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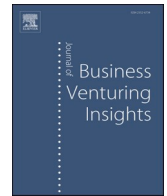
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# Self-confidence predicts entrepreneurship and entrepreneurial success

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## 1. Introduction

Entrepreneurship promotes employment, productivity growth, innovation activity, and the commercialization of innovations (e.g., [Van Praag and Versloot, 2007](#)). However, only a small number of firms in Finland (6%) create a significant portion of new jobs, and a large share of firms experience limited or decreasing growth. While new jobs are typically created in new firms, only a small proportion of these firms survive the “valley of death” during the first years after their market entry ([Vanhala and Virén, 2016](#)). Because of the economic benefits of successful entrepreneurship, the questions of who becomes and what makes a successful entrepreneur are of interest to both academics and policymakers.

Entrepreneurship differs from paid employment in several ways. First, entrepreneurs bear substantial risk, which is typically poorly diversified ([Vereshchagina and Hopenhayn, 2009](#)). Second, entrepreneurs are characterized as “jacks-of-all-trades” who must be competent in many skills ([Lazear, 2005](#)). Third, concerning job tasks, an entrepreneur needs to detect and exploit opportunities and make rapid decisions in uncertain conditions ([Rauch and Frese, 2007](#)). Due to these characteristics, entrepreneurship, particularly when successful, frequently requires “entrepreneurial capital,” consisting of financial, social, and human capital dimensions ([Blumberg and Pfann, 2016](#)).

Personality traits can be considered part of human capital. Previous research has found that entrepreneurship is related to personality traits such as high openness to experiences (in the Big Five sense), need for achievement, self-efficacy, internal locus of control, and risk tolerance (for reviews, see [Zhao and Seibert, 2006](#); [Kerr et al., 2018](#); [Kritikos, 2022](#)). However, the personality traits that drive people to open new businesses are not always the same ones that make entrepreneurs successful ([Caliendo et al., 2014](#); [Bennett et al., 2016](#); [Hamilton et al., 2019](#)). For example, founder CEOs are not necessarily best suited for management ([Bennett et al., 2016](#)), and traits such as openness to experience, which are related to entry into entrepreneurship, may not predict firm survival ([Caliendo et al., 2014](#)). There is evidence that family background and genetics may also explain entrepreneurial outcomes ([Nicolaou et al., 2008](#); [Cardella et al., 2020](#)). However, as family background and genetics may also affect personality traits ([Krueger and Johnson, 2008](#)), it remains unclear whether

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personality traits are related to entrepreneurship after accounting for these potential confounding factors. Acquiring a better understanding of the mechanisms behind the different stages of the entrepreneurial process can offer useful guidance in developing more effective policy interventions.

In this study, we examine how personality traits (neuroticism, extraversion, sociability, hostility, self-confidence, and conscientiousness) are related to the propensity to become and succeed as an entrepreneur. We go beyond the existing literature by providing two important contributions. First, we use survey data on personality traits linked with long-term administrative register data, which enables us to track entrepreneurial activity and success over a 20-year period (1990–2009). Second, we utilize twin data methods to control for unobserved family background and genetic effects. Our results show that self-confidence is an important predictor of both entry into entrepreneurship and better subsequent entrepreneurial performance.

## 2. Materials and methods

### 2.1. Data

We use data that combine information from two data sources: the Older Finnish Twin Cohort Study from the Department of Public Health at the University of Helsinki and the Finnish Longitudinal Employer-Employee Data (FLEED) from Statistics Finland. These two datasets were linked using unique personal identifiers; thus, the matching was exact.

The Older Finnish Twin Cohort Study includes same-sex twins born before 1958 (Kaprio et al., 1979). The subjects for the survey were collected from the Central Population Registry in 1975. The response rate in the 1975 survey was 89% (25,004 participants aged  $\geq 18$ ), and subsequent follow-ups were conducted in 1981 (84% response rate) and 1990 (77% response rate). The Finnish Cohort Study is representative of the overall Finnish population in the same age cohorts. The survey data were linked to register information on education, demographic and family characteristics, socioeconomic status, and employment status from FLEED over the 1990–2009 period. The information in FLEED is register-based, which eliminates the risks of nonresponse and measurement errors related to self-reported measures.

Data on personality traits were drawn from the 1981 survey of the Finnish Cohort Study. This information was linked with register-based data from FLEED, which formed a sample of 16,397 individuals. Restricting the analyses to working individuals for whom we have information on other control variables reduced the sample to 13,755 individuals, with a total of 170,283 yearly observations. The youngest cohort was 33 years old in 1990 and 52 years old in 2009.

### 2.2. Measures

#### 2.2.1. Dependent variables: entrepreneurial outcomes

To measure sorting into entrepreneurship, we use two indicators. The first is entrepreneurship status in year  $t$  ( $t = 1990, \dots, 2009$ ), which equals 1 if the person is an entrepreneur and 0 if the person is in paid employment. The second indicator captures entry into entrepreneurship. The variable equals 1 for those who entered entrepreneurship between years  $t-1$  and  $t$  and 0 for those who were not entrepreneurs in either year (excluding retired persons). The information on entrepreneurship status is based on Statistics Finland's registers, where entrepreneurs are defined as persons who, during the last week of the year, had a self-employed person's pension insurance and were not unemployed. If the person is also in an employment relationship, their entrepreneurial income has to exceed their wage income for the person to be defined as an entrepreneur. Furthermore, people whose entrepreneurial incomes exceed a specific level of earnings belong to the category of entrepreneurs (for a detailed definition, see Appendix A).

We use three indicators for entrepreneurial success. The first outcome variable is an indicator capturing exit from entrepreneurship. The variable equals 1 for those who exited from entrepreneurship between years  $t-1$  and  $t$  and 0 for those who were entrepreneurs in both years. Those who exited entrepreneurship because of retirement were excluded from the analyses. The second variable is the logarithm of the sum of capital and earned income from entrepreneurship in year  $t$ . As the third and last indicator of entrepreneurial success, we use the logarithm of the firm's total sales divided by the number of employees in year  $t$ .<sup>1</sup> This is a proxy for the firm's labor productivity. Variables for income and labor productivity were deflated to 2009 prices using Statistics Finland's cost-of-living index. All the dependent variables were based on the FLEED register data.

#### 2.2.2. Predictor variables: personality traits

Information on personality traits was drawn from the Older Finnish Twin Cohort Study. Two personality traits (neuroticism and extraversion) are based on the short-form Eysenck Personality Inventory drawn from the 1981 survey. Furthermore, the 1981 survey contains 15 items that describe different dimensions of personality (e.g., "lazy versus hardworking" or "insecure versus self-confident"), which were assessed based on a 5-point scale (Langinvainio et al., 1982). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy ( $KMO = 0.76$ ) and Bartlett's test of sphericity ( $\chi^2 = 1.29e + 06$ ,  $df = 105$ ,  $p < 0.001$ ) both supported the factorability of the 15-item personality matrix. Principal component analysis retained four latent factors of personality, similar to Langinvainio et al.

<sup>1</sup> Information on the firm's total sales by the number of personnel is available only for the years 1998–2009. The sales information is based on data from the Finnish Trade Register, a public register that contains information on private traders and businesses. The trade register covers the entire country and includes all traders, regardless of their corporate form or nature of activity. A limited company must always report its financial statements to the trade register, but private entrepreneurs are not required to do so. The limited reporting obligation, along with missing information, limits the coverage of sales information, which is approximately 26% in our sample of entrepreneurs in 1998–2009.

(1982). The latent factors were labeled as sociability, hostility, self-confidence, and conscientiousness.<sup>2</sup> A detailed list of the 15 items and their rotated factor loadings is presented in Appendix Table B1. Each factor was standardized such that the distribution had a mean of 0 and a standard deviation of 1.

### 2.2.3. Control variables

As control variables, we use sex, age, age squared, an indicator for having underage children, marital status (1 = married, 0 = otherwise), level of education (five categories), and field of education (nine categories). The information on the level and field of education is based on the International Standard Classification of Education. These control variables were drawn from FLEED in year  $t$  ( $t = 1990, \dots, 2009$ ). We also include self-reported information on occupation, including 12 indicators, which in the case of entrepreneurs indicates the branch of industry. We control for occupation in 1975 as it is likely to be associated with both personality traits and entrepreneurial outcomes and may thus confound the relationship of interest. To condition out potential two-way causality, we also control for entrepreneurial status (1 = entrepreneur, 0 = otherwise) that originates from the 1975 survey (i.e., before the personality traits were measured).

## 2.3. Models and methods

To study the relationship between personality traits and entrepreneurial outcomes, we estimate models using the following form (Equation (1)):

$$Y_{it} = \alpha' P_{i,1981} + \beta' X_{it} + \delta' O_{i,1975} + \tau_t + \varepsilon_{it} \quad (1)$$

In Equation (1),  $i$  and  $t$  refer to an individual and year, respectively;  $Y$  is the outcome variable;  $P_{i,1981}$  is a vector of six personality traits of individual  $i$  measured in 1981; and  $X_{it}$  is a vector of control variables measured in year  $t$ . The model also includes year indicators ( $\tau_t$ ) and a vector that includes occupation and entrepreneurship status measured in 1975 ( $O_{i,1975}$ ). Individual-level clustered standard errors are used to take into account the within-person correlation over time.

### 2.3.1. Baseline model

A pooled logit model is used to study whether personality traits are related to the probability of being an entrepreneur and entry into and exit from entrepreneurship. When the logarithm of entrepreneurial income and the firm's productivity were used as dependent variables, the models were estimated using ordinary least squares (OLS).

### 2.3.2. Models utilizing twin data

Personality traits develop over childhood and youth and become increasingly stable in adulthood. Changes in personality traits in adulthood are mostly related to maturation, for example, people tend to become more emotionally stable over time (e.g., Soto and Tackett, 2015), but major life events may still shape personality in adulthood (Specht et al., 2011).<sup>3</sup> Previous studies have shown that approximately one-half of the variation in personality traits is explained by genetic factors, with a small contribution of shared environment (Bouchard and Loehlin, 2001; Krueger and Johnson, 2008). The remaining variation is attributed particularly to the non-shared environment, resulting from, for example, peer group influences, family interactions, and random life events, and twins experiencing the same environment differently (e.g., Baker and Daniels, 1990; Torgensen and Janson, 2002). If shared environment and genetic factors affect both personality and entrepreneurial outcomes, the individual-level estimates in the baseline model are likely to be biased.

To control for the aforementioned unobserved characteristics, we utilize information on the zygosity of twins, whether they are dizygotic (DZ) and have the same family background and approximately 50% of their genes or monozygotic (MZ) and have both the same family background and 100% of genes. For specifications that we estimate using OLS (logarithm of entrepreneurial income and the firm's productivity), we apply the traditional twin-pair difference model. Specifications where the dependent variable is binary (the probability of being an entrepreneur, entry into or exit from entrepreneurship), we add twin-specific fixed effects in the model and apply a conditional (fixed-effects) logit regression for twins (e.g., Magnac, 2004). The standard errors in both models are clustered by twin pairs, and the models use a sample in which both twins are observed in year  $t$ . Additionally, to be able to exploit the twin dimension of the data for identification, the individual members of the twin pair must have different employment statuses, with, for example, only one of the twins being an entrepreneur. This decreases the sample size significantly and thus increases the risk of a Type II error (i.e., nonrejection of a false null hypothesis).

The models are estimated separately for DZ and MZ twins, of which the former specification controls for the shared family background and partly for genetics, and the latter controls additionally for the whole genetic inheritance. Therefore, as far as differences in personality traits are not attributable to measurement errors, the results based on MZ twins identify the link between personality traits and entrepreneurial outcomes, where the variation in personality traits stems from the non-shared environment, such as different life experiences.

<sup>2</sup> The sociability and extraversion traits are highly correlated ( $r = 0.63$ ). We therefore re-estimated all the models reported in Tables 1 and 2 by including these two variables in the models separately. The main conclusions remained intact.

<sup>3</sup> Appendix C provides additional evidence on how emotional closeness between family members and different life events are related to differences in personality traits among monozygotic twins in our sample.

### 3. Results

#### 3.1. Descriptive statistics

Fig. 1 presents the scales and distributions of the six standardized personality trait scores by employment status. The distributions of the personality traits are approximately normal, except for hostility, for which the distribution is left skewed. The distributions of the personality traits by employment status show that entrepreneurs are slightly more self-confident and conscientious, on average, compared to paid employees. The average scores for the standardized personality measures and the key demographic characteristics separately for entrepreneurs and paid employees are reported in Appendix Table B2. Approximately 14% of all the employed individuals in our data are entrepreneurs. This share is comparable with the total employed workforce in Finland in the same age distribution as our sample (individuals over 33 years old). As Fig. 1 indicates, entrepreneurs' scores in self-confidence and conscientiousness are, on average, higher than those of paid employees. They also score lower in neuroticism and hostility on average. Compared to the paid employees in our sample, the entrepreneurs are also older, less educated, and more likely to be males than females. Lastly, the means of the absolute values of the twin differences show that MZ twins are much more similar to each other in terms of personality traits than DZ twins (Appendix Table B3). However, differences in entrepreneurship status and personality traits also exist between MZ twins, which is necessary for model identification.

#### 3.2. Personality and entrepreneurship

The marginal effects indicating the links between personality traits and the probability of being an entrepreneur are reported in Table 1<sup>4</sup>. The results show that a one-standard deviation increase in self-confidence is associated with a 1.6 percentage point increase ( $\beta = 0.016$ ) in the probability of being an entrepreneur (Column 1). This marginal effect is equivalent to an increase of approximately 12% in the same probability evaluated at a mean of 0.139. The point estimate for self-confidence is 0.040 (~8% increase in probability) when we focus on the DZ sample, which controls for unobserved family background and part of the genetic effects (Column 2), and 0.067 (~13% increase in probability) when the results are based on the MZ twin design, which condition out all the unobserved family background and genetic effects that identical twins share (Column 3). However, self-confidence in the DZ sample is not statistically significant at the conventional level ( $p = 0.108$ ), whereas in the MZ sample we also observe that neuroticism is positively related to entrepreneurial probability. The results and effect sizes concerning entry into entrepreneurship (Columns 4–6) are in line with the results above. The differences in the results concerning entrepreneurial status (percent increases in probabilities) between the baseline, DZ, and MZ models suggests that omission of family background and genetics may bias the results in opposite directions and offset each other in our model.

#### 3.3. Personality and entrepreneurial success

Table 2 shows how the personality traits in our data are related to different measures of entrepreneurial success. The results indicate that self-confidence is negatively associated with an exit from entrepreneurship ( $\beta = -0.006$ ,  $p < 0.050$ , Column 1). The marginal effect is roughly equivalent to an of 8% decrease in probability. We also find that a one-standard deviation increase in self-confidence is related to an approximately 6% higher entrepreneurial income (Column 4). The positive link between self-confidence and entrepreneurial success remains robust and the point estimates become larger when controlling for both family and genetic effects using the sample for MZ twins. For example, a one standard deviation increase in self-confidence is related to a nearly 20% higher entrepreneurial income in Column 6. A comparison of the baseline and MZ results suggests that omitting both family background and genetic factors may lead to downward biased estimates when examining the relationship between self-confidence and entrepreneurial success. Using the sample of MZ twins, we also find that sociability is positively related to an exit from entrepreneurship ( $\beta = 0.068$ ,  $p < 0.050$ ).

The results regarding the relationship between personality traits and the firm's labor productivity are shown in Column 7. Because information on firm sales is available only for a subsample of entrepreneurs, the sample decreased to 2,779 yearly observations. The within-twin differencing method for MZ twins further decreases the sample size to only 137 observations; therefore, we report only the results using data as an individual panel. However, the findings based on this smaller sample also indicate that self-confidence is related to better entrepreneurial success as a one-standard deviation increase in self-confidence is related to an approximately 6% higher labor productivity among entrepreneurs.

### 4. Discussion

Using longitudinal data that combine personality traits with entrepreneurial outcomes, we found that higher self-confidence was associated with a higher probability of becoming an entrepreneur and better entrepreneurial performance measured by exit from entrepreneurship, entrepreneurial income, and the firm's productivity. The link between self-confidence and entrepreneurial outcomes remained positive when the potential confounders from shared family and genetic background were controlled for using the MZ twin sample.

Previous studies examining self-confidence and entrepreneurship have focused on entrepreneurial self-efficacy (ESE). This specific

<sup>4</sup> The marginal effects of the other control variables are shown in Appendix Table B4. These results show, for example, that females are less likely to be entrepreneurs than males. Previous studies have found that sex differences in personality traits may partly explain the differences in the prevalence of entrepreneurship between the sexes (Kirkwood, 2009). Based on the results shown in Table B4, sex differences in entrepreneurship still exist even if personality differences are taken into account.

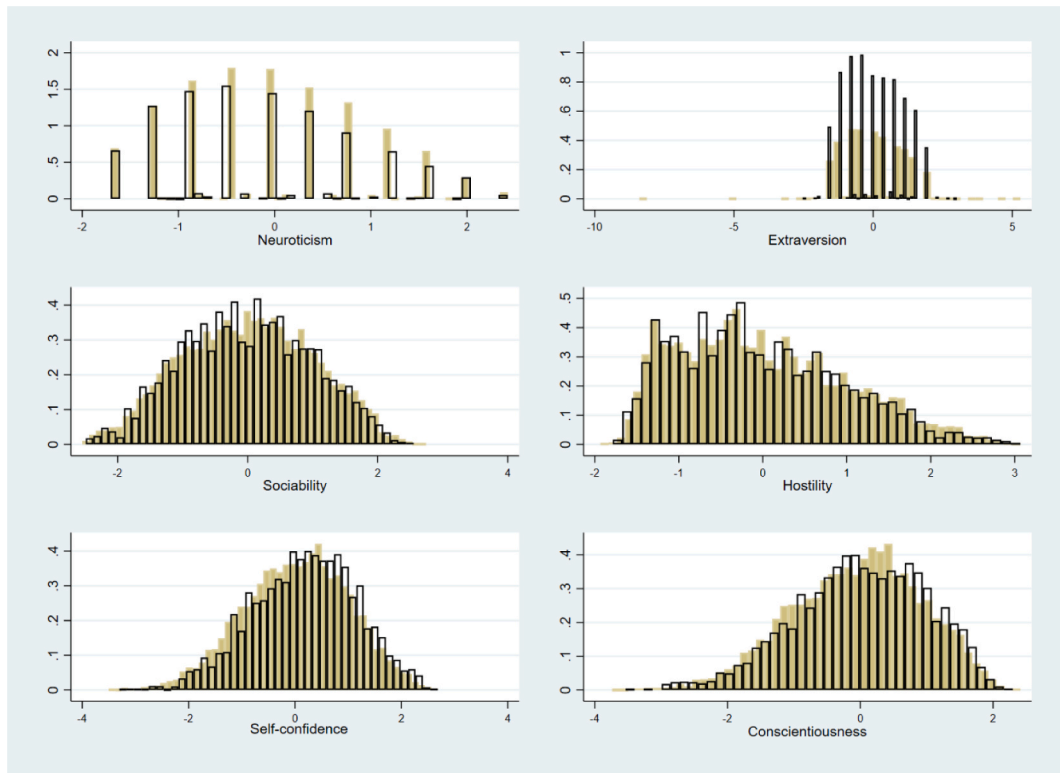


Fig. 1. Distributions of standardized personality trait scores for paid employees (light-brown bars) and entrepreneurs (black-lined bars).

Table 1  
Marginal effects of personality traits and entrepreneurship.

	Entrepreneurship (1)	Entrepreneurship within DZ twins (2)	Entrepreneurship within MZ twins (3)	Entry into entrepreneurship (4)	Entry into entrepreneurship within DZ twins (5)	Entry into entrepreneurship within MZ twins (6)
Neuroticism	0.002 (0.003)	0.001 (0.026)	0.074 (0.028) ***	0.0002 (0.0003)	-0.028 (0.028)	0.062 (0.037) *
Extraversion	-0.001 (0.004)	0.010 (0.027)	0.050 (0.038)	0.0002 (0.0004)	0.001 (0.031)	0.036 (0.044)
Sociability	0.000 (0.004)	-0.023 (0.025)	-0.002 (0.036)	0.0004 (0.0003)	-0.007 (0.030)	0.028 (0.051)
Hostility	0.003 (0.003)	0.016 (0.020)	0.053 (0.030) *	0.0001 (0.0003)	0.028 (0.024)	-0.010 (0.032)
Self-confidence	0.016 (0.003) ***	0.040 (0.025)	0.067 (0.029) **	0.0009 (0.0003) ***	0.046 (0.031)	0.066 (0.034) *
Conscientiousness	0.002 (0.003)	-0.009 (0.020)	-0.004 (0.028)	-0.0000 (0.0003)	0.015 (0.026)	0.014 (0.037)
Family fixed effects	No	Yes	Yes	No	Yes	Yes
Genetic fixed effects	No	No	Yes	No	No	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Mean of the outcome	0.139	0.50	0.50	0.008	0.50	0.50
No. of observations	170,283	27,890	12,707	166,195	10,685	5,340

Notes: Standardized coefficients. DZ = dizygotic twins; MZ = monozygotic twins. Other controls include marital status, having underage children, field and level of education, and prior occupation and entrepreneurship status. The models in Columns 1 and 4 also include age, age squared, sex, and year indicators as controls. Personality traits were measured in 1981, prior occupation and entrepreneurship status were measured in 1975, and other control variables were measured in year  $t$  ( $t = 1990, \dots, 2009$ ). Standard errors are clustered at the individual level (Columns 1 and 4) or at the twin-pair level (Columns 2-3 and 5-6). Estimations were performed using the logit model (Columns 1 and 4) or the conditional (fixed effects) logit model (Columns 2-3 and 5-6). \*\*\* ( $p < 0.01$ ), \*\* ( $p < 0.05$ ), \* ( $p < 0.10$ ).

domain of self-confidence refers to a person's belief in their ability to successfully launch an entrepreneurial venture (McGee et al., 2009). In line with our results, these studies have shown that ESE is positively related to entrepreneurial intention, venture creation, and entrepreneurial performance (for a review, see Newman et al., 2019). In addition, general self-efficacy, which is not specifically related to the entrepreneurial domain, has been found to predict start-up performance and survival during the first years after business creation (Caliendo et al., 2023). In relation to self-confidence, previous research has also found that entrepreneurs, particularly

**Table 2**  
Personality traits and entrepreneurial success.

	Exit from entrepreneurship (1)	Exit from entrepreneurship within DZ twins (2)	Exit from entrepreneurship within MZ twins (3)	Log of entrepreneurial income (4)	Log of entrepreneurial income within DZ twins (5)	Log of entrepreneurial income within MZ twins (6)	Log of firm productivity (7)
Neuroticism	0.001 (0.003)	-0.015 (0.041)	0.023 (0.028)	0.043 (0.026)	-0.035 (0.064)	0.060 (0.095)	-0.037 (0.028)
Extraversion	0.005 (0.003) *	0.015 (0.055)	-0.031 (0.049)	-0.020 (0.032)	0.051 (0.070)	0.093 (0.089)	-0.015 (0.038)
Sociability	0.003 (0.003)	0.016 (0.056)	0.068 (0.034) **	0.003 (0.029)	-0.059 (0.076)	-0.060 (0.088)	0.004 (0.034)
Hostility	0.002 (0.002)	-0.023 (0.042)	0.025 (0.038)	0.002 (0.024)	0.038 (0.058)	0.080 (0.074)	0.013 (0.026)
Self-confidence	-0.006 (0.003) **	0.058 (0.049)	-0.072 (0.042) *	0.059 (0.026) **	0.002 (0.070)	0.188 (0.090) **	0.062 (0.034) *
Conscientiousness	-0.002 (0.002)	-0.097 (0.032)	0.026 (0.027)	-0.018 (0.023)	-0.078 (0.076)	-0.048 (0.084)	-0.007 (0.025)
Family fixed effects	No	Yes	Yes	No	Yes	Yes	No
Genetic fixed effects	No	No	Yes	No	No	Yes	No
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean of the outcome	0.074	0.50	0.50	9.27	...	...	11.26
No. of observations	22,009	4,999	2,574	19,007	4,079	2,276	2,779

Notes: Standardized coefficients. Other controls include marital status, having underage children, field and level of education, and prior occupation and entrepreneurship status. The models in Columns 1, 4, and 7 also include age, age squared, sex and year indicators as controls. Personality traits were measured in 1981, prior occupation and entrepreneurship status were measured in year  $t$  ( $t = 1990, \dots, 2009$ ). Standard errors are clustered at the individual level (Columns 1, 4, and 7) or at the twin-pair level (Columns 2–3 and 5–6). Estimations were performed using the logit model (Column 1), conditional (fixed effects) logit model (Columns 2–3), or OLS (Columns 4–7). \*\* ( $p < 0.05$ ), \* ( $p < 0.10$ ).

founder-managers, may even be overconfident (Forbes, 2005). Furthermore, sex differences in self-confidence may partly explain why more males than females have entrepreneurial careers (Kirkwood, 2009).

The twin design has limitations. In particular, the MZ twin design allows us to establish associations that are not induced by a shared family environment or genetics. However, there may also be other unobservable factors that affect both personality and entrepreneurial outcomes; therefore, results based on the twin approach may not reveal causal effects (e.g., Boardman and Fletcher, 2015). Another limitation of this approach is that potential measurement errors in personality traits may yield estimates that are more biased than those from ordinary cross-sectional analyses at the individual level (e.g., Bound and Solon, 1999). Finally, the possibility of reverse causality cannot be ruled out. To control for potential reverse causality, we used personality traits that were measured before the outcomes, and we also controlled for entrepreneurial status obtained from the 1975 survey (i.e., before the personality traits were measured). However, it is possible that entrepreneurial experiences before the measurement of personality affected self-confidence (Newman et al., 2019).

The main strength of this study is longitudinal data that were linked to register information on entrepreneurial outcomes. The longitudinal data, which covered 20 years, allowed us to examine long-term entrepreneurial success. Furthermore, register information eliminates potential biases related to self-reported measures. We also utilized the twin dimension of the data, which enabled us to control for unobserved shared genetic and family backgrounds that may otherwise have confounded the results.

## 5. Conclusion

High self-confidence may increase both the probability of being an entrepreneur and entrepreneurial performance. Earlier studies have shown that self-confidence, which is specifically related to entrepreneurship (i.e., ESE), may not be stable and can change (Newman et al., 2019). For example, Wilson et al. (2007) found that entrepreneurship education significantly increased the level of ESE in their study, particularly among females. Therefore, providing support that enhances people's self-confidence may promote both entrepreneurship and entrepreneurial performance in society.

## Author contribution

Terhi Maczulskij: Conceptualization, Methodology, Formal analysis, Writing – original draft; Writing – review & editing. Jutta Viinikainen: Conceptualization, Methodology, Writing – original draft, Writing – review & editing.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A

### Definition of entrepreneurship

In Statistics Finland's registers, entrepreneurs are defined as persons aged 18–74 who have a valid entrepreneur's pension insurance in the last week of the year and who are not unemployed, conscripts, or civil servants at the time. If a person has a valid employment relationship in addition to an entrepreneur's pension insurance, the entrepreneurial income must be higher than the salary income for a person to be defined as an entrepreneur. In addition, those persons whose entrepreneurial incomes exceed the defined income limit are classified as entrepreneurs if they are not retired. The income limit is defined annually by Statistics Finland using data on entrepreneurs from the Labor Force Survey.

## Appendix B

**Table B1**  
Rotated factor loadings.

Variable	Factor 1	Factor 2	Factor 3	Factor 4
Talkative	.724	.187	-.042	-.084
Expresses feelings	.684	-.053	-.180	.158
Open	.787	.076	-.064	.137
Social	.748	.062	-.101	-.052
Determined	.089	.718	-.136	.111
Self-confident	.162	.744	-.114	-.003

(continued on next page)



Table B1 (continued)

Variable	Factor 1	Factor 2	Factor 3	Factor 4
Dominant	.091	<b>.681</b>	.177	-.178
Ambitious	-.054	<b>.587</b>	.118	-.179
Quarrels often	.027	-.029	<b>.806</b>	-.014
Often angry	.010	-.023	<b>.889</b>	.045
Easily irritable	-.053	-.017	<b>.814</b>	.013
Hardworking	-.110	.378	-.007	<b>.418</b>
Always on time	-.243	.345	.034	<b>.474</b>
Honest	.032	-.051	.004	<b>.801</b>
Always tells the truth	.164	-.141	.034	<b>.784</b>
Factor name	<b>Sociability</b>	<b>Self-confidence</b>	<b>Hostility</b>	<b>Conscientiousness</b>

Note: High factor loadings are boldfaced.

Table B2

Summary statistics of the basic characteristics by employment status, 1990–2009.

	Entrepreneurs	Paid employees	t-test
<i>Personality traits</i>			
Neuroticism	-0.145	-0.044	4.09 ***
Extraversion	0.028	0.018	0.41
Sociability	-0.014	0.001	0.59
Hostility	-0.035	0.007	1.70 *
Self-confidence	0.175	0.021	6.32 ***
Conscientiousness	0.011	-0.054	2.69 ***
<i>Demographic characteristics</i>			
Female (indicator)	0.39	0.54	12.00 ***
Age	49.4	48.5	7.67 ***
Having children (<18 years old) (indicator)	0.42	0.40	2.98 ***
Married (indicator)	0.78	0.69	9.55 ***
Years of education	11.5	12.2	12.01 ***
No. of observations	23,685	146,598	

Notes: Standardized personality scores. The personality trait scores are based on the 1981 survey, and the means of the demographic characteristics are based on the register data covering the years 1990–2009. The t-tests for equal group means by employment status are clustered at the individual level. \*\*\* $p < 0.01$ , \* $p < 0.10$ .

Table B3

Within-twin differences in personality and entrepreneurship in absolute values.

	Within DZ twins	Within MZ twins
Entrepreneur	0.203	0.157
Neuroticism	0.985	0.831
Extraversion	1.007	0.777
Sociability	1.080	0.798
Hostility	1.047	0.893
Self-confidence	14.003	0.844
Conscientiousness	1.010	0.871

Table B4

Full results of the model presented in Table 1, column 1 (marginal effects).

	Entrepreneurship
Neuroticism	0.002 (0.003)
Extraversion	-0.001 (0.004)
Sociability	0.000 (0.004)
Hostility	0.003 (0.003)
Self-confidence	0.016 (0.003) ***
Conscientiousness	0.002 (0.003)
Female	-0.037 (0.007) ***
Age	0.003 (0.002)
Age <sup>2</sup> /100	-0.003 (0.002)
Married	0.034 (0.005) ***
Having children (<18 years old)	0.021 (0.005) ***
Education level	
Secondary education	-0.024 (0.020)
Lowest level tertiary	-0.018 (0.023)
Lower degree level tertiary	-0.081 (0.021) ***
Higher degree level tertiary	-0.048 (0.023) **
Field of education	
Education	-0.062 (0.024) **
Arts and humanities	-0.009 (0.028)
Social sciences and business	-0.003 (0.019)

(continued on next page)

Table B4 (continued)

	Entrepreneurship
Natural sciences	-0.092 (0.022) ***
Technical fields	0.015 (0.019)
Agriculture and forestry	0.154 (0.031) ***
Health and welfare	-0.027 (0.019)
Services	0.031 (0.021)
Entrepreneur in 1975	0.428 (0.021) ***
Occupation category in 1975	Yes
Year indicators	Yes
Family fixed effects	No
Genetic fixed effects	No
Mean of the outcome	0.139
No. of observations	170,283

Notes: Standardized coefficients for personality traits. Personality traits were measured in 1981, prior occupation and entrepreneurship status were measured in 1975, and other control variables were measured in year  $t$  ( $t = 1990, \dots, 2009$ ). Reference categories for the level and field of education: primary education level and general or unknown field. Standard errors are clustered at the individual level. Estimation was performed using the logit model. \*\*\* ( $p < 0.01$ ), \*\* ( $p < 0.05$ ).

## Appendix C

To illustrate the correlations between non-shared life experiences and twin personalities, Table C1 reports the within-MZ correlations between differences in personality traits and differences in life events. The items of life events that we focus on are 1) emotional closeness with childhood family members assessed in 1981 on a 5-point scale, 2) an individual's health status measured using information on the number of diagnosed diseases in 1975, 3) unemployment shock due to illness or injury measured in 1975, 4) health shock within a family that occurred before 1981 (death of a spouse, serious illness of a family member, and death of a close family member or a friend), and 5) partnership problems that occurred before 1981 (divorce, separation, or sexual difficulties).

The results show that emotional closeness with parents is significantly related to twins' differences in personality scores. For example, the twin with a closer relationship with a parent has lower scores in hostility and neuroticism, whereas the reverse is true for extraversion, sociability, self-confidence, and conscientiousness. The twins who report more diagnosed diseases and partnership problems also report higher scores in neuroticism. The twins who have experienced unemployment shock due to illness or an injury report lower scores in sociability and self-confidence and higher score in conscientiousness. Based on these results, health or death shock within a family is not related to twins' differences in personality traits. We note that there should be no causal interpretations of these associations, but the results imply that MZ differences in personality traits may be related to non-shared environmental experiences. These results are in line with those of previous studies, which found that family relationships and stressful life events could shape personality (e.g., Baker and Daniels, 1990; Torgensen and Janson, 2002).

Table C1

Correlations between differences in personality traits, emotional closeness with family members, and life shocks within MZ twins.

	Within-MZ twin pair differences						
	Emotional closeness with father	Emotional closeness with mother	Emotional closeness with siblings	Number of diseases	Unemployment shock caused by illness or injury	Health shock within a family	Partnership problems
Neuroticism	-0.073 ***	-0.040 *	-0.012	0.053 **	0.102	0.012	0.166 ***
Extraversion	0.076 ***	0.043 *	0.023	0.006	-0.062	0.012	-0.049
Sociability	0.083 ***	0.051 **	0.007	0.032	-0.129 *	0.047	0.010
Hostility	-0.089 ***	-0.112 ***	-0.084 ***	0.001	-0.065	-0.012	0.051 *
Self-confidence	0.096 ***	0.047 **	0.007	-0.006	-0.157 **	0.022	-0.042
Conscientiousness	0.090 ***	0.125 ***	0.059 ***	-0.032	0.146 **	-0.030	-0.090 ***

Notes: Personality traits and emotional closeness with family members were measured in 1981; number of diseases and unemployment caused by illness or injury were measured in 1975. Health shock and partnership problems were measured in 1981, but they refer to retrospective information on the occurrence of life events before 1981. \*\*\* ( $p < 0.01$ ), \*\* ( $p < 0.05$ ), \* ( $p < 0.10$ ).

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