The Entrepreneurial Blueprint

Unravelling the Relationship of Personality Traits, Cognitive Strategies, and Entrepreneurial Behavior

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Abstract

Despite its omnipresence in everyday life and economic importance, entrepreneurship remains largely disregarded in academic inquiries of cognitive and behavioral processes. This project seeks to provide a comprehensive yet concise inquiry into the different psychological facets that shape entrepreneurship. It offers valuable insights for educators, policymakers, investors, and entrepreneurs themselves, aiming to foster a more supportive and effective environment for entrepreneurial endeavors. It begins by outlining the implications of personality for entrepreneurship unravelling the convoluted literature on the predictive qualities of personality in entrepreneurship. It then shifts its focus towards the implications of Judgmental Decision Theory (JDM) for the field. After evaluating Daniel Kahneman's System 1 and 2 theory and its practical implications for entrepreneurship, the project concludes by collecting empirical evidence for the distinct ways in which entrepreneurs think and make choices. Specifically, it tests the ability of entrepreneurs to successfully overcome intuitive choices in a Cognitive Reflection Test (CRT) and measuring their overconfidence (i.e., overestimation) compared to MBA candidates.

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Introduction

In an era where former startups like Tesla are amongst the most highly valued companies listed on the stock market and numerous former one-man shows are undergoing impressive IPOs and redefining markets, understanding the entrepreneurial mind becomes imperative. According to the Small Business Administration (SBA), more than 600,000 startups are incorporated in the U.S. every year. These ventures, accounting for 99.9% of all U.S. companies, are a vital driver of economic growth. Besides their status as economic entities, some of these ventures are the manifestation of entrepreneurial ingenuity in an effort by their founders to challenge the status quo and innovate the world we live in. However, the person behind this innovative economic growth – the entrepreneur[1] – remains enigmatic, subject to debate and mystery.

While this project does not adopt a distinct definition of who or what constitutes an entrepreneur, it draws upon the seminal definition of Joseph Schumpeter, portraying entrepreneurs as agents of creative destruction. Accordingly, entrepreneurs are more than mere business owners. They reinvent markets, replace obsolete technologies, and drive innovative progress (Reinert & Reinert, 2006). However, the path to becoming a successful entrepreneur is fraught with risks. Statistics paint a daunting picture: 20% of companies fail within their first year of operation, and 65% fail within their first decade (Main & Bottorff, 2022). These statistics raise several compelling questions. What psychological underpinnings drive individuals towards entrepreneurship despite such odds, and how could our

[1] Throughout this project, the terms entrepreneur, businessperson, individual, and decision-maker will be used interchangeably.

understanding of entrepreneurs contribute to enhancing the probabilities of those entering this challenging arena?

This master's project will examine how personality and cognitive processes predict and shape entrepreneurial behavior. It seeks to draw a holistic picture of how traits and cognitive processes shape how entrepreneurs are regularly perceived by the broader public – as curious, risk-tolerant, perseverant, and creative businesspeople (Miller, 2020).

I will begin by illuminating the role of personality in entrepreneurship and transition to an examination of the research that has been conducted on entrepreneurship in the field of Judgmental Decision Making (JDM). These lenses will provide insights into the cognitive processes in entrepreneurial decision-making, highlighting the complex interplay between personality, risk propensity, overconfidence, and dual-process thinking. The project will concludes by gathering empirical evidence, testing two hypotheses on the cognitive reflectiveness and overconfidence of entrepreneurs in Germany compared to MBA candidates at Germany's #1 business school.

Through this comprehensive project, I aim to offer a better understanding of the various factors that affect the entrepreneurial mind, contributing to a more nuanced apprehension of what drives entrepreneurs and what makes them successful. As mentioned, this project, at its heart, is guided by the notion of an entrepreneur as a Schumpeterian creative destructor. It seeks to understand the mechanisms behind those that resemble this spirit. Nevertheless, this project will not be limited to studies that examine entrepreneurs under this definition exclusively. Accordingly, studies with varying understandings and definitions of entrepreneurs

will be included, not least because finding sufficient sources would otherwise prove almost impossible and render a comprehensive picture of the entrepreneurial mind impossible.

Chapter 1 – Traits of Triumph: Personality and Entrepreneurship

This chapter will provide a concise overview of the work that has been carried out on the role of personality in entrepreneurship. There is a long-standing debate about whether or not personality relates to entrepreneurial entry and performance at all. Previous, primarily narrative, explanations claimed that there is no relationship between personality and entrepreneurship whatsoever (Gartner, 1988). In the recent past, however, scholars seem to have agreed that these conclusions were premature, arguing in favor of the effect of personality traits on a wide array of entrepreneurial results, such as entrepreneurial intention (i.e., entry into entrepreneurship) or entrepreneurial outcomes (i.e., success) based on empirical evidence (Zhao & Seibert, 2006). While there has been consensus on a relationship, there remains disagreement on the dimension, extent, and traits that correlate with entrepreneurship, which has made this topic subject to lively debates.

Thischapter will cover the most prominent constructs leveraged to explain the relationship between personality and entrepreneurship. A discussion of the Five Factor Model (FFM) of personality will be followed by a review of three more detailed trait characteristics repeatedly held to be found in entrepreneurial personalities. I will then continue by providing examples of studies that examined entrepreneurial personalities in different ways. In addition to summarizing the survey findings, I will analyze the approaches in which the empirical data has been gathered as well as their respective findings. This chapter aims to take a particularly critical viewpoint so that a critique of the individual approaches taken will follow every survey analysis. Following this part, I will adopt the same method for two meta-analyses of surveys that have been conducted in the past, once again taking a critical viewpoint. I will then conduct an

overall analysis, pointing out the traits that have received the most attention in the literature and the most common flaws in study designs. In concluding, I will discuss the practical implications of the research conducted so far.

1.1 Five-Factor-Model

Within personality psychology, the Five Factor Model (FFM, also referred to as the Big Five) arguably stands as the most prominent construct, providing a comprehensive framework for analyzing and understanding individual personalities. It was *rediscovered* and made prominent by Costa and McCrae in 1992, who complimented existing research on scales capturing personality traits (Goldberg, 1990) through their NEO Personal Inventory, ultimately concluding with the present set of five key traits (Costa & McCrae, 1992). This model offers a multifaceted perspective on the intricacies of human personality, boiling it down to Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism, combinations of which have been held to be capable of accounting for most traits (Zhao & Seibert, 2006). Hermann Brandstätter, in his paper on five meta-analyses examining the relationship between personality and entrepreneurship, subsumed those traits under the acronym OCEAN (2011). I will continue by briefly outlining the theoretical underpinnings and practical implications of each trait factor since a wide variety of empirical work that has been carried out on the role of personality in entrepreneurship is built upon this seminal framework. The traits and their respective influences on personalities can be found in a concise overview in Table 1, derived from Costa and McCrae (1978).

Openness to experience

The first key factor necessary to explain diverse individual personalities is Openness to Experience (Costa & McCrae, 1978). This variable represents an individual's openness to interacting with novel and varying notions, ideas, and experiences. People scoring high on this facet of the FFM are generally described as "intellectually curious, imaginative, and creative" (Zhao et al., 2010, p. 385).

Conscientiousness

Conscientiousness, at the highest descriptive level, refers to the level of self-discipline one has, organization, and need for achievement of an individual. People high in conscientiousness tend to be well-organized, punctual, and persevering, amongst other traits. Some authors tend to interpret underlying factors that constitute this factor as separate from conscientiousness. I will cover these below, but for now, it shall suffice to say that people who score higher on conscientiousness have a higher need for achievement and score higher on perseverance scales (Zhao et al., 2010).

Extraversion

The next factor within the model, Extraversion, refers to the degree to which someone is passionate, talkative, and seeks social interactions. Furthermore, people who score high on the extraversion scale are also described as dominant in social situations due to their enthusiasm, especially in group activities (Costa & McCrae, 1992). This trait is particularly helpful for entrepreneurs to build networks they can leverage effectively throughout their entrepreneurial journey.

Agreeableness

People who score high on the agreeableness scale are generally described as softhearted, trusting, and lenient. They are the opposite of critical and stingy persons. What is being measured on this factor is the level of friendliness and cooperativeness. Most importantly, agreeable individuals avoid conflict (Costa & McCrae, 1992).

Neuroticism

Lastly, Neuroticism assesses a person's emotional stability and how they respond to stress and negative emotions. Individuals who score high on neuroticism are regularly more prone to anxiety and are often described as vulnerable, emotional, or worrying. Those low on this scale, in turn, usually remain calm under pressure and are better at handling stress (Costa & McCrae, 1992).

The Five-Factor Model of Personality		
Factor	**Low Score Description**	**High Score Description**
Openness to experience	Down-to-earth, Uncreative, Conventional, Prefer routine, Uncurious, Conservative	Imaginative, Creative, Original, Prefer variety, Curious, Liberal
Conscientiousness	Negligent, Lazy, Disorganized, Late, Aimless, Quitting	Conscientious, Hardworking, Well-organized, Punctual, Ambitious, Persevering
Extraversion	Reserved, Loner, Quiet, Passive, Sober, Unfeeling	Affectionate, Joiner, Talkative, Active, Fun-loving, Passionate
Agreeableness	Ruthless, Suspicious, Stingy, Antagonistic, Critical, Irritable	Softhearted, Trusting, Generous, Acquiescent, Lenient, Good-natured

Neuroticism	Clam, Even-tempered, Self-satisfied, Comfortable, Unemotional, Hardy	Worrying, Temperamental, Self-pitying, Self-conscious, Emotional, Vulnerable

***Table 1*:** Five-Factor Model impact of single traits on personality (derived from Costa and McCrae, 1992)

1.2 Other Approaches

While the Five-Factor Model serves as a gold standard in assessing personalities, it has been held that overreliance on the Big Five is not advisable. Depending on the context, underlying traits might work against each other and weaken the predictive capabilities of the FFM (Frese & Gielnik, 2014). A spectrum of more nuanced approaches that delve deeper into the intricacies of human personality should, therefore, be leveraged to better understand the mechanisms of the entrepreneurial personality.

These narrow traits aim to provide a richer and more comprehensive understanding of individuals by breaking down the broader personality traits into more detailed and specific components (Rauch & Freese, 2007). In his narrative critique of efforts to distinguish entrepreneurial personalities from non-entrepreneurial ones, William Gartner (1988) highlights narrow traits like locus of control, risk tolerance, and the need for achievement. When examined in isolation, they offer profound insights into an individual's behavioral tendencies (Gartner, 1988). Moreover, some detailed models segregate certain facets that constitute the Five-Factor Model and treat them as standalone factors warranting individual analysis and appreciation. For instance, the need for achievement, which is part of conscientiousness in Costa and McCrae's Five-Factor Model, emerges as a distinct and vital element in these more granular frameworks, ultimately contributing to a more detailed understanding of the entrepreneurial personality. However, it is necessary to point out that these narrow trait observations are regularly no clear-cut models, entirely distinct from the FFM but rather

observations that add emphasis and credibility to its observations, easing the measurement of correlations between personality characteristics and entrepreneurial factors such as entry or success (Stewart & Roth, 2001).

As can be seen, the exact relationship between broad and narrow personality traits is intricate and remains subject to debate. However, it seems reasonable to suggest that, as a broad rule, both forms of traits exist in a sort of nested relationship, where multiple narrow personality traits build up the broad traits (Ashton et al., 2014). Nevertheless, it is important to acknowledge that overlaps exist. Narrow traits are not mutually exclusive to just one broad trait, and exemptions exist where a categorization within the FFM proves difficult (Figure 1). This relationship renders them worthy of investigation on their own.

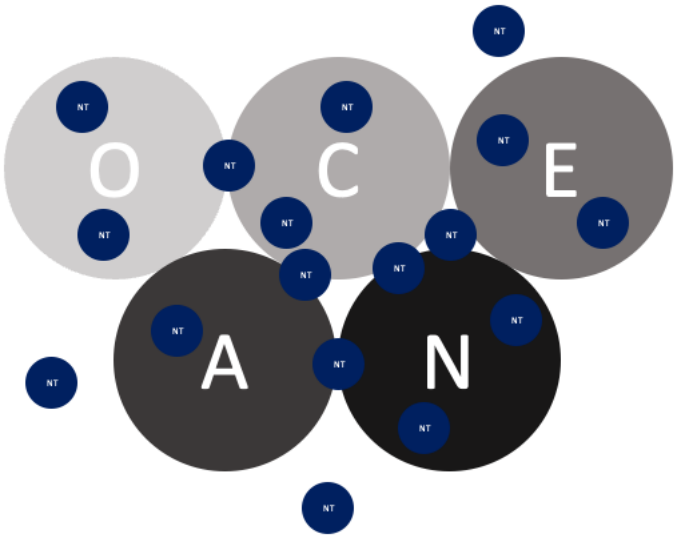


***Figure 1*:** Schematic representation of the nested structure of broad and narrow personality traits (symbolic).
Notes: O+C+E+A+N = Big Five personality Traits, NT = Narrow Traits

While covering all of these more granular trait concepts would go beyond the scope of this project, I will briefly elaborate on three aspects in particular that have received considerable attention in the past to convey a sense of the nature of specific/narrow traits in comparison to

the previously presented Big Five: Risk Propensity, Achievement Motivation, and Locus of Control.

Risk Propensity

As the name suggests, risk propensity describes an individual's willingness to take risks in various situations, such as financial investments or career choices, and therefore, ultimately, within entrepreneurial situations (Densberger, 2014). This trait, commonly associated with entrepreneurs, reflects the degree to which an individual is willing to accept uncertainty about the negative outcomes of decisions (Frese & Gielnik, 2014; Nicholson et al., 2002). Previous literature suggested that risk propensity is influenced by situations and factors such as individual experiences, financial goals, age, and demographic background. However, Stewart and Roth, in their paper on the influence of risk propensity on entrepreneurs, found evidence that suggested that a decision maker's inclination towards risky decision-making is not solely situational but rather a predisposition (2001).

Achievement Motivation

Achievement Motivation describes an individual's ambitions to attain challenging goals and strive for (personal) success. It was defined by McClelland et al. as a trait where those scoring higher on it are more inclined to partake in energetic and creative tasks that demand proactive and forward-thinking planning, as well as personal accountability for task outcomes (1949). It is furthermore defined by a person's competitiveness, intrinsic motivation, and inclination towards setting ambitious goals. The consensus is that entrepreneurs will score higher on achievement motivation than non-entrepreneurs (Collins et al., 2004; McClelland, 1961).

Internal Locus of Control

Lastly, literature suggests that entrepreneurs show an internal locus of control. This means that entrepreneurs, in contrast to individuals with an external locus of control, "believe that success and failure depend on the amount of effort invested and that they can control their fate" instead of a conviction that one's life is determined by chance as people with an external locus of control believe (Hsiao et al., 2015, p. 1158).

1.3 Single Study Analyses

1.3.1 Study I: Are entrepreneurs born or made? The influence of personality – López-Núñez et al.

1.3.1.1 Study Overview and Evaluation of Results and Implications

In their research paper exploring the personalities of entrepreneurs, López-Núñez et al. conducted a comprehensive study that compared three distinct groups: entrepreneurs, university students with a high inclination, and university students with a low inclination toward entrepreneurship (2020). The main goal of their research was to examine whether entrepreneurs scored higher on specific personality traits than non-entrepreneurs. They also sought evidence for the existence of higher scores on these traits in students with a high inclination towards entrepreneurship to potentially infer a predisposition towards entrepreneurship based on this evidence.

The authors examined 597 participants, including 83 entrepreneurs, 254 university students exhibiting high levels of entrepreneurial intention, and 160 university students with lower entrepreneurial intention. Notably, the study did not exclusively select self-employed entrepreneurs but included those in *entrepreneurial* positions within companies. The stable FFM

characteristics, as well as more specific and malleable personality dimensions – coping and problem-solving abilities, tolerance of ambiguity, and emotional intelligence – were tested. Very limited reasoning was provided for the choice of the specific traits at stake in this study.

After accounting for demographic variations among the study's participants through a GLMM analysis and making appropriate adjustments to the survey results, the research unveiled empirical evidence suggesting that entrepreneurs and university students with high entrepreneurial intentions share a consistent psychological profile. The decision to account for differences in sex and age was based on findings suggesting changes in personality factors over decision-makers' lifecycles.

According to the findings, entrepreneurs and those aspiring to be exhibited several common characteristics. These included high scores in extraversion, conscientiousness, and openness on the FFM scale. Additionally, elevated levels of emotional intelligence, self-confidence, and a greater tolerance for ambiguity were found on the narrower and more malleable scales. Lastly, lower scores for agreeableness and neuroticism were detected.

Overall, this research shed light on the personality traits that appear to be associated with entrepreneurship. Furthermore, the findings provided compelling evidence for the existence of a personality capable of predicting entrepreneurial action through illuminating traits shared by both current entrepreneurs and those who aspire to be entrepreneurs in the future.

1.3.1.2 Specific Study Critique

While these findings offer compelling insights, it is imperative to recognize certain limitations within the study's design that impact its results and require thorough scrutiny.

The study's principal shortcoming lies in its absence of a longitudinal design, which limits its capacity to assess the practical validity of its findings. While it is intriguing that students with a psychological profile similar to entrepreneurs exhibit high entrepreneurial intentions, examining whether these students become entrepreneurs over time would be even more meaningful. This observation becomes especially pertinent in the educational environment of university students since they may encounter events related to entrepreneurial activities, such as courses or projects, which could artificially inflate their entrepreneurial intentions. It is crucial to discern whether such external factors influence their intentions or genuinely stem from intrinsic interest. The authors themselves acknowledge this limitation, underscoring that a "longitudinal study would have been more appropriate to determine whether there is a transition from intention to behaviour [sic] among the students in whom the entrepreneurial profile was found" (López-Núñez et al., 2020, p. 4).

The study's design also introduces ambiguity regarding the definition of an entrepreneur, as it fails to clarify whether university students shared a common understanding of what constitutes an entrepreneur. To mitigate this issue, providing participants with a clear and shared definition of entrepreneurship for the experiment would have been beneficial.

Furthermore, the assessment of entrepreneurial intention using a Likert Scale, which involves self-reported measurements of one's ambition to establish their own company and the extent of effort they are willing to invest, on a scale from 1 to 10, would have been more

effective if such a refined and universally accepted definition of entrepreneurship had been established from the outset (López-Núñez et al., 2020). This shared definition would help address the inherent limitations associated with the self-reported nature of a Likert Scale (Ones et al., 1996; Tanujaya, 2022).

Ambiguity is also created through the study's measurement of entrepreneurial success. While the study claims to follow Karimi et al.'s definition of a successful entrepreneur as "a business owner who succeeds in overcoming different challenges and problems and still survives in difficult situations," the translation of this definition into a selection criterion, which includes only those entrepreneurs who "had reached the critical period of the first four years after its establishment" seems arbitrary (López-Núñez et al., 2020, p. 2). Furthermore, the article by Karimi et al. lacks a clear-cut definition as referred to by the authors (2012). Merely referencing characteristics such as high emotional intelligence, strong interpersonal relationships, a realistic outlook, and an optimistic attitude appear too vague to translate into the employed definition. While this sheds some light on the authors' selection of more specific personality traits to be tested, a more precise definition of success in the study would be beneficial.

Lastly, the recruitment of both student populations is worthy of critique. The study lacks information about the homogeneity of the student cohorts, including whether students were sampled from the same university, pursued the same field of study, or shared similar backgrounds. While the authors controlled for the effect of sex and age through a covariate analysis, additional external factors were not observed. This lack of controlling proves problematic, given that exposure to entrepreneurial classes, economic, cultural, or regional

factors and opportunities also require attention in the study design, as they may significantly impact the individual intentions of study participants as well as malleable specific traits. Assuming homogeneity in this context could introduce a significant source of variance that should have been considered to ensure the reliability of study results.

1.3.2 Study II: The relationship between the entrepreneurial personality and the Big Five personality traits – Leutner, Franziska et al.

1.3.2.1 Study Overview and Evaluation of Results and Implications

Similar to the prior study conducted by López-Núñez et al. (2020), this investigation undertaken by Leutner et al. (2014) examined not only the established FFM traits but also more specific, narrow traits (which are not mentioned in detail). The authors sought to ascertain the extent to which various personality traits might indicate entrepreneurial success. It is worth emphasizing that, in this context, entrepreneurial success is not measured solely by business performance but rather by specific behaviors categorized under three overarching themes:

a) Corporate Entrepreneurship: This dimension examines an individual's capacity to enhance and innovate within existing organizational processes.

b) Social Entrepreneurship: Encompassing activities such as founding welfare-oriented businesses within existing ventures, this category focuses on creating value for the broader community.

c) Innovation Entrepreneurship: This theme pertains to patenting innovations and introducing innovative products into the market (Leutner et al., 2014).

It is essential to recognize that this definition of success aligns with the broad understanding of entrepreneurship adopted by the authors, emphasizing “behaviours [sic] relating to opportunity recognition, exploitation, innovation and value creation” (Leutner et al., 2014, p. 59). Therefore, the focus of this understanding transcends financial gains or the sheer size of a company (i.e., business performance). This perspective was adopted in an attempt to address a gap in previous research, which predominantly measured personality as an indicator of entrepreneurial intent, business performance (as measured by financial success or business growth), or occupational status.

For the survey, the authors recruited 670 participants through various social media sites (e.g., LinkedIn, Facebook, X). Participants underwent three separate assessments to measure the Big Five, narrow personality traits, and entrepreneurial success.

Instead of Costa and McCrae’s established NEO-PI measure, the researcher employed a 50-item scale from the International Personality Item Pool to assess the Big Five personality traits, with responses recorded on a five-point Likert scale. In addition, Leutner et al. utilized META, a framework which they developed to gauge narrow personality traits effectively (2014). This instrument delves into four dimensions of the entrepreneurial personality: Entrepreneurial proactivity, entrepreneurial creativity, entrepreneurial opportunism, and entrepreneurial vision. Moreover, META appraises “the degree to which individuals differ in their tendency to engage in entrepreneurial behaviours (opportunity recognition, opportunity exploitation, innovation, and value creation)” (Leutner et al., 2014, p. 59).

This refined approach provides a more comprehensive view of the relationship between personality and entrepreneurial success, acknowledging the multifaceted nature of entrepreneurship and the various ways in which it can create value.

The study resulted in a series of interesting findings. Notably, there was a substantial correlation between META and the defined markers of entrepreneurial success. Additionally, META exhibited significant correlations with the Big Five personality traits, which, on their own, showed significant correlation with Social and Corporate Entrepreneurship as indicators of success. Intriguingly, Conscientiousness failed to establish significant correlations with any of the defined success factors, signaling that META, or the narrower traits it represents, displays stronger predictive powers for determining entrepreneurial success compared to the broader Big Five Traits.

Moreover, amongst themselves, the META factors exhibited a moderate level of correlation with each other. This suggests either an interrelatedness amongst the factors or an influence of them by similar underlying traits, though a precise explanation remains open. A similar result was observed when examining the success outcomes of entrepreneurship measured in this study, hinting at a potential interrelatedness of these measures as well.

To scrutinize these interrelations, the authors employed a parsimonious model to explain observed measures with the fewest variables possible to avoid excessive complexity. In this streamlined model, all META factors and all success measures (labeled Total Entrepreneurial Ability -TEA) were loaded onto latent combined factors, simplifying the analysis. Since the original parsimonious model, which reflected all factors (including demographic

information), had a bad goodness of fit (measured on six different scales), all factors that did not make substantive predictions on entrepreneurial outcomes were deleted. The subsequent reduced model demonstrated a good fit. Leutner et al. visualized this reduced version in a structural equation model (Figure 2) (2014). The results of this model draw an interesting picture. Among the Big Five personality traits, only Extraversion and Agreeableness emerged as significant predictors of entrepreneurial success. Extraversion positively predicted TEA as a whole (r = .256/d = .539) and negatively predicted Innovation Entrepreneurship (r = -.25/d = -.516), while Agreeableness exhibited a negative correlation with Invention Entrepreneurship as well (r = -.07/d = -.14) but failed to predict TEA significantly. Notably, once META was integrated into the model, none of the other Big Five traits retained their predictive power, highlighting META's efficiency in forecasting TEA (r = .62/d = 1.58). Collectively, these findings underscore the multifaceted relationships between personality traits, entrepreneurial success, and the predictive strength of narrow traits as measured through META.

A series of interesting implications may also be derived. Not only do the findings underpin previous study results, which support the existence of a relationship between personality and entrepreneurship, but they also provide proof of personality traits being predictive of success beyond mere business creation and performance, expanding the importance of personality on entrepreneurship. Moreover, the degree of alignment between the traits under scrutiny and the specific entrepreneurial outcome in question directly amplifies their predictive power. While this observation may appear self-evident on the surface, its practical ramifications are quite significant. Consider a Venture Capital fund embarking on a mission to bolster a specific entrepreneurial venture where a distinct outcome holds paramount

importance. Armed with this discerning insight, the VC can meticulously tailor their assessments to precisely match the desired outcome, yielding results that are more robust and strikingly precise in forecasting performance and eventual success. Another interesting observation was that Agreeableness was solely (negatively) predicting Invention Entrepreneurship. This suggests that correlations and predictions depend highly on the entrepreneurial outcome one observes and the type of tasks necessary to attain it.

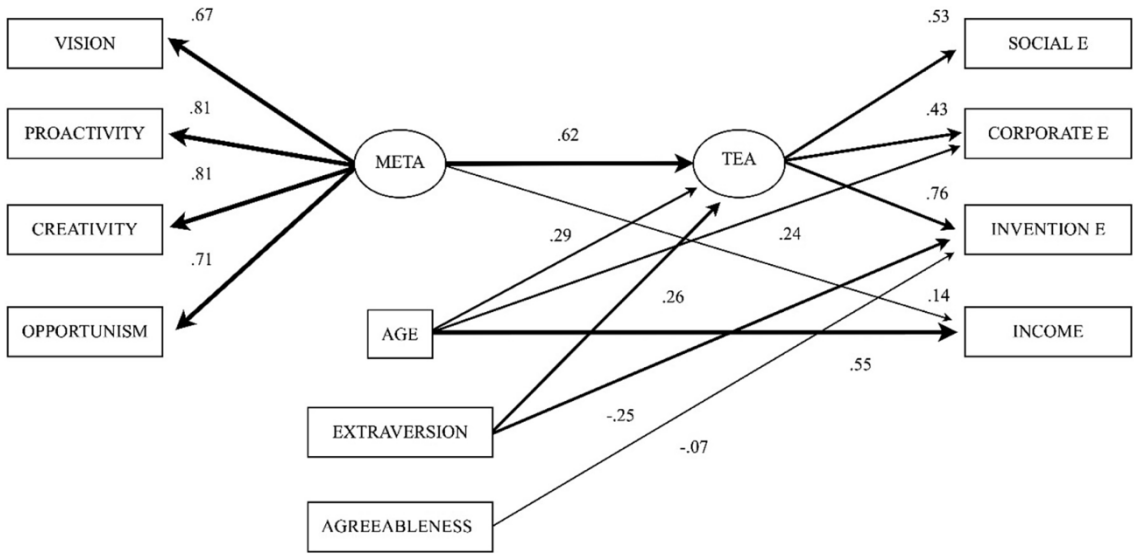


***Figure 2*:** Structural Equation Model. Notes: META Measure of Entrepreneurial Tendencies and Abilities, TEA = Total Entrepreneurial Ability, E = Entrepreneurship. Thickness of lines represents strength of path weights. (Taken from Leutner et al.)

1.3.2.2 Specific Study Critique

This study's most significant advantage lies in its comprehensive and explicit definition of entrepreneurship and entrepreneurial success. By adopting these broad definitions, the study implicitly acknowledges that the predictive power of specific personality traits is inherently linked to how success is defined within the entrepreneurial context. This understanding is essential for the practical implications of personality-focused studies in entrepreneurship. Notably, this approach allows the authors to gain a more profound and nuanced understanding

of entrepreneurial success, extending beyond mere considerations of business ownership or the passage of a specified threshold in terms of years or revenue. Moreover, it enables them to achieve higher and, therefore, more meaningful correlations between variables of interest.

However, certain aspects of the study design introduce limitations that bear on the impact of its findings and implications. Despite being one of the central points of the study, a clear definition of the narrow personality traits it examined is missing. Although the authors extensively discuss the META model for assessing these traits, they do not explicitly define the traits it encompasses. It would have been beneficial to provide explicit definitions of the specific narrow traits rather than the broader groups they encompass to improve the study's impact.

The study's major strength, stemming from its inclusive approach, simultaneously represents its most significant weakness and introduces the potential for seriously compromised results. By encompassing a diverse range of occupational statuses within the same sample, there is a substantial risk that third variables might confound the study's findings. When seeking to make inferences about the relationship between variables such as personality traits and entrepreneurial success, a study that involves multiple groups must carefully consider the impact of unaccounted third variables that could affect each group differently. The diverse categories of entrepreneurs included in this study may not only diverge in their entrepreneurial endeavors but also other pivotal aspects of their lives. These factors can span from variances in financial resources (e.g., steady income inflow of employed entrepreneurs vs. unsteady income of self-employed ones) to disparities in strategic contacts. Without controlling for these factors, as seen in this study, there is potential for these unmeasured variables to obscure the relationship between personality and entrepreneurship, leading to spurious correlations.

Ultimately, this hinders the authors' ability to draw generalizable conclusions, as well as to make causal inferences based on their findings.

Furthermore, this heterogeneity of the sample also causes problems concerning the personality traits held to be most essential and, therefore, positively correlated with entrepreneurial success. For instance, employed entrepreneurs might be intrinsically motivated to maintain job security while pursuing innovative projects within their organization. In contrast, self-employed entrepreneurs often face higher financial risks and need to be more self-driven to establish and grow their businesses. This importance of situational contingencies is also mentioned by Zhao and Seibert (2006), as well as Miner (1997). Consequently, the personality traits associated with success in these two domains could differ significantly. Therefore, the nature of the entrepreneurial activities and the corresponding traits necessary for success resemble a third variable that requires attention. For example, the study could have been undertaken with separate samples to observe whether there are underlying differences in traits that contribute to success across multiple entrepreneurial populations.

Another serious flaw in the study design is its heavy reliance on self-reported measures, particularly concerning entrepreneurial success. This choice exposes the study to potential response biases, which can influence and moderate the obtained results. Furthermore, although Leutner et al. managed to assess a sizeable sample of 670 participants, issues arise from the recruitment methodology. Exclusive reliance on online recruitment creates a convenient yet non-probabilistic sampling approach. Consequently, there is a notable likelihood that the study attracted a specific subset of entrepreneurs characterized by particular skills, potentially leading to self-selection biases that exclude individuals with different personality profiles. This has the

potential to yield non-representative results, thereby limiting the generalizability of the study (Bethlehem, 2010).

Another notable concern pertains to the absence of a detailed definition of narrow personality traits. While the authors delve deeply into the model used to assess these traits (i.e., META), the study falls short of offering a comprehensive and explicit delineation of these narrow traits. Throughout the paper, it remains unclear whether Leutner et al. (2014) explicitly defined them. To enhance the study's impact, it would be better if the specific narrow traits, rather than the broader groups they encompass, were explicitly defined.

Furthermore, while there is no requirement for research to employ a T-Test study design focusing on only one sample certainly resembles a limitation that warrants criticism. By focusing on one cohort exclusively, the authors missed the opportunity to compare their findings to an important benchmark that would have allowed them to infer whether the observed results were inherent to a unique entrepreneurial population or whether they were merely indicative of successful individuals in general. By adding a second, non-entrepreneurial cohort, the study authors would have been able to render their findings more generalizable.

Lastly, the study lacks the inclusion of control variables beyond age and occupational status, which could conceivably exert an influence on entrepreneurial outcomes. The authors themselves acknowledge the need for future researchers to incorporate a broader range of individual variables, such as intelligence (IQ) and motivation. According to Leutner et al., a longitudinal study design that considers such variables could facilitate a more in-depth exploration of these constructs, allowing for examining their causal relationship with

entrepreneurial outcomes instead of mere correlation, which has inherent limitations regarding causal inference (2014).

1.4 Meta-Analyses

1.4.1 Meta-Analysis I: The Big Five Personality Dimensions and Entrepreneurial Status: A Meta-Analytical Review – Hao Zhao and Scott Seibert

1.4.1.1 Study Overview and Evaluation of Results and Implications

The study by Hao Zhao and Scott Seibert is a seminal meta-analysis exploring the intersection of personality traits and entrepreneurship (Rauch & Frese, 2007). It stands as one of the vital academic inquiries into understanding how personality relates to entrepreneurship and resonated greatly across the field. In this study, the authors examined the Big Five and their respective relationship to entrepreneurial status (i.e., being an entrepreneur or not) (Vantilborgh et al., 2015). To do so, a meta-analysis of 23 articles that examined the relationship between the Big Five and entrepreneurship was conducted, each of which examined a distinct pool of data to avoid an overlap of studies.

To be included in this meta-analysis, Zhao and Seibert defined four criteria to be fulfilled. 1) Studies included had to fit the meta-analysis definition of an entrepreneur. This definition was “someone who is the founder, owner, and manager of a small business and whose principal purpose is growth” (Zhao & Seibert, 2006, p. 263). A lenient approach was taken to this criterion, and studies that referred to their samples as entrepreneurs without further specifying what this meant were included. 2) A comparison group was also required. This second population had to meet the analysis definition of a manager, which was defined equally as broad and “include managers of all ranks and functions” (Zhao & Seibert, 2006, p. 263).

Subgroups of entrepreneurs were explicitly excluded. It was also crucial that the data of the comparative groups was collected at the same time as the entrepreneurial one to prevent extraneous method errors. 3) Furthermore, studies needed to measure at least one of the Big Five personality traits. Studies measuring personality traits that show no consistent relationship to any of the Big Five were excluded. It is important to mention that the authors followed scholars such as Mount and Barrick (1991) and perceived conscientiousness as a broad factor composed of two major facets: achievement motivation and dependability. Accordingly, studies examining these facets were included. 4) Lastly, Zhao and Seibert required studies to provide sufficient statistical data for the calculation of effect sizes (2006).

Zhao and Seibert developed hypotheses regarding the differences in personality traits between entrepreneurs and managers (2006). These were grounded in the Attraction-Selection-Attrition (ASA) model, initially introduced by Schneider (1987). The ASA is a widely employed theoretical framework for comprehending the interplay between individuals' personalities and their work environments and career choices. This study adapted the ASA to explain the relationship between personality traits and entrepreneurial status (ES). It was argued that, like other working environments, entrepreneurship will attract, select, and ultimately dismiss individuals with suitable personality foundations.

Two moderator hypotheses were formulated that sought to account for regional differences in the relationships of neuroticism and achievement motivation respective to ES. For studies that provided information on their population's country of origin, information on national tendencies towards uncertainty avoidance and performance orientation, gathered from data provided by Project GLOBE, was categorized and placed on either a high or low end of

a high-low dichotomy. However, these moderator hypotheses were not supported, as evidenced by the overlapping confidence intervals for the effect sizes across cultures with high and low uncertainty avoidance for Neuroticism and high and low performance orientation for achievement motivation.

To compare study findings, Zhao and Seibert employed a series of nuanced and intricate analytical techniques that allowed them to draw meaningful conclusions on the impact of the Big Five on ES (2006). At first, five separate meta-analyses were conducted on each factor of the FFM. Effect sizes were measured using *d* as a standardized way to gauge mean differences and standard deviations between managers and entrepreneurs. Other statistical techniques (e.g., *t* value, *F* value, or point-biserial correlation) were transformed to *d* using formulas derived from Hunter and Schmidt. Subsequently, effect sizes were weighted according to each study's overall sample size, so that those studies with a bigger sample size had more influence on the overall effect size. The result was an average observed effect size, $\bar{d}$. In addition, a corrected average effect size was calculated based on the reliabilities of personality scales used in the study. When studies compared one group of entrepreneurs to multiple groups of managers, a single, sample-weighted average effect size was used. Where subgroups were analyzed, a sample-weighted average was also used as long as the subgroup was not a proposed moderator of results. Lastly, Zhao and Seibert provided 90% confidence intervals (CI) and 80% Credibility Intervals (CRI) (2006). The CI's excluding zero suggested the existence of reliable differences between managers and entrepreneurs. In contrast, the CRI provides insights into the heterogeneity of effect sizes across studies and the potential existence of moderatos.

Overall, the study resulted in findings that suggested significant differences between the personalities of managers and entrepreneurs. Entrepreneurs scored significantly lower than managers on Neuroticism (d = -0.37) and Agreeableness (d = -0.16). However, their scores on Openness to Experience (d = 0,36) and Conscientiousness (d = 0.45) were significantly higher than those of managers. Although the reported effect size on Extraversion of d = 0.2 suggested that entrepreneurs score higher on this factor than managers, its CI included 0. Therefore, Zhao and Seibert had to conclude that both populations do not differ on this dimension (2006). Regardless, the CRI suggested high variability among studies, which could mean that most studies report a positive relationship between Extraversion and ES. Evidently, with an average effect size of 0.45, entrepreneurs and managers varied most significantly on Conscientiousness. See Table 2 below for an overview.

					90% CI		80% CRI	
Trait	K	N	$\bar{d}$	$\bar{d}_c$	Lower	Upper	Lower	Upper
Neuroticism	14	2,305	−0.32	−0.37	−0.54	−0.21	−0.82	0.07
Extraversion	9	1,476	0.20	0.22	−0.01	0.45	−0.28	0.72
Openness	10	2,115	0.30	0.36	0.19	0.52	−0.01	0.72
Agreeableness	7	1,350	−0.14	−0.16	−0.27	−0.05	−0.30	−0.02
Conscientiousness	20	3,480	0.39	0.45	0.38	0.52	−0.07	0.97

Note. K = number of studies; N = total sample size; $\bar{d}$ = average observed effect size; $\bar{d}_c$ = average effect size corrected for reliability of the measure; CI = confidence interval; CRI = credibility interval.

***Table 2*:** Results of Meta-Analyses (Taken from Zhao and Seibert)

In the next step, a multiple regression analysis was conducted to examine the multivariate relationship of the FFM dimensions to ES. By understanding this relationship, authors could determine which personality traits impact ES to what extent. The impact of each FFM dimension was expressed through the standardized regression coefficient β. In essence, the higher the β, the more indicative the respective trait is of someone being an entrepreneur. The results held that Conscientiousness (β = .26) was most predictive of ES, closely followed by

Agreeableness (β = -.22) and Openness to Experience (β = .18). The predictive forces of Neuroticism and Extraversion, in turn, were much smaller with a β = -.12 and β = .09 respectively. The multiple R of the FFM, which quantifies the relationship of the combined Big Five with ES, was moderate at .37.

Trait	β/R^a	*SE*	*t*
Neuroticism	−.12	.03	4.80*
Extraversion	.09	.02	3.88*
Openness	.18	.02	7.67*
Agreeableness	−.22	.02	9.00*
Conscientiousness	.26	.02	10.32*
Multiple *R*	.37	.02	16.94*

Note. Entrepreneur = 1, and manager = 0.
[a] With the exception of the multiple *R* estimate in the last row, all estimates in the β/R column are standardized regression coefficients.
* $p < .01$.

***Table 3*:** Multiple Regression With Entrepreneurial Status as the Dependent Variable (Taken from Zhao and Seibert)

Most importantly, this comprehensive meta-analysis by Zhao and Seibert (2006) allows the conclusion that entrepreneurs do indeed show different personality profiles than other individuals (in this case, managers). Conscientiousness was unveiled to be the most indicative measurement of entrepreneurial status. Even more so, the Big Five in general, with the sole exemption of Extraversion, were all found to be predictive of ES. Also, the multivariate relationship was statistically significant, lending further credibility to the importance of personality in entrepreneurship.

1.4.1.2 Specific Study Critique

Overall, Zhao and Seibert did a remarkable job compiling and interpreting a substantial data set, contributing significantly to the advancement of scholarly discourse surrounding this topic. Their meta-analysis marked a profound step towards denying previous narrative approaches on

personality and entrepreneurship, rejecting a connection. Furthermore, the authors went to great lengths to ensure that the meta-analysis is conducted in a technically sound manner to ensure the highest degree of meaningfulness and generalizability.

Although the analysis exhibits a commendable effort toward achieving a technically flawless study design and offers valuable insights, it is important to recognize and address certain limitations. The authors did not explicitly address whether the studies were conducted in laboratory or real-world environments. The absence of this differentiation may limit the validity of the findings, as the controlled conditions of laboratory research can differ significantly from the complex realities that entrepreneurs face. Therefore, accounting for the context in which the data was collected is crucial for the accurate interpretation and generalization of the results to actual entrepreneurial settings.

While the authors adeptly apply the ASA model to explore the Big Five's impact on ES, they did not account for an entrepreneurial venture's life cycle stages. The ASA model suggests that an individual's personality aligns with specific organizational environments, which can vary significantly from one stage to another in the context of entrepreneurship. Although the authors utilized the ASA framework, which predicts that the entrepreneurial environment will attract, select, and retain individuals with compatible personality traits, they did not differentiate between the distinct phases a venture undergoes. This oversight potentially limits the study's findings, as the criticality of certain personality traits may fluctuate from the conception to the maturity of a venture. However, the authors address this issue and recommend future researchers to address this limitation.

Furthermore, although the authors adhered to a strict methodology throughout their meta-analysis, including well-defined inclusion criteria outlined above, there is an area that demands scrutiny. Despite the rigorous approach, the criteria for including studies based on the absence of explicit contradiction to their definition of entrepreneurship could be seen as overly inclusive. This approach does not guarantee the conceptual uniformity of the selected studies concerning the multifaceted nature of entrepreneurship. It bears the potential to blend sets of studies with fundamentally different assumptions of what constitutes an entrepreneur, leading to a mix of not entirely compatible data. Although part of a strict overall approach, this methodological decision introduces a risk of heterogeneity (which has also been detected across variables) that could compromise the clarity of the relationship between personality traits and ES. The resultant effect sizes, drawn from this broader selection of studies, might therefore be tainted by the underlying variance in how entrepreneurship is defined and ultimately measured. A more discerning selection process not only excluding but actively including only those studies that affirm their operational definition of entrepreneur would be advisable and lend credibility, as well as allow for the study results to be better generalizable.

Furthermore, Zhao and Seibert categorized studies in line with the Big Five, and both broad and narrow traits, were included under the same personality factor. Not only is this a missed opportunity to better discern underlying traits, but it also potentially flaws results since some underlying traits could overlap with more than just one of the Big Five dimensions as suggested above.

Lastly, the study does not adequately account for the potential confounding influence of third variables between entrepreneurs and managers, which are critical to establishing a clear

definition between the two groups. As Herman Brandstätter suggested, comparisons of entrepreneurs with managers only make sense "if other conditions such as gender, education level, professional experience, type of industry, and number of employees reporting to the entrepreneur or manager, respectively, are at least roughly kept equal" (2011, p. 224). Without such controls, the effect sizes reported by the study may conflate the relationship of personality traits with the impact of these unmeasured variables, leading to a third variable problem. This methodological oversight hinders the study's capacity to attribute differences in ES to personality factors confidently. A more nuanced analysis incorporating these variables would yield a more robust understanding of which personality traits distinguish entrepreneurs from managers.

1.4.2 Meta-Analysis II: Let's put the person back into entrepreneurship research: A meta-analysis on the relationship between business owners' personality traits, business creation, and success– Andreas Rauch and Michael Frese

1.4.2.1 Study Overview and Evaluation of Results and Implications

Rauch and Frese's study offers an insightful meta-analysis of how personality traits predict entrepreneurial success and business creation (2007). Focusing on the predictive capabilities of specific, task-related traits, the analysis reviews 116 independent samples collected from 104 articles, concluding that narrow traits aligned with entrepreneurial tasks are significant predictors of entrepreneurial outcomes.

In their pursuit of a more granular understanding of the correlations between personality and entrepreneurship, the authors shifted away from broad personality categories like the Big Five, which might contain conflicting sub-traits that may obscure clear correlations with the respective entrepreneurial dependent variable chosen (Frese & Gielnik, 2014). To

address this, they focused on narrow/specific traits that allegedly provide a more precise predictive value for entrepreneurial behavior. They scrutinized traits like need for achievement (a desire to perform well in relation to a set of standards), innovativeness (a tendency to seek originality, including novel concepts, creative methods, and inventive solutions), proactive personality (the propensity to take charge, make changes, and work to challenge the status quo), generalized self-efficacy (one's conviction of the ability to succeed in particular circumstances), stress tolerance (the capacity to handle stress and deal with ambiguous and unfavorable circumstances), need for autonomy (an individual's willingness to think and act independently and self-directed), internal locus of control (believing that one's own actions influence the outcome), and risk-taking propensity (a person's willingness to engage with and take up risky circumstances) – each providing unique predictive value for entrepreneurial activities (Rauch & Frese, 2007). A complete list of traits covered in the articles that the meta-analysis included can be found below (Table 4).

Need for achievement	Flexibility
Internal locus of control	Protestant work ethic beliefs
Risk-taking propensity	Optimism
Innovativeness	Rigidity
Need for autonomy	Self-confidence
Stress tolerance	Proactive personality
Self-efficacy	Self-esteem
Need for dominance	Goal orientation
Tolerance for ambiguity	Tenacity
Sobriety	Higher order need strength
Type-A behaviour	Creativity
Practicality	Enthusiasm
Openness to experience	Need for affiliation
Extraversion	Scepticism
Emotional stability	Self-reliance
Conscientiousness	Dogmatism
Delay of gratification	Impulsiveness
Discipline	Endurance
Conservatism	Conformity
Neuroticism	Future orientation
Expedience	Aggressiveness
Forthrightness	Passion for work
Shyness	Norm orientation
Tough-mindedness	Originality
Trustworthy	Benevolence
Humility	

Table 4: Traits studied in articles identified (taken from Rauch and Frese, 2007)

The authors underscore the importance of distinguishing between the initiation phase, characterized by business creation, and the subsequent operational phase, defined by business success. This distinction is critical as it acknowledges the varied challenges and skills required at different stages of entrepreneurial ventures, a distinction Zhao and Seibert did not account for despite their recognition of the value of different stages as outlined by the ASA (Zhao & Seibert, 2006).

The study meticulously defined its inclusion criteria, incorporating a broad behavioral definition of entrepreneurship, encompassing both “independent ownership, active management, and/or expressed intention to do so,” as well as “the recognition and exploitation of opportunities” (Rauch & Frese, 2007, p.355). This comprehensive approach captured a diverse array of studies, and the authors applied a stringent matching of personality traits to

specific entrepreneurial tasks, affirming their predictive relevance to business creation and success.

Selected studies examined personality traits and entrepreneurial outcomes with results reported in translatable statistical measures.[2] Studies reporting only significant results, using single-item measures, or conducted in lab settings were excluded to ensure the robustness of the sample.

Subsequently, traits from the included articles were evaluated by experts, who coded them based on their relevance to entrepreneurial tasks, leading to a distinction between 11 task-related traits and 12 non-related ones. This expert coding aimed for an interrater agreement of ≥ .70 for a trait to be considered task-related. Results can be found in Table 5.

Matched	*Mean*	*Interrater reliability (rwg)*	*Not matched*	*Mean*	*Interrater reliability (rwg)*
Self-efficacy	4.6	.76	Optimism	3.8	.69
Proactive personality	4.7	.88	Extraversion	3.1	.73
Tenacity	4.4	.87	Conscientiousness	3.7	.88
Need for achievement	4.5	.75	Rigidity	1.9	.73
Stress tolerance	4.2	.80	Creativity	3.5	.75
Goal orientation	4.2	.80	Self-reliance	3.7	.77
Need for autonomy	4.3	.88	Dogmatism	1.5	.75
Innovativeness	4.3	.77	Conservatism	1.3	.88
Endurance	4.1	.73	Forthrightness	3.2	.80
Flexibility	4.2	.91	Shyness	1.0	1
Passion for work	4.6	.87	Norm orientation	1.9	.73
			Conformity	1.5	.75

***Table 5*:** Results of the expert coding: Traits matched to entrepreneurship and traits not matched to entrepreneurship (taken from Rauch and Frese, 2007)

In the last step, Rauch and Frese conducted a series of post hoc tests to examine the predictive qualities of a series of traits for entrepreneurial behavior (creation and success of a business) (2007). They found that need for achievement, innovativeness, self-efficacy, stress

[2] To enable better comparability across the mentioned studies, I will also provide correlations converted to *d*. Conversions were calculated using the web-tool escal.site

tolerance, need for autonomy, internal locus of control, and risk-taking did not differ and were therefore predictive of entrepreneurial behavior as a whole.

The study veers from broad categories of traits such as the FFM, aligning with the proposed theory that specific traits are better predictors. This theory aligns closely with findings from Barrick and Mount on job performance and Mischel's theory on the interplay between personality and situational contexts (2005; 1968).

After adjusting for variances, the study found that narrow personality traits indeed correlate with business creation (r = .190/d = .387) and business success (r = .195/d = .398). Furthermore, task-related traits showed greater predictive power for entrepreneurial outcomes (r = .247/d = .510 for business creation; r = .250/d = .494 for success) compared to traits not matched (r = .124/d = .250 for creation; r = .028/d = .056 for success). The effect size for traits not matched to business success was statistically insignificant, with the lower confidence interval boundary including zero.

Additionally, the authors found significant heterogeneity across studies, suggesting the influence of moderator variables. This prompted further analysis, testing the relationships between matched traits and entrepreneurial behavior separately. They substantiated direct and significant correlations for Innovativeness (r = .273/d = .568), proactive personality (r = .270/d = .561), self-efficacy (r = .247/d = .510) with success, and stress tolerance (r = .104/d = .209) with business creation, unaffected by moderators. All results can be found below (Table 6).

Personality characteristic	*K*	*N*	*rw*	*So*	*Se*	*Sp*	*Corrected r*	*% variance due to sampling error*	*95% confidence interval*	*Sig. test*
Need for achievement with										
Business creation	29	8698	.188	.0108	.0031	.0057	.219	28.94	.150–.226	$z^1 = 1.16$
Success	31	4115	.232	.0411	.0068	.0338	.304	16.52	.161–.303	
Innovativeness with										
Business creation	15	4620	.196	.0197	.0030	.0164	.235	16.45	.125–.267	$z^1 = 0.15$
Success	7	800	.203	.0052	.0081	.0000	.273	157.23	.150–.256	
Proactive personality with										
Success	5	679	.201	.0062	.0068	.0000	.270	110.09	.124–.278	
Generalized self-efficacy with										
Business creation	8	2250	.335	.0377	.0028	.0347	.378	7.44	.201–.470	$z^1 = 1.79$
Success	11	1331	.205	.0101	.0077	.0024	.247	75.46	.146–.265	
Stress tolerance with										
Business creation	6	1325	.090	.0004	.0045	.0000	.104	1034.42	.073–.106	$z^1 = 1.71$
Success	11	1282	.157	.0161	.0082	.0078	.198	51.18	.081–.231	
Need for autonomy with										
Business creation	11	4256	.252	.0246	.0023	.0223	.312	9.24	.159–.344	$z^1 = 1.70$
Success	8	843	.126	.0262	.0093	.0168	.164	35.42	.013–.238	
Locus of control with										
Business creation	24	5648	.157	.0199	.0041	.0158	.188	20.37	.100–.213	$z^1 = 1.68$
Success	23	3959	.098	.0093	.0057	.0036	.134	61.43	.059–.138	
Risk taking with										
Business creation	18	8863	.086	.0111	.0020	.0091	.102	18.06	.037–.135	$z^1 = 0.16$
Success	13	1744	.079	.0172	.0074	.0097	.103	43.17	.008–.15	

K = number of studies. *N* = overall *N*. *rw* = sample size weighted mean correlation. *So* = observed variance, *Se* = sampling error variance, *Sp* = residual variance. Corrected *r* = corrected for reliabilities. [1]difference in *rw* between business creation and success.

***Table 6*:** Relationships between particular personality traits and different types of entrepreneurial behavior (taken from Rauch and Frese, 2007)

Their analysis not only underscores the relevance of these traits but also advocates for a nuanced understanding of how individual personality traits contribute to entrepreneurial endeavors. It highlights that the more specific the trait and the better matched towards a specific activity, the higher its predictive capabilities. The study thus paves the way for a more tailored and accurate assessment of entrepreneurial potential, moving beyond generalized trait categories to a focused examination of traits directly applicable to entrepreneurial tasks.

1.4.2.2 Specific Study Critique

Once again, despite noteworthy results and implications, a series of limitations and methodological flaws require added emphasis.

The study's methodology thoroughly reviews a large body of literature and aims at a nuanced understanding of the relationship between personality traits and entrepreneurial

success. However, despite its meticulous methodology, high heterogeneity in the effect sizes for unmatched traits raised important questions. The authors' decision to focus on matched traits without thoroughly investigating the sources of heterogeneity among unmatched traits in any depth is arguably a missed opportunity to render the findings more generalizable. Although this choice might reinforce the study's hypotheses, it prevents the authors from exploring the full spectrum of personality's impact on entrepreneurial behavior. The heterogeneity suggests that variables were at play that were not captured by the meta-analysis but could be crucial for understanding the complexity of entrepreneurial outcomes.

Furthermore, the study fails to systematically differentiate between entrepreneurs and successful entrepreneurs. This oversight is significant because not all entrepreneurs achieve success, and the traits that initiate business creation might differ from those that sustain a business. While this might seem contradictory initially, given that the authors also seek to examine factors that predict entrepreneurial success, it represents an important methodological limitation. By not differentiating across these categories the study might run into danger of subjecting itself to a survivorship bias (Carpenter & Lynch, 1999). This bias can obscure the full role of certain traits by excluding those entrepreneurs whose ventures did not survive. Consequently, the traits identified as predictors of success might not be exclusive to successful entrepreneurs but could also be present among unsuccessful ones. Therefore, any conclusions drawn about the predictive power of specific traits for entrepreneurial success could be misleading, failing to capture the full spectrum of entrepreneurial experiences.

As with most studies and meta-analyses in the field, Rauch and Frese also fail to employ a longitudinal approach (2007). While the study offers a snapshot of the relationship between

personality and entrepreneurship, its cross-sectional design limits the ability to conclude how this relationship evolves over time and account for potential alternative explanations. Since entrepreneurship is a dynamic process, traits that are beneficial at one stage may be detrimental at another. Although the authors initially recognized a change of traits predictive of entrepreneurial outcomes throughout the lifecycle of a venture, the study design implicitly assumed a static impact of personality across this lifecycle. However, certain traits might be more valuable during the early stages of venture creation than in the later stages. A longitudinal approach could have provided a clearer picture of the evolving impact of personality traits across the entrepreneurial lifecycle.

As mentioned, the meta-analysis applies a broad behavioral definition of entrepreneurship. While inclusive, it may be too lenient and contribute significantly to the overly heterogeneous sample of studies, making it difficult to draw precise and generalizable conclusions. A more focused definition might yield a more homogenous set of studies with the potential for more robust and specific findings. The significant heterogeneity and variance in the study's findings, in turn, hint at the existence of moderator variables that were not accounted for but could have affected effect sizes. By not identifying these moderators, the study potentially neglects factors that could explain the variability in how traits predict entrepreneurial outcomes. For instance, age, economic conditions, or the previously mentioned life cycle of a venture could all play significant roles in moderating relationships between personality and entrepreneurship (Baron, 2004).

In addition to the possibility of moderators, the authors themselves also mentioned that there might be third variables that could potentially lead to spurious correlations. For instance,

the paper mentioned cognitive ability as a potential confounding third variable for the need for achievement, which has been deemed to predict entrepreneurial behavior. If not controlled for, such a third variable could lead to wrong assumptions on the causality of specific traits. A longitudinal study design is also helpful in reducing such wrong inferences.

1.5 Overall Analysis of All Studies and Meta-Analyses

The overall picture that emerges is that studies usually either examine the Big Five personality traits, examined through the FFM, or focus specifically on narrow personality traits. There are good arguments for both broad and narrow traits to be examined, and there is no apparent reason for or advantage in limiting oneself to only one category. Which approach to leverage ultimately depends on the goal one would like to pursue since the practical implications of broad and narrow traits may be more beneficial for different situations. For example, broad traits could be leveraged to determine who could be trained to be an entrepreneur. In contrast, narrow traits could be better in determining whether or not to fund someone who already is an entrepreneur.

Despite the abundance of research and literature undertaken, there is very little agreement on which traits are the *primordial* predictors of entrepreneurial outcomes. However, across studies, the consensus is that out of the Big Five, conscientiousness, openness, and extraversion correlate positively with entrepreneurial outcomes. The strongest correlations across studies have been found for conscientiousness. While such a precise conclusion cannot be drawn for narrow traits, innovativeness, optimism, and risk propensity have received a sizeable amount of attention. In fact, risk propensity received much attention as a construct in and of itself and shall be illuminated in further detail at a later point in Chapter 2.

1.5.1 Discussion of Typical Problems with Studies

1.5.1.1 Third-Variable Problem

One recurring issue throughout this chapter was the risk of third variable problems, which pose significant challenges for causal explanations. This issue arises when an unaccounted-for third variable influences both the independent (personality traits) and dependent variables (entrepreneurial outcomes), leading to spurious correlations between them (Ewert & Sibthorp, 2009). This complicates the interpretation of results, as it becomes difficult to determine whether the observed relationships are genuinely causal or merely a correlation. This problem underscores the importance of rigorous research design and the need to control potential confounding variables to ensure the validity of causal inferences.

1.5.1.2 Lack of Objectivity/Self-Assessment Methodologies

Furthermore, the evaluation of existing literature revealed a prevalent overreliance on self-assessment methodologies such as Likert scales, leading to concerns about a lack of objectivity across studies. Self-assessments, while valuable for capturing subjective experiences, often lack the rigorous checks of objectivity, potentially skewing results due to personal biases, inaccuracies in self-perception, or social desirability effects (Ones et al., 1996; Tanujaya, 2022). While this may not be as problematic for assessing personality traits and arguably the most viable option in absence of better and more objective opportunities, it resembles a problematic methodology, especially for assessing entrepreneurial success. This overdependence on self-reported data can limit the reliability and validity of findings, as it fails to account for unconscious biases or misrepresentations of study subjects systematically. This chapter

emphasizes this common limitation. Possible solutions could be setting clear thresholds and definitions to assess e.g., business/entrepreneurial success.

1.5.1.3 Lack of Longitudinal Approach

Lastly, most research is limited in that it fails to employ a longitudinal study design. This shortfall is significant because longitudinal studies are crucial for understanding how variables and relationships evolve. Without them, it is challenging to draw robust conclusions about the actual impacts of personality traits on entrepreneurship (Johnson, 2010). The predominant use of cross-sectional designs in the reviewed studies limits the authors' ability to draw conclusions on causality, potentially leading to incomplete or misleading findings and interpretations. A longitudinal study design would also help tackle third-variable problems by observing alleged relationships between two variables over a more extended period and making inferences on the true nature of their relationship. This underscores the need for more longitudinal research to capture dynamic processes and provide a more comprehensive understanding of personality and entrepreneurship.

1.6 Implications

Despite the methodological limitations prevalent in the research on personality in entrepreneurship, which I have thoroughly discussed, the empirical evidence linking personality to entrepreneurial outcomes is striking and significant. However, this relationship does more than exist; it presents a range of significant implications, some of which I would like to shed light on briefly.

In their meta-analysis, Rauch and Frese identified certain personality traits whose correlation with entrepreneurial behavior is almost as strong as the effectiveness of conventional X-rays in detecting tooth cavities (effect size of r = .360/d = .772). Accordingly, they suggested that if effect sizes of this magnitude are robust enough to inform medical decisions, they should be equally influential in decisions related to entrepreneurship (2007).

The practical applications of these findings are multifaceted and far-reaching. For individuals aspiring to become entrepreneurs, personality assessments could serve as valuable tools in guiding their career paths, detecting strengths and weaknesses, and aiding in the selection of complementary partners. Moreover, this research could impact how support entities, such as government agencies, identify and assist potential entrepreneurs. By recognizing specific traits, these agencies can make more informed decisions about which startups to support.

Perhaps most importantly, financial decision-makers like banks and venture capitalists could and already actively do incorporate personality traits in their investment decision-making process. Such an approach can refine their investment strategies, leading to more targeted and potentially successful investments (Andreoli, 2023). In such scenarios, the empirical evidence suggests that narrow traits may have greater practical implications and importance for VCs (e.g.). In contrast, broad models like the FFM are better at showing that there is such a thing as an entrepreneurial personality at all.

However, it is crucial to remember that personality traits are but one piece of a larger puzzle. They should be considered alongside a range of other factors in any decision-making

process related to entrepreneurship, ensuring a holistic and nuanced approach (Rauch & Frese, 2007).

1.7 Conclusion

In this chapter, I have explored the relationship of both broad and narrow personality traits with entrepreneurship. While potentially partly flawed, the evidence unmistakably suggests a strong link between these traits and entrepreneurship. The FFM and narrow traits both emerge as significant predictors of entrepreneurial intention, entry, and success. Arguably, the Big Five offer a more robust framework, allowing for better control of external variables and enhancing the generalizability of findings. They provide a comprehensive view of the connection between personality and entrepreneurship.

However, focusing on narrow traits can be more effective when targeting specific outcomes. These traits offer a tailored approach useful for setting precise benchmarks, such as for financial assistance or entrepreneurial engagement criteria.

Nevertheless, besides their positively connoted predictive qualities, many traits can also have a "Janus-faced" downside (Miller, 2015, p. 2). Qualities like "energy, passion, and optimism," which are fundamental parts of some traits associated with entrepreneurs "can [quickly] lead turn to overconfidence" when excessive (Miller, 2015, p. 2). Beyond a certain threshold, traits that originally exerted beneficial powers could, therefore, reach a tipping point, after which they become detrimental to entrepreneurial performance with potentially devastating effects. For a visualization of this effect, see Figure 3 below.

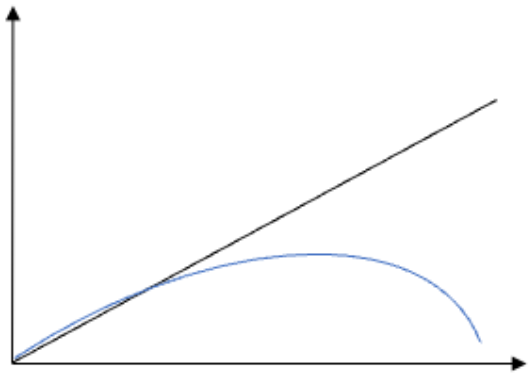


***Figure 3*:** Relationship between degree of certain traits (e.g., Extraversion) (black graph) and entrepreneurial performance (blue graph) (symbolic).

Since such traits have a powerful impact on the decision-making of individuals subject to them, caution and awareness are advised when applying these traits to entrepreneurial contexts. While personality is an important factor in entrepreneurship, it should not be the sole basis for informing critical decisions like investments but complemented by further insights, like the distinct ways in which entrepreneurs judge specific situations and make decisions, which will be illuminated in the following chapters.

In summary, while personality traits are undeniably linked to entrepreneurial outcomes, their application in this field should be approached in a way that acknowledges their potential and limitations.

Chapter 2 – Cognitive Contours: An Inquiry into Judgmental Decision Making and Entrepreneurship

In the first part of this project, I examined the relationship between personality traits and their predictive power for entrepreneurial outcomes. While this examination provided valuable insights, I will continue by shifting the focus of this project towards a different lens. In this second part, I will examine the work of Judgmental Decision Theory (JDM) or Behavior Decision Theory (BDT) and the profound implications it provides for entrepreneurship. This transition serves as a vital bridge toward the final part of this project, where I attempt to gather empirical evidence to shed light on how cognitive mechanisms examined in JDM shape and affect entrepreneurship.

2.1 Risk-Taking and Overconfidence

JDM traditionally examined entrepreneurship through two concepts that broadly align with common stereotypes about entrepreneurs. The first portrays entrepreneurs as risk-seeking individuals who drive the economy by undertaking risky ventures or simply as professional risk-takers. The second views them as overconfident decision-makers who set unrealistic goals and put too much faith in their capabilities and chances of success. Both concepts have taken a fundamental role in the perception of entrepreneurship that demands closer scrutiny. Below, I will dive deeper into their intricacies and evaluate their implications for entrepreneurs.

2.1.1 Risk-Taking Propensity: A Deeper Dive

Entrepreneurs, as conceptualized by Schumpeter, are not merely agents of creative destruction but also embody a remarkable tolerance of risk. As outlined in Chapter 1, risk propensity is frequently seen as a pivotal personality trait of entrepreneurs. Different levels of risk propensity

are therefore regularly leveraged to forecast entrepreneurial outcomes. While some scholars view risk-taking as a facet of the Big Five personality traits, others, like Brandstätter (2011) or Paunonen and Jackson (1996), argue in favor of its distinct status, comparable in significance to the Big Five and a meaningful extension to the FMM. However, its role transcends mere personality traits. Risk-taking is an undeniably central tenet in entrepreneurship and was even held to be the "lifeblood of the entrepreneurial economy" by the Economist (Wooldridge, 2019, para. 23). It encapsulates the entrepreneur's tendency to make decisions with uncertain outcomes, potentially impacting their "financial well-being, career opportunities, family relations, and psychic well-being" (Brockhaus Sr., 1980, p. 510). These claims warrant an in-depth examination through the lens of JDM.

JDM helps understand how risk propensity influences decision-making under conditions of uncertainty, scenarios that are intrinsically related to the everyday challenges entrepreneurs face (Takemura, 2021). As with concepts surrounding personality, the definition of entrepreneurship significantly affects how the risk propensity of entrepreneurs is perceived. For example, self-employed individuals distributing innovative inventions might exhibit a higher risk propensity than corporate entrepreneurs in stable, less risky environments, as those included in the López-Núñez study. This assumption is supported by Hyytinen's findings, which demonstrate varying impacts of risk propensity depending on an entrepreneur's level of innovativeness (2015).

The specificity of entrepreneurial definitions can therefore moderate empirical results concerning whether high levels of risk propensity are found in entrepreneurial populations. Stewart and Roth, in their meta-analysis, reported a moderate effect size (d = 0.36) in risk

propensity differences between entrepreneurs and managers. However, this effect size notably increased when results were focused on entrepreneurs with high growth aspirations exclusively (d = 0.84), a conclusion supported by Kerr et al., who held that "growth-oriented founders tend to exhibit very different characteristics" and therefore likely differ in decision-makings (Kerr et al., 2018, p. 292; Stewart & Roth, 2001,). This suggests that narrowly defined samples yield more substantial effect sizes, though the generalizability of these findings should be kept in mind.

The relationship between risk propensity and entrepreneurial behavior, however, is contested. Diverse studies, as referenced by Kerr et al., show significant heterogeneity, leading to varied conclusions about the extent to which risk propensity predicts entrepreneurial entry and success. Furthermore, Miner and Raju, in their meta-analysis, challenged Stewart and Roth's conclusions, proposing weaker effect sizes between entrepreneurial status and risk propensity (2004). However, Stewart and Roth's subsequent analysis, addressing methodological concerns raised by Miner and Raju, reaffirmed their initial findings, albeit with slightly weaker effect sizes (d = 0.23) (2004).

Setting aside this scholarly debate, Miner and Raju's work highlights the vast potential of examining risk propensity in the context of entrepreneurship, including its correlation with firm survival (2004). Notably, risk propensity does not always correlate positively with entrepreneurial performance. This indicates that while risk-tolerant entrepreneurs might enter the market more frequently, their performance is not consistently superior (Brandstätter, 2011). Furthermore, it has been suggested that risk-averse entrepreneurs may increase their likelihood of success by venturing only with their best ideas (Hvide & Panos, 2014). However, this is not a

definitive conclusion, as evidenced by Cucculelli and Ermini's study, which found that risk-prone entrepreneurs outperformed their risk-averse counterparts in a specific context of Italian manufacturing firms (2013).

Integrating Prospect Theory into the discussion of entrepreneurial risk behavior and tendencies could provide additional valuable insights. Developed by Daniel Kahneman and Amos Tversky, Prospect Theory asserts that people's decision-making is influenced by how they perceive gains and losses relative to a specific reference point rather than absolute outcomes. It postulates that individuals generally exhibit risk aversion when dealing with potential gains and demonstrate risk-seeking behavior in the face of potential losses (2013).

However, when examining entrepreneurs, especially those with a high level of risk propensity, the application of Prospect Theory might reveal unique patterns. These entrepreneurs could potentially display risk-seeking behavior even in situations with potential gains. This disposition could arise from their greater tolerance for uncertainty and a more optimistic outlook on potential outcomes (Kerr et al., 2018). Furthermore, research suggests that entrepreneurs may regard missed opportunities as equivalent to losses (Chavaglia & José, 2023). This perspective implies that entrepreneurs, unlike non-entrepreneurs, might frame missed opportunities for potential gains as equivalent to losses, thereby influencing their risk assessment differently and reaching different conclusions in the same situation.

Furthermore, for some entrepreneurs, financial results are not the (sole) driver behind pursuing an entrepreneurial venture. They seek to build something that they consider worthwhile. If this turns out to be financially unprofitable, this might feel like less of a loss to

them than being required to work in a 9 to 5 job where they work on tasks that they deem not inspirational and unnecessary (Bhidé, 1996). As can be seen, what constitutes a loss and a gain largely depends on individual assessments that vary greatly. However, such effects have not been examined in depth, and current literature still suggests that entrepreneurs tend to act risk-averse in the face of potential gains, as suggested by a study conducted by Hsu et al. (2017).

Entrepreneurial approaches to potential losses might also drastically differ from those of non-entrepreneurs. In such scenarios, their inclination towards risk-seeking could intensify, as they might be more willing to undertake actions that could alleviate or reverse prior losses. Although this phenomenon is generally held to be widely applicable outside of entrepreneurial populations, entrepreneurs will possibly act even more risk-seeking than non-entrepreneurs, passing thresholds where others would simply accept their loss and move on. This likely represents what has been named an escalation of commitment, a concept described by McCarthy et al., where entrepreneurs persist with increasing risk, often driven by previous failures (1993). This behavior poses challenges for investors dealing with serial entrepreneurs who reenter the entrepreneurial arena and seek funding, primarily motivated by compensating for past failures (i.e., losses) (Hsu et al., 2017).

If these deviations from Prospect Theory's standard predictions are substantiated, they underscore a critical point: the theory's applicability may vary based on individual risk propensity. Entrepreneurs with a high-risk propensity might interpret and assess risks and rewards differently from the general population, leading to riskier decision-making approaches than Prospect Theory typically anticipates. This variation emphasizes the necessity and importance of acknowledging individual differences in risk tolerance when applying theoretical

models like Prospect Theory in practical settings, especially entrepreneurial ventures. Understanding these nuances is essential for investors, policymakers, venture partners, and scholars alike who seek to comprehend and support the unique decision-making processes of entrepreneurs.

The implications of this modified understanding are significant. They suggest that entrepreneurs with a higher risk propensity might not only be more likely to initiate ventures despite uncertain outcomes but are also more inclined to persevere in adverse conditions or pursue ambitious growth strategies, which could be to their detriment. This could lead to higher instances of remarkable success but, more notably, to increased failures, contributing to the dynamic and often unpredictable perception of entrepreneurship. In conclusion, exploring risk propensity in entrepreneurship, especially through the lens of JDM and Prospect Theory, reveals a complex interplay of personality traits and situational factors. This complexity underscores the importance of nuanced approaches in understanding entrepreneurial behavior and decision-making processes.

2.1.2 Overconfidence Unveiled: Navigating the Maze of Misguided Beliefs

One aspect of decision-making held to exert considerable influence on risk-taking propensity is overconfidence (Kerr et al., 2018). Although seemingly self-explanatory, this second concept is not as straightforward as it might initially seem. In practice, overconfidence encompasses a broader spectrum of three underlying and more distinct perspectives, each operating under differing circumstances, yielding varying outcomes. Therefore, perceiving overconfidence as an unambiguous unitary construct is an error and demands closer scrutiny (Moore & Schatz, 2017).

Overestimation, the most prominent of the three, occurs when individuals perceive themselves as better than they actually are. It has traditionally been held to be caused by wishful thinking, where decision-makers optimistically overestimate the chances or likelihood of specific outcomes in a self-serving manner. Recent research, however, challenges this view (Moore & Schatz, 2017). It has been argued that self-serving motivation might assist in effective decision-making, suggesting that overestimation could be strategically beneficial. This perspective implies that overestimation aligns with the decision-maker's interests. Yet, this theory remains contested, and empirical evidence is lacking (Moore & Schatz, 2017). While it seems reasonable to suggest that self-enforcing thoughts might support robust decision-making, there is evidence that biased and false beliefs lead to worse outcomes (Chance et al., 2011). The gratifying feeling of being confident, triggered by overestimation, can lead to weaker preparation or performance and will likely be penalized by worse outcomes than desired (Moore & Schatz, 2017; Loughran et al., 2013; Vancouver et al., 2008).

An important determinant of overestimation is task difficulty. Individuals tend to underestimate their performance on easy tasks, such as crafting effective To-Do Lists. However, they tend to overestimate their performance and skills on difficult tasks – such as entrepreneurship (also known as the hard-easy effect) (Moore & Schatz, 2017). One bias that plays a particularly large role in the problematic role of overconfidence for entrepreneurship is the planning fallacy, which posits that people overestimate their capabilities in determining how quickly they will be able to complete especially ambitious and time-consuming projects, such as the successful startup of a business venture (Flyvbjerg & Sunstein, 2016).

The second facet of overconfidence, overplacement, refers to the tendency to believe to be better than others at doing something. Previous literature suggested that this concept is almost omnipresent. However, many study results have been affected and skewed by erroneous study designs where participants could hold erroneous beliefs about their performance (Kerr et al., 2018). In fact, after adjusting for those design flaws, Cain et al. found evidence that people underestimate their chances of success compared to others, especially when faced with difficult tasks (2015). However, entrepreneurial entry is heavily influenced by self-selection. Entrepreneurs will decide to enter markets that they perceive as easy compared to others. This decision is owed to the belief that they will perform better in these markets than in more complex, harder ones. Overplacement will be regularly found in areas where underestimation persists (Cain et al., 2015). The results of these new findings of overplacement are striking evidence for the necessity to differentiate between varying forms of overconfidence. Overestimation and overplacement might negatively correlate (Cain et al., 2015). This contradiction explains the seemingly unsuitable relationship between the hard-easy effect and overplacement of entrepreneurs in *easier* entrepreneurial settings. Evidence suggests that individuals, based on incomplete information, believe that others do better on hard tasks and worse on easy tasks than themselves. This belief holds next to the hard-easy effect, where people overestimate their performance on hard tasks. In other words, while the entrepreneur might not be overconfident in their capability in the chosen domain, they believe in having a competitive edge over others in domains perceived as easy – they will be overplacing themselves. This false belief is grounded in incomplete information about others' performance, which will reinforce the hard-easy effect in overplacement (others will be even more underestimated in easy tasks and even more overestimated in hard tasks) and result in the

subsequent choosing of domains perceived as easy despite not being fully convinced of one's capabilities. Moore and Schatz grounded these findings in a differential regression employed by decision-makers accounting for the role of uncertainty and noise in people's beliefs about task performance (2017).

Lastly, overprecision is the phenomenon of being too sure to know the truth. Like the research undertaken on overplacement, previous studies employed a series of techniques that potentially skewed the results to find higher rates of overprecision than actually present. This included using confidence intervals, which were deemed unsuitable given the unfamiliarity of most decision-makers in expressing their confidence in such a way (Moore & Schatz, 2017). Researchers are yet to identify measures that result in unbiased measurements of overprecision, and a conclusive answer on the actual penetration of overprecision remains impossible. However, suffice it to say that overprecision could profoundly impact entrepreneurial behaviors. In fact, in their meta-analysis of the three types of overconfidence, Kraft et al. found striking evidence for the strong effect overprecision exhibits on entrepreneurial behavior (2022). They found that entrepreneurs tend to continue planning their business ventures based on initial, often optimistic, assumptions without adjusting them throughout the process of venture building (Kraft et al., 2022). These findings are consistent with those of Mamassian, who found that decision-makers failed to sufficiently adjust estimates in various guessing games, implying overprecision (2013).

Evidently, despite all the flaws found in previous research, all of these scenarios, at their heart, refer to situations where decision-makers reach false conclusions based on the data available to them (Moore & Schatz, 2017). As alluded to above, this bears the potential to have

profound implications on entrepreneurial behavior, such as entrepreneurial entry and subsequent performance (Kraft et al., 2022). Furthermore, the entrepreneurial arena, marked by its uncertainty and high reliance on assumptions and an individual's belief in those, allows to suggest that those with higher scores in overconfidence (in all three shapes) are more attracted to entrepreneurship (Koellinger et al., 2007). Therefore, it seems reasonable to suggest that entrepreneurs are more overconfident than non-entrepreneurs on average. However, some research suggests that this might be a feature not exclusive to entrepreneurs but can also be present among top managers. For this reason, it seems possible that entrepreneurial situations do not attract overconfidence exclusively but fast-paced business environments at large (Koudstaal et al., 2015). Nevertheless, the previous findings lead to my first hypothesis, which will be examined in a study in Chapter 4.

Hypothesis 1: Entrepreneurs will be more overconfident than MBA students on their ability to successfully identify and validate entrepreneurial opportunities.

Chapter 3 - Intuition and Insight: Dual Process Thinking and Entrepreneurship

Despite the interconnected nature of concepts like risk-propensity and overconfidence, JDM traditionally struggled to articulate theories that moved away from the specific realm of singular theories like risk-propensity and overconfidence. JDM therefore, regularly failed to grasp the bigger picture. However, the last decade witnessed a paradigm shift (Monteiro et al., 2019). In his seminal 2011 publication, Daniel Kahneman famously publicized the theory of system 1 and system 2 thinking, which offers a compelling theory that seeks to explain cognitive decision-making processes as a whole to present a solution that is generalizable and widely applicable across a vast array of scenarios (2011).

As mentioned, effective decision-making lies at the heart of success in entrepreneurship's fast-paced and uncertain domain. Entrepreneurs are regularly faced with scenarios that require both quick decisions and thoughtful long-term planning. According to Kahneman, this intricate balancing act of decision-making is held to be governed by systems 1 and 2 (2011). The underlying supposition of dual system thinking is that decision-makers are not rational as posited by normative models but subject to heuristics and biases that influence their behavior and decisions (Shleifer, 2012).

This chapter explores these concepts and their impact on entrepreneurial decision-making. It will expand the findings of Chapter 2 with this newer field within JDM that previously afforded little to no attention to entrepreneurship, and set the stage for Chapter 4, which will cover an experiment I conducted to gather empirical findings that shall support differences in dual systems thinking between German entrepreneurs and MBA students.

3.1 System 1

In *Thinking, Fast and Slow*, Kahneman introduced two distinct modes of thought (2011). A fast-paced, intuitive process that is more automated, system 1, as well as a slower, more deliberate, and conscious process, system 2, which attempts to monitor and correct the results of system 1 processes (Larrick, 2012).

Kahneman's precise definitions refer to system 1 as a system that "operates automatically and quickly, with little or no effort and no sense of voluntary control" (2011, p. 20). Think of processes like facial recognition, simple mathematical equations like 2 + 2, or parking your vehicle in its usual spot in front of your house. It is how decision-makers usually reach conclusions (Monteiro et al., 2019). As such, system 1 thinking has regularly been held to be intrinsically susceptible to being influenced by an array of heuristics and biases (Monteiro et al., 2019; Shleifer, 2012).

The literature on the effects of system 1 and system 2 thinking in entrepreneurship is thin. However, a series of studies have been conducted in different fields, some of which present interesting insights and implications that could help to understand how dual process thinking affects and shapes entrepreneurial decision-making. Monteiro et al., in their study of how medical diagnoses are influenced by dual process thinking, pointed out three resulting heuristics and biases, in particular, that frequently lead to erroneous diagnoses (2019). Drawing analogies to entrepreneurship is compelling.

The first bias mentioned is the availability bias. This cognitive shortcut is one of the most common biases overall. It refers to situations in which individuals rely on information, examples,

and associations that come more readily to mind when being confronted with a choice (Monteiro et al., 2019; Zhang et al., 2019). Zhang et al. perceive it as a greater construct that triggers a series of biases such as hindsight bias, illusory correlation, and overconfidence (2019). The inclusion of overconfidence proves the broad approach taken by systems 1 and 2, which envisions concepts that have previously been studied on their own (as outlined above). The implications of the availability bias for entrepreneurship are far-reaching. For example, it could lead to the allocation of resources to certain areas of a business that are more prevalent in the mind of the entrepreneur. This could be to the detriment of other areas within the business which, in turn, lack crucial funding. Monteiro et al. elaborate on hindsight bias outside the purview of the availability bias as well (2019). It refers to a phenomenon where individuals, in retrospect, convince themselves that they actually knew the result before it happened. This might prove to be problematic for entrepreneurs since it drastically diminishes the learning effects of past failures (Zhang et al., 2019). Lastly, overconfidence is mentioned, the dimensions and detrimental effects of which have been elaborated on at length above.

System 1 thinking happens automatically and unintentionally. Therefore, voluntarily stopping its implications is not possible, which bears the potential for decisions that do not appreciate all the information necessary to take over (Streeb et al., 2018). But could biases, being mental shortcuts at their heart, also benefit entrepreneurs? Several scholars argue in favor of this proposition. Frese and Gielnik remark that by helping in fast decision-making, cognitive biases “have a positive function, as they help entrepreneurs to make decisions without putting too much strain on their time and cognitive resources and thus to stay actionable in spite of high cognitive demands” (2014, p.424). Furthermore, Zhang et al. argue that the

dynamic and uncertain environment of entrepreneurship requires a healthy balance of biases and debiasing (2019). In fact, according to the authors, limiting biases as much as possible could be "detrimental for entrepreneurial behavior and performance, because information overload, or the limited time an entrepreneur has available to search for information," demands a satisfactory, rather than optimal decision process, in the spirit of bounded rationality (Zhang et al., 2019, p. 805). This hints at the importance system 1 can play in effective decision-making, which will be illuminated in further detail below.

3.2 System 2

System 2, in turn, "allocates attention to the effortful mental activities that demand it, including complex computations. The operations of System 2 are often associated with the subjective experience of agency, choice, and concentration" (Kahneman, 2011, p.21). You could think of mathematically more challenging equations such as 17 x 37, or parking your car in a tricky parking spot. This process is widely acknowledged to be a corrective mechanism to the often flawed and biased assumptions resulting from system 1 (Larrick, 2012). The possibility of system 2 to override flawed system 1 results hinges upon sufficient mental capacity and motivation (Cunningham, 2013). What distinguishes system 2 thinking most prominently is that it does not operate automatically but requires to be purposefully activated (Bonnefon, 2018). These insights already suggest why entrepreneurs could potentially not always be able to engage in effortful system 2 thinking. The vast array of tasks required to be fulfilled by entrepreneurs, especially in the early stage of their venture, could simply prevent them from regularly allocating cognitive capacities to reevaluate choices through system 2. This, in turn,

renders them more susceptible to the heuristic processes of system 1 in the many choices they make.

However, this does not automatically guarantee better choices, as alluded to above. System 2 processes are not immune to errors, and errors do not occur in system 1 processes exclusively, a fact that warrants emphasis (Evans & Stanovich, 2013; Shleifer, 2012; Streeb et al., 2018). Since system 2 relies on explicit knowledge, it does not automatically result in correct answers. Evidently, when confronted with complex problems such as quantum mechanics, most people will not be capable of reaching the correct conclusions even when applying the effortful and cognitive costly processes of system 2. They just do not have the required knowledge to reach the right conclusion, and devoting more cognitive capacity to solving such a problem will not allow them to make up for this.

Recent literature suggests that default-interventionist models like system 1 and 2 thinking are incapable of preventing errors simply by rendering decision-makers the most effective they can be by conveying a metacognitive critical thinking skillset (Dhaliwal, 2017; Evans & Stanovich, 2013; Lawson et al., 2020; Monteiro et al., 2019). Nevertheless, the existence of two distinct modes of thinking is widely acknowledged, and some evidence exists (Bonnefon, 2018; Frankish, 2010; Kahneman, 2011). It seems reasonable to suggest that the successful operation of systems 1 and 2 is domain-specific and highly reliant on the existence of domain-specific expert knowledge (Larrick & Feiler, 2015; Dhaliwal, 2017; Lawson et al., 2020; Monteiro et al., 2019; Sadler-Smith, 2016). Adding this layer to dual-process thinking might enhance its applicability.

3.3 How Systems Change and Affect Entrepreneurship

Understanding how systems 1 and 2 work has often been associated with an ability to enhance decision-making. According to some scholars, debiasing strategies could help decision-makers to effectively reach fewer erroneous conclusions and better results. For example, Boissin et al. conducted a series of studies that tested the capacity of participants to overcome intuitive responses that resulted in wrong answers based on proliferated biases such as base-rate neglect and found evidence for the effectiveness of debiasing strategies (2022).

However, this notion does not stand uncontested. Monteiro et al. suggest that specific knowledge plays a crucial role in reaching the right conclusions (2019). They even go as far as to suggest that "evidence shows that generalized, content-independent strategies – debiasing, reflection or whatever – to reduce errors have no or minimal effectiveness for the simple reason that errors derive not from inadequate thinking skills but from inadequate knowledge" (Monteiro et al., 2019, p.70). Ultimately, "[i]n the realm of expert performance, knowledge is king." (Dhaliwal, 2016, p.88). A closer look at Boissin et al.'s study (2022) also reveals that correct results were not achieved utilizing deliberative debiasing strategies but through the learning effects of participants and, therefore, the acquisition of knowledge, such as common statistical errors like base-rate neglect.

In fact, according to Kahneman himself, with increasing knowledge and expertise, a change in the domains of both systems occurs (2011; Shleifer, 2012). What might require effortful and deliberate system 2 thinking for most people to even have a chance to reach the right conclusions could be effortlessly solved by system 1 processing by experts in the domain (Larrick & Feiler, 2015). This has been labeled as intuitive expertise (Sadler-Smith, 2016).

In one of the few papers where dual system processing has been applied to and observed through the lens of entrepreneurship, Sadler-Smith explained how intuitive expertise operates. They argue that the foundation of successful intuitive reasoning lies with complex domain-relevant schemas (CDRs). Broadly, they represent nothing else than domain-relevant knowledge and may be attained through implicit and explicit learning processes (Sadler-Smith, 2016).

Think of a professional basketball player like Paolo Banchero or Zion Williamson. Years of training have equipped them with expert knowledge and experience, allowing them to intuitively know which pass to make and when to take a shot. Amateurs, with little or no exposure to the complex strategies and tactics of professional basketball (such as the UNC basketball team), will, with high certainty, be unable to make the right decision in such scenarios even when deliberately affording large amounts of cognitive capacity towards the solving of the problem in system 2, let alone intuitively. Similarly, an entrepreneur who is engaged with the starting up of a business on a professional level and has devoted considerable time and effort in the entrepreneurial arena might be much better at intuitively making the right decisions regarding his business than an outsider who has no previous touchpoints with entrepreneurship – a novice (Larrick & Feiler, 2015). This also explains why so many entrepreneurs fail despite considerable devotion of cognitive capacity to make the right decisions. Suppose they have no expert knowledge in the realm of entrepreneurship. In that case, they will likely fail to intuitively make the right calls under the uncertain conditions of entrepreneurship, even if sufficient time was available to compute different possible scenarios.

Adding the common time constraints entrepreneurs face only diminishes their chances of reaching the correct conclusions (Larrick & Feiler, 2015).

(Experienced) entrepreneurs might be better at making business decisions quickly and under time constraints because they have already engaged with such under time pressure for a long time. It can be compared to basketball players who intuitively know when to shoot or chess grandmasters who intuitively know which move to make, whereas laypersons would have to leverage a significant cognitive load to have a chance of making the right decision (Larrick & Feiler, 2015).

3.4 Implications for Entrepreneurship

While the concept of system 1 and system 2 thinking has achieved a lot of attention across various domains, almost no research has been undertaken on its implications for entrepreneurship. However, since entrepreneurs usually operate within fast-paced environments that require decision-making under conditions of high uncertainty, understanding how entrepreneurial decision-making might differ from that of *ordinary*, non-entrepreneurial decision-makers might provide interesting insights. As can be imagined, the fast-paced environment of entrepreneurship requires an effective command of when to facilitate fast or slow thinking. Proficient use of this could arguably help entrepreneurs. A closer examination is therefore required. Given the previously mentioned findings on how expert knowledge, rather than debiasing, is the key to making the best decisions possible, it seems reasonable to suggest that entrepreneurs, over their lifecycle, attain various CDRs that allow them to quickly identify situations that require closer examination and should, therefore, be afforded additional cognitive capacity. This ability seems closely related to the concept of entrepreneurial alertness,

which posits that entrepreneurs can successfully identify entrepreneurial opportunities by recognizing cues that remain unnoticed by others. The uncertain and ambiguous environments that entrepreneurs frequently operate in could also arguably lead to a mindset skeptical of easy answers and, therefore, CDRs that intuitively recognize underlying complexities where an easy answer seems apparent.

Furthermore, entrepreneurs are regularly required to adapt to very different situations, such as the assessment of new opportunities for developing their product that require initial intuitive detection and subsequent closer deliberate examination thereafter. These scenarios that seem to present straightforward solutions and answers often require closer examination. This environment will equip them with expertise in detecting scenarios that require closer scrutiny despite intuitively apparent solutions and answer options. Larrick and Feiler (2015) examined a similar concept where they posited that it could be possible for decision-makers to train (and therefore acquire CDRs) a general awareness of common decision-making traps. However, they noted that contextual specificities in real-world environments might impact the practicality of such a general awareness, given that abstract rules about decision-making will have difficulties translating into a cross-topic decision-making CDR. Nevertheless, this proves that the idea of a broader decision-making expertise is not unheard of.

3.5 Practical Implications

These insights could have important practical implications for entrepreneurship. They could help better educate those aspiring to become entrepreneurs, rendering entrepreneurial novices experts before attempting market entry. In kind learning environments that are high in forgiveness, necessary steps to succeed could be taught more effectively than just starting into

the real world where the financial well-being of oneself is at stake (Hogarth et al., 2015; Griffin, 2013). *Trainees* could potentially develop CDRs on how to detect viable opportunities or when to stop committing resources to prevent excessive commitment. Furthermore, guided by the notion that "knowledge is king," entrepreneurs should make sure to acquire sufficient expert knowledge on the field in which they operate, as well as an overall business prowess (Dahliwal, 2016, p.88). Committing sufficient time and thought towards the successful development of necessary CDRs could, therefore, potentially increase the likelihood of success once they enter the real entrepreneurial arena.

To put it in a nutshell, through the effective training of entrepreneurship in forgiving environments, entrepreneurs could shortcut their way to knowledge, which is otherwise exclusive to serial entrepreneurs with years of experience, at a much lower cost and risk. However, given the dynamics and vast uncertainties of entrepreneurship and contextual complexities of real-life scenarios in general, this is also no guarantee for success but simply bears the potential to increase chances (Larrick & Feiler, 2015). These implications could also be potentially valuable for investors who could leverage training requirements to enhance their likelihood of more attractive returns on investments.

3.6 Testing Entrepreneurial Thinking and Choice

One of the most popular ways of testing how different populations think about problems is the Cognitive Reflection Test (CRT). What style of thinking is being tested through the CRT remains subject to debate and disagreement (Lawson et al., 2020). As of the time of writing, the CRT has not been applied in an entrepreneurial context, so evidence of the potential performance of entrepreneurs does not exist yet. However, as previously discussed, I suspect entrepreneurs to

perform better on this test than non-entrepreneurs since I assume they have CDRs that allow them to quickly dissect problems that seem to have easy, intuitive responses at first but require closer examination and more thought than initially anticipated. This leads to my second hypothesis, which concerns the capability of entrepreneurs to switch between systems 1 and 2 thinking effectively.

Hypothesis 2: Entrepreneurs are more effective in determining when to use system 2 thinking in a CRT than non-entrepreneurs.

Chapter 4: Research and Reality: Overconfidence and Cognitive Reflection in Entrepreneurs vs. MBA Candidates

In order to gather empirical data on the theoretical findings discussed in Chapters 2 and 3, I conducted an experiment that tested the capability of an entrepreneurial and a non-entrepreneurial crowd to effectively switch from intuitive system 1 to deliberate system 2 thinking. Furthermore, I tested the participants' level of overconfidence (i.e., overestimation for the purpose of this experiment). The full study design can be found in Appendix A.

4.1 Background

Based on the previous findings, I suspect entrepreneurs to be more overconfident than non-entrepreneurs, as well as better in identifying situations that demand the effective command of system 2 thinking. These hypotheses have the potential for powerful practical implications.

Understanding how entrepreneurs think and make decisions benefits entrepreneurs, as well as those who interact with them. Understanding an entrepreneurial tendency towards overconfidence can help entrepreneurs to improve their decision-making. Recognizing one's overconfidence and consistently nudging oneself towards more careful evaluation of choices could potentially lead to a more balanced and better-informed decision-making process. Furthermore, it could help entrepreneurs in selecting their teams. By staffing managerial positions with less overconfident individuals who make more conservative estimates, entrepreneurs could build teams of more diverse thought and develop balanced business strategies.

Understanding the operation of overconfidence and dual system processing in entrepreneurs can also be very valuable for outsiders who seek to conduct business with the

founders of start-ups. Venture Capital firms or banks could more carefully select whom to fund and whom to avoid. Ensuring that potential partners are aware of how they make decisions will allow for a better risk assessment before granting credits or dedicating substantial funds towards the investment in a promising technology or company.

I, therefore, came up with two hypotheses.

Hypothesis 1: Entrepreneurs will be more overconfident than MBA students on their ability to successfully identify and validate entrepreneurial opportunities.

Hypothesis 2: Entrepreneurs are more effective in determining when to use system 2 thinking in a CRT than non-entrepreneurs.

4.2 Method

4.2.1 Materials

To test both hypotheses, two categories of questions were needed: questions that test overconfidence as well as questions that test cognitive reflection (i.e., effective switching from intuitive decisions to analytically reached conclusions). I will briefly describe both sets of questions below.

4.2.1.1 Measurement of Overconfidence

To test the level of overconfidence in both populations, I facilitated an article by Chatterji et al. that concerned the role of judgment in generating entrepreneurial ideas for cues deemed essential for the successful validation of an entrepreneurial opportunity (2023). I selected five cues from the list of seven that were deemed most essential in accordance with one of the

paper's co-authors, Roger Masclans. These cues were: (1) Identifying a value-added product, (2) clarity of idea, (3) market size, (4) founders background, and (5) novelty of the product (Chatterji et al., 2023). I included one of these cues in the same question five times in a row to measure the actual knowledge of participants on the importance of each cue. Each cue was complemented with three made-up cues that had no relation to the successful validation of an entrepreneurial idea but sounded like a reasonable and viable option. Participants were asked to identify which options they deemed most relevant for successfully validating an entrepreneurial idea. I chose to test overconfidence with domain-specific knowledge based on the findings of West and Stanovich (1997), who found that those who exhibit domain-specific overconfidence have a general tendency to exhibit overconfidence.

4.2.1.2 Measurement of Cognitive Reflection

To test the ability of participants to effectively identify problems that require closer attention and more deliberate processing, I measured cognitive reflection using a Cognitive Reflection Test (CRT) as described by Frederick (2005). The CRT is "one of the most widely used instruments in heuristics-and-biases research […] designed to measure a person's propensity to override an intuitive, but incorrect, response with a more analytical correct response (Thomson & Oppenheimer, 2016, p.99). To prevent confusion and account for the geography in which the experiment was conducted (i.e., Germany), I changed the question "A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?" (Frederick, 2016, p.27). It was rephrased to "A tennis racket and a tennis ball cost 1.10€ in total. The racket costs 1.00€ more than the ball. How much does the ball cost?"

Since the questions of the traditional CRT were held to be too numerical, Attali and Bar-Hillel (2020) argued that they actually test the mathematical prowess of survey subjects. Therefore, I complemented my study design with two questions from the CRT-2, which was developed by Thomson and Oppenheimer (2016) and expanded the CRT to include questions that were similar in style but did not require sophisticated mathematical capabilities to come up with the correct answer (Thomson & Oppenheimer, 2016).

4.2.2 Participants

I recruited two separate populations. The first, entrepreneurial, cohort consisted of current and former members (i.e., entrepreneurs seeking funding) of the venture capital investment firm Antler. While not specifically defined, this participant selection roughly equates to a definition of entrepreneurs as founders of innovative start-ups based on the business concept of Antler. Participants were not excluded from the study based on whether they received funding through Antler or were still working on that same venture. The participants were located in Germany. Being German, however, was no inclusion criterion. Participants were recruited through an Antler WhatsApp channel of former applicants and entrepreneurs who received funding, internally referred to as *Antler Alumni*.

The second cohort consisted of current MBA candidates at the WHU – Otto Beisheim School of Management in Vallendar and Düsseldorf, Germany. I specifically decided to select MBA candidates to ensure homogeneity across populations and prevent third variables from potentially impacting the study's results and findings, leading to spurious correlations. This second group was chosen to prevent the moderation of demographic variables. I suspected that the background of MBA students would align closely with entrepreneurs seeking funding at a

VC. They were recruited through various social media platforms (including LinkedIn and WhatsApp) and E-Mails. Furthermore, the university and the VC office through which I accessed entrepreneurs were both located in Germany and chosen deliberately to prevent geographical differences in thinking style from impacting study results.

Contact to both groups was only made after consent from both a Partner at Antler and the WHU MBA Office was given, and the study was approved through Duke's Campus Institutional Review Board (ID#2024-0151).

Participants received a link to an online survey via WhatsApp, LinkedIn, or E-Mail. The link took them to their respective survey using the Qualtrics software. Each population received a separate link, and participants were unaware of the existence of a second population against which their results were compared. Introductory texts were framed to reflect that I studied the decision-making behavior of entrepreneurs and MBA students, respectively. Participants could provide their e-mail to be entered into a raffle for a chance to win a $250 Amazon gift card.

I managed to recruit 10 entrepreneurs, as well as 5 MBA candidates. Given these small populations I conducted the same survey with 121 participants which were recruited through the survey recruiting platform *Prolific*. For the study with the prolific participants, I added two control questions to check whether there were any "hidden" entrepreneurs within the study. However, I was not able to identify any such. The prolific participants can therefore be seen as "average Joes." Prolific participants were paid $3 for participation.

4.2.3 Procedure

The survey consisted of three primary components and was available in English and German. At first, participants were asked to provide demographic information, including gender, age, and education. Participants in the MBA cohort were asked if they had been entrepreneurially active before and were only included if they had no prior such experience.

In the next step, participants were confronted with five questions testing their cognitive reflection. These were separated into two blocks. First, they answered the three *traditional* CRT questions as Frederick (2005) specified, followed by two additional questions derived from the CRT-2 (Thomson & Oppenheimer, 2016, p.101). Answer options were presented in a random order for each participant, determined by Qualtrics. The CRT and CRT-2 questions were presented on separate screens, but no transition was used. Each question had five possible answers, including the correct answer and the intuitive but wrong answer (see Figure 4).

CRT 1: *A tennis racket and a tennis ball cost 1.10€ in total. The racket costs 1.00€ more than the ball. How much does the ball cost?*
10ct; ***05ct****; 1€; 1.05€; 15ct*

CRT 2: *If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?*
100 minutes; 10 minutes; 1 minute; ***5 minutes****; 2.5 minutes*

CRT 3: *In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?*
48 days; 24 days; ***47 days****; 10 days; 20 days*

CRT 4: *How many cubic feet of dirt are there in a hole that is 3cm deep x 3cm wide x 3cm long?*
9; 18; 27; ***0****; 6*

CRT 5: *Emily's father has three daughters. The first two are named April and May. What is the third daughter's name?*
April; May; Gertrude; June; ***Emily***

Figure 4: CRT Questions and Answers - correct answers are indicated through bold letters.

The CRT was followed by a brief transition explaining that I would like to understand what aspects participants deem most essential for being successful as an entrepreneur. On a first screen they were asked to indicate whether they knew how to validate an entrepreneurial idea successfully. Besides "Yes" and "No," participants were able to answer "Partly." In conjunction with performance on the subsequent task, the answer to this question was used to measure overconfidence. On a separate screen, participants were asked to answer the same question, "Which of the following do you consider most essential for successfully evaluating an entrepreneurial idea?" five times in a row. As outlined above, four answers were presented. Each correct answer, derived from Chatterji et al. (2023), was presented along with three incorrect options that sounded reasonable (see Figure 5). To measure the confidence of participants their self-assessed estimated performance (yes, no, and partial knowledge) I assigned values to each of possible answer (yes = 1.0; no = 0; partly = 0.5) in order to calculate mean values for each population (named confidence measure).

Confidence Measure: *Do you think you know how to successfully validate an entrepreneurial idea?*
Yes; No; Partly

OC 1: *Which of the following do you consider most essential for successfully evaluating an entrepreneurial idea?*
Identifying a value-added product*; Financial viability; Timing; Risk*

OC 2: *Which of the following do you consider most essential for successfully evaluating an entrepreneurial idea?*
Clarity of idea*; Overview of the market place; Team members; Competitive landscape*

OC 3: *Which of the following do you consider most essential for successfully evaluating an entrepreneurial idea?*
Market size*; Potential customer feedback; Expertise; Passion for the product*

OC 4: *Which of the following do you consider most essential for successfully evaluating an entrepreneurial idea?*
Founders background*; Scalability; Niche potential; Strategic Partnerships*

OC 5: *Which of the following do you consider most essential for successfully evaluating an entrepreneurial idea?*
Novelty*; Creativity of idea; Branding potential; Pricing*

Figure 5**:** Overconfidence Test.

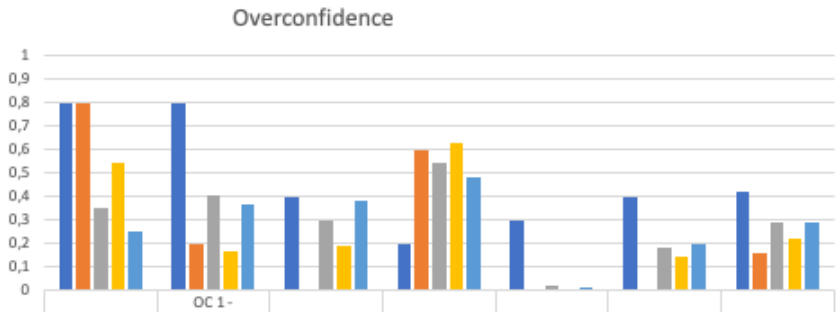
4.3 Results

Despite the small number of participants, I was able to draw some interesting results from the study.

Through the self-assessed confidence of participants in their ability to successfully identify and validate an entrepreneurial opportunity, I was able to conclude that both populations had a confidence of 0.8 on average. The confidence of prolific participants was considerably lower at 0.35. While entrepreneurs were overconfident in their ability to validate ideas (average score of 0,42), MBA candidates were even more overconfident (average score of 0.16). The prolific participants were overconfident as well. However, at 0.29 their mean performance was much better in relation to their self-assessed confidence, indicating that they are less overconfident than both MBA candidates and entrepreneurs. It is noteworthy that entrepreneurs performed especially well on OC 1 (0.8), indicating that there is widespread agreement on the importance of a value-added product in order to identify a viable entrepreneurial idea and opportunity. Hypothesis 1 is therefore rejected since entrepreneurs are overconfident in general but less overconfident than MBA candidates (for results see Table 7).

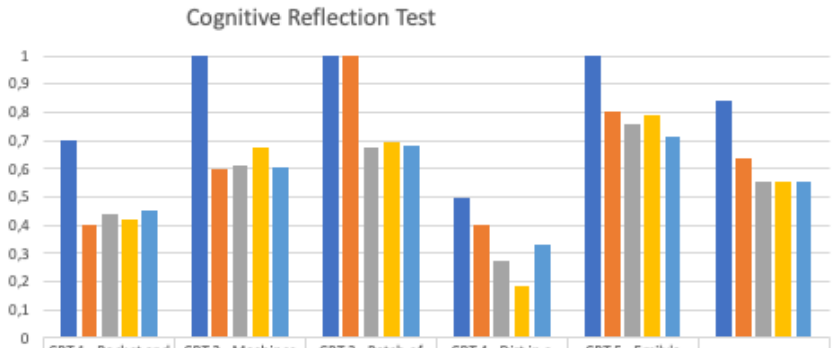
In support of Hypothesis 2, however, I was able to gather evidence for a better performance of entrepreneurs on the Cognitive Reflection Test Questions. In comparison to the MBA candidates, they performed especially well on questions CRT 1 (average score of 0.7

compared to 0.4) and CRT 2 (average score of 1 compared to 0.). The entrepreneurs performed better than the prolific participants as well. However it is important to notice that at 0.29 mean performance, prolific participants significantly outperformed MBA candidates as well. Therefore, for the purpose of this experiment, hypothesis 2 held true and entrepreneurs do, indeed, perform better in a CRT than non-entrepreneurial MBA candidates (for results see Table 8).



	Confidence Measure	OC 1 - Identifying a Value-Added product	OC 2 - Clarity of Idea	OC 3 - Market Size	OC 4 - Founders Background	OC 5 - Novelty	Mean
Entrepreneur (n=10)	0,8	0,8	0,4	0,2	0,3	0,4	0,42
MBA Candidate (n=5)	0,8	0,2	0	0,6	0	0	0,16
Prolific Whole Cohort (n=121)	0,35	0,40	0,30	0,55	0,02	0,18	0,29
Prolific Entrepreneur (n=43)	0,55	0,16	0,19	0,63	0	0,14	0,22
Prolific Non-Entrepreneur (n=66)	0,25	0,36	0,38	0,48	0,02	0,20	0,287

Table 7: Results of Measure of Overconfidence.



	CRT 1 - Racket and Ball	CRT 2 - Machines and Widgets	CRT 3 - Patch of Lily Pads	CRT 4 - Dirt in a Hole	CRT 5 - Emily's Father	Mean
Entrepreneur (n=10)	0,7	1	1	0,5	1	0,84
MBA Candidate (n=5)	0,4	0,6	1	0,4	0,8	0,64
Prolific Whole Cohort (n=121)	0,44	0,61	0,68	0,27	0,8	0,55
Prolific Entrepreneur (n=43)	0,42	0,67	0,70	0,19	0,79	0,55
Prolific Non-Entrepreneur (n=66)	0,45	0,61	0,68	0,33	0,71	0,56

Table 8: Results of Cognitive Reflection Test (CRT 1 – CRT 3) and CRT2 questions (CRT 4 and CRT 5).

4.4 Limitations

Besides the small number of participants, it is worth noting that the study design is subject to a series of additional limitations that would have potentially impacted results even if the number of participants would have been higher.

The study was conducted in a laboratory setting. It did not test whether participants would have been capable of acting cognitively flexible in a real-life environment if they had been confronted with entrepreneurial scenarios. This limitation holds particularly true for the CRT. The choice to select participants from Germany exclusively was made to ensure the causal robustness of the findings without results being influenced by national or demographic variables. However, this could have likely limited the generalizability of my findings to other, international, populations.

Furthermore, the study lacked performance indicators based on which additional results could have been drawn. Therefore, I would have been unable to draw any implications on how cognitive reflection or overconfidence could have either a positive or a negative relationship with entrepreneurial performance. It is reasonable to suggest that the recruitment process led to a self-selection bias. It seems likely that successful entrepreneurs were less likely to participate in the survey, given that they have less time at hand to devote to a study, even if it only consumed 15 minutes.

While the overconfidence measurement employs a robust research foundation, mainly through utilizing the insights from Chatterji et al. (2023), the chosen measures of overconfidence and successful idea validation remain open to debate. Selecting cues deemed

crucial for assessing entrepreneurial validation knowledge remains inherently subjective. Other scholars might prioritize alternative cues, depending on their conviction of what they deem essential. Consequently, it is important to acknowledge that this determination is a matter of interpretation and perspective.

Despite these limitations, the study contributes valuable insights to the nascent inquiries into how entrepreneurs think. Therefore, exploring cognitive reflection and overconfidence among entrepreneurs should guide future research efforts, given its profound practical implications and opportunities. By better understanding such cognitive constructs, academia can contribute largely to the successful and sustainable advancement of this economic powerhouse that is entrepreneurship.

Conclusion

In conclusion, this project delved into the multifaceted nature of the entrepreneur, the entrepreneurial mind, and its cognitive processes. It seeks to offer valuable insights for educators, policymakers, investors, and entrepreneurs themselves, aiming to foster a more supportive and effective environment for entrepreneurial endeavors.

After identifying the predictive capabilities of personality traits as defined by the Big Five, and narrow specific traits in relation to entrepreneurial behavior, this project shifted in focus toward the implications of JDM on entrepreneurship, highlighting how concepts like risk-propensity and overconfidence are related to the convoluted mechanisms of entrepreneurial decision-making.

After examining these relationships, this project took a last turn and examined how systems 1 and 2 thinking could affect entrepreneurship in general, and entrepreneurial decision-making in particular. By doing so this project applied Kahneman's dual process thinking theory to a field that it afforded very little to almost no attention to. The project underscored that while entrepreneurs often rely on intuitive, fast-paced system1 processes, they might have acquired CDRs that afford them with the capabilities to identify situations that require deliberate and analytical system 2 thinking, more effectively than non-entrepreneurs.

The empirical study conducted to test hypotheses on overconfidence and cognitive reflection in entrepreneurs versus MBA students, although limited in its scope and results, offers a foundation for future research in this area, as well as implications that could be of high practical relevance. In the future, those engaging in entrepreneurial arenas or aspire to do so

might benefit from kind and forgiving learning environments in which they can develop CDRs that help them to make better decision in the future, preventing common pitfalls of entrepreneurship like excessive commitment and overconfidence. The findings furthermore have practical relevance for those engaging with entrepreneurs and can help in informing decisions of venture capitalists, banks, and all those in the broader entrepreneurial ecosystem.

It is important to acknowledge the limitations of this project. It did not cover additional factors which have been held to exert considerable influence on entrepreneurial behavior and outcomes as well. Those include externalities such as national culture or human capital (Brandstätter, 2011). Nevertheless, it contributes to a more nuanced understanding of the entrepreneurial mind, integrating insights from personality psychology and JDM, advancing the relatively new academic field of entrepreneurship towards better understanding the traits and cognitive processes that drive entrepreneurial behavior.

Appendix A: *Survey Design*

Recruitment materials

The Same message below will be used on both slack and the E-Mail listserv, to send out the survey link to both crowds.

Hello,

Please find attached a link to a survey for research conducted at Duke University in the United States. It will examine distinctive styles of thinking and should not take any longer than 15 minutes. You will have the opportunity to enter a raffle and a chance to win a $250 Amazon Gift Card.

Link

Participation is of course voluntary.

Should you have any questions feel free to reach out to the researcher Jakob Sieber (jakob.sieber@duke.edu)

Many thanks for your help.

Informed consent

Welcome! Please take time to review the information below before proceeding.

Key Information:

Purpose of the study:

You are being invited to participate in a research project by investigators from Duke University in the United States. The purpose of this study is to investigate how entrepreneurs make decisions.

or

You are being invited to participate in a research project by investigators from Duke University in the United States. The purpose of this study is to investigate how MBA students make decisions.

Voluntary Participation and Withdrawal:

You must be 18 years old to participate. Your participation is voluntary and you may withdraw from the study at any time simply by closing the browser window. You may refuse to answer any questions, however, there are some questions that you must answer in order to continue completing the study.

Procedures:

This survey consists of three parts. First, some demographic information will be collected. After that, you will answer two sets of questions that test your decision-making processes and knowledge of entrepreneurship respectively. The survey is expected to take approximately 13.5 minutes to complete.

Confidentiality:

The data collected in this study will not be used for future research and the data set will not be shared publicly. The data collected will be stripped of identifiers and stored on a secure university server, as well as a separate hard drive that has no access to the internet. At the end of this survey we will ask you to provide an E-Mail address on a voluntary basis in order to enter a raffle for a $250 Amazon Gift Card. The E-Mail addresses will be stored on a separate hard-drive with no access to the internet and not be linked to your survey responses and deleted as soon as a winner has been drawn.

Publication Statement:

The results of this study may be published in professional and/or scientific journals. it may also be used for educational purposes or for professional/academic presentations. When results are reported no individual respondent will be identified.

Risks and benefits:

There are no risks involved in the completion of this study. While you will not directly benefit from participation, your participation may help investigators better understand how entrepreneurs make decisions.

or

There are no risks involved in the completion of this study. While you will not directly benefit from participation, your participation may help investigators better understand how MBA students make decisions.

Compensation:

At the end of this survey, you will have the opportunity to provide your E-Mail address to enter into a raffle for the chance to win a $250 Amazon Gift Card. Your E-Mail address will be collected separate from your survey responses and is not linked to them. Once a winner has been drawn all addresses will be deleted. The addresses will be entered into a tool that randomly selects a winner who will then be contacted through the E-Mail address provided. The odds of winning therefore are 1 : n (where n is the number of participants in the raffle).

Contacts:

If you have any questions about this study or wish for your E-Mail address to be deleted or amended, please contact either Jakob Sieber (jakob.sieber@duke.edu) or Professor Richard Larrick (rick.larrick@duke.edu). If you have questions about your rights as a research subject, please contact Duke University's Institutional Review Board at campusirb@duke.edu or at +(1)-919-684-3030. If contacting the IRB, please reference protocol ID#2024-0151

Data Protection:

The General Data Protection Regulation (GDPR) is a privacy regulation in effect in the EEA that provides for the protection of your personal data. If you are in the EEA at any time during the course of this study, please note that sensitive and personal data you provide, including race, religious or philosophical beliefs, or sexual orientation, may be collected through the study.

The GDPR provides research subjects with privacy rights that may apply in certain circumstances subject to limitations and exceptions. These include right of access, rectification (correction), erasure, restriction of processing, data portability (obtain and reuse) and objection. Click here for GDPR information. Duke's legal basis for collecting and processing your personal data is based solely on your explicit consent. By checking the box, you give us permission to collect and process your data back to the United States, which has not received an adequacy decision under the GDPR. You may review the Duke University Privacy Statement and Privacy policy here.

a) I consent to the collection and transfer of my sensitive and personal data while I am in the EEA during the course of this study.

If you do not affirmatively check this box, you will not be enrolled in this study.

If you agree to participate, then please click the "->" button. If not, then please navigate away from this web page.

Study Intro

We are trying to understand if there are special ways about entrepreneurial thinking and how entrepreneurs make decisions in potentially more effective ways than other populations. As part of the VC network of Antler you have been chosen to participate in this survey and are being asked to answer this short set of questions.

or

We are trying to understand if there are special ways in which MBA students think and how they make decisions in potentially more effective ways than other populations. As part of a WHU MBA cohort you have been chosen to participate in this survey and are being asked to answer this short set of questions.

Demographic Questions

You will now be asked to provide us with some demographic background on yourself. None of this information will be used to identify you as a participant but does solely serve academic purposes in our endeavor to understand entrepreneurial decision-making.

What is your gender identity?

- Male
- Female
- Non-binary / third gender
- Prefer not to say

How old are you?

- Under 18
- 18 – 24
- 25 – 34
- 35 – 44
- 45 – 54
- 55 – 64
- 65 – 74
- 75 – 84
- 85 or older
- Prefer not to say

Have you ever been entrepreneurially active?

- Yes
- No
- Prefer not to say

Are you still working on the same venture you applied to Antler with?

- Yes
- No
- Prefer not to say

or

Are you currently enrolled in a MBA program at the WHU – Otto Beisheim School of Management?

- Yes
- No
- Prefer not to say

or

Do you have a college degree (or higher) related to business? (Prolific only)

- Yes
- No

What is the highest level of education you have ever pursued or acquired?

- No formal education
- High School Diploma or equivalent
- Bachelor's degree
- Master's degree
- MBA
- Other (please specify)
- Prefer not to say

If another type of education than outlined above has been attained, what is it?

Cognitive Reflection Test

CRT 1: A tennis racket and a tennis ball cost 1.10€ in total. The racket costs 1.00€ more than the ball. How much does the ball cost?

- 10ct
- 05ct
- 1€
- 1.05€
- 15ct

CRT 2: If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

- 100 minutes
- 10 minutes
- 1 minute
- 5 minutes
- 2.5 minutes

CRT 3: In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

- 48 days
- 24 days
- 47 days
- 10 days
- 20 days

CRT 4: How many cubic feet of dirt are there in a hole that is 3cm deep x 3cm wide x 3cm long?

- 9
- 18
- 27
- 0
- 6

CRT 5: Emily's father has three daughters. The first two are named April and May. What is the third daughter's name?

- April
- May
- Gertrude
- June
- Emily

Key Factors of Entrepreneurship

We will now ask you about your assessment on what aspects you deem most essential for being successful as an entrepreneur. You will only be allowed to pick one out of the five answers presented per question. This task will be carried out five times in a row, each time with a different set of responses.

Confidence Measure: Do you think you know how to successfully validate an entrepreneurial idea?

- Yes
- No
- Partly

OC 1: Which of the following do you consider most essential for successfully evaluating an entrepreneurial idea?

- Identifying a value-added product
- Financial viability
- Timing
- Risk

OC 2: Which of the following do you consider most essential for successfully evaluating an entrepreneurial idea?

- Clarity of idea
- Overview of the market place
- Team members
- Competitive landscape

OC 3: Which of the following do you consider most essential for successfully evaluating an entrepreneurial idea?

- Market size
- Potential customer feedback
- Expertise
- Passion for the product

OC 4: Which of the following do you consider most essential for successfully evaluating an entrepreneurial idea?

- Founders background
- Scalability
- Niche potential
- Strategic Partnerships

OC 5: Which of the following do you consider most essential for successfully evaluating an entrepreneurial idea?

- Novelty
- Creativity of idea
- Branding potential
- Pricing

End of Survey and Raffle

We thank you for your time spent taking this survey. Your response has been recorded.

Would you like to participate in the raffle?

a) Yes
b) No

If yes --> participant will be able to click a link to enter their E-Mail in a separate form that is not connected to his responses.

If no --> survey is over.

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