Intentions	Six items, seven response options (from 1 – not at all to 7 – completely) 1) I intend to set up a company in the future 2) I will never search for business start-up opportunities (reverse coded) 3) I am saving money to start a business 4) I do not read books on how to set up a firm (reverse coded) 5) I have no plans to launch my own business (reverse coded) 6) I spend time learning about starting a firm
<i>Explanatory Variable (Level 3)</i>	
Commercialization Logic	Fifteen items, seven response options each (from 1 – not at all to 7 – to a very large extent) To what extent are the following activities appreciated within your research institute? 1) Industry co-operations 2) Patenting activities 3) License royalties generated. 4) Membership in a board of directors or advisory board in a private company. 5) Founding activities. To what extent is it normal/taken for granted within your research institute that researchers pursue the following activities? 1) Industry co-operations 2) Patenting activities 3) License royalties generated. 4) Membership in a board of directors or advisory board in a private company. 5) Founding activities. To what extent do formally defined rules and procedures encourage and reward the following activities in your research institute? 1) Industry co-operations 2) Patenting activities 3) License royalties generated. 4) Membership in a board of directors or advisory board in a private company. 5) Founding activities.

Appendix B. Correlations of Continuous and Count Variables at all Three Levels of Analyses

	1.	2.	3.	4.	5.	6.	7.
Organizational Level (L3)							
1. Commercialization Logic							
2. Open Science Logic	.121						
3. Size	.159	.210					
4. Entrepreneurial Track Record	.406**	-.088	-.002				
5. Entrepreneurial Intentions (Leader)	.569**	-.131	-.086	.464**			
6. Age (Leader)	.018	.120	-.148	.013	-.085		
7. Entrepreneurial Intention	.315*	-.060	.182	.356*	.282*	-.020	
8. Age (Researcher)	-.041	-.218	-.134	.163	-.008	.434**	.018
Leader Level (L2)							
1. Commercialization Logic							
2. Open Science Logic	.105						
3. Size	.191	.218*					
4. Entrepreneurial Track Record	.226*	.043	.006				
5. Entrepreneurial Intentions (Leader)	.440**	-.074	.035	.350**			
6. Age (Leader)	.036	.065	-.079	.181	-.042		
7. Entrepreneurial Intention	.194	-.106	.203	.231*	.429**	-.051	
8. Age (Researcher)	.032	-.101	-.008	.247*	-.046	.506**	.035
Researcher Level (L1)							
1. Commercialization Logic							
2. Open Science Logic	.062						
3. Size	.156*	.179**					
4. Entrepreneurial Track Record	.281**	.025	-.073				
5. Entrepreneurial Intentions (Leader)	.424**	-.094	-.127*	.380**			
6. Age (Leader)	.098	.090	-.074	.202**	.020		
7. Entrepreneurial Intention	.086	-.107	.049	.124*	.257**	-.044	
8. Age (Researcher)	.109	.016	-.041	.246**	-.017	.357**	-.030

Notes: * $p \leq .05$, ** $p \leq .01$. $N(L3) = 49$; $N(L2) = 85$; $N(L1) = 254$. To calculate correlations at the three different levels, we followed earlier research (e.g. González-Gómez and Richter, 2015) and aggregated the scores of the higher- and lower-level variables to the respective level of analysis.

NOTES

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- ⁱ According to the theory of planned behaviour (Ajzen, 2002; Fishbein and Ajzen, 2010), intentions that predict subsequent behaviour rest on certain beliefs about the anticipated outcomes, the extent to which this behaviour is expected and appreciated in one's social context and the resources and obstacles that can facilitate or hinder that behaviour in a given situation.
- ⁱⁱ We acknowledge that it is unlikely that the fit between organizational-level commercialization logic and researchers' entrepreneurial intentions is the sole determinant of individual job choice or organizational selection decisions. As suggested by prior research on person-environment fit (De Cooman et al., 2009) and analyses presented later in this manuscript, selection and self-selection processes will likely result in a considerable range of entrepreneurial intentions among researchers within any given research organization.
- ⁱⁱⁱ While leaders' entrepreneurial track records and intentions are likely interrelated, it also seems plausible to assume that leaders who have no entrepreneurial track records may, nevertheless, have entrepreneurial intentions and vice versa.
- ^{iv} Please note that the proposed negative interaction effect does not preclude the possibility that researchers' *entrepreneurial intentions* are highest when they are embedded in work contexts that are characterized by a strong organizational-level commercialization logic and when their direct supervisors have a strong *entrepreneurial track record*, and/or *entrepreneurial intentions*. Rather, a negative interaction suggests that the relationship between leaders' *entrepreneurial track records* and *intentions*, respectively, and researchers' *entrepreneurial intentions* is stronger when researchers are embedded in an organizational context with a weak rather than strong commercialization logic.
- ^v To ensure their content validity, item generation followed a theory-driven, deductive approach. Moreover, we pre-tested our items with academics whose responses were not included in this study. This pre-test consisted of a think-aloud protocol to receive structured feedback on the validity and comprehensibility of the items being used (Sudman et al., 2010). To ensure the structural validity of our scales (Clark and Watson, 1995), we analysed their internal consistency, carefully assessed inter-item correlations, checked for discriminant validity and conducted factor-analyses. We also assessed the criterion-validity of our commercialization logic scale by testing for a correspondence between our items and external referent criteria (Drost, 2011), such as the patenting activities of research institutes.
- ^{vi} To ensure the robustness of our findings, we reran all our models using Stata 14.2 and in so doing obtained results virtually identical to the ones reported below.
- ^{vii} Appendix B reports the correlations of all our continuous and count variables at all three levels of analysis.
- ^{viii} These results were confirmed by Sobel (1982) tests revealing significant indirect effects of *commercialization logic* on researchers' *entrepreneurial intentions* via leaders' *entrepreneurial track records* ($z = 1.65, p = .10$) and leaders' *entrepreneurial intentions* ($z = 2.60, p = .01$).
- ^{ix} In line with prior research observing collinearity when adding correlated interaction terms (York et al., 2017), we observed that the standard error of the interaction between *commercialization logic* and leaders' *entrepreneurial track records* increased considerably (from $SE = .13$, Model 8 to $SE = .24$, Model 10), while the magnitude of the effect did not change substantially (from $\gamma = .33$ in Model 8 to $\gamma = .39$, Model 10). Additional simple slope analyses for Model 10 support this interpretation. These analyses were carried out in an analogous way to the simple slope analyses for Model 8 and revealed a non-significant conditional effect of *entrepreneurial track record* when *commercialization logic* is low ($\gamma = -.19, p = .49$) and a positive and significant conditional effect of *entrepreneurial track record* when *commercialization logic* is high ($\gamma = .27, p = .03$). Following earlier research (Fini et al., 2017), we utilized a modified Gram-Schmidt procedure (Golub and van Loan, 2013) to further substantiate the claim that the drop in the p -value of the interaction term for leader's *entrepreneurial track record* and *commercialization logic* from

Model 8 to Model 10 is a result of collinearity. Specifically, we reran Model 10 with orthogonalized interaction terms. To do so, we transformed our two interaction terms so that they were no longer correlated. Then, we reran Model 10. In line with our interpretation, this analysis revealed a significant positive interaction effect of *entrepreneurial track record* and *commercialization logic* ($\gamma = .18, p = .02$) while the interaction effect of *entrepreneurial intentions* and *commercialization logic* remained non-significant ($\gamma = -.02, p = .72$).

^x As our results rest on cross-sectional data, we acknowledge that they may suffer from reverse-causality. Our theoretical reasoning suggests that an organizational-level *commercialization logic* affects leaders' attributes and, ultimately, researchers' *entrepreneurial intentions*. Assuming reverse causality, one would have to argue that researchers' *entrepreneurial intentions* affect leaders' attributes and the organizational-level *commercialization logic*. Previous research has found higher-level contextual conditions to generally have a larger impact on lower-level factors than the other way around (Mathieu et al., 2008a). Also, previous research has observed that leaders in academia do not have a long-term imprinting effect on their organizations (Krabel and Schacht, 2014). Nevertheless, we conducted additional analyses to rule out the possibility that reverse causality distorts our results. We first resorted to a non-recursive structural equation modelling approach (Wong and Law, 1999). Results revealed that our hypothesized models demonstrate a very good overall fit with our data. Also, we found that our hypothesized models provide a better fit with our data than models that comprise reverse-causal effects. Moreover, we observe that adding reversed-causal effects to our hypothesized models did not add significant explanatory value. To further rule out endogeneity concerns related to omitted variables, we applied a control function approach (see, e.g. Wooldridge, 2015). We first computed generalized residuals for each of our explanatory variables from regressions that included variables considered exogenous, such as age and gender. In a second step, we added the computed residuals into our models. This additional analysis revealed results similar to the ones reported in our main analysis. Thus, we are confident that omitted variables are not a significant issue in our study.

^{xi} *Years of work in industry* is reflected by the number of years that the researchers worked in industry before entering their current research organizations, *prior patenting experience* is captured by the number of patents that researchers filed prior to entering their current research organization. We obtained this latter information from DEPATIS, the database of the German Patent and Trademark Office. *Founding experience* captures the number of companies that a researcher has founded. *Years of self-employment* is measured in number of years that researchers were previously self-employed; a dummy variable indicating whether researchers' parents ever started or took over a business is indicated *parental founding experience*. To capture researchers' *risk-taking propensity*, we relied on seven items that previous research has shown validly capture an individual's general tendency to take risks (Meertens and Lion, 2008; Zhao et al., 2005). These items formed a single scale (Cronbach's alpha = .83).

^{xii} To further probe this result, we resorted to a coarsened exact matching (CEM) approach via *cem* available for Stata 14.2 (Blackwell et al., 2009). In contrast to propensity score matching approaches (Leuven and Sianesi, 2018), CEM works well with continuous data because it does not require that the matched observations have identical values (Blackwell et al., 2009). In a first step, we matched researchers who worked a) in research institutes with a low/high *commercialization logic*, b) for leaders with high/low *entrepreneurial track records* and c) for leaders with high/low *entrepreneurial intentions* based on our control variables that were indicative of ASA processes; i.e. researchers' *risk propensity*, prior *years of work in industry*, *prior patenting experience*, prior *founding experience* and *parental founding experience*. Based on these three data sets with observation weights provided by the coarsened exact matching process, we then re-estimated our original multi-level models. All results provide further support for the argument that socialization—and not solely ASA processes—significantly contribute to the patterns we observed in our data.