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## **Gates or Geek? - Innovation, personality traits and entrepreneurial failure in highly innovative industries**

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### **Abstract**

Studies on moderators of the personality performance relationship in entrepreneurship research are scarce. Thus in this paper we use a dataset consisting of 417 entrepreneurs from the German federal state of Thuringia in order to examine the moderating effect of entrepreneurial innovation on the relationship between the Big Five personality traits extraversion and openness on entrepreneurial failure in highly innovative industries. Correspondingly, we identify failure with the help of bankruptcy information and self reports. Our innovation measure is solely based on self reports. In order to account for self selection into innovative entrepreneurship, stratification on the propensity score is utilized to

overcome self selection bias. We find that innovation moderates the personality failure relationship. The effect of extraversion on failure is decreased in innovative compared to non-innovative firms, while the effect of openness is increased.

## 1. Introduction

Empirical investigations on entrepreneurial failure are rare (Cardon et al., 2011), especially if failure takes place in highly innovative industries. Failure causes financial costs and grief to the entrepreneur (Shepherd et al., 2009) or affects social welfare (McGrath, 1999). Among other factors, the personality traits of the entrepreneur may explain entrepreneurial failure (Shepherd and Wiklund, 2006). Nevertheless, although personality traits have a direct effect on entrepreneurial performance measures (Ciavarella et al., 2004; Baron and Markman, 2005; Rauch and Frese, 2007a, Zhao et al. 2010), factors which moderate the trait performance relationship rarely have been investigated in entrepreneurship research (Rauch and Frese, 2007b, Hisrich et al., 2007, Zhao et al., 2010).

One important moderator may be innovation. Innovative entrepreneurship is supposed to be a main driver of economic growth (Acs et al., 2009) and structural change (Schumpeter, 1911). The extent of uncertainty is an important aspect that borders innovative and non-innovative entrepreneurship. Innovative entrepreneurship usually displays a higher degree of uncertainty than non-innovative entrepreneurship (McGrath, 1999). Uncertainty in innovative entrepreneurship mainly stems from the entrepreneurial firms' liability of newness (Stinchcombe, 1965; Carayannopoulos, 2009). Consequently, personality traits of entrepreneurs may have a different effect on firm performance in case that firms are innovative instead of imitative (Zhao et al, 2010).

We use the Big Five personality traits consisting of conscientiousness, extraversion, openness, agreeableness and neuroticism (Digman, 1990; Barrick and Mount, 1991; Costa and McCrae, 1995) to probe the moderating effect of innovativeness on the relationship between personality and entrepreneurial failure in highly innovative industries. Our study contributes to the literature on the personality performance relationship in entrepreneurship (Rauch and Frese, 2007a; Zhao et al. 2010), in which failure is an under-investigated phenomenon. In particular, a striking shortcoming in investigating entrepreneurial failure is the ignoring of reasons beyond failure that led to the stopping of entrepreneurial activities (Wennberg et al., 2010; Amaral et al., 2007; Headd, 2003). For instance, it is not only insolvency that drives quitting a business but also a successful sale of the venture in question.

Another contribution of our study is considering self selection bias into innovative entrepreneurship when measuring the effect of innovation on entrepreneurial failure. Evidence on the effect of innovation on entrepreneurial firm performance that takes self selection bias into account is scarce. We utilize subclassification on the propensity score to control for entrepreneurial characteristics that determine self selection into innovative entrepreneurship.

Therefore, the design of the present study allows to interpret our results as causal, given the made assumptions hold true.

In conclusion, there is a lack of evidence regarding the moderating effect of innovation on the relationship between personality traits and entrepreneurial failure in highly innovative industries. We therefore attempt to shed some light on the question: “Which Big Five personality traits may have a different effect on entrepreneurial failure in innovative compared to non-innovative firms?” and follow the call of Sarasvathy (2004a) to link specific performance measures to the characteristics of specific subgroups of entrepreneurs. To answer this question, we identify failed withdrawals with the help of external bankruptcy information and self reports, as entrepreneurial failure is not equal to entrepreneurial exit (Wiklund and Shepherd, 2011). In addition, in order to recognize the peculiarities of highly innovative markets, we use a dataset consisting of 423 entrepreneurs. Innovativeness in our case refers to self-reports on the question whether the business idea is based on an innovative product or process. We only investigate entrepreneurs that operate with their firms in industries in which companies on average spend more than 3.5% of their turnover on R&D (see Grupp and Legler, 2000).

We suggest that some of the Big Five personality traits may affect the entrepreneurial firms' liability of newness. Innovative firms in general face a higher liability of newness. The firms' liability of newness is decisive in explaining entrepreneurial success and failure. Consequently, we suppose that a firms' liability of newness may account for divergent effects of personality traits on failure with innovative compared to non-innovative firms.

In the following section we outline the term of entrepreneurial failure that we will employ. This is necessary in order to assess a clear-cut outcome variable within our analytical framework. The third section theoretically treats the relationship between innovation, the Big Five traits extraversion and openness and entrepreneurial failure. In the fourth section, we present our dataset consisting of more than 400 start-up entrepreneurs from the German federal state of Thuringia. Subsequently, our estimation strategy, which is based on subclassification on the propensity score and survival analysis, will be disclosed. The fifth section considers the results of our analysis and the sixth section discusses our findings. Our conclusions are then presented at the end.

## **2. Definition of entrepreneurial failure**

Focusing on entrepreneurial failure, we first have to discuss what we mean by that term. Many studies employ entrepreneurial exit as a proxy for failure. However, even businesses

considered as financially successful sometimes cease (Headd, 2003) or see their owners leave. For example, innovative entrepreneurs may decide to withdraw if they have a preference for more leisure time (Shane and Venkataraman, 2000), have problems with their health, or decide they have earned enough money. Additionally, Bates (2005) argues that entrepreneurial exit is probably also driven by higher opportunity costs for other activities or projects. Thus, entrepreneurial exit in general is apparently not a proper indicator for entrepreneurial failure.

Zacharakis et al (1999; see also Shepherd, 2003) consider only bankruptcy of an owner-manager's firm to be entrepreneurial failure. In this spirit, Kato and Honjo (2010) in their study on firm survival distinguish between bankruptcy, voluntary liquidation and merger. However, even among these exit categories a mixing up of failures may occur, with successful withdrawals within the respective non-bankruptcy categories. More precisely, mergers might be driven by poor business expectations or a meagre performance of one of the merged firms (Wiklund and Shepherd, 2011), and a voluntary firm liquidation must not necessarily be a successful one (Wennberg et al., 2010).

For all of these reasons, we will instead stick with the definition by Gaskill and Van Auken (1993, p. 21). They see business failure as "...wanting or needing to sell or liquidate to avoid losses or to pay off creditors or general inability to make a profitable go of the business". As innovative entrepreneurs are the architects of their businesses (Saravathy 2004b), it is assumed by us that their personality affects failure (see Shepherd and Wiklund, 2006). In order to meet this definition and to consider only exits driven by a low economic performance of the owned firm, we exclude exits that are not forced by failure and recode them as "not failed".

### **3. Personality, innovation and entrepreneurial failure**

The link between personality traits and entrepreneurial performance is empirically well-founded (Rauch and Frese, 2007a; Zhao et al., 2010). In addition, contextual factors may moderate the effect of entrepreneur's personality on firm success though these relationships are sparsely investigated (Rauch and Frese, 2007b). Personality performance relationships in occupational environments are generally contingent on trait-congruent situational requirements in tasks, relationships or organizational settings. (Tett et al., 1999). Innovative entrepreneurship, which may be defined as the implementation of novel business ideas, is characterized by lacking information on customer behaviour, uncertainty regarding production processes or not assessable competition (Koellinger, 2008). Compared to imitative

entrepreneurs, innovative entrepreneurs face different organizational settings (Samuelsson and Davidsson, 2009), task (Shepherd et al., 2000, Alvarez and Barney, 2005) or relationship requirements (de Jong et al., 2010). Innovative entrepreneurship thus may differently affect the impact of personality on entrepreneurial failure than non-innovative entrepreneurship.

We will draw upon the Big Five traits in order to measure personality. The Big Five comprises five broad personality factors, namely extraversion, agreeableness, conscientiousness, neuroticism and openness (Digman, 1990; Barrick and Mount, 1991; Costa and McCrae, 1995). The Big Five personality factors are widely accepted in order to grasp the personality traits of a subject (Digman, 1990; Barrick and Mount, 1991; Barrick et al., 2003), which prevents the investigation of unreasoned or invalid personality traits of entrepreneurs (Chandler and Lyon, 2001). Moreover, the Big Five dimensions are independent of cognitive dispositions (McCrae and Costa, 1987), robust across different cultures (McCrae and Costa, 1997; John and Srivastava, 1999) and relatively stable over time<sup>1</sup> (Costa and McCrae, 1992a; Roberts and DelVecchio, 2000; Hampson and Goldberg, 2006). Secondly, it is broadly suggested that the Big Five personality traits predict essential differences in observed actions and reactions (McCrae and Costa, 1999). Although the Big Five cannot predict a person's actions in a particular situation, they are quite reliable in marking behavioural trends across different situations and over time (McAdams and Pals, 2006).

Meta-analytical evidence by Zhao et al. (2010) points out that the Big Five traits openness, conscientiousness and extraversion positively relate to entrepreneurial performance. Contrarily, neuroticism is detrimental to entrepreneurial performance and agreeableness has no effect. Studies that investigate the relationship between the Big Five and venture survival are given by Ciavarella et al. (2004) and Baron and Markman (2005). The results of the first refer to apparently non-innovative industries, whereas the last investigate entrepreneurs in innovative industries from a single technological domain. In both studies it is neither distinguished between different types of entrepreneurial exits nor between innovative and non-innovative entrepreneurs. Conscientiousness contributed to venture survival in both studies. The trait openness decreased survival prospects in Ciavarella et al. (2004) but not in Baron and Markman (2005). The other traits are not correlated to survival or, in case of agreeableness and neuroticism, not investigated by Baron and Markman (2005).

In the following, hypotheses on the relationship of innovation and personality traits on entrepreneurial failure in highly innovative environments are derived.

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<sup>1</sup> 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.

### **3.1. Innovation and entrepreneurial failure in highly innovative environments**

In the following, innovation refers to the introduction of a new product, service or process into a market by an entrepreneurial firm (see Utterback and Abernathy, 1975). Disregarding entrepreneurial personality traits, recent meta analytical evidence suggests that small firm performance and innovativeness share a positive relationship, though this result is moderated by the regarding context (Rosenbusch et al., 2010). In general, innovations serve as a monopoly for entrepreneurs and thus establish substantial revenue potential (Schumpeter, 1911). Particularly, entrepreneurs with young and small firms possess advantages in commercializing innovations because their activities are hardly visible by established competitors (Carayannopoulos, 2009). As a consequence, they are able to build up advantages by forestalling competitors in acquiring rare assets as well as attracting a customer base (Lieberman and Montgomery, 1988). Entrepreneurial firms likewise may gain competitive advantage over their competitors through competencies and resources that are hardly duplicable (Teece et al., 1997). Innovations may help to create unique organizational competencies and resources (Teece, 1996) which assure a strong firm performance (Peteraf, 1993). The positive relationship between innovation and product performance is shown to be even more pronounced in innovative environments (Droge et al., 2008). An explanation for that reasoning is the fact that highly innovative markets are less established. As a consequence marketing experience does not pay off and innovative entrepreneurs are better off than imitative (Noteboom, 1994).

On the other hand, entrepreneurs with innovative firms face a higher liability of newness regarding their firms (Stinchcombe, 1965; Carayannopoulos, 2009). This obstacle manifests in a lack of market awareness, uncertainty about the production process and in managing the new venture. Entrepreneurs who struggle to diminish the liability of newness through risk reduction strategies by raising well-founded information, proliferation and generating deliverable products are more likely to fail. Diminishing a firms' liability of newness involves strategies like generating market awareness or substantial investments in marketing activities, raw materials, skilled staff, information, external consulting and organization building. As a consequence, acquiring the necessary resources is an imperative to avoid failure in highly innovative environments (Shepherd et al., 2000). In conclusion, innovating small firms face the risk to fail due to tight resources and a relatively higher liability of newness (Noteboom, 1994).

From the above discussion we nevertheless infer that the likelihood of entrepreneurial failure is decreased if entrepreneurs start up with innovative firms, especially in highly innovative industries.

**Hypothesis 1:** Innovative entrepreneurs are less likely to fail in highly innovative industries.

In the next section we discuss the moderating effect of innovation activities on the relationship of personality and entrepreneurial failure.

### **3.2. The Big Five personality traits, innovation and failure in highly innovative environments**

**Extraversion.** 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). People high in extraversion are gregarious, assertive and outgoing (Zhao et al., 2010). Extraverted entrepreneurs thus may have advantages in establishing and maintaining social networks with customers, financiers or other institutions (Ciavarella et al., 2004, Zhao and Seibert, 2006, Shane et al., 2010). Institutional linkages reduce the liability of newness of organizations (Baum and Oliver, 1991). As lowering the liability of newness reduces the risk to fail for innovative entrepreneurs, we suggest that extraversion reduces the likelihood of entrepreneurial failure especially among innovative entrepreneurs. The social abilities of extraverts may also promote the sourcing of financial and other resources, which is particularly important in exploiting innovations and avoiding failure (Choi and Shepherd, 2004). And thus we propose the following hypothesis:

**Hypothesis 2:** Innovative entrepreneurship moderates the effect of extraversion on entrepreneurial failure: the relationship is more negative for innovative entrepreneurs as opposed to non-innovative entrepreneurs.

**Openness.** A person’s openness covers “...the breadth, depth, originality, and complexity of an individual’s mental and experiential life” (John and Srivastava 1999). This trait is suggested to relate positively with opportunity recognition (Ciavarella et al., 2004; Zhao et al., 2010), which is in general a prerequisite of successful entrepreneurship (Baum et al., 2001).

On the other hand, entrepreneurs high in openness have difficulties in concentrating on a single area and to be focussed due to their preference for variety (Ciavarella et al., 2005, Baron and Markman, 2005). Focussing on the generation of profits and cash flows is however particularly important for innovative small businesses as theory and empirical evidence suggests that they struggle more in generating external funding than non-innovative small businesses and thus frequently have a finance gap (Hall and Lerner, 2010). Furthermore, the preference of open entrepreneurs for new experiences, novel ideas and progressive action (Zhao and Seibert, 2006, Zhao et al., 2010) may enhance their firms' liability of newness beyond the innovative business idea. Likewise, concentrating solely on the novel aspects of opportunities may distract entrepreneurs from the operability and economic capacity of innovations (Baron and Ensley, 2006). Open entrepreneurs hence may overestimate the economic potential of an innovative business idea. In conclusion, we hypothesize:

**Hypothesis 3:** Innovative entrepreneurship moderates the effect of openness on entrepreneurial failure: the relationship is more positive for innovative entrepreneurs as opposed to non-innovative entrepreneurs.

#### **4. Data and empirical methods**

##### **4.1. Sample and data selection**

The data for this study stems from the Thuringian Founder Survey, which is an interdisciplinary project on the success and failure of solo or team entrepreneurs in the East German state of Thuringia. The focus in this study was on innovative industries; “advanced technology” and “technology-oriented services” companies according to the Centre for European Research (ZEW) classification (Grupp and Legler 2000). All entrepreneurs in our dataset work in industries in which on average more than 3.5% of the turnover of the firm is spent on R&D. The study draws from a population of 4,215 founders who registered a new entry in the commercial registry in Thuringia between 1994 and 2006. This was the basis of a random sample of 2,606 start ups. From this random sample, 639 face-to-face interviews were realized (response rate 25%) between January and August 2008. The data contains more than 200 socio-economic and psychological variables of the founders and their (team) ventures, like age, education, vocational experience, gender, industry classification of the firm, their Big Five personality scale etc. If there was a team founding, the main founder was interviewed.

Altogether, we dropped 222 observations because of missing values<sup>2</sup>. The remaining sample size then comprised 417 observations, of which 95 (co-)founders had ceased their entrepreneurial activity by 2008. In our study, we consider entrepreneurial exit following DeTienne (2010) as “...the process by which the founders of privately held firms leave the firm they helped to create; thereby removing themselves...from the primary ownership and decision-making structure of the firm”.

#### **4.2. Dependent variable: Hazard rate of entrepreneurial failure**

Considering our dataset, the most appropriate empirical method to link entrepreneurial failure with our independent variables is duration analysis. The time of entrepreneurial activity is the most precise indicator to measure entrepreneurial failure in our sample. We quantify the duration of entrepreneurial activity from the time when the observed entrepreneur started his business until he withdrew from managing his own firm. The duration is measured in years. Furthermore, it is assumed that entrepreneurial exit is a failure if the owned firm that is left can be classified as economically not successful. We estimating the hazard rate to test our hypotheses, which is the instantaneous probability of failing, given that an entrepreneur has maintained his activities until the current period.

Following our definition of failure above, we classify entrepreneurial exits as failures due to Watson and Everett (1996). Accordingly, failure is at hand either if (1) the left firm was filed for bankruptcy, (2) the leaving entrepreneur wanted to prevent further losses or (3) the leaving entrepreneur did not “make a go” of the firm. With the help of Creditreform, which is the leading rating agency for firms in Germany we figured out 46 bankruptcies at the time of exit among the 95 exits in our sample. The remaining 49 firms kept their dates of payment at the time of entrepreneurial exit. Nevertheless, as even underperforming firms remain in operation through personal financial investments of their owners (van Witteloostuijn, 1998; Shepherd et al., 2009), losses to creditors are not sufficient to display failure. Thus, exited entrepreneurs in our sample additionally were asked why they left their firms. Multiple answers were possible. Exit due to prevent further losses was measured with “I lost too much money” (1=Yes or 0=No, 23 cases) and exit because there was an inability to “make a go” of the business was measured with “The firm did not develop like I expected it” (1=Yes or 0=No, 41 cases). An overview of the interrelations of our indices is given in Table 1. Altogether, 72 out of 95 exits are classified as failures as they were either due to bankruptcy,

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<sup>2</sup> 37 observations were deleted due to a poor interview quality, 19 because of missing data and 70 firms turned out to be no original start-ups (for instance, they were a new subsidiary of an existing firm). Moreover, 96 start-ups that were launched earlier than 1994 are not recognized. The intention behind this measure was to minimize the effects of German reunification.

prevent further losses or an inability to “make a go” of the venture. In other words, in case that one of the three mentioned failure indicators was fulfilled, we classified the exit as a failure (see Watson and Everett 1996). The remaining 23 entrepreneurs that resign from apparently economic healthy ventures are coded as censored.

	1.	2.	3.	
1. Bankruptcy/losses of creditors		46		
2. "I lost too much money"		12	23	
3. "The firm did not develop like I expected it"		19	13	41

**Table 1:** Indicators of entrepreneurial failure and their interrelations

### 4.3. Explanatory variables: The Big Five personality traits and innovativeness

The Big Five personality traits are quantified with 45 items (Ostendorf, 1990). Each of the Big Five personality factors is measured by nine German bipolar adjective pairs on a six-point Likert scale (0–5). For all of the Big Five personality traits, a score closer to five represented a higher value in the concerning trait. According to the definitions above, we include variables of conscientiousness, extraversion, agreeableness and openness. 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 (see Table 8 Appendix A). Thus, the validity of our item is given.

We measure innovativeness with the help of the item “Compared to your competitors, your business idea is based on a product or service that is new, qualitatively better, has a higher value or could be faster or cheaper produced” (INNO, 1=YES, 0=NO).

### 4.4. Control variables

Beside personality characteristics of the founder manager there are also other factors that may directly influence entrepreneurial failure. With regard to entrepreneurial exit, it is important whether the founder is involved in a founder team (Ucbasaran et al., 2003). Consequently we control with a dummy whether the founder was involved in a founder team (TEAM). Additionally, the age of the entrepreneur during start up is controlled. Human capital is not only theoretically knotted to a higher economic growth, but also empirically to a prolonged longevity of firms (Bates, 1990), which is in our case the length of study and experience in self-employment (YEARS\_SELFEMP), which is both measured in years. Audretsch and Mahmood (1995) show the importance of firm size on survival. Consequently, we measure firm size with a dummy indicating the turnaround of the firm in the first business

year (SIZE\_TURN, 1=turnaround higher than 100.000 Euros, 0=turnaround lower or equal to 100.000 Euros).

#### **4.5. Estimation strategy**

We apply the Cox approach (Cox, 1972) to estimate respective (semi-)parametric hazard rate models. Nonetheless, innovative entrepreneurship is hardly a randomized event, which that is independent of the qualities of the entrepreneur and his firm (Cohen and Levinthal, 1990; Zahra and George, 2002; Baron and Tang, 2011). Hence, the risk of sample selection bias (confounding) is given, if as non-innovative entrepreneurs have other characteristics than innovative entrepreneurs (see Deheija and Whaba; 2002).

Methods based on the propensity score, which is the conditional probability to assign a treatment given a vector of observables, are useful to overcome sample selection bias (Rosenbaum and Rubin, 1983). In our case, stratification on subclasses of the entrepreneurs' propensity score to innovate is supposed to correct for sample selection bias in Cox regressions (Rosenbaum and Rubin, 1984; Stukel et al., 2007). Compared to frequently used propensity score matching approaches in which some of the observations are discarded, stratification on subclasses of the propensity score is more appealing concerning our data, due to the moderate number of failures at hand.

Stratification on subclasses balances the observations in our sample in a way that the distribution of the observed properties is equal for innovative and non-innovative entrepreneurs (Rosenbaum and Rubin, 1984; Steiner and Cook, in press). Cochran (1968) shows that stratifying on 5 subclasses approximately removes 90% of sample selection bias regarding a covariate. Given that all confounding factors are represented with the propensity score, at least 5 strata correct for almost all confounding with respect to all covariates (Imbens, 2004). In order to fulfill our analysis, we proceed according to the following steps (see Stukel et al., 2007; Schafer and Kang, 2008; Steiner and Cook, in press).

First, we measure the propensity score to innovate by means of a logistic regression model. In line with Schafer and Kang (2008), we fit the propensity score model with variables that may affect both, innovativeness and entrepreneurial failure. Therefore, in addition to the above introduced controls that are supposed to affect failure, we control for factors that are suggested to have an effect on innovativeness as well. Studies on determinants of innovation particularly suggest that patents (Basberg, 1987), R&D (Rosenbusch et al., 2010) and human capital (Subramaniam and Youndt, 2005) affect innovation. Thus, we control for the sum of all patents granted in the four years before start up (NUM\_PAT), R&D activities before the

first business year (R&D, 1=YES, 0=NO) and the number of years of studying (STUY). In addition, it is controlled for age (AGE), former industry experience (IND\_EXP; 1=YES, 0=NO), whether the founded firm is an academic spin off (SPIN\_OFF, 1=YES, 0=NO) and start up before the year 2002 (2002, 1=YES, 0=NO).

Secondly, observations are allocated to one subclass of equal range analog to their propensity scores. With the purpose in mind to fulfill one precondition for balancing within subclasses, it is tested whether the average propensity score of innovative and non innovative entrepreneurs differs. The starting point is one subclass. If the propensity score within a subclass is significantly different, the concerning subclass is split up in half and it is tested once more for balance in the propensity score. This procedure is continued until the propensity score within strata is statistically equal. Then it is tested whether the mean of every characteristic within a subclass is equal for innovative and non-innovative entrepreneurs. A two sided t-test with a significance threshold of 0.01 is utilized for balance testing, respectively (see Becker and Ichino, 2002; Imbens, 2004).

In a third step, we estimate a stratified Cox regression (see Wei et al., 1989) according to the generated subclasses and test our hypotheses.

All standard errors of the respective model will be computed with robust covariance matrix estimators (see Lin & Wei, 1989). Estimations are undertaken with Stata. We use Becker and Ichinos' (2002) Stata application pscore to estimate propensity scores and allocating observations into subclasses. In addition, the Stata package pbalchk by Mark Lunt (2009) is utilized to fulfill balance checking.

	Mean	Mean*	Mean#	SD	SD*	SD#	Max	Max*	Max#	Min	Min*	Min#
1. Conscientiousness	3.64	3.63	3.7	.592	.594	.579	4.89	4.89	4.78	0	0	2.33
2. Extraversion	3.2	3.2	3.16	.619	.623	.601	4.78	4.78	4.44	1.44	1.44	1.67
3. Agreeableness	3.09	3.1	3.02	.574	.554	.664	5	5	4.44	.889	.889	1.22
4. Openness	3.18	3.17	3.24	.541	.542	.533	4.89	4.89	4.38	1.56	1.56	2.22
5. AGE	39.7	39.4	41.3	9	9.52	9.3	67	63	67	18	18	25
6. STUY	4.6	4.56	4.78	6	2.64	3.26	14	13	14	0	0	0
7. YEARS_SELFEMP	2.47	2.13	4.07	4	4.06	5.24	34	34	26	0	0	0
8. R&D	.447	.419	.583	.498	.494	.496	1	1	1	0	0	0
9. IND_EXP	.822	.837	.75	.383	.37	.436	1	1	1	0	0	0
10. SIZE_TURN	.392	.413	.292	.489	.493	.458	1	1	1	0	0	0
11. TEAM	.68	.66	.778	.467	.474	.419	1	1	1	0	0	0
12. NUM_PAT	.32	.355	.153	9	2.73	.573	46	46	4	0	0	0
13. NACE2	.236	.221	.306	.425	.415	.464	1	1	1	0	0	0
14. NACE3	.248	.244	.264	.432	.43	.444	1	1	1	0	0	0
15. SPIN_OFF	.113	.116	.097	.317	.321	.298	1	1	1	0	0	0
16. 2002	.757	.727	.903	.429	.446	.298	1	1	1	0	0	0
17. INNO	.808	.817	.764	.395	.387	.428	1	1	1	0	0	0

\*indicates that observations not failed

#indicates that observations failed

**Table 2: Summary statistics**

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
1. Conscientiousness	1.00																	
2. Extraversion	0.18***	1.00																
3. Agreeableness	0.11**	0.06	1.00															
4. Openness	0.12**	0.28***	0.03	1.00														
5. AGE	0.14***	0.05	0.14***	-0.05	1.00													
6. STUY	-0.03	-0.10**	0.06	0.03	0.25***	1.00												
7. YEARS_SELFEMP	0.02	0.05	0.05	0.05	0.16***	-0.15**	1.00											
8. R&D	-0.04	-0.05	0.01	0.14***	0.03	0.13**	0.09*	1.00										
9. IND_EXP	-0.01	-0.05	-0.05	0.02	0.04	-0.00	-0.05	-0.02	1.00									
10. SIZE_TURN	0.02	-0.00	-0.09*	-0.10**	-0.02	-0.10**	-0.00	-0.04	0.14***	1.00								
11. TEAM	-0.03	-0.02	0.04	-0.01	-0.03	0.11**	0.04	0.04	-0.02	0.09*	1.00							
12. NUM_PAT	-0.04	0.01	0.05	0.10**	0.05	0.13**	-0.03	0.10**	-0.00	0.03	0.07	1.00						
13. NACE2	0.09*	0.05	0.07	-0.13**	0.16***	-0.06	0.03	0.04	0.02	0.15***	-0.04	-0.02	1.00					
14. NACE3	0.04	-0.07	-0.08	0.01	0.15***	0.00	0.03	0.09*	-0.11**	0.04	0.07	-0.00	-0.32***	1.00				
15. SPIN_OFF	-0.11	-0.06	0.09*	0.06	-0.05	0.23***	-0.06	0.24***	-0.09*	-0.13**	0.20***	0.23***	-0.11**	0.13**	1.00			
16. 2002	-0.06	-0.04	-0.05	-0.12**	-0.03	0.09*	-0.12**	-0.11**	0.02	-0.02	-0.04	-0.10*	0.02	0.05	-0.01	1.00		
17. INNO	0.05	0.10**	-0.02	0.05	0.06	0.05	0.09*	0.27***	-0.12**	0.00	0.01	0.06	0.14***	0.05	0.10**	-0.15***	1.00	
18. FAIL	0.05	-0.03	-0.05	0.05	0.07	0.03	0.17***	0.13**	-0.09*	-0.09*	0.10*	-0.03	0.08	0.02	-0.02	0.16***	-0.05	1.00

\*p<.1    \*\*p<.05    \*\*\*p<.01

**Table 3: Correlation coefficients**

## 5. Results

Table 2 shows summary statistics of our variables and Table 3 indicates the respective correlations. The variable FAIL in our correlation table specifies all observations that failed in our sample. The estimation of the propensity score is depicted in Table 4. Table 5 shows the quantiles and the number of innovative and non-innovative entrepreneurs within each quantile. The total number of quantiles after utilizing the above introduced allocation algorithm is 5 and accordingly the number of subclasses is 5 (detailed test statistics on the balance of the propensity scores and characteristics within subclasses are obtainable upon request). Balancing statistics of entrepreneurial characteristics based on standardized differences (Austin, 2009) before and after subclassification on the propensity score are shown in Table 7, Appendix A. After subclassification, all of the standardized differences are below 0.1 and thus balance between innovative and non-innovative entrepreneurs after stratification is corroborated (see Normand et al., 2001).

We employed four models which are listed in Table 6. The Models 1–3 are unstratified specifications, whereas the Models 4–5 are stratified according to the balanced subclasses; in all classified “fails” are counted as events. In the Models 1 and 3 the main effect of innovation on failure is tested and the Models 3 and 5 are specified to test the moderating effect of innovative entrepreneurship on the relationship between extraversion and openness on failure.

Balancing on characteristics affecting innovative entrepreneurship leads to a significantly negative effect of innovativeness on entrepreneurial failure in Model 4 ( $p \leq 0.05$ ), which corroborates Hypothesis 1. According to the coefficient INNO, innovation decreases the likelihood to fail by a factor of  $\exp(-0.718)=0.488$  in our sample.

Regarding the moderating effect of innovative entrepreneurship, the Cox regression stratified on the balanced propensity score subclasses (Model 5) reveals that the hazard rate is significantly more negative for extraverted entrepreneurs who innovate ( $p \leq 0.05$ ). This result is in line with Hypothesis 2. Compared to non-innovative entrepreneurs, the hazard rate is decreased by a factor of  $\exp(-0.884)=0.413$  with a one unit level increase in extraversion. In contrast, compared to non-innovative entrepreneurs, a one level unit increase in openness significantly increases the hazard rate of innovative entrepreneurs ( $p \leq 0.05$ ) by a factor of  $\exp(1.099)=3$ . Hypothesis 3 is hence supported.

In order to check the robustness of our findings, we estimated standard errors on the base of 5000 bootstrap replications. The bootstrapped standard errors are slightly higher than the robust covariance estimations, which indicates that our p-values are relatively stable and not biased through outliers and sampling distribution assumptions.

Logistic Regression	Dep. Var.: INNO
Conscientiousness	0.125 (0.250)
Extraversion	0.429* (0.237)
Agreeableness	-0.346 (0.259)
Openness	-0.0854 (0.277)
AGE	-0.00191 (0.0165)
STUY	0.0684 (0.0558)
YEARS_SELFEMP	0.0618 (0.0426)
R&D	1.413*** (0.337)
IND_EXP	-0.943** (0.451)
SIZE_TURN	0.0110 (0.293)
TEAM	-0.125 (0.299)
NUM_PAT	0.629 (0.766)
NACE2	1.253*** (0.419)
NACE3	0.514 (0.361)
SPIN_OFF	0.615 (0.614)
2002	-1.130*** (0.401)
Constant	1.537 (1.634)
N	416
AIC	370.3
BIC	438.8

**Table 4:** Estimation of the propensity score.

Inferior of block of pscore	INNO		
	0	1	Total
0	10	14	24
.5	23	22	45
.625	16	45	61
.75	22	80	102
.875	9	175	184
Total	80	336	416

**Table 5:** Subclasses of the propensity score

Model	1.	2.	3.	4.	5.
Cox regression	unstratified	unstratified	unstratified	stratified	stratified
Conscientiousness	0.386* (0.231)	0.416* (0.232)	0.370* (0.222)	0.369 (0.228)	0.341 (0.222)
Extraversion	-0.318 (0.199)	-0.304 (0.204)	0.472 (0.353)	-0.391* (0.202)	0.283 (0.361)
Agreeableness	-0.436** (0.215)	-0.470** (0.221)	-0.451** (0.220)	-0.396* (0.206)	-0.393* (0.207)
Openness	0.432* (0.239)	0.442* (0.242)	-0.604 (0.537)	0.455** (0.226)	-0.395 (0.483)
INNO		-0.448 (0.304)	-1.541 (2.023)	-0.718** (0.338)	-1.356 (1.949)
Extraversion*INNO			-0.986** (0.409)		-0.884** (0.407)
Openness*INNO			1.325** (0.599)		1.099** (0.547)
YEARS_SELFEMP	0.0993*** (0.0195)	0.102*** (0.0199)	0.103*** (0.0198)	0.0934*** (0.0194)	0.0945*** (0.0195)
SIZE_TURN	-0.582** (0.274)	-0.571** (0.275)	-0.524* (0.278)	-0.492* (0.276)	-0.452 (0.279)
TEAM	0.723** (0.294)	0.726** (0.294)	0.658** (0.297)	0.767*** (0.294)	0.702** (0.298)
NACE2	0.615** (0.302)	0.688** (0.302)	0.731** (0.292)	0.376 (0.337)	0.491 (0.329)
NACE3	0.146 (0.292)	0.175 (0.294)	0.207 (0.293)	-0.0928 (0.322)	-0.0330 (0.324)
IND_EXP	-0.368 (0.278)	-0.440 (0.281)	-0.465* (0.281)	-0.260 (0.284)	-0.322 (0.285)
2002	0.790* (0.405)	0.743* (0.407)	0.791* (0.418)	0.888** (0.420)	0.885** (0.427)
N	416	416	416	416	416
AIC	810.3	810.1	807.5	628.6	627.4
BIC	854.6	858.5	864.0	677.0	683.8

**Table 6:** Models 1-5.

## 6. Discussion

In this paper we probe the moderating effect of innovative entrepreneurship on the relationship between personality and entrepreneurial failure in highly innovative environments. We find that the effect of extraversion on failure is more negative for innovative than non-innovative entrepreneurs. Inversely, the effect of openness on failure is

more positive in case entrepreneurs are innovative rather than non-innovative. An further rarely established finding is the negative (causal) relationship between entrepreneurial innovativeness and failure. Thus, all of the three tested hypotheses are supported.

The negative relationship between innovativeness and failure was predicted by our hypothesis. Accordingly, advantages of innovative entrepreneurship, like creating monopolies, first mover advantages and low visibility on average seem to outweigh liabilities of newness, especially in innovative environments. The present work hence contributes to evidence that innovativeness increases entrepreneurial firm performance (Rosenbusch et al. 2010). As studies on innovation and performance that acknowledge sample selection bias are scarce, our findings particularly add insights regarding the causal effect of innovation on small firm performance in innovative environments. Zhao et al. (2010) find that entrepreneurial performance is most strongly linked to openness. Though, particularly the studies on entrepreneurial survival show a negative effect of openness on this performance dimension (Ciavarella et al., 2004) or no effect (Baron and Markman, 2005). The result that innovative activities moderate the effect of openness on failure maybe explains this contradiction. Interestingly, openness is suggested to enhance entrepreneurial performance in innovative environments (Zhao et al., 2010; de Jong et al, 2011) and linked to creative performance in occupational settings (George and Zhou, 2001). Nevertheless, given that entrepreneurs innovate, the creativity of open entrepreneurs might be “too much of a good” and lead to liabilities of newness which are not sustainable at the end. Although, we find no significant relationship between innovation and openness in our sample, more open entrepreneurs might innovate comparably more radical. However, we do not control for the radicalness of innovative activities in this study.

The relationship between entrepreneurial failure and extraversion is more negative in innovative than non-innovative firms. Therefore, even if extraversion is only weakly related to entrepreneurial performance in general (Zhao et al., 2010) and entrepreneurial survival in particular (Ciavarella et al., 2004, Baron and Markman, 2005), these findings might be due to neglecting the moderating effect of innovativeness. The lowering effect of extraversion on failure in innovative firms underlines the importance of networking and establishment of financial sources in order to decrease the firms' liability of newness.

There are limitations to our study. First of all, our measure of personality was compiled ex post. Thus instead of only affecting the result of entrepreneurial failure, the Big Five traits marginally might be influenced by this experience (Vaidya et al., 2002). Likewise, meta-analytical evidence shows that especially in young adulthood (20-40 years) moderate mean

level changes in personality occur (Roberts et. al., 2006). Nonetheless, at the time of launching their firm the mean age of the failed entrepreneurs in our sample was over 40 (39 for the not failed), which exceeds young adulthood and therefore personality mean level changes are possibly a negligible problem.

Secondly, our economic success measure for the firms which are related to the entrepreneurs is in part based on self-reports. More precise data on economic firm success would improve the accuracy of our results. A replication of this study with more precise financial firm data may help to solve this problem. The third difficulty concerns our indicator of innovativeness, which is based on self-reports either. Likewise, more precise approach to gauge innovativeness, like measuring the radicalness of innovative activities might be illuminating.

Additionally, one important mediator between personality and failure mentioned in the theoretical part are interpersonal problems. Bono et al. (2002) emphasize that dyadic personality constellations are notably important in order to explain the frequency of conflicts. Furthermore, the personality of the lead founder impacts task and relationship conflicts, which in turn partly determine venture performance (Jong et al. 2011). We may not account for conflicts or dyadic personality constellations in our study due to a lack of data. A replication of this study with more precise data on the firm performance and a panel data structure might be therefore useful.

Despite these limitations our findings offer several contributions. The research design allows to give our results a causal interpretation, given the observed confounders, as almost all sample selection bias concerning innovative entrepreneurship is removed (see Rosenbaum and Rubin, 1983). Thus, setting up a new venture based on an innovative business idea is a more promising strategic choice than imitative business venturing. We also provide robust evidence that the effect of personality on entrepreneurial failure in highly innovative industries is moderated by innovativeness. At present, relatively little evidence exists on this relationship, as with moderators affecting the personality performance relationship in general (Zhao et al. 2010). In line with meta analytical evidence (Rauch and Frese, 2007a; Zhao et al., 2010), this outcome implies that the personality of entrepreneurs is linked to the performance of their (innovative) firms. However, compared to other evidence on personality and entrepreneurial survival (Ciavarella et al., 2004; Baron and Markman, 2005), our study considers apparently “successful” exits.

Practical implications of our results refer mainly to strategic considerations and consulting opportunities. From a strategical point of view, founding a business based on an

innovative business idea is more promising than non-innovative start-up in innovative industries. This suggestion also may inform decisions of financiers, suppliers, customers, investors or employees of new ventures in innovative environments. When it comes to start-up consulting, advisors furthermore ought to make founders aware of the fact that innovative firms are less likely to fail in innovative industries. And, accordingly, motivate their clients to elaborate their business ideas towards a higher degree of innovativeness.

Viewing on implications of the moderating effect of innovation on the personality failure relationship, cognitive learning and business services may be helpful to decrease the hazard of entrepreneurial failure. Less extraverted entrepreneurs in innovative sectors may gain social skills through training in order to outbalance their disadvantages in establishing social networks with stakeholders and decrease the innovative firms' liability of newness, as social skills are trainable (Baron and Tang, 2009). Akin to this proposition, innovative start up entrepreneurs may draw back on external consultants, business angels, venture capitalists or other partners like established firms to decrease their firms liability of newness (Shepherd et al., 2000).

On the other hand, open entrepreneurs may draw back on experienced business consultants, who are able to figure out whether a business idea is realistic or not. Another implication for quite open entrepreneurs is that they ought to back up their risky business ideas with enough financial resources. Yet these suggestions should be taken cautiously, as the economy as a whole may need visionary entrepreneurship, although it may lead to failure from time to time.

Implications for future research concern the investigation of specific subdimensions of openness and extraversion that have a differing effect on entrepreneurial failure in innovative compared to non-innovative firms. As Rauch and Frese (2007b) point it out, narrow traits might explain more variance. Also investigating other moderators that affect the personality performance relationship in entrepreneurship research are helpful, like environmental dynamism or competition.

In conclusion, we add insights to the literature of entrepreneurial failure and point out that personality has at least a moderate impact on this entrepreneurial outcome.

## APPENDIX A (Robustness Checks)

	Before Stratification			After Stratification		
	Mean (INNO=1)	Mean (INNO=0)	Standardized Difference	Mean (INNO=1)	Mean (INNO=0)	Standardized Difference
Conscientiousness	3.65	3.57	-0.137	3.65	3.64	-0.030
Extraversion	3.23	3.07	-0.253	3.23	3.19	-0.055
Agreeableness	3.08	3.11	0.049	3.08	3.09	0.007
Openness	3.19	3.13	-0.113	3.19	3.16	-0.051
AGE	40.04	38.48	-0.163	40.04	40.06	0.002
STUY	4.67	4.29	-0.139	4.67	4.57	-0.035
YEARS_SELFEMP	2.65	1.71	-0.202	2.65	2.50	-0.032
R&D	0.51	0.17	-0.673	0.51	0.48	-0.064
IND_EXP	0.80	0.91	0.280	0.80	0.81	0.028
SIZE_TURN	0.39	0.01	-0.137	0.39	0.33	-0.022
TEAM	0.39	0.39	-0.011	0.39	0.39	-0.001
NUM_PAT	0.68	0.68	-0.014	0.68	0.67	-0.023
NACE2	0.26	0.11	-0.345	0.26	0.25	-0.034
NACE3	0.26	0.20	-0.134	0.26	0.25	-0.009
SPIN_OFF	0.13	0.05	-0.233	0.13	0.11	-0.049
2002	0.73	0.89	0.361	0.73	0.74	0.041

**Table 7:** Standardized differences before and after stratification on the propensity score

Big-Five trait	Item	Factor1	Factor2	Factor3	Factor4	Factor5
Conscientiousness	sparsam - verschwenderisch	<b>0.351</b>			-0.4353	
	ordentlich - unachtsam	<b>0.7344</b>				
	übergenu - ungenau	<b>0.7309</b>				0.2312
	gründlich - unsorgfältig	<b>0.8002</b>				
	geschäftstüchtig - verspielt	0.2974	<b>0.3351</b>		-0.3822	
	strebsam - ziellos	<b>0.4486</b>				-0.3725
	geordnet - ungeordnet	<b>0.6488</b>				
	fleißig - faul	<b>0.6538</b>				
	gewissenhaft - nachlässig	<b>0.8445</b>				
Extraversion	gesprächig - schweigsam		<b>0.6826</b>			
	anschlußbedürftig - einzelgängerisch		<b>0.4665</b>	0.3118		0.3817
	direkt - taktierend		<b>0.2479</b>			
	offen - zugeknöpft		<b>0.7381</b>			
	impulsiv - selbstbeherrscht		0.3344	-0.4545		<b>0.5764</b>
	aktiv - passiv		<b>0.3765</b>			-0.3366
	kontaktfreudig - zurückhaltend		<b>0.8165</b>			
	freimütig - gehemmt		<b>0.6752</b>			
	gesellig - zurückgezogen		<b>0.7461</b>			
Agreeableness	nachsichtig - barsch			<b>0.6515</b>		
	friedfertig - streitsüchtig			<b>0.719</b>		
	leichtgläubig - zynisch			<b>0.5577</b>	-0.2175	0.3718
	gutmütig - reizbar			<b>0.6732</b>		-0.227
	weichherzig - rücksichtslos			<b>0.5589</b>		0.2324
	höflich - grob	0.2755		<b>0.4483</b>	0.3531	
	selbstlos - selbstsüchtig			<b>0.3374</b>		
	vertrauensvoll - misstrauisch		0.2385	<b>0.4898</b>		
	zustimmend - gegensätzlich	0.2238		<b>0.4177</b>		
Openness	künstlerisch - unkünstlerisch				<b>0.3624</b>	0.2068
	komplex - einfach			-0.2458	<b>0.4849</b>	
	phantasievoll - phantasielos		0.2117		<b>0.3029</b>	-0.2667
	originell - konventionell		0.347		<b>0.3897</b>	
	kreativ - unkreativ	0.2083			<b>0.3987</b>	
	modern - traditionell				<b>0.4289</b>	
	intelligent - unintelligent				<b>0.3731</b>	-0.3911
	gebildet - ungebildet				<b>0.3632</b>	-0.2279
	liberal - konservativ	-0.2769			<b>0.55</b>	
Neuroticism	überempfindlich - entspannt	0.2318		-0.3592		<b>0.4672</b>
	labil - gefühlstabil					<b>0.648</b>
	selbstachtunglos - überzeugt		-0.2246			<b>0.4042</b>
	verletzlich - robust					<b>0.597</b>
	furchtsam - mutig		-0.4047			<b>0.2833</b>
	ängstlich - ruhig		0.223			<b>0.6679</b>
	hilflos - selbstvertrauend					<b>0.4878</b>
	selbstmitleidig - selbstzufrieden					<b>0.3465</b>
	unsicher - sicher	-0.2839	-0.3354			<b>0.3813</b>

Only | loads | >.2 are indicated; values in bold show the highest load per item

**Table 4:** Principal component factor analysis with promax rotation with the employed items

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