Technovation 38 (2015) 64–74

Contents lists available at ScienceDirect

Technovation

journal homepage: www.elsevier.com/locate/technovation

Growth intentions among research scientists: A cognitive style perspective

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ARTICLE INFO

Available online 16 January 2015

Keywords:
Growth intention
Cognitive style
Academic entrepreneurship

ABSTRACT

Although academic entrepreneurship has taken place in some U.S. universities for many decades, it is only over the past few decades that there has been an increased interest by universities worldwide to engage in their third mission related to entrepreneurship and economic development. Recently, researchers studying academic entrepreneurship have increasingly focused on understanding research scientists' entrepreneurial intentions. It has however also been acknowledged that, next to understanding entrepreneurial intentions, it is important to generate insights into growth intentions. This is because growth is unlikely to be achieved if no growth intention exists. Taking a cognition and self-efficacy perspective, our study explores how cognitive styles are associated with growth intentions within a group of research scientists having entrepreneurial intentions. Our study indicates that a planning cognitive style promotes while a knowing cognitive style curbs growth intentions. Further, working experience mitigates the negative impact of a knowing style on growth intentions. Our research has practical implications and implications for technology management, academic entrepreneurship and entrepreneurial intentions literatures.

1. Introduction

This study aims at understanding future academic entrepreneurs' growth intentions and particularly focuses on the link between cognitive styles and these intentions. Academic entrepreneurs engage in technological entrepreneurship and are academics whose primary occupation, prior to playing a role in a start-up, and possibly concurrent with that process, was that of lecturer or researcher affiliated with a higher education institute (Samson and Gurdon, 1993). Academic entrepreneurship is often considered crucial for competitive advantage (OECD, 2003) and academic research is a crucial ingredient for the development of new products and processes (Mansfield, 1991). O'Shea et al. (2008) reviewed the literature on the impact of academic entrepreneurship on regional economic development and concluded that academic ventures constitute an economically powerful group of high-technology companies. Furthermore, firms operating in technologically intensive industries contribute significantly to economic growth and innovation (Newbert et al., 2008), regional prosperity and transformation and create individual wealth (Venkataraman, 2004), and new firm creation has been found vital for economic growth (Kirchhoff and Phillips, 1988).

While academic entrepreneurship may generate substantial societal benefits (Shane, 2004; Kroll and Liefner, 2008), it poses major challenges often related to the tension between academic and commercial demands (Massa and Testa, 2008; Van Burg et al., 2008; Van Geenhuizen and Soetanto, 2009; Sohn et al., 2013). Specifically, Kidwell (2013) indicates that challenges occur at any stage of the university commercialization process, ranging from technology identification, through market assessment to business development. Despite these challenges, a number of U.S. universities and technical schools have paid significant attention to entrepreneurship for many decades. In particular, such academic entrepreneurship has flourished over the last decades as universities have increasingly engaged in their so-called "third mission" related to entrepreneurship and economic development (Etzkowitz, 2003; Chang et al., 2006; Todorovic et al., 2011), next to their traditional activities of research and teaching (Wright et al., 2008). As a result, there has been an increase in academic entrepreneurship initiatives worldwide over the past decades and the academic literature has dedicated significant attention to the

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http://dx.doi.org/10.1016/j.technovation.2014.12.001
0166-4972/

phenomenon of academic entrepreneurship. While, initially, most of the empirical literature on academic entrepreneurship referred to top research institutes in highly developed environments such as Stanford and Boston, more recent research has also studied academic entrepreneurship at mid-range universities operating within less developed high-tech environments in different regions worldwide (Wright et al., 2008; Breznitz et al., 2008). This is, amongst others, caused by the fact that, in the U.S., the Bayh–Dole Act 1980 provided incentives for firms and universities to commercialize university-based inventions, while several European and Asian countries adopted similar legislation only from the 1990s onwards (Grimaldi et al., 2011). We refer to Rothaermel et al. (2007), Markman et al. (2008) and Djokovic and Souitaris (2008) for excellent reviews of the academic entrepreneurship literature. In summary, this literature has focused on the macro (studying the role of government and industry), meso (focusing on the university) and micro (studying firms and individual entrepreneurs) levels. Recently, researchers within the micro level have focused on research scientists' motivations (e.g. Lam, 2011) and intentions to engage in academic entrepreneurship (e.g. Goethner et al., 2012; Prodan and Drnovsek, 2010). Intentions are good predictors of planned behavior (Bagozzi et al., 1989) especially if the phenomenon is rare, obscure, or involves unpredictable time lags, which is typically the case in entrepreneurship (Krueger et al., 2000). Entrepreneurial intentions have been studied in diverse contexts (e.g. Lee et al., 2011; Souitaris et al., 2007; Thompson, 2009). The study of intentions in an academic context is important given the overarching presence of entrepreneurial potential through new research knowledge (Obschonka et al., 2012). We identify two important gaps in the entrepreneurial intentions and academic entrepreneurship literatures.

First, entrepreneurial intentions' researchers have recently recognized that it is not only essential to study entrepreneurial intentions, but to distinguish between individuals with low growth intentions and those who aspire to start ventures with a potentially larger impact on the economy (Cassar, 2007; Douglas, 2013). Some people are content with a venture that merely survives while others favor high growth ventures (Gundry and Welsch, 2001). Studying growth intentions is important as growth creation is not trivial and requires large investments which will not be made if the intention to grow is absent (Autio and Acs, 2010). Many ventures do not achieve substantial growth, simply because the entrepreneur did not intend to have the venture reach substantial size (Cliff, 1998; Davidsson, 1989). Such growth intentions predict post-founding growth and delineate rapid-sales growth firms from other firms (Barringer et al., 2005; Delmar and Wiklund, 2008). Indeed, researchers studying the impact of academic entrepreneurship (e.g. Colombo et al., 2010; Wennberg et al., 2011; Zhang, 2009) have to a large extent emphasized growth as an important performance measure. To our knowledge, however, no research has investigated the determinants of growth intentions in academic entrepreneurship. Studying growth intentions in an academic context is important because, while academic entrepreneurship generates employment opportunities for university-based researchers and graduate students from technological spillovers (Siegel et al., 2007), there is a social cost due to the loss in academic research productivity. For instance, Buenstorf (2009) found that academics' publications and citations decreased once they became founders, and Toole and Czarnitzki (2010) warn of the effects of an academic brain drain through spin-off creation. To justify such negative social effects, the social impact of the spin-off firm should be sufficiently high, and that will only be the case if the new venture's return and growth is sufficiently high. Further, studying growth intentions is relevant as technology transfer offices often face significant time constraints (Lockett and Wright, 2005), and thus may benefit from understanding which future academic entrepreneurs are likely to exhibit growth intentions and which are less likely to found growth-oriented ventures. Along the same lines, Douglas 2013) recommends the identification of individuals who are predisposed to manage growth-oriented firms, preferably at the stage when entrepreneurial intentions are forming.

Second, researchers studying growth intentions in a non-academic entrepreneurial context have identified a number of individual-level characteristics affecting growth intentions, including household income and education (Cassar, 2006), significance an individual attaches to financial success (Cassar, 2007), strategic intentions (Gundry and Welsch, 2001), and innovative behavior (Stenholm, 2011). Although these studies made important contributions, the cognitive style perspective remains silent in predicting growth intentions. Such silence is surprising as cognitive styles have been shown to explain entrepreneurial behaviors (Carland et al., 2002; Mitchell et al., 2000), such as distinguishing entrepreneurs from non-entrepreneurs (Allinson et al., 2000; Buttner and Gryskiewicz, 1993), and understanding why some people discover and exploit particular entrepreneurial opportunities, while others do not (Dimov, 2007; Hmieleski and Corbett, 2006). Cognitive styles have also been shown to have an important impact on risk preferences, decision making and information processing (Dutta and Thornhill, 2008), and entrepreneurial self-efficacy (Kickul et al., 2009). To address the identified gaps, we examine how cognitive style—defined as the characteristic way in which individuals process and evaluate information, solve problems, and make decisions (Goldstein and Blackman, 1978; Hayes and Allinson, 1994)—predicts growth intentions. In doing so, we specifically focus on research scientists having entrepreneurial intentions and study their growth intentions in terms of firm size. In the next section, we first offer a literature review on cognitive styles, followed by a presentation of our theoretical framework, linking different cognitive styles to growth intentions, hereby building on self-efficacy theory. Following that, we describe the study methodology. Next, we present our results, and provide conclusions, discussion and directions for further research.

2. Fundamentals of style: literature review on cognitive styles

Several individual factors such as race (Edelman et al., 2010), age (Cassar, 2006), and gender (Cliff, 1998) have been shown to predict entrepreneurial behavior. Unlike these factors, cognitive styles are preferences or habitual strategies determining how individuals perceive, remember, think, solve problems, and relate to others (Witkin et al., 1977). That is, cognitive styles serve as high-level heuristics in complex processes that are applied spontaneously across situations and form an enduring basis for behavior (Messick, 1976). Traits such as the Big Five personality traits tend to be stable, even over a period of 45 years as Soldz and Vaillant (1999) discovered. In contrast, cognitions are malleable and intervention strategies can be used to change how information is processed (Resick and Schnicke, 1992). The term ‘cognitive style’ was first used by Allport (1937) launching it in his work on the psychological interpretation of personality. Subsequently, the first major systematic study of cognitive styles and the development of a theory was made by Witkin (1962). Witkin's work was the start of what became a very active and productive field of study. Consequently, by the late 1960s, cognitive styles research had expanded to such an extent that individual differences psychologists had investigated stylistic differences across a wide range of cognitive functioning (e.g. Pask, 1972). Subsequently, over the past 40 years, researchers in business and management have further demonstrated a willingness and enthusiasm to embrace the concept of style and have explored its relevance for a range of issues in organizational settings, including innovation (Kirton, 1976), decision making (Hough and Ogilvie, 2005), person-environment fit (Chilton et al., 2005; Cools et al., 2009), and various aspects of entrepreneurship (Brigham et al.,

2007; Kickul et al., 2009). In an attempt to introduce a degree of parsimony into the field of styles, a number of authors have attempted to reduce the large number of constructs to one single dimension. Two frequently used unidimensional classifications in the context of business and management research are the adaption-innovation model of Kirton (1976, 2003) and the analysis-intuition dimension of Allinson and Hayes (1996). Kirton (2003) identified an adaptive and innovative style, with adapters being characterized by precision, reliability, efficiency, discipline and conformity, and a preference to seek solutions to problems in previously understood and tested ways, and innovators being characterized by undisciplined thinking and tangential approaches to tasks and problem solving which cut across accepted paradigms. According to the model of Allinson and Hayes (1996), analysis refers to judgment based on mental reasoning and a focus on detail, whereas intuition refers to immediate judgment based on feeling and the adoption of a global perspective. Despite the value of these parsimonious models, researchers recently became increasingly skeptical as to the appropriateness of a single over-arching bipolar dimension that can capture the complexity of individual differences in vital aspects of human cognition (e.g. Sadler-Smith, 2009).

To address this limitation, Cools et al. (2009) developed their Cognitive Style Indicator (CoSI; Cools and Van den Broeck, 2007), identifying a creating, planning and knowing style. The CoSI was developed as a reaction to the use of bipolar unidimensional cognitive style models, as these models exclude the possibility that people can simultaneously show strong or weak preferences for both poles of a dimension (Hodgkinson et al., 2009; Sadler-Smith, 2004). Hence, using such a multi-dimensional cognitive style instrument is in line with developments in the cognitive style field (Armstrong et al., 2012). The CoSI model has been validated in diverse Western and non-Western samples (e.g. students, managers, employees, entrepreneurs) with strong support for the construct and predictive validity of this instrument (Armstrong et al., 2012; Cools et al., 2011; Cools and Van den Broeck, 2007). Our study is the first to use the CoSI in a context of academic entrepreneurship.

In the Cools and Van den Broeck CoSI classification, people with a creating style like playing with new ideas and are constantly in search of hidden possibilities and new horizons. Uncertainty is an exciting challenge for people with a creating style. People with a planning style have a need for structure and like to organize and control in a highly structured environment relying on preparation and planning. Those with a knowing style prefer a rational and impersonal way of information processing and have strong analytical skills. They search for accuracy and like to make informed decisions on the basis of a thorough analysis of facts and figures and logical arguments.

3. Impact of style: the cognitive styles–growth intentions relation

In what follows, we build upon self-efficacy theory to understand the cognitive style-growth intentions relationship. Self-efficacy pertains to the belief that one can successfully execute the behavior required to produce a specific outcome (Bandura, 1977; Gist and Mitchell, 1992) and is not concerned with the skills one has, but with one's judgments of what one can do with whatever skills one possesses (Kickul et al., 2009). Efficacy expectations are a major determinant of people's choice of activities (Bandura, 1977; Gist and Mitchell, 1992) and have been shown to affect risk taking, by affecting perceptions of opportunities and threats (Krueger and Dickson, 1994). In such a self-efficacy framework, people tend to avoid activities they believe exceed their coping skills, while people get involved in activities of which they judge themselves capable of handling (Wood and Bandura, 1989). According to Kickul et al. (2009), cognitive styles may foster some self-perceptions and inhibit others, subsequently affecting intentions. Further, cognitive style can lead individuals to direct their attention to specific areas of knowledge and certain tasks, and reduce the extent to which they focus on other, similarly important, knowledge and tasks. In what follows, building on cognitive styles and self-efficacy theory, we develop a theoretical framework for how cognitive styles can affect an individual's growth intentions.

3.1. Creating cognitive style

People with a creating style like uncertainty and freedom, search for renewal, see problems as opportunities and challenges and have high risk preferences (Barbosa et al., 2007). It is in this sense not surprising for Kickul et al. (2009) to find that a creating cognitive style is particularly effective in the opportunity identification phase of the new venture creation process. Further, Armstrong and Hird (2009) concluded from their research that entrepreneurs who score higher on the creating style dimension have a higher entrepreneurial drive. Following these studies, a creating cognitive style seems to be helpful in the early stages of the venture creation process, leading to a higher likelihood of venture creation (Allinson et al., 2000; Buttner and Gryskiewicz, 1993). While a creating cognitive style is associated with entrepreneurial intentions (Cools, 2008), we argue that people scoring high on the creating cognitive style are also more likely to exhibit growth intentions.

People scoring high on the creating cognitive style dimension feel comfortable in situations of uncertainty and freedom, characterized by high risk and challenges. Following self-efficacy theory, they are likely to look for situations in which they feel comfortable and of which they feel they can handle them. Entrepreneurial growth is a process fraught with difficulties and challenges. For instance, the process of growth requires access to resources, including access to financing, skilled labor, technology and information (Petrakis, 1997; Saemundsson, 2005). According to Shelton (2010), firm growth is impeded by expansion barriers, which represent resource positions that firms of a given size possess which other firms must obtain at a cost. As such, smaller firms have to overcome resource deficiencies, or expansion barriers, if they are to grow. Indeed, small firm growth is neither linear nor described well by biological paradigms, which requires entrepreneurs to act as problem solvers (Orsen et al., 2000). Specifically, Groen and Walsh (2013) indicate that in order to successfully commercialize emerging and disruptive technologies, entrepreneurs need to engage in activities which are difficult to manage, such as alliance management and open innovation, and have to creatively develop new business models. Finally, Andries and Debackere (2007) indicate that firms in less mature and high-velocity industries will need to adapt their initial business plan in order to successfully develop. Given this high risk and uncertainty characterizing the growth process, and following self-efficacy theory, people scoring high on the creating cognitive style should be attracted to the challenging and high-risk proposition of starting a high growth venture. As such, we argue that entrepreneurial research scientists scoring high on the creating cognitive style are likely to be attracted by the challenge embedded in starting a growth-oriented venture, and will be more likely to foster high growth intentions. We offer the following hypothesis:

H1. Entrepreneurial research scientists scoring high on the creating cognitive style dimension will exhibit high growth intentions.

3.2. Planning cognitive style

People with a planning style like to plan and prepare to reach their objectives, and adhere to the motto: “first plan, then act”. Further,

planners tend to be demanding to themselves and to people surrounding them (Cools and Van den Broeck, 2007). The act of planning pertains to the development of a sequence of behaviors used to translate an individual's resources into actions aimed at achieving particular goals (Shank and Abelson, 1977). Planning allows identifying possible positive and negative scenarios (Hoc, 1988), and bestows a number of benefits, such as increased focus, lower susceptibility to distraction, higher persistence, and readiness to act (Gollwitzer, 1996). People scoring high on the planning cognitive style like to prepare and plan. Following self-efficacy theory, they will feel confident that they can deal with situations that require good planning skills. Planning is particularly important in complex and uncertain tasks (Campbell, 1988), and in highly uncertain environments (Liao and Gartner, 2006) such as those faced by nascent entrepreneurs (Dimov, 2010). For instance, Walter et al. (2011) indicate that academic entrepreneurs will have to engage in the arrangement of physical infrastructure, operational matters, agreements and communications structure in the early stages of a spin-off. Subsequently, people who score high on the planning cognitive style will be attracted by the demanding nature of the venture growth process and challenges this process ensues. These challenges include, among others the arduous task of attracting resources into the new venture as a lack of reputation and track record creates a heightened perception of risk by potential resource providers (Brush et al., 2001). Further, establishing a growth-oriented venture requires significant structuring effort (Covin and Slevin, 1988; Gundry and Welsch, 2001), which planners feel comfortable they can do. As such, people scoring high on the planning cognitive style may be attracted by the challenging nature and need for a structured approach typifying a growth-oriented venture as they feel confident that they can deal with such demanding situations requiring planning skills. Subsequently, entrepreneurial research scientists scoring high on a planning cognitive style are more likely to exhibit high growth intentions, as founding a growth-oriented venture matches their search for activities and environments which require planning skills. We offer the following hypothesis:

H2. Entrepreneurial research scientists scoring high on the planning cognitive style dimension will exhibit high growth intentions.

3.3. Knowing cognitive style

People with a knowing style look for data and tend to retain many facts and details. They like complex problems and try to find rational and logical solutions. People with a knowing style prefer to take their time to make decisions, sometimes postponing them to collect more information while a lack of data or relevant information can be a source of doubt for knowing people in the decision-making process. As such, they do not like tasks that are undefined, ambiguous, lack supporting facts and figures, and insufficiently challenging from an intellectual perspective. These people may find it difficult to come up with creative solutions and out-of-the box thinking. In their jobs, they prefer to engage in intellectually challenging tasks with a clearly defined goal. It is unlikely for people who score high on the knowing cognitive style dimension to exhibit entrepreneurial intentions (Cools and Van den Broeck, 2007). This is because the entrepreneurial process is a process fraught with difficulties, unforeseeable hazards and high levels of uncertainty (Nelson and Winter, 1982), and often characterized by decisions that cannot be fully supported by data or facts and figures. We argue that, in case they do have entrepreneurial intentions, the uncertainty related to growth may make them feel uncomfortable. Indeed, in a context of strategic decision making, Nutt (1990) found that managers with a preference for thinking (i.e., the knowing style) were most reluctant to take risks; moreover, growth adds complexity to an organization, and this complexity is sometimes difficult to manage (Covin and Slevin, 1997; Saemundsson, 2005). Indeed, failure of high growth firms is often due to the inability of managers to cope with the demands this complexity entails (Mishina et al., 2004). Given the complexity and uncertainty related to aiming for and achieving growth (Pavia, 1990), it is unlikely there can be a full understanding of the actions needed to achieve growth or the underlying logic of growth. As such, as people who score high on the knowing style may be uneasy with the uncertainty and the lack of facts and figures allowing them to predict the growth process, following self-efficacy theory, they may avoid situations that are characterized by high levels of uncertainty and will therefore not foster growth intentions. Subsequently, it is unlikely for entrepreneurial research scientists scoring high on the knowing cognitive style to foster high growth intentions as they are unlikely to be attracted to the uncertainty and risks the founding of a growth-oriented venture entail. We offer the following hypothesis:

H3. Entrepreneurial research scientists scoring high on the knowing cognitive style dimension will exhibit low growth intentions.

4. Researching with style: data collection and methodology

4.1. Data and data collection

Our research draws upon a sample of 251 doctoral and post-doctoral researchers at the Faculty of Mathematics and Natural Sciences at Oslo University, Norway. Data were collected in February 2010, using an online questionnaire. The data collection phase was preceded by a pilot phase in the period November 2009–January 2010, during which respondents were also requested to provide comments on the questionnaire itself, allowing refinement of the instrument. The survey population consisted of 690 doctoral and post-doctoral researchers in the Faculty of Mathematics and Natural Sciences at Oslo University. They received a request to fill out the online questionnaire through email, sent by the central administration, and signed by the research team and the vice-dean. The first mailing resulted in a response of 170 researchers, and was followed by a second email request for filling out the questionnaire one week later, resulting in 112 additional responses. From the total of 282 responses, 31 were eliminated due to missing data, resulting in 251 full questionnaires, or a response rate of 36%. *T* tests found no significant differences between early and late respondents in age, type of research scientist (postdoctoral vs. doctoral researcher), and time employed at the university.

To limit common methods bias, we pretested the survey on researchers (Tourangeau et al., 2000). Further, we used confirmatory factor analysis controlling for a single unmeasured latent method construct and as such followed the Unmeasured Latent Method Construct technique as outlined by Richardson et al. (2009). Specifically, we used confirmatory factor analysis to analyze four alternative measurement models. Model 1 was a null measurement model (i.e., no factors underlie the data). Model 2 posited that a single method factor explained the data. Model 3 was the measurement model used in this study in which the constructs of interest ('traits') were positioned to underlie the data. Model 4 posited that the data could be accounted for by the traits in Model 3 plus a single uncorrelated method factor. The results of the different models are presented in Table 1 below.

The first important comparison for assessing common method bias involves models 1 and 2. Model 2 provides a significantly better fit to the data than Model 1 ($\chi^2 = 1408$; $df = 25$; $p < .01$), but fits the data very poorly. The second comparison involves models 3 and 4 (measurement model). Model 3 provides a good fit for the data. Model 4 ($\chi^2 = 184$; $df = 25$; $p < .01$), however, fits the data better than model 3. However, while statistically significant, the gain in fit achieved by this model is relatively small. Subsequently, we partitioned the variation accounted for by model 4 into trait and method components. Specifically, for each item, the square of the trait factor

Table 1
Results of ULMC procedure.

Model	χ^2	*df*	GFI	RMSEA	NFI
1	4200*	300			
2	2792*	275	.49	.21	.52
3	562*	265	.83	.072	.83
4	378*	240	.88	.051	.90

GFI=goodness of fit index, NFI=normed-fit index, RMSEA=Root Mean Square Error of Approximation.

* $P < .001$.

loading and of the method factor loading indicate the amount of variance due to the trait and the method factors, respectively. The amount of variance due to the trait model was 60%, compared to 16% for the method factor. It is generally accepted that the common method variance present in the data is not sufficient to bias results if the proportion of variance attributed to method is smaller than 25% (Choi and Chen, 2007), which is the case for our data. Consequently, there is limited evidence to suggest the results will be affected by common method bias. Further, it is unlikely for reverse causality to occur as cognitive styles remain stable over time (Armstrong et al., 2012).

4.2. Models and measures

When analyzing our data, we first had to deal with a potential sample selection problem. Specifically, while we asked all respondents to fill out the questions on entrepreneurial intentions, our pre-tests revealed that respondents did not find it meaningful to reflect on growth intentions in case they scored low on entrepreneurial intentions. Therefore, we constructed the questionnaire in such a way that respondents scoring below 4 on the entrepreneurial intentions scale would not get the questions on growth intentions. This however gives rise to a sample selection problem as we are working with a non-random sub-sample from a larger population of interest to study the cognitive styles–growth intentions relationship. In order to address this selection problem, we use a Heckman two-stage selection model. Since individuals scoring low on entrepreneurial intentions were not requested to fill out the growth intentions questions, they got a score of zero for growth intentions (Cader and Leatherman, 2011). Variable *Y* (growth intentions) is therefore partitioned into observations that are greater than zero (Y_1) and equal to zero (Y_2). The observations are defined as y_{1i} and y_{2i}. A restrictive form of the general model therefore is

$$y_{2i} = \beta_2' x_{2i} + \varepsilon_{2i},$$

$$y_{1i} = \beta_1' x_{1i} + \varepsilon_{1i} if\ y_{2i} > 0$$

where the error terms ε_{2i} and ε_{1i} have a zero mean with constant variance. While the parameter of interest (β_1) can be estimated using the second function above, the estimates are potentially biased because of the omitted-variable problem. Therefore, after specifying conditional density $f(Y|X,\beta)$, the following equation can be derived using Heckman (1976)

$$Y_i = \beta' X_i + \mu\lambda_i + \eta_i$$

where λ_i is referred as the Mill's ratio and a monotone decreasing function of the probability that an observation is selected into the sample. The β is a consistent parameter estimate using OLS (Cader and Leatherman, 2011).

Practically, in this paper, the first stage of the Heckman model, or the selection equation entails assessing a probit model determining whether or not an individual scored at least 4 on the entrepreneurial intentions scale. The majority of respondents, 188 respondents (or 75%) scored below 4, whereas 63 (or 25%) scored 4 or above. Only the latter received the questions on growth intentions. In the second stage, also called the regression equation, the inverse Mill's ratio from the probit estimation enters as an explanatory variable in the least squares regression that estimates the growth intentions model. A statistically significant inverse Mill's ratio in the second stage implies that its inclusion is necessary to avoid sample selection bias. Effectively addressing this selection problem and controlling for sample selection bias in the second stage requires the selection of at least one variable that uniquely determines the discrete choice of entrepreneurial intention but not the continuous choice for growth intentions. In our case, these variables are "entrepreneurial self-efficacy" and "subjective norm".

The selection equation took the following form:

Entrepreneurial intention (0/1)= F (gender, age, subjective norm, entrepreneurial self-efficacy, working experience, creating cognitive style, planning cognitive style, knowing cognitive style)

The measures used for the selection equation are elaborated on below.

Entrepreneurial intentions. We used the scale developed by Linan and Chen (2009), measuring entrepreneurial intention using 6 items on a 7-Likert scale (ranging from 1 – "disagree to a large extent" to 7 – "agree to a large extent"). The items were: "I am ready to do anything to be an entrepreneur", "My professional goal is to become an entrepreneur", "I will make every effort to start and run my own firm", "I am determined to create a firm in the future", "I have very seriously thought about starting a firm", "I have the firm intention to start a firm some day". The scale was reliable with a Cronbach Alpha of .94.

As a number of individual factors predict entrepreneurial activities, we controlled for some of these factors in the analyses.

Gender. Following Zhao et al. (2005), we controlled for gender, using a dummy variable (1 for men, 0 for women). For our sample of researchers, 37% were female and 63% were men.

Age. We controlled for age, because of the impact age has on career decisions (Lee et al., 2011). The average age of the respondents was 32.3 years.

Subjective norm. Kolvereid (1996) found that social context influences the propensity to become an entrepreneur. We used Kolvereid's measure, asking respondents to indicate the extent to which they agreed with the following statements: "I believe that my closest family think that I should pursue a career as an entrepreneur", "I believe that my closest friends think that I should pursue a career as an entrepreneur", "I believe that people who are important to me think that I should pursue a career as an entrepreneur". Likert scales ranged from 1 (not) to 7 (should). Cronbach Alpha of the measure was .94. The average score for subjective norm was 2.32.

Entrepreneurial self-efficacy. As previous research has identified a positive relationship between entrepreneurial self-efficacy and entrepreneurial intentions (e.g. Zhao et al., 2005), we controlled for this type of self-efficacy using the measure developed by Zhao et al. (2005). We asked respondents how confident they were in successfully "identifying new business opportunities", "creating new products", "thinking creatively" and "commercializing an idea or new development". Likert scales ranging from 1 (no confidence) to 7 (complete confidence) were used. Cronbach Alpha of the measure was .84, the average score was 3.84.

Cognitive styles. The 18-item CoSI, developed by Cools et al. (2009) was used. Cronbach Alpha's were .72 for the knowing style, .79 for the planning style and .77 for the creating style. We refer to Appendix 1 for a description of the instrument. Even though the focus of this research is on understanding the relation between cognitive styles and growth intentions, we deemed it necessary to include cognitive styles in the selection model. Indeed, Stewart et al. (1998) suggest that a cognitive perspective may allow

differentiating entrepreneurs from non-entrepreneurs. The average score for the knowing style was 4.13, for the planning style 3.65 and for the creating style 3.98. We used exploratory (EFA) and confirmatory (CFA) factor analysis in order to assess the extent to which the three styles were sufficiently discriminating against each other. EFA resulted in 3 factors with all items significantly loading on their respective constructs, apart from P6 which was loading on a knowing style instead of a planning style. When eliminating this item, Cronbach Alpha for the planning style improved to .81 and a CFA on the remaining cognitive style items resulted in an improved model and in a solution meeting or exceeding the threshold on a wide range of goodness-of-fit measures (GFI=.90; NNFI=.91; CFI=.93; IFI=.93). No problems were found in residuals or standard errors. We subsequently reran the analyses eliminating this item and did not find any significant changes in our results.

Working experience. We controlled for working experience as it was previously found to affect the perception on the ability to implement entrepreneurial behaviors (Fini et al., 2012). On average, the respondents had worked for 3.19 years at the university.

The regression equation took the following form:

Growth intentions=F (creating cognitive style, planning cognitive style, knowing cognitive style, controls) with controls including age, gender and working experience.

We control for age as growth intentions vary with age (Cassar, 2006) and gender, given that venture size and growth differ between male and female entrepreneurs, with women generally being involved in lower growth and smaller scaled ventures (Cassar, 2006). The dependent variable was operationalized as follows:

Growth intentions. Following Cassar (2006, 2007), we asked the respondents to indicate on a 7-Likert scale (1-disagree to a large extent to 7-agree to a large extent) whether or not they agreed with the following statements: "I would like my company to have a size I can manage myself or with a few key employees", and "I would like my company to become as large as possible". Our measure is identical to the one used in the PSED (Panel Study of Entrepreneurial Dynamics) (Cassar, 2007). Cronbach Alpha of the scale was .73. The average score was 3.35.

5. Outcomes of styles: results

5.1. Main results

Table 2 provides the descriptive statistics of the variables used in both the selection and regression equations.

Table 3 offers the results of the selection and regression equations. Correlations between variables were all below .60, while the variance inflation factors were below 3.0 (maximum value of 1.6) indicating that multicollinearity was not an issue (Hair et al., 2010).

We first ran the analysis including the control variables only (Model 1), followed by the full model (Model 2). Model 1 did not significantly explain growth intentions. The model improved significantly when we included cognitive styles as potential determinants of growth intentions (Model 2).

We first comment on the results of the selection equation. The results on gender, subjective norm and entrepreneurial self-efficacy confirm previous findings, with men (β=.51; $p<.05$), subjective norm (β=.44, $p<.0001$), and entrepreneurial self-efficacy (β=.37, $p<.001$) relating positively to entrepreneurial intentions. The latter illustrates, in line with previous research (e.g. Zhao et al., 2005), that people who feel confident that they can be good entrepreneurs, exhibit higher levels of entrepreneurial intentions. We further find that a knowing style is negatively associated with entrepreneurial intentions ($\beta=-.44$, $p<.05$). This finding is consistent with research employing the same Cognitive Style Indicator (Cools, 2008).

Model 2 informs our primary research question on the cognitive styles–growth intentions relationship. Although we find positive results on the impact of a creating cognitive style, this result is not significant; therefore *hypothesis 1 is not supported*. The results *support hypothesis* 2, indicating that people with a planning style exhibit higher growth intentions (β=.91, $p<.001$). Finally, we find *support* for *hypothesis 3* that people with a knowing style will have lower growth intentions ($\beta=-.60$, $p<.05$). Contrarily to our expectations, the relationship between the creating cognitive style and growth intentions was not supported. This may be caused by the fact that other factors beyond self-efficacy may affect growth intentions. For example, while aiming for growth may seem attractive to high creating style people, the motivation to pursue high growth may be mitigated by their continuous search for new opportunities. Even after founding the business, people with this cognitive style may continue to look for new opportunities and prefer to keep their options open. These arguments are consistent with Buttner and Gryskiewicz's (1993) findings that innovative entrepreneurs are less likely to continue their business as time passes, and are more likely to sell or spin off their business. Therefore, even though people scoring high on the creating style may foster high risk and high growth intentions, they may also be attracted by new venture ideas and may feel comfortable that they can deal with these early stage venture situations and therefore be attracted to them.

5.2. Post hoc analyses

We further conducted analyses to assess the robustness of our results and to provide more fine grained insights into the association between cognitive styles and growth intentions. First, when further exploring our data, we identified an interesting interaction effect between knowing style and working experience (Model 3 in Table 3). Specifically, in model 3, we used centered observations for both knowing style and working experience, calculated by subtracting their respective mean values and used these centered variables to calculate the interaction term. This is standard practice in multiple regression to avoid potential multicollinearity problems (Kutner et al., 2005). Fig. 1 illustrates the interaction effect of the time people worked at the university on the association between knowing style and growth intentions. It indicates that when researchers have worked for a limited time at university (mean−1 S.D.), there is a negative association between the extent to which people score high on the knowing style and growth intentions. When researchers have worked for a long time at the university (mean+1 S.D.), there is a positive association between scoring high on the knowing style and growth intentions.

The analysis further revealed that for people who score the maximum on the knowing style (score of 5), the negative impact of this score on growth intentions only gets mitigated after nine years of working experience at the university.

We relate this finding to the fact that people move through different knowledge corridors as they gain experience. According to the knowledge corridor thesis, working experience influences the entrepreneur's ability to comprehend, extrapolate, interpret and apply new information in ways those lacking experience cannot replicate (Shane, 2000). Cliff et al. (2006) further contended that there exist different knowledge corridors; the corridor in the core of an organizational field, one in the periphery and another in other industries. The first corridor was found to lead to the creation of less innovative ventures whereas the other two were catalysts for innovative entrepreneurship. Experiences in the organization's core provide an enhanced appreciation of the risks, in the form of social disapproval and withdrawal of support, associated with the failure to meet social expectations (Cliff et al., 2006). The alternative knowledge corridors allow combining existing stocks of information in different ways.

Table 2
Descriptive statistics.

	1	2	3	4	5	6	7	8
1.Knowing style	1	.30*	.42*	−.11	.10	.17	.09	−.09
2.Planning style		1	.14*	.02	−.08	.14*	−.08	.34*
3.Creating style			1	.15*	.03	.40*	−.03	.13
4.Subjective norm				1	−.06	.45*	−.08	.12
5.Age					1	-.01	.50*	.17
6.Entrepreneurial self-efficacy						1	−.06	.31
7. Working experience							1	.03
8. Growth intentions								1
Mean	4.13	3.65	3.98	2.32	32.29	3.84	3.19	3.35
Standard deviation	.57	.67	.57	1.44	5.79	1.30	2.79	1.63

* Pearson correlations, correlations are significant at $p < .05$, $n = 251$ (except for correlations with growth intentions, where $n = 63$).

Table 3
Results of the Heckman two-step selection model for growth intentions.

Regression equation (step 2)						
Growth intentions (dependent)	**Model 1**		**Model 2**		**Model 3**	
	β	Standard error	β	Standard error	β	Standard error
Independents						
Vocational style			.58	.45	.51	.43
Planning style			.91***	.31	.89***	.29
Knowing style			−.60**	.31	−.35	.32
Controls						
Age	.05	.05	.03	.04	.06	.04
Gender	.67	.56	.73	.53	.89*	.51
Working experience	.01	.09	.04	.08	−.09	.09
Interaction term						
Knowing style × working experience					.47***	.18
Constant	1.59	1.56	−1.40	2.11	−2.53	2.07
Number of observations	251		251		251	
Number of censored observations	188		188		188	
Number of uncensored observations	63		63		63	
Inverse Mill's ratio	−.53	.40	−.42	.37	−.59*	.36
Wald Chisquare for full model fit	3.11		16.10**		24.25***	

Selection equation (step 1)-dependent variable: entrepreneurial intention		
Entrepreneurial intention (dummy)	β	Standard Error
Gender	.51**	.24
Subjective norm	.44****	.08
Age	−.01	.02
Entrepreneurial self-efficacy	.37***	.11
Creating style	.20	.23
Planning style	.05	.16
Knowing style	−.44**	.21
Working experience	.05	.04
Constant	−2.70**	1.16

* Significance levels: $p < .10$.
** $p < .05$.
*** $p < .001$.
**** $p < .0001$.

People with a knowing style are therefore likely to collect information in their core domain, decreasing the likelihood they will foster the ambition to start up innovative and growth-oriented ventures. However, as they gain working experience they are more likely to learn from experiences from peripheral organizations and move through the other knowledge corridors. This is also the case in our study, where research scientists are more likely to move through the other knowledge corridors as they gain working experience. Research scientists are increasingly pressured to engage in industry–science relations and to commercialize at least part of their research results through licensing and/or new ventures (Wright et al., 2007). Consequently, it is likely that people who have worked for a longer time at the university, will have engaged in one or different modes of industry—science relationships. For people who score high on a knowing cognitive style, these modes of interaction provide information and insights into how businesses develop and function. Their inclination towards a knowing style further helps them to look for data and relevant information which may not be readily available in the environment, but may become available as they build experience in interaction with the business community. As a result, working experience may decrease risk perceptions related to starting new ventures, because there is less perceived risk in familiar domains than

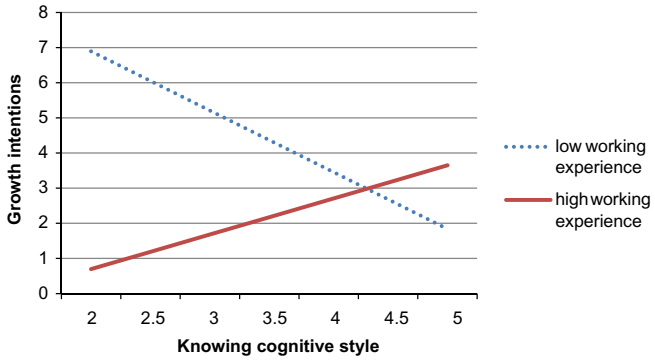

Fig. 1. Interaction effect of working experience on the relation between a knowing cognitive style and growth intentions.
Plots starting at score=2 for a knowing cognitive style (equals minimum value for this style).

in unfamiliar ones (Sitkin and Pablo, 1992). Therefore, working experience may positively affect the earlier identified relationship between a knowing cognitive style and growth intentions.

6. Ending in style: discussion and implications

Growth is important for future welfare and employment. Research in the United Kingdom for instance found that 4% of all start-ups represent 50% of job creation by start-ups (Storey, 1994). Further, Kuratko and Hodgetts (1998) emphasized the role of new and smaller firms to the U.S. economy and, in particular, of job-creating, fast-growing 'gazelle' businesses versus 'life style' businesses (Kirchhoff, 1994). A specific group of companies are companies founded by research scientists. Our study particularly focused on understanding growth intentions of future academic entrepreneurs. By studying the link between cognitive styles and growth intentions, our study is novel in a number of ways. First, while recent studies have shed light on entrepreneurial intentions in an academic context, few studies have addressed the antecedents of growth intentions in academia. Studying these growth intentions is important as growth of firms founded by research scientists will determine, amongst others, the social benefit of firm creation compared to the social cost related to loss of academic research productivity. At the same time, obtaining growth is not trivial, and will be difficult in case the intention to grow is absent at the time of start-up (Autio and Acs, 2010), which makes studying growth intentions early on in the entrepreneurial process important. Identifying which research scientists are likely to found growth-oriented ventures is further important given the variety of academic spin-offs and given the time constraints faced by supporting entities such as technology transfer offices. Second, our study is novel by introducing a cognitive style perspective into the study of growth intentions. As such, our study complements prior research which has looked into individual-level drivers of growth intentions, but has surprisingly neglected to incorporate a cognitive style perspective. Introducing such a perspective is meaningful as cognitive styles have been found to be important determinants of risk preferences and decision making. Our results indeed point to the strength of cognitive styles in explaining growth intentions, just as to the interplay of cognitive styles with other individual-level characteristics, such as working experience. As such, our study has a number of implications for theory and practice, on which we elaborate in what follows. Furthermore, we discuss some limitations which may lead to future research directions.

First, as to what *theoretical implications* are concerned, our study has implications for technology management, academic entrepreneurship and entrepreneurial intentions literatures. Specifically, our study adds to recent conversations in the technology management literature, including those of the entrepreneurial university (Van Geenhuizen and Soetanto, 2009; Van Burg et al., 2008; Kroll and Liefner, 2008; Philpott et al., 2011) and individual and team influences on academic entrepreneurship outcomes (e.g. Massa and Testa, 2008). Furthermore, our study contributes to the academic entrepreneurship literature. Specifically, it provides insights into growth intentions of a specific group of individuals, namely research scientists. While there is an ongoing debate in the academic entrepreneurship literature on growth and performance of the firms these research scientists found, our knowledge on one of the factors that is likely to drive post-founding growth, namely growth intentions, has so far remained limited. Finally, this study contributes to the entrepreneurial intentions literature. Specifically, it advances our theoretical understanding of the processes that underlie the emergence of differences between high-growth oriented and low-growth oriented individuals exhibiting entrepreneurial intentions. Even though only a small proportion of firms, namely those achieving high growth, have been found to substantially contribute to the economy, our understanding of the drivers of growth intentions has so far remained relatively limited. This is remarkable given the impact of growth-oriented entrepreneurs on economic welfare and job creation. We show that cognitive styles in combination with self-efficacy theory offer an important theoretical framework to study these differences.

Second, our study has *practical implications*. Specifically, for stakeholders in new ventures, who may be affected by entrepreneurs' growth intentions (Dutta and Thornhill, 2008), including employees, venture capitalists, customers and suppliers, it may be relevant to understand whether an individual is more likely to build a lifestyle business or to build a high growth business. Venture capitalists, for instance, have incentives to grandstand (Gompers, 1996); this is to take actions signaling their ability to potential investors. As such, they are interested in investing in growth companies which can be brought public in an IPO or generate income through trade sales. As a consequence, an assessment of cognitive styles may complement the assessment of the human capital of the entrepreneur during the due diligence process, which is one of the most important parameters VCs base their selection decision on (Tyebjee and Bruno, 1984). It may further inform parties involved in early venture team composition, including venture capitalists and technology transfer officers (in case of spin-off companies), who could try to match teams' cognitive styles to their (growth) objectives for the venture. It may also help technology transfer professionals at academic institutes to pay extra attention to those research scientists who are more likely to foster growth intentions. Finally, our findings may be relevant for parties involved in education such as public policy makers and education institutes training current and potential entrepreneurs. In this respect, this research shows that entrepreneurship education may not only focus on technical and managerial skills. It is equally, or even more important to give attention to fostering entrepreneurial drive in business education, for instance by showing people the consequences of their individual profile. They could learn from understanding the way in which they cognitively prefer to process and organize information, and how to deal with this in their business (Peterman and Kennedy, 2003; Souitaris et al., 2007).

Finally, we discuss some *limitations and directions for further research*. Despite the contribution of this paper to the fields of academic entrepreneurship and entrepreneurial intentions, this paper has a number of limitations which may lead to future research avenues. First, cognitive strategies may affect both intentions and behavior. As such, future research can examine the extent to which the interaction between cognitive styles and strategies affect the transition from entrepreneurial intentions to entrepreneurial behavior. Along the same lines, future research could study whether researchers with higher growth intentions were eventually better at building growth-

oriented ventures. Indeed, the achievement of growth in academic entrepreneurship requires an optimal mix of elements, such as a strong technological base, a good entrepreneurial team and often a significant amount of risk financing (Knockaert et al., 2011). Second, we find interaction effects at the individual level, with working experience moderating the relationship between cognitive styles and growth intentions. Even though we tested for interaction effects between environmental and individual level factors, our choice to collect a dataset in one faculty of one university may have prevented us from finding interaction effects. Further research studying growth intentions in academia could investigate the extent to which faculty- and university-related factors such as the presence of a technology transfer office, publishing versus commercialization focus of faculties and universities, and incentive systems affect growth intentions of individuals. Subsequently, future studies should take a multi-level approach (cf. Lee et al., 2011) to better understand who, and in what circumstances, undertakes entrepreneurial activities. Such studies can include individual factors such as demographics (Cassar, 2006; Cliff, 1998), cognitive factors, together with contextual factors such as technology gaps (Fagerberg, 1987) and environmental conditions (Alvarez et al., 1994).

7. Conclusions

This paper extends our knowledge on drivers of growth intentions, by highlighting the importance of cognitive styles for growth intentions, which we studied in an academic context. Specifically, we found that people with a predominantly knowing style exhibit lower growth intentions. High knowing style people like to make decisions based upon facts, information and details, and following self-efficacy theory, may find it difficult to cope with the uncertainty related to growth-oriented entrepreneurial ventures. This negative effect of the knowing style can however be mitigated by higher levels of working experience at the university. Notably, a higher score on the planning cognitive style dimension resulted in a higher level of growth intentions. This indicates that people who tend to prepare and plan to reach their objectives may feel more comfortable in situations requiring planning skills, which is typical for growth-oriented ventures.

Acknowledgments

The authors would like to thank Godfrey Sendege for assistance in data collection. The authors would further like to thank Marilyn Uy, Erik Monsen, Hendrik Slabbinck, Martin Obschonka, Bart Clarysse and Veroniek Collewaert for comments on an earlier version of this paper. This paper has further benefited from comments and suggestions at Babson Entrepreneurship Conference 2011 and Academy of Management Annual Meeting 2011.

Appendix 1. Description of the CoSI (Each item receiving a score between 1 (disagree entirely) and 5 (agree entirely)) (Cognitive Style Indicator) – Cools and Van den Broeck (2007)

Knowing style

K1. I want to have a full understanding of all problems.

K2. I like to analyze problems.

K3. I make detailed analyses.

K4. I study each problem until I understand the underlying logic.

Planning style

P1. Developing a clear plan is very important to me.

P2. I always want to know what should be done when.

P3. I like detailed action plans.

P4. I prefer clear structures to do my job.

P5. I prefer well-prepared meetings with a clear agenda and strict time management.

P6. I make definite engagements, and I follow up meticulously.

P7. A good task is a well-prepared task.

Creating style

C1. I like to contribute to innovative solutions.

C2. I prefer to look for creative solutions.

C3. I am motivated by ongoing innovation.

C4. I like much variety in my life.

C5. New ideas attract me more than existing solutions.

C6. I like to extend boundaries.

C7. I try to avoid routine.

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