Schumpeter's Entrepreneur

Psychological, Sociological and Economic Dimensions

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1. Introduction

Entrepreneurship research has always been interested in the types of (potential) entrepreneurs, their embeddedness into their economic and social environment and the resulting performance in terms of innovations, profits, growth or survival (Vivarelli 2013). This type of analysis gains importance for policy in situations where entrepreneurial activities are high on the agenda and appropriate entrepreneurship policies are in need. Interpreting the current economic crisis as an indication of the exploitation of a previous Long Wave (Mazzucatto 2013) with major techno-economic change required to get out of the trough entrepreneurial activities are thought to be a solution. And looking also to regional development policies in the EU and the policy concept of Smart Specialization (Foray et al 2011), entrepreneurial activities preferably pushing but also anchoring in GPTs are suggested to be the most viable way for further prosperous development. In view of that, to know more about the entrepreneur or – better – the entrepreneurs as a rare species has its merits, academically as well as from a policy point of view.

According to Schumpeter (1934), the entrepreneur is a quite special actor willing to break through traditional structures and to challenge the accepted way of doing things. The Schumpeterian entrepreneur is individualistic, self-directed, has an inner drive to innovate, and, as stated by Leskinen (2011), seeks autonomy and "independence from other people" in order to be "in control of one's own destiny" (p. 5). Schumpeter (1934) further argued that the fascination of entrepreneurship is especially strong for people "who have no other chance of achieving social distinction" (p. 93). In recent psychological research this psychological and sociological characterization of an entrepreneur finds some support. In their seminal study on entrepreneurial intentions and the Theory of Planned Behavior, Krueger et al. (2000) argue that the prototypical entrepreneur is an "iconoclastic individualist" with a strong "tendency toward inner-directedness" (p. 424). More recently, Krueger (2007) further highlighted the salience of entrepreneurial self-identity (as opposed to a salient social identity, see Tajfel & Turner, 1979) for the entrepreneurial type.

In this paper we investigate Schumpeter's description of an entrepreneur by applying the basic psychological concepts of the BIG-Five on the one hand and of Ajzen's theory of planned behavior on the other. In both concepts individualistic as well as social categories are taken into account in order to describe the entrepreneur's personality and intentions. In doing so we also raise the question whether there is room for policy intervention. Although this question has always been an interesting and pressing one, recent attempts to better conceptualize a policy towards entrepreneurship (Entrepreneurship Policy) and the inclusion of entrepreneurship in more general policy approaches like Smart Specialization raise the issue on which level and in which direction these policy measures should be designed. Is entrepreneurship policy something which just works on the opportunity set of potential firm founders in the sense of R&D subsidies and the like? Has the policy design to address factors much closer to the individual and related to the social embeddedness and the like? Or is there even a design thinkable which goes very much on the individual level? Certainly, when addressing

basic psychological traits as represented by the BIG-Five, the opportunities of policy intervention come to an end since those traits are considered as nature given and gene-determined. Measures to influence of that level are conceivable but will not be followed further in this paper.

The analysis we pursue is on data from a special group of potential entrepreneurs, namely scientists who may be inclined to commercialize their research findings. This choice can be justified on two grounds. First, academic entrepreneurship and combined with that the concept of the entrepreneurial university have gained importance and momentum during the last decade or so. Secondly, the focus on academic entrepreneurship allowed us to quite easily approach the full sample of all scientists in the German state of Thuringia and generate out of that a rather representative cross-sectional database for our analysis. Certainly, academic entrepreneurs and the pool out of which they emerge are rather different to green field entrepreneurs and their social realm, in the sense of higher education, of not having a strong business focus in their daily work, etc. These non-negligible dimensions will certainly play a role for our results and need to be taken up in the discussion of our results especially when the policy dimensions will be addressed.

Based on that and drawing on own work , to our knowledge we offer a first attempt to integrate basic psychological traits (Big-Five) as well as more context dependent individual and social factors (as suggested by the theory of planned behavior) into a framework that targets scientists' decisions to act entrepreneurially. To this end, we follow the recommended strategy for research on the venture-creation process and apply an interdisciplinary perspective combining arguments from psychology and entrepreneurship (Gartner, 2007). In detail, we focus on the individual scientist's *intentions to start a business based upon his or her own research*. As in the case of general entrepreneurship (Bird, 1988; Krueger & Carsrud, 1993), intentions to engage in new firm formation might be seen as the focal antecedent of the decision to become an academic entrepreneur. Knowledge about the emergence of and influences on scientists' entrepreneurial intentions may therefore be crucial for both future research on the commercialization of science and public policy aiming to stimulate science-based new venture creation. With this in mind, our study aims to develop and empirically test a new *intentions-based model of academic entrepreneurship* incorporating individual characteristics and contextual attributes as well as their complex interplay. We first draw on the BIG-Five approach and the combine that with the theory of planned behavior (Ajzen, 1991), which offers a coherent, parsimonious, and highly-generalizable framework for understanding and predicting intentions (Krueger et al., 2000). We then extend this framework to incorporate arguments from identity theory (Stryker, 1987) and social identity theory (Tajfel & Turner, 1979; Hogg & Abrams, 1988).

The paper is structured as follows. Section 2 briefly sheds light on academic entrepreneurship and its importance. Section 3 introduces entrepreneurial intentions and emphasizes its importance for this study. We then set out our theoretical framework and related hypotheses in section 4. This is followed in section 5 by the presentation of our data and variables

used. Section 6 contains the findings of our empirical analysis. Finally, in section 7, we discuss our findings, conclude, and draw also implications for potential policy interventions.

2. Academic Entrepreneurship

The economic impact of scientific research has received widespread attention (Dosi, 1988; Rosenberg & Nelson, 1994; OECD, 2003). Academic science has been a crucial ingredient for the development of new innovative products and processes (Mansfield, 1998) and for the emergence of entirely new industries, like biotechnology (Audretsch & Stephan, 1996). As a consequence, universities and public research institutions, traditionally viewed as standing out on the *"Acropolis of scholarship"* (Glassman et al., 2003, p. 353), are called to take on technology transfer and commercialization as an integral part of their activities (Etzkowitz et al., 2000). The emerging concept of the entrepreneurial university, the establishment of technology transfer offices and university patenting strategies as well as a growing interest in academic spin-off firms nicely evidence this shift in perspectives (Rothaermel et al., 2007).

At the core of this closer link between science and industry, the academic scientist is expected to combine traditional tasks in research with economic ends. While the traditional academic ethos did not permit profit from science other than in terms of scientific prestige, this perception has changed remarkably in recent decades (Etzkowitz, 1998; Stuart & Ding, 2006). Now scientists are more and more often adopting the role of entrepreneurs, funneling their research results from the laboratory bench to commercial applications. Metaphorically speaking, the "entrepreneurial scientist" (Etzkowitz, 1998) challenged the Acropolis and "descended into the *Agora*[1], the market place, at the bottom of the temple hill" (Glassman et al., 2003, p.353).

Although science-based entrepreneurship has become an increasingly important issue for scholars and policymakers alike (Toole & Czarnitzki, 2007), surprisingly little is known about "creating new ventures" as a way to commercialize scientific research (Shane, 2004). Only recently, a small body of literature has identified social, institutional, and historical determinants of entrepreneurial activity among scientists (Louis et al., 1989; Roberts, 1991; Owen-Smith & Powell, 2001; Kenney & Goe, 2004; Stuart & Ding, 2006). Most of these studies, however, draw on a *contextual perspective* focusing on characteristics of the university or the local environment but not necessarily on the individual scientist. In particular, the *scientist* as an important actor in the process of research commercialization has been a relatively neglected objective in this strand of research (Rothaermel et al., 2007). For example, while there is a compelling entrepreneurship literature looking for psychological determinants of an individual's propensity to engage in new venture creation (Krueger & Carsrud, 1993; Krueger et al., 2000), this perspective has not been explicitly linked to entrepreneurial activity in academia.

[1] The "Agora" was an open "place of assembly" in ancient Greek city-states. It served as a market place where merchants kept stalls or shops to sell their goods and where people came together and discussed their lives and the issues of the day.

This lacuna in mind, to our knowledge we offer a first attempt to integrate core variables, both on the individual and contextual level, into a framework that targets scientists' decisions to act entrepreneurially. To this end, we follow the recommended strategy for research on the venture-creation process and apply an interdisciplinary perspective combining arguments from psychology and entrepreneurship (Gartner, 2007). In detail, we focus on the individual scientist's *intentions to start a business based upon his or her own research*. As in the case of general entrepreneurship (Bird, 1988; Krueger & Carsrud, 1993), intentions to engage in new firm formation might be seen as the focal antecedent of the decision to become an academic entrepreneur. Knowledge about the emergence of and influences on scientists' entrepreneurial intentions may therefore be crucial for both future research on the commercialization of science and public policy aiming to stimulate science-based new venture creation. With this in mind, our study aims to develop and empirically test a new *intentions-based model of academic entrepreneurship* incorporating individual characteristics and contextual attributes as well as their complex interplay. We first draw on the BIG-Five approach and the combine that with the theory of planned behavior (Ajzen, 1991), which offers a coherent, parsimonious, and highly-generalizable framework for understanding and predicting intentions (Krueger et al., 2000). We then extend this framework to incorporate arguments from identity theory (Stryker, 1987) and social identity theory (Tajfel & Turner, 1979; Hogg & Abrams, 1988).

3. The Role of Entrepreneurial Intentions

Entrepreneurship research acknowledges the intentionality of the entrepreneurial process (Bird, 1992; Krueger & Carsrud, 1993). It is well recognized that new firms do not emerge by accident, nor are they a random or passive product of environmental conditions. Instead, acting entrepreneurially is something that people choose or plan to do (Shaver & Scott 1991). The most proximal predictor of the decision to become an entrepreneur is seen in entrepreneurial intentions (Bird, 1988). Simply put, these are cognitive representations of a person's readiness to engage in entrepreneurship. Entrepreneurial intentions signal how intensely one is prepared and how much effort one is planning to commit in order to carry out entrepreneurial behavior. Prospective entrepreneurs are therefore assumed to trigger the process of new venture creation with an expression of intentions (Bird, 1988; Krueger et al., 2000). In turn, "absent intention, action is unlikely" (Krueger 2000, p. 8). That is to say, even if people may have significant potential (e.g., a personally viable opportunity), they will refrain from making the transition into entrepreneurship when they lack the intentions (Krueger & Brazeal 1994). Accordingly, entrepreneurial intentions represent a central variable for researching the entrepreneurial process (Krueger et al., 2000; Lee et al., in press).

Against this background, we apply the concept of entrepreneurial intentions to investigate scientists' proclivity to commercialize own research by setting up a new business, given that their research work would exhibit commercial potential. We acknowledge that starting an entrepreneurial endeavor out of the scientific research context can be deemed an intentions-

driven effort. Previous studies suggest that scientists consciously decide whether to become active outside the scientific realm and if so, to what extent, e.g., whether to remain a full-time academic with limited engagement in the new firm or to leave academia and become a full-fledged entrepreneur (Murray, 2004). Hence, the general relationships to be introduced in the next section are expected to hold the same way in an academic context.

4. Theoretical Framework and Hypotheses

Despite the importance of predicting and understanding scientists' involvement in entrepreneurship, there has been a lack of theoretically-motivated research on this issue. Instead, previous studies primarily focused either on *individual-level factors*, like gender (Murray & Graham, 2007), age (Audretsch & Stephan, 1999), academic status (Shane & Khurana, 2003) as well as Big-Five personality traits (Zhao/Seibert//Lumkin, 2009) or *context-level factors*, such as university traditions (Roberts, 1991) and entrepreneurial peers (Stuart & Ding, 2006; Bercovitz & Feldman, 2008), resulting in a plethora of potentially important antecedents of academic entrepreneurship. Furthermore, both of these streams have evolved in relative isolation, by and large neglecting the fact that one's transition to entrepreneurship is the result of a complex interplay between the individual and his or her environment (Özcan & Reichstein, 2009).

A different and more comprehensive approach is grounded in social psychological research. This literature offers theory-driven models integrating both individual and contextual antecedents of intentions to pursue any deliberate behavior, such as the founding of one's own firm. A prominent and widely-researched example of these models is Ajzen's (1991) theory of planned behavior (TPB) (for an overview see Armitage & Conner, 2001). As a growing number of studies have recently confirmed the TPB's predictive ability with respect to entrepreneurial intentions in general (Krueger & Carsrud, 1993; Krueger et al., 2000; Autio et al., 2001), we consider the TPB a useful analytical framework to analyze scientists' intentions to become an academic entrepreneur. From the perspective of policymakers and representatives of support programs, the TPB highlights predictors that are amenable to change through interventions (Fayolle, 2005). In particular, knowledge about determinants of scientists' entrepreneurial intentions may give hints as to what type of policy initiative and other university interventions would be instrumental in turning prospective scientist-entrepreneurs into actual company founders.

The Big-Five Framework

The so called Big-Five model (see Digman 1990, Costa and McCrae 1995) is for several reasons a quite compelling approach to assess the relation of personality and entrepreneurial intentions. First of all, the Big-Five personality factors are widely accepted in order to grasp the comprehensive personality of a subject (Digman 1990, Barrick and Mount 1991, Barrick et al. 2003), which curtails the threat to investigate unreasoned or invalid personality traits of entrepreneurs (Chandler and Lyon 2001). Moreover, those dimensions are compara-

bly independent of cognitive dispositions (McCrae and Costa 1987), robust across different cultures (McCrae and Costa 1997, John and Srivastava 1999) and possibly stable over time[2] (Costa and McCrae 1992a, Roberts and DelVecchio 2000, Hampson and Goldberg 2006). The Big-Five personality traits are therefore a quite stable construct, which is supposed to be unaffected by specific events. It is broadly suggested that the Big-Five personality traits predict essential differences in observed actions and reactions (McCrae and Costa 1999). Otherwise, trait scores may not predict a person's doing in a particular situation, but are quite reliable in marking behavioral trends across different situations and over time (McAdams and Pals 2006). Notwithstanding, a main shortcoming of the Big-Five construct is its rather descriptive than explanatory nature, and that it's not reflecting dynamic and developmental processes of a personality (John and Srivastava 1999). The Big-Five measure comprises five broad personality factors, namely extraversion, agreeableness, conscientiousness, neuroticism and openness (Digman 1990, Barrick and Mount 1991) and will be defined below.

In order to employ a proper framework to link the Big-Five personality traits to entrepreneurial failure, we draw on the five-factor theory personality system (McCrae and Costa 1996, 1999). In this framework, the Big-Five personality traits are determined by biological factors that constitute the individual. In the following we will derive five hypotheses with the aim to test the average or proportional relation of the Big-Five with entrepreneurial intentions in highly innovative environments.

Conscientiousness is attributed to a socially assessed impulse control that facilitates goal- and task-oriented behavior. Typical traits of this factor are thinking before acting, delaying gratification, following norms and rules, and planning, organizing, and prioritizing tasks (John and Srivastava 1999). Drawing on McClelland (1961), individuals who reveal a need for achievement tend to be attracted by work situations in which they have personal control over outcomes, face moderate risk of failure, and experience direct and timely feedback on their performance. [3] Hence high-need-for-achievement individuals are suggested to be attracted to entrepreneurship that is supposed to offer more of these conditions than traditional forms of employment. Other traits related to conscientiousness such as work goal orientation and perseverance tend also to be associated with the entrepreneurial activities. Markman and Baron (2003) suggest that perseverance is called for by entrepreneurial work, while others have emphasized the importance of motivation, persistence, and hard work (e.g., Chen et al., 1998; Baum & Locke, 2004). Based on the proposition that individuals are attracted to roles that match their personality and interests, we expect conscientious people to be attracted to entrepreneurship.

Extraversion is defined as "… an energetic approach toward the social and material world and includes traits such as sociability, activity, assertiveness, and positive emotionality" (John and Srivastava 1999). Extraverted individuals are gregarious, outgoing, warm, and friendly; they are energetic, active, assertive, and dominant in social situations; they experi-

[2] Empirical evidence suggests that the Big-Five are at least partly genetically determined (Jang et al. 1997). Hampson and Goldberg (2006) find a significant stability over forty years for all traits excepting neuroticism.
[3] See Zhao/Seibert//Lumkin (2009), 384-385.

ence more positive emotions and are optimistic; and they seek excitement and stimulation.[4] These traits have been shown to be associated with people's perception of entrepreneurs (e.g., Baron, 1999; Locke, 2000; Costa, McCrae, & Holland, 1984). Compared to many traditional business occupations running an own firm may appear to be more stimulating and exciting and thus more appealing to extraverts. The match between the traits of extraversion and the attributes associated with leading a new venture lead us to expect extraverts to be more attracted to entrepreneurship.

The Big-Five factor *agreeableness* pictures a pro-social and communal tendency in direction of other people and contains qualities like altruism, tender-mindedness, trust and modesty (John and Srivastava 1999). Individuals showing a high degree of agreeableness are characterized as trusting, altruistic, cooperative, modest, concerned for the needs of others and defering to others in the face of conflict.[5] Contrariwise, individuals without agreeableness appear being manipulative, self-centered, suspicious, and ruthless. Individuals with high agreeableness are most likely to go for a career in social occupations and teaching, rather than business (Barrick, Mount, and Gupta, 2003). Entrepreneurship, however, involves establishing a for-profit enterprise that is built around the entrepreneur's own needs and interests (Singh & DeNoble, 2003). To establish that an entrepreneur must fight hard, sometimes to the detriment of previous employers, partners, suppliers, and even one's own employees. Hence, given the low importance of altruistic behavior for entrepreneurial success and the high likelihood of guarded and even conflict ridden interpersonal relationships associated with entrepreneurship, we suggest highly agreeable people unlikely to find the entrepreneurial role an attractive one.

A person's *openness* covers the broadness, deepness, genuineness, and complexity of her mental and experiential life (John and Srivastava 1999). It is a personality trait that describes an individual being intellectually curious, imaginative, and creative and seeking out new ideas and alternative values.[6] One of the defining characteristic of entrepreneurship is creativity and proclivity to bring about innovative change as suggested by Schumpeter (1912/1934). In this sense, entrepreneurs pursue their creative vision even in the face of overwhelming resistance from more conventional thinkers (e.g., Locke, 2000). Self-employment allows individuals to go for their own creative vision and hence open individuals are suggested to be more attracted by entrepreneurial activities.

Neuroticism renders the inclination to have negative emotions and to feel anxious, nervous, sad and tense (John and Srivastava 1999). In addition, neuroticism is connected to weaker psychological and physiological health (Lahey 2009). Contrariwise, individuals that are emotionally stable can be described as calm, stable, even-tempered, and hardy.[7] The latter characteristics are just ascribed to entrepreneurs (Baron, 1999; Locke, 2000). Individuals that show low emotional stability and hence high neuroticism tend to feel vulnerable to psychological stress and experience a range of negative emotions more frequently and intensely, all

[4] See Zhao/Seibert//Lumkin (2009), 387.
[5] See Zhao/Seibert//Lumkin (2009), 387-388.
[6] See Zhao/Seibert//Lumkin (2009), 385.
[7] See Aus Zhao/Seibert//Lumkin (2009), 386.

of which are detrimental for entrepreneurial activities. Hence, individuals high on neuroticism are considered unlikely to engage in entrepreneurial activities.

From this discussion of the Big-Five we derive five hypotheses (*H1a*)-(*H1e*). We propose the conscientiousness (*H1a*), extraversion (*H1b*), and openness (*H1d*) to be positively related to entrepreneurial intentions; contrariwise, agreeableness (*H1c*) and neuroticism (*H1e*) should relate negatively to entrepreneurial intentions. In addition to that and extending the Big-Five analysis we propose an entrepreneurial profile – index which measures the distance of a scientist in the Big-Five space from an ideal entrepreneur (which is high in conscientiousness, extraversion, and openness, and which is low in agreeableness and neuroticism) – to be positively related to entrepreneurial intentions (*H1f*).

The Main TPB Framework

The central premise of the theory of planned behavior (Ajzen, 1991) is that behavioral decisions are not made spontaneously, but are the result of a reasoned process. The most proximal predictor of a person's behavior is thus seen in intentions or willingness to engage in that particular behavior (Ajzen 1991). *Behavioral intentions* themselves are regarded as an additive function of three latent factors: attitudes, social norms, and perceived behavioral control.

First, *attitudes* reflect the individual's enduring evaluation – positive or negative – of engaging in a particular behavior (Ajzen & Fishbein, 1980). Theorists have further argued for a distinction between affective attitudes, referring to feelings or emotions, on the one hand and cognitive attitudes, referring to beliefs, thoughts, or rational arguments, on the other (Crites et al., 1994). Scarcely existing literature on scientists' motivations and attitudes toward own entrepreneurial engagement suggests that scientists allocate their efforts and time toward entrepreneurship if they perceive entrepreneurial activity as positive and professionally stimulating (Gulbrandsen 2003). Also, academics' entrepreneurial aspirations were found to be driven by the potential commercial benefits of their research (Owen-Smith & Powell, 2001).

The second predictor of intentions, *social norms*, refers to perceived normative pressure from a specific reference group toward engaging or not engaging in a particular behavior (Ajzen, 1991). In line with previous literature on academic entrepreneurship (Louis et al., 1989; Kenney & Goe, 2004; Bercovitz & Feldman, 2008), our study considers individual scientists' workplace peers as a salient reference group determining own entrepreneurial behavior. According to Stuart and Ding (2006), scientists were more willing to become entrepreneurs when colleagues in their university departments had been involved in entrepreneurship and when they perceived commercial technology transfer as legitimate professional activity. Similarly, Bercovitz and Feldman (2008) showed that scientists tend to adopt the behavior of entrepreneurial peers if they were at the same career stage or from the same research field. Following Cialdini et al. (1990), our study further distinguishes between two sources of normative peer influences. The injunctive norm component captures whether scientists' workplace peers would approve or disapprove of one engaging in entrepreneurship, while the descriptive norm component refers to whether workplace peers themselves actually engage in entrepreneurial behavior.

Third, *perceived behavioral control* is comparable with Bandura's (1997) concept of self-efficacy and reflects beliefs about whether one has the necessary capabilities (e.g., time, money, skills, equipment) to perform a particular behavior successfully. According to Ajzen (1988), people who do not feel able to perform the behavior are unlikely to form strong behavioral intentions, even if they have positive attitudes and an approving social environment. In the context of academic entrepreneurship, although scientists may have a positive attitude toward engaging in entrepreneurial activity and believe that their workplace peers would approve of their becoming an entrepreneur, they still may not intend to found their own firm because they may not feel confident about their entrepreneurial skills. In support of this idea, Lockett et al. (2003) recognized that many scientists lack the competencies to undertake entrepreneurial action as it requires different skills and abilities than purely academic ones.

From this discussion of the TPB we derive five hypotheses (*H2a*)-(*H2e*). We expect affective attitude (*H2a*), cognitive attitude (*H2b*), injunctive norm (*H2c*), and descriptive norm (*H2d*) toward the founding of a firm based upon their own research as well as perceived control over the founding of a firm based upon their own research (*H2e*) to positively predict entrepreneurial intentions among scientists.

A further hypothesis concerns the dominance of the TPB variables over the Big-Five. Since the latter are more distal to entrepreneurial intentions and the TPB much more proximate, we propose that using both sets of variables in explaining intentions the TPB variables will dominate the Big-Five (*H3a*) or the entrepreneurial profile (*H3b*) respectively..

A final hypothesis in this section suggests that the individual level TPB variables (affective attitude, cognitive attitude, perceived behavioral control) are related to Big-Five variables (*H4a*) whereas the norm variables (injective and descriptive norm) show no relation to the Big-Five (*H4b*). When using instead of the Big-Five the entrepreneurial profile the latter is proposed to be related to the individual level TPB variables (*H4c*) and to be not related to the norm variables (*H4d*).

The Extended TPB Framework

Several authors have suggested that Ajzen's (1991) theory of planned behavior (TPB) may be supplemented by additional variables in order to increase the model's predictive utility (see Conner & Armitage, 1998). Among the most frequently used variables are measures of self-identity and past behavior. Evidence for their importance as intention predictors has been provided across a wide range of behaviors (see e.g., Conner & Armitage, 1998; Ouellette & Wood, 1998; Terry et al., 1999). In our study, we assess whether this is the case for intentions to commercialize one's own research through business founding.

First, the link between *entrepreneurial self-identity* and entrepreneurial intentions is grounded in identity theory (Stryker, 1987; see also Terry et al., 1999). Following this perspective, a person's sense of self is conceived as a collection of distinct roles that may be enacted in society, such as mother, spouse, scientist, and entrepreneur, for instance. As a psychological entity, self-identity may be defined as the most salient part of a person's self (Conner & Armitage, 1998). A key proposition of identity theory is that self-identity guides action, suggesting that people are likely to behave in accordance to their salient role (Callero, 1985).

Recent attempts to apply this concept to academic entrepreneurship, such as the qualitative study by Jain et al. (2009), conclude that the transition to academic entrepreneurship involves the adoption of an entrepreneurial self-identity. Scientists who engage in commercial activities were found to have a strong self-perception of being an entrepreneur in addition to their focal identity of being an academic. Accordingly, we assume an entrepreneurial self-identity to positively predict entrepreneurial intentions among scientists, above and beyond the effect of the main TPB variables *(H5a)*.

Our second additional predictor of scientists' entrepreneurial intentions is *past entrepreneurial behavior*. Capturing one's behavioral experiences, several TPB studies reported independent effects of past behavior, over and above the effects of attitudes, social norms, and perceived behavioral control (see Conner & Armitage, 1998; Ouellette & Wood, 1998, for reviews). Similarly, entrepreneurship literature suggests that past experience with firm formation increases the probability of starting-up anew (Ucbasaran et al., 2009). Experienced entrepreneurs are argued being better suited to recognizing business opportunities and even more innovative opportunities than novice entrepreneurs. Investigating the commercialization of patented university inventions, Shane and Khurana (2003) found that the likelihood of a new firm formation based on a university invention is predicted by the academic inventor's prior entrepreneurial experience. Given these arguments, we expect past entrepreneurial behavior to positively predict entrepreneurial intentions among scientists, above and beyond the effect of the TPB variables *(H5b)*.

The Person-Context Interplay

The theory of planned behavior (TPB) (Ajzen, 1991) has been criticized for its basic assumption that variables in the model are linear in their effects on intentions (and behavior) (see e.g., Conner & McMillan, 1999). It is argued that incorporating interaction effects into the TPB paradigm relaxes this linearity assumption. Interaction effects may also mark boundary conditions for a relationship between variables and may therefore further theory development. Given that modern approaches of human behavior and development explicitly emphasize the role of person-context interactions (e.g., Elder & Shanahan, 2006), our study sought to examine such dynamics in the context of entrepreneurial behavior among scientists. We considered three interaction hypotheses regarding the interplay of individual and contextual factors in the prediction of intentions to become an academic entrepreneur. Existing theoretical and empirical considerations with respect to each of these interaction effects are justified as follows.

As a general theory of group processes and intergroup relations, social identity theory acknowledges the importance of the social context in behavioral decision-making (Tajfel & Turner, 1979; Hogg & Abrams 1988; see also Terry & Hogg, 1996). Like identity theorists, social identity theorists claim that people are likely to engage in identity-related behaviors in order to validate the salient part of their self-concept (Terry et al., 1999). The basic idea of social identity theory is that a social category, for example the group of workplace peers, which people feel they belong to, provides a source of self-definition. A psychologically important consequence of identifying oneself as a member of a particular group is that one is more inclined to behave according to the perceived norms of that group (Hogg & Abrams,

1988). In the context of entrepreneurial behavior and in view of Schumpeter's description of an entrepreneur we hypothesize here that the relationship between group identification and an entrepreneurial profile, as given by the Big-Five, negative (*H6a*). By this we account for an entrepreneur "acting against the odds" and hence against the peer group.

Based on that, the previously discussed injunctive and descriptive norm components capture the direct effects of peer's normative pressure on intentions; an individual's group identification marks boundary conditions for these peer group effects. In this sense, group identification determines the individual's likelihood to follow the group's norms (Terry & Hogg, 1996; Terry et al., 1999). Applying this reasoning to the context of our study, we expect the relationship between injunctive norm *(H6b)* and entrepreneurial intentions as well as descriptive norm *(H6c)* and entrepreneurial intentions to be stronger for those scientists who show higher identification with their group of workplace peers.

Another way for the social context to determine behavioral decision-making is through reinforcing or inhibiting the effects of attitudes on intentions (Terry & Hogg, 1996). Specifically, a relationship of *contingent consistency* has been suggested such that an individual will behave in a certain way only when both the individual's attitudes and the social environment are strongly favorable (e.g., Andrews & Kandel, 1979). In keeping with this view, academic scientists might be more likely to start their own firm when holding a favorable attitude toward entrepreneurship and when perceiving a reinforcing entrepreneurial climate at the departmental level (see Kenney & Goe, 2004). Consistent with a social identity perspective, the effect of an entrepreneurial climate at the research department – i.e., workplace peers' attitude toward entrepreneurship – might further depend on the individual scientist's level of perceived group identification (see e.g., Terry & Hogg, 1996). Accordingly, we hypothesize that the relationship between affective attitude and entrepreneurial intentions is stronger for those scientists who perceive their group of workplace peers to have a generally positive attitude toward entrepreneurship (i.e., a strong entrepreneurial climate at the departmental level), but only for those scientists who show higher identification with their group of workplace peers *(H6d)*.

5. Research Design

Sample and Procedure

A cross-sectional survey of faculty and academic research staff was conducted to provide the data for the current study. The research was carried out on a regional basis with a focus on the German state of Thuringia.[8] Located in the center of Germany, Thuringia has a legacy of science-based entrepreneurship and a broad spectrum of research organizations like universities

[8] This study is part of the Thuringian Founder Study ("Thüringer Gründer Studie"). As an interdisciplinary research project, it examines the entrepreneurial process and its antecedents from the perspective of economics and psychology.

or non-university research institutions[9]. Data were collected using an internet-based survey.[10] To establish a sampling frame, websites of the research organizations were accessed and prospective participants of the survey were identified. A total of 4638 contact names and email addresses have been collected, comprising scientists from all scientific disciplines. From this initial list of names, a random sub-sample consisting of 2319 individuals was drawn.[11] These scientists were then sent an e-mail containing a cover letter and a link to the online questionnaire.[12]

A total of 565 scientists answered the questionnaire, resulting in a response rate of 24.4%, which is an acceptable rate compared to other studies applying a web-based design (Cook et al., 2000). Compared with official statistics (Statistisches Bundesamt, 2008), the survey sample appeared to be representative in terms of age, gender, and academic rank. Before conducting our statistical analyses, 15 surveys had to be excluded due to incomplete data or non-serious responses. As this study aimed to trace determinants of scientists' intentions to commercialize their own research results, we also omitted responses from faculty and staff members who stated in the questionnaire that they do not conduct any scientific research. The final sample size is 404 scientists.

The descriptive statistics for the sample with all the variables used as well as the correlations among the independent variables are found in the tables A1 and A2 in the appendix.

Participants were on average 38.7 years old and mostly male (72%). Almost two-thirds worked in a university (66%), 10.2% worked in a university of applied sciences ("Fachhochschule") and 23.8% in non-university research institutions. In terms of academic status, 18.1% were professors or university lecturers, the remaining worked as research associates in position such as project-related specialists. Almost half of the sample (44.6%) described their type of engagement in research as basic science, with the remaining being engaged in applied science. Most participants worked in the field of natural sciences (49.8%), while 32.2% were conducting research in engineering sciences and 18% in economics, law, or social sciences.

Dependent Variable: Entrepreneurial Intentions

Ajzen and Fishbein (1980) distinguish between measures of (1) conditional and (2) unconditional behavioral intentions. Other than unconditional intentions, conditional intentions consider potential barriers that could prevent individuals from intending to engage in a particular

[9] Several institutes from three of the most important German public science organizations (Max Planck Society for the Advancement of Science (MPG), Fraunhofer Society for the Advancement of Applied Research (FhG), and Wissenschaftsgemeinschaft Gottfried-Wilhelm-Leibnitz (WGL)) are located in Thuringia.

[10] This way of collecting data was chosen for several reasons. Internet-based surveys allow for highly-standardized data collection at low cost. Furthermore, such surveys are also expected to increase the response rate because the questionnaire can be completed without having to mail any forms (Mann & Stewart, 2000). Moreover, previous research supports reliability and validity of such web-based methods (Gosling et al., 2004).

[11] A small-scale pilot study was carried out prior to the present study in order to identify any problems and omissions with the questionnaire. Following the analysis of the pilot study data, ambiguous or unclear questions were rephrased or removed. Comments and suggestions were taken into consideration for the design of the questionnaire used for this survey.

[12] Two weeks later a reminder was sent to the non-respondents that was set up the same way as the initial e-mail. After another two weeks data collection was completed.

behavior. In our case and adapting from Ajzen (2002), conditional *entrepreneurial intentions* of scientists were measured by: "If my research had economic potential, I would intend to participate in the founding of a firm to commercialize the former" (five-point Likert scale; "no" to "yes"). In turn, an unconditional measure would read as: "I would intend to participate in the founding of a firm to commercialize my research". A potential barrier here might be that if respondents consider their research not to be of any commercial application entrepreneurial intentions probably do not show up.[13] To avoid this and to provide evidence on an unselected representative sample of academic scientists, we decided to adjust for the influence of the commercial orientation of scientists' research knowledge by solely focusing on conditional intentions.[14] Note that one-item measures of intentions – as we applied it here – have been successfully employed in prior entrepreneurship studies (e.g., Krueger et al., 2000).

Explanatory Variables

The *Big-Five* personality traits were quantified in a standardized way with the help of 45 items (Ostendorf 1990). Each of the Big-Five personality factors was measured by 9 German bipolar adjective pairs on a six-point Likert scale (0-5). For all of the Big-Five, a score closer to 5 represented a higher value in the concerning trait. According to the definitions above, we include variables of conscientiousness, extraversion, agreeableness, openness and neuroticism. A principal component factor analysis with promax rotation indicates that the items for the respective Big-Five factor which we utilize actually form five independent personality factors in our sample. Thus, the validity of our items seems to be given.

In addition an entrepreneurship-prone personality profile, the *entrepreneurial profile*, was measured drawing from the five-factor (i.e., Big Five) model of personality above. To calculate an index for an individual's match with an entrepreneurial personality pattern, we defined a specific entrepreneurial reference type with the highest possible score (5) in extraversion, conscientiousness, and openness, and the lowest possible score (0) in agreeableness and neuroticism. Drawing from seminal works (e.g., Holland, 1997, Schumpeter, 1934) and prior trait-focused research, Schmitt-Rodermund and others developed this definition of an entrepreneurial constellation of traits within the person (Schmitt-Rodermund, 2004, 2007; Obschonka, Silbereisen, & Schmitt-Rodermund, 2010). We calculated the "goodness-of-fit" of each person's Big Five profile, with regard to this statistical reference profile with the extreme values. First, we estimated each person's squared differences between the reference values and the personal values on each of the five scales. If a person, for instance, scored a 3 in neuroticism, the squared difference was 9 (because the reference value was 0). Second, the five squared differences were summed up for each person, and third, the algebraic sign of this sum was reversed (e.g., a value of 5 became −5).

[13] Shane (2001) shows that the characteristics of the research scientists do have an effect on the probability that their research will be commercialized through firm formation. Although important, an investigation of these aspects would clearly go beyond the scope of the present paper.

[14] Previous research on entrepreneurial intentions did not adequately consider this distinction, or confounded both types of intentions by taking them together into one variable (e.g., Lee et al., in press).

The *core Ajzen TPB variables* were generated via established measures. *Cognitive attitude* toward entrepreneurship was tapped applying an indirect, belief-based measure (Ajzen & Fishbein, 1980; Ajzen et al., 2004). First, scientists evaluated four potential outcomes of academic entrepreneurship (i.e., higher personal income, conflict of interests with administrations, additional sources of funding for future research projects, increase in scientific reputation)[15] on a bipolar scale ranging from -2 ("extremely negative") to 2 ("extremely positive"). Second, scientists assessed the probability of these outcomes occurring if they would indeed found a firm (five-point Likert scale; "not at all" to "definitely"). To produce a belief-based estimate of cognitive attitude, belief strength and the corresponding evaluation regarding each potential outcome of academic entrepreneurship were multiplied and the resulting products summed up.[16]

Affective attitude toward entrepreneurship was measured with four five-point bipolar adjective scales (e.g., undesirable – desirable, very boring – very exciting; α = .89) (Ajzen, 2001; 2002). Higher scores indicated a more positive affective attitude toward entrepreneurship.

Injunctive norm was assessed across two items (White et al., 1994), e.g., "Most of my colleagues at the university / research institute would encourage my participation in the founding of a firm to commercialize my research" (five-point Likert scale; "not at all correct" to "totally correct"; α = .68). This variable captures (perceived) *workplace peers' pressure* on the responding scientist.

Descriptive norm was determined with two items (Conner & McMillan, 1999), e.g., "How many (if any) of your at the university / research institute have already participated in the founding of a firm to commercialize their research?" (five-point Likert scale; "none" to "all"; α = .64). This variable indicates (perceived) *entrepreneurial activity among workplace peers*.

Perceived behavioral control was assessed by three items used by Ajzen and Madden (1986), e.g., "If I wanted to participate in the founding of a firm to commercialize my research, I am confident that I would succeed" (five-point Likert scale; "not at all correct" to "totally correct"; α = .84). Higher scores on this scale indicated a stronger perception of control over performing entrepreneurial activity.

Entrepreneurial self-identity was measured with three items (Sparks & Shepherd, 1992), e.g., "The idea of participating in the founding of a firm for the commercialization of my research is completely alien to me" (five-point Likert scale; "not at all" to "definitely"; α = .79). Two items were reverse scored. Higher scores reflect a stronger sense of self-perception as a (potential) academic entrepreneur.

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[15] Potential outcomes of entrepreneurial behavior of scientists were derived from the literature on academic entrepreneurship and university-industry technology transfer (e.g., Etzkowitz, 1998; Owen-Smith & Powell, 2001; O'Gorman et al., 2008) and from interviews with experts (e.g., university administrations, founders of academic spin-off firms).

[16] The internal consistency of this construct is fairly weak, with α = .51. However, as Ajzen (2002) noted, people's attitude toward a behavior may be ambivalent if they believe that the behavior is likely to produce positive (e.g., higher income) as well as negative (e.g., conflicts) outcomes. There is, therefore, no expectation that the different beliefs will necessarily correlated with each other and result in a high Cronbach's alpha.

Past entrepreneurial behavior was assessed with a single item. Respondents were asked to indicate whether they previously participated in the founding of a firm to commercialize their own research (0 = no; 1 = yes).

Entrepreneurial climate was captured with two items (White et al., 1994; Terry & Hogg, 1996), e.g., "Think about your group of colleagues at the university / research institute: How much would they agree that participation in the founding of a firm to commercialize one's research is a good thing to do?" (five-point Likert scale; "not at all" to "totally"; α = .81). Other than injunctive and descriptive norm, this construct does not imply workplace peers' pressure or entrepreneurial behavior. It rather captures *workplace peers' general attitude toward academic entrepreneurship.*

Group identification was assessed with two items based on those employed by Terry and Hogg (1996), e.g., "Generally speaking, how much do you identify with your group of colleagues at the university / research institute?" (five-point Likert scale; "not at all" to "totally"; α = .76). Higher scores indicate scientists' stronger sense of identification with the group of workplace peers.

To test whether the statistical structure of the measurement scales used in this study is supported by the data, a confirmatory factor analysis was conducted in AMOS (Arbuckle, 2006). The hypothesized model had eight factors, representing *cognitive attitude*, *affective attitude*, *injunctive norm*, *descriptive norm*, *perceived behavioral control*, *entrepreneurial self-identity*, *entrepreneurial climate*, and *group identification*. The model fits the data well (χ^2 [178] = 203.37, p = .093, RMSEA = .017, CFI = .994), suggesting that the statistical structure of the measures is sound (Kline, 2005). Taken all together, these results underpin the reliability and validity of the different constructs.

Controls

Consistent with previous research (Audretsch & Stephan, 1999; Shane & Khurana, 2003; Murray & Graham, 2007), there are several other influences that may determine scientists' likelihood of entering an entrepreneurial career. Taking this literature into consideration, this study included variables controlling for (1) *gender* (0 = female, 1 = male), (2) *age*, (3) *academic status* (0 = research associate or other field of activity, 1= professor or university lecturer), and (4) *type of research* (0 = basic research, 1 = applied research). We also controlled for scientists' field of specialization (Mansfield, 1998; Nerkar & Shane, 2003) with a series of binary variables (0 = no, 1 = yes) for (5) *engineering sciences*, (6) *natural sciences*, and (7) *social sciences*. The latter category was used as the reference category in the regression models.

6. Results

Entrepreneurial intentions: Big-Five versus TPB

In a first step we analyze to what degree the intentions to economize on own research results via founding a firm are related (can be explained) by basic psychological traits as given by the

Big-Five measures including the entrepreneurial personality profile index as well as by more on the spot variables related to the Ajizen's theory of planned behavior. Table 1 contains the basic results of this first step of analysis.

The econometric exercises have shown that a number of control variables are capturing a couple of broad effects related to the scientists and his research environment. Whereas gender, age and hierarchical position (measured by the dummy professor, with 1 for professor and 0 otherwise) take into account personal dimensions, via research type (applied versus basic) and two dummies for the type of science pursued (engineering and natural sciences, with social sciences for the remaining) we account for institutional conditions of the respective research pursued. As to these controls to which model 1 in entirely devoted, we find that rather men than women and researcher engaged rather in applied research than in basic research are more likely to spin-off.

DV:	conditional intentions	Model 1 Controls		Model 2 BIG5 (a)		Model 3 BIG5 (b)		Model 4 TPB		Model 5 TPB & BIG5 (a)		Model 6 TPB & BIG5 (b)	
method:	ordered logit	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
controls	gender	0.507	0.016	0.594	0.007	0.571	0.007	0.195	0.391	0.236	0.316	0.176	0.445
	age	-0.015	0.122	-0.020	0.044	-0.018	0.057	-0.007	0.501	-0.007	0.485	-0.006	0.555
	professor	0.248	0.374	0.079	0.779	0.197	0.483	0.051	0.860	0.053	0.856	0.059	0.839
	research type	0.405	0.044	0.456	0.024	0.411	0.040	-0.022	0.917	-0.004	0.984	-0.030	0.887
	engineering	0.239	0.385	0.271	0.336	0.368	0.185	0.250	0.388	0.247	0.405	0.226	0.439
	natural sciences	0.004	0.986	0.090	0.730	0.131	0.605	0.199	0.455	0.184	0.503	0.177	0.507
BIG5	conscientiousness			0.268	0.080					0.191	0.225		
	extraversion			0.017	0.915					-0.172	0.321		
	agreeableness			0.137	0.413					0.168	0.323		
	openess			0.630	0.000					0.268	0.152		
	neuroticism			-0.316	0.051					0.224	0.198		
	entrepre. profile					0.050	0.001					-0.010	0.503
TPB	affective attitude							0.756	0.000	0.763	0.000	0.767	0.000
	cognitive attitude							0.112	0.270	0.101	0.323	0.116	0.251
	perc. beh. control							0.778	0.000	0.795	0.000	0.793	0.000
	injunctive norm							0.278	0.008	0.291	0.006	0.275	0.008
	descriptive norm							-0.066	0.536	-0.075	0.486	-0.065	0.543
	Number of obs	404		404		404		404		404		404	
	LR chi2(6)	16.66		50.63		28.89		196.96		203.34		197.41	
	Prob > chi2	0.011		0.000		0.000		0.000		0.000		0.000	
	Pseudo R2	0.014		0.043		0.025		0.168		0.173		0.168	
	Log likelihood	-579.22		-562.24		-573.11		-489.07		-485.88		-488.84	

Table 1: Big-Five and TPB

Looking at the basic personality traits of scientists we capture them on the one hand by the Big-Five components and on the other via an entrepreneurial personality index. Model 2 looks first at the five dimensions of the Big-Five. Three out of the five variables show up significantly. First there is conscientiousness which contributes slightly significant (at 10%) to entrepreneurial intentions (validating *H1a*). The more organized the scientist under consideration, the more planned and thought through the activities, the more this scientist will consider

to economize on own research results. Secondly, in terms of significance and magnitude of the coefficient much more powerful is openness which is positively significant at least at 1% (validating *H1b*) and which is twice as powerful as conscientiousness. Hence, those scientists being open for new ways and issues are much more likely to show entrepreneurial intentions. Third, neuroticism shows a significantly negative coefficient (validating *H1e*), indicating that more stress-resistant scientists show higher intentions. The other two traits, agreeableness and extraversion are not significantly related to the intentions variable (*H1c* and *H1d* are thus rejected). This may be explained by the specific sub-group of scientist which may be much more homogenous in these dimensions than other potential entrepreneurs outside of academia. With respect to the controls, gender and research type again show up significantly positive; in addition age plays a role in the sense that older scientists are less likely to have entrepreneurial intentions.

In case we alternatively apply the entrepreneurial personality index in model 3, the results are not changed. A scientist being closer to the ideal entrepreneurial profile is more likely to have entrepreneurial intentions (validating *H1f*). The significance of the controls remains the same as in the case of applying all five personality traits. The explanatory power of model 3 is slightly below the one of model 2 which has to do with the information reducing and smoothening effect of the index construction.

In model 4 the traditional version of Ajzen's TPB approach is tested for. We find that one attitude term, one norm term and the variable for perceived behavioral control are highly significant and show the expected sign. On the attitude side it is affective attitude which relates positively to entrepreneurial intentions (validating *H2a*) whereas the cognitive attitude remains insignificant (*H2b* to be rejected). The latter result may find an explanation in that the dependent variable, conditional intentions, is based on the assumption that the research results of the scientist have economic value; taken that any cognitive dimension may play a minor role. However, when we alternative use latent intentions, which are not based on the economic viability of the research results, the variable cognitive attitude is also insignificant. Besides affective attitude it is the perceived behavioral control which positively related to entrepreneurial intentions (validating *H2c*). The more a scientist is convinced to always have control over the entrepreneurial project the more likely entrepreneurial intentions can be observed. The norm related variables account for the influence of the proximate context the scientist is related to. Here the injunctive norm and hence whether the peer group would welcome and sustain an entrepreneurial initiative appears positively significant (validating *H2d*). The descriptive norm, accounting for peer group members being themselves engaged in entrepreneurial initiatives, shows up insignificant (*H2e*). Finally, the control variables lose their explanatory power as given by model 1 completely when the Ajzen model is tested. For gender this is explained as follows: the variable perceived behavioral control captures the explanatory power of gender in the sense that man compared to women show a higher perceived behav-

ioral control.[17] For research type it is the combined correlation with perceived behavioral control and affective attitude.

In model 5 we include next to the controls both, the Big-Five and the TPB variables. The explanatory power in this model is completely to the TPB variables – with signs and significance just as in model 4 – and the Big-Five variables (as well as the controls) lose their explanatory value (validating *H3a*). And in model 6, when we use the entrepreneurial profile index instead of the Big-Five items, the same result shows up (validating *H3b*). This result is not entirely surprising as it indicates that proximate variables (TPB) compared to distal variables offer a higher explanatory power.

These two results indicate that the fundamental psychological characteristics via Big-Five are completely dominated by more context related TPB variables. This finding is interesting along the following lines: First of all, it suggests that mediation effects work and one may want to look via which TPB variables basic psychological traits work; any mediation effect for individual level TPB variables could an indication for the respective TPB variable to be a characteristic adaptation of the fundamental Big-Fives. Secondly, in the alternative, not observed case of the Big-Five to dominate the TPB variables any policy discussion would be obsolete since the Big-Five are considered as nature given and hence cannot be "manipulated". In our case, however, when the TPB variables are not completely explained by Big-Five traits there remains room for political intervention.

Mediation: Big-Five as basis for TPB

In this step we have a brief look into the relationship between the core Ajzen variables and the Big-Five personality traits as well as the entrepreneurial profile index. The presumption is that those Ajzen factors which are on the individual level – affective attitude, cognitive attitude and perceived behavioral control – show a significant relation to the personality traits whereas the norm variables – injunctive and descriptive norm – do not. Table 2a shows the results with respect to the Big-Five personality traits.

[17] The average of the z-standardized variable perceived behavioral control of men is 0.19 and for women -0.35 with the difference being statistically significant ($p<0.01$).

		Model 1		Model 2		Model 3		Model 4		Model 5	
	DV	affective attitude		cognitive attitude		perc. beh. control		injunctive norm		descriptive norm	
method:	OLS	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
controls	gender	0.126	0.246	-0.011	0.926	0.427	0.000	0.205	0.081	0.162	0.148
	age	-0.010	0.032	-0.016	0.001	-0.004	0.401	-0.011	0.038	0.009	0.082
	professor	-0.142	0.312	0.168	0.257	0.235	0.075	-0.060	0.692	0.162	0.262
	research type	0.426	0.000	0.125	0.233	0.243	0.009	0.085	0.425	0.139	0.172
	engineering	0.233	0.097	0.108	0.464	-0.061	0.645	0.281	0.064	0.563	0.000
	natural sciences	0.136	0.301	0.188	0.176	-0.222	0.072	0.152	0.282	0.065	0.628
BIG5	conscientiousness	0.054	0.487	0.058	0.478	0.101	0.164	-0.048	0.567	-0.003	0.968
	extraversion	0.135	0.091	0.125	0.138	0.038	0.608	0.116	0.177	-0.082	0.315
	agreeableness	-0.017	0.838	-0.013	0.880	-0.008	0.920	0.088	0.321	-0.093	0.275
	openess	0.325	0.000	0.292	0.001	0.285	0.000	0.154	0.092	0.133	0.128
	neuroticism	-0.291	0.000	-0.107	0.207	-0.402	0.000	-0.158	0.068	-0.067	0.419
	constant	-1.113	0.054	-0.886	0.147	-0.838	0.122	-0.619	0.320	-0.554	0.351
	Number of obs	404		404		404		404		404	
	F(5, 485)	8.42		3.37		12.81		2.64		5.26	
	Prob > F	0.000		0.000		0.000		0.003		0.000	
	R-squared	0.191		0.087		0.264		0.069		0.129	
	Adj R-squared	0.168		0.061		0.244		0.043		0.104	
	d AdjR-squared	0.116		0.052		0.138		0.029		-0.002	

Table 2a: Big-Five and the Ajzen factors

Models 1 to 5 address the five Ajzen variables. For the three individual level variables in models 1 and 2, affective attitude and perceived behavioral control, out of the Big-Five openness and neuroticism are significant and show the expected sign; for cognitive attitude only openness plays a role. These results validate H4a. As to the norm variables, descriptive norm shows no relation to the Big-Five (validating *H4b*); the norm variable simply states whether in the scientists peer group a lot or only a few colleagues show entrepreneurial behavior. This should be a sheer fact without any relations to the scientist's personality. With respect to injunctive norm we find weakly significant coefficients with the expected sign (H4b in this case to be rejected). Since the injunctive norm represents the scientists opinion on how the peers would react on revealed entrepreneurial intentions the influence of personality traits cannot be completely ruled out. We interpret the weak significance just that way.

When openness is considered as a core trait characterizing entrepreneurs, then the results indicate that the entrepreneurial type shows high affective attitudes and a high perceived behavioral control. This type might have certain more positive perception of the peer group's opinion about entrepreneurial projects.

Using instead of the Big-Five the entrepreneurial profile index these results are not much changed. Table 2b delivers the respective results. The index is related to the individual level Ajzen variables in a highly significant way, with the signs of the coefficients as expected (validating *H4c*). As to the norm variables, congruent to the results in table 2a the descriptive norm shows no relation to the index (validating *H4d*) and for the injunctive norm the relation is positively significant at 5% (not validating *H4d*). This all suggests that scientists with a psychological profile coming closer to the ideal one show higher affective attitudes towards

entrepreneurship, consider entrepreneurship as cognitively sound, and are more convinced to keep control over the entrepreneurial process.

	DV	Model 1 affective attitude		Model 2 cognitive attitude		Model 3 perc. beh. control		Model 4 injunctive norm		Model 5 descriptive norm	
method:	OLS	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
controls	gender	0.148	0.174	-0.024	0.831	0.480	0.000	0.210	0.069	0.188	0.085
	age	-0.011	0.026	-0.017	0.001	-0.004	0.361	-0.011	0.040	0.008	0.121
	professor	-0.074	0.608	0.223	0.137	0.298	0.029	-0.011	0.943	0.173	0.231
	research type	0.419	0.000	0.115	0.276	0.243	0.012	0.077	0.473	0.139	0.171
	engineering	0.288	0.043	0.118	0.426	0.026	0.846	0.319	0.035	0.552	0.000
	natural sciences	0.145	0.275	0.160	0.246	-0.168	0.183	0.144	0.307	0.074	0.577
BIG5	entrepre. profile	0.041	0.000	0.026	0.000	0.042	0.000	0.016	0.037	0.006	0.372
	constant	0.969	0.000	1.075	0.000	0.788	0.002	0.443	0.112	-0.610	0.020
	Number of obs	404		404		404		404		404	
	F(5, 485)	9.16		3.19		13.87		2.28		7.78	
	Prob > F	0.000		0.003		0.000		0.028		0.000	
	R-squared	0.139		0.053		0.197		0.039		0.121	
	Adj R-squared	0.124		0.037		0.183		0.022		0.105	
	d AdjR-squared	0.072		0.028		0.077		0.008		-0.001	

Table 2b: Entrepreneurial profile and the Ajzen factors

Extending the TPB in explaining entrepreneurial intentions

The original Ajzen model is enhanced by variables representing the past entrepreneurial behavior of the scientists as well as some further context variables. Table 3 presents the estimation results. We find here that the significance of the core TPB variables as well as the magnitude of the coefficients is not much affected in the extended versions. For the variables representing past entrepreneurial behavior, entrepreneurial self-identity and entrepreneurial experience, we obtain significantly positive coefficients (validating *H5a* and *H5b*).

DV:	conditional intentions	Model 1 Controls		Model 2 TPB		Model 3 TPB & Soc.Context		Model 4 TPB & Entrpr. Exp.	
method:	ordered logit	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
controls	gender	0.507	0.016	0.195	0.391	0.177	0.438	0.146	0.522
	age	-0.015	0.122	-0.007	0.501	-0.006	0.519	-0.019	0.063
	professor	0.248	0.374	0.051	0.860	0.056	0.847	-0.044	0.881
	research type	0.405	0.044	-0.022	0.917	-0.016	0.938	-0.052	0.808
	engineering	0.239	0.385	0.250	0.388	0.236	0.416	0.244	0.408
	natural sciences	0.004	0.986	0.199	0.455	0.169	0.528	0.287	0.286
TPB	affective attitude			0.756	0.000	0.764	0.000	0.489	0.000
	cognitive attitude			0.112	0.270	0.115	0.259	0.111	0.283
	perc. beh. control			0.778	0.000	0.778	0.000	0.559	0.000
	injunctive norm			0.278	0.008	0.220	0.086	0.254	0.016
	descriptive norm			-0.066	0.536	-0.073	0.497	-0.089	0.408
social context	climate					0.075	0.554		
	group_ident					0.076	0.452		
past	entrep_self							0.656	0.000
	entrep_exp							0.991	0.004
	Number of obs	404		404		404		404	
	LR chi2(6)	16.66		196.96		197.98		231.68	
	Prob > chi2	0.011		0.000		0.000		0.000	
	Pseudo R2	0.014		0.168		0.169		0.197	
	Log likelihood	-579.22		-489.07		-488.56		-471.71	

Table 3: The extended TPB model

Peer group effects and group identity

In a last step peer group effects and group identity are included into the TPB approach. Group identity is an individual level variable and we test how it is related to the basic psychological traits relevant for an entrepreneurial personality. Table 4 shows the relevant estimation results. In model 1 we analyze whether the Big-Five traits are related to group identity and we find that the out of the Big-Five only conscientiousness, extraversion and openness receive a significant coefficient. With respect to openness *H6a* is validated but not so with respect to extraversion and conscientiousness. Hence, in terms of the characterization of the Schumpeter entrepreneur as acting against the odds we find here an appropriate relationship of being open and group identification.

Using instead the entrepreneurial profile, model 2 delivers a positive significant coefficient which does not validate *H6b*. Hence, in terms of the characterization of the Schumpeter entrepreneur as acting against the odds we find here a quite positive relationship between being an entrepreneur (according to the profile variable) and group identification.

The relationship between an entrepreneurial characterization and group identification is here not given in a straightforward way. And it is only the trait openness that indicates that entrepreneurs do not identify with their peers. For the further analyses we take that result as a justification to split the sample into group-identifiers and non-group-identifiers.

		Model 1		Model 2	
	DV	group identification		group identification	
method:	OLS	coeff	p-value	coeff	p-value
controls	gender	0.290	0.010	0.236	0.035
	age	-0.004	0.387	-0.002	0.683
	professor	-0.143	0.320	-0.145	0.327
	research type	-0.082	0.421	-0.078	0.457
	engineering	0.223	0.122	0.298	0.042
	natural sciences	0.349	0.010	0.348	0.011
BIG5	conscientiousness	0.136	0.086		
	extraversion	0.416	0.000		
	agreeableness	0.112	0.185		
	openess	-0.228	0.009		
	neuroticism	-0.057	0.486		
	entrepre. profile			0.029	0.000
	constant	-1.438	0.016	0.413	0.126
	Number of obs	404		404	
	F(5, 485)	4.83		3.38	
	Prob > F	0.000		0.002	
	R-squared	0.119		0.056	
	Adj R-squared	0.095		0.040	

Table 4: Group identity, Big-Five and entrepreneurial profile

A further step is to look at the role of peer group identification in the extended TPB framework. Table 5 delivers respective results. From model 1 to 4 by starting with the extended TPB model we include step by step interaction terms of the two TPB norm variables as well as of the affective attitude variable. We find only the interaction term with the injective norm significant. The positive significant coefficient tells that for scientist with a high peer group identification the injective norm becomes relevant (validating *H6b*); for those with no group identification the injective norm is of no relevance. With respect to the descriptive norm as well as the affective attitude no significant coefficients are found (*H6c* and *H6d* have to be rejected).

The weakly significant relation between the entrepreneurial profile and group identification suggested to spilt up the sample into observations/scientists that show high group identification (group>0) and those that do not (group<0). Models 5 and 6 in table 5 deliver the estimates. We find that with respect to the core TPB variables there are some commonalities and some differences between the two sub samples. The commonalities are found with respect to cognitive attitude and descriptive norm. In both subsamples the coefficients of these two variables are not significant – as we had it already in all the TPB estimations before. With respect to the significant coefficients for affective attitude, perceived behavioral control and injunctive norm we find the following for the two subsamples: First, for those scientists which do not identify with their peer group the injunctive norm play no role in their entrepreneurial intentions; contrariwise, scientist identifying themselves with the respective peers, the injunctive norm is relevant in the sense that they follow their peers. Secondly, scientists with low group identification show a much higher significantly positive coefficient for affective atti-

tude than their peer group oriented counterparts; hence, scientists which follow their peers on the average show a lower affective attitude whereas their deviant counterparts much more positively affected by going for an own firm. Third, for both subgroups the perceived behavioral control is positively significant; however, for scientists with above average group identification the perceived behavioral control is more important. This latter result is on a first sight somewhat surprising because on could have hypothesized that a deviant scientist's entrepreneurial intentions are heavily based on perceived behavioral control. However, on a second sight one can argue that those scientists who show high entrepreneurial intentions and identify with their peers derive from the peers the conviction that they always will have control over the entrepreneurial process.

DV:	conditional intentions	Model 1		Model 2 moderation		Model 3 moderation		Model 4 moderation		Model 5 group>0		Model 6 group<0	
method:	ordered logit	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value
controls	gender	0.136	0.552	0.127	0.579	0.149	0.514	0.173	0.449	0.134	0.712	0.312	0.297
	age	-0.019	0.063	-0.022	0.038	-0.023	0.033	-0.022	0.034	-0.015	0.311	-0.006	0.700
	professor	-0.047	0.874	0.000	1.000	0.005	0.987	-0.043	0.884	0.232	0.603	-0.040	0.921
	research type	-0.047	0.828	-0.075	0.728	-0.085	0.694	-0.069	0.748	-0.239	0.449	0.151	0.608
	engineering	0.247	0.403	0.299	0.314	0.290	0.330	0.294	0.324	-0.037	0.937	0.342	0.366
	natural sciences	0.278	0.306	0.325	0.235	0.314	0.252	0.324	0.236	-0.396	0.355	0.561	0.118
TPB	affective attitude	0.486	0.000	0.469	0.001	0.467	0.001	0.447	0.001	0.495	0.011	1.037	0.000
	cognitive attitude	0.110	0.286	0.105	0.312	0.121	0.250	0.125	0.232	0.103	0.504	0.096	0.495
	perc. beh. control	0.565	0.000	0.544	0.000	0.537	0.000	0.551	0.000	1.309	0.000	0.470	0.006
	injunctive norm	0.208	0.109	0.211	0.105	0.205	0.115	0.222	0.088	0.418	0.012	0.094	0.511
	descriptive norm	-0.101	0.359	-0.107	0.332	-0.088	0.429	-0.078	0.482	-0.143	0.394	-0.051	0.725
social context	climate	0.079	0.536	0.090	0.486	0.084	0.512	0.092	0.475				
	group_ident	-0.007	0.944	0.028	0.783	0.027	0.795	0.019	0.851				
past	entrep_self	0.652	0.000	0.663	0.000	0.655	0.000	0.659	0.000				
	entrep_exp	1.007	0.004	0.974	0.005	0.945	0.007	0.957	0.006				
inter-action	inj X group			0.234	0.019	0.207	0.039	0.227	0.024				
	des X group					0.131	0.191	0.135	0.177				
	aff X group							-0.150	0.144				
	Number of obs	404		404		404		404		189		215	
	LR chi2(6)	232.06		237.55		239.25		241.41		128.76		87.09	
	Prob > chi2	0.000		0.000		0.000		0.000		0.000		0.000	
	Pseudo R2	0.198		0.202		0.204		0.205		0.230		0.143	
	Log likelihood	-471.52		-468.77		-467.92		-466.84		-215.96		-262.09	

Table 5: Group identity and entrepreneurial intentions

Towards the Schumpeterian entrepreneur

Based on the forgoing results, in a last step we want to analyze more deeply the question on the deviant Schumpeterian entrepreneur compared to a more conformist type of new firm founder who follows the crowd/peers. For that purpose, along the models 5 and 6 in table 5 we distinguish between those scientists that show a high group identity (group>0) and those with a low one (group<0). For both sup-samples we cross tabulate the entrepreneurial inten-

tions and the injunctive norm. For the form we have the categories “no” and “yes” as well as the “may be” for those not clearly decided whether to potentially go for founding a firm or not. With respect to the injunctive norm, via z-deviations observations with high and those with low group identification can be distinguished. Figures 1a and 1b show the respective cross tables.

		Injunctive norm	
	non-identifiers	low	high
intention	no	34	**13**
	maybe	60	31
	yes	**45**	35

	non-identifiers	low	high
intention	no	0.08	**0.03**
	maybe	0.15	0.08
	yes	**0.11**	0.09

Figure 1a: Non-identifiers

		Injunctive norm	
	identifiers	low	high
intention	no	**37**	10
	maybe	43	24
	yes	24	**54**

	identifiers	low	high
intention	no	**0.09**	0.02
	maybe	0.10	0.06
	yes	0.06	**0.13**

Figure 1b: Identifiers

In figure 1a we analyze the non-identifiers, which are those scientists that show no group identification. In the upper panel the absolute numbers are stated and in the lower panel percentages with respect to the total number of observations. We first find that the “maybe” cases are most frequent with 23% out of the total. The number of scientists with positive intentions that deviate from the opinion of their peers is 45 compared to 35 that would follow the entrepreneurship friendly peers. These 45 scientists (11%) can be interpreted as entrepreneurs in the very Schumpeterian sense – they have intentions against the odd. The other 35 scientists (9%) seem to follow the peers’ opinion although they do not identify with them; in some sense they are also Schumpeterian entrepreneurs. Together these two subgroups account for 20% of all scientists. The remaining 11% of scientists show no intentions to found a firm; of those the majority (8%) follows the peers’ negative opinion.

In figure 1b the identifiers are depicted; they show a high identification with their peers. Looking at the potential founders, the majority of 54 compared to 24 (or 13% compared to 6%) follow the positive opinion their peers have on founding a firm. And of the 11% of identifying potential non-founders the vast majority follows their peers.

Summarizing these results with respect to the notion of potential entrepreneurs in Schumpeter’s sense, among scientists with positive entrepreneurial intentions (38%) 69 (or 17%) follow the Schumpeter pattern of behaving deviant, 89 (or 21%) are just conformists (figure 2).

N=404	**Non-identifiers**		**Identifiers**	
support	**No**	**Yes**	**No**	**Yes**
pos. Intention	**0,11**	**0,08**	**0,06**	**0,13**
	Schumpeterian deviant	Conformist	Schumpeterian deviant	Conformist

Figure 2: Schumpeterian deviants and conformists

This result can be complemented – without any further deeper analysis and for information only – by data on whether the founding intentions in the end lead to a spin-off or not (figure 3).

N=182	non-identifiers		identifiers	
pos. Intention	21 (11.5%)	19 (10.4%)	11 (6%)	26 (14.3%)
realisation	2 (1.1%)	2 (1.1%)	3 (1.6%)	4 (2.2%)
team spin-off	1	1	3	4
solo spin-offs	1	1	0	0
	Schumpeterian deviant	Conformist	Schumpeterian deviant	Conformist

Figure 3: Entrepreneurial intentions and realization

For that we use the answers of the same scientists a few years later, however with a database that contains only 182 replies. In case of the Schumpeterian deviants 15% founded whereas among the conformists this percentage is 13%. For the spin-offs of the conformists 5 out of 6 are team spin-offs; among the Schumpeterian deviants 1 out of 5 founded their spin-offs as a solo entrepreneur.

7. Discussion

The purpose of this study was to provide empirical evidence on antecedents of scientists' intentions to commercialize their own research through founding a new venture and to analaze whether those scientist show a Schumpeterian deviant attitude. Drawing from Ajzen's (1991) theory of planned behavior, identity theory (Stryker, 1987), and social identity theory (Tajfel & Turner, 1979; Hogg & Abrams, 1988), we propose an intentions-based model of academic entrepreneurship that incorporates individual and contextual predictors as well as their interplay; we complement that with including the Big-Five personality traits. In a nutshell, our model proves to be a useful analytical framework.

We find the Big-Five to be related to entrepreneurial intentions in the expected way. However, when including the more proximate Ajzen variables the Big-Five lose their explanatory power completely. Turning Ajzen and to the individual-level predictors of the model (i.e., attitudes, perceived behavioral control, entrepreneurial self-identity, past entrepreneurial behavior), our hypotheses are widely supported by the data. Regarding scientists' attitudes toward entrepreneurship, the emotional component (*affective attitude*) turns out to be a relevant predictor, while the rational component (*cognitive attitude*) does not have an effect. It is therefore a positive feeling and opinion toward research commercialization that predicts scientists' intentions to engage in entrepreneurial activity. This is in line with previous findings emphasizing the "emotional underpinning" of entrepreneurial behavior in non-academic settings (e.g., Smilor, 1997; Cardon et al., in press).

Furthermore, *perceived behavioral control* emerges as a key variable in our model as a scientist's perception of his or her ability to succeed as an entrepreneur has a significant effect on his or her intentions to step into the entrepreneurial realm. This finding concurs with a growing body of research underlining the importance of entrepreneurial control-beliefs (e.g., self-efficacy beliefs) within the entrepreneurial process (see e.g., Rauch & Frese, 2007). The significant relation between these control-beliefs and entrepreneurial intentions further highlights the importance of policy initiatives and support programs aiming to increase the rate of start-ups from the science field. In this regard, sensitizing and qualifying scientists for an entrepreneurial career could be pointed out as a potentially effective strategy.

Extending the traditional Ajzen framework, *entrepreneurial self-identity* appears to be the most powerful predictor of academic entrepreneurial intentions. Fully in accord with identity theory (Stryker, 1987), the stronger scientists' sense of themselves as potential entrepreneurs, the higher their intentions to participate in new venture creation. This finding adds empirical evidence to the notion that understanding the (potential) entrepreneur's perception of "I am an entrepreneur" plays a critical role in understanding entrepreneurial activity (Krueger, 2007). Surprisingly, the concept of entrepreneurial self-identity has not yet been explicitly linked to research on academic entrepreneurship. Our paper, together with the recent contribution of Jain et al. (2009), may thus offer a useful first step at bringing the thoughts of identity theorists into this research area.

Our results confirm previous studies (e.g., Delmar & Davidsson, 2000; Ucbasaran et al., 2009) showing that *past entrepreneurial behavior* is an important stimulus for the actual decision to engage in entrepreneurship. We find that scientists' intentions to create a new business in response to a personally-viable opportunity are enhanced by prior firm-founding experience. Hence, there might to be a learning effect on those scientists who are experienced in entrepreneurial activity, making them more likely to start a further new venture (Politis, 2005; Krueger, 2007).

It is notable that context-level parameters, i.e., *descriptive norm* (whether workplace peers actually engage in entrepreneurship) and *injunctive norm* (whether workplace peers would approve of the respondent's entrepreneurial activity), do not emerge as strong direct predictors of academic entrepreneurial intentions. Two explanations for our findings are plausible. First, individual-level factors, such as personal attitudes, control-beliefs, or self-perceptions, might be more influential with respect to entrepreneurial activity among scientists than the social context, i.e., a scientist's group of workplace peers. Similarly, Krueger et al. (2000) suppose that the "lone entrepreneur's" tendency toward inner-directedness might reduce the impact of social forces. Second, the social context might matter in some but not other conditions. There might be boundary conditions determining the influence of workplace peers on a scientist's decision to participate in research commercialization. Indeed, we find the effect of injunctive norm on entrepreneurial intentions to be moderated by *group identification* (i.e., a scientist's sense of identification with his or her group of workplace peers). Note that we do not find such an effect for descriptive norm. This corroborates the distinct nature of peer influences modeled by these two norm constructs. On the one hand, injunctive

norm refers to whether entrepreneurial behavior *ought* to be shown by members of the research department, implying concrete expectations and wishes of the scientists' workplace peers. On the other hand, descriptive norm captures whether entrepreneurial behavior *is* actually shown by members of the group of workplace peers. However, it does not explicitly impose social pressure to conform and does not show any effect on entrepreneurial intentions. Adding to previous research (Louis et al., 1989; Kenney & Goe, 2004; Stuart & Ding, 2006), these findings demonstrate that instead of working in close proximity to entrepreneurial peers it seems to be *the will to comply with the social pressure of one's peers* that stimulates academic entrepreneurial activity.

Interestingly enough, both the hypothesized interaction between injunctive norm and group identification and the additionally-revealed interaction between affective attitude and group identification add up to a pattern of results that is consistent with social identity theory (Tajfel & Turner, 1979; Hogg & Abrams, 1988). Following this pattern, we might argue that there is a continuum between high and low levels of group identification and that shifts along this continuum determine the extent to which either context-level factors – i.e., injunctive norm – or individual-level factors – i.e., affective attitude – are shaping scientists' entrepreneurial intentions. For example, when scientists report higher levels of identification with their own group of workplace peers, depersonalization occurs, such that the decision to become an academic entrepreneur is guided more by expectations and wishes of the peers at the research department and is less affected by the scientists' own personal attitudes. On the other end of the continuum, for scientists who report lower levels of identification with their group of workplace peers, personal attitudes and beliefs regarding entrepreneurship have a stronger impact on entrepreneurial intentions than the behavioral expectations of their peers.

In view of this discussion, our analysis also put forward that a non-negligible share of scientists show intentions which are based on a rather Schumpeterian attitude, namely being behaving deviant with respect to the own peers.

Limitations

Our study does not come without limitations. First, the data used is correlational and does not allow for strict causal testing of our hypotheses. Second, all information is collected from the same source by using "only" one method. In contrast to multi-informant/multi-method procedures, this method of data collection may result in common-method bias or may suffer from systematic answering tendencies. Nevertheless, our hypothesized model is grounded in well-established theories and provides results that match with existing theoretical and empirical evidence. Therefore, it seems plausible to assume adequate reliability and validity of our results. A third caveat is that this study is limited to the population of German scientists. This might come at the expense of a more general application of our results in other national contexts. Finally, the dependent variable in this study refers to *conditional* intentions rather than manifest (unconditional) intentions to engage in academic entrepreneurship. However, we are interested in studying an unselected representative sample and not exclusively focusing on scientists whose research is most likely to possess commercial potential. Our dependent vari-

able therefore relies on a general behavioral tendency that is independent from the condition of commercial potential of scientists' research.

Implications for policy

Given today's radical social and economic changes, public authorities strive for mechanisms that enable individuals and societies to actively adapt and respond to the new challenges (Silbereisen, 2005). Moreover, economists emphasize the importance of entrepreneurship as an individual's career choice and the entrepreneurial exploitation of scientific research as a particular driver of economic growth (Audretsch, 2007). Consequently, policy schemes targeting academic entrepreneurship might be particularly important.

However, new firms facilitating the commercialization of science do not necessarily emerge and form spontaneously in response to formal policies, such as incubators, technology transfer organizations, or start-up programs. It also takes the entrepreneurial scientists actively creating and pursuing commercial opportunities based on new scientific ideas and knowledge. In this respect, our study suggests that interventions targeting scientists' affective attitudes, entrepreneurial control-beliefs, and entrepreneurial self-identity and experiences might be fruitful. Our result that the more proximate Ajzen factors dominate the Big-Five personality traits – which are rather given by nature and therefore may be difficult to be influenced – opens up room for political interventions. Interventions informed by intentions-based models, such as the theory of planned behavior (Ajzen, 1991), have already proved to be efficacious in changing intentions and behavior among participants who, prior to the intervention, either did not contemplate performing the behavior or were disinclined to do so (Fishbein & Ajzen, 2005). Likewise, there is a growing body of empirical evidence indicating that interventions are able to promote *entrepreneurial* mind-sets (e.g., attitudes, self-efficacy beliefs; see Krueger, 2007) and intentions (Souitaris et al., 2007). Consequently, entrepreneurship scholars strongly recommend the use of intentions-based models in the context of entrepreneurship education and training (e.g., Fayolle, 2005). For example, a targeted intervention could teach scientists critical entrepreneurial competencies to foster perceived behavioral control (Krueger et al., 2000). Information provision and persuasive communication (see Hardeman et al., 2002) to convincingly demonstrate the benefits of academic entrepreneurship might help change attitudes and create an entrepreneurial self-perception among scientists.

Public support schemes may further benefit from understanding that norms and rules of the individual departmental context within which scientists are embedded determine entrepreneurial activity. Specifically, the importance of injunctive norm (i.e., workplace peers' expectations and wishes toward entrepreneurship) advocates an active role for the scientist's group of superiors and colleagues in providing positive pressure to engage in research commercialization. In the light of our findings, policy interventions should be designed to both foster a departmental climate that favors entrepreneurship and strengthen group identification (i.e., scientists' feelings of belongingness to their own group of workplace peers) in order to assist in developing stronger entrepreneurial intentions in academia. In view of these political options, the means to "create" the Schumpeter entrepreneur with a deviant behavior appear to be limited.

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Table A1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
conscientiousness	404	3.398	0.630	1.556	4.889
extraversion	404	2.945	0.668	1.000	4.667
agreeableness	404	3.172	0.576	1.111	4.778
openess	404	3.222	0.579	1.444	4.875
neuroticism	404	1.678	0.664	0.111	4.000
entrepre. Profile	404	-24.773	6.705	-45.222	-6.642
affective attitude	404	0.016	0.996	-2.516	1.654
cognitive attitude	404	-0.018	0.990	-2.814	3.105
perc. beh. control	404	0.043	0.980	-1.928	2.030
injunctive norm	404	0.003	1.001	-2.558	2.406
descriptive norm	404	-0.015	0.988	-0.920	4.251
gender	404	0.720	0.449	0	1
age	404	38.757	11.532	23	65
professor	404	0.181	0.385	0	1
research type	404	0.554	0.498	0	1
engineering	404	0.322	0.468	0	1
natural sciences	404	0.498	0.501	0	1
entrep_self	404	0.017	1.001	-2.038	1.647
entrep_exp	404	0.119	0.324	0	1
group_ident	404	-0.007	0.980	-3.264	1.809
climate	404	0.035	1.011	-2.488	2.110

Table A2: Correlations

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]
conscientiousness	[1]	1																			
extraversion	[2]	**0.18**	1.00																		
agreeableness	[3]	**0.16**	0.07	1.00																	
openess	[4]	**0.16**	**0.33**	0.04	1.00																
neuroticism	[5]	**-0.30**	**-0.40**	**-0.22**	**-0.23**	1.00															
entrepre. Profile	[6]	**0.47**	**0.67**	**-0.34**	**0.52**	**-0.57**	1.00														
affective attitude	[7]	0.12	**0.22**	0.06	**0.24**	**-0.28**	**0.25**	1.00													
cognitive attitude	[8]	0.08	**0.15**	0.02	**0.21**	**-0.14**	**0.16**	**0.24**	1.00												
perc. beh. control	[9]	**0.17**	**0.21**	0.08	**0.26**	**-0.38**	**0.30**	**0.53**	**0.25**	1.00											
injunctive norm	[10]	0.02	0.12	0.08	0.12	**-0.16**	0.08	**0.36**	**0.18**	**0.28**	1.00										
descriptive norm	[11]	0.02	0.01	0.00	0.07	-0.08	0.05	**0.20**	0.01	**0.25**	**0.28**	1.00									
gender	[12]	-0.06	-0.09	0.01	-0.03	-0.12	-0.03	0.05	-0.04	**0.25**	0.08	**0.16**	1.00								
age	[13]	0.12	0.09	0.09	0.03	-0.12	0.11	-0.05	-0.12	0.11	-0.07	**0.19**	**0.25**	1.00							
professor	[14]	0.06	0.11	0.05	0.11	-0.13	0.12	-0.04	0.00	**0.18**	-0.03	**0.14**	**0.24**	**0.51**	1.00						
research type	[15]	0.03	0.03	0.02	-0.03	-0.05	0.02	**0.23**	0.03	**0.18**	0.06	**0.17**	0.12	**0.15**	0.02	1.00					
engineering	[16]	0.01	0.07	**0.13**	-0.01	-0.08	-0.01	**0.15**	0.00	**0.13**	0.11	**0.28**	0.12	0.11	0.02	**0.34**	1.00				
natural sciences	[17]	-0.02	**-0.19**	-0.01	-0.09	0.06	-0.12	-0.12	0.00	**-0.19**	-0.06	**-0.18**	-0.09	0.00	-0.06	**-0.30**	**-0.69**	1.00			
entrep_self	[18]	**0.19**	**0.28**	0.09	**0.25**	**-0.32**	**0.31**	**0.58**	**0.17**	**0.57**	**0.25**	**0.20**	**0.18**	**0.18**	**0.13**	**0.24**	**0.16**	**-0.17**	1.00		
entrep_exp	[19]	0.07	0.08	0.12	**0.19**	**-0.17**	0.09	**0.25**	0.10	**0.37**	**0.18**	**0.20**	**0.18**	**0.25**	**0.23**	0.11	0.12	-0.12	**0.32**	1.00	
group_ident	[20]	0.12	**0.22**	0.11	-0.04	**-0.16**	**0.16**	-0.02	0.00	0.04	**0.15**	-0.01	0.08	0.00	-0.03	-0.03	0.01	0.06	0.07	0.12	1.00
climate	[21]	-0.02	0.09	0.06	0.11	**-0.15**	0.06	**0.26**	0.11	**0.17**	**0.63**	**0.31**	0.11	-0.01	-0.01	0.04	0.06	0.00	**0.22**	0.06	**0.14**

Bold values are significant at $p<0.01$.