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Examining Entrepreneurial Potential¹

Pavlin Bonev & Henrik Egbert & Thomas Neumann

Abstract: Employing public resources for promoting entrepreneurships demands careful selection of candidates who are most promising to set up a successful entrepreneurial career. This study addresses the relation between an individuals' entrepreneurial potential, identified through personality traits, and aspects of human and social capital, based on prior individual experiences in the domain of self-employment. A psychometric test, called F-DUP^N, measures the strengths of personality traits considered relevant for successful entrepreneurial activity. To test our hypotheses we collected data of 166 individuals. All of them are university students or graduates and have indicated a specific interest in entrepreneurial activity. A major result is that participants experienced in self-employment, with self-employed parents and with self-employed friends show a higher entrepreneurial potential than participants who do not have these experiences or relations. Furthermore, we find in line with other studies that differences in entrepreneurial potential become less pronounced with increasing age. An interpretation is that personality traits significant for entrepreneurial activity are not stable over time and can also be acquired at a later stage in life.

JEL: M13, D08

Keywords: psychometric test, human capital, social capital, observational learning, F-DUP, self-employment experience, personality traits

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1. Introduction

For decades the importance of entrepreneurs as a driving force of economic growth and development has been emphasized (Knight 1921; Schumpeter 1934; Kilby 1971; Kirzner 1973). A society that allows its entrepreneurs to flourish (Baumol 1990) benefits from their activities, by realizing more consumption opportunities, jobs and tax revenues. Thus entrepreneurial activities are to be considered the cause for providing positive externalities to a society.

Whether the state or other public organizations should play a role in promoting entrepreneurship has been addressed differently by societies. In continental Europe the role of the state for promoting economic growth, and consequently social development (Gerschenkron 1962), has a long tradition. Such support results in initializing a societies' "take-off" (Rostow 1960) or "spurt", as Gerschenkron (1962) has put it. State support for specific industries – in the sense of a supply side oriented policy – needs justification since resources are scarce. For instance, if public investment is made in favor of promoting entrepreneurship, the same investment cannot be made for other societal needs, such as public education or health. Given such opportunity cost, and also for normative reasons related to distributional fairness and justice, it is necessary for a society to implement mechanisms that allow for effective public investments to promote entrepreneurship.

We focus on this problem and argue that if public support aims to foster specific groups, in our case individuals who have an interest in starting an entrepreneurial career, their *individual entrepreneurial potential* to become a successful entrepreneur should be measured. The argument for validating an individual's entrepreneurial potential is that it is 'better' – in an economic sense – to support those individuals who have a comparatively higher potential and not to support those with a comparatively lower potential. This does neither mean that those identified with a high potential will indeed become more successful, nor that individuals with a lower potential will not be successful. But if, on average, individual entrepreneurial potential positively correlates with the probability of later success, then public subsidies should be allocated to those who show a higher potential rather than to those who lack such a potential.

Choosing this approach, which embeds psychological and business administration research on entrepreneurship in a larger economic context, means that projects which are publicly financed have the task to identify within a group of individuals those who do not only have an interest in entrepreneurship but also those who have the highest potential to become successful.

In psychology the identification of individual traits and characteristics for successful entrepreneurs has a long tradition (McClelland 1961; Rauch and Frese 2000; Baum and Locke 2004). We rely on these insights and use a method developed by psychologists in order to measure entrepreneurial potential.

The data used for the analyses in this paper does not stem from a research project but from an EU-financed project that has been designed to identify high potential individuals as potential members of a founding-team, with the ultimate goal to realize a business idea in form of founding a business. In order to identify individuals who are not only interested in entrepreneurial activity in contrast to those with the highest entrepreneurial potential we use a psychometric test, called F-DUP^N (Müller 2010a).

Our sample consists of data from technology-oriented, university-related individuals who are (or have been) enrolled in a university degree program. More particularly, our sample includes individuals who are enrolled in bachelor's, master's or Ph.D. degree programs and individuals who have at least earned one of these degrees. Participants may or may not have professional experience. Firstly, we contacted research associates and Ph.D. students from across German universities. Secondly, we contacted potential participants through various university networks. The sampling process was carefully structured in that individuals should be technology-oriented or business-oriented, it was yet random in the sense that the decision which person would be contacted was made randomly. We received data from a comparatively small number of persons who have been contacted. This was in line with the project's idea to identify during the sampling process itself those who were interested in participating actively in a business team and business foundation.

In order to identify those individuals with a particularly high entrepreneurial potential we employed the F-DUP^N test (Müller 2010a). The test measures traits that are directly related to the individual. Additionally we placed in context the relation between personality traits and selected aspects of human and social capital. By doing so, we combine facets discussed in different lines of research on entrepreneurship.

Firstly, specific personality traits which are more often to be found with entrepreneurs rather than with non-entrepreneurs have been identified (e.g., Müller and Stilz 2009). These traits can be measured to a certain degree by a number of methods, e.g. the Big-Five-Model (Costa and McCrae 1992) or other psychometric tests (King 1985). Insights gained from this research strand allow identifying individuals who show above average potential for (successful) entrepreneurial activities as regards personality traits. Information gathered from the above tests can be used to provide guidance on the strengths and weaknesses of those who intend to start an entrepreneurial career (King 1985; Müller 1999a, 1999b).

Secondly, the impact of human and social capital on entrepreneurial behavior and business success has been extensively discussed in the respective literature (e.g., Bosma et al. 2004). Results show that the combination of rather heterogeneous aspects, personality-based as well as originating in an individual's social and institutional embeddedness, contribute to her ability (e.g., Hartog et al. 2010), propensity (e.g., Langowitz and Minniti 2007) and willingness to become an entrepreneur, to setup a business and to run this business for a certain period of time (cf. for a survey Ireland and Webb 2007).

While the importance of specific personality traits for successful entrepreneurial activities seems to be widely accepted, there is no consensus in the literature on the question of the stability of personality traits. Roberts (2009, p. 137) describes the field of personality development as “polarized” with “two camps fit neatly into two extreme positions [...]. One group emphasized stability, the other change.” Given these two positions, we favor the approach of personality traits development.

As a case in point, human capital can be acquired through effort. This is particularly the case if formal human capital is measured by years of schooling, respectively university degrees. Degrees can be considered as proxies for different levels of formal human capital acquisition (cf. Becker 1993). Other forms of human capital based on individual experience are less explicit, hence more difficult to identify and to classify. Social capital may also have a positive effect on entrepreneurship, however in contrast to human capital, an individual’s social capital in the form to network access does not only depend on individual effort but might be ascribed to a person by birth (Aldrich and Waldinger 1990).

We divided our sample into sub-groups according to factors which might influence the entrepreneurial potential. While subjects in one sub-group showed a specific factor, the subjects in the second sub-group did not. Thus we used the second sub-group as the comparison group. Given the nature of the project an external control group, i.e. data on individuals who do not have the necessary qualifications for participation in the project is absent in our sample.

The aim of this paper is to investigate the relation between personality traits and aspects of social and human capital. More precisely, we test whether test scores on personality traits show systematic differences between sub-groups of potential entrepreneurs. The variables we test are self-employment experience (specific human capital), self-employed friends (social capital) and self-employed parents. The latter aspect can be interpreted within social capital theory or within the theory of observational learning. However, the context is, as outlined initially, economic by nature.

We find that individuals with experience in self-employment, with self-employed parents and with self-employed friends have higher test scores than individuals in comparison groups. The data also indicates that the older the respondents, the less salient the differences in test scores are. This hints that personality traits relevant for entrepreneurial activity are less stable over time and can also be acquired at a later life stage.

The structure of the paper is as follows. In Section 2 we address findings in the different strands of the literature and place them in context in order to formulate our hypotheses. Section 3 describes the screening process and the data set used for testing the hypotheses. Section 4 provides results and interpretations. The last section concludes.

2. A Brief Review of Selected Findings

A considerable number of factors addressing manifold facets of the relation between an individual and her entrepreneurial potential, her business activities and success have been identified in the last decades. Broadly speaking, theories from Psychology, Business and Economics, as well as from Sociology have distinguished factors that affect one or more aspects of entrepreneurial activity. Recently Walter and Walter (2009) provided a valuable survey on the findings of 99 studies published in peer reviewed journals. We use the survey of Walter and Walter (2009) as a starting point in order to pinpoint those factors that have a positive impact on founding a business and consequently derive our hypotheses.

The psychological literature on entrepreneurship makes the assumption that individual characteristics pertinent to entrepreneurial behavior can be identified through tests. The focus is placed on research, which singles out the strength of specific personality traits, i.e. an individual's predisposition towards entrepreneurship (Allport 1937; McClelland 1987; Mueller and Plug 2006; but McCrae et al. 1999; Roberts et al. 2006). Repeated research has confirmed the robustness of dispositive factors, i.e. personality traits (Walter and Walter 2009).

The psychological literature on measuring personality traits in the context of entrepreneurship has developed different approaches (for a discussion see Müller and Gappisch 2005, pp. 738-739; Caliendo et al. 2014). Empirical measurement of dispositive factors plays an important role. In empirical research two test types are regularly applied. One is based on the Big-Five-Model (Costa and McCrae 1992; Zhao and Seibert 2006; also Caliendo et al. 2014) and the second is based on the *Entrepreneurial Potential Questionnaire* developed by King (1985) who employed a construct of questions addressing behavior and attitude. The latter type of research has been further developed and adapted to the German context by Müller (1999a, 1999b, 2000, 2010a, 2010b). In our study we use results from the psychometric test developed by Müller (2010a) in order to differentiate between individuals who have above average scores with respect to personality traits and those who do not.

The concepts of human capital (Schultz 1961; 1963; Becker 1962; 1964) are applied to describe a person's entrepreneurial ability, her entrepreneurial options and also the success of her enterprise. We follow Becker (1993, p. 17) who considers education and training as "[...] the most important investments in human capital. [...] The earnings of more educated people are almost always well above average [...]". Education is typically assessed by years of schooling or the formal degree obtained. Training can be measured by an individual's experience and duration of activities.

For instance, in a seminal study Bates (1990) shows that companies of owners with a high educational background survive comparatively longer. General as well as specific human capital plays an important role when a business requires the use of high technology or large financial resources. Preisendörfer and Voss (1990, pp. 116-117) find that individuals with

relatively higher human capital more often found a company in the manufacturing sector and that richer human capital also positively correlates with organizational survival and profitability (cf. also Cooper et al. 1994; Gimeno et al. 1997; Colombo and Grilli 2005).

The positive impact of formal human capital on business founding and business success is validated in a considerable number of studies (Walter and Walter 2009). The same positive influence is documented for another form of human capital, namely an individual's previous experience in business-related activities. Davidsson and Honig (2003) found a positive impact of previous start-up experience. Walter and Walter (2009) confirm in their survey the results reached in a number of other papers. In our study all individuals have a comparatively high level of formal human capital, they are however heterogeneous with respect to previous self-employed experience. Therefore, we focus on previous experience as a form of specific human capital.

Other psychologists follow a social cognitive perspective. This perspective leads to another strand of research. Rotter (1954) and Bandura (1971) emphasize the importance of learning for psychological functioning. An individual's observational learning can be a factor that affects her personality traits. The idea of observational learning can also be related to the sociological concept of roles (Linton 1936; Parsons 1951; additional Mead 1934). It can be argued that if children are able to observe and learn from parents who play the role of entrepreneurs, children tend to adapt specific personality traits relevant for their own entrepreneurial activities in later years (cf. Chlostra et al. 2014). The importance of the opportunity to learn from parents or relatives who are entrepreneurs is prominent in this line of behaviorist approach to entrepreneurship. In line with the majority of the literature addressing this field (Walter and Walter 2009), we expect that the possibility to learn from parents influences positively relevant personality traits. Therefore, we distinguish those individuals whose parents have been self-employed from those individuals whose parents have not been self-employed.

Furthermore, entrepreneurial family background can also be tackled from sociological perspective, i.e. the perspective of being a member of a group. The significance of being a group member (or non-member) is emphasized in the theoretical context of social capital², articulated for entrepreneurship by Granovetter (1985) as 'social embeddedness' and by Aldrich and Zimmer (1986) as the 'network approach to entrepreneurship'. A person's access to social capital, understood as the network links to others network members, is influenced by two variables. On the one hand, she has access to social capital because she is a member of a group by birth or ascribed status. Examples are ethnic groups, families (aristocracy), or distinctive religious groups. On the other hand, she may build up private networks including friends, fellow students, acquaintances, etc. (cf. also Glaeser et al. 2002). Such social con-

² We use the term 'social capital' as a heuristics for social networks in a broad sense (e.g., Putnam 2000). Since most of our participants have been socialized within the same educational system and by similar institutions of a specific country, we do not account for the impact of habitus in this study.

tacts, concentrated in networks, can be activated to provide resources, such as information and capital for a business setup as well as in other cases (Granovetter 1973).

The impact of social capital or networks on entrepreneurship and business success is less clear than that of human capital. In this line of research both positive and negative effects of social networks have been identified. Ethnicity and membership in distinctive religious groups can have positive as well as negative influence on business activities (Egbert 1998). The same applies to the influence of the entrepreneur's family on business success (Nafziger 1969; Egbert 2009). Walter and Walter (2009) also reach inconclusive results and show that only a comparatively small number of studies really test the impact of social capital or social networks on business founding and performance. One reason can be that these concepts have become catch-all terms (Portes 1998, p. 2) and difficult to apply in quantitative studies. Another reason can be that the concept of social capital is best to be considered in context with other theories. With respect to this problem Brüderl and Preisendörfer (1998, p. 216) formulate the network compensation hypothesis. This hypothesis states that social networks are used by those entrepreneurs who have comparatively less human capital and limited access to financial capital, thus their social capital compensates for the lack of human capital. Results are diverse, though (cf. additionally Egbert 2004, pp. 302-304).

Despite inconclusive results on the effect of social capital, we assume that an influence on entrepreneurial activity cannot be excluded. As social capital we conceptualize individual networks, in our context networks of friends. In our analysis we distinguish between individuals with friends who are self-employed and those without such friends. We test whether a relation between having self-employed friends and personality traits exist. However, the causality is far from being clear because those who have similar personality traits form networks but it may also be the case that networks include only those who have specific personality traits.

In the economic literature on entrepreneurship the relation between these different variables – human capital, social capital, observational learning, and personality traits – has been rarely addressed. Walter and Walter (2009) find that the existing research does not focus on including cross-disciplinary research. Our paper contributes to enlightening this matter. Lee and Tsang's paper (2001) is closest to our research and also addresses this gap. For two personality traits (internal locus of control and need for achievement) Lee and Tsang identify a positive impact on networking activities among 168 Chinese entrepreneurs.

We argue that if human capital, social capital and observational learning are relevant factors that influence an individual's ability to set up and run successfully an enterprise, then this may also to be found out by conducting a psychometric test which measures an individual's entrepreneurial potential by identifying personality traits pertinent to entrepreneurs. The psychometric test we use is the F-DUP^N (Müller 2010a). With respect to different groups in our sample we test for differences between psychometric test scores and university degrees

and for differences between F-DUP^N scores and the criteria: (1) self-employment experience, (2) self-employed parents, and (3) self-employed friends. In relation to these aspects four hypotheses are formulated.

Our first hypothesis relates to formal human capital and assumes that a positive correlation between an individual's entrepreneurial potential and an individual's university degrees exists.

H1 states that: Participants with higher university degrees achieve higher scores in the F-DUP^N test.

The second hypothesis relates to human capital theory, particularly to an individual's self-employment experience and an individual's entrepreneurial potential measured by the F-DUP^N test.

H2 states that: Participants with self-employment experience achieve higher scores in the F-DUP^N test.

The third hypothesis relates to observational learning approaches to entrepreneurship and assumes that a positive correlation between entrepreneurial potential and having self-employed parents exists.

H3 states that: Participants with self-employed parents achieve higher scores in the F-DUP^N test.

The fourth hypothesis relates to social capital theory and assumes that a positive correlation between an individual's entrepreneurial potential and having self-employed friends exists.

H4 states that: Participants with self-employed friends achieve higher scores in the F-DUP^N test.

A description of the data set follows next.

3. The Data Set and Description of the Screening Process

3.1 Sample Description

In accordance with the aim of the project we initiated a multi-level screening process. During this process different types of data related to the individual respondent were collected. In order to identify eligible participants we first contacted Ph.D. students and research associates (Group 1) enrolled in various technology-oriented fields of studies across German universities directly via emails. We consider this group to be of comparatively high educational background and possessing an affinity towards technology.

We extend our sample by collecting data from a group of individuals who are either enrolled in a university degree program or have already obtained a university degree (Group 2) but who are neither Ph.D. students nor research associates. These individuals were contacted also by email or by using various university networks. Collecting data from individuals enrolled in various university degree programs (Group 1 and Group 2) allows us to control for the influence of the educational background.

In the emails and on the project webpage, the potential participants received information about the project and about the option of becoming part of a founding team to set up a technology-oriented business. To do so, recipients were offered to participate in a three-stage screening process. In the first stage, participants were asked to fill in an online questionnaire. The questions were related to an individual's social and educational background, self-employment experience and entrepreneurial intent. In the second stage, an online-based psychometric test was used to collect data on personality traits. As mentioned above, the test we used is the F-DUP^N (Müller 2010a). In the third stage of the screening process, short-listed respondents were offered to participate in a workshop. The workshop consisted of three elements: a role play, an interview, and a presentation task.³

Table 1: Sample Description

Complete sample	
Sample size:	$n=166$
Female (male):	$n=79$ ($n=87$)
Average age in years:	29.70
Minimum age in years	20
Maximum age in years	59
Participants with migration background:	$n=24$
Group 1 – Ph.D. student and research associates	
Group size:	$n_1=63$
Female (male):	$n=23$ ($n=40$)
Average age in years:	31.63
Minimum age in years	25
Maximum age in years	50
Participants with migration background:	$n=13$
Group 2 – participants enrolled at least in a bachelor's program	
Group size:	$n_2=101$
Female (male):	$n=55$ ($n=46$)
Average age in years:	28.40
Participants with migration background:	$n=11$

³ In this paper we focus only on the results of the first and second levels, and we do not deal with the workshops in detail. For an explanation of the workshop and the questionnaires employed compare Egbert et al. (2014).

In total, we collected data from $n=238$ participants on the first level (by May 2014). Due to particular reasons⁴ on the second level we received data from $n=166$ participants. Of these 166, $n_1=63$ are in the group of Ph.D. students and research associates (Group 1) and $n_2=101$ are participants who are enrolled at least in a bachelor's degree program (Group 2). That is, this group consists of participants who are either enrolled in a bachelor's program and/or hold a bachelor's degree and/or are enrolled in a master's program and/or hold a master's degree. The remaining $n_3=2$ participants hold a secondary education degree only (A-Level). Table 1 provides details of the sample.

3.2 Screening Process

At the first stage of the screening process participants were asked, among other things, to self-report their educational background and their experience in the field of self-employment. The questions did not only refer to self-employment experience but also to the experience in their immediate social surrounding. The criteria used here are (1) their own self-employment experience, (2) self-employed parents, (3) self-employed friends and (4) lacking any self-employment experience. For each criterion we divide our sample into two sub-groups. Participants in group "Yes" show the specific criterion and participants in group "No" do not. In order to test our hypotheses we compare the participants' entrepreneurial potential (measured by the F-DUP^N test) for significant differences between the "Yes" and "No" groups. Table 2 shows the number of participants in the "Yes" and "No" groups.⁵

Table 2: Self-employment Experience

Criteria	Group "Yes"	Group "No"
(1) self-employment experience	$n=42$ (25.30%)	$n=124$ (74.70%)
(2) self-employed parents	$n=60$ (36.15%)	$n=106$ (63.85%)
(3) self-employed friends	$n=127$ (76.51%)	$n=39$ (23.49%)
(4) lacking any self-employment experience	$n=28$ (16.87%)	$n=138$ (83.13%)

To relate the findings from the first stage of the screening process to the personality traits of the participants we had to measure dispositive factors.

For this purpose we used the psychometric test F-DUP^N (Müller, 2010a) in the second stage. The F-DUP^N is based on the Entrepreneurial Potential Questionnaire (King, 1985) and measures ten dispositive factors using nine items each in a forced-choice format.⁶ For each item, two possible answers are presented and the participants had to select one of these.

⁴ One possible reason can be that participants did not meet the requirements needed to enter the next level, e.g. they were not willing to set up a business in Saxony-Anhalt.

⁵ Since we want to test for relations of these criteria to dispositive factors, here we only report the results of the 166 participants, who took part in the second stage of our screening process.

⁶ Strack and Siegmund (2010) and Watzka (2006) also use the F-DUP^N to measure personality traits.

For each factor, a person can achieve nine points (one point per item), and a maximum of 90 points in total.

The ten factors are classified as:

- three motivational factors (internal locus of control, need for achievement, need for autonomy),
- two affective factors (stress resistance, intrinsic motivation),
- three cognitive factors (problem-solving orientation, tolerance for ambiguity, risk-taking propensity),
- two social factors (assertiveness, interpersonal reactivity).⁷

Based on the total F-DUP^N score obtained, which reflects the entrepreneurial potential, participants can be classified as: (L) 00 to 52 points: having only a low entrepreneurial potential, (M) 53 to 65 points: having a medium one, or (H) 66 to 90 points: having a high one. This classification is taken from Müller (2010a, p. 25).

4. Results and Interpretation

The paper focuses on investigating the relation between personality traits and aspects of human capital, observational learning and social capital. Next, we use our sample in order to test for such relations. We hypothesized that persons with higher educational background, with experience as self-employed, with self-employed parents, and with self-employed friends have higher scores in the F-DUP^N test.

4.1 The Influence of University Education

We first compare the achieved F-DUP^N scores of participants grouped according to their educational background to demonstrate the influence of university degrees on entrepreneurial potential. Table 3 shows the average F-DUP^N scores, reflecting the entrepreneurial potential of our participants, using the classification described in Section 3. Given the selection process and a minimum formal human capital requirement, the test scores are comparatively high.

Table 3: Classification of Participants According to Psychometric Test Scores (F-DUP^N)

Classification	\sum obs.	Average F-DUP ^N score
(L) 00 to 52 points (low entrepreneurial potential)	$n_L=44$	45.45
(M) 53 to 65 points (medium entrepreneurial potential)	$n_M=72$	59.99
(H) 66 to 90 points (high entrepreneurial potential)	$n_H=50$	70.00
Sample size: $n=166$, average score 59,15		

⁷ The employed terms are translated from German.

The average F-DUP^N score of the $n_1=63$ participants in group (1) (Ph.D. student and research associates) is 61.27 and of the $n_2=101$ participants in group (2) (participants enrolled at least in a bachelor's program) is 57.86. Regarding the influence of university degrees on an individual's entrepreneurial potential we hypothesized:

H1: Participants with higher university degrees achieve higher scores in the F-DUP^N test.

A comparison using a Wilcoxon-Mann-Whitney-Test (WMW-Test) shows that the achieved F-DUP^N scores of group (1) are statistically significantly different from those of group (2) (WMW-Test $Z = -2.025$, $p=0.043$). Therefore, we confirm our first hypothesis and conclude:

Result 1: Participants with higher university degree have a higher entrepreneurial potential shown by a higher achieved F-DUP^N score.

4.2 The Influence of Having Self-employment Experiences

In order to test our hypotheses H2, H3, and H4 and thereby to better understand the influence of self-employment experience on the F-DUP^N scores, we show these relations in accordance with the three criteria (1) participants with self-employment experience, (2) self-employed parents, and (3) self-employed friends. Additionally we relate the F-DUP^N scores to the age of the participants. This relation addresses the stability of the influence – if existing – over lifetime.

To test our hypotheses we divide our sample into sub-groups. While participants in one sub-group (group "Yes") show a specific factor (such as self-employment experience), the participants in the other sub-group (group "No") do not. Thus one sub-group functions as a comparison group.

We first juxtapose the classified F-DUP^N scores of participants with self-employment experience and those without it (Table 4) to test for the influence of different types of self-employment experiences on the F-DUP^N test scores.

Table 4: F-DUP^N Scores with Respect to Self-employment Experience

		Self-employment experience					
		Yes			No		
		\sum obs.	%	Average	\sum obs.	%	Average
(L)	00 to 52 points	3	7.14	51.00	41	33.07	45.05
(M)	53 to 65 points	19	45.24	60.11	53	42.74	59.94
(H)	66 to 90 points	20	47.62	70.30	30	24.19	69.80
		42		64.31	124		57.40

42 participants in our sample have self-employment experience. While we observe only slight differences in the average F-DUP^N scores of participants classified in groups M or H, we

do observe a difference in the average F-DUP^N scores in group L. We use ANOVA to analyze the data. Based on the results from the ANOVA we conclude that there are no statistically significant differences (Appendix 1: ANOVA – F-DUP^N Scores with Respect to Self-employment Experience).

To demonstrate the relationship of F-DUP^N score and age with respect to (1) self-employment experience, we present Figures 1 and 2. The figures show a histogram of the distribution of F-DUP^N scores over age, Figure 1 for participants with self-employment experience and Figure 2 for those without such experience.

Figure 1: F-DUP^N Scores of Individuals *with* Self-employment Experience

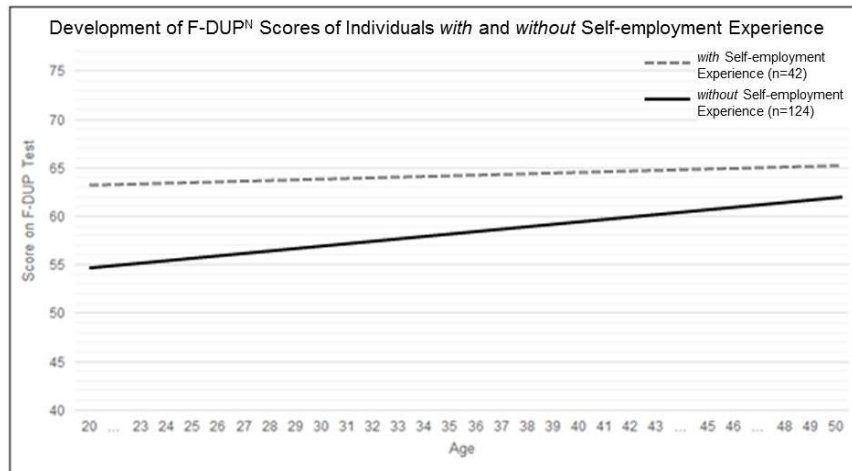


Figure 2: F-DUP^N Scores of Individuals *without* Self-employment Experience



Figures 1 and 2 show that for both sub-groups the average F-DUP^N score increases with participants’ age (additionally illustrated by the trendlines). Irrespective of having self-employment experience or not, the older a person is, the higher her entrepreneurial potential is. Figure 3 shows only the trendlines of the F-DUP^N score with respect to participants’ age.

Figure 3: Development of F-DUP^N Scores of Individuals *with* and *without* Self-employment Experience



Participants with self-employment experience achieve higher F-DUP^N scores than participants without such experience. This holds true independently of the age of the participants. Regarding the influence of self-employment experience we hypothesized:

H2: Participants with self-employment experience achieve higher scores in the F-DUP^N test.

We compare the achieved F-DUP^N scores of the participants with self-employment experience with those without such an experience in order to test this hypothesis. We find that F-DUP^N scores of participants with self-employment experience are significantly higher (WMW-test, $Z = -3.762$, $p = 0.000$). Therefore, we confirm our second hypothesis and conclude:

Result 2: Participants with self-employment experience show a significantly higher entrepreneurial potential than participants without such experience.

An additional observation is that, in terms of the development of personality traits, age positively influences participants' entrepreneurial potential. This influence is stronger for participants without self-employment experience.

4.3 The Influence of Having Self-employed Parents

Next we focus on the second criterion, i.e. self-employed parents. Table 5 shows the average F-DUP^N scores of participants with self-employed parents and those without. It indicates that 60 out of 166 participants have self-employed parents. When comparing the average F-DUP^N scores of the classified participants with respect to the criteria "self-employed parents", we observe only slight differences. Here we again use ANOVA to analyze the data. We find that the differences between the F-DUP^N score of participants classified in group (L) and group (H) are not significant. However, the difference between the F-DUP^N scores of participants

classified in group (M) is statistically significant (Appendix 2: ANOVA – F-DUP^N Scores with Respect to Self-employed Parents).

Table 5: F-DUP^N Scores with Respect to Self-employed Parents

		Self-employed parents					
		Yes			No		
		Σ obs.	%	Average	Σ obs.	%	Average
(L)	00 to 52 points	16	26.67	46.56	28	26.41	44.82
(M)	53 to 65 points	23	38.33	61.35	49	46.23	59.35
(H)	66 to 90 points	21	35.00	69.81	29	27.36	70.14
		60		60.37	106		58.46

We present a histogram of the distribution of the F-DUP^N scores over age for participants with self-employed parents, respectively for participants without self-employed parents, in Figures 4 and 5.

Figure 4: F-DUP^N Scores of Individuals *with* Self-employed Parents

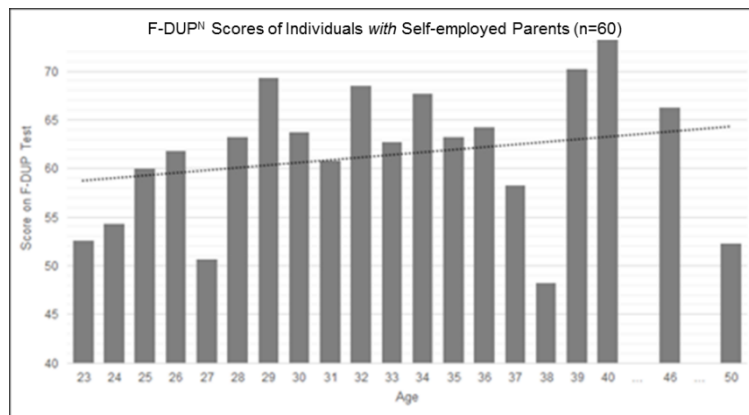
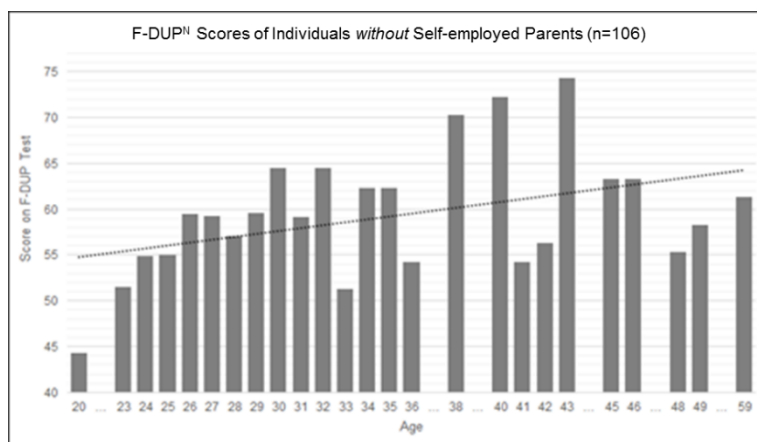
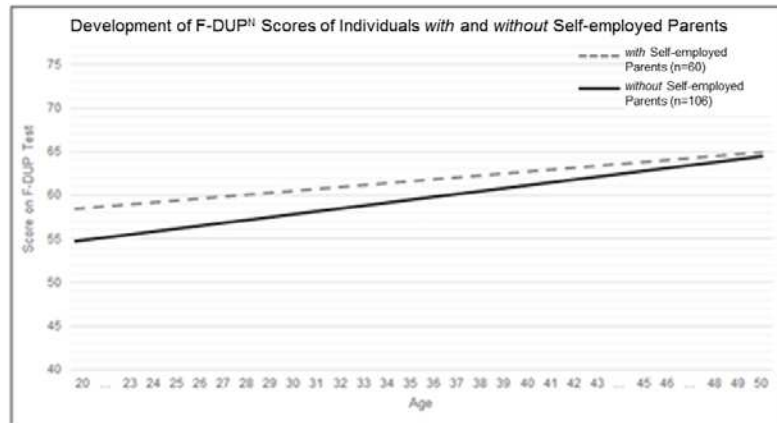


Figure 5: F-DUP^N Scores of Individuals *without* Self-employed Parents



The achieved F-DUP^N scores increase with higher age of the participants in both sub-groups. This is supportive of our interpretation that the older a person is, the higher her entrepreneurial potential is. Figure 6 presents only the trendlines.

Figure 6: Development of F-DUP^N scores of Individuals *with* and *without* Self-employed Parents



Younger participants with self-employed parents achieve higher F-DUP^N scores than those without self-employed parents. The differences between the F-DUP^N scores of the two sub-groups become smaller with an increasing age. Regarding the influence on the entrepreneurial potential that self-employed parents might have, we hypothesized:

H3: Participants with self-employed parents achieve higher scores in the F-DUP^N test.

We find that F-DUP^N scores of participants with self-employed parents are significantly higher than the F-DUP^N scores of those without (WMW-test, $Z=-1.355$, $p=0.088$). Therefore we confirm our third hypothesis. We conclude that observational learning from self-employed parents positively influences entrepreneurial potential.

Result 3: Participants with self-employed parents show a significantly higher entrepreneurial potential than participants without self-employed parents

Additionally, we observe that also with respect to the criterion self-employed parents, age positively influences the participants' entrepreneurial potential. This *lifetime effect* seems to be stronger than the influence of self-employed parents. Moreover, life experience seems to be able to compensate for the effects of observational learning from self-employed parents.

4.4 The Influence of Having Self-employed Friends

Our next point analyzes an aspect of social capital, namely the criterion self-employed friends. The average F-DUP^N scores of classified participants according to the criteria "self-employed friends" are shown in Table 6. As in the case of self-employed parents, we observe only slight differences in the average F-DUP^N scores. Once again we use ANOVA to analyze

the data and have to conclude that there are no statistically significant differences (Appendix 3: ANOVA – F-DUP^N Scores with Respect to Self-employed Friends).

Table 6: F-DUP^N Scores with Respect to Self-employed Friends

		Self-employed friends					
		Yes			No		
		Σ obs.	%	Average	Σ obs.	%	Average
(L)	00 to 52 points	26	20.47	46.58	18	46.15	43.83
(M)	53 to 65 points	56	44.09	60.34	16	41.03	58.75
(H)	66 to 90 points	45	35.43	69.96	5	12.82	70.60
		127		60.92	39		53.38

Here again, we first show a histogram of the distribution of the F-DUP^N scores over age for participants with self-employed friends, respectively for participants without self-employed friends, in Figures 7 and 8.

Figure 7: F-DUP^N Scores of Individuals *with* Self-employed Friends

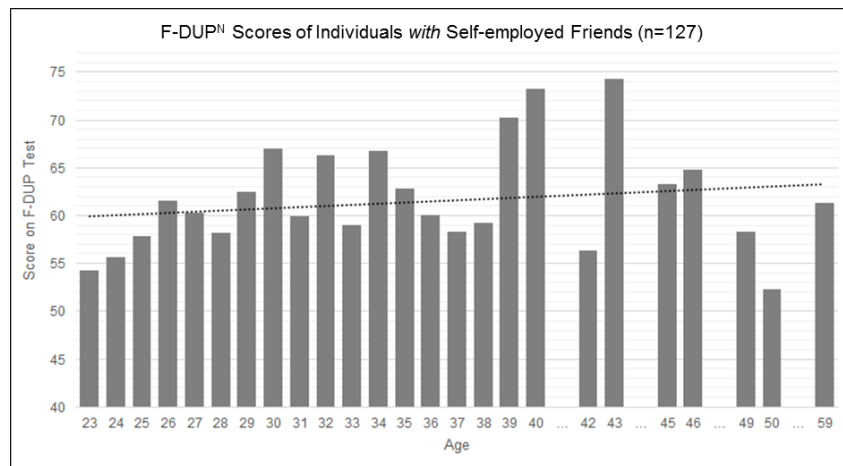
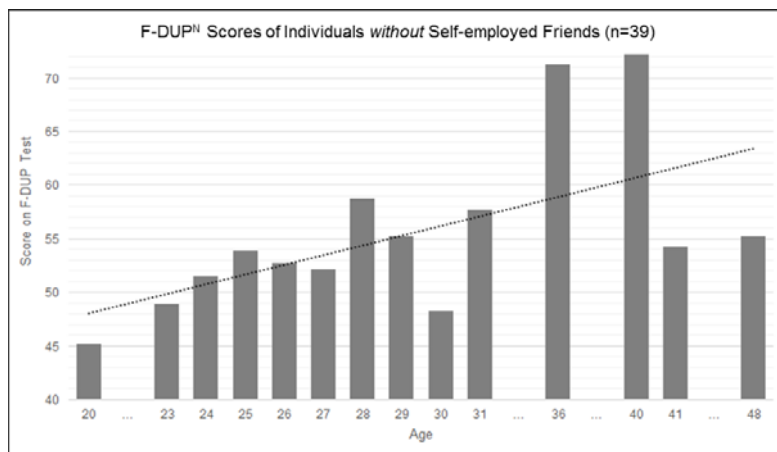
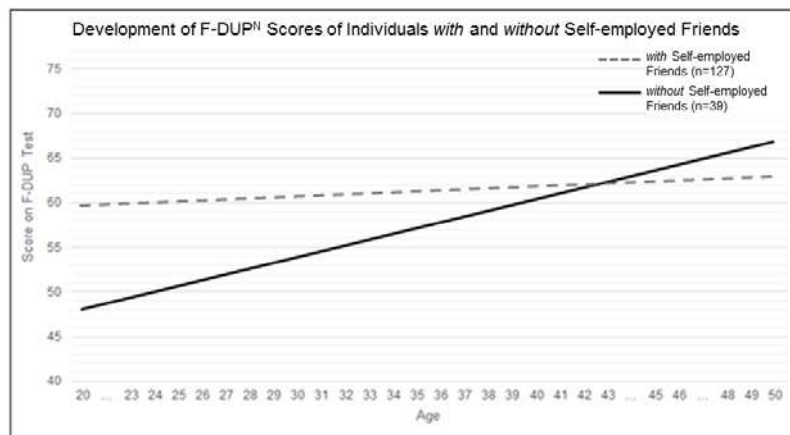


Figure 8: F-DUP^N Scores of Individuals *without* Self-employed Friends



In line with our findings regarding the criteria (1) self-employment experience and (2) self-employed parents, the average F-DUP^N scores increase with the increasing age of the participants in both sub-groups. As mentioned above, this supports our interpretation that the older a participant is, the higher her entrepreneurial potential is. Figure 9 presents the trendline for both sub-groups, indicating the influence self-employed friends have on F-DUP^N scores.

Figure 9: Development of F-DUP^N scores of Individuals *with* and *without* Self-employed Friends



It can be seen that younger participants with self-employed friends achieve higher F-DUP^N scores than those without self-employed friends. This ratio becomes smaller with increasing age, which means that age tends to compensate for the effect self-employed friends have. Our corresponding hypothesis was:

H4: Participants with self-employed friends achieve higher scores in the F-DUP^N test.

We find that the achieved F-DUP^N scores of participants with self-employed friends are significantly higher than the F-DUP^N scores of participants without self-employed friends (WMW-test, $Z=-3.943$; $p=0.000$). Therefore, our fourth hypothesis is confirmed.

Result 4: Participants with self-employed friends show a significantly higher entrepreneurial potential than participants without self-employed friends.

In line with our findings above, we observe that age positively influences participants' entrepreneurial potential.

4.5 Regression Analysis

Next, we apply a regression analysis with the achieved F-DUP^N scores as dependent variables (see Table 7) to evaluate the factors that influence an individual's entrepreneurial potential.

As explanatory variables, we use (1) participants' age⁸, (2) sex⁹, (3) education¹⁰, (4) self-employment experience¹¹, (5) self-employed parents¹², and (6) self-employed friends¹³.

Table 7: Prediction of F-DUP^N Scores Using Linear Regression

Linear Regression – Dependent variable: F-DUP ^N scores		
Explanatory Variables	Coefficients	Significance
Age	0.15497	0.2246
Sex	-3.61606	0.0129
Education	0.51750	0.3013
Self-employment Experience	4.46219	0.0135
Self-employed Parents	0.00799	0.9958
Self-employed Friends	5.64853	0.0014
(Intercept)	48.87741	0.0001
Observations: n=166, R ² = 0.2111 (adjusted R ² = 0.1813)		

From the results of the regression we can infer that parts of a participant's entrepreneurial potential (reflected by the F-DUP^N score) is statistically explained by self-employment experience as specific human capital and self-employed friends representing social capital. From the regression results we additionally conclude that sex has a statistically significant impact on the achieved F-DUP^N scores, with men showing higher entrepreneurial potential. The other explanatory variables have a positive impact on the participants' entrepreneurial potential. None of the variables, however, is statistically significant.

The positive impact of formal human capital as well as specific human capital is in line with the findings of a considerable number of studies (Walter and Walter 2009). With respect to prior self-employment experience, we provide evidence for a positive impact of this specific human capital.

Drawing on behavioral approaches on entrepreneurship which stress the importance of the possibility to learn from parents, we expected self-employed parents to have a positive impact. Our results show only a weak but insignificant impact. One possible interpretation is that the impact of self-employed parents only exists in younger age and will be compensated by lifetime experiences.

⁸ Participants' age is given in years.

⁹ Dummy variable: Equals 1 for female and 0 for male respondents.

¹⁰ Education is coded as: 0 - Secondary Education, 1 – Bachelor's degree, 2 - Diploma (University of Applied Sciences), 3 - Diploma (University), 4 – Master's degree, 5 - Ph.D.

¹¹ Dummy variable: Equals 1 if participants have self-employment experience and 0 if participants do not have self-employment experience.

¹² Dummy variable: Equals 1 if participants have self-employed parents and 0 if participants do not have self-employed parents.

¹³ Dummy variable: Equals 1 if participants have self-employed friends and 0 if participants do not have self-employed friends.

The literature on the effect of social capital on entrepreneurial potential provides diverse results. In particular, the impact of self-employed friends on an individual's entrepreneurial potential is discussed controversially in the literature. Our results show a positive impact of self-employed friends, meaning that participants who have self-employed friends show a higher entrepreneurial potential than those without.

5. Conclusion

The initial argument of the paper is economic in nature: in order to use public resources effectively it is reasonable to support individuals with a comparatively high entrepreneurial potential. Following this argument we conclude that it is necessary to measure an individual's entrepreneurial potential in order to identify those individuals who should benefit from public funds. One instrument to examine entrepreneurial potential is psychometric tests which are used to measure personality traits considered to be important for an entrepreneurial potential.

While the literature on personality traits is to some extent polarized, with one group of researchers emphasizing the stability of personality traits and the other group emphasizing changes (Roberts 2009), we follow the idea of personality traits development. More precisely, we assume that a relation between personality traits (important for successful entrepreneurs) and selected aspects of human and social capital exists. Consequently, we test whether entrepreneurial potential (measured by personality traits) shows systematic differences between sub-groups of potential entrepreneurs in accordance to different variables. These variables are university degrees (formal human capital), self-employment experience (specific human capital), self-employed friends (social capital) and self-employed parents (observational learning).

We hypothesize that all individuals with higher university degrees, with previous experience in self-employment, with self-employed parents and with self-employed friends show significantly higher scores in a psychometric test, when measuring an individual's entrepreneurial potential, than individuals without such experiences.

We report the results from 166 participants. All participants are university students and graduates from different fields of study. We use the F-DUP^N test as a psychometric test to measure the entrepreneurial potential of the participants. All participants indicate a specific interest in entrepreneurial activity. We test whether F-DUP^N scores for personality traits show systematic differences between sub-groups of potential entrepreneurs.

As a major result we found that all variables we tested have a positive impact on participants' entrepreneurial potential. With respect to the participants' age, we find for all tested groups that scores increased with age. These findings allow the following conclusions:

(1) Formal human capital (measured by university degrees) and self-employment experience (in different forms) matters with respect to F-DUP^N scores. These results can be related to theories on entrepreneurship.

(2) Age matters with respect to F-DUP^N scores. We can call this a *life-time effect*. This implies that tested personality traits are not necessarily stable over a person's life-time but change in a way which generates higher test scores, reflecting in this way higher entrepreneurial potential.

(3) The data indicates that differences in F-DUP^N scores with respect to self-employment experience become less salient as regards age. Particularly with respect to the criterion self-employed parents, i.e. the argument of observational learning, life experience seems to compensate for the initially lower test scores of those who do not have an entrepreneurial family background.

From these results we can also derive implications for the practice of supporting business ventures with public resources. Firstly, we found that with moderate effort it is possible to select among a larger group of potential entrepreneurs those who show a higher potential. A consequence is that it is feasible to use psychometric tests for screening processes *ex ante* spending public funds for fostering entrepreneurship. This was demonstrated by using a specific test. Yet, other psychometric tests may be also used. Secondly, we found that a combination of different complementary selection tools (tests, questionnaires) for identifying entrepreneurial potential is applicable. Thirdly, besides identifying high potential, test results can also be used to identify an individual's strengths and weaknesses. Consequently, courses that focus on entrepreneurial education and training can address an individual's shortcomings more precisely thus enhancing the effectiveness of such measures. Fourthly, we demonstrated that an individual's entrepreneurial potential can be, to a certain degree, explained by her experiences. Our results support the finding of Zapkau (2014, p. 12), for instance. They conclude that "prior entrepreneurial exposure may serve as a signal to identify promising entrepreneurs". Consequently, the importance of gathering self-employment experience should be addressed at an early stage of entrepreneurial education, for instance by providing opportunities to young individuals to collect such experiences.

Finally, we address the limitations of our study. This paper is based on the concept and data of a project meant to form entrepreneurial teams for setting up businesses. Since all participants indicated a specific interest in entrepreneurial activities we have a bias in the direction *pro entrepreneurship* among our participants. This is clearly shown by on average high test scores. While this is in line with the project's concept to identify and support those individuals who have an interest in starting a business *plus* having the potential to run this business successfully an external control group is not taken account of. Certainly we cannot exclude the possibility that more efficient ways to identify high potentials exist. Our current approach can be improved by applying more sophisticated techniques when deciding who will and who will not be supported by public funds.

Furthermore, we were rather selective with the variables we tested. We decided for a small set of variables only and considered them as proxies for more general concepts, for instance own self-employment experience as a proxy for specific human capital. We do not deny the employability of other theories and related variables. However, the aspects we used are comparatively easy to identify and also to verify, in interviews for instance. Our approach thus suited well our purposes. Another limitation is that the link between a person's entrepreneurial potential (in our case reflected by the total F-DUP^N score) and the (real) success or failure in running a business needs to be observed in a longitudinal study, including a repetition of the test. Our data is, in this respect, non-dynamic and we are aware of the criticism that the distinction cause and effect remains rather blurred.¹⁴ The insights gained in our study as well as its shortcomings render the questions to be addressed by future research.

¹⁴ We thank the anonymous reviewers who suggested this point.

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Appendix 1: ANOVA - F-DUP^N Scores with Respect to Self-employment Experience

A1.1 Single Factor ANOVA on F-DUP^N scores of participants *with* and *without* self-employment experience, classified in group L (having a low entrepreneurial potential)

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Participants <i>with</i> Self-employment Experience	3	153	51.000	1.000
Participants <i>without</i> Self-employment Experience	41	1847	45.049	25.748

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>	<i>F_{crit}</i>
Between Groups	99.007	1	99.007	4.0297	0.0512	4.0727
Within Groups	1031.902	42	24.569			
Total	1130.909	43				

A1.2 Single Factor ANOVA on F-DUP^N scores of participants *with* and *without* self-employment experience, classified in group M (having a medium entrepreneurial potential)

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Participants <i>with</i> Self-employment Experience	19	1142	60.105	13.433
Participants <i>without</i> Self-employment Experience	53	3177	59.943	10.593

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>	<i>F_{crit}</i>
Between Groups	0.366	1	0.366	0.0324	0.8578	3.9778
Within Groups	792.620	70	11.323			
Total	792.986	71				

A1.3 Single Factor ANOVA on F-DUP^N scores of participants *with* and *without* self-employment experience, classified in group H (having a high entrepreneurial potential)

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Participants <i>with</i> Self-employment Experience	20	1406	70.300	9.905
Participants <i>without</i> Self-employment Experience	30	2094	69.800	8.028

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>	<i>F_{crit}</i>
Between Groups	3.000	1	3.000	0.3420	0.5614	4.0427
Within Groups	421.000	48	8.771			
Total	424.000	49				

Appendix 2: ANOVA - F-DUP^N Scores with Respect to Self-employed Parents

A2.1 Single Factor ANOVA on F-DUP^N scores of participants *with* and *without* self-employed parents, classified in group L (having a low entrepreneurial potential)

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Participants <i>with</i> Self-employed Parents	16	745	46.563	16.263
Participants <i>without</i> Self-employed Parents	28	1255	44.821	31.708

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>	<i>F_{crit}</i>
Between Groups	30.864	1	30.864	1.1784	0.2839	4.0727
Within Groups	1100.045	42	26.192			
Total	1130.909	43				

A2.2 Single Factor ANOVA on F-DUP^N scores of participants *with* and *without* self-employed parents, classified in group M (having a medium entrepreneurial potential)

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Participants <i>with</i> Self-employed Parents	23	1411	61.348	10.601
Participants <i>without</i> Self-employed Parents	49	2908	59.347	10.356

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>	<i>F_{crit}</i>
Between Groups	62.667	1	62.667	6.0065	0.0168	3.9778
Within Groups	730.319	70	10.433			
Total	792.986	71				

A2.3 Single Factor ANOVA on F-DUP^N scores of participants *with* and *without* self-employed parents, classified in group H (having a high entrepreneurial potential)

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Participants <i>with</i> Self-employed Parents	21	1466	69.810	8.362
Participants <i>without</i> Self-employed Parents	29	2034	70.138	9.123

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>	<i>F_{crit}</i>
Between Groups	1.314	1	1.314	0.1492	0.7010	4.0427
Within Groups	422.686	48	8.806			
Total	424.000	49				

Appendix 3: ANOVA - F-DUP^N Scores with Respect to Self-employed Friends

A3.1 Single Factor ANOVA on F-DUP^N scores of participants *with* and *without* self-employed friends, classified in group L (having a low entrepreneurial potential)

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Participants <i>with</i> Self-employed Friends	26	1211	46.577	29.134
Participants <i>without</i> Self-employed Friends	18	789	43.833	18.971

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>	<i>F_{crit}</i>
Between Groups	80.063	1	80.063	3.1999	0.0809	4.0727
Within Groups	1050.846	42	25.020			
Total	1130.909	43				

A3.2 Single Factor ANOVA on F-DUP^N scores of participants *with* and *without* self-employed friends, classified in group M (having a medium entrepreneurial potential)

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Participants <i>with</i> Self-employed Friends	56	3379	60.339	9.974
Participants <i>without</i> Self-employed Friends	16	940	58.750	14.200

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>	<i>F_{crit}</i>
Between Groups	31.433	1	31.433	2.8892	0.0936	3.9778
Within Groups	761.554	70	10.879			
Total	792.986	71				

A3.3 Single Factor ANOVA on F-DUP^N scores of participants *with* and *without* self-employed friends, classified in group H (having a high entrepreneurial potential)

SUMMARY

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
Participants <i>with</i> Self-employed Friends	45	3147	69.933	9.382
Participants <i>without</i> Self-employed Friends	5	353	70.600	2.300

ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>	<i>F_{crit}</i>
Between Groups	2.000	1	2.000	0.2275	0.6356	4.0427
Within Groups	422.000	48	8.792			
Total	424.000	49				

German summary

Ermittlung unternehmerischen Potenzials

Zusammenfassung: Wenn öffentliche Ressourcen zur Förderung privaten Unternehmertums eingesetzt werden, dann ist es ökonomisch sinnvoll diejenigen Personen zu fördern, die ein vergleichsweise großes unternehmerisches Potenzial aufweisen. Im Beitrag wird der Bezug zwischen unternehmerischem Potenzial, eruiert durch den psychometrischen Test F-DUP^N, individueller Erfahrung, Humankapital und Aspekten des Sozialkapitals untersucht. Die verwendeten Daten stammen aus einem Projekt zur Förderung von Teambildungen in der Vorgründungsphase. Es werden Daten von 166 Teilnehmern analysiert, die entweder noch studierten oder einen Hochschulabschluss erworben hatten und ein konkretes Interesse an unternehmerischen Tätigkeiten gezeigt haben. Diejenigen Teilnehmer, die bereits selbst unternehmerische Erfahrung gesammelt hatten, deren Eltern unternehmerisch tätig waren oder deren Freunde als Unternehmer tätig waren, zeigen vergleichsweise höhere Testergebnisse. Der Einfluss dieser Variablen wird mit zunehmendem Alter der Teilnehmer vergleichsweise weniger wichtig. Dies deutet darauf hin, dass Merkmale, die unternehmerisches Potenzial signalisieren, auch mit höherem Alter erworben werden können.

In diesem Arbeitspapier werden ausgewählte Ergebnisse des Projekts „Gründungstandem“ dargestellt. „Gründungstandem“ (25-32327/12-04/ego.-Konzept.068) war ein Projekt der Hochschule Anhalt, gefördert aus Mitteln des Europäischen Sozialfonds und des Ministeriums für Wissenschaft und Wirtschaft des Landes Sachsen-Anhalt.



Für die im Text dargestellten Inhalte sind ausschließlich die Autoren verantwortlich.