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Founder Personality and Start-up Subsidies

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ABSTRACT

Start-up subsidies play an important role in supporting start-up innovation and performance. However, what characteristics help and hinder start-ups to seek public subsidies remains unclear. We study whether and how founder personality links to entrepreneurs' seeking of start-up subsidies. We argue that greater founders' openness, extraversion, and entrepreneurial orientation enhance seeking of start-up subsidies, while greater founders' agreeableness, conscientiousness, and neuroticism inhibit it. Additionally, we argue that entrepreneurial orientation plays a mediating role in the relationship between big five personality traits and start-up subsidies. We find evidence for a positive role of founder entrepreneurial orientation. While we find little evidence for a direct association between founders' big five personality and subsidies, we document an indirect link through entrepreneurial orientation. We also show that personality is not associated with bank financing and borrowing from family and friends while the patterns for venture capital financing are similar to those for subsidies.

KEYWORDS

Start-up subsidies; start-up financing; entrepreneurship policy; entrepreneurial orientation; big five personality traits; venture capital

JEL CODES

G24; L26; O25; O31

1. Motivation and Introduction

Start-ups can play a crucial role in innovation and economic growth, and in turn, generate societal benefits (Haltiwanger, Jarmin, and Miranda 2013). Yet, financial constraints due to limited internal resources and difficulties accessing external finance often hinder start-up innovation and success (Ostgaard and Birley 1994; Vaznyte and Andries 2019). In pursuit of societal benefits, governments have implemented start-up subsidy programmes (Lee, Hwang, and Kim 2022; Zhao and Ziedonis 2020) that aim to alleviate financial constraints to promote innovation (Mina et al. 2021). While start-up subsidies have received limited research attention (Audretsch et al. 2020), the few existing studies confirm their importance in alleviating financial constraints and driving innovation success (Conti 2018; Hottenrott and Richstein 2020). Moreover, as concerns are raised about the effectiveness of alternative interventions (e.g. angel investors tax credits (Denes et al.

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2020), the importance of subsidies for driving start-up innovation and performance has heightened (Buchmann and Kaiser 2019; Heijs, Guerrero, and Huergo 2022). The growing relevance of start-up subsidies begs the vital question of what characteristics influence founders' willingness to seek financial support from subsidy programmes and, hence, whether these programmes reach those entrepreneurs who can make most use of them.

The literature on start-up financing has documented the role of founder characteristics (e.g. experience) and firm attributes (e.g. innovative activities) in founders' ability to access venture capital and bank finance (Bruneel et al. 2020; Caliendo, Künn, and Weissenberger 2020). Emerging, but scant, work also documents their role in start-up subsidies (Cantner and Kösters 2012; Chapman and Hewitt-Dundas 2018; Hottenrott and Richstein 2020; Mina et al. 2021). A largely omitted factor in this literature, however, has been the role of founder personality. Personality reflects an individual's habitual and enduring patterns of cognition and behaviour, and thus, influences general orientation towards decisions and actions (Chatterjee 2014). Innovation and entrepreneurship research has mainly used the concept to examine how founders differ from managers and to study performance and innovation consequences (Rauch and Frese 2007; Zhao, Seibert, and Lumpkin 2010). The role of founder personality in start-ups' access to finance remains largely unknown (Vaznyte and Andries 2019), however; and to the best of our knowledge, the role of founder personality in the context of start-up subsidies has not been studied so far. This omission is striking given the critical role of access to finance for start-up innovation and survival.

In response to this research gap, this paper investigates whether and how founder personality influences start-ups' access to subsidies. We first draw on the social psychology and innovation literatures to theorise the influence of founder *baseline* personality on start-up subsidies. Specifically, we focus on the big five traits (openness, conscientiousness, extraversion, agreeableness, and neuroticism) as they comprehensively capture the most basic personality dimensions (Bainbridge, Ludeke, and Smillie 2022; McCrae and John 1992). We theorise that some of the big five personality traits – such as openness to experience – enhance start-ups' generation of novel ideas and founders' awareness of opportunities to pursue with start-up subsidies and that are worthy of funding. Moreover, we expect a higher growth orientation in founders with certain traits that increase their incentives to seek subsidies. Secondly, we draw on the entrepreneurship literature to theorise the influence of founders' *entrepreneurial* personality on start-up subsidies. Specifically, we focus on founders' entrepreneurial orientation (innovativeness, proactiveness, risk-taking, competitiveness, autonomy) as it effectively captures predispositions towards innovation and entrepreneurship (Anderson et al. 2015; Engelen et al. 2015). While traditionally conceptualised as a firm-level phenomenon, recent work has extended entrepreneurial orientation to the individual level (Covin et al. 2020; Krueger and Sussan 2017). As personality and entrepreneurial orientation both focus on enduring patterns in cognition and behaviour (Wales, Covin, and Monsen 2020), we capture founders' *entrepreneurial* personality using the entrepreneurial orientation construct. We theorise that founder entrepreneurial orientation aids in developing novel opportunities that align with the desires of funding agencies, in selling innovative opportunities to policymakers, and in encouraging resource-consuming dispositions that increase start-up incentives to seek subsidies.

Some evidence supports the role of founder personality and entrepreneurial orientation in shaping start-up innovation decision-making and performance (Rosenbusch, Rauch, and Bausch 2013; Zhao, Seibert, and Lumpkin 2010). It seems therefore crucial to further investigate how founders' baseline and entrepreneurial personality matters in start-ups' access to subsidies. While there may be direct effects from both constructs on founders' seeking subsidies, baseline personality as captured by the big five traits may also be a determinant of entrepreneurial personality. We, therefore, hypothesise that there is an indirect (mediated) effect of founder baseline personality traits on start-up subsidies via founders' entrepreneurial orientation. Investigating the mediating role of entrepreneurial orientation responds to the calls for a deeper examination of mediating variables between baseline personality traits and start-up behaviours (Baum and Locke, 2004; Rauch and Frese 2000). We argue that higher openness and extraversion are associated with greater entrepreneurial orientation by providing a favourable environment and mindset for innovation and entrepreneurship. In turn, stronger entrepreneurial orientation facilitates greater incentives to seek subsidies and facilitates more innovative and novel opportunities that are worthy of funding. Conversely, founder conscientiousness, agreeableness, and neuroticism inhibit entrepreneurial orientation by providing a less favourable environment and mindset for entrepreneurship and innovation, and in turn, the lower levels of entrepreneurial orientation reduce the likelihood to seek start-up subsidies.

We study a large sample of founders in start-ups created in Germany between 2007–2017 in manufacturing and service sectors. About 15% received some form of start-up subsidy[1] The results show little evidence for a direct effect of founder baseline personality on start-up subsidies, but strong evidence for a positive link between entrepreneurial orientation and subsidies. Additionally, we find that baseline personality indirectly links to start-up subsidies through its influence on entrepreneurial orientation. Thus, our results suggest that founder personality plays an important role in their start-ups' seeking subsidies as an early mode of financing, but the effect is indirect, i.e. fully mediated by entrepreneurial orientation. In additional analyses, we benchmark these findings against those for other sources of early-stage financing: venture capital (VC), family and friends, and banks. Unlike for subsidies, we do not find any role of baseline personality (neither direct nor indirect) for raising money from family and friends or from commercial banks. Interestingly, we find similar patterns for VC financing as for subsidies with baseline personality driving entrepreneurial orientation which positively increases the odds of having VC financing. Our results stress the role of entrepreneurial orientation as a mechanism through which baseline personality shapes start-up financing and thereby illustrate the role of founder personality in determining participation in innovation policy programmes.

2. Start-up Subsidies and Personality

A growing literature has investigated what helps and hinders firms to seek subsidies. Unravelling these factors is important to understand which firms can access subsidies, potential barriers, the implicit or explicit selection criteria, and whether potentially

[1]See section 3.1 for more details on public sources of start-up financing in Germany..

Table 1. Description of the Big Five and Entrepreneurial Orientation.

	Description
Big Five *(e.g. George and Zhou 2001; McCrae and John 1992; Zhao and Seibert 2006)*	
Openness to experience	Extent to which founders are imaginative, curious, and open to novel and unconventional ideas, perspectives, and experiences.
Conscientiousness	Extent to which a founder is diligent, persistent, and motivated.
Extraversion	Extent to which a founder is assertive, active, and enthusiastic.
Agreeableness	Extent to which a founder is altruistic, caring and emotionally supportive.
Neuroticism	Extent to which a founder is emotionally stable (e.g. calmness; anxious) and adjusts well.
Entrepreneurial Orientation *(e.g. Covin et al. 2020; Lumpkin and Dess 1996; Pearce, Fritz, and Davis 2010)*	
Competitiveness	Willingness to directly challenge and risk conflict with competitors to grow and succeed.
Innovativeness	Extent to which a founder engages in and supports novelty, new ideas and experimentation.
Autonomy	Extent to which a founder acts, decides, and works independently to bring forth their vision.
Proactiveness	Extent to which a founder seeks and exploits new opportunities and innovations to be ahead of competitors.
Risk tolerance	Willingness to engage in risky behaviours and make resource commitments with uncertain outcomes.

attractive candidates are missing out; thus, reducing programme effectiveness (Blanes and Busom 2004). Most research has focused on the role of firm characteristics, such as prior subsidy receipt, firm age, R&D intensity, and human capital in subsidy participation (Chapman, Lucena, and Afcha 2018; Mina et al. 2021; Segarra-Blasco and Teruel 2016) with an emerging focus on founder characteristics given their key role in start-up innovation and success (Chapman and Hewitt-Dundas 2018; Rojas and Huergo 2016). Yet the role of founder personality remains unknown. Personality reflects dimensions of difference between individuals by capturing their enduring and overarching patterns of cognition and behaviour (Brandstätter 2011; Smith et al. 2018). Personality shows a high degree of stability across time and context (Roccas et al. 2002), and thus, reflects a founder's general orientation and propensity to respond and act in a particular way across various situations (McCrae and Costa, 1997; Rauch and Frese 2007). We focus on the big five personality traits (openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (Bainbridge, Ludeke, and Smillie 2022; McCrae and John 1992) to capture founders' baseline personality and founder entrepreneurial orientation (competitiveness, innovativeness, autonomy, proactiveness, and risk tolerance) to capture their entrepreneurial personality (Lumpkin and Dess 1996; Wales, Covin, and Monsen 2020). Table 1 provides descriptions for these elements of personality which have been shown to shape decision-making, innovation, and performance.

2.1. Big Five Personality Traits and Start-up Subsidies

We expect two founder personality traits – openness to experience and extraversion – to positively influence the likelihood of seeking start-up subsidies. Founders scoring high on openness to experience are intellectually curious and tend to seek and explore novel experiences, opportunities, ideas, and ways to improve existing behaviours and offerings (Zhao and Seibert 2006). More open founders will proactively seek out and search for new knowledge, technology, and opportunities outside of their start-up, and search more broadly, following unique and unusual search paths due to their curiosity and imagination. The broader search and explorative behaviours of highly open founders will give rise to

greater numbers of valuable and innovative opportunities being identified that can be utilised to seek start-up subsidies and that will be more positively received by policymakers seeking novelty and innovation (Audretsch et al. 2020). Founder openness is also characterised by a proclivity to bring about innovative and entrepreneurial change that results in high growth and performance orientations that are heavily resource-consuming (Brandstätter 2011; Zhao, Seibert, and Lumpkin 2010). The greater resource needs to initiate and feed their growth and innovation orientations should increase highly open founders' likelihood of seeking opportunities for start-up subsidies to fund their activities (Yin, Hughes, and Hu 2021).

Start-ups with extraverted founders may produce higher numbers of novel and innovative opportunities that align with the wants of start-up subsidies. Extroverts tend to seek excitement and stimulation in their behaviours (McCrae and John 1992), and thus, have strong tendencies to seek out and experiment with new and radical opportunities and to be curious about existing tasks, ideas, and behaviours, and proactively seek to change and improve them (Guo et al. 2021; Sung and Choi 2009). Extroverts also embrace and tolerate risk in their behaviours and actions, which supports their ability to seek out and explore new opportunities (Chapman and Hottenrott 2022; Oehler and Wedlich 2018). Their high sociability and proactive and talkative nature increase their ability to socialise and proactively form networks with important partners (e.g. customers, suppliers, universities) to access innovative knowledge and opportunities for their start-up to pursue (Zhao and Seibert 2006). The strong networking and innovativeness of extroverts, coupled with their ambitious, energetic, and proactive nature, produces a strong proclivity for the pursuit of innovative opportunities to drive growth and performance (Brandstätter 2011; Zhao, Seibert, and Lumpkin 2010). As above, the greater resource needs embodied in this strong growth and innovation orientation should increase start-ups with extraverted founders' incentives to proactively seek start-up subsidies. Thus, we hypothesise:

H1a: *Start-ups with founders who are (a) more open to experience and (b) more extrovert are more likely to seek start-up subsidies.*

We expect three founder personality traits – conscientiousness, agreeableness, and neuroticism – to negatively influence the likelihood of seeking start-up subsidies. While high conscientiousness can be desirable for entrepreneurship (Zhao, Seibert, and Lumpkin 2010), conscientious founders can be characterised by a lack of creativity and innovativeness (Guo et al. 2021; Sung and Choi 2009). Such founders possess a stronger commitment to current norms and can avoid uncertainties and experimentation in pursuit of efficiency, which inhibits creativity and innovativeness (George and Zhou 2001). Yet, creativity and experimentation are the foundation of the identification and generation of novel opportunities (Gielnik et al. 2012; Sarooghi, Libaers, and Burkemper 2015). They also enable founders to see solutions and knowledge spaces in a new way and recombine and change them to generate novel ideas (Anderson, Potočnik, and Zhou 2014). The lower production of innovative ideas in start-ups with more conscientious founders may reduce their likelihood of possessing opportunities that align with the aims of start-up subsidies and that would be positively received by policymakers (Audretsch

et al. 2020). On the other hand, as subsidies offer a path to finance while minimising cost and risk, highly conscientious founders could be more inclined to seek subsidies. As such, while we anticipate a negative link of conscientiousness to seeking start-up subsidies, theory is unclear ex-ante as arguments for both a positive and negative role of conscientiousness may be at work.

High founder agreeableness may also inhibit creativity, innovativeness and the production of novel ideas and the pursuit of opportunities. Agreeable founders tend to avoid conflict and tension with others, instead prioritising harmony and agreement (Guo et al. 2021). Such behaviours can make it difficult for agreeable founders to generate and express ideas that are novel, innovative, and different from others (De Dreu 2006; Sung and Choi 2009). Even when novel and innovative ideas are generated, highly agreeable founders may lack the self-interest and determination to pursue start-up subsidies to fund their idea (Zhao and Seibert 2006). Start-ups with highly agreeable founders may also have weaker growth and success orientations (Zhao, Seibert, and Lumpkin 2010) that can lessen their incentives to seek subsidies to acquire the resources needed to initiate growth and innovation plans (Chapman and Hottenrott 2022; Yin, Hughes, and Hu 2021).

Neurotic founders may struggle with new and unexpected challenges, and activities with highly uncertain outcomes (Oehler and Wedlich 2018). Their lower levels of emotional stability and stronger pessimism makes it more difficult for them to cope with the associated psychological stress and encourages them to attend more to the possible negative outcomes of activities. Identifying and developing innovative opportunities requires founders to successfully engage in a novel and risky process, that presents unexpected challenges and tribulations, and has an uncertain distribution of potential outcomes (Chapman and Hewitt-Dundas 2018). Thus, high founder neuroticism may inhibit their production of novel and innovative ideas, and in turn, their likelihood to have opportunities that fit with start-up subsidies. Founder neuroticism is also linked to lower start-up growth and success orientation (Brandstätter 2011; Zhao, Seibert, and Lumpkin 2010), and thus, a lower need to seek subsidies to acquire the resources typically needed to exploit growth and innovation opportunities. Thus, we hypothesise:

H1b: *Start-ups with founders who are (a) more conscientious, (b) more agreeable, and (c) more neurotic are less likely to seek start-up subsidies.*

2.2. Founder Entrepreneurial Orientation and Start-up Subsidies

We expect entrepreneurial orientation to positively influence the likelihood of seeking start-up subsidies for three reasons. First, greater entrepreneurial orientation aids founders in developing innovative and novel opportunities (Pérez-Luño, Wiklund, and Cabrera 2011) that fit with the wants of subsidies and will be positively received by policymakers. Entrepreneurial orientation predisposes founders to embrace risk and allocate support to the development and pursuit of novel and innovative opportunities in their start-up. In doing so, it creates a climate of entrepreneurship and innovation that favours the proactive pursuit of novel and breakthrough opportunities to drive growth and outperform competitors (Pérez-Luño, Wiklund, and Cabrera 2011). Such founders proactively scan their environments and monitor developments in knowledge and technology to identify novel trends and opportunities to serve customers and stay

ahead of their competitors (Kim and Ahn 2020). As seeking external financing requires the disclosure of proprietary ideas in the application (Vaznyte and Andries 2019), founder entrepreneurial orientation should also increase founders' willingness to embrace the associated expropriation risk and apply.

Discourse approaches increasingly show how founder entrepreneurial orientation is communicated through their (firm's) written communications to stakeholders (McKenny et al. 2018; Mousa, Wales, and Harper 2015). As Wales et al. (2020, 7) posit, founders signal their entrepreneurial orientation 'via the verbiage used in speeches and publicly available document[s]'. Thus, we argue that founders signal their entrepreneurial orientation to policymakers via their description of their opportunity, their need for financing, and their competitive advantage, in their start-up subsidy application. Founders with high entrepreneurial orientation will write with more optimistic (e.g. change, discover, imagine), ambitious (e.g. bright-idea, game changing, revolutionise), experimental (e.g. explore, experiment), future-oriented (e.g. foresee, forward-looking, proactive), and entrepreneurial (e.g. creator, discover, create) tones in their subsidy application and focus their prose on more exploratory and radical paths to growth and success (Mousa, Wales, and Harper 2015; Short et al. 2010). Whereas those with low entrepreneurial orientation may adopt more conservative and cautious language in describing their project, its impacts, and importance. The prose of founders with higher entrepreneurial orientation should align better with start-up subsidies desires for innovative and novel opportunities that can generate societal benefits, and thus, be more attractive for seeking subsidies.

Finally, founder entrepreneurial orientation induces a competitive and innovative proclivity that drives firm performance and growth (Choi and Williams 2016; Kerr, Kerr, and Xu 2018; Rauch and Frese 2007; Rosenbusch, Rauch, and Bausch 2013; Zhao, Seibert, and Lumpkin 2010). The proclivity is demanding on resources, and thus, start-ups with founders with higher entrepreneurial orientation have greater need for resources to underpin their innovative and growth trajectories. Such founders have greater incentives to seek out opportunities for start-up subsidies to acquire the resources needed to underpin their innovation and growth plans (Covin and Slevin 1991). Innovation success may also not offset their greater need for resources as identifying and exploiting novel opportunities may require greater resources over time (Hottenrott and Peters 2012), thus, embedding their resources needs and incentives to seek start-up subsidies over the long-term. Thus, we hypothesise:

H2: *Start-ups with founders who have higher entrepreneurial orientation are more likely to seek start-up subsidies.*

2.3. The Mediating Role of Founder Entrepreneurial Orientation

We have argued that both big five traits and entrepreneurial orientation may influence the seeking of start-up subsidies. However, this assumes that both personality constructs are independent from each other. Yet it seems plausible to argue that baseline personality links to entrepreneurial orientation. We therefore argue that the general patterns of behaviour and cognition reflected in the big five personality traits influence start-up subsidies through their influence on the

innovation, entrepreneurship and growth predispositions reflected in founder entrepreneurial orientation. We expect entrepreneurial orientation to mediate the positive relationship between a) openness to experience and b) extraversion, and start-up subsidies. The explorative, curious and novelty seeking dispositions of founders with high openness and extraversion (Zhao and Seibert 2006) should stimulate their entrepreneurial orientation by providing a favourable environment and mindset for entrepreneurial and innovative pursuits. These general dispositions favour forward-looking and proactive search and experimentation for radical and innovative solutions and opportunities in their activities (Guo et al. 2021; Sung and Choi 2009). Equally, they tolerate risk (Oehler and Wedlich 2018) and thus, support the pursuit of novel and innovative ideas and actions. Collectively, our discussion suggests that founder openness to experience and extraversion should favour entrepreneurial orientation. The greater levels of entrepreneurial orientation supported by high founder openness and extraversion in turn should give rise to greater identification and generation of novel and innovative opportunities, and more innovative and growth-oriented proclivities that increase founders' incentives to seek start-up subsidies. Thus, we hypothesise:

H3a: *The relationship between founder (a) openness to experience, (b) extraversion, and start-up subsidies will be positively mediated through founder entrepreneurial orientation.*

On the other hand, we second expect founder conscientiousness, agreeableness and neuroticism to inhibit founders' entrepreneurial orientation. Conscientious founders possess a stronger commitment to current norms and a stronger avoidance of uncertainties and experimentation in favour of efficacy (George and Zhou 2001). As entrepreneurial orientation is often characterised by trial and error experimentation, high levels of uncertainty, and a desire to innovate and improve current offerings, the commitment to the status quo and uncertainty avoidance embodied in conscientiousness is likely to be unfavourable for entrepreneurial orientation (Pérez-Luño, Wiklund, and Cabrera 2011). Agreeable founders' avoidance of conflict and tension, and prioritisation of harmony and agreement (Guo et al. 2021; Sung and Choi 2009), and neurotic founders struggle with novelty and uncertainty (Oehler and Wedlich 2018), should equally prove unfavourable for their entrepreneurial orientation. Such founders are unlikely to favour the innovative and risk-tolerant dispositions embodied in entrepreneurial orientation, instead likely preferring to prioritise the status quo and the minimisation of uncertainty (Brandstätter 2011). The resulting lower entrepreneurial orientation induced by high founder conscientiousness, agreeableness, and neuroticism, will in turn hamper the identification and generation of novel and innovative opportunities.Thus:

H3b: *The relationship between founder (a) conscientiousness, (b) agreeableness, (c) neuroticism, and start-up subsidies will be negatively mediated through founder entrepreneurial orientation.*

The conceptual framework summarising our hypotheses is shown in Figure 1.

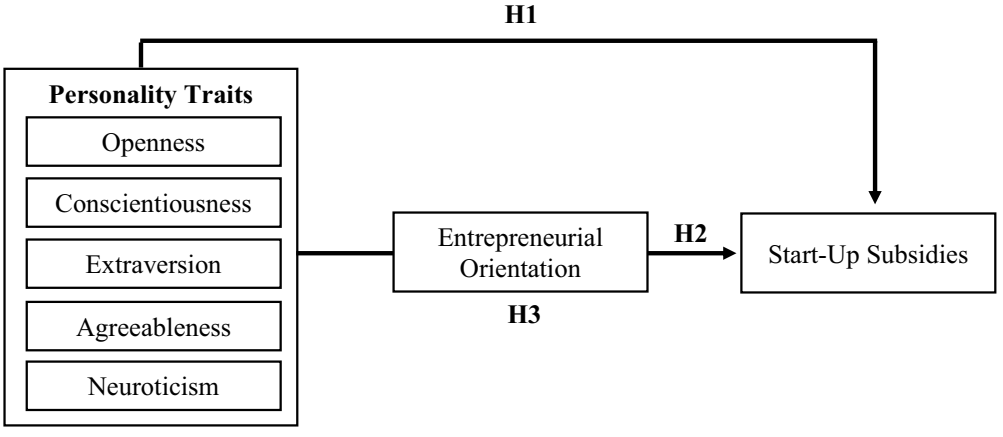

Figure 1. Personality Traits, Entrepreneurial Orientation, and Start-up Subsidies.

3. Data

We build our analysis on detailed data of newly founded, legally independent businesses in Germany collected by the IAB/ZEW Start-up panel.[2] For testing the hypotheses, we use those survey waves that contain information on founder personality. The waves collected in the years 2014 to 2017 contain questions on entrepreneurial orientation and the waves 2018 and 2019 the questions on the baseline personality traits. Since the panel is designed such that it surveys founders annually, but only asks personality-related questions once, we use the personality information for firms that were included in the panel at least twice during the relevant years, so that we capture both sets of responses.

In total, we use information on founders in 2,179 unique start-ups founded between 2007 and 2017. The dataset contains quantitative and qualitative information about the founder(s) such as experience, education, and gender. Firm-specific information (e.g. legal form, exporting activity, R&D expenditures, and profits, financing sources) as well as information on whether the firm had obtained some form of public start-up subsidy.

3.1. Measurement and Variables

We focus on two dominant categorisations of founder personality, namely the big five to capture baseline personality, and entrepreneurial orientation to capture entrepreneurial personality. Theoretically, as illustrated in Table 1, we understand founder big five and entrepreneurial orientation to be multi-dimensional constructs and thus, we construct them as each consisting of five individual components (Covin and Wales 2012; Lumpkin and Dess 1996; McAdams 1992). Both the big five personality traits and entrepreneurial orientation are measured based upon previously established item scales (Covin and Slevin 1989; Vaznyte and Andries 2019). The corresponding survey questions are shown in appendix Tables A1 and A2, respectively. We validate the multi-dimensional conceptualisations of both big five and entrepreneurial orientation (EO) in our data

[2]A stratified random sample of newly registered firms is interviewed via computer-aided telephone survey each year since 2008. See Fryges et al. (2009) for a detailed description of the survey design.

using factor analysis.[3] The results indeed confirm a five factor solution for the baseline personality and a one-dimensional solution for entrepreneurial orientation in line with results by Vaznyte and Andries (2019) for the latter (see Tables A4, A5, and A6, and Figure A1 for details). The measures used in the main analysis are obtained as the predicted scores for each factor.

We deploy a binary subsidy indicator as our main dependent variable. This indicator takes the value of one if the start-up received some form of public financing which included grants, favourable (subsidised) loans or both. Start-ups subsidies are offered by several agencies at the federal and state level in Germany. Subsidised loans are typically granted by the KfW Banking Group (Germany's largest state-owned promotional bank) or by regional (publicly-backed) banks. They provide more favourable conditions in terms of interest rates, collateral requirements, and repayment compared to commercial loans. Besides loans, start-up support often takes the form of grants or stipends which are intended to serve as a salary supplement or substitute for founders. Such grants are typically provided by the Federal Employment Agency and by federal and state governments (e.g. the *Berlin Startup Stipend* or Hamburg's *Innofounder* programme) and comprise monthly payments of up to several thousand euros.[4] While the former address founders in general, some programmes have special requirements such as having links to universities such as the EXIST programme organised by the German Federal Ministry for Economic Affairs and Climate Action (BMWK).[5] In the following, we pool these types of programmes because of their common purpose of providing additional financial resources to founders while all requiring some form of application procedure.

As personality may also be captured or conveyed via observable founder and firm characteristics (e.g. the founder of a start-up with significant R&D intensity may be capturing or inferring innovativeness, proactiveness and openness to experience), we comprehensively account for the role of observable founder and firm characteristics in our models to disentangle what explanatory power founder personality characteristics add over and above the founder and firm observable characteristics that are typically observable to the researcher. Moreover, we account for other direct drivers into subsidies programmes such as founder human capital and experience. We include important indicators such as (previous) profits and exporting. Table A8 presents the distribution of firms in the sample across sectors by status of subsidy receipt.

Table 2 shows descriptive statistics for the personality measures as obtained from the survey (average item scores by construct) and for the subsidy indicators and controls (see Table A7 for definitions and Table A10 for correlations between variables). When looking at the correlations for founder baseline and entrepreneurial personality traits, we find extraversion and openness to be positively correlated with entrepreneurial orientation, whereas, neuroticism, agreeableness and conscientiousness are negatively related (see Table A9).

[3]Tables A3 to A6 show details for the two factor analyses. Figure A.1 shows the density distribution of the big five scores and EO.

[4]Different programs and current amounts are listed on https://gruenderplattform.de.

[5]See Hottenrott and Richstein (2020) for a discussion on differences between loan-based and grant-based programs and more details on the programme 'EXIST – University-based Business Startups'.

Table 2. Descriptive statistics.

Variable	Mean	Std. Dev.	Min	Max
Subsidy information				
Subsidy	0.145	0.352	0	1
Personality				
Openness	3.721	0.732	1	5
Conscientiousness	4.243	0.628	1	5
Extraversion	3.834	0.728	1	5
Agreeableness	4.006	0.672	1	5
Neuroticism	2.389	0.759	1	5
EO	2.711	0.650	1	5
Controls				
Female	0.173	0.378	0	1
Opportunity driven	0.850	0.357	0	1
University degree	0.516	0.500	0	1
Founder age	44.942	10.123	18	99
Failure experience	0.029	0.167	0	1
Serial entrepreneur	0.420	0.494	0	1
Industry experience	18.102	10.156	1	58
Profit	0.665	0.472	0	1
ln(R&D)	2.561	4.506	0	14.509
ln(employees)	1.351	0.656	0	5.185
Team	0.258	0.437	0	1
Exporter	0.215	0.411	0	1
Cohort (firm age)	3.422	1.718	1	7
Limited liability	0.557	0.497	0	1
East Germany	0.139	0.346	0	1

Note: 9,633 firm-year observations (2,179 unique firms). Average item scores shown for personality traits and EO.

4. Methods and Results

Given the nature of start-up subsidies and public funders' predominant pursuit of societal benefits and additionality, we expect that – besides founders' personality – observable founder and firm characteristics that reflect the start-ups innovation potential likely play an important role in start-up subsidies. We therefore investigate the role of a founder's personality for the likelihood to seek a subsidy by first including only the key variables of interest and in a subsequent step, founder and company characteristics which have been linked to public start-up subsidies in previous studies (e.g. Chapman and Hewitt-Dundas 2018; Hottenrott and Richstein 2020; Hottenrott, Lins, and Lutz 2018; Rojas and Huergo 2016). While it is important to account for these characteristics to isolate the role of personality, we need to assume that these variables are not too strongly determined by personality traits as this could lead to misspecification and endogeneity of the controls. To test whether the inclusion of the controls affects the main conclusion regarding personality due to such misspecification, we present specifications with and without controls.[6] Most characteristics are time-invariant and the others are measured in the year prior to the subsidy.

To investigate the mediating effects of entrepreneurial orientation (EO) on start-up subsidies, we first test the direct relationship between big five personality traits and subsidies (H1a, H1b). Next, we establish that there is a significant relationship between big five personality traits and EO before we investigate the mediating role of EO in the

[6]Note that we also tested various specifications with fewer controls and the conclusions regarding the traits were robust to alternative specifications in terms of the signs of the coefficients and their statistical significance.

link between baseline personality and subsidies. Since the big five traits have been shown to be quite stable over time, we can assume them to be exogenous and their value should not depend on the time of measurement in the survey.[7] Hence, we estimate the mediation model using structural equation modelling following Zhao et al. (2010) in which we estimate the direct and indirect paths simultaneously so as to estimate either effect while partialling out the other one. We use the Monte Carlo approach to testing of the statistical significance of the Average Causal Mediated Effects (ACME), i.e. the indirect effect, with the number of Monte Carlo replications set to the number of observations in each case.

4.1. Results

Tables 3 shows the results for the mediation model. Model 1 presents the direct effects of personality on subsidies without controlling for firm and founder characteristics, including only time and industry fixed effects. The big five traits are jointly insignificant [$chi^2(5) = 3.06$]. This suggests that we cannot find support for our Hypotheses 1a and 1b in the data. In line with this test, also the individual coefficients for the five traits are small and statistically insignificant. Models 2 and 3 show the mediation model results with Model 3 accounting for the full list of control variables. The test for joint significance of the big five traits in the EO-equations suggests that they are jointly significant [$chi^2(5) = 114.57^{***}$] even after controlling for other drivers of EO and the signs of the individual traits remain as in Model 1. Unlike for the big five traits, we find that EO is a strong predictor of subsidies. In line with Hypothesis 2, we find that founders with higher EO are more likely to seek public start-up subsidies. A one standard deviation increase in the EO score, increased the probability of public start-up subsidies by 2 percentage points in Model 3 after including control variables, on average. Note that the mean of the subsidy indicator is 14.5 so that the average effect corresponds to a 14% increase the probability to seek start-up subsidies.

Regarding our mediation hypotheses, we find support for H3a because both openness and extraversion are positively associated with EO and EO is positively linked to subsidies. For the traits of neuroticism and agreeableness, we find – as hypothesised in H3b – that these traits negatively predict EO, while EO is positively linked to subsidies. The coefficient for conscientiousness is negative, but statistically insignificant once we control for founder characteristics beyond personality. Regarding the magnitudes of the impact of different standardised scores of the big five traits on EO, we find that neuroticism has the largest negative association with EO while openness has the largest positive one.

To summarise, we find no evidence of a direct association between the big five traits and subsidies, but a significant link between the big five traits and EO. In particular, a positive and significant relationship between openness and extraversion and EO and a negative association between agreeableness and neuroticism and EO. Table 4 presents the results from the significance tests of the ACME. The indirect effects of the big five traits are statistically significant (with the exception of conscientiousness) suggesting mediation of the

[7]Note that the EO questions were included in earlier survey waves than the big five items. If the big five traits would be time-varying, this could result in reverse causality. Based in evidence on the stability of traits over time (e.g. Roccas et al. 2002), however, the timing of measurement should not matter.

Table 3. Big Five personality traits, start-up subsidies and the mediating role of EO.

	(1)	(2)		(3)	
	Subsidy	EO	Subsidy	EO	Subsidy
Openness	**0.002**	**0.141*** **	**0.003**	**0.085*** **	**0.001**
	(0.004)	**(0.016)**	**(0.005)**	**(0.014)**	**(0.004)**
Conscientiousness	**−0.006**	**−0.072*** **	**−0.006**	**−0.015**	**−0.005**
	(0.004)	**(0.017)**	**(0.005)**	**(0.014)**	**(0.004)**
Extraversion	**−0.003**	**0.065*** **	**−0.002**	**0.071*** **	**−0.004**
	(0.004)	**(0.017)**	**(0.005)**	**(0.015)**	**(0.004)**
Agreeableness	**−0.001**	**−0.082*** **	**−0.006**	**−0.043*** **	**−0.000**
	(0.004)	**(0.017)**	**(0.005)**	**(0.015)**	**(0.004)**
Neuroticism	**0.003**	**−0.173*** **	**0.011** **	**−0.104*** **	**0.005**
	(0.004)	**(0.017)**	**(0.005)**	**(0.015)**	**(0.004)**
EO			**0.047*** **		**0.020*** **
			(0.007)		**(0.006)**
Female				−0.080**	0.011
				(0.039)	(0.012)
Opportunity driven				0.099**	−0.011
				(0.042)	(0.011)
University degree				0.158***	0.013
				(0.035)	(0.010)
Founder age				−0.002	−0.002***
				(0.002)	(0.001)
Failure experience				−0.018	0.046*
				(0.044)	(0.026)
Serial entrepreneur				0.102***	−0.036***
				(0.033)	(0.010)
Industry experience				−0.004**	−0.001
				(0.002)	(0.001)
Profit				−0.167***	−0.033***
				(0.023)	(0.009)
ln(R&D)				0.046***	0.010***
				(0.003)	(0.001)
ln(employees)				0.136***	0.070***
				(0.022)	(0.008)
Team				−0.031	−0.002
				(0.038)	(0.012)
Exporter				0.089***	0.013
				(0.030)	(0.011)
Firm age				−0.011	−0.019***
				(0.012)	(0.003)
Limited liability				0.149***	−0.021**
				(0.035)	(0.009)
East Germany				−0.042	0.098***
				(0.041)	(0.014)
Observations			9633		
Joint significance Big 5	3.06	228.73***	8.93	114.57***	3.92
Joint significance industry dummies	33.16***	-	-	19.16**	32.16***
Joint significance year dummies	246.85***	-	-	37.54***	244.56***
var(e.eo)	0.635***	0.635***		0.491***	
	(0.016)	(0.016)		(0.013)	
var(e.subsidy)	0.123***	0.122***		0.105***	
	(0.003)	(0.003)		(0.003)	

Notes: Standard errors in parentheses *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. All models contain a constant; models 1 and 3 also contain the set of industry and year dummies.

big five traits through EO. This indicates that big five traits affect subsidies only *indirectly* via EO[8] Since some of the traits (agreeableness, neuroticism, and conscientiousness) predict EO

[8]We also tested whether the results are sensitive to the inclusion of industry-specific time fixed effects. While these additional interaction terms are jointly significant, the conclusions for the main variables and the mediation effect remain unaffected. See Table A11 for these results..

Table 4. Indirect effects of big five personality traits.

Independent Variable	Dependent Variable	Direct Effect (DE)	Indirect Effect (ACME)
Openness	Subsidy	0.001	**0.002**
		[−0.008; 0.009]	**[0.001; 0.003]**
Conscientiousness	Subsidy	−0.005	0.000
		[−.014; 0.003]	[−0.001; 0.001]
Extraversion	Subsidy	−0.004	**0.001**
		[−0.013; 0.004]	**[0.001; 0.003]**
Agreeableness	Subsidy	0.000	**−0.001**
		[−0.009; 0.008]	**[−0.002; −0.001]**
Neuroticism	Subsidy	0.005	**−0.002**
		[−0.004; 0.014]	**[−0.004; −0.001]**

Table 5. Personality traits and start-up subsidies for solopreneurs.

	EO	Subsidy
Openness	**0.091*** **	**0.001**
	(0.016)	**(0.005)**
Conscientiousness	**−0.013**	**−0.009***
	(0.016)	**(0.005)**
Extraversion	**0.078*** **	**−0.004**
	(0.017)	**(0.005)**
Agreeableness	**−0.064*** **	**0.005**
	(0.017)	**(0.005)**
Neuroticism	**−0.103*** **	**0.006**
	(0.017)	**(0.005)**
EO		**0.018*** **
		(0.006)
var(e.eo/e.subsidy)	0.497***	0.098***
	(0.015)	(0.003)
Observations	7149	
Joint significance Big 5	95.40***	6.74
Joint significance industry dummies	17.00*	30.61***
Joint significance year dummies	44.74***	218.29***

Standard errors in parentheses *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. The model contains a constant and the same set of controls (excluding the team indicator) as well as industry and year dummies.

negatively (Table 3, model 3), and EO predicts subsidies positively, this may be indicative of competitive mediation (Zhao, Lynch, and Chen 2010).

Finally, to account for the fact that about 25% of the start-ups were founded by a team of entrepreneurs, but that we cannot delineate the personalities of each founder, we repeat the analysis for solopreneurs. This allows us to see whether the absence of a direct effect of big five traits on subsidies may be due to the fact that we only capture the traits of one founder. Moreover, it makes sure that the entrepreneurial personality is the one of the key decision maker and that there is no hidden influence of other founding team members on the link between baseline personality and entrepreneurial orientation for which the answers relate to the company's overall strategy (see survey questions in Table A2). Table 5 shows the results for solopreneurs for which the previous conclusions hold (compare to Model 3 in Table 3).

4.2. Extension to alternative sources of early-stage financing

To test whether the presented results are a phenomenon that is unique to start-up subsidies, we perform a corresponding analysis that employs alternative sources of

Table 6. Alternative financing sources.

	Obs.	Mean	Std. Dev.	Min	Max
VC financing	3412	0.090	0.286	0	1
Family & Friends	3412	0.120	0.325	0	1
Bank financing	3412	0.244	0.430	0	1

entrepreneurial financing as dependent variables (venture capital, family & friends, and non-subsidised bank loans) to investigate differences between the roles of personality for public subsidies and these other sources. Table 6 shows descriptive statistics for these financing sources. Note that due to missing values in the financing shares, the number of observations drops to 3,412. Bank financing is the most common source with about 24% and VC financing is rarest (9%).

Table 7 shows the results of the mediation analysis. Unlike for public subsidies, there is no link between EO and bank financing or borrowing from family and friends. There is also no direct link between most big five traits and these sources, except that more neurotic founders are more likely to turn to family and friends. The results for VC financing, on the other hand, show similarities to those for subsidies. Higher EO scores are related to a higher likelihood to receive venture capital with EO mediating the effect from baseline personality on VC. The magnitude of the coefficient for EO is similar to the one for subsidies. The indirect effect is, however, only statistically significant for openness (positive with ACME = 0.002, confidence band = [0.001; 0.004]) and neuroticism (negative with ACME = −0.003, confidence band = [−0.005; −0.001]). This comparison to public subsidies as a means of financing early stage entrepreneurial activities suggests that subsidies – similar to VC – are indeed to a stronger extent associated with founder personality than other bank lending or borrowing from family and friends.

5. Discussion

This paper is premised on the fact that although our knowledge of the important role of start-up subsidies in start-up innovation and survival has increased in recent years (Berger and Hottenrott 2021; Kleine, Heite, and Huber 2022), we still know relatively little about what characteristics help and hinder founders' access to start-up subsidies (Mina et al. 2021; Segarra-Blasco and Teruel 2016). We argued that the personality approach employed in this paper helps to advance our understanding in important ways. Theoretically, we drew on the psychology, innovation, and entrepreneurship literatures to investigate our important questions. We built the foundations of our theorising on the idea that founder personality traits shape access to start-up subsidies through influencing the generation of novel ideas and founders' innovation and growth orientation. Specifically, we hypothesised the behaviours, cognitions and dispositions embodied in greater founder openness, extraversion, and entrepreneurial orientation (EO) would strengthen the mechanisms and thus, enhance access to start-up subsidies. Alternatively, higher founder conscientiousness, agreeableness, and neuroticism would involve behaviours, cognitions, and dispositions that weaken these mechanisms and thus have the opposite effect.

We further conjectured that alongside a main association, founder baseline personality may have an indirect (mediated) effect through influencing founder EO. We

Table 7. Big Five personality traits, other sources of financing and the mediating role of EO.

	(1–3) EO	(1) VC financing	(2) Family & Friends	(3) Bank financing
Openness	**0.089*** **	**0.003**	**0.006**	**−0.004**
	(0.019)	**(0.006)**	**(0.006)**	**(0.008)**
Conscientiousness	**−0.010**	**0.003**	**−0.003**	**−0.011**
	(0.019)	**(0.005)**	**(0.007)**	**(0.009)**
Extraversion	**0.060*** **	**−0.003**	**0.005**	**−0.003**
	(0.020)	**(0.007)**	**(0.007)**	**(0.009)**
Agreeableness	**−0.030**	**0.001**	**−0.000**	**0.000**
	(0.019)	**(0.006)**	**(0.006)**	**(0.008)**
Neuroticism	**−0.106*** **	**−0.011***	**0.014** **	**0.010**
	(0.020)	**(0.006)**	**(0.006)**	**(0.009)**
EO		**0.024*** **	**0.005**	**0.000**
		(0.007)	**(0.008)**	**(0.011)**
Female	−0.121**	−0.005	0.025	−0.030
	(0.052)	(0.016)	(0.020)	(0.023)
Opportunity driven	0.112**	−0.004	−0.014	0.007
	(0.056)	(0.017)	(0.020)	(0.028)
University degree	0.175***	0.015	0.011	−0.043**
	(0.047)	(0.014)	(0.015)	(0.021)
Founder age	−0.003	−0.001	−0.005***	−0.002**
	(0.002)	(0.001)	(0.001)	(0.001)
Failure experience	−0.079	−0.007	−0.028	−0.004
	(0.060)	(0.021)	(0.027)	(0.032)
Serial entrepreneur	0.095**	−0.002	0.040**	−0.017
	(0.047)	(0.015)	(0.016)	(0.020)
Industry experience	−0.004*	−0.002***	−0.001	0.001
	(0.002)	(0.001)	(0.001)	(0.001)
Profit	−0.184***	−0.066***	−0.020	0.081***
	(0.034)	(0.010)	(0.013)	(0.016)
ln(R&D)	0.046***	0.009***	0.002	−0.005**
	(0.004)	(0.002)	(0.001)	(0.002)
ln(employees)	0.094***	0.055***	−0.032***	0.125***
	(0.030)	(0.012)	(0.009)	(0.015)
Team	−0.051	0.031*	−0.027*	−0.022
	(0.052)	(0.018)	(0.016)	(0.021)
Exporter	0.038	0.017	0.019	−0.018
	(0.041)	(0.016)	(0.016)	(0.021)
Firm age	−0.004	−0.008	−0.000	0.050***
	(0.018)	(0.005)	(0.006)	(0.008)
Limited liability	0.193***	0.014	−0.078***	−0.031
	(0.048)	(0.010)	(0.017)	(0.023)
East Germany	−0.028	0.016	−0.029	0.008
	(0.055)	(0.019)	(0.018)	(0.026)
var(e.eo)	0.525***			
	(0.018)			
var(e.vc_fund)		0.068***		
		(0.004)		
var(e.f_fff)			0.098***	
			(0.005)	
var(e.f_bank)				0.160***
				(0.004)
Observations	3,412	3,412	3,412	3,412
Joint significance Big 5	61.08***	4.33	5.89	3.30
Joint significance time dummies	7.46	3.81	10.49	27.90***
Joint significance industry dummies	11.64	27.05***	11.65	39.46***

theorised that the strong inclinations for novelty, proactivity, and broad search embodied in founder openness and extraversion would facilitate a favourable environment and mindset for founder EO, which in turn, would encourage start-ups to seek subsidies. Alternatively, founder conscientiousness, agreeableness, and neuroticism would provide

a more unfavourable environment and mindset for founder EO, and in turn, the relationship would be negatively mediated. Using detailed information, which permits a more fine-grained insight into the role of founder personality in start-up subsidies within various sectors, the findings contribute to research on entrepreneurial behaviour and the role of entrepreneurship policy. While we find little support for a direct link of founder baseline personality to start-up subsidies, we document a positive role of founder entrepreneurial personality and show that it mediates the effect of baseline personality on start-up subsidies. That is, there is a significant indirect relationship between baseline personality and start-up subsidies through its influence on EO. Comparisons with other sources of financing suggest that personality plays indeed a different role for public subsidies than for borrowing from banks or from family and friends. Instead, there are similarities to VC financing. This similarity to VC financing is reassuring for policy makers as it suggests that start-up support programmes indeed reach risky, high potential start-ups by targeting similar founder types as venture capitalists.

This paper makes three main contributions. First, we contribute to the literature on the antecedents of (start-up) subsidies (Berger and Hottenrott 2021; Heijs, Guerrero, and Huergo 2022; Kleine, Heite, and Huber 2022) by proposing a novel theoretical and empirical framework which both specifies why founder baseline and entrepreneurial personality can have a main effect on seeking start-up subsidies, and why founder baseline personality can have an indirect effect mediated through founder EO. Our focus on the role of baseline and entrepreneurial personality and the indirect effect of baseline personality through EO expands our understanding of these links and the types of founder characteristics that influence decisions to seek start-up subsidies. In doing so, we also advance understanding of the range of founder (and leader) characteristics that are important in shaping new ventures innovative behaviours (Bennat and Sternberg 2022; Chapman and Hottenrott 2022).

Our second contribution is to add to the personality and entrepreneurship literature by responding to calls for examination of the mediating variables between founder personality traits and start-up behaviours (Baum and Locke, 2004; Rauch and Frese 2000). We unpack how founder baseline personality traits can indirectly influence access to start-up subsidies by operating through EO. Baseline personality traits shape the favourability of the mindset and environment for EO, which in turn, shapes the decision to seek start-up subsidies. Our insights advance understanding of the relationship between baseline and entrepreneurial personality by illustrating the importance of EO as a mechanism for the effects of founder baseline personality (Kerr, Kerr, and Xu 2018; Rosenbusch, Rauch, and Bausch 2013). In doing so, we explain more of the story and deepen our understanding of how and why founder baseline personality can shape start-up behaviours (Chatterjee 2014).

Our third contribution is to add to the EO literature by expanding understanding of *how* founder EO shapes start-up performance, innovation, and survival (Choi and Williams 2016; Wales, Covin, and Monsen 2020). We unpack and provide empirical evidence that one likely path is through its role in shaping start-ups access to early-stage finance, such as start-up subsidies and VC, which in turn, can support their growth, survival, and innovative efforts. In doing so, we also contribute to a broader understanding of the effects of EO (Yin, Hughes, and Hu 2021) and respond to Wales et al.'s (2020) call for greater attention to founder EO.

These results have important implications for start-ups and policymakers. First, our results provide insights into the types of founders and start-ups that start-up subsidy programmes may attract. Our results suggest it is largely more entrepreneurial oriented founders who are accessing start-up subsidies. This is contrary to concerns that subsidies may sustain low-quality start-ups (Colombo, Grilli, and Verga 2007) and reassuring for policymakers that their subsidies are reaching desirable founders and start-ups. Second, EO is advantageous for start-ups to access start-up subsidies that can support their growth and innovative efforts. Additionally, while baseline personality does not appear to matter directly for access to start-up subsidies, it plays an important indirect role through shaping the favourability of conditions for EO. Hence, founders and start-ups should be aware of the advantages and drawbacks of their personality profiles for EO and start-up subsidies. Founders with certain personality traits may seek to form venture founding teams with individuals possessing more favourable personality traits for EO.

Our study has limitations that provide opportunities for future research. First, we have focused on two dominant configurations of founder personality. A broad range of traits and preferences have been identified in the literature (Kerr, Kerr, and Xu 2018), however, and we believe future research should consider the importance of other dimensions such as altruism, cooperativeness, honesty, or even negatively connotated traits like greed (Tacke et al. 2023). For example, cooperativeness may aid start-ups in searching broadly and in turn, developing innovation worthy of funding by policymakers (Leckel, Veilleux, and Piller 2022). Future research may also have a closer look into different subsidy programmes with potentially different goals and target groups. While we could not differentiate between subsidy programmes by different sponsors, it could be interesting to test whether certain types of programmes attract distinct founder personalities. As start-ups rely on a broad financial ecosystem to innovate and survive, extending our personality insights beyond start-up subsidies to consider the role of personality in access to different sources of government (e.g. tax incentives) and private (e.g. corporate venture capital, angel investors, banks) finance is also a fruitful avenue for future research. Equally, while much literature has amassed on personality traits in entrepreneurship, the comparative evidence on its role in stimulating firm innovation, and particularly, the dark side of innovation (Coad et al. 2021) is less known. Further attention to the potential endogeneity concerns in the link between personality and start-up subsidies would also be welcome. Finally, we conceptualised traits as being separate features of a personality. Recent research, however, suggests there are certain 'personality types' who possess certain combinations of traits (Runst and Thomä, 2023). Looking at these combinations or possible 'non-linearities' in the link between individual traits and founder decisions would be valuable. We therefore encourage more research that advances our understanding of the role of personality in innovative and entrepreneurial decision-making.

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Appendices

Appendix A

Table A1 Personality survey questions Big 5 measures (OCEAN).

Openness
Item 1: I am someone who is original and who brings up new ideas.
Item 2: I am someone who values artistic experiences.
Item 3: I am someone who has vivid fantasies and a good imagination.
Conscientiousness
Item 4: I am someone who works thoroughly.
Item 5: I am someone who is rather lazy.
Item 6: I am someone who gets things done effectively and efficiently.
Extraversion
Item 7: I am someone who is communicative and talkative
Item 8: I am someone who can get out and be sociable.
Item 9: I am someone who is reserved.
Agreeableness
Item 10: I am someone who is at times a little rude to others.
Item 11: I am someone who can forgive.
Item 12: I am someone who is considerate and kind to others.
Neuroticism
Item 13: I am someone who worries often.
Item 14: I am someone who gets nervous easily.
Item 15: I am someone who is relaxed and can handle stress well.

Note: Original questions presented in German. Likert scale from 1 to 5 [1: does not apply to me at all, and 5: fully applies to me]; items 5, 9, 10, 15 enter the analysis in reversed scale.

Table A2 Entrepreneurial Orientation survey questions.

Risk tolerance		
Item 1: In order to achieve corporate goals even in uncertain situations, my company proceeds . . .	(a) . . .rather cautiously, in a wait and see approach, in order to avoid wrong decisions.	(a) . . .rather bravely and aggressively so as not to miss any business opportunities.
Item 2: My company has a strong inclination for projects with. . .	(a) . . .low risk and thus normal but secure returns.	b). . .high risk and thus opportunities for very high returns.
Proactiveness		
Item 3: In dealing with the competition, my company pursues the strategy . . .	a) . . . of reacting to the actions of competitors.	b) . . . of taking the initiative itself, to which competitors must then react.
Item 4: When introducing new products or services, business processes or technologies, in my market environment . . .	a) . . . I do not necessarily want to be one of the first with my company.	b) . . . I want to be one of the first with my company
Autonomy		
Item 5: I generally believe that the best results come about when . . .	a) . . . employees have a say in which business ideas and projects are pursued.	(A) b) . . . as Managing Director, I alone decide which business ideas and projects are pursued.
Item 6: In my company . . .	a) . . . employees make decisions on their own without constantly checking back with me.	b) . . . Employees must always check with me when making decisions.
Innovativeness		
Item 7: My strategy is to make changes to my products or services . . .	a) . . . in a small and incremental way.	b) . . . that are as far-reaching and fundamental.
Item 8: My company focuses on . . .	a) . . . marketing proven products or services.	b) . . . innovation, technology leadership and research and development.
Competitiveness		
Item 9: My company . . .	a) . . . does not make any specific efforts to win sales from competitors.	b) . . . is very aggressive and competitive.
Item 10: My company . . .	(A) a) . . . avoids conflicts with competitors whenever possible and follows the motto 'live and let live'.	(A) b) . . . does not shy away from conflict in order to challenge competitors' market positions.

Note: Original questions presented in German. Likert scale from 1 to 5 [1: completely a), 2: rather a), 3: undecided, 4: rather b), 5: completely b].

Table A3 Factor analysis Big five personality traits (principal-component factors).

	Eigenvalue	Difference	Proportion	Cumulative
Factor 1	**2.801**	**1.124**	.187	**0.187**
Factor 2	**1.677**	**0.027**	.112	**0.299**
Factor 3	**1.650**	**0.266**	.110	**0.409**
Factor 4	**1.384**	**0.269**	.092	**0.501**
Factor 5	**1.116**	**0.246**	.074	**0.575**
Factor 6	0.869	0.044	.058	0.633
Factor 7	0.825	0.103	.055	0.688
Factor 8	0.723	0.040	.048	0.736
Factor 9	0.683	0.008	.046	0.782
Factor 10	0.675	0.069	.045	0.827
Factor 11	0.606	0.060	.040	0.867
Factor 12	0.547	0.031	.036	0.904
Factor 13	0.516	0.022	.034	0.938
Factor 14	0.494	0.060	.033	0.971
Factor 15	0.434	.	.029	1.000

Note: LR test: independent vs. saturated: $chi^2(105) = 2.2e + 04$ Prob>$chi^2 = 0.000$.

Table A4 Rotated factor loadings (pattern matrix) and unique variances.

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Uniqueness
Openness 1	0.001	0.013	**0.767**	0.109	0.202	0.359
Openness 2	0.136	−0.090	**0.619**	−0.080	0.016	0.584
Openness 3	0.103	0.141	**0.748**	−0.083	0.021	0.403
Conscientiousness 1	0.173	**0.716**	0.169	−0.121	−0.091	0.406
Conscientiousness 2	−0.082	**0.646**	−0.147	0.104	0.277	0.466
Conscientiousness 3	0.213	**0.783**	0.045	−0.011	−0.010	0.340
Extraversion 1	−0.034	0.052	0.108	**0.747**	0.045	0.425
Extraversion 2	0.007	−0.026	−0.041	**0.780**	−0.026	0.389
Extraversion 3	−0.033	−0.151	−0.144	**0.604**	−0.301	0.501
Agreeableness 1	**0.795**	0.152	0.139	0.037	0.143	0.305
Agreeableness 2	**0.786**	0.158	0.063	0.055	0.131	0.333
Agreeableness 3	**0.674**	−0.030	−0.067	−0.242	−0.260	0.415
Neuroticism 1	−0.025	−0.127	0.001	−0.166	**0.746**	0.400
Neuroticism 2	0.150	0.163	0.092	−0.106	**0.478**	0.703
Neuroticism 3	0.140	0.133	0.215	0.070	**0.753**	0.345

Table A5 Factor analysis entrepreneurial orientation (principal factors).

	Eigenvalue	Difference	Proportion	Cumulative
Factor 1	**1.832**	**1.397**	1.009	**1.009**
Factor 2	0.434	0.205	.239	1.245
Factor 3	0.229	0.039	.126	1.370
Factor 4	0.190	0.170	.105	1.478
Factor 5	0.020	0.140	.011	1.489
Factor 6	−0.120	0.012	−.066	1.423
Factor 7	−0.132	0.030	−.073	1.350
Factor 8	−0.162	0.068	−.090	1.261
Factor 9	−0.230	0.013	−.127	1.134
Factor 10	−0.243	.	−.134	1.000

Note: LR test: independent vs. saturated: $chi^2(45) = 1.2e + 04$ Prob>$chi^2 = 0.000$.

Table A6 Rotated factor loadings (pattern matrix) and unique variances (entrepreneurial orientation).

Variable	Factor1	Uniqueness
Proactiveness 1	0.354	0.875
Proactiveness 2	0.472	0.777
Innovativeness 1	0.506	0.744
Innovativeness 2	0.499	0.751
Competitiveness 1	0.468	0.781
Competitiveness 2	0.425	0.819
Risk tolerance 1	0.504	0.746
Risk tolerance 2	0.526	0.723
Autonomy 1	−0.100	0.990
Autonomy 2	−0.193	0.963

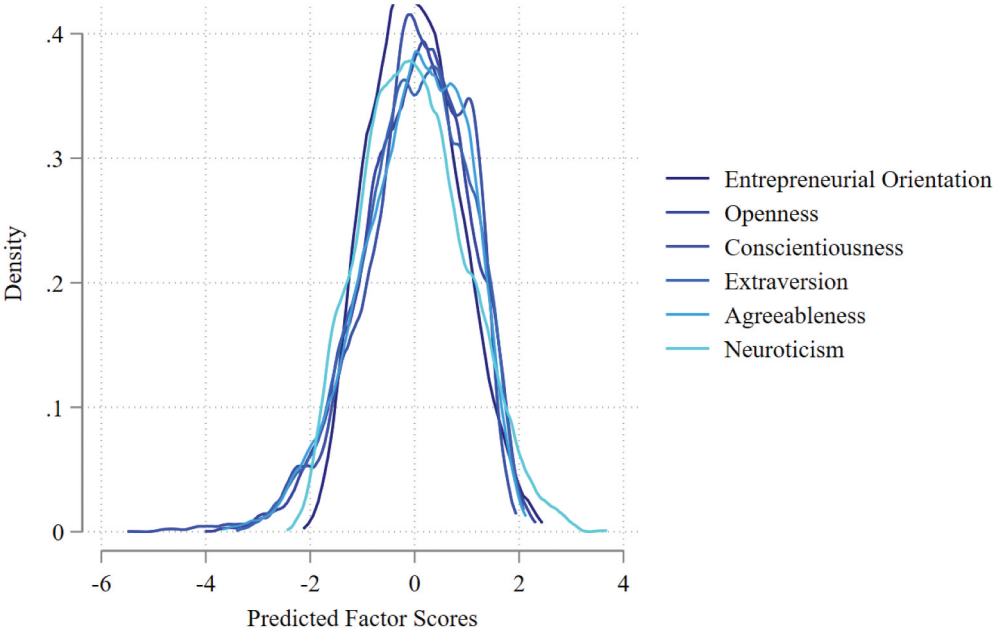

Figure A1. Kernel density distributions of main variables .

Table A7 Description of variables.

Name	Unit of Measurement	Description
Subsidy Indicator		
Subsidy	Binary (yes/no)	Takes the value one if firm has a public grant, subsidised loan or loan guarantee
Other financing sources		
Venture Capital	Binary (yes/no)	Takes the value one if the firm received some form of venture capital in the reference year
Bank financing	Binary (yes/no)	Takes the value one if the firm finances its business activities (at least partly) with commercial bank loans
Family & Friends	Binary (yes/no)	Takes the value one if the firm finances its business activities (at least partly) with money borrowed from family members or friends
Controls		
Profit	Binary (yes/no)	Takes the value one if the firm is at least at break even or makes profits in the reference year. Zero in case of a financial loss.
Experience	Years	Number of years a founder has worked in the same industry as the start-up
ln (R&D expenditures)	Euros	Amount spent on R&D in the reference year
Failure experience	Binary (yes/no)	Takes the value one of founder had a previous firm that closed due to liquidation or bankruptcy
Restarter	Binary (yes/no)	Takes the value one if founder had previously founded a firm
ln(employees)	Head count	Total number of employees (excluding members of the founding team)
Female	Binary (yes/no)	Takes the value one if at least one person in the founding team is female
Opportunity driven	Binary (yes/no)	Takes the value one of the founder indicated to have founded the firm to pursue a specific business idea, to exploit opportunity of higher earnings, or to pursue the opportunity to work independently and self-determined.
Academic	Binary (yes/no)	Takes the value one if at least one the founders has a university degree
Founder age	Years	Average founder age in the firm
Team	Binary (yes/no)	Takes the value one if the firm was founded by more than one person
Exporter	Binary (yes/no)	Takes the value one if the firm has sales outside of Germany
East Germany	Binary (yes/no)	Takes the value one if the firm's location is in one of the five eastern German states
Cohort (firm age)	Years	Founding year 2017 takes the value 1 and the earliest year takes the value eight
Limited liability	Binary (yes/no)	Takes the value one if the firm is a limited liability company
Industry indicators	Binary (yes/no)	Distinguishes between 11 different sectors of activity. See Table A.88.8 for the distribution of firms across industries.

Table A8 Industry distribution.

Industry Classification	Subsidy		
	0	1	Total
Cutting edge technology	484	162	646
	74.92	25.08	100.00
	5.87	11.62	6.71
High-tech manufacturing	476	106	582
	81.79	18.21	100.00
	5.78	7.60	6.04
Technical services	1824	286	2110
	86.45	13.55	100.00
	22.14	20.52	21.90
Software	719	125	844
	85.19	14.81	100.00
	8.73	8.97	8.76
Low-tech manufacturing	769	191	960
	80.10	19.90	100.00
	9.33	13.70	9.97
Knowledge-intensive services	909	83	992
	91.63	8.37	100.00
	11.03	5.95	10.30
Other company services	597	77	674
	88.58	11.42	100.00
	7.25	5.52	7.00
Creative services	543	78	621
	87.44	12.56	100.00
	6.59	5.60	6.45
Other services	414	73	487
	85.01	14.99	100.00
	5.02	5.24	5.06
Construction	753	110	863
	87.25	12.75	100.00
	9.14	7.89	8.96
Trade/retail	751	103	854
	87.94	12.06	100.00
	9.12	7.39	8.87
Total	**8239**	**1394**	**9633**
	85.53	14.47	100.00
	100.00	100.00	100.00

First row has *frequencies*; second row has *row percentages* and third row has *column percentages*.

Table A9 Pairwise correlations between personality traits and Entrepreneurial Orientation (predicted factor scores).

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) EO	1.000					
(2) Extraversion	0.168	1.000				
(3) Conscientiousness	−0.090	0.300	1.000			
(4) Openness	0.081	0.619	0.425	1.000		
(5) Neuroticism	−0.130	0.099	0.321	−0.089	1.000	
(6) Agreeableness	−0.203	−0.158	−0.107	−0.217	0.071	1.000

Table A10 Pairwise correlations between control variables.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Female	1.000													
(2) Opportunity driven	0.015	1.000												
(3) University degree	0.066	0.027	1.000											
(4) Founder age	0.024	−0.097	0.169	1.000										
(5) Failure experience	−0.011	0.018	−0.029	−0.017	1.000									
(6) Serial entrepreneur	−0.036	0.111	0.181	0.217	0.202	1.000								
(7) Industry experience	−0.046	−0.086	−0.083	0.528	−0.022	0.097	1.000							
(8) Profit	−0.051	−0.023	−0.046	−0.015	−0.055	−0.099	0.114	1.000						
(9) ln(R&D)	−0.049	0.067	0.261	0.052	−0.016	0.198	−0.020	−0.109	1.000					
(10) ln(employees)	0.012	0.015	0.089	0.004	−0.044	0.086	0.093	0.066	0.213	1.000				
(11) Team	0.216	0.039	0.243	0.002	0.007	0.241	0.043	−0.055	0.186	0.295	1.000			
(12) Exporter	−0.021	0.016	0.213	0.085	−0.014	0.105	0.002	0.021	0.317	0.164	0.135	1.000		
(13) Firm age	0.012	−0.013	−0.001	0.164	−0.197	−0.003	0.176	0.217	0.015	0.166	0.011	0.084	1.000	
(14) Limited liability	−0.010	0.055	0.369	0.175	0.008	0.311	0.010	−0.146	0.341	0.261	0.295	0.247	−0.023	1.000
(15) East Germany	0.025	0.016	−0.031	−0.031	0.007	0.004	−0.010	0.004	−0.016	0.014	−0.004	−0.068	0.006	−0.070

Table A11. Personality traits and start-up subsidies with industry-year interactions.

	EO	subsidy
Openness	**0.086*** **	**0.001**
	(0.014)	**(0.004)**
Conscientiousness	**−0.015**	**−0.005**
	(0.014)	**(0.004)**
Extraversion	**0.072*** **	**−0.004**
	(0.015)	**(0.004)**
Agreeableness	**−0.043*** **	**−0.001**
	(0.015)	**(0.004)**
Neuroticism	**−0.104*** **	**0.005**
	(0.015)	**(0.004)**
EO		**0.019*** **
		(0.006)
Female	−0.083**	0.010
	(0.039)	(0.012)
Opportunity driven	0.096**	−0.010
	(0.042)	(0.011)
University degree	0.160***	0.013
	(0.035)	(0.010)
Founder age	−0.002	−0.002***
	(0.002)	(0.001)
Failure experience	−0.018	0.038
	(0.044)	(0.026)
Serial entrepreneur	0.102***	−0.035***
	(0.033)	(0.010)
Industry experience	−0.004**	−0.001*
	(0.002)	(0.001)
Profit	−0.173***	−0.039***
	(0.023)	(0.009)
ln(R&D)	0.046***	0.010***
	(0.003)	(0.001)
ln(employees)	0.136***	0.068***
	(0.022)	(0.008)
Team	−0.030	−0.002
	(0.038)	(0.012)
Exporter	0.086***	0.008
	(0.030)	(0.011)
Firm age	−0.010	−0.017***
	(0.012)	(0.003)
Limited liability	0.149***	−0.020**
	(0.035)	(0.009)
East Germany	−0.043	0.100***
	(0.041)	(0.014)
var(e.eo/e.subsidy)	0.489***	0.101***
	(0.012)	(0.003)
Observations	9633	
Joint significance Big 5	116.53***	4.08
Joint significance industry dummies	15.18	41.18***
Joint significance year dummies	16.70**	124.29***
Joint significance industry-year interactions [$chi^2(70)$]	**98.85*** **	**394.70*** **

Standard errors in parentheses *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. The model contains a constant, set of industry and year dummies as well as the interaction terms between years and industries.