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Founder Personality and Start-up Subsidies

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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 start-up subsidies remains unclear. We study whether and how founder personality, as captured by the big five personality traits and entrepreneurial orientation, impacts entrepreneurs' seeking of start-up subsidies. We argue that greater founder openness, extraversion and entrepreneurial orientation enhance seeking of start-up subsidies, while greater founder agreeableness, conscientiousness, and neuroticism inhibits it. Additionally, we argue that entrepreneurial orientation plays a mediating role in the relationship between big five personality traits and start-up subsidies. Drawing on a large multi-sector sample of German start-ups, we find strong evidence for a positive role of founder entrepreneurial orientation. While we find little evidence for a direct effect of a founder's big five personality, we find evidence of an indirect effect through its influence on entrepreneurial orientation.

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

JEL codes: G24, L26, O25, O31

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1. Motivation and Introduction

Start-ups can play a crucial role in innovation and economic growth, and in turn, generate societal benefits (Haltiwanger et al. 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 programs (Lee et al., 2022) that aim to alleviate start-up 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., 2020), the importance of subsidies for driving start-up innovation and performance has heightened (Buchmann and Kaiser, 2019; Heijs et al., 2022). The growing relevance of start-up subsidies begs the vital question of what characteristics influence founders' willingness to seek financial support from subsidy programs.

The literature studying start-ups' access to finance has documented the role of founder characteristics (e.g., experience) and firm attributes (e.g., innovative activities) in their ability to access venture capital and bank finance (Bruneel et al., 2020; Caliendo et al., 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 toward 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 et al., 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 baseline personality (McCrae and John, 1992; Bainbridge et al., 2022). 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 a founder's entrepreneurial orientation (innovativeness, proactiveness, risk-taking, competitiveness, autonomy) as it effectively captures predispositions toward 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 et al., 2020), we capture founders' *entrepreneurial* personality using the entrepreneurial orientation construct. We theorise that founder entrepreneurial orientation aids founders in developing novel opportunities that align with the

desires of funding agencies, in selling their 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 et al., 2013; Zhao et al., 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, hypothesize 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, founder 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 founder entrepreneurial orientation by providing a less favourable environment and mindset for entrepreneurship and innovation, and in turn, the lower levels of entrepreneurial orientation reduce their 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].

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

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 evidence of an indirect effect of baseline personality on start-up subsidies through its influence on founder 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 shaping participation in innovation policy programs.

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 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 (Segarra-Blasco and Teruel, 2016; Chapman et al., 2018; Mina et al, 2021), with an emerging focus on founder characteristics given their key role in start-up innovation and success (Rojas and Huergo, 2016; Chapman and Hewitt-Dundas, 2018). 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 likely shapes founders' preferences (e.g., how favourably they view an action and the utility they derive from it), information search (e.g., where they search for information), information processing (e.g., how they interpret, judge, and use information) and behaviour, and thus reflects their general orientation toward decisions and actions. 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 (McCrae and John, 1992; Bainbridge et al., 2022) 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 et al., 2020). Table 1 provides descriptions for these elements of personality which have been shown to shape decision-making, innovation, and performance.

Table 1: Description of the Big Five and Entrepreneurial Orientation

	Description
Big Five *(e.g., McCrae and John, 1992; George and Zhou, 2001; 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., Lumpkin and Dess, 1996; Pearce et al., 2010; Covin et al., 2020)*	
Competitiveness	Founder's 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	Founder's willingness to engage in risky behaviours and make resource commitments with uncertain outcomes.

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 (Zhao et al., 2010; Brandstätter, 2011). 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 et al., 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 (Costa and McCrae, 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 (Sung and Choi, 2009; Guo et al., 2021). Extroverts also embrace and tolerate risk in their behaviours and actions, which supports their ability to seek out and explore new opportunities (Oehler and Wedlich, 2018; Chapman and Hottenrott, 2022). 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 (Zhao et al., 2010; Brandstätter, 2011). 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 and be positively evaluated by policymakers. 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 et al., 2010), conscientious founders can be characterised by a lack of creativity and innovativeness (Sung and Choi, 2009; Guo et al., 2021). 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 founders' identification and generation of novel opportunities for their start-up to pursue (Gielnik et al., 2012; Sarooghi et al., 2015). They also enable founders to see solutions and knowledge spaces in a new way and recombine and change them to generate novel ideas and opportunities (Anderson et al., 2014). The lower production of novel opportunities in start-ups with more conscientious founders may reduce their likelihood of possessing opportunities and ideas 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 effect of conscientiousness on 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 and innovative ideas and 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 et al., 2010) that can lessen their incentives to seek subsidies to acquire the

resources needed to initiate growth and innovation plans (Yin et al., 2021; Chapman and Hottenrott, 2022).

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 pessimism makes it more difficult for them to cope with the associated psychological stress and encourages them to pay more attention to the possible (highly) 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 and that will be positively evaluated by policymakers. Founder neuroticism is also linked to lower start-up growth and success orientations (Zhao et al., 2010; Brandstätter, 2011), 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 et al., 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 et al., 2011). Such founders proactively scan their environments and monitor developments in knowledge and technology to identify novel trends and competitive opportunities to serve customers and stay ahead of their competitors (Kim and Ahn, 2020). In turn, generating a greater volume of novel and innovative opportunities to seek subsidies. 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 (Mousa et al., 2015; McKenny et al., 2018). As Wales et al. (2020; 7) posits, 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, its need for financing, and its 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, revolutionize), 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 (Short et al., 2010; Mousa et al., 2015). Whereas those with low entrepreneurial orientation may adopt more conservative and cautious language in describing their project and 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 (Rauch and Frese, 2007; Zhao et al., 2010; Rosenbusch et al., 2013; Choi and Williams, 2016; Kerr et al, 2018). 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 greater 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 impacts 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 first expect founder 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 general 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 (Sung and Choi, 2009; Guo et al., 2021). 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.

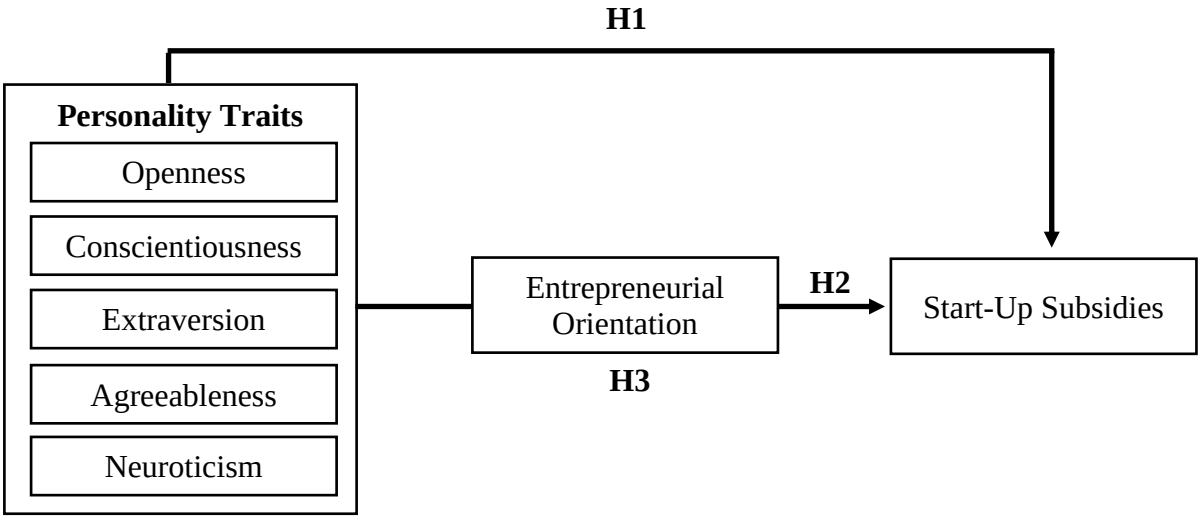
On the other hand, we second expect founder conscientiousness, agreeableness and neuroticism should inhibit founders' entrepreneurial orientation. Conscientious founders' possess a stronger commitment to current norms and a stronger avoidance of uncertainties and experimentation in favour of efficacy (George and Zhou, 2001). As entrepreneurial orientation is often characteristed 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 et al., 2011). Agreeable founders' avoidance of conflict and tension, and prioritisation of harmony and agreement (Sung and Choi, 2009; Guo et al., 2021), and neurotic founders struggle with novelty and uncertainty (Oehler and Wedlich, 2018), should

equally prove unfavourable for their entrepreneurial orientation which typically embodies a strong competitive, risk and innovative predisposition. Such founders are unlikey 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 resultant 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, reducing founders' incentives to seek start-up subsidies:

> *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 summarizing 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 data set 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 Meaurement 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 (McAdams et al., 1992; Lumpkin and Dess, 1996; Covin and Wales, 2012). Both the big five personality traits and entrepreneurial orientation are measured based upon previously established item scales (Covin and Slevin,

[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.

1989; Vaznyte and Andries, 2019). The corresponding survey questions are shown in appendix Tables A.1. and A.2., respectively. We validate the multi-dimensional conceptualisations of both big five and entrepreneurial orientation (EO) in our data 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. 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 (subsidized) loans or both. Start-ups subsidies are offered by several agencies at the federal and state level in Germany. Subsidized 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. *Berlin Startup Stipend*, Hamburg's *Innofounder* programme) and comprise monthly payments of up to several thousand euros.[4] While the former address founders in general, some programs have special requirements such as having links to universities such as the EXIST program organised by the German Federal Ministry for Economic Affairs and Climate Action (BMWK)[5]. In the following, we pool these types of programs because of their common purpose of providing additional financial resources to founders while all requiring some form of application procedure.

[3] Tables A.3 to A.6 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'.

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 programs such as founder human capital and experience. We include important indicators such as (previous) profits and exporting. The former captures previous firm success as well as need for seeking external financing from public subsidy programs which may be lower if there is sufficient cashflow. The latter captures market reach and is likewise an indicator for the need to raise additional financing. Table A.8 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 A.7. for definitions and A.10. 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 A.9).

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., Rojas and Huergo, 2016; Hottenrott et al., 2018; Chapman and Hewitt-Dundas, 2018; Hottenrott and Richstein, 2020). 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 specifiations 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 the use of public start-ups subsidies, we first test the direct relationship between big five personality traits and subsidy receipt (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 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 fully 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.

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 [$chi^2(5) = 3.06$].

[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.
[7] Note that the EO questions were included in later 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.

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 hypothesized 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 standardized scores of the big five traits on EO, we find that neuroticism has the largest negative impact on EO while openness has the largest positive one.

To summarize, we find no evidence of a direct effect 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 big five traits through EO. Indicating that big five traits affect subsidies only indirectly via EO[8]. Since some of the traits (agreeableness, neuroticism, and conscientiousness) predict EO negatively (table 3, model 3), and EO predicts subsidies positively, this may be indicative of competitive mediation (Zhao et al., 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 A.2). Table 5 shows the results for solopreneurs for which the previous conclusions hold (compare to Model 3 in Table 3).

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)

[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 A.11 for these results.

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.

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.

4.1. 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 entrepreneurial financing as dependent variables (venture capital, family & friends, and non-subsidized 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 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

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 on 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 impacted by founder personality than other bank lending or borrowing from family and friends.

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***

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 et al., 2022), we still know relatively little about what characteristics help and hinder founders' access to start-up subsidies (Segarra-Blasco and Teruel, 2016; Mina et al., 2021). 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 two primary mechanisms through which founder personality traits could shape access to start-up subsidies; (a) affecting the generation of novel ideas and spotting of innovative opportunities which makes founders seek start-up subsidies; (b) shaping founders innovation and growth orientations that affect their incentives to seek start-up subsidies. Specifically, we hypothesised the behaviours, cognitions and dispositions embodied in greater founder openness, extraversion, and entrepreneurial orientation would strengthen these primary 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 primary mechanisms and thus have the opposite effect.

We further conjectured that alongside a main effect, founder baseline personality may have an indirect (mediated) effect through influencing founder entrepreneurial orientation. We 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 entrepreneurial orientation, which in turn, would strengthen start-up's seeking of start-up subsidies. Alternatively, founder conscientiousness, agreeableness, and neuroticism would provide a more unfavourable environment and mindset for founder entrepreneurial orientation,

and in turn, the relationship would be negatively mediated. Using detailed multi-sector information, which permits a more fine-grained insight into the role of founder personality in start-up subsidies within various sectors. We find little evidence for a direct effect of founder baseline personality on access to start-up subsidies. We document strong evidence for 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 effect of baseline personality on start-up subsidies through its influence on entrepreneurial orientation. 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 similiartities to VC financing.

This paper makes three main contributions. First, we contribute to the literature on the antecedents of (start-up) subsidies (Berger and Hottenrott, 2021; Kleine et al., 2022; Heijs et al., 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 entrepreneurial orientation. Our focus on the role of baseline and entrepreneurial personality and the indirect effect of baseline personality through entrepreneurial orientation 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 main contribution is that we 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 entrepreneurial orientation. Baseline personality traits shape the favourability of the mindset and environment for entrepreneurial orientation, 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 entrepreneurial orientation as a mechanism for the effects of founder baseline personality (Rosenbusch et al., 2013; Kerr et al, 2018). 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 main contribution is that we add to the entrepreneurial orientation literature by responding to deficits in existing theory that do not explain *how* founder entrepreneurial orientation shapes start-up performance, innovation, and survival (Choi and Williams, 2016; Wales et al., 2020). We unpack and provide strong empirical evidence that one likely path is through its critical role in shaping start-ups access to early-stage finance, such as start-up subsidies, which in turn, can support their growth, survival, and innovative efforts. In doing so, we also contribute to a broader understanding of the system of effects of entrepreneurial orientation beyond performance and respond to Wales et al's (2020) call for greater attention to founder entrepreneurial orientation.

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 programs may attract. Our results suggest it is largely more entrepreneurial oriented start-ups that are accessing start-up subsidies. This is contrary to concerns that subsidies may sustain low-quality start-ups (Colombo et al., 2007) and reassuring for policymakers that their subsidies are reaching desirable founders and start-ups. Second, entrepreneurial orientation 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 entrepreneurial orientation. Hence, founders and start-ups should be aware of the advantages and drawbacks of their personality profiles for entrepreneurial orientation and start-up subsidies. Founders with certain personality traits may seek to form venture founding teams with individuals possessing more favourable personality traits for entrepreneurial orientation.

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 et al, 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 et al., 2022). Future research may also have a closer look into different subsidy programs with potentially different goals and target groups. While we could not differentiate between subsidy programs by different sponsors, it could be interesting to test whether certain types of programs 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 favouring or hindering 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. Moreover, while we believe that baseline personality and entrepreneurial orientation are relatively stable over time

due to their low malleability and also assumed that the control variables used in the empirical models such as profits, R&D, and the number of employees are not affected by these traits. Further attention to the role of personality for these attribues would be very valuable and would allow to better address potential endogeneity concerns in the link between personality and start-up subsidies. Finally, we conceptualized traits as being separate features of a personality. Recent research, however, suggests that there are certain 'personality types' who possess certain combinations of traits (Runst and Thomä, 2022). Looking at these types 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 enrepreneurial decision making.

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Appendix A:

Table A.1: 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 A.2: 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.	b) ...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.	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)… avoids conflicts with competitors whenever possible and follows the motto "live and let live".	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 A.3: Factor analysis Big five personality traits (principal-component factors)

	Eigenvalue	Difference	Proportion	Cumulative
Factor 1	**2.801**	**1.124**	**0.187**	**0.187**
Factor 2	**1.677**	**0.027**	**0.112**	**0.299**
Factor 3	**1.650**	**0.266**	**0.110**	**0.409**
Factor 4	**1.384**	**0.269**	**0.092**	**0.501**
Factor 5	**1.116**	**0.246**	**0.074**	**0.575**
Factor 6	0.869	0.044	0.058	0.633
Factor 7	0.825	0.103	0.055	0.688
Factor 8	0.723	0.040	0.048	0.736
Factor 9	0.683	0.008	0.046	0.782
Factor 10	0.675	0.069	0.045	0.827
Factor 11	0.606	0.060	0.040	0.867
Factor 12	0.547	0.031	0.036	0.904
Factor 13	0.516	0.022	0.034	0.938
Factor 14	0.494	0.060	0.033	0.971
Factor 15	0.434	.	0.029	1.000

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

Table A.4: 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 A.5: 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	0.239	1.245
Factor 3	0.229	0.039	0.126	1.370
Factor 4	0.190	0.170	0.105	1.478
Factor 5	0.020	0.140	0.011	1.489
Factor 6	-0.120	0.012	-0.066	1.423
Factor 7	-0.132	0.030	-0.073	1.350
Factor 8	-0.162	0.068	-0.090	1.261
Factor 9	-0.230	0.013	-0.127	1.134
Factor 10	-0.243	.	-0.134	1.000

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

Table A.6: 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 A.1: Kernel density distributions of main variables

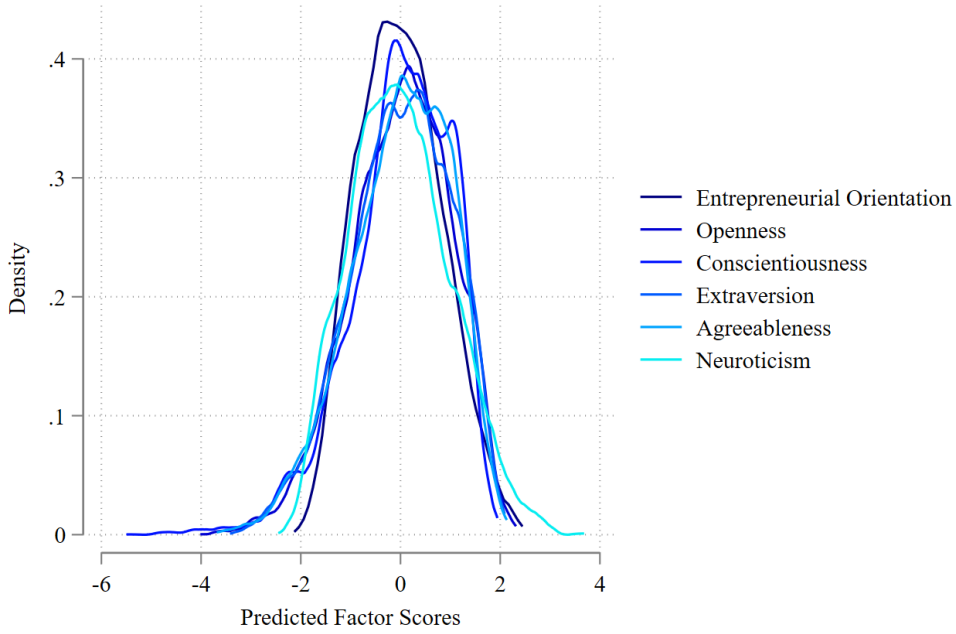

Table A.7: Description of variables

Name	Unit of Measurement	Description
Subsidy Indicator		
Subsidy	Binary (yes/no)	Takes the value one if firm has a public grant, subsidized 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.8 for the distribution of firms across industries.

Table A.8: 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 A.9: 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 A.10: 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 A.11: 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.

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